Chapter 1

Introduction to Synthesis of Current Science-Eastern United States

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This report was produced by a group of scientists and land managers invited by the USDA Forest Service to synthesize the current scientific literature to answer an important question facing the managers of federal and private lands in many parts of the country. The question is: what potential cumulative environmental effects at the watershed scale might be caused by implementing land management activities to reduce forest fuels at large scales? The main body of this report is a compilation of what they found including both what can and cannot be concluded from the current science.

An earlier synthesis on this topic (Elliot et al. in press) focused primarily on fire regimes, vegetation types and management practices from the western United States. Several participants in that initial effort encouraged a parallel report focusing on eastern practices, landscapes, species, and conditions. This report is the result of those suggestions. While western fire conditions tend to be more obvious and dramatic, eastern conditions are similarly important but more subtle. Human use, particularly by European immigrants, has significantly changed most of the eastern landscape, including its vegetation form and distribution (reference Nowacki and Abrams, 2008.). This report reflects these subtle but important changes.

This synthesis is organized somewhat differently from its western counterpart. The report contains sixteen chapters grouped into three main topic areas. Chapters one through four set the stage, providing background material to provide the context for the remaining work. To simplify the presentation, silvicultural types were grouped into several large categories rather than the 26 cover types generally presented in Agricultural Handbook 445 (USDA, 1983). Chapters five through ten discuss fuels management activities grouped by ecological divisions (Figure 1). Chapters eleven through sixteen describe the affects of the treatments described in the preceding chapters, including physical, chemical, biological, and economic consequences.

In chapter 1 we broadly describe fuel reduction treatments on wildlands and the concept of analyzing cumulative watershed effects. For perspective we have referred to some of the primary legislative and policy direction that influence the way that federal land managers apply fuel reduction treatments and analyze cumulative effects.

Fuel Reductions Treatments and Policies and Laws Related to Them:

Fuel reduction treatments are land management actions taken to reduce the threat posed by severe and/or intense wildland fire by manipulating live and dead vegetation to reduce the loading of fuel on the landscape. Fuel reduction can be accomplished in a number of ways with the most common involving mechanical removal of fuel material (usually brush or trees), application of herbicides to reduce growth of undesirable species, and/or consumption of fuel using prescribed fire. These treatments may be applied either alone or in combinations. Treatment of wildlands to reduce fuel was given a national mandate when Congress passed the Healthy Forests Restoration Act of 2003 (HFRA). Efforts to reduce the risk of severe wildland fire may receive additional impetus from studies that attribute recent increases in the frequency of large wildland fires to changing climate (Westerling et al. 2006), raising the possibility that this threat may further increase in forests across the nation as expected climate changes occur.

To effectively reduce the risk of wildland fires, fuel reduction treatments will need to be applied to large areas each year in the form of mechanical fuel removal, herbicide treatment, or prescribed fire. In most cases, vegetation will regrow after treatments, meaning that maintaining low fuel stocking will require repeated treatments at intervals ranging from several years to a few decades. Where they are well designed and implemented, fuel reduction treatments will probably create a relatively low intensity of disturbance. However because they will be carried out over many acres each year and entail return treatments at regular intervals, there remains the possibility that local, project-level impacts of fuel reduction treatments may add up to significant impacts at larger, watershed scales and thus result in cumulative effects.

Cumulative effects on watersheds might be caused by combinations of individual activities directly related to removing fuels (e.g. the felling, skidding and/or chipping to mechanically remove fuel and/or prescribed fire to consume it). Cumulative effects might also include impacts of operations or infrastructure that support fuels reduction that may occur in areas at some distance from the actual site of fuel reduction. Examples of these supporting functions could include the movement of logging, fire control and other vehicles used in fuel management. Examples of supporting infrastructure could include roads, skid roads and landings that provide access to areas where fuel management activities take place and the drainage ditches, culverts and stream crossings associated with them. While significant literature exists reporting the effects of short duration/high intensity activities on the landscape (wildfire, final harvest, site preparation, etc.) less literature exists describing the affects of less intense treatments implemented repeatedly over an extended period. Needed research is identified to fill these knowledge gaps.

In recognition of the critical role of wildland fire in forest ecosystems and the risk that high fuel loads pose in forests, Congress and the Forest Service have taken several actions to accelerate fuel reduction treatments. Several policy initiatives by the Forest Service and other federal agencies (the Federal Wildland Fire Policy of 1995, the Cohesive Fire Strategy of 2000, the National Fire Plan of 2000, and the Ten-year

Comprehensive Strategy and Implementation Plan of 2001/2002) were strengthened when the President announced the Healthy Forest Initiative (HFI) in 2002.

What are Cumulative Watershed Effects?

In order to comply with NEPA, federal agencies that propose alternative land management actions must disclose the potential direct, indirect, and cumulative environmental effects and document those findings in a public report. This report may be an Environmental Impact Statement (EIS), Environmental Assessment (EA) or Categorical Exclusion (CE), depending on the nature and complexity of the action.

The basic concept of a cumulative effects analysis is to identify and consider the total effects of actions that overlap temporally or geographically and that might be missed by evaluating each action individually. The goal of cumulative effects analysis is to provide decision makers and the public with comprehensive information about "the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions" (40 CFR 1508.7). Cumulative effects may arise from single or multiple actions that may result in additive, interactive, direct or indirect effects. Cumulative watershed effects are the net impact on watersheds of multiple management activities that may coincide geographically or temporally.

Although cumulative effects are defined by NEPA, concepts related to cumulative watershed effects also come into play in the application of other environmental laws although in more restricted circumstances than for NEPA. The Clean Water Act (CWA) requires that both point (identifiable sources) and nonpoint sources of water pollution (water pollution that does not have an easily identified "point" source) be controlled, with particular emphasis on waters that have been designated by states as impaired (not meeting water quality standards) under section 303(d) of CWA. A common reason that nonpoint sources are not easily attributable to well defined sources is because they are geographically and/or temporally dispersed and thus may be the result of cumulative watershed effects or may add to cumulative effects.

The Endangered Species Act (ESA) protects species that are at risk of extinctions (listed under the Act as "threatened" or "endangered") from actions by federal agencies that could reduce the number of these organisms or their habitat. Where species that are listed under ESA dwell in aquatic or riparian habitats, the risk to these species or their habitat may be the result of multiple management activities occurring at a watershed scale, that is, a result of cumulative watershed effects. These examples are not exhaustive, and laws such as the Clean Air Act, National Historic Preservation Act and others have requirements of their own that, under some conditions, may call for a cumulative effects analysis. If, for a given landscape, the consideration of cumulative watershed effects for complying with multiple laws becomes an issue for fuel reduction treatments, a more comprehensive watershed-scale analysis that meets the requirement of all these laws might be warranted. The synthesis presented in the report may provide a scientific basis for developing such a comprehensive watershed analysis.

Evidence of Cumulative Watershed Effects:

Implementation of fuel reduction treatments at large scales has only begun recently so direct evidence of cumulative watershed effects is likely to be limited. However cumulative effects of other land management activities have been measured at watershed scales. A classic example comes from a study of fish habitat in streams from across the Columbia River basin (McIntosh *et al.* 2000). In that study, habitat for anadromous fish in 122 streams that had been originally surveyed in the 1930's and 40's was remeasured in the 1980's and 90's. With the exception of streams in unroaded watersheds, the prime habitat features in these streams showed significant losses over the intervening 60 years (e. g. "large pools" decreased by 24% and "deep pools" decreased 65%). An analysis of land management practices in these watersheds showed that no single practice or project was clearly responsible for the loss of habitat in these watersheds. Instead they found that a wide spectrum of land uses had occurred within the watersheds of the degraded streams, including forestry, grazing, urbanization and road construction. It was the aggregate impact of all these practices, i.e. the cumulative effect of all the land uses, that had caused the habitat loss. By comparison, in watersheds with little or no change in land use over the period (watersheds with no roads), habitat condition had remained constant or improved, reinforcing the conclusion that cumulative effects of multiple land management activities had caused the degradation. The lesson from this study for large-scale fuel management is that, in aggregate, wide-spread land management activities have the potential to cause significant, real impacts on aquatic systems even where the impacts of each individual, local project may be small or hard to measure.

Considering Cumulative Watershed Effects in Fuel Management:

It is critical that cumulative watershed effects be considered early as part of planning and implementing fuel reduction treatments in the current legal and policy environment. Under HFI and HFRA, NEPA analysis is not waived. HFRA streamlined NEPA analysis by reducing the number of alternatives that must be considered and added requirements for public collaboration, but did not exempt or waive any projects from NEPA analysis. Although a brief discussion of NEPA requirements follows, it is the purpose of this synthesis to assess what valid scientific information is available to assess the cumulative watershed effects of fuels reduction treatments, rather than to explain the legal requirements for documenting these effects. Interdisciplinary teams can use the information presented in this report to produce environmental documents at the appropriate level.

The Council on Environmental Quality (CEQ) gave guidance on when to include cumulative effects in NEPA analysis (CEQ 1997). In a recent memo, CEQ (CEQ memo June 24, 2005) stated that "except in extraordinary circumstances, proposed actions that are categorically excluded from NEPA analysis do not involve cumulative effects analysis". This means that to be categorically excluded a project must fit within specifically defined categories and must not involve extraordinary circumstances. For the Forest Service, extraordinary circumstances are defined as the degree of environmental impact to seven resource conditions listed in the Forest Service Handbook 1909.15,

chapter 30, section 30.3. Fuel reductions treatments that meet these requirements may not have to consider cumulative watershed effects.

Ultimately, it is the responsibility of the leadership and employees of the agency to find a balance between the broad set of laws and policies designed to create the intended effect of protecting the public from wildland fire, while at the same time complying with other sets of laws intended to protect natural resources and the environment. If members of the public disagree with the balance that is struck, they have the right to challenge these management decisions through appeal and in the courts. Within this changing legal and policy arena, methods for analyzing cumulative watershed effects are likely to remain important for managers of natural resources. Cumulative effects are real and sustaining multiple natural resources over the long run will require that they be considered. Streamlining requirements for analysis under NEPA or other rules assumes that these practices have impacts that are either insignificant or small compared to the long-term benefits from the proposed action. Courts and public opinion will likely place the burden on land managers to demonstrate that those assumptions are valid. The standard for showing that kind of validity usually requires predictions that are supported by the current science.

The Need for Science-based Decisions:

The scope and scale of fuels reduction treatments being undertaken by Federal land managers makes a strong argument for developing available and scientifically-based methods to estimate potential cumulative effects. When decision makers must tackle projects outside of the previous scope and scale that they have experienced, the relevant body of science, where it exists, may be of little practical use if it has not been interpreted and articulated in a manner directly useful for addressing problems at the proper scale.

Potential Uses of this Synthesis:

This synthesis of the current literature on cumulative watershed effects is a step towards developing useful methods for managers. It assembles in one place the current state of thinking that was previously scattered across many outlets in the scientific literature. At the minimum it should provide managers, planners and policy makers with a place to start when they have questions about the topic.

This synthesis, however, goes beyond being a central source of scientific information on this subject. Although cataloging and summarizing the literature are in themselves useful, this report tries to go further to anticipate questions that are likely to be posed by managers, planners and policy makers. In this way it can inform its audience about what relevant questions the current science cannot answer as well as those that science can answer. The “science gaps” are at least as important as current knowledge because it is in these gaps that management and policy may lack science for guidance. These are areas in which managers and policy makers should be cautious because the outcomes of their actions may not be reliably predicted with a scientific basis and may produce unforeseen outcomes. Identifying critical knowledge gaps also performs an important function for

the science community. If managers, planners or policy makers find that they need more detailed or explicit methods, the peer-reviewed knowledge gathered in a synthesis can provide an information base from which scientists can start to develop methods that meet those needs.

The value of this synthesis will depend strongly on how well it reinterprets existing knowledge in the face of a new question. While it is true that a synthesis of the current literature may be a reworking of existing information, asking new questions of old data often casts them in new light. When done thoughtfully, new questions may suggest new insights that have not previously been considered. The questions considered here are indeed new because they involve the implications of a new management practice being imposed on the landscape at expanded scales of space and time.

Conclusion:

We leave it to you, our readers, to decide how well this document meets your particular needs. As you use this document, if you find other pressing questions that we did not anticipate or address, we urge you to ask the science community to answer them. If this report is used in these ways, it will have served its purpose to advance the state of land management and policy making and to set the stage for future research and development.

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