



U.S. National Report to the IDNDR Programme Forum

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Disaster Information on the Web

PPP 2000: <http://www.usgs.gov/ppp2000>

Information about the Public Private Partnership 2000 forum series, texts of the forum reports, links to partners and other hazard-information sites. PPP2000 is cosponsored by the Subcommittee on Natural Disaster Reduction and the Institute for Business and Home Safety.

Subcommittee on Natural Disaster Reduction: <http://www.usgs.gov/sndr>

Information about member agencies and activities of the SNDR (a subcommittee of the National Science and Technology Council's Committee on Environment and Natural Resources).

Institute for Business and Home Safety: <http://www.ibhs.org>

Main home page for IBHS, an initiative of the insurance industry, whose goal is to reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters.

Federal Emergency Management Agency: <http://www.fema.gov>

Main home page for FEMA, whose mission is to reduce loss of life and property and protect our Nation's critical infrastructure from all types of hazards through a comprehensive, risk-based emergency management program of mitigation, preparedness, response and recovery.

National Weather Service: <http://www.nws.noaa.gov>

Main home page for the National Weather Service of the National Oceanic and Atmospheric Administration. Provides information about NWS weather forecasts and maps; international, aviation, and marine conditions; links to historical climate information; and the Interactive Weather Information Network.

U.S. Geological Survey hazards information: <http://www.usgs.gov/themes/hazard.html>

Information about a wide range of hazards studied by the USGS, including earthquakes, volcanoes, landslides, floods, coastal storms and tsunamis, wildfires, and wildlife diseases.

National Science Foundation hazards information: <http://www.eng.nsf.gov/cms>

Information about fundamental engineering and related scientific knowledge needed to mitigate the impacts of earthquakes, extreme floods and droughts, tsunamis, hurricanes and tornadoes, accelerated erosion, wind and water, ice and snow, landslides, and subsidence and expansive soils.

National American Red Cross: <http://www.redcross.org>

Main home page for the National American Red Cross; provides links to Red Cross services, information on the latest disasters, and partner resources.

Natural Hazards Center at the University of Colorado: <http://www.colorado.edu/hazards>

Information about natural hazards and human adjustments to hazards and disasters, from the Natural Hazards Center, a national and international clearinghouse located at the University of Colorado, Boulder.

Progress and Challenges in Reducing Losses from Natural Disasters

NSTC/CENR Subcommittee for Natural Disaster Reduction

Abstract. The fundamental premise for the United Nations' International Decade for Natural Disaster Reduction has been that disasters result primarily from social causes and can therefore be addressed through changes in public policy. The end of the Decade provides an opportunity to reflect on the progress that has been made and the challenges that remain. During this 10-year period, the United States has initiated a significant policy shift, no longer relying on emergency response and recovery alone, but favoring greater emphasis on pre-event mitigation -- a mix of engineering practice and other societal measures that can be taken in advance to reduce the risks, pain, and costs of disasters. Due in part to the delayed impact of past decisions, the costs of disasters continue to rise. Moreover, our scientific understanding of the nature of disasters, though available in broad terms, has significant gaps with regard to important specifics. In fact, advances in knowledge may actually be lagging behind the rapid mutation of natural disasters themselves in response to societal change.

Introduction

The conclusion of the United Nations' International Decade for Natural Disaster Reduction (IDNDR) provides an important opportunity for agencies of the United States federal government to take stock. Where does the nation stand with respect to meeting the challenge of the IDNDR? What have been the major accomplishments of the Decade? What are the prospects for the future? What work remains to be done?

The National Science and Technology Council's Committee on the Environment and Natural Resources/Subcommittee for Natural Disaster Reduction (SNDR) brings together 19 federal agencies to address these and related questions. This paper provides an assessment of where we stand. No attempt is made to provide an exhaustive inventory of ongoing federal work. Instead, the emphasis is on strategic aspects of the problem and the larger context.

The entire premise of the Decade is that so-called *natural* disasters are primarily *social* in origin. Earthquakes, storms, floods, drought, and other geophysical extremes are inevitable. Furthermore, many of these extremes confer benefits as well as pose a hazard. For example, many ecosystems have adapted to occasional wildfire, favored by drought; pyrophytic species in these ecosystems actually require fire for proper germination. Riverine habitats and ecosystems are often dependent upon annual floods, to such an extent that the U.S. Department of the Interior (DoI) has begun to reintroduce such flooding into the environment downstream of the Glen Canyon Dam.

By contrast, *disasters* – disruptions of entire communities, persisting after the hazardous event has come and gone, and exceeding the communities' ability to recover unaided – reflect the ways societies do business. They result from decisions and policies with respect to land use, engi-

neering practice, ecosystem management, and social institutions and frameworks.

As a result, disasters are evolving rapidly in response to major changes in our society -- mutating in response to population increase, economic growth, the globalization of commerce, technological advances, and other trends now underway worldwide. The multi-disciplinary suite of activities known collectively as "natural disaster reduction" is barely keeping pace. The 1990's have seen a shift in U.S. national policy on natural disasters -- a move away from primary reliance on emergency response and reconstruction after an event and toward greater emphasis on pre-event mitigation measures. Over time, the consequences of this change in approach could prove profound.

Background

U.S. economic losses to natural hazards are highly uncertain, in part because of the difficulties in estimation (particularly with regard to resource losses and indirect business losses), and in part because there is no centrally assigned, multi-year responsibility for acquiring such data. However, it appears that losses have not declined during the Decade; instead, they have risen dramatically. Hurricane Andrew (\$27 billion), the Midwest floods of 1993 (\$21 billion), and the Northridge earthquake of 1994 (\$45 billion) each individually inflicted losses of tens of billions of dollars. Year-to-year damages fluctuate wildly, but it appears, on average, that the United States has been losing approximately \$1 billion each week to natural disasters in recent years, based on an informal compilation carried out in 1997 by the White House Office on Science and Technology Policy. Even after adjusting for inflation, these costs appear to be doubling each decade.

This U.S. experience reflects similar global trends. Munich Reinsurance figures, which represent one of the longer records in this field, show a doubling or tripling of economic losses worldwide over each of the last several decades. Their 1996 press release suggested that losses for 1995, which included the Kobe earthquake (originally estimated to be some \$100 billion), approached \$180 billion. Since then, the figures have been adjusted upward, and some estimates for 1995 losses now approach \$200 billion. Munich Reinsurance reported that 1998 was the most costly year ever for weather-related disasters, with losses from this source alone approaching \$90 billion.

The U.S. loss figure of \$1 billion per week might seem high but amounts to only 0.7% of Gross Domestic Product (GDP). The losses in affected states may amount to as much as 5% of the state domestic product. By contrast, the typical Chinese loss experience in bad years (such as 1998, which included substantial flooding) is in the range of 5-7% of GDP. For smaller nations, such as those in the Caribbean and Central America, a single event -- for example, Hurricane Georges or Mitch -- can produce losses of 50% of GDP. These hurricanes were not isolated instances. In 1974, for example, losses in Honduras resulting from Hurricane Fifi were equivalent to 50% of the 1973 GDP. Nor is the threat confined to developing nations. Estimates suggest that a repeat of the Great Kanto earthquake of 1923 would today cost Japan well over one trillion dollars -- a significant fraction of its total economy.

Economic losses are rising for reasons that are likely to continue in the near term:

- a simple rise in the value of assets in harm's way, as a result of population increase and economic growth.
- increasing use of hazardous lands (coastal zones, fault zones, flood plains, unstable slopes, fire-prone areas, etc.) in response to both population pressure and demographic preferences.
- a continuing failure to use best seismic, wind, fire, and flood mitigation and engineering practice. Nations and private enterprise are beginning to take steps to reduce vulnerability, especially in new construction. However, a huge amount of existing construction has taken place in an unsafe manner, in dangerous locations, and has yet to prove it can withstand a major hazard.
- a growing shift in the economic losses from property damage *per se* to associated business disruption. This shift occurs as both developed and developing societies become increasingly dependent on critical infrastructure that is introducing new vulnerabilities to hazards. Today, the direct costs of repairing road damage, restoring power to regional electrical grids, and reinstating disrupted water supplies are often small compared with the losses due to business stoppages while these repairs are being made. The problem may be aggravated because these systems are interdependent and because our society works unceasingly to reduce inventories in favor of "just in-time" practices.

These problems are particularly acute in the world's megacities, where rapid population influx combines with fragile infrastructure and a lack of the supportive, coordinated social systems that characterize more stable nation states to produce unprecedented vulnerabilities. There is also a troubling disparity between developed and developing nations with respect to injury and loss of life. Fatalities are decreasing in developed countries, despite population growth. In developing countries, they are rising.

IDNDR Targets

Early on, the IDNDR Scientific and Technical Committee responsible for coordinating international efforts established three targets. They challenged each nation, in the context of its plans for sustainable development, to:

- identify hazards and assess risk,
- develop and implement mitigation plans, and
- implement regional warning and dissemination systems.

U.S. Actions

Over the past decade, the United States has made substantial progress with respect to each of these three targets. Not all has stemmed directly from the Decade *per se*; much was the culmination of actions already underway. In fact, it might be argued that the role of a United Nations Decade should not be so much the redirection of energy away from previously existing efforts but rather the acceleration or increased emphasis on actions and policies that already make sense, independently of any named "Decade." Salient achievements from the perspective of the SNDR include:

Identify hazards and assess risk

The Federal Emergency Management Agency (FEMA) has made hazard identification and risk assessment the starting point for the *National Mitigation Strategy* (see below). FEMA has worked with the National Institute for Building Sciences to develop HAZards US (HAZUS), a GIS-based computer program to estimate earthquake losses. HAZUS incorporates classification systems for buildings and lifelines in a nationally standardized meth-

odology. HAZUS can be applied at three levels of refinement, depending upon the data available and the application. Default data (Level 1) provide rapid impressions of the type of damage an earthquake might produce. By adding more definitive building inventories, as well as data about local geology, utilities, and transportation systems (Level 2), the results can be refined. Additional data and specialized software routines (Level 3) can be added to study specific conditions such as a potential dam failure or tsunami. The methodology is already being used in the San Francisco Bay and greater New York City areas. Several communities from the Central U.S. Earthquake Consortium (CUSEC) have created HAZUS user groups that bring together state emergency managers and GIS experts. FEMA is currently generalizing the software to incorporate hydrometeorological hazards. Training in the use of HAZUS is available for state and local officials. The U.S. Department of Agriculture (USDA) and the Department of the Interior are together building corresponding risk assessment capabilities with respect to fire.

During the 1990's, a number of private-sector firms have developed proprietary software for hazard identification and risk assessment. Some of the models are highly detailed, involving quite specific characterization of the geophysical event and high-resolution models of building construction and type. These have been used to provide vulnerability assessments for specific events in specific locations, such as a repeat of the San Francisco earthquake of 1906, a repeat of worst-case Los Angeles or New Madrid earthquakes, or worst-case hurricane events in New Orleans, Miami, or New York City. Several scenarios imply losses exceeding \$100 billion for individual events, and in some cases approaching \$250 billion. The insurance and reinsurance industries have been major customers for the information; because the models are proprietary and increasingly sophisticated, testing and evaluation have become a serious and contentious issue.

Finally, during the Decade, more than 100 experts from many institutions and disciplines, under the leadership of the Natural Hazard Research and Applications Information Center (NHRAIC) at the University of Colorado, have worked for more than five years to conduct a Second Research Assessment. (This updates the First Research Assessment, carried out more than two decades ago.) The assessment attempts to pull together, in one summary document, what is known about the evolving nature and causes of natural disasters – and, more important, what is

not known. A summary of their findings, *Disaster by Design: A Reassessment of Natural Hazards in the United States*, was published by the Joseph Henry Press in May 1999. The overall assessment is that the causes of natural disasters are not geophysical, or even engineering, but rather societal. Furthermore, decisions with respect to natural disaster reduction cannot be made in isolation but must be made in a larger context of sustainable development and other societal goals. As the assessment's title suggests, the authors conclude that while disasters cannot be avoided they can be shaped -- a "choose your poison" option. Recognizing this helps us understand why many past mitigation policies (e.g., suppressing fires, building dams and levees) have not eliminated hazard or vulnerability but simply exchanged a profile of many small disasters for fewer, more costly ones.

Develop and implement mitigation plans.

During the IDNDR, the United States has begun a shift in policy emphasis from primary reliance on emergency response and reconstruction to increasing pre-event efforts to mitigate the impacts of hazards. Early in the Clinton Administration, FEMA conducted a series of "town meetings" in each of its regions and developed, in cooperation with state and local emergency management officials and others, a *National Mitigation Strategy* as part of the IDNDR. The *National Mitigation Strategy* laid out five main elements:

- hazard identification and risk assessment
- research application and technology transfer
- information and data access
- resources and incentives
- leadership and coordination

As its instrument for working with state and local governments as well as private enterprise to achieve the ends of the *National Mitigation Strategy*, FEMA conceived and implemented Project Impact, to "help communities protect themselves from the devastating effects of natural disasters by taking actions that dramatically reduce disruption and loss." To date, the agency has selected cities in every state for collaborative work to demonstrate the potential for pre-event mitigation, founded on the following principles: (1) preventive actions must be decided at the local level, (2) private-sector participation is vital, and (3) long-term investments in prevention measures are essential. Through a relatively small direct investment, FEMA has leveraged other federal efforts and achieved a catalytic effect in local/private-sector action. Other com-

munities are beginning to take corresponding actions, even without federal funding.

Similarly, USDA and DoI are working on changes in national policy with respect to forest fire and fuels management. As a result of all the above actions, the United States is well on the way to developing a significant, sustained national mitigation effort for the coming century.

Implement regional warning and dissemination systems

Throughout the 1990's, the United States has taken steps that provide an extraordinary improvement in its ability to forecast and warn of coming hazards:

- *National Weather Service (NWS) Modernization and Associated Restructuring.* The United States has just completed a \$4 billion investment in satellites, radars, surface observing networks and information processing to modernize its ability to observe, forecast, and warn of hydrometeorological hazards. These constitute 85% of the Presidential Disaster Declarations and 67% of the property damage suffered in the United States. As a result, the United States now experiences improved weather warnings and forecasts on time scales ranging from tornado forecasts of a few minutes to hurricane landfalls of a day or so to severe winter storm forecasts out to a week or more.
- *Seasonal/interannual forecasts.* In addition, the United States has worked with other nations to deploy and operate a global network of buoys to monitor the ocean changes responsible for triggering El Niño, La Niña, and related seasonal to interannual changes in the patterns of severe weather worldwide. As a result, the world enjoys its earliest and best warnings to date of such events. Estimates put the savings resulting from successful anticipation of the 1997-1998 El Niño event in the \$10 billion range.
- *The effects of climate change.* The United States has worked with other nations to provide new insights into changes in climate conditions that can be reasonably expected over periods of decades to a century.
- *The Global Disaster Information Network.* Through this initiative, led by Vice President Gore, the United States is beginning to integrate national technical means with other satellite and information processing assets to provide wholly new capabilities for damage assessment and emergency response.

- *Volcanic ash plumes.* U.S. agencies (Federal Aviation Administration [FAA], National Aeronautics and Space Administration [NASA], National Oceanic and Atmospheric Administration [NOAA], and U.S. Geological Survey [USGS]) have instituted an operational capability for alerting aircraft to the presence of volcanic ash plumes. Geosynchronous and polar-orbiting satellites observe plumes injected into the stratosphere by volcanic explosions, and nine volcanic ash advisory centers, including two in the United States, issue real-time warnings around the globe. In addition to continuous surveillance of the volcanoes themselves and their associated ash clouds, the agencies have modified air traffic control procedures and pilot training.

Other U.S. Progress

In other developments closely paralleling the work described above in weather and climate, the United States has made positive strides in natural disaster reduction during the Decade.

- *National Earthquake Hazard Reduction Program (NEHRP).* FEMA, the National Institute of Standards and Technology (NIST), the National Science Foundation (NSF), and USGS lead a coordinated effort to reduce the threat of earthquakes in hazardous areas. These vulnerable areas are indicated on recently-released ground-shaking maps for the Nation.
- *Forest Fire.* USDA and DoI have developed new suites of products for estimating fuel loading and for fire prediction. They work with other federal agencies and state and local entities to reduce the forest fire threat. Significant new resources are now available for controlled burns to reduce the fuel buildup in the United States and therefore the threat of major fire.
- *Tsunamis.* During the IDNDR, NOAA has led an effort with FEMA, the USGS, and the five Pacific states (Alaska, California, Hawaii, Oregon, and Washington) to mitigate the tsunami threat. The program provides for hazard identification and risk assessment, state and local mitigation planning, and improvements in tsunami warning.
- *Space Weather.* In a similar way, several federal agencies (NOAA, U.S. Air Force, USGS, NASA, and NSF) have collaborated to reduce greatly the threat to spacecraft, electrical utilities, global telecommunications, and other sectors posed by space weather. Through x-ray imaging of the sun, instrumenting the

L1 site between the earth and sun to detect solar flares, and other measures, the United States has increased warning times and reduced false alarm rates.

Partnerships with the Private Sector

The federal government has made great strides during the decade to improve its ability to partner with the private sector. By far the most important example has been Project Impact, described above. Additionally, the SNDR has worked with the property and casualty insurers and reinsurers through the Institute for Business and Home Safety (IBHS) to establish the Public Private Partnership 2000. Over the past eighteen months, the Partnership has sponsored 13 day-long forums. Each has focused on a major problem of joint public-private concern, and each has provided an opportunity for lively discussion and new partnerships to resolve these issues. The response has been overwhelmingly positive.

International Collaborations

The United States has also worked bilaterally and multilaterally with other governments to reduce natural disasters. Following the Kobe earthquake, under the Common Agenda for Cooperation in Global Perspective, the United States and Japan began a series of Earthquake Policy Symposia and Forums. These meetings enable participants to share and develop common insights into earthquake research, disaster prevention, emergency response, and long-term recovery and reconstruction. The United States and China conducted a bilateral natural disaster reduction workshop in November 1997 and initiated a number of follow-up measures. The United States and China continued their successful research collaboration under the US/PRC Protocol for Scientific and Cooperative Research on Earthquake Studies, Earthquake Engineering, and Hazard Mitigation. The United States and Indonesia cooperate with respect to forest fire management and related research. These are but a few examples in an extensive list.

General Level of U.S. Effort

Roughly speaking, the U.S. Government allocates a few billion dollars each year to the ongoing costs of maintaining an emergency response capability and providing for recovery from disasters. The U.S. Government spends another few billion each year on unbudgeted emergency response and recovery activities triggered by individual disasters, although the figures vary widely from year to year. Budgeted Federal expenditures for pre-event miti-

gation amount to perhaps 10% of these total figures, in excess of \$500 million per year. In recent years, federal investments in pre-event mitigation measures are rising significantly. In the 1999 budget, increases totaled \$100 million. The 2000 budget requests another \$136M increase for such activities.

Outlook for the Future

Rather than attempt an exhaustive catalog of work underway or contemplated, this section presents a qualitative assessment of needed future work, noting the general degree of difficulty associated with each task.

Success is challenging, but nonetheless likely, with respect to:

- *Warning and emergency response.* Investments made by the United States and other nations have resulted in improved forecasts of hydrometeorological and some geophysical events and rapid assessments of their impacts. These improvements are likely to continue over the next few decades. Furthermore, because of the investments in information infrastructure, the emergency response environment is likely to be transformed from one that is currently information-poor to one that will be increasingly information-rich.
- *Insurance and other mechanisms for spreading risk/loss.* Alarm over the likely size and scope of impending natural disasters has prompted insurers to take action on a broad range of fronts. They are actively creating new mechanisms such as catastrophe bonds for securitizing risk. They are seeking Congressional relief from taxation of contingency reserves, and seeking to formalize government's role as a reinsurer of last resort. The Administration is considering whether and how to provide for federal intervention in reinsurance markets for natural disasters, while adhering to common-sense principles that any such intrusions should not displace private initiative or impose a cost on taxpayers.
- *Access to information.* Information is now much more accessible, not only on mitigation measures in general but also on best practice. Taken together, Project Impact and investments in information infrastructure promise greater future availability of information on pre-event disaster mitigation practices at

the local community and free enterprise level, where it is most needed.

Success is possible, but more problematic, with respect to:

- *Public awareness.* Media attention of the past few years has heightened public interest in and awareness of natural disasters. The question is whether and how this enhanced media coverage will translate into greater public support for pre-event mitigation measures in the face of competing demands for attention and for resources.
- *Sustained, meaningful implementation of pre-event mitigation measures and their concomitant financing.* Again, a broad range of pre-event mitigation measures are demonstrably effective, but the financing of such measures, and steps by government and industry (e.g., the financial sector) to provide incentives, may prove more difficult to implement in practice.
- *International cooperation.* The fall 1998 Atlantic hurricane season, and Hurricanes Georges and Mitch in particular, drove home the point that current international efforts to mitigate natural disasters, and to incorporate disaster risk in international investment, remain far below what is desirable. In this case, for example, dramatic decreases in loss of life for U.S. hurricanes reflects improved forecasting capability plus communications plus planning. This same level of attention and support is needed internationally.

Success is unlikely without new national and international emphasis with respect to:

- *Newly emerging hazards.* These include but are not limited to the technological hazards resulting from otherwise natural extreme events, and other, closely related hazards such as terrorism, particularly with respect to the use of chemical, biological, and nuclear agents of mass destruction.
- *Vulnerability of critical infrastructure to natural hazards.* Not enough is known about the performance of particular structures such as buildings, bridges, power generating plants, water treatment plants, and the like with respect to a variety of natural threats. Far less is known, however, about the performance of these infrastructures as a whole with respect to natural extremes. For example, no individual roadway was directly lost to the Florida forest fires of this past year, but it was necessary to shut down Interstate 95 with a resulting disruption of Florida commerce and

tourism. Many homes were lost, but many more could not be occupied because of the disruption in access and critical support services. The effects of the January 1998 ice storm on the electrical networks of the northeastern United States and eastern Canada were largely unanticipated. New vulnerabilities associated with cyber infrastructure, and particularly with regard to the increasing control of other infrastructures such as communications, electricity, gas, water, sewage, and transportation by cyber infrastructure, remain uncharted and potentially threatening to an unprecedented degree. If nothing else, such technological change transforms the nature of economic loss from actual property damage to economic disruption.

- *Megacities.* Simply put, megacities can be viewed as "job shops" competing for global business and jobs. Like all job shops, they must attempt to keep wages and overheads low. At the urban level, this implies overcrowding, inattention to environmental protection, fewer resources and more responsibilities, greater fragility of infrastructure even in the absence of hazards, and greater recovery problems following disasters.
- *Equity issues.* To the extent that most natural disasters are indeed social in origin, it also follows, as experts agree, that their burden falls disproportionately on those already most economically disadvantaged. This is true both on an international level, where developing countries face greater risk than their developed counterparts, and domestically. The poor within each society are forced to live in substandard structures, on more dangerous land, and have fewer resources to lessen their own risk and vulnerability. Just as these issues remain at the heart of the overall sustainable development challenge, they are at the root of efforts to reduce natural disasters.

Is Science Falling Behind?

Because natural disasters have their roots in societal causes, and today's rates of population increase, economic growth, and technological advance are rapid and unprecedented, disasters are evolving rapidly in response. Scientific understanding and engineering practice may not be keeping up. Furthermore, ecosystem management and the application of scientific knowledge and best practice engineering are lagging. Some examples of problem areas include:

- *The science of loss estimation per se.* The National Academy of Sciences/National Research Council (NAS/NRC) has recently called attention to this issue. We lack standard accounting procedures, which can be applied uniformly from hazard to hazard, for estimating economic losses from disasters. Estimating future losses is even more problematic.
- *Social analysis.* We lack the ability to explain in a systematic way why new scientific and technological advances are not being used effectively to mitigate disasters. The just-completed Second Assessment provides background and a broad range of recommendations in this area.
- *Many geophysical hazards remain resolutely unpredictable.* This is particularly true of solid-earth hazards (with the exception of volcanic eruptions). Reliable earthquake prediction has not been achieved; however, pilot systems to rapidly quantify the earthquake shaking after the event, and to give a few seconds' warning before the shaking begins, are under development. Even hydrometeorological hazards are not forecastable on the extended time scales required by today's society, which must therefore continue to rely on rudimentary maps of hazard zonation and climatologies. For example, although hurricane forecasts are much improved over former years, they have not kept pace with the rise in evacuation clearance times along much of the U.S. coast, occasioned by population increase in coastal counties. Specialized applications, such as evacuation of ships from Charleston and Norfolk in advance of hurricane arrival, and Cape Kennedy Space Shuttle launches in support of the Space Station, now require decisions as much as 120 hours in advance of landfall, well outside the range of reliable hurricane forecast skill.
- *The effects of global change on hazards remains obscure.* What will be the impact of such long-term trends on the intensity, frequency of occurrence, and location of extreme events?
- *The pace of engineering advance and its implementation in practice.* Sometimes needed advances are implemented too slowly; the failure to adopt building codes based on the best current science is a prime example. On the other hand, some advances, like the use of welded steel moment frames for high-rise buildings, are implemented relatively rapidly, on a very broad scale, before their vulnerabilities to hazards (e.g., the weld cracks discovered following the Northridge earthquake) fully surface.

- *Ecosystems.* The interaction of wild and managed ecosystems with extreme events and their changed vulnerability as a result of human interference remain largely uninvestigated and unknown. Some ecosystems actually require extreme events for their health.
- *Critical Infrastructure.* The performance and vulnerability of critical infrastructures on a systems level – communications, electricity, financial, gas, sewage, transportation, and water – to natural hazards also remain poorly understood. Increasingly, all these systems are coming under common computer control with unknown implications for disaster vulnerability.

Furthermore, the interaction of these threats with technological hazards and with willful threats such as terrorism remains unknown and unassessed. All these realities speak to the importance of continued, multidisciplinary scientific and engineering attention to natural disaster reduction in the decades ahead.

Improved science must be accompanied by other efforts. We need sustained, committed emphasis on mitigation planning and implementation, and expanded partnerships between the public and private sector. To fulfill the promise of the IDNDR, we must continue working to make natural disaster reduction a public value in the United States and around the world.



Public Private Partnership 2000

A New Approach To Dealing With Natural Disasters

For centuries, man has attempted to control nature and natural hazards through engineering. During the International Decade for Natural Disaster Reduction, awareness has grown that the human, environmental, and economic costs of attempting to engineer a society completely resistant to natural disaster are too high and that lasting solutions must be rooted in the realities of human behavior. It is the intersection with people that turns a natural *hazard* into a natural *disaster*.

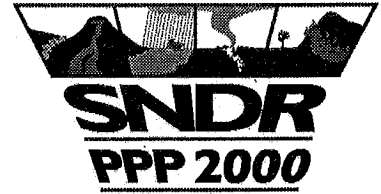
Public Private Partnership 2000* was established to seek opportunities for government and nonprofit, private-sector organizations to work together to develop new strategies that will reduce our vulnerability to natural hazards. The creation of PPP 2000 implicitly recognizes that past approaches to reducing the economic and social impacts of natural hazards will not fully solve the problem and that durable and comprehensive solutions depend on continuing dialog among all sectors of our society. The problem is too large and too complex to be handled by any one group.

Starting in 1997, PPP 2000 has conducted a series of public policy fora. Each forum considered a distinct aspect of reducing the human and economic toll of natural disasters. The topics of the first 13 fora are listed on the back of this sheet, and reports on the first 11 are included in this packet. Additional information about the forum series, and links to public- and private-sector partners, can be found on the web at <http://www.usgs.gov/ppp2000>.

The IDNDR provided an opportunity to review critically our traditional approach to natural disaster reduction. From the resulting insights, broad new paths emerged. PPP 2000, and similar partnerships, are showing the way to a safer society in the future.

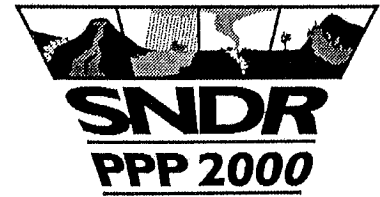
-- Tim Cohn and Kathleen Gohn
June 1999

* PPP 2000 is cosponsored by the Subcommittee on Natural Disaster Reduction (a subcommittee of the National Science and Technology Council's Committee on the Environment and Natural Resources; SNDR comprises 19 Federal agencies), the Institute for Business and Home Safety (a property/casualty insurance organization dedicated to reducing deaths, injuries, property damage, economic losses, and human suffering caused by natural disasters), and more than 20 private-sector organizations.



PPP 2000 Forums on Public Policy Issues in Natural Disaster Reduction

- Forum 1 Natural Disaster Reduction Initiatives of the Insurance Sector**
September 10, 1997
- Forum 2 The Uncertainty of Managing Catastrophic Risks**
December 11, 1997
- Forum 3 Cities and Megacities at Risk from Natural Disaster**
January 21, 1998
- Forum 4 National Lessons from the California Earthquake Loss Reduction Plan**
February 23, 1998
- Forum 5 A Global Perspective on Reducing Losses from Natural Disasters**
April 14, 1998
- Forum 6 Disaster Recovery Business Alliances**
June 9, 1998
- Forum 7 Real-Time Monitoring and Warning for Natural Hazards**
June 30, 1998
- Forum 8 Reducing Losses from Floods**
October 5, 1998
- Forum 9 Protecting Our Critical Infrastructure**
November 17, 1998
- Forum 10 Motivating People to Do Something About Natural Hazards**
December 15, 1998
- Forum 11 Natural Disaster Reduction: Challenges for the Next Century**
January 27, 1999
- Forum 12 Public Health in Natural Disasters**
March 10, 1999 (report pending)
- Forum 13 Mobilizing DOD Hazard Reduction Forces**
May 11, 1999 (report pending)



Natural Disaster Reduction Initiatives of the Insurance Sector
Public Private Partnership 2000
Report on First Forum
10 September 1997

The history of efforts to reduce the economic, environmental and human costs of natural disasters is replete with unforeseen repercussions of well-intentioned policies. Early governmental efforts to control nature with concrete and steel, to create a society *resistant* to natural hazards, often proved costly, ineffective and environmentally unsound. More recent approaches have attempted to encourage accommodation with nature in an effort to develop a sustainable society *resilient* to natural disasters. However, we do not yet know how to do this.

Public Private Partnership 2000 (PPP 2000) was established to address this situation. It seeks opportunities for government and nonprofit, private-sector organizations to work together to develop new strategies to reduce vulnerability to natural hazards in communities throughout the Nation. The creation of PPP 2000 implicitly recognizes that past approaches to reducing the economic and social impacts of natural hazards have been unsuccessful and that the best hope for a solution is a continuing dialog involving all sectors of our society. The problem is too large and too complex to be handled by any one group.

On September 10, 1997, PPP 2000 sponsored the first Forum in a series dedicated to exploring new approaches to natural disaster mitigation. The Forum focused on initiatives of the insurance sector and brought together representatives from federal, state and local governments, the private sector, and non-governmental organizations. The primary goals of the Forum were to bring all of the stakeholders together and to break through traditional patterns of thinking. The Forum included discussion of experiences with previous policies and programs related to reducing the impact of natural hazards. Despite efforts at mitigation, economic losses from natural disasters continue to grow exponentially, tripling every 30 years, causing an average of \$1 billion in economic losses in the United States each week and threatening the safety of thousands of Americans.

Several Forum speakers addressed the issue of "market failure" with respect to natural hazards. Economic theory would predict that a rational citizen, well informed and guided by the "invisible hand" of a free market, could be relied on to minimize net losses from natural disasters (floods, landslides, hurricanes, earthquakes, wildfires, volcanic eruptions, hail, tornadoes, etc.). However, this model does not adequately describe the situation. First, government policies and regulations have greatly distorted the free market. Several well-intentioned government programs have restricted market forces and in some cases have paradoxically encouraged development in hazard-prone areas. For example, some states require insurers to provide below-cost policies for homes built in flood-prone coastal regions; curiously, the law requiring such policies was originally intended to protect inner-city homeowners. Similarly, for humanitarian and political reasons governments choose to provide emergency disaster relief. This alleviates short-term suffering but arguably encourages further development in hazardous locations.

"Market failure" may also arise from a lack of information. Many in our society are uninformed about natural hazard risks, cannot accurately quantify their costs, or believe--often mistakenly--that government will somehow protect them. As a result, individuals discount hazard risks when making economic decisions.

Information failures occur at several levels. At the deepest level, important physical processes are not well understood; we simply do not know enough to adequately characterize and assess the risks from most hazards. This information failure can be addressed only through research in basic earth science. At the next level, monitoring data, warning systems, and actuarial information are not readily available. This lack of information is due to legal barriers (for example, insurance loss data needed to calibrate risk models are proprietary and protected by privacy laws), to the absence of standardized classifications and data formats, and to a shortage of funds needed to collect and disseminate information. Finally, the public has not chosen to educate itself about the true risks posed by natural hazards. For our society to significantly reduce the economic and human losses from natural disasters, it must first make natural disaster reduction a public value, an accepted part of the way we do business, in the same way that wearing seat belts has become an accepted part of riding in a car.

Forum participants observed that many seemingly unrelated actions and policies, both public and private, are developed without adequate consideration of their impact on natural hazard losses. For example, by permitting deduction of losses, the tax code in effect creates incentives for development in hazard-prone areas. Similarly, state laws that guarantee availability of insurance at subsidized rates, though well-intentioned, have removed a direct disincentive to development in harm's way. Even those policies directly concerning natural hazards have sometimes failed to consider long-term consequences. Conversely, the wetland protection provision of the Clean Water Act, which was not directed at natural hazard reduction, may have effectively reduced flood losses by preventing developmeee areas.

Two patterns emerged from the discussion. First, issues surrounding natural hazards cannot be isolated from other public policy issues, such as welfare, climate change, and economic development. Second, decisions on how to address natural hazards will spill over into other aspects of our society. These patterns suggest that developing effective strategies for dealing with natural hazards will require a broad range of disciplines and participants, including business people, scientists, engineers and all levels of government.

Proposed Actions:

The Forum stimulated broad discussion among the groups and led to the following proposals:

1. Make natural disaster reduction a public value. This could involve use of "disaster impact statements" prior to significant public or private activities, analogous to the EIS (Environmental Impact Statement) requirements of NEPA;
2. Emphasize structural and non-structural mitigation;
3. Establish effective warning systems;
4. Develop financing methods to pay for mitigation;
5. Create an accessible data base containing disaster information using standardized classifications and formats;
6. Expand consideration to include international partners and international issues.



The Uncertainty of Managing Catastrophic Risks
Public Private Partnership 2000
Report on Second Forum
11 December 1997

On December 11th, 1997, PPP 2000 held its second forum on natural disaster reduction, "The Uncertainty of Managing Catastrophic Risks," which was cosponsored by the University of Pennsylvania's Wharton School. More than 100 participants from academia, Wall Street, non-governmental organizations, and Federal, State and local Government discussed the interdependent roles of the private and public sectors in creating incentives and institutions to expand our capacity for managing natural disaster risk. Discussion focused on innovative approaches including new financing mechanisms of insurance, re-insurance and capital markets, as well as increased incentives for mitigation. This forum expanded on the theme developed in the first forum that the financial capacity of the insurance industry is inadequate to cope with a megadisaster such as a repeat of the 1906 San Francisco earthquake (estimated losses of \$100 billion) or even a major East Coast hurricane (estimated losses of \$75 billion).

Mitigation: Modern modeling techniques allow us to identify cost-effective mitigation methods which can be expected to benefit property owners, improve the solvency of primary insurers and reinsurers, and reduce the need for costly post-disaster aid by government agencies. However, research on consumer decision making shows that the benefits of mitigation are not recognized by the vast majority of homeowners due to their misperception of the risk, their short-term outlook, and the upfront costs. Consequently, adoption of mitigation must be encouraged by the public and private sectors through education on true risks and benefits and through explicit incentives such as the following: (1) lowering insurance rates and deductibles for those who invest in effective measures and (2) linking lower insurance premiums to long-term loans for mitigation, which would reduce total cost to homeowners and make clear the benefit of investing in loss reduction measures.

The public sector can affect mitigation by creating and enforcing building codes and land use regulations. Governmental bodies can limit post-disaster assistance practices that perversely reward those who choose not to mitigate and who ignore insurance options.

Challenges emerged in the presentations and subsequent discussions. There was general agreement that current insurance regulation is not conducive to creating private sector incentives. Rate restrictions and artificial pooling of risks have created a situation where insurance premiums do not reflect the actuarial risk. As a result, insurers have little incentive to reduce prices or offer lower deductibles to those adopting mitigation. Several participants pointed out that these market distortions are poorly understood and called for further research to illuminate this important element of the public policy debate.

Insurance, Reinsurance, and Capital Market Instruments: A close look at the insurance and reinsurance industry reveals that its capacity to bear large catastrophic losses may be substantially less than aggregate figures suggest. Market and industry structure limits the extent to which reserves might be available to cover a specific mega-disaster. Furthermore, premium-derived capital reserves are currently limited by tax regulation. Reinsurance, while permitting pooling over a wide enough geographic area to create greater statistical independence of low-probability, high-severity events, inevitably carries with it incentive conflicts between primary and secondary insurers which result in increased auditing costs. These additional costs must eventually be borne by the consumer. In addition, the price of reinsurance is cyclical and volatile, making it difficult for insurers to consistently obtain coverage when they need it.

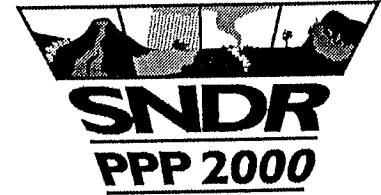
Researchers and practitioners are currently exploring how to bring into play large diversified pools of capital that might efficiently complement traditional insurance and reinsurance risk transfer mechanisms for catastrophic risk. The U.S. securities market is so large (\$15-20 trillion) that capacity relative to natural disaster losses is not an issue. Therefore it is not surprising that using capital market instruments such as bonds to provide protection against losses from hurricanes and earthquakes is now beginning to take place. Inclusion of such securities in diversified portfolios can enhance portfolio efficiency because of attractive pricing and their lack of correlation with conventional asset classes. However, before such financial instruments can become an effective complement to insurance and reinsurance, they must be able to resolve the incentive conflicts between the primary and ultimate risk bearers. Emerging modeling technologies and objective indices will reduce information asymmetries between parties and facilitate this process. Several participants envision substantial progress towards a fully functioning market over the next five years.

The Need for Public Private Partnerships: Current regulation allows property owners in hazard--prone areas to transfer a significant part of their catastrophic losses to the general taxpayer. Insurance regulation may give rise to cross subsidies and thereby impede insurers' attempts to efficiently diversify their risk. Furthermore, public expectations of federal low-cost reconstruction loans for the uninsured, along with a history of subsequent forgiveness, have discouraged mitigation efforts and diminished the perceived need for insurance among property owners. Some speakers asserted outright that private market mechanisms have fared rather poorly in this area

The recent emergence of state catastrophe funds, such as the California Earthquake Authority and the Florida Hurricane Catastrophe Fund, has led to debate about their financial effectiveness and the need for them. A dominant theme throughout the forum was the need for new public policy to support market-driven behavior, such as immediate action by states to permit the use of sound actuarial estimates of catastrophe risk in the insurance rate setting process. At the same time, participants recognized that government has an important continuing role in ensuring that special financial consideration is given to the truly disadvantaged. Finally, it was also noted that for the very highest layers of catastrophe risk, the government (and consequently the taxpayer) is now, by default, the insurer of last resort.

Forum Themes: Several overarching themes emerged during the forum.

1. What is the role of science and modeling in informing hazard policy? What standards are needed to properly evaluate models? Because efficient markets require equal access to information, there is a strong need for unbiased science and sound modeling. Models are also needed for assessing the benefits and costs of various mitigation strategies.
2. How can the framework of funding sources available for catastrophe insurance be expanded and refined to cope with a potential megadisaster?
3. Can rate regulation of insurance be justified? What regulations are needed to ensure solvency?
4. Public-private partnerships should not be a gift to the private sector; such partnerships can only prosper when all parties share in the benefits and the risks. What are the best ways to ensure that benefits and risks are distributed equitably?
5. There is an ongoing need for grassroots education to make the reduction of losses from natural disasters a public value. How can governments and the private sector best work together to develop the needed awareness among the public, the real estate and construction industries, and other significant audiences?



Cities and Megacities at Risk from Natural Disaster
Public Private Partnership 2000
Report on Third Forum
21 January 1998

On January 21, 1998, PPP 2000 held its third forum on natural disaster reduction, "Cities and Megacities at Risk from Natural Disaster." The event was cosponsored by the Stanford University John A. Blume Earthquake Engineering Center, the World Seismic Safety Initiative (WSSI), and the World Federation of Engineering Organizations (WFEO). More than 100 representatives from academia, the private sector, non-governmental organizations, and local, State, and Federal government participated, offering diverse perspectives on natural disasters and on the links between natural hazards and other urban issues.

The World's population has rapidly urbanized during this century, for technological, social and political reasons. While such urbanization yields diverse benefits -- economies of scale and sharing of infrastructure resources -- it also poses difficult challenges with respect to natural disaster risk and risk management. Cities now depend on the functioning and interaction of complex social, political and engineering systems, many of which are not well understood and all of which are subject to disruption by natural disaster. We are only beginning to comprehend these vulnerabilities and their implications for disaster mitigation, for emergency management, and for disaster recovery. One aspect of this problem is recognized, however: Our ability to respond effectively to urban natural hazards is closely linked to larger social issues and to the structure of our society. The fault lines in a city or a society become apparent under the stress of a natural disaster; true natural disaster reduction requires strengthening the social fabric.

The Forum considered cities in the United States and abroad; concerns of both the private and public sectors; issues related to a variety of hazards, including earthquakes, hurricanes, coastal erosion and technological hazards; the interrelationships and specific responsibilities of individuals, neighborhoods, the business community, the insurance sector, private organizations, different levels of government, and the international community in addressing natural hazards; the need for reliable and easily available information about hazards; and mitigation, response, and recovery efforts at both the local and national levels.

Challenges of natural disaster risk in cities and megacities

Today's cities and megacities are unlike any that existed in the past, and thus we cannot expect our experience with historical disasters to guide us in the future. Cities are larger than ever before and growing in size at an unprecedented rate. The average population of the world's 100 largest cities has swelled from 700,000 in 1900 to 5 million in 1990. Furthermore, as cities have grown, they have often expanded onto hazardous lands. For various reasons, people are choosing to live in harm's way.

New threats have arisen as the megacities have grown. In addition to the four horsemen (famine, war, disease, and death) recognized by the ancients, our megacities now face new perils: Climate change, sea level rise, civil unrest and terrorism, and emerging and reemerging diseases. The combination of natural and technological hazards creates an environment in which effects may be multiplied through cascading multi-disasters. For example, an earthquake can lead to a breakdown in the social order and infrastructure, resulting in rioting, the spread of disease through unsafe drinking water, and disruptions to the local economy. Because economic globalization has made the world's cities increasingly interconnected, events in Manila may affect Madrid, Mexico City and Milwaukee.

Global competition for jobs and the economic need to keep costs down are leading to deforestation, loss of biodiversity, marine pollution, and a decrease in cities' ability to protect themselves from environmental impacts and from the shock of a

natural disaster. Societal vulnerabilities, such as increasing gaps in wealth and pre-existing health problems, exacerbate the havoc caused by a disaster. Mitigation and preparedness have not been high priorities in the competitive world economy; worldwide, the approach has been of managing disasters rather than mitigating their effects. At the level of individual companies, the same is true; a focus on the bottom line and the quarterly earnings statement has reduced disaster preparedness efforts in many companies.

Reliable and accessible scientific information about risk is critical to making sound decisions about appropriate mitigation and response strategies. The speed and completeness of the transformation that cities have undergone in the past century complicate efforts to characterize and communicate natural disaster risk. The relative infrequency of natural disasters in some places has created a low level of awareness of the risk. Yet natural forces, such as coastal erosion and sea-level rise, are magnifying urban vulnerability to hazards. A primary challenge, therefore, is to expand risk assessment efforts to better understand the nature and magnitude of the natural hazard risk that cities face.

A second challenge is to communicate the information about risk and mitigation to the many and diverse stakeholders in a form that is meaningful and useful to them. Most megacities contain a mix of peoples from varying ethnic, cultural and socio-economic backgrounds. Special issues arise when trying to communicate information -- about hazards in particular -- to such diverse audiences. Yet improved understanding of risk and mitigation is an essential part of any effort to provide effective mitigation, response, and recovery.

For mitigation to be truly effective, it must become connected with community priorities, especially in smaller cities, and must be shown to be a good investment. An expanded base of support, from utility companies, the news media, the insurance industry, property owners, and others, will help in developing coalitions and champions for mitigation. Cities and megacities have a unique concentration of economic and political power that can prevent -- or encourage -- mitigation.

The role of public-private partnerships

The forum highlighted the idea that, with a common interest in reducing the risk of natural disasters in cities, and with different resources at their disposal, both the public and private sectors could benefit from partnerships in which they work together to address the natural disaster risk of cities. In addition to describing the nature and magnitude of the risk that cities face, many forum participants offered examples of existing risk reduction and management efforts, particularly public-private partnerships, that can serve as models for future work. Mitigation plans need to exist and be coordinated at many levels, from a single company or building to a city or region.

Key issues and challenges

Several key issues were identified in the course of the discussion. Many of these issues echo concerns raised at previous forums, with a heightened intensity due to the size, complexity, and interconnections of today's cities.

1. Partnerships are needed. Natural disasters are too large and costly to be handled by any one sector of the society.
2. Mitigation is critical. Post-event response and recovery are necessary, but alone they are not an efficient or effective means to reduce cities' risk from natural and manmade disasters in the long term.
3. Science and technology must be employed to help reduce the vulnerability of cities and megacities to natural disaster.
4. Hazard mitigation should be integrated into the general urban development process.

How sustainable are cities in their current form?

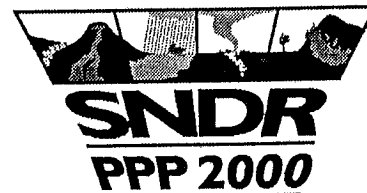
5. In many regions, cities have grown and changed significantly since the last major disaster. Past experience alone, therefore, is not a reliable predictor of the future. How have the changing size and nature of cities affected their vulnerability to natural disasters and their ability to manage risk?

6. Local knowledge of populations and conditions is critical. How are different groups within cities affected differently? In what ways, and to what extent, do the poor and other marginalized groups suffer disproportionately? What could be done to

reduce the vulnerability of these groups to natural hazards? Potential inequities need to be addressed in mitigation and disaster relief policies.

7. Is there a post-event window of opportunity for reducing risk? If so, does it exist everywhere, or only in developed countries? How can it be exploited most effectively?

8. Natural disaster reduction must be made a public value. Reaching out to the community and especially to children through the school systems is essential. Creative thinking at all levels and strong public-private partnerships are needed to accomplish this goal, which has been emphasized in all forums to date.



**National Lessons from the Development and Implementation of the California Earthquake Loss
Reduction Plan 1997-2001
Public Private Partnership 2000
Report on Fourth Forum
23 February 1998**

California's huge earthquake risks have inspired its state government to develop and implement a series of earthquake loss reduction strategies. Its current strategic plan is described in *The California Earthquake Loss Reduction Plan 1997-2001*. The fourth PPP 2000 Forum, held on February 23, 1998, focused on what national lessons can be drawn from this state-led approach to reducing earthquake risks.

The Plan addresses all aspects of natural hazard reduction, from geosciences to emergency preparedness, response and recovery. It considers economic and social issues and the responsibilities and duties of the different segments of the society. Through a series of elements, strategies, objectives and initiatives, it explicitly recognizes the complex interaction between natural hazards and our society and defines the process through which California's earthquake hazards should be addressed. Individual implementation plans describe the actions required to accomplish the initiatives. Implementation policies are developed by the state administration in cooperation with the legislature and others responsible for earthquake safety and loss reduction.

The plan serves as the California Seismic Safety Commission's policy statement on reducing earthquake risk over the long term; it guides the executive branch of the state government in its priorities for seismic safety; and it serves as California's qualified and required mitigation plan for earthquakes, in compliance with the Federal Emergency Management Agency's *National Hazards Mitigation Strategy*.

The magnitude 6.4 earthquake that struck Northridge in 1994 revealed both the success and the failure of California's approach to earthquake loss reduction. On the one hand, the earthquake caused very few deaths, and thus the explicit goal of life safety was met. Paradoxically, while the human population fared well, California's engineered environment suffered serious structural damage. This resulted in huge losses to building owners, insurance companies and the regional economy.

In particular, unexpected weld failures were found in more than 200 steel-frame buildings, in some case requiring building evacuation and demolition. These failures show the dual need to develop nationally applicable standards and to implement local practices. Partnerships between the technical community and policy makers are essential for developing appropriate performance-based standards.

The Northridge experience has influenced public policy, engineering design, and building codes and has resulted in precedent-setting litigation. Unfortunately, in most cases this experience has not led to increased mitigation. For some owners, the benefits of retrofitting do not justify the cost and may create unanticipated civil liabilities.

The lessons from California's earthquake plan are directly relevant to other natural hazards and other states and can be used to suggest and clarify hazard mitigation programs. Forum participants agreed that the development of a national multi-hazard plan is inappropriate and that the goal is for state and local agencies to take primary responsibility. The federal government's role should be to provide leadership and technical assistance and to acknowledge successes.

Forum Themes

Several critical elements of the California plan were also overarching themes of this and the three previous Forums.

California formally recognized that earthquake loss reduction is a public value. The state had already impaneled a Seismic Safety Commission that was influencing seismic safety legislation, codes, and research. Development of the California Earthquake Loss Reduction Plan was a natural outgrowth to formalize and provide a structure for its efforts.

Input from stakeholders is important. California Seismic Safety Commission hearings are held monthly in locations throughout the state, often in cooperation with other state agencies and local governments. Through these formal meetings, committee meetings, and workshops, stakeholders are invited to present their experiences, their needs, and their aspirations for seismic safety. Because stakeholders -- agencies, businesses, and citizens -- implement the program, they must be full participants in its development. Public-private partnerships are encouraged.

Reinforcing the built environment is only half of the equation. The California Seismic Safety Commissioners represent diverse interests and professions and recognize that mitigation activities need to be both structural and nonstructural. Social services, response, and recovery are an integral part of the California plan.

The plan must be a living document. The California plan is evaluated continuously to refine its direction, measure its results, and consider new points of view. It is revised annually and is reprinted in its entirety every five years. The plan and its updates are distributed to the California legislature, the executive office, state agencies, and local governments. It is available to anyone who requests it.

Mitigation is cost effective. Multi-hazard mitigation is especially cost-effective. Stakeholder communities and the public and private sectors should work with regional disaster research centers where they exist to accelerate the pace of mitigation.

Incentives are needed to encourage mitigation. As others have pointed out, many existing policies encourage the status quo. Incentives in the areas of land-use planning, legal liability, financing, insurance, taxes, loans, building permits, and interest rates, for example, would help encourage people to take hazard mitigation seriously. Conversely, insurance companies should consider increasing premiums for those who fail to mitigate.

Ongoing education is needed to change behavior. More effective outreach techniques are needed to reach and involve individual citizens through varied partnerships involving federal, state, and local governments, academia, and the private sector, such as are currently being developed for FEMA's Project Impact.

Acceptable risk needs to be defined. An outgrowth of public education on disaster mitigation is the ability to consider what risks are acceptable. What level of safety are we willing to support? Performance-based engineering can then be applied; codes become secondary.

Federal support is needed. Although California established its Seismic Safety Commission and developed a plan to reduce earthquake risk on its own, help from the federal government is enabling other states to benefit from California's experience. For example, in 1996 FEMA funded a conference for states interested in forming their own seismic safety programs. This opportunity for one state to learn from the experiences of another resulted in many new organizations aimed at reducing earthquake losses in other states.



A Global Perspective on Reducing Losses from Natural Disasters
Public Private Partnership 2000
Report on Fifth Forum
14 April 1998

Natural disasters are becoming more expensive and more threatening worldwide. This is in part because people are moving into regions at risk and because global infrastructure is becoming more complex and hence more vulnerable to natural hazards. The reduction of losses from natural disasters begins with information, and there is an urgent need to merge science and technology with local communities and with their capacity to respond to disasters. The mass media and the insurance industry have critical roles in building public awareness about vulnerability and in educating people and nations about the true, long-term cost of disasters.

On April 14, 1998, the World Bank, UNESCO, and the World Meteorological Organization co-hosted the fifth forum in the Public Private Partnership 2000 series, in cooperation with the Subcommittee on Natural Disaster Reduction and the Institute for Business and Home Safety. The forum, "A Global Perspective on Reducing Losses from Natural Disasters," provided the perspective of several international organizations on the policy issues of reducing the human and economic costs of natural disasters around the world. Participants from the U.S. and international insurance and financial communities, the U.S. Federal government, academia, and non-governmental organizations attended. The Forum considered three topics: the international perspective on natural disasters; investing in mitigation; and fostering partnerships for disaster prevention. The discussions at the Forum recognized the substantial demand for resources for relief and recovery after disasters in both developed and developing countries. However, as a percentage of GDP, the consequences in the less developed countries are particularly severe; relative losses from natural disasters are as much as 20 times greater in developing countries than in developed countries. Five issues were emphasized during the presentations and subsequent discussions.

Forum Issues

1. Disaster Relief or Prevention and Mitigation? Several speakers emphasized the need to shift from a "culture of relief" to a "culture of prevention" and, rather than focusing on immediate recovery, to emphasize the reduction of catastrophic losses. Emergency response must be supplemented, if not supplanted, by pre-event mitigation, and disaster mitigation must include both structural and non-structural aspects.

Political will is a key requirement for disaster prevention and mitigation. Making the transition from emergency response to long-term sustainability requires appropriate government policies, an adequate insurance framework, and support from development bankers and people in the business of helping nations to develop sustainable economies.

The World Bank's interest in disaster prevention and response is rooted in the Bank's mandate to reduce poverty. Although natural disasters threaten sustainable development everywhere, in developing countries the consequences are particularly severe. The Bank's existing process could be improved by inclusion of risk analysis in country strategies, by just-in-time proactive promotion of natural disaster mitigation, and by requiring a sound plan to address mitigation needs before lending for disaster response.

2. Information Needs and Development Networks. Hydrometeorological events account for 70 percent of natural disasters worldwide. While much of the global infrastructure is in place to provide early warning systems, the frequency and severity

of many hydrometeorological disasters has been increasing. The communication between decision makers and the scientific/technical communities that manage the information systems leaves much to be desired. A significant benefit of the IDNDR has been to raise the visibility of forecast and warning systems. Reducing losses from natural disasters requires contributions from many disciplines, and knowledge of the cultural aspects of communication is essential. The United States is currently exploring the feasibility of establishing a national information network, which is aimed at providing better information to emergency managers. The management structure includes an executive committee chaired by NOAA, an integrated program office hosted by USGS, and a public-private partnership with significant participation from stakeholders - defined as anyone who prepares for or responds to natural disasters, from company presidents and farmers to state emergency managers. The Internet is crucial to this disaster information network, but the increased decentralization that the Internet allows makes it harder to ensure integration, security, and reliability. Some countries have placed restrictions on the distribution of environmental data, and it was proposed that development banks consider making their loans conditional on unrestricted sharing of environmental infrastructure data for the benefit of all.

3. Insurance and reinsurance. In developing countries, few people insure adequately, and the premium volume for catastrophe exposure is negligible compared to the sums insured. There are four major reasons that people do not insure: Ignorance; a belief that "it won't happen to me"; true inability to pay; and lack of availability of insurance. Reinsurance supports insurers by reducing exposure and distributing the risk. Reinsurance reduces a potential imbalance in accounts of insurance companies.

4. Cost-effectiveness and other financial issues for mitigation. Measuring the cost-benefit ratio for various mitigation strategies has been an ongoing concern in the disaster reduction community. Techniques now used in environmental valuation could also be applied to measure the value of mitigation. The direct cost of damage to productive assets is relatively easy to derive, but many other costs are hard to value. Other possible quantitative measures are needed, possibly including land inundated, lives lost, or other physical data. Although NOAA's current ability to forecast climate for the next season or two clearly affects the business and insurance communities, there are still major research issues associated with weather and a need for better scientific understanding to make improved estimates for the future.

International development agencies can encourage mitigation through their loan practices. For example, the Inter-American Development Bank has financed a number of mitigation strategies, including risk assessment and mapping, community-level landslide mitigation works, erosion control in coastal conservation programs, information and training materials, and outreach programs, to break from the traditional pattern of development leading to fragile societies and social structures. The new focus must be on the vulnerability of a society to natural disaster rather than on its total wealth.

5. Public-Private Sector Ventures. Disaster prevention and mitigation require partnerships, and governments in particular need to do a better job of creating opportunities for such partnerships. Because natural disasters do not respect political boundaries, the partnerships to address disaster reduction must cross boundaries too; it is time to rethink old partnerships and to forge new ones, to create innovative partnerships like the Consultative Group on International Agricultural Research and the Global Water Partnership. One important challenge is to build up the technical capabilities of the developing world, a particularly fertile and appropriate area for public-private partnerships.

Forum participants agreed that it is time to shift funding from recovery to prevention and to help developing countries increase their resilience to cope with disasters. As a development institution, the World Bank expressed its commitment to place a significant emphasis on prevention and mitigation in its portfolio. It also agreed to promote awareness about disaster reduction and to actively participate in the planning of activities to follow the completion of the International Decade for Natural Disaster Reduction. In sum, the institution intends to promote activities to help build a safer world in the 21st century.



Disaster Recovery Business Alliances
Public Private Partnership 2000
Report on Sixth Forum
9 June 1998

Community Market Recovery

In the aftermath of a natural disaster, quick and coordinated recovery of basic commercial networks -- utilities, food and water distribution, telecommunications, financial services, transportation and fuels, and broadcast media -- is the key to timely recovery of other businesses, the viability of neighborhoods, and the continuity of government. Public sector emergency authorities, utility service providers, emergency medical teams and other primary responders have well-developed emergency response procedures, and they generally coordinate well with disaster relief organizations. However, the recovery of essential commerce and trade is traditionally left to chance, market forces, or ad hoc liaisons created in the chaotic aftermath of the event.

On June 9, 1998, PPP 2000 sponsored "Disaster Recovery Business Alliances," the sixth Forum in a series dedicated to exploring new approaches to natural disaster mitigation. The Forum, cosponsored by the Electric Power Research Institute and the International Association of Contingency Planners in cooperation with the Subcommittee on Natural Disaster Reduction and the Institute for Business and Home Safety, brought together representatives from federal, state and local governments, the private sector, and non-governmental organizations to discuss increasing the awareness of business recovery concerns in communities throughout the nation -- a challenge involving the entire community. The Forum provided an exchange of ideas on various ways to create disaster mitigation plans for businesses and communities. The presentations stressed the importance of developing networks with local businesses, identifying and implementing technological solutions to prepare for mitigation of and response to disasters, and sharing information to reduce financial losses and provide better services to communities before, during, and after disasters. Business preparedness, mitigation, and recovery programs are needed in every community and must be tailored to the community culture. Involvement must be at the grass roots to make the disaster recovery business plans sustainable, and education is critical to help grass-roots business leaders understand the value-added benefits of preparing for a disaster.

The welfare of the society depends critically on the resilience of its business community to natural disasters. If businesses do not survive a disaster, people are out of work, a community's revenue stream is disrupted, and the recovery process is prolonged. This aspect of community vulnerability to disaster is increasingly recognized, and many communities are examining the feasibility of establishing "business recovery alliances." The objective is to bring together the leadership and expertise of business, emergency preparedness, the engineering and scientific community, and others to develop a public/private partnership approach to reducing the vulnerability of businesses and the community's marketplace to flooding, tornadoes and severe weather, earthquakes and other hazards.

Both the Federal Emergency Management Agency Project Impact's Disaster Resistant Community Initiative and the Institute for Business and Home Safety's Showcase Community Program recognize the key role that businesses play in disaster mitigation and recovery. Another approach, a Disaster Recovery Business Alliance (DRBA), offers a tested model to assist interested local leaders from all sectors of the society in forming and facilitating a lifeline-based planning organization to serve a local community. It was established and funded by the Electric Power Research Institute (EPRI) and co-founded by

the Department of Energy and the International Association of Contingency Planners, a non-profit organization of business professionals who have responsibility for or interest in contingency and business recovery planning.

Several examples of organizational models for business recovery were profiled during the forum, through analysis of projects in Evansville, Ind., Rye, N.Y., Memphis, Tenn. and Deerfield Beach, Fla. These successful programs have many similarities:

- They are community-based and community-driven;
- They involve a strong public/private sector collaboration;
- They are based upon a hazard and risk assessment;
- They recognize the importance of land use planning and building codes as mitigation tools;
- They recognize the role of incentives; and
- They integrate professional training opportunities, public awareness and education for all sectors of the community into the whole process.

Several Forum speakers addressed the issue of the interdependence of the business community and the community at large with respect to natural hazards. The mission of FEMA's Project Impact is "to reduce the loss of life and property and protect our institutions from all hazards by leading and supporting the nation in a comprehensive risk-based emergency management program of mitigation, preparedness, response and recovery." IBHS's Showcase Community program goal is to assist a community to help itself by reducing its vulnerability to hurricanes, earthquakes, tornadoes, wildfires, floods, or whatever natural disasters threaten it. The program works with the community to learn what works and what does not work to reduce the emotional and financial devastation caused by natural disasters.

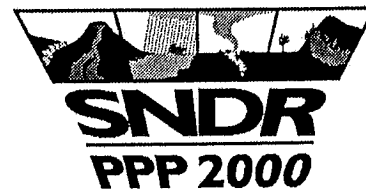
EPRI is eager to catalyze and implement national and regional DRBA alliances of utilities, businesses, contingency planning professionals and community-based organizations to develop sharable regional mitigation and recovery plans. EPRI also is developing public and private disaster mitigation technologies, which are an important part of the DRBA planning process. DRBA has formed partnerships with public and private sector organizations including the American Red Cross, Central United States Earthquake Consortium, National Emergency Management Association, IBHS and many others.

The alliance of business discussed during the forum is a "natural alliance," with shared experience and shared goals of sustainability. It is perhaps the only mechanism likely to bring the entire community together in the ways necessary for mitigation and long-term recovery. Societal change is not easy to engineer. Leaders from the sponsors of this Forum can certainly influence people to pursue challenging goals, but the people must want to get there in the first place for the influence to be effective. Leadership, through the use of champions, is often a process of facilitating the movement of people toward goals that they already hold, like economic recovery, but have not been able to articulate or make concrete and achievable. The participants at the Forum pointed out that the goal of cooperation among community leaders for purposes of economic sustainability should be familiar and welcome to most people. However, many people continue to be unaware of the tremendous value in loss prevention strategies, or believe they lack the means to reach the goal.

Participation in public-private partnerships works to ensure that business organizations will continue to have customers and suppliers when natural disasters impact community life. Though the partnerships are not yet a common feature of the disaster response, recovery and mitigation landscape, events like this Forum will help make them more common. Much work remains before disaster resistance and economic sustainability become public values. Developing a common language and conceptual understanding of mitigation, response and recovery will allow us to begin shaping the strategies for professional and community education and communication that will foster the necessary societal leadership. The Forum participants noted that public and private sector lifeline organizations need to leverage their community leadership positions in support of these goals.

A consensus in the meeting identified a need to initiate team relationships across traditional private-public sector barriers. This includes considering how existing organizations, such as chambers of commerce and professional associations, can serve as natural "mitigation" connections among all sectors of the community.

Above all, it was highlighted during the Forum that we need to take the action step of opening dialogues within each business community toward forming the necessary alliances. There is a lot being learned about what works in places such as Evansville, Indiana, Rye, New York, Memphis, Tennessee and Deerfield Beach, Florida. We need to pay attention and work to transfer that learning to other communities.



Real-Time Monitoring and Warning for Natural Hazards
Public Private Partnership 2000
Report on Seventh Forum
30 June 1998

Overview

The seventh forum in the Public Private Partnership (PPP) 2000 series on natural disaster reduction, entitled "Real-Time Monitoring and Warning for Natural Hazards," was held on June 30th, 1998. The forum was co-sponsored by the American Geological Institute, American Geophysical Union, and Incorporated Research Institutions for Seismology in cooperation with the Subcommittee on Natural Disaster Reduction and the Institute for Business and Home Safety. More than 100 participants from the private sector, non-governmental organizations, academia, and local, State, and Federal government attended the event, held at the American Geophysical Union Building in Washington, D.C.

The purpose of the forum was to address policy issues related to communicating and applying real-time natural hazards data and information. For atmospheric, hydrologic, and geologic hazards, speakers representing both the providers and the users of real-time information addressed the following challenges:

- Effective presentation of scientific information on natural hazards to the public such that they can and, more importantly, will take appropriate action,
- Current state and emerging capabilities of real-time monitoring and warning capabilities,
- Existing ability of users to effectively apply real-time information and warnings,
- Public policy issues related to potential improvements in data and information transmission and applications, and
- Obstacles facing implementation of real-time warning systems, including data transmission, limits on the openness of data exchange, politics, and legal liability.

Technology is radically changing how "real time" is defined for various hazards. In the broadest of terms, "real time" is the timescale in which a specific event can be forecast and a response to that event can be made. It varies from months to seconds depending on the hazard. In the case of seasonal to interannual climate variations, such as the El Niño effect, the National Weather Service now has the ability to make a forecast several months in advance. Such a forecast represents a "real-time" warning in that it provides specific information about how this season's storms will differ from long-term patterns. Accurate seasonal forecasts are important because months of lead time are required for response measures such as clearing out debris from flood control channels, training emergency managers and educating the public. In the case of hurricanes, floods and volcanoes, it is possible to provide several days' warning, allowing for evacuations, property protection, and response preparation. In the case of tornadoes and flash floods, the timescale may be minutes. For earthquakes it is seconds, but even in that narrow window of time it is now possible to implement computerized systems that can shut down gas lines, stop trains, secure hazardous materials, and power down generating stations.

Key Issues

Dissemination is the Critical Link

The forum made clear that it is not enough simply to provide real-time information; one must also ensure that it is understood and used. The data and interpretations made possible by rapid technological advances are only as good as the means of communicating them to policymakers, emergency managers, and the public who can use them.

Providing Information the End-User Will Use

The ultimate success of real-time information depends on whether people at the receiving end take action. The problem is one of psychology as much as technology, because the end-user has to understand and trust the warning in order to act on it. Overly broad warnings can result in a "chicken little" syndrome whereby people will ignore repeated warnings. Overcoming the non-response problem requires the ability to warn only the people directly at risk and in some way to personalize the warning enough that it will elicit a response. A tremendous opportunity exists to work with the designers of intelligent transportation systems, for example to develop the capacity to warn specific cars of flash floods using an on-board global positioning system (GPS). Such capabilities will only be developed, however, through partnerships between the natural hazard community and the private-sector vendors developing such systems.

Future warning systems will need to be more active. Current methods such as television, radio and the World Wide Web are passive, requiring the end-user to tune in to the warning. More active systems (such as pagers, for example) could reach people when they are outdoors and most vulnerable to meteorological and hydrologic hazards, or sleeping and unaware that a warning has been issued. The next generation of systems also should allow people to see the hazard with their own eyes in some fashion. People respond better when they can see a storm coming, making the development of graphical products a priority.

Education Before the Event

The effective use of real-time information requires education before an event is imminent. For children, educational activities should be as participatory as possible, involving them in the collection or use of data. Students in grades 1-6 are believed to be the most receptive. For adults, education should be aimed at improving awareness of natural hazards and increasing responsiveness to real-time warnings. Education also entails training for specific user-groups, for example airline pilots who need to know how to react when they receive a warning of a volcanic ash cloud or severe weather.

Need for Reliable, Consistent Information

Social scientists note that response is enhanced when consistent information is derived from multiple sources. In a crisis situation, it is critical that everybody speak with the same voice. Thus, the many public and private data users need to operate off the same data, particularly images. Developing partnerships ahead of time will help ensure that when a crisis arrives, those groups disseminating warnings and information present a clear and consistent picture. The goal cannot be accomplished through policing by federal agencies.

Reliability is another key attribute for real-time data. Because the data are being provided as they become available, the data may lack some internal quality assurance and review steps normally taken by the data producer. Consequently, it is important that users have a clear understanding of data limitations ahead of time. Since the information is being made directly available, alternative means need to be developed to allow for independent confirmation of the data in some form.

Maintenance of Existing Satellite Capabilities

Concern was raised at the forum that the next generation of GOES satellites will not have the channels necessary for ash cloud detection, which is needed because most active volcanoes are not monitored. Airline safety requires that this capability be maintained, and efforts need to be made to see that it is maintained. Decisions concerning issues such as satellite equipment and portions of the radio spectrum for expanded emergency broadcasts will continue to be made without

consideration of natural hazards applications unless better communication is opened up with those agencies and companies that control these matters.

Importance of Full and Open Access to Data

It is essential to recognize that data are a public good; raw data should be openly available and proprietary value attached only to the interpretation. There has been a historical recognition of the need for full and open data exchange of weather, seismic, and other hazard-related data. Our future ability to develop and improve real-time capabilities demands a strong commitment to full and open access to data.

Liability Considerations

Most of the liability issues discussed at the forum affect only the private sector. Although federal agencies may create some added liabilities as they provide more information directly to end-users without filtering, the law in general grants the federal government broad discretionary judgment exemptions under the principle of sovereign immunity. The fast-growing private weather industry that provides products and services based on NWS data, however, lacks the same immunity and could be liable for harm caused by failure to issue warnings when there was a reliance on them by their clients. Even though the fear of litigation appears to be greater than the actual threat, it nonetheless has the potential to discourage the development of real-time capabilities. The legal experts at the forum agreed that liability issues should not stand in the way of improved warning and monitoring capabilities.

Incorporating Real-Time Rationales Into Funding Decisions

Several of the real-time capabilities discussed at the forum are being funded primarily for their utility in research, and there is a need to incorporate the value of monitoring and eventually warning into the funding rationale. For example, seismic networks have traditionally been operated by universities for research purposes but now serve many more applications. In the case of the U.S. Geological Survey's streamgaging network, individual stations are funded by many different partners for a variety of different purposes, but virtually the entire network provides valuable real-time analysis of flood hazards. Providing real-time monitoring and warning requires a substantial standing infrastructure, and all partners involved in reducing the impacts of natural hazards have a vested interest in maintaining and strengthening this basic structure.

Valuing Long-Term Data Collection

The accuracy of short-term warnings for virtually all natural hazards relies on long-term records of past events and conditions, often on a timescale of decades or centuries. For example, the accuracy of flood warnings depends on forecast models that in turn depend on long-term, continuous records of river discharge, climate variations, changes in hydrological response, irrigation, and pumping. Unfortunately, long-term records may not be critical to some streamgage partners, making continuity highly vulnerable to transitory funding. It is thus very important that agencies have long-term continuity of data collection as part of their central mission.

Need for Long-Term Partnerships

Another challenge discussed at the forum was that partnerships are often viewed from a political standpoint as an expediency measure in a time of shrinking budgets, a matter of political convenience, rather than as something of intrinsic value. Instead, the support for partnerships must be for the long haul, allowing relationships to develop.

Sound Policies Require Strong Partnerships

Just because a technology exists does not mean it can be implemented. Many other policy considerations factor into the decision. For example, if technology makes it possible to cut off power ahead of an earthquake to avoid faulting and burn-down, who becomes responsible for ensuring that hospitals are not cut off? What is an acceptable level of risk? How broadly should real-time data be disseminated? Who pays for these systems? Answering these questions requires inputs from the private sector, all levels of government, the scientific and technical community, and the public. Without standing

partnerships and well-developed lines of communication, it is not possible to bring these diverse elements together and come up with socially acceptable solutions.

Translating Research Into Results

Only through a dialogue such as that set up by these forums can scientists understand user community needs and how best to meet those needs. In the process, new avenues for fundamental and applied research can be identified that will achieve the greater goal of translating research results into public policy that saves lives and reduces losses. Bridging the gap between research and implementation is a shared goal and is only possible through improved communication and partnerships.

Public-Private Partnership Opportunities

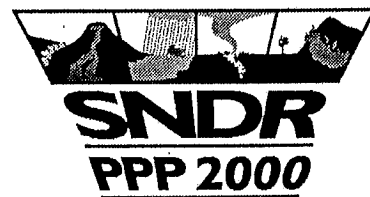
The overall goal of PPP 2000 is to seek new and innovative opportunities for government, private sector organizations and individuals to work together to reduce vulnerability to and losses from natural hazards in communities throughout the Nation. In keeping with that goal, this forum identified a number of existing and potential partnerships.

Data Dissemination Partnerships -- Perhaps the most critical public-private partnership is in communications and dissemination, because regardless of where hazard information is created, increasingly the private sector creates the products that deliver the message. Future partners include agencies and companies designing intelligent transportation systems, satellite platforms, radio spectrum distribution, and systems specifically to provide targeted hazard warnings.

Partnerships with the News Media -- Scientists need to develop closer relationships with the news media before a crisis happens so they can provide more useful information during a crisis--because the media deliver the message. Simultaneously, the media need to understand the limitations and constraints of real-time scientific data, so that they can communicate the information as accurately as possible.

Congressional Natural Hazards Caucus -- A partnership opportunity exists between the private sector and Congress to develop a natural hazards caucus focused on long-term strategies for hazard mitigation. Hazards are broadly distributed in space, affecting all fifty states, but not in time. Public interest tends to be volatile, peaking just after major natural disasters and then dissipating rapidly. A bipartisan forum of interested senators and representatives could provide the needed continuity of message, direction and enthusiasm.

Outreach to the Private Sector -- Data producers at federal and state agencies need to take part in informational sessions with the private sector, getting the message of how real-time data can be useful to the business community and providing needed backup for emergency managers within the companies. In general, large companies with full-time staff are more aware of what is available to them than smaller companies, suggesting that one avenue of forging such partnerships is through an organization such as the U.S. Chamber of Commerce. Better awareness by employers can save lives and help to prepare infrastructure to handle natural hazards, for example reducing gridlock on highways. Outreach efforts to utilities, local government, and business entities are critical to building the relationships and trust that are the foundation of successful partnerships.



**Reducing Losses from Floods
Public Private Partnership 2000
Report on Eighth Forum
5 October 1998**

Despite the billions of dollars that have been spent for structural flood control during this century, the real cost of floods has continued to rise, as has the number of major flood disasters. Currently 85% of Presidentially declared disasters in the United States are related to floods. Floods are also the deadliest natural disasters, killing 140 Americans each year.

Strategies for dealing with floods have changed significantly in the past 100 years. Prior to the 20th Century, flooding was largely the responsibility of the property owner, with charitable organizations or the community offering some help. In the first part of this century the Federal government led the charge to build a flood-resistant society, using structural approaches such as dams, levees, and channels to modify nature's flood hazard areas. Although these approaches often proved costly, ineffective and environmentally unsound, they received strong political support because they put people to work at a time of high national unemployment. Gilbert White's pioneering work in the 1940's showed that, instead of shaping nature to accommodate man, one could also adjust human behavior to accommodate nature. This approach promises to reduce the exposure to flood risk while creating a sustainable society.

However, moving from theory to practice presents many challenges. The 1973 National Flood Insurance Program (NFIP) attempted to shift more of the cost of flooding to those who build in flood-prone areas. In exchange for federally backed flood insurance, local and state governments agreed to regulate development in floodplains in order to reduce the future vulnerability of the built environment. Although NFIP has had enormous impact on land use and development in flood-prone areas, it is not clear whether it has achieved its objectives.

On October 5, 1998, PPP 2000 sponsored its Eighth Forum on natural disaster reduction, "Reducing Losses From Flooding," which was co-sponsored by the Association of State Floodplain Managers (ASFPM). The Forum focused on current national policy for reducing flood losses in the nation, exploring what is and is not working, policy impediments to effective reduction and changes that might improve current approaches.

Aggressive federal policies related to flood hazards have created popular misperceptions about the role and responsibilities of the Federal government. Property owners, communities and states often feel floods and disasters are exclusively a federal problem. This misunderstanding about who will pay for flood damage has the effect of reducing the number of property owners and communities who participate in the National Flood Insurance Program and follow its innovative flood loss reduction policies, including pre-disaster mitigation and non-structural approaches.

The Forum noted a number of positive results of the NFIP. Nearly 20,000 flood-prone communities have flood hazard maps, and have agreed, through zoning and land-use planning, to regulate development in flood plains. NFIP has sold over 4 million flood insurance policies, which generate over \$1.5 billion in yearly premiums to help offset disaster costs and NFIP operating costs. Many communities have passed local ordinances requiring elevation of new structures above the 1% flood elevation. And this process has increased public awareness of flooding issues.

Nonetheless, concerns remain about the NFIP. Approximately 2 out of 3 flood-prone structures are still not insured against floods. People continue to underestimate their vulnerability to floods and assume the 100-year flood will never happen--at

least not again in their lifetimes. Although NFIP is no longer subsidized by taxpayers, there are substantial cross-subsidies among classes of policy holders. Finally, despite its huge impact on our society, no process has ever been established to evaluate the costs and benefits of NFIP.

Policy questions reviewed by the group during the discussion included the following:

- What is the appropriate role of government and the private sector in helping individuals and communities recover from floods, and who (federal, state, local, private) should have primary responsibility?
- What types of and what degree of mitigation should individuals, communities and states be required or encouraged to undertake to reduce flood losses? What incentives can be used to facilitate mitigation?
- What is a fair and appropriate balance of flood recovery costs between individuals and society, and between different levels of government?
- What can be done by the state and federal governments to encourage locally based comprehensive planning? Effective flood loss reduction can only occur in the context of the community's other problems and concerns. Durable solutions require partnerships between the private and public sectors, as well as assistance and incentives from state and federal governments.

The group identified a number of counterproductive policies, including

- All states and communities receive the same disaster cost-share, no matter how good a job they do of preventing flood disasters. This lack of incentives explains why few states or communities choose to strengthen their mitigation programs. A number of states are backing off what were once strong flood reduction standards and programs, retreating to the minimum federal standards.
- Communities not participating in the NFIP are still eligible to receive public assistance for replacing their infrastructure (roads, bridges, utilities, etc.), thereby encouraging development in flood-prone areas. Individuals, on the other hand, can get neither flood insurance nor disaster assistance unless their communities participate in the NFIP.
- Current national flood policy does not encourage or direct people to avoid flood-prone areas but instead tells them how to build in flood hazard areas. This sends the wrong message, suggesting that construction in the flood plain, if built according to code, is not at risk from floods.
- Past federal policy for estimating the costs and benefits of alternative approaches to flood control ignored the costs to natural systems, instead focusing only on the built environment.
- The "100-year flood" terminology, though clear to the technical community, is misunderstood by most citizens and decision-makers. A better vocabulary for communicating flood risk to the public is needed.
- Past policy has considered only how to reduce flood losses, not how citizens and communities can deal with floods in the context of sustainable communities, and can benefit from the natural functions of river systems rather than alter them. Local mitigation actions should address the five basic principles of sustainability: (1) environmental quality, (2) quality of life, (3) disaster resiliency, (4) economic vitality, and (5) inter- and intra-generational equity.
- Governments have failed to maintain adequate funding for collecting and interpreting basic flood data. Good long-term streamgage data are needed by communities to develop effective mitigation programs and by federal and state governments to develop rational and effective programs and policies. Real-time streamgage data are needed for flood forecasting and for emergency response and management. Flood loss data and up-to-date, accurate, readable flood maps are needed by property owners, zoning boards and developers.

Proposed Actions:

Develop an effective strategy for communicating flood risk.

Such a strategy would include the definition of flood hazard areas, so property owners and communities can take actions to reduce that risk. Citizens, businesses, and local and state legislators need to understand that most floods do not become Presidentially declared disasters, and hence the federal government does NOT bail them out in a flood; the risk is theirs.

Establish appropriate incentives for prevention and mitigation.

The lack of broad incentives for more effective local or state standards encourages state legislatures to adopt minimum standards. Appropriate incentives will help state and local governments to assume their responsibility to prevent the disaster. Local and state preventive actions will reduce federal disaster costs, offsetting the cost of federal incentives.

Define the roles of federal, state, and local government.

The federal government must provide leadership, using appropriate incentives and consequences to encourage individuals, communities, states and the private sector to assume their flood loss reduction roles and responsibilities. However, Federal agencies must see their role as facilitators to develop state and local capabilities, **not** as 'doing' the planning and implementation of projects. The federal government is also specifically responsible for collecting hydrologic data, issuing flood forecasts, producing flood insurance rate maps and operating the NFIP.

States should develop a broader approach independent of NFIP to help their communities incorporate floodplain management into other community processes. A key state role is to assist and monitor communities in implementing and enforcing mitigation, a task that can be effectively accomplished by State Hazard Mitigation Councils made up of essential state agencies and reporting to the governors.

Local governments must assume the primary responsibility for hazard mitigation efforts, using comprehensive plans that consider the entire watershed and address a range of community issues and concerns. With the appropriate tools and incentives, with ample involvement of their citizens, local businesses and non-governmental organizations--and without inappropriate interference from federal and state regulations--local governments will be able to achieve the goal: sustainable communities resilient to natural disaster.



**Protecting Our Critical Infrastructure
Public Private Partnership 2000
Report on Ninth Forum
17 November 1998**

Our society has transformed itself during the past century from agricultural and rural, through industrial and urban, and now to information-based and global. This transition has greatly increased our national income, but it has simultaneously made us dependent on shared lifeline systems -- water supplies, gas pipelines, transportation and communication links -- which are vulnerable to natural disasters and to willful human acts. Most recently the emerging critical role of computer communications, and specifically supervisory control and data acquisition (SCADA) systems, have created additional poorly understood vulnerabilities. Our society and economy -- from local businesses to global corporations -- increasingly depend on infrastructures, and keeping those infrastructures functioning requires collaboration and collective solutions.

Since 1996 the President has issued two decision directives (PDD62 and PDD63) in response to concerns about the safety of our infrastructure. In 1997 the President's Commission on Critical Infrastructure Protection issued a report, "Critical Foundations: Protecting America's Infrastructure," which states: "Our national defense, economic prosperity, and quality of life have long depended on the essential services that underpin our society. These critical infrastructures -- energy, banking and finance, transportation, vital human services, and telecommunications -- must be viewed in a new context in the Information Age. The rapid proliferation and integration of telecommunications and computer systems have connected infrastructures to one another in a complex network of interdependence. This inter-linkage has created a new dimension of vulnerability, which, when combined with an emerging constellation of threats, poses unprecedented national risk."

On November 17, 1998, PPP 2000, a partnership between the Institute for Business and Home Safety and the Subcommittee on Natural Disaster Reduction, jointly sponsored its Ninth Forum on natural disaster reduction, "Protecting Our Critical Infrastructure." The Forum was co-sponsored by the Center for Risk Management of Engineering Systems at the University of Virginia and the American Society of Civil Engineers. The Forum focused on current national policy for reducing our Nation's vulnerabilities related to critical infrastructure but emphasized two perspectives that had not been addressed at previous Forums: Our vulnerability to willful hazards (human acts of terrorism), including cyber threats, as well as to natural hazards. The discussion addressed what we know about these issues - surprisingly little - and how best to manage critical infrastructure in light of the extraordinary uncertainties that we face. It became apparent that significant changes in national policies may be needed, but it is not clear exactly what they are.

Panelists noted that strategies designed to deal with natural hazards often help reduce vulnerability to technological hazards, and that the reverse is also true. However, in many ways the two hazards are distinct. Natural disasters have always been with us; cyber terrorism and dependence on computer technology are new. Moreover, our knowledge of natural hazards has benefited greatly from events across the globe; our knowledge of cyber threats will come mostly from first-hand experience. Our attempts to address Y2K problems have shown that our society and economy are surprisingly vulnerable to fragile software and that software is remarkably hard to repair.

Our society has had little time to learn to live with and to rely on technology, and we have yet to develop appropriate legal and institutional frameworks to deal with cyber threats. Our legal systems, for example, are geographically based, but -- as we have learned from efforts to apply existing laws to the World Wide Web -- cyberspace does not respect geography.

Similarly, accounting practices, which precisely quantify traditional business vulnerabilities, are only now beginning to consider vulnerability to fragile software, a surprising result given that Y2K conversions are expected to cost billions of dollars. It is also unclear how responsibility for dealing with cyber vulnerabilities should be divided among private companies, different levels of government, and individuals.

Terrorism presents different issues. Since the Gulf War, military planners in the United States and in nations across the globe have recognized that the United States and its Western allies are likely to have substantial superiority in a battle with conventional weapons. This has raised concern about emerging threats, and specifically terrorist threats to infrastructure. For example, a dam upstream from a population center could become a weapon of mass destruction; do we know how to protect such critical facilities?

Willful attacks present political and social issues that do not arise with natural hazards. Whether a physical infrastructure is disabled due to a natural cause, a disgruntled employee, or a terrorist act, the physical consequences may be similar. However, the impacts -- especially the psychological and political impacts -- are likely to be significantly different.

Willful hazards also present a conflict between the open discussion that democracies require and the need for secrecy as a means of security. Public awareness - understanding our vulnerabilities so that we can act on them - may be the single most important factor in reducing our vulnerability to natural hazards. Paradoxically, the reverse may be true with respect to willful acts. Thus, one finds that public safety may require secrecy, which in itself can become political.

Nonetheless, Forum panelists emphasized the need to educate the public about this emerging era of vulnerability to our critical infrastructure not only from natural hazards but also and especially from willful attacks. Enhancing the survivability and safety of our critical physical infrastructures should be viewed as a long-term process. This entails researching and developing new designs and extending broad educational efforts.

The current severe nationwide shortage of computer engineers can not be ignored when addressing the need to protect both our physical infrastructures and particularly our cyber and information infrastructures. An extensive body of literature documents system failures resulting from the occurrences of natural hazards, e.g., excessive precipitation, earthquakes, and hurricane force winds. In contrast, only a few terrorist threats have been directed against infrastructure systems, and those threats have not been widely publicized.

Forum participants emphasized that much remains to be learned, and that we are likely to struggle with these issues for years to come. Despite the urgency of eliminating the risks, it is not yet clear what actions and policies are needed, by whom, to reduce our vulnerability to cyber threats and willful acts. However, it seems likely that means to lessen the risks that natural hazards pose may, to varying degrees, harden the systems against willful hazards initiated by terrorists. Thus, considering natural hazards is appropriate to characterizing the need for and the alternative means to hardening such systems (i.e., making them less susceptible to becoming dysfunctional).

Our society's overall vulnerability to lifeline and cyber threats is unlikely to decline in coming decades. Threats will evolve; some will be reduced and new ones may emerge. At the same time, powerful economic forces are driving our society toward greater reliance on fragile technologies, toward economic deregulation with less societal control over lifeline resources, and toward more global interdependence. Assuming we continue on these paths, it is likely that our vulnerability to cyber and willful threats will increase faster than new policies and actions can address them.



Motivating People to Do Something About Natural Hazards
Public Private Partnership 2000
Report on Tenth Forum
15 December 1998

Over the past few decades, the science of forecasting natural hazard events such as hurricanes, floods, and volcanic eruptions has advanced significantly, as has the technology of disseminating warning information quickly. However, people at risk often fail to understand or act on the information in appropriate ways, suggesting that our ability to present the information has not kept pace with the technological advances.

Our approach to awareness and education about natural hazards reduction has in general been too simple. Therefore, we must approach the basic problem in a broader frame: disasters are one of many problems that undermine community sustainability when local communities are built in ways that do not interact appropriately with the land.

On December 15, 1998, PPP 2000 sponsored "Motivating People to Do Something About Natural Hazards," the tenth forum in a series dedicated to exploring new approaches to natural disaster mitigation. The American Red Cross and the Institute for Business and Home Safety, in cooperation with the Subcommittee on Natural Disaster Reduction, jointly sponsored this forum that focused on communicating the mitigation message to the public. The forum was held in Washington, D.C., at the American Geophysical Union, which was also a co-sponsor of the event.

Forum presenters examined the effectiveness of existing grassroots mitigation initiatives with particular attention to how and what information needs to be communicated to motivate the public to protect themselves and their property from natural hazards. Many panelists discussed the importance of measuring the effects of mitigation, marketing mitigation success stories, and building partnerships as key elements to effectively reduce the human and economic costs of natural disasters.

The starting point for grassroots mitigation requires an examination of both individual and societal behavior. Natural disaster reduction must become a public value. As a rule, the American public is unaware of its vulnerability to disaster and has not accepted that individuals, rather than the government or charitable organizations, are primarily responsible for ensuring their safety from natural hazards.

Americans are attracted to areas where disasters occur. More than 40 million people live in high-risk areas. Yet people have a low sense of personal risk from disaster, and their perception of risk does not correlate to what they do about their risk. Although scientists think in terms of statistics and probabilities and in the past have presented hazards information in this way, the public generally does not know how to connect probabilities with appropriate action. Scientists must learn how to translate research about hazards and risks into information that influences public action.

Communicating about hazards and risks is a dynamic, multi-faceted process, and effective public education is not simple. In the past twenty years, our ability to communicate with the public about disasters has improved significantly. We have based communication and public education on several assumptions:

- information should come from a number of different credible sources;
- the content should focus on risk;
- warnings should include specific information about who faces the risk;

- repetition is needed;
- communication is not a singular act but a process that can take months or years; and
- the public has a need to validate the information it hears.

However, we have not adequately validated these assumptions or assessed the effectiveness of public information campaigns to know whether or not our communication is eliciting the desired actions or behaviors.

It was proposed that the role of public education is to create uncertainty in people about the stability of their environment in order to get people to educate themselves, convince themselves that change is needed, and, ultimately, act to reduce their vulnerability. Awareness and education campaigns must recognize that people differ in their knowledge about the hazards they face, in their preferred way of receiving information, and in their ability to mitigate hazards. The public is not homogeneous, so education must be customized. The more local and targeted the approach, the more successful it is likely to be. Children make excellent messengers and have amazing ability to influence the adults in their lives. Additionally, the best time to influence a person's behavior is when they are young.

Our current approach to building awareness is hazard specific and is based on a linear model: that the public will understand hazards information if it is clearly presented and will act rationally to reduce its risk. In fact, we now realize that both businesses and individuals have little awareness of what can be done to protect homes and businesses. Future public education messages must be presented in many ways, from many sources, and in many languages. The news media (print, television, radio) are an essential partner in the quest to motivate the public to take more responsibility to protect themselves and their property from natural hazards.

Diverse partnerships and coalitions among both grassroots and national groups are crucial to effective mitigation, yet no formal strategy currently exists to help develop these partnerships. Information and opportunities to influence grassroots mitigation exist but are not always shared; for example, design professionals and regulators must find ways to share technical information with insurers and lending institutions.

Mitigation actions too often have tended to shift the burden of risk onto the poor and other vulnerable populations. Future mitigation strategies need to enhance intra- and intergenerational equity as well as support long-term economic sustainability.

Recommendations:

- Examine how public values about wearing seatbelts, historic preservation, and recycling have been changed, and use those tactics to change public values about disaster vulnerability.
- Establish a natural hazards coalition that will foster partnerships and information sharing among the diverse groups involved in mitigation.
- Expand incentives for grassroots mitigation action, and eliminate government disincentives to mitigation; for example, the current tax code does not allow deduction for retrofit, yet it does allow deductions for catastrophic losses.
- Publicize mitigation success stories to motivate similar actions.
- Target the message to the audience and engage all forms of the media to creatively expand education to the public about reducing vulnerability to natural hazards; for example, involve weathercasters in disseminating mitigation information.
- Maximize the effectiveness of public awareness and education efforts by urging collaborations among stakeholders.



Natural Disaster Reduction: Challenges for the Next Century
Public Private Partnership 2000
Report on Eleventh Forum
27 January 1999

Twenty five thousand Americans died and more than a hundred thousand were injured in natural disasters during the two decades following 1975, the year in which the First Assessment of the Nation's vulnerability to natural hazards was completed. The recently-published Second Assessment seeks to answer why society continues to suffer human and economic losses from natural hazards despite extensive efforts to curtail them during the past quarter century.

The Second Assessment suggests that past approaches, by focusing on the technical aspects of natural disasters, failed to recognize the more important human components. We have now learned that technological solutions alone are inadequate and in general simply redistribute the burden of future disasters. The Second Assessment, in contrast, advocates a shift to a policy of "sustainable hazard mitigation." This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

On January 27, 1999, PPP 2000 sponsored its Eleventh Forum on natural disaster reduction. Forum 11 was co-sponsored by the Natural Hazards Research and Applications Information Center at the University of Colorado and the World Bank. The purpose of the forum was to unveil and discuss the findings of the Second Assessment, a five year research project, involving more than one hundred experts, to assess the state of knowledge on natural hazards and propose policies to reduce future losses.

Disaster losses result from the intersection of the natural system with constructed and human systems, which are becoming increasingly complex. The Second Assessment emphasizes the importance of fostering local sustainability as the foundation for reducing losses from natural disasters. Sustainability encompasses broad human objectives such as enhanced environmental quality, quality of life, local resiliency and responsibility, vibrant local economies, inter- and intra-generational equity, and local consensus building.

The following tools are considered critical to successful sustainable hazard mitigation:

- Land use planning,
- Warning systems,
- Engineering and building codes,
- Insurance, and
- New technology, such as geographic information systems (GIS) and remote sensing.

However, these tools by themselves are not enough. The shift to sustainable hazard mitigation requires that they be used in the context of seven essential actions:

- Build local networks, capability, and consensus;
- Establish a holistic government framework;

- Conduct local hazard and risk assessments across the Nation;
- Build national databases;
- Provide comprehensive education and training;
- Measure progress toward achieving a society resilient to natural disasters, and
- Share knowledge internationally.

These components of sustainable hazard mitigation form the basis for the Second Assessment's major recommendations.

The disaster community's challenge is to realize the goals of the Second Assessment. Forum speakers and participants discussed how the necessary "shift in culture" could occur and how the disaster community could work toward achieving some of these goals. Specifically, Forum participants discussed the establishment of a national database of disaster losses in the United States. Currently, the Nation has no systematic accounting of natural disaster losses. As a result, ad hoc estimates and differing methodologies are used by a variety of government and private entities to collect data, thereby making it difficult to establish the current cost to the Nation of natural disasters, much less assess the benefits of mitigation. Panel discussions helped clarify the types of information that should be collected, including:

- Type of disaster,
- Types of losses,
- Disaster location (preferably in longitude/latitude), and
- Specific characteristics and causes of the disaster.

Developing this new data repository will require standards for geocoding, documentation, and on-line access. This effort must be coordinated with all stakeholders including government, professional societies, academia and the international community.

Forum participants recognized land-use planning as a critical tool for sustainable hazard mitigation. Effective land use planning can limit development in hazardous areas and has a proven record of success in reducing losses. For example, communities that enforce good land use plans have fewer damaged buildings in disasters. Unfortunately, most local governments do not have effective land use plans for hazard mitigation. One suggestion was that the federal government should offer substantial flood insurance rate incentives in exchange for land use planning. Forum participants also noted that the federal government is working towards integrating sustainability and mitigation, as can be seen in the Federal Emergency Management Agency's (FEMA) Project Impact program. Project Impact is also a good example of how private-public partnerships can succeed at the local level.

Many of the policies advocated by the Second Assessment will be difficult to implement given existing political institutions. However, Congressional staffers at the Forum stated that they were interested in talking with members of the hazard community. In addition, the President's Assistant for Science and Technology expressed the Administration's concern over disaster losses and its commitment to sustainable mitigation. He noted the importance of the hazard community's work on this issue and underscored the need for a new paradigm. He endorsed the Second Assessment's recommendations and said that they are at the core of the Administration's goals. He mentioned the need for more resilient communities, better disaster warnings, public-private partnerships, and working on the goals of the Assessment at local levels.

While the Second Assessment addresses hazard issues in the United States, the Forum expanded the discussion to include hazard issues worldwide and particularly in developing countries. Two major ideas emerged: Effective, sustainable development needs to include mitigation; and natural disasters are a symptom of failed development policies.

The World Bank, with its new Disaster Management Facility, is committed to reducing vulnerability by promoting sustainable projects that incorporate effective prevention and mitigation measures. The World Bank is now promoting the

inclusion of risk analysis and disaster prevention mechanisms in its own operations and in its country assistance strategies. The Bank has also established the Market Incentives for Mitigation Investment (MIMI), which allows governments to shift funding from current emergency relief and reconstruction to longer-term projects for sustainable disaster mitigation. Agreeing with the recommendations of the Second Assessment, the World Bank voiced commitment to changing the paradigm and putting more resources toward sustainable hazard mitigation. This creates new opportunities for the U.S. hazard community, the World Bank, and other organizations to establish partnerships to reduce disaster losses worldwide.

Changing our way of thinking about natural hazards and disasters is clearly a challenge. Many Forum participants wondered whether organizations that were set up to respond to disasters will succeed in promoting sustainable mitigation practices. Disaster managers need to become "players in the sustainable development game." Forum participants also recommended that a White House conference be held on the topic of sustainable hazard mitigation, and that disasters and hazards be recognized as critical components of economic and environmental sustainability. Everybody will benefit when sustainability experts consider natural disaster mitigation in their plans, and when the hazards community begins to incorporate all six essential objectives of sustainable hazard mitigation: environmental quality, quality of life, local resiliency, economic vitality, inter- and intra-generational equity, and stakeholder participation and consensus.

The Second Assessment Project was headed by Professor Dennis Mileti at the University of Colorado at Boulder and funded by the National Science Foundation, Federal Emergency Management Agency, U.S. Environmental Protection Agency, U.S. Geological Survey, and U.S. Forest Service. The complete report will be published by the Joseph Henry Press under the title: *Disasters by Design: A Reassessment of Natural Hazards in the United States*.

