

AGATE FOSSIL BEDS NATIONAL MONUMENT

FIRE MANAGEMENT PLAN



**United States Department of the Interior
National Park Service
Agate Fossil Beds National Monument
Harrison, Nebraska**

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I. INTRODUCTION

A. Reasons for Developing this Plan

This Fire Management Plan (FMP) outlines those actions that will be taken by Agate Fossil Beds National Monument (Agate, park) in meeting the fire management goals for the area. This meets the requirement in National Park Service (NPS, Service) Director's Order #18 (NPS 2002a) that all park units with vegetation capable of sustaining fire develop a fire management plan.

B. Resource Management Relationship

Agate's Resources Management Plan (AGFO 2002a) addresses the issue of fire management in a general manner. This specific action plan implements fire related management actions from that document

C. Compliance

An environmental assessment of the actions that are proposed to be conducted under this plan was completed in compliance with the National Environmental Policy Act (42 U.S.C. 4321) and NPS Director's Order #12 (NPS 2001), and is included here as Appendix C. An assessment of the effect of the proposed actions was included with that appended environmental assessment, in compliance with the National Historic Preservation Act (16 U.S.C. 470) Section 106, and includes a letter of concurrence from the Nebraska State Historic Preservation Officer. This plan includes provisions for complying with the Archaeological Resources Protection Act (16 U.S.C. 470a) as amended, the Native American Graves Protection and Repatriation Act (25 U.S.C. 3006), and Executive Order 13007, Indian Sacred Sites. In compliance with these documents and the Executive Order of April 29, 1994, on Government-to-Government Relations with Native American Tribal Governments, the Agate environmental assessment and assessment of effect (AGFO 2003) were developed in consultation with the 31 tribes that are culturally affiliated with the park landscape. The plan is developed in consideration of NPS Director's Order #77-1, Wetland Protection (NPS 2002b) was also addressed in the appended environmental assessment.

D. Authorities for Implementing this Plan

Authority for carrying out a fire management program at Agate Fossil Beds National Monument originates with the Organic Act of the National Park Service, August 25, 1916 (16 U.S.C. 1). This Act states that the primary goal of the Service is to preserve and protect the natural and cultural resources found on lands under its management in such manner as will leave them unimpaired for future generations.

NPS fire management policy is expressed in Director's Order #18 (2002a) and its accompanying Reference Manual 18, *The Wildland and Prescribed Fire Management Policy: Implementation and Reference Guide*. The *Guide* is being constantly updated and is available online at www.nps.gov/fire/fire/policy/rm18/. These documents are incorporated herein by reference. The park's fire management objectives conform to the referenced documents.

II. COMPLIANCE WITH NPS POLICY AND RELATION TO OTHER PLANS

A. National Park Service Management Policies concerning Fire Management

Fire once played an important role in the functioning of the local ecosystem. Far from being a negative and destructive force, naturally occurring fires have helped to shape the landscape over time. In many cases, the landscapes we see today are the legacy of both past fires and fire suppression. Many plant and wildlife species have evolved under the influence of fire and, in some cases, depend on fire for their continued existence. To remove fire from an ecosystem deprives that system of a powerful and dynamic natural force. The ultimate goal of fire management in the National Park Service is to restore fire to park ecosystems, where possible, through the use of prescribed fire.

The presence in and adjacent to Agate of people, contemporary and historic developments, and archeological, sacred, historic, and geological resources requires that the protection of life and property be a primary concern. Mechanical hazard fuel reduction and prescribed fire can be implemented to prevent loss of life or damage to resources.

It is the policy of the Service to allow natural processes to occur to the extent practical while meeting park management objectives.

B. Enabling Legislation and Purpose of the Park

Agate Fossil Beds National Monument was Congressionally authorized on June 5, 1965 (Public Law 89-33, 79 Stat. 123). The park was established on June 14, 1997. The purpose of the park is "to preserve...the outstanding paleontological sites known as the Agate Springs Fossil Quarries, and nearby related geological phenomena...[and] to facilitate the protection and exhibition of a valuable collection of Indian artifacts and relics..." The park was also to be administered in accordance with the National Park Service 1916 Organic Act, "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such a manner and by such a means as will leave them unimpaired for the enjoyment of future generations" (16 U.S.C. 1).

C. The *Statement for Management* as It Relates to Fire Management

Fire management goals are addressed generally in Agate's *Statement for Management* (AGFO 1995:5), which reads that the Service will "...identify, inventory, monitor the condition of natural, cultural and scenic values of the park and provide appropriately for their preservation, protection and use."

D. Objectives of Agate Fossil Beds National Monument's *Resources Management Plan* as They Pertain to Fire Management

Agate's *Resource Management Plan* (AGFO 2000a:13) states that the park needs to "...conduct prescribed burns, manage exotic plant species and restore the functioning of disturbed vegetation

communities.” In addition (p. 15), based on research, modeling, and fire history information Agate's 1988 *Fire Management Plan* needs revision to include prescribed fire.

E. How the *Fire Management Plan* Will Help Meet Agate Fossil Beds National Monument's Objectives

Agate's *Master Plan* (AGFO 1966), the park's primary planning document at the present time, noted that while no fire records were available when the Plan was developed the area was “in a high danger zone, because of the fuel types involved. The park's 1995 *Statement for Management* (AGFO 1995:5) listed as a primary management objective “...to provide appropriately for their [natural, cultural, and scenic values] preservation, protection, and use.” In its discussion of the park's existing resources and conditions, the *Statement* (p. 6) says:

The mixed grass prairie is in need of “rebirth” by fire. The park has not had a fire on the prairie for over ten years [and that one was only a small controlled test]. This has aided exotic species in taking over additional ground from the native prairie.

Authorization and implementation of this fire management plan would clearly assist in meeting Agate's objectives.

F. *Fire Management Plan* Description

The *Fire Management Plan* for Agate Fossil Beds National Monument is a detailed and comprehensive program of action to carry out fire management policies and objectives.

III. SCOPE OF FIRE MANAGEMENT PROGRAM

A. Goals

1. Resource Management Goals

Goal RM. Restore fire as a critical component of the ecosystem, restoring habitat conditions existing in the late 1800s when there was the first significant Euroamerican settlement of park lands. This would include strengthening of the mosaic pattern of different plant communities associated with post-fire stages.

Goal RM2. Rehabilitate areas that have been historically planted or grazed and in which exotic plant species (e.g., *Bromus tectorum* [cheatgrass], *B. japonicus*) have become established, with native plant species.

2. Fire Management Goals

Goal FM1. Make firefighter and public safety the highest priority of every fire management activity.

Objective: Ensure all wildland fire and prescribed fire operations do not result in serious injuries to the public, park staff or firefighters.

Strategy: All personnel involved in fire management operations will receive a safety briefing describing known hazards and mitigating actions that addresses established firefighter safety practices, current fire season conditions and current and predicted fire weather and behavior.

For prescribed fires all personnel involved must meet National Wildfire Coordinating Group standards listed in publication 310-1 (NWCG 2000), including the fitness test. The requirement for unplanned ignitions will mandate that firefighting personnel meet the qualification standards of their agency. After the initial stages of the incident, every effort will be made to use only personnel that meet the 310-1 standards.

- Park neighbors, visitors, interagency partners and the local residents will be notified of all planned and unplanned fire management activities that have the potential to impact them.
- The Superintendent may close, to the public, all or portions of the park when fire activity poses a threat to human safety.
- On every prescribed fire project, there will be one person designated as being responsible for safety.

Goal FM2. Suppress all unwanted and undesirable wildland fires regardless of ignition source to protect the public, check fire spread onto private property and protect the natural and cultural resources of the park.

Objective. Contain a minimum of 95% of unwanted wildland fires at less than 10 acres in size.

Strategy.

- Prioritize suppression actions on fires or portions of fires that threaten to damage public property.
- Ensure park staff is trained in wildland fire operations.
- Ensure park engine is in a state of readiness during fire season.
- Ensure park staff responsible for fire operations understands fire policy.

Goal FM3. Manage wildland fires so that park resources (natural, cultural, and administrative) are protected from damage by suppression actions and fire.

Objective. Manage suppression actions so that rehabilitation costs are less than 10% of suppression costs.

Strategy.

- Ensure wildland fire suppression operations employ “Minimum Impact Suppression Tactics”.
- Ensure fire operations personnel are briefed on park resources and potential damage from fire management actions.

Goal FM4. Facilitate reciprocal fire management activities through the development and maintenance of cooperative agreements and working relationships with pertinent fire management entities.

Objective. Annually review and modify as necessary agreements with neighboring agencies.

Strategy. Coordinate with Harrison Rural Fire Protection District, Nebraska National Forest, Crescent Lake/North Platte National Wildlife Refuge Complex and other cooperating agencies.

Goal FM5. Use prescribed fire where and when appropriate as a tool to meet resource management objectives within the park. Maintain or restore, where possible, the natural resources of the park and those ecological conditions that would prevail were it not for the advent of modern civilization.

Objective. Treat 40%-60% of the fire-dependent ecosystem within the park every five years.

Strategy.

- Achieve resource objectives such as reduction of woody species encroachment.
- Improve watershed by increasing herbaceous cover to keep soil erosion at natural levels.
- Increase native plant diversity and reduce exotic species occurrence.
- Implement hazard fuel reduction burns around developed and resource areas to reduce intensity of subsequent unwanted wildland fires.
- Restore fire as an ecological process in the park.
- Monitor the effects of fire on the ecosystem.

Goal FM6. Reduce wildland fire hazards around developed areas, along boundary areas and adjacent to cultural sites.

Objective. Ensure fire does not destroy any structures or developments, nor incur any damage to any cultural site.

Strategy. Apply hazard fuel reduction around developed areas and resource sites that are at risk from wildland fire to reduce fire intensity and severity.

Goal FM7. Manage prescribed and wildland fires in concert with federal, state and local air quality regulations.

Objective. Ensure air quality thresholds for National Ambient Air Quality Standards are not exceeded and visual quality is not significantly reduced in adjacent airsheds due to prescribed fire activities.

Strategy.

- Air quality impacts will be addressed as a part of the alternative development and selection in the Wildland Fire Situation Analysis.
- Air quality objectives will be incorporated in each prescribed burn plan.

- Smoke impact mitigation measures will be developed and implemented for prescribed burn and all wildland fire actions.

Alternative methods (i.e., mechanical, biological, etc.) to prescribed fire will be analyzed prior to selecting prescribed fire treatments.

B. Wildland Fire Management Elements to be Applied

1. Wildland Fire

All wildland fires will be suppressed using an appropriate management response. Management responses to specific wildland fires will be determined through evaluation of public and firefighter safety, fire behavior, values at risk, potential suppression damage and availability of fire management resources.

Management responses will vary from fire to fire and sometimes even along the perimeter of a fire. Appropriate management response options range from monitoring without on-the-ground disturbance to intense suppression actions on all perimeters of the fire.

2. Prescribed Fire

Hazard Fuel Reduction Management. Hazard fuel reduction will be used in close proximity to development, cultural, natural and geologic resources that are at risk from a high intensity fire. The intent of this program is to reduce the wildland fire hazard to levels that enable fire suppression forces to control fires with minimal loss of values. At Agate hazard fuel reduction will be accomplished by mowing and by the use of prescribed fire.

Ecosystem Management. Prescribed fire will be used in support of ecosystem management in order to maintain and/or restore plant communities, cycle nutrients, reduce or remove exotic plants and for a variety of other resource management objectives.

C. Fire Management Unit

Agate Fossil Beds National Monument consists of a single fire management unit. This fire management unit encompasses all lands owned and managed by the NPS at the park.

1. Physical And Biotic Characteristics

Located on the Niobrara River in northwestern Nebraska, the Agate Fossil Beds and their surrounding prairie are preserved in a 3,055 acre national monument (2,270 acres of Federal fee ownership land). Once part of James H. Cook's Agate Springs Ranch, the fossil beds are an important source for 21-19 million-year-old Miocene epoch mammal fossils. Cook's ranch also became a gathering place for Chief Red Cloud and Oglala Lakota (Sioux) and Cheyenne Indian people. The park's Cook Collection of Native American artifacts reflects years of gifts brought by the Indians during visits to the ranch from the 1880's through the early 1900's.

The elevations within the park range from 4,380 feet at the Niobrara River on the eastern boundary, to a high of 4,560 feet at the top of the fossil hills. Rocky bluffs line both the northern and southern edges of the park with the Niobrara River running through the center. The fossil beds, the primary resource, are located within the relatively shallow valley in the high table lands between the North Platte Valley and the crest of the Pine Ridge. About 250 feet of relief exists within the Niobrara River valley through the park, and the valley is generally $\frac{2}{3}$ of a mile wide. Valleys with rolling grasslands as well as small canyons can be found in the park.

The moderately dense, short to medium grassland consisting mainly of Wheatgrass and Needlegrass prairie represents an increasingly valuable natural resource. See *Fire Effects Monitoring Plan* (Appendix E) for a more complete description of Agate's vegetation. Mammal species such as beaver, mink, and badger are present in the area, as well as transient species such as mule and white tail deer.

Land uses surrounding the park have for many years and for the foreseeable future will be agricultural in nature. The park was carved from these agricultural lands, primarily grazing acreage, and the visual differences that are the most notable on adjoining land are those vegetative differences that are the result of continued grazing activity outside the park.

The *Agate Resource Management Plan* (AGFO 2000a) has more detail about the park's vegetation, soil, air, wildlife, and cultural and geological resources.

2. Strategic Objectives

The strategic fire management objectives specific to this fire management unit are as follows:

- Contain 95% of all wildland fires at less than 10 acres in size.
- By September 30, 2005, 32 acres (6.3%) of the 500 acres of lands disturbed by agricultural use (and targeted for restoration) are restored through the use of fire (AGFO 2000b).
- Restore fire to ~2,100 acres of the fire dependant ecosystem to meet resource management objectives through the use of prescribed fire.
- Reduce the presence of exotic species by 15% within the park's boundaries within 5 years.

3. Management Objectives That Are Tactical In Nature

Avoid adverse impacts by fires or fire management activities to:

- Sacred sites
- Bone Cabin Complex
- Hoffman House
- Fossil quarries, wayside exhibits, and the Agate ash deposit
- Canada thistle insectaries
- Administrative areas (Visitor Center and Museum, picnic area, well house, maintenance facilities, eastern residences)

Reduce the occurrence of *Bromus tectorum* through treatment with fire.

4. Management Constraints

- Ensure that air quality regulations are considered in developing implementation plans.
- Ensure that there are no unacceptable impacts to geologic, cultural, natural, or threatened or endangered species.
- Ensure that sociopolitical and economic impacts are considered in developing implementation plans.
- Whenever consistent with safe, effective suppression techniques, the use of natural barriers will be used as extensively as possible. The use of backfire techniques, burnout lines improvement, and wetting agents (ground and airborne) is authorized. Fire retardant agent used must be on the approved list of retardants used by the Forest Service and Bureau of Land Management.
- All extended attack and project fire operations will have a park employee designated and available to assist suppression forces in the capacity of Resource Advisor.
- River crossings will be limited to set locations.
- Except for spot maintenance to remove obstructions, no improvements will be made to intermittent/perennial waterways, springs or seeps, trails, or clearings in forested areas. Vegetation jams/debris in the streams should be left in place (protect fish and aquatic insect habitat). All sites where improvements are made or obstructions removed will be rehabilitated to pre-fire conditions, to the extent reasonably possible.
- Earth moving equipment such as tractors, graders, bulldozers or other tracked vehicles will not be used for fire suppression (if special circumstances warrant extreme measures to ensure protection, the Superintendent may authorize the use of heavy equipment).
- Fireline location will be outside of highly erosive areas, steep slopes, and other sensitive areas. Following fire suppression activities, firelines will be re-contoured and water-barred.
- Riparian areas, which have been completely burned, may be seeded depending on the intensity of the burn and the composition of the vegetation prior to the burn (exotics vs. natives).
- Consult with park neighbors concerning the planning or implementation of any activity that has the potential to impact their activities.

5. Physical Descriptors

The fire management unit includes and is adjacent to current developed areas and geological fossil, administrative, and cultural sites. Fire suppression strategy will be coordinated with

neighboring fire protection agency strategies on shared boundaries. Much of this fire management unit is accessible by paved, gravel or dirt roads (no more than ½ mile hike is typically required to access most portions). Major roads are Nebraska Highway 29 and the River Road. These roads provide access to private access and administrative roads within park lands. Developed trails are also present within the fire management unit.

The vast majority of the vegetation is mixed prairie. Along the Niobrara River and adjacent drainages the vegetation is riparian with rush, brush, predominantly willow, cottonwood and other wet site species present.

Mammalian species in the park include whitetail deer, mule deer, pronghorn antelope, coyote, beaver, cottontail and numerous species of small mammals. There are no known resident threatened or endangered species within the park’s boundary (also see Section III).

6. Fire History, Effects, and Behavior Characteristics

The fire history is the same as stated above in Section V.

Fuel Characteristics. The predominant fuel type in the park is mixed prairie (National Fire Danger Rating System Fuel Model L and Fire Behavior Fuel Model 1). Grass fuel beds have much heavier than normal fuel loadings (1-2 tons/acre) and are very flammable after curing. Fire spread and intensity characteristics under normal and extreme conditions are summarized below:

Fire Behavior -- Extreme Conditions*			
Fuel Model	Rate of spread	Flame Length	Fire Characteristics
Fuel Model 1	126 chains/hour	5.6’	Fires in this fuel model would move extremely fast. They would have a short residence time as these fuels are consumed rapidly.
Normal Conditions**			
Fuel Model	Rate of Spread	Flame Length	Characteristics
Fuel Model 1	101 chains/hour	5.0’	These fires also exhibit fast rates of spread. They will burn out rather quickly.

*Extreme is for slopes greater than 41%, 1 hr fuel moisture 3% and midflame wind speeds of 10mi./hr.

**Normal is for slopes less than 40%, 1 hr fuel moisture 6% and midflame wind speeds of 4mi./hr.

Note: 1 chain = 66⅔feet

Fire Regime Alteration. Fire suppression and land use practices, primarily livestock grazing and farming, were in place from the 1890’s through the 1960’s. These practices have resulted in almost the complete exclusion of fire from the park and have significantly altered the ecosystem.

Control Problems Related to Fire Behavior. Specific areas with potential control problems would be areas where slope, exposure and wind could result in extreme rates of spread. Areas

with taller grass species and cattails will increase control complexities. A special concern for this fire management unit is the reduction of hazardous fuels build-up along the park boundary.

7. Values to be protected

The Early Miocene mammalian fossils still held in the Stenomylus and Amherst (North), University, Carnegie, and Beardog Hills quarries are of international paleontological significance. The Daemonelex trace fossils in the northwest portion of the park are as well, as are the Agate Ash outcrops on the north side of the valley and a small fossil deposit in the same vicinity. At least 95 prehistoric archeological sites (camps, chalcedony quarries, mounds, and isolated finds) have been recorded on Federal park lands, several of which are part of the Crazy Buffalo Complex. This Complex is a sacred site or traditional cultural property of documented significance to the Lakota, as is Red Cloud’s historic campsite at the western end of the park. The historic Agate Springs Ranch headquarters is also at the west end of the park but is privately owned. The Bone Cabin Complex, an early twentieth century vernacular cabin and associated windmill and fence, is listed on the National Register of Historic Places. The park landscape as a whole is assumed to be eligible for the National Register as a cultural landscape, with component landscapes such as the Bone Cabin and Crazy Buffalo complexes and the Hoffman House (currently used as an employee residence).

Since 1996 the park has had an ongoing integrated pest management program to control its exotic Canada thistle (*Cirsium arvense*) infestation. Eight insectaries have been established as part of this program, and their locations are documented in a park GIS database; the insectaries themselves should be protected from fire during the spring and early summer.

Also needing protection are the Visitor Center and Museum, picnic area, Fossil Hills Trail and Daemonelex Trail wayside exhibits, main well house and reservoirs, maintenance facilities with their two wells, and the eastern residential structures.

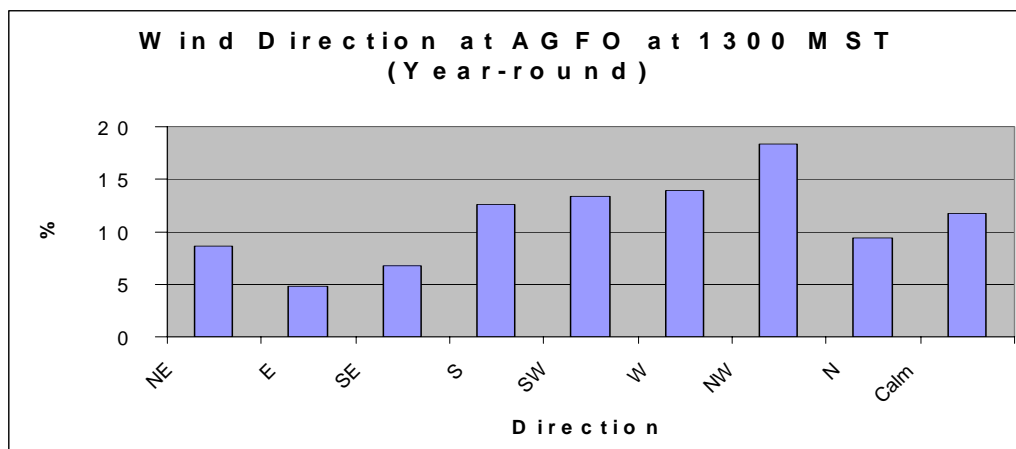
The park includes three inholdings, one of which (Agate Springs Ranch) is in part wholly-owned by the ranch corporation and in part under an easement to the government; the easement lands are grazed. A second inholding, at the east end of the park, is privately owned but under easement to the government and includes cultivated acres as well as grazing land. The third easement is a narrow corridor in a privately owned valley bottom that provides access to Agate’s Stenomylus Quarry outlier; the corridor lands are grazed. Private lands used for grazing surround the park.

8. Annual Fire Weather Cycles and Historical Weather Analysis

Wind Direction for Agate Fossil Beds Nat’l Mon., 1987 - 2000
% of the time, by direction, at 1 PM, Mountain Standard Time

Month	NE	E	SE	S	SW	W	NW	N	CLM
Jan	4	2	2	5	12	19	9	10	37
Feb	0	0	2	6	13	15	27	6	33
Mar	3	7	6	19	11	10	16	5	23

Apr	12	5	10	10	8	8	29	15	4
May	16	7	10	16	6	15	17	13	0
Jun	12	7	9	22	12	10	16	11	0
Jul	13	8	11	20	14	7	11	13	2
Aug	13	10	12	15	18	11	12	8	2
Sep	12	4	6	12	14	17	24	8	2
Oct	7	4	8	13	15	15	26	10	1
Nov	6	1	5	9	23	25	18	11	2
Dec	6	3	0	4	15	15	15	3	35



Weather data recorded on the Forest Technology Systems weather station, NFDRS #250105, between September 1, 1997 and January 26, 2002:

- Average wind speed (10 minute average): 9.0 mph
- Maximum wind speed (gust): 55 mph
- Maximum temperature: 100°
- Minimum temperature: -16°
- Maximum Burning Index: 102

Fire Season. Generally, the fire season extends from March through Mid-October.

D. Historic Role of Fire

The pre-Euroamerican fire regime in mixed prairie can be characterized as frequent and low severity. Historically, fire return intervals averaged 5 years, eliminating most young woody species that had become established since the previous fire and rejuvenating native perennial grasses and forbs. Land use and suppression actions since the turn of the century have significantly altered the vegetative composition of the native plant communities. This places key components of this fire regime at, minimally, moderate risk of being lost.

IV. Wildland Fire Management

A. General Management Considerations

1. How Wildland Fire Will Be Managed

All wildland fires will be suppressed using an appropriate management response. Management responses to specific wildland fires will be determined through evaluation of public and firefighter safety, fire behavior, values at risk, potential suppression damage and availability of fire management resources.

Management responses will vary from fire to fire and sometimes even along the perimeter of a fire. Appropriate management response options range from monitoring without on-the-ground disturbance to intense suppression actions on all perimeters of the fire.

2. Implementation Procedures

The procedures outlined in *Reference Manual 18* (NPS 2002a) relative to the use of a Wildland Fire Implementation Plan (WFIP) will be followed. The Initial Attack Incident Commander will conduct the State 1 Initial Fire Assessment to begin the process of selecting the most appropriate management response. The required procedures will not be duplicated here.

B. Wildland Fire Use

Due to the small size of the park and the proximity to private lands, wildland fire use will not be used. All fires will be suppressed using the appropriate management response.

C. Wildland Fire Suppression

1. Range of Potential Fire Behavior

Fire behavior in the park can range from fast moving surface fires in light fuels to stand replacement fires of cottonwood trees in riparian areas. For more detailed discussion refer to the fire behavior discussions found in Unit III of this plan.

2. Preparedness Actions

a. Prevention and Prescribed Fire Educational Activities.

Fire prevention and education include all activities designed to reduce the number of human-caused wildfires that occur in the park. The objective of the program is to minimize preventable fires.

Prevention and education activities for Agate will consist of signing, messages delivered by park staff, and prevention watches during periods of high fire danger. Associated with prevention messages will be prescribed fire awareness messages tailored for the public.

Fire prevention and education will be discussed at a selected staff safety meeting in the early spring to make sure personnel are aware of concerns and procedures regarding response to suppression and actions related to prescribed fires.

The park may participate in fire prevention and education activities at local schools, groups and meetings so that the general public is aware of the importance of fire prevention and all other aspects of fire management.

During periods of high fire danger, the general public and park visitors will be informed of conditions through press releases, interpretive media and, if necessary, the posting of signs at park entrances, the Visitor Center and Museum.

Nationally, the first week of July is historically a high fire danger period. During this week, the visiting public will be reminded of regulations (Title 36 of the *Code of Federal Regulations*) regarding the prohibition of fireworks in the park and the policy regarding contained fires.

b. *Annual Training.*

Training will consist of fire fighter safety refresher training, first aid and other safety training for appropriate individuals. Agate needs to make every attempt to have a Type 4 Incident Commander on site or dispatched and on scene within 90 minutes.

c. *Annual Preparedness Activities.*

January. Perform fire physical exams every three years as per standards in *Reference Manual 18* (NPS 2002a).

February.

- Administer annual pack test to fire personnel as per standards in *Reference Manual 18* (NPS 2002a).
- Inventory fire cache and personal equipment, order needed supplies and update equipment list.
- Review step-up plan.
- Inspect all fire equipment for readiness.
- Check operation of engine pump and backpack pumps.
- Check established procedures for using suppression and emergency preparedness accounts.

March.

- Complete all prescribed fire plans for spring season (if any) and have them signed by the Superintendent.
- Obtain or prepare signs regarding prescribed fire interpretation.

March To Mid-October (Fire Season).

- Inspect all fire equipment to readiness and operate engine monthly.
- Complete all prescribed fire plans for the fall season and have them signed by the

Superintendent.

November.

- Critique fire season including all fire management activities (i.e., wildland fire suppression, prescribed fires and mechanical fuel treatments, prevention, etc.)
- Evaluate individual performance of park staff to correct deficiencies and recommend personnel for training.

December.

- Review and revise *Fire Management Plan* as needed.
- Update and submit fire qualifications to National Park Service Wildland Fire Computer System through the Northern Great Plains Area Fire Management Office.

d. *Fire Weather and Danger.*

Preparedness activities during the fire season are based on the National Fire Danger Rating System. Fire days are broadly divided into five staffing classes according to the intensity of danger factors as indicated by the Burning Index.

The Burning Index integrates the effects of weather, fuels and topography to estimate potential fire behavior and the corresponding amount of effort required to contain a fire. The staffing classes relate to the expected severity of fire conditions.

Preparedness actions are based on the predicted fire weather before 2:00 PM and on actual fire weather after 2:00 PM for all staffing classes.

Presently two stations are being used to determine the Burning Index. The first is at Agate Fossil Beds National Monument (Station # 250105) and the second is at Scott's Bluff National Monument (Station # 251905). At this time there has been an insufficient time period of data collection to use the Agate station as the primary station. Data from the Scott's Bluff station (1984 to 1999) indicate a value for the 90th percentile equaling a Burning Index of 44. The value for the 97th percentile is 60. The analysis was based on using Fuel Model L, a Slope Class of 2 (26-40 percent slope), perennial herbs and a Climate Class of 1 (Semi-arid).

Burning Index	Staffing Class
0-10	1
11-20	2
21-42	3
43-51	4
51+	5

e. *Step-Up Staffing Plan.*

The Superintendent and the Fire Management Officer have the ability to move up one preparedness staffing class for unusual park situations that would increase the potential for wildland fire.

Staffing Class 1 And 2 (Burning Index 0-20)

Conditions: Fires will present a low to moderate level of control difficulty. Fires occurring at this level may be controlled with existing forces. Wind speed and direction will determine severity of fire spread. Fine fuels will be drying.

Preparedness Actions:

- Fire weather reviewed daily.
- Hand tools and portable equipment kept in a state of readiness.
- One qualified employee will depart within 10 minutes to the fire location. Additional attack forces will be dispatched after size-up and upon request of the first firefighter to arrive.
- If the fire location is along the road or threatening structures, the park's engine will be dispatched.
- If necessary, cooperator assistance will be requested as described in the Northern Great Plains Mobilization Guide.

Funding Source: These activities will be funded through programmed park accounts or non-emergency FIREPRO funds.

Staffing Class 3 (Burning Index 21-42)

Conditions: Fires will present a moderate level of control difficulty. Light fuels are becoming dry. Heavy fuels are drying. Mop-up will be more difficult and time-consuming.

Preparedness Actions:

- All actions specified for Staffing Class I - II days will be implemented.
- Ensure that a minimum of two qualified fire personnel is available for initial attack.

Funding Source: These activities will be funded through programmed park accounts or non-emergency FIREPRO funds,

Staffing Classes 4 And 5 (Burning Index 43+)

Conditions: Fire will present a moderate to high level of control difficulty. Initial attack and reinforcing crews may have difficulty controlling a fire at this level. All fuels are dry. Air temperature is high and humidity is low. Strong gusty winds are possible. Spotting will likely occur.

Preparedness Actions:

- All actions specified for Staffing Class III days will be conducted.
- Daily fire situation reports will be reported to the Northern Great Plains Area Fire Management Office by 9:30 AM.
- Visitor Center and Museum personnel will alert the public to fire conditions and hazards.
- Interpretive activities will include a fire safety message.
- Fire danger notices will be posted.

Funding Source: FIREPRO emergency funds may be used at these staffing classes with the approval of the Northern Great Plains Area Fire Management Officer. It is recognized that both nonessential routine activities and project work may be postponed on Staffing Class IV and V days.

3. Pre-Attack Plan

Due to the size and scope of the fire program at Agate, no formal pre-attack plan has been written. Some preparations and procedures are established prior to and during the fire season. Some are mentioned in the Annual Preparedness Activities section, other pre-attack plans are informally discussed among the park staff and neighboring cooperators during practice or equipment maintenance assemblies. The value of a written pre-attack plan, or checklist, is recognized.

4. Initial Attack

a. *Priority Setting Resources during Multiple Fire Occurrences*

- Wildlife habitat and vegetation maps.
- Cultural and geological sensitivity zone map.
- Park facility map.
- Map displaying private structures within one mile of the park's boundary.

b. *Criteria for the Initial Attack Response Is Consistent with Park's Resource Management Plan Objectives*

- Public and firefighter safety.
- Protection of cultural and natural resources.
- Protection of improvements and private property.
- Minimum fireline construction.
- Available suppression resources and response times.
- Fire danger as determined by fuels, weather and topography.

c. *Confinement as an Initial Attack Suppression Strategy*

All initial attack actions should be to contain the fire as fast as possible to keep fires from leaving or entering the park boundary and damaging property and resources. "Minimum Impact Suppression Tactics" should be used in initial attack efforts when ever possible. Initial attack should be a reasoned response that considers the full range of available strategies. Confinement is a strategy that may be implemented in order to enhance firefighter safety, minimize suppression costs or best use limited available firefighting resources. Confinement may not be used to meet resource objectives.

d. *Typical Fire Response Times*

Typical fire response times at Agate vary depending on the park staffing, fire management activity in the local area, and time of day. During fire season when no other fire activity is

occurring and staffing is available, the Agate engine can respond to fires within 30 minutes. Reinforcements from local agencies can respond to a fire in the park within 30 minutes. Air tanker and helicopter attack can typically reach a fire within 1 to 2 hours. Reinforcements from outside the Custer Interagency Coordination Center dispatch area cannot be counted on arriving any sooner than eight hours after being requested. All response times are subject to availability of firefighting resources.

e. Restrictions and Special Concerns

- The Superintendent must authorize the use of any off-road mechanized equipment.
- “Minimum Impact Suppression Tactics” will be used when ever possible.

5. Extended and Large Fire Suppression

The size, location and fuels of Agate are such that if a large or extended attack fire were to occur it would have to be managed in cooperation with other jurisdictions. The following information should be used in determining management actions and decisions.

- Threats to life, property and park resources
- Availability of suppression forces
- Current and expected fire behavior
- Wildland Fire Situation Analysis

6. Exceeding Existing Wildland Fire Implementation Plan

If a wildland fire exits or imminently threatens to leave the park or if initial attack objectives are not met after 24 hours, the fire is to be considered to be in extended attack and a Wildland Fire Situation Analysis (WFSA) must be prepared.

7. “Minimum Impact Suppression Tactics”

All fire management activities in Agate will rely on tactics that do a minimum amount of resource damage while maintaining the safety of firefighters, personnel and the public as the highest priority.

8. Rehabilitation

After the fire is declared out, an evaluation of the impacts of the fire on cultural and sensitive geological resources will be made by a qualified subject expert who will recommend the rehabilitation and avoidance efforts necessary to protect affected cultural and geological materials. A fire ecologist or related subject expert will also evaluate the rehabilitation and avoidance efforts necessary to protected natural biological and geophysical resources. In consideration of those recommendations, all litter and trash will be removed and constructed firelines will be refilled and erosion control devices installed as is appropriate. The severity of the burn and its resultant impact, and the impact of proposed reseeding, will be considered in determining the need to seed or otherwise re-establish native plant species in the burned areas. Such efforts regarding landscaping and plants will be in full compliance with NPS management policies. A rehabilitation plan, outlining what species are to be planted, techniques to be used,

locations and cost estimates will be prepared in consultation with cultural and geological resource specialists as is appropriate before any action is taken.

9. Records and Reports

At Agate the Northern Great Plains Fire Management Officer is responsible for all fire management records and reports except as noted below.

a. *Individual Fire Report (U. S. Department Of Interior Form DI 1202)*. The Initial Attack Incident Commander for the fire is typically the person responsible for preparation of the Individual Fire Report. In most cases, this is the individual who put the fire out. That person may also want to complete a Case Incident Report (Standard Form 10-343) for the fire in addition to the DI 1202 form. Fires will be sequentially assigned, by the Northern Great Plains Fire Management Office, a fire number by calendar year, i.e., fires in 2000 are numbered 0001, 0002, etc. Instructions for filling out the report are found in *Reference Manual 18* (NPS 2002a).

For large fires, a complete fire report will include the following attachments, if applicable:

- Written policies, guidelines or authority statements signed by the Superintendent.
- Copies of equipment purchased or personnel request orders.
- All situation maps.
- Personnel lists including Emergency Firefighter Time Slips.
- Press clippings.
- Accident reports.
- All weather data reports and records.
- Documentation of financial charges made against the incident.
- Rehabilitation plan.

The completed Individual Fire Report is submitted by the Initial Attack Incident Commander to the Northern Great Plains Fire Management Officer who will review the report and is responsible for entry into the NPS Shared Applications Computer System.

b. *Training and Experience Records*. The NPS Wildland Fire Management Computer System at the National Interagency Fire Center is the central repository for all individual fire experience and training records. The Northern Great Plains Area Fire Management Officer is the person responsible to see that all training and experience for Agate is entered into the computer and ensuring the information is up to date.

c. *Daily Situation Report*. Daily Situation Reports are required on those days when the Burning Index reaches the 90th percentile and the park moves into Staffing Class IV and V or when a fire has occurred or is on going. The park will notify the Northern Great Plains Area Fire Management Officer who will then enter this report into the NPS Wildland Fire Management Computer System by 9:30 AM.

d. *Resource Order Form (National Fire Equipment Schedule Form 1470)*. All assistance requests must be documented on the Resource Order Form 1470. These forms can be transmitted orally over the telephone. The order form is, in essence, an obligating procurement document.

f. *Delegation of Authority*. Whenever an incident management team is ordered, the Superintendent must provide a written limited delegation of authority and a briefing package to the incoming Incident Commander.

V. FUELS MANAGEMENT

A. Scope of Prescribed Fire Program and Linkages to Resource Management

Prescribed fire is a very important tool to manage vegetation communities and to achieve the resource management goals of the park. Agate's *Resource Management Plan* notes that there is a need for an updated Fire Management Plan including a section on the management of ignited burns. Based on Wendtland's (1993) research at the park, prescribed fire could be used to "maintain the native prairie vegetation and reduce the numbers of exotic plant species" (AGFO 2000a:45).

The park's *Statement for Management* (AGFO 1995:5) identifies an objective "To identify, inventory, and monitor the condition of natural, cultural and scenic values of the park, and to provide appropriately for their preservation, protection and use."

Vegetation communities at Agate have been altered by extensive cattle and horse grazing from the late 1800s until 1974. There is no significant record of fire suppression, but overgrazing and the low fuel load may have inhibited the propagation and spread of natural fires from lightning strikes. The result has been a change in the native vegetation, with a decrease in forbs and an increase in exotic species (Canada thistle, cheatgrass [downy brome]). This has meant an increase in herbaceous and fire fuel loading. Since the early 1970's the park has excluded livestock grazing, which increases the potential for successful restoration of native grasses and forbs-dominated communities following a fire event. Restoration of fire would reduce the impacts of fire exclusion that has contributed to the current ecosystem perturbation, and scarify native seeds and prepare an establishment site. Prescribed fire is one of the most appropriate management actions to facilitate native vegetation restoration and resilient ecosystems at Agate.

B. Prescribed Fire

1. Annual Planning Activities

Burn plans should be prepared well in advance of their anticipated implementation date. The Superintendent, prior to any ignition, must approve all prescribed burn plans. In addition, all burn plans will be peer-reviewed by a subject matter specialist who was not involved with the development of the plan. A burn plan may have multiple burn units if these units have similar vegetation types, burn prescriptions and resource management objectives.

Prescribed fire burn units may vary in size but larger units are encouraged to assist in landscape scale restoration. Prescribed fire unit boundaries should use the natural features (slope, aspect and vegetation), natural fuel breaks and existing roads and trails for perimeter control.

Construction of perimeter fire control lines should be evaluated due to impacts to natural and cultural resources, cost and defensibility. Boundary and fence lines are often costly to construct and increase risk to fire fighter safety during holding operations.

2. Long Term Prescribed Fire Schedule

The goal of the program is to reintroduce fire into the ecosystem at the park. This will be done through a series of burns that will be conducted on a rotational basis coinciding with the historic return interval. A five-year burn schedule will be developed to accomplish this goal. See Appendix F.

3. Personnel Needed To Plan and Execute the Prescribed Fire Program

Planning and execution of this prescribed fire management program will use qualified personnel, as determined by National Wildfire Coordination Group standards and will follow the guidelines stated in document *Reference Manual 18* (NPS 2002a).

Currently, Agate does not have sufficient qualified staff to implement prescribed burns without assistance. The Northern Great Plains Area Fire Management Officer and adjacent agencies must be relied upon for assistance in planning and implementing each of the prescribed burns.

4. Prescribed Fire Monitoring

The Northern Great Plains Area Fire Ecologist will develop, in concert with the Northern Great Plains I & M Network, a short- and long-term monitoring program to measure attainment of prescribed fire objectives. Monitoring is essential for adaptive management, where qualitative and quantitative changes to resources are measured and used as a tool to guide modifications for subsequent prescription treatments and burn objectives. See Section VIII Monitoring and Appendix E.

5. Documentation Requirements

See *Reference Manual 18* Chapter 10, Prescribed Fire Plan Section (NPS 2002a).

6. Reporting Requirements

See *Reference Manual 18* Chapter 10, Prescribed Fire Plan Section (NPS 2002a).

7. Prescribed Fire Critiques

Critiques should address such issues as success of burn objectives, burn implementation, equipment and safety issues. Additionally, comments on how the planning and implementation process could be improved should be discussed.

C. Prescribed Fire Plan

The requirements for writing, reviewing, and implementing burn plans are in *Reference Manual* 18, Chapter 10 (NPA 2002a).

D. Exceeding Existing Prescribed Fire Plan

If the implementation of a prescribed fire is unsuccessful, the procedures in *Reference Manual* 18, Chapter 9 (2002a) will be followed, which would include the development of a Wildland Fire Situation Analysis.

E. Air Quality and Smoke Management

1. Pertinent Air Quality Issues

The subject of air quality and its effect on the Agate resources, as well as visitor enjoyment of those resources, is of great concern to park managers and the local public. The quality of the airshed for the park and the surrounding valley should be discussed with all concerned parties in order to heighten awareness and support for the prescribed fire program. In carrying out day-to-day operations, park staff will follow a policy of carrying out internal operation in such a way as to have a minimum impact on all park resources including air quality related issues.

2. Smoke Management Planning and Implementation Measures

Agate's fire management program for will be in full compliance with interstate, state and local air pollution control regulations as required by the Clean Air Act, 42 U.S.C. 7418. Necessary state air quality clearances and permits will be obtained prior to the initiation of a prescribed fire. During prescribed fires smoke will be monitored for trajectory, mixing height and impact to air quality sensitivity areas.

Goal 1. Park staff and visitors are protected from unhealthful levels of air pollution from prescribed fires.

Objective. Do not exceed ambient concentrations of particulate matter (PM₁₀ and PM_{2.5}) in the National Ambient Air Quality Standard (EPA 1997).

Objective. Keep ambient concentrations of carbon monoxide measured below the National Ambient Air Quality Standard established by the Environmental Protection Agency (EPA 200a,b).

Strategy. Use and identify state of the art fire management practices to foster smoke dispersion, or limit the size of the burn to reduce the amount of particulate matter produced. The Simple Approach Smoke Estimation Model, or equivalent, will be used to estimate particulate matter and carbon dioxide concentrations and to ensure the proposed prescribed fire does not cause National Ambient Air Quality Standard violations. On-site monitoring will be conducted to determine particulate matter concentrations and smoke dispersion for burns with the capability to significantly affect the local airshed for more than one burning period.

Goal 2. Average visibility within the park is not impaired to levels where visibility seriously impairs the neighboring airshed.

Objective. Smoke plumes will disperse within 10 miles downwind of the fire as observed from a point perpendicular to the smoke trajectory.

Strategy. Management practices will be used to foster rapid transport and dispersal of smoke. Ignition techniques will be timed to take advantage of dispersion and to limit smoke production during those times of day when free air mixing is less likely (evening and night).

3. Smoke Management Practices

- Burn in seasons characterized by meteorological conditions that allow for good smoke dispersion.
- Use ignition techniques, which produce high intensity fires with short duration impacts when cost effective.
- Ignite burns under good-to-excellent ventilation conditions and suspending operations under poor smoke dispersion conditions.
- Consider smoke impacts on local community activities and land users.
- Burn only essential fuels to meet resource management objectives.
- Minimize smoldering through fuel moisture considerations.
- Burn piles when other burns are not feasible, such as when snow or rain allows.
- Use all opportunities that meet the burn prescription and all burn locations to spread smoke impacts over a broader time period and geographic area.
- Burn during optimum mid-day dispersion hours, with all ignitions in a burn unit completed by 3:00 PM to prevent trapping smoke in inversions or diurnal wind patterns.
- Implement maintenance burning in a periodic rotation mimicking natural fire cycles to reduce excessive fuel accumulations and subsequent excessive smoke production through smoldering or wildfire.
- Manage smoke impacts as follows:
 - Limit smoke impact to levels that allow safe use by vehicles.
 - Use appropriate signing if smoke will impact any roadways.
 - Determine nighttime impacts and take appropriate precautions.
 - Contact appropriate authorities, as needed, regarding smoke or visibility impacts.

F. Non-Fire Applications

Since the primary vegetation type at Agate is grass, there is little need for a large-scale mechanical hazard fuel reduction program such as those in park units with large quantities of timber. Mowers or other types of grass trimming machines will be used to construct firelines as part of the preparation of prescribed fires, taking into consideration cultural and/or geological sensitivity zones and soil/vegetation characteristics. Mowing will continue to be used to reduce the fuel loading of the grass around the structures and other improvements. Mowing is also used to control exotic species. But, it is not likely that FIREPRO funds or personnel will be involved in large-scale mechanical fuel reduction projects.

VI. FIRE MANAGEMENT ORGANIZATION AND RESPONSIBILITIES

A. Organizational Structure of the Park's Fire Management Program

Agate does not have a formal fire management organization. The Northern Great Plains Area Fire Management Officer provides oversight and assistance as requested. The personnel at Agate, Scotts Bluff National Monument, and Fort Laramie National Historic Site frequently assist each other with fire management activities.

B. FIREPRO Funding

FIREPRO is the mechanism for funding requests and resource allocation for the NPS fire management program. Currently, the Northern Great Plains Area Fire Management Officer manages all FIREPRO funding for Agate. Funding is available for engine maintenance, personal protective equipment for firefighters and training funds on an as-needed and available basis.

C. Fire Management Organization in Relation to Park Organization

The Northern Great Plains Fire Management Officer is the focal point for fire management at Agate. This entails coordinating with the park, NPS Midwest Region and the Fire Management Program Center staff on fire and resource management issues generated by either prescribed or wildland fire.

D. Fire Use

(Does not apply)

E. Interagency Coordination

Interagency coordination and cooperation is integral to successful implementation of the fire management program at Agate. Only small, slow moving wildland fires can be managed within the current capabilities of the park. All other wildland and prescribed fires will require external support by interagency cooperators and/or other NPS units. Annual review of cooperative agreements will ensure successful coordination.

E. Key Interagency Contacts

- Chief, Harrison Rural Fire Protection District (Phil Hughson, President 2003-4, Ph. 308-623-3126 but dispatched through Chadron 911)
- Chief, Harrison Volunteer Fire Department (Jim Ellicott, Chief 2003-4, Ph. 308-668-2146 but dispatched through Chadron 911)
- Fire Management Officer, Nebraska National Forest, Chadron (Allen Setzer, 308-432-0300; dispatched through Rapid City Dispatch Center)
- Fire Management Officer, Crescent Lake-North Platte National Wildlife Refuge Complex, Scottsbluff (Steve Knode or Brad McKinney are Complex contacts, Ph. 308-635-7851, but dispatched out of Rapid City Dispatch Center)

G. Fire Related Agreements

There is a General Agreement between Agate Fossil Beds National Monument and the Harrison Rural Fire Protection District (Appendix D).

VII. FIRE RESEARCH

A. Completed Research

Kyle J. Wendtland conducted controlled burns at Agate and Scotts Bluff National Monument in 1988 and 1989 as a University of Wyoming graduate fire management research project (Wendtland 1993). Wendtland focused on Scotts Bluff's ecology and fire management program, but also conducted work at Agate. He described the Agate vegetation communities, including the Buckley oldfield that had been cultivated one season in the 1950s and is now dominated by cheatgrass (*Bromus tectorum*); his ten 10x10m burn plots were all located within this oldfield. Wendtland also described Agate's precipitation pattern, soil water content, and aboveground primary plant production, and compared spring, summer, and fall burns in selected plots. He found a "drastic reduction [in annuals] with summer and fall burning (Wendtland 1993:31) and estimated that Agate's historical point fire return interval was five years. Wendtland's professors, Dodd and Smith (1994:3), noted that "[i]t is doubtful that native plants will dominate this community within the next 50 years or even longer unless something is done to weaken cheatgrass."

B. Needed Research

Additional research is needed at Agate to identify methods to more effectively use fire as a tool in reestablishing the native mixed prairie, while concurrently reducing exotic species and not adversely impacting significant cultural, geological, biological, and geophysical resources. As research opportunities become available specific studies could be undertaken to evaluate fire effects on water quality, riparian erosion rates, avifauna habitat, sacred landscapes, archeological sites, and relatively friable fossiliferous geological deposits.

Implementation of the *Agate Fire Management Plan* should not be contingent on completion of additional research of the local fire regime and fire effects on vegetation. A significant body of scientific information regarding effects of fire and fire exclusion for plant associations typical of Agate already exists (see Appendix E). Although this research was accomplished outside of Agate, it is in similar geographic areas and its results may be applied to the Agate landscape.

Fire research has limited funding within the NPS. However, if it is determined that significant information is needed concerning the effects of fire or fire exclusion Agate may submit funding requests through the annual FIREPRO budget call. Additionally, requests for research funding may be made through the Interagency Joint Fire Science Group.

VIII. MONITORING

A. Monitoring Requirements

A fire effects monitoring program (Appendix E) must be initiated in conjunction with the prescribed fire program. Monitoring will focus on native grass, shrubs, herbs and trees responses to prescribed fires. Evaluation and interpretation of fire effects monitoring is the joint responsibility of fire and resource management personnel. Interpretation of monitoring results will then be linked to adaptive management decisions.

Long-term monitoring will include the installation of permanent plots to determine the plots of prescribed fire. Long-term monitoring will also detect if the resource management objectives are being achieved, such as percent change in grass cover.

Short-term monitoring will follow the procedures and protocols established in the NPS *Fire Monitoring Handbook* (NPS 2003). Short term monitoring will also determine if the quantifiable burn unit objectives have been achieved, such as the amount of tree and shrub mortality.

B. Fire Monitoring Handbook

All prescribed fire monitoring activities at Agate will follow guidelines in the National Park Service *Fire Monitoring Handbook (FMH; NPS 2003)*.

In addition to the *FMH*, photo points are a very valuable site-monitoring tool and will supplement the handbook. The establishment of permanent photo points prior to a prescribed fire should be the minimum monitoring procedure. The use of both Handbook plots and photo points will provide effective monitoring.

All prescribed fires must include the appropriate number of prescribed fire monitors to record on site weather, smoke dispersal, fire behavior and to collect data from FMH plots within the burn unit. A prescribed fire monitoring report that includes weather observations, fire behavior observations, ignition pattern and immediate post fire effects, will be completed for each burn. Monitoring critiques will also be accomplished after prescribed fire projects have been completed.

C. Fire Monitoring Plan

See Appendix E.

IX. PUBLIC SAFETY

A. Public Safety Issues

Wildland and prescribed fires can present a hazard to firefighters, employees and to the public visiting the park. Additionally, private and park developments are at risk from wildfire. The

safety of all people and developments in the area are the foremost concern of the Incident Commander and/or Prescribed Fire Burn Boss. Escape routes and safety zones will be identified to enhance public safety.

B. Procedures for Mitigating Safety Issues

Usually the entire perimeter of a wildfire is easily monitored and there is little likelihood the fire will spread far. In these cases, the concern will be to keep the public out of the immediate fire area, far enough away that they will not hinder the suppression activities. Under no circumstance will anyone be permitted near a fire without the appropriate training and personal protective equipment.

In the case of a wildland fire that has potential for rapid spread, there will be a possibility that park visitors will be in areas of danger. Visitors will be informed at the park entrance and the Visitor Center and Museum regarding the fire and the area where caution should be exercised. Efforts will be made to inform park visitors and neighbors of any fire activity that may threaten them and what measures to take to stay safe.

Temporary closure of the park or a portion may be needed when fire behavior has potential to endanger visitor and employee safety. When a fire threatens to escape from the park or has the potential to do so, adjacent authorities will be given as much advance notice as possible in order to take appropriate action.

In extreme situations where the rate of spread constitutes an immediate threat, all efforts should be made to inform and evacuate all threatened parties as quickly as is safely possible.

Signs will be placed at each trailhead warning hikers when a prescribed fire is in progress. Signs warning of possible smoke on the road will be placed if smoke produced during wildland and prescribed fires creates a safety concern. Roads will be closed if visibility on park roads is significantly impaired.

X. PUBLIC INFORMATION AND EDUCATION

A. Public Fire Information Capabilities and Needs

As with all park activities, the presence of an informed public can go far in providing support for the fire management program at Agate and fostering its goals. A concerted effort will be made to make the public aware of fire concerns at the park including fire prevention messages, fire danger indices when they are high or extreme, and the presence of on-going fires. Fire management messages will be introduced into interpretive programs where appropriate. The park may participate in fire prevention and education activities in the community in conjunction with neighboring fire departments. Visitors will be made aware of fire restrictions and closures in and around the park. High fire danger notices will be posted at the Visitor Center and Museum when needed. Local media will be informed of fire prevention and education concerns through news releases. Media access to fire scenes will be facilitated when it is safe to do so. When interest is

warranted, a staff member will be designated as the contact person for all information requests.

B. Step-Up Plan Information Actions

Refer to Section IV.C.2.E of this plan.

XI. PROTECTION OF SENSITIVE RESOURCES

A. Archeological, Fossil, and Geological Sites, Historic (including Cultural Landscapes and Traditional Cultural) Properties, and Ethnographic Resources

Agate has 95 archeological sites documented on its fee-owned lands. Most of these are sparse scatters of stone tools or flaking debris more than 150 years old and probably are not eligible for listing on the National Register of Historic Places. A few of them are apparently older mounds or cairns, some of which have been identified as Register-eligible traditional cultural properties. GIS-documented locational data are available for all these sites. The park has been extensively surveyed to identify archeological remains on government lands during the past thirty years, but presently undocumented sites may be present and visible once their vegetative cover is removed because of Agate's extensive gopher activity. The entire park is considered Register-eligible as a cultural landscape with included ethnographic resources, with component landscapes identified as the Red Cloud Camp, Carnegie Hill, and the Crazy Buffalo Complex, as well as the Registered Bone Cabin Complex. The locations of these sites and areas are mapped.

Known paleontological deposits are located in the Stenomylus Quarry outlier and in University, Amherst (North), Carnegie, and Beardog Hills, Buffalo Woman Rock, the Agate Ash Quarry site, the Daemonelix Trail area, and some isolated occurrences. The Agate Ash, a critical time marker in the Agate area, outcrops on Amherst (North) Hill, at a site west of Agate Road 312, and in a few other localities. Ancient sand dunes are present in the Daemonelix area. All of these fossil/geological localities have documented condition assessments and are mapped and included within the park GIS database.

It is probable that the archeological lithic scatters would not be adversely affected by wildfire or prescribed fire itself, but they could be by mechanical disturbance during fire fighting or cleanup. In the event of a wildfire, culture resource location maps (available only on a need to know basis, and collected after any fire) will be consulted and sites protected as is appropriate (e.g., from mechanical intrusion or fire itself)—significant historic structures would be protected from all fire impacts insofar as possible. Geological sites will also be protected from mechanical disturbance during wildfire or prescribed fire, and impacts to them will be carefully monitored and documented. All currently undocumented cultural sites discovered during a fire activity will be protected and reported.

The Native American Graves Protection and Repatriation Act (P.L. 101-601, 25 U.S.C. 3002, 104 Stat. 3048) Sec. 3(d) addresses the inadvertent discovery of Native American remains and objects during Federal activities such as firefighting. The law requires that "If the discovery occurred in connection with an activity...the person shall cease the activity in the area of the

discovery, make a reasonable effort to protect the items discovered before resuming such activity, and provide notice under this subsection.” To accommodate this requirement and the related regulations and guidance, an *Emergency Discovery Native American Consultation Plan* has been developed as part of Agate’s fire management program and is included here as Appendix H.

B. Sensitive Natural Resources

No Federally listed threatened or endangered species reside at Agate. There are a few plants at Agate listed as rare species by the State of Nebraska, but it is improbable that they would be adversely affected by wildfire or prescribed fire over them.

SPECIES	COMMON NAME	NEBRASKA STATUS*
<i>Chenopodium subglabrum</i> (S. Wats.) A. Nels	Smooth goosefoot	S3
<i>Erigeron ochroleucus</i> Nutt.	Buff fleabane	S2
<i>Eriogonum cernuum</i> Nutt.	Nodding wild buckwheat	S1
<i>Fritillaria atropurpurea</i> Nutt.	Purple mission bells	S2
<i>Phacelia hastata</i> Dougl. ex Lehm.	Scorpionweed	S2
<i>Tripterocalyx micranthus</i> (Torr.) Hook.	Small-flowered sand verbenas	S1

*S1=critically imperiled, S2=imperiled, S3=rare or uncommon, SU=status undetermined; NNHP 2002

There are currently eight Canada thistle insectaries established on Agate park lands, and these will be protected against inappropriate mechanical and wildfire intrusion during insect growth periods (spring and early summer).

C. Infrastructure and Developments

Urban-interface wildland fire risk mitigation techniques should be applied to prevent or reduce negative impacts to infrastructure and developments within the park’s boundaries.

XII. FIRE CRITIQUES AND ANNUAL PLAN REVIEW

A. Critiques

All fires occurring within the park will receive, at a minimum, a review by those involved to evaluate such topics as: the initial response, “hotline” (on-going fire incident) review, control methods used, safety concerns and the need for new and replacement equipment. This review will be conducted by one of the following: the Incident Commander, Prescribed Fire Burn Boss, Fire Management Officer, or the official who has designated fire program responsibilities. The purpose of this review is to recognize and document actions that were successful and identify

and rectify actions that were unsafe or ineffective.

The Superintendent will conduct closeout meetings with Incident Management Teams to ensure a successful transition of the incident back to the park and to identify and evaluate incomplete fire business. Refer to *Reference Manual 18* (NPS 2002a) Chapter 13, Exhibit 1 for a sample Incident Management Team closeout.

A regional or national level fire review may be conducted if one of the following occurs.

- Fire crossed the park boundary into another jurisdiction without the approval of landowner or agency.
- Fire resulted in adverse media attention.
- Fire involved serious injury or death, significant property damage, or had the potential to do so.
- Fire resulted in controversy involving another agency or landowner.

Refer to *Reference Manual 18* (NPS 2002a) Chapter 13, Exhibits 2 and 3.

All entrapments and fire shelter deployments will be reported and investigated as soon as possible after the deployment incident. Refer to *Reference Manual 18* (NPS 2002a) Chapter 13, Exhibits 4 & 5 for review directions and a written outline format.

B. Plan Reviews

An informal fire management program review will be conducted annually to evaluate current procedures and identify any needed changes to the park's *Fire Management Plan*. A formal fire management review will be conducted every five years. The Superintendent must approve significant changes to the body of this plan. The only exceptions to this procedure will include: grammatical corrections, minor procedural changes, deletions, corrections and additions to the Appendix. Copies of all changes will be promptly forwarded to the Northern Great Plains Area Fire Management Officer who will forward them the Midwest Regional Fire Management Office. Changes requiring approval and concurrence will be submitted with a new cover sheet for signature and dates, which will replace the original cover sheet upon receipt by the Superintendent.

XIII. CONSULTATION AND COORDINATION

A. Agencies Consulted

Apache Tribe of Oklahoma
Arapahoe Tribe of the Wind River Reservation
Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation
Cheyenne-Arapahoe Tribes of Oklahoma
Cheyenne River Sioux Tribe of the Cheyenne River Reservation
Comanche Indian Tribe of Oklahoma
Crow Creek Sioux Tribe of the Crow Creek Reservation

Crow Tribe of Montana
Flandreau Santee Sioux Tribe
Fort Sill Apache Tribe of Oklahoma
Jicarilla Apache Tribe of the Jicarilla Apache Indian Reservation
Kiowa Tribe of Oklahoma
Lower Brule Sioux Tribe of the Lower Brule Reservation
Mescalero Apache Tribe of the Mescalero Reservation, New Mexico
Nebraska State Historic Preservation Office
Northern Cheyenne Tribe of the Northern Cheyenne Indian Reservation
Northwestern Band of Shoshoni Nation
Oglala Sioux Tribe of the Pine Ridge Reservation
Omaha Tribe of Nebraska
Pawnee Indian Tribe of Oklahoma
Ponca Tribe of Indians of Oklahoma
Ponca Tribe of Nebraska
Rosebud Sioux Tribe of the Rosebud Indian Reservation
Santee Sioux Tribe of the Santee Reservation
Shoshone-Bannock Tribes of the Fort Hall Indian Reservation of Idaho
Shoshone Tribe of the Wind River Reservation
Shoshone-Paiute Tribes of the Duck Valley Reservation
Spirit Lake Sioux Tribe of the Devils Lake Sioux Reservation, North Dakota
Standing Rock Sioux Tribe of the Standing Rock Reservation, South Dakota and North Dakota
Three Affiliated Tribes of the Fort Berthold Reservation
Yankton Sioux Tribe

B. Persons Consulted

Dave Carr, Fire Management Officer, Crescent Lake National Wildlife Refuge, Oshkosh, NE
Kenny Keener, Marsland, NE
Leona Keener, Marsland, NE
Ritch Nelson, Nebraska Game and Parks Commission, Alliance, NE
Joe Nunn, Sioux County Commissioner, Harrison, NE
Dan O'Brien, Fire Management Consultant, Central Point, OR

XIV. APPENDICES

Appendix A. References

Agate Fossil Beds National Monument (AGFO)

- 1966 *Master Plan for Agate Fossil Beds National Monument*. U. S. Department of the Interior, National Park Service, Agate Fossil Beds National Monument, Harrison, NE.
- 1988 *Wildfire Management Plan, Agate Fossil Beds National Monument*. U. S. Department of the Interior, National Park Service, Agate Fossil Beds National Monument, Harrison, NE.
- 1995 *National Park Service Agate Fossil Beds National Monument Statement for Management*. U. S. Department of the Interior, National Park Service, Agate Fossil Beds National Monument, Harrison, NE.
- 2000a *Agate Fossil Beds National Monument Resources Management Plan*. U. S. Department of the Interior, National Park Service, Agate Fossil Beds National Monument, Harrison, NE.
- 2000b *Strategic Plan for Agate Fossil Beds National Monument, October 1, 2001, - September 30, 2005*. U. S. Department of the Interior, National Park Service, Agate Fossil Beds National Monument, Harrison, NE.
- 2003 *Agate Fossil Beds National Monument National Environmental Policy Act Draft Environmental Assessment and National Historic Preservation Act Draft Assessment of Effect to Develop a Wildland Fire Management Program within the Park*. U. S. Department of the Interior, National Park Service, Agate Fossil Beds National Monument, Harrison, NE.

Dodd, Jerrold L., and Michael A. Smith

- 1994 *Fire Ecology and Management of Scotts Bluff and Agate Fossil Beds National Monument: Final Report*. Report on file, U. S. Department of the Interior, National Park Service, Agate Fossil Beds National Monument, Harrison, NE.

Environmental Protection Agency (EPA)

- 1997 *National Ambient Air Quality Standards for Particulate Matter (40 CFR 50)*. 62 *Federal Register* 38792.
- 2000a *Air Quality Criteria for Carbon Monoxide*. EPA 600/P-99/001F. Office of Research and Development, U. S. Environmental Protection Agency, Washington.
- 2000b *Air Quality Criteria for Carbon Monoxide (Final): Notice of availability of a final document*. 65 *Federal Register* 50202.

National Park Service (NPS)

2001a Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision-Making. U. S. Department of the Interior, National Park Service, Washington.

2002a Director's Order #18: Wildland Fire Management. U. S. Department of the Interior, National Park Service, Washington. This is accompanied by NPS Reference Manual 18, *The Wildland and Prescribed Fire Management Policy: Implementation and Reference Guide*, which is being constantly updated and is available online at www.nps.gov/fire/fire/policy/rm18/.

2002b Director's Order #77-1: Wetland Protection. U. S. Department of the Interior, National Park Service, Washington.

2003 *Fire Monitoring Handbook*. Fire Management Program Center, National Interagency Fire Center, Boise.

National Wildfire Coordinating Group (NWCG)

2000 National Interagency Incident Management System Wildland and Prescribed Fire Qualification System Guide. PMS 310-1. National Wildfire Coordinating Group, Washington.

Nebraska Natural Heritage Program (NNHP).

2002. *Nebraska Plants of Concern*. <http://www.natureserve.org/nhp/us/ne/plants.html>.

Wendtland, Kyle J.

1993 Fire history and effects of seasonal prescribed burning on northern mixed prairie, Scotts Bluff National Monument, Nebraska. M.S. thesis, Department of Range Management, University of Wyoming, Laramie. 188pp.

Appendix B. Definitions

Wildland Fire Management Terminology (Adopted By National Wildfire Coordinating Group 6/12/97; http://www.nwcg.gov/nwcg_admin/terminol.htm)

Wildland Fire – Any non-structure fire, other than prescribed fire, that occurs in the wildland.

Fire Use Fire -- A naturally-caused wildland fire that may not be immediately suppressed, but is managed for resource benefits, if authorized in the unit's Fire Management Plan. Various tactics may be used to confine the fire within a Maximum Management Area, slowing or stopping the spread in certain areas. These fires may burn for months, and require a very large land base, for example, at least 40,000 to 100,000 acres, preferably more.

Fire Management Plan - A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plan.

Preparedness - Activities that lead to a safe, efficient, and cost effective fire management program in support of land and resource management objectives through appropriate planning and coordination.

Prescription - Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include safety, economic, public health, environmental, geographic administrative, social or legal consideration.

Appropriate Management Response - Specific action taken in response to a wildland fire to implement protection and fire use objectives.

Prescribed Fire - Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met prior to ignition.

Wildfire - An unwanted wildland fire.

Initial Attack - An aggressive suppression action consistent with firefighter and public safety and values to be protected.

Wildland Fire Situation Analysis (WFSA) - A decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economic, political, and resource management objectives as selection criteria.

OBSOLETE TERMS

Many traditional terms have either been omitted or made obsolete by the Policy. The terms

listed here have uses or connotations that are contrary to the new policy.

Presuppression -The term "presuppression" has been replaced by the term "preparedness" to match policy and appropriation language.

Prescribed Natural Fire

Management Ignited Prescribed Fire

Escaped Fire Situation Analysis - This term is replaced by Wildland Fire Situation Analysis,

Confine/Contain/Control - These terms, when used in the context of suppression strategies, are confusing since they also have tactical meanings. Containment and control are assumed to maintain their definition for fire reporting Purposes.

Appendix C. National Environmental Protection Act and National Historic Preservation Act Compliance

These are addressed in a separate document (AGFO 2003).

Appendix D. Cooperative Agreement

GENERAL AGREEMENT
between
NATIONAL PARK SERVICE
AGATE FOSSIL BEDS NATIONAL MONUMENT
and
HARRISON RURAL FIRE PROTECTION DISTRICT

I. PURPOSE

This agreement shall define and set fourth the basic understanding concerning the cooperation in fire control activities between Agate Fossil Beds National Monument and the Harrison Rural Fire Protection District.

II. AUTHORITY

The authority for Agate Fossil Beds National Monument to enter into this agreement is 42 USC, Section 1856a, 16 USC Section 1b(1), and the Department of the Interior Manual 910. These provide authority to enter into interagency agreements for the provision of mutual aid in the suppression of fires.

The authority of the Harrison Rural Fire Protection District to enter into this agreement is Nebraska Revised Statute 13-801 et. seq. (R.R. 1987) and the following agreements:

- Order and Certificate of the Sioux County Commissioners to Organize a Harrison Rural Fire Protection District, dated March 30, 1961,
- Harrison Volunteer Fire Department Articles of Incorporation, filed with the State of Nebraska July 15, 1985, and
- Agreement between the Harrison Rural Fire Protection District and the Harrison Volunteer Fire Department for Mutual Cooperation. September 11, 1986.

III. FIRE SUPPRESSION

A. Agate Fossil Beds National Monument Agrees:

1. To dispatch available National Park Service trained and qualified fire fighters and equipment to any wildfire in the Mutual Aid Zone. The Mutual Aid Zone will be defined as that area of Sioux County, Nebraska, which is under the protection of the Harrison Rural Fire Protection District. Requests for fire fighters and equipment must be made by the President, Harrison Rural Fire Protection District; Chief, Harrison Volunteer Fire Department; or a designee of either, to any of the following persons: Fire Coordinator, Agate Fossil Beds National Monument; Superintendent, Agate Fossil Beds National Monument; Fire Coordinator, Scotts Bluff National Monument; Chief Ranger, Scotts Bluff National Monument and Agate Fossil Beds National Monument; or Superintendent, Scotts Bluff National Monument.

Fire equipment owned by Agate Fossil Beds National Monument which may be available under this agreement for wildland fire use by monument staff includes, but may not be limited to:

- One (1) 150 gallon slip-on pumper unit mounted on 4x4 diesel brush truck,
- One (1) 150 gallon slip-on foam unit in storage but can be quickly mounted onto a 4x4 pickup truck,
- Two (2) portable pumps,
- One (1) 1,000 gallon portable water tank,
- Three (3) portable radios (2 low band, frequencies 39.9 and 39.98 and one programmable radio),
- One (1) mobile radio on the fire truck, programmable,
- One (1) chain saw, and
- Other miscellaneous items including: hoses, fire line building tools, hose and pump fittings.

Dispatch of fire fighters and equipment is subject to the limitations as set fourth in Section III.C.1 of this document.

2. To provide access to, and water from, fire hydrants and natural water sources located within the boundaries of Agate Fossil Beds National Monument for the suppression of fires within the Harrison Rural Fire Protection District. Access to water sources is restricted to existing bridges and service roads unless otherwise approved by the Superintendent, Agate Fossil Beds National Monument.
3. To take initial suppression action by trained fire fighters on wildland or structural fires occurring within the defined Mutual Aid Zone.

Due to the lack of structural fire fighter trained personnel, and the absence of structural fire fighter protective equipment (SCBA's, turnouts, etc.), Agate Fossil Beds National Monument staff are prohibited from performing interior attack on structural fires.

4. To have all designated park fire fighters meet the training, experience, and physical fitness requirements for their respective fire suppression positions, and have them wear the required personal protective equipment, as established by the National Wildland Fire Qualifications System, when performing fire suppression activities.
5. To inspect and maintain a system of portable fire extinguishers located at structures throughout Agate Fossil Beds National Monument, and to routinely inspect, test, and maintain monument-owned fire hydrants.
6. To notify the Harrison Rural Fire Protection District of any scheduled research or prescribed burns on Agate Fossil Beds National Monument.

B. The Harrison Rural Fire Protection District Agrees:

1. To dispatch available personnel and equipment upon request to emergencies occurring within the boundaries of Agate Fossil Beds National Monument. Emergency response situations for which assistance may be requested include, but are not limited to, wildland fire, structural fire, and other emergency situations for which the Harrison Rural Fire Protection District is currently trained and equipped to handle (e.g., hazardous materials spills, vertical rescue, vehicle fires).

Requests for assistance may be initiated by any of the following persons: Superintendent, Agate Fossil Beds National Monument; Fire Coordinator, Agate Fossil Beds National Monument; Fire Coordinator, Scotts Bluff National Monument; Chief Ranger, Scotts Bluff National Monument and Agate Fossil Beds National Monument, Superintendent, Scotts Bluff National Monument.

Dispatch of fire fighters and equipment is subject to the limitations as set fourth in Section III.C.1 of this document.

2. To exercise reasonable care while responding to requests for assistance in Agate Fossil Beds National Monument in order to prevent damage to the natural and cultural resources. The reason for this caution is that the operation of certain mechanized fire fighting equipment, or hasty construction of fire line could damage archeological, fossil, or other park resources at or near the surface. In these cases, the damage to the resources from fire fighting activities could be greater than damage which would be caused by the fire itself.

Under no circumstances will heavy equipment (bulldozers, plows) be used in the monument without the direct permission of the Superintendent, Agate Fossil Beds National Monument, or the Superintendent, Scotts Bluff National Monument.

3. To issue burning permits in accordance with Nebraska Statute 81-520.01 (as amended) to private individuals or organizations holding interests in lands within the boundaries of Agate Fossil Beds National Monument (See Appendix A).

The Harrison Rural Fire Protection District agrees to notify requestors of such permits that the permit is issued with the following understandings and stipulations:

- 1) That the Agate Superintendent, Fire Coordinator, or Chief Ranger must be contacted at least 48 hours prior to any planned burning activity within the boundaries of Agate Fossil Beds National Monument, and
- 2) That Agate Fossil Beds National Monument, under the property clause of the U.S. Constitution, has full authority to control, limit, restrict, or prohibit any burning activity on any lands within the legislative boundaries of the monument.

C. The Two Agencies Mutually Agree:

1. That the responding agency may limit the quantity of fire fighters and equipment sent to assist the requesting agency in order to maintain an adequate level of protection for their primary area of responsibility. In such cases the responding agency will immediately notify the requesting agency of the amount and type of equipment and fire fighters to be supplied.
2. That upon arrival at the scene, the responding agency's commanding officer shall put his/her equipment and fire fighters at the disposal of and under the direction of the requesting agency.
3. To encourage participation by the other agency in sponsored fire training activities.
4. To exchange appropriate fire management plans and maps.
5. To exchange telephone numbers of the responsible persons to be contacted in an emergency.
6. That nothing in this agreement shall be construed to prevent either agency from suppressing fires on adjacent lands if such fires endanger property in the responding agency's area of responsibility. Either agency, upon discovery of a fire, may, upon notifying the other agency, take immediate action to suppress a fire in the other agency's primary protection zone in order to save life or property.

D. Suppression Costs:

Each agency will assume the costs of its respective fire control actions.

This agreement does not obligate funds nor shall anything herein be construed as obligating the Service to obligate funds as a result of this agreement.

IV. OFFICIALS NOT TO BENEFIT

No member of or delegate to Congress, or resident Commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

V. NON-DISCRIMINATION

During the performance of this agreement, the agencies agree to abide by the terms of Executive Order 11246 on non-discrimination, and will not discriminate against any person because of race, color, religion, sex, or national origin.

VI. LIABILITY

Each agency waives all claims against the other agency for compensation for any loss, personal injury, or death occurring in consequence of the performance of this agreement.

VII. APPLICATION AND TENURE OF THIS AGREEMENT

- A. This agreement supersedes and cancels all previous fire control agreements and memoranda.
- B. This General Agreement will continue for five (5) years from the date of the last signature. Either participant may request re-negotiation or revision of this Agreement annually.


 Superintendent Date 2/1/02
 Agate Fossil Beds National Monument


 President Date 2/5/02
 Harrison Rural Fire Protection District


 Superintendent Date 2-14-02
 Scotts Bluff National Monument

**Appendix A. PRIVATE INDIVIDUALS HOLDING INTERESTS IN
LANDS WITHIN AGATE FOSSIL BEDS NATIONAL MONUMENT**

Agate Springs Ranch, Inc.
Skavdahl Brothers, Inc.

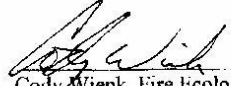
Appendix B. PARK CONTACTS FOR REQUESTING MUTUAL AID ASSISTANCE

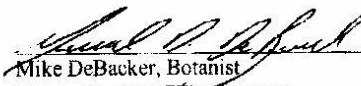
The "WORK TELEPHONE" number is answered at either Agate Fossil Beds National Monument (AGFO) or Scottsbluff National Monument (SCBL) from 8 a.m. until 5 p.m. every day of the year (except Thanksgiving, Christmas Day, and New Years Day), and should be called first. After normal business hours please attempt to contact staff at their residence in the order listed below.

<u>TITLE</u>	<u>NAME</u>	<u>WORK TELEPHONE</u>	<u>RESIDENCE TELEPHONE</u>
Fire Coordinator, AGFO	Casey J. Osback	308-668-2211	308-668-9426
Superintendent, AGFO	Ruthann Knudson	308-668-2211	308-668-2572
Maintenance Worker Sup'r, AGFO	Bill Matthews	308-668-2211	308.668-2256
Chief Ranger, SCBL and ABFO	Deborah J. Qualey	308-436-4340	308-436-2862
Fire Coordinator, SCBL	Robert W. Manasek	308-436-4340	308-436-7767
Superintendent, SCBL	Valerie J. Naylor	308-436-4340	308-436-3019

Appendix E. Fire Effects Monitoring Plan

National Park Service
Agate Fossil Beds National Monument, Nebraska
Fire Effects Monitoring Plan

Prepared By:  18 August 2003
Cody Wienk, Fire Ecologist
NGPA Fire Management Office
Date

Peer Reviewed:  4 Aug 03
Mike DeBacker, Botanist
Prairie Cluster LTEM Program
Date

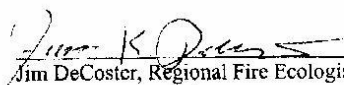
Concurred:  8 August 03
Jim DeCoster, Regional Fire Ecologist
Midwest Region, NPS
Date

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INTRODUCTION

Agate Fossil Beds National Monument (AGFO) encompasses approximately 2270 acres in western Nebraska. The park was established to protect the concentrations of animal fossils found in beds of sedimentary rock in the area. Vegetation of the park is largely mixed-grass prairie with the exception of the riparian areas adjacent to the Niobrara River, which bisects the park. Dominant species of the mixed-grass prairie include needle-and-thread (*Stipa comata*), blue grama (*Bouteloua gracilis*), threadleaf sedge (*Carex filifolia*), western wheatgrass (*Pascopyrum smithii*), prairie sandreed (*Calamovilfa longifolia*), and sand bluestem (*Andropogon hallii*). Mixed-grass prairie dominated by western wheatgrass (*Agropyron smithii*), needle-and-thread, and grama grasses (*Bouteloua* spp.) is believed to be the major pre-settlement vegetation type for the area, although the exact composition of the communities before settlement is unknown. Kuchler (1964) described the potential vegetation for the AGFO area as wheatgrass-needlegrass prairie and Nebraska sandhills prairie.

Large and small-scale disturbances shaped the landscape of AGFO and surrounding areas. Disturbances included seasonal bison grazing, extended wet and dry periods, soil disturbance (bison wallows and prairie dog towns) and fire. Some of these disturbances continue in AGFO today. Fires started both by lightning and Native Americans maintained the prairies and kept shrubs and trees limited to wetter areas or areas of broken topography until the area was settled by Europeans in the 1880s. Fire suppression, overgrazing and plowing for farming broke up the areas of continuous fuels and significantly reduced the number of fires and acres burned. The lack of trees with fire scars make interpreting fire history for the area difficult. Wendtland (1993) considered historical accounts and fire scar data from the edges of the Black Hills. They estimated fire return intervals from as short as 5 years in level to gently rolling topography to 15-30 years in more broken topography at Scotts Bluff National Monument (SCBL), Nebraska.

Collins and Gibson (1990) documented the need for an interaction of four different disturbance types to maintain diverse community structure in mixed grass prairie. The interaction of cyclical weather patterns, grazing, fire and soil disturbance--both bison wallows and prairie dog towns--alters community structure. In the absence of any one of these disturbances, species richness (the number of species per unit area), evenness (the distribution between dominance among species), and patch structure (the association of species at various spatial scales) will change. The absence of fire tends to increase woody species and reduce species richness and patch structure. The absence of grazing by large ungulates and/or soil disturbance reduces species diversity and decreases community heterogeneity. Management actions that include all disturbance types should be considered to maintain diverse community structure.

Prescribed fire will be used to maintain and restore the fire adapted ecosystems at AGFO. National Park Service (NPS) *Reference Manual* 18 states, "Monitoring is a critical component of fire management and the Fire Monitoring Plan is important to identify why monitoring will be done, what will be monitored, how it will be monitored, where it will be done, and how often it will be completed." Monitoring of these fires is mandated in Director's Order #18: Wildland Fire Management issued in 1998. Section 5.2, *Fire Management Plans* (no. 10) states, "Include procedure for short and long term monitoring to document that overall program objectives are

being met and undesired effects are not occurring”. Section 5.8 directly addresses *Prescribed Fire Monitoring*:

- a) Fire effects monitoring must be done to evaluate the degree to which objectives are accomplished.
- b) Long-term monitoring is required to document that overall programmatic objectives are being met and undesired effects are not occurring.
- c) Evaluation of fire effects data is the joint responsibility of fire management and natural resource management personnel.

There are two communities at AGFO that will be monitored: (1) native mixed-grass prairie, and (2) non-native prairie. There is no record of significant fire within the current park boundary for nearly a century and grazing by domestic livestock ended in 1974. Fire will be used to restore non-native communities to more native conditions and to maintain native systems by burning within the predicted range of fire return intervals. A more complete discussion of fire effects and management follows.

DESCRIPTION OF THE ECOLOGICAL MODEL

NORTHERN GREAT PLAINS MIXED-GRASS PRAIRIE

The vegetation of AGFO is mixed-grass prairie. Mixed-grass prairie is characterized as having a mixture of mid-height and shortgrasses as well as a mixture of grasses with different photosynthetic pathway types (C₃: cool-season and C₄: warm-season) (Singh et al. 1983). This diversity of species found on the Northern Great Plains is a result of great and repeated migrations of species that responded to changes in climate during periods of glaciation (Weaver and Albertson 1956, Wells 1970). One of the unique traits of the Northern Great Plains mixed-grass prairie is the dominance of cool-season grasses (Singh et al. 1983). A complex disturbance regime of biotic and abiotic disturbances (including periodic drought, grazing, fire, and soil disturbances) have interacted to form and continue to maintain grasslands of the Northern Great Plains (Anderson 1990, Collins and Gibson 1990). These disturbances also interact with climate, topography, soils, and competition among plant species to influence grassland composition (Fig. 1) (Wells 1970, Wright and Bailey 1980, Collins and Gibson 1990).

Although cool-season species tend to dominate northern mixed-grass prairies, warm-season species co-dominate on more xeric sites since these species are generally better adapted to warm, dry conditions (Singh et al. 1983). Light to moderate grazing also favors warm-season species while heavy grazing can shift composition toward warm-season shortgrasses like buffalograss (*Buchloe dactyloides*) and blue grama (Weaver and Albertson 1956, Ode et al. 1980, Singh et al. 1983). Native ungulates generally favor graminoids over forbs which may lead to increases in occurrence of forb species (Krueger 1986). Annual forbs colonize small-scale soil disturbances such as prairie dog mounds or buffalo wallows (Collins and Gibson 1990).

Historically, fire was a frequent and large-scale disturbance on northern mixed-grass prairies and continues to be a tool that managers use. Historic fire frequencies are very difficult to determine largely due to a lack of trees on the plains to record fire scars (Wright and Bailey 1980). Most fire frequency estimates have been based on accounts of early settlers or known fire frequencies needed to prevent woody plant encroachment into grasslands. Mean fire return intervals have

been estimated at 4 to 9 years for the sandhills of north-central Nebraska (Steinauer and Bragg 1987), 10 to 12 years for the forest-prairie ecotone of the Black Hills of South Dakota (Brown and Sieg 1999), and 15 to 30 years for the broken topography of Scotts Bluff National Monument, Nebraska (Wendtland and Dodd 1990, Wendtland 1993).

Ignition sources for fires in pre-Euroamerican settlement times are believed to be mainly lightning and both intentional and unintentional ignition by American Indians. A study of lightning-ignited fires in the Northern Great Plains over the past five decades indicates that nearly 75% of lightning-ignited fires occurred during July and August and lightning-ignited fires were recorded every month from April to September (Higgins 1984). It is presumed that this pattern has not changed significantly for at least a few centuries. Historical documents and accounts of early settlers suggest that there were two seasonal periods for fires ignited by American Indians, one during the spring with a peak in April and one during the fall with a peak in October (Higgins 1986).

Effects of fire can vary depending on the season the burn occurred, frequency of fire, grazing history, precipitation before and after burn, vegetation composition, fire intensity and severity, and topography (Anderson 1990, Collins and Gibson 1990). Fire can influence both productivity and structure of plant communities. Productivity may be increased following fire as a result of reduction in the litter layer and grazing may have similar effects (Anderson 1990). In mixed-grass prairie, with both warm- and cool-season species, season of burn can strongly affect species composition. Generally, spring and fall burns favor warm-season grasses while summer burns tend to favor cool-season grasses (Steuter 1987, Howe 1994).

VEGETATION OF AGATE FOSSIL BEDS NATIONAL MONUMENT

The vegetation of AGFO is comprised of three general types: 1) native mixed-grass prairie, 2) non-native prairie, and 3) Niobrara River floodplain (Fig. 2). Before AGFO was established, the area was grazed by domestic livestock and parts of the current park were used for other agricultural purposes (i.e. cultivation, livestock coral). Nevertheless, the overall condition of vegetation is good and is considered similar to historic vegetation communities (Stubbendieck and Willson 1986).

Native mixed-grass prairie

Mid- and upper-slopes are generally covered by needle-and-thread, threadleaf sedge, and blue grama. Lower slopes contain needle-and-thread, prairie sandreed, western wheatgrass, and sand bluestem. Shrubs and subshrubs include yucca (*Yucca glauca*), skunkbush sumac (*Rhus aromatica*), and fringed sagewort (*Artemisia frigida*). Forbs such as annual sunflower (*Helianthus annuus*), slimflower scurfpea (*Psoralea tenuiflora*), milkvetches (*Astragalus* spp.), milkweeds (*Asclepias* spp.), and rush skeletonplant (*Lygodesmia juncea*) are found in these areas. Non-native species present include cheatgrass (*Bromus tectorum*), prickly lettuce (*Lactuca serriola*), lambsquarters (*Chenopodium album*), goatsbeard (*Tragopogon dubius*), field pennycress (*Thlaspi arvense*), and Kentucky bluegrass (*Poa pratensis*).

Non-native prairie

This vegetation type occurs mainly in disturbed areas or areas that were under cultivation before the park was established. Cheatgrass is the most common non-native grass, but Kentucky

bluegrass, Japanese brome (*Bromus japonicus*), and crested wheatgrass (*Agropyron cristatum*) are also present. Non-native forbs include kochia (*Kochia scoparia*), Russian thistle (*Salsola tragus*), and tumble mustard (*Sisymbrium altissimum*), yellow sweetclover (*Melilotus officinalis*), Canada thistle (*Cirsium arvense*), and curly dock (*Rumex crispus*). Native species such as prairie sandreed, needle-and-thread, blue grama, western wheatgrass, sedges (*Carex* spp.) and annual sunflower also occur in this monitoring type.

Niobrara floodplain

The floodplain can be separated into the lower, middle, and upper terraces. The lower terrace is adjacent to the river and tends to be the wettest part of the floodplain. Graminoids that occur on the lower and middle terraces include sedges, rice cutgrass (*Leersia oryzoides*), foxtail barley (*Hordeum jubatum*), Baltic rush (*Juncus balticus*), scratchgrass (*Muhlenbergia asperifolia*), switchgrass (*Panicum virgatum*), and softstem bulrush (*Schoenoplectus tabernaemontani*). Native forbs such as broadleaf cattail (*Typha latifolia*) and American licorice (*Glycyrrhiza lepidota*), and non-native forbs like field sowthistle (*Sonchus arvensis*) and Canada thistle (*Cirsium arvense*) are present in these areas. The non-native yellow iris (*Iris pseudacorus*) occurs in very saturated areas along the river. Narrowleaf willow (*Salix exigua*) and western snowberry (*Symphoricarpos occidentalis*) occur in small patches along the floodplain.

The upper terrace is the area of the floodplain that is most likely to be impacted by fire. This area contains mainly western wheatgrass, Kentucky bluegrass, and smooth horsetail (*Equisetum laevigatum*). Forbs include giant sumpweed (*Iva xanthifolia*), twoscale saltbush (*Atriplex micrantha*), and Flodman's thistle (*Cirsium flodmanii*).

FIRE EFFECTS

Cheatgrass and Japanese brome

Cheatgrass and Japanese brome are both members of the genus *Bromus*. They are very similar in growth, reproduction, and habitat. Both are cool season annuals that germinate primarily during the fall from the previous year's seed crop (Baskin and Baskin 1981). They reproduce entirely from seeds and are prolific seed producers. Little research has been carried out regarding the effects of fire on cheatgrass in the Northern Great Plains. Response of Japanese brome to burning appears to be highly correlated with litter reduction by fire and the amount of precipitation the autumn after the fire.

At Wind Cave National Park, Japanese brome density was reduced the first growing season after both fall (Sept. 18) and spring (Apr. 10) burns, with slightly better reduction following the fall burn (Gartner 1975). Yield of Japanese brome was reduced following both spring (May 15) and fall (Nov. 7) burns in a study near Rapid City, SD (Gartner et al. 1978). A fall burn (2nd week of October) near Miles City, Montana resulted in a reduction in cheatgrass and Japanese brome cover of nearly 70%; while reduction was only 50% following a spring (Apr. 9) burn (White and Currie 1983). Significant reduction in Japanese brome density and yield was reported following a spring (April 20) burn at Badlands National Park, but this reduction appeared to persist for only one season unless burning is followed by dry weather (Whisenant and Uresk 1990).

MANAGEMENT OBJECTIVES

Management objectives are set based on the best available information and data. They are intended to be flexible and dynamic as the prescribed fire program develops and fire effects data are collected. Objectives and success in meeting those objectives should be assessed periodically and modified as appropriate. This process should include resource management staff, fire ecologist, fire effects monitors, and others with knowledge of the vegetation of AGFO.

NATIVE MIXED-GRASS PRAIRIE

This monitoring type is dominated by native species, so desired future conditions are primarily to maintain native species in these areas. As prescribed fire is applied, it is desired to maintain or increase native grass species to at least 80% relative cover, increase native forb species to more than 10% relative cover, reduce non-native grass and forb species to less than 10% relative cover, and maintain or increase species diversity.

Immediate post-burn

- Burn at least 75% of the burnable project area
- Achieve burn severity of at least ‘lightly burned’ (3) as defined in the Fire Monitoring Handbook

Two years post-burn

- Increase or maintain relative cover of native perennial grass species at or above 80%
- Increase or maintain relative cover of native forb species at or above 10%
- Reduce relative cover of non-native grasses and forbs to less than 10%

Five years post-burn

- Maintain cover of native perennial grass species
- Maintain cover of native forb species
- Maintain reduction in non-native species

NON-NATIVE PRAIRIE

Because this monitoring type generally occurs in areas that experienced high levels of disturbance, non-native species dominate and native species are somewhat scarce. These areas may require intense management practices including prescribed fire, seeding, mowing, and herbicide application to reduce dominance of non-native species. Desired future conditions for this monitoring type are to reduce cover of non-native grass and forb species while increasing cover of native grass and forb species and species diversity. Within 5 years after initiation of prescribed fire program, it is desired that relative cover of native species is greater than 50%, and within 10 years relative cover of native species is greater than 75%.

Immediate post-burn

- Burn at least 75% of the burnable project area
- Achieve burn severity of at least ‘lightly burned’ (3) as defined in the Fire Monitoring Handbook

Two years post-burn

- Reduce relative cover of non-native grasses and forbs by at least 20%
- Increase relative cover of native perennial grass and forb species by at least 20%
- Evaluate need for additional treatment (fire or other)

MONITORING DESIGN

MONITORING OBJECTIVES

Native mixed-grass prairie

- Install enough plots to be 80% confident that relative cover of native perennial grass and forb species is within 25% of the true population mean.
- Install enough plots to be 80% confident that relative cover of non-native grass and forb species is within 25% of the true population mean.

Non-native prairie

- Install enough plots to be 80% confident that relative cover of non-native grass and forb species is within 25% of the true population mean.
- Install enough plots to be 80% confident that relative cover of native perennial grass and forb species is within 25% of the true population mean.

SAMPLING DESIGN

Three types of plots have been established at AGFO: 1) Fire Monitoring Handbook (FMH) plots, 2) pilot sampling plots in areas dominated by non-native species, and 3) long-term photo monitoring plots.

FMH plots follow protocols described in the NPS Fire Monitoring Handbook (2001). The sampling design for the FMH plots are contained in the individual monitoring type description sheets found in Appendix 1.

Alternative protocols were developed to monitor vegetation change in areas dominated by non-native species. These plots were designed to require less sampling time than standard FMH plots so a larger number of plots can be established. This should allow us to detect changes in vegetation over short time periods (1 to 3 years) with high confidence levels. Appendix E-2 includes sampling protocols and a sample data sheet.

Long-term photo monitoring plots are intended to document vegetation change over time at stand to landscape levels. Examples of data sheets and photos are located in Appendix E-3. Additional photo points will be established as other burn units are scheduled for treatment.

FIELD MEASUREMENT

The individual variables to be measured are defined in the monitoring type description sheets (Appendix E-1). All plots are marked with steel rebar approximately half a meter in height. Each piece of rebar has a brass tag indicating its location within the plot. The rebar at the zero end of each plot has a tag with complete plot data as specified by the handbook. All locations have been

georeferenced with a GPS unit. A hard copy of each plot location is retained in the Northern Great Plains Area Fire Management Office (NGPA) at Wind Cave National Park. A digital text file with UTM coordinates and ArcView shape file are also on file at the NGPA. The Northern Great Plains Fire Monitoring Crew will retain copies and backups and will be responsible for providing updated versions to AGFO as needed.

MONITORING LOCATION

Currently there are 13 monitoring plots in 2 burn units. See attached map (Fig. E-3).

PRESCRIBED FIRE MONITORING PARAMETERS

AGFO has adopted the NPS Fire Monitoring Handbook (2001) as a guide for fire effects monitoring. The handbook identifies four monitoring levels:

Level 1 – Reconnaissance	Fire Cause, location, size, fuel and vegetation types, relative fire activity, potential for spread, current and forecasted weather, resource or safety threats and constraints, and smoke volume and movement
Level 2 – Fire Conditions	Fire monitoring period, ambient conditions – topographic and fire weather, fuel model, fire characteristic, and smoke characteristic
Level 3 – Immediate Post fire Effects	Fuel reduction, vegetative change or other objective dependent variables within 1 to 5 years after a burn
Level 4 – Long-term Change	Continued monitoring of Level 3 variables to measure trends and change over time

The FMH plots that have been described in this document thus far are being used to examine levels 3 and 4.

Wildland fires that are suppressed will be monitored at levels 1 and 2 with observations entered into the park's monitoring database. In the event that long-term fire effects plots are burned in a wildland fire, they will be read by the NGPA Fire Monitoring Crew, according to the schedule of plot rereads following a burn treatment. Level 1 and 2 monitoring observations will be filed with the final fire package and a copy placed with the records for the Fire Management Unit that was burned.

Prescribed fires will meet at least the Level 1 and 2 recommended standards. If there are FMH plots in a unit, information on Level 3 and 4 Variables will be collected.

Level 1 variables

Reconnaissance monitoring (Level 1) provides a basic overview of the fire event. The following variables will be collected on all fires.

- Fire cause (origin), location and size
- Fuels and vegetation type
- Relative fire activity
- Potential for further spread
- Current and forecasted weather

- Resource or safety threats and constraints
- Smoke volume and movement

Specific information on the collection of these variables can be found in the NPS Fire Monitoring Handbook (2001) or the RX-91 – ‘Monitoring Prescribed and Wildland Fire’ text.

Level 2 variables

Fire conditions monitoring (Level 2) provides information on fire weather, fire behavior and resource values at risk. The following variables will be collected and summarized in a monitoring report (see Appendix (h) for specific protocols, data sheets, and example reports) on all wildland fires for resource benefit and all prescribed fires.

- Fire monitoring period
 - fire number and name
 - observations data and time
 - monitor’s name
- Ambient conditions
 - topographic variables
 - slope (%)
 - aspect
- Fire weather variables
 - dry bulb temperature
 - relative humidity
 - wind speed
 - wind direction
 - fuel shading and/or cloud cover
 - time-lag fuel moisture
 - live fuel moisture
 - drought index
- Soil moisture
- Fuel model
- Fire characteristics
 - linear rate of spread
 - perimeter or area growth
 - flame length
 - fire spread directions
- Smoke characteristics (based on state and local requirements)

INTENDED DATA ANALYSIS

Plot installations will be based on burn priorities and with the intention of achieving a statistically valid sample size within five years for the priority monitoring types. The Northern Great Plains Fire Ecologist will be responsible for checking the minimum plot numbers in all types that have more than five plots installed. Each monitoring type description delineates the variables that will be analyzed. When minimum plot numbers have been reached, objectives will be evaluated after the data have been checked to meet the assumptions of the statistical test. If the data meet the assumptions, including normality, then confidence intervals will be used for

change over time comparisons. If data do not meet the assumptions, a statistician will be consulted. Correlation of Level 2 data with vegetation data can be done with either regression or multivariate analysis.

The Northern Great Plains Fire Ecologist will compare data with fire effects research that has been completed in the park and area. Inconsistencies should lead the ecologist to examine different methodologies, data interpretation, and potential research questions.

MONITORING IMPLEMENTATION SCHEDULE

Burn unit schedule

Appendix ? of the Fire Management Plan identifies the planned burn schedule for the next several years. The unit rotation is based on a 5 to 15 year fire return interval. Units dominated by non-native species may require shorter burn intervals to meet desired objectives. A map of the burn units is also included (Fig. 4).

Timing of monitoring

We attempt to sample plots near peak biomass, which occurs between the peak in cool and warm season grasses. Plots are sampled at approximately the same time of the growing season from year to year. All plots are currently sampled pre-burn, immediately post-burn, and 1, 2, 5, 10, and 20 years post-burn. This schedule is reset when each time a plot is burned.

Pre-burn sampling

Pre-burn sampling will be done during peak phenology. Plots should be installed the growing season before prescribed burns. All plots that have not burned within 2 years of installation will not be reread until that unit is again scheduled to burn. These plots can also be considered for control plots depending on long-term burn planning.

Post-burn sampling

Post-burn sampling will be done immediately post-burn and 1, 2, 5, 10, and 20 years after the burn. Plots that burn in the spring will be read at peak phenology that summer, and then at the regular 1, 2, 5, 10, and 20 year schedule. The 1-year reads for grassland plots burned in the spring are during the growing season the same year as the burn, and the 2-year read occurs in the following year. The 1-year reads for forest plots burned in the spring are during the growing season one year after the burn. Fall burns will be read the following summer as 1 year post-burn reads. If a unit is scheduled to be burned for a second or third time between reads, an additional pre-burn read will be added. For example, a unit burned in the spring of 2000 would be sampled immediate post-burn within two weeks of the fire, 1-year read summer 2000, 2-year read summer 2001, and 5-year read summer 2004. The unit is then scheduled to burn again in 2008. A second pre-burn read should be added summer 2007.

ADDITIONAL VEGETATION MONITORING

Vegetation monitoring plots were established at AGFO in 1998 by the Prairie Cluster Long-Term Ecological Monitoring (LTEM) Program to detect and describe long-term changes in grassland plant communities. Eleven sample sites, covering five vegetation types, were chosen. Sampling protocols and plot locations can be found in Appendix 4. The fire effects monitoring

program will coordinate with the LTEM program to minimize duplication and develop an efficient monitoring program for AGFO.

DATA MANAGEMENT

Other monitoring programs have shown that between 25-40% of the time associated with monitoring should be on data management. The data for AGFO is collected and managed by the Northern Great Plains Fire Monitoring Crew located at Wind Cave National Park, Hot Springs, South Dakota. All data collected at AGFO will be entered and checked by this crew at their office. Generally the seasonal field staff enters and checks data. This process is supervised the NGP Lead Monitor and Fire Ecologist. Original copies of all data will be kept at the crew's office. Hard copies of the Plot Location Data Sheets will be archived at AGFO in the Resource Management files. The Lead Monitor will provide monitoring data to the AGFO Resource Management Specialist annually on CD for archiving. Data are currently entered and analyzed in the FMH software. It is backed up to the server at Wind Cave. It will be sent annually to AGFO and the Midwest Regional Ecologist in conjunction with the annual report. Global positioning data of plot locations are stored on CD at the Fire Monitoring Office at Wind Cave.

QUALITY CONTROL

Data quality will be insured through proper training of the crew in data collection and a system of checks in the data entry process. All data sheets will be checked by the lead crewmember before leaving a plot for data accuracy and completeness. Data will be summarized annually and results reported to the park and regional fire ecologist. A program review should happen every 3-5 years to maintain consistency of data collection and analysis and re-assessment of program requirements. More frequent review may be necessary if there are significant staffing changes, additional ecological concerns, or by request of the park or monitoring crew.

SOURCES OF DATA ERRORS

Errors in recording can be reduced by checking all data sheets for completeness and accuracy before leaving the plot. Standardized crew training at the beginning of the season will insure all data are being collected in the same manner by all crewmembers. Transcription errors will be corrected by checking all data once entered in the computer. Collecting voucher specimens and using the study collection to verify plant identifications can minimize incorrect identification of plant species. All unknown plant species will be photographed and added to the unknown plant database. These photos can be used as a field reference to insure that all unknowns are consistently observed. AGFO Resource Management personnel will be notified of unknowns of particular concern so special attention can be given to identify it. Undersampling of less-frequently occurring species is a large problem in the grass types. An additional sampling technique, nested frequency, will be added after consulting with the regional fire ecologist to better sample the species richness found in these types.

The impacts of monitoring include compacting of fuels and vegetation and the collection of voucher plant specimens. Compaction can be minimized by crew awareness as to where data are collected. Voucher specimens are not collected in the plot – if no other specimen is found, the unknown plant will be photographed and added to the unknown plant photo database. Accurate plot locations including GPS data will aid in plot location and minimize vegetative compaction.

Test all directions by having new crewmembers use previously written directions to ensure accuracy. Incomplete or missing data will be corrected as soon as possible. Plot protocols need to be reviewed annually with the seasonal crew prior to beginning work to insure that data are accurately collected. Problems encountered by the field crew must be brought to the attention of the lead monitor and fire ecologist.

RESPONSIBLE PARTIES

This **Fire Monitoring Plan** was written by Cody Wienk, Northern Great Plains Fire Ecologist

Administrative duties will be assigned as follows:

- Plan revision, crew supervision, and data analysis will be done by the *Northern Great Plains Fire Ecologist*
- Park liaison will be done by the *Superintendent, AGFO*
- Data collection, data entry, data management and field crew supervision will be done by the *Northern Great Plains Lead Monitor and Monitoring Crew*
- Program reviews will be coordinated by the *Midwest Regional Fire Ecologist*

FUNDING NEEDS ASSESSMENT

FIREPRO funding for the Northern Great Plains Fire Monitoring crew will be used for all monitoring activities. A new funding matrix for FY 2003 is being implemented based on 'fire points'. Travel for the Fire Effects Monitoring Crew will be funded by a matrix based on the number of parks the crew travels to. Travel and overtime for all prescribed, wildland fires, and immediate post-burn reads will come from the project funds. Control plots will be done in conjunction with the AGFO Resource Management staff.

MANAGEMENT IMPLICATIONS OF MONITORING RESULTS

Monitoring results will be summarized and presented to the park in the fall meeting of the Fire Committee with the NGPA Fire management Officer, Prescribed Fire Specialist and Fire Ecologist. This meeting helps coordinate fire activities including prescribed fire for the park in the coming year. The annual report information can be conveyed to the Badlands Resource Management Division in an additional meeting as requested.

Review of the data summary and analysis by the NGPA Fire Ecologist, Prescribed Fire Specialist, and AGFO Resource Management staff should determine if the current program is moving the vegetation towards the desired conditions and/or having unwanted results. Targets should be reviewed and refined, and burn prescriptions and other vegetation management techniques could be adjusted to compensate. This review could also generate questions that may lead to fire effects research being conducted in the park. Information from the AGFO program could be analyzed with other parks from the NGPA group as appropriate and should be presented to other parks and at scientific meetings and publications.

CONSULTATION AND COORDINATION

The Northern Great Plains Fire Monitoring Crew is responsible for coordination and consultation with other parks in the group, fire management personnel, and the Midwest Regional Fire Ecologist. AGFO Resource Management staff will be responsible for coordination and consultation with the park and all other cooperators including:

Nebraska Game and Parks Commission, Alliance, NE
Sioux County Commission, Harrison, NE
Crescent Lake National Wildlife Refuge, Oshkosh, NE
Apache Tribe, OK
Arapahoe Tribe of the Wind River Reservation
Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation
Cheyenne-Arapahoe Tribes, OK
Cheyenne River Sioux Tribe of the Cheyenne River Reservation
Comanche Indian Tribe of Oklahoma
Crow Creek Sioux Tribe of the Crow Creek Reservation
Crow Tribe of Montana
Flandreau Santee Sioux Tribe
Fort Sill Apache Tribe, OK
Jicarilla Apache Tribe of the Jicarilla Apache Indian Reservation
Kiowa Tribe, OK
Lower Brule Sioux Tribe of the Lower Brule Reservation, SD
Mescalero Apache Tribe of the Mescalero Reservation, NM
Northern Cheyenne Tribe of the Northern Cheyenne Indian Reservation
Northwestern Band of Shoshoni Nation
Oglala Sioux Tribe of the Pine Ridge Reservation, SD
Omaha Tribe, NE
Pawnee Indian Tribe, OK
Ponca Tribe of Indians, OK
Ponca Tribe, NE
Rosebud Sioux Tribe of the Rosebud Indian Reservation
Santee Sioux Tribe of the Santee Reservation
Shoshone-Bannock Tribes of the Fort Hall Indian Reservation, ID
Shoshone Tribe of the Wind River Reservation
Shoshone-Paiute Tribes of the Duck Valley Reservation
Spirit Lake Sioux Tribe of the Devils Lake Sioux Reservation, ND
Standing Rock Sioux Tribe of the Standing Rock Reservation, SD and ND
Three Affiliated Tribes of the Fort Berthold Reservation
Yankton Sioux Tribe

The AGFO Resource Management Division participated in shaping and preparing this plan. The following provided assistance with, or review of, this plan:

Robert Manasek, Resource Management Specialist, Scotts Bluff NM
Ruthann Knudson, Superintendent, Agate Fossil Beds NM
Valerie Naylor, Superintendent, Agate Fossil Beds NM & Scotts Bluff NM
Andy Thorstenson, Lead Monitor, NPS, NGPA Fire Monitoring Crew
Kevin Rehman, Asst. Lead Monitor, NPS, NGPA Fire Monitoring Crew
Bill Gabbert, Fire Management Officer, NPS, NGPA Fire Management Office
Jim DeCoster, Regional Fire Ecologist, NPS, Midwest Region, Omaha
Cody Wienk, Fire Ecologist, NPS, NGPA Fire Management Office

PEER REVIEW

Peer/technical review for this plan was provided by:

Mike DeBacker, Botanist, Prairie Cluster LTEM Program

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Figure 1. The Northern Great Plains mixed-grass prairie is characterized as having a mixture of mid-height and shortgrasses with different photosynthetic pathway types (cool- and warm-season). Cool-season grasses are dominant. A complex disturbance regime of biotic and abiotic disturbances (including periodic drought, grazing, fire, and soil disturbances) have interacted to form and continue to maintain grasslands of the Northern Great Plains. These disturbances also interact with climate, topography, soils, and competition among plant species to influence grassland composition.

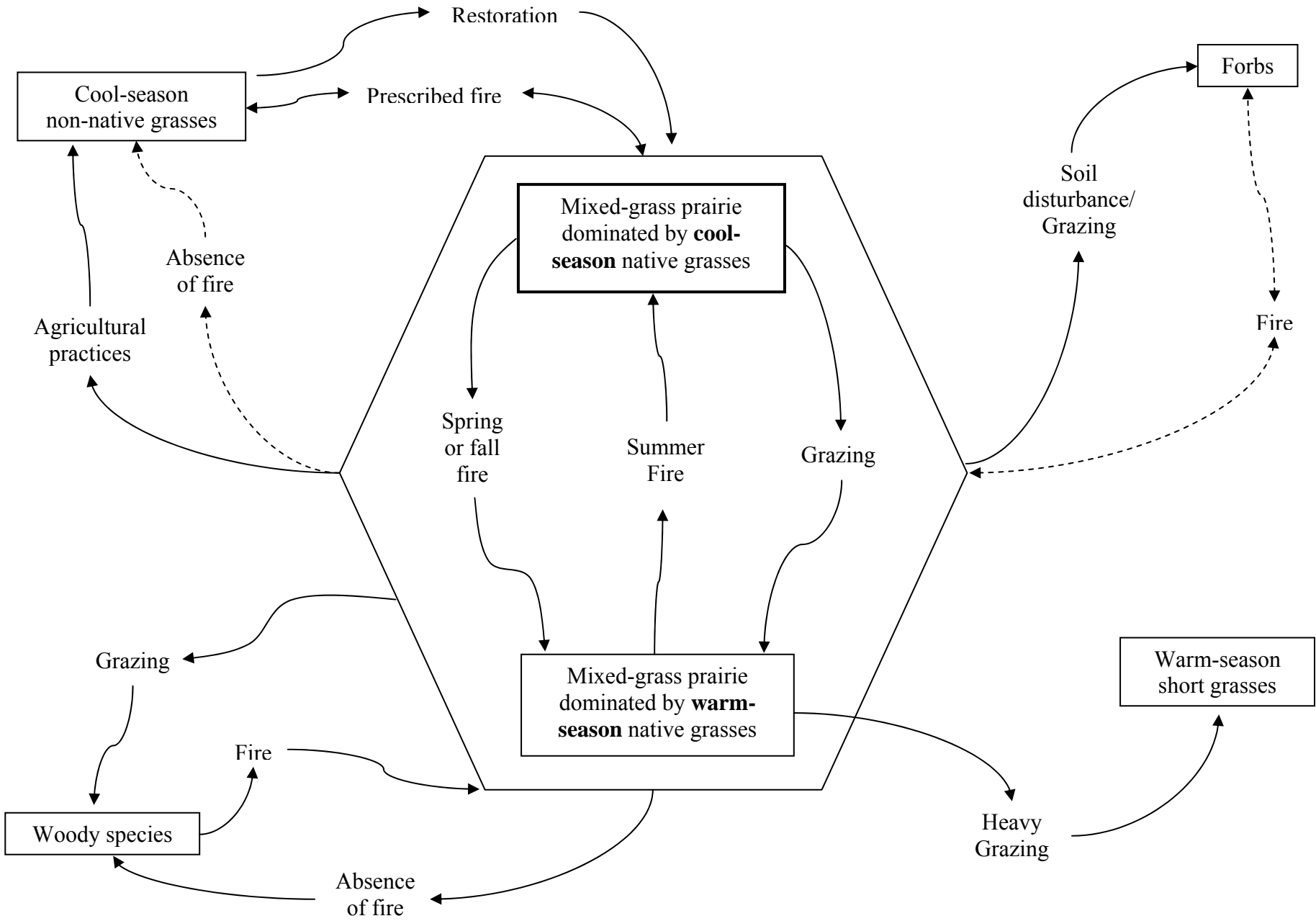


Figure 2. Vegetation map of Agate Fossil Beds National Monument. Product of the USGS-NPS Vegetation Mapping Program (USGS 1998). PODE = *Populus deltoides*, plains cottonwood; Salix = *Salix exigua*, sandbar willow; SYOC = *Symphoricarpos occidentalis*, western snowberry; STCO = *Stipa comata*, needle-and-thread; BOGR = *Bouteloua gracilis*, blue grama; CALO = *Calamovilfa longifolia*, prairie sandreed; ANHA = *Andropogon hallii*, sand bluestem; PASM = *Pascopyrum smithii*, western wheatgrass; Juncus = *Juncus balticus*, Baltic rush; Typha = *Typha latifolia*, broadleaf cattail; SCSC = *Schizachyrium scoparium*, little bluestem.



2 0 2 4 Miles

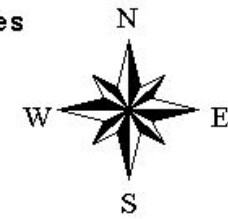
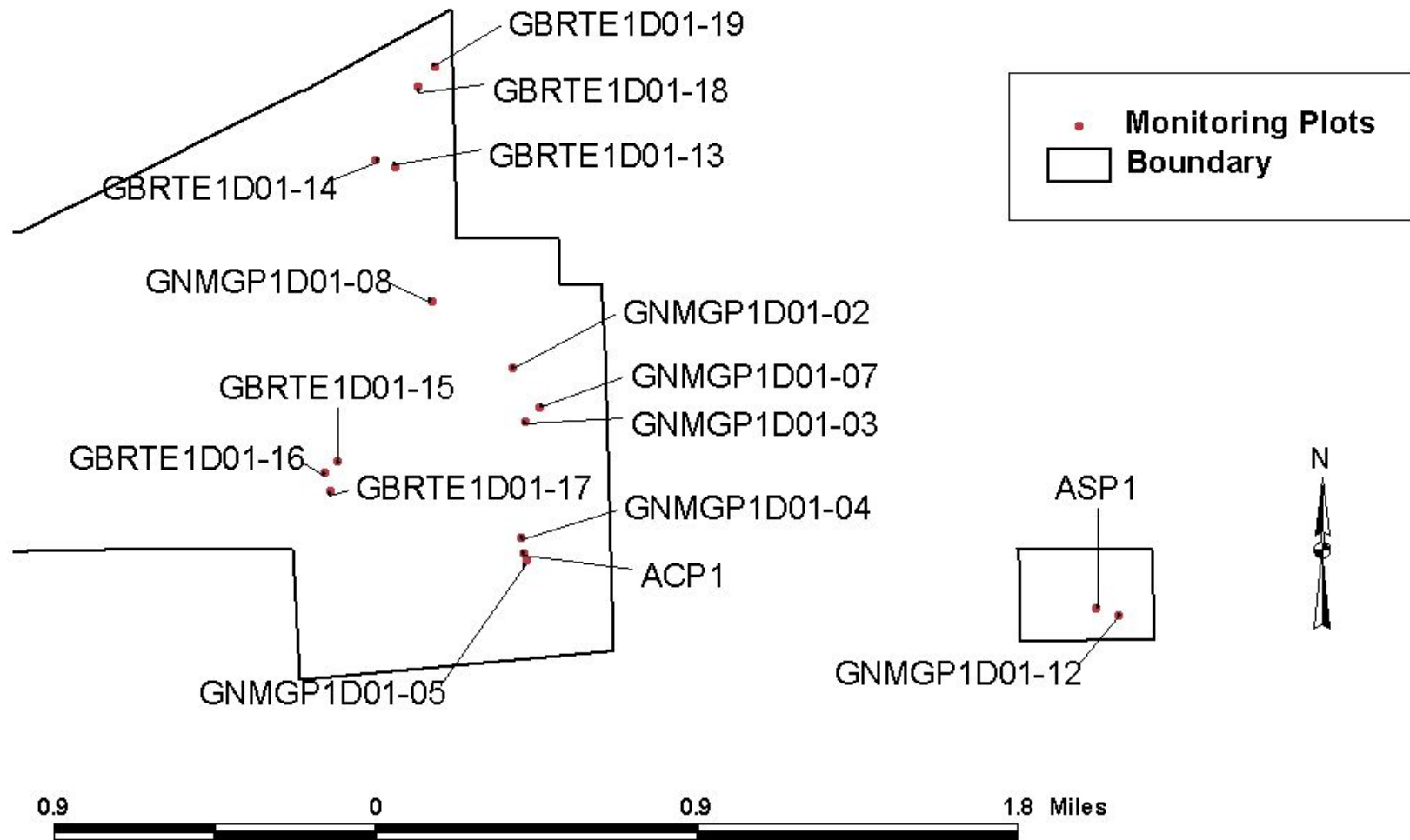
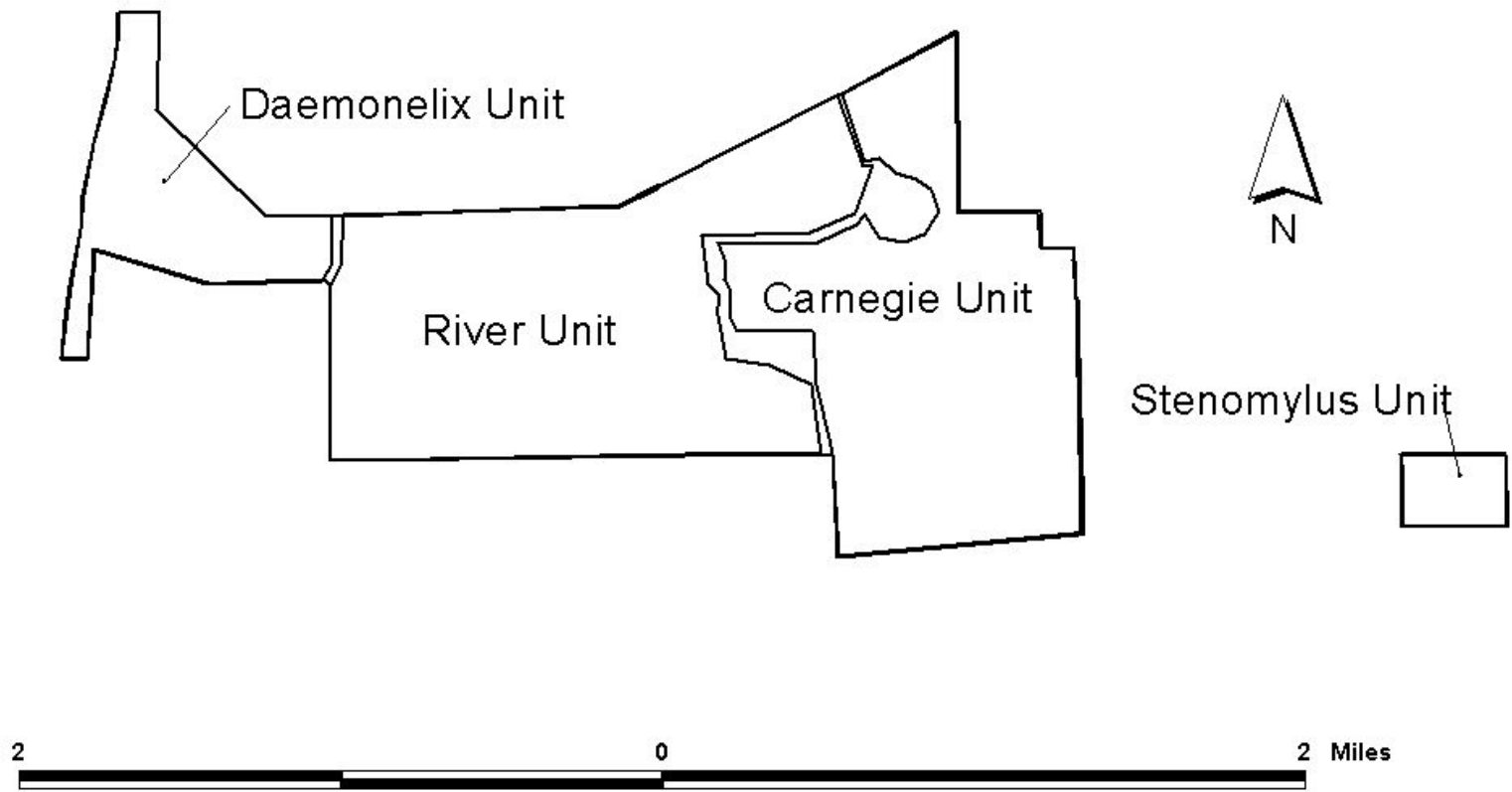


Figure 3. Location of fire effects monitoring plots.



Created by: Cody Wienk
Date: 3/14/03

Figure 4. Burn units at Agate Fossil Beds National Monument.



APPENDIX E APPENDICES

APPENDIX E-1 – MONITORING TYPE DESCRIPTION SHEETS

FMH-4

MONITORING TYPE DESCRIPTION SHEET

Park: AGFO

Monitoring Type Code: GNMGP1D01

Date Described: 10/20/02

Monitoring Type Name: Native Mixed-grass Prairie

Prepared by: C. Wienk, A. Thorstenson, K. Rehman

Physical Description

Soils are generally loamy very fine sands of the Oglala-Canyon Association, Tassel-Ashollow-Rock outcrop Association, and Otero-Las Animas-Lisco Association. Soils of the Oglala-Canyon Association are well drained, loamy soils found on 1 to 30% hillslopes and are derived from sandstone parent materials. Tassel-Ashollow-Rock outcrop soils are well drained, sandy soils derived from sandstone parent materials and are found on hillslopes ranging from 3 to 60%. Soils of the Otero-Las Animas-Lisco Association are very deep, loamy and sandy soils on flood plains and stream terraces. Topography of the park is gently rolling and elevations range from 4400 feet along the flood plain to 4600 feet at the tops of the surrounding hills.

Biological Description

Mid- and upper-slopes are generally covered by needle-and-thread (*Stipa comata*), threadleaf sedge (*Carex filifolia*), and blue grama (*Bouteloua gracilis*). Lower slopes contain needle-and-thread, prairie sandreed (*Calamovilfa longifolia*), western wheatgrass (*Pascopyrum smithii*), and sand bluestem (*Andropogon hallii*). Shrubs and subshrubs include yucca (*Yucca glauca*), skunkbush sumac (*Rhus aromatica*), and fringed sagewort (*Artemisia frigida*). Forbs such as annual sunflower (*Helianthus annuus*), slimflower scurfpea (*Psoralea tenuiflora*), milkvetches (*Astragalus* spp.), milkweeds (*Asclepias* spp.), and rush skeletonplant (*Lygodesmia juncea*) are found in this monitoring type. Non-native species present include cheatgrass (*Bromus tectorum*), prickly lettuce (*Lactuca serriola*), lambsquarters (*Chenopodium album*), goatsbeard (*Tragopogon dubius*), field pennycress (*Thlaspi arvense*), and Kentucky bluegrass (*Poa pratensis*).

Rejection Criteria

- Large outcrops or barren areas >20% of the plot
- Areas with anomalous vegetation
- Monitoring type boundaries
- Riparian areas
- Bio-control areas
- Areas within 20 meters of roads, man-made trails, or human created disturbance areas

Desired Future Condition

Mixed-grass prairie dominated by western wheatgrass, needle-and-thread, and grama grasses

(*Bouteloua* spp.) is believed to be the major pre-settlement vegetation type for the area, although the exact composition of the communities before settlement is unknown. Kuchler (1964) described the potential vegetation for the AGFO area as wheatgrass-needlegrass prairie and Nebraska sandhills prairie. The fire return intervals reported for this type of prairie vary from as short as five years in level to gently rolling topography to 15-30 years in more broken topography (Wendtland and Dodd 1992). It is believed that the historic fire return interval in these areas would have been on the more frequent end of this range.

This monitoring type is dominated by native species, so desired future conditions are largely to maintain native composition in these areas. General desired future conditions include:

- Maintain or increase native grass cover to >80% total relative cover.
- Increase cover of native forb species to >10% total relative cover.
- Maintain or increase diversity (richness).
- Reduce non-native cool season annual grasses and non-native forbs to <10% total relative cover.

Burn Prescription

If prescribed burning is used to mimic historic fire regimes, this monitoring type will be burned between April and October, with most fires occurring in July, August and September.

Fire Prescription Elements	
RH: 25%-55%	Average Flame Length: 0.4-1.5 feet
Temp: 50°-90°F.	Live Fuel Moisture: NA
Average Mid-flame winds: 2-12 mph	1-hour TLFM: 4%-12%
Fuel loading: 2-5 tons/acre	10-hour TLFM: 8%-15%
Average Rate of Spread: 1-100 chains/hr.	100-hour TLFM: NA

Monitoring Variables (in order of importance)

- Relative cover of native perennial grass species
- Relative cover of native forb species
- Relative cover of non-native grass and forb species

Prescribed Fire Objectives*

Immediate post-burn

- Burn at least 80% of the burnable project area
- Achieve burn severity of at least ‘lightly burned’ (3) as defined in the Fire Monitoring Handbook

Two years post-burn

- Increase relative cover of native perennial grass species by at least 20%
- Increase relative cover of native forb species by at least 20%

* Objectives intended for first prescribed fire treatment and are subject to change as information becomes available through fire monitoring activities.

- Reduce relative cover of non-native grasses and forbs by at least 20%

Five years post-burn

- Maintain increase in native perennial grass species
- Maintain increase in native forb species
- Maintain reduction in non-native species

Fire Monitoring Objectives

- Install enough plots to be 80% confident that relative cover of native perennial grass and forb species is within 25% of the true population mean.
- Install enough plots to be 80% confident that relative cover of non-native grass and forb species is within 25% of the true population mean.

Data Analysis

- Assess relative and absolute cover of native grass and forb species after sampling years 1, 2, and 5.
- Assess relative and absolute cover of non-native grass and forb species after sampling years 1, 2 & 5.

Relevant Literature

Kuchler, A.W. 1964. Potential natural vegetation of the coterminous United States. Special Publication 36 (Manual), American Geographical Society, New York, NY.

Stubbenieck, J., and G. Willson. 1986. An identification of prairie in National Park units in the Great Plains. USDI National Park Service Occasional Paper No. 7, Washington, DC.

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Wendtland, K.J., and J.L. Dodd. 1992. The fire history of Scotts Bluff National Monument. In: Smith, D. and C. Jacobs (eds.) Twelfth North American Prairie Conference. Cedar Falls, Iowa.

Plot Protocols

GENERAL PROTOCOLS		YES	NO			YES	NO	
Preburn	Control Plots/Opt		•	Herb Height/Rec		•		
	Herbaceous Density/Opt		•	Belt Transect Width: 2 meters				
	OP/Origin Buried		•	Abbreviated Tags		•		
	Voucher Specimens/Rec	•		Stakes Installed: 0P & 30P				
	Stereo Photography/Opt		•	Crown Intercept/Opt			•	
	Brush Individuals/Rec		•	Herb. Fuel Load/Opt			•	
	Herbaceous Data Collected at: 0P-30P							
Burn	Duff Moisture/Rec		•	Flame Zone Depth/Rec		•		
Postburn	Herbaceous Data/Opt: Not collected.			Herb. Fuel Load/Opt			•	
	100 Pt. Burn Severity/Opt		•					

Rec = Recommended, Opt = Optional

FMH-4

MONITORING TYPE DESCRIPTION SHEET

Park: AGFO

Monitoring Type Code: GBRTE1D01

Date Described: 10/22/02

Monitoring Type Name: Non-native Prairie – Cheatgrass

Prepared by: C. Wienk, A. Thorstenson, K. Rehman

Physical Description

Soils are generally loamy very fine sands of the Oglala-Canyon Association, Tassel-Ashollow-Rock outcrop Association, and Otero-Las Animas-Lisco Association. Soils of the Oglala-Canyon Association are well drained, loamy soils found on 1 to 30% hillslopes and are derived from sandstone parent materials. Tassel-Ashollow-Rock outcrop soils are well drained, sandy soils derived from sandstone parent materials and are found on hillslopes ranging from 3 to 60%. Soils of the Otero-Las Animas-Lisco Association are very deep, loamy and sandy soils on flood plains and stream terraces. Topography of the park is gently rolling and elevations range from 4400 feet along the flood plain to 4600 feet at the tops of the surrounding hills.

Biological Description

This monitoring type occurs mainly in disturbed areas or areas that were under cultivation before the park was established. Cheatgrass (*Bromus tectorum*) is the most common non-native grass, but Kentucky bluegrass (*Poa pratensis*), Japanese brome (*Bromus japonicus*), and crested wheatgrass (*Agropyron cristatum*) are also present. Non-native forbs include kochia (*Kochia scoparia*), Russian thistle (*Salsola tragus*), and tumble mustard (*Sisymbrium altissimum*), yellow sweetclover (*Melilotus officinalis*), Canada thistle (*Cirsium arvense*), and curly dock (*Rumex crispus*). Native species such as prairie sandreed (*Calamovilfa longifolia*), needle-and-thread (*Stipa comata*), blue grama (*Bouteloua gracilis*), western wheatgrass (*Pascopyrum smithii*), sedges (*Carex* spp.) and annual sunflower (*Helianthus annuus*) also occur in this monitoring type.

Rejection Criteria

- Large outcrops or barren areas >20% of the plot
- Areas with anomalous vegetation
- Monitoring type boundaries
- Riparian areas
- Bio-control areas
- Areas within 20 meters of roads, man-made trails, or human created disturbance areas

Desired Future Condition

Mixed-grass prairie dominated by western wheatgrass, needle-and-thread, and grama grasses (*Bouteloua* spp.) is believed to be the major pre-settlement vegetation type for the area, although the exact composition of the communities before settlement is unknown. Kuchler (1964) described the potential vegetation for the AGFO area as wheatgrass-needlegrass prairie and Nebraska sandhills prairie. The fire return intervals reported for this type of prairie vary from as short as five years in level to gently rolling topography to 15-30 years in more broken topography (Wendtland and Dodd 1992). It is believed that the historic fire return interval in

these areas would have been on the more frequent end of this range (5-15 years).

Because this monitoring type generally occurs in areas that experienced high levels of disturbance, non-native species dominate and native species are somewhat scarce. These areas may require intense management practices including prescribed fire, seeding, mowing, and herbicide application to reduce dominance of non-native species. Desired future conditions for this monitoring type:

- Reduce non-native cool season annual grasses and non-native forbs
- Increase native grass cover
- Increase cover of native forb species
- Increase diversity (richness) of native species
- 5-year goal: 50% relative cover native species
- 10-year goal: 75% relative cover native species

Burn Prescription

This monitoring type should be burned in the fall or spring, shortly after germination of cool-season annual grasses. Prescribed fire may be applied more frequently than historic fire in order to achieve resource management objectives.

Fire Prescription Elements	
RH: 25-55%	Average Flame Length: 0.4-1.5 feet
Temp: 50-90 °F	Live Fuel Moisture: NA
Average Mid-flame winds: 2-12 mph	1-hour TLFM: 4-12%
Fuel loading: 1-5 tons/acre	10-hour TLFM: 8-15%
Average Rate of Spread: 1-100 chains/hr.	100-hour TLFM: NA

Monitoring Variables (in order of importance)

- Relative cover of non-native grass
- Relative cover of non-native forb species
- Relative cover of native perennial grass and native forb species

Prescribed Fire Objectives*

Immediate post-burn

- Burn at least 80% of the burnable project area
- Achieve burn severity of at least ‘lightly burned’ (3) as defined in the Fire Monitoring Handbook

Two years post-burn

- Reduce relative cover of non-native grasses and forbs by at least 20%
- Increase relative cover of native perennial grass and forb species by at least 20%

* Objectives intended for first prescribed fire treatment and are subject to change as information becomes available through fire monitoring activities.

Five years post-burn

- Maintain reduction in non-native species
- Maintain increase in native species

Fire Monitoring Objectives

- Install enough plots to be 80% confident that relative cover of non-native grass and forb species is within 25% of the true population mean.
- Install enough plots to be 80% confident that relative cover of native perennial grass and forb species is within 25% of the true population mean.

Data Analysis

- Assess relative and absolute cover of native grass and forb species after sampling years 1, 2, and 5.
- Assess relative and absolute cover of non-native grass and forb species after sampling years 1, 2 & 5.

Relevant Literature

Kuchler, A.W. 1964. Potential natural vegetation of the coterminous United States. Special Publication 36 (Manual), American Geographical Society, New York, NY.

Stubbendieck, J., and G. Willson. 1986. An identification of prairie in National Park units in the Great Plains. USDI National Park Service Occasional Paper No. 7, Washington, DC.

USDA, NRCS. 2002. The PLANTS Database, Version 3.5 (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA.

USDI National Park Service. 2001. Fire monitoring handbook. National Interagency Fire Center, Boise, ID. 288 pp.

USGS. 1998. Agate Fossil Beds National Monument, USGS-NPS Vegetation Mapping Program Products (<http://biology.usgs.gov/npsveg/agfo/index.html>). USGS-NPS Vegetation Mapping Program, USGS Center for Biological Informatics, Denver, CO.

Wendtland, K.J. 1993. Fire history and effects of seasonal prescribed burning on northern mixed prairie, Scotts Bluff National Monument, Nebraska. Thesis. University of Wyoming, Laramie, WY.

Wendtland, K.J., and J.L. Dodd. 1992. The fire history of Scotts Bluff National Monument. In: Smith, D. and C. Jacobs (eds.) Twelfth North American Prairie Conference. Cedar Falls, Iowa.

Plot Protocols

GENERAL PROTOCOLS		YES	NO			YES	NO	
Preburn	Control Plots/Opt		•	Herb Height/Rec		•		
	Herbaceous Density/Opt		•	Belt Transect Width: 2 meters				
	OP/Origin Buried		•	Abbreviated Tags		•		
	Voucher Specimens/Rec	•		Stakes Installed: 0P & 30P				
	Stereo Photography/Opt		•	Crown Intercept/Opt			•	
	Brush Individuals/Rec		•	Herb. Fuel Load/Opt			•	
	Herbaceous Data Collected at: 0P-30P							
Burn	Duff Moisture/Rec		•	Flame Zone Depth/Rec		•		
Postburn	Herbaceous Data/Opt: Not collected.			Herb. Fuel Load/Opt			•	
	100 Pt. Burn Severity/Opt		•					

Rec = Recommended, Opt = Optional

APPENDIX E-2 – ALTERNATE SAMPLING PROTOCOLS

Abstract

These alternative sampling plots are intended to provide information on vegetative conditions in grassland areas. Data collected will provide occurrence, density, and frequency by species, lifeform, or native versus non-native.

Methods

- Plots are randomly located using a G.I.S. application within a specific ecological community.
- Plots consist of 20 Daubenmire frames, 3 nested frequency frames, and a complete list of observed species.
- 2 rebar are located at 0 meters and 25 (or 24) meters with a centerline run between them.
- Plot azimuth is randomly determined.
- Plot location is described with written directions from roads or trails, and global positioning coordinates are listed in UTM format datum NAD 83.
- Complete list of species is created for the 25m x 10 m area (within 5 meters either side of the centerline).
- Plots are currently located in Agate Fossil Beds NM (7) and Knife River NHS (9).

Daubenmire frames are read beginning at 1m-1.2m, 2m-2.2m, 3m-3.2m...20m-20.2m

Daubenmire frames are placed on the left side of the centerline

Frames measure 20cm x 50cm

Each species is recorded and given a cover class 1 through 6

Nested frames are placed beginning at 1m-4.16m, 10m-13.16m, and 20m-23.16m

Nested frames are placed on the right side of the centerline

Frame sizes are 0.01 m² (10cm x 10cm), 0.1 m² (31.6cm x 31.6cm), 1 m² (100cm x 100cm), 10 m² (3.16m x 3.16m)

Presence of each species is recorded for each size interval

Data sheets created for a plot include:

FMH-5 Plot Location Data Sheet

FMH-6 Species Code List

Nested Frequency Data sheet

Daubenmire Data Sheet

Equipment

2-30 meter tapes

Daubenmire frame(s)

Set of 3 increments of Nested frequency frames

4 Chaining pins for 10 m² nested frame

Set of 4 Data sheets

Plant identification guides

APPENDIX E-3 – LONG-TERM PHOTO MONITORING
LONG TERM PHOTO MONITORING SHEET

Plot # _____
Burn Unit: _____

Park: _____

Date: _____
Recorders: _____

UTM Zone: _____	Camera height: _____ ft.	Elevation: _____ ft
UTMN: _____	Lens size: _____ mm	Slope along transect: _____ %
UTME: _____	Distance from pole: _____ ft.	Slope of terrain: _____ %
Datum: _____	Azimuth from camera to pole: _____	No. of Photos Taken: _____
EPE: _____	Height on pole used for shot: _____ ft	Compass Bearing(s): _____

Describe the route to the plot, include or attach a hand drawn map illustrating these directions, including the plot layout, and significant features:

Visit	Initial/ Date	Comments
Install/Pre		
Immediate Post		
1 Year Post		
2 Year Post		
5 Year Post		
10 Year Post		

Long-term Photo Point – Carnegie Unit



APPENDIX E-4 – LTEM SAMPLING PROTOCOLS AND PLOT LOCATIONS

The following two documents describe the LTEM monitoring protocols at AGFO. Both documents are on file at the NGPA Fire Management Office.

DeBacker, M. D., J. R. Boetsch, and L. P. Thomas. 2003. Frequency measures for grasslands – examining scale, sample size and precision. DOI, USGS, Northern Prairie Wildlife Center, Missouri Field Station.

Abstract

For long-term monitoring of grazing and fire regimes, both changes in species diversity and abundance shifts among dominant species are of interest. Our current monitoring protocol employs estimates of foliar cover in large sample frames to best capture species richness and diversity. However, frequency measures may provide a more accurate indication of changes in abundance than foliar cover, given the high inter-annual variability in aboveground primary production in prairie ecosystems. While effective at capturing species diversity, large sample frames provide poor frequency measures of dominant species because estimates at or near 100% essentially eliminate the ability to detect positive changes in abundance. A multi-scale method for measuring frequency was tested in tallgrass prairie in order to determine an optimal plot size for dominant species, the appropriate sample intensity at each scale, and to assess logistical constraints and cost. The largest plot size (10m²) was substantially better at capturing species richness, however, 15 species had frequencies near saturation (i.e. 100% frequency). The multi-scale approach enabled us to optimize frequency measures for multiple taxa simultaneously, with a 0.01m² plot size providing optimal frequency measures for many of the common grasses. Results indicate that a prohibitively large sample size is required to detect small changes in frequency; however, changes in frequency in the range of 12- 15% may be detected with a sample size of 40 plots. Furthermore, results of a simulation using field data suggest that variance among sites in the measure of frequency decreases dramatically as sample size increases to 40 plots.

Willson, G.D., L.P. Thomas, M.D. DeBacker, W.M. Rizzo and C. Buck. 2002. Plant Community Monitoring Protocol for Six Prairie Parks. DOI, USGS, Northern Prairie Wildlife Center, Missouri Field Station.

LTEM Sites



Appendix F. Five-Year Prescribed Fire Schedule and Burn Unit and Vegetation Description

CALENDAR YEAR	UNIT	REMARKS
2003	3 and 4 (Carnegie and Stenomylus Units)	Unit 3 has a significant amount of cheat grass, and should be burned in the late summer before it greens up in the early fall. It will need to be burned at least 2-3 times in quick succession.
2004	3 (Carnegie Unit)	
2005	3 (Carnegie Unit)	
2006	2 (River Unit)	
2007	1 (Daemonelix Unit)	

Burn Unit and Vegetation Description

Unit 1 (Daemonelix Unit)

The vegetation of Unit 1 is predominately native mixed grass prairie. This includes needle-and-thread (*Stipa comata*), blue grama (*Bouteloua gracilis*), sideoats grama (*B. curtipendula*), threadleaf sedge (*Carex filifolia*), prairie sandreed (*Calamovilfa longifolia*), sand bluestem (*Andropogon hallii*), and little bluestem (*Schizachyrium scoparium*). Areas dominated by western wheatgrass (*Pascopyrum smithii*), smooth scouring rush (*Equisetum laevigatum*), and Kentucky bluegrass (*Poa pratensis*) can be found on the upper terrace of the Niobrara River floodplain.

Since the majority of the vegetation in this unit is native, late summer or fall prescribed burns in this unit are recommended but it potentially could burn in the spring (see ‘Season of Burn’ below).

Unit 2 (River Unit)

The vegetation of Unit 2 is very similar to that of Unit 1, except for one area with a history of agricultural use which is currently dominated by non-native grasses and forbs. The disturbed area contains cheatgrass (*Bromus tectorum*), crested wheatgrass (*Agropyron cristatum*), Russian thistle (*Salsola tragus*), kochia (*Kochia scoparia*), and Canada thistle (*Cirsium arvense* as well as a mixture of native species. Sixty acres of this area have recently been seeded with native grass seed.

Prescribed burning plans in this unit should be closely coordinated with resource management at AGFO to ensure that prescribed burning does not hinder other restoration efforts. This unit could be burned in the fall or spring. The disturbed area may require repeated treatments to restore.

Unit 3 (Carnegie Unit)

Native mixed grass prairie is the dominant vegetation of Unit 3. However, there are some areas dominated by non-native species in this unit. These areas are mainly associated with developed sites such as the visitor’s center and museum, maintenance area, and the two housing areas.

Vegetation found in these areas includes cheatgrass, kochia, dock (*Rumex* spp.), and Canada thistle (*Cirsium arvense*).

Cheatgrass reduction may be accomplished by either a fall burn shortly after the cheatgrass has germinated or a spring burn before the cheatgrass begins growth for the season. Cheatgrass germination and growth is largely dependent on precipitation, so some flexibility may need to be written into burn plans to account for this. If it is determined that repeated annual burning is required to continue cheatgrass reduction, areas that are dominated by native species should be excluded.

Unit 4 (Stenomylus Unit)

This unit is predominately native mixed grass prairie. Vegetation includes the upland species listed for Unit 1. Late summer or fall burns are recommended for this unit but it potentially could burn in the spring (see ‘Season of Burn’ below).

Fire Return Intervals

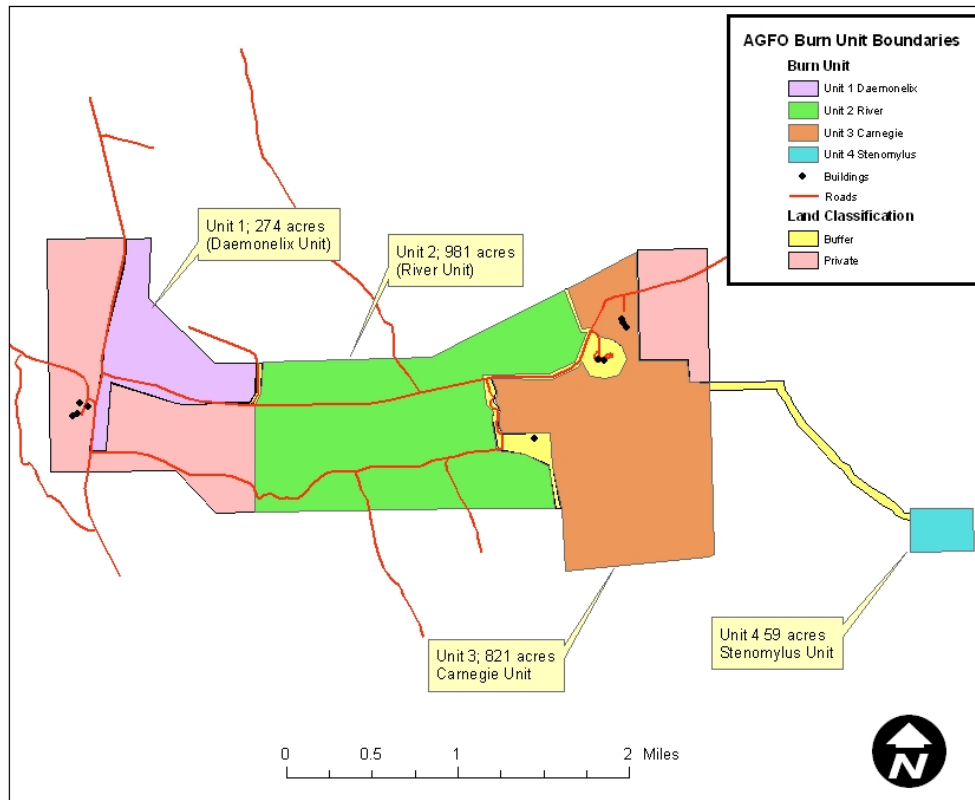
Research in the local area has estimated pre-European settlement fire return intervals as follows:

- the sand hills of Nebraska (4 to 9 years),
- smooth and gently rolling topography in the northern mixed prairie (5 years)
- the broken topography of Scotts Bluff National Monument (15 to 30 years), and
- the prairie-forest ecotone of the Black Hills (10 to 12 years).

Based on the fact that the vegetation and topography are similar to the smooth and gently rolling topography in the northern mixed prairie, and to a limited extent similar to the sand hills of Nebraska, the recommendation is that units at the park dominated by native mixed grass prairie be burned within a range of every 4 to 15 years. But the burn frequency for an individual unit may vary within that range. Areas dominated by non-native species will require more frequent burning to restore these areas.

Season of Burn

Ignition sources for fires in pre- Euroamerican settlement times are believed to be mainly lightning and both intentional and unintentional ignition by American Indians. A study of lightning-ignited fires in the Northern Great Plains over the past five decades indicates that nearly 75% of lightning-ignited fires occurred during July and August. Lightning-ignited fires were recorded every month from April to September. It is presumed that this pattern has not changed significantly for at least a few centuries. Historical documents and accounts of early settlers suggest that there were two seasonal periods for fires ignited by American Indians, one during the spring with a peak in April and one during the fall with a peak in October. It appears that for at least the past several centuries, mixed grass prairies of the Northern Great Plains have experienced fire every month from April through October.



Revised: 4/5/2002
Wind Cave NP GIS

Appendix G. Fire Prevention Plan

I. Objective

- To reduce the threat of human-caused wildland fires through employee and visitor awareness and education.

II. General Actions

- Wildfire and its prevention will be incorporated into some visitor contacts.
- Fire prevention will become a frequent topic at employee safety meetings.

III. Fire History

In the ten-year study period between 1992 and 2001, there were no wildland fires reported within the boundaries of the park. Two fires in 1992, reported with the same location, date, and time, occurred 1½ miles east of the park on private land. The reports stated that the two fires were caused by “field burning” and “trash burning.”

IV. Specific Fire Prevention Zone Ratings and Action Items

A. Risk. Moderate. During the fire season, the risk is moderate. This is a result of a low to moderate amount of off-road activities, primarily consisting of hikers on the trails and mowing. There is a moderate amount of traffic on State Highway 29, and a low volume of traffic on River Road through the park. It is possible that fires could be ignited from vehicle exhaust or smoking devices tossed from vehicles. However, cigarettes will only start a fire when the relative humidity is less than 24%.

B. Hazard. Low. The fuels, approximately 95%, fall into Fuel Model 1, short grass. This fuel loading is much lower than other fuel models, such as timber or brush.

C. Value. High. The value of the Visitor Center and Museum, the residences, the historic structures, and the maintenance structures is high.

D. Specific Fire Prevention Actions Required

1. Continue past practices of mowing the grass around the structures and public use areas.
2. Inspect the public areas on a regular basis to ensure the mowing is on schedule.
3. Inspect the residential areas on a regular basis to ensure the mowing is accomplished.
4. Inspect the spark arrestors on all gasoline and diesel engines that are used off roads to ensure that they are “approved” and in good working order.

Responsible Person: Chief Ranger

Appendix H. Memorandum of Agreement Regarding Intentional Excavation and/or the Inadvertent Discovery of Native American Human Remains and Associated Funerary Objects at Agate Fossil Beds National Monument, Nebraska (in process of being signed)

Whereas, the National Park Service (NPS), Agate Fossil Beds National Monument (hereafter referred to as the “park” or “Agate”), periodically engages in construction and maintenance projects on park lands that require compliance with the Native American Graves Protection and Repatriation Act of 1990 (25.U.S.C. 3002; 104 Stat. 3048) (“NAGPRA”) and

Whereas, the administration of its duties to protect cultural and natural resources, or through the monitoring of natural processes (animal burrowing, erosion, etc.) or as a result of vandalism; and

Whereas, at a future date Agate may uncover through inadvertent discovery, intentional excavations (or as a result of vandalism, natural erosional processes, or animal burrowing) Native American human remains and/or associated funerary objects; and

Whereas, Agate recognizes its responsibility under NAGPRA and the National Historic Preservation Act as amended (16 U.S.C. 470) to consult with Native American peoples who are culturally and historically affiliated with park lands and resources regarding the discovery, treatment and disposition of all Native American human remains and all items falling under the definitions of NAGPRA that are discovered on, or retrieved from, park lands; and

Whereas, Agate recognizes the cultural and historic affiliation with its lands and resources held by the federally recognized Indian Tribes party to this agreement (hereafter referred to as the “tribes”); and

Whereas, appropriate treatment of Native American human remains and funerary objects affiliated with the tribes requires respect for the deceased, and respect for the feelings of the genetic and cultural descendants; and

Whereas, it is the intent of the parties to this agreement to avoid any unnecessary disturbance or damage to discovered human remains and associated funerary objects; and

Whereas, Section 10.6 (f) of the (NAGPRA) Regulations [43 CFR Part 10 (December 4, 1995)] permits and encourages specific agency-tribal agreements to ensure the appropriate treatment of human remains and associated funerary objects; and

Whereas, Section 10.3 – 10.5 of the (NAGPRA) Regulations [43 CFR Part 10 (December 4, 1995)] address procedures regarding the intentional excavation and the inadvertent discovery of human remains, and consultation requirements regarding the disposition and treatment of these remains.

NOW, THEREFORE: Agate and the tribes agree that the following procedures will be adhered to for the excavation, treatment and disposition of all Native American human remains and

associated funerary objects which are found as a result of inadvertent discovery, intentional excavation, natural erosion, animal burrowing activity, or vandalism within the boundaries of Agate Fossil Beds National Monument.

I.

Agreements Regarding the Discovery of Human Remains and Associated Funerary Objects Resulting from Inadvertent Discovery or Intentional Excavation at Agate Fossil Beds National Monument, Nebraska

- A. The National Park Service shall provide a professional archaeologist to monitor all activities within the park that have the potential of discovery of NAPRA-defined remains.
- B. If a discovery is made in the course of an authorized planned excavation, Agate (or the park-designated representative) shall notify the tribes that are party to this agreement and any additional tribes determined to have a likely affiliation with the remains pursuant to Section II of this agreement.
- C. If an inadvertent discovery of remains is made the park, contractor or subcontractor will cease all activity at the burial site and take immediate steps to protect the remains from further disturbance pursuant to Section II of this agreement.
- D. All employees of the National Park Service, or its contractors or subcontractors involved in maintenance, construction or other Agate-authorized activities, upon discovery of remains, will report such discovery to the park superintendent or to her/his designated park official within one (1) working day.
- E. The discovered remains shall be protected from the time of discovery until their disposition in accordance with the procedures set forth herein. All construction or other activities that may cause disturbance to the remains will cease until notification (three working days following the discovery) and consultation with affiliated Indian tribes is completed or the mandated 30-day consultation period expires; whichever occurs first.
- F. When a discovery in the park occurs a professional archaeologist and/or physical anthropologist will make an *in situ* determination, to the degree possible, of the cultural affiliation, antiquity (e.g., chronological time since interment) and condition of the remains based upon professional archaeological standards (cf. *Federal Register*, September 9, 1983, Archeology and Historic Preservation, Secretary of the Interior Standards and Guidelines, vol.48, pp. 44716-44742) and inform the park superintendent of these determinations. Agate will transmit these findings to the tribes as soon as possible as part of the consultation process. Determination of how objects are classified as NAGPRA defined objects will be completed through an examination of all available evidence, including evidence gathered through consultation with affiliated tribes.
- G. Intentional excavations will be conducted by NPS-authorized professional archaeologists only after notifying and consulting with culturally affiliated tribes. Intentional excavation

will only take place in cases where such excavation is deemed unavoidable by the superintendent and/or when such excavation is necessary to provide adequate and appropriate protection of the remains. Subsequent treatment and disposition of the remains resulting from an intentional excavation will be determined after consultation with culturally affiliated tribes. Data recovery resulting from intentional excavation will be limited to data necessary to determine cultural affiliation and/or data necessary to ensure appropriate treatment and disposition as outlined in Section III of this agreement.

II. Notification of the Discovery of Remains

- A. Discovery of remains in the park due to any cause will be followed by the procedures outlined below:
 - 1. First, Agate personnel, or park contractors or subcontractors will report the discovery within one working day to the Agate superintendent, or the acting superintendent.
 - 2. Second, Agate will notify the appropriate NAGPRA coordinating official of each of the tribes within three (3) working days of the discovery and initiate plans to consult on the appropriate treatment and disposition of the remains. Any and all data associated with the remains (to include, but not limited to, the location of the remains, their condition and antiquity), their specific cultural affiliation (to the degree that this can be determined) and the criteria applied to determine cultural affiliation shall be included in the notification to the tribes.
- B. If a discovery of remains is made within the park and is initially thought to be culturally affiliated with a tribe(s) that is not a signatory of this MOA, a good faith effort shall be made by Agate, in compliance with the provisions of the law, to contact such tribe(s) and afford them the opportunity to express their wishes concerning the treatment and disposition of the remains.

III. Excavation, Treatment, and Disposition of Remains

- A. The following procedures regarding the excavation, treatment, and disposition of remains shall be implemented subsequent to the discovery of all remains except at the express wish of, or in conformity with the policies and guidelines of the tribes expressed to Agate during consultation.
- B. All remains shall be treated with respect and dignity in order to avoid any unnecessary disturbance of remains, separation of human remains from associated funerary objects, or physical modification of remains.
- C. Whether discovered through inadvertent means, or through planned excavation, Agate will make every attempt to protect and preserve the integrity of the burial site *in situ*. When

leaving the remains undisturbed *in situ* indefinitely is not possible (See Section I, part G of this agreement), Agate or its contractor or subcontractor will take measures to protect the remains in place until appropriate measures for excavation and reburial of the remains can be taken. This may include removing the remains to a facility within the park for temporary care and protection. While protection of the remains may involve some curation techniques (e.g., protective wrappings of coverings), the remains will not be subject to any intrusive, direct labeling or marking procedures.

- D. The excavation and removal of human remains and funerary objects shall be undertaken in accordance with current professional standards for archaeological data recovery (cf. *Federal Register*, September 9, 1983, Archeology and Historic Preservation, Secretary of the Interior Standards and Guidelines, vol. 48, pp. 44716-44742).
- E. Unless otherwise agreed between Agate and the tribes, the treatment and disposition of remains shall be as follows:
1. All remains discovered in the park shall be left *in situ* without disturbance other than that necessary to confirm discovery, provide data as specified for the notification, and to assure their protection until the affiliated tribes have been notified. If the remains are identified as those of a Native American whose lineal descendants cannot be identified, and if leaving them *in situ* is not possible, representatives of the tribes shall be consulted regarding the disposition and reinterment of the remains, and official representatives of the tribes shall be given the opportunity to carry out activities attendant upon reinterment of the remains. Every effort will be made by Agate to select a reburial site as near as possible to the original burial without causing disturbance to any archaeological site, unless such disturbance is approved by the superintendent and judged culturally appropriate by consulting tribes.
 2. Disarticulated human remains exposed to erosion, acts of vandalism, or animal burrowing shall be reinterred and covered with surrounding fill material upon discovery to assure their protection and safeguarding. The tribes shall be notified as to the protection or reinterment of these remains and provided with the opportunity to consult with Agate on any additional needs for treatment or reinterment of the remains.
 3. When excavation of remains is determined to be necessary, reinterment shall occur as soon as possible after the completion of the stabilization, restoration, restoration, mitigation, maintenance activities, and/or the completion of necessary documentation. When the tribes wish to conduct ceremonies or rituals attendant upon reinterment of the remains, the scheduling of excavation and reburial shall be adjusted to accommodate those interested affiliated tribes wishing to conduct such ceremonies or rituals. In the event that it is necessary to adjust the scheduling of excavation and reburial, procedures to protect the remains will remain in place to accommodate this rescheduling.

When the reinterment is on park lands the location shall be reported to the Agate superintendent and to the appropriate tribal officials of the tribes having cultural affiliation with the remains.

4. Non-destructive “in-field” analysis of the remains shall be permitted. Such analysis shall be conducted in the field by a physical anthropologist or a professional archaeologist fully qualified to perform analysis of remains. Destructive analyses of the human remains shall not be permitted unless authorized by the tribes that are party to this agreement or by those additional tribe(s) determined by Agate to be affiliated with the remains.
- A. Representatives of the Tribes shall have the opportunity to be present during the excavation, treatment and disposition of the remains; the tribal chair, governor or president, or his/her designee shall be responsible for the timely designation of tribal representatives to assure that the excavation, treatment and disposition of the remains can proceed expeditiously.
 - B. No excavated human remains shall be put on public display, in any manner, not photographed except for documentation purposes; no photographs of the human remains shall be distributed or published without the written permission of the tribes.
 - C. In those instances when cultural affiliation cannot be determined and the tribes do not state a claim to the remains, the NPS shall determine their treatment and disposition in conformity with the provisions of this Agreement.
 - D. The specific locations of the discovery and reinterment of remains shall be withheld from disclosure (with the exceptions listed below) and protected to the fullest extent allowed by federal law. Consistent with the provisions of the National Historic Preservation Act, as amended, the original location and the reinterment of the remains shall be withheld from public disclosure. The only parties to be given information relating the location of the discovery and reinterment shall be the Agate cultural resource manager and the officially designated representatives of the tribes that are party to this agreement.
 - E. All reasonable expenses associated with the disposition of remains shall be paid by the NPS. All reasonable expenses associated with the consultation process (including final consultation pursuant to reburial) will be paid by the NPS. The NPS agrees to cover travel expenses and per diem costs for tribal individuals involved in the consultation process, unless these individuals are tribal employees tasked by their tribal government to work with the NPS or other federal agencies to aid in the implementation of NAGPRA.
 - F. Within 90 days, after the disposition of the remains, the National Park Service shall submit a final report documenting the discovery, treatment and disposition of remains to the appropriate tribal officials.

IV.

Dispute Resolution

All disputes regarding the cultural affiliation of discovered remains shall be resolved in accordance with the procedures set forth here following:

- A. Tribes with conflicting claims of cultural affiliation to remains, or who are not able to agree on the disposition or treatment of such remains, shall give written notice of their claims to the Agate superintendent.
- B. The NPS shall convene a meeting with the disputing parties within 15 days of receiving the notice. The disputing parties shall attempt to agree on the designation of a third party to assist in the resolution of the dispute.
- C. If the disputing parties cannot agree within 15 days on a third party, Agate shall appoint one to serve in that capacity.
- D. The disputing parties shall attempt to reach a resolution with the assistance of the third party.
- E. If a resolution cannot be reached within 90 days of the designation of the third party, the disputing claims will be forwarded to the NAGPRA Review Committee for consideration of resolution.

V.

Terms and Amendment

- A. From the date of the last signature, this MOA shall remain in effect for a term of five (5) years and may be amended only with the written consent of all parties hereto at the time of such amendment.
- B. Any signatory party may terminate their participation in this MOA upon 30 days written notice to the other signatories.

VI.

Additional Parties

In addition to those listed here, interested tribes who have been determined by the NPS to be culturally affiliated with the NAGPRA-defined remains, or who can demonstrate cultural affiliation with NAGPRA-defined remains in this park, may execute this Agreement at a later time, if they express a desire to do so.

VII.

Multiple Counterparts

This document may be executed in multiple counterparts, and when taken together, shall be deemed as one instrument.

AGATE FOSSIL BEDS NATIONAL MONUMENT

By: _____ Date: _____

Title: _____

By: _____ Date: _____

Title: _____

By: _____ Date: _____

Title: _____