PRESCRIBED BURNING

TECHNICAL GUIDANCE DOCUMENT

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Photo by Ken Graeve/MnDOT

INTRODUCTION

Fire is an important process in many ecosystems, and can be an important tool in the management of restored landscapes. Prescribed fire can achieve specific vegetation establishment or weed control objectives, or can take the form of a recurring treatment to mimic the natural process in well-established restorations. Prescribed burning in uplands is an important strategy for controlling cool-season grasses and woody vegetation. Burning can also remove thatch that can inhibit native plant growth. Many plant communities in Minnesota, particularly those in the prairie region require fire to maintain diversity and control woody plants such as willow, boxelder and cottonwood. In this region where fire traditionally controlled such invasions, the growth of woody vegetation can suppress prairie species by producing excessive shade and decreasing habitat value for ground nesting grassland birds.

Fire also makes nutrients available to plants by breaking down litter. This increased nutrients leads to vigorous growth, and increased flower and seed production, providing more food for grassland birds and animals.

There are many factors that influence decision making about the timing, frequency and need for prescribed burning in and around wetlands and upland buffers, including; the location in the state, surrounding plant communities, target plant communities, invasive species threat, and current vegetation.

A wide variety of equipment is needed for prescribed burning including drip torches for ignition, nomex fire suites, leather boots and gloves, hard hats with face shield and nomex ear/neck protection, first aid kit, radios, drinking water for crews, backpack pumps, slip-on water pump and truck, ATV with water tank, fuel cans, replacement parts and took kit, grass/thatch rakes

APPLICATION

It is more common that prairie buffers around wetlands are burned than wetland communities; though many prairie pothole wetlands benefit from burning to decrease woody vegetation around the perimeter of open water. Soil saturation is often a limiting factor in the ability to burn wetland communities. There has also been some concern that sunlight and nutrients after prescribed fire can benefit reed canary grass and cattail establishment.

Burn Crew managing a back fire
photo by Ken Graeve/Mn/DOT

Prescribed burning is often initiated around the third year of growth, after most vegetation has fully established. Spring burns are commonly used to set back cool-season grasses that are active earlier in the spring before native grasses and forbs are active. Burns for woody species control are typically conducted in late summer or early fall. Fall burns can also benefit early blooming native species. It is commonly recommended to alternate burn dates to benefit multiple plant species. Soil types can also influence decision making about timing. Peat soils are often burned early in the spring when they are still frozen to prevent peat fires. Personnel planning and conducting prescribed burns require expert knowledge of fire behavior and the influence of fuel loads, relative humidity, temperature, winds, and vegetative moisture. When planning a prescribed burn county and city clerks should be contacted to find out what ordinances are required at a site, and to obtain required permits from local fire departments. Neighboring property owners should also be notified of plans to burn (Fuge 2000).

A prescribed burn plan should be developed that outlines the environmental conditions appropriate for the burn as well as details about how the burn will be conducted. Table 1 summarizes important items of a burn plan. A Minnesota DNR burn plan form can be found at:
http://files.dnr.state.mn.us/forestry/wildfire/rxfire/forms/burnplanform.doc

Items to be Included in a Burn Plan
Location of the burn
Resource management objectives of the burn
Necessary approvals, permits and variances
Pre-burn vegetative description of the area
Prescription for weather conditions required and observed conditions
Description of the burning method to be used
Description of pre-burn preparation
Firing sequence of area to be burned
Smoke management considerations
Contingency plan for fire escapes
Communication plan
Job assignments and descriptions of responsibilities for all persons assisting with the burn
Equipment and materials checklist (ex. Drip torches, tractors, discs, pump trailers, etc.)
Job assignments and descriptions of responsibilities for all persons assisting with fire patrol, containment, mop-up and suppression of the burn.
Post-burn evaluation and management
Burn boss or landowner signature acknowledging acceptance of full liability resulting from implementation of the burn plan.

Table 1. NRCS 2001

Roughly one-half of a site should be burned at a time to provide a refuge for small mammals, reptiles and invertebrates living within the restored area (Galatowitsch and van der Valk 1994). This is particularly important if no natural areas surround the site. Burns every three to five years are recommended except for dry prairies that may take up to ten years to accumulate enough plant litter for a burn (Fuge 2000). Burn season and intervals should be varied over time, as this will decrease the risk of setting back desirable species or benefiting non-native species.

Ten to fifteen foot wide firebreaks should be established around units to be burned. Fire hazards such as buildings, trees and adjacent fields should be identified and incorporated into a burn plan. Other structures that could be damaged such as plastic pipes that are part of the restoration, and utilities should be noted and protected as needed. The impact from smoke should also be assessed. Table 2 summarizes smoke impacts that need to be considered as part of project planning.

Smoke Management Considerations
A 360 degree check for possible restrictive air space
A 360 degree check for sensitive areas such as residences, roads, airports
A check of sensitive areas downwind and 45 degrees on either side of initial wind direction
An estimate of the length of time necessary to conduct the burn, plus a margin of error for wind shift or loss of speed, to predict smoke duration.
Electrical or high power transmission lines should be documented and the burn plan designed and applied so that high dense smoke columns will not cross under or contact these lines.
Electrical discharge can occur due to high concentrations of carbon in smoke columns.
Moist fuels produce more smoke than dry fuels
Head fires produce more smoke than slower burning backing fires
Smoke problems at night are more hazardous than during daylight
Stable air mass conditions can cause air inversions, which restrict smoke convection. Unstable atmospheric conditions are usually better for smoke management.

Table 2. NRCS 2001

Weather conditions play a key role in the completion of a successful prescribed burn. Temperature, relative humidity, wind, moisture, time of day and fuel loads should all be considered when planning a burn and on the day of the burn. Ideal burning conditions are summarized in table 3.

Ideal Burning Conditions	
Temperature	50-90 Degrees F
Relative Humidity	25 to 50 percent
Wind	Steady winds between 5-18 MPH
Fine Dead Fuel Moisture	5-11 %
Time	10 am to 4 pm
Fuel Load	At least 1,200 lbs/acre of fine fuel (dry grass and litter)

Table 3. NRCS 2001

There are three kinds of prescribed fires that are selected for sites based on burn objectives and site specific conditions. The three types of prescribed fires include back fires, head fires and flank fires.

Types of Prescribed Fires		
Back Fires	**Head Fires**	**Flank Fires**
Back fires are conducted into the wind and are the hottest type of burn. Back fires work best with wind velocities of 4-12 MPH	Head fires burn with the wind. They burn quickly and have high flame heights. They burn cooler than backing or flank fires.	Flank fires burn at oblique angles to the wind direction. They are often used to secure the flanks of a head fire to gain greater control

Table 4. NRCS 2001

Conditions for any particular burn will depend on desired outcomes of the burn. These conditions include weather, time of year, and techniques used. For example, a very hot fire may be required for brush control while a less intense fire may be ideal for maintaining well-established restorations yet providing refugia for arthropods.

Prescribed burns are often conducted to aid in the removal of specific invasive species or weeds. Table 5 was developed by the Nature Conservancy and summarizes the influence of prescribed burning on specific plant species.

Effects of Burning on Plant Species Adapted from Tu et.al. 2001		
Bromus inermis Smooth brome	-Burning at time of tiller elongation (late spring), yields an instant and persistent reduction in tiller density and biomass.	Willson 1990 Willson & Stubbendieck 2000
Bromu japonicus Japanese brome	-Litter accumulation aids in the growth of Japanese brome - Burning once every 5 years will reduce plant litter	Whisenat 1990
Centaurea maculosa Spotted knapweed	-Repeated burning will reduce spotted knapweed, but it is often difficult to get a burn to carry through dense knapweed patches -Burning is only effective where re-growth of native species is vigorous	Mauer 1985 Watson & Renney 1974
Cirsium arvense Canada thistle	-Fewer thistles were seen in years following a burn than before or year of the burn. -Late spring burns (May-June) are most detrimental– thistles may increase the first year following a May burn, but will decline within 2 growing seasons; immediate reductions in thistles occur following a June burn -Early spring burns can increase sprouting and reproduction -During first 3 years of control efforts, burning should be conducted annually	Evans 1984 Hutchinson 1992 Sather 1988 Smith 1985
Dipsacus sylvestris Teasel	-In sparse stands, late spring burns are effective. -Little control is provided by burning in dense stands, because fire will not carry through. -Burning works best in conjunction with other means of control.	Glass 1991
Euphorbia esula Leafy spurge	-Fire stimulates vegetative growth. -Fire followed by herbicide treatment has been effective, because the regrowth is more vulnerable to herbicides.	Biersboer & Koukkari 1990 Cole 1991a

	-Late fall herbicide application of picloram and 2,4-D followed by a fall burn resulted in 100% control after 2 years of treatment	
Hypericum perforatum St. John's Wort	-Fire tends to increase stands.	Crompton et al. 1988
Lysimachia nummularia Moneywort	-Best to burn in spring when moneywort is green and native vegetation is dormant. -Regular burning regime for several years will be needed for control.	Kenney & Fell 1992a
Melilotus alba & *Melilotus officinalis* White sweet clover & Yellow sweet clover	-At least two burns are necessary for control. -Increase in abundance in first year after burn. -Burning in late spring of the second-year as the shoots elongate, results in a kill of second year plants prior to flowering and seed set. -Mulching was found to be more effective than late spring burning. -Dormant season burns stimulate germination and increase the chance that plants will survive to produce seeds. -Dormant season burns can be used in conjunction with mowing or clipping in summer of the following year as plants flower.	Cole 1991b Eidson & Steigmann 1990 Kline 1983 Schwarzmeier 1984 Turkington et al. 1978
Pastinaca sativa Wild parsnip	-Fire removes ground litter and standing litter, providing favorable conditions for the development of parsnip rosettes. -Periodic burning may help maintain the vigor of native plants to allow them to better compete with parsnip.	Kenney & Fell 1992b
Phalaris arundinacea Reed canarygrass	-Growing season fires may reduce vigor and help control the spread. -Growing season burns may give native species a competitive advantage. -Burning may stimulate reed canary grass germination in some cases	Apfelbaum & Sams 1987 Henderson 1990
Phragmites australis Phragmites	-Burning will not reduce growth unless the roots burn. -Burning removes phragmites leaf litter, allowing seeds of other species to germinate. -Burning in conjunction with chemical control has been found effective. -Burn with caution, since spot fires can occur up to 100 feet from burning phragmites.	Beall 1984 Marks 1986
Typha spp. Cattail	-Fire provides little or no control unless the roots are burned. -Drawdown followed by burning and then flooding to a depth of 8 – 18" will provide control.	Apfelbaum 1985 Nelson & Dietz 1966

Table 5.

An alternative to typical prescribed burning involves the use of propane torches to target individual plants. An advantages of torches is that they can be used in areas with low fuel loads and they can be used in wet conditions. Similar to prescribed burning, the use of torches typically requires a burn permit. Torches have

been used effectively on buckthorn seedlings. Herbaceous vegetation such as garlic mustard can also be killed with torches.

OTHER CONSIDERATIONS

Prescribed burning is an important practice for the long-term maintenance of fire dependent plant communities. Burning and spot treatment of weeds are practices that are recommended indefinitely for sites to manage unwanted vegetation. In the case of woody vegetation, the use of herbicides is sometime necessary in combination with burning to achieve sufficient control. When biological controls are being used for a site the influence of fire on the biological organisms should be considered.

COSTS

The cost of prescribed burning can vary greatly depending on the location and site conditions of the burn with urban prescribed burns typically costing more than rural projects. Costs tend to be the lowest ($20-$40 per acre) for projects that are surrounded by tilled agricultural fields and highest for projects surrounded by suburban development ($40-$180 per acre)

Head fire burning previously treated vegetation

ADDITIONAL REFERENCES

Going Native, A prairie restoration handbook for Minnesota landowners, Fuge

The Tallgrass Restoration Handbook for Prairies, Savannas, and Woodlands, Packard, S., Mutel, C.F.

NRCS Conservation Practice Standard, Prescribed Burning, Code 338, 2001

Restoring Canada's Native Prairies: A Practical Manual, Morgan, J.P., Collicutt, D.R. and Thompson.

Restoring the Tallgrass Prairie: An Illustrated Manual for Iowa and the Upper Midwest. Shirley S.

MN Department of Natural Resources Burn Plan Form
http://files.dnr.state.mn.us/forestry/wildfire/rxfire/forms/burnplanform.doc

Prescribed Burn Handbook, MN Department of Natural Resources, 2004
http://files.dnr.state.mn.us/forestry/wildfire/rxfire/handbook.pdf