To Burn or Not to Burn: Summary of the Forum on Urban/Wildland Fire, January 26, 2001, Washington, DC

Natural Disasters Roundtable, National Research Council

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THE NATIONAL ACADEMIES

TO BURN OR NOT TO BURN

SUMMARY OF THE FORUM ON URBAN/WILDLAND FIRE JANUARY 26, 2001 WASHINGTON, DC

A REPORT TO THE
NATURAL DISASTERS ROUNDTABLE

BY
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CHAIR, NATURAL DISASTERS ROUNDTABLE

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FOREWORD

The Natural Disasters Roundtable seeks to facilitate and enhance communication and the exchange of ideas among scientists, practitioners, and policymakers concerned with urgent and important issues related to natural disasters. Roundtable meetings are held three times a year in Washington, DC. Each meeting is an open forum focused on a specific topic or issue selected by the NDR Steering Committee.

The NDR Steering Committee is composed of 5 appointed members and sponsoring ex officio members. Appointed members are: Rutherford H. Platt, Chair, University of Massachusetts, Amherst; James P. Bruce, Global Change Strategies International, Inc., Ottawa, Canada; Wilfred D. Iwan, California Institute of Technology, Pasadena; Stephen P. Leatherman, International Hurricane Center, Florida International University, Miami; and Mary Fran Myers, Natural Hazards Research and Applications Information Center, University of Colorado at Boulder. Ex officio members are: Ralph Bernstein, EPRI; Lloyd S. Cluff, Pacific Gas & Electric; Miriam Heller, NSF; Robert M. Hirsch, USGS; Margaret Lawless, FEMA; Earnest D. Paylor, II, NASA; and Helen M. Wood, NOAA.

This paper presents the rapporteur's summary of the forum discussions and does not necessarily reflect the views of the roundtable members or other participants.

For more information on the Roundtable visit our website: http://nationalacademies.org/naturaldisasters or contact us at the address below.

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NATURAL DISASTERS ROUNDTABLE

FORUM ON URBAN AND WILDLAND FIRE

INTRODUCTION

The Natural Disasters Roundtable (NDR), formed by the National Academies in 2000, held its first public forum on January 26, 2001 at the National Academy of Sciences Building in Washington, D.C. The topic of this forum was Urban/Wildland Fire—a session intended to exchange information and stimulate discussion about the problems and solutions for the increasing hazards resulting from widespread urban and exurban encroachment into forested lands subject to wildfire. This topic was selected by the Roundtable steering committee in response to the outbreak of tens of thousands of fires during the 2000 season that scorched 7.2 million acres and destroyed more than 850 structures across the West and Southeast United States. The most publicized, though not the largest of these, was the Cerro Grande Fire in Los Alamos New Mexico from May 4 to June 6, 2000 (NIFC, 2000).

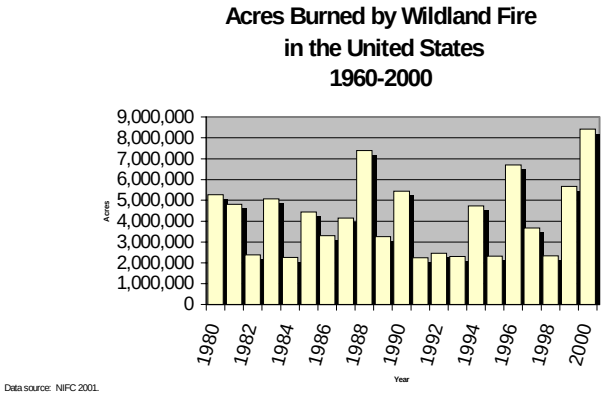
To address science and policy issues associated with urban/wildland fire, the NDR steering committee selected an interdisciplinary group of speakers and panelists from the United States and Canada (See Appendix A for the agenda and speakers list). Although discussion focussed largely on North America, certain issues raised may apply to other regions of the world affected by similar hazards. As a one-day meeting, the forum sought to identify a number of key issues for science and policy which may be addressed in more comprehensive studies in the future. Approximately 125 attendees including the steering committee members and speakers participated in this forum (See Appendix B for a list of attendees).

The National Research Council defines a “roundtable” as a type of convening activity of the National Academies that provides a means for representatives of government, industry, and academia to gather periodically for the identification and discussion of issues of mutual concern. In contrast to National Research Council study committees and other committees of the National Academies, roundtables are intended solely to enable dialogue and discussion among key leaders and representatives on a particular issue. They provide a valuable forum for exchanging information and for the presentation of individual views. However, because roundtables are not subject to institutional requirements concerning conflicts of interest, composition, and balance that apply to NRC committees, roundtables are prohibited by the National Academies from providing any advice or recommendation. This paper presents the rapporteur's summary of the forum discussions and does not necessarily reflect the views of the roundtable members or other participants.

SUMMARY

OVERVIEW OF THE URBAN/WILDLAND FIRE PROBLEM

Wildland fire is a normal and often ecologically beneficial element of the natural environment. Wildland fires in North America may be ignited by natural causes such as lightning or by human action through carelessness (e.g. sparks from campfires), malice (arson), or deliberate burning to reduce fuel density. On the average, about 135,000 wildland fires annually burn about 4 million acres in the United States (NIFC, 2001). This average has been increasing since 1980, punctuated more frequently by extreme fire years.



Wildfire costs and damages have been rising. Wildland fire management and suppression cost federal and state agencies more than two billion dollars a year. According to the National Fire Protection Association, wildland-urban interface fires from 1985 to 1994 destroyed 8,925 structures, or an average of about 900 structures a year (Cleaves, 2001).

About 7.2 percent of the land area of the coterminous United States and 14.4 percent of the population (38.6 million people) live in fire-impacted urban interface areas (Sampson, 2000). This includes the true interfaces where subdivisions are adjacent to wildland vegetation as well as intermix areas where structures are scattered more widely through the landscape (Cleaves, 2001).

Vulnerability to wildfire is based upon several factors, including weather, type and condition of threatened structures, slope of the terrain, and available fuel supply, including structures. And to these immediate factors must be added the effects of global warming which is predicted to lead to higher temperatures and greater aridity in many areas that are already fireprone (Houghton et al., 2001). Large fires directly contribute vast quantities of smoke, carbon dioxide, and other greenhouse substances to the atmosphere. The U.S. Forest Service and the National Center for Atmospheric Research are conducting research on the interaction of large wildfires with the atmosphere.

Structures themselves are a major fuel source for urban/wildland fires. The density of housing development and the combustibility of materials used in their construction substantially affect fuel loading and fire behavior (Baum and Rehm, 2001). The vulnerability of structures is also a function of how they are designed (e.g. boxed eaves, overhanging decks), where they are located (e.g. at the top of a canyon that may act as a "chimney"), and the design of the surrounding domestic landscaping. There is a lack of research on models for community-scale (rural, suburban or urban) fire spread, i.e. fire involving both structures and natural fuel. At a fundamental level, because structures are discrete, fire propagation at a community scale is not understood (Baum and Rehm, 2001).

While wildland fires are increasing, so is the trend of human settlement in and/ or near the wildland edge, referred to as the urban/wildland interface. The settlement in this interface "stems from urbanites, people with urban ambitions, urban esthetics, and urban understanding" desiring a rural landscape (Pyne, 2001). Preliminary data from the 2000 Census indicate that the five fastest growing states happen to be western states with extensive areas of wildfire risk: Nevada (66% growth, 1990-2000), Arizona (40.0%), Colorado (30.6%), Utah (29.6%), and Idaho (28.5%). Much of this population growth is occurring in new

homes in forested, shrubland, savanna, and desert/grassland areas subject to urban/wildland fire hazard. As population and investment at risk are expanding in wildland areas, fire suppression and landscape practices are increasing fuel supply, even as climate change is projected to cause warmer temperatures, drought, and conditions that produce lightning strikes (Houghton et al., 2001). All of these factors conspire to increase the risk of losses and threat to public safety.

The most noteworthy case studies of urban/wildland fire in the United States are the Oakland/Berkeley Hills, California fire in 1991 and more recently the Cerro Grande, New Mexico fire in 2000. Kelly Carpenter, community development director of Los Alamos County, New Mexico, presented a case study of the Cerro Grande fire at the Roundtable forum.

Elk bathe while a wildland fire burns behind them. Photo taken on August 6, 2000 on the East Fork of the Bitterroot River on the Sula Complex in Alaska. (Photo courtesy of Alaskan Type I Incident Management Team. Photographer: John McColgan, Bureau of Land Management, Alaska Fire Service).

The Cerro Grande fire began as a prescribed fire set by the National Park Service to reduce hazardous fuel accumulations in the Jemez Mountains. The Cerro Grande Peak, part of Bandelier National Monument near Los Alamos, New Mexico, subject to frequent lightning strikes in the summer months, was the target of this controlled burn (Marble, 2000). When the fire was finally extinguished on June 6, 2000, about 43,000 acres burned and 235 residential structures were damaged or destroyed (LANL, 2000) but about 8000 residential structures did not burn and there were no fatalities (Carpenter, 2001). Los Alamos County Councilor Robert Gibson credits the County's preparedness to a "wake up call" dome fire in 1996. The 1996 fire prompted the county and all of the affected jurisdictions to begin planning and preparation for such an event (Gibson, 2000); this preparation will continue.

In July 2000 the Cerro Grande Fire Act was signed into law (Public Law 106-246) providing financial assistance to business and home owners who lost property or whose property suffered diminution of value as a result of the Cerro Grande Fire. Also, FEMA has guaranteed funding to Los Alamos County to make the community more fire-resistant. The funds will be used to create defensible space, reduce fuels in the forest, and bury utilities underground (See FEMA <http://www.fema.gov/CerroGrande/cg_00r35.htm> for more information). The rebuilding of Los Alamos is in progress.

One of the most damaging urban/wildland fires to date occurred on October 20, 1991 in the Oakland/Berkeley Hills overlooking San Francisco Bay. Despite a long history of wildfire outbreaks, the steep, west-facing slopes of the Hills had been extensively subdivided with homes on very small lots served by narrow, winding roads. Under conditions of desiccation due to a prolonged drought and strong offshore winds, a brush fire developed into a firestorm that within one day destroyed 2,621 homes and 758 apartments and condos, and caused 25 deaths. Among many factors identified in post-disaster reports were (1) the build-up of flammable vegetation due to landscaping and fire suppression for many years, (2) the use of decorative but combustible wood shake roofs, (3) difficulty of mobility due to narrow roads, (4) a failure of the water supplies (5) equipment and procedural incompatibility among various fire companies that responded to the disaster, (6) lack of familiarity with fire suppression/monitoring techniques at the urban/wildlands interface by fire departments trained primarily in structural fire suppression; (7) lack of interorganizational training among emergency response departments that responded to the fire from the surrounding region; and (8) inadequate information infrastructure to support decision making among multiple organizations and jurisdictions in a rapidly evolving disaster response system. With the benefit of federal assistance and over one billion dollars in private insurance payments, the burned area was substantially rebuilt at the same or greater density due to unwillingness of local political authorities to buyout properties or change permissible

lot sizes. Although shake roofs were prohibited and a new vegetation management district was established, the rebuilding process may have set the stage for an even greater urban/wildland conflagration, especially since the entire area is situated just upslope from the Hayward Fault where a major earthquake is likely within the next thirty years (Platt, 1999).

REGULATION VERSUS PROTECTION: WHAT ROLE FOR GOVERNMENT?

The forests of the West, the Appalachians, and other scenic regions are being colonized by people, many of them fleeing metropolitan areas, who shun governmental limits on their freedom to build just about anywhere. The Oakland Fire experience suggests that market pressures to build and rebuild in fire hazard zones proximate to urban areas are nearly unstoppable, even in cities or counties with up-to-date planning and zoning capabilities. Rural county or municipal governments with limited land-use planning expertise, and a constituency favoring "freedom" from regulations, are even less likely to limit private development, even in areas of known fire risk. Government officials at all levels have met opposition from a reinvigorated property rights movement since the mid-1990s. [1]

But ironically, among those moving into the urban/wildland fringe are people who are anti-government property regulation who also expect "the government" to protect their new homes and lives from the threat of wildfires. Thus there is widespread political pressure to fight fires at public expense that under pre-development conditions would have been left to burn themselves out. As stated above, wildland fire management and suppression cost federal, state, and local agencies more than two billion dollars a year. Risk to firefighters is another cost of urban/wildland fire suppression. Although fatalities are rare, in 1991, the Dude wildland fire near Payson, Arizona killed six firefighters as they attempted to protect a rural subdivision. The South Canyon fire in 1994 resulted in the death of 14 firefighters who were suppressing a wildland fire that was approaching homes near Glenwood Springs, Colorado (Cleaves, 2001).

Much of the economic cost of fighting urban/wildland fires is ultimately borne by the federal taxpayer. When the President issues a major disaster declaration or when an agency issues an emergency fire suppression declaration, the federal treasury reimburses a percentage of state and local response costs in addition to the direct costs of federal response (e.g. U. S. Forest Service, National Park Service and military personnel and equipment).

Fire-fighting and evacuation capabilities in fact operate as a form of "insurance policy," albeit one that is funded by taxpayers rather than owners of property at risk. These become incentives for further building and rebuilding. Thus, assurances of protection through aggressive fire suppression and fuels management can create a "moral hazard" that encourages residents to build in fireprone areas, further exacerbating the problem. Government policy has been to fight all forest fires, big and small. This has been so for nearly a hundred years. The excessive forest fuels now in place in many regions of the nation, owing to aggressive wildland firefighting, have helped create a significant portion of the vulnerability shouldered by new settlers moving away from (and at the same time adding to) urban sprawl (Pyne, 2001).

The insurance industry in the U. S. and Canada also has been effected by the rising economic costs of urban/wildland fires. The Insurance Services Office since 1970 has maintained a consistent database of insurance payments in the United States due to wildfires and other catastrophes. During the 1970s and 1980s

[1] The property rights movement maintains that government land use regulations often reduce the value of land vis-à-vis prohibited current and future uses. They argue such regulation constitutes a "taking" of private property rights without compensation in violation of the Fifth Amendment to the U. S. Constitution (" . . . Nor shall private property be taken for public use without just compensation.")

there were eight major wildfires which led to insurance payments of between $5 and $43 million for each event, or adjusted for inflation, losses between $10 and $100 million in U. S. dollars (ISO, 1997). Between 1990 and 1993, however, there were four costly fires in California which led to several thousand insurance payments totaling $265 million to $1.7 billion for each event or, adjusted for inflation, a total payment of $3 billion (ISO, 1997) (Kovacs, 2001).

Aggressive suppression of natural fire outbreaks in many cases transforms the nature of the fire hazard from frequent but modest surface burns to more violent crown fires. Surface fires while hot, generally do not burn deeply into the soil and are more easily suppressed than other more consumptive fires. Frequent surface fires favor a grassy understory (Armstrong, 1998) and keep tree density down. A crown fire is a catastrophic fire that spreads quickly through the tops of trees in dense forests. Crown fires are very hot, burning deeply into the soil and are very dangerous and expensive to suppress (LANL, 2000).

The decrease in wildland fire, largely through suppression, has destabilized many forested ecosystems that depended on periodic fires to maintain healthy functions and processes. Understory vegetation has become so dense that wildland fires that do occur are larger and more severe than the historical fires. These extreme fires can have catastrophic effects on ecosystems and the human communities that depend on them. The severity of these fires poses threats to species persistence, watershed integrity, and biotic community resilience. Extreme fire behavior can result in loss in soil productivity and site stability, increase sedimentation in streams and water supplies, degrade or destroy critical habitat for fish, wildlife, and plant species, including those at risk of extinction, and increase the spread of invasive weeds or non-native plants. Such fires also emit millions of tons of gasses and particulate matter into the atmosphere (Cleaves, 2001).

MITIGATING URBAN/WILDLAND FIRE HAZARDS

The primary techniques proposed to reduce hazard to structures in urban/wildland hazard areas include: (1) deliberate prescribed burns; (2) selective timber harvesting and thinning; and (3) firebreaks surrounding structures or communities. Each has serious drawbacks.

After decades of fire suppression, there are now many proposals to reduce the density of forest fuel loadings through deliberate burns (NPS, 2000). This practice in fact led to the outbreak of the Cerro Grande Fire at Los Alamos in 2000, which provoked widespread criticism of deliberate burns near urban areas. In the opinion of one roundtable participant, William A. Patterson, professor at the University of Massachusetts, those who advocate increasing the one million acres per year we now burn by two or three fold, may fail to consider the limitations of increased burning (Patterson, 2001). The risk of fire escapes will increase, as will air pollution near population centers. Weather already limits our opportunities to burn, as well as a critical shortage of skilled fire managers. Will homeowners really put up with the smoke and temporarily blackened forests, even if they are told that burning today might prevent the loss of their homes tomorrow? Will local governments be willing to accept the risk of fire singeing parklands or threatening roadway safety? Controlled burning to maintain a natural forest ecosystem in urban areas also confronts local hostility according to the managers of the Hitchcock Woods in Aiken, South Carolina as reported at a recent conference in Columbia, South Carolina on Shaping the Ecology of a City (March 26-27, 2001).

The second approach, selective harvesting, is opposed by environmental organizations like the Sierra Club due to the potential damage to natural habitat and endangered species (Janofsky, 2000). Patterson is skeptical that thinning alone would have prevented the start and spread of fires in many of the forest types that burned this past summer (Patterson, 2001).

Firebreaks involve removal of potentially flammable vegetation within a certain distance around structures or communities, leaving an open area to retard the advance of a fire by denying it a fuel supply. Firebreaks may also contain roads to provide evacuation routes and facilitate mobility of firefighting

equipment and personnel in forested country. However, research by the Canadian Forest Service reported by Martin Alexander suggests that high-intensity crown fires may leap across firebreaks of standard widths of 50-100 meters (Alexander, 2001).

THE NATIONAL FIRE PLAN

In response to the fires of 2000, a multi-agency National Fire Plan has been developed to deal with the wildland fire problem. An increase of nearly $1.8 billion to a level of $2.8 billion in funding for wildfire hazard programs has been approved to implement this Plan. The Plan addresses five aspects of the problem: making all necessary fire fighting resources available, restoring landscapes and rebuilding communities, investing in projects to reduce fire risk, working directly with communities, and being accountable.

Science can play an important role in documenting the interaction between different elements of the biophysical and human systems that comprise the urban interface, quantifying variability and uncertainty for improved risk management decision making, describing extreme event scenarios, and challenging conventional assumptions. From a perspective of national science policy, there is a need for leadership to provide a synthesis of the problem, develop frameworks for risk management, advocate a national agenda for hazard research, support scientific "learning", and develop models for natural hazard research and development (Cleaves, 2001).

The insurance industry in the United States and Canada offers another approach to reducing future vulnerability to urban/wildland fires (Kovacs, 2001). Specifically, insurance rating practices are a tool for promoting better land management and building design by property owners. Pricing and other conditions act as an incentive to reward good behavior (Kovacs, 2001). For instance, the use of minimum firebreaks around structures may be adopted voluntarily by property owners in exchange for lower fire insurance premiums.

Insurance Services Office, a supplier of statistical, actuarial, and underwriting information for and about the insurance industry, has recently developed a geographic information systems tool that makes use of recognized risk factors and satellite imagery to pinpoint potential hazards from wildfire. It combines street maps; satellite maps that measure fuel density; and topographical maps showing slope, elevation and severe weather frequency. This new product shows how the insurance industry is determined to underwrite high-value wildfire risk based on accurate measures of risk.

Finally, improved land-use planning and adequate resources for wildfire management are critical. The insurance community promotes the use of knowledge to reduce our vulnerability to natural hazards and is a natural ally in the promotion of better land-use planning and for providing adequate resources for wildfire management (Kovacs, 2001).

We have tools available to help mitigate losses from all natural disasters and specifically wildfires. Making better land-use decisions and increasing our understanding of the interplay of physical and human systems will help to reduce losses. Land-use issues are often a challenge to the political will but are necessary to reduce wildfire losses. Some of the most unpopular decisions for policy makers are decisions to disallow development or construction in hazard-prone or vulnerable areas.

Policies mentioned by various speakers and participants at this forum for reducing losses due to wildland fires include:

- Limit new construction in wilderness lands or designate forest hazard areas where public fire suppression may not be utilized to save isolated homes;
- Reduce the density and composition of fuel through prescribed burns and/or thinning while minimizing adverse effects on local residents and natural habitat;

- Require use of fire-resistant building materials (e.g., no wood shake roofs) and installation for smoke alarms, sprinkler systems, and other self-help fire safety systems;
- Provide defensible space or buffers around structures and/or communities to retard the spread of wildfire and to decrease wildfire intensity,
- Improve fire warning and evacuation capabilities, with possible mandatory evacuation under conditions of extreme fire risk (equivalent to evacuation orders along coastal shorelines threatened by hurricanes), and
- Strengthen insurance incentives to promote adoption of wildland fire risk mitigation guidelines set by the insurance industry or fire-related agency

The following are research challenges worthy of future consideration and study as identified by some forum participants:

- The interaction of forest cover and climate change at different scales and trends in frequency of lightning and dry periods with climate change;
- Cost effectiveness of mitigation actions, including costs of fighting fires and costs of limiting their extent;
- Impact of forest "preservation" in relation to buildup of fuels;
- Policy and practices related to fuel reduction through prescribed burns and thinning;
- Effects of forest evolution/changes on fire hazard (e.g., Bar Harbor, Maine forest change prior to 1947 Fire);
- Fire as an ecological agent of change;
- Utility of field experiments and modeling, (e.g. the Canadian crown-fire research project);
- Research on combustible factors in building technology;
- Need for better remote sensing and geographic information systems (GIS) to model wildland fire risk factors (e.g., fuel, slope, climate, etc.);
- Development practices (density, slope, construction materials/practices, water, road access and egress) to reduce urban/wildland fire hazard;
- Utility of regulations (zoning, subdivision/landscape/building codes) to achieve better development and building practices;
- Education and incentives (remodeling guidelines, demos for builders, tax abatement, permit fee waivers on retrofits);

Potential role of the private insurance industry in establishing voluntary or compulsory standards for fire risk reduction in urban/wildland fringe;

- Development of training modules for fire personnel in techniques of risk assessment and fire suppression for urban/wildland fire, using computer graphics and simulation to enhance learning for operations in this dangerous environment;
- Design and development of an interdisciplinary knowledge base regarding the vulnerability of communities exposed to risk of wildland fire; and
- Development of computer-based models that simulate rapidly escalating urban/wildland fires and include the range of conditions that contribute to fire, as well as the range of conditions that inhibit it.

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APPENDIX A

Friday, January 26, 2001
National Academy of Sciences
2100 C Street, NW
Washington, DC
Lecture Room

AGENDA

Morning session: Rutherford H. Platt, Moderator

9:00 a.m. Welcome and introductions
Rutherford H. Platt, *Chair*

9:10 a.m. **Creating an Ecological Omelette: How we got out of an agrarian frying pan and into and exurban fire**
Stephen J. Pyne, *Arizona State University*

9:50 a.m. **What are the trends in wildland fires and what is the future for increased fires/risk?**
William A. Patterson, III, *University of Massachusetts, Amherst*

10:30 a.m. Break

10:45 a.m. **Fires in the wildland urban interface: Dilemmas of duality and the role of national science leadership**
Dave Cleaves, *USDA Forest Service*

11:25 a.m. **Addressing the wildland-urban interface fire problem in Canada through forest fire behavior research**
Martin E. Alexander, *Canadian Forest Service*

12:05 p.m. Lunch (cafeteria available)

Afternoon session: Wilfred D. Iwan, Moderator

1:15 p.m. **Wildfires and insurance**
Paul Kovacs, *Insurance Bureau of Canada*

1:55 p.m. Land use issues
Raymond J. Burby, *University of North Carolina, Chapel Hill*

2:35 p.m. **Case study: Los Alamos**
Kelly K. Carpenter, *Los Alamos County, New Mexico*

3:15 p.m. Break

3:30 p.m. Discussion with speakers
Mary Fran Myers, *Moderator*

4:30 p.m. Wrap up
Jim Bruce, NDR Steering Committee and *Chris Topik,* Staff, U.S. House of Representatives, Appropriations Committee

5:00 p.m. Adjourn

APPENDIX B

LIST OF ATTENDEES

Martin E. Alexander, Canadian Forest Service
David Applegate, AGI
Allan Auclair, RAND
Howard Baum, NIST
John S. Bishop, State Farm Insurance
Paul Bollea, GAO
Linda Reed Brown, Church World Service
James P. Bruce, Global Change Strategies International, Inc.
Raymond J. Burby, University of North Carolina, Chapel Hill
Susan Cannon, USGS
Curtis Carleton, FEMA
Kelly Carpenter, Los Alamos County, NM
Amar Chaker, ASCE
Terry Clark, NCAR
David Cleaves, USDA Forest Service
Lloyd Cluff, PG&E
Jack Cohen, USDA Forest Service
Tim Cohn, USGS
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