NATURAL RESOURCES MANAGEMENT AND PROTECTION TASK FORCE REPORT

PRESIDENT'S COUNCIL
ON SUSTAINABLE DEVELOPMENT

The views expressed in this report are those of the Task Force members and were not the subject of endorsement by the full Council. Many of the federal officials who serve on the Council also serve on the Council's Task Forces and participated actively in developing the Task Force's recommendations, but those recommendations do not necessarily reflect Administration policy.

To obtain copies of this Report, please contact:
President's Council on Sustainable Development
730 Jackson Place, NW
Washington, D.C. 20503
1-800-363-3732
(202) 408-5296
Website: http://www.whitehouse.gov/PCSD

TASK FORCE MEMBERSHIP

CO-CHAIRS

Richard Barth, Chairman, President, and CEO, Ciba-Geigy Corporation
James R. Lyons, Undersecretary for Natural Resources and the Environment, U.S. Department of Agriculture
Theodore Strong, Executive Director, Columbia River Inter-Tribal Fish Commission

MEMBERS

Bruce Babbitt, Secretary, U.S. Department of the Interior
James Baker, Undersecretary for Oceans and Atmosphere,
National Oceanic and Atmospheric Administration, U.S. Department of Commerce
Carol Browner, Administrator, U.S. Environmental Protection Agency
A.D. Correll, Chairman and CEO, Georgia-Pacific Corporation
Fred D. Krupp, Executive Director, Environmental Defense Fund
Michele Perrault, International Vice President, Sierra Club
John C. Sawhill, President and CEO, The Nature Conservancy

TABLE OF CONTENTS

PREFACE

This Task Force report is one of seven prepared for the President's Council on Sustainable Development. The Council was established by President Clinton through Executive Order No. 12852 on June 29, 1993, to:

- Make recommendations to the President to advance sustainable development, including a national sustainable development action strategy.
- Expand public awareness of the challenges inherent in moving toward sustainability, including the need to manage the nation's natural resources carefully.
- Institute a Presidential Honors Program recognizing exemplary efforts that advance sustainable development.

Members of the Council are leaders in industry; the federal government; and environmental, labor, and civil rights organizations.

Shared responsibility for success was a hallmark of the eight task forces organized by the Council. Their purpose was to provide advice to the Council in major issue areas, spur dialogue, and involve the public. The work of the task forces culminated in policy recommendations for consideration by the full Council. Individual Council members served on the various task forces, together with a network of several hundred professionals from throughout the country.

The eight task forces were: Eco-Efficiency; Energy and Transportation; Natural Resources Management and Protection; Population and Consumption; Principles, Goals, and Definition; Public Linkage, Dialogue, and Education; Sustainable Agriculture; and Sustainable Communities. Each developed a workplan responding to the challenges posed by the respective sets of issues and developed recommendations through workshops, demonstration projects, case studies, regional roundtables, public comment, and other methods.

The task force reports serve as a record of each task force's deliberations and contributions to the Council's deliberations. This report is intended to illustrate the lessons learned and advice prepared for the Council's consideration by the Natural Resources Task Force; it is also intended to stay true to the voices of the various participants in the task force process. The data and descriptions in this report reflect the circumstances that prevailed at the time when the document was written. Because there was a considerable time lag between the writing of this report and its publication, some of the information and statistics contained herein are somewhat dated, and, in some cases, the facts reported have been overtaken by subsequent events.

EXECUTIVE SUMMARY

Chartered by the President's Council on Sustainable Development (PCSD) in 1994, the Natural Resources Task Force was charged with developing a vision of sustainable management of renewable natural resources in the United States and with making policy recommendations that will help the nation realize that vision. To fulfill its task, the Task Force regional teams convened 16 workshops across the country, all focused on grassroots successes, experiences, and perspectives on sustainable use of natural resources.

Based on these workshops, Task Force discussions, findings from reports prepared for the Task Force by the National Academy of Sciences's Water Science and Technology Board and by the University of Maryland's Center for Environmental and Estuarine Studies, and the Bruntland Commission definition of sustainable development ("development that meets the needs of the present without compromising the ability of future generations to meet their own needs"), the Task Force identified six major themes regarding sustainable natural resource management:

- Despite progress, unsustainable natural resource management policies and practices persist.
- To ensure sustainability, economic and social values need to be balanced against the protection of natural resources.
- By bringing stakeholders together to seek and act on their common interests, community conflicts regarding natural resource management can be resolved.
- The burdens placed on natural resources by rapid population growth mean that human life style choices are an important input to effective natural resource management.
- Natural resource management by social and legal systems organized by national, state, county, and municipal boundaries unknowingly promotes community conflict through the creation of a regulatory morass.
- Natural systems-based approaches provide a useful framework for natural resource management and conflict resolution.

These themes comprise the principles upon which the Task Force formulated its vision of sustainable natural resource management and the policies it recommends for realizing this vision. The Task Force sees the goal of sustainable development as preserving and enhancing the natural systems upon which humans depend for their economic and social well-being. Meeting this goal means ensuring that human pressures do not exceed each system's limited capacity to sustain itself. The policies recommended by the Task Force

are directed toward better management of specific resources (air, water, soil, forests, fisheries, and biodiversity, among others) and the utilization of more effective management tools and techniques. Specifically, these policy recommendations are:

1. **Soil, Air, and Water Quality.** Revitalize the country's collective efforts to secure healthy, high-quality air and water resources and productive soil—not only for ourselves, but also for our children and their children.

2. **Natural Resource Inventory and Assessment.** Integrate existing federal, tribal, and state natural resource inventories and assessments through the development and use of compatible standards, methods, and protocols.

3. **Accounting for Natural Resources.** Link natural resource conditions and trends to national income accounts and to economic assessments and analyses. Develop a set of indicators based on the above linkages that assess the flows, conditions, and trends of natural resource stocks.

4. **Sustainable Forests.** Convene a National Forestry Advisory Council comprised of a representative balance of stakeholders to define and help achieve sustainable management of forests on a national basis by the year 2000.

5. **Restore American Fisheries.** Eliminate over-fishing and rebuild depleted stocks in U.S. waters; adopt the precautionary principle in decisionmaking—in the face of scientific uncertainty, err on the side of resource conservation.

6. **Incentives for Conservation of Natural Resources.** Create and promote incentives at all levels of government that will support the self-interest of corporations, property owners, and resource users to embrace conservation of natural resources and enlist their knowledge and skills to work on its behalf.

7. **Integrated Land Use Planning.** Encourage local governments to engage their citizens in forging and implementing a vision that conserves natural resources for their communities.

8. **Integrate Sustainable Design Principles Into Land Development.** Initiate a major collaborative public-private effort to integrate sustainable design principles into all aspects of land development to secure environmental benefits and mitigate impacts for people and their communities.

9. **Partnerships for Conservation.** Create conservation areas through public-private partnerships at the local level.

10. **Improve Natural Resource Decisionmaking.** Deploy the resources of government to improve natural resource decisionmaking, ensuring that it is well-coordinated; based on high-quality information; and

integrated with respect to social, economic, and environmental aspects.

11. **Finding Consensus Between Stakeholders and the Federal Government.** Empower the federal government to play a more active role in building consensus on difficult issues.

12. **Community-Based Multi-Stakeholder Collaborative Watershed Approaches.** Employ voluntary community-based multi-stakeholder collaborative approaches to protect, restore, and monitor watersheds and to resolve natural resource conflicts.

In performing its work, the Task Force used the organizing framework of watersheds. Watersheds provide an excellent frame of reference for gauging the impact of human pressure because:

- They provide natural boundaries for all the social and economic activities that take place within them.
- They offer a broad spatial and temporal perspective for assessing the impact of human activities on natural systems.
- For humans, they are the confluence of cultural, aesthetic, spiritual, and economic values.

For these reasons, the Task Force felt that by understanding how sustainability concepts apply to watersheds, it would discover a powerful model for moving the nation toward a more sustainable future.

Natural resource management on the scale of watersheds will create new challenges and opportunities. One challenge is improving processes for resolving conflicts over various uses of natural resources. Another is overcoming long-standing institutional barriers to coherent management of these resources. Different components of individual watersheds are usually administered by various agencies and usually transcend state boundaries, making the politics and consensus building required for decisionmaking as complicated as the management of the ecosystems themselves.

Careful management of natural resources is a critical component of sustainable development. Such management must recognize the limited capacity of natural systems and the present generation's obligation to maintain these systems for future generations. It should be based on precise and periodic assessments of the condition of natural resources. It should respect the values of all stakeholders. Finally, it should equitably balance competing uses of these resources through processes that encourage public participation, cooperation, and collaboration.

INTRODUCTION

As a nation, as individual communities, we are blessed with an abundance of natural resources that provide the basis for life. Actions that impair the ability of natural systems to purify water and air, maintain and build soils, provide nurturing habitats for aquatic and terrestrial species, and maintain the diversity of life attack the very foundation of support for the human community over time.

For a community to sustain itself, it must have the requisites of life, including clean air and water, productive soils, and a sustainable economic base. Thus, a healthy economy and a healthy community are fundamentally and irrevocably dependent on the health of the natural environment. To ensure sustainability, policies that ensure a healthy economy and healthy communities must be balanced against policies that ensure the protection of natural resource systems.

Geophysical features in watersheds such as lakes, rivers, mountains, or forests often are a source of pride and the central focus for people, their communities, and their activities including employment, recreation, and spiritual renewal. As cradles of civilization, watersheds have played a pivotal role in the development of human species—the great cultures of the world today revolve around many unique, complicated, and beautiful watersheds. And, throughout human history, people have sought to fulfill their basic physical needs by residing near water sources. Watersheds are living records of the cultural, aesthetic, and spiritual values that people have invested in them over the course of human history. They are an important link with the past and potentially bountiful legacy to the future.

In performing its work, the Task Force looked to and relied on the organizing concept of the watershed in analyzing its research and developing its recommendations.

GOALS AND ASPIRATIONS

In the course of the activities and research conducted by the Natural Resources Management and Protection Task Force of the President's Council on Sustainable Development, we heard from people all across the country. They articulated a primary ethic that the way we manage our natural resources will determine the quality of the air we breathe, what we eat, and the vitality of our economy. People said that sustainability is a fundamental part of this ethic—an understanding that what we do today should not compromise the options available for future generations. They told us that sustainability for natural resources implies high standards of environmental care, productive functioning of ecosystems, maintaining the viability and diversity of species, use of natural resources for economic benefits, and sharing our natural

resource endowment widely and equitably.

People spoke with deep frustration regarding today's tenacious—but failing—natural resource strategies. However, they spoke with a great sense of hope as they recognized the importance of seizing opportunities to experiment. People spoke of a need for improved societal dialogue to discover what has been lost in the public rhetoric surrounding our environment. They told us of their struggles to find less acrimonious ways to resolve conflicts revolving around the multiple use demands we place on natural resources.

People recognized that we all depend on natural resources for our social and economic well-being. The participants in our various workshops were very appreciative of the opportunity to help forge a new understanding of the role of natural resources in sustainability. They were eager to help catalyze coherent, purposeful action moving the United States toward sustainability in its use and management of natural resources in the 21st century.

Each workshop participant told a different story about his or her own community's unique problems, perspectives, and opportunities. Collectively, the stories they told about people and natural resources had a remarkable commonality that seemed to resonate deeply with participants all across the country. It became apparent to us that, as a nation, we are struggling to build a conservation ethic—a shared vision and set of aspirations about stewardship of natural resources—and an understanding of our relationship to the Earth and the natural resources upon which we depend. The following points were made during the Task Force workshops.

- **Watershed integrity.** Every watershed is different; the mix of its attributes varies. But essential qualities of health for every watershed include rivers and streams of good quality with sufficient in-stream water to sustain natural resources and processes, productive riparian areas, healthy and diverse populations of fish and wildlife, and complex and interconnected habitats and ecological communities. People recognized the need to protect and restore watersheds and the functions of their aquatic and terrestrial ecosystems, processes, and biodiversity because they are crucial to our continued social and economic well-being.

- **Air, water, and soil.** People pointed out that we are not fully meeting standards for air, water, and soil quality and that we need to do so as quickly as possible because we all have a stake in so doing: We experience the adverse effects of deteriorated quality, and we all enjoy the benefits of healthy air, water, and soil.

- **Forests and rangelands.** People attested to the rich abundance and variety of benefits arising from our nation's forests, prairies, and rangelands and declared the importance of managing, conserving, or protecting all U.S. forests, prairies, and rangelands to meet the social,

economic, environmental, cultural, and spiritual needs of present and future generations.

- **Fisheries.** People recognized that many fisheries have been overexploited and are collapsing, causing loss of jobs and detrimental effects to industries and communities. People asserted that we must restore freshwater, marine, and anadromous fisheries to a self-sustaining condition to meet both our present needs and those of the future.

- **Coastal and inland water ecosystems.** People affirmed the benefits of conserving and restoring healthy coastal and inland water ecosystems and pointed out the importance of ensuring that economic development is managed in ways that maintain or enhance biodiversity and long-term ecosystem health and productivity.

- **Information for natural resource decisions.** Because natural resources are crucial to our social, economic, and environmental well-being, people said that it was of utmost importance that all natural resource decisions be based on science and high-quality information. They said that this science and information needs to be credible, easily understandable, and sufficient to serve as a basis for an integrated understanding of the social, economic, and environmental effects of decisions over time and space. Such information should be readily accessible for use by citizens, corporations, nongovernmental organizations, and government agencies at all levels.

- **Improving governance for natural resources.** People told us that natural systems know no administrative boundaries. Workshop participants were unanimous in telling us that natural resource policies and programs, as well as all other policies and programs that affect natural resources, within and among governments at all levels—federal, state, tribal, and local—should be coherent and well-coordinated. They told us that such policies and programs should be based on full public participation and focused on meeting the needs of the present without compromising the ability of future generations to meet their own needs. They also told us that there were legal and regulatory impediments to meeting this goal and that these impediments should be identified and rectified.

- **Resolving natural resource conflicts.** People said that we all need to change the way in which we resolve natural resource conflicts. They said that collaborative approaches involving communities and multiple stakeholders within the framework of watersheds, ecosystems, bioregions, or other defining land-forms should be a primary mechanism used in the United States to balance the social, economic, and environmental uses of natural resources and resolve associated conflicts.

ROLES AND RESPONSIBILITIES

Communities, individuals, and families, as well as governments, corporations, and nongovernmental organizations, all have important roles to play in our quest for sustainability—and particularly in securing the health of the watersheds in which we live. From the workshops and research that made up our process of discovery, we have attempted to articulate a vision of sustainability consistent with the richness and depth of the presentations and opinions we heard all across the country. We have synthesized this material to develop conclusions about the essential roles and responsibilities arising from human actions in concert with the processes of nature.

- **Role of individuals.** Individuals as citizens or members of business enterprises who live or operate in watersheds have a responsibility to the area and its natural resources. Ideally, individuals should know their watershed, be aware of its condition, and understand the essential links between the health of the watershed and the long-term interest for future generations of the community. They should respect the views of others on the uses of the watershed and participate actively in the planning, care, and monitoring of the watershed in a civil manner.

- **Role of communities.** Communities are challenged to protect and enhance the values of natural resources in the watersheds in which they reside as an essential part of their business. An important part of this challenge is for communities to take responsibility for restoring their watersheds to a healthy state and monitoring their condition over time.

- **Role of state and federal governments.** State and federal governments have two primary responsibilities relating to watershed planning and management: (1) they implement laws and regulations, and (2) they manage public lands under their jurisdiction. Ideally, state and federal governments should facilitate community efforts to protect watersheds by sharing data and providing technical resources and funding. They should recognize an obligation to participate as community or watershed stakeholders, particularly where they own or manage land within the watershed. They should recognize an obligation to coordinate multi-agency participation in watershed efforts. They should advise communities of the legal and regulatory requirements affecting watershed health and integrate local watershed efforts into broader regional initiatives.

- **Role of tribal governments.** Because of their culture, history, and status as sovereign entities, tribal governments can offer unique perspectives and authorities in watershed planning for sustainability. Tribal governments can provide perspectives and tribal management models and take an active role in watershed health efforts particularly in the protection of fish, wildlife, and plant resources.

CHAPTER 1
TASK FORCE APPROACH

The President's Council chartered a Natural Resources Management and Protection Task Force to develop an integrated vision of what constitutes sustainability for domestic natural resources, considering biodiversity, ecosystems, and watersheds with a focus on issues in the areas of wetlands, fisheries, coastal resources, and forestry. The Task Force was charged with:

- identifying barriers to sustainability,
- developing a vision, and
- making recommendations that would help move the country toward sustainable management and protection of natural resources.

The Task Force designed and implemented an innovative workplan, aimed at obtaining both theoretical and practical information on natural resources management and protection issues and experiences. Specifically, it:

- provided a substantial number of opportunities all across the country for receiving citizen testimony through workshops, case studies, and regional team activities; and
- commissioned academic reports by leading scientists.

The information obtained through these activities was discussed, analyzed, and synthesized; the results of this analysis are documented in the next chapter of this report ("Findings") and codified as policy recommendations in chapter 3.

THE ROLE OF THE WATERSHED

Individual natural resource issues cannot be neatly divorced from natural resource systems. For example, while air quality is compromised by fire, prescribed burning is a critical tool in land management. It is therefore useful to take a systemic approach in discussing and analyzing natural resource management.

In performing its work, the Task Force looked to and relied on the organizing concept of the watershed.

> *A watershed is more than a physical landscape that is defined by its ridges with one outlet for water to flow. A watershed supports a variety of resources, uses, activities, and values, where everything is linked in such a way that eventually all things are affected by everything else in the watershed. Perhaps more importantly, a watershed contains the history of all that went before, and the spirits of those who touched it remain.*

—Definition developed through work with children by George Wingate, Bureau of Land Management, in Adopt a Watershed Program, Lake Tahoe meeting, October 4-6, 1994

The Task Force used watersheds as a primary organizing principle for several reasons, including the following:

- Water is an essential element to all life.
- Watersheds provide policymakers with a robust conceptual tool in grappling with vexing environmental issues.
- People attach cultural, aesthetic, and economic value to healthy watersheds.

The term “watershed” refers to a geographic area in which water, sediments, and dissolved materials drain to a common outlet—a point on a larger stream, a lake, an underlying aquifer, an estuary, or an ocean. As a geographical region on the Earth’s surface, each watershed has a particular association and pattern of vegetation cover, land uses, human and animal populations, and economic activities. Watersheds provide a basic framework as the home of all living things, and they provide a natural integration of all social and economic activities that take place within them.

Watersheds provide policymakers with a useful framework within which to identify comprehensive solutions to complicated environmental problems. Watersheds are a basic geophysical unit with boundaries defined by topographic features that dictate natural drainage patterns; for this reason, watersheds provide a practical means for addressing ecosystem issues which often do not have easily definable boundaries. Furthermore, watersheds are a particularly robust conceptual tool for dealing with spatial issues—they come in all sizes, with smaller watersheds sometimes nested within larger ones—and temporal issues—changes over time in vegetation, communities, settlement patterns, and industries are reflected in each watershed.

More importantly, watersheds force scientists and decisionmakers to account for the fact that environmental processes and human activities in one location may have far-reaching consequences downstream. The watershed approach also provides policymakers and industry analysts with a useful framework in which to apply natural resource accounting methods that measure the effect of economic activity on communities and their natural resource base. Periodic assessments of the condition of specified natural resources within a given watershed will indicate whether a particular economic activity is compromising the long-term sustainability of those resources and the communities that rely upon them.

While many human activities that affect the environment seem disconnected, considering their effects from the perspective of watersheds weaves them together and often makes visible cause-and-effect relationships and long-term implications. For example, construction practices designed to keep harmful

sediments from accumulating in rivers and lakes also help protect water quality for drinking and swimming. Careful planning of a community's development along a lake or river waterfront can enhance property values, increase merchants' sales, and enhance people's appreciation of the natural environment—all the while protecting wildlife habitat. Watershed approaches enable communities to see environmental and community growth issues through a kaleidoscope rather than a microscope. They thus allow communities to make better and more informed decisions.

WORKSHOPS AND CASE STUDIES

The primary input to the Task Force's work was citizen testimony. Task Force members heard presentations from hundreds of individuals including representatives from corporations and associations, farmers, writers, scientists, and academics. This information was gathered through 16 different workshops (see appendix B for a complete list) and case studies encompassing 40 states, through public comment and informal sessions, and on an informal basis.

Much of the Task Force's work was achieved through three regional teams—Eastern, Midwestern, and Western (see appendix A for membership lists)—each of which created its own agenda of watershed workshops and case studies to reflect the unique geographic, cultural, and natural resource diversity of its region. Departing from traditional methodologies, the Regional Teams' workplan process involved going into the communities of watershed regions and listening to the stakeholders—those who live, work, recreate in, and are committed to the well-being of the particular watershed.

Regional Team members listened to stories about what comprises sustainability, what processes and policies are working, and what barriers exist in moving toward sustainability within regional watersheds. The teams held workshops at the following locations:

- **Eastern Team**
  - Chesapeake Bay, Maryland
  - Hudson River, New York
  - St. Johns River, Florida

- **Midwestern Team**
  - Baton Rouge, Louisiana
  - Chicago, Illinois
  - Des Moines, Iowa
  - La Crosse, Wisconsin

- **Western Team**
  - Bellevue, Washington
  - Las Vegas, Nevada

— San Francisco, California
— Santa Fe, New Mexico
— Stateline, Nevada
— Willapa Bay, Washington
— Yakima, Washington

As noted above, the information gathered through these workshops was discussed and synthesized by the Task Force as a whole as input to the present report. Additionally, the teams developed some stand-alone regionally based reports, as follows:

- The Eastern Regional Team organized a Hudson River Advisory Board to develop a strategy for achieving sustainable development in the Hudson River Valley. This board met several times to (1) develop a vision for the Valley for the year 2045, (2) identify obstacles to achieving that vision, and (3) make recommendations for overcoming the obstacles. The resulting report is included in appendix C.

- A group assembled by the Eastern Regional Team prepared a case study of Florida's Lower St. Johns River Basin. This study looked at the history and status of area natural resources, concerns about these resources, and resource use in the basin and the problems and solutions associated with this resource use. Policy recommendations were developed based on this information. The group's report is in appendix C.

- The Eastern Regional Team prepared a report on a workshop convened in the Chesapeake Bay. The workshop brought together representatives of government agencies, environmental groups, and industries to review efforts to preserve and restore the Chesapeake Bay and consider how these efforts are related to the objective of sustainable development. This report also appears in appendix C.

- The Midwestern Regional Team focused on an economics issue relevant to natural resource policies; specifically, the team examined the issue of how to use accounting methods to capture and express natural resource conditions. To analyze this issue, the team contracted with the University of Maryland's Center for Environmental and Estuarine Studies to prepare a report on natural resource accounting. This report appears as appendix F.

- The Western Regional Team prepared a report detailing a vision of natural resource management and recommendations for realizing this vision. The report, which appears as appendix D, is based on five workshops that convened representatives of environmental organizations, business interests, citizen groups, government entities, and private landowners in five watershed regions—the Puget Sound, Columbia River, Lake Tahoe, Colorado River, and Rio Grande River basins.

THE WATER SCIENCE AND TECHNOLOGY BOARD

The Natural Resources Task Force also tapped the expertise of the National Research Council/National Academy of Sciences. In response, the Water Science and Technology Board of the National Academy of Sciences convened a two-day meeting of 14 expert scientists from a range of disciplines including geomorphology, wetlands ecology, aquatic biology, resource economics, environmental law and policy, soil science, environmental engineering, limnology, sociology, hydrology, restoration ecology, and water chemistry. The objective of this meeting was to provide a better understanding of watershed sustainability and develop a framework for assessing sustainability and integration of human activities in watersheds based on a set of scientifically defensible questions. Specifically, the participants generated a series of questions (presented in chapter 2, “Findings”) that could be posed to present and future federal, state, and local decisionmakers who face the problem of sustaining ecological resources of watersheds under pressure from human activities and management. The full meeting report is included in appendix E.

Although the workshop participants were drawn from a wide range of specialties, they used natural science and engineering perspectives as their starting point. Social and behavioral sciences, humanities, and policy perspectives were included as they related to the natural sciences. As a result, some questions emerged that are best directed to the scientific community as it attempts to provide guidance to decisionmakers.

The workshop identified the critical questions and, through discussions of experts in a variety of specialties, offered some indications of the significance of each question, along with avenues to investigate possible answers.

The workshop participants met only once; the proceedings were documented by the workshop’s chair and by board staff.

The purpose of the workshop was to formulate questions and create a framework and context in which to answer them, to point the direction for future investments of intellectual capital rather than review the results of past efforts, and to offer a series of starting points rather than conclusions.

NATURAL RESOURCE ACCOUNTING STUDY

The Task Force also initiated a project to link natural resource conditions and trends to traditional economic accounting. Through the U.S. Environmental Protection Agency, Dennis M. King and Curtis C. Bohlen, economists from the University of Maryland’s Center for Environmental and Estuarine Studies, and Pierre R. Crosson, an economist from Resources for the Future in Washington, D.C., prepared a report for the Task Force on natural resource accounting (see appendix F). The team used the Upper Mississippi River

Basin as its study area. This watershed was selected for several reasons, including its economic and social dependence on the natural resource base, and the availability of relevant comprehensive and accessible data.

In conducting their study, the researchers developed preliminary economic accounts for agricultural sectors in the Upper Mississippi River watershed as well as a general set of natural resource accounts for same. The economic accounts were set up to measure the income received by specific agricultural sectors—that is, how much the sectors receive from all sources—and the income they generate—that is, the difference between the value of goods produced and the cost of goods used in production. The natural resource accounts were set up in a hierarchical structure that includes high order resources (timber, fish); intermediate order resources (wetlands, riparian areas); and low order resources (invertebrates, pollinators). No effort was made to assign dollar values to these accounts.

The researchers made a “rebuttable presumption” that because of the sediments, nutrients, and contaminants they release into water bodies, agricultural sectors in the Upper Mississippi River Basin have a net negative effect on stocks of natural capital. They then applied criteria to illustrate how the sustainability of each sector could be judged based on (1) its capacity to invest in other offsetting forms of capital and (2) whether such offsetting investments are actually being made.

The research team developed a three-stage test of sector-level sustainability:

- **Stage 1.** Sectors that generate zero or negative net income are not contributing to overall economic or environmental sustainability because they are not producing income that could be invested in other forms of capital to offset the losses in natural capital they are causing.
- **Stage 2.** Sectors that generate only enough net income to cover consumption outlays of income recipients (e.g., farm workers and farm owners) are not contributing to overall economic or environmental sustainability because there is no surplus income that could be invested in other forms of capital to offset the losses in natural capital they are causing.
- **Stage 3.** Sectors that generate enough net to provide a surplus over the consumption requirements of income earners may—or may not—be contributing to overall economic or environmental sustainability depending on (1) whether the surplus is sufficient to finance investments that could offset losses in natural capital; or (2) whether the surplus, if sufficient, is actually being used for that purpose.

The researchers developed economic accounts for 21 regional agricultural sectors using 1991 data. Based on Stage 1 criteria, 9 of the 21 sectors in the watershed and
8 in the floodplain are *not* sustainable without subsidies at levels of income generated in 1991.

Study findings are summarized in the next chapter of this report. The complete research report is included as appendix F.

CHAPTER 2
FINDINGS

This chapter summarizes the key findings of the Natural Resources Task Force for each of its main activity areas—workshops and case studies, and commissioned research studies. The purpose of this chapter is to convey the opinions, convictions, and information voiced to Task Force members by people across the country. To the greatest extent possible, we have tried not to filter or interpret these findings, but to present them as they were expressed to us.

WORKSHOP AND CASE STUDY FINDINGS

The Regional Teams of the Natural Resources Task Force listened to hundreds of people, including scientists, ranchers, irrigation farmers, Indian tribal members, corn growers, foresters, river barge operators, hydropower utility representatives, fishermen, homebuilders, recreationists, environmentalists, federal officials, government representatives at all levels, tribal leaders, grassroots activists. These individuals most generously shared their experiences and concerns, and counseled the teams regarding the nation's quest for sustainability.

Despite great variety in the way people approached and dealt with their own issues, six major themes emerged in the workshops and case studies initiated by the Task Force and its Regional Teams:

- Despite progress, unsustainable natural resource management policies and practices persist.
- To ensure sustainability, economic and social values need to be balanced against the protection of natural resources.
- By bringing stakeholders together to seek and act on their common interests, community conflicts regarding natural resource management can be resolved.
- The burdens placed on natural resources by rapid population growth mean that human life style choices are an important input to effective natural resource management.
- Natural resource management by social and legal systems organized by national, state, county, and municipal boundaries unknowingly promotes community conflict through the creation of a regulatory morass.

- Natural systems-based approaches provide a useful framework for natural resource management and conflict resolution.

The following discussion clarifies these themes based on citizen input.

CONTINUING POLICIES AND PRACTICES OF UNSUSTAINABILITY

People are proud of the great progress they as individuals and we as a country have made in recognizing and protecting the many values associated with natural resources and the environment. However, people cited situations all across the country where use and management of natural resources over the last two centuries have resulted in impaired and unsustainable natural resource conditions and the impaired health of terrestrial and aquatic ecosystems. For example:

- In the Chesapeake Bay, demographic trends (including increases in population, the ratio of dwelling units to population, and lot sizes) run counter to efficient land use and sustainable development. Regions that restrict themselves to sustainable rates of growth will face a short-term disadvantage in competing with regions that pursue laissez-fare growth policies.1

- Scientists told us that past land and water use practices have damaged natural resources in measurable ways in the Chesapeake, Klamath, Columbia, Mississippi, Rio Grande, Colorado, Lower St. Johns, and Tahoe basins. They speculated that this decline would continue if our policies and practices did not change.

- In the Hudson Valley, wildlife habitats such as boreal bogs, wetlands, hardwood forests, and meadows are disappearing at an alarming rate. This serious depletion is due primarily to a pace of land development that has exceeded the rate of population growth by a ratio of more than 8 to 1.

- Beyond habitat destruction, the natural resource issues raised by sprawling development in the Hudson Valley are legion. This pattern of land development is highly inefficient with respect to energy consumption, has created several air pollution nonattainment areas, and has degraded surface and groundwater resources. It threatens the viability of the region’s rivers and streams and the integrity of its scenic byways.

- The outlook for habitat conservation in the Lower St. Johns River Basin is, in general, not good from a long-term sustainability viewpoint. The state of Florida has been, and is continuing to, purchase some of the best wild areas to make additional parks, state forests, wildlife management areas, etc. Even so, the threats of pollution, hydroperiod alteration, and exotic species invasion from beyond public land boundaries frequently cause habitat degradation.

- Ranchers in New Mexico and Nevada knew that grazing was reducing the soil's ability to hold the water to feed streams during the dry season. Many reported that streamside vegetation "wasn't the way it used to be."

- Tribal members in New Mexico said that, due to pollution, it was no longer possible to drink directly from the waters of the Rio Grande below their holdings.

- Tribal members from the Columbia Basin noted that they can no longer fish for salmon, since their numbers have dwindled because of too many dams, too much habitat destruction, and too much fishing. And one participant at the Columbia River workshop noted that "The demise of Columbia River salmon during this century is truly one of this nation's great tragedies. It is not just a story of an exploited resource, but a story of anguish and sadness to the Indian and non-Indian people alike whose lives depended historically on Columbia River fisheries."

BALANCING NATURAL RESOURCE MANAGEMENT AGAINST ECONOMIC AND SOCIAL VALUES

People recognize that, as a nation, we have derived great wealth from the development of our rich heritage of natural resources over the last century. However, there is widespread unwillingness to maintain those resources. A Nevada official observed that rising tensions between economic development and the limits of the natural environment arise from decisions made years ago out of a different perception of the world; he added that change will not be easy.

- A participant at the Columbia River workshop noted that "Perverse economic policies have unleashed a torrent of conflicting social, economic, and political forces that work at cross purposes to conservation. Many activities are motivated by short-term economic returns without consideration of the impacts on long-term sustainability. The failure to adequately capture economic externalities in our public and private decisions is a major cause for the inability to sustain the productivity of our natural resources."

- Environmentalists tend to believe that there are still too few people who willingly protect environmental values when that protection comes at some economic cost. They feel that overuse of natural resources has subsidized the nation's economy for too long and point out that those using the resources must share in their protection and bear the costs.

Tribal members told us that Native Americans are tied to natural resources more than any other U.S. people; consequently, they said, they recognize that

short-term exploitation brings poverty. They also told us that they have always lived in a changing world, constantly challenged to adapt their culture to new situations and technologies while maintaining their tribal heritage. Tribal participants noted that what they have learned about maintaining communities within natural resource constraints over the thousands of years that they have lived on this land will serve as a lesson to others facing those problems today.

We also heard "success stories"—accounts of policies and practices that are successfully, and often innovatively, balancing natural resource management against economic and social values:

- Local governments are striving to meet the conflicts associated with balancing environmental protection with economic and social realities head on. They are addressing them by working to expand economies, often building on traditional natural resource-based industries; by encouraging local investment that keeps capital and profits within their areas; and by seeking to attract new capital.

- The Chesapeake Bay study notes that "The real estate economy is benefited by the preservation of open space. The value of homes in Maryland is enhanced by proximity to protected open space. Studies completed in other states document that the house values adjacent to such land in the same neighborhood increase by as much as 10 percent to 50 percent. Increased property taxes from homes adjacent to protected land have been documented to offset costs for maintenance of the open space" (see appendix C, "Chesapeake Bay Watershed Workshop Report," p. 10).

- In the Lower St. Johns River Basin, best management practices in silviculture were documented; many of these offer solutions to the maintenance of productive forests and protection of natural resources, for example:

  — special management zones with operational restrictions designed to protect water quality, protect streambank stability, and provide wildlife habitat;

  — wetland restrictions and limitations to protect soils and hydrology of wetlands;

  — road construction techniques to minimize erosion and sedimentation; and

  — guidelines for application of pesticides and fertilizers.

- The state of Florida has begun to explore an innovative "less-than-fee" philosophy of resource management. The purchase or transfer of development rights may be used to protect the land from urban development while compensating the landowner, thus retaining the land

values for commodity production, wildlife habitat, recreation, and green space. Other workable incentives are: actively recruiting forestry-based business into the state, tax incentives that discourage development from encroaching on timberlands, and aggressively advocating the positive economic and environmental position of forestry in Florida.

BRINGING STAKEHOLDERS TOGETHER

Many individuals, agencies, tribes, and interest groups told us that they are learning the hard way that controversy about natural resources and their use and protection can foster major conflicts within their communities—and, in turn, have adverse effects on the quality of life that brought them to live there in the first place. Many people testified that they have found a better way to resolve their conflicts: bringing stakeholders together in collaborative processes to seek and act on their common interests.

Those who addressed these basic principles expressed a sense of success from having improved community dialogue and implemented management solutions. Although every participant had a different personal or business aim, these groups arrived at a common set of values and goals for the natural resources in their area, and an understanding of their relationship to community and economic values. Respecting each others' differences was crucial to keeping participants together. The most successful processes were broadly inclusive, with all stakeholders at the table.

- A member of the Henry's Fork Watershed Council in Idaho pointed out that the council had been born of conflict and polarization. "There was a basic mistrust of the environmentalists by the irrigators. We felt the environmentalists were there to take away our water rights; we viewed them as a threat to our livelihood. We just didn't trust them at all. At first, we were meeting out of fear; fear of what the other guy was going to do to us if we didn't show up at the meetings. Now the trust level is building. We're building lines of communication, and we're finding there is common ground between the irrigation interests and the environmental interests."

- New Mexico agencies are experimenting with ways to work in partnership with citizens in cooperative watershed planning efforts—and discovering that by so doing, they are starting to get "on top" of problems they thought intractable. Moreover, the agencies are starting to dispel the distrust of centralized government.

- A Columbia River workshop participant, in explaining the essential fairness of the collaborative problem-solving process, noted "No one gets everything they want—not the grazers, the miners, the wood fiber industry, the irrigators, the developers, or the forest interest and wildlife advocates."

IMPORTANCE OF HUMAN LIFE STYLE CHOICES

It was clear to many participants that maintaining the environment is as much about people and the way we live as it is about animals, plants, or rivers. Our formal social processes, according to participants, often take us far from the pathway that leads to sustained communities and healthy environments. They note that population pressures and rapidly expanding economic development in many areas are threatening to force us still farther off the track.

For example, the projected disappearance of Hudson Valley's "green" character is not due to the influx of additional population, but rather to the high rate of land consumed to serve these additional people. An 8 percent increase in population over the next 50 years will yield a population density of about 450 persons per square mile. Ordinary low-density suburbs contain around 1,500 persons per square mile, so it is how people live on the land, not the population of 450 persons per square mile, that is the issue. If land planners in the Valley can develop effective strategies to array the population properly on the land, then the Valley can unite behind a strategy of modest population growth, support dynamic development projects, and maintain a place with the open, high-quality character that is in the Hudson Valley tradition.

Many participants told us that they thought they could help restore and maintain valuable natural resources. They noted that they were willing to commit their individual and business resources to this end because they personally cared and because their customers and neighbors cared. In fact, many have voluntarily changed some of the ways they managed their construction projects, ranches, farms, and forests.

- A rancher in New Mexico is on a regimen to alter the vegetation on his ranch from pinyon/juniper to grasslands and ponderosa pine. As he has done so, the water in the streams has come back—and so have the fish.
- Timber companies are beginning to plan their activities on a watershed scale and in coordination with their neighbors and agencies.
- Tree farmers are experimenting with alternative silvicultural and managerial practices to provide more natural amenities from their forests.
- Rice and corn growers have improved their farm operations to protect water quality and support migratory waterfowl along their Western and Midwestern flyways.
- Landowners in the Midwest said that floodplains could be better used to temper flood peaks and provide much-needed wetland habitat. Fast-growing native hardwood species would be especially well-suited to this task, according to Midwest foresters.

- Farmers in Louisiana are providing habitat for an endangered species of bear.2
- Farmers are helping improve water quality in Chesapeake Bay, Maryland, Discovery Bay, Washington, Henry's Fork, Idaho, and Tillamook, Oregon.

REGULATORY MORASS

state, and local jurisdictions, authorities, programs, regulations, and laws. There are many aspects to this problem, including the following:

Overlapping jurisdictions. A complex system of congressional committees and the distribution of responsibility and authority for various natural resources among many different agencies (with inevitable overlaps, gaps, and disagreements) contribute to severe problems in achieving sustainable resource management.

- **Gaps in authority and responsibility.** Often, responsibility and regulatory authority are lodged at an inappropriate level. For example, the Hudson Valley case study participants noted that comprehensive planning must measure the impact of local land uses on neighboring municipalities, yet comprehensive planning is defined as local in nature. There is no statutory requirement that localities consider the impacts of their land use decisions on adjacent areas or on the region as a whole. They further noted that even though New York's highest court required local governments to consider regional housing needs in adopting and amending their zoning ordinances, there is no agreed-upon definition of what a relevant housing region is, identification of regional housing needs, or method for defining the share of housing needs that each municipality should bear. Localities have no practical authority under this system to create an adequate supply of housing for young and elderly households and for families of modest means.
- **Institutionalized unsustainability.** Although significant and appropriate changes are occurring in federal agencies, managers continue to work within an agency system that many believe has inevitably institutionalized nonsustainable policies. Participants in the Chesapeake Bay case study concurred, noting that obstacles remain regarding the implementation of ecosystem-based management. Central to these obstacles, they explained, are difficulties in defining management units; understanding the biological, physical, economic, and cultural factors at play; and structuring a management framework that properly integrates all component parts.

- **Financial disincentives.** The nation's legal and social systems are burdened with financial and operational disincentives, and with institutions more supportive of destructive behavior than the enabling of constructive action. Moreover, the growing layering and complexity of interlocking legal and economic disincentives threatens to—and in many cases does—compromise the intent of environmental safeguards. Badly directed subsidies and taxes and the use of public and private funds to support poorly conceived projects undermine developers' and builders' efforts to move toward sustainability.

- **Ambiguous standards.** Most of the people at our meetings agreed that standards should be clearly defined and strictly enforced, and officials held accountable. They said that governmental ambiguity and indecision are exacting a heavy toll among the regulated stakeholders and those concerned about public land, water, and wildlife.

- **Distrust and suspicion.** Federal actions are instilling uncertainty and anxiety about the potential impacts of environmental regulation. Many spoke of their growing distrust of government. In addition, people often resist change, questioning motives before results are recognized.

Furthermore, state officials—who described their role as one of enabling actions at local levels of government while coordinating community action and environmental protection at regional levels—cited many other challenges to successful accomplishment of that mission, including population growth, faltering economies, inconsistent funding, conflicting policies, and lack of structures to coordinate information and dialogue among many jurisdictions.

Some progress has been made, however, in addressing the problems of regulation:

- A multitude of agencies have renewed or expanded their commitment to balance resource use with environmental integrity. Although often underemphasized, this vision exists in such enabling legislation as the National Forest Management Act, National Environmental Policy Act, Magnuson Fisheries and Conservation Act, Marine Mammal Protection Act, Endangered Species Act, and Clean Water Act.3 Agencies are also expanding the scope and scale of regulation to include ecosystem protection under the umbrella of existing legislation. However, they reported that criteria and standards for administering new policies under old laws and responsibilities remain vague and unspecific.

- Federal agencies told how they are improving their management and protection of natural resources. They are realigning agency missions and searching for more efficient organizations. While heading in a positive direction, agencies were less willing to challenge basic approaches, such as reliance on regulation. They were not clear on how they will adapt to a changing world that increasingly seeks solutions to complex problems through collective decision processes

and partnership arrangements with other public agencies and private citizens. Some laws and regulations, such as the Federal Advisory Committee Act, inhibit such dialogue and reinforce agency resistance.4

- Federal agencies told of significant and rapid change in their governance of natural resources. We heard from officials representing federal, state, and local government agencies of the difficulties in trying to meet social expectations within their legal authority, while encouraging community-supporting economies. We heard all levels of government voice commitment to protecting environmental values. However, the more local the government, the greater the awareness shown for the social and economic effects of public policies on the community and its members.

USING NATURAL SYSTEMS-BASED APPROACHES

One solution to many of the quandaries of natural resource management that we heard espoused over and over again—by scientists, representatives of grassroots organizations, and bureaucrats, among others—was to manage natural resources on their own terms, that is, based on their own boundaries rather than in a context of artificial governmental jurisdictions. Organizing around natural resource boundaries, such as watersheds or geographic areas having specific physical or biological values, forced communities to transcend the limitations of traditional governmental jurisdictions. Further, working with and for a real, specific place helped community members crystallize abstract concepts into pragmatic expressions of their stewardship values. Moreover, people told us that a community planning process can be a good vehicle for starting and maintaining dialogue among individuals.

The concept of taking a natural systems-based (generally, watershed-based) approach to resource management was expressed by numerous constituencies.

- Citizens reported positive results from their experiments with watershed initiatives to create common visions, goals, and values. These experiments did not increase regulatory constraints. Instead, by helping to clarify community expectations and acknowledge performance within existing law, they facilitated the business of land use and environmental stewardship. We learned that watershed initiatives cannot replace legal and regulatory systems, for there will always be choices too hard for the community to make and people who are unwilling to conform. They also cannot replace government agencies, because some environmental issues must be addressed at the regional, national, or international levels. There remains a need to coordinate and communicate among watersheds to meet larger scale goals. But participants made it clear that watershed initiatives can be used to engage public debate about stewardship and sustainability in pragmatic situations and can provide a vehicle for continual renewal of those values.

- The Water Science and Technology Board corroborated these findings, pointing out that natural scientists have long used the geographic definition provided by watersheds in collecting data, analyzing problems, and assisting in decisionmaking, so it is logical that we should address the broader philosophical issues of sustainability in that context, especially issues related to long-term planning and management for sustainable resources.

- Rural communities are discovering that the loss of traditional cultures to population growth and changing economy is perhaps more important than the loss of jobs to environmental protection. As a community organizer from Discovery Bay, Washington, noted: “Water may be the last tool we have to create communities. Water is an issue we can use to build interdependence in a community.”

- People representing community grassroots organizations explained that adversarial approaches had not worked and that traditional jurisdictional boundaries were not appropriate for environmental decisionmaking. To reconcile community and environmental needs, they sought new approaches where the definition of problems and solutions was better matched to ecosystems and natural boundaries. Each watershed initiative was different in terms of both the issues that initially provoked the need to come together and in the solutions found. For example, Tillamook Bay and Puget Sound both became part of the National Estuary Program; New Mexico created a citizens’ Interstate Stream Commission; and watershed councils have been formed in communities all over the West.

People reported making significant progress in natural resource management by using watershed approaches—which honor their sense of place—and collaborative processes—which honor both their individual and collective values. They counseled us that every watershed is unique, but that it is important to place decisions within a broader ecosystem context. They cautioned us that nature is constantly changing. We inferred that successful solutions would be found at local levels informed at larger scales. We also understood that resource managers must be ever watchful to see nature’s ways and adapt through time.

WATER SCIENCE AND TECHNOLOGY BOARD FINDINGS

As stated in the previous chapter, the goal of the Water Science and Technology Board workshop was to develop a series of questions for decisionmakers to use in meeting the challenge of managing watersheds. The key questions developed at the workshop encompass social and economic well-being; existing scientific institutions and data gathering to assess trends; the concept of adaptive management and watershed analysis; stakeholders; relative scales of decisionmaking processes and the scale of natural systems; dynamics of watersheds; tradeoffs among economic, social, and

environmental considerations; existing monitoring programs; and communication of environmental information and behavior change.

These key questions are presented within a framework that represents the step-by-step process for attaining sustainable watersheds. The steps in this process and related questions are as follow:

1. Identifying Specific Natural Resource Services and Concerns

- What elements of the environment are essential to social and economic well-being; or, alternatively, what elements of the environment constrain social and economic well-being?
- What existing data would be useful to assess the current status and trends of economic, environmental, and social conditions within a watershed? Can existing programs for data needs and management be modified, or will new ones be required to fill gaps?
- Are present scientific institutions organized to provide information that can inform decisionmakers responsible for sustainable watershed development?

2. Identifying the Stakeholders

- Who will determine whether data are adequate to identify needs, set priorities, make timely decisions, and measure progress toward achieving and sustaining goals? What processes and/or criteria will be employed to determine data adequacy?
- Who has a stake? What are the stakes?
- Are stakes and stakeholders fully accounted for?

3. Linking the Relevant Scale of the Problem to Decisionmaking

- How can we match the scale of decisionmaking processes to the scale of the natural systems that are the object of our decisions?

4. Specifying the Tradeoffs Among Economic, Social, and Environmental Considerations

- How can the natural dynamic of watersheds be taken into account?
- Can scientific information be integrated effectively into decisionmaking?
- Are metrics and methods available that are capable of evaluating the tradeoffs among and between the three distinct groups of economic, social, and environmental considerations?

5. **Exploring the Values That Guide Stakeholders in Deciding Among Tradeoffs**

   - What can science do to make clear the values that stakeholders have and want represented in the policymaking process?

6. **Identifying the Best Actions to Achieve the Desired Balance Among Tradeoffs**

   - How can science assist in defining and assessing the consequences of social/economic decisions?
   - What can science do to assist adaptive management/ development?
   - Will existing programs be adequate to monitor progress toward achieving desired goals? If not, can they be modified to do so, or will new ones be required?
   - Is knowledge dissemination effective in changing behavior under current economic circumstances?
   - How do equity issues affect human behavior toward watersheds and their natural resources?
   - How does social/economic insecurity affect human behavior toward natural resources or watersheds?
   - Are processes under way to develop institutional/political mechanisms to better translate scientifically determined costs/ benefits into optimal human behavior regarding watersheds?

The workshop participants believed that watersheds can provide the basis for assessing many of the resources that contribute to human welfare and well-being. A challenge for the future will be to develop a method and related models to overlay economic and social considerations on the watershed-based analysis of natural processes.

A further challenge for decisionmakers will be to develop the capacity to predict the broad range of biological, physical, environmental, social, and economic consequences of human action impacts in watersheds. Workshop participants found that scientific knowledge is available to provide some answers and that cooperative interactive efforts among scientists and decisionmakers will be required to develop new tools and methods if the nation is to achieve a goal of truly sustainable watershed resources.

NATURAL RESOURCE ACCOUNTING STUDY FINDINGS

The authors of the natural resource accounting study, described in the previous chapter, reached three general conclusions.

- Any accounting system that deals with sustainability must cope with significant uncertainty. This uncertainty arises from the need to make assumptions about a future that will be affected by environmental, economic, and technological changes that may not be reflected in today's accounts. The researchers note that it is possible to develop a well-founded accounting system to deal with sustainability on the basis of what we know about human preferences today. Because of technological and cultural change, however, the opportunities that future generations will have—and the mix of natural, built, and human assets they will require to satisfy their preferences—is certain to change.
- Accounting for sustainability requires that income be measured with overall wealth held constant. (Income is the maximum amount that can be spent on consumption in one period without reducing the wealth available to support consumption in future periods.) This means that we must carefully define and measure privately owned, publicly owned, and—perhaps—unowned wealth as well as establish accounting conventions that distinguish among the creation of new wealth, the transfer of wealth from one sector or region to another, and the conversion of wealth from one form to another. For the purposes of accounting for sustainability, it is more important for economic accounts to measure income generated—the economic value of goods and services produced less the economic value of the goods and services used up in production—than income received—income generated plus direct and indirect transfer payments received.
- Contributions to sustainability by economic sectors that are degrading or depleting natural capital should be analyzed in a particular way. The researchers point out that where economic sectors are known to be adversely affecting stocks of natural capital, it is useful to begin judging their contributions to overall economic and environmental sustainability with "means tests"—tests that ask whether income generated is sufficient to potentially invest in offsetting forms of capital—rather than relying on "ways tests"—tests that ask whether it is possible to replace or restore the forms of natural capital that are being lost.

With respect to accounting for sustainability in the context of watersheds, the authors came to the following conclusions:

- Environmental accounts, when used in conjunction with conventional economic accounts, can be developed into effective tools for evaluating the sustainability of watershed management and of specific watershed uses.
- Whatever the goal of watershed management, sustainability should be defined (at least for accounting purposes) in terms of the stock of wealth or "social capital" we bequeath to future generations.
- For accounting purposes, wealth or social capital should be defined as a mix of natural, built, and human capital that includes both conventional economic assets and environmental and other assets with more roundabout links to human welfare.
- For purposes of evaluating movements toward or away from

CHAPTER 3
POLICY RECOMMENDATIONS

Drawing upon people's presentations at the workshops, the Natural Resources Task Force responded to people's ideas, visions, hopes, and aspirations with the following policy recommendations.

POLICY RECOMMENDATION 1

SOIL, AIR, AND WATER QUALITY

Revitalize the country's collective efforts to secure healthy, high-quality air and water resources and productive soil—not only for ourselves, but also for our children and their children.

This recommendation affirms what we heard from people all across the country—the fundamental importance of our nation's framework of environmental laws, regulations, and programs. It acknowledges that despite existing laws and regulations, there remains a compelling need to make improvements and better enforce our existing laws at all levels.

DISCUSSION

Citizens all across the country attest to the importance of soil, air, and water quality to their livelihoods, health, and well-being and to their children's futures. Environmental quality is essential to the survival of our planet.

Who

This recommendation is aimed at recognizing and affirming that we all—citizens, households, communities, corporations, nongovernmental organizations, and governments at all levels—have a vital interest and a critical role to play in ensuring soil, air, and water quality. In addition to moral responsibilities, our nation's framework of laws and regulations enumerate specific responsibilities that must be redeemed to secure our collective rights and interests in soil, air, and water quality.

How

Our framework of laws that provide for soil, air, and water quality are of fundamental importance and must be preserved. Protecting soil, air, and water

quality depends on people who are familiar with their own unique environmental, social, and economic settings and continued enforcement of the laws we already have. Actions need to be taken on many fronts. Individual actions make a crucial difference. In our communities, we can support planning and decisions that minimize impacts to soil, air, and water. Corporations can take initiatives that increase efficiency and reduce waste and pollution. And many actions will require public-private partnerships.

- **Soil.** Rates of soil erosion from human activities should be reduced to the point that they do not exceed the rate of soil regeneration. Agricultural practices that minimize soil losses and pollutant loadings and that build soils and improve their organic and nutrient composition should be promoted. Land use practices that prevent adverse effects of erosion and contamination on downstream beneficial uses should be implemented.

- **Air.** In our homes, we can take important actions such as conserving energy to reduce the total amount of pollution from electricity generation. Corporations can ensure that emissions harmful to human health, including smog, toxics, and other emissions, are stopped. Cleaner fuels, less-polluting vehicles, more efficient modes of transportation, and more convenient services near transit centers which reduce unnecessary driving can be encouraged.

- **Water.** Individuals can recycle automobile oil and make proper use and disposal of household chemicals to reduce contamination of rivers and lakes through storm runoff. Communities can ensure that water sources, systems, and watersheds are free from harmful contaminants and safe for recreation. Local governments can emphasize meeting established water quality standards and discourage growth and development that would degrade water quality. Water conservation and protection of natural water recharge zones for aquifers can be encouraged.

Indicators

- **Soil:**
  - — Reductions in soil losses through erosion.
  - — Reduced contamination of air and water from fertilizer and pesticide uses.
- **Air:**
  - — Compliance with air quality standards.
  - — Reduction in the number of air-related adverse health effects (e.g., asthma, respiratory infections) in areas with historically poor air quality.
  - — Increased visibility.
- **Water:**

— Compliance with water quality standards.

— Presence of indicator species for designated water use categories and other organisms that indicate healthy ecosystems.

— Return of historic wildlife and vegetation communities.

RATIONALE

Soil, air, and water resources are the fundamental building blocks of any natural system's basic functions and its ability to provide social, economic, and environmental benefits. Soil, air, and water quality standards are articulated in a variety of laws, regulations, and guidelines. This recommendation acknowledges the importance of soil, air, and water quality to sustainability and affirms the explicit role of laws, standards, regulations, and guidelines in achieving sustainability by internalizing environmental factors and providing a "level playing field" for economic activities.

Soils are the basic medium from which the vegetative component of terrestrial biological systems arise. Soils grow crops, absorb and filter water, recycle nutrients, break down or immobilize wastes and pollutants, as well as provide a place for children to play. Soil degradation from erosion, compaction, loss of organic matter, nutrient overenrichment, and toxic effects from wastes and excessive use of pesticides not only impairs long-term productivity and sustainability of soils, but can also result in adverse air and water quality.

Air quality has a far-reaching effect on the quality of our lives. Our health and welfare are adversely affected by poor air quality. The U.S. Environmental Protection Agency has established ambient air quality standards to protect public health, including the health of sensitive populations such as children and the elderly. In 1995, approximately 80 million people lived in counties where measured pollutant concentrations were above the national standards—that is, areas where the ambient air quality is sufficiently poor that the established margin of health safety is exceeded.5 Additionally, regional haze increasingly affects scenic vistas throughout the country, particularly our national parks, where decreased visibility impairs people's enjoyment of the nation's natural wonders.6

The public water supply is a major source of exposure to environmental contaminants. A primary mechanism for sustaining healthy drinking water is source water protection. Although most of America's surface waters currently provide safe recreation, beach closures in the Northeast and outbreaks of infectious water-borne diseases demonstrate the need to improve water safety.

POLICY RECOMMENDATION 2

NATURAL RESOURCE INVENTORY AND ASSESSMENT

Integrate existing federal, tribal, and state natural resource inventories and assessments through the development and use of compatible standards, methods, and protocols.

This recommendation is aimed toward a comprehensive inventory and assessment of our nation's renewable and nonrenewable natural resources and biodiversity. It is intended to provide a sound comprehensive basis for informing public and private natural resource decisions. It also provides for the interchange of information among governments, citizens, corporations, and nongovernmental organizations.

DISCUSSION

An accurate assessment and inventory of our nation's biodiversity and natural resource stocks is critical to understanding the contributions of natural resources to our country's sustained economic health.

Who

The inventory should be conducted through a coordinated federal effort. The U.S. Department of Agriculture (USDA), through the Natural Resources Conservation Service (NRCS) and Forest Service, and working with state and local partners, has been conducting statistically reliable National Natural Resource Surveys for the past 20 years.7 USDA would team up with other federal agencies in the Departments of Commerce and the Interior, other bureaus, the U.S. Environmental Protection Agency, state and local governments, and the private sector using existing capability to carry out a systematic National Natural Resource Survey.

How

Common terminology and definitions, along with standard methodologies and protocols, should be developed by 2000. These should be developed building

on several efforts already under way to integrate resource inventories in NRCS and the Forest Service, as these two agencies already are responsible for collecting natural resource data for almost 90 percent of the nation.8 The methodologies would be fed by research efforts such as the previous Natural Resources Inventories of 1982, 1987, and 1992, and should facilitate information sharing with citizens and governments at all levels.9

Standard methodologies should be pilot tested during the period 1997 through 2002. This effort should build on pilot testing initiated in 1995 to integrate NRCS's Natural Resource Inventories and the Forest Service's Forest Inventory and Analysis. Methodologies should aim at providing easy electronic access, with interpretations providing cross-boundary analysis.

Indicators

The ultimate indicator of soil, air, and water quality is the flow of information to land managers, manufacturers, planners, regulators, and consumers to provide the basis of information to modify management regimes and production processes, and effectively influence consumption patterns. The actual inventory should:

- enable the identification of trends over time;
- feature stable definitions and inventory designs;
- be scientifically defensible and statistically valid;
- be geospatially referenced to integrate with existing socioeconomic, demographic, and political information;
- enable measurement of results (e.g., soil erosion rates, forest health, range condition, etc.); and
- facilitate public access.

RATIONALE

As a nation, we are struggling to build a conservation ethic—a shared aspiration about stewardship of natural resources—and an understanding of our relationship to the Earth and its natural resources upon which we depend. The way we manage our natural resources will determine the quality of the air we breathe, what we eat, and the vitality of our economy. An important part of this ethic is the notion of sustainability—an understanding that what we do today should not compromise the options available for future generations. Sustainability for natural resources implies high standards of environmental care, productive functioning of ecosystems, maintaining the viability and diversity of species, using natural resources for economic benefits, and sharing our natural resource endowments widely and equitably. Being able to measure and assess our nation's natural resources is essential to making informed decisions about them.

The relationships between the physical and biological features of various ecosystems and people's influence on these systems are highly complex. To assess these relationships accurately and plot our proper course toward future economic use of these systems while we protect environmental integrity, we must first assess the issues and then move forward with carefully crafted combinations of regulation, incentives, acquisition, land use planning, and other creative steps to protect natural system integrity.

Consumer consumption is directly related to impacts and demands placed on natural systems. Although natural systems can be managed with respect to their environmental integrity, increasing demands and conflicts in multiple uses make this a proportionally difficult challenge. Consumers need better education regarding the relative demands that certain products place on natural systems. Incentives should be further developed to encourage use of renewable natural resources and other products that place less demand on our natural systems.

Improved productivity will enable us to focus our most intensive management efforts on fewer acres while targeting certain more environmentally sensitive lands to be managed less intensively—or, in some cases, placed in a reserve status. Better understanding of the interrelationships between different sites and their inherent characteristics, including the influence of management, is needed to help us make these difficult choices most effectively.

In order to meet the challenges outlined above of protecting environmental integrity through policy formulation, shaping consumer choices, and improving management productivity, it is essential that we recognize the fundamental importance of high-quality information on natural resource conditions and trends. Current information is often disjointed, not easily accessible, and incomplete. This recommendation is aimed at providing a solid foundation of natural resource inventories and assessments from which it will be easy to draw useful information for decisionmakers, land managers, and consumers.

POLICY RECOMMENDATION 3

ACCOUNTING FOR NATURAL RESOURCES

Link natural resource conditions and trends to national income accounts and to economic assessments and analyses. Develop a set of indicators based on the above linkages that assess the flows, conditions, and trends of natural resource stocks.

DISCUSSION

This recommendation is designed to lay the foundation for eventual full accounting of natural resource stocks in national income accounts and in the economic analyses agencies employ to make decisions about natural resources. This recommendation is ultimately aimed at applying a systems approach to linking and tracking the social, economic, and environmental elements of sustainability.

Who

This recommendation has three primary agents for change:

- federal agencies that make natural resource decisions,
- federal agencies with specific responsibilities for collecting and publishing information for national income accounts, and
- academic institutions that are focusing on this issue.

Successful accounting for natural resources will, in large measure, be determined by the collaboration of these key players.

How

An implementing mechanism for this recommendation would be an executive order directed at federal agencies under the Government Performance and Results Act (GPRA).10 Federal agencies should be directed in their strategic planning, conducted under GPRA, to collect information on flows, conditions, and trends of natural resources and link this information to economic assessments and analysis conducted by their own and other agencies.

Those agencies that have responsibilities for collecting, keeping, and publishing economic statistics for national income accounts should work with agencies that collect information on natural resources—as well as with institutions that have particular expertise in this area—to link information on natural resource flows, conditions, and trends to conventional economic statistics. Federal agencies should collaborate, particularly in support of strategic planning done under GPRA, in the development of a suite of sustainability indicators that link information on natural resource flows, conditions, and trends to conventional economic statistics.

Indicators

- By 2000, standard methodologies for accounting for natural resource stocks should be developed; by 2010, standard methodologies should be accepted and applied on a pilot basis. By 2025, measurements of national economic status and trends should fully account for changes in the nation’s stocks of renewable and nonrenewable resources.
- Accepted methodologies should be developed by 2000 and routinely

employed by 2010 to guide decisionmakers at all levels of government in assessing social and economic values and priorities and measuring the various demands placed on natural resources.

- By 2000, a suite of sustainability indicators should be in wide use that link and measure the flows, conditions, trends, and economics of our country's stocks of natural resources.

RATIONALE

Natural resources account in large measure for the economic prosperity we have enjoyed this last century. The United States has a natural resource base rivaled by few other countries in the world. However, we have used large portions of our natural capital in ways that are sometimes not sustainable. Expanding human demands and national and international economic activities place ever-increasing pressures on our nation's natural resources, causing some alarming trends in air, water, and soil degradation. These trends, in turn, translate to diminished ability of natural resources to provide social, economic, and environmental benefits. We are compelled to rectify natural resource accounting and economic assessments to ensure sustainability of our natural resources and continued prosperity.

Present-day accounting and economic assessments do not fully account for the fundamental importance of natural resources to our economy. This problem is exacerbated by the long time horizons necessary for assessing natural resource conditions and the complexity caused by the fact that productivity of natural resources is often directly linked to the functioning of natural systems—that is, the health of ecosystems. Society, in addition, places great value on many nonmarket aspects of natural resources. These nonmarket values are not adequately addressed by present-day accounting and economic assessment practices.

Efforts to develop natural resource accounts are under way. For example, the Bureau of Economic Advisors in the U.S. Department of Commerce has made significant strides in adjusting national income accounts to reflect natural resource conditions.11 These efforts, however, have not reached the point of being fully accepted. Important strides have also been made in incorporating natural resource considerations into economic assessments, but their use and efficacy remain controversial.

Good-quality information on the conditions and trends of natural resources does, however, reside within many federal, tribal, and state agencies. This recommendation takes the logical next step in the evolution toward full accounting for natural resources by forging links between existing natural resource inventories and existing economic accounts and assessments. This recommendation charges those agencies that have first-hand knowledge of natural resource conditions or economic accounts to be the same agencies to forge the links.

Academia has an important role to play in these next steps for two reasons:

- Basic economic theory and accounting practices need to be fortified with respect to giving full consideration for natural resources.
- Academia can be a rich source of ideas for agencies about how actually to make and use the linkages called for in this recommendation.

Taking these next steps of implementation at the agency level will ensure relevance to current issues.

A set of indicators for sustainability and natural resource accounts, when used in conjunction with conventional economic accounts, can be developed into powerful tools for evaluating the sustainability of natural resource policies and management. Integrated accounting and assessment, when fully developed, can deal with sustainability at the scale of an eco-region or watershed and can provide insights into broader national and global concepts of sustainability.

POLICY RECOMMENDATION 4

SUSTAINABLE FORESTS

Convene a National Forestry Advisory Council comprised of a representative balance of stakeholders to define and help achieve sustainable management of forests on a national basis by the year 2000.

This recommendation is aimed at fostering a continuing dialogue on a national basis to consider the sustainability of both public and private forests. It is intended to build on, bring together, and synthesize public and private initiatives that are already under way.

DISCUSSION

Important public and private initiatives regarding sustainability of forests have taken place over the last few years. This recommendation is designed to bring together these initiatives on a national basis and to establish positive dialogue in the debate over sustainable forestry and implementation of sustainable forestry practices. Its ultimate aim is to move forward in the implementation of sustainable forestry practices on public and private forestlands as we approach the new millennium.

Who

Key stakeholders would form a federal advisory committee. Members would be selected to represent a balance and full range of views. The balance should be similar to that achieved by the President's Council on Sustainable Development (PCSD) and would draw upon participants from current initiatives such as the American Forest & Paper Association's (AF&PA's) Sustainable Forestry Initiative,12 as well as key stakeholders representing constituencies such as small, private, nonindustrial landowners.

How

A variety of international and domestic initiatives, such as the 7th American Forest Congress, AF&PA's Sustainable Forestry Initiative, the Forest Stewardship Council, U.S. efforts in international negotiations, and the Society of American Foresters' Forest Health and Productivity Initiative, among others, would provide the basis for discussions. The National Forestry Advisory Council would review issues surrounding sustainable forestry, develop its own terms of reference, and examine avenues of cooperation aimed at implementing sustainable forestry practices on all forestlands.

The initiative, among other things, would aim at ensuring, by 2000, that all landowners are aware of and have information easily available that allows each to recognize how they can make significant contributions to achieving a national goal of sustainable management of all forests. It also would focus on fully implementing sustainable forestry on public lands by the year 2000, using the principles of ecosystem management. In addition, this recommendation would include reviewing the possible classification of public and private forestlands in states by management goal categories. Some precedents have been set for such a categorization through existing programs such as the Stewardship Incentive Program, Conservation Reserve Program, National Forest Land Management Planning, and industry forestland programs.

Indicators

- Increased health and sustainability of American forests.
- Multi-stakeholder consensus on definitions and criteria.
- Agreement by all key stakeholders, on a national basis, that good progress is being made in achieving sustainable forest management.

RATIONALE

benefits. Forests cover about 30 percent of the United States, or 648 million acres. Nearly two-thirds of U.S. forests are productive as timberland. More

industries own about 15 percent; the balance of 28 percent is in public ownership, most of which is contained in national forests administered by the

The United States has a rich fabric of laws, policies, regulations, and institutions at the federal, state, tribal, and local levels that guide the management of public and private forests, prairies, and rangelands toward sustainability in its social, economic, and environmental dimensions. The goal for forests represents U.S. policy developed in response to the United Nations Conference on Environment and Development. This recommendation is intended to apply on a national basis to our nation's forests:

- industrial forests,
- nonindustrial woodlands,
- federal forests,
- tribal lands forests,
- state and other public forested lands, and
- urban forests.

The United States announced its commitment to implement ecosystem management on all federal forestlands at the Earth Summit in June 1992 at Rio de Janeiro.14 The United States also made a commitment to a national goal of achieving sustainable management of U.S. forests by the year 2000 at the Ministerial Conference on the Protection of Forests in June 1993 at Helsinki, Finland.15

Industrial forest landowners have also made an unprecedented commitment to sustainable forestry by adoption of a Sustainable Forestry Initiative through AF&PA. AF&PA represents more than 90 percent of the nation's forestland base.16

Many of the member organizations of PCSD have a demonstrated interest in the outcome of these debates over forest sustainability. As many players have taken initiatives to make progress in forest sustainability, key PCSD stakeholders in this area could be instrumental in helping establish a framework for an approach to this complex issue. In this way, PCSD could play an instrumental role in meeting the goal of implementing sustainable forestry on America's forestlands by the year 2000.

POLICY RECOMMENDATION 5

RESTORE AMERICAN FISHERIES

Eliminate over-fishing and rebuild depleted stocks in U.S. waters; adopt the precautionary principle in decisionmaking—in the face of scientific

uncertainty, err on the side of resource conservation.

DISCUSSION

Individuals, families, communities, regions, and the country have all experienced significant adverse economic and social impacts due to a precipitous decline, and sometimes complete collapse, in freshwater, marine, and anadromous fisheries. This recommendation is aimed at reversing this trend and restoring American fisheries to a self-sustaining condition by 2010.

Who

The U.S. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, in conjunction with regional fisheries management councils, U.S. Fish and Wildlife Service, Native American tribes, and state fisheries management agencies are responsible for implementing this recommendation. Native tribes, industry, and private citizens all participate in the development and implementation of fishery management plans through which this recommendation will be carried out.

How

- Where over-capitalization exists, pursue limited-entry management programs while taking active measures to reduce harvesting capacity.
- Improve the precision of science for fishery management decisionmaking.
- Generate quantitative assessments of social and economic effects associated with limited-entry management and develop impact assessment models for specific U.S. fisheries.
- Pursue public and private mitigating actions aimed at offsetting socioeconomic impacts of management decisions.
- Reduce bycatch by fostering public and private development of conservation gear, modifying fishing practices, and incorporating quantified bycatch data into stock assessments.
- Foster environmentally sound marine aquaculture and associated standards for sustainability.
- Improve cooperation and coordination among fisheries and land management agencies, private industry, hydropower agencies, and other stakeholders involved in anadromous fish conservation and management.
- Strengthen programs to prevent accidental introduction of exotic aquatic species, and screen intentional introductions for adverse

unintended economic and environmental impacts.

Indicators

- Our nation's rivers, lakes, and estuaries are fully restored to provide self-sustaining, healthy, and diverse aquatic life by 2025: 2,000 square miles of estuaries, 20,000 river miles, and 1.5 million acres of lakes are restored by 2000; 3,000 square miles of estuaries, 30,000 river miles, and 3.0 million acres of lakes are restored by 2010.
- National marine and freshwater fisheries policies and management have a prime focus of restoring fisheries to a self-sustaining basis by 2025.
- The scientific basis of information for marine fisheries is sufficient to establish a firm basis for determining and measuring sustainability of marine fish resources by 2010.
- Impaired anadromous and freshwater fisheries are fully restored by 2025: one-third restored by 2000; two-thirds restored by 2010. The quality of waters that currently produce contaminated fish and shellfish fully restored by 2025: one-third restored by 2000; two-thirds restored by 2010.
- All vessels operating in U.S. waters are required to use effective ballast management practices by 2002. A system for screening and evaluating introduced species is up and running by the year 1999.

RATIONALE

The nation's economic health and the quality of life for tens of millions of Americans can be greatly increased through wise use of its fishery resources. Much of the prevailing controversy regarding marine fisheries can be reduced or eliminated by applying sound, comprehensive scientific information to the development of national fishery policy. Implementation of science-based fishery management plans will help resolve the multifaceted problems facing marine fisheries, including:

- over-fishing and resource depletion,
- uncontrolled participation in commercial fishing,
- over-capitalization,
- loss of crucial spawning and nursery habitat,
- controversial allocation decisions, and
- incidental harm to other marine resources due to imprudent harvesting practices.

By coordinating these sorts of efforts in marine fisheries with similar actions targeting freshwater fisheries, tremendous national economic and societal gains can be realized—particularly in the revitalization of commercial fishing industries—providing recreation for millions of Americans, increasing net fishery values, and meeting treaty obligations to Native American tribes.

While an important segment of our economy is tied to the health of our nation's marine and freshwater fisheries, there is an equal responsibility to protect highly valued protected species and their associated fragile freshwater and coastal habitats. Fishery resources and protected species are interactive members of the same ecosystem, and, in some cases, protected species are taken in fishing operations. Two hundred and fourteen salmon runs are considered at risk, two of which are endangered, due to commercial exploitation and habitat degradation.17 By taking a stewardship role over our living resources and balancing exploitation of natural resources with the management of protected resources, we will ensure that future generations of Americans will have a rich diversity of freshwater and marine life for both their consumptive and nonconsumptive enjoyment.

POLICY RECOMMENDATION 6

INCENTIVES FOR CONSERVATION OF NATURAL RESOURCES

Create and promote incentives at all levels of government that will support the self-interest of corporations, property owners, and resource users to embrace conservation of natural resources and enlist their knowledge and skills to work on its behalf.

Executive and legislative bodies at the federal, tribal, state, and local levels that establish tax, economic, and other policies that directly influence natural resources are challenged to examine those policies that lead toward natural resource degradation or depletion and redirect them toward conservation. This recommendation intends to relieve and redirect pressures that are leading to degradation or depletion of the natural resource base upon which our country's social, economic, and environmental vitality depends. A prime example would be for the U.S. Army Corps of Engineers to integrate an environmental restoration mission fully into its management of the Mississippi River.

DISCUSSION

The United States is at risk of degrading natural resources that are critical to our national social, economic, and environmental well-being. Pressures leading to degradation and potential exhaustion of natural resources are often due to perverse effects of public economic policy in three distinct areas: subsidization, public expenditures, and taxation. Tax policy can be used to create a set of powerful economic incentives and disincentives to promote sustainability. By integrating tax policy with market-driven economic incentives and appropriate regulatory prohibitions, private property interests and users of public lands can be encouraged to make socially desirable and beneficial decisions that promote resource conservation.

Who

Executive and legislative bodies at the federal, tribal, state, and local levels that are charged with establishing economic, tax, and other policies that directly influence natural resources.

How

Use tax policies and incentives programs to encourage and reward industry, businesses, communities, and individuals for shifting to sustainable practices and efficient use of natural resources. Review current policies and tax programs to identify and eliminate deterrents to sustainable practices. Develop a matching fund program to encourage local, regional, state, tribal, and national investment in sustainable programs and projects.

Economic incentives and disincentives that encourage conservation of natural resources can include, where appropriate:

- **property tax reductions** for those who commit to managing property for species of concern;
- **tax credits** for expenses incurred in improving degraded habitat or creating new habitat for target species;
- **tax deduction** for income derived from economic activity on lands managed fully and perpetually for species of concern;
- **inheritance tax reform** to promote conservation by ensuring that large tracts of habitat do not have to be liquidated, broken apart, or devoted to more economically intensive use as a consequence of inheritance taxes (or their avoidance);
- **capital gains tax deferral** on land transfers that facilitate or continue to provide for conservation;
- **denial of direct and indirect subsidies** (e.g., farm commodity price supports, federally defrayed costs of water, energy, and timber sales) to individuals engaged in practices that are averse to sustainability and resource conservation; and
- exploration of the use of **conservation credits** as a mechanism to

create a market for environmentally protective actions.

Indicators

- By 2025, the nation's incentives and disincentives fully reflect a commitment to sustainable management and use of natural resources.
- Landowners and business owners utilize tax incentives to conserve natural resources and implement environmentally sound activities.
- The government and the private sector should collectively offer an engineering prize for the best proposal for a future transportation system for agricultural products that best achieves economic and environmental objectives on the Upper Mississippi River.

RATIONALE

Perverse public policies have unleashed a torrent of conflicting social, economic, and political forces that work at cross purposes to conservation of natural resources. Currently, the beneficiaries of conservation have little incentive to pay, while those who can provide sustained benefits are unable to profit from their conservation actions. Private lands are critical to achieving sustainability and resource conservation, because only about 20 percent of the lands in the contiguous United States (rising to about 30 percent if Alaska is included) are owned by the federal government.18 Of the 728 species listed as endangered or threatened under the Endangered Species Act, 50 percent are found exclusively on nonfederal lands (including private, tribal, state, and local government land, as well as land protected by groups such as The Nature Conservancy).19 Laws and regulation alone have not been satisfactory in achieving positive results. Adding conservation incentives through economic and other policies can create a powerful combination of economic self-interest and necessary regulatory controls to promote sustainability. Public economic policies that are perverse to concepts of sustainability are apparent in three distinct areas: subsidies, expenditures, and taxation.

Subsidies

Many subsidies encourage consumptive rather than conservation-based behavior by obscuring the real costs of decisions. Examples of subsidies that are in direct conflict with other laws and policies include the following:

- Subsidized overgrazing by permit practices for public lands is leading to the destruction of habitat for endangered species such as the desert tortoise.20
- Cheap hydropower and subsidized diversion of water for irrigation jeopardize the continued existence of Columbia River salmon and other endangered species.21
- Price supports for sugar producers encourage habitat loss and result in pollution of waterways in Florida.22

Expenditures

Public expenditures on economic infrastructure such as roads, dams, schools, and industrial parks can encourage investment and induce development in areas that might not be attractive in contravention of sustainability values in that, for instance, they encourage sprawl which requires new costly infrastructure or agriculture which requires costly subsidized electricity.

Taxation

Tax codes and policies can promote sustainability and resource conservation because tax policy can be used to create a set of powerful incentives and disincentives to promote sustainability and can transfer value among various segments of society. These tools do not eliminate costs of sustainability and conservation, but rather transfer costs from the private to the public sector.

POLICY RECOMMENDATION 7

INTEGRATED LAND USE PLANNING

Encourage local governments to engage their citizens in forging and implementing a vision that conserves natural resources for their communities.

This vision can be realized through the exercise of a locality's land use authorities and expenditure of its fiscal resources. Federal, tribal, and state governments should support communities in their efforts to realize conservation in land use. Taxpayers, municipalities, and endangered species all currently suffer from the adverse effects of urban sprawl; and all would benefit from integrating the conservation of natural resources into planning and zoning. This recommendation is intended to encourage and support community planning processes to develop and take steps to achieve a common vision for their locality that will result in economically sound land use and environmental conservation.

DISCUSSION

One of the principal causes of environmental degradation and failing regional marketplaces is urban sprawl. In many parts of the country, development patterns consume land and natural resources at several times the rate of population growth.23 This pattern of land development is neither environmentally conserving nor economically sound. Taxpayers suffer as much as endangered species. An integrated land use planning system needs

to be created that encourages more compact and conservation-oriented patterns of growth. Reforms are needed at the local level that are encouraged and supported by regions, states, and federal agencies working together in setting policies and coordinating programs.

Who

This recommendation calls for support and integration of planning processes at the local, regional, state, and federal levels. Hence, agencies at all levels that have an interest in development and conservation of particular lands should be involved. This includes agencies at the federal and state levels; their regional administrative offices; and local zoning, planning, and conservation boards as well as the general public.

How

Local governments, with the inputs of their citizens, should adopt and implement land use plans and programs in patterns that conserve land and resources. These plans and programs should be coordinated with those of their neighbors to accommodate current growth, as well as plan for future development needs. State governments should adopt and implement land use planning acts that create state land use plans. States should find ways to advocate and encourage local action that leads toward conservation of natural resources. The federal government should establish a mechanism to provide a coordinated, well-focused federal effort in support of local planning where there is a federal interest. The effort would also include exercise of federal authorities in conjunction with state and local authorities to assist in meeting common goals.

Incentives should be provided to encourage localities within the same region to coordinate their community visions or plans with one another, ensuring that they are compatible rather than competitive. Regional, state, and federal agencies should streamline the approval and development of projects that conform to the intermunicipal plans. Where these plans envision conservation, federal, state, and regional agencies should join in actions to protect resources for the future. Local, regional, state, federal, and tribal agencies should collaborate in creating a network to exchange information related to land use and conservation.

Indicators

- Reversed trend of urban sprawl.
- Increase in intermunicipal and intergovernmental land use planning efforts.
- Increase in the number of local land use plans that are purposefully oriented toward reducing urban sprawl and increased integration of the social, economic, and environmental dimensions of sustainability.

RATIONALE

This recommendation envisions a locally initiated process of policy development, planning, and implementation to achieve cost-effective conservation in land development patterns. The locally initiated process would be supported by intergovernmental cooperation. The issues and interests involved in resource use and conservation are interdependent. However, this is the basis from which a successful strategy for sustainable land development patterns can emerge, since mutual dependence is the essence of sustainability, in general. Yet for disparate interests to unite in seeking mutually beneficial solutions, they first must be encouraged to cooperate. Strategies that provide incentives, rather than coercion, are better at facilitating compromise.

Systems adopted to achieve sustainability need to be responsive systems, listening and reacting to a variety of interests, open to innovation, and encouraging collaboration—yet patient enough to achieve incremental success. Importantly, these systems need to be grounded at the local level to encourage patterns to emerge from the unique qualities and contributions each community can offer. For order to emerge among these local patterns of thought and development, however, these systems must ensure that local communities communicate and collaborate with their neighbors so that their influences on one another, on balance, are positive.

The original system of land use control, created over 80 years ago and designed primarily for cities, was relatively simple and effective.24 Since then, however, it has been augmented in a piecemeal fashion in reaction to new pressures from population growth, technology development, and environmental research. The result is an uncoordinated, disconnected morass of regulations, processes, and financial incentives administered by disparate public agencies at various levels of government. Rather than constituting an organized and efficient legal system aimed at compatible objectives, it has become a complicated tangle of influences that collide and produce highly inefficient land use patterns.

Growing discontent with the results of this system has led to even greater regulation and litigation, lengthier processes of approval, and a pervasive caution about where and when development should occur. This greatly disadvantages land developers and expanding business interests as well as

the urban poor and the environmental quality of many developing regions. That the land use system needs to be reinvented is clear; this proposal is an integrated method of beginning that process.

POLICY RECOMMENDATION 8

INTEGRATE SUSTAINABLE DESIGN PRINCIPLES INTO LAND DEVELOPMENT

Initiate a major collaborative public-private effort to integrate sustainable design principles into all aspects of land development to secure environmental benefits and mitigate impacts for people and their communities.

The scope of this recommendation includes siting, site and building design, land development, landscaping, construction practices, sources and choices of materials, technology, and policy. This recommendation focuses on efficiency in use of land, energy, water, and materials. Attention would be given to life cycle impacts and durability; nontoxic materials; use of recycled and recyclable materials and buildings; and reduced reliance on fertilizers, pesticides, and landscaping water demand. This initiative would result in demonstrations, guidelines, and model building codes that would inspire and guide designers, engineers, and builders.

DISCUSSION

This recommendation is intended to shape design and construction practices by demonstrating that design and construction can be conducted in ways that provide environmental benefits and reduce undesirable environmental impacts.

Who

This recommendation would be initiated by a professional association, such as the American Institute of Architects, which would invite collaboration among other professional and trade associations, environmental groups, and agencies with particular interest at the federal, state, and local levels.

How

A professional association would initiate a multi-stakeholder national steering group with corollary groups at state or local levels to identify, publicize, and build on successes in using building codes to secure environmental benefits. The scope of this effort would include:

- **Construction**—incentives for developers to use life cycle approaches to costing construction and demolition practices; certification of construction companies, the use of sound land management practices such as erosion and sediment control; building on environmentally sensitive lands.
- **Design**—energy-efficient building designs; incentives for open space, saving existing natural resources like trees and wetlands; siting and design considering the path of the sun.
- **Landscaping**—education of landowners, developers, and golf course managers about planting trees for shade and energy savings; edible landscaping, reduction of water-intensive landscaping in drought areas; recycling of water from the home for gardens.
- **Policy**
  limiting urban sprawl, in-fill development and open space preservation; development around public transportation nodes to lessen reliance on

  federal highway aid; revenue sharing to encourage compact development, use of existing infrastructure, and mixed-use

- **Technology**
  efficiency.

Indicators

Existence of state and federal incentives to use environmentally friendly building codes.

Availability and use of information on sound land use planning and development practices.

Existence and use of standards and building codes for the environment.

Demonstrations.

Land development and the construction industry are extremely important elements of our national economy and the well-being of our families.

responsible for where we live, work, and play in our daily lives. Both industries provide great opportunities to enrich each of our lives through providing

Energy bills keep climbing, and people want to know what they can do to save money. On a national basis, we are challenged to find energy sources for the

future. Many utilities are finding the highest returns on investments are in increasing efficiency rather than increasing production of energy. Energy-efficient buildings, using sound construction materials, solar energy, and tree shading, can result in savings for consumers and our nation as a whole.

Our nation's landfills are rapidly reaching capacity. Recycling, composting, and removing yard waste reduces the waste stream significantly.

Water is in short supply in the West. If people were to use water wisely by conserving, recycling, and using efficient technologies, the problem could be significantly reduced.

POLICY RECOMMENDATION 9

PARTNERSHIPS FOR CONSERVATION

Create conservation areas through public-private partnerships at the local level.

This recommendation is intended to capture important biodiversity values on those lands that lie somewhere between densely populated urban lands and protected wildlands. The recommendation is aimed at conserving biodiversity while securing social, economic, and environmental benefits from lands that are still largely in their native vegetated state. These voluntary partnerships are formed within a framework that provides opportunities for individuals and corporations to make important contributions to biodiversity while still making a living from their lands. The networks of conservation areas arising from these partnerships will complement the nation's existing system of public and private protected areas, conservation areas, and preserves, which provide an important web of biodiversity across the country.

DISCUSSION

A large percentage of the American landscape is in a semi-natural condition where people make a living on land that is still largely in its native vegetated state. Extremely important contributions to biological diversity can arise from the interactions between people and their environment in these semi-managed, semi-natural environments on private lands. Many individuals, communities, corporations, governments, and nongovernmental organizations desire to make contributions toward biodiversity. This recommendation is intended to take advantage of that desire; and, in so doing, contribute to the protection and restoration of aquatic and terrestrial ecosystems, processes, and biodiversity upon which we depend.

Who

Private individuals, corporations, and nongovernmental organizations that desire to make contributions to biodiversity would be afforded the opportunity through a framework created by collaborative effort among multiple stakeholders. The White House, working through the U.S. Departments of Agriculture, Commerce, and the Interior; tribal, state, and local governments; conservation groups; and industry would initiate and facilitate a collaborative effort creating a framework for public-private partnerships for biodiversity in each major bioregion of the country.

How

Creating a network of conservation areas based on public-private partnerships requires a collaborative effort among key stakeholders to forge a commonly shared vision for these landscapes and to craft a set of widely accepted goals and priorities for each major bioregion of the country. The next step is to develop an implementing mechanism that would foster voluntary partnerships among individuals, governments, corporations, and nongovernmental organizations to meet these goals. The partnerships could include preserves, easements, agreements, trusts, and other arrangements on public and private lands. One possible implementing mechanism could be a quasi-public entity chartered by Congress to support and facilitate the building of this locally based network of conservation areas.

Indicators

- By Earth Day 1997, establish a multi-stakeholder entity to create a network of conservation areas through “Partnerships for Conservation.”
- By Earth Day 2000, achieve consensus on an implementing mechanism for “Partnerships for Conservation” which has a wide basis of support among Congress, the executive branch—including agencies; tribal, state, and local governments; conservation groups; and industry.
- By Earth Day 2001, celebrate the establishment of a national network of conservation areas for each major bioregion in the country.

RATIONALE

We are losing the elements and functions of biodiversity in our country and on the Earth at an alarming rate. From the fossil record, scientists conclude that the background rate of extinction is one species per century to one species per year. The extinction rate today is between one species per day to one species per hour.25 As populations and species drop out of the natural communities of which they are a part, the communities begin to decay. There are three principle causes of loss of biological diversity:

- habitat loss (the main cause of species extinction),
- pollution, and

- exotic species.

Habitat fragmentation is closely related to habitat loss in that it breaks up habitats into smaller pieces which do not function as they did when they were larger and connected.

Just as families, their houses, neighborhoods, shopping centers, and the roads that connect them make up the basic building blocks of communities, so it is that biological diversity provides the basic building blocks of ecosystems. Biological diversity has basic elements of genes; species; their interactions; and important functions such as the natural processes of fire, nutrient, and water cycling—including droughts, floods, and annual fluctuations in stream flows.

Thomas Lovejoy of the Smithsonian Institution suggests that 4.5 percent of the U.S. gross domestic product was attributable to wild species in 1986.26 He also recognizes the economic benefits of biodiversity in the areas of agriculture and pest management, pharmaceuticals, environmental applications, and products generated from naturally occurring molecules.27 It is important to recognize that almost all of the species in trouble are going extinct incidental to some economic pursuit—that is, as an unintended consequence. In manufacturing jargon, we would call this waste.

A large percentage of the American landscape is in a semi-natural condition where people make a living on a landscape that is still largely in its native vegetated state. Protection of biological diversity and securing environmental benefits for future generations will, in large part, be determined by how the interactions between people and their environment takes place in these semi-managed, semi-natural environments. Individuals, communities, corporations, governments, and nongovernmental organizations all have essential roles to play in protecting biodiversity and securing environmental benefits.

POLICY RECOMMENDATION 10

IMPROVE NATURAL RESOURCE DECISIONMAKING

Deploy the resources of government to improve natural resource decisionmaking, ensuring that it is well-coordinated; based on high-quality information; and integrated with respect to social, economic, and environmental aspects.

Strategic decisions should be made by government agencies at all levels to better manage the collection and use of natural resource information and

improve natural resource decisionmaking by (1) making available the best possible natural resource information based on science, and (2) using this information to make open and transparent decisions about natural resources that are coordinated among agencies and levels of government and well-integrated in social, economic, and environmental aspects. This recommendation is intended to provide a firm basis in knowledge to encourage adaptive management in applying sustainable development principles in the face of uncertainty rather than refraining from action until certainty is achieved. An implementing mechanism would be an executive order directed at federal agencies under the Government Performance and Results Act.

DISCUSSION

Because natural resources are crucial to our social, economic, and environmental well-being, people all across the country said it was of utmost importance that all natural resource decisions should be based on science and high-quality information and that decisions by government agencies at all levels should be coherent, coordinated, and well-integrated.

Who

The President should issue an executive order directing federal agencies to implement this recommendation through their strategic planning under GPRA. The President should also call on the nation's governors and tribal leaders to take up this recommendation at the state level.

How

Agencies, in the strategic planning mandated under GPRA, should make strategic decisions focused on making available the best possible natural resource information based on science and using this information to make open and transparent decisions about natural resources that are coordinated among agencies and levels of government and well-integrated in social, economic, and environmental aspects.

To focus such strategic planning efforts in federal agencies, the White House should develop a collaborative mechanism to set the Administration's national natural resource goals and priorities and establish a related common

accessible database for natural resource management at all levels of government by 2000; by 2010, changes should be instituted in agency authorities, programs, and priorities to reflect national goals and priorities.

Indicators

- Decisionmakers communicate interrelationships of natural resource systems and sustainability in terms simple enough to fully inform public participation in decisionmaking.
- Federal agencies use adaptive management to apply sustainable development principles in the face of uncertainty rather than refraining from action until certainty is achieved.
- Integrated, collaborative decisionmaking within and among governments is the norm.

RATIONALE

Because natural resources are crucial to our social, economic, and environmental well-being, people said that it was of utmost importance that all natural resource decisions should be based on science and high-quality information. They said that the science and information needs to be credible, easily understandable, and sufficient to serve as a basis for an integrated understanding of the social, economic, and environmental effects of decisions over time and space. Such information should be readily accessible for use by citizens, corporations, nongovernmental organizations, and government agencies at all levels.

People told us that natural systems know no administrative boundaries. Workshop participants were unanimous in telling us that policies and programs that affect natural resources should not be dictated by administrative boundaries, but should be coherent and well-coordinated at all levels—federal, state, tribal, and local. They told us that such policies and programs should be based on full public participation and focused on meeting the needs of the present without compromising the ability of future generations to meet their own needs.

The workshops have pointed out that challenges for improving natural resource decisionmaking to achieve sustainable development are threefold:

- **Overcome conflicting and incoherent goals between jurisdictions and set national, regional, state, tribal, and local goals linking protection and development of natural resources with measurement of progress in meeting those goals.** Unless we set measurable goals, the old adage will apply: "When you don't know where you're going, any road will get you there."

- **Establish institutional arrangements that are sufficiently robust to manage the tradeoffs and resolve conflicts between multiple uses and demands at various scales.** Air pollution, for example, created in one region of the country that causes damage to forestry or agriculture in another region needs to be addressed. It is much simpler and more politically expedient to maintain a narrow focus, but nature brutally reminded us of this inefficiency during the 1993 Midwest flood. In trying to shape and subdue the Mississippi River, we ended up paying tremendous social, economic, and environmental costs. In south Florida, California, and other places across the United States, industries, governments, and private interests alike are discovering that—particularly within watersheds—the way one manages natural resources can set off a chain reaction that has significant economic, environmental, and social consequences within and beyond the immediate area.
- **Understand the interrelationships between different resources and the interaction with social and economic forces.** This challenge includes understanding how the health of one resource affects or is affected by the health of others. Important linkages between resources and policies are often overlooked. Sometimes detrimental effects to particular natural resources occur when attention is focused separately on individual resources or policies through different regulatory agencies or different federal or state laws, or by oversight from different congressional committees.

POLICY RECOMMENDATION 11

FINDING CONSENSUS BETWEEN STAKEHOLDERS AND THE FEDERAL GOVERNMENT

Empower the federal government to play a more active role in building consensus on difficult issues.

Create flexibility in Federal Advisory Committee Act of 1972 (FACA) procedures that, while still achieving the underlying goals of the act—integrity and honesty of government—encourage more collaboration in resolving conflicts between federal officials and local, regional, state, and tribal stakeholders.28 This recommendation is intended to provide the authority for the federal government to play an active role in forging common visions, finding common interests, building consensus, and finding ways for stakeholders to work together toward common goals.

DISCUSSION

Conflicts related to the protection and management of multiple uses of natural resources are increasingly exceeding the capacity of existing institutions, processes, and mechanisms to resolve them. FACA requires rigorous procedures that often hinder federal officials in their efforts to resolve conflicts and help stakeholders find common ground. FACA currently takes a "one-size-fits-all" approach.

Who

Flexibility in FACA can be created by the President through executive order, by agency heads through the promulgation of regulations, and by Congress through FACA amendments.

How

FACA, its implementing regulations, and any associated executive orders should be amended to create a better match between procedures and scope of issues/decisions at hand. Agencies should promulgate regulations that delegate authorities and streamline procedures, particularly to allow for flexibility in FACA's application. The President should revisit Executive Order No. 12838, Termination and Limitation of Federal Advisory Committees, to allow agencies to work more closely with stakeholders on an informal basis.29

Changes should be aimed at:

- facilitating meetings between officials of the federal government and representatives of any combination of one or more state, county, or local governments, or Indian tribes;
- encouraging federal agencies to convene stakeholders to forge consensus around particular natural resource issues and find ways to work together toward commonly shared goals;
- empowering federal, state, tribal, and local agencies to employ a watershed (or other defining landform) approach using collaborative multi-agency, multi-stakeholder processes; and
- fostering use of alternative dispute resolution techniques.

Indicators

- Increase in the use of alternative dispute resolution techniques for natural resource conflicts.
- Increased federal, tribal, state, and local government collaboration and increased citizen and corporate support for government actions.
- Decreased litigation on natural resource issues.

RATIONALE

The key to successful resolution of natural resource conflicts often lies in being able to forge a common vision and goals and collaborate in activities aimed toward meeting those common goals. FACA sets high standards and requires rigorous procedures that often hinder collaborative decisionmaking between federal agencies and other governments including states, tribes, and local governments. The stringent provisions of the act have also become a barrier to developing support or consensus among stakeholders for contemplated government actions.

As a nation, we are struggling to build a conservation ethic—a shared aspiration about stewardship of natural resources—and an understanding of our relationship to the Earth and its natural resources upon which we depend. The way we manage our natural resources will determine the quality of the air we breathe, what we eat, and the vitality of our economy. An important part of this ethic is the notion of sustainability—an understanding that what we do today should not compromise the options available for future generations. Sustainability for natural resources implies high standards of environmental care, productive functioning of ecosystems, maintaining the viability and diversity of species, use of natural resources for economic benefits, and sharing our natural resource endowment widely and equitably.

The development and implementation of watershed approaches to sustainable development will require collaborative approaches by governments and stakeholders. Permitting such meetings will require an amendment of FACA. Collaborative decisionmaking requires that all governmental bodies should be able to communicate with stakeholders in order to develop supportable decisions. FACA specifies procedures by which federal agencies may accept advice from nonfederal entities and individuals. Because FACA's standards are highly formalized, the statute may hinder collaborative decisionmaking between citizens, federal agencies, and other governments including states, tribes, and local governments. For example, because the experts were not properly organized under FACA, a federal court ruled that FACA prevented the federal government from utilizing a committee composed of state and tribal technical experts in the implementation of the President's Forest Plan for the Pacific Northwest.

Communities and citizens across the country are discovering that collaborative watershed-based approaches involving communities and all stakeholders are a powerful tool for resolving natural resource conflicts. People are discovering that such approaches are capable of providing a reliable means for balancing competing interests; taking a broad view of the problems; integrating the social, economic, and environmental aspects; moving beyond boundaries in jurisdictions and agency authorities; and reflecting community interests as well as the interests of individual citizens. Sustainability ultimately cannot be decided by the government for people—people will have to decide it for themselves. In order to ensure that all interests are represented, it is important that all stakeholders are at the table, including, but not limited to, private citizens, local representatives of government, national

nongovernmental organizations, federal agencies, in addition to members of the local community.

COMMUNITY-BASED MULTI-STAKEHOLDER COLLABORATIVE WATERSHED APPROACHES

Employ voluntary community-based multi-stakeholder collaborative approaches to protect, restore, and monitor watersheds and to resolve natural resource conflicts.

These approaches should be open and inclusive; based on existing laws; and conducted within a framework of natural systems—watersheds, ecosystems, bioregions, or other defining landforms—using the best available science. This recommendation is patterned after successful approaches used all across the country. It is intended to provide impetus for stakeholders and communities to work together in searching for common goals, resolving conflicts, becoming aware of and using best available science, meeting legal requirements for protecting the environment, monitoring natural resources, and redeeming collective responsibility for conditions and trends of natural resources.

DISCUSSION

This recommendation is intended to reduce conflict and enable stakeholders, communities, and governments to redeem their responsibilities for stewardship to protect the crucial contributions that natural resources make to our collective social and economic well-being.

Who

Public and private leaders, communities, governments, and their agencies at all levels—local, state, tribal, and federal—should embrace a new way of doing business using voluntary collaborative approaches based on the framework of natural systems, whereby stakeholders:

- search for common goals, values, and interests;
- work together in resolving conflicts and directing energies and investments; and
- take collective responsibility for actions and monitoring outcomes.

How

In recognition of the importance of natural resources, communities all across the country should, individually and working together with stakeholders and communities, employ collaborative approaches. These efforts would be aimed toward the protection and restoration of natural resources and systems; implementation of applicable laws; resolution of natural resource conflicts;

ENDNOTES

1. This report contains many statements made by public workshop participants. Most of these statements are taken from the regional workshop reports (in appendices C, D, and F) and represent the recorded recollections of the workshop organizers and workshop report authors. The President's Council on Sustainable Development does not hold minutes of the workshops and has not verified the factual accuracy of these statements.
2. From Lower Mississippi Basin Workshop, Summary Report, Baton Rouge, Louisiana, January 5-6, 1995, pp. 3-4.
3. National Forest Management Act of 1976, Pub. L. 94-588, 90 Stat 2949; National Environmental Policy Act of 1969, 42 U.S.C. 4321 (1988); Magnuson Fisheries and Conservation Act of 1976, 16 U.S.C. 1801 et seq. (1985); Marine Mammal Protection Act of 1972, 16 U.S.C. 1361 et seq. (1985); Endangered Species Act, 16 U.S.C. 1531 et seq. (1982); and Clean Water Act, 33 U.S.C. 1251 et seq. (1982).
4. Federal Advisory Committee Act of 1972, 5 U.S.C. App. 2 (1976) and 41 C.F.R. 101-6.10.
5. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *National Air Quality and Emissions Trends Report, 1995*, EPA 454/r-96-005 (Research Triangle Park, NC, 1996).
6. See National Research Council, *Protecting Visibility in National Parks and Wilderness Areas* (Washington, DC: National Academy Press, 1993); and Ned Burks and Chris Fordney, "Battle for the Blue Ridge," *The Washington Post*, October 31, 1993: mag. p. 14 (air pollution in Shenandoah National Park).
7. U.S. Department of Agriculture, Natural Resources Conservation Service, *1992 National Resources Inventory Backgrounder* (Washington, DC, 1995).
8. Ibid.
9. U.S. Department of Agriculture, Natural Resources Conservation Service, *Summary Report 1992 National Resources Inventory* (Washington, DC, 1995).
10. Government Performance and Results Act of 1993, 31 U.S.C. 1115-1119 (1995).
11. See Carol S. Carson et al., "Integrated Economic and Environmental Satellite Accounts," *Survey of Current Business*, April 1994: 33-49. The article reviews work by the Bureau of Economic Analysis, U.S. Department of Commerce.
12. Scott Wallinger, "A Commitment to the Future: American Forest and Paper Association Sustainable Forestry Initiative," *Journal of Forestry* 93, no. 1 (January 1995): 16-19.
13. Douglas S. Powell et al., *Forest Resources of the United States, 1992*, no. 234 (Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experimentation Station, 1994), p. 132; Richard W. Haynes, *An Analysis of the Timber Situation in the United States: 1989-2040*, Forest Service Report RM-199 (Washington, DC: U.S. Department of Agriculture, 1990), p. 174, table 126; U.S. Department of Agriculture, Natural Resources Conservation Service, *Summary Report 1992 National Resources Inventory* (Washington, DC, 1995), p. 5,

fig. 1; and Council on Environmental Quality, *Environmental Quality: The Twenty-Fourth Annual Report* (Washington, DC: U.S. Government Printing Office, 1993), p. 451, table 45, and p. 462, table 57.

14. See Daniel Sitarz, ed., *Agenda 21: The Earth Summit Strategy to Save Our Planet* (Boulder, CO: Earth Press, 1993).

15. Information presented by Elson Ross, Associate Deputy Chief for Research for the U.S. Forest Service, to the Second Ministerial Conference on the Protection of Forests in Europe, Helsinki, Finland, 16-17 June 1993, p. 4.

16. Wallinger, p. 17.

17. See W. Nehlsen, J.E. Williams, and J.A. Lichatowich, "Pacific Salmon at the Crossroads: Stocks at Risk From California, Oregon, Idaho, and Washington," *Fisheries* 16, no. 2 (1991): 4-21.

18. U.S. Department of Commerce, *Statistical Abstract of the United States 1995* (Washington, DC: U.S. Government Printing Office, 1995), p. 227, table 364, and p. 228, table 365.

19. Bruce A. Stein et al., "Significance of Federal Lands for Endangered Species," in U.S. Department of the Interior, National Biological Service, *Our Living Resources—A Report to the Nation on Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecological Systems* (Washington, DC, 1995), pp. 398-401.

20. For further information on overgrazing and grazing reform on federal lands, see U.S. Department of the Interior, Bureau of Land Management, *Ecosystem Management in the BLM: From Concept to Commitment*, BLM/SCGI-94/005-1736 (Washington, DC, 1994), p. 2; National Research Council, *Rangeland Health: New Methods to Classify, Inventory, and Monitor Rangelands* (Washington, DC: National Academy Press, 1994); and Rick Weiss, "Tracking a Dwindling Desert Denizen," *The Washington Post*, March 18, 1996: p. A-3.

21. For further information, see U.S. Department of Commerce, National Oceanic and Atmospheric Administration, *Proposed Recovery Plan for Snake River Salmon* (Washington, DC, 1995) (this addresses salmon runs in the Columbia and Snake Rivers); and Tom Kenworthy, "Agency Outlines Salmon Protection Plan: Costly Measures Could Send Shock Waves Through Northwest Economy," *The Washington Post*, March 21, 1995: p. A-3.

22. For newspaper accounts, see William Booth, "Sweet Progress in Everglades: Florida Sugar Farmers Send Less Phosphorus Into Marsh," *The Washington Post*, September 4, 1996: p. A-1; and William Booth, "Sugar Growers Stuck in Everglades Battle: Opposition Pushing Tax to Pay for Cleanup," *The Washington Post*, January 12, 1996: p. A-3.

23. For example, while Greater Los Angeles increased its population by 45 percent between 1970 and 1990, its geographical reach expanded by nearly 300 percent. Henry L. Diamond and Patrick F. Noonan, *Land Use in America* (Washington, DC: Island Press, 1996), p. 88.

24. New York City enacted the country's first zoning ordinance in 1916. In 1926, the U.S. Supreme Court upheld the basic constitutionality of zoning in the landmark decision *Village of Euclid v. Ambler Realty Co*, 272 U.S. 365 (1926). See Charles M. Haar and Jerold S. Kayden, eds., *Zoning and the American Dream: Promises*

Still to Keep (Washington, DC: Planners Press, 1989), p. ix.

25. Estimating extinction rates is difficult, but scientists agree that rates of extinction have accelerated several times over background rates. See John H. Lawton and Robert M. May eds., *Extinction Rates* (New York: Oxford University Press, 1995), pp. 1-4.

26. See World Resources Institute, *Global Biodiversity Strategy: Guidelines for Action to Save, Study and Use Earth's Biotic Wealth Sustainably and Equitably*, prepared in collaboration with the U.N. Environment Program and the World Conservation Union (Washington, DC: World Resources Institute, 1992), p. 2, citing C. Prescott-Allen, *The First Resource* (New Haven: Yale University Press, 1986).

27. Regarding the economic value of biodiversity, see Walter V. Reid et al., *Biodiversity Prospecting: Using Genetic Resources for Sustainable Development* (Washington, DC: World Resources Institute, 1993); and Norman Myers, *A Wealth of Wild Species: Storehouse for Human Welfare* (Boulder, CO: Westview Press, 1983).

28. Federal Advisory Committee Act of 1972, 5 U.S.C. App. 2 (1976) and 41 C.F.R. 101-6.10.

29. Executive Order No. 12838, February 10, 1993, 3 C.F.R. 590 (1994), requires that the number of advisory committees be reduced by one-third, that all remaining committees be justified in detail, and that new committees be created only when compelling considerations necessitate their creation.

APPENDIX A
TASK FORCE MEMBERS

PRINCIPAL TASK FORCE LIAISONS

Marcia Aronoff, Deputy Director for Programs, Environmental Defense Fund
John Bullard, Director, Office of Sustainable Development, U.S. Department of Commerce
David Gardiner, Assistant Administrator for Policy, Planning and Evaluation, U.S. Environmental Protection Agency
Glynn Key, Special Assistant to the Secretary, U.S. Department of the Interior
Michael McCloskey, Chairman, Sierra Club
John Mincy, Vice President, Safety and Environmental Affairs, Ciba-Geigy Corporation
John Platt, Special Assistant to the Director, Columbia River Inter-Tribal Fish Commission
Jody Thomas, Director of Community Relations, The Nature Conservancy
Russell Van Herik, Vice President, Special Projects, The Nature Conservancy
Susan Vogt, Director, Environmental Policy Training and Regulatory Affairs, Georgia-Pacific Corporation

WORKING GROUP LIAISONS

Terry D'Addio, Special Assistant to the Undersecretary for Natural Resources and the Environment, U.S. Department of Agriculture
Margaret Delp, Columbia River Inter-Tribal Fish Commission
Nancy Foster, Deputy Assistant Administrator of Fisheries, National Marine Fisheries Services, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
Ted Lillestolen, Special Assistant to the Deputy Assistant Administrator of Fisheries, National Marine Fisheries Services, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
Robert Olszewski, Manager, Forest Resources, Georgia-Pacific Corporation
Tim Searchinger, Environmental Defense Fund
David Taylor, Vice President, Public Affairs & Communications, Ciba-Geigy Corporation

EASTERN REGIONAL TEAM

Hudson River Case Study

Co-Chairs

Richard Barth, Chairman, President, and CEO, Ciba-Geigy Corporation
Edward Skloot, Executive Director, Surdna Foundation

Case Study Manager

John R. Nolon, Professor of Law, Pace University School of Law

Members

Peter Bienstock, President, Mid-Hudson Land Corporation, and Trustee, Friends of the Hudson Valley
Hooper Brooks, Program Officer for the Environment, Surdna Foundation
Nancy Campbell, Vice Chairman, National Trust for Historic Preservation
Audrey Carey, Mayor, City of Newburgh
Jayne Daly, Pace University School of Law
Lawrence E. Dwyer, President, Westchester County Association
Christopher J. Elliman, President, Open Space Institute

Frances S. Gibbs, Mayor, City of Peekskill
William T. Golden, Chairman Emeritus, American Museum of Natural History
Shelby Green, Professor of Law, Pace University School of Law
Alistair Hanna, Director, McKinsey & Co., Inc.
Tony Hiss, Institute of Economic Analysis, New York University
Tim Idoni, Mayor, City of New Rochelle
Kenneth T. Jackson, Barzun Professor of History and the Social Sciences, Department of History, Columbia University
James B. Joyce, Division Vice President, The Bank of New York
Andrew Lawrence, Atlantic Chapter, Sierra Club
Olivia Millard, Executive Director, Lower Hudson Chapter, The Nature Conservancy
Sheila Newman, Mayor, City of Poughkeepsie
Michael F. Northrop, Rockefeller Brothers Fund
P. Lynn Oliva, Commissioner, Westchester County Department of Planning
Frederick Osborn III, Vice Chairman, Scenic Hudson
Robert Osborne, Chief Operating Officer, Carl C. Icahn Foundation
Constantine Sidamon-Eristoff, Former Administrator, U.S. Environmental Protection Agency, Region II
Albert Smiley, Smiley Brothers, Inc.

St. Johns River Case Study

Co-Chairs

A.D. Correll, Chairman and CEO, Georgia-Pacific Corporation
Mike Branch, Fernandina Region Manager, Jefferson Smurfit Corporation, Container Corporation of America
Linda Bremer, Florida Chapter Member, Sierra Club

Case Study Manager

Rob Olszewski, Manager, Forest Resources, Georgia-Pacific Corporation

Members

Dennis Auth, Environmental Consultant, Auth and Associates
John Flowe, Director of Water Quality, Jacksonville Regulatory and Environmental Services
Judy Hancock, Chairman, State Public Lands Committee, Sierra Club
Brad Hartman, Director of Environmental Services, Florida Game and Freshwater Fish Commission
Herb Kale, Vice President, Florida Audubon Society
Kraig McLain, Intergovernmental Coordinator, St. Johns River Water Management District
Dawson McQuaig, Developer, north Florida
Bob Simons, Member, Florida Defenders of the Environment

Special Advisors

David Bruderly, Bruderly Engineering Associates, Inc.
Bruce Hill, Florida Division of Forestry
Charles Kibert, University of Florida

Chesapeake Bay Case Study

Co-Chairs

A.D. Correll, Chairman and CEO, Georgia-Pacific Corporation
Jean Packard, Sierra Club

Participants

Elizabeth Bauereis, Director, Environmental Affairs, Baltimore Gas & Electric Company
Donald Boesch, President, University of Maryland, CEES
Nick Carter, Maryland Department of Natural Resources, Tidewater Administration
Edwina H. Coder, Board of Directors, Alliance for the Chesapeake Bay, Inc.
Glenn Eugster, Chesapeake Bay Program Office
Frances H. Flanigan, Executive Director, Alliance for the Chesapeake Bay, Inc.
John M. Flynn, Manager, Public Policy, Corporate Relations Department, Ciba-Geigy Corporation
Patricia Hill, Manager, Federal Regulatory Affairs, Georgia-Pacific Corporation
Robert Kaufman, National Vice President, Michael T. Rose Corporation
Stella Koch, Virginia Conservation Associate, Audubon Naturalist Society
William Matuszeski, Director, Chesapeake Bay Program
Debi Lee Osborne, Project Manager, The Trust for Public Land
Ann Pesiri Swanson, Executive Director, Chesapeake Bay Commission
Betty Spence, National Wildlife Federation

MIDWESTERN REGIONAL TEAM

Co-Chairs

Richard Barth, Chairman, President, and CEO, Ciba-Geigy Corporation
Fred D. Krupp, Executive Director, Environmental Defense Fund
John C. Sawhill, President and CEO, The Nature Conservancy

Members

Robert P. Bringer, Staff Vice President, 3M Corporation
Michael O'Keefe, Executive Vice President, The McKnight Foundation
Dan Ray, Program Oficer for the Environment, The McKnight Foundation
Duane Sand, Iowa Natural Heritage Foundation
Richard E. Sparks, Director, River Research Laboratories
Evan G. Stadlman, Executive Director, Iowa Corn Growers Association

WESTERN REGIONAL TEAM

Chair

Theodore Strong, Executive Director, Columbia River Inter-Tribal Fish Commission

Members

Lori Bodi, Co-Director, Northwest Regional Office of American Rivers
Emory Bundy, Director, Bullitt Foundation
Gershon Cohen, Executive Director, Alaska Clean Water Alliance
Bonnie Colby, Associate Professor, Department of Agriculture and Resource Economics, University of Arizona
Paul Dolan III, President, Fetzer Vineyards
Bob Doppelt, Executive Director, Pacific Rivers Council
Jim Enote, Project Leader, Zuni Conservation Project
Lill Erickson, Northern Rockies Representative, Sonoran Institute
Katrina Florez Fitt, President and CEO, Fitt Environmental, Inc.
Terry Flores, Hydro Policy Administrator, Pacificorp
Lawrence J. MacDonnell, Director, Natural Resources Law Center, University of Colorado School of Law
Mary Lou Soscia, Manager, Oregon Watershed Health Program

Kate Sullivan, Forest Hydrologist, Weyerhauser Corporation
Sara Vickerman, Director of State Conservation Programs, Defenders of Wildlife
Brooke Williams, Consultant, Plateau Innovation

President's Council on Sustainable Development Staff and Associates

Gary Larsen, Coordinator, Natural Resources Task Force
Lois Morrison, Policy Advisor, President's Council on Sustainable Development
Peggy Duxbury, Policy Advisor, President's Council on Sustainable Development
Alissa Schmeltz, Research Associate, President's Council on Sustainable Development
Stewart Schwartz, Research Associate, President's Council on Sustainable Development
Patricia Sinicropi, Administrative Officer, President's Council on Sustainable Development
Nita Congress, Editor

APPENDIX B
TASK FORCE MEETINGS AND WORKSHOPS

TASK FORCE

Seattle, Washington	January 12-13, 1994
Chicago, Illinois	July 22, 1994
Washington, D.C.	October 27, 1994*
Chattanooga, Tennessee	January 12-13, 1995
San Francisco, California	April 26, 1995

**The Task Force also met in Washington, D.C., in conjunction with meetings of the full President's Council on Sustainable Development.*

EASTERN TEAM

Chesapeake Bay, Maryland	October 30-November 1, 1994
Hudson River, New York	May 22, 1994
St. Johns River, Florida	October 17, 1994
	October 31, 1994
	November 7, 1994

MIDWESTERN TEAM

La Crosse, Wisconsin	July 18-20, 1994
Chicago, Illinois	July 22, 1994
Des Moines, Iowa	November 28-29, 1994
Baton Rouge, Louisiana	January 5-6, 1995

WESTERN TEAM

Willapa Bay, Washington	January 15, 1994
Bellevue, Washington	September 29-October 1, 1994
Stateline, Nevada	October 3-6, 1994
Yakima, Washington	November 2-3, 1994
Santa Fe, New Mexico	November 20-22, 1994
Las Vegas, Nevada	December 12-14, 1994
San Francisco, California	April 26, 1995

APPENDIX C
EASTERN REGIONAL TEAM REPORTS

This appendix contains three separate reports of the Eastern Regional Team of the Natural Resources Task Force:

- Report of the Hudson River Advisory Board on Sustainable Development,
- Lower St. Johns River Basin Regional Team Report, and
- Chesapeake Bay Watershed Natural Resources Task Force Workshop Report.

These reports represent the work of the authors of those reports and have not been subjected to fact-checking by the President's Council on Sustainable Development. **HUDSON RIVER ADVISORY BOARD ON SUSTAINABLE DEVELOPMENT**

December 29, 1994

I. President's Council on Sustainable Development

Assembling the Advisory Board

The Hudson River Advisory Board was organized in August 1994 to develop a strategy for achieving sustainable development in the Hudson River Valley for a report to the President's Council on Sustainable Development. As part of that process and because much groundwork had already been done, it was hoped that the Board would focus a significant part of its effort on advising the Land Use Law Center of Pace University School of Law to refine its study of the obstacles to achieving sustainable land development patterns in the Valley and recommendations to overcome them.

Membership of the Board

The Advisory Board is co-chaired, as are all the committees and boards of the President's Council, by a private sector leader and an environmentalist. Richard Barth, CEO and Chairman of Ciba, and Edward Skloot, Executive Director of the Surdna Foundation, occupy these leadership posts. The full membership of the Board is listed at the end of this report. It includes business and environmental leaders, four city mayors, social service providers, planners, academics, preservationists, nonprofit executives, and writers. The Board does not represent, nor does it speak for all groups in, the Hudson Valley, but it brings vast experience from varied interests to the job of evaluating the future of the Hudson Valley as a sustainable region.

The Process

The Board has met on four occasions. One of these meetings was held in conjunction with an Economic Summit on Sustainable Development, cosponsored by the Westchester County Association and Pace University. At these meetings, the Board has reviewed the results of numerous studies, heard from the staff of the President's Council, and listened to a variety of experts speak on various aspects of sustainable development. This report is a product of those activities. It will be presented at a citizens' conference in May 1995 and revised to reflect input received at that event. Subsequently, a final report on the sustainability of the Hudson River Valley Region will be submitted to the President's Council.

At the request of the President's Council, the Advisory Board is to take a long view with regard to the subject of sustainable development in the Valley. We were asked "What would the Hudson Valley look like 50 years from now, in the year 2045, if it were developed in a sustainable fashion?" We were then asked to identify the obstacles to achieving that vision and, finally, to make recommendations for overcoming them. The President's Council uses this approach to encourage representatives from all sides of the issue to look beyond their short-term disputes and arrive at a vision of the future that unites them in effective problem solving.

The Focus

The Hudson River Advisory Board identified many issues that must be addressed in shaping a comprehensive strategy for sustainable development, but determined that its initial focus should be the pattern of land development that is occurring throughout the Valley. This issue was selected because it is urgent and because it was possible for the Board to develop useful recommendations, in time for a report to the President's Council, based on a large body of background work already accomplished by the Land Use Law Center. If the Board decides to extend its activities past the spring of 1995, it may broaden its scope of concern.

The land use pattern is characterized by low-density, dispersed development moving gradually away from urban and village centers along inadequate transportation corridors and into the unsettled countryside. The pace of land development, configured in this way, outstrips population growth by a ratio of about 8 to 1.

Our projections show that, over the next several decades, while population will increase by a modest 4 to 8 percent per decade, if current land development patterns continue, the Valley will be transformed from predominately open space to predominately developed land.[1] The consequences of this pattern of development, if not reversed, will be an increasingly uncompetitive economy, greater urban poverty and injustice, and a severely threatened natural environment.

The Larger Context

This land development pattern describes just one threat to a sustainable future for the Valley and is but one aspect of the concept of "sustainable development." The President's Council has adopted the following definition of the term: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Under this broad banner march a host of issues no less important than land development patterns. They all bear on how we use material and

natural resources. Are these uses compatible with the resource needs of future generations or even of today's urban and rural poor? Are we using our creativity and technology and common business sense as effectively as we can to conserve these resources for the difficult challenges that lie ahead?

Among the other critical concerns of sustainable development are energy efficiency, renewable resources, best manufacturing and industrial practices, recycling in all its applications, preserving historic and cultural resources, full-cost accounting of resource utilization, pricing that reflects these full costs, transportation and transit facility construction, building design and siting, personal responsibility for consumption, forest, watershed, and habitat management, and the grand issue of preserving biological diversity, among others.

Interdependence of Issues

Many of these issues are inseparable. Compact and integrated land development patterns are more energy efficient and tend to have less impact on resources such as forests, watersheds, and habitats. However, these more efficient patterns are dependent on the availability of transit facilities and excellent building and landscape design for their viability as alternatives to current development practices. In addition, citizens who demand conservation and cost efficiency in land development are more likely to require it, as consumers, of their manufacturers and service providers.

Key Principles of Sustainability

One of the essential attributes of sustainability, in fact, is mutual dependence. This is the basis from which a successful strategy for sustainable land development patterns can emerge, since it is the essence of sustainability in general. The issues and interests involved in all aspects of resource use and conservation are interdependent. However, for disparate interests to unite in seeking mutually beneficial solutions, they first must be encouraged to cooperate. Strategies that provide incentives, rather than coercion, are better at facilitating compromise.

Systems adopted to achieve sustainability need to be responsive systems, listening to and reacting to a variety of interests, open to innovation, and encouraging collaboration, yet patient enough to achieve success incrementally. Importantly, these systems need to be grounded at the local level, to encourage patterns to emerge from the unique qualities and contributions each community can offer. For order to emerge among these local patterns of thought and development, however, these systems must ensure that local communities communicate and collaborate with their neighbors so that their influences on one another, in balance, are positive.

These principles seem broadly applicable to the achievement of sustainable development in all its dimensions; they have guided our thinking as we have worked through our vision of the Hudson Valley, and the obstacles to its sustainable future, toward recommendations for

1Some members of the Board expressed concern with the accuracy of these population projections. As a result, the Board intends to investigate alternative projections and readdress this issue and its effect on open space depletion in the Board's final report to the Council.

moving forward.

II. Visions of a Sustainable Hudson River Valley–2045

The River

The river that runs through the Hudson River Valley compels us to understand how organically we are connected. In its relatively short length, as great rivers are measured, it flows out of ancient, glacier-worn mountains that are as old as any rock in the world. From its source west of Lake Champlain in Essex County, it runs through the heart of the Adirondack Park, plunging every way but north, gathering in the force of other streams and rivers as it emerges from near wilderness before being harnessed. After such indecisive coursing, the Hudson seems to take on a purpose at Fort Edward as it heads south to become a commercial thoroughfare before passing Albany.

From the state's capital, which it connects to the global commercial center of New York City, the Hudson gradually takes on the character of a fjord; as an estuary that is tidally influenced from Manhattan to Troy, the river becomes one of the most diverse and productive ecosystems in the world. Atlantic tides push north as they are resisted, and periodically overcome, by the growing force of freshwater that pours from the Hudson's upper branches and the kills, creeks, and springs that perpetually fill its ancient banks. This mix of high mountain freshwater with the saline tides of the deep Atlantic gives the river its dynamic fertility.

From Greene and Columbia counties, until just before the waters pass by New York City on the south, the Hudson defines the region of our study: one that is organically and historically connected by the river that runs through it.

The Region

The study region encompasses the 7,283 square miles included in the counties of Westchester, Putnam, Dutchess, and Columbia that lie to the east of the Hudson River, and Rockland, Sullivan, Orange, Delaware, Ulster, and Greene to the west. This region is bounded roughly by the Delaware River on the west, the Catskill Park on the northwest, Connecticut and Massachusetts on the east, and New Jersey on the southwest. In addition to being the southern watershed of the Hudson, this region constitutes a significant portion of a larger ecoregion, generally referred to as Central Appalachia, which includes Pittsburgh, Trenton, Springfield, Albany, and Binghamton.

Natural Resources

The environmental issues raised in the Hudson Valley are typical of those affecting most areas in Central Appalachia where 35 million residents and a variety of economic pressures threaten the region's still abundant farmland, meadows, backcountry areas, and wildlife. Habitats here shelter countless species of wildlife, some of which are threatened or endangered, including the great blue heron, the bog turtle, and the bobcat. They, along with nearly 100 species of migrating neotropical birds, rest and feed here each year.

The habitats of this wildlife, such as boreal bogs, wetlands, hardwood forests, and meadows,

are disappearing at an alarming rate. This serious depletion is due primarily to one phenomenon: The pace of land development has exceeded that of population growth by a ratio in excess of 8 to 1. Beyond habitat destruction, the natural resource issues raised by sprawling development in the Hudson Valley are legion. This pattern of land development is highly inefficient with respect to energy consumption, has created several air pollution nonattainment areas, and has degraded surface and groundwater resources. It threatens the viability of the region's rivers and streams and the integrity of its scenic byways. Over 85 percent of the most productive farmland in the Hudson Valley is directly adjacent to developing areas, precipitating a dramatic decrease in the number of fields, forests, and meadows that are devoted to agricultural uses.

The Economy

Like the cross currents of tidal and freshwater coursing in the Hudson, environmental and economic pressures have agitated public policy and private action in the Valley. The steady push of development into the region has spawned dozens of conservation groups that resist significant development projects while the recent loss of tens of thousands of jobs in the region has heightened public pressure for economic expansion of any kind, wherever located.

In this agitated state, the region collectively does not seem to know which way to grow. Some see a Hudson Valley region standing somewhat apart from the New York metropolitan area, retaining its rural character as it grows slowly, resisting successfully the development forces of metropolitan commerce. Others envision a continuation of past trends and assume that the Valley will continue to develop as a suburban area servicing the greater metropolitan area. A third view is that the Hudson region can take on its own economic character as a high-technology market functioning more or less independently of the New York City market.

Whether in fact the Valley can stand aloof, will be appended, or can become independent of metropolitan commercial pressures, there is little evidence yet of any effective strategy emerging to change the current pattern of development. With 268 municipalities, 10 counties, and a host of state agencies influencing development decisions, the contours of a clear policy are hard to identify. In its absence, our assumption is that the region will remain heavily influenced by the metropolitan area economy and continue to develop in an unpredictable, sprawling pattern.

Current Trends Projected

The vision of the Hudson Valley that emerges if current development trends and patterns are projected forward to the year 2045 is not a happy one. The population of the region has grown over the past four decades at a rate exceeding 8 percent. In the current period, the growth rate per decade is around 5 percent. Projections contained in several current studies of development occurring in the New York City watershed, around Stewart airport, in Sterling Forest, and on David's Island, for example, indicate that a growth rate of 5 to 8 percent could easily continue in the region.

Using the higher 8 percent population growth rate projection, which will be attained if current development projections are realized, the look and feel of the Hudson Valley by the year 2045 will be changed significantly. Based on the past rate of land committed to

development to serve population growth, the region will be transformed from one characterized by open space to one characterized by developed land. Today, the majority of the land in the region is undeveloped. At the current rate of land consumption (a ratio of 8 to 1) and with an 8 percent increase in population over the next 50 years, significantly less than half of the region's land will be undeveloped in the year 2045.

Measures of Sustainability

This projected disappearance of the region's green character is not due to the influx of additional population, but rather to the high rate of land consumed to serve these additional people. An 8 percent increase in population over the next 50 years will yield a population density of about 450 persons per square mile. Ordinary low-density suburbs contain around 1,500 persons per square mile, so it is how people live on the land, not the population of 450 persons per square mile, that is the issue. If land planners in the Valley can develop effective strategies to array the population properly on the land, then the Valley can unite behind a strategy of modest population growth, support dynamic development projects, and maintain a place with the open, high-quality character that is in the Hudson Valley tradition.

The vision of the Hudson Valley and its communities that allows the cost-effective integration of this population growth is not difficult to sketch. The future population of the Valley would be accommodated principally in communities that are relatively self-contained, with a variety of jobs, diverse housing stock, and basic services located within relative proximity of one another. These communities of the future, of various sizes and shapes, in fact, would look a great deal like traditional Hudson River villages. They would have clearly identifiable centers, parks and squares, and well-defined edges; and be surrounded by greenbelts featuring recreation, productive agriculture, and very low-density development. The largest of these, the region's central cities, would resume their historical roles as centers for economic, cultural, governmental, educational, and civic activity.

If this vision were realized, the tension between economic development and environmental conservation would abate. Such development patterns would be economically strong, defended by economic diversity and a high quality work-force, and environmentally sound, with an open quality of the type celebrated in the Hudson Valley by poets, painters, and ordinary citizens throughout its modern history.

III. Obstacles to Sustainable Development

The Land Use System

This vision will be difficult to realize. To the extent that it requires a change in land development patterns, its success depends on the efficacy of the public system of controlling land use. For seven decades in New York state, local governments have shaped land development patterns by enacting comprehensive plans and zoning ordinances, approving subdivision and site plan applications, and paying for capital infrastructure. The pattern of land development sketched by municipal ordinances and actions has been influenced, in turn, by state and federal actions such as highway funding, low-cost mortgage financing, and environmental regulation.

These local, regional, state, and federal actions that direct, influence, or react to the use of

the land, make up our "land use system." The deficiencies in this system are the principal reason that we are not developing in a sustainable fashion in the Hudson River Valley and may not in the future.

The region that is codified in the laws of local and state agencies is quite different from our vision of a sustainable Hudson Valley. If the land in the region is developed as locally zoned, the current pattern of sprawling, low-density development will become even more pronounced. The 130 economic stimulus programs of the state's economic development department will be available to assist that development wherever it occurs. The capital budgets of local, county, and state governmental agencies will be stretched to build roads, water and sewer systems, and schools and libraries to keep up with this spread-out development pattern.

Meanwhile, a variety of statutes administered by the state departments of state, environmental conservation, agriculture and markets, and public health will resist that development, to the extent that it affects negatively publicly protected natural resources. One effect of these regulations will be to discourage, and increase the cost of, development that the market is prepare to absorb.

The Route 28 Scenic Byway Example

In the ebb and flow of these contrary forces, a sustainable pattern of efficient and livable communities is unlikely to emerge. Consider, for example, the threat to the environment and economy that is occurring along the Route 28 corridor, 50 miles of rural highway that stretches from Kingston, in Ulster County, to Delhi, in Delaware. This roadway was recently designated, by Scenic America, as one of the most threatened scenic byways in the country. The economy of this area is defined by tourism, recreational activity, and agriculture. The threat to these is random and strip development occurring along Route 28 which is gradually eroding the high quality of the environment that brings tourists, skiers, hunters, fishermen, and weekend visitors to the area.

A cohesive management plan is needed in this short corridor that allows development to happen, but in accordance with the measures of sustainability described above. For such a plan to be developed, the agencies and boards that control land use decisions along Route 28 must be integrated and aimed at similar objectives. This task is daunting, since over 50 major governmental jurisdictions, one for each mile of the roadway, control these decisions. They include three regional agencies of the state department of transportation, three regional agencies of the state department of economic development, the regional office of the state department of environmental conservation, three regional councils, 14 town or village legislative bodies and their separate planning and zoning boards, and three county governments.

The Regulatory Morass

In the Hudson Valley region there are 268 cities, towns, and villages that adopt zoning ordinances and other land use controls. Their jurisdictions are cross hatched by a dizzying array of county, regional, state, and federal agencies whose activities are uncoordinated, except in unusual circumstances. These jurisdictional contradictions are compounded by a

variety of other inconsistencies. Here are a few illustrations:

1. Local zoning, according to state law, must be in accordance with a local comprehensive plan. The law, however, does not go on to require local governments to adopt comprehensive plans, so many do not have up-to-date land use plans with which zoning can conform.

2. Comprehensive planning must measure the impact of local land uses on neighboring municipalities, according to the state's highest court, yet comprehensive planning is defined as local in nature. There is no statutory requirement that localities consider the impacts of their land use decisions on adjacent areas or on the region as a whole.

3. Federal law requires state transportation and air quality planning to consider and coordinate with land use planning, yet no land plan exists in our region at a level that is helpful to transportation and air quality planning which are areawide in scope. Meanwhile, the Hudson Valley region is experiencing air pollution and now contains several air quality nonattainment areas; this has resulted in inexpensive mandates on large employers to provide for more efficient employee commuting arrangements and other costly mandates on economic development in the region.

4. The state's highest court has required local governments to consider regional housing needs in adopting and amending their zoning ordinances. Yet, there is no agreed-upon definition of what the relevant housing region is. There is no identification of regional housing needs. Further, there is no method employed to define the share of housing needs that each municipality should bear. As a result, local officials who want to meet their share of the need for affordable housing are frustrated. Since housing demand is areawide, they fear that local plans to develop affordable housing will result in a disproportionate burden on them since there is no general scheme under which all municipalities will act. Localities have no practical authority, under this system, to act to create an adequate supply of housing for young and elderly households and for families of modest means.

5. This practical erosion of local control is paralleled by the preemption of local land use authority by a growing list of state statutes. Acting to protect legitimate "statewide" concerns advocated by important constituent groups, the state legislature has preempted local land use control in the interest of protecting freshwater and tidal wetlands; coastal ecosystems; wild, scenic, and recreational streams and rivers; agricultural lands; safe drinking water; regional aquifers; the purity of lakes and reservoirs; air quality; and forest areas, to name a few.

6. The complex and time-consuming land use approval system that has resulted from this thicket of regulations is recognized officially as discouraging, and increasing the cost of needed economic development. The response of a prestigious advisory committee was to recommend 56 methods of streamlining the development approval process, many of which involve local and areawide planning to integrate development decisions and to measure their intermunicipal impacts.

7. The essence of the current local land use system is local competition for tax ratables. It is a competition in which there are no clear winners. The most dramatic losses are

suffered by the cities that have lost taxable assets, affluent people, jobs, and commercial activity to outlying communities. The victory won by the developing suburb is a questionable one, for with new development comes the responsibility for new schools and libraries, commercial centers, roads, sewers and water systems—all expensive to provide. Tax rates in developing areas in the region have not been stabilized by the pattern of development achieved. Our older suburbs are beginning to experience the asset and human resource drain that the cities have suffered for years.

8. Eighty-five percent of the productive agricultural land in the Valley is directly adjacent to developing lands and is at risk of disappearing. While the policy of the state is to protect agricultural lands from nonagricultural uses, much of the farmland in the Valley is zoned for low-density residential or commercial development. The tax incentives and other relief provided to production farmers by a variety of state programs are no match for the development pressures nipping at their heels. Public programs that encourage development often contradict public policies that seek to protect productive farms.

Dissatisfaction with the Land Use System

Few people are satisfied by the result of this "regulatory morass," including local officials, developers, environmentalists, and experienced professionals such as architects, planners, and lawyers intimately involved in the land use system. According to a statewide survey conducted in the spring of 1993 by McKinsey and Company, international business consultants, these individuals rated the performance of the land use system unacceptable by a ratio of three to one. The system's performance, according to this survey, was rated very poor 10 times more frequently than it was rated outstanding. If this system were a private product, McKinsey reported, it would recommend pulling it from the market.

Conclusion: The Need to Reinvent the Land Use System

The McKinsey survey evaluates, and the above examples illustrate, the principal obstacle to achieving sustainable land development patterns in the Hudson Valley region. The many and overlapping jurisdictions, the cross currents of countless programs and regulations, and the heavy competition among municipalities for increased tax base constitute a regulatory morass that is good neither for business, the environment, or the quality of life of the Valley's residents and workers.

The original system, created over 70 years ago and designed primarily for cities, was relatively simple and effective. Since then, however, it has been augmented in a piecemeal fashion in reaction to the new realities of population growth, technology development, and environmental research. The result is an uncoordinated morass of regulations, processes, and financial incentives administered by unconnected public agencies at various levels of government. Rather than constituting an organized and efficient legal system aimed at compatible objectives, it has become a complicated tangle of influences that collide and produce highly inefficient land use patterns.

Growing discontent with the results of this system has led to even greater regulation, lengthier processes of approval, and a pervasive caution about where and when development

should occur. This greatly disadvantages land developers and expanding business interests as well as the urban poor and the environmental quality of all regions in the state. That the land use system needs to be reinvented is clear; to date, there has been little agreement about how to proceed toward this goal. What we have learned about sustainable development guides us in making the recommendations contained in the final section of this report.

IV. Recommendations

Strategic Principles

As mentioned above, in the section on key principles of sustainability, we found that one of the essential attributes of sustainability is mutual dependence. This is the basis from which a successful strategy for sustainable land development patterns can emerge, since it is the essence of sustainability in general. The issues and interests involved in all aspects of resource use and conservation are interdependent. However, for disparate interests to unite in seeking mutually beneficial solutions, they first must be encouraged to cooperate.

From this we have concluded that strategies that are based on incentives are better than those that coerce. Systems adopted to achieve sustainability need to be responsive systems, listening to and reacting to a variety of interests, open to innovation, encouraging collaboration and patient enough to achieve success incrementally. Importantly, these systems need to be grounded at the local level, to encourage patterns to emerge from the unique qualities and contributions each community can offer. For order to emerge from these local patterns of thought and development, however, these systems must ensure that local communities communicate and collaborate with their neighbors so that their influences on one another, in balance, are positive.

Three Key Ingredients

Moving from these principles toward specific recommendations, three key ingredients of a reinvented land use system appear. First, local governments must be encouraged to adopt comprehensive land use plans. Second, these plans must be coordinated with those of their neighbors. Third, these intermunicipal land use plans must define sustainable patterns of development, indicating where development is to be encouraged and where land conservation is to be encouraged.

If these three recommendations were instituted, a reinvented system would be possible. The capital budgets of local, county, state, and federal agencies could be aligned with these intermunicipal plans for cost efficiency. Land investors and developers would know where to invest and, in those areas, pruning of the thicket of regulations would be possible. From this cost-effective beginning, competitive patterns of development could emerge. Funds available for acquiring land or easements to protect open space and achieve natural resource conservation could be directed to areas designated for those purposes without suffering expensive competition with development pressures. Local officials could expect assistance from all relevant state and federal agencies in implementing their plans, reducing intergovernmental tension and competition.

Keynote Recommendations: The Economy and the Environment

Paul Tippett, former chairman of American Motors and the keynote speaker at our second Advisory Board meeting, encouraged business leaders to take a leadership role in developing and supporting such a strategy. He called this approach "Listening to the Echo." Mr. Tippett commented that his phrase has three meanings. First, it encourages us to listen to all the voices of the Hudson Valley, including the echoes and wisdom of the past and the interests of future generations, and to account for all interests in land use planning. Second, it integrates "eco-logical" thinking into the economic development planning of private sector leaders. Third, it requires environmentalists to respect "eco-nomic" objectives. In this regard, the Advisory Board noted with interest the recent report of the Institute for Southern Studies that suggests that states and regions that do the most to protect their natural resources develop the strongest economies and best jobs.

James Gilbert, chairman of the New Jersey State Planning Commission, also spoke at this second meeting about the enthusiasm of local officials in New Jersey over the State Development and Redevelopment Plan. The notion in New Jersey is that concentrating growth is more efficient than allowing it to sprawl. Their studies show that low-density sprawl is five times more expensive for municipalities to service than more compact forms of growth. The guidelines allow every single town in the state to grow if it wishes. But the plan says that growth or redevelopment should be concentrated in centers in those municipalities. Those units of government that grow in accord with the plan move up in priority for discretionary state funding. He reported that local officials support this plan because they believe in cost efficiency and incentives for municipalities that create efficient patterns of development.

Regional Strategies and Recommendations

1. The Advisory Board will hold a regional citizens' conference on this report and its recommendations to listen to and incorporate their ideas. This input will shape the final report of the Board to the President's Council.

2. The Advisory Board will organize one or more meetings between local officials and state elected leaders representing the Hudson River Valley and local officials in New Jersey to determine the features of that reinvented land use system that are attractive to political leaders in this region.

3. The Advisory Board will consider how the following studies and exercises can be undertaken:

a. A problem-solving exercise focusing on a key land use issue in the Hudson Valley. This exercise will be designed to contrast the outcome of the conflict under the current land use system with the result likely under a program that encourages cooperative solutions. From this, the strategic principles for reinventing the land use system should become clearer and more support developed for them. This exercise is to be conducted with the technical expertise of the Santa Fe Institute and McKinsey and Company, internationally recognized experts on the behavior of natural and business systems.

b. An inventory of the legal tools and techniques that municipalities can use immediately to create cost-effective land use patterns. This inventory must be a

practical guide for local citizens, officials, and their advisors to illustrate specifically how such patterns can be created by local governments. Where deficiencies in state law obstruct the effective use of these techniques, proposals for changes in those laws should result.

c. A strategic plan for revitalizing the central cities in the Hudson Valley. The four mayors on the Advisory Board report that New York state has no recognizable urban revitalization strategy, while evidence mounts that strong economic regions do not evolve unless they are organized around strong economic centers.

d. A process for supporting, reinforcing, and coalescing the institutional leadership of the Hudson Valley region, including municipal, environmental, and private sector leadership, so that an effective consensus can be achieved to support strategies that are capable of resulting in sustainable patterns of land development.

4. The Advisory Board further recommends that the regional directors of all state agencies operating in the Hudson Valley whose activities affect land use form a task force to accomplish the following objectives:

a. Develop a set of policies and implementation mechanisms that ensure that state resources available in the Hudson Valley are employed on a priority basis to support municipal efforts to create sustainable patterns of land development.

b. Develop a plan for realigning the jurisdictions of these agencies so that they are as coterminous as possible, so that the delivery of services to local agencies is more efficient, and so that their budgets and staff resources can be harmonized and used principally to encourage and support inter-local land use efforts that identify where land development and land conservation activities are to be encouraged.

c. Develop a program for delivering to local governments and agencies all available land-linked data gathered by all state agencies and for integrating these data on a digitized geographic map of each municipality, working through the 10 county governments in the region to create an extensive base of land-linked data that makes effective land planning possible in the Hudson River Valley.

State Recommendations

In order that these strategic principles may guide the conduct of state agencies in the region, the Advisory Board recommends that the state of New York:

1. Study the statewide land policies adopted in nine other states for guidance in preparing and adopting a set of principles to influence the expenditure of its resources and the conduct of its regulators so that they support sustainable land use patterns and intermunicipal planning that achieves such patterns.

2. Coordinate the activities of all of its departments and offices that influence land use

and develop a rationale for integrating the administrative jurisdictions of those agencies so that they can be coordinated at the regional level and become more friendly to, and supportive of, the policies and programs of local officials and agencies.

3. Develop a program for delivering to local governments and agencies all available land-linked data gathered by all state agencies and for integrating these data on a digitized geographic map of each municipality, working through county governments to create an extensive base of land-linked data that makes effective intermunicipal land planning possible in the Hudson River Valley and the entire state.

4. Develop a plan for making technical and financial assistance available to local governments to enable them to develop intermunicipal plans for sustainable development and for rewarding local governments that develop such plans by giving them a priority in the distribution of state aid and local governments.

V. Implementing the Recommendations

In making these recommendations, we recognize the limits of the Advisory Board's ability to carry them forward and its dependence on a coalition of local officials, environmentalists, and business leaders to support and advance them. For this reason, we offer these recommendations for the further consideration of the residents of the region and their business and environmental leaders whose interests we have tried to represent as our Board was assembled and in its deliberations.

We are indebted to the President's Council for its emphasis on this coalition-building approach and for encouraging us to look beyond the existing controversies and institutional complexities toward a vision of a sustainable Hudson River Valley in the year 2045. It is our hope that this vision will have the intended result of uniting all constituent groups in the region in an effort to realize the objective of sustainable land development patterns for the benefit of the current and future generations of the Valley that is so gracefully defined by the river that runs through it.

LOWER ST. JOHNS RIVER BASIN REGIONAL TEAM REPORT

Charge to the Regional Team: Regional teams will analyze key problems and successes of sustainable management and protection of specific resources and their interrelationship within the boundaries of selected individual or representative watersheds.

The Lower St. Johns River Basin Team's goals are to:

- identify what sustainability means in the context of managing the natural resources that exist within the watershed of the St. Johns River in Florida;
- identify steps that must be taken to achieve these goals with particular attention to impacts on forestry, mining, and urbanization; and
- identify public policy options to help reach those goals.

Definition: Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Description: The Lower St. Johns River Basin is an area dominated by the northward-flowing St. Johns River, and characterized by a mix of natural areas, agricultural lands, forestry lands, and urban uses. The basin consists of 2,780 square miles, which is about 22 percent of the land area of the St. Johns River Water Management District. Included within the boundaries of the Lower St. Johns River watershed are 12 major tributaries. The area consists of portions of six northeast Florida counties and the municipalities of Crescent City, Palatka, Hastings, Green Cove Springs, Orange Park, and Jacksonville. The economy of the watershed is diverse, with urban markets, industrial manufacturing, deepwater ports, and military bases of Jacksonville; commercial and private forestlands and paper mills, sawmills, etc., of Putnam and Duval counties; potato and cabbage farms of St. Johns and Putnam counties; and water-dependent industries of the St. Johns River (e.g., fisheries, shipping, and recreation).

Team Members:
Dennis Auth, environmental consultant on mining and paper companies, Auth and Associates
Mike Branch, Team Co-Chair, Regional Manager of Container Corporation and Jefferson Smurfit Paper Companies
Linda Bremer, Team Co-Chair, State and National Wetlands Committee, Sierra Club
John Flowe, Director of Water Quality, Jacksonville Regulatory and Environmental Services
Judy Hancock, State Public Lands Chairman, Sierra Club
Brad Hartman, Director of Environmental Services, Florida Game and Fresh Water Fish Commission
Herb Kale, ornithologist and Vice President, Florida Audubon Society
Kraig McLain, Intergovernmental Coordinator, St. Johns River Water Management District
Dawson McQuaig, consultant and developer in north Florida
Rob Olzsewski, coordinator
Bob Simons, private forester, Florida Defenders of the Environment

Special Advisors:
David Bruderly, Bruderly Engineering Associates, Inc.
Bruce Hill, Florida Division of Forestry
Charles Kibert, University of Florida

1. Natural Resources Discussion (History, Status, Needs)

Air

Overall, air quality is good in the region with the exception of the Jacksonville/Duval County urban area. The city has corrected problems associated with odor and volatile organic compounds and is developing strategies to handle ozone.

Jacksonville developed a unique solution to odor problems in the late 1980s following a buildup of resentment by the community against the sources of the emissions within the urban center. The emissions were caused by two Kraft paper mills, two organic chemical manufacturing facilities, and a municipal sewage treatment plant—all located close to the

population centers. By 1987, there were 200 odor complaints per 100,000 population; the national average is 29 per 100,000. These complaints turned into political action when the new mayor's election platform included mitigating the city's odor problem.

An odor ordinance was enacted, which received broad support from the community and the city council. The ordinance provides for large civil penalties for air, water, odor, and noise pollution; adds a nuisance provision with civil penalties; and creates an "odor nuisance standard" which subjects violators to civil as well as criminal action. Enforcement requires inspectors to investigate each complaint using a methodical approach. Additionally, the new law provides for development of ambient odor standards and development of industry-specific emission/work practice standards. A special task force of industry representatives and agency personnel worked together to identify reasonable abatement measures and specific steps to be undertaken by each industry within one year.1

Important areas that still need to be addressed in the basin's urban areas are: source reduction strategies for industry (pollution prevention) and automobiles (clean alternative fuels and mass transit emphasis to integrate into everyday life), and education and proper land use planning.

A major conflict regarding the maintenance of air quality is the use of prescribed burning as a land management tool. Because prescribed fires reduce the frequency and severity of wildfires and produce much less smoke than wildfires, they have an environmental benefit. Moreover, prescribed—as opposed to wild—fires occur during daylight hours, when smoke is less dangerous for highways; when weather conditions are favorable for smoke dispersion; and when wind directions are away from highly smoke-sensitive areas.

In recent years, prescribed burning has been recognized as a key component in maintaining healthy ecosystems that contain populations of rare, threatened, and endangered plant and animal species. In fact, nearly all of the plant and animal communities in Florida have evolved with and depend upon periodic fires for their existence. Examples of fire-dependent species include Bartram's ixia, wiregrass, red-cockaded woodpeckers, fox squirrels, and gopher tortoises. Additionally, prescribed fire continues to be the most effective tool for protecting timber resources from the devastating effects of wildfires. Cessation of the practice would thus have certain adverse economic, as well as ecological, impacts.

Unfortunately, population growth in Florida has created an environment in which few land managers can burn without exposing populated areas and public roadways to smoke. Public health is always important with regard to prescribed burning; in order to prevent incompatible situations, we should strive to gain public understanding and support.

Water

The St. Johns River Water Management District separates water resources into two areas: surface water and groundwater. Surface waters may have minimal structural improvements, such as dams and related control structures or systems of canals, ditches, etc. Many of these water bodies have experienced degradation associated with urbanization and agricultural uses. While sources of pollution continue to be addressed, stormwater runoff from agriculture and urban areas developed prior to stormwater management regulations

have together created a backlog of needed infrastructure improvements. These areas contribute significantly to water quality and flooding problems and have yet to receive stormwater management for quantity or quality. Funding to improve the stormwater infrastructure of urban and rural areas is a significant problem for communities and individuals.

Groundwater systems are generally in good condition because of an abundant supply of clean water from the Floridian Aquifer. Surficial aquifer contamination causes localized problems. Leaking fuel storage systems have contaminated soils and groundwater. Urban water system impacts and seasonal agricultural pumping have contributed to declining water quality, especially along coastal communities where chloride levels are rising in some wellfields. Excessive withdrawals from public wellfields and agricultural irrigation have damaged nearby wetland ecosystems. Measures needed to protect the water supply include wellfield protection area designations and regulations, wellfield pumping management, and water conservation.

Water management districts have been created to manage and regulate water resources in five state regions. Flooding associated with the hurricanes of the 1940s and l960s and a drought in the early 1970s provided the impetus for their creation. In 1972, the Florida Legislature passed the Water Resources Act that provided the framework for the present water management system. With this authority and a 1976 voter-approved referendum, the water management districts could levy ad valorem taxes to support water management. The districts implement programs within their areas of responsibility, which include water supply, flood protection, water quality, and natural systems. Through land acquisition, planning, restoration, regulation, and public education, these water resources are managed. The districts' ability to manage with a regional perspective and authority has afforded local governments and other agencies valuable information and services. Besides these districts, the Florida Department of Environmental Protection is also involved in many aspects of water management.

Land

Wetlands. Within the Lower St. Johns River Basin, wetlands are generally intact and have not received the vast alterations of the wetlands in the Upper St. Johns River marshes (headwaters). Dominant impacts have been attributed to urbanization. Current protection is afforded by state and federal regulations, local comprehensive planning policies, and land acquisition programs. Larger wetlands are closely regulated; wetlands of less than one-half acre in size are not. Thus, these small isolated wetlands are receiving the least protection from regulatory and acquisition efforts. Protection efforts need to focus on maintaining viable isolated wetlands in the landscape based on their value to wildlife and in flood containment and groundwater recharge.

Uplands. Uplands in northeast Florida provide space for human development and use,

1Source: K. Mehta and James Manning, "Hatching an Environmental Battle Plan in Jacksonville," *EPA Journal* May 1988.

habitat for wildlife, water recharge, mineral resources, and soil resources for agriculture and silviculture.

Agricultural use of uplands is declining within the state, and many of the former agricultural lands are being converted to urban development. Those lands left to agriculture are being more intensively managed, and, as more acreage is irrigated, water resource use is increasing statewide.

Silviculture is by far the largest and least intensive commercial land use. This use maintains high-quality watershed and water recharge values and air quality. It also maintains a major proportion of the region's wildlife habitat. Loss of productive forestlands to urban development is significant—and accelerating. This loss is compensated for by an increase in the intensity of management for forest products on the remaining lands. However, the losses of watershed quality, air quality, wildlife habitat, and recreation are *not* compensated.

Although the state passed a Comprehensive Growth Management Act, rapid and uncontrolled growth remains a major environmental problem in Florida. Community attitudes toward growth are unfocused, and political action favors continuation of traditional zoning practices. Impacts to other resources from this land use include those to water resources, which have declined significantly because of damage from persistent chemicals, overuse of water, and the compaction and paving of water recharge areas found on many north Florida uplands.

Biodiversity. Biological diversity is "the variety and variability among living organisms and the ecological complexes in which they occur." Because "items are organized at many biological levels, biodiversity encompasses different ecosystems, species, genes and their relative abundance."[2]

In discussing the concept of biodiversity, one must also include biological integrity. This term refers to the wholeness of a system, "including the presence of all appropriate elements and occurrences of all processes at appropriate rates."[3]

The Lower St. Johns River watershed includes most of the area of five counties in the northeast Florida region: Flagler, Putnam, St. Johns, Clay, and Duval. This region contains a diverse mixture of land-cover types which support several rare species of birds and mammals. The region's proportion of conservation areas—that is, the public and private lands devoted to some extent to conservation—is 11.9 percent, considerably below the statewide average of 19.6 percent. This gap is especially notable in Putnam, Duval, and Flagler counties.[4]

Lands recommended for additional protection—called Strategic Habitat Conservation Areas—include those that could be purchased by the county, state, or federal governments, or protected by incentives such as cooperative agreements, conservation easements, etc. These areas include wetlands in Flagler and St. Johns counties; forested areas of Flagler, Putnam, St. Johns, and Duval; coastal areas in Flagler, St. Johns, and Duval; and sandhill and xeric uplands in Clay County.

2. Economic Use Discussion (Use, Problems, and Solutions)

Urbanization

With a population expected to reach 19.4 million by the year 2020, Florida is one of the four fastest growing states in the nation. Moreover, its population boom has made Florida the fourth most populous state. This rapid growth and large numbers of new residents have placed a strain on the state's ability to manage growth and maintain environmental quality.

Most of Florida's growth has occurred away from the central cities in communities located on the fringes of metropolitan areas. Of Florida's 13.4 million residents in 1992, most lived in unincorporated areas of the state. During the 1980s, 17 of Florida's 21 metropolitan areas experienced much higher population growth in suburban communities and outlying areas than in the central cities. Thirteen of the nation's 25 fastest growing suburban areas are in Florida.

The construction industry has responded to this growth in Florida and the rest of the nation, and consequently has recorded unprecedented gains in employment and share of gross national product (GNP). Nationwide, the construction industry employs 7.5 million people and accounts for 9.5 percent of GNP. The industry is a major consumer of resources and has been significantly affected by environmental regulations.

Members of the Lower St. Johns River team found uncontrolled, sprawling growth in the state and population pressures from immigration and migration to be the greatest cause of unsustainability of Florida's natural resources. Current practices in the billion dollar construction industry are notably unsustainable. They are reinforced by embedded zoning codes; building standards; federal and state infrastructure (roads, drainage projects, schools) funding practices; and myriad regulations designed to discourage reuse and redesign of urban communities.

Much of the blame for the failure of growth management in the state must be attributed to a lack of understanding about Florida's environment (especially among new residents) and the tradeoff between regulatory constrictions and environmental consequences. This public ignorance translates into a laissez-faire attitude among political officials who demonstrate little foresight regarding the state's future. This attitude will lead to a collapse of Florida's ecosystems in the near future. America, as a land-rich country, is paying the price for its frontier attitude toward growth in terms of destroyed ecosystems, loss of community spirit, and waste of public infrastructure.

Recently, a nonprofit collaborative effort has sprung up among construction professionals in the north Florida region to foster sustainable principles in all phases of the building life cycle. The Sustainable Development and Construction Initiative Inc., formed in May 1994, is working to provide the necessary technology, techniques, information, and training to move the construction industry toward "greener" practices. The principles of sustainable construction are:5

2Office of Technology Assessment, *Technologies to Maintain Biological Diversity,* OTA-F-330 (Washington, DC: Congress of the United States, 1987).

- **Conserve.** Minimize resource consumption. Design for passive efficiency in heating, cooling, and lighting. Use durable materials.
- **Reuse.** Maximize resource reuse. Reuse materials in reconstruction and new construction. Recapture water. Create new buildings in previously occupied spaces or "gray zones."
- **Reuse/recycle.** Reuse renewable and recyclable materials. Some European countries are requiring that much of a building's materials be recyclable and reusable when deconstructed.
- **Protect nature.** Protect the natural environment. Scrutinize impacts of materials acquisition, and minimize environmental damage by reducing the need for fertilizers and pesticides.
- **Eliminate toxins.** Create a healthy environment inside and outside buildings. Eliminate toxins in paint, landscaping, and lighting fixtures.
- **Plan for quality.** Plan communities to reduce automobile trips and to enhance quality of life. Use existing infrastructure. Design buildings to last many generations.

Silviculture

Forestry is the single largest land use element in the Lower St. Johns watershed. The pressures on this resource are enormous and include demands from urban developers for more land and high management costs. Commercial forests are also under great pressure to meet increased commodity production demands. Purchase of public lands also eliminates the land available for forest use, thereby placing a greater strain on remaining forestry lands, which consequently must be managed more intensively. Total forestland area in Florida in 1950 was 67 percent of the state. In 1994, total forestland area had been reduced to 42 percent.

Solutions to issues regarding the maintenance of productive forests and protection of natural resources are documented in the *1993 Silviculture Best Management Practices* manual. This manual was prepared by such diverse interests as industrial and individual forestry operators, state and federal agency staff, environmentalists, and educators, all of whom worked together to produce a document that would help ensure better protection of the environment through techniques and approaches such as the following:

- Special management zones with operational restrictions designed to protect water quality, protect streambank stability, and provide wildlife habitat.
- Wetland restrictions and limitations to protect wetlands soils and hydrology.
- Road construction techniques to minimize erosion and sedimentation.

3P.L. Angermeir and J.R. Karr, "Biological integrity versus biological diversity as policy directives. Protecting biotic resources." *Bioscience* 44 (1994): 690-97.

4J. Cox, R. Kautz, M. MacLaughlin, and T. Gilbert, *Closing the Gaps in Florida's Wildlife Habitat Conservation System* (Tallahassee: Florida Game and Fresh Water Fish Commission, 1994).

- Guidelines for the application of pesticides and fertilizers.

In addition, several incentives have been proposed that will help keep Florida's forests green and productive. For example, the state of Florida has begun to explore an innovative "less-than-fee" philosophy of resource management. The purchase or transfer of development rights may be used to protect the land from urban development while compensating the landowner, thus retaining land values for commodity production, wildlife habitat, recreation, and green space. Other workable incentives include actively recruiting forestry-based business into the state, a state tax structure promoting a positive forest business climate, and aggressively advocating the positive economic and environmental position of forestry in Florida.

Mining

Within the St. Johns River Basin, the primary types of surface mining that are currently operational include heavy mineral sands (rare earth minerals, titanium, and zircon); fuller's earth; and limestone, sand, and fill dirt. No shaft mines exist in the study area.

The sustainability of these mining operations depends on the normal interplay between the quality and character of the deposit and the internal efficiencies brought to bear in the management of production costs and marketing versus externalities beyond the control of the mining operator such as capital equipment, labor, environmental monitoring, reclamation, and mitigation costs. Sustainability is also dependent on successful exploration for new reserves; technological advances in mining, extraction, processing, and reclamation; and the creation of new uses in the marketplace.

Conditions that negatively affect the future of mining include:

- A general absence of appreciation for the role of mining in providing the materials necessary to support the American economy.
- Land use regulations that effectively "sterilize" already-identified mineral reserves by creating prohibitions against mining.
- Escalation of different types of taxes unique to mining.
- Duplicative and multijurisdictional state and federal permitting programs administered by agency personnel unfamiliar with the mining industry.
- A lack of comprehensive efforts by government to develop and improve mining operations with new technology or methods.

Habitats

Habitat is usually defined as a requirement for a specific species. The study region features about 2,000 vascular plant species, thousands of insect species, over 200 bird species,

5Charles J. Kibers, "Establishing Principles and a Model for Sustainable Construction," *Sustainable Construction: Proceedings of the First International Conference of CIB TG 16* (University of Florida, 1994).

about 50 mammal species, about 70 fish species, about 60 reptile species, and over 30 amphibian species—each with its own set of habitat requirements.

Some species are very adaptable, making use of a broad range of habitats. White-tailed deer, raccoons, opossums, cardinals, common grackles, yellow rat snakes, green anoles, and southern toads are examples of animals that make use of a very wide range of habitats—ranging from human suburbs and upland pine and hardwood forests to pine flatwoods and hardwood swamps. However, most species, both plant and animal, are far more specific in their habitat requirements. Many occur only in scrub, or in pine flatwoods, hardwood forest, open marsh, or open water.

There is also a wide range in the size of the area needed to maintain viable populations of these species. The area of the habitat under some form of protection needs to be increased to protect many species. For some species, connections need to be made to additional areas of habitat.

The quality of habitat is also important; this involves many factors. Changes in hydroperiod and fire regimes are the dominant factors affecting quality. Other factors include air pollution, water pollution, and exotic plant invasion.

Another factor in habitat quality is an area's dominant land use. Some places have been set aside as public lands and are managed—to a significant extent—to maintain good-quality habitat for native species. However, a much larger percentage of the habitat area for most native species is on private land used for commercial forestry. There are also large areas of pasturelands, row crop agriculture, and low-density residential development. All these areas provide wildlife habitat for many species and are currently much greater in size and overall importance for most species than are public lands.

The outlook for habitat conservation, in general, is not good from a long-term sustainability viewpoint. The state of Florida has been purchasing, and is continuing to purchase, some of the best wild areas to make additional parks, state forests, wildlife management areas, etc. Even in these areas, however, the threats of pollution, hydroperiod alteration, and exotic species invasion from beyond public lands boundaries frequently cause habitat degradation.

3. Public Policy Recommendations

Air

1. Establish policies and programs to address source reduction strategies to reduce air pollution from industry and automobile use. Encourage incentives to use clean alternative transportation fuels especially in government vehicles. Develop strategies and incentives for reducing automobile use via mass transit, car pooling, etc.

2. Establish policy that reflects the importance of prescribed burning to manage native ecosystems and protect private and public lands and property from wildfires. Work cooperatively with governments and community groups to lessen the impact of prescribed fires and to promote public understanding.

3. Continue cooperative efforts with industry to control emissions, and maintain a strong

regulatory program to enforce air quality standards.

4. Pass federal legislation to encourage state utility regulators to approve programs for regulated utilities to finance and promote active and passive solar technologies for residential and commercial customers. Allow state regulators to decouple rates so utilities can make a profit on aggressive energy conservation measures. Support and fund research, development, and demonstration programs for renewable energy technologies.

Water

1. Establish policy and funding to address the backlog of needed stormwater infrastructure for urban and agricultural uses, while maintaining existing regulatory programs to prevent future backlogs. Continue and enhance water quality improvement activities, such as monitoring, research, and education.

2. Establish policy that links the availability of groundwater resources to consumption, so that monitoring and modeling are used to allocate resources to ensure they are maintained in good condition and that existing residents, businesses, and industries have an adequate and clean water supply.

3. Establish government incentives for "gray water" reuse and reduction of impervious surfaces within urban developments.

Land

1. Work within the regulatory framework to develop incentives for protection of on-site wetlands, especially isolated wetlands. Educate landowners and the public on the values of isolated wetlands to unique Florida species and in on-site flood containment.

2. Retain private ownership of forestlands to ensure the maintenance of Florida's timber industry. Keep land values low to discourage conversion to urbanization through use of greenbelt tax exemptions and other incentives. Design and implement a combination of regulatory enforcement and financial incentives to help pulp mills with outdated equipment and practices to become more community acceptable and more protective of natural resources.

3. Protect biological diversity on commercial forestlands through the use of silviculture best management practices and through conservation easements to protect threatened species identified by the Florida Game and Fresh Water Fish Commission.

4. Encourage the establishment of an independent private organization to develop standards and apply them to developments that meet the criteria for sustainable construction using the latest known technology and methods of construction. Amend national appliance manufacturing rating systems, criteria, and standards to be more appropriate for states like Florida that have hot, humid climates.

5. Work with financial institutions to offer "resource-efficient mortgages" to homeowners and developers who meet sustainable construction standards. Develop life-cycle costing and techniques for evaluating construction and deconstruction practices.

6. Educate local governments on establishing zoning codes and public-funded incentives for the redevelopment of urban areas as mixed-used neighborhoods using the existing

infrastructure and thereby avoiding consumption of undeveloped land. Modify revenue-sharing formulas to provide priority funding to communities that encourage compact development through local ordinances.

7. Institute regulatory procedures for mining that emphasize land reclamation rather than limiting or restricting extraction zones to non-wetland or specific upland habitat. Initiate a national effort to research, perfect, and publish a set of land reclamation technologies applicable to all wetland and upland habitat types in all geographic regions of the United States. Establish university curricula to develop mine reclamation specialists.

8. Institute and promote an initiative devised to research, develop, and implement a national and global strategy for extending the life of nonrenewable mineral resources.

9. Divert state severance taxes for solid minerals, petroleum, and gas for use as matching funds to federal support of reclamation technology, conservation of nonrenewable mineral resources, public education efforts, etc.

10. Design and establish a national mine registry program which will maintain a current inventory of all operational mines and have the authority to license individual mines and track the interrelationship of mine owners, holding companies, consortia, etc., for the purpose of quantifying mineral reserves, production data, and other sustainability issues. The registry should have the authority to revoke or suspend mine licenses for failure to perform satisfactory land reclamation at a single mine.

11. Encourage all states to implement programs such as Florida's Preservation 2000 for state land acquisition. Encourage landowners to practice good stewardship on large tracts of land held for agriculture, silviculture, ranching, and mining. Organizations such as the Nature Conservancy and Trust for Public Lands are exploring and implementing creative techniques and incentives for protection of private lands. These incentives need to be used by each federal agency with land use oversight, where maintenance of biological diversity is a critical issue.

Chesapeake Bay Watershed Natural Resources Task Force Workshop Report

August 18, 1995

Prepared by Workshop Sponsor/Participants

"Plan for and manage the adverse environmental effects of human population growth and land development in the Chesapeake Bay watershed."

—Mission Statement
Subcommittee on Land, Ground and Stewardship
Chesapeake Bay Agreement

I. Introduction

From October 30 to November 1, 1994, the Eastern Team on Natural Resources Management and Protection, President's Council on Sustainable Development (PCSD), held

a workshop on the Chesapeake Bay Watershed.

The workshop was convened by the Chesapeake Bay Program and included local environmental, government, academic, and industry representatives experienced in Bay activities. Most of the workshop attendees represented affected federal and state government agencies, researchers, and nonprofit environmental groups. Of the four representatives of private industry, one represented forestry, one utilities, one chemicals, and one residential development. Efforts were made to reach consensus.

The purpose of the workshop was to bring together Chesapeake watershed interests to review the region's history, ecology, economy, and resource management strategies. The Chesapeake Bay seemed a natural choice for investigation as part of the PCSD effort, since the Bay has been recognized as one of the first successful regional watershed activities. While the array of Bay activities is broad, the goal continues to be focused on the Bay's preservation and restoration to ensure that its resources are maintained for future generations—thus continuing the "Chesapeake Bay way of life." Restoration success is viewed in terms of restored abundance of living (nonhuman) resources.

The workshop was designed to explore Bay accomplishments and consider their applicability to the PCSD objective of sustainable development. Reflecting on Bay successes and pending issues served to strengthen the body of information the Natural Resources Task Force had to draw upon in developing its recommendations. Major themes and lessons of the Chesapeake Bay Program and recommendations expressed in the workshop are summarized below.

II. Major Theme of Workshop—Elements of Ecosystem Management

The level of commitment of Chesapeake Bay citizens is high. Although the actions that have occurred in the Bay often involve expenditures of public money and changes to law and regulation, the Chesapeake Bay Program is voluntary. No law required its establishment. The importance of general public's understanding and support in ensuring the continuation of Bay activities cannot be overstated.

Referenced repeatedly throughout the workshop was the fact that the initial focus was limited to very local situations. This focus has broadened to a wider scope—without losing this important local perspective—as Bay residents have come to realize that in order to protect their local situations, they must become involved in the wider area as well.

Four major themes emerged in the workshop as essential components of Bay restoration:

- sound problem identification and goal setting;
- integration and cooperation among many levels of government, with agreement on goals at the highest level;
- private sector participation—with incentives provided to it and accountability oversight provided by it; and
- the role of public awareness, participation, and accountability in maintaining sustained focus.

Critical elements for successful ecosystem management of the Bay which may be equally

applicable to sustainable development include the following:

- setting goals and standards for restoration;
- managing nutrient loadings;
- ensuring livable communities and healthy urban areas;
- ensuring healthy natural systems;
- understanding ecological values;
- predicting, identifying, researching, communicating, and solving problems;
- ensuring a self-correcting market system;
- establishing ecosystem goals and management; and
- ensuring citizen identification with stewardship roles.

To achieve sustainable development:

- apply restoration science;
- motivate scientists and managers to ensure the use of up-to-date information;
- understand degradation of soil, water, air, plant, and animal resources;
- implement visioning processes for all citizens in all areas;
- understand the role of markets in achieving sustainable development;
- monitor and model living resources and actions based on them;
- understand market externalities; and
- emphasize non-auto-based transportation.

III. Background: Concerns That Led to the Chesapeake Bay Program

The EPA Study, 1977-82

In the 1970s, there had been no agreement that the Bay's problems were systemic and cumulative. Many believed that the perceived problems were only the downward-trending phases of cycles or isolated situations.

Maryland Senator Charles Mathias vacationed in the Chesapeake Bay in the early 1970s. During his vacations, he spoke with many Bay users: watermen, yachtsmen, estuarine scientists, marina owners—people whose lives led them to observe the Bay at first hand. After 1972's Hurricane Agnes, Sen. Mathias became convinced that things in the Bay, and the Bay itself, were changing. Too many people were telling the same tales of zones of depleted oxygen, declining seagrasses, disappearing fish stocks, and increases in turbidity for the assertion that "it was just another cycle" to be persuasive.

Sen. Mathias introduced legislation that, in 1976, resulted in a budget for a five-year comprehensive study of the Bay by the U.S. Environmental Protection Agency (EPA). The

study ran from 1977 through 1982. Concomitantly, in the early 1980's, Maryland's Governor Hughes—dealing with increasing growth, sewage, eutrophication, and degradation in the Patuxent River—gave real and sustained support to his natural resources management agencies for moving toward cleaning up that river. That support carried over into efforts on the Chesapeake Bay as a whole.

After some early false starts, the EPA study coalesced in examination of eutrophication, toxic materials, and the decline of submerged aquatic grasses. Every major academic research institution in the Bay area took part, with much of the work being done by the University of Maryland, Johns Hopkins University, and the Virginia Institute of Marine Science.

The findings were that point- and nonpoint-source eutrophication, by stimulating excessive phytoplanktonic alga growths, was resulting in deoxygenation of large areas of deeper waters as the alga died, sank, and decomposed. The increased water fertility also aggravated epiphytic alga growths on the seagrasses themselves, leading to additional competition for, and blockage of, light. These growths added mechanical stressing to the grasses, causing them to break more frequently under wave action. Toxic materials, both metals and organics, were delivered from both point and nonpoint sources, and were widely distributed among all ecological compartments in the Bay—although concentrated in loci of sediment deposition, especially the sediments near industrialized areas such as Baltimore and Hampton Roads.

The project thus identified severe systemwide problems, many of which were attributable to or exacerbated by numerous and widespread human activities that affected everyone in the basin and their lifestyles. This finding by a consensus of respected scientists confirmed the observations of many concerned citizens, and the combination of scientific evidence and public concern forced governmental action. Moreover, it led to unprecedented cooperation among state and federal governments, academic, and the public: Government, science, and the citizenry at large all moved toward agreement and action.

Being able to tie together the oxygen deficits, algal blooms, and depression of the submerged aquatic grasses as different facets of the same eutrophication problem was of great importance, for it had the effect of showing that problems in many different geographic parts of the Bay were closely related. This meant that many people from different areas could support correction efforts aimed at this single problem. Subsequently, that realization was linked to the losses of habitat—through the grass decline and barren bottoms due to deoxygenation—and to shifts in abundance of harvestable fish and wildlife. It was understood that those habitat shifts led to decreases in wintering redheads and canvasbacks, losses of deep oyster bars, crab kills, and—tentatively—depressions of striped bass and blue crab abundance. That linkage created a climate powerfully conducive to mobilizing public opinion and commitment.

Government Processes

The result was that in 1983, Maryland, Virginia, Pennsylvania, and the District of Columbia signed the Chesapeake Bay Agreement, thereby pledging to restore and protect the Bay. The agreement called for the preparation and implementation of coordinated plans to improve and protect water quality and living resources; this in turn resulted in the July 1985 Chesapeake Bay Restoration and Protection Plan. The plan specifies goals and objectives for carrying out the 1983 agreement. Goal statements cover nutrients; toxics; living resources; related

matters (sludge, dredging, groundwater, atmospherics, public access, recreation); and institutional arrangements (public input, educational opportunities, data management, monitoring, and research. The implementation of these goals has generated about 12 major committees and 30 working task forces.

Although the actions taken under the agreement can involve expenditures of substantial public money and changes to law and regulation, the Bay Program is voluntary. No law required its establishment; the fact that this cooperative agreement and program came about without a mandating statute is one of its remarkable features. And the Bay Program's ability to deal with concepts like watershed management and ecosystem approaches in the face of the numerous separate legal entities participating in the program sets it apart from other efforts aimed at managing multijurisdictional problems.

In 1987, the agreement was renewed and updated. Time tables for accomplishment that allow and require accountability were added, including 29 specific major commitments addressing goals for living resources, water quality, and four other categories. Most specifically, a commitment based on state-of-the-art water quality modeling was made to reduce the nutrient loading to the Bay by 40 percent. A goal was added to plan for and manage the adverse effects of population growth and development; this ultimately resulted in the 2020 Panel and subsequent commissions and laws.

In addition, goals involving public involvement and participation in decisionmaking were broadened. The agreement was amended to state specifically that the understanding and support of the business community and general public were essential to sustaining long-term commitment to Bay restoration and protection. Information and education programs were committed to, public review of all implementation plans was adopted, and a general communication plan adoption date was specified. Finally, a formal, working arrangement for federal and state interjurisdictional management coordination vis-ˆ-vis data, monitoring, and research was adopted; as were specific provisions for the inclusion of local government participation.

Because the 1987 agreement anticipated improvements in modeling technology, it built in a 1991 reevaluation of the commitment to reduce controllable nutrient inputs by 40 percent. By that time, data generated by eight years of monitoring, and advances in understanding the estuary produced by continuing research, allowed for modeling work that confirmed that a 40 percent nutrient inflow reduction would materially improve the Bay's oxygen-depletion problem.

This led to the 1992 amendment that states that, in order to address the problems of the Bay as a whole, both point and nonpoint sources of nutrients in the watersheds of each of the many tributaries feeding the Chesapeake would have to be reduced.

The beginning of that tributary strategy is where matters stand today. All three states and the District have target load reductions. Pennsylvania has passed an agricultural nutrient management law, and Virginia is formulating its river-specific strategies. Maryland has developed a tentative list of practices for each of 10 aggregate watersheds, covering point sources, urban and agricultural nonpoint source best management practices, and resource protection techniques. Maryland's tributary strategy team has been through two phases of

discussions with the public including over 20 meetings and exchanges with the county planning staffs in the 10 watersheds. Proposed tributary-specific implementable strategies were presented to the public in spring 1994, with adoption in October 1994. Tributary teams in each region/watershed are charged with implementation, with aid from various governments (as of this writing, these last are not yet guaranteed).

Chesapeake Bay Agreement Goal

In supporting the 1987 Chesapeake Bay Agreement, the Land Use, Growth and Stewardship Subcommittee is responsible for identifying growth and land use issues of a Bay-wide nature, addressing development topics, and forging alliances with other organizations and interests to

- promote sound land management decisions,
- provide growth projections and assess the impacts of existing growth on the Bay and its tributaries, and
- encourage public and private actions to reduce the impacts of growth.

These activities will be pursued in support of the 1992 Chesapeake Bay Agreement which commits the signatories to, among other things, implement tributary-specific strategies that meet mainstream nutrient reduction goals and achieve water quality requirements necessary to support living resources in both the mainstream and the tributaries of the Chesapeake Bay. Furthermore, the 1992 amendments commit the signatories to explore opportunities to reduce airborne sources of nitrogen which enter the Chesapeake Bay and its tributaries beyond the requirements of the 1990 amendments to the federal Clean Air Act.

Objectives

- Create public forums for the exchange of ideas and strategies on land conservation, sound growth, development, and stewardship.
- Provide local governments with the technical and information assistance to continue and expand their management efforts to reduce the negative impacts of growth.
- Develop and analyze Bay-wide information to measure trends and patterns in population growth and development and to better understand its impacts on the Bay and its watershed tributaries.
- Enhance public access in and around the Bay and its tributaries.
- Promote stewardship among local, state, and federal governments and the private sector. Encourage partnerships with land conservation groups, land trusts, or other efforts promoting land conservation.
- Evaluate the potential growth and development impacts of local, state, and federal government policy decisions.

IV. Supporting Nongovernmental Organizations

The Alliance for the Chesapeake Bay

The Alliance for the Chesapeake Bay is a federation of citizen organizations, businesses, scientists, user groups, and citizens. It is funded by grants from government, foundations, and individuals as well as corporate contributions.

The Alliance coordinates citizen water chemistry and biological monitoring efforts in several tributaries. It has organized conferences on Bay issues, provides speakers, and operates a regional information service. It serves as staff for the Citizens Advisory Committee, the citizens' official input organ to the Chesapeake Bay Program. It publishes a news journal on Bay issues 10 times a year. A nonadvocacy organization, the Alliance's role in protecting the Bay is through citizen education and involvement. Its excellent *Bay Journal* and issues papers; broad citizen monitoring program; and extremely energetic, dedicated, and capable director give the citizenry an active role in the Bay Program.

Chesapeake Bay Foundation

lThe Chesapeake Bay Foundation (CBF) combines advocacy with educational efforts. It lobbies for passage of Bay-protective legislation, joins in lawsuits on pollution issues, and is active in land trust development. Members of its staff sit on various management advisory committees, such as for striped bass, in Maryland. CBF frequently serves as a sort of "loyal opposition gadfly," generally urging government and user groups to go farther in their efforts to preserve and restore the Bay. CBF sees itself as a catalyst, watchdog, and constructive critic. Most recently, CBF prepared a "report card" on how well the Bay Program is carrying out its 1987 commitments—and whether these commitments are adequate to meet restoration goals.

The outstanding CBF program, though, is its environmental education effort. Through a mixture of canoes, island reserves, farms, stream conservation efforts, boat trips, and curriculum development workshops, CBF annually exposes some 35,000 educators, students, and concerned citizens to hands-on, in-the-field learning about the Chesapeake ecosystem.

Chesapeake Research Consortium

The Chesapeake Research Consortium (CRC) is an organization of the six most active research institutions in the region: the Academy of Natural Sciences, College of William and Mary, Johns Hopkins University, Old Dominion University, Smithsonian Institution, and University of Maryland. CRC has served as a cohesive force to bring together the scientific community for research and assessment dealing with the Chesapeake Bay restoration. Much as the Alliance staffs the Citizens Advisory Committee, CRC staffs the Scientific and Technical Advisory Committee of the Bay Program. It holds conferences and workshops on critical issues and publishes targeted syntheses of the scientific and technical literature. CRC also provides interns and fellows who work within the management agencies for fixed terms. This regional organization has played a central role in providing a scientific "compass" to guide Bay restoration.

Other Supporting Organizations

Additional organizations involved in Bay efforts include the local Sierra Club chapter, the Maryland Conservation Council, Save-Our-Streams, Trout Unlimited, the Maryland Saltwater

Sportsmen's Association, and the Maryland and Virginia Watermen's Association. Also involved are the charterboatmen, advisory committees such as the State Water Quality Advisory Committee and the Coastal/Watershed Advisory Committee, and numerous local focus groups in geographic areas. Many of their members are also members of the Alliance, which serves to bring local concerns into the larger Bay context. This dual membership thus helps foster the recognition that much of the overall Bay problem is the cumulative effect of many local area ones. All of these groups have their own points of view and make themselves heard through their various contacts and mechanisms.

In addition to the education and advocacy organizations within the Bay watershed, the region has a growing number of local and regional land conservation organizations. These groups conserve a variety of natural areas, recreational open space, and rural resources that are a critical component of the sustainable community and growth management equation. These groups use an array of mechanisms to conserve open space and working landscape: conservation easement, transfer of development rights, agricultural purchase of development rights programs, and fee acquisition. Maryland, Virginia, and Pennsylvania have enacted several model funding programs that support the land protection efforts of land trusts. While many of these programs began before the Bay Program, they have been strengthened and expanded because of the growing concern for the protection and restoration of the Chesapeake Bay and the recognition of the interrelationship of land use and water quality.

The Citizens and the Government

Formation of the Alliance, CBF, and other groups dates back to the 1960s and early 1970s. Many of the members of these various citizen groups have now been environmental activists for several years. Many activists became involved early on because of perceptions that government was not aggressive enough in protecting the environment. Others became involved because of some local area degradation of the natural environment, such as new developments, a pollution of nearby waters, forest losses, or disturbance of tranquility. Clashes between the rights of private property and a presumed, but ill-defined, right to common resources aroused citizens.

Few citizens understood, early on, that the government environmental management agencies did not see themselves principally as environmental preservers. The hard facts of conservation politics, theretofore experienced primarily by fish and wildlife interest factions, subsequently had to be learned by the broader, environmentally concerned citizenry. Very few realized that government resource agencies were far from monolithic or single-purpose conservation-oriented, especially where constraining the exploitation of natural resources was involved. Discovering that government agencies were generally reluctant to say "no" to polluting activities—activities that historically had been considered perfectly normal exercise of property rights—was a shock to many citizens.

Many of the management agencies were slow to change in response to growing citizen environmental concern. They frequently wished to avoid controversy, especially regarding exploitation of private property. While justified in some cases, government agencies frequently saw environmental protestations as simply "Don't do it in my back yard," or as unjustified efforts to keep a little bit of "paradise" sacrosanct to the protesters, with little regard to the rest

of the world.

In defense of the government agencies, though, there has been, in this country, a historical tradition of noninterference with individual rights unless a public interest could be strongly shown. Thus, laws frequently were written requiring an agency to give equal weight to rights to direct use of resources. In the Bay region, even after the 1972 Water Pollution Control Act, there was great difficulty in obtaining satisfactory proof that a significant environmental problem existed. In fact, change had to wait, to a large degree, for completion of the EPA program studies documenting the degradation.

In addition, the scientific community—many of whose members are part of these same management agencies—led the effort to push for adequate research and data collections. The results of that push often served as the example or basis for further citizen action. The scientific work that identified nutrients as the most significant problem in the Bay is an excellent example.

Volunteer Monitoring

The Chesapeake Bay Program began supporting volunteer monitoring in 1985 by giving a grant to the Alliance to set up a pilot program. From a fledgling effort of 35 volunteers, the program has grown, expanded, and been copied by groups all over the country. Today, there are 200 volunteers in the Alliance program and hundreds of others in similar programs throughout the watershed. And the number of similar programs around the country continues to expand. Volunteers take water samples in a variety of ways, but a hallmark of the Chesapeake effort has been quality assurance. Training is provided to all volunteers, and quality control sessions are held semi-annually. Data that do not meet standards are not used. In this way, volunteers have developed a high level of credibility.

New programs are being developed to involve volunteers in other kinds of monitoring, including wetland monitoring, buffer surveys, and assessments of resources such as submerged vegetation.

V. What Was Learned

Basis for Preservation Programs

Maintaining elements of the natural, rural, historical, and cultural environment of the Bay is essential to maintaining the quality of life for all its inhabitants—human and otherwise. The aim of protecting and restoring the Chesapeake Bay is based on a desire to maintain the way of life for the people around the Bay. The watermen not only provide a symbol of Chesapeake Bay life, but are a major economic force in the region. Further up the tributary, on the Susquehanna, we see a similar example: The Amish are a symbol of the rural and agricultural life of Lancaster County. The ability to sustain their way of life is bound up with the efforts of the Bay Program to keep farming a viable occupation in the county.

The Bay's economy is largely dependent on the maintenance of its environmental assets. Agriculture, forestry, and tourism are the primary industries; these depend on natural and historical resources for their continued viability. The fishing industry, while declining, depends on the quality of Bay waters, which are affected by the use of its land. New businesses and

residents move to and remain in the area in large part because of its environmental amenities—the loss of which could cause a decline in jobs and tax revenues. The costs and benefits of new development to the citizens are directly related to the location and pattern of this development as it affects the natural, rural, and historical resources of the area. Therefore, the following principles have been recognized and supported by state and local governments, and serve as a basis of preservation programs.

- Open space, including farmland, forests, and natural areas, is less expensive for local governments to service than most alternative forms of land use, particularly the low-density residential sprawl that constitutes the fastest growing form of land use. Permanent protection of farmland and open space also encourages compact growth, lowering costs of public services and infrastructure and the need for new taxes.

- Agriculture is the Bay's largest industry, accounting for about 14 percent of Maryland's gross product. This industry depends on the retention of productive farmland at reasonable costs to the farmer.

- Tourism is one of the leading industries, and is likely to become the largest industry in the state of Maryland before the turn of the century. Historical structures, landscapes, and villages are essential to the continued growth of this sector of the economy; these should be preserved.

- Rural and urban historical and cultural sites, and residential and commercial historical districts throughout the region, also help maintain diversity and improve quality of life for all citizens. Preservation and enhancement of these special assets help ensure community vitality, making these places more attractive and dynamic. Keeping existing communities attractive and livable helps prevent suburban sprawl by retaining existing residents and businesses.

- Forest-based recreation and tourism continue to grow in importance to the area economy. Forestland is also most beneficial to the health of the Chesapeake Bay and the continued viability of fisheries. As an example, Maryland's forest products industry remains the fifth largest industry in the state and continues to be the primary employer in western counties and the second most important on Maryland's Eastern Shore.

- Recreation and park use are essential to citizens of all incomes and ethnic backgrounds. The right to a safe, accessible, and pleasant place to play is a right every bit as important as jobs and housing; and the citizens of Maryland have learned to expect it and to pay for it through the transfer tax on real estate transactions. Proceeds go into Program Open Space for land acquisitions by public entities.

- The real estate economy benefits from the preservation of open space. The value of homes in Maryland is enhanced by proximity to protected open space. Studies completed in other states document that house values adjacent to such land increase by as much as 10 percent to 50 percent. Increased property taxes from homes adjacent to protected land have been documented to offset costs for maintenance of open space.

Thus, protecting natural, recreational, agricultural, and historically significant open space is critical to the sustainability of the region. Besides using local and state regulations to protect open space, purchasing critical properties is essential. Public agencies have been acquiring

recreational and natural lands for decades. More recently, creative partnerships between public agencies and land conservation organizations have increased both groups' ability to protect key resources. Following are examples of such efforts.

- Maryland's Program Open Space was established in 1969 to expedite the acquisition of recreation and conservation lands by the state and counties. The program is funded through a 0.5 percent real estate transfer tax. The program has been expanded over the years to assist with the state's purchase of development rights on prime agricultural land, a revolving loan fund for land trusts (through the Maryland Environmental Trust—MET), and—most recently—direct grants to land trusts.

- In 1993, Pennsylvania created a permanent Recreation, Park and Conservation Fund. There will be a bond issue of $19.5 million in 1994; and, beginning in FY 1995, a realty transfer tax will be instituted which is anticipated to provide $10 million annually. Much of the money is available on a matching basis to local governments. However, about $3 million annually will be used to provide grants to qualified land trust organizations to assist the state and local governments in land acquisition, primarily natural resources protection.

- The Maryland Environmental Trust, a quasi-public statewide conservation easement holding organization (with easements of over 40,000 acres) has creatively used Coastal Zone Management Act money to facilitate land conservation. This money is used to provide a statewide land trust coordinator as well as small operating grants made available to land trusts on a competitive basis.

- Calvert County, Maryland, has established a $1.0 million no-interest revolving loan fund for land trusts. The county also has a very successful transfer of development rights program protecting natural resource and agricultural areas.

- Maryland has provided additional incentives for the donation of conservation easements: land covered by easements held by MET or jointly by MET and local trusts receive a 15-year property tax abatement. Anne Arundel County recently implemented a similar law, and related efforts are under way in several other counties.

- Both Pennsylvania and Maryland have successful purchase of development rights programs for agricultural land using a combination of funding sources. Many counties supplement the funding with additional funds, tax abatements, etc. Local trusts are actively encouraging landowners to enroll in the programs. Howard County, Maryland, enacted an extremely innovative program of installment sale purchase of development rights using tax-exempt bond installment sales. Fitch Investment Service actually increased Howard County's bond rating to AAA because of its efforts to control development and protect the county's quality of life.

Steps Toward Sustainable Development—Comments by Workshop Participants

Following is a sampling of comments made by workshop participants regarding steps that have been, or should be, taken toward sustainable development.

- "Chesapeake Bay restoration benefits from regionwide public support; the high socioeconomic status of surrounding population; a large scientific capacity and

database; and special federal funding, which has helped unify actions."

- "Bird hunting is a significant recreation industry in the Bay area, requiring property owners to preserve and manage open land."
- "Recovery efforts responsible for restoration of striped bass population included fishing bans by Maryland and Virginia, threat of federal government action, and large base of scientific data."
- "Advocates of controlling the flow of nutrients (nitrogen and phosphorus) into the Bay used computer models that simulated this contamination to convince government to intervene."
- "Some jurisdictions (for example, Prince George's County) have established flexible performance-based zoning that encourages clustering and high density in exchange for public benefits . . . Some jurisdictions have experimented with transferring development rights."
- "Everything we've talked about is prologue. It relates to the ecosystem, which perhaps is the basis for moving toward sustainability. [There is a] continuing need for more outreach, education. People still don't understand they are the problem . . ."
- "Find new ways to expand involvement in the process of protecting the Bay and organize state, county, and local partnerships to protect the Bay against nutrient loading."
- "Involve a broader range of groups and tie sustainable development to the economic health of the regions . . . Establish some scientific evidence of problems with rational solutions . . . Amend existing legislation—tax code, zoning and master plans, subdivision standards—that encourages sprawl and discourages high-density development to encourage more efficient use of land and transportation . . . Bring together social and natural scientists to discern community sustainability . . . Set broad but measurable goals."
- "Sustainable development is not a matter of esthetics or ethics, but of enlightened self-interest and survival—of economics, costs, benefits, and problems of quantification. The major issues are accommodating population growth, public regulation, and loss of property rights."
- "Ecosystem management cannot be measured by the health of a single plant or animal species. A comprehensive review of all natural resources in the watershed is needed . . . Sustainable development efforts must be made comprehensible to the public."
- "Work [is needed] by the various states [in] recognition [of the fact] that population in [the] region [is] greatly increasing. [It is] necessary to take steps to ensure that urban sprawl [is] limited if possible [and to recognize the] importance of [the] element of planning."
- "Support existing state and locally led, place-based sustainable use efforts with technical, information, and financial assistance."

- "Examine ways to improve the delivery of existing federal programs and services to help people and organizations help themselves achieve sustainable development."
- "Housing demand can be met with less impact on the environment through creative zoning solutions such as performance-based zoning and clustering options."
- "Document and publicize existing examples of local sustainable development—i.e., Lower Rappahannock River Valley, Virginia, Project; International Countryside Stewardship Exchange Case Studies; Lackawanna Heritage Valley, Pennsylvania, Project; Annapolis, Maryland, 'Toward a Community Vision' Project; Northampton County, Virginia, Sustainable Development Plan)."

Barriers to Sustainable Development—Comments by Workshop Participants

The workshop participants cited the following barriers to meeting sustainable development goals.

- "National transportation policies, including low fuel taxes, support [of] commuter systems centered on automobiles."
- "Regulation of surface water does not protect the Bay from transported agricultural materials. Recent research shows that groundwater carries most of the harmful agricultural materials (such as nitrogen) into the Bay."
- "There are numerous examples of ecosystem degradation resulting from excessive demands on natural resources."
- "Population growth, and its associated demands on the system, is the major problem facing efforts at sustainability. What we don't yet seem to know is how to implement a halt or a reversal of these trends."
- "Sufficient scientific data to understand the significance of the decline in blue crabs [are] lacking. Has the stock collapsed or merely returned to normal levels?"
- "Demographic trends—including increases in population, the ratio of dwelling units to population, and lot sizes—run counter to efficient land use and sustainable development. Regions that restrict themselves to sustainable rates of growth will face a short-term disadvantage in competing with regions that pursue laissez-fare growth policies."
- "U.S. land use policies have not effectively applied the English common law doctrine of public trust."
- "It is difficult for a local government to support policies helpful for the region if they impact negatively on local constituents. Projects that are imposed on local communities by regional jurisdictions compound this problem."
- "Gaps include minority participation, scientific information that can lead to measurable goals, large lot zoning as an environmental policy, and economic impact analyses concerning jobs and cost benefits."

- "Government policy inadvertently exacerbated the land use impacts with overly burdensome road requirements, grading requirements, and density caps. Trees especially were the victim in meeting state and local grading standards. Large lot zoning has led to further sprawl. And restrictions against multifamily and attached housing in many areas has led to sprawl and unnecessary grading."

VI. Guidelines for Sustained Ecosystem Management: Threshold for Sustainable Development

A report prepared by the Chesapeake Bay Commission in 1993 summarizes the lessons learned from the Bay experience. These lessons offer some guidelines for structuring a national ecosystem management approach and could serve as the critical threshold for moving toward sustainable development.

1. **Begin with comprehensive studies that are multidisciplinary in scope, combining theory, detailed knowledge, and integrative monitoring and modeling.** The EPA Bay Program study presented the region's public and political leadership with a solid, scientific foundation for decisionmaking. The information was comprehensive and multidisciplinary. It determined clear linkages among land, water, and living resources. Since the release of the EPA report in 1983, highly sophisticated monitoring, modeling, and targeted research have continued to serve as the backbone for policy decisions in the region.

2. **Test scientific theories and management approaches on a small scale and then transfer the results to the whole watershed.** In the late 1970s and early 1980s, a number of scientific investigations concerning ecosystem processes were comprehensively studied in smaller watersheds within the Bay ecosystem. The effectiveness of various nonpoint source controls and approaches to public involvement were evaluated. In the Bay region, testing research methodologies and pollution control strategies on a smaller scale, using demonstration or pilot projects, has led to increased success when those techniques were applied more broadly.

3. **The highest levels of leadership possible must embrace clear, strong, specific, and comprehensive goals for the management effort, based on the best science available at the time.** There is strength in strong leadership, clear goals, and accountability. The Bay Agreements, and the high-level leaders who have signed them, provide an outstanding and enduring commitment to the restoration of the Bay ecosystem. A set of highly specific goals has been adopted that is unmatched nationwide. These goals cover a comprehensive array of issues including water quality, living resources, growth management, public information and education, research and monitoring, and public access. They include such specific goals as achieving a 40 percent reduction in nitrogen and phosphorus reaching the Bay by the year 2000 and eliminating fish blockages throughout the Bay's tributaries. Goals that are quantifiable make progress measurable and leaders accountable.

4. **The success of ecosystem management lies in the diversity of the participants.** Ecosystems are extraordinarily complex. A framework to manage them must involve a complex array of players representing all levels of government, the private sector,

scientists, and citizens. In the Bay region, these players are represented by 3 governors, 40 members of Congress, hundreds of state legislators and local elected officials, 13 federal agencies, 4 interstate agencies, and more than 700 citizen groups—all of whom play a role in the restoration effort. Together, these players bring immense political leadership and financial support to the program.

The formal Bay Program has established more than 50 subcommittees and workgroups to ensure that all of these interests are represented and that the goals of the program are ultimately achieved. Over time, no part of the ecosystem or any stakeholder in it is omitted. Strong communication is the primary vehicle for integrating all of these parts, thus ensuring the success of the ecosystem management approach.

5. **Incentives and methods for institutional cooperation must be in place.** In the Bay region, the principal incentives are either money or public pressure. The active, financial involvement of EPA and other federal agencies has leveraged hundreds of millions of state and local dollars. Cost share and technical assistance programs have been established to address a range of management issues.

6. **An informed public is key.** The citizenry of the Bay region is remarkably knowledgeable. While there is a naturally high public sentiment toward "saving our Bay," at least some of the credit should go to the Bay leaders' extensive educational and technical assistance efforts. Survey after survey reveals overwhelming public support for the restoration efforts and a growing understanding of concepts such as "watersheds" and "ecosystems." Ecosystem management involves complex political decisions. An informed public can be an ecosystem manager's greatest ally.

7. **Mandatory to any ecosystem management approach is a willingness of the players to constantly reassess.** A cornerstone of the Chesapeake Bay Program has been a constant commitment to "pulse taking" and tracking progress. The health and vitality of the living resources serve as one important measure of success. In addition, routine water quality trends and assessments of pollution loading reductions track progress in achieving the goals. These measures serve as "canaries in the mine shaft." Periodic research to assess progress toward goals provides new information that, in turn, leads to improved ways of controlling pollution, managing fisheries, and restoring habitat. Regardless of the commitments that have been made in the past, Bay community leadership has repeatedly demonstrated an ability to alter course if new knowledge dictates a new approach. This dynamic approach to management has contributed to the program's integrity.

8. **Ecosystem management requires a balanced approach.** In a program that spans land use policy to fisheries management to recreational boating to airborne toxics, a diversity of implementation tools is critical. When managing an ecosystem, no one approach works best in all ecological, political, and economic situations. If ecosystem management is to work, management scenarios must take into account the varying ecological, economic, cultural, and political forces involved in the various reaches of the

ecosystem.

The Bay Program involves three states and several thousand empowered local governments of markedly different orientation. As a result, management tools range from legislative mandates to voluntary efforts. Strong laws and regulations ensure effective pollution control and resource stewardship in the region, while broad public education and technical assistance programs provide incentives.

9. **Integration is the ultimate key to an ecosystem management approach.** Despite the existence of theory, practice and tools that support the implementation of ecosystem-based management remain. Central to these obstacles are difficulties in defining management units; understanding the biological, physical, economic, and cultural factors at play; and structuring a management framework that properly integrates all the component parts. Achieving proper integration is highly complex, challenging the boundaries of traditional resource management. It requires the cooperation of diverse players whose educational, philosophical, and professional orientations are often worlds apart. It involves constant communication and collaboration of multiple agencies at multiple levels of government. It often crosses traditional areas of management, forcing fisheries scientists to work with land planners, sewage treatment plant operators to coordinate with farmers, and so on.

10. **The success of any program rests in its ability to demonstrate results.** The Bay Program was officially launched in 1983. Since that time, its efforts have held the line on nitrogen and have achieved a 20 percent reduction in phosphorus in the Chesapeake Bay. Participants are hopeful of achieving their goals by the year 2000. There have been demonstrable gains in the way we manage land, provide fish passage, restore seagrasses, manage fisheries across state lines, and ban the use of toxic chemicals known to have an impact on the ecosystem. Measuring and publicizing tangible results are key to sustaining leadership commitment and public support. They are also essential to maintaining the trust and commitment of the stakeholders involved in any management decisions made.

VII. The Chesapeake Bay: Is Sustainable Development Achievable?

In spite of the tremendous efforts under way to preserve the Bay, the Chesapeake isn't what it used to be. Many of the Bay's historic natural resources—its legendary herring and shad runs, oyster beds, and luxuriant grassbeds—have declined seriously.

People's activities sometimes hundreds of miles away have had the greatest effect on Bay resources. With more than 15 million people in the Chesapeake watershed—and 2 million or more to be added by the year 2020—how will vital natural resources survive?

The issues of quality of life and stewardship, issues that indirectly affect economic issues, must be made tangible and real to everyone. Preservation activities must be integrated into economic activities. Pollution reduction—proactive initiatives, not restrictive regulations—must be made part of everyday activities.

The workshop participants concluded that we don't know yet if we can protect our natural resources, fulfill our economic objectives, and provide a high quality of life for all people in the watershed. Fortunately, the Chesapeake Bay is blessed with a large number of citizens dedicated to continuing to work constructively in addressing these issues.

APPENDIX D
WESTERN REGIONAL TEAM REPORT

Following is the report of the Western Regional Team. This report represents the work of the authors of the report and has not been subjected to fact-checking by the President's Council on Sustainable Development.

APPENDIX E
REPORT OF THE WATER SCIENCE AND TECHNOLOGY BOARD

Following is the report of the Water Science and Technology Board. This report represents the work of the authors of the report and has not been subjected to fact-checking by the President's Council on Sustainable Development.

CRITERIA FOR WATERSHED SUSTAINABILITY: PROCEEDINGS OF A WORKSHOP

Held on

December 6 and 7, 1994

at the

National Academy of Sciences

Washington, D.C.

Water Science and Technology Board
Commission on Geosciences, Environment, and Resources
National Research Council

August 1995

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the workshop responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Support for this project was provided by the President's Council on Sustainable Development.

This report is available from the
Water Science and Technology Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

Copyright © 1995 by the National Academy of Sciences. All rights reserved.
Printed in the United States of America. **WORKSHOP PARTICIPANTS**

WILLIAM GRAF, *Chair*, Arizona State University, Tempe
J. DAN ALLEN, Chevron USA, Inc., New Orleans, Louisiana
PETER BISSON, Weyerhauser Co., Tacoma, Washington
JOHN BOLAND, The Johns Hopkins University, Baltimore, Maryland
PATRICK BREZONIK, University of Minnesota, St. Paul
WILLIAM EICHBAUM, The World Wildlife Fund, Washington, D.C.
WILFORD GARDNER, University of California, Berkeley
WILLIAM LEWIS, JR., University of Colorado, Boulder
WALTER R. LYNN, Cornell University, Ithaca, New York
CAROLYN OLSEN, Brown and Caldwell, Pleasant Hill, California
MAX PFEFFER, Cornell University, Ithaca, New York
RICHARD SPARKS, Illinois Natural History Survey, Havana
CATHERINE VANDEMOER, Bureau of Indian Affairs, Washington, D.C.
HENRY VAUX, JR., University of California—Riverside, Oakland

STAFF

STEPHEN D. PARKER, Director
SHEILA D. DAVID, Senior Program Officer
ANGELA F. BRUBAKER, Senior Project Assistant

INVITED GUESTS

GARY LARSEN, Policy Advisor for Natural Resources, President's Council on Sustainable Development
LOIS MORRISON, Policy Analyst for Natural Resources, President's Council on Sustainable Development
EILEEN SHEA, NRC, Board on Sustainable Development

WATER SCIENCE AND TECHNOLOGY BOARD

DAVID L. FREYBERG, *Chair*, Stanford University, Stanford, California

BRUCE E. RITTMANN, *Vice Chair*, Northwestern University, Evanston, Illinois
LINDA M. ABRIOLA, University of Michigan, Ann Arbor
J. DAN ALLEN, Chevron, USA, Inc., New Orleans, Louisiana
PATRICK BREZONIK, University of Minnesota, St. Paul
WILLIAM E. EICHBAUM, The World Wildlife Fund, Washington, D.C.
WILFORD R. GARDNER, University of California, Berkeley
WILLIAM GRAF, Arizona State University, Tempe
THOMAS M. HELLMAN, Bristol-Myers Squibb Company, New York, New York
CHARLES C. JOHNSON, JR., U.S. Public Health Service, Washington, D.C. (retired)
WILLIAM M. LEWIS, JR., University of Colorado, Boulder
CAROLYN H. OLSEN, Brown and Caldwell, Pleasant Hill, California
CHARLES O'MELIA, The Johns Hopkins University, Baltimore, Maryland
IGNACIO RODRIGUEZ-ITURBE, Texas A&M University, College Station
HENRY VAUX, JR., University of California—Riverside, Oakland

STAFF

STEPHEN D. PARKER, Director
JEANNE AQUILINO, Administrative Specialist
ANGELA BRUBAKER, Senior Project Assistant
SHEILA D. DAVID, Senior Staff Officer
CHRIS ELFRING, Senior Staff Officer
ETAN GUMERMAN, Research Associate
ANITA A. HALL, Administrative Assistant
GARY KRAUSS, Staff Officer
JACQUELINE MACDONALD, Senior Staff Officer
MARY BETH MORRIS, Senior Project Assistant
GREGORY NYCE, Senior Project Assistant

COMMISSION ON GEOSCIENCES, ENVIRONMENT, AND RESOURCES

M. GORDON WOLMAN, *Chair*, The Johns Hopkins University, Baltimore, Maryland
PATRICK R. ATKINS, Aluminum Company of America, Pittsburgh, Pennsylvania
JAMES P. BRUCE, Canadian Climate Program Board, Ottawa, Ontario
WILLIAM L. FISHER, University of Texas, Austin
EDWARD A. FRIEMAN, Scripps Institution of Oceanography, La Jolla, California
GEORGE M. HORNBERGER, University of Virginia, Charlottesville
W. BARCLAY KAMB, California Institute of Technology, Pasadena
PERRY L. MCCARTY, Stanford University, California
S. GEORGE PHILANDER, Princeton University, New Jersey

RAYMOND A. PRICE, Queen's University at Kingston, Ontario, Canada
THOMAS A. SCHELLING, University of Maryland, College Park
ELLEN SILBERGELD, University of Maryland, College Park
STEVEN M. STANLEY, The Johns Hopkins University, Baltimore, Maryland
VICTORIA J. TSCHINKEL, Landers and Parsons, Tallahassee, Florida
EDITH BROWN WEISS, Georgetown University Law Center, Washington, D.C.

STAFF

STEPHEN RATTIEN, Executive Director
STEPHEN D. PARKER, Associate Executive Director
MORGAN GOPNIK, Assistant Executive Director
JAMES MALLORY, Administrative Officer
SANDI FITZPATRICK, Administrative Associate
SUSAN SHERWIN, Project Assistant

CONTENTS

SUMMARY

In response to a request from President Clinton's Council on Sustainable Development (PCSD), the Water Science and Technology Board held a workshop to assist the PCSD in its charge to develop bold new approaches to integrating economic and environmental resource policies organized according to watershed boundaries. Workshop participants generated a

series of questions that could be posed to present and future federal, state, and local decision-makers who face the problem of sustaining ecological resources of watersheds under pressure from human activities and management. Some questions are directed to the watershed scientists who supply decision-makers with information and knowledge.

The workshop adopted the council's concept of sustainability as an ethical concept meaning the characteristic of resource management that "meets the needs of the present without compromising the ability of future generations to meet their own needs." Workshop participants agreed that the term "sustainable development" is problematic because it implies that the purpose of resource management is to preserve continuous economic development and expansion within a system that obviously has limits. Participants observed that the term "sustainable" should be used in association with specific things, objects, or services that can be defined, identified, mapped, and measured. The objective of sustainability is, therefore, to preserve the productive integrity of the natural and human resources that form the base upon which stable economic conditions depend.

Workshop participants emphasized the importance of an overall conceptual framework for dealing with the sustainable resources of watersheds. Such a framework includes identifying specific natural resource problems and concerns; identifying stakeholders; defining the relevant scale of the problems; specifying tradeoffs among economic, social, and environmental considerations; exploring the values of stakeholders in deciding among the tradeoffs; and identifying the best actions in achieving the desired balance among competing interests. The workshop concluded that watersheds can provide the basis to assess many of the resources that contribute to human welfare and well-being. A challenge for the PCSD will be to develop a method and related models to overlay the economic and social considerations on the watershed-based analysis of natural processes.

The key questions developed at the workshop encompass social and economic well-being; existing scientific institutions and data gathering to assess trends; the concept of adaptive management and watershed analysis; stakeholders; relative scales of decision-making processes and the scale of natural systems; dynamics of watersheds; tradeoffs between economics, social, and environmental considerations; existing monitoring programs; and communication of environmental information and behavior change.

The purpose of the workshop was to formulate the questions rather than answer them, to point the direction for future investments of intellectual capital rather than review the results of past efforts, and to offer a series of starting points rather than conclusions. A challenge for the PCSD and for decision-makers will be to develop the capacity to predict the broad range of biological, physical, environmental, social, and economic consequences of human actions impacts in watersheds. Workshop participants found that scientific knowledge is available to provide some answers and that cooperative interactive efforts among scientists and decision-makers will be required to develop new tools and methods if the nation is to achieve a goal of truly sustainable watershed resources.

BACKGROUND

At the request of the President's Council on Sustainable Development (PCSD), the Water Science and Technology Board (WSTB) of the National Research Council (NRC) convened a two-day workshop in December 1994 to develop a list of key questions to be posed to future decision-makers as a basis for determining the sustainability of watershed activities.

The PCSD was created by President Clinton in 1993 and was charged with developing bold new approaches to integrate economic and environmental policies. It was chartered with

meeting three specific objectives:

- to recommend a national sustainable development action strategy to foster economic vitality and protect our cultural and natural resources,
- to increase public awareness about the need for sustainable development, and
- to institute a presidential honors program to recognize exemplary efforts that advance sustainable development.

Sustainable development as defined by the PCSD is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This concept was put forward by the Brundtland Commission (WCED, 1987). It means maintaining our nation's economic prosperity in a way that does not compromise the integrity of our natural resources.

The PCSD is made up of 25 leaders from industry, government, environmental, labor, and civil rights organizations. The council created eight task forces to address major issues dealing with sustainable development. The request for the NRC's involvement came from the Natural Resources Management and Protection Task Force, which is developing a vision of sustainability as it relates to biodiversity, ecosystems, and watersheds. The PCSD will submit a final report integrating all eight reports from its task forces to President Clinton in 1995.

A watershed is a unit of the Earth's surface defined by the flow of water: if all other aspects of the Earth-surface system are equal, all surface flow with a watershed flows downslope into channels that form a network to conduct the water to a single exit point from the watershed. The drainage basin that combines slopes and channels to form the watershed is more, however, than a simple conduit for water. As a geographical region on the Earth's surface, each watershed has a particular association and pattern of vegetation cover, land uses, human and animal populations, and economic activities. The natural and human environments within a watershed include rural and urban areas with a variety of resources with human values that include commodities (water, timber, agricultural produce) and services (dispersion of pollution, service as habitat for wildlife, opportunities for recreation).

A watershed-scale approach to environmental management takes into consideration the entire watershed, including the land mass that drains into an aquatic ecosystem (NRC, 1992a). Because watersheds provide a natural integration in assessing and analyzing the social, environmental, and economic sustainability of people's activities, the PCSD chose to use watersheds as its primary organizing framework in the task force investigations. The PCSD believes that a clear understanding of the application of sustainability concepts to watersheds is essential for policy development.

The PCSD requested that the NRC assist in its task by developing questions that could be posed to present and future federal, state, and local decision-makers as they face the necessity of sustaining the ecological resources of watersheds in relation to the variety of human activities that will continue to occur within them. This report responds to that request from a scientific perspective. Although the workshop participants were drawn from a wide range of specialties, this proceedings uses natural science and engineering perspectives as a starting point. Social and behavioral sciences, humanities, and policy perspectives were included as they related to the natural sciences. As a result, some questions emerged that are best directed to the scientific community as it attempts to provide guidance to decision-

makers.

The workshop identified the critical questions and, through discussions of experts in a variety of specialties, offered some indications of the significance of each question, along with avenues to investigate possible answers. In some cases, potentially useful answers are briefly explored by way of illustration and by necessity certain value judgments are made.

The workshop participants met only once and contributed written comments after this meeting for the proceedings. The chair of the workshop and the WSTB staff then prepared this document. The purpose of the workshop was to pose the questions rather than answer them, to point the direction for future investments of intellectual capital rather than review the results of past efforts, and to offer a series of starting points rather than conclusions. This proceedings is intended to be attached as an appendix to the PCSD's final report and thus differs from the more typical reports generated by NRC committees. Participants met only during the workshop session itself and did not reconvene to negotiate the final form of the report. This report therefore represents an overview of opinions expressed by the workshop participants rather than a committee consensus.

GENERAL COMMENTS

Natural science has long used the geographic definition provided by watersheds in collecting data, analyzing problems, and assisting in decision-making, so it is logical that scientists address the broader philosophical issues of sustainability in that context, especially issues related to long-term planning and management for sustainable resources. As stated by Weiss in her paper, "Intergenerational Fairness and Water Resources" (NRC, 1993), the challenge before us is to ensure that the interests of future generations are represented in the decisions we make today. Her paper also points out that water resources are critical to both economic development and the maintenance of natural systems. While technically water does not disappear but only changes form, the quality and quantity of water resources in any one place can be degraded or improved by a variety of human activities. Weiss states that every generation must, therefore, be concerned about the supply and quality of water and its management and who has access to it and at what cost. Sustainable development is inherently intergenerational because it implies that we must use our environment in a way that is compatible with maintaining it for future generations.

Before generating the questions, the workshop participants discussed the concept of sustainability for natural resources in watersheds with some analysis of the general descriptive definition for sustainable development: "to meet the needs of the present without compromising the ability of future generations to meet their own needs." Sustainability is an ethical concept, directed toward defining acceptable modes of human behavior. Sustainability as a term and a concept is most useful when applied to some object, such as watershed resources or watershed services. The goal of "sustainable development" is problematic because it seems to imply that the purpose is to preserve continuous economic development rather than the integrity of the natural resource that supports economic development.

Therefore, in this proceedings we use the term "sustainable" in association with specific things, objects, or services that can be defined, identified, and measured. It is especially important to use measurable attributes of resources, because without measurements it is not possible to determine if the resource is being sustained or not. Scientific explanation of processes depends on measurements, and without such explanation prediction of the consequences of policy and management decisions is impossible. A convincing example of the application of these general principles is PCSD Goal 2, Watershed Integrity, as outlined by

the President's Council. The goal specifies the objects to be sustained (functions of the aquatic and terrestrial ecosystems and processes) and specifies which ones are most important (those upon which we depend for our social and economic well-being). This general statement is a useful model for other goals.

Fundamentally, the ethical concept of sustainability refers to the sustainability of human well-being. The sustainability of natural resources and the environment is one important and critical component of human well-being, from the perspectives of economics, collective social welfare, and individual welfare. The attachment of values to the various watershed services (economic, social, and environmental) to be sustained is a political judgment. The weighting of the various components, measuring them, explaining how they interact, and predicting likely futures are scientific activities that can be carried out in support of the sustainability ethic within the context of political judgments.

Effective decision-making requires a conceptual framework to capture the linkages and tradeoffs among the different assets that contribute to human welfare. Each asset must be described, measured, and related to other assets in a rigorous fashion. Thus, the framework for sustainability of natural resources should be seen as distinct from but complementary to the various decision processes by which alternatives are identified and courses of action are selected. Watersheds provide a basis to assess many of the environmental assets that contribute to human welfare. However, one challenge for the PCSD is to develop a framework and related models that will overlay economic and social considerations on the watershed-based analyses of environmental assets.

The challenge is to develop the capacity to predict at least the boundaries or limits to the broad range of biological, physical, environmental, social, and economic consequences of human actions in development. The NRC workshop participants identified the following questions as crucial ones that should be addressed by the Natural Resources Task Force of the PCSD and decision-makers. The workshop participants were divided into groups that focused on general philosophy, environmental issues, information/data problems, and human/social issues, but in this proceedings the key questions are presented in a framework representing the step-by-step process of achieving sustainable watersheds. That general process is as follows:

1. Identifying specific natural resource services and concerns
2. Identifying the stakeholders
3. Linking the relevant scale of the problem to decision-making
4. Specifying the tradeoffs among economic, social, and environmental considerations
5. Exploring the values that guide stakeholders in deciding among tradeoffs
6. Identifying the best actions to achieve the desired balance among tradeoffs

Each of the key questions posed for decision-makers is connected to one of the steps in this process.

KEY QUESTIONS

1. Identifying Specific Natural Resource Services and Concerns

1A. What elements of the environment are essential to social and economic well-being; or, alternatively, what elements of the environment constrain social and economic well-being?

Elements of the environment essential to social and economic well-being include (1) those natural resources from which societies extract useful products and services or from which they may extract such products and services in the future and (2) environmental elements that form the basis of environmental values and aesthetics that enrich human existence. Sometimes the environmental and aesthetic values are themselves marketable resources. Natural resources that are environmental assets directly utilized by society are plants and animals, soils and minerals, clean water, and clean air. Important characteristics of natural resources include ecological services necessary for sustainability: production, recycling, assimilation, and recovery. Elements of the environment essential to values and aesthetics include "wildness" (the absence of significant human impacts), natural processes that generate the full range of successional ecosystems, biodiversity, and certain species that inspire spiritual values and beliefs. Environmental values include "human life support services" and therefore have implications for human health.

The traditional view of an inherent conflict between ecology and economics is giving way to a new viewpoint that recognizes that bad economics is bad ecology and that bad ecology is bad economics. The notion that we can be rich by wanting and using less, as opposed to having more, is at the heart of a debate about social values about the natural world that has become a potent force in virtually all advanced industrial societies. Across the political spectrum, conservation is recognized as an essential societal asset rather than an economic constraint. A conservation ethic is particularly important for certain natural resources that are not renewable over human time scales. Some environmental assets may not be stable over time scales important to people and do not easily lend themselves to management regimes that depend on continuous stable supplies. Long-term cycles of scarcity and abundance, on the order of decades to centuries, are often the rule in nature. Natural resource managers have historically failed to adequately consider these cycles, resulting in resource use that tends to increase during periods of abundance in many cases but that responds only slowly when resources become scarce. The most obvious failures of resource management (e.g., the recent collapse of the North Atlantic cod fishery) show an inability or an unwillingness of society to respond quickly to warning signs of resource depletion in favor of short-term economic stability. It is essential that resources not be overexploited or otherwise reduced to a point where they cannot recover after periods of stress or scarcity.

Recognition of the fact that our perspective on resources and their uses is inherited from a time when the United States appeared not to be approaching true limits in the balance between resource demand and supply implies that a strengthened and more purposeful strategy is required. Uncertainty, conservatism, and adaptive management may provide a much more successful social and economic framework for natural resource management. Management for uncertainty places constraints on short-term economic development with attending costs, but its rewards may be long-term sustainability of the resource base with high cumulative payoffs in the long run.

Social and economic constraints imposed by regulating development and resource use differ from constraints imposed by environmental degradation. Constraints imposed by social and economic forces include zoning and land-use controls as well as commodity and service prices. Constraints imposed by degradation frequently magnify resource variation, further reducing long-term predictability. Degradation in this sense includes the introduction of exotic

species and diseases that disrupt established biological communities and natural ecological processes. Degraded watersheds not only impair the long-term quantity and quality of resources along with the associated economic systems, but they also reduce opportunities for the public to appreciate the natural beauty of the landscape.

1B. What existing data would be useful to assess the current status and trends of economic, environmental, and social conditions within a watershed? Can existing programs for data needs and management be modified or will new ones be required to fill gaps?

Existing data in federal, state, and local repositories can be useful in characterizing the economic, environmental, and social conditions within watersheds, and much of these data remain to be fully exploited. Although many data are not intentionally collected to serve the needs of watershed analysis, the data are often geographically referenced to small areas that can be aggregated to larger units that are similar to drainage basins. Economic data, collected and published by the federal government as the Census of Business, and social data for the general population are readily available through the Bureau of the Census. These data are on a county-by-county basis, but in many cases medium to large-scale watersheds can be closely approximated by groups of counties, so that with minimal processing the economic and social data are readily compatible with physical and chemical environmental data collected from watersheds. Environmental conditions in watersheds, reflected in streamflow data and hydrochemistry information collected and stored by the U.S. Geological Survey, and information collected by the Bureau of Reclamation and the U.S. Army Corps of Engineers are all organized on the basis of watersheds. Finally, the climatologic component of the environmental data collected and stored by the National Oceanic and Atmospheric Administration is organized according to climatological regions, which, like counties, can be aggregated to geographic forms similar in outline to medium and large-scale watersheds. These existing data and the continued collection of them can adequately inform decisions regarding management of watershed resources.

Sound decision-making depends not only on data, however, but also on the use of those data to understand the nature of changes in watersheds and to elucidate the interaction between human and environmental systems. Multiple demands on watershed resources (e.g., water, scenery, open space, habitat) further complicate the issue, and early attempts at managing watersheds with more than one demand on the principal resources have often been ineffective. Problems associated with identifying appropriate spatial and temporal scales for management, cumulative effects from multiple users, lack of realistic modeling approaches, and a lack of indices and integrative measures of dynamic socio-environmental systems have all contributed to the difficulties in making effective use of available data. A promising array of quantitative approaches for assessing complex issues with several causes and competing solutions is beginning to appear. Empirical techniques for watersheds that require more sophistication include quantitative assessments of watershed condition and integrated risk assessment models. The following paragraphs outline the promise of adaptive management and watershed management, problems with quantitative measures, and the issue of integrated socio-environmental models in more detail.

Adaptive Management. Adaptive management is an important avenue to cooperative efforts toward sustainable development of watershed resources. This concept implies constantly changing management practices that reflect fluctuating conditions of the resource. In the

abstract, adaptive management monitors the resource in question to determine whether stability is occurring, or perhaps unfavorable change. If unfavorable change is detected, administrators adjust the management of the resource to improve conditions. In reality, adaptive management requires a scientifically designed monitoring program for comparison of present conditions to a base-line condition, along with a cooperative arrangement among resource users to accommodate management changes. The management experience of the Colorado River below Glen Canyon Dam (located in the Grand Canyon National Recreation Area), built and operated by the Bureau of Reclamation, illustrates the usefulness of adaptive management for water and related drainage basin resources (NRC, 1987).

The operation of the dam directly influences a variety of resources related to the river, including storage of irrigation water, generation of hydropower, and provision of recreation on the upstream reservoir as well as downstream on the river. Wildlife management was also to be part of the benefits of the structure. When the dam was ready to begin operating in 1963, its monthly operations were designed to store and deliver water to seven states according to the "Law of the River," which specifies that a certain amount of water is to be passed through the dam every 10 years. The daily operations were designed to maximize the production of hydroelectric power, mostly by rapidly increasing and decreasing production to serve demands for power during peak periods of the day. These artificial fluctuations of flow, sometimes causing changes of flow in the river of up to 13 feet in a single day, had unexpected negative impacts that became apparent by the early 1980s. The flows changed the habitat for endangered native fishes, particularly the humpback chub and Colorado River squaw fish, and reduced their reproductive capabilities. Radical changes in flow, along with the entrapment of sediment by the dam, caused the erosion of beaches along the 277-mile length of the river below the dam, severely impacting the white-water rafting industry in the canyon. During some floods, however, the conditions of the beaches improved, and spawning of endangered fishes improved under some spring-time conditions, when a favorable combination of main stream and tributary flows occurred.

The Bureau of Reclamation supported more than 10 years of research and experimentation in the Glen Canyon Environmental Studies to learn how dam operations influence all the resources of the river. By the mid-1990s, the bureau designed a long-term monitoring plan to provide measures of key attributes of the Grand Canyon ecosystem on a continuous basis. If those measures indicate excessive erosion of beaches, for example, dam operators can simulate a beach-building flood by releasing a large flow. By assessing the amount of water in storage in the reservoir, requirements of the "Law of the River" for water delivery, electrical power demands, and the availability of sediment in the canyon from undammed tributaries, the operators can select the timing of the flood flow to minimize its collective cost to all users of the river's resources. Dam operations were modified during certain seasons to create favorable conditions for endangered fishes, again in such a way that minimized the cost to other resource users.

Adaptive management on the Colorado River takes into account the fact that watershed resources are complex and interconnected; management of one resource alone is not likely to be effective. Management of many resources together imposes costs on some users, but with a collective approach the costs can be determined fairly and distributed equitably. Adaptive management accounts for change—first, by recognizing that the resources change and, second, by allowing informed change in the use of the resources. Adaptive management depends on continuing assessments, monitoring, and measuring of the resources coupled with an insightful scientific understanding of the interplay among the various system components. With this sort of powerful support for decision-making, management options

can be assessed by all stakeholders on the same basis. While the stakeholders may have differing objectives or even different value systems, they can collectively agree on the likely outcomes of their joint decisions.

Watershed Management. There is an increasing need to understand the cumulative effects of human activities on watersheds. Only through a broad geographic perspective can the unique qualities of each watershed and their spatial and temporal effects on natural resources be understood. A recent development in forest management planning has been the use of "watershed analysis" to evaluate resources and the potential environmental impacts of land management proposals. A watershed-scale or management approach to decision-making takes into consideration the entire watershed, including the land mass that drains into the aquatic ecosystem. A watershed management approach would identify opportunities for habitat restoration at somewhat larger geographical scales than are normally used.

As stated in *Restoration of Aquatic Ecosystems* (NRC, 1992a), fragmentation of ecosystem management is common in U.S. governmental organizations and in industry. Watershed and political boundaries are not often aligned. Furthermore, different components of a watershed are usually administered by different agencies. Thus, the politics and consensus building required for watershed management are often as complicated as the management of the ecosystem itself.

Watershed analysis is a perspective or point of view—it is a way of organizing and integrating a view of the complex human and natural systems. In this view the interactions of the elements of each system are taken in the context of the functional boundaries of a drainage basin. Alternative schemes for organization may use airsheds, ecosystems, or political regions. Watershed analysis, however, offers a distinct advantage for the management of environmental resources because of the central role of water, and water organizes itself on the Earth's surface according to drainage basins. From the standpoint of physical science, watershed approaches force the analyst to account for the fact that environmental processes in one location on the landscape may have far-reaching consequences downstream. Application of fertilizers on fields in Iowa, for example, results in varying contaminant loadings in the Mississippi Delta, several hundred miles downstream. Land management has definable implications for water quality. From the policy standpoint, watershed analysis implies that the scale of policy is critical—if decisions focus on very small areas, unforeseen consequences may be transmitted to other populations downstream. If the scale of the policy is too large, it may fail to account for the internal yet connected variation within the watershed. A successful example of watershed analysis is the management system currently used in the state of Washington, where policy defined in a drainage basin context successfully promotes efficient regulation, continued timber production, and protection for the physical integrity of forest ecosystems.

Watershed-scale management may provide a relatively clear understanding of existing resources and factors affecting them. However, social preferences, institutional constraints, and other human factors may preclude use of certain solutions to existing problems. For example, dewatering a stream by irrigation diversions could be solved by shifting to irrigation techniques that are more efficient and less consumptive. Any water savings might be retained in the stream. Alternatively, improved water efficiencies may instead allow a land owner to increase the amount of area under irrigation with no net change in water diverted. Or, if the water is no longer used by the land owner, it may be sold to another land owner with junior water rights. What seemed like a relatively simple approach to problem solving begins to

involve important institutional barriers. The notion of “use it or lose it,” so firmly etched in western water law, precludes what in some instances might be a simple solution to an environmental problem. No institutionally sanctioned means exist whereby environmental resource conditions can be assessed and opportunities for restoration identified over multiple ownerships encompassing a variety of land uses. New programs may be needed to extend this analytical approach from forested headwaters to other types of land use.

Quantitative measures of watershed attributes are the foundation of understanding and prediction when dealing with drainage basin resources. Most simply, the total area and proportion of the watershed occupied by each vegetation or habitat type can be identified and its area and perimeter recorded. Analyses of the total number of patches and their spatial arrangement can be easily computed using geographic information systems. In addition to metrics describing individual patch types, edges between patches (likely zones of management conflicts and areas of sensitive measures of habitat fragmentation) can be calculated as the length of edge between each pair of land cover classes or as edge-to-area ratios. These relatively simple measures can provide valuable insight into changes in watersheds and thus contribute to more effective management and conservation.

Although the development of quantitative measures of watershed condition has taken place rapidly, empirical studies that test for significant relationships between watershed metrics and ecological conditions (e.g., the presence or abundance of species or water quality) are still infrequent. There is a clear need to identify the most important watershed measures as well as the levels beyond which socio-environmental conditions change significantly. In addition, it is essential to be aware of the assumptions and constraints that are implicit in the metrics. For example, selection of land cover categories to be used in the analysis constrains the type of results, and the spatial resolution of the data—both the total extent of the area and the resolution—can strongly influence numerical findings.

The integration of sociological and environmental measures and models is a more pressing need than the need for more data. The risk of undesirable conditions within a watershed can be assessed by using such models to explore alternative land management scenarios. An example of such a model is the Land-Use Change and Analysis System (LUCAS). LUCAS is a spatial simulation model at the large river basin scale in which the probability of an area converting from one land use to another depends on a variety of social, economic, and ecological factors. Conditional transition probabilities are estimated empirically by comparing land use at different times (decade to decade) and projecting future watershed conditions.

1C. Are present scientific institutions organized to provide information that can inform decision-makers responsible for sustainable watershed development?

Watershed boundaries rarely match political boundaries—rivers rather than drainage divides often serve as boundaries between counties or states, so aggregates of county units provide useful watershed approximations, but subdivisions of the basins may not always be possible. While data may be reorganized to approximate watershed boundaries, political jurisdictions may not be handled so easily. The problem may be complicated where state or other significant jurisdictional boundaries transect the watershed. Furthermore, the biology of some natural resources, e.g., migratory waterfowl and the Pacific salmon, transcend the jurisdictions of local research and management organizations. The result is a fragmented and

disjointed approach to watershed management and data gathering. Attempts at basin-scale cooperation have met with only limited success. Attempts during the 1930s to duplicate the economic development successes of the Tennessee Valley Authority in other basins failed, most notably in the Missouri and Rio Grande watersheds. In a more recent example, the Northwest Power Planning Council (NPPC) was formed to develop policies for sustainable power generation through the Bonneville Power Authority. This was an attempt to deal with complex natural resource issues in the Columbia River Basin which is highly impacted by hydroelectric dams. NPPC had a broad mandate from the federal government and the northwestern states to operate under the principles of adaptive bioregional comanagement. Yet one of the most important charges given the council—to assemble a plan to halt the decline of salmon in the Columbia River—has not been fulfilled despite a budget exceeding a billion dollars over the past two decades. Part of the reason for the admitted failure of many of the NPPC programs has been the reluctance of major interest groups (federal, tribal, and state governments; cities; forestry concerns; power utilities; and anglers) to cooperate in a meaningful way. As a result, to restore the Snake River sockeye and chinook salmon, the Columbia Basin now faces a very costly recovery plan.

The Columbia example illustrates a breakdown in the use of scientific methods by political entities. At least some of the problems experienced by the NPPC could have been avoided if an aggressive cooperative research and monitoring program had been undertaken at the inception of the program. For example, even after more than 15 years of awareness of the problem of restricted fish migration in the rivers, the relative merits of barging young salmon to sea versus speeding their downstream passage by drawing the reservoirs down is not understood with certainty, and scientific consensus on the issue does not exist. Scientists have known what tests would be necessary to evaluate these two strategies, but the political will to carry out these experiments has been lacking. Institutional turf battles have too often prevented critical studies from occurring, and this problem may be symptomatic of a widespread mismatch between the research and monitoring agendas of organizations often in competition for limited research dollars. Given this sort of political climate—competitive rather than cooperative, exclusive rather than inclusive—adaptive management becomes virtually impossible. Science in these matters is therefore a necessary but insufficient condition for sound management.

2. Identifying the Stakeholders

2A. Who will determine whether data are adequate to identify needs, set priorities, make timely decisions, and measure progress toward achieving and sustaining goals; what processes and/or criteria will be employed to determine data adequacy?

If sustainable development is grounded in ethical considerations, the determination of values attached to various environmental, resource, social, and economic components of sustainable development must be based on acceptable principles. The most widely accepted principle of political behavior in the United States is democratic decision-making. This principle demands that all citizens with a stake in the outcomes of political decisions are able to represent their interests either directly or through duly elected political representatives.

Historically, in the United States the question of democratic representation has been handled by drawing political boundaries based on a number of contingent and often arbitrary criteria. However, environmental problems that are of increasing concern do not respect

these boundaries. The sources of environmental problems are often in one location, while the consequences appear in another. Industrial production of the constituents of acid rain occur in one region, for example, but the damaging consequences for forestry and inland fisheries occur in different areas. Under such circumstances, citizens of the latter jurisdiction have limited or no control over the actions that create the problem.

Environmental concerns also expand the stakes involved in natural resource management. Those stakes are no longer limited to the costs and benefits directly associated with production and consumption activities. The indirect consequences of these activities that degrade other resources require more comprehensive cost/benefit accounting than previously. Such accounting would include not only externalities associated with economic activities but also the monetary valuation of intangibles considered essential to a high quality of life, such as scenic beauty, lack of congestion, and access to nature. A more comprehensive cost/benefit accounting better identifies the stakes involved in sustainable development and in doing so extends the range of stakeholders. Ecologically informed accounting also creates a need for more meaningful political units that better approximate natural boundaries, encompassing the relevant stakes and stakeholders, and establishing the basis for effective democratic decision-making in sustainable development.

2B. Who has a stake; what are the stakes?

Watersheds are useful natural entities that, in principle, can serve as practical political units in determining sustainable development. They have flexible additive boundaries in the sense that the political entities they define can range from micro- to macro-scale. Because watersheds are nested hierarchically, they establish a natural base for linking local with regional, or upstream with downstream, concerns. Flexibility in choosing the relevant watershed scale allows for more accurate identification of both the stakes and stakeholders involved in sustainable development issues. The limitation of using watersheds as political entities is that occasionally stakeholders may also be outside the boundaries of the watershed directly in question. Hydropower customers, water users, or wilderness users might reside far from the basin where the resources lie. Decisions about resource management in one basin may have a ripple effect on other watersheds. For example, solutions to the problem of the Pacific Northwest salmon might reduce hydroelectric generation in that basin, placing greater demand on power generation in nearby basins.

2C. Are stakes and stakeholders fully accounted for?

Whether or not stakeholders are accounted for often becomes a question of information dissemination, because in order to participate in democratic decision-making citizens must be well educated and fully informed about the issues. The information made available to the public should help make citizens aware of the interconnections between private and public economic activities and their environmental and social consequences. Likewise, the public must be made aware of the economic costs associated with economic development. Because of the complexities involved in sustainable development, data collection and dissemination by scientists must be intensified and reoriented to identify the full range of stakes and stakeholders. These data collections in a watershed context must: (1) approximate the watershed boundaries; (2) be available for micro-watersheds, which can then be aggregated for more macro-analysis while taking into account the process changes accompanying scale changes; (3) include measures useful in guiding and measuring

sustainable development; and (4) result in informational products that are readily accessible to planners and public officials at the appropriate levels. Data needs will change as new problems emerge, and scientists will need to be flexible in meeting those needs. Public resources will need to be available to finance this data collection and dissemination as well as to maintain the scientific capacity to do so.

3. Linking the Relevant Scale of the Problem to Decision-Making

3A. How can we match the scale of decision-making processes to the scale of the natural systems that are the object of our decisions?

Matching the scales of decision-making with the variable scales of natural processes is difficult because not all natural systems operate on the same scale. A medium-scale drainage basin (e.g., the Upper Rio Grande above Albuquerque) has within it many smaller natural systems that might reasonably be the objects of decision-making on their own. The artesian groundwater basin of the San Luis Valley would have different concerns than the alpine areas of the San Juan Mountains upstream or the diversion-irrigation lands of northern New Mexico. Yet all these concerns are intertwined through the basin processes connected to water, so that at some point decision-making must account for the entire Upper Rio Grande Basin. None of these natural resource regions corresponds to a political or jurisdictional region, but rather they transcend two states, several tribal lands, several counties, and public as well as private lands.

The only obvious method of matching decision processes with the scale of the resource base is to aggregate small political and jurisdictional units into larger commissions or councils that correspond roughly to the watershed area. These commissions or councils do not fit into the established political framework, however, and their actions would likely require ratification by the entities that participate in them. Nonetheless, such aggregations offer the opportunity to reorganize the democratic process without disrupting established structures. The Northeast Ozone Commission exemplifies such successful arrangements.

Fragmentation of watershed management among a myriad of federal, state, tribal, and local agencies is an impediment to sustainable development because of competing and contradictory mandates for the various agencies. Sometimes, individual units within agencies have contradictory objectives, as illustrated by the various units of the U.S. Department of the Interior. The River Basin Planning Commissions authorized by the Water Resources Planning Act of 1965 were not as effective as they might have been because of competing agendas. An exception was the New England Basin Commission, which succeeded in developing large-scale watershed plans. This was successful in part because of a relative absence of interagency competition and because it had strong leadership. The resolution of conflicts by cooperative participation in regionally defined commissions or councils is possible but only with aggressive leadership from agency directors who view the sustainable development objective as a national goal that supersedes more limited objectives.

Another consideration with regard to scale is the definition of the watershed itself and the recognition that there are other important ways to partition the resource base. Airsheds are becoming increasingly important in understanding and managing the quality of life, and regional power grids are a way of viewing a resource critical to both economic development and environmental resource conservation and maintenance. The meshing of these other regions with watersheds is an important consideration that probably needs to be addressed

on a case-by-case basis.

4. Specifying the Tradeoffs Among Economic, Social, and Environmental Considerations

4A. How can the natural dynamics of watersheds be taken into account?

Natural watershed processes have many characteristics and attributes that are maintained by disturbance, so in using watersheds for human purposes it is necessary to preserve these natural disturbances insofar as possible. Natural fires are required for the regeneration of many forest ecosystems, and fire suppression results in the development of unnatural and (more importantly) unstable conditions. Many riparian ecosystems depend on periodic flood events for maintenance, so if these flood events are eliminated by upstream dams, radical and undesirable adjustments follow. Successful sustainable development strategies must include mechanisms for ensuring the continuation of such events that bring about change within the system. This represents a departure from previous management strategies that have sought to impose rigid stability on resource systems.

Change in watersheds responds to both natural and human forcing functions. Variations in precipitation, tectonic instability, sea-level changes, and changes in land cover are natural adjustments that are to be expected. Human-induced changes through the building of dams, channelization, and changes in land use are also aspects of watershed change that are worldwide. From a management standpoint, recognition of these changes is often difficult because the adjustments in the forcing function are hard to measure and predict and the response of the watershed may operate on time scales that are much beyond conventional planning horizons. Decade- or century-long plans seem lengthy in human terms, but they may be conventional for watershed changes. Therefore, sustainable development needs to be viewed against a backdrop of a changing resource base rather than a static one that is consistent and dependable in its dimensions and location.

4B. Can scientific information be integrated effectively into decision-making?

The principle contributions of the physical and biological sciences in furthering the goals of sustainable development of watershed resources lie in their capacity to predict the consequences and effects of human actions and natural events. Decisions to construct a second-home development in a particular basin will have undeniable consequences for land use, runoff, surface water processes, groundwater quality, and a variety of connected ecosystems. The scientific means exist to predict at the very least the direction of these changes and in many cases the probable magnitude of change to be expected. Similarly, the social and behavioral sciences can add significantly to our understanding of the human impact of choosing varying levels of resource usage. Internal population shifts and migrations that stimulate and are stimulated by resource development have far-reaching consequences, ranging from the need for transportation facilities and housing to expanded school systems and social services. The social and behavioral sciences can predict the nature of these changes and provide at least broad estimates of the magnitude of the needs.

4C. Are metrics and methods available that are capable of evaluating the tradeoffs among and between the three distinct groups of economic, social, and environmental

considerations?

Generally, the methodologies for considering tradeoffs among economic, social, and environmental considerations in watershed resource sustainability do not exist at the level of sophistication required for informed decision-making. The metrics for assessing economic activity, social well-being, environmental quality, and resource stocks or services are available in some cases but not all. Models that blend these disparate measures into a cohesive intellectual whole are in their infancy and will require considerable improvement if they are to provide an information base for public and private policy decisions that are part of a sustainable development ethic.

5. Exploring the Values That Guide Stakeholders in Deciding Among Tradeoffs

5A. What can science do to make clear the values that stakeholders have and want represented in the policy-making process?

An underlying assumption of the conduct of scientific research in the logical positivist tradition is that the effort is as valueless and dispassionate as possible, so that the results reflect a reality that is "true," untainted by cultural or political biases. This ideal is open to question, however, and ways need to be found to incorporate people's values into the formation of scientific research questions (Norton, 1992).

Social behavioral science can, however, contribute understanding to the values held by stakeholders in the policy-making process. Survey research is a sophisticated methodology widely used to plumb the opinions of various segments of populations. While values probably cannot be quantified, the number of people adhering to given values and the strength of their convictions can certainly be measured by a variety of social and economic measures that have been used previously. The social value that human populations place on various environmental resources, including certain nonuse values, can frequently be converted in rough terms to economic equivalents and then compared to other costs or benefits.

6. Identifying the Best Actions to Achieve the Desired Balance Among Tradeoffs

6A. How can science assist in defining and assessing the consequences of social/economic decisions?

The consequences of social and economic decisions include impacts on resource stocks and services as well as on environmental quality. The physical, chemical, and biological sciences have the ability to identify and quantify many of the threats to resources and the environment based on investigations of past experiences. Information about these experiences can be developed into models of various scenarios that imitate the consequences of possible policy decisions. Provision of electrical power by the Tennessee Valley Authority, for example, can be examined for a variety of possible future conditions to test the effects of supplementing hydropower with coal-fired or nuclear generating plants or making efforts at reducing demands. The impacts that have variable effects include the impact of increased demand for coal or uranium, stress on transportation networks to get the fuel to generating sites, the economic outcomes of attempting to reduce demands, and pollution potential of increased fossil fuel use in the Southeastern United States. Physical, social, and economic scientists have the tools in hand to provide such information. Ecosystem perturbations in other examples are sometimes more subtle and difficult to evaluate. For

example, the downstream effects of dam operation on the Platte River in Nebraska include subtle but ecologically significant changes in the temperature of the river water, which in turn have far-reaching but little-known effects on fish and wildlife.

Science can also provide useful information on the "pulse" of the sustainable resources in question. Established methods can provide a reading of the present status of resource stocks, for example, and can establish the present trends of change in those stocks or services. There is no mystery about the lumber resources of the nation, for example, nor about the economic value of transportation services provided by the inland barge system on rivers and in coastal waterways. Reasonable policy decisions should take advantage of these data to make and defend rational choices. Statisticians can also inform decision-makers about the degree of uncertainty involved in predicting outcomes or in estimating the behavior of present resource, environmental, or human systems (NRC, 1994). Our knowledge about resource stocks, environmental system behavior, economic processes, and social attributes, including values, is about probabilities. Decisions that rely only on the average or so-called normal condition inevitably will be wrong at least sometimes. Statistical understanding of variability and uncertainty can prepare populations and decision-makers for these real uncertainties and may lead to more conservative and cautious projections for future scenarios. Understanding of Midwestern droughts is a case in point—rather than considering them to be interruptions in an otherwise beneficent climate, we now know they are expectable events in this climate system, with a particular probability of occurring each year. Stable agribusinesses can build this probability into their long-term planning and account for it before droughts occur.

Finally, the physical, chemical, and biological sciences can contribute to sustainable development by identifying thresholds of natural system behavior when the system begins rapid change or degradation. Beneficial wildlife populations provide a case in point. Management of black-tailed deer and important game species on public lands in northern Arizona at the beginning of this century assumed that there were virtually no limits on the deer population. Predators and other population controls were removed, only to discover that the carrying capacity of the land and its vegetation imposed a ceiling to the deer population that was enforced through starvation. Definition of the threshold of carrying capacity by scientific means can serve as a guide to natural resource management.

6B. What can science do to assist adaptive management/development?

Science can contribute to sustainable development by improving the society/environment connection, by suggesting ways of either adapting development to natural features, or by changing environmental resources to foster a particular type of development. Drought- and disease-resistant crops have been produced through agricultural research—an example of adapting crops to their environment. The engineering of highly efficient irrigation systems that transport water great distances and use it sparingly but efficiently in growing imported nonnative crops shows that it is possible to modify local environmental conditions to make an area economically productive. Science can also provide insights into the relative costs and benefits of either adapting human activities to the environment or changing the environment. Economic and social measures of efficiency and human well-being can be useful input for decision-making in the management of watersheds, and such techniques already exist.

6C. Will existing programs be adequate to monitor progress toward achieving desired goals? If not, can they be modified to do so or will new ones be required?

American government at all levels has numerous monitoring agencies that measure resources, environmental attributes, and economic performance. Any objective related to sustainable development of watershed resources will require monitoring of resource attributes such as agricultural productivity, streamflow characteristics, ecosystem integrity, and human social well-being. Communications among these monitoring agencies is important to ensure that measures are compatible with each other and to make the data available not only to a select few decision-makers or researchers but also to the affected public, who must collectively reach value-based decisions about the resources in question.

6D. Is knowledge dissemination effective in changing behavior under current economic circumstances?

No matter how effective monitoring agencies are in the collection and processing of measurements related to resource stocks, services, environmental integrity, or human well-being, these data are not useful unless they reach the decision-makers and the general public. Perhaps the poorest performance of American science has been in the area of communicating its information and conclusions to decision-makers and the public. American society appears to have a widespread mistrust of science, as evidenced by recent public doubts about the evidence in issues ranging from the effects of Agent Orange to breast implants, endangered species, and global warming. The problem is made even worse when the scientific community fails to generate a consensus among its own members. Therefore, fundamental changes will be necessary because our institutions are structured in a way that virtually precludes watershed-scale planning and management. Financial resources will have to be spent on the development of data and models, and strong political leadership will be required, if sustainable watershed management is to become a reality. The dissemination of scientific knowledge in understandable and convincing ways needs to be improved before managers can hope to change public behavior toward an emphasis on sustainable development. The experience of the USDA Cooperative Extension Service in disseminating information related to agriculture may serve as an example of how scientific knowledge related to sustainability can be transmitted to decision-makers and stakeholders.

6E. How do equity issues affect human behavior toward watersheds and their natural resources?

The end of the Cold War and the absence of an external competitor have brought about a more inward-looking perspective in American society. Concerns about equity are becoming more focused on watersheds (often in the form of questions related to the allocation of water resources), and future management schemes dealing with watersheds will certainly have to deal with equity questions. In the western states, for example, upstream residents in watersheds frequently have an abundance of water but lack arable lands for productive agriculture. They often rely on resource extraction for minerals or lumber and emphasize a rural lifestyle in an area dominated by public lands. Downstream residents have more arable land but lack a dependable flow of water for productive agriculture with extensive water

storage and distribution facilities. They tend to emphasize an urban lifestyle in an area dominated by private lands. Ethnic diversity in each of these regions also requires equitable distribution of resources, so that Native Americans and Hispanic residents can share in the benefits of resource management. All these disparate groups share the same watershed, however, and must come to some equitable agreement about behavior toward the watershed resources. An NRC report, *Water Transfers in the West* (NRC, 1992b), states that reallocation of water among users will be a principal feature in a new era of western water management, along with increased conservation, increased use efficiency, and improved reservoir operation.

6F. How does social/economic insecurity affect human behavior toward natural resources or watersheds?

Social and economic insecurity leads to emphasis on short-term strategies in natural resource use, because such strategies offer the promise of relief from financial or social stress. In the case of extractive resource use, emphasis on the short term leads to a brief period of prosperity but long-term decline in economic and social conditions. A recent NRC report, *Wetlands: Characteristics and Boundaries* (NRC, 1995), suggests that functional assessment of wetlands could be most useful in the context of watershed or landscape-level planning. This approach facilitates consideration of the interaction between wetlands and the surrounding landscape features, as well as the location of the wetland in the watershed. Landscape-level planning provides a framework for incorporating the interests of all affected parties. Creation of such a framework increases the likelihood that regulatory activities will be acceptable to all parties.

The degradation of almost all the major fisheries in the United States illustrates the following point. If watershed resources are managed so as to be sustainable on a long-term basis, the result can contribute to social and economic security, which will have the feedback effect of giving watershed managers more options in maintaining resources.

6G. Are processes under way to develop institutional/political mechanisms to better translate scientifically determined costs/benefits into optimal human behavior regarding watersheds?

Existing institutions in the United States are not well suited to encourage optimal human behavior regarding watersheds. The jurisdiction of local, regional, and state governments rarely, if ever, coincides adequately with meaningful watershed boundaries (though they could if counties were more routinely aggregated for the specific purpose of approximating watershed boundaries). This problem means that land-use planning and zoning activities are rarely based on or account for the functions or values of watersheds. Similarly, private land holdings infrequently encompass watershed or subwatershed units. The result is that individual land owners rarely have any incentive to account for the impacts of their activities on the larger watershed. For the most part, collective action to maintain and enhance the functions of watersheds is largely absent.

Water quality provides an example of this private versus public interest. Despite compelling evidence that watershed management is one of the least expensive ways to maintain water quality, interest in developing institutional and political mechanisms that will

foster optimum human behavior regarding watersheds has been slow to develop. Indeed, current concerns about government encroachment on private property rights may be eroding some efforts to account for watersheds in planning and development. This trend toward an absence of effective institutions or political mechanisms that adequately account for watershed processes is symptomatic of an underlying lack of national will and interest. The costs of further subjugating private land-use decisions to collective action may be perceived as too high and may reduce action in many areas. In some regions, especially New England, local organizations may step in to the watershed planning process and assume roles once thought of as the federal domain.

Although a national will appears to be lacking, the tools to achieve watershed sustainability through collective action already exist. Zoning, building codes, land-use rules, and taxation are all mechanisms that might be employed to regulate activities on watersheds or to provide incentives for desired actions if there were widespread support for them.

REFERENCES

National Research Council. 1987. *River and Dam Management: A Review of the Bureau of Reclamation's Glen Canyon Environmental Studies*. National Academy Press, Washington, D.C.

National Research Council. 1992a. *Restoration of Aquatic Ecosystems*. National Academy Press, Washington, D.C.

National Research Council. 1992b. *Water Transfers in the West*. National Academy Press, Washington, D.C.

National Research Council. 1993. *Sustaining Our Water Resources: A Proceedings of the Water Science and Technology Board*. National Academy Press, Washington, D.C.

National Research Council. 1994. *Assigning Economic Value to Natural Resources*. National Academy Press, Washington, D.C.

National Research Council. 1995. *Wetlands: Characteristics and Boundaries*. National Academy Press, Washington, D.C.

Norton, B. 1992. "A New Paradigm for Environmental Management," pp. 23-41 in R. Costanza, B. Norton, and B. Haskell, eds., *Ecosystem Health: New Goals for Environmental Management*, Island Press, Washington, D.C.

The World Commission on Environment and Development (WCED). 1987. *Our Common Future*. Oxford University Press, Oxford, England.

APPENDIX F
NATURAL RESOURCE ACCOUNTING REPORT

Following is the report on natural resource accounting commissioned by the Midwestern Regional Team. This report represents the work of the authors of the report and has not been subjected to fact-checking by the President's Council on Sustainable Development.

APPENDIX G
PRESIDENT'S COUNCIL ON SUSTAINABLE DEVELOPMENT MEMBERS

CO-CHAIRS

David T. Buzzelli, Vice President and Corporate Director, The Dow Chemical Company
Jonathan Lash, President, World Resources Institute

EXECUTIVE DIRECTOR

Molly Harriss Olson

MEMBERS

John H. Adams, Executive Director, Natural Resources Defense Council
Bruce Babbitt, Secretary, U.S. Department of the Interior
Richard Barth, Chairman, President, and CEO, Ciba-Geigy Corporation
Ronald H. Brown, Secretary, U.S. Department of Commerce
Carol M. Browner, Administrator, U.S. Environmental Protection Agency
Benjamin F. Chavis, Jr., National Chairman, National African-American Leadership Summit
Richard A. Clarke, Chairman and CEO, Pacific Gas and Electric Company (Retired)
A.D. "Pete" Correll, Chairman and CEO, Georgia-Pacific Corporation
Kenneth T. Derr, Chairman and CEO, Chevron Corporation
Dianne Dillon-Ridgley, Co-Chair, Citizens Network for Sustainable Development
Thomas R. Donahue, Former President, AFL-CIO
Judith M. Espinosa, Former Secretary of the Environment, State of New Mexico
Jay D. Hair, President Emeritus, National Wildlife Federation
William E. Hoglund, Executive Vice President, General Motors Corporation (Retired)
Samuel C. Johnson, Chairman, S.C. Johnson & Son, Inc.
Fred D. Krupp, Executive Director, Environmental Defense Fund
Kenneth L. Lay, Chairman and CEO, Enron Corp.
Hazel R. O'Leary, Secretary, U.S. Department of Energy
Michele A. Perrault, International Vice President, Sierra Club

William D. Ruckelshaus, Chairman, Browning-Ferris Industries, Inc.
John C. Sawhill, President and CEO, The Nature Conservancy
Theodore Strong, Executive Director, Columbia River Inter-Tribal Fish Commission

EX OFFICIO MEMBERS

D. James Baker, Undersecretary for Oceans and Atmosphere, U.S. Department of Commerce
Madeleine M. Kunin, Deputy Secretary, U.S. Department of Education
Richard E. Rominger, Deputy Secretary, U.S. Department of Agriculture
Timothy E. Wirth, Undersecretary for Global Affairs, U.S. Department of State

LIAISON TO THE PRESIDENT

Kathleen A. McGinty, Chair, Council on Environmental Quality

ACKNOWLEDGMENTS

Private sector contributions to support the Natural Resources Task Force were administered by four nonprofit organizations: the Columbia River Inter-Tribal Fish Commission, Pace University, the Tahoe-Douglas Chamber of Commerce, and the University of Nevada-Las Vegas. Through a Memorandum of Understanding, these organizations raised, received, and spent funds on behalf of the Task Force under the authority of Take Pride in America.

The following organizations contributed financial and in-kind support to the Columbia River Inter-Tribal Fish Commission:

Browning-Ferris Industries, Inc.
Bullitt Foundation
Ciba-Geigy Corporation
Georgia-Pacific Foundation
Jennifer Altman Foundation
Navaho Tribal Utility Authority
Northwest Power Planning Council
Pacific Power
Seafirst National Bank
Weyerhauser Foundation

The following organizations contributed financial and in-kind support to Pace University:

Ciba-Geigy Corporation
Surdna Foundation

The following organizations contributed financial and in-kind support to the Tahoe-Douglas Chamber of Commerce:

Heavenly Ski Resort
Lake Tahoe Community Trust
Lake Tahoe Gaming Alliance
League to Save Lake Tahoe
Park Cattle Company

The following organizations contributed financial and in-kind support to the University of Nevada-Las Vegas:

Harrah's Las Vegas
Nevada Power Company
Nevada State Energy Office
Southern Nevada Water Authority

In addition, Ciba-Geigy Corporation made direct contributions to the Task Force.