Soil and Water Resources Working Paper
Buttermilk Hollow/ Talbott Hollow Blow-down Project Environmental Assessment
Mississippi Bluffs Ranger District
Shawnee National Forest

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Introduction

This assessment analyzes the potential effects of the proposed Buttermilk Hollow-Talbott Hollow Blowdown Project on soil and associated watershed resources. The primary purpose of this assessment is to determine whether the likely effects would result in a degradation of watershed resources in the project area.

Formal objectives of this assessment include:

1. identify watershed resources that would be affected by the proposed project,
2. ensure that Forest Service actions do not result in degradation of the quality of soil, water or air,
3. provide a process and standard that ensures that watershed resources receive full consideration,
4. make certain that best management practices, as per the Shawnee National Forest Land and Resource Management Plan (USDA 2006) and the Region 9 Soil Quality Standards, are followed, and
5. to maintain a case file on actions regulated under environmental policy and procedures.

Current Management Direction

Current policy as stated in the Forest Service, Region 9 Soil Quality Standards includes the following: Temporary roads used for vegetation management are included as areas evaluated for soil quality. System road and trails, on the other hand, and other administrative facilities within or adjacent to the activity area, are dedicated land uses and not considered detrimental soil conditions (USDA Forest Service 2005). However, changes to the existing condition of watershed resources in the project area and the cumulative effects analysis area because of activities associated with the project need to be addressed. Detrimental soil disturbance will be minimized to the extent possible. Adherence to soil quality standards identified in Land and Resource Management Plan (Forest Plan) for the Shawnee National Forest (Forest Service 2006).

The management direction specified by the Forest Plan (USDA 2006) is to conserve soil and water resources and ensure the protection of streams, stream banks, lakes, wetlands, and other bodies of water in accordance with applicable laws and regulations. Activities will be guided by the best management practices defined by the Illinois Department of Natural Resources (IL DNR), Illinois Forest Development Council, Southern Illinois University, & University of Illinois. These practices may include stream bank restoration and/or stabilization and management of large, woody debris (IL DNR et al. 2007).

Existing Environment

The project area occurs within the overall cumulative effects analysis area (CEA). This CEA consists of three watersheds: Kinkaid Lake / Kinkaid Creek, Owl Creek / Mississippi River, and Worthen Bayou.

Kinkaid Lake / Kinkaid Creek is characterized by steep slopes and steep, incised streams among a primarily forested landscape. A large component of cave/ karst topography occurs in the Buttermilk area. Within this watershed is Kinkaid Lake which is recognized as a municipal watershed. Recreation is key in this watershed with 497 acres of recreation areas and trail networks in proximity to the lake. Some agricultural acres occur north of the Lake and other agricultural areas are dotted among the forest land. The southern portion of Ava occurs at the northern end of this watershed. Forest Service has jurisdiction over nearly one-third of this watershed.

Worthen Bayou is a primarily forested area north or Highway 3 and agricultural area south of Highway 3. Most of the wetland acres occur among the agricultural areas. Agricultural acres are the major portion of this

watershed. Some cave / karst topography occurs within the forested portion of the watershed. Some steep topography and high stream gradients also occur in the forested section. Approximately 1,300 acres of Buttermilk area of this project occur in this watershed. Forest Service has jurisdiction over approximately 13 percent of this watershed.

Owl Creek / Mississippi River lies to the west of the Worthen Bayou watershed. This forested acres of this watershed lies north of Highway 3 and the agricultural acres in this watershed occur south of Highway 3. About 640 acres of Buttermilk and all but 28 acres of the Talbot section of this project occur in this watershed. Approximately 1,450 acres of karst / cave topography occur on the project areas within this watershed. There are also steep slopes and incised streams occurring in the primarily forested sections. Like Worthen Bayou, agriculture acres make up the major portion of this watershed and some wetland acres occur among these acres. Forest Service has jurisdiction over approximately 13 % of the watershed.

Overall, in the CEA over all three watersheds, 36,117 acres of agricultural occur mainly within the Owl Creek / Mississippi River and the Worthen Bayou watersheds. 17,958 acres of forested land and 1,655 acres of wetlands occur. 3,534 acres of surface water occur primarily at Kinkaid Lake and associated tributaries although some surface water occurs in the other watersheds also. There are 497 acres of urban land (primarily Ava) and 13 acres of barren exposed land.

Soil

Riparian soils - Wakeland silt loam (0 – 2 percent slope) and Burnside (1 – 4 percent slope) are the two soil mapping units are riparian soils (about two percent of the project area) occurring on the areas of moderate to severe canopy damage and comprise approximately four percent of the project area. Wakeland silt loam is a hydric soil and Burnside silt loam is not.

Soils with erosion potential – The aforementioned riparian soils have a slight erosion potential. 28.23 percent of the project areas on moderate to severe canopy damage occur on areas of slight to moderate erosion potential (slight off roads and trails and moderate on roads and trails). The project area is in the Kinkaid area on the west side of the Forest where the topography is hilly, some slopes are very steep, and erosion rates will be high. Areas of moderate to severe erosion potential (moderate off roads and trails and severe on roads and trails) make up 62.5 percent of the project areas on moderate to severe canopy damage. Soil mapping units with severe erosion potential occur on 2.9 percent of the project areas on moderate to severe canopy damage.

Soils with compaction potential. - Nearly every soil-mapping unit has a severe potential for compaction given the silt loam textures which will compact readily. Compaction will not impact this project except for those places where fire trails required pre-construction.

Soils with low potential for damage to soils from fire - Approximately 95 % of the area occur on soil mapping units with slight limitations affecting prescribed burning and moderate potential of damage to soils from fire due to texture and slope. Approximately 3 percent of the area occurs on soil mapping units having moderate limitations affecting prescribed burning due to slope. Soils information is found in Tables 1, 2, and 13.

Water Quality - Water quality has been evaluated for major streams in or associated with the project and cumulative effects analysis area. The 2006 Illinois Environmental Protection Agency (IEPA 2007) stream assessments were consulted and the results of this consultation are given in Tables 6 & 7 in the Appendix. Some of the streams listed have gone through the TMDL process with the IEPA. Some previously listed impairments to water quality in some streams has been removed due to new data and evidence of full support for beneficial uses.

Floodplains - The Forest Plan defines floodplains as areas subject to a one percent or greater chance of flooding in any given year. Soil mapping units designated as occasionally flooded may be seen as meeting the floodplain designation. These mapping units were mentioned above in the section on riparian soils. Site

productivity and riparian function would be maintained in the project area in all alternatives, therefore, also on the floodplains in the project area.

Wetlands - The National Wetlands Inventory (NWI) was consulted for information on wetland resources. While the NWI is not the most accurate natural resource inventory, it does contain information on wetland resources by NWI type. Along Kincaid Creek, south to Highway 3, freshwater forested/shrub wetlands and freshwater emergent wetlands were noted. Freshwater ponds were dotted throughout the project area.

None of the alternatives will have an adverse effect on the site productivity or function of the sites in the project area or the watersheds in the CEA near the project area identified as having one or more wetland characteristics. Alternatives 2 would result in a slight, temporary, minor increase in sediment in the streams running through the forested floodplains on Kinkaid Creek but this would not affect these wetlands. Adhering closely to the Forestry Best Management Practices will "protect water quality from erosion and minimize changes to the surface and subsurface water movement" (Illinois Best Management Practices, Pages 35 – 40).

Air quality - Air quality has been evaluated for adjacent air sheds in or associated with the project and cumulative effects analysis area. 2005 Illinois Environmental Protection Agency (IEPA) air assessments were consulted and the results of this consultation are given in Tables 8 - 11 in the Appendix. Emissions of pollutants in Union and Jackson counties have been much lower than more urban locations in the state. This project is not expected to either improve or degrade air quality and is not considered an issue to address (Illinois EPA 2006).

Alternatives Considered

Alternative 1: No Action Alternative

Direct Effects

No new management activities would take place, nor any associated activities with the proposed action. Therefore, no management related appreciable changes in productivity of the land would occur. Soils would be impacted by regular maintenance and use of roads as well as planned and ongoing natural resource management activities. In the absence of wildfire, current runoff and erosion pattern would be maintained. An upland erosion rate of less than one ton per acre per year is predicted by Forest Service Water Erosion Prediction Project (FSWEPP) for stands on steep slopes in the absence of fire. Natural processes and functions would continue to occur as dead material decomposes. Actual soil organic matter may increase with an accompanying increase in microorganisms and fungi. Since there is no burning, no carbon would be removed from the forest. Dead and dying trees would decay with carbon released to the atmosphere. Management activities in and adjacent to the project areas already planned would be carried out.

Indirect Effects –

Natural functions would also include pathogens and insects contributing to oak decline leading to dead and down trees. Salvage operations (no salvage planned) would not take place under this alternative. Dead and down trees would increase fuel levels leading to increased wildfire danger. In the absence of wildfire, dead and down trees would decompose over time leading to increased macro and micro-organism populations carrying out the decomposition process. As decomposition proceeds, dead and down material would eventually be incorporated into the organic horizon and surface horizons leading to increased soil nutrient capital.

Cumulative Effects –

No ecological restoration or vegetation management will occur under this Alternative. There would be no direct or indirect effects to soil or water from prescribed burning. Soil quality and productivity would be increased in the long-term as organic matter decomposes and converts to the A horizon leading to increased soil nutrient capital. Water quality would be maintained at current levels considering anticipated future actions and assuming the inputs from private land remain stable. Some geologic erosion could be expected to continue in the project

area and in the cumulative effects analysis area and some of this sediment could be expected to enter the streams. This alternative would likely result in less soil erosion, compaction, sediment load, and percentage of bare ground than the action alternative. There would be no sedimentation resulting from the no action alternative and there would be no cumulative effect. Implementation of this alternative is not anticipated to result in any changes to water quality.

Under this alternative, fuels will not be reduced nor will biomass be removed through prescribed burning. Wildfires that could occur under conditions of increased fuel loading can be expected to burn at a higher intensity and over a larger area than would have occurred if fires had burned at historical fire frequencies. The probability of stand replacement wildfires could be expected to increase in the absence of fuel reduction through silvicultural treatments in this proposal. The stands in other alternatives where wildfire does not occur would maintain current runoff and erosion pattern. An upland erosion rate of less than one T/A/Y is expected for stands on steeper slopes and near water if fire is excluded. Fire exclusion would result in accumulation of hazardous amounts of fuels.

Lack of fuel reduction could result in stand replacement wildfires and increase the probability and levels of erosion and sedimentation from lands where these fires occur. FSWEPP modeling indicates that a high severity fire for conditions similar to those described above would produce a ten to fifteen fold increase in erosion (depending on slope) and a like increase in sedimentation. Predicted erosion and sediment quantities are listed in the Appendix (Table 2b). According to the model, wildfire produces many times more erosion than do prescribed burns (Table 2b). The model runs tend to indicate a wildfire could be expected to have detrimental effects on water quality and the maintenance of a municipal water supply due to erosion and sedimentation. The application of prescribed fire in Alternative 2 could be expected to have erosion and sedimentation levels far less than far lower than those levels resulting from a high severity wildfire. Hence, from a watershed standpoint, Alternative 2 would appear to qualify as an “authorized” and “covered” project under HFRA.

Alternative 2: Proposed Action –

Description of the Proposed Project

The Mississippi Bluffs Ranger District of the Shawnee National Forest proposes to burn approximately 5,631 acres of Forest land and private land in T8S, R3W, Sections 19 and 28-33, T8S, R4W, Sections 20-29, 33-36, T9S, R3W, Sections 5-6, and T9S, R4W, Section 1 (see attached map). The project area will be subdivided to make burns more manageable, yet keeping unit size large enough to mimic pre-settlement fire regimes and keep per acre costs down. Burns will be lit by hand or with the aid of a helicopter.

Use of pre-existing features (e.g. roads, streams) that will be used for the 11 miles of fire-lines, reducing fuels on adjacent private land, allowing for fewer fire-lines to be constructed, and making those fire-lines easier and safer to hold. This in turn would reduce preparation and implementation costs and risks.

Prior to burning, several precautions would be taken, including but not necessarily limited to:

- Mowing, chipping, or cutting fuels around selected structures (~25 acres) to provide defensible space and reduce intensity during prescribed burning
- Improving preexisting control features or building up to 11 miles of firelines where necessary
- Writing a prescribed burn plan to describe in detail the actions and mitigations needed, contingency planning, and the specific conditions required for conducting the burn
- Notifying the public
- Coordinating the timing and/or placement of burns with specialists to minimize negative impacts on wildlife, recreation opportunities, or public safety
- Protecting recreational infrastructure and cultural resource sites where needed

- The burns would be closely monitored to prevent escapes. After the burn, more precautions would be taken to avoid negative impacts on the land.

- Shawnee National Forest personnel would remain on scene until the burn is deemed safe to leave
- Fire-lines would be rehabilitated where necessary to avoid erosion and establishment of non-native invasive species
- Post-burn monitoring would be conducted to measure the effectiveness of any treatments and mitigation measures

Burns would be conducted between October 1 and April 15. First entry on all units would be made within two years. Subsequent burns would be made after 2 – 5 years. Burn frequency would be adjusted if monitoring shows desired future condition is already reached or will not be reached in 10 – 15 years.

Table 3. Design Criteria for Buttermilk Hill – Talbott Hollow Blowdown Project.

Resource Area	Design Criteria	Rationale / Effectiveness
Soil and Water Resources	Use erosion control measures for fire lines that could erode soil into lakes, streams and wetlands.	Illinois Forestry Best Management Practices are designed to ensure that prescribed fire operations do not degrade the forested site and that waters associated with these forests are of the highest quality (IDNR *et al.* 2007 (revised)). We have monitored the effectiveness of mitigation measures on several past prescribed fire projects and found. that the measures were effective in minimizing soil erosion and subsequent sedimentation in streams. Specific guidelines can be found in the Illinois Forestry Best Management Practices, Chapter 7, Prescribed Burning.
	Avoid intense burns that remove forest floor litter which may expose soil that may erode into surface water.	
	Where possible, locate bladed fire lines on the contour. Construct water bars as needed to direct surface water off fire-lines and into undisturbed forest cover.	
	Maintain soil stabilization practices until the site is fully re-vegetated and stabilized.	
	Avoid operating heavy equipment in a manner that causes excessive soil displacement, rutting, or compaction.	
	Guidelines for protection of water quality; Standards for protection of soil and water in riparian corridors and riparian areas; Guidelines for the reduction of bare soil disturbance and exposure in riparian corridors; Standards for restoration of disturbed soil areas; Standards for the limitation and use of heavy equipment, and Standards for soil disturbance limitations.	Implementation of the protection measures and management recommendations presented in the FW25 Water, Soil, and Air Management of the Forest Plan (Forest Plan 2006, pp. 40-41, R9 Soil Quality Standards, and IL Best Management Practices) will prevent excessive sedimentation.

Table 4. Design Criteria – Purpose, Effectiveness, Monitoring and Responsibility.

Design Criteria: Use erosion control measures for fire lines that could erode soil into lakes, streams and wetlands.
Purpose: To reduce accelerated erosion from the fire-lines and associated trails and roads employed as fire-lines.
Effectiveness: Installing drainage structures will shorten the slope length of the trails. The lesser and shorter the slope, the less erosion is expected during an event that produces runoff and sedimentation into streams. (Dissmeyer 1984).
Mitigation Monitoring: Spot checks will be done periodically following initial maintenance activities to check spacing and construction of drainage structures. These structures will be further checked for need for maintenance.
Responsible Person: Soil Scientist or Civil Engineering Technician

Design Criteria: Avoid intense burns that remove forest floor litter, which may expose soil that may erode into surface water.
Purpose: Increase surface cover that will increase and infiltration in the soil. The greater the soil cover, the less erosion is expected during an event that could produce runoff and sedimentation.
Effectiveness: The greater the soil cover, the less erosion is expected during an event that could produce runoff and sedimentation

Table 4. Design Criteria – Purpose, Effectiveness, Monitoring and Responsibility.
Mitigation Monitoring: Spot checks will be done periodically following initial project activities to check bare ground and rill erosion and checked for compliance with R9 Soil Quality Standards. **Responsible Person:** Soil Scientist or Fuels
Design Criteria: Where possible, locate bladed fire lines on the contour. Construct water bars as needed to direct surface water off fire-lines and into undisturbed forest cover. **Purpose:** To reduce accelerated erosion from the fire-lines and associated trails and roads employed as fire-lines. **Effectiveness:** Diversion of surface water off fire-lines reduces runoff and prevents the fire-line from being a conduit for sediment into streams. As runoff water moves through plants and organic matter, runoff slows and drops the sediment that has been carried along. This settling keeps sediment and nutrients from flowing into streams. (IDNR et al. 2007) **Mitigation Monitoring:** Ocular monitoring after completion of project activities also checking on need for additional maintenance needs of water diversion structures. **Responsible Person:** Soil Scientist or Fuels
Design Criteria: Maintain soil stabilization practices until the site is fully re-vegetated and stabilized. **Purpose:** Maintain soil cover and root systems thereby reducing runoff and sedimentation. **Effectiveness:** Trees, plants, leaves and twigs slow surface runoff, allowing water to soak into the soil. As runoff water moves through plants and organic matter, runoff slows and drops the sediment that has been carried along. This settling keeps sediment and nutrients from flowing into streams. It also allows plant roots to take up the nutrients that were previously dissolved in the runoff and soaked in the soil further reducing the amount of pollution flowing into streams. (IDNR et al. 2007) **Mitigation Monitoring:** Ocular check after completion of project activities. **Responsible Person:** Soil Scientist or Civil Engineering Technician
Design Criteria: Avoid operating heavy equipment in a manner that causes excessive soil displacement, rutting, or compaction. **Purpose:** Maintain the infiltration capacity of the soil and reduce sources for additional sedimentation. **Effectiveness:** Rutting and compaction would reduce infiltration into the soil and displacement would provide additional sources for sediment into streams. Avoidance of heavy equipment would keep runoff and sedimentation to minimal levels. **Mitigation Monitoring:** Rutting will be monitored according to depth and length of ruts to check compliance with the Regional Soil Quality Standards. Compaction would simultaneously using a penetrometer. Excessive soil displacement, if present, would simultaneously be monitored with spot checks. **Responsible Person:** Soil Scientist or other person designated by him.
Design Criteria: Adhere to guidelines for protection of water quality; standards for protection of soil and water in riparian corridors and riparian areas; guidelines for the reduction of bare soil disturbance and exposure in riparian corridors; standards for restoration of disturbed soil areas; standards for the limitation and use of heavy equipment, and standards for soil disturbance limitations. **Purpose:** Carry out the project in an environmentally responsible way with respect to watershed resources and in accordance with existing direction. **Effectiveness:** The guidelines and standards are designed to ensure that prescribed fire operations do not degrade the forested site and that waters associated with these forests are of the highest quality (IDNR *et al.* 2007 (revised)). The guidelines and standards are from the 2006 Revised Shawnee Forest Plan, The IDNR et al. Best Management Practices guidelines, and the Region 9 Soil Quality Standards. **Mitigation Monitoring:** We have monitored the effectiveness of mitigation measures on several past prescribed fire projects and found. that the measures were effective in minimizing soil erosion and subsequent sedimentation in streams. **Responsible Person:** Soil Scientist or person designated by them.

Direct Effects –

Prescribed fire – Prescribed burning will occur on approximately 5,631 acres. The effects of prescribed burning on soil erosion and nutrient loss are related to the severity of the burn. These effects are complex and depend on a host of factors. Erosion can increase as a result of prescribed fire, but WEPP model runs indicate that the erosion levels are much lower than erosion and sedimentation levels after a high severity stand replacement fire. The soil erosion potential is given in Table 2a in the Appendix Soil erosion modeling for this activity for all the soil mapping units are given in Table 2b the appendix. The potential of damage to soil from fire is moderate to high for every soil mapping unit except for Wellston and Belknap silt loams. Surface erosion occurring could result in sedimentation in adjacent streams especially in the steeper areas of the project area and those areas within 300 feet from stream areas.

Fire trails – 11 miles of fireline construction are a part of this alternative. Erosion levels have been modeled by WEPP for each soil-mapping unit and the model results are given in Table 2b in the Appendix. Erosion control measures such as water bars would reduce these to minimal levels.

Many of fire-lines are not expected to occur on areas with fragipans in the soil profile. Fireline location employing roads as firebreaks and hand fireline construction in sensitive areas would reduce soil disturbance to these soils to minimal levels. However, roads and streams will also be employed as fire-lines and will not require pre-construction.

Fire-lines can also become additions to the stream system during areas of heavy precipitation. In order to minimize erosion and subsequent sedimentation to streams, drainage structures should be installed where there is potential for soil loss. Road drainage structures (e.g., culverts, broad-based dips, and water bars) should be spaced at intervals close enough to minimize water flow volume and speed. Table 1 below shows the recommended distance between drainage structures at varying road grades. In addition, to drainage structures erosion protections riprap, mulch, and/or seeding may be necessary to control erosion (Forestry Best Management Practices for Illinois, 2007). Continued maintenance of these drainage structures would help to minimize erosion and sedimentation long after project activities have been completed.

Table 1. Recommended distances between drainage structures on Forest roads and skid trails (from Forestry Best Management Practices for Illinois, 2000).

Road Grade %	Distance Between Waterbars (ft)	Distance Between Broad-Based Dips and Cross-Drain Culverts (ft)
1	400	500
2	250	300
5	130	180
10	80	150
15	50	130
20	45	120
25	40	110

This is covered in the Illinois BMP's.

Indirect Effects –

Prescribed fire - Burning has its most pronounced effect on the forest floor where carbon (C), nitrogen (N), and sulfur (S) are volatilized and calcium (Ca), magnesium (Mg), potassium (K), and phosphorus (P), and other elements are left as ash. The ash is leached by rains into the mineral soil which increases its base

saturation and pH. (Alban 1977) Increased nutrient availability at higher pH may result in positive plant responses following fire (Van Lear and Kapeluck (1989) These coincide with results from a variety of other reviews and studies. (DeBano 1998, Liechty, Luckow, & Guldin 2004, Neary, Ryan, & DeBano 2005).

High intensity fire can also affect soil physical properties and result in hydrophobicity and increased soil erosion and runoff. Prescribed fire generally results in lower intensity burns and hydrophobicity has not been observed in prescribed fire at the Mississippi Bluffs area. Burning can also have an effect on the macro and microbiological communities both inside and outside the soil profile. The possible effects on biota are covered in greater detail in the appendix.

Fire Trails – Pre-constructed fire-lines can become ATV trails and result in an increase in soil disturbance. Spreading trees and branches over the fire trails at the end of project activities would decrease the probability of an increase in ATV trails as well as a decrease in erosion and sedimentation. Other post-fire maintenance activities from Forestry Best Management Practices for Illinois (2007) are listed below.

• Use erosion control measures for fire lines that could erode soil into lakes, streams and wetlands. Erosion control measures include re-vegetation and installing water bars. Placing sod back into plowed furrows at appropriate intervals can act as water bars.
• Maintain soil stabilization practices until the site is fully re-vegetated and stabilized.
• Use mowing or other practices that do not expose soil as alternatives to blading or disking for maintaining firebreaks where erosion may degrade water quality.

Cumulative Effects - Boundary of the Analysis
Spatial Boundary:
The area considered for cumulative effects is three sixth field hydrologic units (HUC's) in the location of the Buttermilk Hill / Talbott Hollow Blowdown project area. The total acreage for the analysis area is 60,628 acres, including about 12,993 acres of federal land (about 21.43% of the cumulative effects analysis (CEA) area). The remainder of the analysis area is private land under different land uses and ownerships. The total project area is about 6,500 acres of National Forest and private land or approximately 10.7 percent of the cumulative effects analysis area. Watershed based cumulative effects (water quality, soils, etc.) are best addressed from analyses based on a watershed or sub-watershed areas. No other watersheds were included as erosion and sedimentation would not be supplied across watershed boundaries.

Temporal Boundary:
The time frame considered is fifteen years for the following reasons:

1. Fifteen-year time frames provide a significant basis for measuring change in soil disturbance due to soil erosion and soil compaction.
2. Increases in soil erosion from project and associated activities usually return to pre-project levels within three to five years.

Soil compaction effects are variable and there is no information as to the time length for compacted soil to return to pre-project conditions in Illinois or in the Shawnee Hills. Some information from the southeast U.S. indicates 10 - 15 years is the average time for restoration of compacted areas through natural processes. The source of this information is from a technical bulletin on the effect of heavy equipment on the physical properties of soils and long-term productivity done under the auspices of the National Council for Air and Stream Improvement (NCASI, Miller, Colbert, & Morris 2004).

Soil erosion is generally low to medium throughout the analysis area although soil erosion is rated high in certain areas of the 12-digit HUC making up the analysis area. Soil compaction is generally high throughout the analysis area. Soil productivity is generally low. The hazard of damage to soil from fire is generally medium to high. Riparian soils occur adjacent to streams throughout the analysis areas and can be subject to occasional to frequent flooding for brief periods. (See table in Appendix)

Past, present, and reasonably foreseeable actions.
Past, present and future actions for the project area are listed in the EA. The effects of these projects are bounded in time and analyzed cumulatively with the anticipated effects of the proposed action for each resource. The baseline for the cumulative effects analysis is the current soil conditions of the project area and the existing water quality in adjacent streams.

Forest Service Actions
Road maintenance and use – County roads and highways, as well as gravel roads, are maintained within the watershed.

Past and Present Action: Issuance of Special Use Permits
The effects of the past and present Special Use Permits (SUPs) are distributed in time and space. Existing permits for roads are counted in the existing road miles. The majority of the permits are for communication or utility line maintenance, recreation facility operation, or recreation special events. The issuance of these types of permits typically results in some minor ground disturbance over a localized area. Mitigation measures are included in the permit to reduce the time of exposure of bare soil, which reduces the potential for erosion and sedimentation. The majority of these permits will result in a short-term increase in soil erosion over a small, localized area with the permitted activities distributed in time and space within the project area.

Future Action: Issuance of Special Use Permits
The proposed Special Use Permits are very similar to the past and current Special Use Permits. Although it is difficult to predict, these reasonably foreseeable permitted actions are not likely to alter patterns of use enough to substantially increase soil erosion and sedimentation effects.

Past Action: Wild land Fires
The effects of the prescribed, wild land fires that have occurred in 2006 and 2007 are short-term and separated by time and space. There were about 99 acres of prescribed fire (not wildfires) within the CEA during those years. Wildfires typically occur during dry periods and can be more intense and consume more of the leaf litter/organic matter in comparison to prescribed fires, which are typically implemented during periods of high soil moisture. If more bare soil is exposed, the potential for erosion and sedimentation is increased in the short-term (the site, including emergency fire-lines, is typically stabilized within 1-2 years. Some soil displacement and/or rutting have occurred because of emergency suppression activities, but this has been minor in extent, and has not adversely affected site productivity. Although it is likely that short-term increases in erosion and sedimentation occurred because of the past wildfires, only the wildfires that occurred in the past year or so are potentially still eroding at a slightly accelerated rate due to decreased soil cover. Leaf fall can reduce erosion and sedimentation from these events.

Future Action: Wild land Fires
Future wild land fires may occur in similar frequency and size to historic wild land fires in the Shawnee National Forest. Further information on frequency and size of historic wild land fires is covered in the Fire and Fuels working paper. Each occurrence will increase the short-term (3-5 years) erosion from the area affected by the wildfire; however, these fires will likely be separated by space and time.

Past, Present and Future Action: Recreation, Including Unauthorized Recreation
Past recreation activities include hiking, horseback riding, rock climbing, hunting and authorized/unauthorized ATV use. These activities are all currently happening on public and private land, are expected to occur in the future, and contribute to the existing conditions in the watersheds. These activities can all expose bare soil, which is evident at several of the small concentrated use areas scattered throughout the project area.

Horseback riding, hiking, and the use of wheeled recreational vehicles can cause varying degrees of rutting, compaction and soil erosion (Weaver and Dale, 1978). Use of stock may have contributed minor amounts of

nutrients to the streams through manure runoff. This is likely to continue in the future, and it is expected to have a negligible to minor long-term negative effect on water quality.

These direct effects are mainly concentrated in localized areas; climbing areas, concentrated use recreation areas, and trails. These recreational activities, both authorized and unauthorized, have caused accelerated erosion and sedimentation to adjacent streams.

The direct and indirect effects of the project when added to the sediment loading from past, present, and/or reasonably foreseeable would result in a short-term cumulative increase (2-10 years) in sediment loading. In the long-term (10-15 years) the effects of the project should diminish back to baseline levels.

Private Land –
Farming - In the ten year period between 1997 and 2006, corn, hay, sorghum, and wheat are crops which have been grown and used in Jackson County. Cattle and swine are primarily the livestock grown in Jackson County. This information is in the Appendix for the aforementioned ten year period. The past ten years have shown variable production of crops and livestock in Jackson County. Trends are not apparent and future production is likely based on economic and market forces impossible to determine at this time. The amount of sediment to the project area streams from agricultural use greatly exceeds any sediment increase anticipated from the proposed action. Our input will be negligible and there would be no detectable increase in sediment related to the proposed action.

Surface mining - Surface mining has been identified as a source of some water quality impairments in certain stretches of the Big Muddy River. This would be expected to continue in the future. The project will also result in some minor sedimentation within the Cumulative Effects Area, which will have an effect on water quality. However, the increase in sediment will be minor; therefore, any cumulative effects to water quality will be negligible.

Municipal Water Supply Watersheds. Kinkaid Lake is identified as municipal public water supply watersheds. The Total Maximum Daily Load (TMDL) process has either been started or is ongoing for this lake. The Illinois Environmental Protection Agency (IEPA) 2006 Water Quality Report was consulted to assess the water quality of these lakes, support for beneficial uses, causes for less than full support, and sources of the cause. The primary source for less than full support was identified as toxics from atmospheric deposition. Runoff from forests / grasslands / or parks was not identified as a water quality degradation source. Although the project has potential to contribute minor amounts of sediment to Kinkaid Lake, adherence to Best Management Practices will result in little or no sediment entering the Municipal Water Supply. Thus, there will be no cumulative effect on water quality in Kinkaid Lake.

Cumulative Effects Checklist Table for the proposed Project

Cumulative Effects Checklist
Resource Area
Date

The beginning of Chapter 3 of the Environmental Assessment for the Buttermilk Hill – Talbott Hollow Blowdown Project presents a list (Tables 6 and 7) of the past, present and future actions with the potential to produce cumulative effects. This comprehensive list provides the basis for the cumulative effects analysis for each resource.

One or more of the following reasons should explain why the identified past, present or foreseeable future actions would not have cumulative effects:

1. The proposed action has no direct or indirect effects relative to the action.
2. The identified action has no direct/indirect effect relative to the proposed action.

3. The identified action is not geographically or temporally relevant to the proposed action.
4. There is no difference in effects between the action alternative and the no action alternative.

Temporal Boundary

The time frame considered is fifteen years for the following reasons:

3. Fifteen-year time frames provide a significant basis for measuring change in soil disturbance due to soil erosion and soil compaction.
4. Increases in soil erosion from project and associated activities usually return to pre-project levels within three to five years.

Soil compaction effects are variable and there is no information as to the time length for compacted soil to return to pre-project conditions in Illinois or in the Shawnee Hills. Some information from the southeast U.S. indicates 10 - 15 years is the average time for restoration of compacted areas through natural processes. The source of this information is from a technical bulletin on the effect of heavy equipment on the physical properties of soils and long-term productivity done under the auspices of the National Council for Air and Stream Improvement (NCASI, Miller, Colbert, & Morris 2004).

Soil erosion is generally low to medium throughout the analysis area although soil erosion is rated high in certain areas of the 12-digit HUC making up the analysis area. Soil compaction is generally high throughout the analysis area. Soil productivity is generally low. The hazard of damage to soil from fire is generally medium to high. Riparian soils occur adjacent to streams throughout the analysis areas and can be subject to occasional to frequent flooding for brief periods

Spatial Boundary

The area considered for cumulative effects is three sixth field hydrologic units (HUC's) in the location of the Buttermilk Hill / Talbott Hollow Blowdown project area. The total acreage for the analysis area is 60,628 acres, including about 12,993 acres of federal land (about 21.43% of the cumulative effects analysis (CEA) area). The remainder of the analysis area is private land under different land uses and ownerships. The total project area is about 6,500 acres of National Forest and private land or approximately 10.7 percent of the cumulative effects analysis area. Watershed based cumulative effects (water quality, soils, etc.) are best addressed from analyses based on a watershed or sub-watershed areas. No other watersheds were included as erosion and sedimentation would not be supplied across watershed boundaries.

Past, Present or Reasonably Foreseeable Future Actions

Cumulative Effects Checklist

Resource Area

Date

The beginning of Chapter 3 of the Environmental Assessment for the Buttermilk Hill – Talbott Hollow Blowdown Project presents a list (Tables 6 and 7) of the past, present and future actions with the potential to produce cumulative effects. This comprehensive list provides the basis for the cumulative effects analysis for each resource.

One or more of the following reasons should explain why the identified past, present or foreseeable future actions would not have cumulative effects:

5. The proposed action has no direct or indirect effects relative to the action.
6. The identified action has no direct/indirect effect relative to the proposed action.
7. The identified action is not geographically or temporally relevant to the proposed action.

8. There is no difference in effects between the action alternative and the no action alternative.

Temporal Boundary

The time frame considered is fifteen years for the following reasons:

5. Fifteen-year time frames provide a significant basis for measuring change in soil disturbance due to soil erosion and soil compaction.
6. Increases in soil erosion from project and associated activities usually return to pre-project levels within three to five years.

Soil compaction effects are variable and there is no information as to the time length for compacted soil to return to pre-project conditions in Illinois or in the Shawnee Hills. Some information from the southeast U.S. indicates 10 - 15 years is the average time for restoration of compacted areas through natural processes. The source of this information is from a technical bulletin on the effect of heavy equipment on the physical properties of soils and long-term productivity done under the auspices of the National Council for Air and Stream Improvement (NCASI, Miller, Colbert, & Morris 2004).

Soil erosion is generally low to medium throughout the analysis area although soil erosion is rated high in certain areas of the 12-digit HUC making up the analysis area. Soil compaction is generally high throughout the analysis area. Soil productivity is generally low. The hazard of damage to soil from fire is generally medium to high. Riparian soils occur adjacent to streams throughout the analysis areas and can be subject to occasional to frequent flooding for brief periods

Spatial Boundary

The area considered for cumulative effects is three sixth field hydrologic units (HUC's) in the location of the Buttermilk Hill / Talbott Hollow Blow-down project area. The total acreage for the analysis area is 60,628 acres, including about 12,993 acres of federal land (about 21.43% of the cumulative effects analysis (CEA) area). The remainder of the analysis area is private land under different land uses and ownerships. The total project area is about 6,500 acres of National Forest and private land or approximately 10.7 percent of the cumulative effects analysis area. Watershed based cumulative effects (water quality, soils, etc.) are best addressed from analyses based on a watershed or sub-watershed areas. No other watersheds were included as erosion and sedimentation would not be supplied across watershed boundaries.

Past, Present or Reasonably Foreseeable Future Actions

Agriculture (row-cropping)	About 1250 acres (past, present and future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
Explain: Agricultural row cropping has been done, is being done, and will be done in the future on private land in the CEA. Herbicides, pesticides, fertilizer, and other chemicals are part of that program. Depending on slope, some erosion and sedimentation will occur on an annual basis. The project proposal will initially add to this erosion and sediment load in the CEA, will decrease over two to three years to pre-project levels, and will result in a minimal effect on watershed resources.	

Agriculture (pastureland)	About 500 acres (past, present and future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal

This is similar to row cropping above depending on the management practices which may be different with different landowners. Effects may be less than those associated with row cropping but will have a greater impact on the watershed resources than the project proposals. The project proposal will initially add to the erosion and sediment load in the CEA, will decrease over two to three years to pre-project levels, and will result in a minimal effect on watershed resources.

Wildfires	About 10 acres per year (past, present and future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
Explain: Erosion and sedimentation levels after a wildfire is varied and the influenced by the details of each individual event. A wildfire usually results in ten to twenty times more erosion as prescribed fires over the same area. The project proposal would have a cumulative effect of adding to the erosion and sedimentation load and revert to pre-project levels in two to three years after implementation resulting in a minimal effect on watershed resources.	

Prescribed fire	About 65 acres per year (past). About 130 acres per year (future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
Explain: Other actions on private and public land will involve prescribed burning also and there will be short term increases in erosion, pH, and base saturation. These increases will revert to pre-burn levels within a few years. The project proposal adds more prescribed burning which will result in increases in erosion, sedimentation, pH, and base saturation revert to pre-project levels in two to three years after implementation resulting in a minimal effect on watershed resources.	

Timber harvest	About 100 acres per year (past, present and future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
This timber harvest will likely occur on private land. Some erosion, sedimentation, and runoff can be expected from this activity. The project proposal will have a cumulative addition to this erosion and sediment load during implementation and revert to pre-project levels two to three years after completion of the project and associated activities. There would be no to minimal effect on the CEA.	

Timber Stand Improvement	About 80 acres per year (future).
X	May have cumulative effects with the proposal

	Will not have cumulative effects with the proposal

It can be expected this activity would result in higher initial ground cover on the scattered areas thereby reducing erosion. Over a period of years, this biomass would break down and be converted into organic matter and incorporated into the soil. The project would add additional erosion and runoff into the CEA which would revert to pre-project levels after completion of project activities as well as add additional nutrients into the soil via ash which would be incorporated into the soil.

ATV use	Variable use in the watershed (past, present and future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal

Explain: Unless the fire trails are "put to bed", covered with slash, or made unusable after project activities have been completed, fire trails may be seen as new ATV trails. Additional erosion, sedimentation, and runoff into the streams via stream crossings can be expected. The project proposal would result in a cumulative addition of sediment, erosion, and runoff in the short term and a long term cumulative negligible effect.

Road Maintenance	About 20 miles maintained per year (past, present and future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal

Road maintenance will result in a short-term increase in erosion and a longer term reduction in erosion, sedimentation, and runoff. The project proposal would result in a cumulative short-term increase in erosion, sedimentation, and runoff and longer term cumulative negligible effect.

Road right of way maintenance	About 10 acres maintained per year (past, present and future).
	May have cumulative effects with the proposal
X	Will not have cumulative effects with the proposal

This will occur whether the project happens or not. Thus there would be no difference in the effects between the proposed action and the no action alternative.

Tree planting	About 10 acres per year (past, present and future).
	May have cumulative effects with the proposal
X	Will not have cumulative effects with the proposal

There would be no cumulative effect with the proposal..

Invasive species control	About 10 acres manual treatments per year (past and present).
	May have cumulative effects with the proposal
X	Will not have cumulative effects with the proposal

Invasive species control	About 100 acres of invasive species of herbicide treatment (future).
	May have cumulative effects with the proposal
X	Will not have cumulative effects with the proposal
Three brands of herbicides may be used to control/eradicate garlic mustard in the CEA as part of the NNIS project. Degradation for all three herbicides occurs primarily through microbial degradation in the soil though degradation can also occur by light and hydrolysis for triclopyr and imazapic in water. When herbicides are used as directed by label specifications, no long term impacts to soil or hydrologic resources are expected. Herbicides are used on some of the private lands in the CEA. These activities are ongoing today and will continue in the future on non-Forest Service lands at the same rates and the same acreages as they are today. Herbicides used for row cropping and pastureland could reach over 1,750 acres in the CEA which would be a greater impact than the 100 acres in the project area.	

Brush pile creation for wildlife	About 120 acres (past).
	May have cumulative effects with the proposal
X	Will not have cumulative effects with the proposal
The brush piles would eventually break down. When this happens, this activity would result in higher initial ground cover on the scattered areas thereby reducing erosion. Over a period of years, this biomass would break down and be converted into organic matter and be incorporated into the soil. Neither project	

Utility right of way maintenance	About 25 miles maintained (past, present and future).
	May have cumulative effects with the proposal
X	Will not have cumulative effects with the proposal
The slash and brush severed through this activity would result in higher initial ground cover on the scattered areas thereby reducing erosion. Over a period of years, this biomass would break down and be converted into organic matter and be incorporated into the soil. The project proposal adds additional prescribed burning which will add additional increases in erosion, sedimentation, pH, and base saturation These effects are relatively short term and minimal effect on watershed resources in the CEA.	

Trail maintenance	About 10 miles maintained per year (past, present and future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
Trail maintenance results in a short-term increase in erosion and a longer term reduction in erosion, sedimentation, and runoff. The project proposal would result in a cumulative short-term increase in erosion, sedimentation, and runoff and longer term cumulative negligible effect.	

Horseback riding	Variable use in the watershed (past, present and future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
Horseback riding is a popular activity in the CEA and can result in erosion and runoff although trail maintenance has reduced these levels. The project proposal will result in some in some cumulative increases in erosion and runoff in the CEA which will revert to pre-project levels and minimal effect on watershed resources.	

Non-system trails	Estimate less than 25 miles of trail (past, present and future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
Non-system trails, especially those which become ATV trails, result in key increases in erosion, sedimentation, and runoff. The project will cumulatively add to those levels in the CEA. These levels would decrease in the next few years following project activities and the levels associated with non-system trails may likely continue.	

Special-Use Permits (telephone lines, electric lines, water lines, and driveways	Estimate less than 2 acres per year (past, present and future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
Some of the special use permits appear have effects which would be the same for the proposed action as for the no action alternative, however some ground disturbance does result. Additional ground disturbance would result during implementation of the project proposal. The effects of the cumulative ground disturbance could remain for about one year and revert to pre-project levels.	

Open-lands management	Disking and planting of food plots on about 230 acres (future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal

Disking 230 acres may result in some increase in soil compaction. The disking will increase in soil infiltration capacity and planting will increase cover and reduce erosion and runoff. The project would cumulatively increase erosion and sedimentation so the erosion and sedimentation reductions with open-land management would be cancelled out by the project . Two to three years after the project completion, pre-project levels for erosion and sedimentation would return with no or minimal effect to watershed resources.

Trail construction	About 0.5 miles of trail construction to reroute an existing trail (future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
Trail construction results in a short-term increase in erosion and a longer term reduction in erosion, sedimentation, and runoff. The project proposal would result in a cumulative short-term increase in erosion, sedimentation, and runoff and longer term cumulative negligible effect.	

Shoreline stabilization - Kinkaid Lake	About 6 miles of shoreline (future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
The activities associated with the shoreline stabilization project are not expected to add to erosion and sediment levels in the CEA. Thus, there will be little or no effect on watershed resources in the short term and the accompanying shoreline protection and other Possum Road activities will provide a long term benefit to watershed resources. The project would add a cumulative increase in erosion and sedimentation in the CEA which would revert to pre-project levels in two to three years, resulting in a minimal effect on watershed resources.	

Gully stabilization - Kinkaid Lake	About 900 feet (future).
X	May have cumulative effects with the proposal
	Will not have cumulative effects with the proposal
There will be little or no effect on watershed resources in the short term and the accompanying gully stablization will provide a long term benefit to watershed resources. The project would add a cumulative increase in erosion and sedimentation in the CEA which would revert to pre-project levels in two to three years, resulting in a minimal effect on watershed resources.	

Adverse Consequences Which Cannot be Avoided

- Slight, temporary accelerated rates of soil erosion would occur in Alternatives 2 even though Illinois forestry BMPs guidelines, Forest Plan Standards and Guidelines, and soil suitability and limitation interpretation identified by the NRCS would be used to guide activities.

- Temporary, minor increases in turbidity in adjacent streams after storm events resulting in runoff.

- Temporary, minor soil compaction would occur as result of mechanized fire line construction equipment**.**

Irreversible or Irretrievable Commitment on Resources

The proposed action alternative would not have an irreversible commitment and one irretrievable commitment on this resource in the proposed project area or adjacent analysis area if mitigation measures are strictly adhered to.

Irreversible Effects

There are no known irreversible effects on soil and water resources from any alternative.

Irretrievable Effects

Soil erosion above natural rates is an irretrievable effect. The proposed action would result in a temporary (3-5 year), slight increase in erosion rates above natural geologic rates.

Monitoring

Monitoring would demonstrate whether or not the management has been implemented as specified and if the design criteria were effective (Table 4). If monitoring exposes unacceptable resource damage, appropriate measures would be implemented to correct problems.

Table 4. Monitoring for the Proposed Action Alternative.

Monitoring Activity	Description	Location and Timing
Soil Erosion	BMP compliance checks (Dissemeyer, 1994).	During and after harvest and burning activities are completed in project area.
	Penetrometer compaction comparison (Amacher and O'Neil, 2004).	Before and after harvest and burning activities are completed in project area.
	Visual inspection for sheet, rill and gully erosion.	Before, during and after and burning activities are completed in project area.
	Inspection of soil disturbance.	Before, during and after and burning activities are completed in project area.
	Visual inspection of log landings, skid trails and other disturbed areas slow re-vegetation.	After harvest and burning activities are completed in project area.
Aquatic Habitat	Wolman pebble count method for assessing changes in the aquatic habitat.	Before and after burning activities are completed in project area.
Non-native Invasive Species (NNIS)	Samples of project area would be surveyed to determine an assessment of NNIS presence and increase/decrease.	Selected locations within the Project Area. Prior to project implementation and up to ten years.
	Ensure that mitigation measures to control the spread of NNIS are part of project implementation.	Several times during project implementation. Throughout the Project Area.
	Review project location prior to implementation and evaluate NNIS survey results over the 1 to 10-year period.	Every one to ten years. Throughout the Project Area

	Develop and propose for implementation measures to control NNIS that spread or are a result of project implementation.	Periodically for the first ten years after decision. Throughout the Project Area
Vegetation	Monitoring plots have been established to determine vegetative changes.	Post-project monitoring will determine effectiveness in meeting the purpose and need.
Heritage Resources	Ensure that heritage resources are protected and preserved during and after implementation of this project.	This project will be included in the Forest Monitoring Plan, which checks annually to assess the nature and degree of damage to historic properties.
Wildlife Resources	Snags will be monitored to determine if snag retention standards and guidelines are effective.	Operations will be monitored during and after the project. A report will be prepared documenting the success in protecting snag habitat within the project area.
	Number of cavity trees retained post-treatment will be monitored to determine if standards and guidelines are effective.	Cavity trees will be monitored during and after project implementation.
	To determine the balance between early, mid- and late-successional habitat conditions is appropriate-tiers to Forest-level monitoring objectives.	Post-treatment, and then every five years within the project area.
	Permanent monitoring points would be surveyed annually to determine changes in avian management indicator species populations.	Monitor annually an established network of permanent bird monitoring points in treated stands and untreated pine stands.

Soils and Watershed –

Objective: Ensure that soils and watershed resources are maintained during and after implementation of this project.

Desired Result: Minimal degradation to soil quality as a result of project implementation.

Methods: BMP compliance checks (implementation monitoring) during and after project begins. (Dissemeyer, 1994).

Responsibility: Soil scientist or personnel designated by same.

Objective: Ensure that soils and watershed resources are maintained during and after implementation of this project.

Desired Result: Minimal degradation to soil quality as a result of project implementation.

Methods: Penetrometer compaction comparison during pre and post project compaction on skid trails, fire trails and other selected areas in the project areas.(Amacher and O'Neil, 2004). The comparison would be performed via random areas of point sample readings.

Responsibility: Soil scientist or personnel designated by same.

Objective: Ensure that soils and watershed resources are maintained during and after implementation of this project.

Desired Result: Minimal degradation to soil quality as a result of project implementation.

Methods: Visual inspection for sheet, rill and gully erosion before, during and after and burning activities are completed in project area. This inspection would take place on fire trails, riparian areas, and other selected areas.

Responsibility: Soil scientist or personnel designated by same.

Objective: Ensure that soils and watershed resources are maintained during and after implementation of this project.

Desired Result: Minimal degradation to soil quality as a result of project implementation.

Methods: Inspection of soil disturbance during and after and burning activities are completed in project area. The inspection would be done on randomly selected areas with a series of point samples taken. R 9 Soil Quality Standards use 15%, or more, of a land unit scale area in detrimental soil condition as a standard for potentially detrimental soil disturbance.

Responsibility: Soil scientist or personnel designated by same.

Objective: Ensure that soils and watershed resources are maintained during and after implementation of this project.

Desired Result: Minimal degradation to soil quality as a result of project implementation.

Methods: Visual inspection of log landings, skid trails and other disturbed areas slow re-vegetation. Inspection would include presence of water diversion structures, compaction (via penetrometer), rutting and displacement (ocular estimate), and erosion.

Responsibility: Soil scientist or personnel designated by same.

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Appendix A – Soils information

Table 1 – Soil mapping units in the moderate / severe damage areas.

Soil mapping units	Acres	% of project area	% of CEA
Menfro silt loam (2 – 5 %), eroded	6.0	0.62	0.01
Menfro silt loam (5- 10%), eroded	203.8	21.11	0.34
Menfro silt loam (5- 10%), severely eroded	7.0	0.72	0.01
Menfro silt loam (10 – 18 %), eroded	44.5	4.61	0.07
Menfro silt loam (10 – 18 %), severely eroded	11.3	1.17	0.02
Menfro silt loam (18 – 25%)	363.0	37.59	0.6
Menfro silt loam (18 – 25%), severely eroded	18.1	1.87	0.03
Alford silt loam (35 - 70%),	5.4	0.56	0.01
Wakeland silt loam (0–2%), frequently flooded, long duration	20.9	2.16	0.03
Burnside silt loam (1–4%) occasionally flooded	18.6	1.93	0.03
Menfro – Wellston silt loams (18 – 35 %)	217.4	22.51	0.04
Menfro – Wellston silt loams (35 – 70%)	3.5	0.36	< 0.01
Neotoma channery silt loam – Rock outcrop complex (35–70%)	8.3	0.86	0.01
Neotoma channery silt loam – Wellston silt loam (18–25 %)	5.1	0.53	0.01
Neotoma channery silt loam – Wellston silt loam (35–70%)	11.0	1.14	0.02
Water	21.8	2.26	0.04
Total	965.6	100.00	0.74

Table 2a – Soil interpretations for mapping units in the moderate / severe damage areas.

Soil mapping units	Riparian soils	Erosion potential	Compaction potential	Potential soils damage	Limitations affecting prescribed

				from fire	burning
Menfro silt loam (2–5%), eroded	No	Slight off roads & trails; moderate on roads & trails	Severe	Moderate	Slight
Menfro silt loam (5-10%), eroded	No	Slight off roads & trails; moderate on roads & trails	Severe	Moderate	Slight
Menfro silt loam (5-10%), severely eroded	No	Slight off roads & trails; moderate on roads & trails	Severe	Moderate	Slight
Menfro silt loam (10–18%), eroded	No	Slight off roads & trails; moderate on roads & trails	Severe	Moderate	Slight
Menfro silt loam (10–18%), severely eroded	No	Slight off roads & trails; moderate on roads & trails	Severe	Moderate	Moderate
Menfro silt loam (18–25%),	No	Moderate off roads & trails; severe on roads & trails	Severe	Moderate	Moderate
Menfro silt loam (18–25%), severely eroded	No	Moderate off roads & trails; severe on roads & trails	Severe	Moderate	Moderate
Alford silt loam (35-70%)	No	Severe	Severe	Moderate due to slope	Moderate due to slope
Wakeland silt loam (0–2%), frequently flooded, long duration	Yes	Slight	Severe	Slight	Slight
Burnside silt loam (1–4%) occasionally flooded	Yes	Slight	Severe	Slight	Slight
Menfro – Wellston silt loams (18–25 %)	No	Moderate off roads & trails; severe on roads & trails	Severe	Moderate	Slight
Menfro – Wellston silt loams (35–70%)	No	Severe	Severe	Moderate	Moderate due to slope
Neotoma channery silt loam – Rock outcrop complex (35–70%)	No	Severe	Severe	Moderate	Moderate due to slope
Neotoma channery silt loam – Wellston silt loam (18–35 %)	No	Moderate off roads & trails; severe on roads & trails	Severe	Moderate	Slight
Neotoma channery silt loam – Wellston silt loam (35–70%)	No	Severe	Severe	Moderate	Moderate due to slope
Water	N.A.	N.A.	N.A.		N.A.

Table 2b – WEPP model runs for prescribed fire and fire trail construction.

Soil mapping units	**Erosion (t/a/yr) prescribed fire**	**Erosion (t/a/yr) wildfire**	**Erosion (t/a/yr) constructed fire trail**

Menfro silt loam (2–5%), eroded	0 – ½	*4 - 15*	0 – ½
Menfro silt loam (5-10%), eroded	½ - 1	*12 - 34*	1
Menfro silt loam (5-10%), severely eroded	½ - 1	*12 - 34*	1
Menfro silt loam (10–18%), eroded	1 – 1 ½	*19 - 52*	2 – 2 ½
Menfro silt loam (10–18%), severely eroded	1 – 1 ½	*19 - 52*	2 – 2 ½
Menfro silt loam (18–25%),	2	*27 - 71*	5
Menfro silt loam (18–25%), severely eroded	2	*27 - 71*	5
Alford silt loam (35-70%),	4 - 4 ½	*48 - 124*	42
Wakeland silt loam (0–2%), frequently flooded, long duration	< ½	*2 ½ - 11*	0 – ½
Burnside silt loam (1–4%) occasionally flooded	< ½	*4 - 14*	0 – ½
Menfro – Wellston silt loams (18–35%)	2 ½	*31 - 82*	7 ½
Menfro – Wellston silt loams (35–70%)	4 - 4 ½	*48 - 124*	42
Neotoma channery silt loam – Rock outcrop complex (35–70%)	4 - 4 ½	*60 - 145*	47
Neotoma channery silt loam – Wellston silt loam (18–25%)	2 – 2 ½	*34 - 83*	5 – 5 ½
Neotoma channery silt loam – Wellston silt loam (35–70%)	4 - 4 ½	*60 - 145*	47
Water	N.A.		N.A.

FSWEPP provides relative versus absolute results to estimate and compare the magnitude of effects of alternatives. The analysis allows a comparison of alternatives but does not predict the effects for a specific stand. The outputs are given in tons per acre. One ton of soil loss is approximately equal in weight to a uniform depth of 0.007 inches of soil over one acre. (Troeh et al.1991) Models were run for prescribed fire, wildfire, and fire trail l treatments with the following assumptions: 30 year climate events (climate station: Carbondale, IL), silt loam soils, mainly non-skeletal conditions (< 35 percent rock by volume except for Neotoma channery), 200 foot slope length.

Appendix B – Cumulative Effects Analysis Area information

Table 3. Ownership of the CEA (Cumulative Effects Analysis Area)				
Watershed	Acres (total)	Acres (Forest Service)	Acres (other ownership)	% acreage in Forest Service jurisdiction
Kincaid Lake - Kincaid Creek	25,708	8,448	17,260	32.86
Owl Creek – Mississippi River	24,595	3,188	21,407	12.96
Worthen Bayou	10,325	1,357	8,968	13.14
Total	60,628	12,993	47,635	21.43

Table 4: Special areas in the CEA.		
Watershed	Developed Recreation Areas (Acres)	Natural Areas (Acres)
Kincaid Lake - Kincaid Creek	497	
Owl Creek – Mississippi River		1
Worthen Bayou		

Table 5: Prescribed fire activity in the CEA							
	2003	2004	2005	2006	2007	2008	Total
Kincaid Lake - Kincaid Creek				30.5	33.5		64
Owl Creek – Mississippi River				22.2	13		35.2
Worthen Bayou				0	0		0
Total				52.7	46.5		99.2

Appendix C – Water information

Table 6 -2006 303d list for impaired waters in the IEPA 5th field watershed.				
IEPA 5th field watershed	Segment Name and ID	Priority	Cause	TMDL Schedule
Kinkaid Creek	IL-RNC		Phosphorus	Approved September, 2004
Kincaid Creek	IL-RNC		pH	Approved September, 2004; Aquatic Life use full support; no longer an impairment for aesthetic quality
Big Muddy River	IL-N12		pH	Approved September, 2004
Big Muddy River	IL-N12		Manganese	De-listed; new data; no longer an impairment
Big Muddy River	IL-N12		Sulfates	Approved September, 2004
Big Muddy River	IL-N12		Total suspended solids	Approved September, 2004
Big Muddy River	IL-N12		Dissolved oxygen	Approved September, 2004
Kincaid Lake				

Table 7 Major water bodies in or adjacent to the project area – from IEPA 2006 Stream Assessments.			
Stream Name	Beneficial Uses	Cause	Source
Kinkaid Creek	Not assessed	N.A.	Not applicable
Kincaid Creek	Fully supporting for aquatic life, primary contact, and secondary contact	N.A.	Not applicable
Big Muddy River	Not supporting for aquatic life, primary contact; fully supporting fish consumption	Atrazine, cadmium, dissolved oxygen, sedimentation / siltation, sulfates, total suspended solids, pH, fecal coliform	Non-irrigated crop production, source unknown, municipal point discharges, crop production, natural sources, surface mining
Big Muddy River	Not supporting aquatic life, fully supporting fish consumption	Dissolved oxygen, sedimentation / siltation,	Non – irrigated crop production, natural sources
Big Muddy River	Not supporting aquatic life, fully supporting fish consumption	Dissolved oxygen, sedimentation / siltation, sulfates, total suspended solids	Sources unknown, crop production, surface mining
Worthen Bayou	Not assessed	N.A.	N.A.
Owl Creek	Not assessed	N.A.	N.A.
Kincaid Lake	Fully supporting aquatic life; non supporting fish consumption, public and food processing water supplies, aesthetic	Manganese, mercury, and total phosphorus	Atmospheric deposition (toxics), source unknown

	quality		

Appendix D – Air Quality

Table. 8. Estimated County Stationary Point Sources Emissions (Tons per Year) (IEPA 2005) (Air)					
County	**Carbon monoxide**	**Nitrogen oxides**	**Particulate matter (PM)**	**Sulfur dioxide**	**Volatile organic matter**
Jackson	164.6	183.9	170.5	778	64.8
Statewide High (County)	18,165.3 (Madison)	27,531.1 (Tazewell)	9,836.4 (Cook)	80,861.9 (Will)	15,329.0 (Macon)
Statewide low	0.0	0.0	0.0	0.0	0.0

Table 9 - 2005 Air Quality Monitoring for Air Region 74 (Southern Illinois Intrastate).							
Pollutant	Sample type	Sample Location	IEPA Standard	Readings			
Ozone	1 hour	Effingham	0.12 ppm	0.086	0.083	0.078	0.077
Ozone	1 hour	Knights Praire	0.12 ppm	0.087	0.086	0.086	0.085
Ozone	8 hour	Effingham	0.08 ppm	0.076	0.075	0.073	0.073
Ozone	8 hour	Knights Praire	0.08 ppm	0.081	0.081	0.080	0.077

Table 10 - More 2005 Air Quality Monitoring for Air Region 74 (Southern Illinois Intrastate).						
Pollutant	Sample type	Sample location	IEPA Standard	Readings		
PM (2.5 microns)	24 hour	Knights Prairie	65 ug/m3	39.1	29.3	28.0
PM 10 microns	24 hour	Carbondale	150 ug/m3	56	42	42
Sulfur dioxide	3 hour	Mt.Carmel	0.5ppm	0.187	0.160	
Sulfur dioxide	3 hour	Rural Wabash	0.5ppm	0.165	0.112	
Sulfur dioxide	24 hour	Mt.Carmel	0.14 ppm	0.039	0.038	
Sulfur dioxide	24 hour	Rural Wabash	0.14 ppm	0.038	0.024	
Sulfur dioxide	Annual Mean	Mt.Carmel	0.03 ppm	0.006		
Sulfur dioxide	Annual Mean	Rural Wabash	0.03 ppm	0.004		

Table 11- Air Quality Trends (for particulate matter (10 microns) and sulfur dioxide in Region 74.									
Pollutant	Sample type	sample Location	IEPA Standard	2000	2001	2002	2003	2004	2005
PM (10)	Annual Mean	Carbondale,	50 ug/m3	23	19	19	19	20	
Sulfur dioxide	Annual Mean	Mt. Carmel	0.03 ppm	0.005	0.005	0.004	0.004	0.004	0.006

Sulfur dioxide	Annual Mean	Rural Wabash	0.03ppm	0.006	0.005	0.003	0.003	0.003	0.004

Appendix E

Table 12 a - NASS (Agricultural Statistics)						
County	Crop	Year	Planted (acres)	Harvested (acres)	Yield per acre (bushel)	Production (bushel)
Jackson	Corn for grain	1997	34,000	32,900	89	2,928,100
Jackson	Corn for grain	1998	30,000	29,000	96	2,784,000
Jackson	Corn for grain	1999	28,000	27,000	83	2,241,000
Jackson	Corn for grain	2000	31,00	29,300	141	4,131,300
Jackson	Corn for grain	2001	35,000	34,200	145	4,959,000
Jackson	Corn for grain	2002	27,000	26,200	70	1,834,000
Jackson	Corn for grain	2003	32,000	31,100	126	3,918,600
Jackson	Corn for grain	2004	33,000	32,000	143	4,576,000
Jackson	Corn for grain	2005	32,000	31,300	141	4,413,300
Jackson	Corn for grain	2006	27,000	26,800	142	3,805,600

Table 12b - NASS					
County	Crop	Year	Harvested (acres)	Yield per acre (tons)	Production (tons)
Jackson	Hay (All Dry)	1997	15,200	2.58	39,290
Jackson	Hay (All Dry)	1998	14,700	2.51	36,870
Jackson	Hay (All Dry)	1999	13,100	2.05	26,810
Jackson	Hay (All Dry)	2000	12,800	2.67	34,160
Jackson	Hay (All Dry)	2001	11,300	2.51	28,320
Jackson	Hay (All Dry)	2002	10,800	1.84	19,920
Jackson	Hay (All Dry)	2003	12,900	2.8	36,080
Jackson	Hay (All Dry)	2004	12,500	2.32	28,960
Jackson	Hay (All Dry)	2005	10,100	1.96	19,780
Jackson	Hay (All Dry)	2006	9,100	2.43	22,100

Table 12C - NASS						
County	Crop	Year	Planted (acres)	Harvested (acres)	Yield per acre (bushel)	Production (bushel)
Jackson	Sorghum for grain	1997	3,600	3,500	98	343,000
Jackson	Sorghum for grain	1998	2,300	2,200	77	169,400
Jackson	Sorghum for grain	1999	3,300	3,200	95	304,000
Jackson	Sorghum for grain	2000	4,700	4,500	103	463,500
Jackson	Sorghum for grain	2001	2,800	2,700	110	297,000
Jackson	Sorghum for grain	2002	3,000	2,900	96	278,400
Jackson	Sorghum for grain	2003	4,000	3,900	106	413,400
Jackson	Sorghum for grain	2004	3,300	3,200	144	460,800
Jackson	Sorghum for grain	2005	3,500	3,400	92	312,800
Jackson	Sorghum for grain	2006	2,300	2,200	114	250,800

Table 12d – NASS						
County	Crop	Year	Planted (acres)	Harvested (acres)	Yield per acre (bushel)	Production (bushel)
Jackson	Soybeans	1997	73,000	72,500	32	2,320,000
Jackson	Soybeans	1998	73,000	71,600	32	2,291,200
Jackson	Soybeans	1999	81,000	80,700	30	2,421,000
Jackson	Soybeans	2000	76,000	75,900	39	2,960,100
Jackson	Soybeans	2001	74,000	73,000	42	3,066,000
Jackson	Soybeans	2002	86,000	85,500	28	2,394,000
Jackson	Soybeans	2003	79,000	78,700	35	2,754,500
Jackson	Soybeans	2004	78,000	77,800	42	3,267,600
Jackson	Soybeans	2005	78,000	77,600	42	3,259,200
Jackson	Soybeans	2006	81,000	80,300	41	3,292,300

Table 12 e - NASS						
County	Crop	Year	Planted (acres)	Harvested (acres)	Yield per acre (bushel)	Production (bushel)
Jackson	Wheat	1997	23,600	22,300	61	1,360,300
Jackson	Wheat	1998	26,000	25,200	42	1,058,400
Jackson	Wheat	1999	26,600	25,800	52	1,341,600
Jackson	Wheat	2000	18,800	18,100	49	886,900
Jackson	Wheat	2001	15,500	15,200	61	927,200
Jackson	Wheat	2002	10,000	9,100	39	354,900
Jackson	Wheat	2003	17,000	16,200	64	1,036,800
Jackson	Wheat	2004	16,600	16,200	50	810,000
Jackson	Wheat	2005	10,200	9,800	60	588,000
Jackson	Wheat	2006	15,200	15,000	58	870,000

Table 12f - NASS					
County	Livestock	Year	Cattle all (head)	Beef Cows (head)	Cattle and Calve Marketing's (head)
Jackson	Cattle and Calves	1997	15,500	7,400	5,700
Jackson	Cattle and Calves	1998	15,000	7,200	5,800
Jackson	Cattle and Calves	1999	15,700	7,300	5,700
Jackson	Cattle and Calves	2000	15,500	8,400	5,300
Jackson	Cattle and Calves	2001	14,800	7,600	5,300
Jackson	Cattle and Calves	2002	14,400	8,000	5,000
Jackson	Cattle and Calves	2003	13,100	7,100	4,200
Jackson	Cattle and Calves	2004	12,300	8,000	3,000
Jackson	Cattle and Calves	2005	12,100	6,600	4,000
Jackson	Cattle and Calves	2006	12,100	6,600	3,700
Jackson	Cattle and Calves	2007	12,800	7,300	

Table 12 g - NASS

County	Livestock	Year	Hogs All (head)	Hogs Marketed (head)
Jackson	Hogs and Pigs	1997	10,200	31,000
Jackson	Hogs and Pigs	1998	10,500	34,000
Jackson	Hogs and Pigs	1999	8,000	33,000
Jackson	Hogs and Pigs	2000	8,600	31,000
Jackson	Hogs and Pigs	2001	6,600	23,000
Jackson	Hogs and Pigs	2002	6,100	14,000
Jackson	Hogs and Pigs	2003	5,500	14,000
Jackson	Hogs and Pigs	2004	5,700	14,000
Jackson	Hogs and Pigs	2005	4,600	11,000
Jackson	Hogs and Pigs	2006	5,000	11,000

Table 12h - NASS					
County	Livestock	Year	Annual Pig Crop (head)	Annual Sows farrowed (head)	Annual Pigs per litter (head)
Jackson	Hogs - farrowings	1997	19,920	2,400	8.3
Jackson	Hogs – farrowings	1998	17,600	2,200	8
Jackson	Hogs – farrowings	1999	24,900	3,000	8.3
Jackson	Hogs – farrowings	2000	10,350	1,500	6.9
Jackson	Hogs - farrowings	2001	16,640	2,600	6.4
Jackson	Hogs – farrowings	2002	14,200	2,000	7.1
Jackson	Hogs – farrowings	2003	15,130	1,700	8.9
Jackson	Hogs – farrowings	2004	10,660	1,300	8.2
Jackson	Hogs – farrowings	2005	7,920	1,100	7.2
Jackson	Hogs - farrowings	2006	8,690	1,100	7.9

Appendix F – Soil Ratings – Descriptions and Considerations
From National Forestry Manual – Natural Resources Conservation Service

Soil rating criteria found on Exhibit 537-2 in the National Forestry Manual – NRCS. - Found on-line at: ftp://ftp-fc.sc.egov.usda.gov/NSSC/National_Forestry_Manual/2002_nfm_complete.pdf

Potential Erosion Hazard (Road/Trail)
Description: The hazard or risk of soil loss from un-surfaced roads.

Ratings assess:

- The force that precipitation events have to dislodge and move soil materials on roads, trails, and fire breaks.
- Activities on roads and trails that result in bare ground, compaction, and reshaping of the soil surface.
- Use by trucks, skidders, off-road vehicles, and other similar equipment.
- The impact on compacted, bare ground, trail surface using the representative value for slope gradient of the soil component.

Ratings assume:

- Roads and trails are generally linear, continuous, and narrow ranging up to 7.5 meters in width.

Ratings do not assess:

- Frozen or snow covered soil.

Ratings:

- **Slight** – Little or no erosion is likely.
- **Moderate**- Some erosion is likely; maintenance needed; simple erosion control measures needed.
- **Severe** – Significant erosion expected; roads require maintenance; costly erosion control measures needed.

Potential Erosion Hazard (Off-road/Off-Trail)
Description: Ratings indicate the hazard or risk of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface.
Ratings assess:

- Sheet or rill erosion from exposed soil caused by silvicultural practices, grazing, mining, fire, firebreaks, etc.
- Activities that disturb the site resulting in 50–75 percent bare ground in the affected area.
- The use of any equipment type or size and uncontrolled grazing by livestock.

Ratings assume:

- 50 – 75% roughened mineral surface layer.

Ratings do not assess:

- Clean tillage or similar activity that disturb up to 100 percent of area and change the character of the soil.
- Histosols
- Individual precipitation or storm events.
- The impact of gully erosion.
- Sediment production/delivery ratio or stream bank or stream bed erosion for water courses on the site.
- Ground disturbing activities on the amount of surface or subsurface water runoff.

Ratings:

- **Slight** – Erosion is unlikely under normal climatic conditions.
- **Moderate** – Some erosion is likely; control measures may be needed.
- **Severe** – Erosion is very likely; control measures for vegetation re-establishment on bare areas and structural measures are advised.
- **Very Severe** – significant erosion is expected; loss of soil productivity and off-site damages is likely; control measures are costly and generally impractical.

Soil Rutting Hazard (Compaction)

Description: Ratings indicate the hazard or risk of ruts in the uppermost soil surface layers by operation of forest equipment. Soil displacement or puddling (soil deformation and compaction) may simultaneously with rutting.

Ratings assess:

- The operation of equipment on forest sites (3–10 passes) when the soil is near field capacity.
- The use of standard rubber-tired vehicles (non-flotation tires).
- Year long water tables (<30 cm)
- Soil displacement and puddling that may affect aesthetics, groundwater hydrology, and site productivity.

Ratings assume:

- Rutting depths usually range from 5–60 cm and depends, in part, on weight of the equipment (including carried and pulled loads) and shape and size of the wheels.
- Lack of organic/vegetation surface cover.
- Condition occurs on soil with slopes and other characteristics that allow use of ground-based equipment.

Ratings do not assess:

- Impacts of rutting on sloping sites that might channel surface water and effect hydrology.
- Frozen soil within 60 cm of the surface.

Ratings:

- **Slight -** Little or no rutting
- **Moderate –** Ruts are likely
- **Severe –** Ruts readily

Potential damage to soil from fire

Description: The potential hazard of damage to soil nutrient, physical, and biotic characteristics from fire.

Ratings assess:

- The impact fires (prescribed or wildfire) of moderate fireline intensity (116–520 btu's/sec/ft) that provide the necessary heat to remove the duff layer and consume soil organic matter in the surface layer.
- *Ratings assume:*
- Soils with shallow surface layer lack the capacity to safely absorb the effects of fire.
- Steep slopes are more likely to erode if the protective duff layer is removed.
- Soil texture and rock fragment content relate to soil erodability, vegetative recovery rate, and vegetative productivity.
- Medium textured soils, with their greater inherent water holding capacity, are more likely to be cooler and provide higher productivity potential.
- Soils with large volumes of rock fragments transmit heat to a greater depth in a shorter period of time.
- Soils with less than two percent organic matter are more resistant to sheet or rill erosion and have a greater water holding capacity.

Ratings do not assess:

- The time of year in which the fire occur (winter versus summer)
- Fuel moisture content or volume
- Weather conditions

Ratings:

- **Low –** Little or not negative impacts to the soils characteristics are expected.
- **Moderate –** Negative impacts to the soil characteristics may occur.
- **High -** Negative impacts to the soil characteristics are expected.

Appendix G - Water Erosion Prediction Model

The Forest Service Internet-based interface to the Water Erosion Prediction Model (FSWEPP; Elloit et al 2000) was used as part of this analysis. Climate was simulated for ten years at the Harrisburg, IL to obtain a range of wet and dry conditions. Erosion and sedimentation predictions must be evaluated with a full understanding of the uncertainties.

"At best, any predicted runoff or erosion value, by any model, will be within only plus or minus 50 percent of the true value. Erosion rates are highly variable, and most models can only predict a single value. Replicated research has shown that observed values vary widely for identical plots, or the same plot from year to year (Elliot et al 1994; Elliot et al 1995) Also, spatial variability and variability of soil properties add to the complexity of erosion prediction. " (Elliot et al 2000) (excerpted from Disturbed WEPP(Draft02/2000)WEPP Interface for Disturbed Forest and Range Runoff, Erosion and Sediment Delivery (William J. Elliot, David E. Hall, Dayna L. Scheele. U.S.D.A. Forest Service Rocky Mountain Research Station and San Dimas Technology and Development Center, February 2002) online from http://forest.moscowfsl.wsu.edu/fswepp/docs/distweppdoc.html.

FSWEPP provides relative versus absolute results to estimate and compare the magnitude of effects of alternatives. The analysis allows a comparison of alternatives but does not predict the effects for a specific stand. The outputs are given in tons per acre. One ton of soil loss is approximately equal in weight to a uniform depth of 0.007 inches of soil over one acre. (Troeh et al. 1991) Models were run for silvicultural treatments with the following assumptions: 30 year climate events (climate station: Salem), silt loam soils, skeletal conditions (> 35 percent rock by volume), 200 foot slope length.

Appendix H – Soil Organisms

Soil biological properties involve a wide range of organisms which the soil as well as the properties they regulate**.** These components are made up of both living and dead biomass and both can be affected by the project activities including harvest and prescribed fire. Living organisms are classified in several ways. Soil flora includes algae, some bacteria, mycorrhizae and plant roots. Soil fauna includes protozoa, earthworms, and insects. This is further divided into micro, meso, and macro fauna. These participate in processes such as nitrogen cycling processes (nitrogen fixation and denitrification), decomposition, and mineralization. Management activities, including prescribed burning, will influence these processes. (Neary et al. 2005) (De Bano et al. 1998)

Fire affects living organisms in direct and indirect ways. Because organic matter and organisms are located at or near the surface, they can be exposed to flaming fuels and smoldering forest floor fuels. In the period after fire, a stable recovery of microbial populations to pre-fire levels can be expected. The moisture content of the litter, organic matter, and soil influences the effect on organisms. Water absorbs a lot of heat and this will reduce the temperatures and amount of substrate consumed. Because most soil micro-organisms are heterotrophic and require pre-formed organic material in the litter and soil for their source of energy. (Neary et al. 2005) (De Bano et al. 1998)

Low severity prescribed fire has a minimal effect on soil organisms. Temperatures can be non-lethal except in the upper litter layer and the consumption of forest floor substrate is limited. A single entry burn could be considered to have a minimal effect but repeated entries over time may reduce microbial population size and activity. (Neary et al. 2005) (De Bano et al. 1998)

In the past, soil organisms were not seriously considered in natural resource management as many were invisible to the naked eye, there was no economical field test available, and research studies did not always give matching

results of the response of organisms to management activities. Some generalizations can be made from past experience and studies.

- Micro-organisms do re-colonize disturbed forests due to a great physiological and genetic diversity.
- Fire effects are greatest in the forest floor and decrease with depth in the mineral soil. Recovery of microbial populations increases with the increasing moisture content of the litter layer and soil profile.
- Repeated prescribed fire can reduce organic matter content and increase the loss of soil organisms through erosion.
- Avoiding drastic changes in soil temperature, moisture, and substrate availability will have a higher probability of ensuring maintenance of soil biological populations.
- Knowledge gaps exist such as the effect of repeated prescribed burns on organisms. (Neary et al. 2005) (De Bano et al. 1998)

Based on the above, some recommendations can be made:

- Minimize loss of the forest floor (litter and duff) as micro-organisms are vulnerable to heat damage and substrate changes. Burning when the upper layer of the forest floor is dry enough to carry a fire and the lower layers are moist enough to avoid consumption. Extending the recovery time between repeated fires may be needed to meet these conditions.
- If anticipated fire severity is high, burning may need to be avoided as mortality of organisms may be higher in moist soil at high temperatures. If the anticipated severity is high, the burn can be rescheduled.
- Burning with varying consumption occurring in mosaic patterns can provide substrate and habitat for microbial re-colonization following a fire.
- Supplement burning with other silvicultural practices (Neary et al. 2005, De Bano et al. 1998).

Appendix I – Watershed soils

Table 14a

Soils in Kinkaid Lake – Kinkaid Creek watershed							
Soil Mapping Unit	Buttermilk (FS)	Buttermilk (private)	Buttermilk (total)	Talbot (FS)	Talbot (private)	Talbot (total)	Watershed Total
Stoy silt loam, 2–5%		1.5	1.5				1.5
Dupo silt loam , 0–2% occasionally flooded		34.2	34.2				34.2
Hosmer silt loam, 5 – 10 %, severely eroded		4.9	4.9				4.9
Winfield silt loam, 2 – 5 %	97.4	107.3	204.7	1.2	17.1	18.3	223
Winfield silt loam, 5 - 10 %, eroded	562	458.1	1,020.1		6.6	6.6	1,026.7
Winfield silt loam, 5 - 10 %, severely eroded	14.4	0.4	14.8				14.8
Menfro silt loam, karst, 10 – 18 %, eroded	146.3	103.5	249.8				249.8
Menfro silt loam, karst, 10 – 18 %, severely eroded	68.9	65	133.9				133.9
Menfro silt loam, karst, 18 – 25 %	1,048.5	816	1,864.5		3	3	1,867.5
Menfro silt loam, karst, 18 – 25 %, severely eroded	9.7	61.4	71.1				71.1
Menfro – Wellston silt loams, 35 –		12	12				12

70 %							
Haymond silt loam, 0 – 3 %, frequently flooded		33.6	33.6				33.6
Wakeland silt loam, 0 – 2 %, frequently flooded		31.7	31.7				31.7
Birds silt loam, 0 – 2 %, frequently flooded		1.2	1.2				1.2
Burnside silt loam, 1 – 4 %, occasionally flooded	86.8	32.9	119.7				119.7
Booker silty clay, 0 – 2 %, occasionally flooded		21.2	21.2				21.2
Orthents, clayey sloping		2.5	2.5				2.5
Okaw silt loam, 0 – 2 %		8.6	8.6				8.6
Menfro – Wellston silt loams, 18 – 35 %	567	197.3	764.3				764.3
Menfro – Wellston silt loams, 35 – 70 %	188.2	75.7	263.9				263.9
Neotoma – Rock outcrop complex, 35 – 70 %	5.6		5.6				5.6
Neotoma – Wellston complex, 18 – 35 %	0,.1		0.1				0.1
Neotoma – Wellston complex, 35 – 70 %	210.8	123	333.8				333.8
Water	17	13.6	30.6				30.6
Total	3,022.7	2,205.6	5,228.3	1.2	26.7	27.9	5,256.2

Table 14 b

Soil mapping units in Owl Creek – Mississippi River huc 6 watershed							
Soil Mapping Unit	Buttermilk (FS)	Buttermilk (private)	Buttermilk (total)	Talbot (FS)	Talbot (private)	Talbot (total)	Watershed Total
Winfield silt loam, 2 – 5 %	4.7	7.5	12.2	27.1	62.1	89.2	101.4
Winfield silt loam, 5 - 10 %, eroded	71.7	35.6	107.3	144.4	65.9	210.3	317.6
Winfield silt loam, 5 - 10 %, severely eroded	0.2	15.1	15.3	7.8		7.8	23.1
Menfro silt loam, karst, 10 – 18 %, eroded		2.6	2.6	152.1	36.9	189	191.6
Menfro silt loam, karst, 10 – 18 %, severely eroded	2.6	32.6	35.2	52.3	34.2	86.5	121.7
Menfro silt loam, karst, 18 – 25 %	31.6	28.7	60.3	652.4	321.7	974.1	1,034.4
Menfro silt loam, karst, 18 – 25 %, severely eroded	3.1	11	14.1	49	32.1	81.1	95.2
Menfro – Wellston silt loams, 35 – 70 %	6.2	6.1	12.3	3.5		3.5	15.8
Haymond silt loam, 0 – 3 %, frequently flooded		5.1	5.1		16	16	21.1
Wakeland silt loam, 0 – 2 %, frequently flooded				33.5	16.6	50.1	50.1
Birds silt loam, 0 – 2 %, frequently flooded							
Burnside silt loam, 1 – 4 %, occasionally flooded	7.9	5.1	13	52.1	38.3	90.4	103.4

Coffeen silt loam, 0 – 2 %, occasionally flooded					7.1	7.1	7.1
Raddle silt loam, 0 – 2 %, rarely flooded		5	5		42	47	47
Booker silty clay, 0 – 2 %, occasionally flooded							
Darwin silty clay, 0 – 2 %, frequently flooded					0.5	0.5	0.5
Orthents, clayey sloping							
Okaw silt loam, 0 – 2 %							
Menfro – Wellston silt loams, 18 – 35 %	213.5	101.9	315.4	151.8	152.9	304.7	620.1
Menfro – Wellston silt loams, 35 – 70 %				32.4	55.6	88	88
Neotoma – Rock outcrop complex, 35 – 70 %				12.4	28.9	41.3	41.3
Neotoma – Wellston complex, 18 – 35 %	26.9	12	38.9	5.3	11	16.3	55.2
Neotoma – Wellston complex, 35 – 70 %				96.9	12.3	109.2	109.2
Water		0.7	0.7		3	3	3.7
Total	368.4	269	637.4	1473	937.1	2,410.1	3,047.5

Table 14c

Soil mapping units in Worthen Bayou huc 6 watershed							
Soil Mapping Unit	Buttermilk (FS)	Buttermilk (private)	Buttermilk (total)	Talbot (FS)	Talbot (private)	Talbot (total)	Watershed Total
Winfield silt loam, 2 – 5 %	9.8	4.8	14.6				14.6
Winfield silt loam, 5 - 10 %, eroded	127.5	45.4	172.9				172.9
Winfield silt loam, 5 - 10 %, severely eroded	2.6	13.8	16.4				16.4
Menfro silt loam, karst, 10 – 18 %, eroded	0.9	67.7	68.6				68.6
Menfro silt loam, karst, 10 – 18 %, severely eroded	5.9	13.2	19.1				19.1
Menfro silt loam, karst, 18 – 25 %	220.4	125.8	346.2				346.2
Menfro silt loam, karst, 18 – 25 %, severely eroded	20.5	0.3	20.8				20.8
Menfro – Wellston silt loams, 35 – 70 %	8.3	31.4	39.7				39.7
Haymond silt loam, 0 – 3 %, frequently flooded	1.9	18.7	20.6				20.6
Raddle silt loam, 0 – 2 %, rarely flooded	2.6	40.9	43.5				43.5
Menfro – Wellston silt loams, 18 – 35 %	62.1	163.9	226				226
Menfro – Wellston silt loams, 35 – 70 %	92.5	110.2	202.7				202.7
Neotoma – Wellston complex, 18 – 35 %		34.1	34.1				34.1

Neotoma – Wellston complex, 35 – 70 %	25.8	26.2	52				52
Water		0.3	0.3				0.3
Total	580.8	696.7	1,277.5				1,277.5

Design Criteria for all Action Alternatives (from the Draft EA)

In order to minimize impacts to other resources, several design criteria were included in the proposed action (Table 3). These design criteria are similar to mitigation measures but have been incorporated into the design of the project rather than as a response to concerns or ongoing effects.

Table 3. Design Criteria for Buttermilk Hill – Talbott Hollow Blowdown Project.

Resource Area	Design Criteria	Rationale / Effectiveness
Vegetation Resources	Clean all equipment before leaving the project site. Clean before use on the site.	Minimizes spread of noxious weeds from one site to the next (USDA-FS 2004). Guide to Noxious Weed Prevention Practices (2001).
	Workers should inspect, remove and properly dispose of plant parts and seeds found on clothing and equipment before entering or leaving the project area.	
	Minimize soil disturbance to avoid creating favorable conditions that encourage weed establishment.	
	Avoid ground disturbance at the turk's-cap lily and heartleaf plantain sites to avoid any direct negative impact to these sensitive species.	Both sites will be identified on the ground and activities causing ground disturbance will be avoided in these areas.
Soil and Water Resources	Use erosion control measures, waterbars, seeding etc? for fire lines that could erode soil into lakes, streams and wetlands.	Illinois Forestry Best Management Practices are designed to ensure that prescribed fire operations do not degrade the forested site and that waters associated with these forests are of the highest quality (IDNR *et al.* 2007 (revised)). We have monitored the effectiveness of mitigation measures on several past prescribed fire projects and found that the measures were effective in minimizing soil erosion and subsequent sedimentation in streams is this doc in the project files?. Specific guidelines can be found in the IL Forestry Best Management Practices, Chapter 7, Prescribed Burning.
	Where possible, locate bladed fire lines on the contour. Construct water bars as needed to direct surface water off firelines and into undisturbed forest cover.	
	Maintain soil stabilization practices until the site is fully revegetated and stabilized.	
	Avoid operating heavy equipment in a manner that causes excessive soil displacement, rutting, or compaction.	
	Guidelines for protection of water quality; Standards for protection of soil and water in riparian corridors and riparian areas; Guidelines for the reduction of bare soil disturbance and exposure in riparian corridors; Standards for restoration of disturbed soil areas; Standards for the limitation and use of heavy equipment, and Standards for soil disturbance limitations.	Implementation of the protection measures and management recommendations presented in the FW25 Water, Soil and Air Management of the Forest Plan (Forest Plan 2006, pp. 40-41, R9 Soil Quality Standards and IL Best Mgmt Practices) will prevent excessive sedimentation.
Wildlife Resources	Retain all standing dead trees unless necessary to cut for human safety or to accomplish project objectives. Is it fair to say that this will only occur on lines and adjacent to staging area and not internal to any stand – don't want folks to think we are snagging the entire area Suitable Indiana bat summer roost trees cannot be removed April 1 - Sept. 30 unless documented as non-use by roosting bats.	These design criteria are required "terms and conditions" or "reasonable and prudent measures" in December 2005 US Fish & Wildlife Service Biological Opinion for the Forest Plan.
	To reduce the chance of affecting maternity roosts and foraging habitats, no prescribed burns shall be done in upland forests from May 1-Sept 1.	
	Burning near known timber rattlesnake den locations will be done only during hibernation seasons when individuals are in dens (11/1-3/31).	Den sites are extremely important to the maintenance of populations. Scott Ballard, IDNR, personal communication, 11/27/07.
	In order to protect Eastern small-footed bats, rock outcroppings and cave entrances in the project area will not be intentionally ignited by burn crews. No fire-lines would be constructed in or immediately adjacent to cave habitat.	These habitats require additional protection, which is specifically identified in the Forest Plan (USDA 2006).
Heritage Resources	The Area of Potential Effects will be inventoried to ensure that all heritage resources are adequately protected from project-related impacts.	Project monitoring from 1991-2005 has indicated that few sites have been missed using our inventory methods (McCorvie: A Decade of Monitoring).

Table 3. Design Criteria for Buttermilk Hill – Talbott Hollow Blowdown Project.		
Resource Area	**Design Criteria**	**Rationale / Effectiveness**
	Sites will be protected by removing leaf or woody fuel, excluding fire, reducing heat output by burning under wetter conditions, using wet lines or handlines in place of dozer lines, or combinations of these techniques as determined on a site by site basis by the Forest Archaeologist.	I thought we used the full 106 process on this project – are we using the methods in the programmatic as examples of how we would do the work? As specified in the Programmatic Agreement Among The Advisory Council on Historic Preservation, the USDA-FS Shawnee National Forest and Midewin National Tallgrass Prairie, and the Illinois State Historic Preservation Officer for Prescribed Fire Programs on the Shawnee National Forest and Midewin National Tallgrass Prairie. Combine these two & have Mary make sure that the success of these techniques is covered in these references.
Recreation & Visual-Resource Management	Ensure visitor safety before, during and after burning activities. Burn areas should be signed prior to ignition and closed to the public.	Shawnee National Forest 2006 Forest Plan, Chap. I, B (p. 6), Chap. V, FW23.2 (S) & FW23.3 (G), p. 33
	Protect existing recreational improvements, such as campgrounds, trailheads and trail signing and other amenities.	Shawnee National Forest 2006 Forest Plan, Chap. V, FW23.2 (S), p. 33
	Damage to existing trails and roads employed as firebreaks or for access should be repaired to standard.	Shawnee National Forest 2006 Forest Plan, Chap. V, FW23.3 (G), p. 33
	Constructed firelines will be rehabilitated and closed after use to prevent unauthorized recreational use (ATVs, horses, etc.)	Prior experience has shown this to be successful in preventing unauthorized use.
Air Quality	Obtain smoke permits as required. Manage smoke to limit impacts to human health, visibility and public safety. Specific measures such as timing of burns would be included in the Prescribed Fire Burn Plan.	State requirement to obtain smoke permit that has obligatory terms and conditions. Prior experience has shown standard smoke management techniques to be effective.
Human Health and Safety	Existing infrastructures such as utility lines, power poles and pedestals will be protected during burn activities. Burn areas should be signed prior to ignition and closed to the public during ignition. Notify cooperating agencies and affected public. Traffic management measures may be taken if visibility is sufficiently degraded along public highways. Specific protection measures are included in the required Prescribed Fire Burn Plan.	Smoke-sensitive individuals and cooperating agencies would have time to prepare for smoke impacts. Warning traffic and/or controlling traffic flow may reduce the likelihood of an accident caused by reduced visibility.
Socioeconomics	Improvements on private land in proximity to burn operations would be protected.	Potential for high value economic losses from burned structures.

Monitoring

Monitoring would demonstrate whether or not the management has been implemented as specified and if the design criteria were effective (Table 4). If monitoring exposes unacceptable resource damage, appropriate measures would be implemented to correct problems.

Table 4. Monitoring for the Proposed Action Alternative.		
Resource Area	**Monitoring Activity Description**	**Location and Timing**
Soil and Water Resources	BMP compliance checks (Dissemeyer, 1994).	During and after burning activities are completed in project area.
	Penetrometer compaction comparison (Amacher and O'Neil, 2004).	Before and after burning activities are completed in project area.
	Visual inspection for sheet, rill and gully erosion.	Before, during and after burning activities are completed in project area.
	Inspection of soil disturbance.	Before, during and after burning activities are completed in project area.
	Visual inspection of log landings, skid trails and other disturbed areas that are slow to re-vegetate. Do we have any log landing and skidtrails?	After burning activities are completed in project area.

Aquatic Resources	Wolman pebble count method for assessing changes in the aquatic habitat due to sedimentaiton	Before and after burning activities are completed in project area.
Vegetation Resources	Documented garlic mustard sites within the project area will be monitored to determine increases or decreases in population size.	Garlic mustard locations within the Project Area will be mapped before and monitored after implementation.
	The project area will be monitored for spread of existing invasive species populations and establishment of new sites. The need to implement control measures within the project area will be evaluated periodically.	Periodically before, during and after project implementation in the Project Area.
	Monitor the effects, if any, to known turk's cap-lily and heartleaf plantain populations within the project area.	Periodically before and after burning activities within the vicinity of the populations.
	Monitoring plots have been established to determine vegetative changes.	Post-project monitoring will determine effectiveness in meeting the purpose and need.
	Flame lengths, rate of spread, spotting amount and distance will be visually monitored during the burn.	Quantitative fuel reduction monitoring will be accomplished at already? established monitoring plots.
	Bark scorch, litter depth and continuity, and reduction of larger fuels will be monitored soon after the burn.	
Heritage Resources	Ensure that heritage resources are protected and preserved during and after project implementation.	This project will be included in the Forest Monitoring Plan, which annually assesses the thoroughness of our inventory methods and our mitigation/protection measures.
Air Quality	Smoke column height, color, direction and visibility will be monitored during burn activities. Success of smoke management efforts will be monitored by tracking public comments.	Visual estimates done by Burn Boss, Fire Effects Monitor(s), or designated person(s). Comment logs tracked by FS personnel at designated offices and the burn boss.
Wildlife Resources	To determine the balance between early, mid- and late-successional habitat conditions is appropriate-tiers to Forest-level monitoring objectives.	Post-treatment, and then every five years within the project area.

Comparison of Alternatives

This section provides a summary of the effects of implementing either alternative (Table 5).

Table 5. Effects of the Alternatives on the Key Issues.		
Issue Statement: The increased fuel loading has increased the probability of a severe wildfire.		
Indicator	**Alternative 1**	**Alternative 2**
Heavy Damage – Hardwood Stands	28	12
Heavy Damage – Pine Stands	78	26
Light Damage – All Stands	19	4
No Damage Oak Stands	14	4
No Damage Mesophytic Stands	14	4
Issue Statement: The project area needs restoration of native plant communities and species.		
Indicator	**Alternative 1**	**Alternative 2**
Changes in the numbers and frequency of native and non-native plant species.	Increase in invasive species over time. Are we assuming in this alternative that a fire happens – if so would not the fire control NNIS Decrease in native species diversity.	Burning would have a detrimental effect on invasive plant species. Native plants diversity should increase.

Chapter 3 - Affected Environment and Environmental Consequences (from the Draft EA)

This chapter describes by resource area the physical, biological and social/economic conditions that may be affected by the proposed action and its alternatives. As directed by the Council on Environmental Quality (CEQ) implementing regulations for NEPA, the discussion focuses on resource conditions associated with the key issues. The discussion of environmental consequences forms the scientific and analytical basis for comparing the alternatives. Environmental consequences are discussed in terms of direct, indirect and cumulative effects.

Cumulative Effects

Resource specialists analyzed the cumulative effects of implementing the proposed action on their respective resource area. These cumulative effects analyses are displayed under each resource section presented in this chapter. The spatial and temporal boundaries for the cumulative effects analysis may differ for each respective resource area. The analysis of cumulative effects considers all known actions past and present, and reasonably foreseeable future actions. The following discussion describes past, present and future actions and will be used for the discussion of cumulative effects in each resource area. The June 24, 2005 CEQ guidance on cumulative effects was considered in the development of this environmental analysis.

Past Actions

Southern Illinois, including the Forest, has a rich agricultural history. Settlers cleared the land for fields and homestead development and some of this land eventually became the Forest. Both active and passive management have shaped the Forest today. Shortly after the Forest was formed, pine and hardwood were planted and successfully ~~to~~ stabilized old fields and ~~to~~ have begin to restore the forest habitat.

Activities occurring on Forest and private lands in the three ~~project area~~ 6th Hydrologic Unit Code (HUC 6) watersheds, throughout the years include, but are not limited to, farming and grazing, mining, timber harvest (primarily on private land), wildfires, creation and use of system and non-system equestrian and hiker trails, wildlife management including wildlife openings and pond and waterhole construction, outdoor recreational use (including picnicking, hunting, fishing, hiking), use of all-terrain vehicles (ATV's, authorized and unauthorized) and off-highway vehicles, unauthorized artifact hunting and collection, issuance of special-use permits, recreational facilities construction and maintenance, road construction, maintenance and use, tree-planting and timber-stand improvements, including tree-thinning, power-line construction and maintenance and electrification of rural areas. Activities occurring on national forest and private lands in the project are included in Table 6.
Will the access created by this project provide a means for further impacts to Arch sites? Addressed in Heritage
The analysis period for past actions was determined separately for each resource area.

Present Actions

Many of the past activities that occurred in the three project area watersheds are still occurring, however, the prevalence of many of the past activities has changed. Present actions in the project area watersheds include, but are not limited to, trail construction, maintenance and use, use of non-system trails, power-line maintenance, ATV use (authorized and unauthorized, see below), timber harvest (mainly on private lands), agricultural management (row-cropping and pasture) on private lands, prescribed fire, wildfire, and fire suppression, road maintenance and use, tree-planting, public visitation and outdoor recreational use (including picnicking, hunting, fishing, hiking and equestrian use) and special-use permitting (Table 6).

Within the project area watersheds there is some ATV use. Some of this use is permitted (authorized) and some is unauthorized. Authorized use includes disability permits that allow ATV access to the Forest, exclusive of ecologically sensitive areas and all use on private lands. Unauthorized use is fairly common throughout the watershed (do they impact/effect sensitive resources based of field work associated with this project – improved access as a result of this project?). The effects of ATV use are spread over the watershed. What are the effects? Delete whole paragraph.

Reasonably Foreseeable Future Actions

Reasonably foreseeable future activities on National Forest land include those activities that are awaiting implementation, planned, or listed on out-year schedules such as the Quarterly Schedule of Proposed Actions. Reasonably foreseeable future activities on private land include those planned and/or awaiting implementation. In general, many of the past and present activities will continue into the future. In the next ten years, the Shawnee National Forest plans to continue to maintain roads and trails, issue special use permits similar to those issued in the past, suppress wildfires, implement prescribed burn plans, treat non-native invasive species, disk and plant for food crops and warm season grasses (Table 6).

It is difficult to quantify the extent of future damage that could be caused by unauthorized ATV use or cross-country horse riding because of the nature of off-trail use. It is impossible to predict where this use will occur and the potential extent of damage to various resources. We have examined this incomplete information using the procedure outlined in 40 CFR 1502.22. It is impossible to quantify how many plants, plant populations, or other resources could be affected.

Table 6. Past (last ten years) present actions, and reasonably foreseeable future actions, with potential for cumulative effects, within the three project area HUC 6 watersheds.

Action	Scope of Action
Agriculture (row-cropping)	About 27,500 acres (past, present and future).
Agriculture (pastureland)	About 9,000 acres (past, present and future).
Wildfires	About 10 acres per year (past, present and future).
Prescribed Burning	About 85 acres per year (past). About 900 acres per year (future).
Timber Harvest –fire wood cutting?	About 100 acres per year (past, present and future).
Timber Stand Improvement	About 80 acres per year (future).
ATV Use	Variable use in the watershed (past, present and future).
Road Maintenance	About 20 miles maintained per year (past, present and future).
Road Right of Way Maintenance	About 10 acres maintained per year (past, present and future).
Tree Planting	About 10 acres per year (past, present and future).
Utility Right of Way Maintenance	About 25 miles per year maintained (past, present and future).
Trail Maintenance	About 10 miles maintained per year (past, present and future).
Horseback Riding	Variable use in the watershed (past, present and future).
Non-system Trails	Estimate less than 25 miles of trail (past, present and future).
Special-use Permits (telephone, electric, water, and driveways	Estimate less than 2 acres per year (past, present and future).
Invasive Species Control	About 10 acres manual treatment per year (past and present). About 100 acres herbicide treatment (future). Effects?
Wildlife Brush Pile Creation	About 120 acres (past).
Openlands Management	Disking and planting of food plots on about 40 acres (past) and 230 acres (future).
Trail Construction	About 0.5 miles of trail reroute of an existing trail (future).
Shoreline Stabilization	About 6 miles along Kinkaid Lake (past and future).
Gully Stabilization	About 900 feet near Kinkaid Lake (past and future).
Residential Development	About 200 houses per decade (numbers are for three project area townships: Kinkaid, Levan, and Sand Ridge)

Soil and Water Resources (from the Draft EA)

This section discusses the soil and water resources within the project area and the effects of the alternatives on these resources. The discussion of soil and water resources is in two sections: Affected Environment and Effects of the alternatives. This section is a summary of the Soil and Water Working Paper that was prepared for this project, more detail can be found in that paper (Project Record).

Affected Environment - Soil and Water Resources

Riparian Soils - Riparian soils make up about four percent of the project area soils. Wakeland silt loam (0–2 percent slope) and Burnside (1–4 percent slope) are the two soil mapping units occurring on

the areas of moderate to severe canopy damage and comprise about four percent of the project area. Wakeland silt loam is a wetland soil and Burnside silt loam is not.

Soils with erosion potential – The aforementioned riparian soils have a slight erosion potential. About 28 percent of the project areas with moderate to severe canopy damage occur on areas of slight to moderate erosion potential (slight off roads and trails and moderate on roads and trails). Areas of moderate to severe erosion potential (moderate off roads and trails and severe on roads and trails) make up about 63 percent of the project areas on moderate to severe canopy damage. Soil mapping units with severe erosion potential occur on about three percent of the project areas on moderate to severe canopy damage.

Soils with compaction potential - Nearly every soil-mapping unit has a severe potential for compaction.

Soils with low potential for damage to soils from fire – About 95 percent of the area occur on soil mapping units with slight limitations affecting prescribed burning and moderate potential of damage to soils from fire due to texture and slope. About three percent of the area occurs on soil mapping units having moderate limitations affecting prescribed burning due to slope.

Water - Water quality has been evaluated for major streams in or associated with the project and cumulative effects analysis area. The 2006 Illinois Environmental Protection Agency (IEPA) stream assessments were consulted. Some of the streams listed have gone through the TMDL process with the IEPA. Some previously listed impairments to water quality in some streams have been removed due to new data and evidence of full support for beneficial uses.

Floodplains - The Forest Plan defines floodplains as areas subject to a one percent or greater chance of flooding in any given year. Soil mapping units designated as occasionally flooded may be seen as meeting the floodplain designation. These mapping units were mentioned above in the section on riparian soils. Site productivity and riparian function would be maintained in the project area in both alternatives, therefore, also on the floodplains in the project area.

Wetlands - The National Wetlands Inventory (NWI) was consulted for information on wetland resources. While the NWI is not the most accurate natural resource inventory, it does contain information on wetland resources by NWI type. Along Kincaid Creek, south to Highway 3, freshwater forested/shrub wetlands and freshwater emergent wetlands were noted. Freshwater ponds were dotted throughout the project area.

Neither alternative will have an adverse effect on the site productivity or function of the sites in the project area. The proposed action would result in a slight, temporary, minor increase in sediment in the streams running through the forested floodplains on Kinkaid Creek but this would not affect these wetlands. Adhering closely to the Forestry Best Management Practices will "protect water quality from erosion and minimize changes to the surface and subsurface water movement" (Illinois Best Management Practices, Pages 35–40).

Soil erosion is generally low to medium throughout the analysis area although soil erosion is rated high in certain areas of the 12-digit HUC what is a 12 digit making up the analysis area. Soil compaction is generally high throughout the analysis area. Soil productivity is generally low. The hazard of damage to soil from fire is generally medium to high under what conditions – parameters?…. Riparian soils

occur adjacent to streams throughout the analysis areas and can be subject to occasional to frequent flooding for brief periods.

Effects of the Alternatives – Soil and Water Resources

Alternative 1 – No Action

No new management activities would take place, nor any activities associated with the proposed action. Therefore, no management related changes in productivity of the land would occur. Soils would be impacted by planned and ongoing natural resource management activities such as road use and maintenance. In the absence of wildfire, current runoff and erosion patterns would be maintained. An upland erosion rate of less than one ton per acre per year is predicted by Forest Service Water Erosion Prediction Project (FSWEPP) for stands on steep slopes in the absence of fire. Natural processes and functions would continue to occur as dead material decomposes. Dead and dying trees would decay with carbon released to the atmosphere. Actual soil organic matter may increase with an accompanying increase in microorganisms and fungi. Since there is no burning, no carbon would be removed from the forest.

Natural functions would also include pathogens and insects contributing to oak decline leading to dead and down trees. Dead and down trees would increase fuel levels leading to increased wildfire danger. In the absence of wildfire, dead and down trees would decompose over time, leading to increased macro and microorganism populations carrying out the decomposition process. As decomposition proceeds, dead and down material would eventually be incorporated into the organic horizon and surface horizons leading to increased soil nutrient capital. No ecological restoration or vegetation management will occur under this alternative. There would be no direct or indirect effects to soil or water from prescribed burning. Soil quality and productivity would be increased in the long-term as organic matter decomposes and converts to the A horizon, leading to increased soil nutrient capital. Water quality would be maintained at current levels considering anticipated future actions and assuming the inputs from private land remain stable. Some geologic erosion could be expected to continue in the project area and in the cumulative effects analysis area and some of this sediment could be expected to enter the streams. This alternative would likely result in less soil erosion, compaction, sediment load, and percentage of bare ground than the proposed action. There would be no sedimentation resulting from the no action alternative and there would be no cumulative effect. Implementation of this alternative is not anticipated to result in any changes to water quality.

Under this alternative, biomass (fuels) will not be removed by prescribed burning. Wildfires that could occur under conditions of increased fuel loading could burn at a higher intensity and over a larger area than would have occurred before the blowdown event. The probability of high intensity wildfires would increase in the absence of fuel reduction in this proposal. The stands where wildfire does not occur would maintain current runoff and erosion patterns. An upland erosion rate of less than one ton/acre/year would be expected for stands on steeper slopes and near water if fire were excluded. Fire exclusion would result in accumulation of hazardous fuels. Fire ignitions could? would increase relative to historic wildfire frequency because project area fuels are more exposed to sun and wind and may be in a readily combustible state more often. Future wildfires could be more intense and much larger due to the changed fuel conditions. Each occurrence would increase the short-term (3-5 years) erosion from the area affected by the wildfire; however, these fires will likely be separated by space and time. Further information on frequency and size of historic wildland fires and predicted intensity of future wildfire is covered in the Fire and Fuels Working Paper.

Alternative 2 – Proposed Action

The effects of prescribed burning on soil erosion and nutrient loss are related to the severity of the burn. These effects are complex and depend on a host of factors. Erosion can increase as a result of prescribed fire, but WEPP model runs indicate that the erosion levels are much lower but are they within a range we can stand than erosion and sedimentation levels after a high severity stand replacement fire. The potential of damage to soil from fire is moderate to high for every soil mapping unit except for Wellston and Belknap silt loams. Surface erosion occurring could result in sedimentation in adjacent streams especially in the steeper areas of the project area and those areas within 300 feet from stream areas.

Burning has its most pronounced effect on the forest floor where carbon, nitrogen and sulfur are volatilized and calcium, magnesium, potassium, phosphorus, and other elements are left as ash. The ash is leached by rains into the mineral soil that increases its base saturation and pH (Alban 1977). Increased nutrient availability at higher pH may result in positive plant responses following fire (Van Lear and Kapeluck 1989). These coincide with results from a variety of other reviews and studies. (DeBano 1998, Liechty *et al.* 2004, Neary *et al* 2005). High intensity fire can also affect soil physical properties and result in hydrophobicity and increased soil erosion and runoff. Prescribed fire generally results in lower intensity burns and hydrophobicity has not been observed in prescribed fire at the Mississippi Bluffs area. Burning can also have an effect on the macro and microbiological communities both inside and outside the soil profile. The possible effects on biota are covered in greater detail in the Soil and Water Working Paper.

Fireline construction is an important part of the preparation for prescribed burning. Natural features (trails, roads or streams) are used for firelines whenever possible. Under the proposed action, about 11 miles of firelines would be constructed. Where lines must be constructed, hand raking or leaf-blower lines are preferred but dozer line may be used near heavy fuel concentrations, structures and other areas of high value. The proposed action calls for about 9-10 miles of hand raking or leaf-blower lines and 1-2 miles of dozer line.

Fireline construction involves removing organic material to expose mineral soil to stop the movement of the fire. Hand raking or leaf-blower lines are usually an 18-20 inch wide swath of bare soil within a 3-4 foot leaf blown area do we have documentation of the impacts via this method – pictures before and after. Dozer-lines are usually a 4-6 foot wide swath cleared down to mineral soil of vegetation duff and debris. After the prescribed fire, the dozer-lines are rehabilitated to minimize soil loss. The berms created during construction are pushed back into the path and water bars are installed. What about seeding with annuals Accelerated erosion related to constructed fire control lines can be minimized by controlling the location and duration of mineral soil exposure.

Fire-lines can also become trails for all-terrain vehicles and result in an increase in soil disturbance. Spreading trees and branches over the firelines at the end of project activities would decrease the probability of an increase in trails and decrease erosion and sedimentationthis is a mitigations is it considered in mitigation?. The constructed firelines have the potential to result in temporary, minor negative effects of limited extent in the project units. Accelerated rates, above natural rates, of soil erosion on the firelines would be temporary (1-2 years). Limited areas of displacement and erosion on the fire control lines would not substantially affect site productivity. Over the next ten years of project implementation, the constructed fire lines would be reused, as necessary, for subsequent prescribed fires.

Cumulative Effects

The period considered for the cumulative effects analysis is 15 years because this period provide a significant basis for measuring change in soil disturbance due to soil erosion and soil compaction. Additionally, increases in soil erosion from project and associated activities usually return to pre-project levels within three to five years. Soil compaction effects are variable and there is no information as to the time length for compacted soil to return to pre-project conditions in Illinois or in the Shawnee Hills. Some information from the southeast U.S. indicates 10-15 years is the average time for restoration of compacted areas through natural processes. The source of this information is from a technical bulletin on the effect of heavy equipment on the physical properties of soils and long-term productivity done under the National Council for Air and Stream Improvement (NCASI, Miller, Colbert & Morris 2004).

The area considered for cumulative effects is three sixth field hydrologic units (HUCs) in the location of the project area. The total acreage for the analysis area is 60,628 acres, including about 12,993 acres of federal land (about 21.43% of the cumulative effects analysis (CEA) area). The remainder of the analysis area is private land under different land uses and ownerships. The total project area is about 9,600 acres of National Forest and private land or about 16 percent of the cumulative effects analysis area. Watershed based cumulative effects (water quality, soils, etc.) are best addressed from analyses based on a watershed or sub-watershed areas. No other watersheds were included as erosion and sedimentation would not be supplied across watershed boundaries.

Past, present and reasonably foreseeable actions
Past, present and future actions for the project area are listed Table 6. The effects of these projects are bounded in time and analyzed cumulatively with the anticipated effects of the proposed action for each resource. The baseline for the cumulative effects analysis is the current soil conditions of the project area and the existing water quality in adjacent streams.

Road maintenance and use – County roads and highways are maintained within the watershed.

Past and Present Action: Issuance of Special Use Permits - The effects of the past and present Special Use Permits (SUPs) are distributed in time and space. Existing permits for roads are counted in the existing road miles. The majority of the permits are for communication or utility line maintenance, recreation facility operation, or recreation special events. The issuance of these types of permits typically results in some minor ground disturbance over a localized area. Mitigation measures are included in the permit to reduce the time of exposure of bare soil, which reduces the potential for erosion and sedimentation. The majority of these permits will result in a short-term increase in soil erosion over a small, localized area with the permitted activities distributed in time and space within the project area.

Future Action: Issuance of Special Use Permits - The proposed Special Use Permits are very similar to the past and current Special Use Permits. Although it is difficult to predict, these reasonably foreseeable permitted actions are not likely to alter patterns of use enough to substantially increase soil erosion and sedimentation effects.

Past Action: Wildland Fires - The effects of the wildland fires that have occurred in 2006 and 2007 are short-term and separated by time and space. Though summers of those years were fairly to very dry, soil moisture remained high during fire season (usually October - April). There were about 99 acres of prescribed fire (not wildfires) within the CEA during those years, and two small wildfires totaling about three acres. Wildfires typically occur during dry periods and can be more intense and consume more of the leaf litter/organic matter in comparison to prescribed fires, which are typically implemented during periods of high soil moisture. If more bare soil is exposed, the potential for erosion and sedimentation is

increased in the short-term (the site, including emergency fire-lines, is typically stabilized within 1-2 years). Some soil displacement and/or rutting have occurred because of emergency suppression activities, but this has been minor in extent, and has not adversely affected site productivity. Although it is likely that short-term increases in erosion and sedimentation occurred because of the past wildfires, only the wildfires that occurred in the past year or so are potentially still eroding at a slightly accelerated rate due to decreased soil cover. Leaf fall can reduce erosion and sedimentation from these events.

Future Action: Wildland Fires - Future wildland fires may occur in similar frequency to historic wildland fires in the Forest. Intensity of these fires would also be similar to historic conditions in undamaged or treated areas (about 5650 acres), but may burn more intensely and grow more rapidly in tornado-damaged, untreated areas (about 75 acres spatially separated into several small areas). Each occurrence will increase the short-term (3-5 years) erosion from the area affected by the wildfire; however, these fires will likely be separated by space and time. Further information on frequency and size of historic wildland fires and predicted intensity of future wildland fires is covered in the Fire and Fuels working paper.

Past, Present and Future Action: **Recreation, Including Unauthorized Recreation -** Past recreation activities include hiking, horseback riding, rock climbing, hunting and authorized/ unauthorized ATV use. These activities are all currently happening on public and private land, are expected to occur in the future, and contribute to the existing conditions in the watersheds. These activities can all expose bare soil, which is evident at several of the small concentrated use areas scattered throughout the project area.

Horseback riding, hiking and the use of wheeled recreational vehicles can cause varying degrees of rutting, compaction and soil erosion (Dale and Weaver, 1978). Use of stock may have contributed minor amounts of nutrients to the streams through manure runoff. This is likely to continue in the future and it is expected to have a negligible to minor long-term negative effect on water quality.

These direct effects are mainly concentrated in localized areas; climbing areas, concentrated use recreation areas and trails. These recreational activities, both authorized and unauthorized, have caused accelerated erosion and sedimentation to adjacent streams. The direct and indirect effects of the project when added to the sediment loading from past, present and/or reasonably foreseeable future actions would result in a short-term cumulative increase (2-10 years) in sediment loading. In the long-term (10-15 years) the effects of the project should diminish back to baseline levels.

Farming - In the ten-year period between 1997 and 2006, corn, hay, sorghum and wheat are crops which have been grown and used in Jackson County. Cattle and swine are primarily the livestock grown in Jackson County. The past ten years have shown variable production of crops and livestock in Jackson County. Trends are not apparent and future production is likely based on economic and market forces impossible to determine at this time. The amount of sediment to the project area streams from agricultural use greatly exceeds any sediment increase anticipated from the proposed action. Our input will be negligible and there would be no detectable increase in sediment related to the proposed action.

Surface mining - Surface mining has been identified as a source of some water quality impairments in certain stretches of the Big Muddy River. This would be expected to continue in the future. The project will also result in some minor sedimentation within the cumulative effects area, which will have an effect on water quality. However, the increase in sediment will be minor; therefore, any cumulative effects to water quality will be negligible.

Municipal Water Supply Watersheds - Kinkaid Lake is identified as municipal public water supply watersheds. The Total Maximum Daily Load (TMDL) process either has been started or is ongoing for this lake. The Illinois Environmental Protection Agency (IEPA) 2006 Water Quality Report was consulted to assess the water quality of these lakes, support for beneficial uses, causes for less than full support, and sources of the cause. The primary source for less than full support was identified as toxics from atmospheric deposition. Runoff from forests / grasslands / or parks was not identified as a water quality degradation source. Although the project has potential to contribute minor amounts of sediment to Kinkaid Lake, adherence to Best Management Practices will result in little or no sediment entering the Municipal Water Supply. Thus, there will be no cumulative effect on water quality in Kinkaid Lake.
What about herbicide use?

Air Quality

Affected Environment and Effects of the Alternatives – Air Quality

In general, southern Illinois has good air quality and meets the National Ambient Air Quality Standards (NAAQS). The area around Carbondale had the lowest annual average particulate matter less than 10 microns in diameter (PM_{10}) in the state in 2005, the year of most recent data. Background concentrations of particulate matter and other pollutants are thought to chiefly arise from agricultural, industrial, commercial, and residential sources.

Alternative 1 – No Action

Under this alternative there would be no likely effects to air quality since no proposed activities would take place. Current use and activities that do produce some pollutants would continue, but in the past these have not contributed to degraded air quality and are not expected to do so in the future. A wildfire in the tornado-damaged area would likely produce higher emissions than a prescribed fire in the same area.

Alternative 2 – Proposed Action

Prescribed fire produces particulate matter emissions that could temporarily impact air quality and would be the pollutant of most concern to public health and safety. Past experience has shown these effects are greatly diminished with increasing distance from the burn. Computer modeling suggests that smoke impact levels may reach unhealthy levels near the burn at the time of greatest impact, but detectable smoke may be transported much farther. However, at those distances it is expected that most impacts will be in the form of “nuisance” smoke and/or smell, but all the ambient air quality standards would still be met. Actual emissions and impact are expected to be much lower than those modeled based on past experience. Most emissions would occur during active ignition phases of the burn, which would likely last 4-6 hours, depending on burn unit size, complexity, and weather and fuel characteristics during the burn. Smoldering may occur for another day or two. In prior prescribed burns on the Shawnee National Forest the residual smoke has typically been light. Higher moisture in duff and large logs probably limit combustion of these fuels more than during wildfires or when compared to fires in other parts of the country. Smoke may settle into lower areas at night.

Burning would likely occur fall through early winter (October through December) or early spring (February – April). These months are also the time of better air quality (based on visibility and the typical ozone season in Illinois) and lower visitor use to local campgrounds. Frontal systems tend to pass the area frequently during these months, helping to clear residual smoke.

Still, several sensitive receptors (e.g. homes, hospitals, highways, schools, airports) are potentially affected by these emissions. In the theoretical “worst case scenario” residents within 8 miles may

experience a few hours of elevated concentrations but overall 24-hour averaged concentrations should still be within the National Ambient Air Quality Standard for particulate matter 2.5 microns in diameter ($PM_{2.5}$). Within 20 miles, those sensitive to smoke (potentially children at school, the elderly or sick in nursing facilities or hospitals) may be affected temporarily. The greatest concentrations of these individuals are in Murphysboro (approximately 10 miles east-southeast of the project) and Carbondale (approximately 15 miles east-southeast of the project), though smaller towns such as Ava, Vergennes, and De Soto may also have sensitive receptors.

Visibility may be reduced at the Southern Illinois Airport but not to the level of impacting aviation operations. The greatest potential for visibility reductions is in the Kinkaid Lake basin and major valleys such as Logan and Austin Hollow and the Mississippi River floodplain as smoke settles into low spots at night. These are of particular concern since State Highways 3 and 151 run through these areas.

Design criteria such as timing burns to coincide with good smoke dispersion, public notification, and highway signing have been included in the project to alleviate most of these impacts.

Cumulative Effects Rationale – Air Quality

The spatial boundary is the southern Illinois counties of Perry, Franklin, Jackson, Williamson, Union, and Johnson. Smoke from fires may travel long distances, and direction is determined by transport winds. Maximum detectable smoke transport from the project is estimated to be around 30-60 miles. Most burning is done with south, southwest, west, northwest, and north winds, so downwind areas to the south, southeast, east, northeast, and north are considered for potential cumulative effects.

Past and Future Agriculture (hundreds of thousands of acres/year)

Row crop agriculture is heavily mechanized and widespread in the southern Illinois counties comprising the analysis area. Farm production activities in dry soil can release substantial dust and other particulate matter into the atmosphere and reduce visibility. Mechanized equipment also produces pollutants from internal combustion engines. There would be overlap in time as farming may occur during both spring and fall burn seasons. The effects from agriculture are expected to far outweigh any from burning.

Past and Future Wildfires (tens to hundreds of acres/year)

In general wildfires produce more pollutants than prescribed fires. The amount depends on the amount of fuel consumed, fuel qualities, and emission rates. The lift, dispersal, and transport of these pollutants are dependent on atmospheric conditions. Past wildfire amounts have been variable in the analysis area but have only contributed temporarily to decreased air quality. Future wildfire occurrence is difficult to predict but may have a higher potential to produce large volumes of emissions.

Past and Future Prescribed Fires (thousands of acres/year)

Past prescribed fires in southern Illinois have not produced many negative impacts. Other prescribed fires are foreseeable in the analysis area and time period. Another burn project has been proposed on Forest Service land north of the project area, and other prescribed fires on Forest Service lands and other ownerships are likely in these counties. Further, several of these buns may occur simultaneously since many people may choose to burn on the same day. The combined effects of these burns are still expected to be far outweighed by the effects of agriculture, industry, and widespread automobile use, and are not expected to collectively diminish air quality of the region.

Other Activities and Determination

May other activities will occur in the analysis area in the analysis timeframe (see Table 6), but the combined impact of all activities has been small enough to be acceptable for all NAAQS criteria pollutants and visibility in the past. The temporary production of smoke would yield a short term increase in some pollutants, especially near the fire, but would not be enough to negatively impact air quality as a whole.