National Park Service
U.S. Department of the Interior

Big South Fork National River and Recreation Area
Oneida, Tennessee

Environmental Assessment

For the
Fields Management Plan

March 2006

U.S. Department of the Interior
National Park Service
Big South Fork National River and Recreation Area
Kentucky and Tennessee

EXPERIENCE YOUR AMERICA

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INTRODUCTION

The Big South Fork National River and Recreation Area (National Area), established by Congress in 1974 (P.L. 93-251) and managed by the National Park Service (NPS), is composed of approximately 123,000 acres situated on the Cumberland Plateau, a rugged scenic area in southeastern Kentucky and northeastern Tennessee (Figures 1 and 2).

According to the enabling legislation, the National Area was established:

> "(F)or the purpose of conserving and interpreting an area containing unique cultural, historic, geologic, fish and wildlife, archeological, scenic, and recreational values, [and] preserving as a natural, free-flowing stream, the Big South Fork of the Cumberland River…for the benefit and enjoyment of present and future generations, the preservation of the natural integrity of the scenic gorges and valleys, and the development of the area's potential for healthful outdoor recreation."

This environmental assessment (EA) was prepared in compliance with the National Environmental Policy Act of 1969 and its implementing regulations. Three alternatives, including a No Action Alternative, were developed and analyzed, and are included in the Alternatives Section. In accordance with National Park Service policy, an environmentally preferred alternative has been identified. The EA will be made available to the public for a 30-day review and comment period. Upon completion of the public review, the National Park Service will assess public comments and modify the preferred alternative as necessary. A Finding of No Significant Impact (FONSI) would then be prepared, or the agency would begin the environmental impact statement (EIS) process.

This is a programmatic EA in that it analyzes the impact of the Field Management Plan for the National Area. Although the sites addressed in this plan were previously disturbed by agriculture or other human development, they may, nonetheless, contain sensitive natural or cultural resources. Consequently, additional site specific surveys would be performed prior to any prescribed burn, herbicide application, or other major disturbance proposed within the Plan.

Figure 1 - Big South Fork National River and Recreation Area Region and Vicinity Map

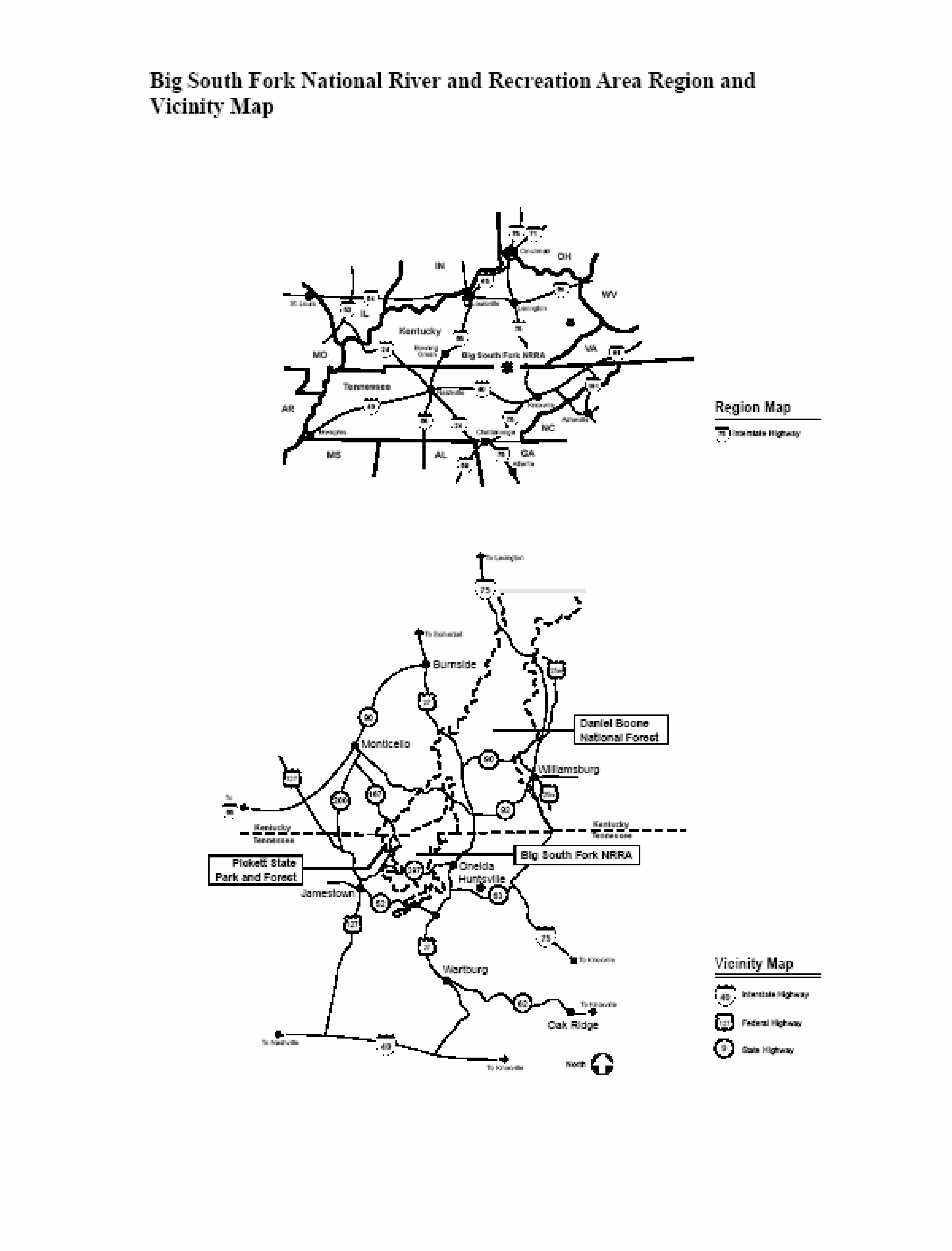
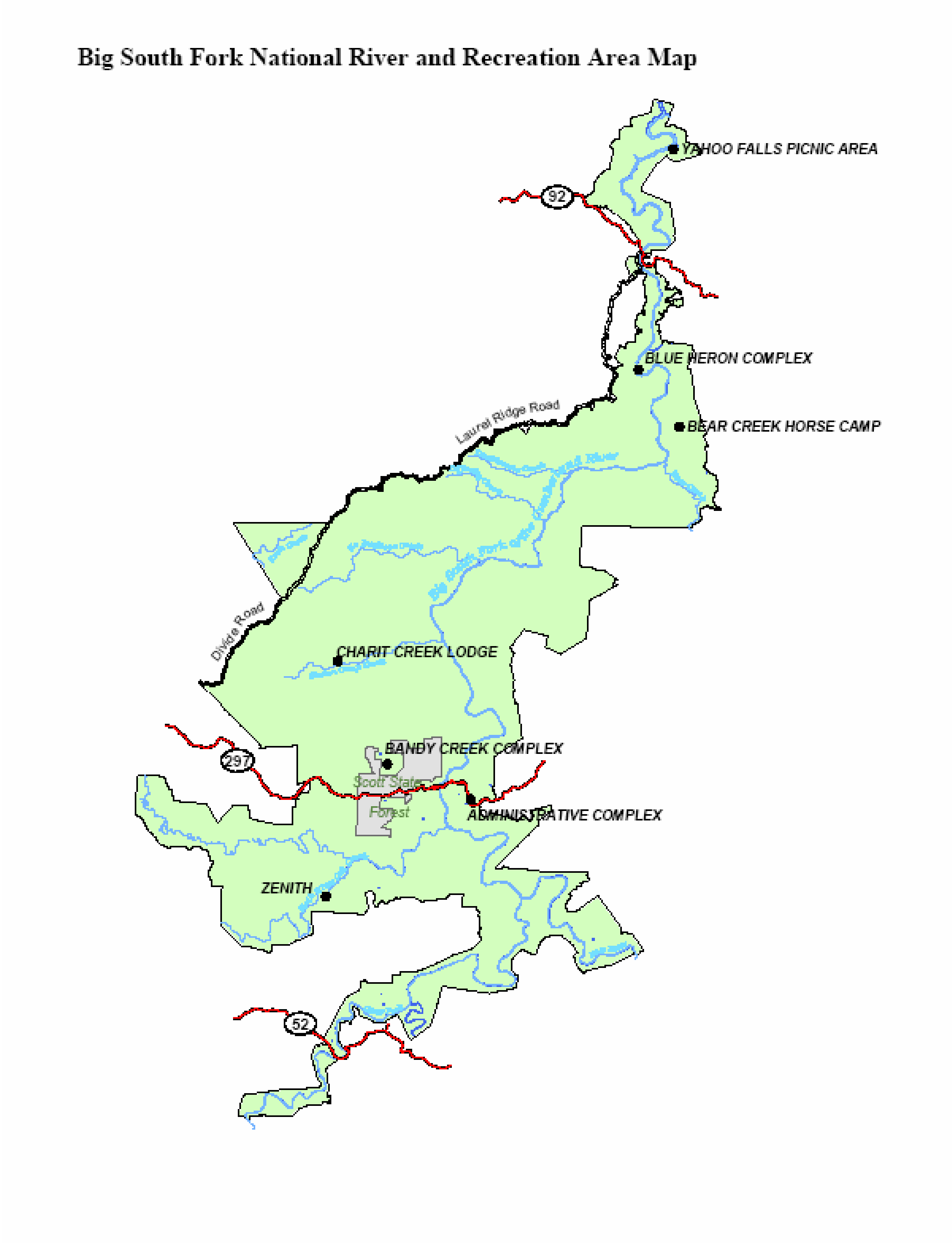


Figure 2 – Big South Fork National River and Recreation Area Map



1.0 PURPOSE AND NEED

Big South Fork National River and Recreation Area (National Area) contains 101 field units, totaling over 730 acres in area. Although this represents a very small part (less than one percent) of the National Area, fields are important components of its natural and cultural landscape. Fields and natural open areas are distinct in character and use from those of the surrounding forest. However, in their current condition, many fields are not beneficial to wildlife or native plants and are not fulfilling visitors' needs or expectations.

Forest vegetation dominates the Big South Fork landscape. In contrast, open areas constitute a minor part of the National Area. Evidence suggests that natural wet meadows, open pine-oak woodlands, and sandstone glades were previously more extensive on the Cumberland Plateau (Campbell 2001). Fire suppression and agricultural development are often cited as causes of decline of these natural open habitat types. Old fields, although not natural features, have helped support open-habitat plants and wildlife as natural openings have declined. However, the National Area's fields are also rapidly changing. Fields that were regularly plowed, grazed, or harvested prior to establishment of the National Area are no longer being actively managed. Active management, such as bush-hogging or burning, is required to maintain the fields in an open and treeless condition. Without these management activities, woody plants are colonizing old fields. Over time, these fields will become overgrown with shrubs and trees and ultimately become forests. This process, although natural, is at some sites inconsistent with other National Area objectives and mandates, including protection of certain wildlife, rare plants, and cultural landscapes.

Encroaching woody vegetation threatens to change the character and diminish the historical accuracy of remaining homesteads and other cultural landscapes. The National Area is significant as a cultural landscape because it preserves examples of development patterns unique to the upper Cumberland Plateau. Ten field units are components of officially designated cultural landscapes in the National Area. National Park Service policies require that the National Area maintains the integrity and character of official cultural landscapes by stopping or slowing deterioration caused by natural forces and normal use. These guidelines pertain to buildings and other structures as well as the associated fields. However, the fields and pasturelands are slowly being lost to the invasion of exotic species, and the encroachment of woody species, and the structures are at increasing risk from wildland fires as brush and other vegetation encroaches. Therefore, maintenance of official cultural landscapes must involve control of encroaching woody vegetation in specially designated fields.

Another serious problem with the National Area's existing fields is the presence of exotic plant species. Many of the plants growing in the National Area's fields are of European or Asian origin. Others are cultivated non-native species that were planted for livestock forage. Common examples of non-native field plants are tall fescue (e.g., Kentucky-31), sericea lespedeza, johnsongrass, Queen Anne's lace, ox-eye daisy, dandelion, yellow rocket, field bindweed, bittersweet nightshade, red clover, timothy, common teasel, and common cocklebur. Exotic invasive shrubs, although not abundant in all fields, commonly include multiflora rose, privet, and autumn olive. Invasive tree species, such as tree-of-heaven, have quickly gained a foothold in some old fields. Fields, roads, trails, and other disturbed areas are often source areas for exotic plants. From these sites, exotic plants can migrate into previously stable communities where they displace native plants and reduce wildlife habitat quality.

Non-native tall fescue dominates most of the National Area's fields. Fescue-dominated fields do not share the same physical characteristics as native-grass meadows and typically do not satisfy the biological needs of desirable plants and animals (Barnes and Washburn 2000). For example, fescue tends to form a tight sod that restricts the tunneling and burrowing habits of small mammals and birds. Fescue does not provide overhead protection from avian predators, space for catching insects, bare ground for finding seeds, or sites for nesting. Fescue is also host to a toxic fungus that can affect the health and reproductive success of some wildlife (Barnes and Washburn 2000).

Many state-listed plants occurring in the Big South Fork region, some more common only decades ago, are rare today because of the absence of fire (Campbell et al. 1990a). Species that are typical of open, fire-maintained, oak-pine woodlands with grassy understories are increasingly rare in the National Area (Campbell 2001). This includes two federally listed species, both extirpated from the region: American chaffseed (*Schwalbea americana*) and red-cockaded woodpecker (*Picoides borealis*). The federally endangered chaffseed, for example, is a species that exists on sandstone knobs and inland plains where frequent, naturally occurring or human-caused fires maintained these sub-climax communities (U.S. Fish and Wildlife Service 1995). There were several historical collections of the plant in Tennessee and Kentucky, including a 1935 collection by Braun from a "sandstone knob" along the Alum Creek Road (KY 700) in the vicinity of the National Area (Campbell 1990b). Repeated searches for this species have been unsuccessful. As recently as the mid -1980's, several colonies of the fire adapted, federally endangered Red-cockaded Woodpecker were found within a twenty-mile radius of the park, with some colonies in the immediate vicinity (USDA Forest Service 1995). In 1994, five known active clusters were located on the Daniel Boone National Forest that adjoins the National Area (Costa and Walker 1995). None of these clusters remain.

Fire-maintained grassland or grassy-woodland communities with relatively high diversity of native species, once more common in size and extent, are now restricted to a few patches along old backcountry road margins, and will soon be extirpated (Campbell et al. 1990a). The loss of the native barrens vegetation has had an adverse impact on grassland birds and other species that depend on this type of habitat (Campbell et al 1990a, Stedman and Stedman 2002).

Given the issues described above, the Big South Fork National River and Recreation Area needs a Fields Management Plan that achieves a range of desired conditions to meet a variety of objectives. The long-term objectives for this plan are to (1) restore disturbed lands to natural conditions, (2) enhance habitat for game and non-game wildlife, (3) preserve cultural landscapes, and (4) enhance recreational opportunities. This EA analyzes the management actions and procedures proposed for achieving these field management objectives. Specifically, the EA addresses (1) mechanical vegetation control, (2) chemical vegetation control, (3) conventional tillage, and (4) planting. Prescribed fire is briefly addressed; a more comprehensive treatment can be found in the EA for the Big South Fork Fire Management Plan (NPS 2004). The effects of these activities are evaluated for (1) soil productivity, (2) water quality, (3) air quality, (4) vegetation, (5) wildlife, (6) threatened and endangered species, (7) cultural resources, and (8) visitor use.

2.0 ALTERNATIVES

2.1 Alternative A – No Action. Fields are not actively managed.

Under this alternative, most fields would not be bush-hogged, mowed, burned, or otherwise managed, with the exception of selected exotic plant control measures. Consequently, woody vegetation would continue to colonize fields. A process of old-field succession would result in an eventual return to forest. After a period of several decades, these reforested field units would be mostly indistinguishable from the surrounding forest matrix.

Existing management practices would not change for selected field units. Seven significant cultural landscapes, one hay field, one horse pasture, and two group camping fields would continue to be managed in an open condition. Turfgrass associated with developed areas (e.g., Bandy Creek recreation fields) would continue to be maintained. A small field within a cultural landscape would continue to be planted in sorghum as part of an interpretive program. One cultural landscape and adjacent sandstone glades (41 acres) are currently being managed with fire to maintain open grassy woodland; these activities would continue.

2.2 Alternative B (Preferred): To actively manage many existing fields but allow selected fields to return to a forested condition.

Under this alternative, field units would be prioritized based on their cultural, biological, and recreational value. Field units of highest value would be retained and actively managed for a specific desired condition. Those that are considered lower priority would not be actively managed; rather, they would be allowed to revert to forest. Actively managed fields would be bush-hogged, mowed, burned, or planted, depending on their designated desired condition and use. Fields would be managed for one of four main vegetation condition cateogories: (1) native warm-season grasses, (2) tall fescue mix, (3) turfgrass, and (4) grassy woodland. A given field unit would be assigned a condition based, in part, on its most probable use. For example, a recreation field might be managed in turfgrass or tall fescue mix. Cultural landscape fields would primarily be managed as tall fescue mix. The interpretive sorghum field would be retained, as in Alternative A. Fields of high wildlife value might be managed as native warm-season grasses or grassy woodlands. All remaining fields would be allowed to revert to forest.

2.3 Alternative C – Actively manage all existing open fields and open field remnants

Under this alternative, all 742 acres of existing open fields and open field remnants would be regularly maintained to current boundaries. Existing turfgrass would continue to be managed, without changes. A majority of fields would be managed as tall fescue mix. These old fields would be bush-hogged or otherwise mechanically treated to clear encroaching shrubs and saplings. Periodic bush-hogging and/or fire would be used to keep fields open. One cultural landscape and adjacent sandstone glades (41 acres) are currently being managed with fire to maintain open grassy woodland; these activities would continue.

2.4 Environmentally Preferred Alternative

The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act of 1969 (NEPA), which is guided by the Council on Environmental Quality (CEQ). The CEQ provides direction that "[t]he environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101:

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

Alternative A (no change from current management), fails to meet the policies outlined above. Lack of management action would reduce recreational opportunities, fail to maintain significant cultural landscapes, reduce habitat for certain plant and wildlife species that are dependent on early successional habitat, and perpetuate invasive non-native plants across the National Area landscape.

Alternative C also fails to meet the outlined policies. Maintaining all existing fields would put emphasis on recreation and cultural resource preservation at the expense of other beneficial uses. This alternative would have undesirable environmental consequences by perpetuating disturbed-land conditions and increasing invasive non-native plants across the landscape. This alternative would be costly to implement and put a long-term strain on the National Area's financial resources.

<u>Alternative B is the environmentally preferred alternative</u>. This alternative meets policies 1-6 to varying degrees and strikes an appropriate balance among environmental protection, cultural resource preservation, visitor use, and visitor experience. Such a balance would not be achieved by the other two alternatives. Furthermore, Alternative B is also consistent with federal regulations, NPS guidelines, the National Area's enabling legislation, and the Big South Fork General Management Plan (GMP) (2005).

A majority of the National Area’s field units are contained within the Natural Environment Recreation Zone identified in the GMP. The desired resource condition for this management zone is described in this way in the GMP:

> *Natural processes would be protected within this unit, and a predominately natural condition would be readily apparent to the visitor. Natural succession into mature forest would generally be the resource objective, although some areas may be managed to promote certain vegetation types, such as native grasses.*

Both Alternatives A and B, but not Alternative C are consistent with the objectives for this management zone.

Although Alternative A would be generally consistent with the GMP, it would not result in the mixture of conditions necessary to accommodate the wide range of values described in the National Area’s enabling legislation. Table 1 presents a comparison of acreage by vegetation condition that would result from implementation of each alternative. Only Alternative B would maintain fields that are important for visitor use, administrative purposes, or cultural resource protection, while also improving wildlife habitat quality and diversity. Alternative B best favors natural resources and recreational opportunities, while simultaneously fulfilling the National Area’s obligations to cultural landscape preservation.

Table 1. Comparison of desired field condition acres for three field management Alternatives.

Field Condition	Alternative A		Alternative B		Alternative C	
	Acres	Units	Acres	Units	Acres	Units
Native warm-season grass	0	0	309	32	0	0
Tall fescue mix	93	10	101	12	635	89
Turfgrass	66	10	66	10	66	10
Grassy woodland	41	2	125	16	41	2
Forest	542	79	141	31	0	0

3.0 AFFECTED ENVIRONMENT

3.1 Soils: The Cumberland Plateau is underlain by roughly horizontal sedimentary rock strata, which is primarily sandstone, and shale (Campbell and Newton 1995). As would be expected, most of the soils on the plateau are formed from these weathered materials. The depth of the soil to bedrock ranges from about one foot on steep hillsides to about four-to-five feet on broad, smooth interstream divides (Campbell and Newton 1995). Generally, the soils are well-drained, silty clay loam. Although low in natural fertility, plants grown on these soils generally were higher in nutritive value than plants grown on other soils and had the best potential for supporting wildlife of any in the McCreary-Whitley County, Kentucky area (Byrne et al. 1964).

3.2 Air Quality: Air quality in the National Area receives protection under several provisions of the Clean Air Act (CAA), including the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) Program. The area is considered to be in attainment of the NAAQS, the minimum standards for air quality throughout the country. The PSD Program provides additional protection from air pollution. One of the goals of the PSD Program is to preserve, protect, and enhance the air quality in areas of special natural, recreational, scenic, or historic value, including the National Area (Ross 1990). Under this program, the National Area is classified as a Class II area. Only a limited amount of additional air pollution, due to moderate growth, can be allowed in the area over time (certain national parks and wilderness areas are classified as Class I and receive the highest protection under the CAA).

Despite this protection, air quality and visibility are affected by air pollution in the area. Visibility is often reduced by fine particulate pollution, as it is throughout the East. In its 1993 report on visibility in national parks and wilderness areas, the National Research Council concluded that in most of the East, the average visual range is less than 20 miles (about 30 km), or about one-fifth of the natural range (National Research Council 1993). The visual range in the National Area is approximately 10-15 miles (17-25 km) (EPA 1998).

3.3 Hydrology: One of the primary reasons the National Area was established was to preserve as a natural, free-flowing stream, the Big South Fork of the Cumberland River for the benefit and enjoyment of present and future generations. The Big South Fork River is formed by the New River and the Clear Fork, and drains the northern portion of the Cumberland Plateau in Tennessee. As the Big South Fork flows from south to north it is fed by a variety of sources ranging from perennial streams, such as North White Oak Creek, to many ephemeral creeks. Flooding is common during the winter months (December – March) when soils are saturated, frozen or covered with snow. Springs and ponds can be found scattered throughout the National Area. Preserving the water quality of the Big South Fork is an important management concern for the National Area.

The aquatic environment of the Big South Fork gorge and adjacent plateau supports a wide variety of plant and animal life which depends upon the aquatic systems for drinking, food, living space and cover (U.S. Army Corps of Engineers 1976). The river and its floodplain are habitat for nine federally endangered or threatened species (2 floodplain plant species and 7 animal species). Therefore, caution must be exercised while carrying out management operations to prevent impacts to this special resource. A complete overview of the management of the water resources is contained in the Big South Fork NRRA Water Resources Management Plan (Hamilton and Turrini-Smith 1997) on file at the National Area Headquarters.

3.4 Vegetation: The vegetation of the National Area is very diverse as the result of soil, available moisture, aspect, and previous land use (Safley 1970, Hinkle 1989). The majority of the landscape is forested. Forests of mixed oaks with a hickory component characterize the broad flats and the gentle slopes of the upland. Common dry site oaks include post oak, southern red oak, scarlet oak, and black oak; on moister sites, white oak predominates. Hickories, including pignut, mockernut, sand and bitternut, form a widespread but minor component. Red maple, blackgum, and sourwood are common. Shortleaf pine was commonly mixed with oak on dry sites prior to a southern pine beetle outbreak that killed a majority of mature yellow pines in the National Area (1998-2002). On more xeric sites, such as narrow ridges and cliff edges, mixed-oak communities are replaced by pines and ericaceous shrubs.

Gorge forest communities are generally dominated by more mesic species with a rich oak element on the middle to lower slopes. These gorge forest communities are characterized by high biodiversity and are among the most biologically rich systems of the temperate regions of the world, certainly in the United States (Hinkle et al. 1993). Mixed-mesophytic vegetation is found on protected sites with richer soils, and is restricted to escarpment slopes, coves, and deeper ravines. Eastern hemlock is prominent in narrow gorges in north-facing coves and along streams. Examples of dominant north-facing tree species in the mixed mesophytic vegetation type include northern red oak, shagbark hickory, yellow buckeye, American basswood, black birch, magnolias, and yellow-poplar. In the zone between the river floodplain and the middle reaches of the gorge, sugar maple, beech, and yellow-poplar grow.

On the level floodplain, where floodwaters periodically inundate the vegetation but do not destroy it, a well-established forest has developed. This alluvial forest consists of river birch, sycamore, green ash, sweetgum, cucumber tree, and other mesic species. The understory includes ironwood, bigleaf magnolia, box elder, leatherwood, and many others. Stands of native cane are locally present.

The frequently flooded and scoured river banks are dominated by shrubs and stunted trees. Sycamore, black gum, river birch, and persimmon are common among the boulders and cobble that make up the river bank and bars. Stunted eastern redcedar are occasionally observed. Shrubs include willows, alder, sweetspire, winterberry, smooth azalea, and pinxterflower.

3.5 Wildlife: Mammals of the National Area include the white-tailed deer, gray fox, bobcat, raccoon, muskrat, beaver, Russian wild boar, eastern gray squirrel, pygmy shrew, hispid cotton rat, white-footed mouse, and woodland (pine) vole (Britzke 2004). The little brown bat, big brown bat, red bat, and several other bat species are present. Black bears and elk are sighted with increasing frequency in the Big South Fork and surrounding region.

The National Area provides a variety of habitats for several species of birds. The Wild Turkey and Ruffed Grouse are two principal game birds and can be found in the hardwood and mixed hardwood-pine habitat type. Some of the National Areas other common bird species include the Turkey Vulture, Whip-poor-will, Downy Woodpecker, Pileated Woodpecker, Acadian Flycatcher, Red-eyed Vireo, American Crow, Golden-crowned Kinglet, Black-throated Green Warbler, Pine Warbler, Black-and-White Warbler, Ovenbird, Hooded Warbler, Worm-eating Warbler, Scarlet Tanager, Dark-eyed Junco, and Indigo bunting. (Stedman and Stedman 2002).

Reptiles, like other species, require a variety of sites, ranging from xeric to very moist. Reptiles present in the National Area include the northern copperhead, eastern garter snake, northern ringneck snake, black rat snake, five-lined skink, and eastern box turtle. Common amphibian species are the green salamander, Northern spring salamander, Black Mountain dusky salamander, seal salamander, slimy salamander, spotted salamander, American toad, mountain chorus frog, green frog, pickerel frog, and wood frog (Stephens 2005).

Comiskey and Etnier (1972) confirmed the presence of 67 species of fishes in Big South Fork of the Cumberland River and its tributaries. Fish include popular game species, such as walleye, smallmouth bass and bluegill and more obscure species, such as spotfin chub, whitetail shiner, and ashy darter. The National Area supports 25 documented species of freshwater mussels, five of which are federally endangered. In the southeast only the Clinch and Green Rivers contain this level of diversity, and only two other National Park Service units in the country have greater diversity (NPS 2005).

3.6 Threatened and Endangered Species: Federally and state-listed endangered, threatened, and rare flora and fauna have been inventoried by the state Natural Heritage Programs and NPS. By law and NPS policy, these species require special consideration and protection. The stretch of the Big South Fork from Leatherwood Ford to Bear Creek is particularly noteworthy because its water quality and streambed characteristics combine to provide important habitat for federally listed aquatic species (NPS 2005). Seventeen federally listed species have occurred or potentially occur within the National Area (Appendix A). In addition to the federally listed species, dozens of additional species, listed by the states of TN and KY, are know to exist within the National Area. A complete listing of state-listed species that occur in the National Area is on file at National Area Headquarters.

3.7 Cultural Resources: When the National Area was created, numerous cultural sites were acquired within the legislative boundary. These sites include settlements, mining sites and towns, logging sites, prehistoric and historic archeological sites, and farmsteads with associated agricultural fields. To date, five sites and 15 structures have been determined to meet criteria for listing on the National Register of Historic Places.

Cultural landscapes in the National Area include farmsteads, cemeteries, openings for sawmill sites, and coal mines. A large number of old farm fields in the National Area are remnants of the agricultural lifestyle of the inhabitants of the upper Cumberland Plateau. Some of these fields have been preserved as cultural landscapes. Numerous (over 2,000) archeological sites, ranging from lithic scatters to rockshelters, document human activity from several hundred to over 12,000 years ago.

One of the goals for this Fields Management Plan is to produce and maintain landscape configurations that existed at cultural landscapes during the periods of historic significance. On the basis of research and investigations conducted at Big South Fork (Des Jean 1994, 2001; Ferguson et al. 1986; Hasty and Goetcheus 1998; Hutchinson et al. 1982; Prentice 1992, 1993b, 1993c, 1995, 1999; Wilson and Finch 1980), none of the previously disturbed agricultural fields selected to be included in this Plan contain archeological resources that will be affected by the proposed actions.

A complete listing of cultural resources is on file at National Area Headquarters.

3.8 Visitor Use

The National Area draws approximately 900,000 visitors to the area annually (NPS 2005). As a result, recreation is expected to play an ever-increasing role in the local economy. The primary recreational pursuits are fishing, hunting, horseback riding, rafting, kayaking, canoeing, camping, hiking, sightseeing, and related activities. School groups come to the area to study the environment. The nearby land is being subdivided into second-home developments, increasing the amount of area included within the wildland urban interface adjacent to the National Area.

3.9 Sacred Sites and Indian Trust Resources: Although there has been occupation by Native Americans in the area for thousands of years, past studies at the National Area have failed to identify any sites here that would be considered “Sacred” by Native Americans. The majority of the sites associated with Native Americans in the National Area have been determined to be prehistoric sites of temporary seasonal occupation. Many of the sites were located on ridge tops and intersections of ridges that were heavily impacted by road construction since the logging era began.

4.0 ENVIRONMENTAL CONSEQUENCES

Methodology for Assessing Impacts

Potential impacts are described in terms of type (are the effects beneficial or adverse?), context (are the effects site-specific, local, or even regional?), duration (are the effects short-term, lasting less than one year, or long-term, lasting more than one year?), and intensity (are the effects negligible, minor, moderate, or major?). Because definitions of intensity (negligible, minor, moderate, or major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this environmental assessment/assessment of effect.

In addition, National Park Service's *Management Policies, 2001* require analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. National Park Service managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the National Park Service the management discretion to allow certain impacts within park, that discretion is limited by the statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible National Park Service manager, would harm the integrity of park resources or values. An impact to any park resource or value may constitute impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

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

Impairment may result from National Park Service activities in managing the park, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park. A determination on impairment is made in the *Environmental Consequences* section for each impact topic.

Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations, which implement the National Environmental Policy Act of 1969 (42 USC 4321 *et seq*.), require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for all of the alternatives.

Cumulative impacts were determined by combining the impacts of Alternatives with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects at the park.

Private Development Around Big South Fork NRRA

Property development outside the park is likely. Tracts just outside the park are currently being subdivided and developed with homes. As Big South Fork NRRA becomes a more popular tourist destination, subdivision and development of adjacent private property becomes more and more prolific, increasing the value of the National Area as a natural area and recreation destination.

Consumptive Uses Outside the Park

Mining and minerals exploration are likely because the area is known to contain both coal and oil and gas resources. The Tennessee Valley Authority has begun planning for a substantial amount of coal extraction (approximately 70 million tons) in the Royal Blue Wildlife Management Area, which is in the watershed of the Big South Fork.

4.1 Soils

Methodology and Intensity Thresholds

The thresholds of change for the intensity of impacts to soils are defined as follows:

Negligible: The impact is at the lowest levels of detection and causes very little or no negative change in soil chemical or physical properties, compaction, or unnatural erosion, when compared with current conditions.

Minor: The impact is slight but detectable in some areas, with few perceptible negative effects on physical or chemical properties, compaction, or unnatural erosion of soils. Beneficial effects include measurable increases in soil productivity or function in small, localized areas.

Moderate: The impact is readily apparent in some areas and has measurable effects on physical or chemical properties, compaction, or unnatural erosion of soils. Beneficial effects include measurable increases in soil productivity or function in several large areas.

Major: The impact is readily apparent in several areas and has severe effects on physical or chemical properties, compaction, or unnatural erosion of soils. Beneficial effects include measurable increases in soil productivity or function in a substantial portion of the park.

Short-term Impacts: Each alternative would have a unique short-term effect on soil properties and productivity. Responses would be dependent on the current vegetation condition of a given field unit and the level of disturbance associated with an alternative.

Short-term impacts would be negligible except where management actions result in substantial soil disturbance or major changes to vegetation structure. Soil disturbance is most likely to occur when converting old agricultural fields to native warm-season grasses under Alternative B. In this scenario, short-term effects will include soil loss, nutrient loss, and decreased above- and below-ground productivity as the existing vegetation is killed through mechanical or chemical methods. Over 200 acres would be affected by these treatments. However, the response will be ephemeral. Within the same year of treatment, native grasses and forbs will be well established. Studies in the Midwest have demonstrated that as restored grasslands age, below-ground biomass and carbon-nitrogen ratios approach those of natural tallgrass prairies (Baer et al. 2002).

Major shifts in vegetation structure would occur under Alternative C, when overgrown old fields are cleared of shrubs and saplings to restore historic field boundaries. Many of the fields proposed to be maintained were abandoned several years ago. Consequently, these fields are now thick shrub-scrub habitat with tall saplings. Major disturbances to vegetation, such as converting forests to fields, result in rapid and major loss of nutrients (Johnson and Swank 1973, Vitousek and Reines 1975) and alterations to nitrogen cycling (Swank and Vose 1997). Soil loss can also be expected, as heavy equipment is used to clear small trees and shrubs.

Short-term nutrient releases and other effects are also associated with fire, which may be used in establishing and maintaining native grassland and grassy woodlands under Alternative B. These effects are discussed in detail in the Fire Management Plan EA on file at National Area Headquarters.

Long-term Impacts: Long-term changes in soil properties are expected for any management action that involves major changes in vegetation structure and composition, even in the absence of soil disturbance.

As old fields revert to forest under Alternative A and, in part, Alternative B, soil properties will increasingly resemble baseline conditions of mature hardwood forests. During intermediate stages of succession, higher rates of evapotranspiration and plant growth will result in low cation (e.g., calcium) and other nutrient loss (Johnson and Swank 1973). As the forests mature, biomass accumulation will be incrementally lower and eventually negative, at which point nutrient loss may accelerate (Vitousek and Reines 1975).

As restored native warm-season grasslands, prescribed by Alternative B, age and accrue above-ground biomass, they also accumulate considerable root biomass. Twelve years after restoring cultivated fields to native grasslands in the Midwest, root biomass and carbon-nitrogen ratios were similar to natural native grasslands that had never been cultivated (Baer et al. 2002). Recovery of soil carbon pools exceeded the rates observed for abandoned cropland undergoing natural succession. These changes indicate a long-term positive response to restoration, not just in above-ground vegetation structure, but also of below-ground structure, soil productivity, and soil function.

A similar positive long-term response can be expected where old fields are converted to grassy woodlands. The most substantial difference in grassy woodlands and native grasslands is the allocation and storage of carbon between above-ground and below-ground resources. As conifer trees grow, increases in tree biomass may be accompanied by a reduction in soil carbon storage (Norris et al. 2001).

Mowing, harvesting, and possibly fertilizing—required to manage turfgrass, cool-season pasture, and other grassy vegetation (all alternatives)—will have long-term impacts on soil properties. Repeated mowing and other heavy equipment use compacts soil, reducing porosity and increasing bulk density. Harvesting removes carbon and nutrients from the system. Fertilizers affect nutrient cycling. These impacts are long-term, in that as long as the management action continues, the effect will persist.

Cumulative Impacts: Adjacent landowners continue to impact soil resources through tree harvesting, converting hardwood forest to pine plantations, agriculture, mineral extraction, and land development. Their efforts, combined with Alternative C and some prescriptions in Alternative B, could have a cumulative net adverse effect on regional soil resources on the Cumberland Plateau. Alternative A, and some prescriptions in Alternative B, would have a net benefit on soil resources.

Methods to Reduce Impacts: Management actions that reduce long-term impacts to soil resources would be favored over those that continue to alter soil function. Short-term negative impacts would be allowed in order to make achieve long-term benefits. Practices that limit soil disturbance would be encouraged. For example, when converting old fields to native grasses, no-till agricultural practices would be favored over conventional tillage practices.

Conclusion:

- <u>Alternative A</u> will not lead to soil degradation. Soil impacts would be positive and minor. No impairment to National Area resources would occur.
- <u>Alternative B</u> would protect soil resources in the long-term by allowing old fields to revert to forest and converting others to productive native grass systems. Short-term impacts would be offset by long-term benefits. Some long-term negative impacts, associated with turf and pasture management, would occur; however, they would be

localized and minor. Impacts from Alternative B would not result in an impairment of National Area resources.

- Alternative C would have the most extensive and lasting negative impact on soil resources. Losses in productivity and soil function would be moderate; however, impacts from Alternative C would be reversible and would not likely result in an impairment of National Area resources.

4.2 Air Quality

Methodology and Intensity Thresholds

The thresholds of change for the intensity of impacts to air quality are defined as follows:

Negligible: Impacts are not detectable, well below air quality standards, and within historical baseline air quality conditions.

Minor: Impacts are detectable but well within or below air quality standards and within historical baseline air quality conditions.

Moderate: Impacts are detectable, within or below air quality standards, but historical baseline air quality conditions are being altered on a short-term basis.

Major: Impacts are detectable and persistently alter historical baseline air quality conditions. Air quality standards are locally approached, equaled, or exceeded.

Short-term Impacts: Short-term air quality effects would be associated with use of gasoline or diesel-powered engines on tractors and mowers and prescribed fire under Alternative B and C. Prescribed fire, in particular, would have the most noticeable effects. Prescribed fires, associated with establishing and maintaining native grasslands, grassy woodlands, or other early successional habitat, would be relatively small (<100 acres). Such fires would affect only the area adjacent to the scene of the fire for a short time, generally one to two days, depending on the size of the fire, the fuels, and the environmental conditions present. Visibility could be reduced for short periods of time in areas within the river gorge and adjacent to the National Area. Human health standards (National Ambient Air Quality Standards for particulate matter size class of 10 microns in diameter and smaller and particulate matter of 2.5 microns in diameter and smaller) could be approached for short periods in the area immediately adjacent to the fire. Air quality on a regional scale would be affected only when many acres were burned on the same day (NWCG 1985).

Alternative A would have the least short-term impact on air quality of the three alternatives because prescribed fire and motorized equipment would not be used.

Long-term Impacts: All alternatives may have positive impacts on air quality by mitigating carbon-dioxide emissions through carbon storage in soils and plant tissue. Alternatives A and B have more value for mitigating CO_2 emissions than does Alternative C. Native grasslands and intermediate-succession forests store carbon as they accrue biomass in root and above-ground plant tissue. Less carbon is stored in turfgrass or cool-season pasture.

Cumulative Impacts: Actions prescribed under Alternatives B and C would contribute to regional air quality impacts through smoke production and motorized equipment emissions. Regional air quality during prescribed fire operations can be affected by meteorology; existing air quality; the size, timing, and duration of the activity; and other activities occurring in the same airshed, such as when many acres are burned on the same day. Alternatives B and C would provide flexibility to schedule burns and to coordinate with other regional smoke producers to take advantage of favorable conditions that are required to disperse smoke and avoid regional cumulative smoke impacts.

Methods to Reduce Impacts: The Environmental Protection Agency (EPA) recognizes that prescribed fires contribute to regional haze, and there is a complex relationship between what is considered a natural source of fire versus a human-caused source of fire. For example, the increased use of prescribed fire in some areas may lead to particulate emissions levels lower than those that would be expected from a catastrophic wildfire. Given that in many instances the purpose of prescribed fire is to restore the natural fire cycles to the forest ecosystems, EPA will work with state and federal land managers to support development of enhanced smoke management plans to minimize the effects of emissions on public health and welfare (EPA 1999).

Several methods are available to reduce the impacts to air quality including, (1) minimizing the area burned, (2) reducing the fuel loading in the area to be burned through mechanical pretreatment, (3) reducing the amount of fuel consumed by fire through the use of smaller units, and (4) minimizing emissions per ton of fuel consumed by burning under favorable conditions or using different firing techniques. Another action that can be taken to minimize fire emission includes rapid and complete mop-up of fuels known to contribute to poor air quality or impact human health. Prescriptive elements in prescribed burn plans would specify the proper conditions necessary to increase smoke dispersal and enhance burning, thereby reducing impacts from smoke.

Under the Clean Air Act, the Service is responsible for protecting air quality within park boundaries, and to take appropriate action to do so, when reviewing emission sources both within and in proximity to parks (Malkin 1994). Therefore, all management actions would be conducted in accordance with regulations established by the Commonwealth of Kentucky, the State of Tennessee and the Clean Air Act.

Conclusion:

- The adverse air quality impacts associated with Alternative A, in the short term, would be negligible. No impairment would result from the implementation of alternative A.

- Alternative B would include smoke and motorized equipment emissions. Adverse short-term and long-term impacts from Alternative B would be minor. No impairment to park resources would result from Alternative B.
- Adverse air quality impacts from Alternative C would be similar to those of Alternative B. There would be no impairment to park resources.

4.3 Water Quality

Methodology and Intensity Thresholds

The thresholds of change for the intensity of impacts to water quality are defined as follows:

Negligible:	Impacts are not detectable, well below water quality standards, and within historical baseline water quality conditions.
Minor:	Impacts are detectable but well within or below water quality standards and within historical baseline water quality conditions.
Moderate:	Impacts are detectable, within or below water quality standards, but historical baseline water quality conditions are being altered on a short-term basis.
Major:	Impacts are detectable and persistently alter historical baseline water quality conditions. Water quality standards are locally approached, equaled, or exceeded.

Water quality is of great concern at Big South Fork NRRA because of populations of six federally listed endangered mussels and one fish that exist in the main stem of the river and some of the major tributaries. Water quality must be protected and enhanced to the maximum extent possible.

Short Term Impacts: The greatest potential impacts to water quality exist under Alternative B and C, through prescribed fire and herbicide application. Surface runoff following prescribed fire may carry suspended soil particles, dissolved inorganic nutrients, and other materials into adjacent streams impacting water quality (Wade 1989). However, vegetation regrowth and regeneration following burns on grasslands and grassy woodlands occurs quickly; consequently, surface runoff is an ephemeral phenomenon. Further discussion of the impacts of prescribed fire on water quality is found in the Fire Management Plan EA (2004) on file at National Area Headquarters.

The greatest potential for toxic chemical inputs to water exists under Alternative B. Herbicides are an important tool for converting fescue-dominated fields to native warm-season grasses and grassy woodlands. In particular, glyphosate, triclopyr, 2,4-D, imazapyr, and imazapic herbicides would be used in this process. Glyphosate, triclopyr, and 2,4-D are post-emergent herbicides applied to actively growing weeds or undesirable vegetation. Imazapic and imazapyr have both pre-emergent and post-emergent action, meaning they will kill existing standing vegetation as well as suppress seed germination. Profiles of each herbicide are in Appendix A.

Herbicides applied to cropland have relatively predictable runoff rates for a given soil texture and topographic position. Herbicide runoff is likely to occur, regardless of tillage system used. Because of this, herbicides that exhibit low toxicity are preferred over those that exhibit high toxicity. Imazapic would be applied at a rate of 4-8 ounces/acre to establish native grasses. This is a one-time input. Herbicides would not be required to maintain native grasses. In a study of agricultural chemical loss in Kentucky croplands using three different tillage practices, total runoff was <3% for all chemicals (Seta et al. 1993). Furthermore, riparian buffer forests have been demonstrated to act as nutrient sinks that buffer nutrient discharge from surrounding agricultural inputs (Lowrance et al. 1984). Given the low volume of herbicides used and the existing forest buffers that exist around all nearby streams, chemical runoff from native grass establishment under Alternative B is anticipated to have negligible to minor impacts on surface water or groundwater quality.

Post-emergent herbicides would also be used under Alternative A and C for control of non-native invasive plants. Primarily, applications would be spot treatments for localized infestations. The volume of herbicide used for these applications is low, but may require repeat treatments. Herbicide volumes used under Alternative A would gradually taper to only occasional use, as old fields revert to closed-canopy forests and exclude shade-intolerant exotic plants. In contrast, herbicide use may increase under Alternative C as heavily vegetated fields were reopened, promoting invasion by exotics. Old fields and homesites are among the areas most infested by exotic species (Campbell et al. 2003). Alternative C would perpetuate and enhance the problem and subsequent herbicide use.

Long-term Impacts: Long-term water quality concerns are not anticipated for any alternative. Soil disturbance would not occur under Alternative A and is mostly a single-time event under Alternative B and C. Herbicide for exotic plant control will be limited where fields are allowed to revert to forest or are converted to native grasses or grassy woodlands. The highest potential for water quality impacts exists under Alternative C, where the highest number of acres would be disturbed and where repeated herbicide applications presents potential for repeated inputs to waterways. The environmental fate of herbicides depends on chemical formulation and environmental conditions. Herbicide properties, including toxicity and environmental fate of herbicides proposed to be used for managing fields, are summarized in Tables 2-4.

Table 2. Five herbicides proposed for use in managing fields at Big South Fork NRRA.

Herbicide	Brand Name Examples	Chemical Name	Herbicide Family	Target Weed Sps.	Mode of Action
2,4 D	Navigate®, Class®, Weed-Pro®, Justice®	(2,4-dichlorophenoxy) acetic acid	phenoxy	broadleaf weeds	Auxin mimic
Glyphosate	RoundUp®, Rodeo®, Accord®	N-(phosphonomethyl)glycine	none generally recognized	annual/perennial weeds	Inhibits shikimac acid pathway, depleting aromatic amino acids
Imazapic	Plateau®, Plateau Eco-Pak®, Cadre®	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid	imidazolinone	annual/ perennial weeds	Inhibits AHAS synthesis, blocking amino acid synthesis
Imazapyr	Arsenal®	(+)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid	imidazolidinone	annual/ perennial grasses, broadleafs, vines, brambles, brush, and trees	Inhibits acetolactate synthase, blocking amino acid synthesis
Triclopyr	Garlon®, Remedy®	[(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid	pryridine	woody and annual broadleaf weeds	Auxin mimic

From TU, M., C. HURD, and J.M. RANDALL. 2001. Weed Control Methods Handbook. The Nature Conservancy. http://tncweeds.ucdavis.edu. Version: April 2001.

Table 3. Physical properties of five herbicides proposed for use in managing fields at Big South Fork NRRA.

	---------------Behavior in Soils--------------			-------Behavior in Water--------	
Herbicide	**Average Soil Half-life**	**Soil Sorption (Koc)**	**Mobility[1]**	**Water Solubility**	**Average Half-life in Water**
2,4 D	10 days	20 mL/g (acid/salt), 100 mL/g (ester)	moderate to high	900 mg/L (acid), 100 mg/L (ester), 796,000 mg/L (salt)	varies from hours to months
Glyphosate	47 days	24,000 mL/g	low	15,700 mg/L (acid), 900,000 mg/L (IPA salt), 4,300,000 mg/L	12 days to 10 weeks
Imazapic	120-140 days	206 mL/g	low?	36,000 mg/L (pH 7)	< 8 hours
Imazapyr	25-141 days	poor, Koc unk.	low to moderate	11,272 mg/L	2 days
Triclopyr	30 days	20 mL/g (salt), 780 mL/g (ester)	moderate to high	430 mg/L (acid), 23 mg/L (ester), 2,100,000 mg/L (salt)	4 days

[1]Based on Helling's classification system (Helling & Turner 1968)

From TU, M., C. HURD, and J.M. RANDALL. 2001. Weed Control Methods Handbook. The Nature Conservancy. http://tncweeds.ucdavis.edu. Version: April 2001.

Table 4. Toxicity of five herbicides proposed for use in managing fields at Big South Fork NRRA.

	--------------Toxicity (EPA Toxicity Categories)----------------			
Herbicide	**Oral LD50, Mammals[1]**	**LD50, Birds[2]**	**LC50, Fish[3]**	**Dermal LD50, Mammals[4]**
2,4 D	764 mg/kg [low]	500 mg/kg (BW) [moderate]	263 mg/L [moderate]	NA
Glyphosate	5,600 mg/kg [slight]	> 4,640 mg/kg (BW/M) [low]	120 mg/L [moderate]	>5000 mg/kg
Imazapic	> 5,000 mg/kg [slight]	> 2,150 mg/kg (BW) [low]	> 100 mg/L [moderate]	> 5000 mg/kg
Imazapyr	> 5,000 mg/kg [slight]	> 2,150 mg/kg (BW/M) [low]	>100 mg/L [moderate]	>2000 mg/kg
Triclopyr	713 mg/kg [low]	1,698 mg/kg (M) [low]	148 mg/L [moderate]	>2000 mg/kg

[1] Rat
[2] BW: Northern Bobwhite, M: Mallard
[3] Bluegill sunfish
[4] Rabbit

From TU, M., C. HURD, and J.M. RANDALL. 2001. Weed Control Methods Handbook. The Nature Conservancy. http://tncweeds.ucdavis.edu. Version: April 2001.

Cumulative Impacts: A mixture of land development, mineral extraction, timber harvesting, cause sedimentation and toxic inputs to the Big South Fork. Alternatives B and C could contribute a minor component to the cumulative effects of those activities.

Methods to reduce impacts:

- Chemical treatments would follow all product label requirements.
- Herbicide treatments would follow recommendations of the Southeast Exotic Plant Pest Council Invasive Plant Manual (www.se-epcc.org 2004) or printed in USDA-FS Gen. Tech. Rep. SRS-62, Nonnative Invasive Plants of Southern Forest: A Field Guide for Identification and Control (Miller 2003).
- All exotic plant control efforts would be conducted under the direction of the National Area's Botanist.
- All park staff, including seasonals and interns, who apply herbicides, would be required to receive a Tennessee Department of Agriculture Private Applicator Certification.
- The Botanist would provide applicators additional training on plant identification and specific control techniques for target species.
- Only herbicides that are approved, per the product label, for application near water, would be used within 100 m of streams.
- To avoid water contact from drift, foliar spray techniques will not be used within 10 m of seeps, streams, or other water sources.
- If foliar application are required within 10 m of water, herbicides would be brushed, sponged, or wiped onto foliage.
- Surfactants would not be added to herbicides unless target plants were > 100 m from seeps, streams, or other water sources.

A Biological Assessment (BA) for the application of herbicides near riparian areas was submitted to U.S. Fish & Wildlife Service (USFWS) on February 8, 2005. Concurrence for the BA was issued by USFWS on March 15, 2005. The BA and correspondence from USFWS are on file at National Area Headquarters.

Conclusion:

- Alternative A would minimize soil disturbance and reduce chemical inputs over time. No impairment to water quality would occur.
- Under Alternative B, there would be a short-term high-volume use of herbicides and moderate amounts of soil disturbance. Impacts to water quality are potentially moderate. No impairment would occur.
- Alternative C would result in moderate impacts to water quality from soil disturbance and potential long-term inputs of herbicide. Impacts from Alternative C would not result in impairment to water quality.

4.4 Vegetation

Methodology and Intensity Thresholds

The thresholds of change for the intensity of impacts to vegetation are defined as follows. Impacts can be beneficial or adverse:

Negligible: Effects on individual plants, plant populations, or functional processes are not observable. Disturbance does not result in changes to plant community structure or composition, beyond what would occur through natural processes.

Minor: Impacts are detectable, but not apparent. Damage to individual plants is restricted to herbs and small shrubs and does not affect below-ground plant structures. Changes in community structure and composition are restricted to the herbaceous and low-shrub layer. Post-disturbance plant communities quickly return to pre-disturbance conditions.

Moderate: Impacts are apparent. Damage to above-ground structures is extensive for herbs, shrubs, saplings, and some fire-intolerant trees. Significant changes in plant community structure and composition occur in the understory and midstory. Post-disturbance plant communities retain many characteristics of pre-disturbance communities, but differences persist for several years.

Major: Impacts are obvious without close inspection. Plant damage extends to below-ground structures (e.g., roots). Changes in community structure include all vegetation strata. Changes in species composition are dramatic because of species loss and invasion of new species. Post-disturbance plant communities may not resemble pre-disturbance communities even after several years or decades.

Short- and Long-term Impacts: Short-term and long-term impacts are discussed jointly with a specific focus on general vegetation trends, exotic plants, genetic integrity, and herbicide damage.

***General Trends*:** Under Alternative A, fields would gradually be lost as they are invaded by trees and other woody species. Dominance by grasses and forbs would give way to woody vegetation. Dry upland fields would continue to be colonized by Virginia pine, shortleaf pine, white pine, post oak, red maple, dogwood, winged sumac, persimmon, and blackberries. Moist fields would be colonized by sweetgum, winged elm, yellow poplar, red maple, and white pine. Eastern redcedar would be a major component of a small number of fields. As tree canopies closed and excluded sunlight, a more litter-rich forest floor would begin to develop. Within four to five decades after abandonment, former fields would resemble the adjacent oak-pine and mixed hardwood forests.

Under Alternative B, the above-described trends would also apply to those fields selected for a return to forest conditions. Some other fields would not change from their current conditions of turfgrass, tall fescue, cool-season pasture, or other low grass-forb mixtures. Regular mowing, bush-hogging, or burning, in rare cases, would maintain these fields in their desired condition. The most immediate change in vegetation structure and composition would occur for those fields that were being converted to native warm-season grasses or grassy woodlands. Dominant tall fescue would be replaced with native grasses. Some native forbs and grasses currently present in old fields would survive the establishment process, depending on the conversion method and herbicide formulation and rate used (e.g., see Barnes and Washburn 2000, Washburn and Barnes 2000). The end condition for native grasslands would be a mixture of short and tall grasses (up to 9 ft tall) mixed with native forbs and some common weedy exotics. For fields intended to become grassy woodlands, existing shortleaf pine and post oak trees would be protected during establishment and subsequent prescribed fire. The density and distribution of trees would range from very sparse isolated trees (< 20 trees/acre) to dense tree clumps separated by small to large openings. The understory would be composed of native grasses and forbs, with little to no shrub layer.

Alternative C would result in a landscape checkered with open fields, dominated by tall fescue. Field maintenance (primarily bush-hogging) would occur on a rotation, meaning vegetation structure would range from recently cut low vegetation to low-intermediate height shrubs and saplings. Bush-hogging would occur at an interval that precludes dominance of any field by woody vegetation.

Exotic Plants: Under Alternative A and for part of Alternative B (for fields where desired condition is forest), non-native, invasive trees and shrubs, such as tree-of-heaven, multiflora rose, and autumn olive would colonize fields shortly after abandonment. In many fields, these species are already well established. Without aggressive and repeated control efforts, non-native woody shrubs would persist and increase in abundance over time, then eventually decrease as native trees assume dominance. In an examination of old field exotic plant invasions over 40 years, exotic species cover and small-scale exotic species richness declined with time (Meiners et al. 2002). Native plant regeneration may be temporarily inhibited when exotic shrub infestations are severe; however, over a period of decades native trees are likely to resume dominance. Native tree dominance may be inhibited in the long-term where infestations of the invasive tree, tree-of-heaven, are severe. Shade-tolerant exotic plants may also persist or increase in abundance as canopy closure approaches.

If implemented, Alternative B, would result in elimination of exotic plants as old fields are converted to native warm-season grasses and grassy woodlands. Herbicides and fire would be used to eliminate tall fescue, johsongrass, sericea lespedeza, and other exotics, prior to establishment. A combination of glyphosate and imazapic have proven effective in eliminating tall fescue (Barnes 1999, Barnes and Washburn 2000, Washburn and Barnes 2000) and johnsongrass (Jim Bean, personal communication). Triclopyr (Richard Conley, personal communication) or triclopyr mixed with 2,4-D (John Seymour, personal communication) have proven effective for eliminating sericea lespedeza, either prior to or after native grass establishment.

Alternative C would result in the persistence of exotic plants in old fields. Tall fescue would remain the dominant component of most fields. Existing old fields and old homesites are among the sites most affected by exotic plants within the National Area (Campbell et al. 2003). Further disturbance to maintain (or restore, in some cases) this acreage of fields would perpetuate the National Area's vulnerability to exotic plant invasion. Periodic bush-hogging has not effectively controlled woody or herbaceous exotic plants in existing fields (Campbell et al. 2003). Exotics such as multiflora rose and autumn olive are so well established in the Big South Fork region, that local long-term control is not feasible without regular treatment with herbicides.

Genetic Integrity: Land managers should be aware of genetic integrity concerns for restoration activities that involve planting native plant materials. Seed provenance, source distance, multiple vs. single source, regional adaptation, local adaptation, and genetic diversity are some of the factors that should be considered prior to introducing native plant material to a restoration site (Kaye 2001, Knapp and Rice 1994). Alternatives A and C do not involve site restoration through planting; therefore, issues of genetic integrity are not as relevant.

For Alternative B, however, native warm-season grasses may be introduced for converting old agricultural fields to native grasslands and grassy woodlands. Without proper attention to appropriate selection of plant material for restoration, the success of that restoration and the genetic integrity of adjacent native wild populations may be jeopardized. Two scenarios exist for National Areas fields selected for restoration to grasslands or grassy woodlands: (1) desired native grass and forb material already exists on site and introduction of new plant material is not necessary, and (2) desired native plant material is not present on site and off-site sources will be introduced. Under the first scenario, restoration will occur through propagation of on-site plant material or that which moves on site from adjacent seed sources. The genetic integrity discussion is mostly irrelevant to this scenario.

Under the second scenario, native grass seeds would be obtained in two ways: (1) purchased from regional commercial producers, and (2) collected from native grassy remnants within the National Area. The provenance of purchased seed may be the most important variable in the competitive ability and ecological performance of the resulting grass stand (Gustafson et al. 2004a, Gustafson et al 2004b). Local seed tends to be adapted to local conditions, improving the outcome of restoration (Gustafson et al. 2005). Using local seed also tends to prevent loss of genetic qualities of remnant wild populations that can occur when off-site seed sources are planted near wild populations (Kaye 2001). Genetic integrity can also be compromised when multiple seed sources, formerly separated by habitat type or geographic distance, are combined at a single restoration site. When this occurs, genetic qualities of individual populations can be lost and hybrid progeny may not have the same vigor or fitness as parents (Kaye 2001). However, multiple source plantings may have an advantage in that the probability of all of those different source materials failing is lower than if seeds from only one source are planted (Kaye 2001). Essentially, multiple-source planting avoids the “all your eggs in one basket” scenario. Under Alternative B, sites will be planted with each combination of local vs. regional seed and single vs. multiple sources. Sites at the south end of the National Area will be planted with commercially available multiple-source seed from east and middle Tennessee (30-125 miles away). Poor local adaptation and outbreeding depression may jeopardize these restorations, although this outcome is unlikely given the success of other regional natural areas that have used this seed source. Similar circumstances exist at the northern part of the park, (primarily in Kentucky) where sites will be planted with commercially available single- or multiple-source seed from central and eastern Kentucky (10-100 miles). Sites in the central portion of the park will be planted with local seeds collected from sites within the National Area. These sites are anticipated to perform well and may best preserve local genetic integrity.

Herbicide Damage: Herbicides kill or injure plants through specific physical or biochemical mechanisms (Tu et al. 2001). The mode of action of a given herbicide is very specific and generally will not affect all plants or all stages of a plant’s lifecycle in the same way. The five herbicides proposed for use in managing the National Area’s fields (glyphosate, imazapic, imazapyr, triclopyr, and 2,4-D) are categorized by two modes of action. Herbicide synopses are provided in Appendix A.

Glyphosate, imazapic, and imazapyr kill plants by preventing synthesis of certain amino acids that are unique to plants (Tu et al. 2001). Glyphosate and imazapyr are non-selective, meaning they will kill a majority of annual and perennial plants. Imazapic is more selective; it will kill some annual and perennial grasses and some broadleaf weeds, but have little or no effect on others. Imazapic and imazapyr are active in the soil and can affect pre-emergent vegetation.

Triclopyr and 2,4-D mimic auxin, a plant growth hormone, resulting in uncontrolled cell growth and eventual mortality (Tu et al. 2001). These herbicides are selective for broadleaf herbaceous and woody plants, with little impact to grasses. Triclopyr and 2,4-D are post-emergent herbicides, although triclopyr may have additional minor soil activity.

Under all three alternatives, herbicides would be used to control exotic plants in all infested field units. Target plants include tree-of-heaven, mimosa, multiflora rose, autumn olive, privet, Japanese honeysuckle, sericea lespedeza, white poplar, wineberry, johnsongrass, and kudzu. Targeted spot applications with backpack sprayers would be used to help minimize injury or mortality to non-target native plants. However, minor off-target plant injury or mortality would be likely, as overspray hit adjacent or underlying grass, herbs, and shrubs. Volume of herbicide use would taper as forest canopies developed on old fields under Alternative A. Herbicide volume may be greatest under Alternative C, where control of exotics in the many early successional fields would involve frequent and repeated spot treatments.

Under Alternative B, herbicides would additionally be used to assist in converting fields to native warm-season grasses and grassy woodlands. Imazapic, 2,4-D, glyphosate, and triclopyr would be used to prepare sites for planting by killing fescue, sericea lespedeza, johnsongrass, and other exotic and native plants that might inhibit successful native grass establishment. Mortality of plants within the field unit boundary will be high. Because herbicides will be applied with boom sprayers over large areas, there is moderate potential for herbicide runoff. Because glyphosate, triclopyr, and 2,4-D are pre-emergent herbicides, there would be little potential for runoff to affect off-site vegetation. Neither glyphosate nor triclopyr have been shown to inhibit seed germination of forest grasses, herbs, shrubs or trees (Morash and Freedman 1988). At high application rates, imazapic would have moderate potential to inhibit off-site seed germination of selected species. However, imazapic product label rates for native warm-season grass establishment are low (e.g., Plateau ®; 4-8 oz/ac). Effects would be moderated by chemical dilution that would occur during any substantial rainfall event that moved materials off the original application site. Adjacent forest floor herbicide effects are likely to be short-term and have little potential to cause a catastrophic loss of a population's entire seed bank (Morash and Freedman 1988).

Cumulative Impacts: Alternative A would help counter a trend in increased regional forest fragmentation resulting from development, timber harvesting, and mining operations. This alternative would also decrease regional abundance of exotic plants and seed. Although to a lesser extent, Alternative B would also help counter a trend in regional forest fragmentation. By converting fescue fields to fire-maintained native warm-season grasses and grassy woodlands, Alternative B would also increase the abundance of high-quality early successional plant habitat in the region. The effect of introducing native plant material to the National Area under Alternative B is not expected to result in a decline in regional genetic integrity. Alternative C would contribute to further regional forest fragmentation and increase the regional abundance of exotic plants.

Methods to reduce impacts:

- Restoration is likely to be more successful with seeds that are regionally or even locally adapted. To ensure local adaptation to soil type, topography, microclimate, pathogens, etc., seed should be selected from areas very close to and with strong similarities to the planting site.
- Sufficient quantities of local seed will not be available for all proposed restoration projects in the National Area. In this case, regional seed—from within 125 miles of planting sites—will be planted.
- To avoid off-target herbicide activity, all herbicides will be applied by or under the supervision of the National Area Botanist.
- Only NPS-approved herbicide formulations will be used.
- All herbicides will be applied according to product label specifications.
- All mitigations listed in the aforementioned BA, for applying herbicides near riparian areas, will be followed.

Conclusion:

- Alternative A could exclude the processes that generate and maintain fire-adapted plants and upland communities. Loss of these communities would result in diminished habitat diversity at a landscape level. This would be a major adverse impact, but would likely not constitute an impairment of vegetation resources.
- Alternative B. Vegetative composition and structure would be restored in areas that have been previously converted from natural systems to pastures and fields. Impacts from this alternative would be beneficial and moderate to major. No impairment of vegetation resources is expected.
- Alternative C would reverse several years of natural succession and a trend toward closed canopy conditions and recreate a more fragmented forest landscape. Impacts from this alternative would be adverse and moderate. No impairment of vegetation resources is expected.

4.5 Wildlife: Terrestrial Species

Methodology and Intensity Thresholds

The thresholds of change for the intensity of impacts to wildlife are defined as follows. Impacts can be beneficial or adverse:

Negligible: Impacts occur, but are so minute that they have no observable effect on individuals, populations, or the ecosystems supporting them. Impacts result in parameter measurements that are well within the natural range of variability.

Minor: Impacts are detectable, but parameter measurements are not expected to be outside the natural range of variability and are not expected to have long-term effects on populations or the ecosystems that support them. Long-term effects could occur to individuals. Population numbers for common species may have small, short-term changes. Rare species remain stable even in the short-term.

Moderate: Impacts are detectable and parameter measurements are expected to be outside the natural range of variability for short periods of time. Changes within the natural range of variability may be long-term. Population numbers for common species may experience small to medium, short-term changes. Rare species may experience short-term changes.

Major: Impacts are detectable and parameter measurements are expected to be outside the natural range of variability for short to long periods of time, or even be permanent. Population numbers for common species may experience large, short-term changes with long-term population numbers substantially altered. Rare species may also experience long-term changes. In extreme cases, species may be extirpated from the park and key ecosystem processes may be disrupted.

Short-term Impacts: Short-term impacts of the proposed alternatives could include acute response to herbicide toxicity (all alternatives), direct effects from prescribed fire (Alternative B and C), and direct effects from bush-hogging or other mechanical field treatments (Alternatives B and C).

Herbicide toxicity for terrestrial animals (e.g., birds, mammals) is rated by the LD50 value, which is the dose of herbicide (taken orally or through the skin) that kills half the population of a specific species of study animals in lab trials. LD50 measures acute response to the herbicide's active ingredient, but typically not the other inactive ingredients, such as surfactants (Tu et al. 2001). Oral LD50 values for rats indicate slight or low toxicity for all five herbicides proposed for use (Table 4). LD50 values for either the Northern Bobwhite or Mallard Duck are low for all proposed herbicides except 2,4-D, which has a moderate rating for Northern Bobwhite (Table 4).

Given these LD50 values and the precautions that would be taken during herbicide application and cleanup, acute damage to terrestrial wildlife from herbicide applications is unlikely under any alternative. The cumulative volume of herbicide applied under Alternative A would likely to be the least of any alternative; consequently, the probability of negative impacts to wildlife is likely the lowest. Conversely, high cumulative volumes of herbicides would be used under Alternative C, increasing the risk to terrestrial wildlife. Risk to wildlife would be highest during the initial native warm-season grass establishment efforts of Alternative B, but long-term use and cumulative volume would be low. Adverse herbicide effects of any alternative are anticipated to be minor.

Prescribed fire can have direct effects on amphibians, reptiles, small mammals, and ground-nesting birds that are unable to escape the fire. Mortality of wildlife during prescribed fire may be most affected by rate of fire spread (Fire Effects Information System 2005). Grassland fires, which may burn very quickly, have a greater probability of overtaking or trapping animals. However, research indicates that most small mammals are able to enter burrows or otherwise escape direct injury from fire (Fire Effects Information System 2005). Bird injury or mortality is typically restricted to eggs or young chicks of ground-nesting species such as the American Woodcock or Northern Bobwhite (Fire Effects Information System 2005). Many reptile species also avoid injury by entering burrows, hiding under cover objects, or fleeing (Fire Effects Information System 2005). Mortality from prescribed fire may also be an issue for amphibian populations occurring in fields with ponds or seasonal wet depressions (Nora Murdock, personal communication). Some mortality of terrestrial wildlife is expected from prescribed fire operations under Alternatives B and C; however, a majority of individuals are expected to escape injury. Alternative A does not involve the use of prescribed fire.

Similarly, some injury or mortality to small mammals and bird nests, in particular, is expected to occur from bush-hogging and other mechanical treatments under Alternatives B and C. Alternative A will not have short-term effects on terrestrial wildlife caused by mechanical equipment.

Long-term Impacts: Each of the proposed actions will have long-term effects on wildlife as a result of direct habitat alteration or other long-term change in vegetation structure and composition. Habitat change tends to benefit a particular group or groups of habitat-specialists species, while harming other groups. Certain habitat generalists may remain unaffected.

Alternative A would result in a gradual transition from grassy and low herbaceous vegetation to shrub-scrub habitat to eventual closed-canopy forest. Each stage of this transition would favor different groups of species. For example, shrub-scrub habitat in the National Area is likely to favor birds such as Field Sparrow, White-eyed Vireo, Common Yellowthroat, Eastern Towhee, and Yellow-breasted Chat (Hamel 1992). The final condition of closed-canopy forest would favor forest interior birds, such as many warblers, vireos, and Scarlet Tanagers (Hamel 1992). The transition to forest may have a detrimental effect on shrub-scrub birds as well as some forest-interior birds that prefer shrub-scrub habitat for raising fledglings (Stephan Stedman, personal communication). Shrub-scrub habitat would ultimately be somewhat reduced by Alternative A; however, the regional impact to wildlife may not be significant, as natural disturbance (e.g., southern pine beetle damage) and human disturbance (powerline right-of-ways) perpetuate this type of habitat.

Likewise, certain mammals would be affected by the loss of open field habitat that would occur under Alternative A. The least shrew, prairie vole, deer mouse, eastern harvest mouse, hispid cotton rat, southern bog lemming, eastern cottontail, and groundhog are all known to occur in National Area fields (Britzke 2004). Many other mammal species also use fields for grazing, foraging, hunting, or other essential habits.

Alternative B would maintain a mosaic of habitat types across the National Area, providing habitat for grassland, shrub-scrub, and forest specialists. Conversion of cool-season grass fields to native warm-season grasses would enhance habitat for early successional species. Again, using birds as an example, native warm-season grass pasture in southwest Pennsylvania supported more species and numbers of birds, such as Song Sparrow, Field Sparrow, Chipping Sparrow, and Grasshopper Sparrow, than did comparable cool-season pastures (Giuliano and Daves 2002). Similarly, conversion to grassy woodlands would enhance habitat for species associated with early successional habitat. For example, pine-grasslands restored to enhance Red-cockaded Woodpecker habitat in Arkansas appear to favor species such as Indigo Bunting, Hooded Warbler, Prairie Warbler, Eastern Wood Pewee, Northern Bobwhite, Chipping Sparrow, and Red-headed Woodpecker (Masters et al. 1998). Grassland and grassy woodland restoration would also be consistent with the recommendations of the Northern Bobwhite Conservation Initiative for the Appalachian Mountains Region (Dimmick et al. 2002). Furthermore, tall fescue throughout the Southeast is infected with an endophytic fungus that provides some protection against herbivory by insects and mammals (Schardl and Phillips 1997). Endophyte-infected fescue has been linked to weight loss and/or poor reproductive health of rodents (Fortier et al. 2000) and birds, including Northern Bobwhite (Barnes et al. 1995). Some fields, under Alternative B, would return to forest, thereby favoring shrub-scrub for an intermediate period and ultimately forest-interior species.

Several reptile species would benefit from native warm-season grass and grassy woodland restoration, as proposed under Alternative B. In particular, the pine snake, six-lined racerunner, eastern hognose snake, corn snake, scarlet snake, and slender glass lizard are associated with fire-maintained grassy-pine woodlands (Wilson 1995).

Alternative C would maintain a large area of early successional habitat within the National Area. Although this action would benefit a number of species, it would have a detrimental effect on others, particularly forest-interior specialists. Tall fescue, which otherwise is being gradually shaded out as old fields become more heavily vegetated, would again exhibit dominance in these areas.

Additional resources documenting the effects of grassland and fire management activities on birds and other species can be found at the websites for the USGS, Northern Prairie Wildlife Research Center (http://www.npwrc.usgs.gov) and the USDA Forest Service, Fire Effects Information System (http://www.fs.fed.us/database/feis/index.html).

Cumulative Impacts: The Fields Management Plan will affect less than one percent of the total land area in the National Area. Consequently, the cumulative effects of any alternative are likely to be minor. The actions proposed in Alternative A may help counteract regional forest fragmentation resulting from logging, mining, and development. Alternative A, therefore, may have a positive effect on regional forest-interior wildlife species. Alternative B would reduce fragmentation slightly, but its largest cumulative impact would be on habitat improvement for grassland and open woodland species. Alternative B, in combination with wildlife and habitat management actions on regional state lands and the Daniel Boone National Forest, would have a net positive effect on Northern Bobwhite and other species dependent on early successional natural habitats. Alternative C would perpetuate forest fragmentation, which may benefit early successional wildlife species, while having a negative cumulative effect on forest-interior species.

Methods to Reduce Impacts:

- Use only NPS approved herbicide formulations.
- Follow all herbicide product label specifications for application and cleanup.
- The National Area Botanist will supervise all herbicide applications.
- Confine prescribed fire operations to the period from late fall to early spring, thereby avoiding growing-season and nesting-season burns.
- Confine bush-hogging and mechanical treatments to periods that are outside the projected nesting window for most species of ground-nesting birds.

Conclusion:

- Alternative A would favor forest-interior wildlife species. Impacts would be moderate to major and beneficial or adverse, depending on species. Impairment to National Area terrestrial wildlife would not occur.
- Alternative B would enhance habitat for a wide range of wildlife species by minimizing exotic plant impacts and creating a diverse mix of wildlife habitats. Impacts would be moderate to major and beneficial or adverse, depending on the species. Impairment to National Area terrestrial wildlife would not occur.
- Alternative C would favor early successional wildlife species. Impacts would be moderate to major and beneficial or adverse, depending on species. Impairment to National Area terrestrial wildlife would not occur.

4.6 Wildlife: Aquatic Species

Methodology and Intensity Thresholds

The thresholds of change for the intensity of impacts to wildlife are defined as follows. Impacts can be beneficial or adverse:

Negligible: Impacts occur, but are so minute that they have no observable effect on individuals, populations, or the ecosystems supporting them. Impacts result in parameter measurements that are well within the natural range of variability.

Minor: Impacts are detectable, but parameter measurements are not expected to be outside the natural range of variability and are not expected to have long-term effects on populations or the ecosystems that support them. Long-term effects could occur to individuals. Population numbers for common species may have small, short-term changes. Rare species remain stable even in the short-term.

Moderate: Impacts are detectable and parameter measurements are expected to be outside the natural range of variability for short periods of time. Changes within the natural range of variability may be long-term. Population numbers for common species may experience small to medium, short-term changes. Rare species may experience short-term changes.

Major: Impacts are detectable and parameter measurements are expected to be outside the natural range of variability for short to long periods of time, or even be permanent. Population numbers for common species may experience large, short-term changes with long-term population numbers substantially altered. Rare species may also experience long-term changes. In extreme cases, species may be extirpated from the park and key ecosystem processes may be disrupted.

Short-term Impacts: Short-term impacts of the proposed alternatives to aquatic wildlife would most likely occur from acute response to herbicide toxicity, under all three alternatives.

Herbicide toxicity for aquatic species is rated by the LC50 value, which is the concentration of herbicide required to kill 50% of the population of a specific species of study animals in lab trials. LC50 measures acute response to the herbicide's active ingredient, but typically not the other inactive ingredients, such as surfactants (Tu et al. 2001). Ester herbicide formulations tend to pass easily through skin and gills and do not readily dilute in water. Consequently, ester formulations are more toxic to aquatic species than salt and acid herbicide formulations, which readily dilute in water (Tu et al. 2001). Of the herbicides proposed for use, triclopyr and 2,4-D are available as an ester formulation. The remaining herbicides are all formulated as salts or esters.

In bluegill sunfish, LC50 values indicate moderate toxicity for all five herbicides proposed for use (Table 4). Given these values, extra precautions should be taken during herbicide application and cleanup, in order to avoid acute damage to aquatic wildlife.

Long-term Impacts: There are no anticipated long-term impacts to aquatic wildlife from any of the three alternatives.

Cumulative Impacts: There are no anticipated cumulative impacts to aquatic wildlife from any of the three alternatives.

Methods to Reduce Impacts:

- Follow all herbicide product label specifications for application and cleanup.
- Avoid use of ester herbicide formulations within 100 m of water.
- Follow all mitigations presented in the BA for the use of herbicides near riparian areas at Big South Fork (copy on file at National Area Headquarters).
- Follow all methods to reduce impacts presented in Section 4.6, Water Quality.
- Leave suitable buffer strips around ponds and waterways occurring in all management units.

Conclusion:

- <u>Alternative A</u> would have negligible effects to aquatic wildlife species. No impairment to aquatic wildlife species would occur.
- <u>Alternative B</u> would have negligible effects to aquatic wildlife species. No impairment to aquatic wildlife species would occur.

- Alternative C would have negligible effects to aquatic wildlife species. No impairment to aquatic wildlife species would occur.

4.7 Threatened and Endangered Plants and Animals

Methodology and Intensity Thresholds

The thresholds of change for the intensity of impacts to threatened and endangered species are defined as follows. Impacts can be beneficial or adverse:

Negligible:	An action that could result in a change to a population or individuals of a species or a resource, but the change would be so small that it would not be of any measurable or perceptible consequence.
Minor:	An action that could result in a change to a population or individuals of a species or its habitat. The change would be small and localized and of little consequence.
Moderate:	An action that would result in some change to a population or individuals of a species or its habitat. The change would be measurable and of consequence to the species or its habitat, but more localized.
Major:	An action that would have a noticeable change to a population or individuals of a species or its habitat. The change would be measurable and result in a severely adverse or exceptionally beneficial impact, and possible permanent consequence, upon the species or its habitat.

Short-term Impacts: By adhering to existing NPS policies and following established protocol, very little potential impacts to federally listed species exist under any of the three alternatives. During consultation with U.S. Fish & Wildlife Service (USFWS), they encouraged us to consider impacts to three plants and all aquatic species. None of the referenced plants occur in or near the project areas. Two of those plant species are extirpated from both KY and TN. Copies of all correspondence with USFW are available at National Area Headquarters. Prescribed fire and herbicide use pose, perhaps, the only potential threat of the proposed actions to threatened and endangered species.

The use of prescribed fire as proposed under Alternatives B and C is not expected to affect any of the 17 federally listed species that potentially occur within the National Area. There are no known occurrences of federally listed species in any of the proposed field management units. A Biological Assessment (BA) for the National Area's Fire Management Plan (2004) was submitted to USFWS on July 15, 2004. Concurrence for the BA was issued by USFWS on August 18, 2004; copies are available at National Area Headquarters. By complying with the described mitigation actions and conditions, the proposed fire management actions were determined to have no effect or to not likely adversely affect any of the evaluated species. The FMP and BA detail the mitigation measures that will minimize impacts to aquatic organisms from silt, ash, sediment, and chemical inputs that may result from fire management activities. Mitigation measures are also presented for terrestrial plants and animals. The BA and correspondence from USFWS are on file at National Area Headquarters.

Likewise, the use of herbicides as proposed under all three alternatives, but particularly under Alternatives B and C, is not expected to affect any threatened or endangered species. There are no known occurrences of federally listed plants within the proposed herbicide spray zones. As discussed under section 4.3 Water Quality, herbicide runoff could have a minor impact on water quality and mitigation measures are suggested. A Biological Assessment (BA) for the application of herbicides near riparian areas was submitted to U.S. Fish & Wildlife Service (USFWS) on February 8, 2005. Concurrence for the BA was issued by USFWS on March 15, 2005. The BA and correspondence from USFWS are on file at National Area Headquarters.

Long-term Impacts: The proposed alternatives are not likely to have any long-term impacts on federally listed threatened and endangered species potentially occurring in the National Area.

Cumulative Impacts: The proposed alternatives are not likely to have any cumulative impacts on federally listed threatened and endangered species potentially occurring in the National Area.

Methods to Reduce Impacts: A paramount objective of exotic plant control efforts in the National Area is protection of threatened and endangered species. NPS will continue to collaborate with U.S. Fish and Wildlife Service to ensure the continued protection and recovery of threatened and endangered species and their associated habitats. The actions proposed in this document are not anticipated to adversely affect any such species or habitat. Compliance with proposed mitigation actions and conditions will further ensure the protection of sensitive species.

These mitigations have been proposed to avoid adverse impacts to federally listed and other rare species:

- The National Area Botanist will supervise all herbicide applications.
- Foliar spray applications will not be used within 25 m of state of federal T&E plant populations.
- Foliar spray applications will not be used within 25 m of streams containing state or federal T&E aquatic species or 10 m of all other streams.
- When target plants are being treated within 25 m of state or federal T&E plants or streams containing T&E aquatic species, herbicides will be applied to target plants with cut-stump, hand-bottle spray, sponge, or cambium injection techniques.
- Herbicide surfactants or herbicide formulas that include surfactants will not be used within 100 m of streams.

- Shields will be used to prevent drift or splash when applying herbicides within 10 m of state or federal T&E plant populations.
- All treatment sites with federal T&E or state-listed plant populations will be monitored by the National Area's botanist for non-target effects.
- The use of dozers and other ground disturbing equipment will not be permitted during prescribed fire operations without the approval of the Superintendent, unless life or private property is immediately threatened.
- Natural topographic boundaries (e.g., ridge tops, streams) and existing trails/roads will be used as prescribed fire control lines where feasible. Leaf blowers and burn-out zones will be used to create fuel breaks, thereby reducing the need to dig hand lines.
- NPS will develop annual prescribed fire plans and will complete Section 7, Endangered Species Act consultation with USFWS to evaluate each plan.
- Periodic and post-treatment monitoring of T&E species and habitats will allow for more careful analysis of treatment effects. Future management actions will be adapted to reflect the better understanding of management effects provided through monitoring.
- NPS will regularly provide to USFWS updated monitoring data on T&E species in or near field management areas.

Conclusion:

- Alternative A. There would be no effects or impairment of the National Area's threatened and endangered species resulting from this alternative.
- Alternative B would have negligible effects to threatened and endangered species. No impairment to threatened and endangered species would occur.
- Alternative C would have negligible effects to threatened and endangered species. No impairment to threatened and endangered species would occur.

4.8 Cultural and Archaeological Resources

Methodology and Intensity Thresholds

In order for an archeological resource, an historic structure, or Cultural Landscape to be eligible for the National Register of Historic Places, it must meet one or more of the following criteria of significance: 1) associated with events that have made a significant contribution to the broad patterns of our history; 2) associated with the lives of persons significant in our past; 3) embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction; 4) have yielded, or may be likely to yield, information important in prehistory or history.

An archeological resource, an historic structure, or a cultural landscape must also possess integrity of location, design, setting, materials, workmanship, feeling, association (*National Register Bulletins: Guidelines for Evaluating and Registering Archeological Properties; How to Apply the National Register Criteria for Evaluation*).

For purposes of analyzing potential impacts to archeological resources, historic structures/buildings, and landscapes, the thresholds of change for the intensity of an impact are defined as follows:

Negligible:	Impact is at the lowest levels of detection: barely measurable with no perceptible consequences, either adverse or beneficial, to archeological resources or historic structures or remnant landscape features. For purposes of Section 106, the determination of effect would be *no adverse effect*.
Minor:	Adverse impact: disturbance of a site(s) results in little, if any, loss of significance or integrity and the National Register eligibility of the site(s) is unaffected. For purposes of Section 106, the determination of effect would be *no adverse effect*. Beneficial impact: maintenance and preservation of a site(s). For purposes of Section 106, the determination of effect would be *no adverse effect*.
Moderate:	Adverse impact: disturbance of a site(s) does not diminish the significance or integrity of the site(s) to the extent that its National Register eligibility is jeopardized. For purposes of Section 106, the determination of effect would be *adverse effect*. Beneficial impact: stabilization of a site(s). For purposes of Section 106, the determination of effect would be *no adverse effect*.
Major:	Adverse impact: disturbance of a site(s) diminishes the significance and integrity of the site(s) to the extent that it is no longer eligible to be listed in the National Register. For purposes of Section 106, the determination of effect would be *adverse effect*. Beneficial impact: active intervention to preserve a site(s). For purposes of Section 106, the determination of effect would be *no adverse effect*.

Short-term Impacts: Under all three alternatives there are no known short-term impacts of the proposed actions.

Long-term Impacts: Under Alternative A, cemeteries, houses, outbuildings, fences, historic orchards, and other structures and improvements at cultural sites scattered throughout the National Area would be placed at greater risk from fire as heavy accumulations of fuels continue to increase and encroach on a site or structure. Cultural features associated with historic homesteads and farmsteads (e.g., fences, orchards, pens and pasturelands) could be lost due to the encroachment of woody species.

Through the manipulation of vegetation described in Alternative B, high-priority sites would be safeguarded by removing encroaching vegetation. This alternative would provide a cost-effective means of maintaining the cultural landscape, including old fields, landscape features, and pasturelands so that future generations would be better able to understand the story of subsistence farming in the Cumberland Plateau region. Some sites with less historical significance or of otherwise lower priority would be lost to encroaching vegetation.

Alternative C would remove and control encroaching vegetation from all historic homesteads, farmsteads, and pastures. Once reestablished to their historic boundaries, these sites would be maintained with mechanical means or fire. This alternative would have a net positive benefit to cultural resources and provide additional opportunity to develop related interpretive programs.

Cumulative Impacts: There are no known cumulative impacts of these alternatives.

Methods to Reduce Impacts: Prior to conducting field management operations that involve soil disturbance, archeological surveys would be conducted to determine if significant resources were present. The NPS Cultural Resource Management Guideline, NPS-28, Chapter 5 (1998), requires an archeologist "review and assess all proposed undertakings that could affect archeological resources to ensure that all feasible measures are taken to avoid resources, minimize damage to them, or recover data that otherwise would be lost". Any archeological sites or resources discovered during fire management operations *that retain archeological integrity* (i.e. that have not been completely destroyed by past farming practices) would be avoided or protected. When required, consultation with Native American tribes would be completed to address these resources.

All field management work around National Register eligible structures and Cultural Landscape features would be coordinated with the Cultural Resource Specialist. No actions will be taken that are not consistent with the long term goals identified for each Cultural Landscape or the requirements of National Park Service Management Guideline, NPS-28, Chapter 7 (1994). Consultation with the appropriate State Historic Preservation Officer would be obtained prior to any actions that deviate from this plan.

Conclusion:

- Alternative A: The greatest threat to cultural resources is encroachment of woody vegetation and potential loss of historic structures, fields and other features from fire. Under this alternative, Cultural Landscapes would slowly disappear as fields and pasturelands were taken over by trees and other woody species. This phenomenon has already occurred at cultural sites and landscapes like the No Business Community. Therefore, adverse impacts associated with Alternative A would be major, but would not likely lead to impairment of the National Area's cultural resources.
- Under Alternative B, degradation of high-value cultural sites would be avoided through regular maintenance. Adverse impacts from Alternative B would be minor.

Beneficial impacts would be major. There would be no impairment of the National Area's cultural or archaeological resources.

- Alternative C would not have adverse effects on cultural or archaeological resources. There would be no impairment.

4.9 Visitor Use

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to visitor use were derived from park staff's observations of the effects fire on visitor use. The thresholds of change for the intensity of impacts are defined as follows:

Negligible:	The impact is barely detectable, and/or will affect few visitors.
Minor:	The impact is slight but detectable, and/or will affect some visitors.
Moderate:	The impact is readily apparent and/or will affect many visitors.
Major:	The impact is severely adverse or exceptionally beneficial and/or will affect the majority of visitors.

Short-term Impacts: Under all three alternatives, users may be temporarily excluded from field units while management actions are taken to achieve or maintain a desired condition.

Long-term Impacts: Alternative A would have a long-term impact on visitors who use open fields for hunting game birds and small game that depends on early successional habitat. Loss of this habitat would impact the presence of associated bird species which may affect the recreational experience of bird and wildlife watchers. Backcountry campers or special-user groups that use fields for camping would also be negatively impacted. Aesthetics would be improved for those who appreciate a natural resource setting with few signs of human disturbance.

Under Alternative B, some fields would be eliminated, potentially affecting users of those fields. Conditions of other designated fields would be enhanced for hunting, camping, bird watching and other recreational uses. Native grasslands and grassy woodlands, in particular, would increase hunting opportunities for certain game birds or other game animals. Aesthetics would be improved for those who appreciate a more natural resource setting.

Alternative C would maintain or increase the opportunity for camping in fields and hunting for certain game species. Bird watchers may be impacted as species dependent on shrub-scrub habitat would not benefit from clean or frequently cut fields. Aesthetics would be improved for those who appreciate an anthropocentric and manicured landscape.

Cumulative Impacts: There are no known cumulative impacts to visitor use from the three alternatives.

Methods to Reduce Impacts: When it would be necessary to close an area during field management operations, all affected areas would be signed so that closures would be easily recognized. Success of restoration activities may depend on defining alternative sites for visitor access during closures and adequate pre-project planning to ensure that visitors are aware of upcoming changes (Harrington 1999). Interpretative programs would be presented, when appropriate, to better inform the public of the historical and biological relevance of affected fields

Conclusion:

- Alternative A. Because of the loss of open habitat hunting, impacts to visitors would be moderate.
- Adverse impacts to visitor use resulting from the implementation of Alternative B would be negligible.
- Visitor use impacts associated with Alternative C would also be negligible.

CONSULTATION AND COORDINATION

Under the provisions of the Endangered Species Act of 1973, as amended, the Service must work with other federal and state agencies to protect, conserve and enhance the continued existence of any endangered species or threatened species. Any actions that may impact these species are subject to review by the U.S. Fish and Wildlife Service. A copy of this document will be made available to the U.S. Fish and Wildlife Service for consultation under Section 7 of the Endangered Species Act.

The National Historic Preservation Act, as amended in 1992 (16 USC 470 *et seq.*); the National Environmental Policy Act; the NPS Cultural Resource Management Guideline (1998), and NPS Management Policies (2001) require the consideration of impacts on cultural resources listed, or eligible for listing, on the National Register of Historic Places. The actions described in this document are also subject to Section 106 of the National Historic Preservation Act, under the terms of the 1995 Programmatic Agreement among the NPS, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers. Impacts to cultural resources, therefore, have been analyzed and reviewed in accordance with applicable laws, policies and agreements.

The following individuals were consulted during the development of this plan:

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John Seymour	Roundstone Native Seed, LLC
Richard Conley	Tennessee Wildlife Resources Agency
James Bean	BASF
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APPENDIX A. Federal endangered, threatened, and candidate species known to occur or potentially occurring in or adjacent to Big South Fork NRRA.

Common Name	Scientific Name	Federal Status	Confirmed Present
Cumberland bean	*Villosa trabalis*	Endangered	Yes
Cumberland elktoe	*Alasmidonta atropurpurea*	Endangered	Yes
Cumberlandian combshell	*Epioblasma brevidens*	Endangered	Yes
Little-wing pearlymussel	*Pegias fabula*	Endangered	Yes
Tan riffleshell	*Epioblasma florentina walkeri*	Endangered	Yes
Oyster mussel	*Epioblasma capsaeformis*	Endangered	No
Fluted kidneyshell	*Ptychobranchus subtentum*	Candidate	Yes
Clubshell	*Pleurobema clava*	Endangered	No
Duskytail Darter	*Etheostoma percnurum*	Endangered	Yes
Blackside dace	*Phoxinus cumberlandensis*	Threatened	No
Red-cockaded woodpecker	*Picoides borealis*	Endangered	No
Indiana bat	*Myotis sodalis*	Endangered	Yes[2]
Cumberland sandwort	*Arenaria cumberlandensis*	Endangered	Yes
Cumberland rosemary	*Conradina verticillata*	Threatened	Yes
White fringeless orchid	*Platanthera integrilabia*	Candidate	Yes
American chaffseed[1]	*Schwalbea americana*	Endangered	No
Virginia spiraea	*Spiraea virginiana*	Threatened	Yes

[1]Extirpated from Kentucky and Tennessee.

[2]A single male bat was observed in 1981; none have been observed since.

APPENDIX B-1

Herbicide Profile: 2,4-D

APPENDIX B-2

Herbicide Profile: Glyphosate

APPENDIX B-3

Herbicide Profile: Imazapic

IMAZAPIC

Herbicide Basics

Chemical formula: (±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid

Herbicide Family: Imidazolinone

Target Species: selected annual and perennial broadleaves and grasses

Forms: acid, ammonium salt

Formulations: SL, DG

Mode of Action: Inhibits the enzyme acetohydroxyacid synthase (AHAS), that is involved in the synthesis of aliphatic amino acids

Water Solubility: 2200 mg/L at 25° C

Adsorption potential: low

Primary degradation mech: microbial activity

Average Soil Half-life: 120 days

Mobility Potential: low

Dermal LD50 for rabbits: >5,000 mg/kg

Oral LD50 for rats: >5,000 mg/kg

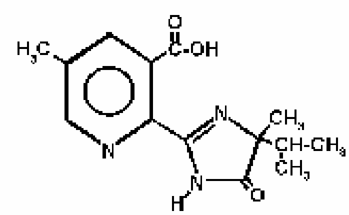
LC50 for bluegill sunfish: >100 mg/L

Trade Names: Plateau®, Cadre®, Plateau Eco-Paks®

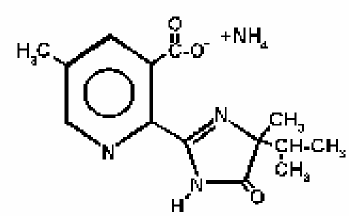
Manufacturer: BASF (previously American Cyanamid Company)

Synopsis

Imazapic is a selective herbicide for both the pre- and post-emergent control of some annual and perennial grasses and some broadleaf weeds. Imazapic kills plants by inhibiting the production of branched chain amino acids, which are necessary for protein synthesis and cell growth. It has been useful for weed control in natural areas, particularly in conjunction with the establishment of native warm-season prairie-grasses and certain legumes. Imazapic is relatively non-toxic to terrestrial and aquatic mammals, birds, and amphibians. Imazapic has an average half-life of 120 days in soil, is rapidly degraded by sunlight in aqueous solution, but is not registered for use in aquatic systems.



Imazapic acid



Imazapic ammonium salt

APPENDIX B-4

Herbicide Profile: Imazapyr

APPENDIX B-5

Herbicide Profile: Triclopyr