Synthesis Report:
Current Work on Prescribed Fire Related to Longleaf Pine Restoration

Overview

The Range-Wide Conservation Plan for Longleaf Pine calls for increasing longleaf pine from 3.4 million acres to 8 million acres by 2025. This effort is supported by federal and state agencies and nongovernmental organizations (NGO) in the Southeast, and dovetails with the Southeastern Regional Partnership for Planning and Sustainability's (SERPPAS) interest in sustaining longleaf pine. Based on limited information about the amount of prescribed burning currently done in longleaf ecosystems, meeting the 8 million acre goal likely will depend on the ability to more than double the current amount of prescribed burning in longleaf, with most of the increase occurring on private lands and within Significant Geographic Areas identified in the Conservation Plan. Given the barriers to implementing prescribed fire at the magnitude and frequency needed, relevant stakeholders must work together to develop and implement a strategy to address the social, financial, political, and regulatory challenges to move forward.

Purpose

At the Fall 2011 SERPPAS meeting, the Principals established a SERPPAS Prescribed Fire Work Group to develop a synthesis of current efforts on prescribed fire for longleaf pine restoration. The Prescribed Fire Work Group represents diverse agencies and organizations including the Department of Defense, US Forest Service, US Fish and Wildlife Service, Environmental Protection Agency, Southern Group of State Foresters, National Coalition of Prescribed Fire Councils, The Nature Conservancy, North Carolina State University, and Texas A&M University. This synthesis summarizes current knowledge about barriers and alternatives related to prescribed fire in the Southeast, including documentation of goals and priority activities of relevant agencies, organizations, and other stakeholders. Lists of recommendations are presented throughout the synthesis. These recommendations emerged from many of the documents we reviewed (Appendix 1). They are not SERPPAS recommendations, but rather represent current thinking on what has been written on the topic.

We reviewed a variety of documents (Appendix 2) pertaining to the nine states in the historic longleaf pine range – VA, NC, SC, GA, FL, AL, MS, LA, and TX – to summarize collective knowledge about prescribed fire. This synthesize lays the foundation for the second stage of our project: crafting a Comprehensive Strategic Plan for Prescribed Fire Related to Longleaf Pine Restoration.

Numerous and interrelated challenges are deterring wider application of prescribed burning, including air quality regulations, smoke management, and public health concerns; land use changes, urbanization, and fragmentation; public and landowner perception and fire knowledge; liability from smoke or escaped fire; capacity in terms of personnel, equipment, training, and funding; and relevant data and models. Yet, a host of alternatives and approaches already are being implemented, or at least examined, to overcome these challenges.

This document summarizes the following challenges facing prescribed fire and actions currently being taken or recommended to address them:

- **Regional, State, and Local Smoke Management**: Inconsistent smoke management programs and guidelines across the nine states
- **Federal and State Air Quality Regulations**: Uncertainty related to air quality limitations on burning
- **Agency Missions, Policies, and Programs:** Lack of coordination, fragmented approaches across federal, state, local agencies
- **Land Use Changes**: Fragmentation, parcelization, urbanization inhibit integrated management
- **Public Perception/Knowledge**: Ineffective information dissemination and marketing efforts to key stakeholder groups and the general public
- **Liability**: Legal and practical uncertainties creating a risk averse environment
- **Capacity**: Lack of fully trained prescribed burning practitioners and services
- **Financial Resources:** Lack of adequately funded, appropriately incentivized programs or private markets that support prescribed burning practitioners and landowners
- **Fire Science and Information**: Lack of adequate information and decision support structures to inform smoke emissions, air quality, and other decisions

While these categories are presented discretely, there is clear overlap among them. Making progress in one area will yield benefits in other areas. Appropriately sequencing activities to fully capitalize on the synergies among them will be critical as we move forward with developing the Comprehensive Strategic Plan for Prescribed Fire Related to Longleaf Pine Restoration. While the primary focus of our work is increasing prescribed fire for longleaf pine restoration, progress toward this goal also will yield benefits for other species and forested ecosystems.

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Regional, State, and Local Smoke Management

Smoke is recognized as a primary challenge for prescribed burning for two reasons: public health and safety. Smoke contains air pollutants; fine particulate matter ($PM_{2.5}$) and ozone precursors[a] are the primary pollutants of concern[b]. These pollutants can negatively affect human health, particularly in sensitive populations like the elderly and those with respiratory problems. Particulate matter also can reduce visibility, which is of particular concern along roads and highways where loss of visibility can range from an inconvenience to a safety threat. In the Southeast, the combination of smoke and high relative humidity can create near white-out conditions, especially in the early morning. Often, waiting for the optimal fuel and weather conditions to minimize smoke dispersal and safety risks can stop a planned burn from happening.

The Environmental Protection Agency's (EPA) 1998 "Interim Air Quality Policy on Wildland and Prescribed Fires" encourages states to develop Smoke Management Programs (SMP) to address smoke and minimize its impacts. EPA recommends that a state's SMP include the procedure for authorizing burns, methods for minimizing emissions, preparation of burn plans, public education and awareness, surveillance and enforcement, and periodic program evaluation.

In the historic longleaf pine range, smoke management is addressed in a variety of ways. Alabama, Florida, Georgia, and South Carolina all have state-certified Smoke Management Programs that address the criteria contained in EPA's 1998 Interim Policy. Louisiana, Mississippi, North Carolina, and Virginia have voluntary smoke management guidelines to minimize the impact of smoke and maintain air quality, but their guidelines do not comply with EPA's Policy. The North Carolina Forest Service and Mississippi Forestry Commission are developing Smoke Management Programs. Texas' Outdoor Burning Rule serves as the state's smoke management guidelines; compliance with the rule requirements is mandatory for an authorized burn.

Florida and Georgia employ full-time meteorologists to help plan smoke management and prescribed fire. Florida has the most sophisticated system in the Southeast for evaluating smoke impacts prior to issuing burn authorizations. The Florida Fire Management Information System uses a Geographical Information System (GIS) to estimate fuel loading and emissions, and then runs a smoke dispersion model (Smoke Screening Tool) to determine whether a burn is likely to impact smoke sensitive areas. The US Forest Service Southern Research Station provides an online smoke screening tool for public use, which allows users to enter a fire location and make simple assumptions about the fire and wind direction. It then generates a smoke plume on a Google map so users can easy zoom in/out and pan around to identify sensitive receptors. This is a useful tool for landowners to learn about and consider smoke impacts.

In the existing literature we reviewed for this synthesis, many recommendations were made to manage or reduce smoke, or to reduce concerns about smoke. We have organized and presented these recommendations below. For these recommendations, and those presented throughout the synthesis, the number in parentheses corresponds to the document from which the recommendation originated. These documents are referenced in Appendix 1. These recommendations do not necessarily reflect SERPPAS recommendations.

Guidance

- Develop state Smoke Management Programs that are as consistent as possible across states (1)

Training

- Train burners on appropriate burning and smoke management techniques (2)
- Work in partnership with landowners, US Forest Service, National Weather Service, researchers, and others in providing training and information for burners on scheduling prescribed burning when smoke dispersion will minimize air quality impacts (3)

Timing

- Burn in late winter through spring when high ozone level days are less likely (4)
- In areas where warm season burning is an important tool for longleaf restoration and/or maintenance, conduct prescribed burning and control smoke to minimize smoke and air quality issues (5)
- Coordinate/control burn permit authorizations to adapt to air pollution conditions and weather conditions affecting smoke transport and dispersion to reduce the overall impact of smoke (1; 2)
- Burn under specific conditions that allow for adequate combustion and smoke dispersal to reduce particulate matter (6)
- Set ignition termination times based on dispersion conditions, expectations for inversion, and predictions of fog; constrain or prohibit ignitions under poor dispersion or mixing conditions (1)
- Be prepared to change plans if the wind forecast is uncertain or variable (1)
- Take advantage of good weather to do large burns (1)

Technology/Information

- Use empirical data on downwind $PM_{2.5}$ to set limits for impacts to sensitive populations/areas (1)
- Use the latest technology to model and track smoke plumes and monitor visibility in smoke sensitive areas (6; 7)
- Use on-site weather, fuels, and air quality monitoring equipment (2)

Technique

- Use ignition patterns and methods that lift smoke to the upper portion of the mixing layer (1)
- Minimize the amount of smoldering smoke (8)
- Conduct small test fires to determine pattern and direction of smoke dispersion (1)
- Confirm wind direction multiple times throughout the burn (1)
- Complete the burn as soon as possible (1)
- Conduct post-ignition patrol (1)

Smoke Mitigation

- Consider the time between prescribed burns when evaluating burn requests (1)
- Use a 2-4 year burn interval to reduce fuel loads and resulting emissions (1)
- Reduce available fuel loads before burning (1)

Incentives

- Develop an incentive program to encourage landowners to reduce fuel loads and to burn under more favorable weather conditions that limit downwind impacts (1)

Burn Planning

- Identify areas suitable for burning based on wind direction and distance to sensitive populations downwind, to anticipate possible conflicts and who may be affected if wind direction changes (1)

Communications

- Alert the public about planned prescribed burns through press releases, radio announcements, etc. (9)
- Develop a brochure to inform the public about smoke produced by prescribed fire and what to do if they encounter smoke from fire (9)

Federal and State Air Quality Regulations

EPA does not directly regulate the use of prescribed fire within a state; rather the agency's authority is to enforce the requirements of the Clean Air Act, which requires that states attain and maintain National Ambient Air Quality Standards (NAAQS) to protect public health and welfare. Emissions from prescribed fire can contribute to violations of NAAQS and potentially lead to designation of non-attainment areas. To allow fire to function in its natural role while also protecting public health, EPA recommends that states develop and implement SMPs. Actions taken under the SMPs to reduce emissions of particulate matter reduce most other NAAQS pollutants as well.

A state with a state-certified SMP (or a state that can demonstrate that basic smoke management practices, such as those recommended by the US Forest Service and Natural Resources Conservation Service, were followed for the burn in question) may be given consideration under the Exceptional Events Rule (EER) for particulate matter or ozone violations attributed to prescribed burning. A case can be made that prescribed fires performed to restore and maintain healthy ecosystems (e.g., longleaf pine ecosystems) meet the criteria to qualify as an exceptional event, thus avoiding the NAAQS violation. However, in accordance with the EER, a demonstration must be made on a case-by-case basis. The application process can take considerable time and technical resources, placing a strain on the requesting agency and potentially negatively affecting the EER's implementation.

To comply with federal regulations, states establish limits on air emissions from many sources, and may decide to restrict prescribed burning to ensure they meet the NAAQS[c]. Each of the nine states in the historic longleaf pine range has a regulation for open burning[d] to protect air quality. These regulations do permit prescribed burning for forest, agricultural, or wildlife management practices, provided it is done in accordance with other applicable statutes, regulations, and guidelines. However, the regulations restrict prescribed burning in counties within the states with larger or more sensitive populations when the air quality index[e] exceeds 100. Further, local ordinances, such as county burn bans, take precedence over state law if they are more restrictive than what the state allows.

In South Carolina, the Forestry Commission works with counties in the state that are considering outdoor burning ordinances or legislation to ensure that prescribed burning is excluded from burning prohibitions. There has been a trend toward increasing regulation, so the agency monitors outdoor burning ordinance proposals to ensure that prescribed burns are exempt.

In 2011, the SERPPAS Smoke Management and Air Quality Subcommittee issued a draft report providing a comprehensive summary of federal air quality regulations as they relate to prescribed fire for longleaf restoration. As part of the report, the group conducted spatial analyses of (1) $PM_{2.5}$ concentrations for the states in the SERPPAS region, (2) current longleaf pine ecosystems, and (3) the historic longleaf pine range. The results indicate that $PM_{2.5}$ concentrations are below the current NAAQS in longleaf pine areas. In other words, currently there are no air quality issues limiting prescribed fire for longleaf restoration (though NAAQS are periodically reviewed and therefore subject to change).

Recommendations are put forth to ensure the increase in prescribed burning necessary for the longleaf restoration effort will not result in NAAQS violations in the future. The SERPPAS Smoke Management and Air Quality Subcommittee's analysis suggests that better data on current prescribed burning, future prescribed fire needs for longleaf restoration, and air quality impacts/constraints can help prioritize areas for increased burning.

Many of the reports we reviewed made recommendations to address air quality issues. These are summarized below:

Fire Activity and Emissions Data

- Develop a Southeast regional fire activity and emissions tracking system to collect and store data needed to evaluate prescribed fire impacts on air quality (1)

Coordination and Collaboration

- Work with air quality agencies to ensure that prescribed fire remains a viable management tool, and to maximize flexibility for its use (2)
- Work with EPA and state air quality agencies to facilitate increased burning while complying with state laws (10)

Education

- Educate agencies, organizations, and other prescribed fire practitioners about air quality concerns and regulations, and the importance of implementing smoke management practices to limit impacts on air quality and human health (8)
- Educate federal and state air quality regulators about the difference between frequent prescribed fire and wildfire and their effects on air quality and pollution (6)

Prevention

- Postpone or reschedule prescribed burning within an airshed if forecasted $PM_{2.5}$ or ozone will exceed NAAQS for that day, based on EPA forecasts posted on airnow.gov or state/local air quality agency forecasts (1)

Agency Missions, Policies, and Programs

In the historic longleaf pine range, state forestry agencies, not air quality agencies, issue prescribed burning permits. This makes sense given that smoke management/air quality is only one of a number of issues that must be considered when granting the authorization to burn. Ideally, forestry agencies would work closely with air quality agencies to manage the timing and quantity of emissions to be released. However, given the different missions of land management agencies and air quality agencies (i.e., ecosystem health vs. air quality and public health), smoke management policies can conflict with air quality objectives. For example, the amount and type of burning allowed under a smoke management policy may not account for other local air quality impacts or concerns.

South Carolina provides a good example in the Southeast of a state's forestry and air quality agencies working together to address common air quality concerns. The South Carolina Forestry Commission collaborates with the SC Department of Health and Environmental Control to ensure prescribed burning is taken into account as air quality-related regulations are implemented. Similar to South Carolina, the Alabama Forestry Commission works with the state's Department of Environmental Management and the Alabama Prescribed Fire Council to ensure prescribed fire is maintained and supported as the state moves forward with steps to improve air quality. The Georgia Wildlife Resources Division collaborates with the Environmental Protection Division and the Georgia Prescribed Fire Council to help provide reasonable burn windows in metropolitan counties.

Natural resource agencies often manage programs like fire control, prescribed burning, and wildlife habitat as separate programs, not explicitly planning or accounting for their interrelated nature. Cumulative impacts left uncoordinated could result in violations of air quality standards. Moreover, the lack of coordination can make planning, prescription, and implementation of common goals less efficient and effective.

Florida coordinates prescribed burn activities across the state through a statewide burn authorization approval and tracking process. Other states in the longleaf range that require a permit to conduct prescribed burns (North Carolina, Georgia, Alabama, and Mississippi) issue permits out of their local forestry offices or dispatch centers, which can preclude coordination.

Recommendations for addressing problems related to different agency approaches to fire emerged out of the documents we reviewed for this synthesis. These include:

Coordination and Collaboration

- Promote coordination among agencies, organizations, and practitioners of prescribed burning activities to address air quality concerns (2)
- Integrate public lands programs for fire management and smoke management to achieve common desired conditions, gain efficiencies, and improve program delivery (10)
- Integrate wildfire planning with prescribed fire to leverage capacity and resources to achieve multiple objectives (10)

Standardize and Centralize Practices at the State Level

- Initiate a standard prescribed fire planning and execution process within the state (6; 7)
- Create a centralized and coordinated burn authorization system within the state (7)

Land Use Changes

Land use changes including forest fragmentation, parcelization, and urbanization complicate the application of prescribed fire. Fragmentation is the division of contiguous forest land into isolated pieces or less contiguous tracts as the result of conversion to urban and other uses. Parcelization occurs when the number of forest landowners increases and the size of the parcels decreases. In the Southeast, parcelization has resulted from a variety of factors including intergenerational transfer (i.e., inheritance), partitioning and sale by owners, and divesture by the forest industry. These changes create less efficient management units, increasing the cost and difficulty of applying prescribed fire. As a result, land managers have to work with numerous private landowners with have diverse land management objectives to burn across large areas.

Another result of fragmentation, parcelization, and changing ownership is a mosaic of management philosophies. Although land may remain forested, new owners may not want or understand the need for management practices like prescribed fire. Thus the increase in the number of landowners can decrease the implementation of sound forestry practices.

Growing populations, urban growth and development, and the resulting expansion of the wildland-urban interface (WUI) represent another problematic area of land use changes. Urbanization increases concerns and apprehension about fire, smoke, health, and safety. Proximity of forestland to residential or other development such as homes, schools, roads, hospitals, and other infrastructure increases the nuisance complaints and threat of liability related to smoke and escaped fire. Air emissions from other

pollution sources in and around metropolitan areas can result in non-attainment of air quality standards and restrict burning. All of these issues make planning and execution of prescribed fire more complex and time-consuming, and require better trained practitioners and more resources to successfully implement fire management practices.

Efforts to address land use changes include the Community Protection Grant program, which supports private sector burn managers in conducting prescribed fires adjacent to US Forest Service land. Several states in the Southeast have participated in this program. In addition, Prescribed Burn Associations in Texas and Oklahoma are working to foster good relations between neighbors and within the community with regard to using prescribed fire.

Out of the works we reviewed for this synthesis, recommendations to address land use change issues include:

Targeted Education

- Expand and provide continuous outreach and education to landowners and residents, particularly those new to the region and/or with a non-traditional ownership background (2)
- Focus fire education efforts on people moving into wooded areas from urban areas (11)
- Target education and outreach to the communities and private landowners in the WUI, who are most affected by prescribed fire (12)
- Use education and incentive programs to encourage landowners, particularly new and non-traditional landowners to deliberately, actively manage land, including fuels management, regardless of ownership objectives to contribute to resiliency while providing forest products and expanding ecosystem markets (2)
- Focus prescribed fire technical assistance in the WUI within Significant Geographic Areas for longleaf (10)
- Integrate defensive driving tips for smoke and fog into the state licensing process (6; 7)

Growth Planning

- Engage local growth management processes to preserve the ability to burn in urban and suburban environments, e.g., incorporate pro-prescribed fire language in County comprehensive plans, and introduce smoke disclosure language in deed transfers and HOA agreements with county planning (6; 7)
- Keep authorization for prescribed fire under state forestry authority to address issues of local government intervention into the authorization process (6; 7)
- Create effective development plans for WUI areas (2)
- Increase prescribed fire knowledge in community planning (2)
- Develop agreements for fuels mitigation across jurisdictions (2)
- Focus local and community planning efforts in the WUI within Significant Geographic Areas for longleaf (10)
- Develop a smoke easement template to inform growth management and transportation planning (6)

Community Awareness

- Notify adjacent landowners and other adjacent entities (e.g. post signs on nearby roads) before conducting burn (1)
- Develop prescribed burn associations to foster good relations between neighbors and within the community (13; 14)

Public Perception/Knowledge

Past emphasis on fire prevention and a wildfire-based perception of risk have created public misconceptions about prescribed fire. Many people do not understand the role of fire in some natural environments, or the benefits of prescribed burning to the ecological and economic welfare of the states. Lack of effective communication and outreach from land management agencies and credible prescribed burners can allow negative attitudes about smoke and fear about escaped fire, degraded air quality, and impaired visibility to grow. As a result, some people are unwilling to support prescribed fire, and some landowners are afraid to invest in the practice.

In 2007, the South Carolina Forestry Commission conducted a survey of residents in the state to determine their perceptions, knowledge of, and opinions on wildfire and controlled burning. The Florida Forest Service (then the Division of Forestry) conducted a similar survey of Florida residents in 2010. While the majority of respondents in both states knew what prescribed fire was, they demonstrated less understanding about why it is used and its positive benefits. Nevertheless, the majority of those surveyed approved of or supported the use of prescribed fire.

The Alabama Forestry Commission, along with federal and NGO partners, has worked with the media and educators to improve the public's knowledge of the use of prescribed burning and its impact on the environment. Prescribed Burn Associations in Texas and Oklahoma are working to educate the public, local communities, and decision-makers about the benefits of prescribed fire, and to enhance communication between local officials, fire managers, and landowners. They have found that gaining community support is essential to creating and sustaining a viable prescribed fire program.

Thirteen states in the Southeast participate in the Southern Group of State Foresters' (SGSF) "One Message, Many Voices" campaign to promote prescribed burning and increase awareness among the general public and public officials about the need for prescribed fire. The project has produced two websites, VisitMyForest.org and GoodFires.org, which provide information about forest recreation opportunities and the benefits of using prescribed fire as a management tool.

To help raise awareness of prescribed fire, Governors in Florida, Georgia, and North Carolina have designated weeks in February and March as Prescribed Fire Awareness Week. During those weeks, the states promote prescribed burning and encourage citizens to learn more about it and the role of fire in natural resource stewardship.

The South Carolina Bureau of Air Quality and the South Carolina Forestry Commission have convened a diverse work group to develop a prescribed fire communication plan for the state. The goal is to create a consistent, ongoing message about prescribed fire and open burning that accommodates the needs and interests of air quality regulators, government, non-governmental and private prescribed burners, regulated industries, local governments, and health and other interest groups, while benefiting the public.

Tall Timbers Research Station in Florida has an education and extension program that shares fire ecology and land management information with communities in Florida and surrounding states. Fire in Florida's Ecosystem (FIFE) is a curriculum and educator training program that provides teachers the information and tools they need to teach about fire in Florida, including how prescribed fire is used to manage ecosystems and prevent wildfire. The FIFE program began in 1996 and has reached well over 2,700

teachers in more than 90% of Florida counties. The Jones Ecological Research Center in Georgia also provides education and outreach on various topics including prescribed fire and longleaf pine management.

Recommendations that came out of the documents we reviewed to improve public opinion and enhance knowledge about prescribed fire include:

General Education

- Expand public education and outreach efforts through a variety of media including websites, workshops, press releases (11)
- Support SGSF's "One Message, Many Voices" campaign and development of other unified prescribed fire education programs (2)
- Use SGSF's "One Message, Many Voices" informational/educational program to increase understanding of prescribed fire's benefits relative to effects on air quality (3)
- Identify, develop, and distribute key messages to the public to expand understanding of fire's role in sustaining ecosystems, the relationship between fire management and wildfire, and the benefits of frequent fire management (6; 7; 10)
- Introduce fire education in school curricula using private and government personnel (7)
- Encourage greater public smoke tolerance through outreach and education (2)
- Use state parks, wildlife management areas, natural areas, and other public lands to showcase habitat restoration efforts using prescribed fire (15)

Targeted Education

- Target education and outreach to state and federal air quality regulators, key policymakers, and state and local planners (10)
- Target "messaging campaigns" to increase understanding, acceptance, and application of fire in Significant Geographic Areas for longleaf (10)
- Prepare a package showing the success of the prescribed fire program and outlining future needs, to be delivered in Washington DC by a coalition (6)
- Educate state and federal air quality regulators, key policy makers and planners at state and local government levels about the importance of and support needed for the use of frequent prescribed fire in longleaf pine (16)
- Inform media personnel of the benefits of fire weather forecasts for the public in their area (7)

Message Development

- Collect data on awareness, knowledge, attitudes, and behaviors of target audiences toward fire management to develop effective communication efforts (10)
- Conduct social marketing survey on the use of prescribed fire (11)
- Work collaboratively with Prescribed Fire Councils and other NGOs to develop and deliver a positive prescribed fire message to community members and landowners (2)
- Develop a "brand" for prescribed burning similar to the Smokey campaign (6; 7)
- Retain a public relations firm to do "Disney" style promotion (7)
- Adapt prescribed fire message with "Firewise" message (7)
- Create and implement a standard communication plan (6; 7)

Burner Media Training

- Initiate a media relations continuing education course as part of Prescribed Fire Council meetings (7)

Liability

Liability for escaped fire and smoke is an important consideration and can be a significant deterrent to landowners and agencies that want to conduct prescribed burning. Potential legal consequences and the threat of litigation from fire-related damages are real barriers to burning. Moreover, liability insurance is often prohibitively expensive for landowners, consultants, and other fire service providers, which compounds the challenge. Legislation to protect fire management service providers from liability has not been widely tested in courts, but there is little evidence in case law that properly conducted prescribed fires have resulted in significant sums of money being exchanged as a result of damages. Nevertheless, fear of liability is a commonly cited concern.

Each of the nine states in the historic longleaf pine range has a prescribed burning law declaring that the use of prescribed fire is not a public nuisance if conducted according to applicable statutes, guidelines, and other regulations. These laws provide liability protection for damage or injury caused by fire or smoke unless negligence is proven; or, in the case of Florida, Georgia, and South Carolina, unless gross negligence is proven. To obtain liability protection, landowners or their agents must burn in compliance with law (e.g., have a burn plan, use a certified burner) (Appendix 3). Landowners can burn without having a written plan or a certified burn manager present (provided they obtain a permit from the forestry agency, if required), but they will not be protect from liability under the law. Texas has an additional requirement that certified prescribed burn managers carry at least $1 million of liability insurance coverage, which can cost between $3000 and $5000/year.

Texas and Oklahoma have formed Prescribed Burn Associations to help decrease the risk of liability. The associations decrease risk and increase safety by ensuring members have proper training, experienced help, and proper equipment. Texas also is seeking to use Prescribed Burn Associations to defray the costs of insurance. The Associations have formed a statewide alliance with the primary intent of obtaining liability insurance coverage for Associations as a whole, rather than individual members. The model is largely in the conceptual stage, though the Edwards Plateau Prescribed Burn Association has managed to procure insurance coverage for its 300 members for about $15,000/year.

The Nature Conservancy (TNC) has cooperative agreements and Memoranda of Understanding (MOUs) with land management agencies in some states to facilitate cooperation on prescribed burning. These agreements include a section on liability, specifying that each party is liable for its own actions and the actions of its employees.

Recommendations for addressing liability issues were summarized from the documents we reviewed and include:

- Analyze and identify appropriate changes in federal, state, and local laws and policies regarding liability to address impediments to applying fire (e.g., tighten liability laws where possible) (10)
- Conduct research on current status of liability issues and costs (11)
- Develop a state policy addressing the acquisition of adequate and affordable liability insurance for prescribed burners (11)
- Develop and maintain a certification system for prescribed burners (11)

Capacity

There is a shortage of fully trained or qualified prescribed burning practitioners and service providers. Currently, the capacity to burn rests with federal and state agencies, some NGOs, and some private landowners. Common impediments for these groups to increase acreages burned include lack of trained people/staff, funding, and equipment. Private consultants and other service providers also are lacking; there are too few contractors, certified prescribed burners, or other trained personnel to do prescribed burning. Private landowners are a key constituency for increasing acres burned in longleaf pine ecosystems. Existing reports suggest that the experience of private forest owners and managers is unequal across and within states. In some places, there is considerable experience. In others, there is little experience, and little confidence to burn without adequate technical assistance, personnel, equipment, and liability protection. In some states, it is difficult for private landowners to obtain the initial or continued training necessary to conduct their own burns.

TNC has MOUs or cooperative agreements with many agencies/organizations throughout the Southeast to capitalize on TNC's expertise, personnel, and equipment for conducing prescribed burns. In North Carolina, TNC has a cooperative agreement with the Division of Parks and Recreation and the Wildlife Resources Commission. The agreement covers technical assistance, pre-burn preparations, burn implementation, post-burn monitoring, and training of staff and volunteers. TNC also has a cooperative agreement for Wildfire and Prescribed Fire with the North Carolina Forest Service. The parties agree to notify each other when prescribed fires are planned, coordinate burn permits, provide smoke management information and fire weather updates, and review annual burn plans.

The Virginia Department of Forestry, North Carolina Forest Service, South Carolina Forestry Commission, Georgia Forestry Commission, Florida Forest Service, Alabama Forestry Commission, Mississippi Forestry Commission, Louisiana Department of Agriculture and Forestry, and the Texas Prescribed Burning Board all have Certified Prescribed Burn Manager programs. They offer training for landowners, managers, and contractors/consultants in fire behavior, burning methods, safety, planning, smoke screening and management, and local fire laws. These agencies also provide initial and refresher training courses to their employees on proper use of prescribed fire. Several of the states, including Georgia, Florida, and North Carolina, provide landowner workshops on the use of fire. Many of the states use grants from the US Forest Service to support their prescribed fire training courses. The Natural Resources Conservation Service conducts prescribed burning classes for its field personnel, training them to discuss and plan prescribed burns with private landowners. In Texas, the Academy for Range Management, local universities, Texas AgriLife Extension, Texas Parks and Wildlife, and the Soil and Water Conservation Board also offer prescribed fire training.

Georgia has developed a code of ethics for prescribed burners. The North Carolina Prescribed Fire Council is working on a similar code of ethics. Alabama has reciprocity with Mississippi, Georgia, and South Carolina for certified prescribed burn managers; South Carolina has reciprocity with Mississippi, Georgia, and Florida. Mississippi will consider extending prescribed burning certification to individuals certified in other states on a case by case basis.

Texas and Oklahoma have formed Prescribed Burn Associations, which are organized landowner cooperatives that are user owned, controlled, and operated. These associations share knowledge, experience and equipment to reduce risk and increase the application and safety of prescribed fire. With neighbors helping neighbors, burn associations enlarge the labor and equipment pool so no one

person has to hire help or buy all the equipment. Some associations develop relationships with their local Volunteer Fire Departments (VFDs). This relationship gives the association additional equipment, personnel, and safety, while giving the VFD training time, additional income, and community service.

Prescribed Burn Associations can (1) increase efficiency by organizing required labor and support quickly within narrow burn windows, (2) reduce risk by increasing experience, equipment, training, and technical assistance, and (3) increase number of prescribed burners and amount of prescribed burning done. They also relieve demand on public agencies for on-site technical assistance, and allow agencies to help more landowners with fewer resources. Alabama currently is considering forming Prescribed Burn Associations.

The Florida Forest Service has multiple hazard mitigation teams stationed geographically across the state to conduct prescribed burning and other hazardous fuel reduction activities on private and state lands, and to support wildfire efforts as needed. In addition, the Florida Chapter of The Nature Conservancy operates multiple Ecosystem Restoration Teams (ERTs), which serve as mobile, supplemental resources to agency fire managers, assisting with burns on federal, state, county and private lands. These teams add capacity to existing land management staff to help public agencies meet their conservation goals more quickly. The teams move from site to site as weather and site readiness permit, and typically consist of a coordinator, a couple of professional fire staff, and a few seasonal fire crew members. ERTs have burned over 600,000 acres to date, a significant portion of which are within the longleaf landscape.

Georgia recently formed an Interagency Burn Team (IBT), consisting of agencies such as the Georgia Department of Natural Resources, the US Forest Service, The Nature Conservancy and the Georgia Forestry Commission, as well as a seasonal burn crew made up of Student Conservation Association members to facilitate application of prescribed fire in Georgia. Because prescribed fire is weather dependent, a mobile team like the IBT can get to more places, sometimes with little notice. This frees up state agency personnel for other responsibilities, which is especially important during tight economic times. A grant from the Wildlife Conservation Society helped fund the crew in 2010.

Recommendations for capacity building that emerged from the reports we reviewed include:

Burners

- Build the network of trained practitioners capable of planning and conducting prescribed fire (2)
- Enhance coordination among prescribed fire practitioners to increase safety and prescribed burning intelligence (2)
- Form interagency prescribed fire teams including rural fire departments (2; 7)
- Develop/expand eco-regional fire management strike teams (e.g., see models in Florida, Georgia) (10)
- Reflect the high priority of prescribed fire in agency fire managers' performance standards (6; 7)
- Implement a compensation retention system for prescribed fire staff at public agencies (6)
- Develop and maintain online databases of certified burn vendors by state (10)

Landowner Training/Education

- Provide burn training and services to facilitate landowners’ ability to apply fire (10)

- Provide educational resources for landowners to learn state burning regulations, and training and permitting requirements (1)
- Encourage landowners to get training, and/or to work with experienced burn managers (1)

Burner Training/Education

- Develop and implement a standard code of ethics for all prescribed fire professionals (6; 7)
- Encourage strong understanding of weather conditions and forecast reliability and issues that can lead to smoke problems (1)
- Encourage participation in state prescribed fire manager certification program (1)
- Increase the location and availability of certified burner training opportunities and training on fuel and advanced smoke modeling programs for agency personnel and private individuals (7 ; 11)
- Improve training and procedures for law enforcement personnel associated with prescribed fire (6; 7)
- Provide better training for current agency positions dealing with prescribed fire (7)
- Standardize the fire qualifications for cooperators (i.e., government agencies and non-governmental organizations) within the state so they have the same training, equipment and qualifications as the forestry agency to assist with burns (7)

Data Tracking

- Employ full-time dispatchers to operate 24-hour dispatch centers to track wildfire activity, issue burn authorizations, and monitor smoke impact (17)

Cooperation

- Enhance collaboration, training and capacity building across agencies to increase management effectiveness (2)
- Build partnerships between Fire Councils, state and federal agencies, and NGOs (10)
- Develop mechanisms to create implementation-level partnerships for prescribed fire (6)
- Streamline the MOU process through public and private agreements (7)
- Develop and implement inter-organizational MOUs and identify lead individuals and/or organizations to improve coordination and collaboration among agencies, stakeholders, and partners (11)
- Maintain strong partnerships with state and regional fire councils, state and federal fire and resource management agencies, and other natural resource conservation and management organizations to achieve cooperatively and across jurisdictional boundaries agency objectives for prescribed fire, management and restoration goals for longleaf pine (16)
- Organize and encourage participation in local fire management "cooperatives" (e.g. see models in Texas, Oklahoma) (10)

Financial Resources

In addition to limited staff and training capacity, there also exists a basic lack of funding for prescribed fire programs, presenting a hurdle to public agencies and private landowners. Agency resources are stretched thin, and grant funding, state funding, and cost-share programs are lacking. Lack of funding and the prioritization of fire suppression over prescribed burning threaten public land managers' ability to put fire on the ground, as well as to implement effective training, education, outreach, and communication efforts. For private landowners, management costs related to applying fire at a regular interval are high, and long investment horizons are needed to recover these costs. Costs are not being offset by early or periodic income, or financial incentives. Moreover, the social and ecological services

provided by landowners who apply fire are not accounted for. In short, when private landowners do their own cost-benefit analysis associated with prescribed burning, it is often not favorable for increased burning.

Some federal and state agencies and NGOs provide technical assistance and cost-share assistance to landowners to do prescribed burning, though these programs are often over-subscribed and under-funded. Several federal programs under the Farm Bill provide financial assistance to landowners to implement prescribed fire for wildlife and land management on private lands, including the Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentive Program (WHIP), and Landowner Incentive Program (LIP). The Forest Resource Development Program in Mississippi, funded by a severance tax, can provide funding for prescribed fire. Mississippi also uses funds from US Forest Service State and Private Forestry programs to provide technical assistance and for training, equipment, and prescribed burning. Non-industrial private forest landowners in North Carolina can apply for cost-share assistance for prescribed burning under the state Forest Development Program. The North Carolina Forest Service also offers a free fire line program for private landowners to help defray the cost of prescribed burning. As designed, the North Carolina Forest Service will construct the fire line (i.e., boundary cleaning) free of charge, if the landowner promises to conduct the burn themselves.

Many state forestry agencies, including those in North Carolina, South Carolina, Florida, and Georgia, provide professional forest management assistance to public and private forest managers for a fee, including providing services such as prescribed burning. The Louisiana Department of Wildlife and Fish has two Prescribed Burn Initiatives, covering the full cost of a landowner's first burn, and hiring contractors or working with Department of Agriculture and Forestry to write a burn plan and implement the burn. Mississippi also has a Prescribed Burn program, which provides 50:50 cost share for landowners to do burning. In Florida, if a landowner does not have the necessary manpower or other resources needed to conduct prescribed burning and no private contractors are available, then the Florida Forest Service may provide fire management assistance with agricultural/land clearing burning, "prevention" or fuel reduction burning, or fire line plowing.

Prescribed Burn Associations like those in Texas and Oklahoma can help reduce costs by sharing equipment and providing assistance. These cooperatives allow agencies to help more landowners with fewer resources. Also, because they are community created and locally led, the government only provides technical assistance and guidance, which helps relieve the burden on land management agencies.

Recommendations for addressing lack of funding for prescribed fire summarized from the literature we reviewed include:

Needs Assessment

- Develop a needs assessment that summarizes required resources for meeting the workload (6; 7)

Broad Funding

- Form a coalition to secure a dedicated source for prescribed fire funding (6)

State Agencies

- Form a coalition to increase budgets for state fire agencies (6)
- Provide continuous funding for agencies to hire and train new prescribed fire personnel (6)

- Expand and leverage wildland fire control resources to expand planning and application of prescribed fire (10)
- Elevate the priority of prescribed fire in rankings of competing projects (7)
- Increase the proportion of state fire funds directed to prescribed fire (7)
- Maximize the use of current resources for prescribed fire (7)

Private Landowners

- Increase amount of funding available through grants and state and federal cost-share and incentive programs to private individuals to implement prescribed burning (6)
- Create/provide financial incentives to facilitate landowners' ability to apply fire on private lands (10)
- Form a coalition to review existing federal and state cost share programs and grants to identify and enhance prescribed fire opportunities on private lands (7)
- Develop a system to inform private landowners of funding that is available for prescribed burning (6)
- Encourage specialty and emerging markets to help overcome longleaf restoration/fire management costs; develop new models of public/private ventures to support greater private sector engagement (10)

Fire Science and Information

There is a dearth of fire science and information to inform prescribed fire decision-making, particularly as it relates to smoke emissions and air quality. There are no standard procedures across states in the longleaf pine range for collecting data on fire activity and air emissions, information that could contribute to better smoke management models and predictions about air quality impacts. Current fire and ecological research tools, models, and techniques could benefit from more research on fire behavior, fuels, and air quality, which will allow resource professionals to conduct safer and more effective prescribed burns. More technological systems are needed to help track smoke and determine its impact. Current inventory and condition of existing longleaf communities and estimates of desired, fire-maintained acres are needed to determine potential air quality impacts of fire for longleaf restoration purposes, as well as indicate whether ecological goals are being met.

In 2011, the SERPPAS Smoke Management and Air Quality Subcommittee issued a draft report summarizing existing fire activity and emissions tracking systems, and providing recommendations for a regional tracking system. Tracking fire activity and air emissions data is essential for evaluating air quality impacts from prescribed burn activities. Existing systems for tracking this data vary greatly across the region. Consistent, high quality data would prevent the need for making assumptions about emissions from prescribed burning, helping to ensure there are no unnecessary limitations on the use of prescribed fire in the future. To ensure the ability to analyze air quality impacts from prescribed fire, SERPPAS recommends fourteen data elements that should be tracked in a regional system, similar to the Fire Emissions Tracking System already in place in the Western US.

Currently, Florida, South Carolina, Georgia, and Alabama have electronic databases tracking fire activity. Mississippi expects to have an electronic database online in 2012. The Florida Fire Management Information System (FMIS) tracks the size and location of all fires in the state, and cross references the locations of prescribed fires with GIS layers of fuel type and amount to estimate emissions. South Carolina maintains records based on data collected from fire managers including location, time of burn, fuel type, available tons to be burned, acres to be burned, nearest downwind smoke sensitive area,

purpose for the burn, and other pertinent information. Georgia's burn permit tracking system provides real-time information on fire activity, and tracks how many acres have been burned in the state.

A collaborative effort of Georgia, North Carolina, South Carolina, Louisiana, and Tennessee is underway to develop a Fire Activity and Emissions Tracking System (FAETS), which will be based on Florida's FMIS. North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi are currently tracking fire activity, but the type of the data varies and is only available electronically in four of the states.

Recommendations for improving fire science and information gleaned from the documents we reviewed for this synthesis include:

Fire Tracking

- Establish online information tracking systems to collect consistent data about where and when agencies, organizations, and individuals are burning/have burned (10)
- Develop estimates of longleaf acres by condition and management category to determine where and how much burning needs to be done to restore longleaf in Significant Geographic Areas (10)
- Develop user-friendly computer systems to log and track information on prescribed burns, pinpoint burns on maps, capture data for current and future needs (17)

Smoke/Air Quality

- Work with National Weather Service and other agencies to improve accuracy of forecasts essential to reducing smoke impacts (1)
- Develop a database containing up-to-date consistent data on fire activity and air pollutant emissions to provide the information needed to evaluate air quality impacts from prescribed burns. Use in conjunction with screening-level air models (e.g. VSMOKE-GIS or BlueSky) to evaluate potential air quality impacts, which could allow a burn to be conducted when other factors may indicate that burning should not be done (1)
- Evaluate and improve smoke models' ability to reliably predict long distance transport and mixing of $PM_{2.5}$ (1)
- Compile empirical data on fuel consumption, fuel loading and emissions and put into web-based map (e.g. Simple Smoke Screening) to help landowners visualize smoke impacts (1)
- Review the newest smoke management tools at every Prescribed Fire Council meeting (6)
- Develop user-friendly computer systems to track smoke and its effects on highway traffic and air quality (17)
- Work in partnership with state agencies, USDA Forest Service, National Weather Service, and others in on-the-ground monitoring of prescribed fire smoke concentrations (3)
- Develop a smoke management database (11)

Technology Transfer

- Expedite the transfer of new prescribed fire technology to field use through a formal technology transfer program (6; 7)
- Incorporate a technology transfer session in Prescribed Fire Council meetings (7)

Other

- Expand applied fire and ecological research, field application, validation, and implementation of fire environment products, projects, and activities (11)
- Identify lead individuals and/or organizations and form teams to focus on fire research (11)
- Merge data from fire danger monitoring and agriculture monitoring stations to create a more efficient and robust statewide monitoring network (11)

- Gather GIS information to evaluate fuels, communities, and vegetative layers (17)
- Support GIS mapping and on-ground verification (10)
- Use and expand LANDFIRE for longleaf systems (10)

In summary, this report provides a synthesis of current prescribed fire knowledge and activities in the southeastern United States. In our review, we found challenges associated with smoke management, air quality regulations, agency coordination, land use changes, public and landowner perception and education, liability, capacity and financial shortcomings, and fire science and information. We did not attempt to ascribe relative significance to the various challenges, nor did we explore their relationships and interactions. Moreover, this is not a statement of activities that should be undertaken. The recommendations offered, which were drawn from a variety of sources, serve to lay the groundwork for crafting a Comprehensive Strategic Plan for Prescribed Fire Related to Longleaf Restoration in the Southeast.

APPENDIX 1

Recommendation Sources

The recommendations presented throughout this synthesis were compiled from the following documents and people. The numbers correspond to the parenthetical references in the text.

1. *Southeast Regional Partnership for Planning and Sustainability (SERPPAS) Smoke Management Recommendations and Prescribed Fire Tracking*. SERPPAS Smoke Management and Air Quality Subcommittee, 2011.
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APPENDIX 2

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APPENDIX 3

Summary of States' Prescribed Burn Laws and Permitting Policies

State	Prescription/Plan	Burner	Permit	Notification	Special Cases
Virginia	Prescription must be prepared by a CPBM; must include a smoke management plan	CPBM must prepare a prescription for the burn; must supervise the burn	Not required	Local Forestry office should be notified prior to the burn	
North Carolina	Prescription must be prepared by a CPBM and filed with NC Forest Service; must comply with voluntary smoke management guidelines	CPBM must prepare a prescription for the burn; must conduct the burn	Open-burning permit must be obtained from NC Forest Service	NC Forest Service should be notified prior to the burn	
South Carolina	Plan must be prepared by the burner	At least one CPBM must be present and supervising the burn	Not required	SC Forestry Commission should be notified prior to burning	
Georgia		Burner must have experience or training	Permit must be obtained from the local GA Forestry Commission office		
Florida	If CPBM conducting burn, prescription must be completed before authorization given	If CPBM conducting burn, must be onsite with prescription for duration of burn	Authorization/permit must be given from FL Forest Service on the day of the burn		Florida Forest Service can cancel authorizations if air quality or fire danger conditions change
Alabama	Prescription must be prepared	CPBM must supervise the burn	Permit must be obtained from AL Forestry Commission		Permits may be revoked if proper burning procedures are not followed or

					weather changes
Mississippi	Prescription must be prepared and notarized prior to burning	CPBM must supervise the burn	Permit must be obtained from MS Forestry Commission		
Louisiana	Prescription must be prepared by a CPBM	At least one CPBM must be present	Not required		
Texas	A prescription must be prepared; plans should be made for notifying neighbors, Texas Commission on Environmental Quality, and local fire agencies	At least one CPBM must be present; CPBM must have liability insurance	Not required	TX Forest Service must be notified before a burn	

CPBM = Certified Prescribed Burn Manager

[a] Ozone is a "secondary pollutant" that is not directly emitted from fires, but may be formed from nitrogen oxides (NOx) and volatile organic compound (VOC) emissions from fires– commonly referred to as "ozone precursor" emissions.

[b] See *Southeast Regional Partnership for Planning and Sustainability (SERPPAS) Smoke Management Recommendations and Prescribed Fire Tracking* (2011) for the full list of air pollutants associated with fire.

[c] In the case of prescribed burning on federally-owned or managed lands in nonattainment areas, federal agencies must comply with EPA's General Conformity Regulations. These regulations require compliance with state-specific Smoke Management Programs (SMP) or at a minimum, use of basic smoke management practices (BSMPs) if the State and EPA allow it.

[d] Open burning is the burning of any material in a manner such that the products of combustion are emitted directly into the atmosphere without passing through a stack, chimney, or air pollution control device. Prescribed burning is a form of open burning.

[e] The air quality index is an index ranging from 0 to 500 that reports daily air quality. Higher values indicate higher levels of air pollution and greater health concerns. More information can be found at www.airnow.gov.