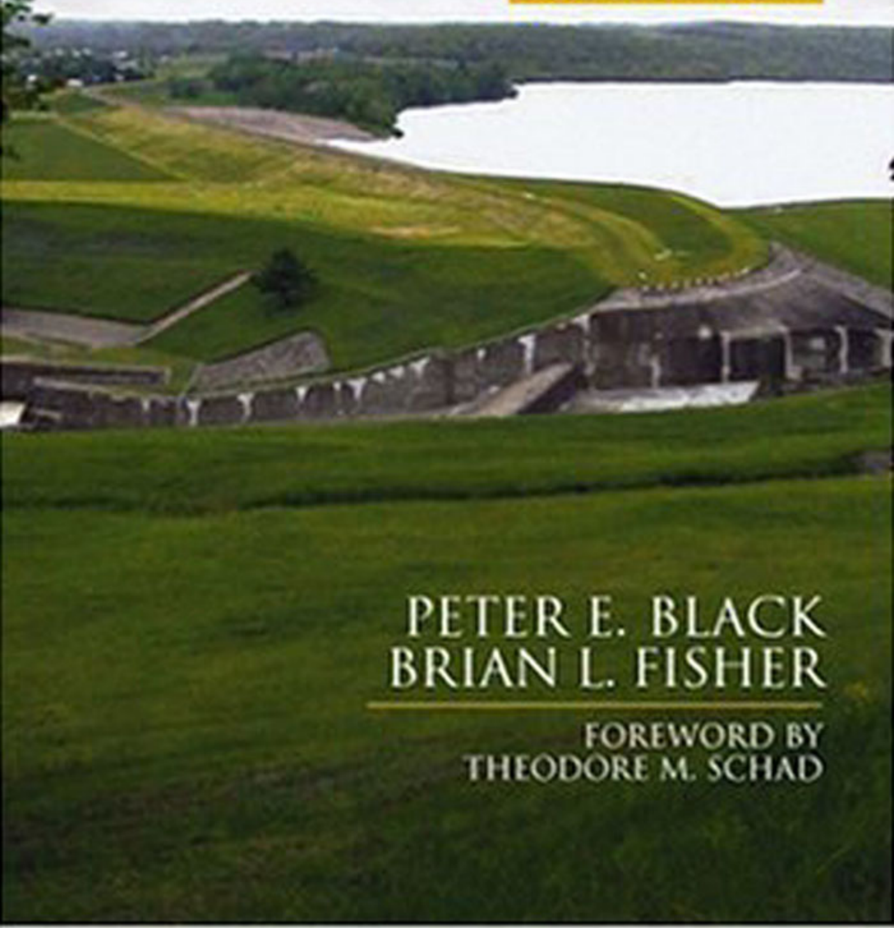
CONSERVATION OF WATER AND RELATED LAND RESOURCES

3RD EDITION



PETER E. BLACK
BRIAN L. FISHER

FOREWORD BY
THEODORE M. SCHAD

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Boca Raton London New York Washington, D.C.

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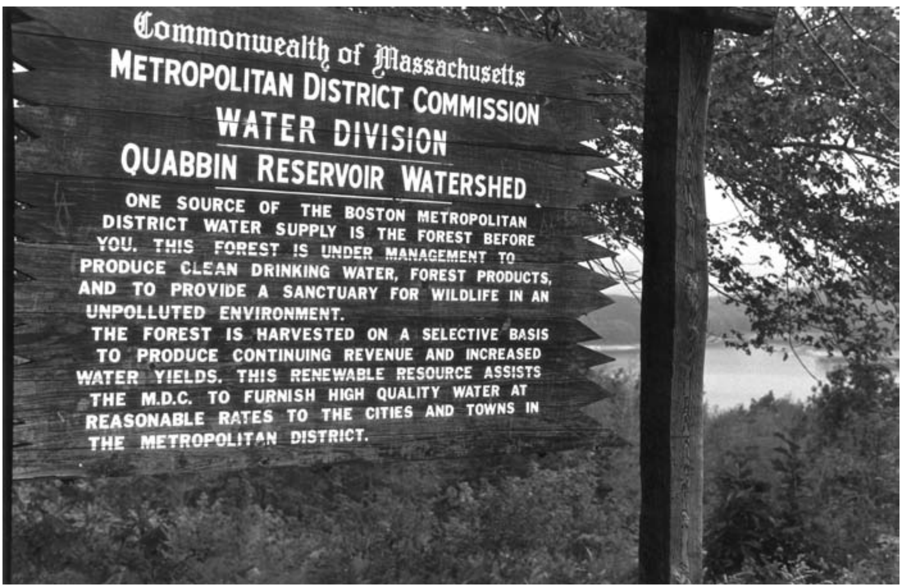
Library of Congress Cataloging-in-Publication Data

Black, Peter E.
Conservation of water and related land resources / Peter E. Black, Brian L. Fisher-- 3rd ed.
p. cm.
Includes bibliographical references and index.
ISBN 1-56670-541-X (alk. paper)
1. Water conservation--Government policy--United States. 2. Land use--Government policy--United States. I. Title.

HD1694 .A5105 2000
333.91′16′0973—dc21 00-045044

International Standard Book Number 1-56670-541-X
Library of Congress Card Number 00-045044
Printed in the United States of America 1 2 3 4 5 6 7 8 9 0
Printed on acid-free paper

Frontispiece



The Quabbin Reservoir Watershed, part of Boston's water supply, is an example of a complex conservation issue in that extensive rural resources are dedicated to intensive, distant urban demands. Its development, construction, and use span the history of the conservation of water and related land resources in the United States. That history embraces the economics, laws, organizations, policies, plans, pollution control programs and permits, and economics that influence decisions made by and affecting all citizens.

Cover Photographs

Front Cover: Whitney Point Reservoir, Whitney Point, New York completed by the Corps of Engineers on the Tioughnioga River, tributary to the Upper Susquehanna River in 1942 as authorized by the 1936 Omnibus Flood Control Act. **Back cover**: best management practices — silt fence and grass mulch — for protection along the stream buffer on a home development project site in northern Virginia, 2000. Between these covers, and the 64 years that separate their subject matter, watershed management practices have evolved from an emphasis on downstream flood control engineering to an emphasis on upstream flood prevention, especially to maintain and enhance water quality. A more integrated approach to water and related land resources management is further exemplified in the shift from control of point sources to nonpoint sources of pollution. During these six-and-one-half decades, the downstream and upstream responsibilities assigned by the 1936 Act to the Corps and the Soil Conservation Service (now the Natural Resources Conservation Service) have merged — along with a host of other federal, state, local, and private organizations — into a comprehensive (and often complex) assembly of policies, programs, plans, and projects, the evolution of which is the subject matter of this book. (Photographs by Peter E. Black.)

Dedication

To

Robert E. Dils

The Authors

Peter E. Black is professor of water and related land resources at the SUNY College of Environmental Science and Forestry in Syracuse, NY, where he has taught and conducted research since 1965. He was awarded M.F. and M.S. degrees from the School of Natural Resources at the University of Michigan in 1956 and 1958, respectively, and a Ph.D. degree in Watershed Management from Colorado State University in 1961. From 1956 to 1959, he was a research forester at the U.S. Forest Service's Coweeta Hydrologic Laboratory in North Carolina and taught at Humboldt State College in Arcata, CA from 1961 to 1965. Additionally, Black has taught forest management, surveying, and forest hydrology, and currently offers graduate and undergraduate courses in watershed hydrology, watershed management, conservation policy, and environmental impact analysis.

Black's published works include an education film; numerous articles on hydrology and water resources; and three books entitled *Environmental Impact Analysis* (Praeger, 1981), *Conservation of Water and Related Land Resources* (Rowman & Littlefield, 2nd ed., 1987), and *Watershed Hydrology* (Ann Arbor Press, 2nd ed., 1996). In 1974, he co-founded Impact Consultants, a private firm in Syracuse, for which he served as Environmental Impact Statement (EIS) project manager for 12 years. He is a member of several professional organizations, and served as president (and held many other offices) in the American Water Resources Association (AWRA), including general chairperson for its 1987 Summer Symposium entitled, "Water Quality Monitoring, Modeling, and Mediation," its 1996 Summer Symposium entitled, "Watershed Restoration Management," and "Building Interdisciplinary Water Resources Partnerships" in 1998. He has been active in the Renewable Natural Resources Foundation as a representative from AWRA, and is associate editor for Watershed Management for the *Journal of American Water Resources Association and Water Resources Impact*.

Black holds environmental professional certification by the National Association of Environmental Professionals and has served on its education committee. He holds professional hydrologist certification by the American Institute of Hydrology. He has served on local, state, and national advisory committees; the board of directors of the Universities Council on Water Resources (1994–1997); the U.S. Army Corps of Engineers' Environmental Advisory Board from 1992–1996, and as its chairperson in 1995–1996, for which he received the Commander's Award for Public Service in November 1996. Black was appointed the SUNY Distinguished Teaching Professor in 1997.

Brian L. Fisher, a native of Erie, PA, is currently the Forestry Program Manager for the Watershed Agricultural Council of the New York City Watersheds, located in Walton, NY. He oversees forestry outreach and management efforts on nonindustrial, private forestlands for the 1,969-square-mile New York City Watersheds (Catskill/Delaware and Croton) that supply New York City with approximately 1.4 billion gallons of potable water for some 8 million water consumers daily.

Fisher received his B.A. degree in political science in 1978 from Syracuse University and a M.S. in environmental science from the SUNY College of Environmental Science and Forestry, Syracuse, NY, in 1983. A former nature center director and resource program specialist, Fisher has also taught conservation policy, environmental law, and was formerly on the conservation faculty of the SUNY Finger Lakes Community College in Canandaigua, NY.

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Abbreviations

AEM	Agricultural Environmental Management program
af	acre-feet
ARS	Agricultural Research Service
BAT	Best Available Technology
BCA	Benefit-Cost Analysis
BIA	Bureau of Indian Affairs
bgd	billion gallons per day
BLM	Bureau of Land Management
BMP	Best Management Practice
BPT	Best Practicable Control Technology
BR	Bureau of Reclamation
CBT	Colorado-Big Thompson Project
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second (second-feet)
COE	Corps of Engineers
COR	Council of Representatives
CWA	Clean Water Act (see PL 92-500)
EIA	Environmental Impact Analysis
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EQ	Environmental Quality
FERC	Federal Energy Regulatory Commission
FIA	Flood Insurance Administration

FIARBC	Federal Inter-Agency River Basin Committee ("Firebrick")
FPC	Federal Power Commission
FS (USFS)	Forest Service
FWCA	Fish and Wildlife Coordination Act (of 1946)
FWS	Fish and Wildlife Service
FY	Fiscal Year
GIS	Geographic Information System
GLO	General Land Office
gpd	gallons per day
GS (USGS)	Geological Survey
IACWR	Inter-Agency Committee on Water Resources ("Icewater")
NED	National Economic Development
NEPA	National Environmental Policy Act
NEWS	Northeastern Water Supply Act
NGO	Non Government Organization
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWA	National Water Alliance
NWC	National Water Commission
NWS	National Weather Service
OFCA	Omnibus Flood Control Act (of 1936)
OMB	Office of Management and Budget
OWP	Office of Water Policy
OWRT	Office of Water Research and Technology
P&S	Principles and Standards
PHS	Public Health Service
PIA	Practicably Irrigable Acreage
PL 566	Watershed Protection and Flood Prevention Act
PL 92-500	Water Pollution Control Amendments (of 1972)
PWPL	Priority Waterbodies Problems List
SCS	Soil Conservation Service (now NRCS)
SEA	Science and Education Administration
SPDES	State Pollutant Discharge Elimination System

TMDL	Total Maximum Daily Load
TVA	Tennessee Valley Authority
WPCA	See PL 92-500
WPI	Water Policy Initiatives
WRC	Water Resources Council
WRPA	Water Resources Planning Act

Foreword

Theodore M. Schad

Water, like sunlight and air, is one of the basic ingredients of human life. Without water, life as we know it would perish from the Earth. The United States is blessed with a bountiful supply of water that has contributed mightily to the nation's growth and economic development. But the water is not always in the right place or of the right quality to meet needs. Efforts to control the use of the nation's waterways antedate the Constitution and, in fact, helped lead representatives of the 13 states to the Constitutional Convention in Philadelphia. Yet the Constitution that was drafted there contains not one word about the control of the use of the water resource. But it did grant Congress the power "To regulate commerce with foreign nations, and among the several states, and with the Indian tribes."

As early as 1907, Congress saw the need for internal improvements to facilitate transportation among the states and the lands lying to the west of the Appalachians, and authorized the Secretary of the Treasury to prepare a report on how this could be accomplished. The report was prepared by Albert Gallatin and transmitted to Congress on April 4, 1908. It proposed construction of a series of canals to make possible inland navigation along the Atlantic seaboard. Canalization of several of the great rivers draining into the Atlantic Ocean, would include turnpike roads from their headwaters across the Appalachian mountains to provide transportation routes connecting with westward flowing rivers. The report also proposed canals from the Hudson River to Lake Champlain and Lake Ontario and around the falls and rapids at Niagara to open navigation between the Atlantic seaboard and the Great Lakes. Gallatin estimated the cost of such works to be about 20 million dollars. His strict construction of the Constitution, however, led him to suggest a constitutional amendment to permit the federal government to undertake the internal improvements that were recommended in the report and that he felt exceeded the financial capability of the states. No action was taken on the report, but the War of 1812 created further demands for better transportation facilities. The State of New York began construction of the Erie Canal in 1917. Legislation to authorize federal construction of other canals was passed by Congress, but was vetoed by President Madison on his last day in office on the grounds that it was unconstitutional.

For over a decade, efforts by Congress to provide a federal role in the development of water transportation were stymied by the struggle for supremacy between the legislative and executive branches of the government. They struggled over the constitutionality of the use of federal funds for internal improvements. The first agreement was reached on construction of the National Road to connect the eastern states with the Ohio River Valley, but it was not extended to include any improvement of water transportation routes. In the absence of federal action in this area, the states retained control over waterways. Construction of the Erie Canal continued and New York passed laws controlling the use of its navigable waterways; Fulton and Livingston, inventers of steamboats, were granted exclusive rights to navigation by steamboat to all the waters of the state.

In 1820, when a conflict arose between Aaron Ogden, assignee to the Fulton and Livingston rights, and Thomas Gibbons, holder of a federal license to engage in coastal trade, the New York State Courts upheld an injunction that prevented Gibbons from navigating on the waters within the state. The case was eventually appealed to the Supreme Court of the United States which, in 1824, reversed the decision of the lower court saying that the Commerce Clause of the Constitution gave Congress ultimate power over navigation "…within the limits of every State in the Union, so far as that navigation may be, in any manner, connected with 'commerce with foreign nations, and among the several states, and with the Indian tribes.'"

The struggle between Congress and the executive branch over internal improvements was not ended by the *Gibbons v. Ogden* case but the camel's nose was under the tent. Congress passed legislation authorizing works of improvement of rivers that was vetoed by a succession of presidents. But Congress gained the upper hand by overriding the presidential vetoes. So the development of the nation's waterways proceeded. As West Point provided the only advanced engineering education in the U.S. at that time, the Corps of Topographic Engineers, predecessor of the Army Corps of Engineers, was given the responsibility for this work.

Improvement of rivers and harbors soon became a political “grab bag” in Congress, handled under special provisions in the Committee of the Whole House on the State of the Union. Its unwritten rule was, “I’ll vote for your project if you’ll vote for mine,” and terms like “log-rolling” and “pork barrel” began to be applied to the program. Efforts to give public lands to the states in the lower Mississippi River Valley in return for their taking responsibility for reclamation of low-lying swamp lands were unsuccessful. The Army Corps of Engineers was eventually given responsibility for flood control in that area.

In 1856 and 1860, the presidential election platform of the fledgling Republican Party called for federal support of internal improvements. The Civil War increased support for federal funding of transportation facilities, and, over the years, a number of court decisions upheld federal responsibility over navigable rivers and their tributaries. In the years following the war, both political parties supported the use of federal funds for internal improvements.

In the late 19th century, the problems encountered in the development of the West led to an appreciation of the relationship between land and water resources, and the conservation movement was born. A report by Major John Wesley Powell of the U.S. Geological Survey proposed joint planning for development of the land and water resources of the western states and territories. The Mississippi River Commission was established and given responsibility for preparing plans for coordination of flood control and navigation in the Mississippi River Basin. The seeds of comprehensive planning for development of land and water resources had been planted.

During the same period, the Desert Land Act of 1877 was enacted to authorize the sale of 640 acres of the public lands in the West at $1.25 per acre to any person who would irrigate it within 3 years. Few individuals had the resources to accomplish this and little progress toward the development of sustainable irrigation resulted. In 1894 the program was expanded by the Carey Act, which authorized donation of up to one million acres of desert lands to each of the western states that agreed to cause the lands to be irrigated, reclaimed, occupied, and cultivated by actual settlers. Again, the states were unwilling or unable to assume such responsibilities. The federal government finally took over the responsibility for the settlement of the West by passage of the Federal Reclamation Act of June 17, 1902. A new actor came upon the resource development scene in the form of the Bureau of Reclamation in the Department of the Interior.

The relationship of land use to water resources was recognized with the creation of the National Forest System in 1891. One of its purposes was to regulate streamflow to help navigation. In 1905, administration of the National Forests was vested in the Department of Agriculture since the Forest Service was created in that department. But with three major federal departments, Agriculture, Interior, and War, having responsibilities in this area, and with each reporting to a different Congressional committee, conflict became inevitable.

With the flowering of the conservation movement during the administration of President Theodore Roosevelt, the concept of comprehensive planning for multiple uses of land and water resources was actively promoted. The National Waterways Commission, which reported to Congress in 1912, stressed the need for coordinating the activities of all of the departments and agencies having responsibilities for conservation of land and water resources. Under the leadership of Senator Newlands of Nevada, the Congress of 1917 passed legislation authorizing the President to create a seven-member Water Commission. This commission would formulate comprehensive plans for development of the water resources of the U.S. for every useful purpose. Such an agency might have been able to coordinate all of the water-related programs of the three departments, but it was never appointed. The First World War intervened and, in 1920, the Federal Power Act repealed the portion of the 1917 Act that would have created the Water Commission. It established, instead, a three-member Federal Power Commission consisting of the Secretaries of Agriculture, Interior, and War. When the commission staff sought funds to undertake the preparation of the comprehensive plans, which it was authorized to prepare, that function was taken over by the Army Corps of Engineers (at that time called the United States Engineering Department). The comprehensive plans that resulted were known as the "308 reports," taking the number from the House Document containing the list of the river basins for which the Corps planned to prepare reports.

Since that time, a bewildering array of federal legislation dealing with water resources has been enacted. In the 1930s, flood control became a major purpose of federal water resources development and, in 1946, the Fish and Wildlife Coordination Act was passed. More recently, protection of endangered species, recreation laws, and water pollution control laws have been added. River basin commissions have been created and abolished along with the Water Resources Council, which had been created to coordinate the programs of the federal agencies. The states are now forced to take a larger role as federal water resource programs become a smaller portion of the federal budget. Interest groups are making themselves heard in more effective ways.

We are making some progress in learning to live in harmony with our environment. Flood control is giving way to flood plain management. Water pollution control is becoming water quality management. Recycling is a way of life. But we still have a long way to go and Professor Black's book will help us find the way. As we search for better ways to manage our resources, it is important that we be cognizant of the history of water resources management in the U.S., lest we succumb to the oft-quoted words of the philosopher, George Santayana, who once said, "Those who do not remember the past are condemned to repeat it."

Preface

This book examines the history and details of relations between the U.S. and its natural resources. The world is currently faced with monumental challenges, many of which focus on water and the land resource to which it is related. These challenges include providing sufficient water for both a healthy environment and a healthy population, and to serve local and worldwide capacities to buffer energy, nutrients, wastes, and gases so that the Earth can continue to be a viable place for life. Wild spaces need to be preserved not just so that we can enjoy them, but so they can fulfill their functions in the Earth's environment. Important issues include the necessity to define on a broad scale, the terms "sustainability" and "carrying capacity," and, on a more limited scale, terms such as "wetlands," "healthy," and even "conservation" itself. Complicating decisions about our future is the fact that communities at all scales need to be prepared for global change and for the scientific and social information base necessary to understand the situation. First and foremost, we must deal with the issue of population growth. That is necessary in order to begin to manage the concept of sustainability to achieve our conservation goals. As a nation that uses more than its per capita share of the Earth's resources, U.S. citizens need to comprehend how we got to where we are, the nature of our limitations, and what the opportunities are to improve our lot. The purpose of this book is to prepare the reader for understanding and working as a professional or as a citizen for conservation, for sustainability.

We expect that this book will be of interest and use to the informal student of water and related land resources, as well as to those enrolled in formal courses. As a consequence and in response to the interests of the times, the subject matter of conservation courses has shifted, gradually incorporating more social sciences; simultaneously, the social sciences pursued conservation-related subjects as legitimate fields in their own right. By the early 1960s, the terminology had shifted from “soil erosion control” and “soil and water conservation” to “river basin projects” and “river basin planning” and, eventually, to “comprehensive planning” and “water and related land resources.”

“Water and related land resources” now embraces the strategies and methods embraced earlier by the phrase “soil and water conservation” during the first half of the 20th century. Those two phrases are forever linked in technology and literature, the natural resource professions, and in our culture. For example, as one of the earliest courses in the Department of Forestry at the SUNY College of Environmental Science and Forestry, *Soil and Water Conservation* provided practical information on soil erosion and erosion control at a time when soil conservation was cutting edge material and in its infancy in the middle 1930s. At that time, the course was created to present information on the newly formulated techniques of soil erosion control. As those practices became more widely known and accepted, the material presented therein became a subject more for field training than for academic credit. Over the years, the course evolved into one that now focuses on political science and policy. Culturally, the 1930s film “The River” emotionally linked the Mississippi River with its watershed that provided the runoff, floods, and nutrients of its valuable agricultural flood plain lands. The patriotic tone and wonderful music by Virgil Thompson built a foundation for the war years as well as for the stirrings of what was to become the environmental movement. The phrase, “planning of water and related land resources,” was first used in the report of the Senate Select Committee on Water Resources in 1961. It — or simply “watershed planning” — might be a more appropriate label for our course, but the original title is retained for its intrinsic historical value and perspective.

It is entirely fitting that the terminology “water and related land resources” be associated with schools of forestry or natural resources management that were created in the early 1900s. The first official linkage between land and water was embraced in the 1911 Weeks Forest Purchase Act, born of deforestation and consequent increased runoff, erosion, sedimentation, and floods. That legislation enabled the federal government to become engaged in forest management “in order to protect navigable streams.” The most recent linkage is in a variety of innovative programs that implement provisions of Section 208 of the 1972 Water Pollution Control Amendments. In between, there have been many lawsuits initiated and overturned, congressional acts passed and repealed, administrative agencies created and decommissioned (or allowed to languish). The legalities of navigability and interstate commerce have continued to be important tests of and constraints on the constitutionality of many water and related land resource programs, and therefore comprise much of the necessary substrate for the comprehension of soil and water conservation policy.

The objectives of the course identify the scope of this book: (1) to acquaint the reader with soil and water conservation issues; (2) to stimulate an appreciation for an integrated, comprehensive approach to land and water management; (3) to illustrate the influence of institutional, economic, and cultural forces on the practice of soil and water conservation; and (4) to identify sources of information, methods, and techniques by which soil and water conservation measures are applied to the land, as well as the basis for predicting and evaluating results. Emphasis in our course is on the first three, with references provided for accomplishing the fourth, along with the basic understanding necessary for an individual to proceed with whatever is of interest. Extrapolating to the general public, it is hoped that the information and approach presented in this book will be of use to the citizen who is interested in taking an active part in the decision-making process concerning water and related land resources, as well as to the student, legislator, administrator, and practicing professional.

During the 20th century, soil and water resources were increasingly tied together in legislation and management after the 1911 Weeks Forest Purchase Act. The trend continued with the 1936 Omnibus Flood Control Act that linked the fledgling land-managing Soil Conservation Service with the ancient river-managing engineering of the Army Corps of Engineers; and the 1954 Watershed Protection and Flood Prevention Act that "brought responsibility home" to all the stakeholders in land and water management. At the peak of the populist environmental ground swell in the 1960s and 1970s, the 1972 Water Pollution Control Amendments ("Clean Water Act") were enacted. This specifically linked water quality to land use in Section 208 entitled "Areawide Waste Treatment Management," and introduced the important arena of nonpoint source pollution control. Currently, this is where the action in watershed management is, where the conflicts, the challenges, the opportunities, and the money are; where "the rubber meets the road." And that is likely to be true for a long time. The demand for competent professionals, conservation–minded land operators, and informed citizens are and will continue to be the most pressing need underlying successful sustainability as we extend human civilization into the 21st century.

Peter E. Black and Brian L. Fisher

Acknowledgments

From the earlier editions:

I am deeply indebted to Dr. Robert E. Dils, my major professor at Colorado State University. Twenty-five years ago, he let me, as a graduate student, pursue an interest in an independent course that led to wide-ranging study, consulting, and teaching about the subject matter of this book. Without his confidence and guidance, this book would not have been written. I am also especially indebted to my friend, colleague, and neighbor, Dr. Arthur R. Eschner, who put up with a battering barrage of my thinking-out-loud during carpooling and other odd moments. He answered many questions, and gave me many. Two other members of the School of Forestry faculty at the SUNY College of Environmental Science and Forestry, Drs. John D. Bennett and Hugh O. Canham, gave generously of their time and knowledge in economics to answer countless questions, provide references, and review materials.

Gerry D. Seinwill, former Acting Director of the Water Resources Council, cheerfully contributed precious time during hectic days in Washington for me to interview him, answer numerous phone calls, and review my manuscript. His comments, suggestions, criticism, and ideas were invaluable, and I am most grateful for them. My thanks, too, to Dr. Kenneth L. Bowden of Northern Illinois University, who also reviewed the manuscript and encouraged me. Mr. Warren Viessman, Jr., Senior Specialist at the Environmental and Natural Resources Policy Division, Library of Congress, illuminated many poorly lit areas of mine, providing valuable reference materials, insight, and encouragement. I am further indebted to Mr. Thomas R. Bellinger, former graduate student and teaching assistant, who provided important library research and support, and to Mr. David L. Naylor, librarian at the Syracuse University College of Law, who provided needed guidance and information.

The encouragement, constructive criticism, and continued cheerful attitudes of Dr. Jerry L. Stone and Ms. Jean Blackburn have been indispensable to the completion of the first edition of the book. I remain in their debt and that of their associates at Praeger Publishers, New York, and have enjoyed working with them. I also remain responsible for the views contained herein, as well as for any errors and, knowing the inevitability of change, hope to learn of those that I have made or that are created thereby. For the second edition, I express my appreciation to Paul A. Lee, Mary D. Simmons, and Martyn J. Hitchcock of Rowman and Littlefield. They provided many useful suggestions, and were fun to work with.

I add here my sincere appreciation to the graduate and undergraduate students, both at the SUNY College of Environmental Science and Forestry and the Geography department of the University of Colorado who have provided continual review and comment on the text. I am grateful, too, to Karen Helgers who provided critical review of the manuscript for the second edition as well as assistance with the tables and figures, and to Geraldine C. Trendell who drafted many of the figures. I wish to especially thank Leo M. Eisel, former Director of the Water Resources Council, and David C. Harrison, Project Consultant with the National Water Policy Project, both of whom provided me with material and comment. I am deeply indebted to them.

Peter E. Black, 1981

I take the opportunity to add to the Acknowledgments at the time of this edition's second printing a most serious error of omission: while at the University of Michigan, I had the good fortune to enroll in Dr. Lyle E. Craine's *Conservation Trends Seminar*. The influence of that course on my views of conservation, on my understanding of the importance of an historical perspective, and on the value of integrating history, law, organization, and people in the natural resources arena are readily apparent in this book. I am deeply grateful to Dr. Craine for opening the door to the whole field of conservation policy for me.

Peter E. Black, 1987

Third edition:

For this third edition, we are particularly grateful to Kenneth Stevens, Environmental Engineer with the Division of Water, New York State Department of Environmental Conservation in Albany, who furnished details on stormwater permits; Richard D. Swenson and Paul A. Ray, Natural Resources Conservation Service, Syracuse, NY, who provided a variety of information concerning and recent changes in that organization's activities; Paul D. Rubenstein, Arlene L. Dietz, and Martin Reuss of the Corps of Engineers, who were always free to give of their time and knowledge; and Robert W. Malmsheimer, Esq., SUNY College of Environmental Science and Forestry, Syracuse, NY, who continues to provide valuable information and innovative ways of reflecting on old facts. Thanks also to Sara E. Keith, Donald W. Floyd, and Mark S. Mesiner, all faculty who have provided answers to questions and information. Thanks are also due (again) to Thomas R. Bellinger, now of the Bureau of Reclamation and former ESF student, who contributed up-to-date information on relationships between the Bureau of Reclamation and the Bureau of Indian Affairs. And Julie Tasillo, graduate student at SUNY ESF, provided excellent service keeping track of and organizing figures and tables, and important file-keeping services, and she intensively reviewed the manuscript.

We are delighted that Theodore M. Schad agreed to provide a Foreword, based in part on his insightful historical analysis of U.S. water policy (Schad 1979). His long and distinguished association with 20th century water policies and related issues are many: he worked for numerous federal agencies prior to employment with the Congressional Research Service, organized the mid-century Senate Select Committee on Water Resources and as staff director for Senator Robert S. Kerr. He then served as Executive Director of the National Water Commission and, since "retirement," has continued to be active in national and international agencies and organizations. A wonderful account of Ted's long and illustrious career, and a delightful-to-read interview were published by Reuss (1961). There is a great deal to be learned from Ted, and many are indebted to him for his many insightful observations about events, people, and places; he has provided invaluable information and unique insights into water policy in the last century, and I have also greatly enjoyed our personal contacts.

Brian L. Fisher, former student and colleague, volunteered to put his knowledge of the status of the Clean Water Act into Chapter 6 as well as assist with this third edition: he will be able to keep the book going as the ever-changing practice of conservation continues over the years ahead. Together, we thank all those listed above and the many fine professionals at CRC Press who have made this edition available in a most timely manner.

Peter E. Black and Brian L. Fisher, 2000

Introduction

Legacies of the past, environment of the present,
challenge of the future

July 22, 1965. Congress approved and the President signed the Water Resources Planning Act (P.L. 89-80, 79 Stat. 244). Nearly 200 years after the founding of the nation that used (and abused) its water resources for a variety of purposes without coordinated effort, a comprehensive planning directive went into effect. The bill provided (see Appendix A for the full text) (1) the creation of a Water Resources Council in the Executive Branch, (2) the creation of river basin commissions, and (3) planning grants to the states. The legislation mandated certain responsibilities to the council, including coordinating, assessing resources, and setting "principles, standards, and procedures for federal participants in the preparation of comprehensive regional or river basin plans for the formulation and evaluation of federal water and related land resources projects." The act was carefully constructed to comply with existing laws, interstate compacts, and already established river basin commissions where appropriate.

August 3, 1973. A news release from the Water Resources Council in Washington announced that the President approved "new principles and standards for planning water and related land resources to be used by federal agencies in regional or river basin planning and in planning federal and federally assisted water and related land resources programs and projects." The word "new" was misleading. There had been no formal principles and standards earlier; we had only guidelines for the economic (with minimum attention to the aesthetic) considerations for river basin projects, especially dams, levee systems, channel modifications (like dredging or straightening), and other water resource developments. The news release continued:

> The principles and standards represent a marked departure from past resource planning, which was based primarily on the economic impact of land and water resources. In the new system, planning for the use of the nation's water and related land resources will be carried out in the context of broad national objectives, relating to national economic development, and environmental quality. Each objective will be given equal consideration in the conservation, development, and use of our nation's water and related land resources.

The principles and standards were the results of a long history of events, crises, and laws, as well as political, economic, and social battles. Nor was the equality of the two objectives assured, for the method of evaluating the contribution of a proposed project to the national economic development objective was the result of about 40 years' experience in benefit-cost analysis (BCA), even though BCA was not a perfected technique. The contribution of the proposed project to the environmental quality of the United States had the benefit of only a few years of partially tried, but well-intentioned guidelines with which to work. The news release did not resolve the nation's water problems.

February 23, 1981. *Newsweek* displayed a parched United States on its cover with the bold caption, "Are we running out of water? Americans have used water as though their wells would never fail," the cover story said (Adler et al., 1981), "but in the past few months they have come to realize how close to bottom they really are." The article highlights the problems of water shortages, floods, pollution, high food costs, waste, unrealistic programs of development that do not effectively deal with water surpluses, high water rates, and the billions of dollars needed to rehabilitate aging urban water distribution systems. The article did not indicate that most of the problems are political, economic, and social, exacerbated by the normal vagaries of weather and climatic cycles.

March 11, 1981. The *New York Times* detailed President Reagan's plans for budget trimming, including "elimination of funds for the Water Resources Council, saving $44.8 million" (Cowan, 1981). Rumors persisted that Secretary of the Interior, James G. Watt, plans to recreate the Water Resources Council (WRC) in his department, which includes the Bureau of Reclamation that the WRC was supposed to monitor. Within 6 months, the WRC was indeed rendered helpless by imposition of a zero budget, although temporary funding of $2.8 million was later appropriated. Of that sum, $1.8 million went to support the Office of Water Policy in the Department of the Interior's Division of Land and Water. That agency also expired for lack of funds. For a time, the Secretary of the Interior headed the cabinets' Advisory Council on Resources and Environment. Thus, it had much the same makeup as the Water Resources Council, but little funding. Some support was provided by the Assistant Secretary's Working Group on Water Resources, the principal effort of which seems to have been the issuance of the severely weakened principles and standards. This working group was led by Assistant Secretary of the Army, William R. Gianelli, but that group too disappeared. Thus, there was no central control of federal water resource policy. The minimal duties of the Water Resources Council continued to be carried out by the Secretary of Interior.

March 18, 1985. *U.S. News and World Report* published a brief page of observations under the headline "Water: the Nation's Next Resource Crisis?" The article included comments by eight members of Congress who formed a National Water Alliance, a bipartisan effort to forge a comprehensive water policy. "You can live without oil, and you can live without love," said Senator Daniel P. Moynihan, "but you cannot live without water." More to the point was Senator Dole's comment, "Water policy has suffered from two problems: executive politics and provincialism. We endured a policy paralysis during the Jimmy Carter 'hit list' years and the Ronald Reagan 'cost-sharing' years." Brent Blackwelder of the Environmental Policy Institute said "Our water crisis is a crisis of mismanagement" (Taylor, 1985).

And now, in 2000. As we enter a new era, we are faced with monumental problems that include population pressures on water resources, greater variability in climate along with a potentially major climate change due to significant global warming (van Dam, et al. 2000), and newly identified pathogens from improper land management that affect receiving water bodies. To comprehend potential solutions to the current problems of our water and land resources, it is necessary to understand what lies behind these major developments and shifts in policy (or lack thereof). In the 8 years between adoption and near-destruction of the principles and standards, and the zero budgeting for the Water Resources Council, many customs, laws, and institutions established in the previous century played important roles. Examination of such historical events — and of the policies and individuals who make them — is necessary to begin to resolve current water and related land resources problems.

There are several "threads" to this chronicle. The first is water law, which reflects both climatic and cultural conditions. The several types of water laws in the United States grew from customs brought independently to the eastern and western states, respectively, and differ greatly. In some states, the two primary doctrines (riparian and appropriation) have been combined, in others, they have not. In some states, different doctrines apply to ground and surface waters. The two principal doctrines provide us with an orderly, if somewhat complex, method for allocating water supplies among users. In addition, the recently defined Native American water rights produced a conflict of significant proportions, especially in the arid southwestern states. The ramifications of the conflict, however, are evident throughout the nation and should be of concern to all.

A second thread is comprised of the organizations, primarily the agencies at the federal level, but also those at regional, state, and local levels. The organizations include professional entities, private businesses, and nongovernment organizations (NGOs). Individual and corporate interests have often emerged as national policy. Those interests may be reflected in the programs, plans, and projects for water development and preservation, often developed by the actions of well-funded special interest groups and/or lobbyists, many in the name of "conservation." Bolstered by the need in the 1930s to boost the economy and promote conservation, the agencies multiplied, grew, and developed territoriality and proprietary interests in specific programs, many of which resulted in single-purpose projects, especially in the water resources arena. Soon, the agencies began to encroach on each other's territories physically, fiscally, and politically. This created a need for coordination and leadership to survey and inventory the nation's water resources and problems. There followed a period characterized by a call for comprehensive planning and culminated in the establishment of the Water Resources Council in 1965, assigned to coordinate the activities of the numerous agencies and water and related land resources planning of the federal and state governments. Charged with an urgent national responsibility and restrained by a lack of power and the unwillingness of other agencies to relinquish territory, the WRC could not accomplish its objective, and its demise was not unexpected. No replacement for the council or provision for coordination of agencies has been identified to date.

The third thread arose from the tumultuous events after the end of World War I and before the turn of the millennium. The 1980s rebellion against big government was a set-back (or perhaps a beneficial realignment of policies and priorities, depending upon one's viewpoint) because many of the early, often shaky justifications for regulations and standards now have a more sound basis in substantiating research and results, and are therefore less likely to fail. The water pollution problem cannot be considered in a vacuum: wastes we have, and wastes we must release into the water, the soil, or the air. They are most likely to end up in the water. We can begin to resolve that problem when we start considering wastes as resources and invoking conservation-based economic pricing policies. Ultimately, the control of water quality will lead to control over land use. The process commenced with the passage of the 1972 Water Pollution Control Amendments. Section 208 calls for identification and control over "nonpoint sources" of pollution. These sources (from farms, forests, resource extraction, salt water intrusion, on-land disposal of wastes, rangelands, and urban development) are numerous, insidious, and pervasive. Many of the worst sources are incredibly expensive to detect, evaluate, and clean up.

Fourth, there is the development of Benefit-Cost Analysis (BCA). BCA evolved as an evaluation process because of a need by economists in the universities and governmental centers to measure and evaluate benefit and cost data as required by law. This was "especially true" for the evaluation of aesthetic values of water in place and after water development. The 1936 Omnibus Flood Control Act, for the first time, required that action be taken only if "the benefits to whomsoever they may accrue are in excess of the estimated costs." The evolution of BCA took from 1936 to 1973 when the principles and standards were adopted and published in the *Federal Register*. There are some peculiarities of both the water resource and the water resource development projects that make the application of BCA unusual. For example, with such a high proportion of water resource development project costs tied up in fixed (or "first") costs, strict adherence to BCA computational guidelines may be self-defeating for a project. Even so, BCA is not very complex in theory. That theory is essential to an understanding of why the U.S. is currently undergoing a shift away from major structural projects. The normal process of development of the best sites for a natural resource, coupled with concern over environmental quality and high interest rates, all combine to impede structural project financing and, as a consequence, implementation.

Fifth, some major changes in pollution control have occurred. As the nation invested in municipal waste treatment plants, the point sources of pollution dramatically improved. The 1972 goals of "fishable and swimmable waters" and "zero discharge of pollutants" could be considered as achieved if we only consider point sources. However, once the point sources were (by and large) cleaned up, the nonpoint sources became more visible as well as more troublesome. Even without increasing in number, nonpoint sources' percentage share of the impairment of water bodies went up as the point source percentage went down. Paramount among the nonpoint sources of pollution, agriculture is the target for most of the current pollution control effort. With a dramatically reduced farm population during the 20th century and with increased "edge effect" interactions between farmers and suburban dwellers, the 70-year economic protection for farmers by Congress is quickly eroding. In short, the first of what will probably be a series of court rulings identified manure spreaders as point sources and, therefore, in need of a permit. Even now, other permits are required for better control over pollution. These include permits for stormwater runoff and diffused runoff from nonpoint sources of pollution, identified as Total Maximum Daily Loads (TMDLs). This is the most recent – current – of the historical threads.

A sixth and longer-range thread concerns policy. It is associated with planning because of the obvious linkage in developing strategy, as well as in Section 208 of the 1972 Water Pollution Control Amendments. Policy and planning (Chapter 5) are further associated with partnerships because they are the current, common, and preferred approach to resolving complex problems such as those that water resources usually present. Consideration of shifting public opinion during the history of the development of the water law doctrines, the federal organizations, and the Benefit-Cost Analysis process shows a change from single-purpose to multi-purpose projects. This was followed by a need for centralized planning and control over the big dollars and important resources on which they were being spent. Public opinion rode along on the crest of change from single-purpose to multi-purpose projects at mid-century. Then came comprehensive planning, and finally coordination of planning at several levels of government. Public opinion, which probably would have supported stronger Water Resources Council power as the "environmental movement" grew in the late 1960s and early 1970s, was severely undermined by the actions of the federal government in both the Vietnam War and Watergate. The result was a severe lack of trust in government and, consequently, in any attempt at centralized planning. The continuing rebellion against big government is a natural part of the long-term sequence. Furthermore, when the conservation movement made its major strides in the 1930s, practically all of the financing was federal (Heft, 1984). In the last two decades of the 20th century, the changes in the administrations' programs of "cost-sharing" were successful attempts that shifted more and more of the burden of water development costs to state and local governments and to citizens. Now, those units of government, the NGOs, and the people themselves have the responsibility and opportunity to participate.

Participating in the National Water Commission's broad investigation into the nation's water problems, Teclaff and Teclaff (1973) wrote:

> The most significant lesson of history is that without a technological breakthrough, which would provide new sources of water or permit reduced consumption in many of the tasks which water now performs, sufficient water for the needs of a growing economy can be provided only at ever increasing cost to the physical environment or to the social environment or

> both. *There is a point in water resource development when water can no longer be matched to the economy, but the economy must be matched to the water available.* This may be a bitter pill to swallow for a development-minded modern society, but history teaches us that when such time arrives, water development must be controlled with the utmost thoroughness. The fluvial civilizations send a warning across the ages that there is a limit to which water development can be pushed without impairing the quality of life. [Emphasis added.]

We must receive that warning, and with it the understanding, will, and capability to deal effectively with crises related to water and related land resources. Our failure to avoid the many problems pointed out by the 1981 *Newsweek* article lies in our long-standing failure to build institutions that are capable of solving the problems and in our lack of willingness (or ability) to reconstruct, re-direct, and support those institutions.

Weaving the chronicle's threads together is the aim of this book: to put water and related land resources in perspective, with all relevant parts identified. Accomplishing that objective will not solve our water problem any more than rain will, however. The ultimate objective of the book is to provide that perspective, but only people will solve the problems of imbalance between populations and resources. The legacy of the past is awaiting all those who wish to build on it, the environment of the present is there if we choose to inform ourselves, and the challenge of the future is staring us in the face. The information for solving these problems is available to us, so are the tools. Our survival may depend on them.

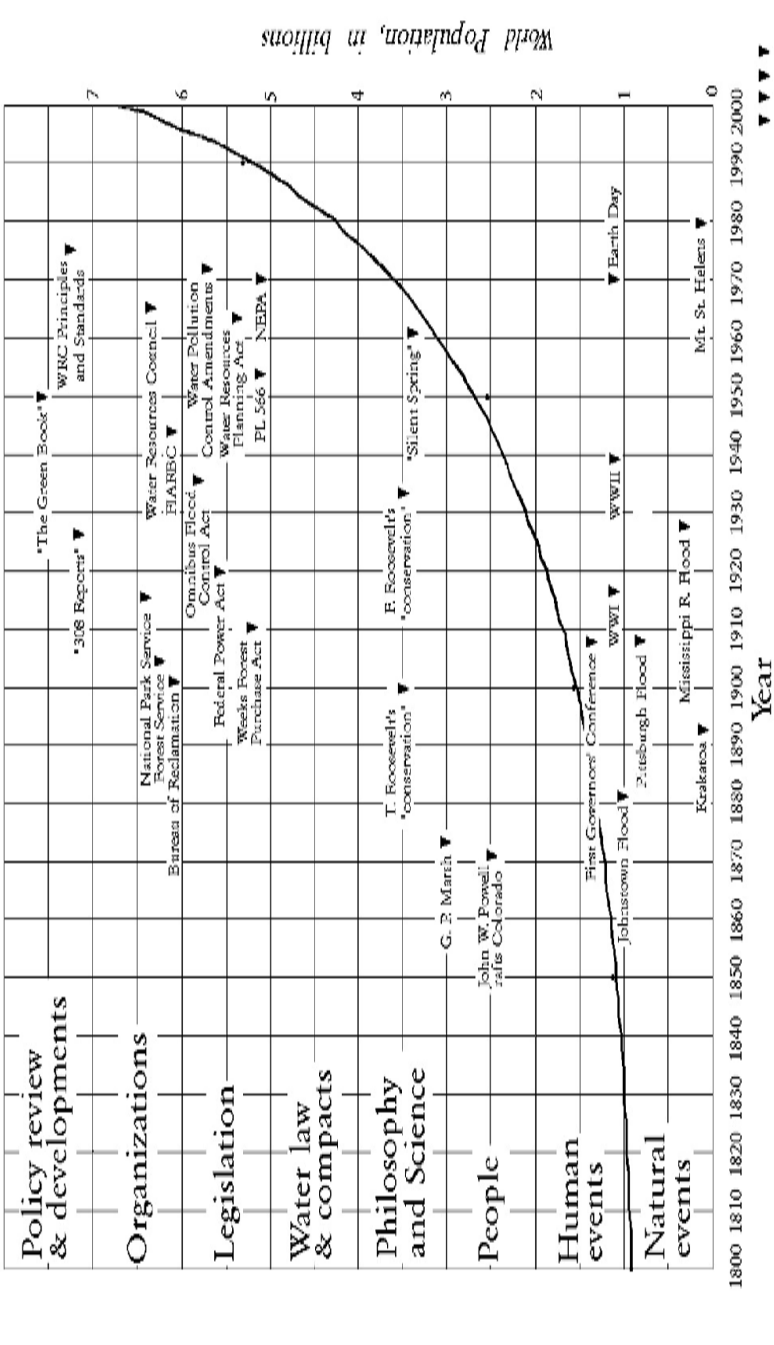

Plate 1 Timeline

Chapter 1

Setting the Stage

Natural and artificial boundaries rarely coincide

Boundaries

The need for complex institutions to manage water and related land resources stems from the fact that natural and artificial boundaries rarely coincide.

Reference to Figure 1.1 shows the major rivers of the U.S. and state boundaries. Only some segments of the Appalachian Mountain state borders and a part of the Idaho-Montana border coincide with minor watershed divides. Figure 1.2 shows, with thickened lines, those portions of state boundaries that coincide with major rivers; there are more in the east than the west. There is also a notable difference in the appearance of the political boundaries between the eastern and western states due to the surveying method used.

In the east, most boundaries were determined by the metes and bounds system, which fits boundaries to local features (trees, boulders, streams, and, when they could be seen through the brush and forest, ridge tops). This practice rarely included bearings or distances when many of the original 13 colonies were surveyed. In more recent years, lines of known length and direction have been substituted as closely as possible for the old surveys, or new surveys have been run with modern equipment. In some areas of the east where boundaries were surveyed by metes and bounds, there are still several places where state boundaries are fixed by

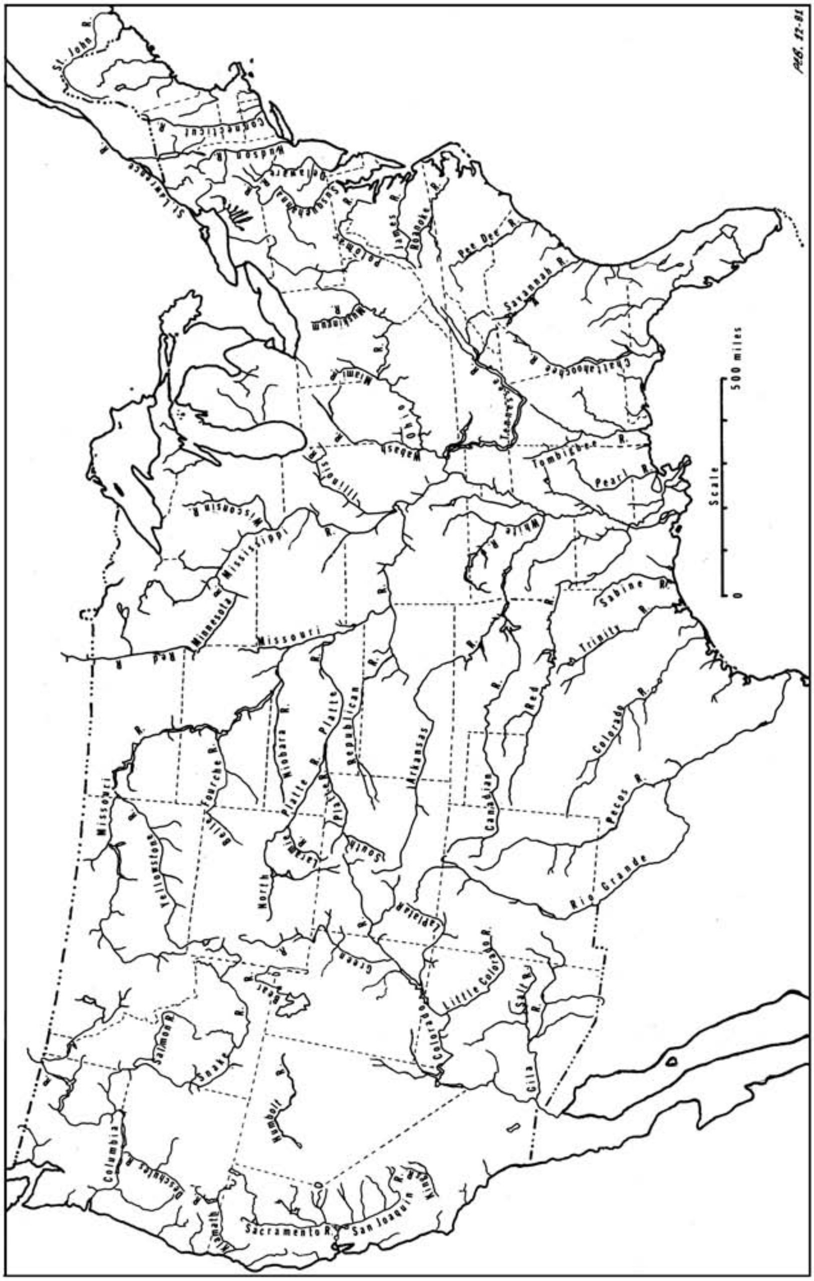

Figure 1.1 State lines and principal rivers of the U.S.

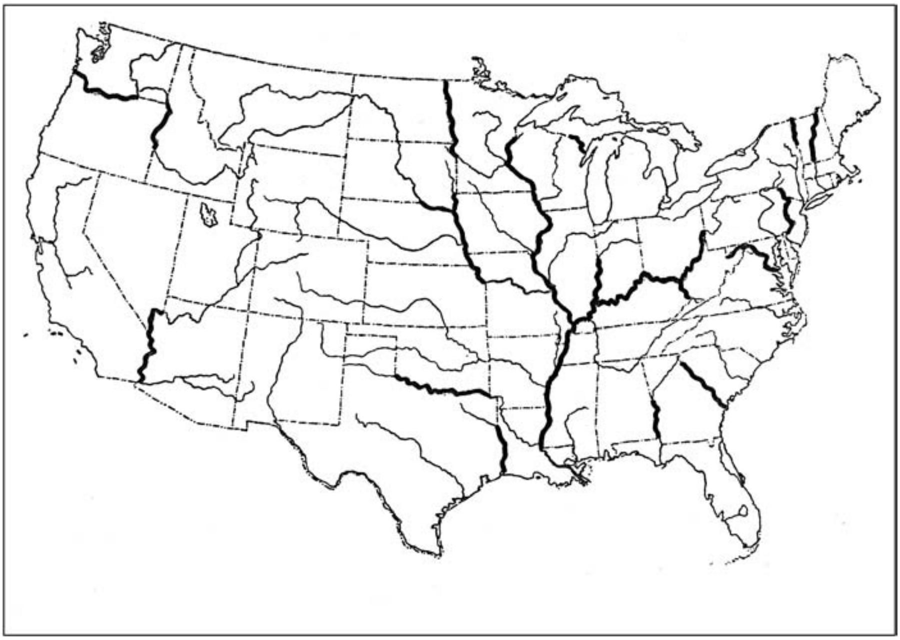

Figure 1.2 Where U.S. rivers serve as state boundaries.

river or stream locations. Very few are fixed by watershed divides. Notable exceptions are the boundaries between West Virginia and Virginia, and between Tennessee and North Carolina. Normally, more local political (county and private) boundaries coincide with natural ones.

West of the Mississippi, where virtually all of the surveying was accomplished with the rectangular General Land Office (GLO) system, political boundaries generally run in cardinal compass directions. Again, parts of some rivers form parts of state lines, for instance the Columbia River, the Red River of the North, the Colorado, and the Arkansas. Drainage basin boundaries, that is, watershed divides, were used even less frequently. Only the boundary between Idaho and Montana is a natural divide and that, allegedly, is the result of an error* made by surveyors who were supposed to mark the state line between the two states along the Continental Divide, which is actually further to the east. The boundaries of California nearly coincide with the natural watershed divides of its major river systems, the San Joaquin and Sacramento River systems of the

* The error, actually, must have been twofold: first, to mistake the Snake/Bitterroot River Divide for the Missouri/Bitterroot River (Continental) Divide; and second, for blazing the line on the way out instead of waiting for the return trip to mark the boundary.

Central Valley, making California the most geographically isolated of the contiguous 48 states. More importantly, California has unilateral control over its major water supply, eliminating the frequent concern that results from the lack of coincidence of natural and political boundaries.

There are three major implications of this lack of coincidence of boundaries. First, virtually all U.S. waterways are interstate streams or tributaries thereof. Only the Sacramento/San Joaquin system, the Hudson, and 13 other river basins about the size of the Hudson or larger (six in Texas, two each in North Carolina and Maine, and one each in Florida, Georgia, and Virginia) are completely intrastate. The Sacramento and San Joaquin in California actually have a small percentage of their drainages in neighboring states; the Hudson has a small area of its watershed in Massachusetts.

Second, with the exceptions of those drainage basins listed and because all streams are interstate, planning efforts for the water and related land resources within a basin become a complex task, usually involving two or more states. This necessitates and provides the opportunity for many different types of institutional arrangements for the management of water and related land resources on a regional basis. Included are such organizations as the Tennessee Valley Authority (TVA), the Connecticut River Watershed Council, the Colorado River Compact Commission, and the Ohio River Sanitary Commission. The different types of regional organizations, their origins, responsibilities, shortcomings, and opportunities are the subjects of Chapter 4.

Third, since most river basins are interstate, those waters fall (at least partially) under the jurisdiction of the federal government. This is because the U.S. Constitution (Article 1, Section 8) reserves the right "to regulate commerce with foreign nations, and among the several states, and with the Indian Tribes" to the federal government. Commerce among the several states was, and in many cases still is, on waterways that flow through several states. The determination of a river's contribution to commerce is simply a test of its navigability; if a stream can float a boat that is capable of being involved in or is actually involved in commerce, the stream is navigable, as are its tributaries and connections (Oakes et al., 1945). The successful test of navigability means that the federal government is now involved in virtually all aspects of water resource management, including the following:

- Regulation of obstructions to navigable waters (chronologically, this came first, owing to concerns over defense and early navigation routes).
- Forest and range management on the headwater lands of navigable rivers and streams that came about following the destruction of

watershed cover during the "cut-out and get-out" practices of the lumber companies in the 19th century, especially in the East and Midwest and later extended to western states.

- Construction and operation of major water management facilities (such as dams to control the navigation and other waterway uses).
- Irrigation of arid lands to aid the settlement and development of the western states and provide food for the eastern states.
- Flood control, needed as the upper watersheds were denuded and as more and more of the population settled in the flood plain where they were vulnerable to inundation.
- Pollution control, the inevitable consequence of affluence and a growing population.

In some cases, the federal government manages water resources by itself. In other cases, it is in competition with the states and/or private development, and, in yet other cases, the federal government functions cooperatively with local and state governmental units. The successful development of partnerships between different levels of government and private interests has dominated the recent past. These arrangements are usually unique for each resource development situation, involving large numbers of stakeholders and a high degree of cooperation. They tend to take a long time, but are usually more satisfactory and less subject to law suits than older strong-arm methods of big government.

Water resource management arrangements at the state and local levels exhibit many of the same effects owing to the lack of coincidence between natural and artificial boundaries. Management of water resources is often a multi-county job, and it is rare that a single county or municipality has complete control over a stream's drainage basin. Consider the hypothetical map of a watershed that is divided among three counties, as illustrated in Figure 1.3. Here, the county seats of Washington and Jefferson Counties are located outside the watershed. That, of course, is where the political clout is found. The seat of government in Madison County is (partly) inside the watershed boundary, and represents the largest population, has the most expensive homes, and, consequently, has the greatest financial resources of the three counties. Furthermore, Washington County, with the lowest population and tax base, is the site of the largest contributor to nonpoint sources of pollution. Which county has the strongest voice in the distribution of funds for BMPs to clean up the pollution from the watershed? Or, to put it another way, with the county seat of Washington County in the adjacent watershed, wouldn't it be more likely for financial resources to be invested in the watershed where the county seat is located? This greatly oversimplified example could be made infinitely more complex. For example:

1. The clout of the representatives from each county to the state government, who have the power to allocate federal funds for implementation of Best Management Practices for control of nonpoint sources of pollution, could be considered.
2. The proximity of the nonpoint source areas to the stream could be changed.
3. The largest nonpoint source area could be in Madison County, which would greatly change the priorities for water quality management on the watershed.
4. The large nonpoint source area of pollution in Washington County might be a golf course and, therefore, be of far greater value to and a playground for the residents of Madison County than a large farm.
5. Town and/or village jurisdictions could be superimposed, and often are.
6. The stream and its watershed could be a sole source aquifer for another urban area downstream.

Such complex situations are the norm, not the exception. The need for free, frank, and informative communication among the numerous stakeholders presents fertile ground for the creation of partnerships for effective watershed management.*

Because some states can control nonnavigable waters or waters that are not used for navigation, there is considerable opportunity for disagreements over what governmental level has jurisdiction over certain water bodies. This has been the subject of numerous court cases, many involving the federal "right" to intervene or regulate. For example, *Avoyelles Sportsmen's League v. Alexander* (1981) was the source of the Environmental Protection Agency's authority to control activities in coastal wetlands that are tributary to the Intracoastal Waterway, a navigation route along the Atlantic and Gulf coasts (National Wetlands Technical Council, 1981). A continuing source of major conflict, especially in the western states, is the question of whether federal or state governments have the right of allocation of water use under the appropriation doctrine. This is of special concern over access to and use of waters that are on lands of the public domain and have not yet been appropriated.

* Some important related, current, and, in some cases, persistent issues that may be affected by this political/geographical problem concern (1) the organization that is paying the district employees (e.g., county or district); (2) whether the reimbursement is coming from federal, state, or county funds; (3) to whom the district employees are responsible; and (4) the extent and seat of liability for malpractice of district employees.

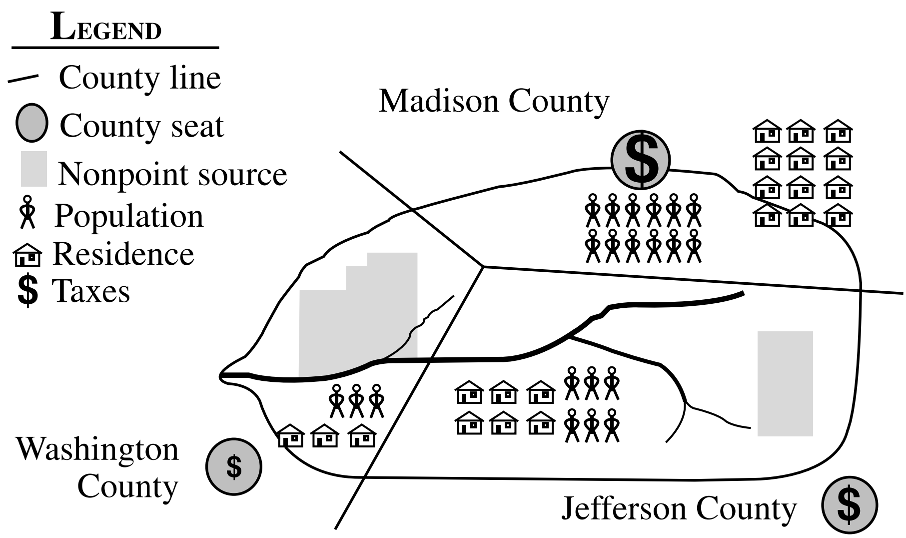

Figure 1.3 Governmental and watershed boundaries. While the locations of the county seats and areas of nonpoint sources of pollution are as shown, the icons representing people and residences are figurative, indicating only the relative demographics of the counties.

On the other hand, the fact that various institutional arrangements are necessary and that the federal government must "intervene" in water and related land resources planning and management is not all bad. First, if a stream is wholly within one state, that state could exercise unusual power over its neighbors and could operate in an institutional (that is, a social, economic, and political) vacuum. For example, if the entire Ohio River were within one state, that state's control over the river might not be in the best interests of downstream states. Lower Mississippi River residents and their governments would be at the mercy of the powerful upstream state and subject to floods and pollution over which they had no control.

Second, local governments often have neither the financial wherewithal nor the technical expertise to plan and effectuate sound water and related land resources schemes. In addition, most of our water and related land resources problems are so complex that an interdisciplinary team approach is essential to provide the expertise and balance necessary to effect sound solutions. Thus, pluralism, so important to our political and social way of life, extends to the management of our water and related land resources because natural and artificial boundaries do not coincide.

Human Needs Antedate Political Boundaries

Historically, there is no reason to expect that political lines should conform to natural ones. The needs of people in early civilizations for food, clothing, shelter from the elements, and protection from marauding tribes, could not be satisfied by a line drawn in the sand or at a river's edge, much less a line drawn by a government. Early civilizations didn't draw boundaries at all, as was the case with most Native Americans who conceived of the land and its resources as commons and not even subject to "ownership" or boundaries. Many tribes were nomadic owing to limited resources or seasonal changes in climate. The opportunity for agriculture — converting from hunters to seed-growers — necessitated the protection of cleared land, crops, and stored surpluses. Indeed, civilization advanced significantly when agriculture placed such demands on the wits of humans (Huntington, 1945).

Eventually, governments evolved that did draw boundaries around populations to protect resources, settlements, and agricultural developments. If a government could not provide the essential role of protection, that government was changed (White, 1961). Consequently, such lines were often based upon the need for defense; thus, a river frequently became a boundary because it was the principal deterrent to pedestrian movement and, in addition, provided an avenue of escape. Less frequently, the land was cleared sufficiently enough to permit humans to see or use a ridge. More often, political boundaries were formed from lines drawn by the passage of explorers, pilgrims, or emigrants; at the edge of a clearing or woods where soil capabilities changed; or from the effects of some geologic event resulting in a surface feature that impeded or encouraged human activity. Water or other resource supplies, protection from persistent winds, sun, or cold, or simply the need to see livestock often provided reason for settlement location. The lines were drawn when the population grew to a size large enough to warrant protection by a government.

The growth of populations has led to serious problems. Some of the problems include increased demands on the water supplies, excessive encroachment on the flood plains requiring more effective flood control, and greater development on the watersheds, which causes more and more rapid runoff. In addition, as populations grow, there is increased use of water and greater pollution, especially when the settlement was too close to — and occasionally — upstream of the water supply. These problems are typical of an urbanized society. Problems of less developed nations include, primarily, water supply and water quality. Often the lesser degree of development is due to the lack of fresh and abundant water (Huntington, 1945), such as in arid countries where water supplies are far from the settlements and are polluted by livestock that share the available supply.

In addition to many complex cultural conditions, the growth of civilization is limited by the ability of one person, usually the wife, to obtain sufficient water for the household. In many of the arid nations of Africa, women must make a multi-mile trip each day, carrying heavy jugs of unpurified water on their heads. In 1980, African women spent an average of 2 1/2 hours per day getting water (National Public Radio, 1985). With so much time and energy spent on merely obtaining water for minimal existence, few resources are left for other pursuits. “Illness and death from waterborne diseases have plagued one country after another,” says Frank (1955). Though rich and poor are affected alike; “the popular indifference toward safe, clean water prevailed well into the 19th century.” It was not until the 19th century that there was widespread acceptance and understanding of the important links between the hydrology, chemistry, and biology of aquatic ecosystems on the one hand and human health on the other. It is ironic that as our civilization becomes more complex and attains a higher level of understanding of the hydrologic environment, we are forced to revert to the conditions of undeveloped civilizations. Thus, as our wells become polluted, both old and new diseases assert themselves and remind us of our vulnerability. That vulnerability is increased by the closer proximity of larger numbers of people, by living in urban environments, and by a greater percentage of the population living and working in enclosed — and therefore artificial — environments or spaces.

The development of civilizations is so critical a problem that it is an integral part of considerations about natural resources. Indeed, resources are defined as things that have utility and scarcity and, by implication, are managed for people. Thus, the distribution and numbers of people are an essential concern of any resource planner.

Population

The population figures are very sobering. In 1985, the worldwide birth rate was 2.7 percent and the death rate was 0.98 percent yielding an annual growth rate of 1.74 percent (down from 1.79 in 1950) (Cohen, 1995). With today’s larger population, however, that rate amounts to a net increase of about 270,000 people per day (*up* substantially from about 190,000 per day in 1985). That increase, nearly 100,000,000 per year, is more than one third of the U.S. population. If those 100 million add to the current demand of 150 gallons per person per day (the amount the average American needs for personal and household uses), the water needed would cover New Jersey to more than 36 inches, that state's average annual precipitation.

The resource base of the population interrelates with per capita income and living space, too (Table 1.1) from the sources indicated. The contrasts are exacerbated by the present population of the three countries shown. It is even more sobering to examine the projected future characteristics of populations and land resources. Table 1.1 shows data from the work of the Leonardo Scholars (1975) and the *Statistical Abstract of the United States 1980* (Bureau of the Census). Even without adjusting for that percentage of the total land that is arable, the figures show significant contrasts. The incredible poverty of underdeveloped countries and the demands that their large numbers are going to place on the world's resources demand our attention. At the present time, the approximately 6 percent of the world's population that may be called "developed" utilizes an estimated 30 percent of the world's resources. While a great reserve of resources remains, to ignore maldistribution of populations and resources is a grave mistake. The figures are, in all likelihood (assuming that such measurements could be made), similar for the percentage of pollution caused.

Table 1.1 Population Growth Rates, Doubling Times, and Per Capita Incomes

	Nation		
Characteristic	*Japan*	*U.S.*	*India*
Growth rate (%)	1.0	1.4	2.5
Doubling time (yrs)	70	50	28
1968 population (millions)	115.9	220.3	667.3
Land area (millions of mi^2)	0.14	3.63	1.23
Density (number/mi^2)	805	61	542
Income per capita in 1968	$1,190	$3,980	$100
Income per capita in 2000	$23,000	$11,000	$140
Estimated population in 2000 (millions)	200	400	1,000

Source: Leonardo Scholars (1975) and Bureau of the Census (1980).

It took about 5 billion years for the Earth's population to reach one billion individuals, at around 1840. It took less than a 100 years to produce the second billion, 30 to produce the third billion, about 15 to produce the fourth billion, and about the same for the fifth billion. The growth of the overall human population may finally be slowing somewhat. If all 6 billion people currently on Earth used water at the same rate as U.S. citizens (about 2000 gallons per person per day, including commercial and industrial ones), there would still be enough fresh water on the planet, especially with recycling of the supply. But the water would not be where we wanted it nor in the condition needed for human consumption, as is often the case even now. And our rate of use would certainly stress the world supply if all 6 billion human beings used as much as U.S. citizens do.

Earth's water is poorly distributed in time and space with regard to the people who need it. In Joel Cohen's (1995) treatise "How Many People can the Earth Support?," only one of his 18 chapters focuses on a resource with the purpose of helping to answer the title's question. That resource is water. Estimating a population carrying capacity based on water is not a simple task. The factors that influence the amount of available fresh water on the planet include the amount of energy available for photosynthesis, the amount of water necessary to grow wheat, and the human intake of calories. Considering all of those influencing factors, Cohen estimates that the Earth could support far more people than we would likely be comfortable with. He also points out that there are necessary uses of water in addition to growing crops. He correctly asserts that "how many people the Earth's renewable water supply can support at a given level of well-being cannot be calculated without knowing how much water is required to maintain viable ecosystems …". Black (1994) confirms that we need the beneficial buffering of many resources (air, water, carbon, oxygen, and space) in order to maintain our environment in a livable condition. This is in addition to the relatively small percentage of the resource needed in order for the individual to survive. The buffering value of the vast amounts of Earth's water needs to be assessed and provided for in policies that address population demands.

What will be the local, state or province, regional, national, and global balance of power in the next millennium? Will we really be capable of supporting the anticipated population at the level to which we have become accustomed? Will we have to lower our standards of living? Do we really expect that the world's starving peoples will sit patiently by while we affluent peoples lackadaisically, even if altruistically, reduce our consumption of the world's resources? Can the areas of the Earth where water is in critically short supply resolve international boundaries? Water rights? Will we have to go to war to defend what we have, what we want? Can we justify our current rate of resource usage? Can we tell the world's starving peoples that we are managing our resources effectively and efficiently? Are we? How do we manage our resources in the face of this data? How do we assist underdeveloped nations in effectively managing their resources?

Along the way to discovering the answers to these and related questions, "we have to ask to what degree social conflict in the United States has been mitigated by the past high level of material consumption? Could a *poor* United States have put an end to slavery? Could a *poor* United States have developed a widespread system of secondary and higher education? Could a *poor* United States have avoided severe battles between the working classes and their employees?" (Leonardo Scholars, 1975). One might add, "Can the world afford to let rapidly growing populations have the luxury of educating themselves, as we have been able to do?" Is it even possible?

This book does not presume to answer these questions, but not to raise them is irresponsible. Thus, while resource problems cannot be examined in a vacuum, neither can all the problems be resolved at once. They are too complex and their solution requires expert input from a wide variety of specialists and the public.

In 1798, Malthus noted that the population growth rate was increasing at a greater rate than the food supply. He failed to reckon with the Industrial Revolution, however, which resulted in hundred-fold increases in farm productivity through technological innovation and the application of scientific knowledge and new, efficient management practices. We now support hundreds more people per acre than we did in earlier times. Consequently, our farm population dwindles while urban and suburban populations grow. With this shift in population location and a changing life style that, in many cases, requires more water per capita, attendant problems of resource management are intensified. This dual shift plays an important role in the management of soil and water resources.

In contrast to Malthus and many other futurist writers in the early part of this century, Harrison Brown (1954) wrote optimistically that it is within the capacity of man's intelligence to find the solutions to critical resource problems. There are, however, serious concerns over the Earth's capacity to support the projected population, as the *Global 2000* report (Council on Environmental Quality and U.S. Department of State, 1980) indicates. How to deal with such problems is a major source of controversy, as is the data upon which the problems are based. In any event, we have less time to make major policy changes. Toffler (1970) has pointed out that we no longer have the luxury of a generation (40 years) in which to adjust to a new idea. He adds that the tremendous amount of new information now available may be more than we can handle. It should be noted, therefore, that many of our current water and related land resources problems are not going to be quickly resolved. First, the problems are complex and not readily discerned. Second, their chemical, biological, and physical nature (the intricate interrelationships of the many parts of aquatic ecosystems) eludes even our most capable researchers. Third, the reality of repairing the environment is that more time may be required than that which we are accustomed to having available to make the necessary decisions.

If we are to cope with the controversial, difficult, and complex problems associated with population control, we must work with institutions available to do the job. These institutions, many of which are inadvertently (and in many cases, unknowingly) involved with "the population problem," are found at different levels of government within the U.S., with a variety of structures, functions, responsibilities, and authorities. Many came to be what they are by historical happenstance, others by design.

From Antiquity to 1900

Water and related land resources played an important role in the growth of civilizations, a point already indicated as of importance to boundaries. In addition, Huntington (1945) cites examples of interactions between environmental conditions and civilization. These include unique characteristics of water such as the fact that it is most dense at 4°C, that water may be found naturally in liquid, solid, and vapor phases, that the range of water maintains a rather uniform temperature, and so on. In addition, annual rainfall distribution is important in providing crops and irrigation, and in buffering energy, chemicals, and gases in the atmosphere.

Michener's *The Source* (1965) provides an excellent example of how access to water might have influenced early settlements and affected the course of history. Family customs, locations of wells, agriculture, and intertribal relations were all affected by the relation of humans to water and related land resources. For example, geometry was developed in the delta of the Nile River in order to facilitate the relocation of land boundaries following the annual flooding (Biswas, 1970). Hammurabi, in 1750 B.C., established an elaborate legal system to deal with water supplies and an irrigation network for Babylonia and Sumeria. The enumeration of individual responsibilities, labor contributions, and taxes formed the basis of orderly relationships with those controlling sources of water (Biswas, 1970). The empire's downfall was assured when the invading Mongols destroyed the irrigation works.

Yet, it wasn't until 647 A.D. that the Nile was first gauged and people began to have some understanding of — and consequently began to manage — the quantities of water available. The Egyptians devised an elaborate system of river management schemes and learned how to live with its annual floods. A dam had been built around 2900 B.C., unfortunately without a spillway,* and was washed out (Jansen, 1980). Various types of water development projects were built, including some very sophisticated dams and aqueducts still in service (Biswas, 1970; Jansen, 1980).

* A passage designed to handle excess flows on, through, or around a dam.

During the Renaissance and the Industrial Revolution, two important developments necessitated clarification of the basic relationships between people and natural resources. First, exploration, including circumnavigation of the globe, resulted in the conclusion that the Earth's resources are limited. Second, scientists described the hydrologic cycle and related phenomena, yielding information on how much water was likely to be available. Knowledge of the hydrologic cycle certainly existed long before the Industrial Revolution, but was known only to a few. The essence of the hydrologic cycle is contained in Ecclesiastes, for example, in "the rivers run unto the sea, yet the sea is not full." Leonardo Da Vinci also comprehended the hydrologic cycle, and Bernard Palissy (16th century) wrote his observations in French, which was not then considered an appropriate language for science (Biswas, 1970). It was not until 1674, when Pierre Perrault, the father of modern hydrology, published *The Origins of Springs*, that the basic flow of water between Earth and atmosphere was generally set forth. The observations made by Perrault included measurements of the amount of precipitation on the watershed of the Seine River. He reported that precipitation volume was six times the amount of runoff at the mouth of the watershed. In other words, there was ample water in precipitation to sustain river flow (previously it had been believed that hydrostatic pressure maintained springs and linkage between the oceans and rivers). For the first time, a realistic, quantifiable, and acceptable model of the hydrologic cycle emerged.

In the U.S., exploration also identified the limits of resources concurrently with Perrault's and others' discoveries. A primary activity of exploration involved clearing land as well as establishing defenses and trade routes, often linked by virtue of the fact that travel was most efficient by, and sometimes limited to, water. Thus, water played an important role in the early history of the nation, especially in defense and commerce. As the Industrial Revolution progressed, water was needed for energy as well. Thus, development of cities along the East Coast Fall Line (where the Piedmont drops down to the Coastal Plain) attests to dependence upon water. The location of settlements along the Fall Line reflects the strong impetus of industrialization. Commerce could often not progress beyond the falls, and the falls provided energy. Commerce was extended initially by portage and later by the construction of locks — and dams to control the water levels in them — and canals. An important corollary to this development relates to the attitudes toward water and the laws controlling access and use that are different from those of our ancestor settlers' countries of origin.

The settlement of the continent was hastened by conquests and acquisitions, most notable of which was the Louisiana Purchase from France in 1803 by Thomas Jefferson. His view at the time was that the area would not be settled for a thousand years (Kline, 1997), which attests to his thoughts of settlement by an agrarian populace as well as by an inaccurate estimate of the inertia already established by the Industrial Revolution. Exploration and settlement was speeded by the U.S. government policy that sought to get as much of the land into private ownership as quickly as possible to control the frontier, subdue the Indians, and provide an economic base for the growing nation. Various pieces of legislation, commencing with the 1862 Homestead Act that provided 160 acres to individuals and 320 acres to couples, fed the growing population and industry with free land. Subsequently, the Railroad Grant Acts, and the Timber and Stone and the Timber Culture Acts provided a variety of programs under which additional public domain lands were transferred into private ownership. The railroad grants, in particular, led to some very complex management problems caused by the vast checkerboard ownership patterns that stretched for 20 miles on each side of the railroad rights of way. The grants of land provided incentives to the railroad backers, as well as a source of railroad ties, fill, and trestle construction materials.

Near the end of the 19th century, many important individuals influenced the development of resources management. John Wesley Powell was the first man to successfully navigate the length of the Colorado River in 1870 (Powell, 1961; Porter, 1969). Powell recommended careful management of the water and related land resources of the arid* western states, as well as the creation of government organizations to carry out the needed work (Sibley, 1977). His 1878 Report on the Lands of the Arid Region of the United States included recommendations concerning irrigation agriculture, specifying minimum size of family farms, and that state boundaries in the west should follow watershed boundaries (McClurg, 1999). The Bureau of Reclamation and the Geological Survey, which he directed, are today major organizations in water development as a direct result of the innovative and energetic spirit of this important figure. Powell, and many others who influenced our current resource management programs, published reports, autobiographies, and books on their explorations, frustrations, successes, and failures in a political arena that was often far from the natural world they so longed to protect. Communication was slow, so that word of their discoveries or ideas took a long time to reach the public. In the late 19th century, George P. Marsh (1874), among others, published important works dealing with forest and related resources and the impact of man's activities on natural resources, respectively. Gifford Pinchot, Theodore Roosevelt, and John Muir, pioneers in conservation and preservation, were involved in the milestone battle over the Hetch-Hetchy Valley. This dispute (described in the next section) was

* "Arid" refers to less than 20 inches of precipitation per year.

a precursor to a host of complex battles over the basic nature of the conservation of natural resources.

The need for attention to natural resources was augmented by natural disasters that occurred from a combination of mismanagement, abuse of forest (and other) resources, natural storms, snowmelt runoff, earthquakes, and other natural phenomena. The Johnstown flood of 1881, in which 2,100 people perished, was caused by heavy rains following extensive forest cutting and augmented by a dam failure. The Pittsburgh flood of 1907, which caused an estimated $8 million in damage, was caused by excessive precipitation exacerbated by denuded watersheds of the Monongahela and Allegheny Rivers in Pennsylvania. Similar accelerated erosion, siltation of reservoirs, and extensive forest fires in the Midwest and West finally convinced enough people that efforts should be taken to prevent further damage and to restore abused lands and resources. With an ardent conservationist in the White House, the conservation era had begun.

The Conservation Era, 1900–1960

The purpose of this section is simply to summarize the character of the period, along with a summary of the principal forces and trends that shaped present conditions. The events are tied to natural and institutional changes. Some of these were uncontrollable disasters, while others were intentionally constructive. The principal forces include the growth of the population, the westward movement, war, the development of hydroelectric power, the reaching of limits to growth, and the increasingly complex regulations promulgated by (especially) the federal government. Not all of the individuals involved in the periods' history can be named, but several stand out, some of whom have already been identified. The towering conservationist at the turn of the century was President Theodore Roosevelt. His brand of conservation included big game hunting and collection of specimens that today we might call "trophies." However, many of his collections were gifts to museums, especially the American Museum of Natural History in New York City, where the Roosevelt Rotunda pays tribute to the environmental awareness that this explorer awoke and continues to instill in his fellow citizens.

Principal trends during this period include the public's changing attitudes with regard to the role of government in resource management as well as changing attitudes toward government itself; the urbanization of the population; and the growth of a professional cadre to administer natural resources. Growing "environmental awareness," recognition and monitoring of water and air pollution on an unprecedented scale, and serious concerns with human health were only just arising at this time and did not become major forces until the 1960s. In fact, many of the sciences were just becoming respectable disciplines in their own right, based on accepted principles, data collection, and discovery.

Coming out of a period in which federal policy had the dual conflicting goals of disposal and preservation, Washington was ill-equipped to manage the resources on those lands. In 1902, the Bureau of Reclamation (BR) (originally the Reclamation Service, also known for a brief time as the Water and Power Resources Service) had been created in the Department of the Interior upon passage of the Newlands Reclamation Act. The purpose of the BR was, and still is, to bring water to arid lands, but it played an important role in the disposal of the public domain lands. It did so by providing viable farmsteads to settlers over and above those described above under the Homestead Act and related legislation. Disposal was directed largely into private and corporate ownership of the public domain lands west of the Mississippi River.

Preservation was limited to certain lands that were seen either to be of value to future generations or of no interest to anyone — they remained under government jurisdiction by default. Preservation in the form of federal park and forestlands had begun in 1872 with Yellowstone Park (Yosemite had been set aside earlier, but as state land) and continued in 1891 with the Forest Reserves. The Forest Reserves were under the jurisdiction of the Department of Agriculture, but the Bureau of Forestry, which was supposed to manage them, was out of effective management range in the Department of the Interior. First Chief Forester Gifford Pinchot, Agriculture Secretary James Wilson, and President Roosevelt engineered the move of the Bureau of Forestry, renamed the Forest Service, to the Department of Agriculture in 1905 (Dana, 1956). The purpose of the Forest Service was identified in the famous letter of instructions from Wilson to Pinchot that was drafted by the recipient. The goal was to manage all resources of the National Forest lands "for the greatest good for the greatest number in the longest run." This early definition of conservation may have sounded good, but it is a physical impossibility.

The magnitude of the conservation job was not apparent at the time, thus, the President called for the first governors' conference in 1908, the reported start of the conservation movement (Ackerman, 1976). It focused on conducting an inventory of natural resources that was made available in 1909, but with which nothing was done as William Howard Taft became President (Coyle, 1957). This was the first of many such inventories of natural resources.

Concurrent with this and many other events, the Weather Service and the Forest Service commenced studies near Wagon Wheel Gap in Colorado examining the effects of forest cutting on climate. Fortunately, this included gauging streams where runoff was found to increase, although no effect of forest cutting on precipitation was detected.* The final but inconclusive results were not published until much later (Bates and Henry, 1928), and early prognostications were combined with the work of others (e.g., Church, 1912). Nevertheless, the observations of the effects of denudation on floods (Marsh, 1874) clearly suggested that control over forests meant control over the water draining from them (Dana, 1956). Thus, the basis for reserving (and returning by abandonment and/or purchase) forest lands for management by the federal government in the East was legislated and made constitutional by the word "navigation," which provided the necessary legal linkage to the Commerce Clause of the Constitution (Article 1, Section 8). This initial linkage between water and related land resources was accomplished by the Weeks Forest Purchase Act of 1911. Specifically, the primary purpose of the Weeks Act was "the purchase of forest lands necessary to the protection of the flow of navigable streams." The act provided funds and a commission to carry out its primary provisions, and it also started a cooperative fire prevention program that was to be expanded later to the western states. Another important provision of the Weeks Act was that it authorized the enactment of interstate compacts for the conservation of forests and water supplies, discussed in Chapter 2.

The first major confrontation over divergent concepts of the meaning of the word "conservation" occurred soon after the turn of the century between John Muir and Gifford Pinchot. Muir, the naturalist, sought to preserve a portion of the High Sierras as a park. This section, known as Hetch-Hetchy, is a valley adjacent to and every bit as spectacular as the Yosemite Valley. Pinchot sided with those who wished to see the valley dammed for a water supply for the city of San Francisco. That city had recently suffered a disastrous earthquake and fire, and new and old settlers alike needed to be reassured that theirs was a fire-safe city with ample water for domestic, municipal, and fire-fighting purposes.**

Both men claimed to be "conservationists." Pinchot had in fact coined the word "conservation" in 1907 to apply to the use of natural resources (Coyle, 1957). As an advisor to President Theodore Roosevelt and first head of the Forest Service, Pinchot commanded considerable political clout and, with the impetus of San Francisco's recent disaster and the favorable view of the exploitation that accompanied industrialization, the "wise use" conservationists prevailed. (The wise use conservationists believed in a "constant and sufficient supply of natural resources for

* Local forest cutting does have an effect on the microclimate, and widespread changes in forest conditions may indeed have an effect on broader climatic and weather conditions.

** While the fire was caused by the uncontrollable earthquake hazard, the San Francisco Chamber of Commerce sought to focus attention on the fire, for which a first class water supply would allay the concerns of residents and businesses alike.

human use" (Pinchot, 1947).) Consequently, in 1916 the National Park Service was created in the Department of the Interior. It was created with the purpose of accumulating and controlling the nation's treasured outdoor resources. The concept of conservation is thus attributed to Theodore Roosevelt's administration and leadership. It is noteworthy that the word *conservation* has the same root as "conservative" which, in the 19th century, was associated with the Republican Party to which Theodore Roosevelt belonged. But the word conservation is also associated with the administration of Franklin D. Roosevelt, a Democrat who furthered and exploited the concept of conservation by creating federal agencies in order to pull the nation out of the Great Depression. By then, the meaning of the word had changed, leaning more toward the concept of saving.

Lands administered by the National Park Service (NPS) total about 71 million acres (about 3 percent of the total U.S. area) and Forest Service (FS) lands total approximately 181 million acres (about 8 percent of the total U.S. area). Of particular significance for this 11 percent is the fact that the acreage is generally high water yielding, often producing as much as 3 or more acre-feet* per acre per year. These lands were secured for their mountainous terrain and glaciers, or they were residual lands that also were steep, of high elevation, economically unsuitable for agriculture, and undesirable for development. The extensive, high-forested lands receive disproportionately high precipitation, and snow packs often exceed 20 feet or more. Much of the nation's runoff comes from this relatively small percentage of the total land area.

The FS is especially charged with the responsibility of maintaining appropriate conditions for needed water supplies. In fact, many municipalities and numerous irrigation districts rely directly upon FS lands for runoff. Parks that include high water yielding lands are Glacier, Grand Teton, Great Smoky Mountain, Olympic, Rocky Mountain, Sequoia, Shenandoah, Yellowstone, and Yosemite. These total only 10,300 square miles or 0.28 percent of the total U.S. area. But these parks are usually surrounded by Forest Service or Bureau of Land Management (BLM) lands as well. As a consequence, all three agencies are involved in major soil and water conservation programs. In addition, many of the other parks are set aside because they contain scenic water and related land resources or examples of erosion. Moreover, many of the recreation areas administered by the NPS are, for the most part, located around reservoirs impounded by dams built by the BR. Water bodies similarly are surrounded by many state, county, and local parks and forests as well.

* An acre-foot is a unit of water volume defined as an acre covered by one foot of water, equal to 43,560 cubic feet, or about 325,800 gallons.

The development and use of electric energy sources grew rapidly in the early part of the 19th century. One of the major early sources of electricity was hydropower, which must be produced at or near the source of the falling water, or "head." One of the attractive opportunities for early BR dams was the possibility of including hydroelectric generating capacity, which would add to the revenue potential of the facility, thus helping to pay for the high cost of construction. Because dam construction was largely a federal activity (smaller dams had been and still are built by private power companies), and because dams interfered with navigation, various interests coalesced by 1920 and were instrumental in increasing government regulation in the form of the Federal Power Act. This act created the Federal Power Commission (FPC), authorized to grant 50-year licenses for private power development, and also reserve certain dam sites for later development by the government. The relatively recent adoption of such an efficient, quiet, and useful "servant" as electrical energy was very successful, and has resulted in practically everyone taking it for granted. Yet it was only in 1879, in Cleveland, that the first lighting for public use was installed (Bouman, 1983). Electricity changed our way of life, from the improvement of waste-disposal practices to the development of private power companies and their water conservation battles with the federal government and, ultimately, the environmentalists.

In 1924, the provisions of the Weeks Act were extended by the Clarke-McNary Act to include the western states. The Act also greatly expanded the cooperative forest fire prevention program and started the State and Private Branch of the Forest Service. This branch coordinates water and related land resources management programs at several governmental levels and is now a major partner in soil and water conservation activities on nonfederal lands.

As the federal government grew in response to President Franklin D. Roosevelt's attempts to pull the economy out of the Depression (Holmes, 1972), soil and water received special attention. This was partly because of the President's own conservation priorities and, in large part, because of the severe drought and many floods that occurred during this period. Roosevelt's Hyde Park estate on the Hudson River and nearby Dutchess County lands were the object of much of his interests in conservation, especially reforestation. Catastrophic floods on the Mississippi River in 1928 and the completion of initial surveys of flood control potential, published as House Document 308 in 1927 (the "308 Reports"), resulted in the first major flood control effort by the Corps of Engineers (COE). Most of the flood control effort, however, was project-oriented with no overall river basin plans until, on Saint Patrick's Day in 1936, major flooding occurred on the Susquehanna River. This helped prompt passage of the 1936 Omnibus Flood Control Act, another milestone in the history of legislation dealing with water and related land resources. It was the beginning of a nation-wide flood control program (Leopold and Maddock, 1954). This act was the first major *comprehensive* flood control act (omnibus flood control or public works project bills have been acted upon by Congress almost every year until recently). It was the first piece of legislation to recognize the need for consideration of the watershed* as the basis for flood control; it assigned responsibility for downstream flood control to the COE, and upstream flood prevention and control to the Soil Conservation Service (SCS). Since the latter organization had only recently been established (1933), it was not equipped to forge ahead with the same degree of effectiveness as was the COE, which had a long history of experience with both engineering works and congressional politics. The act, in addition to authorizing numerous projects around the nation, also initiated Benefit-Cost Analysis, although it was not explicitly identified by that name.

In response to its 1902 mandate, the Bureau of Reclamation (BR) was constructing dams for irrigation on the Missouri River, gradually working its way *downstream*. Concurrently, and in response to its mandate in the 1936 Omnibus Flood Control Act, the Corps of Engineers was working its way *upstream*, building levees and dams for control of floods on the lower Mississippi River. As the two agencies approached each other, warnings flew from Congress to the effect that the BR and COE had better work out the details of how the projects were to be divided. Born of the necessity to coordinate agency actions on an informal basis, the Federal Inter-Agency River Basin Committee (known as FIARBC or "Firebrick") came into existence in 1943. FIARBC's creation was also a response to the failure of Congress and the President to achieve permanent standing for the National Resources Planning Board (Holmes, 1972). As an informal or unofficial organization, FIARBC is not mentioned in the government organization manuals, yet it is the forerunner of the Water Resources Council (see planning in Chapter 3). FIREBRICK's members were the heads of the primary water management agencies of the federal government. These included the leaders of the Federal Power Commission and the Departments of Agriculture, Interior, Labor, and War. Those individuals represented — or sometimes were represented by — the heads of the Forest Service, Soil Conservation Service, Geological Survey, National Park Service, Fish and Wildlife Service; the Corps of Engineers; and the Public Health Service. The group's attempts to coordinate activities on the Missouri River failed to satisfy Congress, which legislated the legendary and highly controversial "shotgun marriage" of the Corps and the Bureau. This

* A watershed is the natural unit of land on which precipitation is collected to run off at a common outlet.

union is also referred to as "The Pick-Sloan Plan" in the 1944 Omnibus Flood Control Act, the name having been derived from the heads of the respective agencies at the time. The word "plan" is rather presumptuous, though, considering that the legislation is an amalgamation of the individual agency's proposals, not an attempt to define and attain goals and then delegate responsibilities to bring them about.

The 1944 Omnibus Flood Control Act also reinforced the role of the SCS in watershed protection and flood prevention, which that agency was now more capable of handling than it had been in the 1930s. By then it had 10 years of experience with defining and evaluating practices such as contour furrowing, strip cropping, range pitting, and terracing. These practices were rapidly accepted and incorporated into farming and range management methods and used for rehabilitation (Bennett, 1955).

In 1949, the Hoover Commission, appointed by President Truman to examine the organization of the federal government in general, recommended combination of several of the resource-managing agencies under one roof. However, too many well-entrenched, vested interests precluded that from ever happening. One move in that direction was accomplished by President Nixon who, in Reorganization Plan 3 of 1970, combined portions of those agencies then responsible for a wide variety of water and related land resources programs and regulatory functions into the Environmental Protection Agency (EPA). In Reorganization Plan 4 of 1970, he further combined the National Weather Service (NWS) with other agencies to form the National Oceanic and Atmospheric Administration (NOAA). Both the EPA and NOAA are of particular importance in the conservation of water and related land resources, and both are discussed in greater detail in Chapter 3. A second, more ambitious move toward agency combination into a department of natural resources occurred during the Carter administration, but failed at the last minute because of opposition, allegedly, by the Forest Service.

Two important developments in 1950 related to inventory and Benefit-Cost Analysis (BCA). The President's Water Resources Policy Commission, also known as the Cooke Commission, issued the first of its three reports (Dana, 1956), which brought attention to the nation's growing water problems and provided a focus for discussion. Recognizing the urban population shift and the attendant changes in demands on the water resources of the nation, the Commission recommended a variety of institutional changes and innovations in order to deal effectively with the future (Holmes, 1972). These included a single Department of Natural Resources (as the Hoover Commission had recommended), river basin commissions (not to come into existence until 1965), and basin-wide programming of water development schemes. According to Holmes (1972), "no new legislation was introduced following this report, but [it] is reported to have inspired the Bureau of the Budget Circular A-47."

Circular A-47 enforced the 1950 document known as "The Green Book" (Subcommittee on Benefits and Costs 1950), formally titled *Proposed Practices for the Economic Analysis of River Basin Projects*.* The document was the first attempt at standardization of evaluation procedures that were an amplification of the broad and necessarily vague economic statement** in the Omnibus Flood Control Act (of 1936). A great deal of experience with the proposed practices, however, did not occur since President Eisenhower's approach to inflation had been to cut down on government spending, which was ramified in his "No New Starts" policy. Thus, only a handful of projects were actually evaluated according to the recommendations/guidelines in *The Green Book*. Nevertheless, both the Cooke Commission reports and the Green Book were important steps in the water and related land resources history of the nation.

Another important milestone in both water and related land resources activities and in the general development of environmental protection, was the enactment in 1946 of the Fish and Wildlife Coordination Act (FWCA). The act, which called for mere reporting of project plans by a sponsoring agency to the Fish and Wildlife Service, was strengthened by an amendment in 1958 (it is discussed in greater detail in association with the Fish and Wildlife Service in Chapter 3). The idea of notification about a proposed action, and awaiting and commenting on responses thereto, was officially incorporated in the environmental impact statement process that was embodied in the National Environmental Policy Act of 1970. The process was embedded in the guidelines and regulations generated by the Council on Environmental Quality that was also created by the act.

The Watershed Protection and Flood Prevention Act of 1954 (more generally known as "PL 566") reenforced the role of the Soil Conservation Service (SCS) in upstream flood prevention and control. It was the initial step in a long-term and continuing trend that shifted responsibility for conservation programs from the federal government to local governments and interests (Brown, 1955). Prior to PL 566, the federal government had usually borne 100 percent of the flood control costs (Leopold and Maddock, 1954; Heft, 1984). PL 566 also required local interests to provide the initiative for the project and to bear the costs of rights-of-way and maintenance (the beginnings of "cost-sharing"). This was a fully appropriate policy, since the primary benefactors of PL 566 projects were the local land owners, usually farmers, whose crops and income levels

* The long title prompted the more cryptic version.

** The statement reads, "… if the benefits to whomsoever they may accrue are in excess of the estimated costs."

improved as a result of the improved flood control, as did the general welfare of the communities in which they lived. The shift also was part of a larger, continuing conflict between ecologists' and engineers' approaches to flood control. Engineers had held sway in the nearly two decades between the 1936 Omnibus Flood Control Act and PL 566 in 1954 (Leopold and Maddock, 1954), but the pendulum now began to swing toward a more effective balancing of the two approaches.

If any single event closed the conservation era insofar as water and related land resources are concerned, it was the Senate Select Committee on National Water Resources.* This committee was created in April 1959 and was led by Public Works Committee Chair, Senator Robert S. Kerr of Oklahoma. The Senate Select Committee held 23 hearings around the nation (rather than calling everyone to Washington to testify) and issued its reports in January 1961 (Holmes, 1979b). It grew out of the growing public concern over the continuing conflict between President Eisenhower's No New Starts policy and the desire of Congress to maintain the pork barrel.** In fact, much of the controversy over water and related land resources conservation is ramified in, and often exacerbated by, the constitutionally derived struggle for power between the executive and legislative branches. Responding to several calls for water policy reform to management of both water supplies and quality in this instance, the Senate Select Committee made the following recommendation:

> The Federal Government, in cooperation with the States, should prepare and keep up to date plans for comprehensive water development and management for all major river basins of the United States (Senate Select Committee on National Water Resources, 1961).

The reports themselves were comprehensive, dealing with all conceivable water and related land resources programs, problems, and opportunities. The reports also covered different levels of government and interrelationships between government and private activities. The committee's call for comprehensiveness in water and related land resources planning in the reports shared the spotlight with four concurrent and related events:

1. The expansion of the Space Age, ushering in a new view of the planet and its limited resources.

* It is this organization that first used the phrase "water and related land resources" used throughout this book.

** "Government appropriations for political patronage" (Webster's Dictionary). See Chapters 7 and 8 for discussion.

2. The return of a Democrat to the White House with, presumably, a return to more federal spending.
3. A politically, economically, and ecologically controversial conflict, Vietnam, that wreaked havoc with public attitudes toward government.
4. The publication of *Silent Spring* by Rachel Carson (1962), the book that started the sensitization of the American public to the use of DDT and other chemicals, and eventually ushered in Earth Day and the Environmental Movement.

It was, indeed, a new awakening.

A New Awakening

This period lasted a scant 10 years. By the time the 1960s were over, the public had a better base of information and better and more effective means to participate in those governmental processes that involved environmental decision making. The 1960s were a decade of great turmoil in the U.S., including assassinations, undeclared war, the growth of ethnic group pride and strength, urban riots, and legal and political struggles of epic proportions over environmental issues. Many factors provided the lay public with the information and tools necessary to play a role in decisions about water and related land resources. The factors included:

1. The growth of environmental problems.
2. The observance of Earth Day (April 22, 1970) and similar events.
3. The views from orbiting satellites.
4. The defoliation in Vietnam.
5. The arrival of realistic and reliable color television with which to see all of the foregoing developments.
6. The genuine interest in involving the public on the part of some government officials and scientists.

Not all the participation was constructive, however. Given new legal means to enter the decision-making process, special-interest and (alleged) public-interest groups blocked developments of all types for a variety of causes and purposes. Foremost among those legal means was the National Environmental Policy Act of 1969 (NEPA), the law that formalized the environmental impact statement (EIS) process (Black, 1981).

Several important pieces of legislation flowed from the recommendations of the Senate Select Committee during the decade. The first was a 1961 proposal for a Water Resources Planning Act (WRPA), which was not adopted until 1965 (See Appendix B). In the meantime, President Kennedy had created the *ad hoc* (or President's) Water Resources Council to accomplish certain goals in the intervening 4 years, including revision of the Green Book (Holmes, 1972). The WRPA created the statutory WRC, provided for river basin (Title II) commissions (cf. the quoted recommendation of the Senate Select Committee), and established a planning grant program that would encourage states to coordinate and plan activities in regard to water and related land resources.

Second, the Water Resources Research Act of 1964 was a major effort launched to fill serious gaps in research on hydrologic and other water resources information. The act granted $1 million to each state and Puerto Rico every year for water resources research, administered through the land-grant institutions. The action resulted in a new journal by the American Geophysical Union (1965) entitled *Water Resources Research* that stated in its first volume:

> The development of water resources is linked to many sciences … . [S]ocial sciences … provide sound principles as guides to public decision about the development of water. Some of the same kinds of analyses may apply to resources other than water, but water resources have led the way toward integrating the social and the natural sciences in resource development. The role of this journal as a forum for research is believed … to be in the modern trend and in the public interest.

In the early 1980s, funds for the water resources research centers around the nation were drastically cut (Universities Council on Water Resources, 1984). Some replacement funds have been appropriated and become available through the Geological Survey and the Land Grant Colleges.

Third, a Water Quality Act was enacted in 1965 that was, like many of its predecessors and successors, an amendment to the 1948 Water Pollution Control Act. This act was just one in a series of steps that brought about greater regulation of water quality. In this particular case, it provided for federal approval of ambient (surrounding or receiving waters) standards on interstate waters (Kneese and Schultze, 1975).

The fourth piece of legislation was the National Water Commission (NWC) Act of 1968 that was recommended by the Senate Select Committee as a consequence of two controversial issues. One was a proposal to build the Bridge and Marble Canyon Dams that would impact the Grand Canyon (National Water Commission, 1973), and the other was to construct works that would alleviate the critical — but presumably temporary — water shortages caused by the extended drought in the Northeast (Holmes, 1972). The National Water Commission Act called for a thorough nonfederal study of all aspects of water and related land resources, appropriating $5 million and allocating 5 years for completion of the job. Turning unused funds back to the Treasury in 1973, the NWC completed its assignment and provided Congress, the government, and the people with a valuable summary report (National Water Commission, 1973). The report consisted of 64 background study reports, and many papers and other volumes of useful information on water resources (e.g., Goldman, McEvoy, and Richerson, 1973). The NWC made 229 recommendations, including many that dealt with the WRC. The Senate Select Committee hearings and the involvement of many hundreds of people in the NWC studies raised the public's consciousness still further. Consequently, the nation was ready for the National Environmental Policy Act of 1969, Earth Day, and the "decade of the environment," the 1970s.

But it wasn't only the public whose consciousness was raised; many technical experts in a wide variety of water resources activities were also sensitized to a new approach to problem solving. Interdisciplinary approaches to teaching, problem analyses, EIS preparation, and the very infrastructure that enabled these processes became the standard. The field of water provided the perfect opportunity for a variety of disciplinary approaches. One approach that has been highly successful was the establishment of the American Water Resources Association in 1964. This group "is a scientific and educational nonprofit organization established to encourage and foster interdisciplinary communication among persons of diverse backgrounds working on any aspect of water resources disciplines" (American Water Resources Association, 1981). Its formation is exemplary of the times. Both the need and means were now available for water and related land resources to enter the environmental era.

The Environmental Era

The 1970s were initiated with President Nixon's signing of the National Environmental Policy Act (NEPA) enacted in the closing days of 1969. This important piece of legislation opened up the administrative decision-making process. It built upon ideas of notification and response, simplification of process, full disclosure, and participation contained in the Fish and Wildlife Coordination Act of 1946, the Administrative Procedures Act of 1946, the Freedom of Information Act of 1968, and the Intergovernmental Coordination Act of 1968, respectively (Black, 1981). Today, NEPA remains the only comprehensive piece of environmental legislation. It is particularly important to water and related land resources because much of the environmental impact of a given action ends up in the water, and because the phrase "water and related land resources" often concisely defines the scope of environmental impact. Through the EIS process, NEPA is further tied to several other important pieces of federal legislation that pertain to water and that mark the decade.

First and foremost among these acts were the Water Pollution Control Amendments of 1972, also known as PL 92-500. While this material is covered in Chapter 6, it is important to point out here that federal activity in water pollution control reached what probably is a maximum of regulatory activity as a result of its passage. Federal control over water quality was extended to *navigable*, not merely *interstate*, waters. In addition, water quality standards were applied to *effluent*, not *ambient*, waters. National goals and a national permit program were established, and nonpoint sources of pollution were recognized and a system was established to control them. A permit system for the control of point sources, PL 92-500 also contained a self-correcting mechanism, providing for a 5-year commission to recommend "mid-course corrections" in the water pollution control programs as the goal deadlines (1983 and 1985) approached. The recommendations of the commission (known in the law as the Water Quality Commission but referred to as "the Rockefeller Commission") resulted in the "Clean Water Act" (CWA) of 1977, now the title by which PL 92-500 is officially known.

Other legislative acts of the 1970s are presented in Table 1.2. They are linked in many important ways to water and related land resources and the NEPA. In sum, they round out a balanced, if often ill-planned and ill-coordinated, program of environmental quality assurance. With the creation of the EPA and the Council on Environmental Quality (CEQ, created by NEPA), the federal government was prepared to oversee all that it was constitutionally authorized to regulate.

Regulation itself became an issue in the 1980 presidential election, and concern about excess control by the federal government caused the budget cuts recommended in March 1981 by President Reagan to be directed first to the regulatory functions of many of the agencies. In the first round of cuts* were the EPA and CEQ, but even ahead of these was the WRC, which has since received "zero funding," effectively putting it out of commission. Thus, federal activity in coordinating water and related land resources seems to have peaked and ceased. Controlling the spread of toxic substances and hazardous wastes and maintaining the environmental quality successfully were high priorities of the Reagan administration, but deregulation at the federal level had an adverse impact on pollution

* The EIS guidelines remain well-established as part of the planning process, as intended by NEPA's drafters, and are not readily vulnerable to budget-cutting, nor likely to be repealed (Black, 1981).

Table 1.2 Major Legislation During the 1970s Pertaining to Water and Related Land Resources

Title	*Year*	*Citation*	*Responsibility*
Coastal Zone Management Act	1972	16 USC 1451	Coordinates management and research
Water Resources Development Act	1974	88 Stat 12	Set interest formula, deauthorization, and projects
Toxic Substances Control Act	1976	15 USC 2601	Identifies and controls toxic substances
Rare and Endangered Species Act	1976	16 USC 1536	Protects rare and endangered flora and fauna
Safe Drinking Water Act (amended 1986)	1976	42 USC 300	EPA sets and enforces standards
Clean Water Act (amended in 1987)	1977	33 USC 466	Mid-course corrections, nonpoint source controls expanded

cleanup. Most of that activity is now focused in laws (Table 1.2) administered by the Environmental Protection Agency.

Extensive and exciting water and related land management programs effectively have been put together by partnerships in the 1990s. These opportunistic programs have successfully involved land operators, local, state, and national organizations, citizens' groups, businesses, and individuals. Coupled with the decrease in federal activity and spending, there has been an increase in state activity in soil and water conservation activities (Larson et al., 1981). A growing acceptance of responsibility on the part of landowners is also the trend. This trend resulted from passage of the 1987 amendments to the CWA, the 1986 amendments to the Clean Drinking Water Act, and the 1985 Food Security Act ("Farm Bill"), and the establishment of a large number of incentive-based programs directed at cleaning up nonpoint sources of pollution. Many of these programs have been supported by state bond acts and federal funds administered through a variety of institutions, with a major effort by the Soil Conservation Service that was renamed in 1994 as the Natural Resources Conservation Service.

Summary

The historical view of the natural events, legislation, conflicts, development of civilization in the U.S., and people and organizations involved, provides the skeleton of the trends in conservation thought and philosophy. This chapter has presented the framework; the details follow in the subsequent chapters. Understanding where we are in our conservation of water and related land resources must be based on the past. The future can then be effectively wrought to meet our needs.

Along with this historical sketch of the last 100 years or so in the U.S., a body of law, treating water resources and providing for utilitarian access to water, has been developed as well. It is the subject, of Chapter 2.

Activities and Questions for Critical Thinking

1. Enter names of individuals, events, organizations, and legislation on the timeline, Plate 1 (found on page 8) at the end of the Introduction.
2. What differences would you anticipate had Powell's suggestion concerning western state establishment coinciding with watershed boundaries been followed?
3. Make a two-column table with the names of the two Roosevelts, and enter conservation-related events and people particularly associated with their presidencies.
4. What is your definition of "conservation"?
5. What do you think the advantages and disadvantages would be of having all the federal natural resources management agencies combined into one?
6. How would the relationships among the several groups of stakeholders (or the county seats) in Figure 1.3 change if the district was based on the Watershed Boundary instead of the counties?

Chapter 2

Water Law

Intrastate and interstate agreements build upon legal principles

Introduction

Intrastate and interstate agreements build upon legal principles that define terms and conditions of water use derived from a combination of cultural and environmental factors. There are two dominant legal doctrines in the U.S. that underlie almost all of the rights to the use of water. These are the **riparian doctrine** and the **appropriation doctrine**. There are some other less widely used doctrines as well.

Under the riparian doctrine, the right to the use of water resides in the ownership of riparian lands, that is, property that borders the water body. Under the appropriation doctrine, the right to use of water requires (1) a diversion from the natural channel on a first-in-time, first-in-right basis, (2) subsequent continuous use, and (3) beneficial use. The **correlative rights doctrine** combines certain elements of both the riparian and appropriation doctrines. Under all three doctrines, the right of access to water is usufructuary, that is, a person obtains the right to the *use*, not the body, of the water. This is because water is considered real, not personal property. One cannot "capture" water any more than one can capture land. Thus, a person only obtains title to the use of the water that adjoins riparian land, or to water in a water body from which a specified amount has been appropriated for beneficial use earlier than anyone else. The title may be bought and sold. In the case of the riparian doctrine, the title is attached to the adjacent land; under the appropriation doctrine, the title is independent of any land. A fourth process for access to and use of water is the **reservation doctrine**. This rule is federal, whereas the other three are state laws. The reservation doctrine is claimed by the federal government as antedating any state laws on lands that have been withdrawn (reserved) from the public domain. While the reservation doctrine is currently a source of major controversy, especially in the western states, it is of much broader geographic concern owing to the current movement to assert land and water rights for Native Americans for whom the doctrine was first defined. There are other, less widely used doctrines of water use in the U.S. that govern surface water rights that are not covered herein. These are the **Pueblo Rights** recognized in a part of New Mexico (Clark, 1960; Maynez, 1978) and California (Spencer et al., 1967; Merrill, 1980). There are also some additional modifications of the three basic doctrines.

This chapter examines these water law doctrines governing water rights, interstate compacts, and some ongoing federal-state conflicts. Some of these conflicts persist and have become political battles as well. Attention is focused on surface waters, which are usually public property and under state control. Limited attention is given to ground waters.

Other topics of water law, also not included herein, include navigation law, nuisance and trespass law, as applied to water resources, and a large body of drainage law. There are two basic rules of drainage law. The **dominant owner rule** permits the highland owner to discharge water through natural channels and depressions, and the **common enemy** rule precludes drainage in such as a way as to cause damage to another (Linsley and Franzini, 1964). For certain regions, such as Florida, drainage law is particularly important (Maloney and Plager, 1968). These and other ground water rules are often unique to a state or particular aquifer and are so variable as to preclude coverage in this volume.

The Riparian Doctrine

The riparian doctrine came to the U.S. from England, and derives its legal basis from classical Rome. Conflicts over the limits or rights to the use of surface and ground waters during the 19th century were responsible for definition by the courts. Land, the basis for England's system of aristocracy, was deemed the most important factor in the establishment and maintenance of vested rights. Therefore, it is not surprising that land ownership became the standard and basis for access to water in the American colonies — the practice was simply transplanted along with the colonists.

The doctrine was initially established in England in the precedent-setting case of *Mason v. Hill** in 1833. The court held that the owner of riparian lands is entitled to the use of the flow in the stream adjoining those lands undiminished in quantity and quality, and that the right to such use passes with conveyance of the land title. The ruling applied to surface waters only. Interestingly, the decision actually superseded a version of the appropriation doctrine, a residue of the Roman Empire that had been brought to England by the French (Hutchins, 1942).

Ten years later, the decision in *Acton v. Blundell* (1843) held that the water under the surface of the land was the absolute property of the owner of the land. The court further stated that if the owner's use of such water drained the well of the stream from which another person derived water, the latter had no recourse. Although the nature of the hydrologic cycle had been defined 200 years earlier by Pierre Perrault, methods for tracing potential connections between ground and surface waters were not yet developed. Ground water, then, was declared the absolute property of the landowner, however distasteful that might be to the hydrologist.

Because climatic conditions in the American colonies were similar to those of England, the riparian doctrine was simply brought over by the English settlers. Early cases in the eastern states established the principles declared in the two English cases cited above with an important modification: the right became not a right to the *flow* of the water in the stream, but the right to the *use* of the water that was in the stream. This important difference reflected the utilitarian attitudes of the times associated with the growing competition for the use of natural resources caused by the Industrial Revolution and the simultaneous carving of a civilization out of the wilderness.

The case that formally adopted the basic concepts of the riparian doctrine in the U.S. was *Heath v. Williams* in 1845 (only 2 years after the riparian doctrine had been clarified in England). The doctrine was modified in 1862 by the decision in *Bassett v. Salisbury*, which tied the doctrine to "reasonable use," the utilitarian manifestation of the growing nation's need to exploit its water resource. This adaptation of the riparian doctrine is known as the *American Rule*, and is recognized in all of the states east of the Mississippi River, although there are some deviations, as shown in Figure 2.1 (National Water Commission, 1973).

Since the courts define "reasonable use" in each specific situation, investments in major water developments in the riparian doctrine states are uncertain. Thus, with a few exceptions protected by other arrangements (for example, the Delaware River Basin Compact and the diversion of Lake Michigan water into the Chicago, Illinois, and Mississippi Rivers), there are no major diversions east of the Mississippi River. The abundant

* See Appendix D for all case and statute citations.

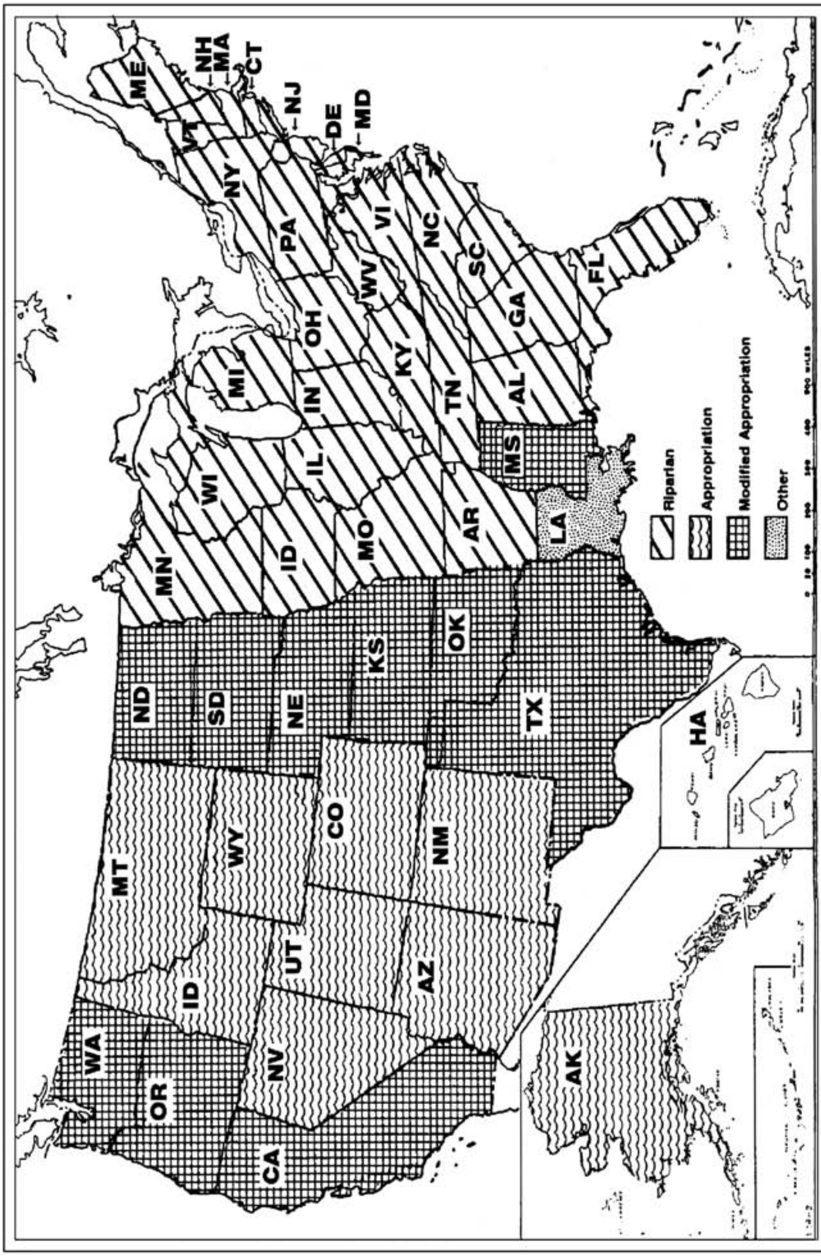

Figure 2.1 Distribution of water law doctrines by states.

water and humid conditions that preclude the necessity for irrigation also negate most of the need for diversions. These are, of course, the major reasons why the riparian doctrine was adopted in the eastern states. The doctrine varies somewhat in its application in each state (Soil Conservation Service, 1957), with modifications by size of water body, known connections with ground waters, and interpretations with regard to how unusual situations are considered. Access to lakes and ponds varies from state to state, depending upon acreage of water surface, construction of jetties or docks,* and the drainage of stream-bordering wetlands, as well as on other activities affecting water resources. Access to lakes and ponds is often uniquely treated in each state (Oakes et al., 1945).

A hypothetical ownership pattern is depicted in Figure 2.2 to illustrate which landowners would have access to the water in the stream under the riparian doctrine. Simply put, all those with some land that borders the stream (*A* through *E*) have the right to the use of the water; all whose lands do not border the stream (*F* through *J*) have no rights. It does not matter how *much* land an owner has. *D*, for example, has a minimal amount of waterfront footage, yet the right that goes along with that ownership parcel's frontage is the same as that which is attached to the lands owned by *B*, even though they border both sides of the stream. Thus, all riparian owners have equal rights in the stream. As a matter of practicality, the downstream-most owner may be able to make use of the stream in a way that could not be done were he located further upstream. The important corollary to this observation is that each riparian owner bears the burden of a shortage of supply equally with every other riparian owner, too. The water may not be applied to or used on lands that are outside the natural watershed of the stream, even if such lands are part of a contiguous ownership. Artificial canals conveying water to or acmuross nonriparian lands are not endowed with riparian rights (Teclaff, 1972).

The change from the instream flow rights to reasonable use of water under the riparian doctrine is categorized into two basic theories of the doctrine, *use* and *flow*. The differences between the use and flow theories are summarized in the decision from *Heise v. Schultz et al.* (1949), from which the following is abstracted:

The Natural Flow Theory

> Under this theory, the primary or fundamental right of each riparian proprietor on a watercourse or lake is to have the body of water maintained in its natural state, not sensibly diminished

* If they extend into navigable waters, the Corps of Engineers, not the state, may have jurisdiction over these "obstructions to navigation."

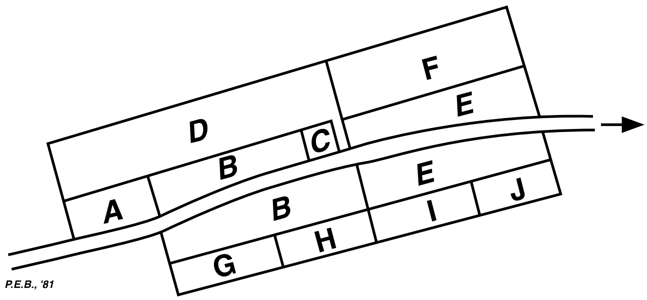

Figure 2.2 The riparian doctrine: a hypothetical land ownership pattern. Italic letters designate owners with rights to water in the stream.

> in quantity or impaired in quality. Each proprietor, however, is recognized as having a privilege to use the water to supply his “natural” wants, and each also has a privilege to make “extraordinary” … uses so long … as such uses do not sensibly or materially affect the natural quantity or quality of the water, and are made on or in connection with the use of the riparian land. Thus, according to this theory of riparian rights, all proprietors have equal rights to have the water now as it was wont to flow in the course of nature. … The advantages of this theory are that it is relatively more definite and certain, and that each riparian proprietor knows what uses he can or cannot lawfully make. … The disadvantages are that … it is nonutilitarian and prohibits many beneficial uses.

The primary use to which water may be put under this theory is domestic, or household, use. “Domestic uses are declared in advance to be reasonable, and riparians, when supplying needs of the family dwelling, may consume as much water as is necessary without regard to the needs of lower neighbors” (Teclaff, 1972). Such restrictions disappear under the American adaptation of England’s brand of the riparian doctrine:

The Reasonable Use Theory

> Under [this] theory the primary or fundamental right of each riparian proprietor on a watercourse or lake is merely to be free from an unreasonable interference with his use of the water therein. … Reasonableness is determined from a standpoint of a court or a jury and depends not only upon the utility of the use itself, but also upon the gravity of its consequences on

> other proprietors. The advantages of this theory are that it is entirely utilitarian and tends to promote the fullest beneficial use of water resources.

Although, in theory, the riparian doctrine provides for protection of or equal access to high water quality, a major decision in 1886 in eastern Pennsylvania effectively negated the quality provisions of the doctrine. *Pennsylvania Coal v. Sanderson* involved a riparian landowner whose successful suit to prevent a coal company from polluting the stream with mine drainage waters was reversed on appeal by the Pennsylvania Supreme Court:

> The Plaintiff's grievance is for a mere personal inconvenience, and we are of the opinion that mere private inconvenience arising in this way and under such circumstances, must yield to the necessities of a great public industry, which although in the hands of a private corporation, subserves a great public interest.

This decision illustrates the interplay between the Industrial Revolution and resources' development in the U.S. As Teclaff and Teclaff (1973) point out, "the reasonable use doctrine had a built-in preference for industry because the great social value attached to manufacturing clothed it with reasonableness when competing with other uses." Perhaps even more important is the fact that the decision frustrated efforts to keep the nation's water clean, causing proponents of water pollution control to seek other means to achieve their goals. They pursued the legislative route, seeking also to avoid the individual case-by-case approach inherent in the nuisance laws. They commenced with the 1899 Refuse Act, which was actually an amendment to the Rivers and Harbors Act of that year. The act required a permit to deposit material into, or to build jetties, docks, or other improvements on, navigable streams. The permit administration was established under the Corps of Engineers, further extending its activities in water resources management. The permit system was not widely used or challenged, until the growing environmental awareness of the 1960s. It was first challenged by Congressman Richard L. Ottinger, who sought redress for the discharge of diesel oil into the Hudson River from the Croton-Harmon railroad. His lawsuit was successful, and he was able to utilize his share of the fine — a "finder's fee" — to aid his campaign as well as to call attention to pollution problems.

In summary, the riparian doctrine allows the riparian landowners the right to the *use* of water flowing adjacent to their land, undiminished in quantity and quality. Reasonable use is left to the courts to decide each situation, and investment in major water works is therefore insecure. All riparian landowners share water shortages equally, and the doctrine is recognized in the states east of the Mississippi River, with some local modifications.

The Appropriation Doctrine

Also known as the “doctrine of prior appropriation,” the “Colorado Doctrine,” and “statute water law,” the appropriation doctrine was, in fact, adopted in a single precedent-setting case in the gold fields of California. It is somewhat of a misnomer to refer to it as statute law since to do so implies that the other principal doctrine (riparian) is *not* based on a statute, but on common law. In fact, both doctrines were established in court decisions after widespread use in their respective regions of the country. The frequent use of the word “statute” in relation to the appropriation doctrine may refer to the fact that the doctrine was written into a state constitution with some major ramifications discussed later in this chapter. But the riparian doctrine had been written into statute form, too. The first entrance of a water law doctrine in a statute occurred in 1876 when Congress approved the Colorado constitution as the territory was admitted to the Union as a state, thus the term “Colorado Doctrine.”

Following the decision in *Irwin v. Phillips* (1855) and inclusion in Colorado’s constitution, considerable court activity ensued, refining definitions, extending the doctrine to new watercourses and aquifers, and elaborating specific details for individual situations. For example, the court specifically excluded the riparian doctrine in the Colorado precedent-setting case of *Coffin v. Left Hand Ditch Co.* (1882):

> We conclude, then, that the common law doctrine giving the riparian owner a right to the flow of water in its natural channel upon and over his lands, even though he makes no beneficial use thereof, is inapplicable to Colorado. Imperative necessity, unknown to the countries which gave it birth, compels the recognition of another doctrine in conflict therewith (quoted in Hutchins, 1942).

Similar cases were litigated in each state in order to challenge the statute or to initially establish, extend, and interpret the appropriation doctrine and are summarized in Hutchins (1942). Since its adoption in 1855, the appropriation doctrine has been applied extensively to all the public domain states west of the Mississippi River (Figure 2.1).

The appropriation doctrine had its origins in Roman law and was brought to the U.S. by the Spaniards in the 16th and 17th centuries. It seemed particularly well adapted to an area of limited water resources, such as the arid western states. Adaptation of the Spanish principle of appropriation grew out of the custom in the western states of taking the water for any of a variety of uses, almost all of which required a genuine diversion of the water from the natural stream bed. Cuzan (1983) cites Locke in noting that "in the beginning, the Earth and its products constitute a great common to mankind while individuals have a property in their own persons," and that "a person's right to anything in the commons is established by the simple act of taking or enclosing it with his or her own labor." Using this as an argument in favor of privatization of water rights, Cuzan incidentally points out that the appropriation doctrine, like the riparian doctrine, is definitely geared to and supportive of the private rights of individuals and corporations. This view, too, is consistent with the utilitarian approach to water law that the U.S. adopted as it grew during the Industrial Revolution. However, the issues of water transfers, conservation, inefficiency of use, and the inability to make instream use of water are now being successfully addressed rendering some profound changes in the doctrine.

Irwin v. Phillips (1855)

The California Supreme Court decided in 1855 that Phillips had a better right to the water in the stream than did Irwin. Phillips was the owner/operator of a canal for irrigation of lands distant from the public lands on which the stream was located, and was the first to put the water to beneficial and continuous use. Irwin was a miner who had subsequently diminished the flow by using the water on public land under the concept of riparian use (*Irwin v. Phillips*). The decision, according to Hutchins (1942), asserts that "[I]n deciding that the common law rule should not prevail, the court pointed out that the lands were not owned by individual proprietors but were the property of the United States, and that the diversion objected to by the appellants was made prior to the time they located upon the creek." It was then stated:

> Courts are bound to take notice of the political and social condition of the country, which they judicially rule … A system has been permitted to grow up by the voluntary action and assent of the population, whose free and unrestrained occupation of the mineral region has been tacitly assented to by the one government, and heartily encouraged by the expressed

> legislative policy of the other. If there are, as must be admitted, many things connected with this system, which are crude and undigested, and subject to fluctuation and dispute, there are still some which a universal sense of propriety have so firmly fixed as that they have come to be looked upon as having the force and effect of *res judicata*. Among these the most important are the rights of miners to be protected in the possession of their selected localities, and the rights of those who, by prior appropriation, have taken the water from their natural beds.

Essentials of the Appropriation Doctrine

As first adopted, there were three criteria for a valid appropriation of water: (1) beneficial use; (2) continuous use; and (3) a *bona fide* diversion of the water from the stream. In addition, a fourth action is advisable, namely, to record such appropriation, usually with the State Engineer. Since virtually all the streams in the western states are over appropriated, and documentation of their use protects the investment that is usually necessary to divert needed water and ensure the continued benefits of the appropriation, this is most certainly a necessary step. The requirement for diversion has undergone some substantial change in recent years, and the topic is addressed in subsequent sections of this chapter.

There are several important ramifications of the appropriation doctrine. They include:

1. *The water right is separate from that of the land.*

There is no reference to land in the criteria listed above, thus land need not be owned by the appropriator at the point of diversion, at the point of use, or in between. Obviously, the appropriator must secure a right-of-way and, under the law, the landowner must provide such access, usually in return for just compensation. If the landowner holds out for an exorbitant amount of money, condemnation proceedings may be in order. Many early battles over resources, especially grazing lands and access to good stock watering holes, were fought (some are still going on) in the western states, providing themes for many movie and television scripts.

2. *The water right may be bought and sold apart from the land.*

This allows the highest price that users would be willing to pay in the market. It is expected, then, that in the absence of other constraints, of which there may be several, the water will be put to the highest and best use. An exception is that the appropriation doctrine promotes waste. In anticipation of rising demand for water, speculators can purchase water rights and, because nonuse would mean loss of the right, they may maintain diversion until such time as they can be sold at a profit (Williams, 1983).

3. *Historically, up until 1986, certain purposes did not qualify as legitimate beneficial uses under the law because the water must be diverted from the natural stream bed.*

These uses included navigation, recreation, and fisheries, all of which usually require water *in situ*. If the water was, however, physically removed from the stream, for instance, to a canal or a fish pond, a valid appropriation could be obtained.

Early cases dealt with this interesting and controversial question. One of the more celebrated of these cases resolved the issue so that *beneficial use* was not construed as including aesthetic value. This was the result of the appeal of a 1910 case in Colorado, *Cascade v. Empire Co.* Here, in the words of the court:

> Complainant owned several hundred acres of land, which it improved at great expense for a summer resort. On the lands is Cascade Canyon through which a small, precipitous stream flows. The seepage from the flow of the stream and the mist and spray from its fall produce a luxuriant and exceptionally beautiful growth of vegetation on the floor and sides of the canyon, thus rendering the canyon and the stream with its falls flowing through it rare in beauty and the chief attraction of the resort, and they were so advertised by complainant.

The Empire Power Company sought to divert the waters of the canyon above the falls for hydropower generation, a recognized beneficial use. Such a diversion would, of course, destroy the aesthetic (and, presumably, the economic) value of the falls to the resort. Although initially a lower court held in favor of the plaintiff, a reversal in 1913 (*Empire Water and Power Co. v. Cascade Town Co.*) has never been successfully challenged. For most of the 19th and 20th centuries, court decisions upheld the idea that instream recreational and fish uses could not be bases for valid appropriations; only if the water is diverted to an artificial and commercial pond could a right be obtained (Ellis, 1966). This viewpoint supported the observation that the appropriation doctrine promoted utilitarianism, (the conclusion in a comprehensive summary of the status of appropriation of water for recreation and access to streams and lakes in the western states (Johnson and Austin, 1967). Concurrently with numerous other changes in water resources policy and legislation, that viewpoint has changed, and *bona fide* diversion from the stream channel is no longer legal requirement for beneficial use. Given that stipulation, it is still possible, and necessary, to see how the appropriation doctrine system works.

How it Works

A hypothetical western stream, its average flow, and its natural watershed boundary are shown in Figure 2.3, along with some additional characteristics of the appropriations. The sequence in which appropriators have arrived on the scene is indicated by their alphabetical designation. Thus, A arrives first and diverts 30 of the 100 units of flow for mining purposes. All of the water returns to the stream. B is the second to arrive on the scene and diverts 60 units for irrigation. Typically, half of the diversion for irrigation is removed ("lost") from the system by evaporation, transpiration, and conveyance. This leaves 10 units in the stream immediately below B's diversion and 70 units below the point of B's return flow, until C diverts 10 units outside the watershed for mining purposes. All of C's diversion is thus lost to the stream system, and the flow immediately below A's diversion is now 60 instead of 70. The stream is therefore dried up below B's diversion until the combined return flows from A and B bring the flow back up to 60 units.

User D's appropriation of 40 units from the stream for irrigation removes 20, and returns 20 units to the stream. User E, mining beyond the watershed boundary, removes all 20 units available, again drying up the stream. Although E has access to up to 60 units if his point of diversion is a bit further upstream (above D's point of diversion), the water is unavailable owing to prior appropriation. Note that the original 100 units of flow supply 160 units for use in an orderly, if somewhat confusing, manner. Even more can be appropriated as flood rights, which are junior to all others.

The situation can become even more complex, although the decisions covering such situations in a number of precedent-setting cases are logical enough. For example, if A moves the point of use outside the watershed boundary *after* D's appropriation, provision will have to be made for running the return flow back to the stream to meet D's vested interest. Moving the point of use (with appropriate mitigative measures such as those described) or changing the beneficial use is allowed under the appropriation doctrine, however, changing the point of diversion or the amount diverted is not permitted. If the right is sold, the beneficial use and/or place of use may also change, but not the point of diversion or the amount diverted. If one of the appropriators needs additional water, a new appropriation must be made, subject to availability. The new

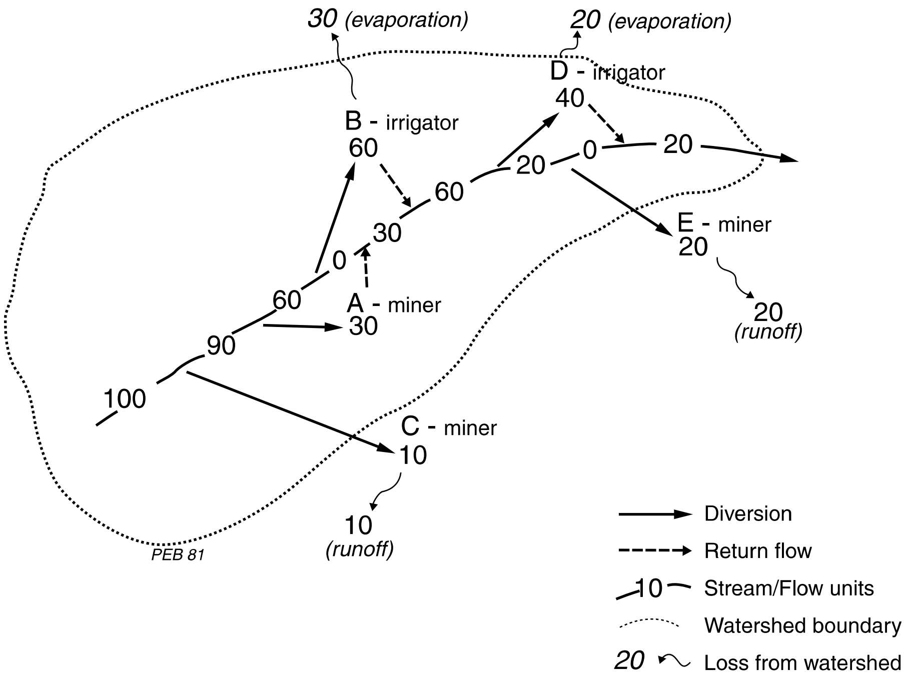

Figure 2.3 The appropriation doctrine: a hypothetical history of use. Chronology of appropriation is represented by letters.

appropriation must be identified by the new date, amount, and place of diversion (even if it is in the same location as the previous appropriation).

Given these court-sanctioned developments, it becomes apparent that points of diversion can be traded if both parties agree and no other appropriator is adversely affected. There are many situations in the western states where this has taken place to the mutual benefit of the traders and of water resource conservation. These are referred to as "water transfers" and are treated at length by Getches (1984) and Goldfarb (1988).

Originally, the unit involved was the **miner's inch**, the amount of water that will flow through a one-square-inch opening in the base of a box into which a portion of the stream is diverted. The depth of the water in the box is maintained by the overflow outlet, which returns excess water to the stream (Figure 2.4). The water flowing through the opening goes into a flume or ditch. Since the dimensions of the flume, box, and opening have never been universally standardized, each state had a different unit of flow, and conversion factors were necessary to compare appropriations and to convert the miner's inch to the widely standardized second-foot or cubic foot per second (*cfs*).

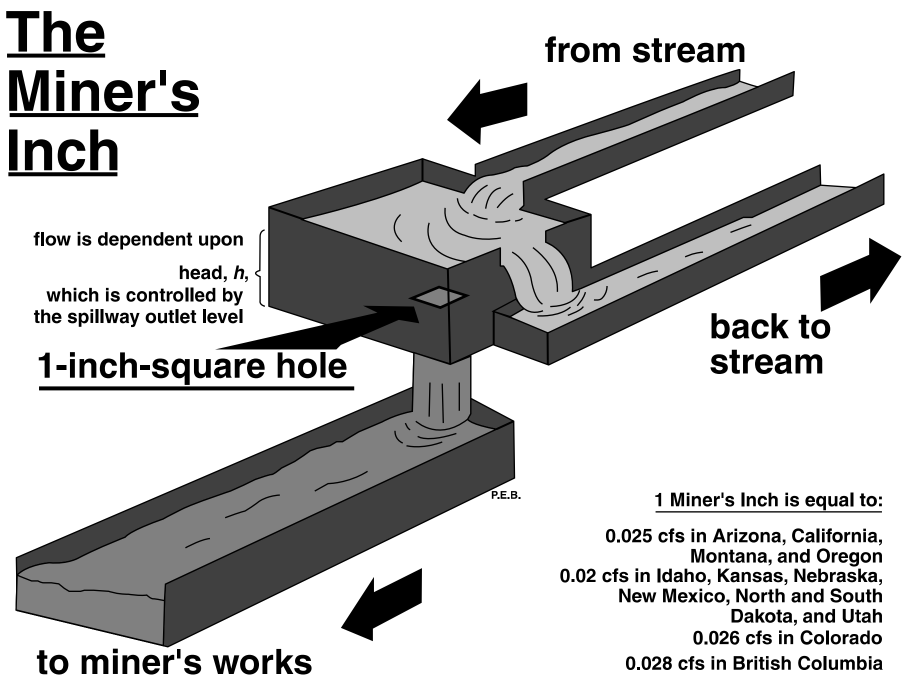

Figure 2.4 Schematic of the apparatus that defines the miner's inch.

Quantification of the water resource is an essential first step to allocate it among the many, often conflicting, users. Yet attempts to "standardize and quantify present water use" by the biggest and most unpredictable water user (the U.S. government itself) is not looked upon favorably by the states (Othmer, 1974). As a consequence, many of the court proceedings are devoted to the basic details of how much water there is in the water body under consideration.

An important issue in the appropriation doctrine is apparent if one considers what happens if, in a dry year, there are fewer than 100 units of flow in the stream. Under such circumstances, when the flow for a given year falls below the average, junior appropriators may not be able to obtain their water, hence the short-hand expression for the appropriation doctrine, "first in time, first in right." When a junior appropriator loses the right obtained by a valid appropriation, there is a loss of property without compensation. According to Hutchins (1942), the Supreme Court found that a loss of water owing to junior appropriation status was "not violative of the due process clause of the fourteenth amendment" (*Pacific Live Stock Co. v. Lewis*, 241 U.S. 440, 1916). The conflict is precluded by making junior appropriations subject to the stipulation that the water rights may not be satisfied at times of low flow. This is quite different from the riparian doctrine, under which all users equally share the burden of low flow. A related issue concerns compensation for right-of-way condemned for access to water, which was settled in *Sternberger v. Seaton Mountain & Co.* (45 Colo 401, 102 Pac 168) in 1909.

If two (or more) appropriations are filed at the same time, adjudication is accommodated in each state by what is referred to as a **preference listing** of beneficial uses. Reflecting some degree of social priorities, the general preference listing is domestic, residential, municipal, irrigation, industrial, and hydropower, with some overlap of terms and perhaps some degree of grouping, which may shift the specific categories somewhat. The preference listing for the 17 western states is shown in a footnote to Table 2.1. The preference listing is also used to support essential-to-life uses for junior appropriators when those uses are jeopardized by dry periods. Administration of the water law and water resource planning in the states is not well coordinated: in only two of the states (New Mexico and Oklahoma) are the two functions vested in the same office. In the remaining 15 states, the two functions are either in completely separate departments or in different offices of the same department.

Municipalities are often forced into buying both land and water rights on a stream and its watershed. This occurs when current owners will not sell the water rights without also unloading the land, since the land is often of no value without the water. Subsequently, this creates a predicament for the municipality in that they either have to manage those lands, or accept the fact that the public ownership has diminished the tax base. Consequently, dry lands may be offered for sale in order to put them back on the tax rolls. Such lands may not be usable for purposes that would be economically or environmentally viable if water were available.

If the points of use and diversion are widely separated, the construction of the diversion may take considerable time. To protect the appropriator, the date of the appropriation will be the date of the first filing if the appropriator exercises "due diligence" in building the ditches, tunnels, or flumes. Abandonment of the construction or of the appropriation itself for 3 to 5 years, depending upon the state (Hutchins, 1942), may result in loss of the appropriation.* The appropriation may also be lost by statutory forfeiture or adverse use by another, also known as *prescription* or *estoppel*. According to Hutchins (1942), prescription is defined as "open, notorious, adverse use of the water throughout the statutory period, under a claim of

* Legislation in Colorado, Senate Bill 5, signed by the governor on June 6, 1985, requires appropriators of ground waters to re-file each year in order to protect the right.

Table 2.1 Summary of Selected Aspects of Western Water Laws

	Doctrine[a]		*Legal Feature*		
State	*Surface*	*Ground*	*Ownership*	*Basis*[b]	*Preference*[c]
AR	PA	RU	Public	BU	1-2-3-4-5
CA	PA/RU	CR	People	BU/RU	1-2
CO	PA	PA	Public	BU	1-2/5
ID	PA	PA	State	BU	1-2
KN	PA[d]	PA	People	BU	1-2-5-6-3
MT	PA	PA	State	BU	None
NE	PA[d]	PA[e]	Public	BU	1-2/5
NV	PA	PA	Public	BU	None
NM	PA	PA	Public	BU	None
ND	PA	PA	Public	BU	1-2/5-6
OK	PA[d]	PA	–	BU	None
OR	PA[d]	PA	Public	BU	1-2-4
SD	PA[d]	PA	People	BU	1-2-4
TX	PA[d]	AO	State	BU	1-5-2-4
UT	PA	PA	Public	BU	1-2
WA	PA[d]	PA	Public	BU	None
WY	PA	PA	State	BU	1-5

Source: Abstracted from two tables in Radosevich (1979)

[a] Water law doctrine:
PA = Prior Appropriation, AO = Absolute Ownership, CR = Correlative Rights
[b] Underlying principle: BU = Beneficial Use, RU = Reasonable Use
[c] Preference listing:
1 – domestic/municipal; 2 – agricultural; 3 – power;
4 – mining; 5 – manufacturing/industrial; 6 – recreation;
7 – navigation
[d] All new water by Prior Appropriation
[e] Lacks comprehensive ground water laws

right." Estoppel is use that "involves turpitude, fraud (such as misleading statements or acts, or concealment of facts by silence) with the result that one party is induced or led by the words, conduct, or silence of another party to things he otherwise would not have done." Prescriptive rights are those obtained by continued, and likely unchallenged, use. The right may be perfected upon completion of the statutory period, which varies from state to state.

A particularly interesting aspect of the appropriation doctrine is that waters that are added to the stream, "made" waters, may be exclusively the property of the party that can prove he did, in fact, add the waters to the stream. With such proof, "made" waters can be appropriated ahead of all other appropriations. This leads to the sticky problem of ownership and rights to waters in a stream that are alleged to result from cloud-seeding activity that is, for example, designed to increase runoff over and above the natural precipitation. Successful cloud-seeding is difficult to prove in a court of law, yet such proof is necessary in order to establish ownership of the resultant runoff. Indeed, once responsibility is established, lawsuits have been launched to recover damages from excess precipitation caused by the rainmaker. Nor is this a hypothetical problem, for the Bureau of Reclamation was actively seeding clouds to augment snowpack in the Colorado River basin in the early 1970s (Division of Atmospheric Water Resources Management, 1970).

Concern over "made" waters also relates to difficult questions about "standing" (the right to sue in court) for natural objects such as timber crops, giving rise to some very complex situations (Stone, 1972). For example, consider the difficulties encountered on a watershed within a National Forest where turn-of-the-century logging and subsequent grazing increased annual runoff. In the ensuing years, water users appropriated the waters of the stream that drained the land. During the Depression, a major tree-planting effort restored forest cover to the watershed, with consequent reduction of runoff owing to the increased (restored) transpiration by the trees. Does the forest have a prior right to the water? Do the junior appropriators who lose their water to the National Forest trees have recourse? In a few situations, as noted later, these questions have been addressed and resolved; in others, solutions have yet to be devised.

A parallel problem in water rights, east and west, is that of rights to waters in artificial surface watercourses. Opportunities for such become more and more abundant as major engineering works move water around, cut navigation channels, and modify the landscape by creating lakes, wetlands, and other water bodies. Some examples include artificial ponds, man-made canals, and flood-created lakes: who has the right to the use of such waters? An example of a complex but typical issue arose in Hawaii in *Kaiser Aetna v. United States*, in which the Corps of Engineers contended that a man-made waterway for a marina was navigable and, therefore, came under their permit process making it a public waterway. This would constitute a regulatory taking (Bosselman et al., 1973), which the court refused to grant. Corbridge (1984) finds that generally "the rules applicable to surface rights in natural watercourses are a complex product of common law and statutory development and vary widely between one jurisdiction and another." He adds "the courts have found the rules associated with natural watercourses helpful in allocating surface water rights in some artificial watercourse situations, but not in others. From state to state, the choices have been inconsistent."

Ground waters in the western states have been treated either as the exclusive property of the overlying land owner, or by considering them subject to appropriation. Ideally, the former approach would be applicable to nontributary ground waters, that is, waters that do not flow to a surface stream. The latter approach would be used for tributary ground waters. As ground water supplies were appropriated, though, their tributary status was not always known. It became necessary to coordinate the simultaneous appropriations of ground and surface waters, as was commenced in Colorado in 1960. A controversial decision by the Supreme Court dealt with a particularly complex situation involving the Sporhase Farm that straddles the Colorado-Nebraska border. Drought restrictions on drilling new ground water wells in Colorado prompted the operators to drill a well in Nebraska, the water from which was used to irrigate land in Colorado. Thus, the water was directly or indirectly (Thomas, 1983) used in interstate commerce, and was alleged to have violated a Nebraska law forbidding the export of water without a reciprocal agreement on the part of the state of import; Colorado does not have one. The case, *Sporhase v. Nebraska*, "seems to give states the power to restrict the export of water when sufficiently important state interests are at stake" (Barnett, 1984). Even that opinion is uncertain. Thus the coal slurry program, where coal resources are flushed long distances with (exported) waters, was of dubious merit and might have been undermined by adverse court decision after long-distance water transfers. Greenberg (1983) maintains that *Sporhase* "added confusion to an already unsettled state ownership doctrine." Green (1983) suggests that the decision may cause states to be "more cautious in narrowly tailoring new water legislation to the important goal of water conservation."

Colorado adopted the appropriation doctrine into its constitution by reference to the precedent-setting *Irwin v. Phillips* case, followed first by the western states and then by the remaining states. The term "Colorado Doctrine" is used to refer to the original version of the appropriation doctrine, because the state of its origin, California, has substantially modified it. In 1985 Montana incorporated a temporary change in its Surface and Ground Water Law that authorized beneficial use "to maintain or enhance instream flow to benefit the fishery resource" (Montana Water Law, 1997, Title 85, Chapter 2 *Water Use*;* Goldfarb, 1988).

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* http://www.dnrc.mt.gov/wrd/wtright/WLBCont.htm July, 1999.

Correlative Rights Rule

The correlative rights rule combines certain features of the appropriation and riparian doctrines and recognizes the watershed (or some other natural water supply system such as an aquifer)* as the basic management unit. Its development in California has led to the integration of many different types of water rights, but especially the riparian and appropriation doctrines (Spencer et al., 1967).

The decision in *Lux v. Haggin* in 1886 brought back the riparian doctrine in the absence of any appropriations, or upstream of a diversion. The ensuing confusion was not cleared up until the 1902 decision in *Katz v. Walkinshaw* adopted "a new rule of reasonable use … as being better suited to the natural conditions of the State." Hutchins (1942) notes:

> As a result of this and later decisions, owners of land overlying common water-bearing strata have correlative rights in the common supply; and such landowners and owners of land riparian to a stream to which such waters are tributary, or with which they are so interconnected that interference with either surface or ground waters affects the other class, have correlative rights in the common supply.

In order to protect riparian rights against future appropriations under this doctrine, an amendment to the state water code was enacted in 1928 that required counties to identify their "ultimate" needs (for the year 2020) by October 1, 1963. This Counties of Origin Act, as it is known,** demanded early consideration of anticipated growth, induced needs, and local water resources development plans. Aside from giving the counties 35 years in which to identify, inventory, and specify an amount that they wished to reserve for their ultimate needs, the act filled a gap in the practical application of the two doctrines.*** First, it provided a means for coordinating local needs with the soon-to-be-developed California Water Plan involving long-distance, out-of-watershed diversions from northern to southern California. Second, it coincided with an important date specified in the Colorado River Compact. Actually, California recognizes several

* An aquifer is usually any water-bearing strata, such as a layer of sandstone, but, here it is any natural water source.

** California would not have been very happy with the idea of calling the legislation "Limitation Act," as required in the Boulder Canyon Project Act (page 72) language: "The Counties of Origin" act effected the onerous mandate, and with a much more innovative term.

***It would appear that the county was the most logical and strongest entity capable of representing local interests on a uniform statewide basis.

different approaches to the granting of water rights (Bain, Caves, and Margolis, 1966). The complexity of the regulations precludes extensive coverage here, and the interested reader is referred to the California Water Rights Board or the Resources Agency.

The two water rights doctrines and the correlative rights rule do not accommodate allocation of water between states. Indeed, it was necessary to establish both authority and means in order to settle water allocation problems arising from the fact that, especially in the water-short west, natural and artificial boundaries are different. With the highest average elevation of any state; with four major river systems (the Arkansas, Colorado, and Platte Rivers, and the Rio Grande); and with many lesser streams originating in the Rocky Mountain snowpacks, Colorado was the leading candidate for precedent-setting interstate litigation to provide the basis for interstate compacts. In fact, Colorado is party to more interstate compacts than any other state.

Interstate Compacts

Under the authority of the commerce clause of the U.S. Constitution and the 1911 Weeks Forest Purchase Act, two or more states can agree to allocate and manage a stream that flows through those states. Such agreements — termed interstate compacts — have been approved by Congress for a number of purposes, mostly dealing with boundary matters or defense (League of Women Voters, 1959). Over 90 percent of the remaining compacts involve water. The first two interstate compacts treating water were quite different. One established the New York Port Authority as the first joint interstate agency to handle complex governmental problems associated with the management of the Port of New York (Zimmerman, 1969). The second involved the management of the Colorado River.

First Interstate Compact

The first river basin compact was for the Colorado River in 1922. Subsequent to initial developments on the lower Colorado, plans to restore flood-damaged irrigation in California works were presented in 1919. A main stem dam and reservoir to regulate the flow of the river and provide a stable and controllable flow regime for the river's principal user, California, were proposed. The situation at that point is well described in the words of the Supreme Court, as a part of the 1963 decision in *Arizona v. California*:

> The prospect that the U.S. would undertake to build as a national project the necessary works to control floods and store river waters for irrigation was apparently a welcome one for the basin states. But it brought to life strong fears* in the northern basin States that additional waters made available by the storage and canal projects might be gobbled up in perpetuity by faster growing lower basin areas, particularly California, before the upper States could appropriate what they believed to be their fair share. These fears were not without foundation, since the law of prior appropriation prevailed in most of the Western States. Under that law the one who first appropriates water and puts it to beneficial use thereby acquires a vested right to continue to divert and use that quantity of water against all claimants junior to him in point of time.

In 1921, Congress and the seven basin states of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming agreed in the Colorado River Apportionment Act to form a compact with the U.S. as a party to protect its interests, hoping to achieve that goal by January 1, 1923. The compact (discussed in greater detail in the section on Colorado River litigation) provided for division of the waters of the river between the Upper Basin and Lower Basin States at Lee's Ferry, near the Arizona-Utah boundary, after granting certain rights to Mexico.

Wyoming v. Colorado

It was not until the 1922 decision in the landmark *Wyoming v. Colorado* case that there was finally a legal and practical basis for allocating the water among two or more states. The case did not involve the Colorado River at all. It concerned the Laramie River, the geography of which is shown in Figure 2.5. Prior irrigators on the lower portions of the Laramie River sought redress via the Wyoming State Engineer's office for reduction in flows allegedly caused by two Colorado junior appropriators. From the decision, quoted in Witmer, 1956, the plaintiffs alleged that the upstream users

* Author's note: In the propaganda film "The Last Waterhole," the nasty downstream appropriator is identified as "Cagey Cal." Produced at about 1955 by the Cooperative Extension at Colorado State University, the film had the purpose of uniting the people of the state, who were divided by west-slope and east-slope interests. Unification was necessary so that the Upper Colorado River Basin Compact could be perfected and subsequent funds from Congress obtained for the Upper Colorado River Storage Project.

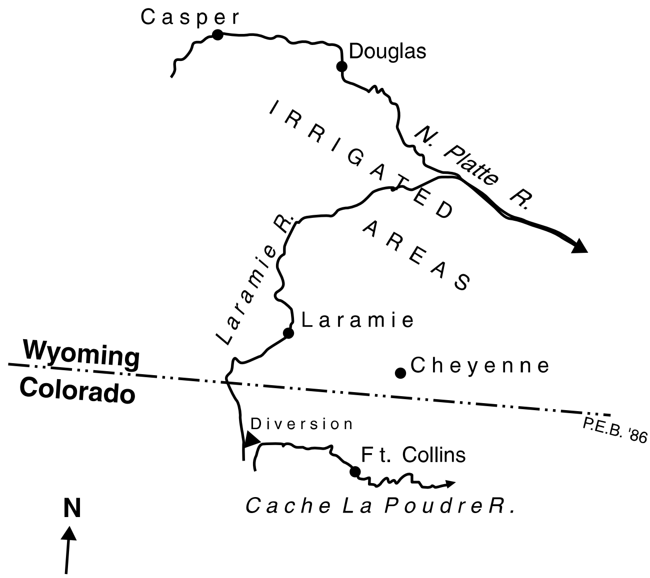

Figure 2.5 Geography of the Laramie River.

> were proceeding to divert in that State a considerable portion of the waters of the river and to conduct the same into another watershed, lying wholly in Colorado, for use in irrigating lands more than fifty miles distant from the point of diversion. The topography and natural drainage were such that none of the water can return to the stream or ever reach Wyoming.

Wyoming sued Colorado in 1911, and the case was re-argued three times before a decision was reached in 1922. In addition to issuing a decree of equitable apportionment to somewhat satisfy both the prior irrigators in Wyoming and the Laramie-Poudre Tunnel Project in Colorado, and other interested water-using parties, the Court stated:

> We conclude that Colorado's objections to the doctrine of appropriation as a basis of decision are not well taken, and that it furnishes the only basis which is consonant with the principles of right and equity applicable to such a controversy as this is. The cardinal rule of the doctrine is that priority of appropriation gives superiority of right. Each of these States applies and enforces this rule in her own territory, and it is the one to which intending appropriators naturally would turn for

> guidance. The principle on which it proceeds is not less applicable to interstate streams and controversies than others.

The decision in *Wyoming v. Colorado* standardized how adjoining appropriation states would provide for the equitable allocation of water. It held that the waters of the interstate stream should be allocated and priorities of appropriation should be established as if the stream lay wholly within one state. This logical decision paved the way for much regional development, management, conservation, and exploitation of wide areas of water and related land resources, not only in the western states, but throughout the U.S.

The year 1922 is, therefore, a milestone in the development of water law in the U.S. The lengthy decision in *Wyoming v. Colorado* permitted adoption of the Colorado River Compact officially on November 24, 1922, followed almost immediately by the La Plata River Compact, and then by a host of others at a more moderate pace. (All the water resource compacts are listed, with citations, in Appendix D.) While the citations indicate individual Congressional approval, compacts now have blanket approval if they meet certain requirements (Beuscher, 1967). Congress has usually been amicable to interstate compacts (Zimmerman, 1969). That observation heralds a developing focus of water and related land resources control at the river basin or regional level, thus decreasing the federal role.

Some of these compacts have been negotiated by the states themselves, while others have resulted from court decisions and decrees. They are discussed here and in Chapter 4.

Types of Interstate Compacts

According to the National Water Commission (1973), interstate water compacts may be grouped under four generalized headings. Figure 2.6 shows the locations and types of compacts currently in force for the U.S.

First, there are the *water allocation* compacts, such as the Colorado River Compact. Not all of the compacts have allocated the waters of major rivers; Costilla Creek is an example of a small stream that has a geography sufficiently complex to require an interstate compact. The stream is a tributary of the Rio Grande. A complex 11-page compact was necessary to settle the heated battles that raged over the stream owing to the patterns of land ownership, state lines, and water development. The area of use and water source was located in Colorado, and the area of the principal impoundment and deficit (because of evapotranspiration losses associated with both irrigation and the storage of water in the reservoir) was located in New Mexico. It is reported that the battle became so fierce that the engineers of the two states actually came to blows.

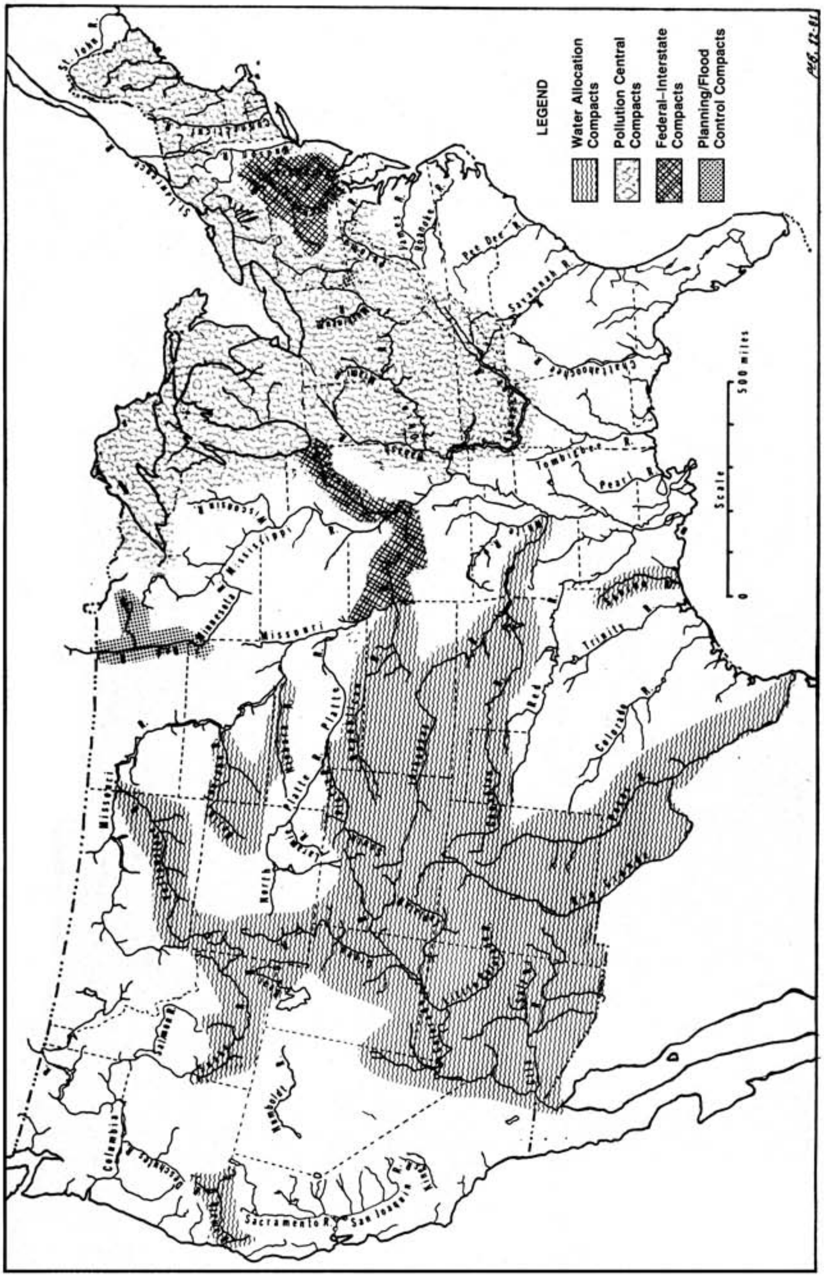

Figure 2.6 Interstate compact types and locations in the U.S.

Second, there are the *pollution control* compacts such as those on the Klamath, Ohio, and Hudson Rivers. As few as two states are involved in the Klamath River Compact, and as many as eight in the compact on the Ohio River. The signing of the Ohio River Valley Water Sanitation Compact on the same day as the first comprehensive Water Pollution Control Act in 1948 (Cleary, 1967), under the jurisdiction of the overall compact, illustrates two very different institutional approaches to resolving the same basic problem.

Third, there are *planning flood control* compacts. These are "a handful of compacts that deal with certain flood control aspects of water resources management: the Red River of the North Compact, three compacts on the Connecticut, Merrimack, and Thames Rivers in New England, and the Wheeling Creek Compact" in West Virginia and Pennsylvania (National Water Commission, 1973).

The fourth type of compact, the most recent on the scene, is the comprehensive regulatory and project development compact, also known as the *federal-interstate* compact. This differs from the earlier interstate compacts in that the federal government is a full participant in the agreement, not just an interested observer. To date, the two major compacts of this type are those on the Delaware and Susquehanna Rivers.* There is some overlap between the types of compacts since there are some water quality standards set in these two compacts, and they could also be listed in the water pollution control category instead of this one. Because this type of compact is more flexible, the two existing compacts are discussed here in greater detail.

The Delaware River Basin Compact (1961)

The Delaware Compact is the first comprehensive interstate compact in which the federal government is a full member. That, and the fact that it is the first compact in which the Compact Commission has the authority for planning, regulation, financing, construction, and operation of facilities that are agreed to by the states, differentiates it from the more typical water allocation compacts described previously. It is also provided with an administrative body that has the power to allocate waters within certain guidelines (Northrup, 1967). "In short," says Zimmerman (1969), "the Delaware River Basin Compact created the first truly intergovernmental agency in U.S. history."

The Delaware Compact grew out of the Interstate Commission on the Delaware (also known as INCODEL), which was established in 1936. The

* This type of compact is particularly conducive to the application of partnerships to effect a comprehensive program of water resource management (see Chapter 5).

impetus given to the states of Delaware, New Jersey, New York, and Pennsylvania was the potential diminution of the river's flow by New York City's dam construction and headwater diversions from the Catskill Mountains. Returning waters would flow to the Hudson River, not back to the Delaware. An earlier (1931) Supreme Court decree had "granted the City diversion rights of up to 440 mgd [million gallons per day] and provided for augmenting low-flows during drought periods" (Wilm, 1965). The compact itself is based on the 1954 Supreme Court decree that allows the city to divert up to 490 mgd "pending full operation of Cannonsville Reservoir, and then to divert 800 mgd contingent upon maintaining a minimum flow of 1525 cubic feet per second (cfs) at Montague, New Jersey."

The drought in the early 1960s provoked the city to violate this minimum flow, but the Court, reacting to an appeal from New Jersey, could do little other than disapprove. The drought of the late 1970s prompted joint conservation measures by New York City and New Jersey under the jurisdiction of the compact (Sheppard, 1981). However, during the severe drought of the summer of 1982, some northeastern New Jersey communities were so short of water that house fires were allowed to burn where it was known that no human lives were in danger. At one time Newark was reportedly facing a reserve water supply of less than a day. New York City's Mayor Koch altruistically offered to send some of the city's water to aid drought-stricken New Jersey. A pipeline was even laid over the George Washington Bridge to effect the transfer. New Jersey declined, however. Interestingly, New York City was offering water that would have flowed past New Jersey on its way to Delaware Bay, had the city not diverted it from the headwaters of the Delaware River in the first place. Urban citizens do not always know where their water comes from.

Another interesting part of the Delaware story is the major battle that was waged over Tocks Island Dam, the principal project alleged to be necessary to the integral development of the river. This Corps of Engineers' structure was to be constructed in the Delaware Water Gap (on the boundary between New Jersey and Pennsylvania) for the multiple purposes of low-flow augmentation, water supply, hydroelectric power production, recreation, and flood control. Because of growing public activism and concern for environmental quality during the 1970s, fluctuating political pressures prevented all four governors (throughout that decade) from ever simultaneously agreeing to build as required by the compact, thus the dam was never built. The dam site is within a two-hour bus ride of a major U.S. population corridor. Many of those residents, as inner-city dwellers, do not otherwise have access to the type of recreation facilities that the project would have provided. The dam was bitterly opposed (Schindler and Sinden, 1973), in large part by liberals who wanted to maintain high environmental quality, but who also found themselves opposing expanded recreational opportunities for the many disadvantaged citizens whom liberals also usually support. Unfortunately, many water and related land resources project decisions exhibit such ironies.

The Susquehanna River Basin Compact (1970)

The Susquehanna River is not a source of municipal water supply as is the Delaware. The principal problems of the Susquehanna are floods and water quality. Acid mine-drainage from the many strip and tunnel coal mines prevalent in eastern and central Pennsylvania occurs in this area, where the majority of the river's watershed lands are found. An Interstate Advisory Committee on the Susquehanna River Basin was established around 1962 (Voigt, 1972) and gave way to the Susquehanna River Basin Commission upon adoption of the compact (a familiar pattern) in 1970. The principal effort of the commission, to date, appears to be encouraging and involving public support for the broad plans and specific projects contemplated, many of them carried out by the joint efforts of federal, state, local, and private institutions. In contrast to the Delaware, public support for the Susquehanna River Compact ensures it a high level of visibility (by such means as educational films).

If the complex and broad geographically distributed goals of the compact are to be met, comprehensive public support is necessary, whereas the provisions of the Delaware River Compact are supported by the decree of the Supreme Court and so, presumably, don't need intensive public efforts to enforce visibility. The Delaware, on the other hand, needs broad comprehension of that river basin's complex problems in order to effectively manage New York City's municipal water supply (see Chapter 5).

In 1984 the Chesapeake Bay Critical Area Commission focused on the narrow strip of land surrounding the bay. It evolved into a watershed-wide partnership that is comprehensive in its approach to controlling the bay's aquatic ecosystems and all the critical land management activities that affect water quality (Chesapeake Bay Critical Area Commission, 1992). On a smaller scale, the Upper Susquehanna River Basin has been recognized as a principal contributor of fresh water to Chesapeake Bay. The principal goal is to achieve control over nonpoint sources of pollution on the upper portions of the watershed in New York and Pennsylvania "to protect and improve water quality in the Upper Susquehanna River." The Upper Susquehanna Coalition has been created to work in partnership with federal, state, and local governments and with land owner/operators (Upper Susquehanna Coalition, 1998). The Interstate Compact's Susquehanna River Basin Commission is restricted to administering the terms of the Compact; the two partnership-based organizations can involve a wider array of members.

Relation of Interstate Compacts to Other Types of River Basin Institutions

The function of the river basin commissions associated with interstate compacts is quite different from that of the river basin commissions created under the 1965 Water Resources Planning Act. The latter, known as "Title II commissions" (from the title of the act), were established for planning purposes only. Thus, they had no authorization for project construction, water allocation, or regulation. The interstate compact commissions are also different from the several inter-agency committees spawned by the 1943 Federal Inter-Agency River Basin Committee, which are largely involved in coordination. Each group of compacts and commissions has unique histories, purposes, and solutions to the problems that exist in the drainage (see Chapter 4). Many have been written up as case studies or books by students and/or involved participants. (See, for example, the Inter-University Case Program, Inc. at Syracuse University as well as the documents referred to in this section.)

Upper Colorado River Basin Compact (1948)

The compact on the Upper Colorado River in 1948 among the Upper Basin States was an essential part of the development on the Colorado, and played a unique role in water and related land resources development throughout the basin. First, the compact was necessary as a practical demonstration that there was unification among the Upper Basin States. Once that was achieved, the incomplete allocations of water specified in the main stem Colorado River Compact of 1922 for the Upper Basin States could be agreed upon (Duncan and Sudman, 1985). That, in turn, enabled Congress to enact the Colorado River Basin Storage Project Act of 1956. This act provided the support needed by the Bureau of Reclamation to construct the dams on the Upper Colorado River largely for the Upper Basin States. Finally, the Bureau of Reclamation could then construct other projects in the Lower Basin States that assured distribution of compact-guaranteed water deliveries at Lee's Ferry.* A succinct yet thorough discussion of the 1963 decision is presented by Getches (1984).

* The decision in the 1963 *Arizona v. California* case also played a role here by retrieving the waters claimed by Arizona, which California had been diverting, so that the Central Arizona Project could be built.

Second, one of the many projects authorized in the Project Act was Echo Park Dam, which would back waters into Dinosaur National Monument. The battle fought over Echo Park "provided a new climate of opinion regarding river development" (Nash, 1973). The Echo Park controversy brought many preservation groups to national prominence. It also placed preservationists and private power companies on the same side of the issue, both opposing federal development of hydroelectric power. This is probably the first, last, and only time the preservationists and electric power interests were on the same side of the issue. It ended with the dam being deleted from the 1956 Colorado River Storage Project Act (Stratton and Sirotkin, 1959). Finally, the settlement over Echo Park necessitated construction of the Glen Canyon Dam to provide the capability of storing and delivering the long-term requirements of the Colorado River Compact to the Lower Basin States. Another battle was fought at the same time over the construction of the Bridge Canyon and Penny Cliffs Dams. Both would have been barely visible inside the inner gorge of the Grand Canyon, yet both were defeated by the growing strength of preservationists groups on the conservation scene.

Viewed in a larger context, the Echo Park controversy continued a change that began when the early conservationists Muir and Pinchot (see Chapter 1) locked horns over the Hetch-Hetchy. In the earlier case, the use-conservationists prevailed, only to "lose" in the backlash creation of the National Park Service in 1916. Of course that agency had jurisdiction over the resource threatened by the Echo Park proposal, namely, the Dinosaur National Monument. Here, the preservationists prevailed, only to "lose" to the necessity of constructing dams at Flaming Gorge (upstream on the Green River) and at Glen Canyon (downstream at the Arizona-Utah border). The lake created by the Glen Canyon Dam (completed in 1963) inundates the magnificent canyon and is ironically named after John Wesley Powell, the first to successfully navigate and describe the canyon's unique natural beauty (Powell, 1961).

Perhaps one of the more interesting aspects of the Echo Park battle is that it was not over whether or not the spectacular and valuable "bones" section of the monument was to be preserved or flooded. In fact, the dam site is *upstream* of the excavation sites. The reservoir would indeed have inundated Echo Park itself, the serene confluence of the Green and Yampa Rivers, and magnificent Steamboat Rock, along with the spectacular canyons in which they are located. Thus, the issue was really unequivocal: preservation of aesthetic values or exploitation of the water resource. The only successful incursion of a dam on any area under the jurisdiction of the National Park Service involved the anticipated damage to Rainbow Bridge National Monument by the waters of Lake Powell (Hannay, 1974).

The role of the Colorado River compacts, known collectively as "The Law of the River" (Leeper, 1997), has been of considerable import to the southwestern region of the U.S. This includes the 1922 perfection of the Colorado River Compact by the Boulder Canyon Project Act of 1928, the adoption of the Upper Colorado River Basin Compact in 1948, and the completion of Glen Canyon Dam in 1963. The implications for irrigation in California, phenomenal growth in the Arizona and New Mexico sunbelts, and the rights of Native Americans to water sent shock waves throughout the nation. There were also strong incentives for California to resolve the conflict between the appropriation and riparian doctrines, accomplished by enactment of the Limitation Act, and to construct the multi-billion dollar California Water Project that supplied water to Los Angeles and the Imperial Valley from up to 600 miles away. The latter, in turn, has led to cooperation and water transfers between the Bureau of Reclamation and California, which have recently had to deal with reductions in long-standing appropriations for irrigation districts owing to unprecedented drought. The resultant impact on the prices of irrigated crops from the number one agricultural state affects all of us at the supermarket and has even been an important factor in migrant farmer rights, international relations, and unionization issues. In spite of these continuing controversies, the interstate compact remains an important vehicle for the management of water and related land resources on a regional or river basin level, helping to resolve the fundamental problem of the noncoincidence of natural and artificial boundaries.

The case that affects development in California and Arizona today, and will continue to do so well into the future is worth looking at in greater detail. It is important background for subsequent discussions about the controversies between the states and federal government, and for understanding the magnitude of the problems of Native Americans. It also involves a great many federal tax dollars, thus affecting all U.S. citizens. Settlement of water allocation on the Colorado River itself has been a long, complex process, and was not accomplished solely by perfection of the Colorado River compacts.

Colorado River Litigation

Ultimate settlement of water allocation among the states of the Colorado River Basin was much more complex than the original Colorado River Compact suggests. As noted, "agreement" on the compact was not really reached until 1928, and some of the waters were still being allocated through appeals and litigation to define terms as late as 1983. To understand the settlement, it is necessary first to characterize the basin and to summarize the provisions of the compact.

*The Colorado River Basin**

The 244,000 square-mile watershed of the Colorado River contains some of the nation's hottest and driest lands, as well as some of its most spectacular scenery, preserved in National Parks and National Monuments. The river is 1,440 miles long and falls about 10,000 feet from its official start, on the west slope of the Continental Divide at the west boundary of Rocky Mountain National Park; to the Gulf of California, also known as the Sea of Cortez. The river basin comprises approximately 1/12 of the area of the contiguous 48 states. Water resources management on the river has tremendous impact throughout the western states. Resource management issues include:

1. How water is used in streams outside the basin for diversion to areas that are jointly served by them and the Colorado River.
2. The delivery of some of the 12 billion kilowatts-per-year of hydroelectric power generated into the western and national power grids.
3. The management of the many National Park Service recreation areas, National Forests, and Bureau of Land Management lands.

Water is diverted out of the watershed to the east slope of the Continental Divide for irrigation and municipal use, and subsequently flows to the Gulf of Mexico, rather than to the Sea of Cortez. Probably 20 million people and one million acres of irrigated land get their water from the Colorado River.

The Colorado River Basin was one of the last areas of the contiguous U.S. to be explored. Lt. Joseph C. Ives explored the river from its mouth 420 miles upstream to the site of the Hoover Dam in 1857, and the entire river was first successfully negotiated by John Wesley Powell in 1869 (Porter, 1969; Powell, 1961). As early as 1901, 100,000 acres in California's Imperial Valley were irrigated with Colorado River water, conveyed, in part, by an old river channel that flowed into and out of Mexico. In 1905, a flood broke through the control gates and caused the entire flow of the river to be diverted to the Imperial Valley, thus forming the Salton Sea. Subsequently, Imperial Dam and the All American Canal (completely within the U.S.) were built to continue diverting water for irrigation in the valley. Grand Canyon National Park was created in 1919, reserving a 132-mile stretch of the river, and inhibiting dam development there.

Also in the early 1900s several dams were under construction both downstream and upstream of the Grand Canyon. Parker Dam, which

* This fact was abstracted from several sources, but especially Duncan and Sudman (1983) and NOVA (1974).

created Lake Havasu, was completed in 1941 and provides water for the Los Angeles area via the 242-mile-long Colorado River Aqueduct. Davis Dam provides water for Mexico, while a host of other dams provide local water supplies for municipalities, industry, and irrigation, as well as for diversions out of the watershed. But dams were still needed, especially for management and control of the river within the basin and to achieve the original objectives of the Colorado River Compact.

The Colorado River Compact (1922)

Ultimate settlement of the allocation of water among the states of the Colorado River Basin was much more complex than the 5-page compact suggests (Witmer, 1956), and it was not actually achieved until long after 1922. To understand the settlement, it is necessary to summarize the provisions of the compact.

The compact divides the watershed in two ways for purposes of administration. It was first separated into two *divisions* for use of water (including a preference listing of agricultural and domestic supply, power, and navigation,* in that order), and then into two *basins*, based on supply, as determined on the map by drainage (Figure 2.7). The states of the Upper Division include Colorado, New Mexico, Utah, and Wyoming, and the states of the Lower Division include Arizona, California, and Nevada. There is thus an imbalance of states between the two divisions. To preclude domination of the basin by one of the divisions, the basins were ingeniously divided. The states of the Upper Basin include all those portions of Colorado and Wyoming that lie within the watershed, along with parts of Arizona, New Mexico, and Utah. The states of the Lower Basin include all those parts of California and Nevada that lie within the watershed, and the remaining portions of Arizona, New Mexico, and Utah. Thus, each basin has two "whole" states, and only portions of three others, providing the basis for a political balance of power.

The selection of Lee's Ferry (incorrectly identified as "Lee Ferry" in the compact) for the division of the basin was, at least in part, arbitrary. Nonetheless, the location provides the solid geographic basis for the two equal divisions described above. As the only site accessible from both sides of the river between Moab, Utah and Needles, California, this historic crossing was an important geographic location and, with potential dam sites up and downstream, surveys had been made for hydroelectric development. To determine the quantities of water available, stream gauging

* This is a moot point since navigation is not possible with all the dams and no connection to the Sea of Cortez because of reduced flow caused by diversions and consumptive use (the river dries up).

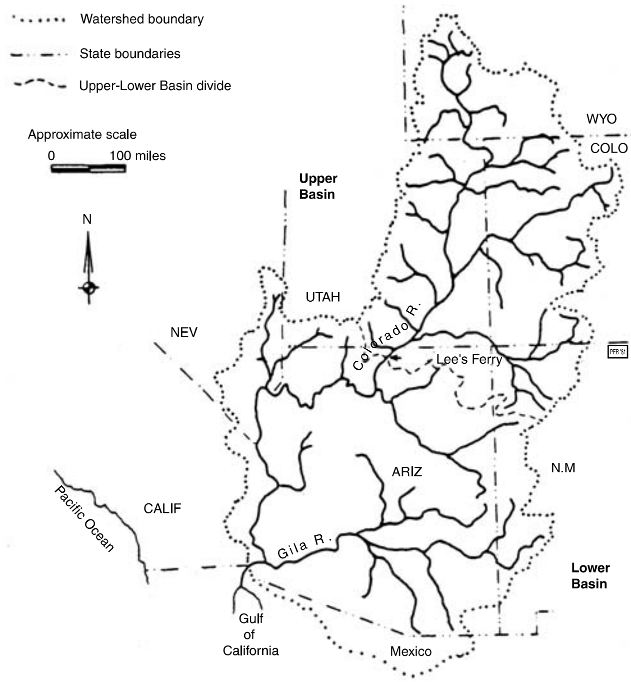

Figure 2.7 The Colorado River Basin.

had been done at the site prior to 1922, and with such records available, the site was a most logical choice for the division of the basin. Commencing in 1872, fugitive John D. Lee operated the ferry for 14 years before being killed by a firing squad for his part in the Mountain Meadow Massacre (Rusho and Crampton, 1981). The ferry continued operating until 1928 when it was replaced by the nearby Navajo Bridge and, eventually, by the bridge at Page, Arizona 14 miles upstream at the site of Glen Canyon Dam (Rusho and Crampton, 1981).

Quantitative provisions of the compact were based upon those early flow measurements that indicated the annual runoff of the Colorado River to be 16.5 million acre-feet. With a vague reference to the U.S.'s obligation to Mexico (Article III, Sec. c) "guaranteeing" 1.5 million acre-feet,* the

* The U.S. formally agreed to provide that much in an agreement with Mexico in 1944 and, by Minute 242 signed by the U.S. and Mexico on August 30, 1973. It provided that 1.36 million acre-feet are to be delivered to Mexico upstream of Morelos Dam, with no more than 115 parts per million (ppm) salinity. For a comprehensive review of the salinity problem on the Colorado River, see Volume 15, Number 1, of the *Natural Resources Journal* (January 1975) that reports the proceedings of a 1974 symposium.

compact divides the remaining 15 million acre-feet equally between the Upper and Lower Divisions. While the compact specifies the allocation to each of the Lower Basin States by percentage, it leaves the allocation among the Upper Basin States to an unspecified later action, which turned out to be the 1948 Upper Colorado River Basin Compact. The principal operative clause (Article III, Sec. d) of the compact authorizes that "the States of the Upper Division will not cause the flow of the River at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years." It is this clause that required construction of major storage facilities to control the flow over long periods and at the dividing point between the basins. Many of the dams needed for this degree of river regulation have been built, although some damsites, namely, Echo Park, Penny Cliffs, Bridge Canyon, and Marble Canyon, have not been approved for construction as noted earlier. Glen Canyon Dam, just 14 miles upstream of Lee's Ferry, is the keystone of the river's overall management. Over the years it has been the subject of controversy over loss of stored water into the sandstone walls of the canyon, destruction of the beauty of Glen Canyon itself, and disruption of the aquatic ecosystems within the Grand Canyon. It was also the site of the first protest by Earth First! in the form of a giant piece of fabric that was deployed on the face of the dam to resemble a crack.

The Colorado River Compact called for a meeting in Denver, on October 1, 1963, to divide whatever flow of the river at that time had not been appropriated. The meeting was called off, however, as all the waters had been appropriated and there was nothing left over. Part of the reason for this unhappy situation was that the flow of the river estimated in the early 1900s was found to be considerably less than the 16.5 million acre-feet measured during what turned out to be one of several wet cycles (Coats, 1984; NOVA, 1974).

The Boulder Canyon Project Act (1928)

Although drawn up and ready for signatures immediately after the decision in *Wyoming v. Colorado*, the compact was not immediately ratified by all seven basin states. Arizona refused to ratify on the grounds that she did not approve of the inclusion of allocation of the Gila River waters* and that California was already exceeding or planning to exceed her authorized allocation. Ratification came about through the passage of the Boulder Canyon Project Act of 1928, which provided for construction of Boulder (now Hoover) Dam, and the adoption of the compact if:

* Arizona did, in fact, finally ratify the compact in 1944.

1. California passed a Limitation Act restricting her diversions from the river to 4.4 million acre-feet per year.
2. Six of the seven basin states, including California, signed the compact.
3. The President signed the bill.

All the conditions were met, and the compact shows a perfection date of 1922. Boulder Dam was built in record time and completed in 1932. It provided needed river regulation as well as a huge reservoir (Lake Mead) for storage and recreation, now administered by the National Park Service as a National Recreation Area. In spite of this settlement, portions of the Colorado River Compact were contested before the Supreme Court for 60 years, from 1922 until 1983.

Arizona v. California (1931, 1934, 1936, 1961, 1964, 1983)

The principal concern of this lawsuit was over the waters of the major tributary, the Gila River (see Figure 2.7). Specifically, and in relatively simple terms, Arizona asserted that the 1 million acre-feet annual flow of the Gila belonged exclusively to Arizona and, consequently, should not be included in the total river runoff apportioned by the compact. Faced with a percentage allocation of the 7.5 million acre-feet among the Lower Division states, Arizona stood to gain if the Gila was "outside" the Colorado River flow, as divided by the compact. At the time, the extent of the Colorado River's shortage was not known. By the terms of the Boulder Canyon Project Act, Arizona was to have exclusive right to the Gila River runoff. That river's runoff was not to be diminished "by any allowance of water [that] may be made by treaty or otherwise to the U.S. or Mexico," but California and Arizona were to equally share such a commitment in the event of threatened shortage thereof. In order to get additional water, Arizona sought to have the compact voided and sued California for violation of that state's Limitation Act. In fact, there were four almost-consecutive lawsuits before a decision was reached on the original issue. Those were followed by another suit based upon the allocation of water to the Indian tribes along the Lower Colorado River.

In the first suit (*Arizona v. California*, 1931), the Supreme Court dismissed Arizona's attempt to have the Colorado River Compact declared unconstitutional. In the second suit (*Arizona v. California*, 1934), the Court rejected Arizona's contention that the Bureau of Reclamation, which was building water development projects in California and on the lower Colorado River, was illegally contracting Arizona's water. Trying a different approach (*Arizona v. California*, 1936), Arizona lost the attempt to have the U.S. declared an indispensable party to the compact because there were alleged unappropriated waters in the river.* The Court sidestepped the issue, because it has consistently resisted requests to make judicial apportionments (Corker, 1960).

Finally, in the 1964 decision, the Supreme Court upheld the 1961 decision of its Special Master. The court had referred the case to George I. Haight (sitting as a Special Master) due to the over-abundance of material presented by both sides. Upon Haight's untimely death in 1955, Simon H. Rifkind was appointed Special Master. The final trial lasted from June 14, 1956 to August 28, 1958 and included 340 witnesses, 4,000 exhibits, and 26,000 pages of testimony. Rifkind found in favor of Arizona. California immediately planned an appeal. As a hedge against an adverse decision, however, California overwhelmingly passed a $1.6 billion bond act in 1961 to finance the State Water Project. The practical apprehension over losing the appeal was well based; appealing a decision of a Special Master appointed *by* the Supreme Court *to* the Supreme Court seems fruitless. Would the court be likely to reverse its decision, thereby acknowledging that it had not selected a "good" Special Master? California delayed, hoping for a more favorable court in the face of two anticipated judicial resignations and replacements by President Kennedy: Justice Felix Frankfurter, on the bench from 1932 to 1962, was replaced by Justice Byron White, and Justice Charles Whittaker (1957–1962), was replaced by Justice Arthur Goldberg. In all, by the time the appeal was completed, there had been 22 hours of argument before the court, including 6 hours familiarizing the new Justices with the facts of the case.

It may be difficult to comprehend the validity of the decision (that is, the Gila River *is* part of the Colorado River) in light of watershed integrity. Supporters of the decision maintain that by exempting tributaries from the Compact's provisions. According to Haber (1964), the decision in *Arizona v. California* was perfectly consistent with other decisions in that southern California's own "tributaries," her northern water-rich rivers, were similarly not considered in the compact.

Many of the officially involved personnel were well acquainted with the case and had more than a passing interest in its outcome. Secretary of the Interior Stewart L. Udall was a former Arizona Congressman, and Undersecretary James K. Carr was former chairman of the California Water Commission. The Department of the Interior's Bureau of Reclamation would be very involved if Arizona were to prevail — that agency would build the Central Arizona Project (CAP): that project was, and is, of major economic importance to Arizona. The appointment of Coloradoan Byron White to the court seemed favorable to California; Colorado would certainly be interested in seeing California prevail, since a decision in favor

* See the discussion to follow on *Nebraska v. Wyoming* (page 77).

of Arizona would be viewed as an abrogation of the appropriation doctrine.

In the final action, Chief Justice Earl Warren had to disqualify himself from the decision — he not only was from California, but he had been Governor, and had served as Attorney General during some of the earlier *Arizona v. California* cases. The resultant 4-4 split decision by the court allowed the finding of the Special Master to stand.

In one stroke, California lost 1.1 million acre-feet of water; the amount by which she had been exceeding her Limitation Act restriction. Simultaneously, the water Arizona needed to proceed with the CAP was "released." In response to the Special Master's decision and the anticipated failure of the appeal, California had already sped up the State Water Project and now hastened to get northern California water 600 miles south to the Los Angeles area by 1972 instead of the originally planned 1984 target date. Water for municipalities, industry, and irrigation in the then-fastest-growing state was extremely important (Bain, Caves, and Margolis, 1966). The advanced delivery date was met, but not before another billion-dollar bond act was approved. To date, one of the keystones of the State Water Project, the Peripheral Canal (designed to take fresh water around the Delta from the Sacramento River on the north to the pumping plants on the south side of the Delta), has not been built. It remains the source of considerable and continuing controversy (McClurg, 1999a, 1999b).

The importance of the decision to Arizona cannot be overemphasized. Authorized in 1968 by the Colorado River Basin Project Act, the Central Arizona Project brings 1.2 million acre-feet to the Phoenix and Tucson areas at a cost in excess of $3.4 billion. Barring discovery of new ground water supplies and/or tapping of the Navajo sandstone into which water flows from Lake Powell, Arizona has no other source of water for development.

In the dissenting opinion, Justice William O. Douglas pointed out that "California does not seek these waters. She merely seeks to have them taken into consideration in the formula that determines the allocation between her and Arizona," and that Congress had granted authority for the government (Bureau of Reclamation) to develop irrigation systems. Douglas continued, "… those regimes have been posited on the theory that state law determines the allotment of waters coming through irrigation canals that are fed by federal dams." Most importantly, he argued, as did many western water lawyers, that "*Wyoming v. Colorado*… had recently been decided, holding that priority of appropriation was the determining factor in reaching an equitable apportionment between two Western States." Many thought that the *Arizona v. California* decision would undermine the basis for western water law in general, but it didn't. Finally, with great foresight, Justice Douglas stated:

> The decision today, resulting in the confusion between the problem of priority of water rights and the public power problem, has made the dream of federal bureaucracy come true by granting it, for the first time, the life-and-death power of dispensation of water rights long administered according to state law.

Current conflicts over water, as foreseen by Justice Douglas, are not restricted to state versus state — some of the biggest water battles have been and continue to be, between the federal and state governments. The conflict over Native American rights to water was brought to the fore by the decision in *Arizona v. California*. The situation has been exacerbated by the increased demand for water, the apparent squandering of much of the precious resource, and the increasing cost of water in the sunbelt region. The result has been development of some innovative solutions that have included intentional replenishment of ground water supplies, and revision of some details of the appropriation doctrine that relate to the connection between the land and the water when rights are transferred. The water supply picture in Arizona has recently undergone some major changes,* but the legal history has to be dealt with in order to understand the basis of the problem that, ironically, has the greatest potential impact on Arizona itself.

Federal-State Litigation

In addition to the litigation between Arizona and California over the meaning of the Colorado River Compact and the status of the waters of the Gila River, several other cases have raised important questions about water, especially in the western states. The root of the problem appears to be that although the federal government obtained the rights to the land, minerals, and water in the various cessions and purchases of territories west of the Mississippi River, those rights were not explicitly claimed. The federal government maintained that it retained control over those rights because it did not specifically delegate their allocation. The problem manifests itself differently on lands that (1) *remain* in the public domain, (2) were in the public domain but have been *transferred* to private title, and (3) were *reserved* from the public domain for various public purposes.

The state-administered appropriation doctrine enabled application of water to private lands that had come into existence in the latter half of

* See further discussion of *Arizona v. California* (1983) on p. 87.

the 19th century by the many federal acts that helped dispose of public domain lands.* As use of water on privately owned chunks of public domain increased, the federal government identified and quantified its needs for the beneficial use of those who used the lands that were reserved from the public domain. These reserved uses included those that ensured survival of Native Americans, drinking water for grazing animals, and water for growing trees. These conflicts demanded clarification.

Nebraska v. Wyoming (1945)

This was not a simple case, as the 62-page summary in Witmer (1956) attests. The issues centered about the flows of the North Platte River which, Nebraska alleged, were diminished by irrigation in the regions served by the North Platte and Kendrick Projects constructed and operated by the Bureau of Reclamation. Some of the problems were diminution of the flow by evaporation from reservoirs, as well as by evaporation and transpiration loss from application of the water to crops; recapture and use of return flows from the reservoirs; and dates and ownerships of specific appropriations. Colorado was impleaded as a defendant in the case, in part because she was involved in similar proceedings with Kansas, and in part because there was a direct involvement with water supplies in Colorado on the Laramie River, tributary to the North Platte, in Wyoming. Ultimately, Colorado was interested because, as the first state to have included the appropriation doctrine in its constitution, she thought the issue was already settled. Colorado's Constitution states:

> Section 5. Water of Streams Public Property
>
> The water of every natural stream, not heretofore appropriated, within the state of Colorado, is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the state, subject to appropriation as hereinafter provided.

Through Congressional approval of Colorado's Constitution in 1876, the U.S. would appear to have acquiesced to local and state authority to

* These included the Homestead Act of 1862, the Timber Culture Act of 1873, the Desert Land Act of 1877, the Timber and Stone Act of 1878, and several railroad and other development land grants and modifications and extensions thereto (Dana, 1956).

control allocation of water rights (Simms, 1980a). The U.S. maintained otherwise, and its view was included in the decision in the case:

> Claim of the U.S. to Unappropriated Water
>
> The U.S. claims that it owns all the unappropriated water in the river. It argues that it owned the then unappropriated water at the time it acquired water rights by appropriation for the North Platte Project and the Kendrick Project. Its basic rights are therefore said to derive not from appropriation but from its underlying ownership which entitles it to an apportionment in this suit free from state control. The argument is that the U.S. acquired the original ownership of all rights in the water as well as the lands in the North Platte basin by cessions from France, Spain, and Mexico in 1803, 1819, and 1848, and by agreement with Texas in 1850. It says it still owns those rights in water to whatever extent it has not disposed of them. (*Nebraska v. Wyoming*, 1945)

Many argue that the federal government had "disposed of them" (those rights in water) by virtue of Congressional approval of Colorado's Constitution. However, the court sidestepped the issue by declaring that the waters in question in the suit were all properly appropriated for use in the two projects, and that the stream was indeed overappropriated at the time. Thus there were no unappropriated waters and the decision was inapplicable. A complex decree was issued governing the allocation of the waters of the North Platte. It was further modified in *Nebraska v. Wyoming* (1952). Nevertheless, the claim had been made.

The court added "that there may be unappropriated water to which the U.S. may in the future assert rights through the machinery of state law *or otherwise*" (emphasis added). The implication is that if the river was not fully appropriated at the time of the federal reservation, then the U.S. might make good on its claim. This view is fully consistent with, although based on a different premise than, the Public Trust Doctrine, which can apply at the state and local levels as well as to the federal government (page 89). The question of antedating appropriations by virtue of the originality of federal ownership and reservation of land for purposes that may require water has indeed come up again. In fact, the federal government was being completely consistent: it followed the same logic and arrived at the same conclusion concerning unappropriated waters on the reserved public domain lands in *Nebraska v. Wyoming* that it had successfully argued on behalf of the Belknap Tribe on the Milk River in Montana in 1908 (see the Winters Doctrine, page 80).

Federal Power Commission v. Oregon (1955)

This case, also known as The Pelton Dam Decision, concerned the lands upon which the Northwest Power Supply Company wished to build a dam (Chilson, 1960). The lands had been reserved by the government for future use, and were therefore not public lands on which water was subject to appropriation as required by Oregon law. Some of the lands in question were reserved for the Warm Springs Indian Reservation, and some were reserved specifically for power development under provisions of the 1910 General Dam Act that were later adopted in the 1920 Federal Power Act (Holmes, 1972). In another dissenting opinion, Justice Douglas indicated that the provisions in the Desert Lands Act reflected long-standing governmental policy to separate the land and water rights, and said that the 1910 General Dam Act did not intend to interfere with those provisions. As quoted in Chilson (1960):

> According to this opinion, the reason why the Court should not construe any law as achieving the recall by the Government of its jurisdiction over rights is that the rule adopted by the Court profoundly affects the economy of many States, ten of whom are here in protest. In the West, the U.S. owns a vast amount of land — in some states, over 50 percent of all the land. If by mere Executive action the federal lands may be reserved and all the water rights appurtenant to them returned to the United States, vast dislocations in the economies of the Western States may follow. For the right of withdrawal of public lands granted by the 1910 Act is not only for "water-power sites," but for a host of public projects — "irrigation, classification of lands, or other public purposes." Federal officials have long sought that authority. It has been consistently denied them. We should deny it again. Certainly the U.S. could not appropriate the water rights in defiance of Oregon law, if it built the dam. It should have no greater authority when it makes a grant to a private power group.

It seems that Justice Douglas had considerably more foresight than he was given credit for at the time. At any rate, it should be pointed out that the waters involved in the Pelton Dam Case were not navigable waters (as was true, too, in *Nebraska v. Wyoming*), which are clearly under the jurisdiction of the federal government. The Pelton Dam decision had ramifications in the Denver Blue River case, settled by agreement within the year (Chilson, 1960). With the many millions of acres of western lands withdrawn for a variety of purposes, the problems raised are far from being resolved. One of the truly major areas of concern is that of the rights of Native Americans to water.

Reserved Water Rights

The decisions in the foregoing sections all point to the consistent opinion of the federal government that as lands were set aside from the public domain, water rights were not ignored. On the contrary, they were *reserved*, even if not so stated explicitly. The issue had actually been raised much earlier in 1908, in *Winters v. the United States*.

The Winters Doctrine

This particular issue concerns the rights to surface waters on Indian Reservations. Until the mid-1960s, government policy was to encourage assimilation of Native Americans into U.S. culture.* Under that policy, the assignment of Indians to federal reservations was considered temporary (Simms, 1980a). Therefore, no great concern was expressed over the need for water on those reservations (DuMars and Ingram, 1980; Merrill, 1980), nor was there much water on them, or in most other locales throughout the western states for that matter.

Getches (1989) personalized the story of an intrepid Indian agent who fought for members of the Belknap Indian Reservation of the Gros Ventre and Assiniboine Indians of the Blackfeet Tribe. They had found the flow of Montana's Milk River diminished, owing to upstream appropriators. A "maverick" U.S. Marshall concurred and helped convince a courageous judge to grant an injunction pending a decision in the 9th Circuit Court. Getches (1989) said that these three men "did what they had to do because it was right." The Supreme Court established what are referred to as *Winters Rights*, in the decision on appeal (*Winters v. United States*, 1908). This forever changed resources management in the western states and, ultimately, has affected court and resource management decisions in the eastern states as well. Winters rights are one of three "species of Indian water rights:" aboriginal, Pueblo, and Winters (Williams, 1997). The precedent-setting decision created the *Winters Doctrine*, which does not give Native Americans seniority of appropriation; these are rights quite outside the states' appropriation doctrine rights. Said the court:

* With the growth of the American Indian Movement following the second Battle of Wounded Knee in the 1960s, the policy of the Bureau of Indian Affairs (BIA) changed to one of achieving independence for Native Americans. See the section on the BIA in Chapter 3, Organizations.

> The case, as we view it, turns on the agreement of May, 1888, resulting in the creation of Fort Belknap Reservation. In the construction of this agreement there are certain elements to be considered that are prominent and significant. The reservation was a part of a very much larger tract that the Indians had the right to occupy and use and that was adequate for the habits and wants of a nomadic and uncivilized [sic!] people. It was the policy of the Government, it was the desire of the Indians, to change those habits and to become a pastoral and civilized people. If they should become such, the original tract was too extensive, but a smaller tract would be inadequate without a change of conditions. The lands were arid and, without irrigation, were practically worthless. … The power of the Government to reserve the waters and exempt them from appropriation under state laws is not denied, and could not be. … That the Government did reserve them we have decided, and for a use which would be necessarily continued through the years. This was done May 1, 1888, and it would be extreme to believe that within a year [when Montana was admitted to the Union] Congress destroyed the reservation and took from the Indians the consideration of their grant, leaving them a barren waste.

The precedent, then, is that any rights to the use of the water date from the time of the reservation (in the case of the Fort Belknap Reservation, 1888), and therefore are senior to any appropriations whatever the date. The Winters Doctrine is derived from the basic concept that the Indians' rights to water come under federal, not state, law. Consequently, the first issue was in which jurisdiction the case would be tried (Taylor and Birdbear, 1979). The Native Americans wanted the conflicts to be heard in federal courts, whereas the supporters of the appropriation doctrine wanted the trials to occur under state jurisdiction. In order for the Indians to successfully litigate water rights that were not very favorably looked upon by the state courts that have original jurisdiction over the state-based western water law, it was necessary for the U.S. to allow itself to be sued. This issue — sovereignty — was granted by the McCarran Amendment (43 USC 666, 1988) of 1952 (Stein, 1997). Since, like Pueblo Rights in New Mexico, Winters Rights do not come under the jurisdiction of the state (O'Brien, 1977), all cases were tried in federal court. The Winters Doctrine has been repeatedly and consistently upheld.

The Winters Rights require no diversion, no beneficial use, nor application for a permit to divert under state law (National Water Commission, 1973); nor could they be lost by nonuse (Brookshire et al., 1983). If an Indian reservation was created on lands that were the aboriginal lands of that particular tribe, the appropriation carries the absolute first priority, dating from time immemorial. Uncertain as to whether reserved water rights for Native Americans ought to be tied to present or future Indian populations, to available waters, or to some specific reserved amount, the court did not deal with that issue in 1908. Nevertheless, as with the vague reference to some U.S. commitment to Mexico, the Colorado River Basin Compact included the following, in its entirety, in Article VII: "Nothing in this compact shall be construed as affecting the obligation of the U.S. of America to Indian tribes." No one paid any attention. Appropriation doctrine water users were happy to have the issue swept under the rug (if, indeed, they even knew about it). Most appropriators didn't want to know how *much* water was involved, either. The issue lay dormant (except, perhaps, for Justice Douglas' premonitions) until the 1963 *Arizona v. California* decision.* Then, the court was forced to address it by the existence of Article VII of the compact, the Winters case itself, and by the claims of several Indian tribes along the lower Colorado River:

> As to the claims asserted by the U.S. to waters in the main river and some of its tributaries for use on Indian reservations, national forests, recreational and wildlife areas and other government lands and works… . This Court sustains the Master's finding that, when the U.S. created the Chemchuevi, Cocopah, Yuma, Colorado River, and Fort Mohave Indian Reservations in Arizona, California and Nevada, or added to them, it reserved not only the land but also the use of enough water from the Colorado River to irrigate the irrigable portions of those lands. 1) The doctrine of appropriation should not be used to divide the water between the Indians and the other people of the State of Arizona. 2) Under its broad powers to regulate navigable waters under the Commerce Clause and to regulate government lands under Art. IV, Sec. 3, of the Constitution, the U.S. had power to reserve water rights for its reservations and property. (*Arizona v. California*, 1964)

While the court set the irrigation amount at 6.63 acre-feet/acre for the five tribes, it still did not specify a total quantity. An actual quantity could not be specified without reference to the number of acres of irrigated land to which the water would be applied. The court did refer to the land capable of being irrigated as "practicably irrigable acreage (PIA).*

* The term was actually first used in the 1963 decision of *Arizona v. California* (373 US 546), which was affirmed in the 1964 decision on appeal, cited throughout, including the List of Cases (Appendix D).

But the Indian's methods of irrigation and the white man's method of irrigation are not necessarily the same. While Indians may, indeed, wish to implement large-scale systems for simultaneous irrigation of hundreds of thousands of acres with automated overhead center pivot systems, or with extensive ditch systems, their concept of living in concert with the Earth suggests a smaller scale of operations. Irrigation of Indian fields and gardens is often a matter of individual plant irrigation, usually by caring hands that are driven by an entirely different understanding of, and a more environmentally sustainable approach to, the relationship between man and nature. The amount of water required by the Indian and by the white man may be the same, but perhaps, the Indian's use of water was more efficient. In fact, it has been pointed out (Wardlaw, 1975), and is the Special Master's opinion that there is evidence of extensive irrigation works built and used by the Hohokam Indian tribe as many as 2,000 years ago, but the amount used is unknown. The Indians had long ago established a right to the use of water. Now, finally, it was necessary to determine the amount of PIA.

To give some idea of the magnitude of the problem, Table 2.2 presents current data on Indian lands in the western states. The observation that about 38 percent of all Indian lands are in Arizona is of particular importance. With 27.6 percent of that state's lands in Indian reservations, Arizona, which fought so long and hard over the Gila River and the Colorado River Compact, then, does have an added burden.

Applying the *Arizona v. California* decision's figure of 6.63 acre-feet of water per acre for 136,636 acres on the five reservations (Chemchuevi, Cocopah, Yuma, Colorado River, and Fort Mohave) produces a huge amount of water for the Native Americans. Simms (1980a) stated, probably quite accurately, that "perhaps the area of greatest potential conflict over water in the West is the area of Indian water rights, virtually all of which remain unadjudicated." At that rate of irrigation water application, Coats (1984) points out that "if only 500,000 acres, or four percent of the Navajo Reservation, are practicably irrigable, the Navajo entitlements would be about 2 million acre-feet per year, and could be as high as 5 million acre-feet." That is about 33 percent of the annual flow of the Colorado River! In fact, if the 6.63 acre-feet per acre figure is applied to even 1/20th of the 51.6 million acres of Indian Reservation lands in the arid western states (excluding the water-blessed Columbia River Basin), about 17 million acre-feet of water would be required. That is more than the 16.5 million acre-feet of the (hoped-for) annual flow of the Colorado River.

A nonquantitative explanation and summary of the overall problem is cited in the report of the National Water Commission (1973):

Table 2.2 Indian Lands in the Western States

State	*Land Area*	*Indian Lands*	*Percent*
	(in thousands of acres)		
Alaska	365,482	386	0.1
Arizona	72,688	20,036	27.6
California	100,207	573	0.6
Colorado	66,486	783	1.2
Hawaii	4,106	0	0.0
Idaho	52,933	827	1.6
Kansas	52,511	28	0.1
Montana	93,771	5,258	5.6
Nebraska	49,032	65	0.1
Nevada	70,745	1,146	1.6
New Mexico	77,766	7,557	9.7
North Dakota	44,452	853	1.9
Oklahoma	44,088	1,240	2.8
Oregon	61,599	761	1.2
South Dakota	48,882	5,091	10.4
Texas	168,218	0	0.0
Utah	52,697	2,286	4.3
Washington	42,694	2,517	5.9
Wyoming	62,343	1,888	3.0
Subtotal	1,485,263	51,611	3.47
Rest of U.S.	741,324	1,351	0.18
Totals	2,226,587	52,962	2.37

Source: Bureau of the Census (1980). The data are for 1979.

These data do not include privately owned Indian lands in some eastern states. As of 1979, the total acres were distributed as follows:

Tribal lands	42,447,000
Lands held in Trust	10,057,000
U.S.-owned lands	458,000

Most Indian Reservations were established before substantial water development was made by nonIndians. Thus, Indian priorities are usually superior to nonIndian priorities. But for a variety of reasons, … Indian irrigation lagged far behind other irrigation. The Nation is therefore confronted, in the decade of

> the 1970s — 100 or more years after most Indian Reservations were established — with this dilemma: in the water-short West, billions of dollars have been invested, much of it by the Federal Government, in water resources projects benefiting nonIndians but using water in which the Indians have a priority of right if they choose to develop water projects of their own in the future. In short, the Nation faces a conflict between the right of Indians to develop their long-neglected water resources and the impairment of enormous capital investments already made by those holding appropriation rights in the same water supply. To resolve that conflict is not an easy task.

The issue has not remained dormant, however, as it did between 1908 and 1964. The Western Network, "a new, nonprofit, tax exempt organization attempting to facilitate the understanding of natural resource conflict in the western states through a program of research, publication, seminars and other activities," published a comprehensive summary of the problem (Folk-Williams, 1982). By 1982, 19 tribes were involved in litigation in Arizona, seven in Montana, and three in New Mexico. In addition, 10 cases were pending in Nevada and, in South Dakota, "water rights to the entire Missouri River and its tributaries in western South Dakota [were] at issue in a massive suit." "[A]lmost every tribe [was] litigating either water rights or fishing rights in Washington" and "important Winters Doctrine cases [were] in litigation for Indian communities in Wyoming (Wind River), Oregon (Klamath), Colorado (Ute Mountain and Southern Ute), and California (Mission bands), in addition to several negotiating efforts in Arizona and Montana" (Western Network, 1982). Certainly, one of the solutions that has occurred to Indians and nonIndians alike is that Indians have a tremendous economic resource at their disposal, either for them to develop, or to sell to the highest bidder. The process is still going on and changing continuously.

Much of the problem of evaluating and quantifying PIA was determining (1) the extent of arable lands, (2) ways to measure economic feasibility, and (3) how much land can be made arable by engineering feasibility studies (Brookshire et al., 1983; Burness et al., 1983). Most of the specific lawsuits — and the actual amount of PIA and rights to waters — still have to be settled. Litigation of the Big Horn I case (*In Re Rights to Use Water in Big Horn River*, 753 P2d 76, Wyo 1988)* was an early harbinger of western water law conflict under the Winters Doctrine (Bates et al., 1993). Many of the conflicts have produced more satisfactory and productive

* The "Wind River Case" was not fully settled in the courts and therefore not considered a legal precedent (M. A. McGinnis, personal communication, 1994).

negotiations rather than lawsuits, where one side always loses, leading inevitably to appeals and more litigation (McCool, 1997).

In addition, some basic rules have been laid down in court decisions. In *Cappaert v. U.S.* (426 US 128, 1976), the court "held that when the Federal Government withdraws its land from the public domain and reserves it for a federal purpose, the Government, by implication, reserves appurtenant water then unappropriated to the extent needed to accomplish the purpose of the reservation." Winters Rights have been found to exist for fisheries and "general homeland" purposes as well as for irrigation, and there is some degree of coordination of water rights between state and federal jurisdictions (Williams, 1997). Winters Rights may be transferred from one beneficial use to another (*In Re Big Horn River System*, 835 P2d 273, 1992); future water needs are anticipated and provided for and points of diversion may be changed (*In Re Rights to Use Water in Big Horn River*, 753 P2d 76, Wyo 1988); and Cappaert was upheld by the decision in *United States v. New Mexico*. Some conflicts have also been settled by congressional action (Stein, 1997).

Complications have also arisen. The economic feasibility challenge was the subject of a portion of the Water Resources Council's *Principles and Standards*, but those are now officially not applicable to Bureau of Reclamation (BR) projects, having been changed to *Principles and Guidelines* by the Reagan Administration. While secondary benefits are not to be included in those calculations anyway (Burness et al., 1982), excess power revenues from other projects of the BR "would pick up any deficit" according to reclamation policy (Burness et al., 1980). But the BR and other major dam-building agencies have dramatically decreased their dam-building activity. This has come about as a response to three developing conditions:

1. The expansion of the environmental movement, which in large part grew based on the increased awareness of the impact of major water resource developments, especially dams.
2. The major increase in the fedeal budget's percentage of welfare costs due to increasing health and elderly care and veterans' benefits, as opposed to public works, especially following Eisenhower's "no new starts" policy.
3. Most of the superior dam sites were already developed — those that were left were obviously marginal.

The bottom line is that the Native Americans are not likely to enjoy the federal largesse that benefited the settlers and appropriators.

Calling for "strict and appropriate criteria" to guide planners for the Winters Rights, Brookshire et al. (1983) state "the concept of practicably irrigable acreage is likely to be the focus of controversy and litigation throughout the West in the coming years." In the words of one Native American:

> The fundamental issue is this: as long as Indian rights are seen incorrectly as an exception to the system, and as long as funding for their development is considered to be an additional cost, Indian tribes will have no choice but to fight every inch of the way, making the system costly and inefficient as possible. However, if those who are interested in water development in the West come around to the view that it is in their interest to see that Indian water rights are defined in such a way as to satisfy reasonable Indian needs, Indians and nonIndians in the West will be able to sit down and plan development that meets the common and interdependent needs of all people and interests in the West. … In the bluntest possible terms, those who are interested in western water development will be acting in their own best interest if they become the Indians' most effective lobbyists (Deloria, 1985).

The most recent development in this matter is the 1983 Supreme Court opinion in *Arizona v. California*. Here the court found several points in favor of the five Lower Colorado River tribes, including the fact that they were not adequately represented in the earlier proceedings, and that there were, owing to improper surveys, "omitted" lands on which the Indians sought to have their irrigation rights increased. But the court did not find substantial changes in the PIA to warrant readjudicating the 1964 Special Master's decree.

Perhaps one of the more fascinating recent developments doesn't directly involve water rights at all. In the summer of 1996, in an arid site near the confluence of the Snake and Columbia Rivers, a well-preserved bone skeleton was discovered that was carbon-dated at 9,300 years of age. That is, he arrived, and died, shortly after the ice retreated. Kennewick Man, as this skeleton is known, has now been claimed by resident tribes as a part of their heritage under the 1990 Native American Graves Protection and Repatriation Act. The well-preserved skull, though, is "suggestive of Caucasoid features" and there is now a wealth of evidence of other geographic sources for "Native Americans" (Anonymous, 1997; Anonymous, 1999; Malakoff et al., 1999). Once the ownership battles to the skeleton are settled in the courts, the definition of "Native Americans" may undergo some change, too, possibly further complicating rights to water under the Winters Doctrine.

Other developments, however, have spread from the generalization of the Winters Doctrine into what is referred to as the "reservation doctrine."

The Reservation Doctrine

Another aspect of the use of water on federal lands reflects the continuing conflict between the federal and state governments (King, 1982). The issue of the reservation doctrine is derived from extension of the Winters Doctrine to cover all reservations from the public domain lands created by executive order, as well as by treaty, and to the lands allocated to individual tribal members under federal statutes. In the landmark case of *Arizona v. California* (1963), the Supreme Court stated that "the principle of reserved rights extended to all federal reservations, not just to Indian lands" (Folk-Williams, 1982). The concept of what is now known as the reservation doctrine was actually applied earlier in the 1945 *Nebraska v. Wyoming* decision (page 77).

The 1978 decision in the *U.S. v. New Mexico* case found that previously unappropriated water in the Rio Mimbres drainage of the Gila National Forest was considered reserved for water and timber production, since those are the purposes for which the National Forest was originally reserved. The court held that the reservation could not be extended to the purposes of aesthetics, recreation, wildlife, or stock watering, which were added later. In general, it is recognized that reserved rights exist, but are limited "to an amount of water necessary to satisfy the purposes for which the forest lands were withdrawn from the public domain" (Simms, 1980b). Water for subsequent uses must be obtained by the U.S. via state law (its purpose may not, as discussed, be identified as a beneficial use), or by eminent domain (Brooks, 1978). In Noble's (1978) opinion, as the law now stands, "the public has been effectively denied much of the recreational use of the Gila National Forest. Without water for picnic facilities, fishing purposes, wildlife use, and general aesthetics, the forest may become nothing more than a storage area for insuring water and timber supplies: a virtual wasteland for large numbers of New Mexicans and tourists who would otherwise receive many benefits from the Forest's use."

The reservation doctrine has been widely extended to other National Forests and other federal lands under the jurisdiction of the National Park Service, and Bureau of Land Management as well. In this light, the reservation doctrine may eventually also become enmeshed with the Public Trust Doctrine, as the government assumes responsibility for those aspects of the people's general welfare. Such a development would seem to be the case in the attempt to control development on the Yampa and Green Rivers, which join in Echo Park at Dinosaur National Monument. Here, in simplistic terms, the National Park Service is attempting to guarantee water under the reservation doctrine for recreational rafting, endangered species protection, and riverine ecology preservation (Bassin, 1985). This and other cases illustrate a definite, identifiable consistency to the federal government's approach to its claim(s) to water, especially in the western states carved out of the public domain (Bird, 1980).

Public Trust Doctrine

Government plays a role in the protection of the people being governed. To what extent does that role extend the physical protection from enemies to the protection of resources for the general welfare? And, consequently, to what extent does the government have authority to control water resources that the state has already indicated are under its jurisdiction?

These views are responses to the question: to what extent does the federal government hold, protect, and manage public resources for its citizens? "The Public Trust Doctrine is an ancient legal theory with its origins in English law. In the United States, it can be defined as the right of the individual state to regulate and control its navigable waters and the lands underlying them on behalf of its citizens' interests in certain public uses, namely navigation, commerce, and fisheries" (Casey, 1984). Casey further asserts "that the Public Trust Doctrine … affords far-reaching protection to public rights of access … and that, in contrast, the underlying principle of California's water law, indeed of western water law, is maximum beneficial use … which often require[s] diverting water from its natural channels. These large scale diversions have a disastrous effect on protected trust interests."

Grounds for challenging appropriation rights in the general public interest have been upheld (*National Audubon Society v. Superior Court of Alpine County*, 1983), with the consequence that instream uses are protected. This interesting case presents a challenge to future water litigation: can the public's interest in water be better served by being used for agriculture to supply food for the people who live in urban areas, or by being used directly by urban dwellers for domestic supply? There are, of course, a variety of other nondomestic urban purposes such as watering lawns or open space maintenance, both of which reflect on and affect the quality of life. Here, the situation is not one that relies on the original ownership of the land and other resources obtained by the federal government, but rather on the function of government.

Water uses that are now considered as beneficial uses under the appropriation doctrine are requiring quantification. This is especially true for recreational uses, including fishing, aesthetics, and on- and in-water activities. Estimates of requirements for instream flows for National Parks and other governmental jurisdictions demand innovative and often questionable values for stream discharges. Determination of instream flow values for fishing, for example, with and without the diverted use, is proposed along with willingness to pay on the part of the recreational users to derive marginal values and subsequent discharge quantities (Hanson and Hallam, 1991). In a recent decision (*Kraft v. Burr*, 252 VA 252, 1996), a riparian land owner who sought to prevent access to adjacent navigable waters as a successor to a royal grant obtained standing by the court for review of this principle, "possibly for the first time in centuries" (Roos-Collins, 1999).

Summary

The use of surface waters in the U.S. is allocated according to the utilitarian Riparian and Appropriation Doctrines. The Riparian Doctrine, applicable in the states east of the Mississippi River, with some modifications, vests the right to the reasonable use of water undiminished in quantity and quality in the ownership of the lands that border the stream. However, protection of quality has been accomplished in other ways since a Supreme Court decision in 1886 made individual rights subservient to those of industry.

The Appropriation Doctrine pertains to the states west of the Mississippi River and is based on a first-in-time, first-in-right concept. Originally, the water had to be diverted from its natural watercourse and had to be put to beneficial and continuous use in order to perfect the right. The first criterion has been successfully challenged on economic grounds and in most western states, the water need no longer be diverted from the stream to establish a valid appropriation.

In California, the two doctrines are combined in the Correlative Rights Rule, which applies to ground and surface water conflicts that were resolved by that state's Limitation (or Counties of Origin) Act. The Appropriation Doctrine provided the means for establishing rights to streams that flowed from one state into another. Since the 1922 decision in *Wyoming v. Colorado*, the basis for interstate compacts to manage water quantity and quality on a regional basis has been available and widely used. Supreme Court decrees are also available to resolve differences between states and to provide the basis for interstate compacts.

In the western states, the original ownership of the public domain lands by the federal government had led to the assertion by the U.S. that it retains rights to water and to the allocation thereof to whatever extent it had not disposed of them, which it hadn't. This is in spite of state constitutions that included the Appropriation Doctrine, to which the federal government acquiesced by congressional approval when the states were admitted to the Union. The potential for the U.S. to usurp state law and to take unappropriated waters, if such exist, jeopardizes existing appropriations and the monumental private and governmental investments associated with them. In spite of this potential economic upheaval, there is a consistency in the U.S.'s claim to waters that carries an implied reservation for use of waters from the date of reservation of land from the public domain, for a variety of purposes. Consequently, the status of western water rights has been complicated by the two conflicting doctrines, the states' Appropriation Doctrine and the federal government's Reservation Doctrine. The federal concept of reserved rights enunciated in the Winters Doctrine, which applies to water rights for Native Americans, has been generalized. All have merit and a solid historical basis. The amount of water to which Native Americans are entitled on the reservations to which they have been confined, and/or on which they continue to live, is a threat to the water security of all other citizens, regardless of whether they live east or west of the Mississippi River. Either some Native Americans are going to get very rich, or some nonIndians are going to have to defend their investments in ways that may not be conducive to peaceful living conditions.

Activities and Questions for Critical Thinking

1. Enter the significant precedent-setting cases on Plate 1, the timeline (page 8 after the Introduction).
2. What are the terms of surface and water rights in your state?
3. How do you think western water law would be structured today had the court not found in favor of the appropriation doctrine in *Irwin v. Phillips*?
4. Under the circumstances of your response to the preceding question, how do you think water rights for Native Americans would be structured?

Chapter 3

National Organizations

The national organizations derive their authority from several sources

Introduction

National organizations derive their authority from the constitution, Congress, and the courts. There are a large number of organizations that, in one way or another, attend to water and related land resources; they have been created and have evolved at national, regional, state, and local levels. Some of these organizations conflict with one another because of overlapping or ill-coordinated legislative or traditional mandates, or because of contradicting goals. Inevitably, there are also gaps in the overall management of the nation's resources. There are economic, social, and political pressures on the legislatures that create, modify, and control the agencies at all levels of government, as well, and they play a predominant role in shaping the institutions that carry out the public's wishes.

There are three general interpretations for the term "institutions" (Leonardo Scholars, 1975):

1. A specific rule or practice, such as the interest rate set on a government loan.
2. A general pattern of action, such as the institution of monogamous marriage or the institution of private property.
3. A specific organization exhibiting some charter, mission, or scope of authority.

All three types of institutions are discussed in this book. The first appears in relation to the only official residual function of the statutory Water Resources Council, a lingering necessity because an interest rate must be identified to complete economic analyses, as required by the 1974 Water Resources Development Act. The second kind of institution has many examples, the most obvious of which are the several water law doctrines described in Chapter 2. It is the third definition with which Chapters 3 and 4 are concerned. Each organization's pertinent history, its authority and responsibilities, its scope of activities, its relationships to other governmental units, and some public attitudes that bear on the organization's mandated objectives, will be the focus of concern.

The purpose of these chapters is, first, to present an overall picture of the water-resources managing units of government to enhance understanding of the existing political structure. Second, as the nation seeks ways to overcome new and existing problems, comprehension will make using or reconstituting that political framework more effective. The public, and those who interact with or lead governments at all levels, are required to be involved in the water resources decision-making process. Invariably, this process takes place through many organizations. Hopefully, our continued effort to maintain and enhance environmental quality for high quality and plenteous water will always require that interaction between government and the individual citizen, despite often conflicting demands. We must also maintain capability to change the institutional means by which we can resolve pressing issues. Viessman (1983) put it succinctly: "As time goes on, our social goals will shift, and these changes must be incorporated in our plans and programs. Institutions, as well as facilities, must be kept current." Considering the long time it has taken to evolve the current institutional framework in the U.S., it is definitely a good idea to be prepared to act. As Toffler (1970) pointed out, we do not have the luxury of plenty of time.

Why So Many Organizations?

The answer to this question lies in two truths. First, the need for the various functions of government did not all appear at the same time and, consequently, legislatures and administrators created the agencies to meet current needs. Second, the high degree of variability in the condition of the water resources in the U.S. demands a similarly high degree of variability in the approaches to their management. As problems have intensified by greater resources' use and increased population, and as communications and general knowledge concerning water resources problems have improved, there has been a continuing debate over whether and how to combine the natural resources managing agencies. This joining of agencies was originally recommended by the Hoover Commission (see Chapter 1) and will undoubtedly come about if and when conditions warrant. It was clearly impossible to bring about unification of all the resource management agencies in the 1970s since public distrust of government was high.

The American public fears that combining all the agencies under one roof will bring corruption, collusion, in-house suppression of facts and information, and communications gaps. As a result, the ability to objectively and successfully make a decision that represents the public interest becomes impossible. Consequently, there is a real lack of faith in and support for any single government organization charged with the (complete) responsibility of comprehensive water management. In fact, agencies that approach such a comprehensive mandate have often been a source of scandal in recent years, brought on by the involvement and concentration of money and power.

However, despite the proliferation of agencies, responsibilities, and programs, there is a legitimate displeasure with the current federal structure. Many political commissions and committees examined the functions and interactions of the resource-managing units of the federal government during the 20th century. Scholars of political science have noted that the principal failure of our ability to effectively manage the resources that sustain us is not a technological failure, but, rather, a failure to build institutions (Kneese and Schultze, 1975; Leonardo Scholars, 1975). "But," according to Rogers (1993), "institutions also look after their own survival, often outliving their utility or the goals that brought them into existence."

The Establishment

The organization of this chapter is designed to simplify the complex political and functional structure of the federal government. Since different federal agencies have different functions, it would seem prudent to keep them separate. The federal agencies are thus described and discussed according to their five broad functions of Land Management, Construction and Operation, Regulation and Enforcement, Research and Inventory, and Coordination.* Universal, similar arrangements at the state and local levels

* Recent changes have suggested removal of one of the Construction and Operation agencies (Soil Conservation Service, now the Natural Resources Conservation Service) and another agency (Bureau of Indian Affairs) in a subcategory (Advisory Agencies) of the Land Management group. But, for the reasons presented, they remain in their former categories.

do not exist, so examples of state, local, and private organizations are presented separately in Chapter 4.

The National Organizations

Federal Agencies

Federal agencies, the units of the executive branch, carry out a variety of legislative mandates. In Table 3.1, these are arranged by function with an explanation of each agency's principal activities, its date of creation, and the statute or organic act that created it. The identification and combination of the functions are somewhat arbitrary, providing a comprehensive grouping of the agencies. Again, there is considerable overlap; most of the agencies have responsibility for considerably more than one function, and the classification is based on the primary mission of the agency. Thus, while almost all agencies administrate some land, most (91 percent, in fact) federal lands are administered by only five agencies. Furthermore, the Natural Resources Conservation Service, formerly the Soil Conservation Service, underwent reorganization and experienced a major change in mission in 1994. But, with the word "service" still in its title, and still involved in construction projects, albeit at a smaller scale than in earlier days, it remains in the Construction and Operation category.

The distribution of federal (and nonfederal) land by states is shown in Table 3.2. The clear message from this table is that the distribution of federally administered land is quite lopsided. Nearly 46 percent of all federally administered lands are in Alaska, where 98 percent of the state is under the jurisdiction of the federal government, and, nearly 70 percent of the all lands in the top ten states are federally administered. Two thirds of those federal lands in Arizona are in Indian reservations (see Table 2.2). The distribution of the lands by federal agency is shown in Table 3.3.

One agency, the Office of Management and Budget (OMB), plays both an indirect role in water and related land resources by controlling agency budgets, and a direct role by influencing (or reflecting) administration policy with regard to both fiscal and water resources policy. In the first instance, OMB has functioned "to assist the President in his program to develop and maintain effective government by reviewing the organizational structure and management procedures of the executive branch to ensure that they are capable of producing the intended results" (Office of the Federal Register, 1980). Second, in addition to the Budget Director's advice to the President that includes recommendations on all aspects of budgetary control from broad fiscal policy to itemized expenditures, the OMB may assist in the "preparation of proposed Executive Orders and proclamations [and] in the development of regulatory reform proposals."

This was the case with the 1973 Principles and Standards, and may involve individual project review as well. Created in 1921 as the Bureau of the Budget in the Department of the Treasury, OMB was reestablished in the Executive Office of the President and was authorized by Reorganization Plan 2 and Executive Order 11541 of 1970. The amount of control that OMB exercises over water resources policy and governmental programs depends upon individuals in several key locations, the degree of autonomy under which they operate, and the extent to which fundamental fiscal and water resources polices are structured and articulated by the Administration in power.

In the discussions of each agency that follows, attention is given to those aspects that are particularly important from the viewpoint of water and related land resources and, as in previous chapters, they are described in a historical perspective.

Land Managing Agencies

Of basic concern in the management of water and related land resources is the biophysical relationship between forests and water yield. In a 1956 article, Rosa and Croft called attention to the need for water users, especially in the western states, to deal with the relationship between vegetation change and water available for runoff. As they put it, "the amount of water required to prime the soil mantle so it will percolate water to streams may be changed by one or two inches on plots by changing grass cover to mixed weeds and vice versa" (Rosa and Croft, 1956). The legal aspects of this concern are discussed in Chapter 2, and one must keep in mind that the land-managing agencies can intentionally or inadvertently affect runoff.

Bureau of Indian Affairs (BIA)

The Bureau of Indian Affairs was originally established in the War Department and has since moved and changed its mission. Originally, its mission was oriented toward termination of the reservations and, presumably, the Indians. It changed in the mid-twentieth century from assimilating Indians into U.S. culture — "termination" as the policy was known — to helping Indians achieve self-sufficiency and maintain their cultural heritage as well. The 52 million acres administered by the Bureau for its "wards" are some of the worst lands in the U.S. This reflects the attitudes of the pioneers and the politicians of a century or more ago who denied the Indians their equal rights, destroyed their heritage, and ran roughshod over them to conquer the frontier (Weeks and Gidney, 1981). While a few of the tribes

Table 3.1 Federal Agencies with National Responsibilities for Water and Related Land Resources

Function and Agency	Date	Authority	Department	Major Responsibilities	Special Notes
Land Management					
Bureau of Indian Affairs	1824	48 Stat 984 25 USC 461	War Interior	Forest, range, and water management, education, representation	Trustee for Native Americans; original mission was to assimilate tribal members into western civilization, now to celebrate and develop cultural heritage
Forest Service	1905	33 Stat 861	Interior, Agriculture	All renewable resources, administration, research, and state and private forestry and related activities	Under Multiple Use and Sustained Yield Act, Forest and Rangeland Renewable Resources Act, and Forest Management Act
National Park Service	1916	39 Stat 535 16 USC 1	Interior	Preservation and scientific investigation of, and recreation on unique natural and historic areas	Management funds provided by Land and Water Conservation Fund Act of 1965
Fish and Wildlife Service	1940	70 Stat 1119	Interior	Management of fish and wildlife habitat; development review	Was Bureau of Sports Fisheries; 1946 Wildlife Coordination Act
Bureau of Land Management	1946	5 USC 133	Interior	Renewable resources management and research on public lands	Created from General Land Office, Taylor Grazing Service
Construction and Operation					
Corps of Engineers	1774		Continental Congress	Survey, defense construction, emergency assistance services	Authority uncertain
	1824	4 Stat 22	Army	Rivers and harbors, roads, canals	Official creation by General Survey Act
	1899	30 Stat 1152		Permits for dumping in navigable streams	"Refuse Act," extended by PL 92-500 in 1972; wetlands
	1936	49 Stat 1540		Downstream flood control responsibility	Major flooding prompted Omnibus Flood Control Act

	1965	79 Stat 1073		Water supply and recreation	1960-64 drought prompted Northeast Water Supply Act
	1972	PL 92-367		Dam inspections	Numerous dam failures prompted Dam Safety Act
	1974	88 Stat 12		Nonstructural alternatives for floodplain management	Water Resources Development Act
	1990	33 USC 2330		Flood control, navigation, and environment equal missions	Aquatic ecosystem restoration, 1990 Water Resources Development Act
Bureau of Reclamation	1902	32 Stat 388	Interior	Water for arid, irrigable lands in western states; hydropower	Works with districts, governments, and companies
Soil Conservation Service, now the Natural Resources Conservation Service	1933 1994	49 Stat 163 108 Stat 3225	Agriculture	Land classification and soil surveys, flood prevention and control, land evaluation, services to homeowners, nonpoint sources of pollution, wetlands, and incentive programs for nonpoint source pollution control	Upstream flood prevention responsibility by 1936 Omnibus Flood Control Act; Watershed Protection and Flood Prevention Act (1954); wetlands and highly erodible land by Food Security Act (1985)
Tennessee Valley Authority	1933	48 Stat 58	Independent	Comprehensive land and water management throughout basin	Justified on bases of defense, economic condition, hydropower development
Regulation and Enforcement					
Interstate Commerce Commission	1887	24 stat 379	Independent	Regulation of carriers, sets and settles interstate freight rates, rules on control issues and new railroad lines	Duties transferred to Surface Transportation Board and Federal Highway Administrator (1995)
Federal Power Commission	1920	41 Stat 1063	Independent	Licenses hydropower sites on navigable streams, public lands	Now Federal Energy Regulatory Commission in DOE
Flood Insurance Administration	1968	42 Stat 4001	Housing and Urban Development	National Flood Insurance Program	Title XIII of the HUD Act
Environmental Protection Agency	1970	Reorganization Plan 3	Independent	Pollution control and abatement; permits; research and grant programs for treatment plant construction; hazardous wastes	Combined functions of several existing agencies; now also monitors Environmental Impact Statement process

Table 3.1 Federal Agencies with National Responsibilities for Water and Related Land Resources (Continued)

Function and Agency	*Date*	*Authority*	*Department*	*Major Responsibilities*	*Special Notes*
Research and Inventory					
Geological Survey	1879	20 Stat 394 43 USC 311	Interior	Mapping, hydrologic data collection and research projects and grants for research, benchmark watershed program	Also performs land, geologic and mineral resources surveys, and arid lands assessments
National Weather Service	1890	20 Stat 653 15 USC 311 Reorganization Plan 4	Signal Corps, Agriculture, Commerce, and NOAA	Flood and fire weather forecasting, data collection, and research	1970 Reorganization Plan 4 relocated NWS, formerly known as the Weather Bureau in NOAA
Agricultural Research Service	1953	Secretary of Agriculture memo 1320	Agriculture	Conducts soil-water-vegetation research at numerous experiment stations	Combined with other USDA Service agencies in 1978 into Science and Education Administration (SEA)
Office of Water Research and Technology	1964	78 Stat 329	Interior	Promotion, coordination, and funding for research	From Water Resources Research Act; now abolished
National Oceanic and Atmospheric Administration	1970	Reorganization Plan 4	Commerce	Explores, maps, and charts the global oceans, atmosphere, and space environments	Combined many organizations with similar charters under one administration
Coordination and Study					
Senate Select Committee on Water Resources	1959	Senate Resolution 48, 86th Congress	Congress	Thorough federal investigation of all water resources issues; also known as the “Kerr Commission”	Recommendations for legislation included bills on pollution, research, planning, and further study

Water Resources Council	1965	79 Stat 244 42 USC 1962	Independent	Coordination of all federal water activities; established flood control regulations, and Principles and Standards	From Water Resources Planning Act; not funded since 1983
National Water Commission	1968	82 Stat 868	Independent	Thorough non-federal study of all water issues	Report filed 1973, as required; terminated as planned
Council on Environmental Quality	1970	83 Stat 652	President	Policy, research, advise to President, Congress, and the public	Created by NEPA, established EIS guidelines and regulations
National Study Commission	1972	PL 92-500 33 USC 466 §315	Independent	Charged with reporting on necessary adjustments by 7/1/77, half-way to the act's goals for 1983 and 1985	Also known as the Rockefeller Commission after its chairman

Sources: this table compiled from many sources, including The United States Government Manual 1998-1999, government agency, U.S. Code, and Federal Statutes web sites.

Table 3.2 Distribution of Federal and Nonfederal Lands in the U.S. (in thousands of acres)

State	*All Lands*	*NonFederal Lands*	*Federal Lands*	*Federal as a Percent of Total*
Alaska	365,482	6,348	359,134	98.3
Nevada	70,264	9,758	60,506	86.1
Idaho	52,933	19,174	33,760	63.8
Utah	52,697	19,167	33,530	63.6
Oregon	61,599	29,258	32,314	52.5
Wyoming	62,343	32,013	30,330	48.7
California	100,207	53,505	46,702	46.6
Arizona	72,688	40,674	32,014	44.0
Colorado	66,486	42,878	23,608	35.5
New Mexico	77,766	51,893	25,874	33.3
Subtotals	982,465	304,668	677,772	69.0
Rest of U.S.	1,288,878	1,196,811	92,091	7.1
Totals	2,271,343	1,501,479	769,863	33.9

do have fine renewable and mineral resources on their reservations, most of the lands on which the Indians were located are marginal insofar as crop, forest, or range production is concerned. Owing to a host of changes that have come about since the growth of the American Indian Movement in the 1960s, Native Americans are beginning to see an improving economic situation. This is the result of ongoing land claims against the "treaties" of the 19th century, better education and resources management, economic opportunities in the form of enterprises from handicrafts to gambling casinos, and, in no small part, the settlement of water rights claims.

Water and related land resources management problems range from too little water to too much. Drought conditions typically plague the Navajo, who barely eke out a living in northeastern Arizona. And there is too much water on the reservation of the Seneca, where the oldest "treaty" (Weeks and Gidney, 1981) of the U.S. (from 1794) was broken in order to build Kinzua Dam and Reservoir on the Allegheny River in southwestern New York (Laycock, 1970). On the Columbia and Klamath and many other rivers, and on the Great Lakes, there are fishing rights concerns. Many tribes — including several in the eastern states — are currently seeking return of promised lands from treaties broken long ago, and are meeting with some success. In addition, limited success with court

Table 3.3 Federal Agencies Administering More than One Million Acres of Land in the U.S.

Agency	*Acres Administered**	*Percent of Total*
Bureau of Land Management	470,383,250	54.0
Forest Service	186,914,250	21.5
Fish and Wildlife Service	94,000,000	10.8
Bureau of Indian Affairs	52,017,550	6.0
National Park Service	23,311,850	2.7
Bureau of Reclamation	8,680,150	1.0
Corps of Engineers	7,148,150	0.8
Nuclear Regulatory Commission	2,139,700	0.3
Subtotals	844,594,900	97.0**
Other military agencies	23,657,500	2.7
All other federal agencies	2,144,450	0.3
Totals	870,396,850	100.0

Source: Bureau of Land Management (1969)

* Rounded to the nearest 50 acres.
** By calculation, not summation.

settlement of water rights cases has prompted negotiation of the issues (McCool, 1997). This approach is preferred because it can be nonconfrontational and involves government as well as private interests. The alternative is litigation, which is time-consuming, expensive, confrontational, and nearly always results in an appeal that has the same unfortunate characteristics. The Bureau of Indian Affairs and other units of federal, state, and tribal governments are all stakeholders in these proceedings and are actively involved in a large array of activities and with a wide variety of cultural and economic objectives (Keeney, 1997).

In sum, the Bureau is faced with the principal problem of effective, efficient, and equitable management of the Indians' resources in consideration of the Native American cultures. In the West especially, successful management is dependent upon the outcome of the current conflict regarding water rights. Elsewhere, the problem is one of sufficient land for economic and sustainable management of agricultural, forest, and wildlife resources, as well as the water necessary for irrigation. Many of the eastern reservations, however, are state-sanctioned or have the use of separate nation status.

Forest Service (FS)

Responsible for the management of all renewable resources on 188 million acres of land, the Forest Service has a particularly important role in water and related land resources. The Charter Act of 1897 stated, "No national forest shall be established except to improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of the United States." This language is important to several soil and water conservation concerns, as discussed in Chapter 2. These include the rights of the federal government to water on former public domain lands (*Nebraska v. Wyoming*), the reservation doctrine (*United States v. New Mexico*), and Native American water rights (*Winters v. the United States*). Other FS lands, including those acquired under the Weeks Act of 1911 and the Clarke-McNary Act of 1924, were those that reverted to the government after homestead failure, by abandonment, or for nonpayment of taxes (or all three). In most cases, these were high-elevation lands that were not suited for farming, but did receive high annual precipitation. As a result, the forest cover was able to protect the soil, and the high runoff that the rains and snowpacks yielded became one of the more important resources of the national forests.

Originally located in the Department of the Interior, the Bureau of Forestry was moved so it could effectively manage the lands reserved under the 1891 Act that were under the jurisdiction of the Department of Agriculture. Acquiring its new label as the Forest Service in the 1905 move, the organization sought, in the words of its progenitor Gifford Pinchot, "to provide the greatest good for the greatest number in the longest run." Pinchot not only adapted the word "conservation" to mean wise use, and with it the extensive resource development necessary to the economic times, but he also set standards for government employees and foresters, regardless of their employers. Pinchot's keen political insight (he served as Governor of Pennsylvania after retiring from the national scene) aided in coordination of many resource conservation topics. These included mapping by the Geological Survey, power site reservation by the Inland Waterways Commission, timber harvesting by private companies, and national trends and needs through his close association with President Theodore Roosevelt.

The FS is organized into four branches. These branches administer the National Forests, the FS research program, an international program, and coordination of all pertinent program activities with state and private forest (S&PF) entities. National Forest Administration challenges pertinent to the prime concern of this book are primarily legal ones. These challenges arise from changes in water yields as a result of forest cutting and re-growth. Other important problems deal with water quality control, especially on the many acres reserved or restricted in use for municipal water supplies. The Research Branch has several outdoor laboratories of world renown studying effects of forest practices on water yield and quality (plus all other forest areas of scientific inquiry). The Branch of State and Private Forestry cooperates with those units (as the name implies) to disseminate information and bring about effective management that need not be tied to only one governmental level. Most recently, nonpoint source pollution control has become the focus of a major portion of this branch.

Identified as one of the suspected primary sources of pollution (primarily from sediment production on logged lands), silvicultural activities were included in the list of nonpoint sources in Section 208 of the 1972 Water Pollution Control Amendments. Research has shown that this is not as serious a problem as originally thought, that other nonpoint sources are more significant, and that there are other water quality considerations on logged areas. The sediment production tends to be limited to the immediate vicinity of the logged areas in time and space, but the public still has aesthetic concerns. The FS is improving both its public image and its management of problem areas. As expected, a relatively small amount of attention paid to critical zones on watersheds where logging and product removal operations have the potential to cause damage, provides large dividends in improved water quality.

A major problem for the FS had been its ability to communicate effectively with the public, which made it clear that it wanted the FS to be more responsive. Currently, under the requirements of the National Forest Management Act of 1976, the FS is required to develop comprehensive land management plans for all administrative units. In the process of articulating those plans, the FS now communicates more effectively with the public and also provides the public with opportunities to respond (Cortner and Richards, 1983) and to feel involved in the agency's decision-making process. As is the case with most federal agencies, modern high-speed communication and longstanding dissatisfaction by the public is being effectively addressed. Many of the agencies are working hard to improve their image through partnerships and the Internet.

The FS has undertaken major management and research efforts in the realm of urban forestry, especially in the northeast. The proposed sale of a major tract of forest land in the highlands region of New York and New Jersey prompted a lengthy study of the area's ecology and development, funded by a special appropriation by Congress (Neville and Zipperer, 1993). A multi-million dollar research project on the impacts of urbanization and urban forest trees on water quality and other environmental conditions was launched in Baltimore. The FS is a most effective agency, and detailed histories may be found in Pinchot (1947) and Coyle (1957), while an administrative study is presented by Kaufman (1960). A thorough, referenced, and up-to-date source of information on the Forest Service history, policy, and challenges may be found in a report by the Society of American Foresters (Floyd, 1999).

National Park Service (NPS)

The National Park Service was created in 1916, as part of the backlash to the preservationists' defeat in the battle over the Hetch-Hetchy in California. The NPS is charged with the dual responsibilities of preserving the scenic and historic resources under its jurisdiction and making them available for "the enjoyment and education of our citizens" (Office of the Federal Register, 1980). Many of the parks were in existence long before the NPS was created. All types of recreation areas — national parks, national monuments, and historic sites — were consolidated under the NPS jurisdiction by President Franklin Roosevelt in 1933, and the lands were not to be used for any commercial purpose (Dana, 1956).

Parks make up 22 percent of all the NPS lands. Other recreation areas make up 4.6 percent of the NPS lands. Many of these, such as the Lake Mead Recreation Area, surround water facilities, often constructed by the Bureau of Reclamation, the NPS's sister agency in the Department of the Interior. And 73 percent are in National Monuments and other areas, including about 40 million acres (56 percent) added to the system in 1978 in Alaska (Bureau of the Census, 1980). As noted in Chapter 1, about 10,300 square miles in nine National Parks are of particular significance with regard to water yield. This is only about 9.3 percent of the total area under the NPS administration. However, these lands are important from the standpoint of public attitudes toward water, government, and the NPS itself, not just because of the physical, chemical, and biological characteristics of the water that flows from them. Thus, the areas administered by the NPS are of particular interest and importance to the nation's water resources.

Current visitor load for all NPS areas is about 282 million visits per year; a disproportionate 26 percent of those visits are made to only nine NPS areas that comprise a mere 13.9 percent of the total area. There are considerable pressures to make use of the many thousands of acres that are used indirectly as scenic backdrop for the relatively few intensively used acres in Rocky Mountain, Yellowstone, Yosemite, Glacier, Great Smoky Mountain, and Grand Canyon National Parks. Most visitors stay within a few hundred yards of the principal access routes, and only a handful enters the more remote areas (Brockman, 1959). Minerals exploration as well as limited timber harvesting (owing to generally poor commercial value) are continually proposed for the large tracts of many of these "unused" NPS lands.

Campgrounds in the more popular parks are often as crowded as the communities the vacationers left behind. Because sanitary facilities and the assimilative capacities of thin mountain soils and fragile ecosystems are often overtaxed, the quality of on-site as well as off-site water supplies is often threatened. Heavy vehicular traffic provides pollutants, often nitrous oxides, that may make significant contributions to acid deposition (Sun, 1985). In the face of limited budgets and multimillion-dollar budget cuts, the NPS is and will continue to be hard-pressed to provide both environmental controls to preserve the water-yielding resources of the high country and the mandated "use and enjoyment," or recreation, the prime reason for the parks' existence.

Fish and Wildlife Service (FWS)

The Fish and Wildlife Service is responsible for 26 million acres of prime wetlands* that play a vital role in the migration and sustenance of innumerable species of wildfowl and other fauna and flora. Its predecessor, the Bureau of Fisheries, was established in 1871 in the Department of Commerce. The Bureau of Biological Survey (est. 1885) under the Department of Agriculture, was combined with the Bureau of Fisheries in 1939, and the new agency (FWS) was created in 1940. In 1970, the Bureau of Commercial Fisheries was removed from the FWS to the Department of Commerce, leaving the Bureau of Sports Fisheries and Wildlife to become the FWS (Office of the Federal Register, 1980).

Of particular importance in the entire field of water resources is the role that the FWS plays in the review of proposals for construction that may impact fish and wildlife resources. The 1946 Fish and Wildlife Coordination Act** required project sponsors, notably the Corps of Engineers and the Bureau of Reclamation, to inform the FWS of their plans. Any proposal to dam or manipulate a river or to commence construction of some other project that would impact areas of mandated concern (especially habitat) to the FWS, for example, drainage, channel straightening, or dredging, required notification of the FWS. The FWS might then expend considerable time and energy attempting to conduct research and to obtain support for their stand against the project proposal (if that were

* With the associated dry lands, the agency is responsible for managing more than 93 million acres (Table 3.3).

** The 1946 Act was actually an amendment to the original version, enacted in 1934, which focused on wildlife (Rogers, 1993) and was largely voluntary and ineffective. So was the 1946 version, according to Veiluva (1981). Veiluva also points out that the 1934 Act was Congress' response to growing concern over the effects of urban growth along the Potomac River on riverine resources.

the case). But the results of the FWS studies only had to be considered, not necessarily taken into account in the sponsoring agency's decision (Veiluva, 1981). The Coordination Act, strengthened by the 1958 amendment, required the project sponsor to await comment from the FWS and to take positive action to enhance fish and wildlife resources. The basic concept of adequate time for review and timely response from organizations is now incorporated in the Environmental Impact Statement process (Black, 1981).

Owing to the very nature of the lands under its jurisdiction, the FWS is responsible to the public for a wide variety of water-related resources. Its activities include biological monitoring in basic research; surveillance of pesticides, heavy metals, and other pollutants; environmental impact assessment and EIS review; and cooperative efforts in planning with states and other federal agencies, especially in regard to river basins. The FWS activated a plan in 1999 for the control of heavy metals, especially lead, in its wetlands by requiring anglers to use nontoxic sinkers and jigs in 13 "Lead-Free Fishing Areas" in order to protect common loons.* This program is in addition to the agency's program of supporting lead-free shots for wetlands hunting activity in 1976 (Fish and Wildlife Service, 1976).

The FWS is a significant contributor both to the preservation and enhancement of fish and wildlife resources in the U.S. and to protection of the critical water resources for which it is responsible. These aquatic ecosystems, the extensive coastal and inland wetlands, constitute critical habitat and haven for fish, wildlife, and migratory waterfowl. Interacting with larger aquatic ecosystems, they are of major concern to the overall water resources of the nation and are a focus of continuing controversy over endangered species.

Bureau of Land Management (BLM)

Created in 1946 from the merger of the General Land Office and the Taylor Grazing Service, the Bureau of Land Management is the largest land administrator in the nation.** The General Land Office was created in 1812 to administer the survey, disposal, and settlement of the public domain lands that had been added to the U.S. by the 1803 Louisiana Purchase. The Taylor Grazing Service was created in 1934 to administer

* Information from http://news.fws.gov/newsreleases/Display.cfm?ID=141&TimePeriod=30 on April 8, 2000.

** According to the BLM web site, "The BLM's roots go back to the Land Ordinance of 1785 and the Northwest Ordinance of 1787. These laws provided for the survey and settlement of the lands that the original 13 colonies ceded to the federal government after the War of Independence." (http:www.blm.gov/ June 1999.)

the issuance of grazing leases on public domain lands. With virtually all the public domain lands surveyed and settled, and with much of the grazing activity on reserved lands administered by the Forest Service, a new agency was needed to administer the remaining resource management responsibilities on the public domain.

The BLM administers about 417 million acres* in the western states (including Alaska) as well as the mineral rights to an additional 169 million acres of lands "where mineral rights have been reserved to the federal government" (Office of the Federal Register, 1983). The 417 million acres constitute 54 percent of all federal lands. (Only 0.3 percent of Connecticut is federally administered; 98.3 percent of Alaska, most of which is BLM responsibility, is federally administered.) Except for Alaska, these lands are not as important from the standpoint of water supplies as are the lands of the Forest Service and the National Park Service. Nevertheless, they are important because they contain many other resources, especially energy resources such as uranium ore, and coal and oil shale, the development of which may significantly affect water yields, use, and quality.

BLM lands are administered under the Classification and Multiple Use Act of 1964 (Dolgin and Guilbert, 1974), similar to the one enacted in 1960 for the National Forests. The attention of the BLM had been focused primarily on grazing lands, an inheritance of the Taylor Grazing Service's responsibilities, and on long and continuing haggling with the cattle and sheep ranchers who use federal land for forage, not available on their own limited, arid land holdings (Gates, 1968). Current conflict on the BLM (and FS) grazing lands centers on whether there should be higher fees for permits, or no public land grazing at all. The arguments are:

- Ranchers using public lands for sheep and cattle grazing enjoy an unfair advantage over those who gaze their stock entirely on private lands.
- Grazing is detrimental to the public lands and to the runoff emanating therefrom.
- Restoration is supported by broad-based tax dollars.
- Cost to the federal government for restoration and water quality protection is far greater than the revenues, which make up an infinitesimal proportion of the agency income.

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* In 1983 the figure was down to 341 million acres (Office of the Federal Register, 1983), owing largely to transfers to private individuals and to the National Park Service in Alaska. Such transfers among the agencies, grants and exchanges with individuals and other organizations, and alterations of categories make placing faith in the numbers represented in Table 3.3 (compiled from BLM data in 1969) extremely risky. The BLM does remain, however, the largest land administrator in the U.S.

These and other issues specific to geography and politics need to be considered in light of other policy issues raised in Chapter 6.

The BLM also holds 2.6 million acres of prime Douglas fir forest in western Oregon. These were the former Oregon and California railroad lands that reverted to the U.S. following determination of fraud when they were originally secured from the public domain. (For a time, these lands were under the jurisdiction of the FS.) Another 2.4 million acres were formerly Land Utilization Projects under Soil Conservation Service administration. Like the FS, the BLM manages the timber for harvest, and it realizes revenues from this activity as well as from mineral and grazing leases. Guided by the multiple-use concept, the lands, like those of the FS, should continue to provide varied products, including water.

The situation is more tense in Alaska as Alaskan natives, the state, lumber and oil companies, prospectors, homesteaders, grizzlies, and moose all vie for the large tracts of land necessary to sustain life (and, indeed, a way of life) in an often hostile environment (McPhee, 1977). Little is said, even in the definitive study by the Public Land Law Review Commission's report *History of Public Land Law Development* (Gates, 1968), about the BLM in Alaska:

> The public lands have been managed or disposed of through a complex, confused, and intricate mixture of laws — said to be more than 5,000 — supplemented by an even greater number of administrative decrees. These laws sometimes have worked hardships on individuals, and have involved administrative officers in detailed examinations of minute questions that have delayed decisions, and produced vexing tangles, necessitating appeals to the courts. On the other hand, the delays may have prevented unwise decisions.

Clearly, for the agency with the greatest amount of land to administer, much remains to be accomplished to effectively manage the water and related land resources in its charge.

Construction and Management Agencies

The four major construction agencies are discussed in this section. One, the Tennessee Valley Authority, is also properly considered as a regional organization and is therefore discussed in detail in Chapter 4. All four are linked in that the 1981 *Principles and Guidelines* apply only to them; these four construct and therefore account for nearly all of the major water projects in the nation.

Corps of Engineers (COE)

Because protection of navigable waters is necessary for defense and because only a unit with technical capabilities could accomplish that purpose in 1824, the Corps of Engineers became "the first construction agency" (Holmes, 1972). Rivers, of course, were also vital means of transportation for commerce and settlement. The COE built roads, forts, canals, and in 1824, received its first civil works responsibilities (Laycock, 1970) in the General Survey Act, which was later repealed. "It is noteworthy," says Holmes (1972), "that the Corps' planning responsibilities for river and harbor improvements, which also began in 1824, were not authorized generally by the General Survey Act but by separate congressional enactments." The implication is clear — the COE had established a direct pipeline to the coffers of Congress (Drew, 1970). While the Corps still enjoys that relationship, it has responded to the demands for greater environmental responsibility and, indeed, has led the way toward establishment of higher standards of environmental quality and the constructive use of partnerships to achieve them.

The Corps has been at the forefront of the federal agencies that have responded positively, and even led, in the late 1960s, to the environmental movement (Moody, 1983b). It has always had strong views about its mission in conservation, and it has, in addition to causing some serious environmental disasters (Moody, 1983b; Morgan, 1971), provided many communities with life- and property-saving projects. It has a nasty reputation to live down, however: for many people, rampant bulldozing of the environment is synonymous with the construction activities of the COE and the Bureau of Reclamation. The dichotomous view of the COE and the Bureau is caused by the nature of the traditional water project. "A dam or a levee is, literally, a concrete symbol the congressman can point to to show he can bring home the bacon" (Moody, 1983a). Civil works may be monuments to a legislator's political clout, but they may also be persistent reminders of environmental devastation. They are also monuments to the development of civilization, which may or may not be looked upon favorably.

The extensive network of Divisions and Districts (Figure 3.1) enables the close communication linkages necessary to support water and related land resources management close to the place of need or problem. The Chief of Engineers is responsible directly to the Director of the Army Staff, and "provides engineering, construction management, and environmental services in peace and war. The civil works program includes navigation, flood damage reduction, recreation, hydropower, environmental regulation, and other missions." In addition to providing services to all army and air force bases, the COE "supports other federal agencies and responds

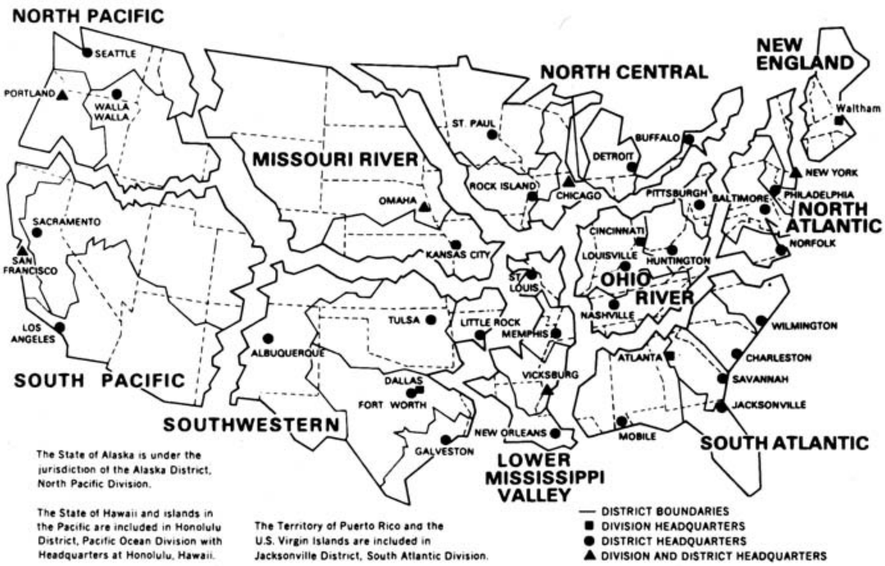

Figure 3.1 Divisions and districts for Corps of Engineers' civil works activities.

to natural disasters and other emergencies as the Nation's primary engineering agency" (Office of the Federal Register, 1998). As noted in Table 3.3, the COE has acquired the water and related land resources responsibilities from a variety of legislative acts during its long existence.

Most of the COE's Civil Works Branch staff members are civilians, supervised by regular Army officers; the construction work is contracted out, usually to local contractors (Laycock, 1970). This tradition, along with opportunistic connections between contractors, banks, real estate monies, and local and national politicians, have given the COE its muscle and pipeline. Many canals, harbors, waterways, and other water resource developments apparently go to or connect with nothing other than a legislator's home town or district (Carter, 1977; Laycock, 1970; Morgan, 1971). For example, the late Senator Kerr's home community near Tulsa (in the middle of the Great Plains), is now a COE-built seaport (Drew, 1970). The 234-mile long Tennessee-Tombigbee Waterway that parallels the Mississippi River, too, runs through the home territories of Sen. John Stennis, former head of the Senate Subcommittee on Public Works, Rep. Jamie Whitten, Chairman of the House Appropriations Committee, and Rep. Tom Bevill, Chairman of the House Subcommittee on Energy and Water (Moody, 1983a). (See further discussion of this controversial project in Chapter 5.)

Despite some questionable projects and evaluation procedures (Conservation Foundation, 1971; McCaul, 1975; Parry and Norgaard, 1975; Reuss, 1971), the COE is complying rather well with the new environmental regulations (Moody, 1983b). Concurrently, it has expanded its zone of influence — in addition to its original military and civil works programs and projects (Table 3.1), the COE has numerous other authorities. These include:

1. Granting permits for dumping in navigable waters (Rivers and Harbors Act of 1899).
2. Maintenance of water quality in wetlands (Water Pollution Control Amendments of 1972 and the decision in *Avoyelles Sportsmen's League v. Alexander*, 1981).
3. Depositing dredged material in the ocean (Marine Protection Act of 1972). It acquired responsibility for flood control (1936 Omnibus Flood Control Act), water supply (1965 Northeastern Water Supply Act), dam safety (1972 Dam Inspection Act), and floodplain management (1974 Water Resources Development Act).
4. Environmental restoration and management (Water Resources Development Act of 1990), especially as implemented in association with the major renovation of the locks and dams on the nation's navigable waterways necessary to meet current and anticipated barge traffic volume.

The focus on floodplain management is due to: (1) pressures from the nationwide environmental movement in the 1960s and 1970s, (2) development of the best sites for structural measures, leaving nonstructural measure as preferred alternatives, and (3) high interest rates since the early 1970s (see Chapter 8). The COE responded positively to the 1974 Water Resources Development Act mandate to be more involved in floodplain management, as opposed to flood control measures, prompted by public concern over the previous three reasons (Dzurik, 1979). The COE is also active in the provision of disaster relief from local floods and other natural disasters, such as the cleanup following the 1981 eruption of Mount St. Helens. Most recently, the COE acquired the responsibility of environmental protection and restoration in the 1990 Water Resources Development Act. It now considers its navigation, flood control, and environmental responsibilities its three top and equal missions. In keeping with that mission, the Corps' North Pacific Division sponsored a comprehensive report entitled "Saving the Salmon" that tracks the long history, impacts, and strategies for restoration of the Columbia River salmon (Mighetto and Ebel, 1994).

In short, the COE is not only the first, but is also the most diversified and widely involved agency (both geographically and functionally) that manages water resources. It is also one of the best equipped and best financed agencies in the federal government. Whether its activities continue at this level will depend upon many factors, not the least of which is the active and effective participation of the public in policy and planning. In an article reporting studies of the COE and public participation, Dodge (1973) pointed out that "the planner must experience public participation and the public must experience a situation where its views are sincerely solicited and taken into account in the decision-making process". Six years later, Edgmon (1979) noted that "with the high degree of [COE] District autonomy came the District Engineer's reticence to delegate authority and unwillingness to recruit professionals skilled in citizen participation techniques. As [a] consequence, the process in some cases has been merely procedural, with no direct impact on the decision making process."

Long-range and regional planning and management are associated with the construction activities of the COE, and the organization obviously plays an important role in the nation's water and related land resources. There have been calls for reform of many aspects of the processes by which the COE becomes involved and is evaluated, in addition to calls for consideration of other programs and goals (Buehler, 1977; League of Women Voters, 1966; National Water Commission, 1973; and Schad, 1968, among others). If the COE is to succeed at its mandated multi-faceted mission of water resources management, it must actively take the public's views into account and give the public the feeling that it has, indeed, contributed to the Corps' projects and programs. Research points the way to achieving greater public participation (Priscoli, 1977), especially through the effective use of citizen advisory groups (Ertel, 1979).

Despite the fact that its image is still somewhat tainted, the COE has successfully changed its approach since the 1960s. Following the 1968 implementation of annually retaining an in-house expert who reviewed project proposals for environmental "red flags," the COE established an Environmental Advisory Board consisting of nine experts of diverse geographical and educational backgrounds to review policies, programs, and projects directly with the Chief of Engineers. In a 1967 pre-environmental movement depiction of how to get a project proposed, funded, and approved," the COE displayed a certain amount of bravado and exploitation of human, financial, and environmental resources (Figure 3.2). In contrast, a 1977 pamphlet entitled "U.S. Army Corps of Engineers and the Environment" states that "The Civil Works Program will be conducted in an atmosphere of public participation, trust, and mutual cooperation" (Department of the Army, 1977). Most recently, the COE states that "new environmental restoration authorities, studies and projects now emphasize management of watershed hydrology to return hydrologic variability which was often reduced by past engineering works" (Shabman, 1993). An excellent detailed analysis of the current COE operational process and the incorporation of an environmental mission is presented for the reconstruction of Lock and Dam 26 on the Mississippi River by Rogers (1993).

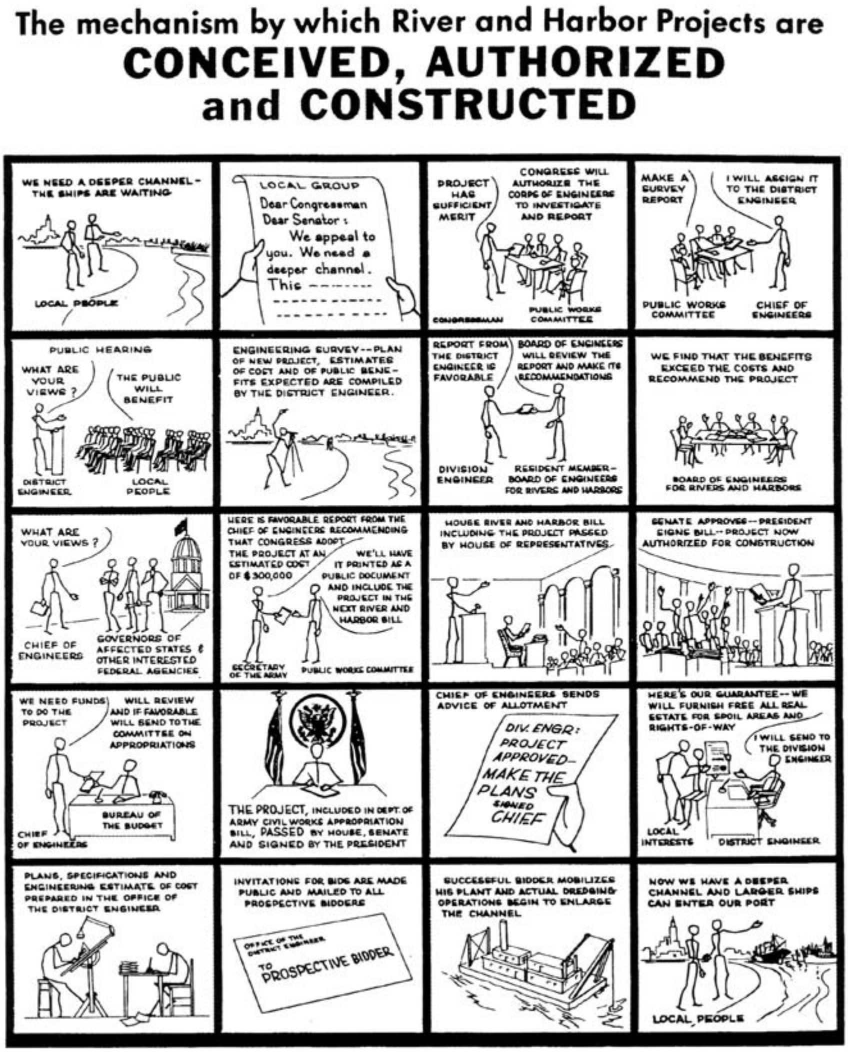

Figure 3.2 Twenty steps in the conception, authorization, and construction of civil works projects (Corps of Engineers, 1967).

Included in the current (year 2000) $4.064 billion dollar budget request of the Corps are major environmental projects, many of which are restorations of pre-construction conditions, such as the Everglades, riparian restoration, and fish mitigation measures (Showstack, 2000).*

* One of the frustrating failures of writing such a chronicle of active agencies is that nothing is static: new ideas and mandates are commonplace.

Attesting to the commitment of the COE to work with the public, the Corps of Engineers has been a leader in the development of effective partnerships with other federal agencies, state and local governments, nongovernment organizations, and private citizens.

Bureau of Reclamation (BR)

All of the Bureau of Reclamation's lands and regional offices are located west of the Mississippi River. The BR maintains a major research facility at the Denver Federal Center where models of various water control projects are tested (the Waterways Experiment Station, a similar facility of the COE, is located in Vicksburg, Mississippi). Major projects are built both in the western states and in foreign countries. Originally created as the Reclamation Service in the Geological Survey, the BR was made a full-fledged bureau within the Department of the Interior in 1902, although it did not receive its present name until 1923. In 1979, the name was changed to the Water and Power Resources Service and, subsequently, changed back to the BR. The insertion of the word "power" in the name reflected the major by-product of dams built by the BR, as well as the fact that usually 80 percent of the major irrigation project costs are repaid by the sale of power, not the sale of a project's primary product, irrigation water that repayment under the Small Reclamation Projects Act of 1956 limits the amount of the share paid by power to no more than 50 percent.

The BR is authorized "to locate, construct, operate, and maintain works for the storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the Western States" (Office of the Federal Register, 1980). While not listed as a land-managing agency, the BR does have the responsibility for 8.7 million acres (Table 3.3) and influences land use as much as, if not more than, any other organization (Barnes, 1971; DuMars and Ingram, 1980). The BR contracts with irrigation districts for the sale of water and with various other governmental units (from municipalities to the Rural Electrification Administration) and private companies for the sale of power. The BR's 1978 installed capacity was about 7 million kilowatts (kw), or 13 percent of the total federal power capacity. Combined with the 17 million kw installed by the COE and the 27 million kw by the TVA, the three agencies have over 94 percent of the federally installed capacity. Nevertheless, to put that figure in perspective, the federal total is under 10 percent of the installed capacity of *all* electric utilities (Bureau of the Census, 1980). The BR also is active in cooperation with other government agencies in riparian zone management. The need to control phreatophytic ("water loving") vegetation is acute, especially where salt cedar (*Tamarix* spp.), an introduced species, has spread widely throughout the western states and transpires large amounts of precious water into the atmosphere. Clearly, while the BR has an impact on land, water, and grocery prices, it impacts electricity production nationwide. Its far-flung, 15,000-mile network of transmission lines is part of a network throughout the western states that is connected to other regional networks. Its benefits include the ability to shift power supply requirements readily to locations of low demand, while a major shortcoming is the potential for widespread blackouts.

The agricultural influence, however, can be formidable. The BR administers the Small Reclamation Projects Act of 1956 and also brings waters to multiple 160-acre units of western acres under the Desert Land Acts. BR waters may be used for limited municipal use as well as for irrigation purposes (Holmes, 1979a). A long-term and continuing major issue is the 160-acre legislative limitation. The limitation, which can be 320 acres for husband and wife, was established originally for the family-sized farm, not for the vast irrigated acreages necessary for today's mechanized agriculture. Part of the intent of the limitation was to discourage monopolization (Goldfarb, 1983), yet the Bureau itself and the local irrigation district tend to influence conditions the other way. Further, the courts have tended to ignore the 160-acre limitation, the results of which include California's first-place rank in agricultural products, farm worker exploitation (and, consequently, the controversial issues of immigration, migrant workers, unions, and relations with Mexico), and the entire agribusiness community (Barnes, 1971). "Acreage limitations were circumvented by legal subterfuges, statutory exemptions, and liberal administrative interpretations" (Goldfarb, 1983). Amendments to the Reclamation Act in 1992* have rectified some of the problems in new and amended contracts between the BR and the irrigation district brought on by the drought, simultaneously resolving current concerns over maintenance of instream flows (Rogers, 1993).

Many of the major reservoirs constructed and operated by the BR provide major recreational opportunities, since bodies of water in arid climates are rare. The BR estimates that about 27 million people per year visit its 191 facilities. Most of these are administered by the NPS as national recreation areas. Thus, visitors to our National Parks are often not aware of the BR's contribution to their water-based recreation because of its low profile among environmentalists and the public. In the past, the BR worried little about the quality of the human environment except for minimal aesthetic considerations (Arthur, 1973).

* http://www.usbr.gov/, June, 1999

Although exact figures are difficult to determine because of factors such as the definition and status of irrigated lands, the 9 million acres of land irrigated with BR water (Gates, 1968) are nearly equal in area to the lands it administers (Table 3.3), most of which are under water. It is also difficult to ascertain which was the first BR project. Many projects were already under way (some with federal funding) when the agency was created in 1902. The Salt River Project in Arizona, including Roosevelt and Granite Reef Dams, was the earliest according to the Bureau of Reclamation itself (1948). Probably the largest BR project is also in Arizona: the Central Arizona Project (CAP), the water for which was made possible by the decision in *Arizona v. California*. This $1.2 billion project that was included in the Colorado River Basin Project Act brings 1.2 million acre-feet of Colorado River water per year from Lake Havasu to central and southern Arizona. Some of the water will eventually travel all the way to the Mexican border for irrigation, municipal and industrial supply, and recreation use (Water Resources Council, 1968). It is ironic that some CAP water made possible by the decision in *Arizona v. California* will go to Mexico: the destination for that CAP water is within the Gila River watershed, the contribution of which Arizona had denied to the Colorado River in the original case (see Figure 2.7). In order to meet the needs of the lower Colorado River Basin especially, the BR has also been involved in a major and somewhat controversial cloud-seeding program on the Colorado and San Juan River watersheds (Sheridan, 1981).

The Bureau of Reclamation is a major influence in water conservation throughout the western states and in the many jurisdictions with which the states, irrigators, power companies, agricultural interests, and related individuals (contractors, politicians, students, planners, economists, lawyers, and land managers) interact. In a scathing attack on the BR, Welsh (1985) observed that "the bureau is now a bureaucracy looking for a purpose" and recommends that "it is time to repeal reclamation." The arguments relating to this issue are discussed in Chapter 8 in the section on irrigation.

BR projects also have major implications for foreign relations and policy. For example, major projects and associated evaporation from reservoirs, canals, and fields, are principally responsible for the low flow and high salinity of the Colorado River. They are also responsible for our feud with Mexico over intolerably high salinity of the river's waters after extensive evaporation associated with impoundments and irrigation (Sibley, 1977).

Another international example involves Fidel Castro's 1959 seizure of the Cuban government and the subsequent limitations on privately owned acreage in Cuba and on nationalized American-owned plantations. "[B]y 1962, Cuban agriculture was in bad condition. The sugar output dropped greatly" (Starkey, 1971). It may not have been only Castro who interfered with Cuban sugar production, but both Congress and the BR. Congress, by passing the 1948 Sugar Act, drove prices up to favor domestic production, thus impacting Cuba's most important crop (Starkey, 1971). The BR was certainly involved, though not necessarily intentionally or with the purpose of undermining one-third of the Cuban economy, which is surely what happened. The BR's massive Colorado-Big Thompson Project (CBT) brings water from the Colorado River on the west slope of the Continental Divide to the irrigable acres along the Big Thompson and South Platte Rivers on the east slope. The CBT thereby created the opportunity to grow sugar beets on a large scale in 1947 when the 12-mile Adams Tunnel (under Rocky Mountain National Park) went into service. On June 19, 1948, Congressman Roy O. Woodruff of the sugar beet-growing state of Michigan documented that "sugar is now one of the cheapest commodities on the market" (from the *Congressional Record*) and that this development followed elimination of wartime price controls. Earlier in the year, Congressman R. Walter Riehlman of New York read into the *Congressional Record* an article published in the *Bakers Weekly* by Arthur T. Joyce that stated, in part:

> On January 2, 1948, the Secretary of Agriculture, acting under the law passed by Congress last summer, announced the sugar quota for domestic consumption for the current calendar year. He set this figure at 7,800,000 tons. This figure was substantially lower than the 8,500,000 tons which had been recommended to the Secretary by the industrial users' sugar committee, representing bakers, confectioners, and other converters in December. There was a gradual decline in sugar prices during the next 8 weeks until, on February 26, the Department slashed this quota by 300,000 tons to 7,500,000. In other words, it is evident that the Government acted to create an artificial shortage for the purpose of increasing prices.
>
> Just prior to this action, the Department had accounted for the purchase of 1,000,000 tons of Cuban sugar for Army and foreign distribution; the agreed price was 4 cents per pound, although a decline in world sugar prices had brought quotations down at the time to 3.75 cents.
>
> This manipulation of available supply to create an artificial shortage and bolster prices seems a strange course for an administration which has consistently proclaimed that controls should be maintained in order to prevent business interests

> from taking advantage of a free market to limit supply and force prices up.
>
> This apparent inconsistency is blindly ignored as the Department declares that it is ready to make still further revisions in the quotas for civilian use if necessary to protect domestic producers against possible surpluses (Riehlman, 1948).

In fact, the concern for equity in Section 302(b) of the Sugar Act seems to be directed primarily at the Philippines, Puerto Rico, and Hawaii, and also seems "to protect the interests of new producers." Complex provisions and only limited extension of the proposed legislation were not in Cuba's economic interests, reported Secretary of Agriculture Clinton P. Anderson during hearings on the bill. The bill included payments to domestic producers and "protection of consumers against excessive profits" (Anderson, 1947). Certainly, Castro's actions were a reaction to an already adversely affected sugar industry in Cuba. They played some, if unidentified and undocumented, role in the U.S. sugar beet development in Colorado (Michener, 1974) and, perhaps, in political and international relations between Cuba and the U.S. But not unquantified: the first to testify after Anderson was Frank A. Kemp, Chairman of the American Sugar Beet Industry's Policy Committee. He also was a resident of Colorado (about third in sugar beet production). His company was "the Great Western Sugar Co., beet sugar" (Kemp, 1947). It worked. During the 20 years following passage of the 1948 Sugar Act, domestic production of beet sugar increased 76 percent, whereas imports from all foreign areas increased only 30 percent. Beet sugar climbed from about 22 percent of annual U.S. sugar production in the middle 1940s to more than 55 percent by 1970 (Bureau of the Census, 1980).

Recently BR attention has had to respond to calls for its elimination owing to the fact that virtually all the best sites for dam construction have already been developed, the growth of the environmental movement, and the aforementioned implication of high interest rates on major structural projects. In fact, there have been several proposals to remove BR dams, providing the opportunity for the genuine "reclamation" of hydrologic and watershed integrity. It is this opportunity that has been the primary force in staying the BR's elimination. The BR has been faced with the necessity of construction of waste treatment facilities for return flows laced with selenium from the Central Valley Project that was imported to the Kesterson Wildfowl Refuge and Reservoir (California). In addition, BR has had a long-standing responsibility since passage in 1921 of the Snyder Act:

> The Bureau of Indian Affairs, under the supervision of the Secretary of the Interior, shall direct, supervise, and expend

> such moneys as Congress may from time to time appropriate, for the benefit, care, and assistance of the Indians throughout the U.S. for … extension, improvement, operation, and maintenance of existing Indian irrigation systems and for development of water supplies.

The BR has recently been actively involved in building partnerships with other federal agencies, tribes, and communities, especially in the western states, to achieve those objectives.

Finally, the BR has had to reduce contracted water deliveries to irrigation districts in the face of severe drought in California. Given a new mandate for irrigation water conservation, Moore (1991) pointed out that "[t]he Bureau of Reclamation sits at the threshold of a new era of federal water management in the American West," but that the motivation and means for change were not then apparent. In the 1992 Reclamation Projects Authorization and Adjustments Act, Congress mandated reductions of up to 20 percent in irrigation deliveries, making the water available for fish and wildlife purposes. "Other provisions of the bill include $992 million for the completion of the Central Utah Project (the very last of the federal water juggernauts)" (Rogers, 1993). California enacted Drought Water Banks in the early 1990s to enable reallocation of water rights to meet the drought restrictions (Rogers, 1993; Frederick, 1999). Once the precedent of reduction in vested prior appropriation water rights was established in order to meet more critical municipal demand, it is to be expected that similar reallocations of water will be forthcoming as the need arises. The most recent developments may be found regularly in *Western Water News* and are cited in the section on California in Chapter 4.

Natural Resources Conservation Service* (NRCS)

The third major construction and operation agency, the Soil Conservation Service (SCS), could at one time have been classified as a land-managing agency. It had under its authority 2.3 million acres of Land Utilization Projects, submarginal farm lands that were purchased by the government for rehabilitation and demonstration under the 1937 Bankhead-Jones Act. The lands, which were temporarily under the jurisdiction of the Department of the Interior, caused the SCS to be moved from Agriculture to Interior, then back again when the lands were finally transferred to the BLM.

The SCS was created in 1935 in the Department of Agriculture, having spent the previous two years as the Soil Erosion Service in the Department

* This agency was originally known as the Bureau of Soils, then the Soil Erosion Service, and the Soil Conservation Service.

of the Interior. Prior to 1933, it had been known as the Bureau of Soils, also in the Department of the Interior. The bureau and its sister organizations, the Bureau of Plant Industry and the Bureau of Agricultural Engineering, were transferred in whole or in part through a series of moves in the 1930s (Office of the Federal Register, 1983). The SCS was largely the result of the dedicated work of Walter Lowdermilk and Hugh Hammond Bennett, who pioneered the concepts and practices of soil erosion control and soil conservation and shepherded the agency through its infant years (Coyle, 1957; Buie, 1961). The SCS, in particular, reflected Bennett's evangelistic approach to soil conservation. That, its widespread personnel in almost every community in the U.S., and the Jeffersonian concept of a nation based on small, independent farms, gave the agency its mission, its strength, and its continued support.

One of the reasons for the success of the SCS was that it was a "grass roots organization, with personnel in almost every community and personal contact at county and state fairs. Its successor, the Natural Resources Conservation Service (NRCS), continues that tradition, along with many of the SCS programs. The SCS conducted soil surveys, provided land classification services to landowners, and assisted in agricultural pollution control and rural community development.

With the exception of numerous controversial channel-straightening projects (Gillette, 1972), the SCS programs had been eminently successful. "There is little that can be said *a priori* about the merits of individual stream channelization projects other than voicing the normal skepticism that suggests that many are ill-conceived. … this … is evident from the enormous opposition that they have generated" (Brown, 1974). The conservation-supporting SCS suffered a severe blow to its image, when, ironically, it had to get a permit from the Corps of Engineers for the straightening of channels in or near wetlands and navigable waters. To maintain operations in the face of environmentalists' criticism of the channel-straightening program and funding, many stream channel proposals were deleted from PL 566 projects that would otherwise have been delayed. The vehicle for organized assistance to local government is the soil and water conservation district, of which there are approximately 2,950, administering more than 2 billion acres in the 50 states, Puerto Rico, and the Virgin Islands (Office of the Federal Register, 1980).

The Watershed Protection Flood Prevention Act of 1954, or PL 566, reversed the trend of government providing all the funds for flood control projects. Local communities — often through the soil and water conservation districts — had to supply a significant portion of the cost, and also provide the initiative for the project, in contrast to many of the COE projects. PL 566 mandated that local governments contribute 25 percent of the cost of new projects and provide operation, maintenance, and rights-of-way (Steele and Sandals, 1955). The movement away from having the flood control project provided by the federal government generally improved the SCS image in the public's view, although the agency's program of flood prevention was not as dramatic and therefore didn't enjoy the same prestige as did the COE. Nor did the SCS have the advantage of the same degree of contact with Congress. With greater cost-sharing percentages paid by local interests, that viewpoint changed as those who benefited directly from the project had to commit investment in flood damage reduction.

In 1985, however, the role of SCS had changed even more. This occurred as a direct result of the "Sod Buster" and "Swamp Buster" sections of the 1985 Food Security Act, known more generally as the "Farm Bill" that extended and dramatically changed the Conservation Reserve Program.* These two sections mandated that lands classified as highly erodible land (HEL) or as wetlands be identified by the SCS to the Agricultural Commodity and Stabilization Service if they were being newly brought into cultivation. If such was the case, the violating landowner could not receive *any* agricultural federal benefits (Nightingale, 1986). This provision, however small in total acreage and/or in number of instances, made the SCS into a regulatory agency, a role that countered the agency's effective, cooperative communication with landowners. Up until this time, the SCS was primarily an informational and educational organization. The state offices of the SCS** mobilized to meet the target dates for reporting land operator compliance with the wetlands and HEL requirements of the act. They managed to do so without alienating the farmers that the agency was supposed to help. Accomplishing this was a monumental task, a job that had to be undertaken with great skill and sensitivity on the part of all government officials — federal, state, and local.

The SCS had been created, in part, in response to the devastation caused by the Dust Bowl, the mid-1930s floods, and the Great Depression. Under Roosevelt's administration, federal agencies created conservation programs to assist in reducing unemployment as well as to control erosion.

* The Conservation Reserve Program was actually started by the 1933 Agricultural Adjustment Act, which was rejected by the Supreme Court. As discussed subsequently, the concept of controlling farm output while taking land out of production for conservation purposes (largely soil erosion control) attained its major program stature in the 1954 Soil Bank Act and was continued in the 1985 Food Security Act.

** Although a federal agency, the SCS – and now the NRCS – is organized on a state basis, with a federal employee in charge designated as "State Conservationist." NRCS employees, like their SCS counterparts before them, are often detailed to state agencies or to specific soil and water conservation districts. Since districts are enabled by each state, it is difficult to generalize on the specific joint appointments arrangements.

Only 1 year later, in 1936, the SCS was ill-prepared to fulfill its mandate of upstream flood prevention under the Omnibus Flood Control Act, partially due to its infancy and partially to the status of soil conservation practices at the time. By the time the 1944 Omnibus Flood Control Act reiterated the role of the SCS in upstream flood control, the agency was prepared to forge ahead with its program of educating the U.S. farmers in soil conservation, water resources management, and increased agricultural production. Throughout the agency's history, individual farmers and landowners have been able to receive substantial technical assistance and information from the SCS and its successor, the Natural Resources Conservation Service (NRCS).

The NRCS was created in 1994 by §246 of the Federal Crop Insurance Reform and Department of Agriculture Reorganization Act (PL 103-354). This act was a response to a declining agricultural base in the population, and a result of the disenchantment with both the fiscal regulatory policies that had evolved since the Depression years and the influence of agriculture on the political scene in general. Americans tend to take the sustainability of agriculture for granted (Sitarz, 1998). This is because the U.S. has an excellent agricultural base and also because it has been held in high esteem, deservedly, for its role in building the nation. The percent of the U.S. population that was identified as rural had decreased from around 60 percent in 1900 to less than 25 percent by 1990.* Statistics reflecting economies of scale and more efficient farming and food processing techniques are shown in Table 3.4 including the percentage change during the years from 1940 to 1974. Along with other agricultural programs and agencies in the USDA, the SCS was threatened by its proposed elimination. Broadening the scope of the organization and coordinating its activities with those of other agencies in the USDA was a viable solution ramified in the (PL 103-354) act.

One excellent example of the revolution in U.S. agriculture is the nation's 60-year program of artificial insemination. There were 23,215,000 cows on U.S. farms in 1938 producing a total of 105,807 million pounds of milk. By 1997, 9,258,000 cows produced 156,602 million pounds, a 50 percent increase in production from 60 percent fewer cows (McCarry, 1999) or a threefold increase in production per cow. With such dramatic changes, it is not surprising that nonagricultural interests have sought a reduction in the role (not necessarily the importance) of agriculture in the nation's economy. In 1900, 44 percent of the U.S. population of 123 million

* The number of farms decreased from 5,737,372 in 1900 to about 2,146,000 in 1990. Like the percent of population that is rural or average farm income, though, the definitions change, making comparisons little more than approximations. Nevertheless, the changes are dramatic.

Table 3.4 Change in U.S. Farmland Characteristics between 1940 and 1974

U.S. Farmland Characteristic	*1940*	*1974*	*Percent Change*
Land in farms, acres	1,065,000	1,017,000	+4.5
Number of farms	6,102,000	2,314,000	–62.1
Farm population, number	30,547,000	9,712,000	–68.2
Average farm value, dollars	$4,959	$90,736	+1729.7

Source: Statistical Abstract of the United States (Bureau of the Census, 1980)

was rural; by 1990 the rural inhabitants had dropped to under 25 percent of the nearly 249 million inhabitants.* Agricultural interests have maintained a presence in our culture in a number of ways, including the school calendar, the acreage limitation, implementation and maintenance of daylight savings time, crop subsidies, and special incentives and tax breaks for farmers. These were definitely warranted a century ago, but are much harder to justify — and maintain — today. Thus, by the 1990s, there was an expressed desire to eliminate the strangle hold that agricultural interests had on the nation's political scene. One of the ramifications of this shift in the role of agriculture was the 1994 Reorganization Act itself. It, too, reflects the change of the much smaller number of members of Congress who are able to represent farmer's interests.

The Reorganization Act consolidated many of the USDA service agencies and prompted relocation of many of the offices throughout the nation's counties so that communications between and access to them by the public was more efficient. While still involved in construction projects in a wide variety of soil and water resource projects, the NRCS is still in large part a service agency. The NRCS is now responsible for the administration of PL 566 (the Watershed Protection and Flood Prevention Act of 1954) and is therefore legitimately considered a construction agency. It not only constructs flood control and prevention devices, it also constructs and implements BMPs to control nonpoint sources of pollution, and provides emergency construction relief services where there is threat of or has been flooding and/or sediment production from landslides, slips, and floods.

The NRCS is also a major player in the creation and use of interdisciplinary partnerships. These efforts, which often involve private land

* http://www.census.gov/population/censusdata/urpop0090.txt Bureau of the Census web site on June 2, 1999.

operators, state, local, and federal personnel along with representatives of local and national NGOs, are the primary means of control over nonpoint sources of pollution. The programs under which these efforts are coordinated include the Conservation Reserve Program, Conservation Reserve Enhancement Program, Environmental Quality Incentive Program, Forestry Incentive Program, Integrated Farm Management Program, Water Quality Incentives, Wetland Habitat Incentive Program, and the Wetland Reserve Program. The NRCS is also involved with other federal, state, and local agencies in the National Estuary Program, Natural Heritage Rivers, Priority TMDL Watersheds, regional river basin and lake/watershed coalitions (such as Chesapeake Bay, the Upper Susquehanna River Basin Coalition, and the Colorado River Salinity Program discussed in Chapter 4). Within each state, the NRCS is also involved with state and local government in their establishment and maintenance of the Priority Waterbodies List (Natural Resources Conservation Service, 1996; 1997).

All in all, the NRCS is living up to the implications of its 1994 name change and reorganization. It remains the only resource managing agency with the word “conservation” in its title.

Tennessee Valley Authority (TVA)

The Tennessee Valley Authority was established in (1933) to raise an underdeveloped seven-state portion of the nation (the entire Tennessee Valley) to a level from which it could compete with and contribute to the other, more prosperous regions of the country. To achieve this, the agency was created as “a unique, independent government corporation charged with multipurpose development and management on a regional rather than a functional basis” (Rogers, 1993). The TVA provided jobs during the Great Depression, and probably could not have been established at any other time or at any other place (National Water Commission, 1973).

The primary justifications for the TVA, insofar as Congress was concerned, were defense (Gunther, 1953) and the threat of war, ramified in several ways. First, the power facilities at Oak Ridge, Tennessee were an important source of electricity for the top secret Manhattan Project (the code name for the development of atomic bomb capability). Second, the development of fertilizer plants provided an easy conversion to ammunition plants that would be necessary in the event of World War II: they could readily be switched to munitions production again, using the same raw materials. Munitions had already been produced at Muscle Shoals (AL), where dam construction and hydroelectric power ensured continued munitions facilities. The public was told that the project was needed for flood control. Flood losses where the Tennessee joined the Ohio River, just above that river’s confluence with the Mississippi River near Cairo, Illinois, were indeed staggering (Tennessee Valley Authority, 1939). Soil erosion and sediment control, sorely needed throughout the region, were also cited as project justification.

Stairstepped by more than 30 dams from its mouth near Paducah, Kentucky to Fontana Dam in North Carolina, the 852,000 acres of the Tennessee's water surface combine with a 9-foot-deep dredging operation to provide 650 miles of navigable channel. The hydroelectric facilities provide more than 15 billion kilowatt hours per year. The entire operation lifted the material and spiritual wealth of the region with demonstration projects, conservation activities, inexpensive electrical power, education, and jobs. More than 500,000 acres have been reforested (Fry, 1957).

The TVA is largely self-contained in that it has its own division of personnel and purchasing, and its own staff for labor relations and research within the Division of Natural Resources (Figure 4.1). The latter is involved with watershed management research as well as with farm-related studies on crops, soil erosion, and fertilizer/growth relations. Its power program is self-supporting; for its other activities, the TVA receives appropriations from Congress (Office of the Federal Register, 1980).

On the negative side, the TVA is also the nation's biggest customer for strip-mined coal (Laycock, 1970). Detrimental effects of this activity may offset some of the gains in soil conservation made by the demonstration projects, as well as the many years of research and information dissemination on erosion control. The TVA is also the sponsor of the controversial Tellico Dam (TN). Congress allocated $100 million for its completion, which was delayed because of the potential destruction of the only known habitat of the rare and endangered snail darter (Ausherman, 1978; Council on Environmental Quality, 1980a).

Regulatory and Enforcement Agencies

These agencies were created primarily for the specific purpose identified in the name. The FS and the COE, for example, have incidental enforcement powers, as do several of the other agencies already discussed above. As noted, the COE has such a diversified portfolio that it could really be listed in any of the categories presented.

Federal Power Commission (FPC)

Now known as the Federal Energy Regulatory Commission (FERC), and located in the Department of Energy (DOE), the FERC plays a major role in the administration of government power output. The Federal Power Commission (FPC) was created in 1920 to administer provisions of the

Federal Power Act of that year, specifically, "licensing nonfederal power developments on navigable waters in the public domain" (Rogers, 1993). Its principal duties included identifying and reserving potential power sites for later governmental development, encouraging private development of power resources, and granting leases for hydroelectric power development projects on public domain lands. With the expiration of 50-year power licenses that were issued after 1920, re-licensing comes under the National Environmental Policy Act's environmental impact statement requirements. In the re-evaluation process, a number of hydroelectric facilities are not being re-licensed and are even being removed to re-establish aquatic ecosystems and habitat.

The new five-member commission "has retained many of the functions of the FPC, such as the setting of rates and charges for the transportation and sale of electricity and the licensing of hydroelectric power projects" (Office of the Federal Register, 1980; 1998). Five regional power administrations (Bonneville, created in 1937; Southeastern, 1950; Alaska, 1950; Southwestern, 1943; and Western, 1977) coordinate the production and distribution of electricity from the government (primarily BR and COE) with state and local organizations.

The FERC is of concern here because of the general interactions between energy development and water resources, especially the now-discounted demands on the western water resources for oil shale and coal developments, and the continuing pollution potential of nuclear and other thermal power installations. The demands on water for energy occur for both steam and hydropower production. Impacts of hydropower production on aquatic ecosystems and endangered species habitat are primarily due to fluctuating water levels and reservoir evaporation (Gleick, 1993) and are currently of considerable interest, especially in the northwest, most notably to salmon (Mighetto and Ebel, 1994) and other anadromous species.* In 1990, the U.S. produced 28 percent of the world total hydroelectric energy (Gleick, 1993). Steam plants add considerable heat loads to receiving water bodies unless — and sometimes even with — evaporation cooling facilities. In warmer tropical and subtropical regions the cooling capability is not present, and in temperate regions, the impact on water temperatures can only be mitigated by use of evaporative cooling

* The potential for remediation and aquatic habitat restoration by dam removal is a highly site-specific issue. References are best found in current media (e.g., Lovett, 1999). For example, articles on re-licensing requirements for the Noxon Rapids and Cabinet Gorge dams on the Clark Fork River in Idaho, and the Quaker Neck Dam on the upper Neuse River in North Carolina are in the June 1999 *U.S. Water News* 16(6), pages 1 and 3, respectively. It is clear that consideration of ecological, hydrological, and aquatic system functions must be at the heart of such removal strategies.

towers, which result in as much as double the consumptive use — loss — of water to local ecosystems (Gleick, 1993).

Flood Insurance Administration (FIA)

Established in Title XIII of the 1968 act that created the Department of Housing and Urban Development, the Flood Insurance Administration was moved to the Federal Emergency Management Agency (FEMA) by Reorganization Plan 3 of 1978. The FIA is responsible for the National Flood Insurance Act of 1968 and the Flood Disaster Prevention Act of 1973, in addition to other legislative mandates (Office of the Federal Register, 1980). Federal efforts to influence floodplain zoning have been slow in large part because "land use regulation has traditionally been considered the exclusive property of the states and (especially) their political subdivisions. … All federal land use regulatory powers over private or state lands must be implied from other federal powers" (Holmes, 1980). Thus, the effort must be largely incentive-oriented and cooperative. As it cooperates with states and the insurance industry in establishing standards by which insurers can underwrite policies to individuals, the FIA becomes a major influence on land use and zoning of floodplains throughout the nation. The basic and simple concept of the flood insurance program is an offer of subsidized insurance for existing structures if matched by community control of future flood-prone area development. The Flood Insurance Standards become the backbone of the state and local floodplain regulation.

A set of "Floodplain Management Guidelines," issued by the Water Resources Council (1878a), reflects the goals of flood hazard evaluation (Johnson, 1966), floodplain management (J. Carter, 1977), and the Unified National Program for Floodplain Management (Water Resources Council, 1979a). They also enforce the FIA's flood insurance standards on the federal agencies. The guidelines affect federal government agency activities in the floodplains, as well as insurance coverage and private developments, providing the same standard for the federal government as it expects of local governments.

A thorough analysis of the legislative history of the National Flood Insurance Program, its status, the taking issue, and the model floodplain management ordinance that was prepared by the Atlanta office of the FIA is presented by Maloney and Dambley (1976).

Environmental Protection Agency (EPA)

Established by Reorganization Plan 3 of 1970, the Environmental Protection Agency assumed the duties of many existing agencies and assimilated some of their personnel as well. It is now one of the largest natural resources agencies in the executive branch and is of concern here primarily because of its role in maintenance (and restoration) of water quality throughout the nation. The EPA is responsible for administration of the 1972 Water Pollution Control Amendments,* or PL 92-500, now known as the Clean Water Act by the amendments of 1977. According to Rogers (1993), in 1970 the "EPA was essentially off on its own, with the largest of the federal programs and the smallest technical manpower to administer them."

The EPA is organized into five activity branches: (1) Air and Radiation, (2) Prevention, Pesticides, and Toxic Substances, (3) Water, (4) Solid Waste and Emergency Response, and (5) Research and Development. In addition to operational offices, 10 regional offices "represent [the agency's] commitment to the development of strong local programs for pollution abatement" (Office of the Federal Register, 1998).

The Water branch is responsible for programs in:

- Technical policies and regulations for both water supply and pollution control.
- Ground water protection.
- Marine and estuarine protection.
- Enforcement standards.
- Water quality standards and effluent guidelines development.
- Technical direction, support, and regional activity evaluation.
- Technical assistance and technology transfer program development.
- Water quality training (Office of the Federal Register, 1998).

For the past several years, EPA's Research and Development branch has been cooperating with the National Science Foundation, soliciting proposals and granting up to $10 million in support of a broadly based and extensive research program on Water and Watersheds. EPA also maintains major research facilities at 15 national laboratories that examine into various biological, chemical, and social aspects of pollution and pollution control.

Thus, from a functional standpoint, EPA is a widely diversified agency, with major efforts in research, coordination, construction (via grants to municipalities for waste treatment plants), and enforcement power. It lacks only land to manage. But it has considerable influence over the management of lands everywhere through the administration of "Superfund"

* EPA has turned over to the states some of those responsibilities, especially the NPDES permits, and shares with the Corps of Engineers the administration of §404 permits.

(generally contaminated with toxic substances) and "Brownfield sites" (generally potential sources of contamination for specific uses of the sites). EPA has also been involved in the administration of the nonpoint sources pollution control program identified in §208 Areawide Waste Treatment Program of PL 92-500. This section identified nonpoint sources of pollution from agricultural, mining, construction, grazing, forestry, waste disposal, and salt water intrusion, and other activities on the watershed lands of the U.S. Early reports on the status of the knowledge of pollution from these land uses were published in the 1970s. In compliance with the legislation, EPA negotiated agreements with each state that identifies priority nonpoint sources and a program for their control and elimination.

On occasion, EPA initiates plant closings and/or other major enforcement proceedings, such as fines, as a consequence of Clean Water Act violations. These often make major headlines and may be controversial, especially when people are likely to be unemployed as a result of these plant closings. When possible, the agency prefers to work out long-term agreements, such as those made with New York City's Department of Environmental Protection concerning the water quality problems in the Catskill watershed (see Chapter 5). EPA's exposure makes it much better known to the public at large than the FPC and FIA, for example, which usually work behind the scenes. The EPA is likely to continue having tremendous influence on water resources management in the future.

Research and Development Agencies

Several agencies are involved rather restrictively in the business of data collection and analysis and, concomitantly, in exploration. Historical consideration of several of these agencies shows how their roles, and the need for their services, have changed over the years as scientists and managers have gained a greater understanding of the hydrologic environment (and the environment, in general). While it would be premature to say that there will be only small changes in the future, it certainly does appear that these agencies have "settled down," and are currently involved in refining the bases for management of water and related land resources.

A major research concern is whether a nationwide coordination effort of these agencies is needed and could even be established and maintained, were it found to be desirable. At present, water and related land resources research is conducted by the ARS, EPA, FS, GS, NASA, NOAA, NOS, NWS, SCS, and TVA. Water resources research is also being conducted at numerous biological, economic, engineering, geological, legal, natural resources, and political science departments of colleges (some of which are under the auspices of and in cooperation with these agencies) and, of course, by individual states. Widespread federal funds are being used to assist in this research effort.

It is generally acknowledged that much of the current difficulty in resolving problems with water and related land resources is caused by the institutions that the public empowers by legislative mandate to manage natural resources, and not by insufficient technical know-how. Nevertheless, there is a serious, continuing need for data. The complexity of the water resource problem, especially water quality, means that agencies are continually confronted with the need for making management decisions with inadequate data. Making the situation even more difficult is the long planning horizon necessary for large and complex water resources facilities construction. Add to that the uncertainties surrounding climate change and population growth, and the task for the organizations conducting research is formidable. Finally, a considerable effort is directed at technology transfer. That refers to the difficult task of getting the technical information from the "hard" scientist to the decision-makers, as well as to the public (Walesh, 1999).

Research issues in forest hydrology were identified by Black (1998) as being at different scales: (1) the molecular or pore level, (2) hydrological processes, (3) watershed function, (4) global considerations, and (5) the human dimension. Many of these topics are being addressed or financially supported by the federal agencies that are listed in this group. The need for public research — research conducted by publicly supported agencies — was summarized unequivocally by the Soil Science Society of America (Larson et al., 1981):

> In the case of soil and water protection, public research must do what private research cannot undertake because of the uncertainty in payoff. But it is precisely this type of research that no nation, including the United States, can ignore. Prolonged strength in the national economy cannot rely on a public policy of resource exhaustion.

The six top priorities in soil and water were identified as: (1) sustaining soil productivity, (2) developing conservation technology, (3) managing water in stressed environments, (4) protecting water quality, (5) improving and implementing conservation policy, and (6) assessing soil and water resources. To varying degrees, the following agencies meet some of these needs (as do some of those already described that have primary responsibilities other than research) (Larson, et al. 1981). There will be a continuing need for research in these areas.

National Weather Service (NWS)

When the National Weather Service was created in 1890, it was under the auspices of the Army Signal Corps. It was moved among the Departments of Agriculture, Army, and Commerce, before recently coming to rest in the National Oceanic and Atmospheric Administration under the Department of Commerce by virtue of Reorganization Plan 4 of 1970. From 1965 to 1970, it was combined with the Coast and Geodetic Survey and was known as the Environmental Science Services Administration, also located in the Department of Commerce. The name changes cause considerable confusion, especially when searching for data from a period of time when the title was other than "National Weather Service."

The NWS is responsible for meteorological data collection, analysis, and research, and flood forecasting. Its data are published in the national daily weather map, as electronic data banks and as remote data transmission information. Individual station data are published monthly on a state-by-state basis in *Climatological Data* and, along with the annual summaries, is an essential tool in water management. Numerous web sites provide ready reference to weather and climate information as well.

Geological Survey (USGS)

Established in 1879 in the Department of the Interior under the influence and guidance of John Wesley Powell, the Geological Survey expanded its responsibilities for basic inventory to include stream gauging in 1894. "The broad objectives of the Geological Survey are to perform surveys, investigations, and research covering topography, geology, and the mineral and water resources of the United States; classify land as to mineral character and water and power resources; enforce regulations and contracts; and publish and disseminate data relative to the foregoing activities" (Office of the Federal Register, 1980). Like the NWS, the maps and data the USGS provides are indispensable to the management of water and related land resources. Approximately 25 percent of the USGS's effort is funded directly to the Survey. Another 17 percent is funded in cooperation with about 25 other federal agencies that benefit from the Survey's activities, and the remaining 58 percent is funded on a matching basis by state and federal monies with over 480 participating state and local agencies (Radlinski, 1973).

Currently, the USGS conducts and supports research in cooperation with other governmental and educational institutions, and at its field stations. It also maintains data bases (on the internet as well as in traditional media), is in the forefront of the development of geographic information systems (GIS), and serves as the lead agency for the Federal Water Information Coordination Program (Office of the Federal Register, 1998).

Agricultural Research Service (ARS)

In 1978 the Agricultural Research Service was combined with the Extension Service, the Cooperative State Research Service, and the National Agricultural Library into the Science and Education Administration (SEA). It is now known again as the ARS. It had been created in 1953 by the Secretary of Agriculture "to provide knowledge and technology for farmers to produce efficiently, conserve the environment, and meet the food and fiber needs of the American people" (Office of the Federal Register, 1980). Research on numerous agricultural problems is administered out of eight area offices around the nation, and is conducted at 140 field locations, often in cooperation with other government and private institutions. One of the seven major research installations is at Coschocton, Ohio, where classic investigation into soil-water-vegetation relations is conducted. (Soil and water research is done elsewhere, too, with and by other organizations, often the FS and TVA).

ARS combines the soil and water conservation (and other) programs and activities of the several members that were formerly separate bureaus. Together, the offices represent the major cooperative effort necessary to effect water and related land resources policy through the research, education, and service programs that are the hallmark of a diversified approach to soil and water management on agricultural and rural lands. The Extension Service, created by the Smith Lever Act of 1914, and the Cooperative State Research Service were combined into the Cooperative State Research, Education, and Extension Service (CREES) and is administered out of the Washington office. The agency cooperates with the Land Grant colleges, and with county and state governments, providing grant funds, technical expertise, and research information for researchers, landowners, and other interested individuals, groups, and businesses.

Office of Water Research and Technology (OWRT)

Located in the Department of the Interior before its termination, the Office of Water Research and Technology had been created in 1964 as the Office of Water Resources Research. It was originally established to administer the program for grant research into all facets of water that was created by the Water Resources Research Act. That act created the opportunity for creating and funding water resources research centers or institutes at each of the land grant colleges and greatly enhanced the supply of basic information upon which to base important resource decisions.

OWRT, created in 1974 by a merger of the Office of Water Resources Research and the Office of Saline Water created in 1971, had the rather difficult but limited goal of finding economical ways to obtain usable water for agricultural, municipal, and industrial supplies from saline ocean and ground waters. The merger was partial fulfillment of a recommendation of the NWC (National Water Commission, 1973), which suggested inclusion, too, of the weather modification activities of the National Oceanic and Atmospheric Administration and the geothermal resources of the BR.

Until it was abolished in 1982 and its functions transferred to the USGS, OWRT administered the Department's in-house training and research programs, as well as the grants program of the original research act. Those funds have been phased out, too, and the now irregular federally supported research effort aimed at water and related land resources problems is administered by grants from ARS and the USGS and other agencies, as well as by the Water and Watersheds program of the EPA and NSF described above. OWRT was also responsible for administration of the provisions of the Water Research and Conversion Act of 1977 and the Water Research and Development Act of 1978. "The fundamental purposes of OWRT [were] to develop new or improved technology and methods for solving or mitigating existing and projected state, regional, and nationwide water resource problems; to train water scientists and engineers, … and to accomplish water research coordination and research results information dissemination activities" (Office of the Federal Register, 1980).

National Oceanic and Atmospheric Administration (NOAA)

Created in 1970 by Reorganization Plan 4, the National Oceanic and Atmospheric Administration combines responsibilities of the NWS and the National Marine Fisheries Service. In addition to the legislation that chartered those agencies, NOAA administers provisions of the Coastal Zone Management Act of 1972 and other legislation (Office of the Federal Register, 1980). "NOAA conducts an integrated program of management, research, and services related to the protection and rational use of living marine resources, and protects marine mammals. The agency prepares and issues nautical and aeronautical charts, provides the nation's precise geodetic surveys, and conducts broad research programs in marine and atmospheric sciences" (Office of the Federal Register, 1980). NOAA is also responsible for control of ocean dumping, marine and energy resources, and weather modification. It also administers the research-supporting National Sea Grant program. According to the Office of the Federal Register (1998), "[a]s the Nation's premier environmental steward, NOAA is committed to protecting America's ocean, coastal, and living marine resources while promoting sustainable economic development." (See also the National Weather Service.)

Coordination and Study Agencies

Two of the three groups discussed here no longer exist: the National Water Commission, by design, and the Water Resources Council, due to ineffectiveness and major budget cutting (the Council on Environmental Quality ensures severe budget cuts). While it might be considered inappropriate to devote space to the discussion of defunct agencies, the contribution that each has made to water and related land resources management as it now exists demands attention. The Kerr Committee and Rockefeller Commission are discussed in Chapters 1 and 6, respectively.

Water Resources Council (WRC)

The WRC was terminated in 1982 by zero funding, its termination announced in March of 1981. While a Cabinet-level Committee on Natural Resources existed for a while in the Department of the Interior following the demise of the WRC, that, too, has expired, and there is no replacement for the WRC to date, nor is one expected. Nevertheless, what the WRC accomplished during its 17-year life is important.

Ever since the Inland Waterways Commission was established by the President in 1907, coordination of resource use and planning has been sought. "[i]n its report to the President [the Commission] emphasized the interlocking character of the problem of natural resources and pointed out how the control and use of water would conserve coal and iron and the soil and at the same time also make necessary the preservation of the forests" (Van Hise, 1965). The linkage to water resources was, as could be expected, via navigation and the commerce clause of the Constitution. The 1908 Governors' Conference resulted. More than 20 study groups and numerous commissions later, the Water Resources Planning Act* of 1965 was enacted, creating the WRC.

The WRC originally included the Chairman of the FPC and the Secretaries of Agriculture; Army; Health, Education and Welfare; and Interior. The Administrator of the EPA and the Secretaries of Transportation, and Commerce, Energy, Housing and Urban Development were added, while the Secretary of Health, Education and Welfare was dropped. There were also regular observers from the Office of the Attorney General, the Office of Management and Budget, Tennessee Valley Authority, and several river

* The 1965 Water Resources Planning Act is reproduced in its entirety in Appendix A. Although its provisions are no longer applicable, the act is a particularly fine example of well-constructed legislation, with carefully organized titles, sections, and subsections that will benefit those who have never seen such. It is also of historic interest owing to the benefits that the WRC and the River Basin Commissions did provide.

basin and Inter-Agency river basin committees and commissions. Holmes (1979) and Rogers (1993) point out that transfer of federal water quality control from the Department of the Interior to the EPA, which did not have full membership on the WRC, may have contributed to the inability of the WRC to carry out its desired goals.

The Water Resources Planning Act also specified that the Chairman of WRC was to be designated by the President (§101). Every President named his Secretary of the Interior as chairman. A consequence of a recommendation by the National Water Commission (NWC) and upon action by President Carter, the Director of the WRC was specified as a full-time, independent individual who served at the pleasure of the Chairman. Implementation of this recommendation addressed a long-standing complaint that the WRC was no stronger than its members allowed it to be, and that it often was incapable of rising above agency interests to exercise its broader mandate. Congress itself may have doomed the commission by giving it a task to do while constraining its operations by the very nature of its organization.

The WRC was officially known as the statutory Water Resources Council, to distinguish it from the President's Water Resources Council that preceded it. The President's Water Resources Council had enjoyed the same membership, except for the addition of the chairman of the FPC. The earlier Council's Interdepartmental Staff Committee "formed a body known as the Council of Representatives (COR), which became the key working group of the Council. … The bulk of the Council's work [was] carried out through a number of groups other than the members: the COR, the staff, task forces, and various technical, advisory, and field committees. It [was] the COR, however, that … generally thrashed out issues and made the majority of the decisions for the members" (National Water Commission, 1973).

The WRC was to "prepare an assessment biennially, or at such less frequent intervals as the Council may determine, of the adequacy of supplies of water necessary to meet the water requirements in each water resources region in the United States" (§102(a)), among other responsibilities. Lengthening the interval for the mammoth job to 10 years, the WRC published the *First National Assessment* in 1968, and the *Second National Assessment* in 1978 (Water Resources Council, 1968 and 1978b). With an emphasis on planning, and armed with predictions of population growth and forecasts of water demands for the years 2000 and 2020, the *First National Assessment* identified major problem subjects, including floods, water supply, institutional arrangements, regions likely to experience shortages, and available alternatives. The states' own assessment of their problems, taken from Title III grant applications, are summarized by river basins in Table 3.5. The distribution patterns of classes 1 through 4 give

Table 3.5 Summary of Existing and Emerging Regional Water Management Problems

			Water Quality				
Region	*Adequacy of Annual Natural Runoff*	*Ground Water Storage Depletion*	*Wastes*	*Heat*	*Salinity*	*Sediment*	*Flood Damages*
North Atlantic	2	2	4	4	1	2	2
South Atlantic/Gulf	1	2	3	2	1	3	3
Great Lakes	2	1	4	4	1	2	1
Ohio	2	1	3	3	1	2	3
Tennessee	1	1	2	2	1	2	2
Upper Mississippi	2	1	3	3	1	2	3
Lower Mississippi	1	1	2	1	1	4	3
Souris-Red Rainy	3	1	2	1	2	1	3
Missouri	3	3	2	2	2	3	4
Arkansas-Red-White	3	4	2	1	4	3	3
Texas-Gulf	3	4	3	2	3	3	2
Rio Grande	4	4	3	1	4	4	2
Upper Colorado	4	1	2	1	2	3	1
Lower Colorado	4	4	3	1	4	4	2
Great Basin	4	2	3	1	2	2	1

Columbia-North Pacific	2	2	2	1	3	1	3
California	3	3	3	2	3	2	3
Alaska	1	1	2	1	1	1	2
Hawaii	1	1	2	1	1	1	1
Puerto Rico	1	1	2	1	1	3	1

Source: Water Resources Council (1968).

Key: 1 = Minor problem in some areas
2 = Moderate problem in some areas or minor problem in many areas
3 = Major problem in some areas or moderate problem in many areas
4 = Severe problem in some areas or major problem in many areas

a clear picture for many of the regions where the priority problems are as well as how severe they are.

Perhaps of greater importance than the localized, regional estimates of future water problems, is the statement that goes beyond echoing what many have been saying for a long time. Namely, that a nation that overtaxes its water supplies is doomed:

> As the nation grows, the limitation in water and related land resources available to competing regions becomes more important from a national viewpoint. … Water and related resource development offers one means to countering the trend to over concentration in urban areas and to correct the deficiencies of underdeveloped areas (Water Resources Council, 1968).

What the WRC suggested is that "the time when water can no longer be matched to the economy, but the economy must be matched to the water available"* may indeed have arrived in the U.S. (Teclaff and Teclaff, 1973). If so, citizens must re-think their attitudes toward comprehensive planning, population growth, standards of living, and a long list of associated and often unpleasant topics. The observation is now even more applicable, and of vital concern, on a worldwide basis.

The data in Table 3.5 provide two important perspectives. First, from a historical point of view, the geographical distribution of water resources projects and programs is clear. For example, salinity and sediment are major issues in the southwest. In contrast, plentiful natural runoff and groundwater supplies in the northwest preclude major salinity and water quality problems there. Floods are the source of major concern in the Mississippi River basin, and wetlands are a rather low-level concern prior to the developing knowledge about their loss in the 1970s.

Second, the identified water management problems provide a reference point when considering the possible shift in priorities with incipient global change. Long-term, or even intermittent, shifts in climate will have a profound impact on water resources infrastructure. Since water resources development projects often take decades to plan, design, approve, and build, some long-range anticipation of future needs is imperative. Without the WRC, or a replacement agency that can perform these analyses, these services are lost. Rogers (1993) points out that the statutory provisions of the Water Resources Planning Act have never been repealed and are still

* Full quote in Introduction.

law. In the meantime, the USGS has been issuing an annual report* on the state of the nation's water resources. However, that is not the same as the comprehensive assessment made by the WRC owing to the fact that the USGS — as good as it is with regard to water resources monitoring, analysis, and research — is *within* one of the executive branch departments and therefore not independent.

The WRC made other more specific contributions as well — it encouraged river basin commission establishment (Title II of the Water Resources Planning Act), and administered the grants for planning to the states (Title III). The Council also (1) cooperated with the FIA in the preparation of floodplain management guidelines; (2) assisted in the administration of the National Flood Insurance Program (together with the FIA); (3) participated with several other organizations in the Unified National Program for Floodplain Management (Water Resources Council, 1979b); and (4) collaborated with the CEQ on the regulations for compliance with the National Environmental Policy Act of 1969. Not long before its demise, the WRC prepared, completed, and published the manuals of procedures for evaluation of the NED and EQ benefits and costs necessary to implement the Principles and Standards. These were mandated components of the water and related land resources planning process that the 1969 act identified. The WRC also produced a number of publications (some available from the National Technical Information Service (NTIS)) on floods, inventories, and regulations, as well as several regional, state, and historical reports and conference proceedings.

There was a quadruple danger in eliminating the WRC and re-creating its replacement under the Department of the Interior. First, eradication of 45 years of legislative evolution and hard work by many dedicated individuals to create the only comprehensive planning and coordination organization in the federal government set back recent gains in environmental quality control many years. Many of those dedicated public servants left government service demoralized and disillusioned. Owing to its cooperative and coordination efforts with the CEQ, the WRC came close to ensuring that the U.S. would not go the way of ancient civilizations. Had the two agencies been free to do so, they might have been able to build institutions that could provide for the long-term conservation of water and related land resources.

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* The *National Data Summary* published in 1983 includes an analysis by states of their priority issues and problems, and a national summary thereof. A series of Water Supply Papers published in the 1990s summarizes nationwide status, issues, and problems, and new nationwide summary information online is in the works.

Second, the emasculation of the Principles and Standards to Principles and Guidelines* in 1983 separated the National Economic Development (NED) and Environmental Quality (EQ) objectives, a development objected to by many. However, that may have preserved the CEQ's regulations for implementation of the EIS process as the means of evaluating the degree to which a project proposal contributed to EQ.

Third, with the poorest record of urgently needed environmental quality considerations, the Department of the Interior was the worst choice as a foster parent for the WRC's successor at that time. That department's administration of natural resources has a history of exploiting the nation's reserves by granting easy access to a select few, due to the department's own vested interests (Welsh, 1985). Oil, gas, and coal developers were gaining access to public lands through Department of Interior agencies** at the expense of current and future taxpayers. The only (unplanned) constraints were those of the fluctuating energy markets. The lack of coordination with other federal programs of resource development and preservation, or with environmental regulations that protect the public's health and safety as well as recreational and aesthetic values, could have had devastating, long-lasting, and perhaps irreversible consequences.

Finally, it hardly seems likely that an among-agency coordination unit could do its job under the direction of one of them. While it is certain that improvements in the WRC could have been made, and that belt-tightening by budgetary control is usually beneficial in the long run, complete elimination of the statutory WRC and the *Principles and Standards* was a classic case of throwing the baby out with the bath water.

National Water Commission (NWC)

The NWC was authorized by the National Water Commission Act of 1968. This act provided $5 million and 5 years of existence, during which the NWC was to examine all aspects of water resources in the U.S. and file a report with the President and Congress. According to the report's preface, the NWC "stemmed from proposals for water developments in the Colorado River Basin which raised a number of fundamental questions as to the future policies for water resources development in the United States"

* In addition to a change in the title, the new Principles and Guidelines apply only to the four construction agencies, COE, BR, TVA, and NRCS.

** President Reagan's Secretary of the Interior, James Watt, was a controversial lightning rod for the preservationist faction of the public. His proposals for change caused no end of consternation among — and a concomitant tremendous increase in membership of — organizations such as the Sierra Club, Audubon Society, Wilderness Society, Izaak Walton League, and others.

(National Water Commission, 1973). The focal points of that furor were the controversial Bridge and Marble Canyon Dams which, as former Executive Director of the Commission Theodore M. Schad pointed out, "would use more water than the river could supply. … Among other things, the Commission was asked to consider how future needs might be met by conservation and more efficient use of existing supplies" (Schad, 1978). The National Water Commission Act required the NWC to examine virtually all problems of water and related land resources, including trends in and anticipated problems of water quantity, quality, and regimen (timing), as well as economic and social consequences of development. The NWC was to make recommendations and terminate upon completion of its report. It did so in September of 1973, on schedule and within budget.

The seven-member commission, with the aid of staff and counsel, conducted hearings and contracted for a total of 64 background study reports. To assure conduct of a disinterested study of the federal role in water resources management, none of the NWC members were federal officers or employees. Many of the recommendations in the report deal with federal actions, authorities, and responsibilities, as well as those of regional, state, and local governments, and private concerns.

There were 61 conclusions and 229 recommendations scattered throughout the report. Many of these have already been acted upon by Congress or by the executive branch and, as Deputy Administrator for River Basins Eugene C. Buie suggested, the NWC report "unquestionably will have a significant influence on many aspects of federal programs" (Buie, 1973). One of the major influences of the NWC report was the passage of the Water Pollution Control Amendments in 1972, although even that broad extension of federal involvement in water quality control is deemed inadequate (Sylvester, 1974). While many of the NWC's suggestions have been adopted, a large number have not, and the improvement in water and related land resources administration could still stand considerable change for the better.

The NWC was instructed to, and did, cooperate with the WRC in preparing the report. There are seven major recommendations directly concerning the WRC, as follows:

1. The WRC should have an independent, full-time chairman.
2. Each WRC member should be represented by a qualified employee from the member's department or agency.
3. Federal appropriations for all resources planning studies being conducted under the auspices of the WRC should be made to the council, and the council made responsible for assigning studies and appropriating funds.

4. The grant program in Title III of the Water Resources Planning Act should be extended.
5. All applications emanating in a single year from various agencies of a particular state seeking federal funds for water and related land resource planning should be consolidated into a single grant application.
6. The Water Resources Planning Act should be amended as to membership, as reported.
7. Congress should enact appropriate legislation giving the Chairman of the WRC the responsibility for coordinating federal participation and administration of river basin compacts of the Delaware and Susquehanna types, and water management compacts of the Ohio River Valley water sanitation compact type.

Some of the first recommendations were acted upon, including appointment of a full-time director (Leo M. Eisel, who was succeeded, upon his retirement, by Acting Director Gerald D. Seinwill), but the WRC was still chaired by the Secretary of the Interior. Recommendations 4, 5, and 6 were also acted upon, but the suggestion to have an independent review board was not. The NWC had recommended that such a board "should fully assess the relevant policy issues … [and] evaluate not only project proposals but also river basin plans and grant programs." It was not implemented due to lack of support from the many entrenched water resource development interests. However, the National Environmental Policy Act's EIS process provides some of the same goals that a review board would have provided, and, in many cases, partnering negates the need for a review board entirely. President Carter's executive order to create an Independent Water Project Review in 1979 was repealed by incoming President Ronald Reagan.

Schad (1978) noted that what might be considered the most important recommendation, namely that "identifiable beneficiaries" of water projects should pay for the project, had not been implemented. While numerous minor recommendations have been implemented, since the President never transmitted the report to Congress, the original mandate of Congress in the National Water Commission Act had not been met. President Carter's Water Policy Initiatives included several of the basic concepts and recommendations of the commission. And both Presidents Carter and Reagan called for project beneficiaries to pay a greater share of the costs. Schad's overall conclusion is that massive interbasin transfers of water are not likely to be the dominating means by which the U.S. resolves its water problems in the future (as it had been in the past), rather it will be along the lines recommended by the NWC. Seven years later Schad (1985) noted that some progress had been made on the report's themes including: (1) increased local control; (2) a shift toward conservation and preservation;

(3) payment of costs by beneficiaries; and (4) better ties between water development and land use planning. He also observed that "the demand for water in the future is not on an inevitable growth trend but depends in large part on policy decisions within the control of society — shades of Teclaff and Teclaff (1973) again. Schad's long experience includes his service to the Kerr Committee in 1960, and his perspective from over 25 years in the midst of the continuing water policy and planning action provided a continuing glimmer of hope at this time:

> The sun, however, is beginning to shine in some places. Public understanding of the problem is growing. The tools available for solving problems are being improved. Decreasing availability of federal funds is forcing decisions on local water problems to be made by state and local agencies. Nearer to the problem, these agencies should be able to develop more cost-effective and efficient solutions. Above all, the nation is richly endowed with water resources. We are not going to run out of water, but we are going to have to take better care of what we have. We have a long way to go to achieve a sound water management philosophy that will permit needs to be met in the future. The National Water Commission pointed the way in 1973. It's time to get on with the job (Schad, 1985).

The fully documented report of the National Water Commission has been re-issued* and remains a valuable history and summary of the nation's water resources, including problems, challenges, and potential solutions.

Council on Environmental Quality (CEQ)

The three-member CEQ was created by Title II of the National Environmental Policy Act of 1969. It is in the executive office of the President, and has a small staff. Unlike the WRC, however, the CEQ administers a separate Office of Environmental Quality, which provided permanent, full staffing. Budget cuts of 80 percent since the fiscal year of 1982 have caused the CEQ to drastically cut its activities; it has reduced its research and interrupted the issuance of its annual report as mandated by NEPA.**

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* The NWC report contains a wealth of information and references and is currently available from the Water Information Center, Inc., 6800 Jericho Turnpike, Syosett, NY 11791.

** From 1983 to 1990, the Conservation Foundation's ongoing annual report, entitled "State of the Environment," covered much of the same material formerly covered by the CEQ's Annual Report on environmental quality. The CEQ started issuing its annual report again in 1990.

The CEQ has been responsible for the evolution of the regulations (Council on Environmental Quality, 1978) by which all of the federal agencies comply with the Environmental Impact Statement (EIS) provisions in NEPA. CEQ and WRC personnel cooperated closely in bringing about the Principles and Standards (P&S) and the Manuals of Procedures (see the previous section on the Water Resources Council). With the changes brought by the Reagan Administration, the NED objective of the P&S is monitored by the Benefit-Cost Analysis (BCA) procedures, while the EQ objective is monitored by the EIS procedures, which are keyed to the CEQ regulations. Thirteen consecutive annual reports and numerous special studies are major accomplishments of the CEQ. Many of these are important and useful sources of information and analyses that are closely linked to water and related land resources.

There was a parallel between the WRC's *Principles and Standards* and the CEQ's EIS regulations before the Reagan Administration's regulatory and budget cutting. Previously, all federal agencies were mandated to comply with these coordinated rules. Now, however, the *Principles and Guidelines* (P&G, formerly P&S) apply only to the four major construction agencies (BR, COE, SCS, and TVA), while the CEQ's EIS regulations still apply to *all* agencies (except actions such as exempt routine operations, emergency, temporary, and national security activities). The reason the EIS regulations remain in force is because the basic concepts and operations are well entrenched in agency operation patterns, especially at the preliminary planning level. And without specific line items in any agency's budget for EIS preparation and review, EIS budgets are not easily removed. Thus, the funds for BCA are more readily identifiable and are more vulnerable to budget cutting.

Budgets

Budgets reflect the federal activity in water resources. Several tables created from available data have been assembled to illustrate (1) the changes that have occurred over the past half century (Table 3.6), (2) how the budgets can be dramatically affected by a new presidential administration (Table 3.7), and (3) the relative involvement, in terms of dollars, of the several federal agencies (Table 3.8). The periods selected are arbitrary and are intended to present typical figures, not necessarily definitive events or trends.

A summary of information is presented in Table 3.6, derived from several sources. The trends are clear. The percentages of total federal expenditures made up of water and related land resources conservation programs have dropped precipitously and steadily, reflecting a dramatic reduction in the nation's investment in its essential natural resource

Table 3.6 Natural Resources and Environment, Agricultural and Rural, and Water Expenditures by the Federal Government as a Percent of Total Expenditures, and Population and Gross National Product Changes, 1940 to 1989 (data in 1982 dollars; data not available for areas left blank)

		NR & Env.		*Agric. and Rural*		*Water*			
Year	*Total Expenditures (millions)*	*Amount (millions)*	*Percent of Total*	*Amount (millions)*	*Percent of Total*	*Amount (millions)*	*Percent of Total*	*U.S. Population (millions)*	*U.S. GNP (billions)*
1940	$9,589	$0.48	0.0050	$1.58	0.0165	$3.10	0.0323	132	$800.00
1950	$43,147	$1.25	0.0029	$2.82	0.0065	$5.80	0.0134		
1960	$92,223	$1.00	0.0011	$3.32	0.0036	$4.70	0.0051		
1970	$196,558	$2.57	0.0013	$6.20	0.0032	$19.30	0.0098		
1980						$5.00			
1989	$763,000					$3.70	0.0005	250	$4,200.00

Sources: Office of Budget and Program Analysis (1993); Bureau of the Census (1975).

Table 3.7 Budget Changes in Selected Federal Water Management Agencies and Programs, 1981 and 1985

Agency or Program	Fiscal Year 1981	Fiscal Year 1985	Percent Change
Agency budgets, in millions of dollars			
Environmental Protection Agency	$1,291.3	$4,376.6	238.9
Water Resources Council	$19.8	$0.0	–100.0
Program budgets, in millions of dollars			
BLM, renewable resources	$130.0	$113.2	–12.9
BLM, planning and data management	$31.2	$22.7	–27.2
BR, construction	$576.1	$754.3	30.9
BR, operation and maintenance	$106.3	N/A	
COE, construction	$1,593.9	$955.3	–40.1
COR, operation and maintenance	$967.9	$1,307.8	35.1
DOE, total nuclear fission	$986.0	$612.9	–37.8
DOE, defense activities	$3,668.0	$7,324.4	99.7
EPA, water quality*	$318.2	$95.1	–70.1
EPA, drinking water	$79.3	$26.6	–66.5
EPA, hazardous waste	$141.4	$52.5	–62.9
EPA, toxic substances	$94.1	$38.9	–58.7
FS, soil and water management	$30.6	N/A	
FS, road construction	$224.8	$235.4	4.7
FWS, operation	$98.5	$147.5	49.7
FWS, land and water conservation	$36.1	$46.5	28.8
NPS, operation	$475.0	$636.0	33.9
NPS, land and water conservation	$288.6	N/A	
SCS, PL 566 (small watersheds)	$192.5	$151.4	–21.4

Sources: Conservation Foundation (1982), U.S. budgets, and government officials.

* Some sources indicated expenditures in the range of $200–250 million, but program scope is not clear in either entry.

management. Simultaneously, the population nearly doubled while the GNP increased more than fivefold. There was a consequent 280 percent increase in personal consumption expenditures per capita from $3,800 to $10,700 (Office of Budget and Program Analysis, 1993). The disparity reflects nationwide increases in expenditures on entitlements and interest (which has since decreased substantially), and perhaps more efficient expenditures on conservation programs and projects coupled with a shift toward more nonstructural measures.

Table 3.8 Fiscal Year 1974 Water Resources Expenditures by Purpose and Agency (to nearest thousand dollars)

Purpose	*Department of Agriculture*	*Corps of Engineers*	*Department of Commerce*	*Environmental Protection Agency*	*Department of Housing and Urban Development*	*Department of Interior*	*Department of Transportation*	*Other Independent Agencies*	*Totals*
Urban flood damage	$4	$363,935	$0	$0	$146,901	$0	$0	$284,779	$795,619
Agricultural production and rural flood control	361,917	403,987	0	0	0	144,899	0	100	910,903
Agricultural production	0	2,497	5,721	0	0	0	0	0	8,218
Water quantity management	314,183	52,303	3	0	0	42,291	0	0	408,777
Water quality management	295,226	19,722	0	2,719,249	136,055	527	3,150	0	3,173,929
Recreation	11,371	172,572	0	0	79,928	182,184	3,502	2,532	452,089
Natural areas and cultural resources	2,046	793	0	0	0	23,899	0	100	26,838
Navigation	0	543,095	0	0	0	4	113,127	3,523	659,749
Hydropower	0	205,619	0	0	0	130,452	0	82,792	418,863
Area re-development benefits	0	3,009	62,122	0	16,631	0	0	0	81,762
General support of unallocated funds	28,702	97,686	0	0	0	88,293	0	30,963	245,644
Other	11	13,494	0	0	0	18,092	0	0	31,597
Totals	$1,013,460	$1,878,712	$67,843	$2,719,249	$379,515	$630,641	$119,779	$404,789	$7,213,998

Source: Viessman (1978b).

The budgets of numerous agencies involved with water and related land resources were severely cut between 1981 and 1985, reflecting the deregulation and reduced spending priorities of the Reagan Administration. The data are shown in Table 3.7.

Under normal conditions, the agencies' budgets show a distribution that is illustrated in Table 3.8. The appropriations, though only for one fiscal year (1974), are typical of the agency activities as mandated and funded by Congress and constrained by executive branch policies at that time. The data shows the peak of expenditures on environmental conservation projects and programs during the "environmental decade" of the 1970s. It does not reflect the shift that followed in which a greater percentage of environmental investments were made in pollution control and prevention rather than in water resources development and infrastructure.

Nearly 50 percent of the Department of Agriculture's budget is spent in the two areas of agricultural production of rural flood control and water quality management. Similarly, 80 percent of the Army's obligations in water resources was used for three purposes: urban flood damage reduction, navigation, and agricultural production and rural flood control. Note that the Army has expenditures in every category — no other agency can make that claim. Similar disproportionate distributions of funds in Table 3.8 highlight the primary mission of the water resources programs of each agency or department. The "Total" column gives a clear indication of the attention paid to water quality management, which claims 43 percent of the total.

Cost sharing by the federal government varies considerably. In the fiscal year of 1974, the federal government contributed 93 percent of navigation project/program costs, 81 percent of irrigation expenses, and 80 percent of the budget for COE projects and programs. Yet, it contributed only 50 percent to the Department of Agriculture's projects and programs, and only 37 percent to the EPA (Waters, 1980). Government subsidies mask and make it difficult to maximize net benefits, the primary goal of the NED objective where, on occasion, the beneficiaries of the actions are not paying the costs (see Chapter 7). In fact, subsidies are included in water and related land resources management quite extensively, and comprehensive coverage of their activities is beyond the scope of this book. Often, their involvement is documented in a project, or program analysis effort (as described in Chapter 8).

Serious students of policy are advised to keep abreast of developments through their professional associations, newsletters, and news agencies. Change is the hallmark of the activities of the federal agencies of the executive branch.

It is easy to overlook the other two branches of the government after considering the mind-boggling extent of the executive branch. The other branches also have major water and related land resources responsibilities. The judicial branch has considerable influence over water resources management in interstate litigation, and is thus called in to mediate major conflicts such as those identified in the chapter on water law. In addition, "[t]he Supreme Court has original jurisdiction, is assisted in its decisions by special masters, and administers its decisions through federal water masters that report it" (Caulfield, 1968). The legislative branch, of course, has its say on a regular basis, and controls the executive branch to an extent, through the budgetary process and hearings. It, or rather its members, make major policy pronouncements that appear in the *Congressional Record* from time to time. Congress' committee structure plays an important role in the nation's water resources policy and programs. But the judiciary branch and Congress must play the political game, too, as the executive branch proposes legislation, appoints members of the judicial branch, and through its Office of Management and Budget, can control expenditures mandated by the legislative branch.

Other National Organizations

There are dozens of organizations focused on water and related land resources that are national in scope. There are three basic types: associations, societies, and federations. All three meet the functional (e.g., networking) or substantive (e.g., information) needs of professionals, the public, and even other organizations.

Associations are generally open to anyone who meets the rather unrestricted membership requirement of interest in the activities of the organization. Dues are required, but usually are not as high as those for societies that serve educational and certification services. Individuals may attend meetings or subscribe to periodicals that provide information that is of use or interest. Some of the more prominent water associations include: American Water Resources Association, Canadian Water Resources Association, and International Water Resources Association. Other organizations are also involved with water-related resources, such as Ducks Unlimited, Trout Unlimited, and the Freshwater Foundation.

Societies normally have stricter requirements for membership, often a college degree or rigorous on-the-job training in some professional endeavor. They also may have higher dues and periodic testing for maintenance of credentials, licenses, or certification, as well formal periodic accreditation reviews for academic and field training programs. Some examples are the American Society of Civil Engineers, the Soil Science Society of America, and the American Society of Agricultural Engineers.

Federations serve, and have representation from, member organizations. Often, interested people can be individual members with lesser privileges than delegates from the member institutions. Examples of federations include the New York State Federation of Lake Associations, the Water Environment Federation, and the Renewable Natural Resources Foundation.

Names can be deceiving, however. The Renewable Natural Resources Foundation — a federation of other associations and societies — is not readily identifiable by its name as a "foundation." That is also true of other federations such as the Universities Council on Water Resources, serving about 100 colleges and universities that have major teaching, research, or public service programs in water resources. The Audubon Society, Soil and Water Conservation Society, and Wilderness Society are really associations, although their names imply otherwise. The National Ground Water Association provides professionals in ground water occupations — including well drillers — with the more formal services typical of a society, as does the American Water Works Association (AWWA) that provides certification and college program accreditation for all waste water and water treatment plant operators. The AWWA also maintains an up-to-date listing (and URLs) of a large number of water and related land resource organizations.* So does the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA), which is currently expanding to conduct more work with watershed management interests. Twenty-two national water resources organizations are presented (alphabetically) in Table 3.9 arranged by membership. Another way to keep up with professional organizations and interest groups is through the monthly newspaper *U.S. Water News*.**

Most of the organizations identified herein tend to specialize with regard to interest or to serve a particular profession. Two of them are interdisciplinary in nature: the American Water Resources Association (AWRA) and the Universities Council on Water Resources (UCOWR). These two organizations serve water resources managers, hydrologists, educators, engineers, planners, government employees, consultants, practitioners, politicians, political scientists, forestry, fishery, and range managers, ground and surface water specialists, wetland scientists, chemists, laboratory technicians, water and waste water treatment plant operators, and lay people from all walks of life. Their common bond is activity and an interest in water resources. The AWRA and many of the other national organizations have sub-units based on local interest or state sections, and subject-oriented working groups.

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* http://www.awwa.org/proforgs.htm, May 1999.

** This paper is published in cooperation with the Freshwater Foundation by U.S. Water News, Inc., 230 Main Street, Halstead, KS 67056.

Table 3.9 Selected Water and Related Land Resources Organizations Categories

Organization	*Association*	*Society*	*Federation*
American Fisheries Society		√	
American Geophysical Union		√	
American Institute of Hydrology		√	
American Water Resources Association	√		
American Water Works Association		√	
American Society of Civil Engineers		√	
Association of Metropolitan Water Agencies			√
Conservation Foundation	√		
International Water Resources Association	√		
Irrigation Districts Association			√
National Ground Water Association		√	
National Parks Association	√		
Nature Conservancy	√		
National Wildlife Federation	√		
Renewable Natural Resources Foundation			√
Sierra Club	√		
Society of American Foresters		√	
Soil and Water Conservation Society	√		
Soil Science Society of America		√	
Universities Council on Water Resources			√
Water Environment Federation			√
Wilderness Society	√		

There are also two major action-study groups: the Environmental Defense Fund and the Natural Resources Defense Council. Both grew to meet a need for citizen and class action lawsuits in the environmental quality arena in the late 1960s and early 1970s. The League of Women Voters is a major source of education and information and has, for a long time, been an important, nonpartisan, and effective influence on the natural resources scene.

Both the Audubon Society and the Sierra Club maintain active watchdog and lobbying efforts and have been involved in several high visibility lawsuits over environmental quality and water resources issues over the years. There are also numerous other national interest groups, some profit-motivated, others more altruistic (Larson et al., 1981). All may, at one time or another, join the more prominent, established organizations to lobby for or against some particular piece of legislation or pending government action or program. Some of the interests are international in scope, but all, in some measure, have an impact on the nation's water and related land resources.

Activities and Questions for Critical Thinking

1. As you enter the major organizations' initials on the timeline, Plate 1 (found on page 8 after Introduction) on the appropriate dates, think about the conditions that brought about each organization's creation. Add any significant natural or human-caused events, too.
2. Consider what the numbers might look like in Table 3.5 if global change resulted in a cooler, wetter western climate and a hotter, drier eastern climate.
3. Should grazing of privately owned livestock on federal lands be permitted?
4. If you had the authority to do so, how would you replace the Water Resources Council's nationwide functions?
5. How might you organize a partnership involving all pertinent stakeholders on a watershed such as that shown in Figure 1.3, which includes both a watershed association and a county soil and water conservation district? What special or innovative approaches can you identify?
6. Enter the initials of some of the organizations identified in this chapter on the Internet to see the breadth of information and links offered. (For example, http://www.awra.org/.)

Chapter 4

Regional, State, and Local Organizations

Nonfederal organizations serve many diverse functions

Nonfederal organizations implement national mandates, or respond to state, regional, or local, and interest group needs. They serve many diverse functions. Like the federal organizations, lower levels of government can exhibit characteristics of formal or informal construction. The latter are often not bound by regulatory restrictions and have the opportunity to be innovative, experimenting with new approaches to solving water and related land resources problems. This chapter presents an overview of the types of organizations at the levels indicated, summarizes organizations where data are available, and presents some examples at each level.

Regional Organizations

Regional organizations in the U.S. are generally (but not always) interstate. They may be established for any of a variety of purposes, including long-range planning water allocation, comprehensive multiple-purpose management, or single-purpose management. They may be either formal or informal in structure and in response to the law that authorizes them. The formal organizations operate under legal powers of government. By their nature, it is difficult to categorize the informal ones.

The purpose of formal organizations, in general, is either to control a serious pollution problem or to provide a means to redistribute water. One of the best examples of pollution control on an interstate basis is the Ohio River Valley Water Sanitation Compact (ORSANCO). In operation for more than 50 years, its cleanup is a continuing process (Ohio River Valley Water Sanitation Commission, 1983). Although it has a limited budget and each member state has veto power, a "small and dedicated staff" has produced "considerable improvement in water quality along the Ohio River" (Thomas, 1973). "A properly empowered river basin authority would be the logical institution to plan and implement a coordinated water quality management program." The breadth and timeliness of current activity on the river is evident in the ORSANCO home page.*

On a broad, regional level, Ackerman (1960) points to problems that will arise, and have in fact arisen, since he wrote 40 years ago. His data are presented in Table 4.1. His findings are about due for a (lower 48) nationwide reassessment by regions to ascertain his clairvoyance.

Table 4.1 Regional Distribution of Population, Land, and Water Resources in the U.S. in the Year 2000

		Percent in the Year 2000		
Region	*Number of States*	*Population*	*Land Area*	*Runoff*
Northwest	8	7	21	18
Southwest	9	24	41	14
East	31	69	38	68

Source: Ackerman (1960).

Formal Organizations

There are four general types of formal regional organizations, that is, units of government that have some power and authority to manage water and related land resources. Because they are usually interstate, their authority must come, in part, from Congress. However, the powers and responsibilities vary, depending upon what the goals of the organization are and what the individual states are willing to concede to the regional government authority. All of these types are not necessarily viable or active as of this writing, but they are all identified because they have in the past played — and may continue to play — an important role in the management of soil and water resources.

* http://www.orsanco.org/ as of June 15, 1999.

Interstate Compacts

Under the joint authority of the Constitution and the 1911 Weeks Act, two or more states can enter into an agreement on the interstate waters they share. This is called a compact.

There are four types of compacts. **Water allocation** compacts comprise 18 of the 31 entries in the list of Interstate Compacts following the text.* There are 10 **water pollution control** and **planning and flood control** compacts, and 3 **federal-state-Inter-Agency** compacts in which the federal government, usually represented by the secretary or chief administrative officer of a department or agency, is a full-signature, participating member.

Only six states (Alaska, Florida, Hawaii, Iowa, South Carolina, and Washington) are not involved in at least one interstate compact. Colorado and New Mexico are each party to eight compacts. Wyoming is party to seven, and Pennsylvania to six.

Each compact establishes a commission that is empowered by the compact and congressional assent thereto, to administer the provisions of the compact. Usually, the official state representative, the governor, designates a deputy. In the eastern states, this is often the chief administrative officer of the state's department of conservation, natural resources, or water resources; in the western states, it is usually the state engineer.

The water allocation compact is created to resolve some specific problem by detailed distribution of water under normal and/or stress situations; it may be based on a court decree resolving differences that existed prior to the compact adoption, e.g., the Delaware River. The classifications (Beuscher, 1967; Muys, 1971) are not a mutually exclusive set of categories. For instance, the Delaware River Basin Compact does allocate water, in fact, but it is also listed under the federal-Inter-Agency category. The Susquehanna River Basin Compact is primarily directed at improving planning and at coordinating intergovernmental management goals, yet it is categorized with the Delaware as a federal-Inter-Agency type. Both of these compacts have considerable interest in water quality, which is of great importance in the estuaries and bays through which they discharge water to the Atlantic Ocean. And, of course, water quantity is important to the water quality of that discharge. Clearly, it is important to examine any particular compact under consideration on an individual basis. Generally, however, breadth and effectiveness of regional management differs by compact type and is a function of the commission's authority and responsibility, not to mention the severity and extent of the problem being resolved.

* Appendix D. See, also, Chapter 2.

Congressional Authority

Congress exercised its authority to create a regional management agency only once, and it did an effective job. The Tennessee Valley Authority (TVA), created in 1933, is a self-contained, largely self-supporting, government-owned corporation (Office of the Federal Register, 1980). The organization chart (Figure 4.1) illustrates the comprehensive nature of the agency. Called a grass roots enterprise and a triumph for democracy by its first and long-time chairman, David Lileanthal, the TVA was considered a model of regional development and management to the world (Lileanthal, 1944).

The TVA has exerted a positive influence on the surrounding area and has been accepted by the public, although it received much opposition from a variety of interest groups at varying stages during its development (Tate, 1980). Congress retains the authority to create similar regional management institutions. Greater prosperity and a definite lack of desire for government "intervention" precluded the creation of TVA-like institutions for the Missouri River and Columbia River basins in the 1950s. There was much serious thought about their viability at the time, and much pressure to establish similar authorities (see, for example, Coyle, 1957; Montana Farmers Union, 1952; and Pick, 1946). The TVA, according to the National Water Commission (1973),

> is a singular example of a federal corporation performing major functions in this area. But it has never been duplicated in the United States despite efforts to do so. It does not appear to be either advisable or feasible in the foreseeable future to establish additional federally owned and operated regional resource corporations of the scope and type of TVA. However, there may be isolated situations in which federally owned and operated water resource projects of a self-supporting nature can be organized more feasibly as a federal corporation than as a branch of another government department or agency.

At age 50, a compilation of papers by TVA scholars was published with the tongue-in-cheek — and oxymoronic — subtitle, "Fifty Years of Grass-Roots Bureaucracy." In its introduction, Hargrove (1984) writes that TVA had "been presumed to be a grand experiment, a moral force and a beacon to the nation." He continues, "when all is said and done, the picture is one not of comprehensive regional development according to plans but of practical actions to improve specific areas of life. Yet the spirit of action was utopian and TVA employees seemed possessed of a special dedication." Hargrove summarizes by pointing out that TVA carried out its mission in two primary ways. First, through its autonomy in the production of power,

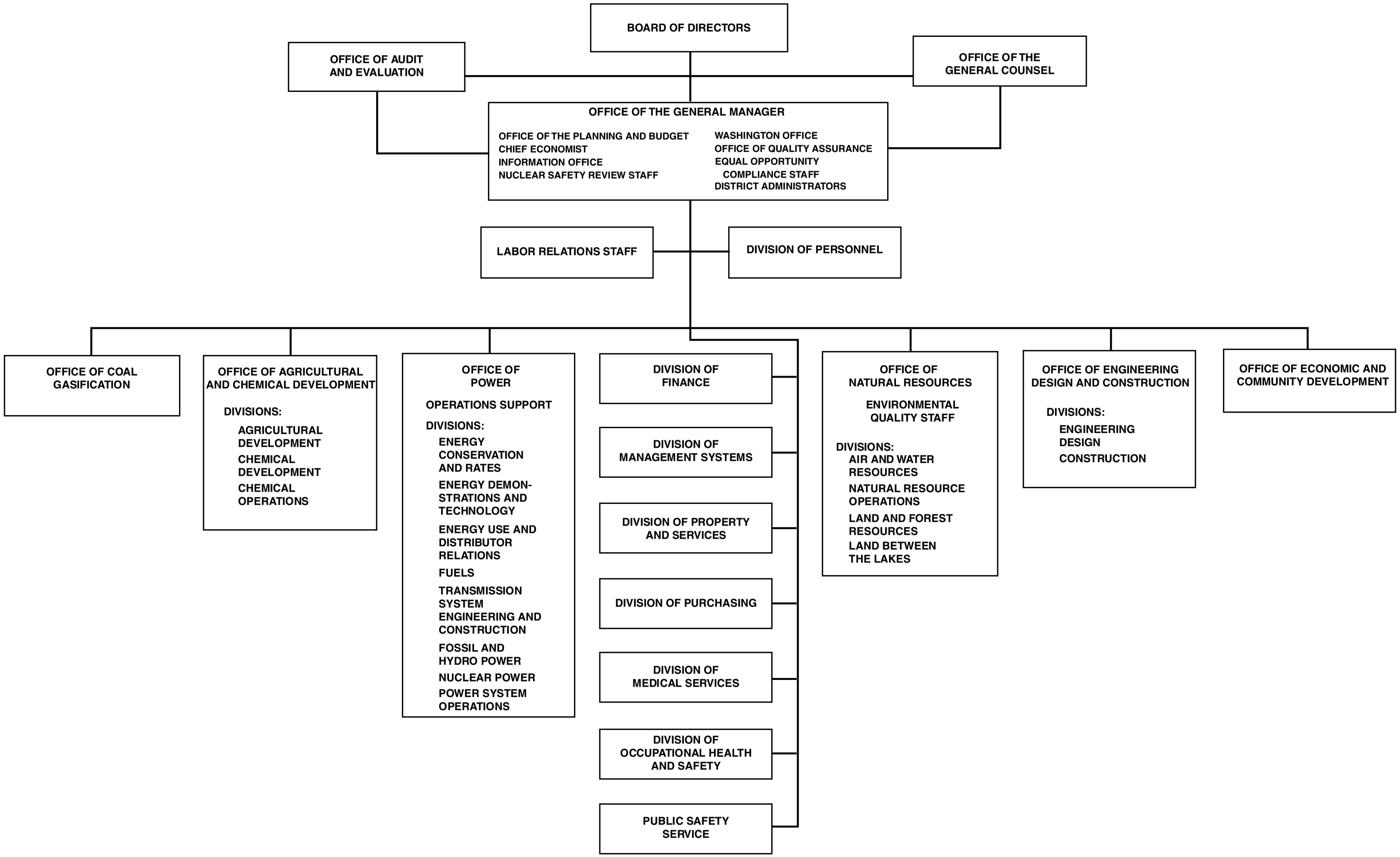


Figure 4.1 Organization chart of the Tennessee Valley Authority.

fertilizer, and navigation, and second, through technical assistance. "In the first sphere," says Hargrove, "TVA could dominate others. In the second sphere, TVA was dependent on the good will of others." In the collection's concluding article, Granthum (1984) states that, "The Tennessee Valley Authority was conceived as a *national* agency with a *regional* focus" (emphasis in the original). Hargrove explains, "regional bodies with real authority are not compatible with federalism." Granthum sums it all up by writing, "No other institution, with the possible exception of the federal forces led by Generals Grant and Sherman, has had a greater impact upon the Tennessee Valley."

Title II Commissions

River basin commissions established under Title II of the Water Resources Planning Act of 1965 (WRPA) were referred to as "Title II Commissions" and were restricted in their activities to planning and coordination, as mandated under WRPA.* The locations of Title II commission, federal-interstate commissions, and river basin Inter-Agency committees are shown in Figure 4.2. Almost the entire nation is covered by one type of commission or another.

With the attendant inadequacies of the Inter-Agency committee approach to regional water management and the inappropriateness in many instances of a full-scale interstate compact or a TVA-like agency, the river basin commission approach evolved as a means to achieve necessary planning and coordination on many of the nation's rivers. Upon passage of the WRPA, the Inter-Agency Committee on Water Resources (ICWR, or "Icewater," successor to "Firebrick") was abolished by President Johnson (National Water Commission, 1973), along with the President's Water Resources Council giving way to the (statutory) WRC that functioned until 1982.

Under the WRPA, a river basin commission could be created by executive order of the President upon either request of the WRC, or by a consensus of at least half of the states involved.** The Title II commission was made up of representatives from the federal agencies as well as from the states, with the chairman appointed by the President. The duties of the commission were, broadly, "to engage in such activities and make such studies as are necessary and desirable in carrying out the policy set forth in Section 2 of this Act."

The commissions reported annually to the President and the WRC, and were authorized to hold hearings, establish offices, hire personnel, and

* The process is also referred to as "Level B" planning.

** This is true except in the upper Colorado River and Columbia River basins, where three of the four states had to consent to the creation of the commission.

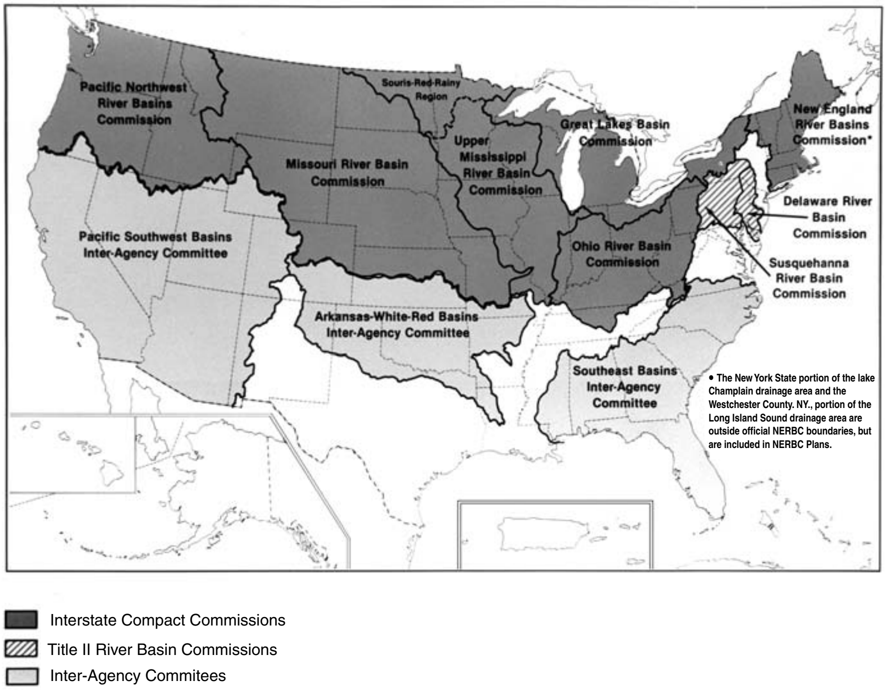


Figure 4.2 Title II river basin commissions.

incur other administrative expenses that were reasonably necessary to the pursuit of their goals. The commissions were funded jointly by the states and the federal government, which paid each chairman's salary and contributed agency personnel as needed. The NWC (National Water Commission, 1973) notes:

> The resources available to the chairman and [the] staff give them much flexibility but not much authority. A commission can become involved in a wide range of resource and environmental questions on the basis of the Planning Act and the responsibilities of the commission membership. … The commissions have resources to study or recommend. However, the commission has no way to enforce its decisions. There are few resources at the command of a chairman to reward those who work through a river commission and penalize those who do not. [The chairman] is dependent upon … state and federal membership for funding. … Since a number of separate entities are involved in water resource decision making in a region covered by a river basin commission, and the power of those

> separate entities is undiminished, river basin commissions can act only as facilitators and provide a framework for bargaining. … It is likely that a river basin commission may perform its role more strongly where it does not need to compete with one dominant water development agency that has control over [its] decisions.

Despite this limited control and authority, the NWC continues:

> River basin commissions are to be preferred over Inter-Agency and ad hoc committees for water and related land resources planning and should be encouraged as regional planning entities for water and related land resources.

The reason behind this conclusion and its accompanying recommendations must be considered in light of the two primary alternatives. The first alternative is the anarchy-like, "coordinate-only-when-necessary" approach of the independent agencies, each seeking to achieve its own goals and perpetuate its own organization (as was the case on the Missouri River in the 1940s). The second is the now unacceptable, over-centralized, over-powerful approach of an organization like the TVA.

On the positive side, the river basin commission approach was preferred first because "it mandate[d] federal participation in the coordinated planning process, which [was] essential to the development of any meaningful comprehensive plan and provide[d] a mechanism for federal-state coordination. Second, it provide[d] financial assistance" (Muys, 1971). A third value was that the Title II Commission can, and should be, flexible and fitted to the "actual conditions" (Hoggan, 1974).

An example of application of the Level B river basin planning is described by Nelson (1975), in which the planning process is applied to a highly urbanized area (Long Island, New York). The situation required coordination with Section 208 and the 1972 Coastal Zone Management Act. Most important, and in contrast to nonurbanized areas with big-project solutions, a high degree of effective public participation had to be provided (Nelson, 1975). Thus, the river basin commissions had the seeds of the partnership approach to complex and far-flung water resources management situations, and may have been ahead of their time.

Nevertheless, the weakness of the WRC and the uncertain future of river basin commissions are the subject of continuing consideration. The Unified River Basin Management Symposium I (Allee et al., 1981) reported that the regional river basin management infrastructure was in a state of development. This three-part symposium provided guidance to the evolution of effective regional management of water and related land resources. Schramm (1980) maintains that "river basin or watershed development … should not proceed before looking at the major interrelated factors by which developmental goals and objectives are achieved. … Environmental planning must be built into the overall process."

As of September 30, 1981, federal funding for Title II river basin commissions was eliminated and, unless local, state, or regional interest has been forthcoming, the regional planning efforts by this vehicle have terminated. In response to the demise of the Title II river basin commissions, various alternative planning strategies have emerged, as summarized in Figure 4.3.

Section 208 Planning Agencies

Section 208 of the 1972 Water Pollution Control Amendments requires that, following publication of guidelines by the EPA administrator,

> the Governor of each State, within sixty days, … shall identify each area within the state which … has substantial water quality control programs. Not later than one hundred and twenty days following, … the Governor shall designate (A) the boundaries of each such area, and (B) a single representative organization, including officials from local governments or their designees, capable of developing effective areawide waste treatment management* plans for such area. [Footnote added.]

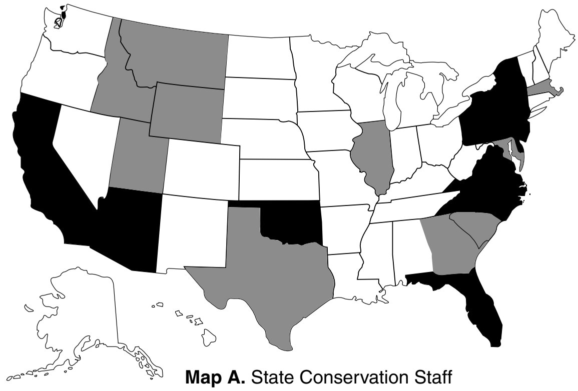
Subsequent provisions provide for governors who fail to act, and for combining areas in two or more states. The provisions conclude:

> Not later than one year after the date of designation of any organization … such organization shall have *in operation* a continuing areawide waste treatment planning process.

Such planning processes are to include:

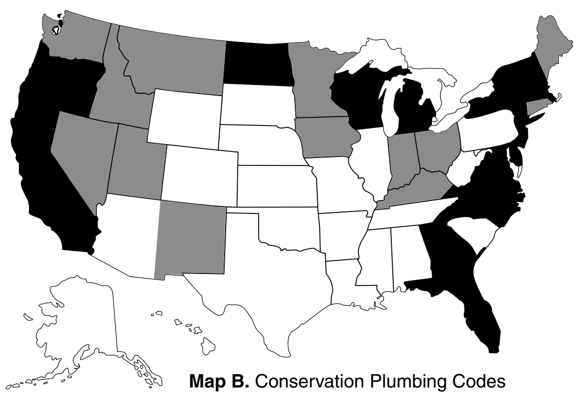
1. Identification of treatment works "necessary to meet the anticipated municipal and industrial waste treatment needs of the area over a 20-year period."
2. Establishment of construction priorities and a regulatory program.
3. Identification of agencies "necessary to construct, operate, and maintain all facilities required by the plan" and of the measures "necessary to carry out the plan," as well as a schedule of compliance.

* "Areawide Waste Treatment Management" is the title of this section, now usually referred to as the "Nonpoint Sources section" or simply as "Section 208."



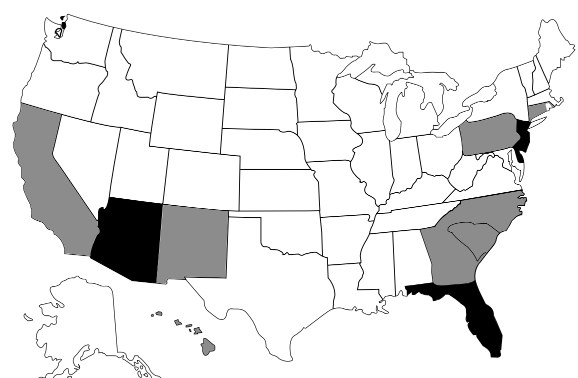
Map A. State Conservation Staff

- ☐ No full time staff, partial staff commitments less than 1 FTE
- ▩ No full time staff, partial commitments 1or more FTE
- ■ One or more full time conservation staff



Map B. Conservation Plumbing Codes

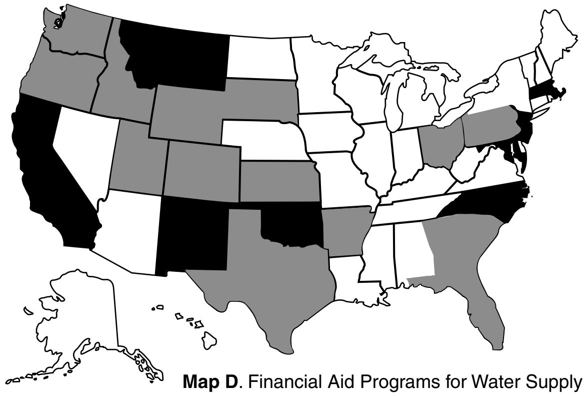
- ☐ No statewide code
- ▩ Statewide code with no conservation
- ■ Statewide code mandates conservation



Map C. Appropriation Permits

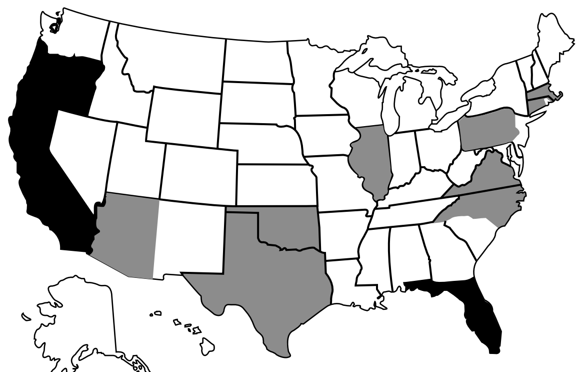
- ☐ No conservation required
- ▩ Conservation required in most new permits
- ■ Conservation required in new and renewed permits

Figure 4.3 Distribution of conservation. (Sawyer, S.W., 1984, State water conservation strengths and strategies, Water Resources Bulletin, 20(5):683. With permission from the American Water Resources Association.)



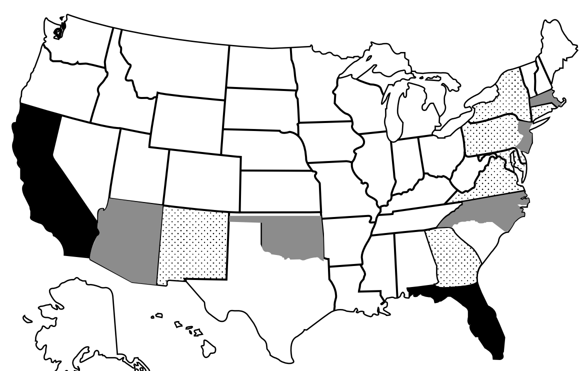
Map D. Financial Aid Programs for Water Supply

- □ No program identified
- ▩ Aid program without conservation
- ■ Aid program stresses or requires conservation



Map E. Conservation Technical Assistance Programs

- □ No or minimal efforts
- ▩ Modest outreach activities
- ■ Major outreach programs



Map F. Overall State Conservation Effort

- □ Minimal
- ⬚ Modest programs
- ▩ Active programs
- ■ Most active, comprehensive programs

Figure 4.3 Continued.

Section 208 is referenced directly or indirectly to 24 other sections of the act, and requirements of that section are tied to the WRC *Principles and Standards* and the CEQ EIS Regulations, as well as to a dozen or more agencies and programs relating to water quality. Better coordination is needed among some of the sections (Drobowoski and Grillo, 1977; Howe and White, 1979), but by being so complex and interacting with so many water resources concerns, §208 becomes a focus of virtually all water and related land resources, not merely water quality and nonpoint sources. It is, indeed, the most recent and wide-ranging step in the evolution of our understanding to relate soil and water, and methods to control water quantity and quality that commenced with the 1911 Weeks Forest Purchase Act. Highlighted in §208 is the requirement to identify processes, procedures, and methods to control nonpoint sources of pollution from agriculture silviculture mining construction, salt water intrusion residual waste, and systems for land disposal of wastes. The practices are known as Best Management Practices, a translation of the act's requirement for Best Practicable Control Technology.

Consequently, the ramifications of §208 are extensive, as is the type of pollution it seeks to control. Distinguishing "end of the pipe" point sources [covered under the National Pollutant Discharge Elimination System (NPDES)] from nonpoint sources, "the Section 208 process is the principal section applying land use planning to the problems of pollution control" (Holmes, 1979b). Following delays, the EPA issued guidelines in 1975 and began executing agreements with the states that documented compliance with the provisions of the section. At the local level, agencies are quite varied, with counties, conservation districts, multi-county combinations, and states as a whole being designated as local "208 planning agencies." Many states and local governments already had programs for sediment* control in effect, while others enacted legislation that was designed to provide assistance to local landowners through existing soil and water conservation districts (Holmes, 1979b) and the USDA Cooperative Extension Service (Scott, 1979).

EPA grants, model legislation, and technical assistance from the SCS and other federal agencies are available to help the local planning agencies accomplish the tremendous job involved in identifying and controlling these ubiquitous sources of pollution. However, §208 planning monies were cut from the federal budgets in spite of its great promise (Pisano, 1976). Again, the flexibility with which §208 problems can — and need

* The fact that Section 208 was originally aimed almost exclusively at sediment control is indicative of the state of information at the time. Research quickly established that other pollutants were far worse, especially runoff from urban areas, and that some of the sources, notably silvicultural activities, were not as critical as anticipated.

— to be resolved will provide for opportunistic compliance on the part of a variety of local organization types. Nevertheless, some states may need to modify their district enabling laws in order to meet the challenge and opportunity (Garner, 1977). Pierce (1980) adds that "existing control programs are capable of instituting solutions to the problems if and only if specified actions take place within the respective states and regions in the future. Critical research needs are identified which will assist states and regions in developing cost effective programs to control nonpoint source pollution."

Informal Organizations

It is obviously impossible to categorize the many varieties of informal arrangements that could be made to minister to the needs of regions managing and conserving water and related land resources. Two primary types of arrangements have emerged over the years, one that builds from outside the river basin itself, and one that builds from within.

Inter-Agency Committees

The informal Federal Inter-Agency River Basin Committee (FIARBC) was created, according to Rogers (1993), "when the National Resources Planning Board was abolished in 1943 by a vindictive Congress" that sought to limit President Roosevelt's attempt to use the board for water resources planning purposes. The FIARBC spawned regional committees on the Missouri River in 1945, on the Columbia River in 1946, in the Pacific Southwest region in 1948, and in the Arkansas-Red-White River Basins and the New England-New York region in 1950. The 1973 report of the National Water Commission (NWC) points out that these informal committees were limited in their ability to achieve the degree of coordination desired. The NWC reported this was due to (1) lack of statutory standing and budget, (2) no transfer of authority from the existing agencies to the committees, and (3) statutory limitations on the agencies, which precluded the agencies taking action through the committees even if they had wished to do so. Several of the individual river basin committees live on, even though their "parents," FIARBC and IACWR, have been abolished.

The Columbia River Basin Inter-Agency Committee was one of the more active of the Inter-Agency committees. Established in 1960, it was made up of representatives from seven states (Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming), and from seven agencies (the FPC and the Departments of Agriculture; Army; Commerce; Health, Education and Welfare; Interior; and Labor). It had 11 technical subcommittees, and annual meetings were attended by personnel from local, state, and federal agencies, as well as by members of the public. The objectives of the committee were coordination of programs and resolution of conflicts; comprehensive planning for the conservation, development, and use of water and related land resources; fact-finding via the technical committee structure; and providing a public forum for discussion thereof. The informality was (and still is) tempered and constrained by international concerns (Sewell, 1964).

Under the authority of the 1965 WRPA, the Pacific Northwest River Basins Commission was set up "with broader and more definite responsibilities in comprehensive river basin planning" (Water Resources Council, 1968). The new commission replaced the Columbia River Inter-Agency Committee. Control over the river for power production is now governed by three "interrelated institutional arrangements: (1) the Columbia River Treaty with Canada; (2) arrangements for use of the Pacific Northwest-Pacific Southwest transmission interconnections, and (3) the Pacific Northwest Coordination Agreement" (Water Resources Council, 1968). Currently, the region's resource management is dominated by conflict over timber harvesting policy on one hand, and habitat for the Northern Spotted Owl (Kohm and Franlklin, 1997) and several species of endangered salmon (National Research Council, 1996) on the other.

The additional demands on the river for agricultural and domestic water, recreation, navigation, and fisheries; the need for flood control and floodplain management; and the need for a greater degree of control than could be provided by a formal organization have eclipsed the older, informal arrangement. At present, on the Columbia, discussion continues about dam decommissioning, even removal of dams (Mighetto and Ebel, 1994; Lovett, 1999), and all aspects of "related land resources management" on which extensive discussion, analysis, and recommendations are presented by the National Research Council (1996). The broad scope of this report includes ocean conditions, land management, river control, and species characteristics. For example, the council observes that "[n]o body of law or practical way to consolidate governing powers is sufficient to put each bioregion under the supervision of a single management entity today." For a more extensive area than just the pacific northwest, Floyd (1999) ties together many of the fundamental forest land issues that affect water and related land resources management through considerations of ecosystem management, multiple use, and sustained yield, along with institutional issues.

The Corps of Engineers' proposals for a higher degree of engineering to protect endangered species — along with the funds necessary to achieve more naturally functioning rivers — will probably prevail in the long run. This is more likely to occur than the creation of a new, formal organization. It is perhaps inevitable that the informal organization on the Columbia will also prevail, but with a highly complex and carefully watched partnership.

Watershed Councils

The term "watershed councils" may indiscriminately include all informal organizations that have been formally structured through government sanction of their activities. But informal organizations include associations, sometimes without sanctioned structure or even incorporation that minister to the needs of people and problems on a watershed basis. Thus, there is confusion between classifications of formal or informal, and structured or nonstructured organizations. According to Griffin (1999) there are more than 12,000 watershed-based organizations, but most of the associations — as they are more often named — are intrastate. Councils tend to be interstate. Councils are "born of frustration by members of the public to be involved in natural resource management activities" (Griffin, 1999). Normally, councils are considered formal and may have both government and nongovernment representation with some mandated degree of official authority. Typically, associations are not mandated, although government representation may be present. Associations are discussed at length below in the section on local organizations.

Councils may also be developed on an intrastate basis, with attention focused on a watershed that does not span state boundaries, in which case the management requires only local input. On occasion, this vehicle is developed on the larger interstate basis, often with a high degree of uniqueness. Such is the case with the Connecticut River. The four states involved are Connecticut, Massachusetts, New Hampshire, and Vermont. The purpose of the Connecticut River Watershed Council is to develop a "fully integrated watershed program for protection, conservation, regulation, research, and equitable allocation of water supplies." Achieving such goals on a river where there was intensive, uncoordinated (mostly private) hydropower development and uncontrolled pollution was an ambitious undertaking.

Founded in 1952 "to assure both conservation and appropriate use of [the] valley's natural resources," the Connecticut River Watershed Council (a nonprofit organization) "is funded entirely by memberships and contributions." The council's program reflected the growing environmental concerns of the 1970s, and expanded from 400 to over 1,500 members during the decade (Connecticut River Watershed Council, 1980). It has programs aimed at preserving farm land in the basin, as well as programs for river and estuary cleanup, water quality monitoring, river restoration projects, and recreation. The council, administered by a four-state board of directors, an executive committee, and administrative officers, sponsors conferences and recreation activities. It cooperates with institutions of higher education in the valley and produces maps, guides, and publications for its members, as well as educational and promotional programs.

State Organizations

Overview

States vary not only in the nature and extent of the water and related land resources problems that they face, but also in their methods for resolving those problems. Some states have departments of water resources directly responsible to the governor. In other states, the departments of water resources may be under broader divisions of natural resources or conservation. In some cases, the activities are split, with pollution and human health concerns regulated by the state department of health, and other concerns regulated by the department of conservation. Policy is sometimes set in an advisory commission that is made up of representatives from the public as well as from various agencies. In some cases, policy is set only by the executive, or the attorney general who, by virtue of election, may be politically independent of the governor and have a different opinion about water resources.

Whatever the structure of government to deal with water, the ultimate control over water quality, and often over the related land resources, rests with the *county* department of health. Other concerns are assigned to the department of conservation. Good coordination often exists between the two. State-enabling legislation has created the opportunity for water management to be made effective by strengthening local government, but, in some states, the legislature has not relinquished or yielded that power to county governments. Many different types of state agencies have an interest in water resources, as is the case at the federal level.

Comparability of data among the states is nonexistent. As one might expect, inventory, monitoring, analysis, modeling, prediction, planning, enforcement, and management have been carried out (and studied and summarized) on so many different bases within and between states as to preclude a general summary. Thus, this section cannot present more than a few examples and summary information on the states. Most of the data on water resources availability and activity in the states have been collected and compiled on the basis of the standardized water resources regions by the WRC, and the data are available only in those categories.

A summary of the problems encountered in the states is shown in Table 4.2. "A vacant cell should not necessarily be construed to mean a problem-free area" (Water Resources Council, 1980c). The preponderance of entries in 4 of the 12 columns clearly identifies priorities among the many problems with water and related land resources (although extent and magnitude in each state is not shown): flooding (29 states), planning and evaluation improvements (29), inadequate surface water supplies (20), and intergovernmental cooperation (20). Close behind these categories are the problems of quality and overdraft of ground water supplies (16 and 15 states, respectively). While these data are from 1980, they present the nature of water and related land resources problems. As a function of geography and basic resource characteristics, they change little in relation to each other and between the states. Actual magnitudes may change over the years as problems are successfully tackled. The entries may also reflect either reluctance on the part of a state to expose difficult-to-control resource situations that might affect business or problematic political issues to which officials do not wish to admit.

Planning activities of the states are shown in Table 4.3. These run the gamut of combined planning and management legislation ("omnibus" legislation) through integrated planning, comprehensive planning, or no planning whatsoever. Generally, as might be expected, states with water problems have responded to a degree necessary to cope with that situation. Details of the specific legislation for each state are given in *State of the States: Water Resources Planning and Management* (Water Resources Council, 1980c). According to Shabman (1984), the states "are pursuing an adaptive planning process focusing on specific policy issues and are attempting to maintain flexibility to adapt decisions to circumstances." This was a timely development, as the federal government reduced its activity in planning: the need reclaimed, and the states or some other entity had to take over that responsibility.

By 1979, 23 states had enacted river protection legislation, while 10 had defeated similar proposals (Alling and Ditton, 1979). According to a 1981 survey, nearly the same number showed evidence of positive activity in water conservation programs. Some degree of regulation was exhibited by 21 states, 15 had community assistance programs, 31 had varying degrees of formalized, public education programs, and 22 supported research on water conservation from "evaluation of plumbing codes to studies of attitudes toward water conservation and the water needs of various crops" (Debo and Rogers, 1984). As of 1979, only 19 states had fully certified areawide waste treatment management plans for control of nonpoint sources under Section 208 (Water Resources Council, 1980d). At present, all of the states are participating in one or more of the many nonpoint source remediation or prevention programs that are financed through the NRCS, as described in Chapter 8.

Under the mandate of the 1972 Water Pollution Control Amendments, by 1979, 24 states had standards that were fully accepted by the EPA. Eleven had partial approval for their standards, and the remainder were in the process of achieving approval. Forty-five states had designated all streams as being within the 1972 Clean Water Act's "fishable-swimmable" objective (see Chapter 6), 33 had approved programs for compliance with the NPDES. Thirty-one states had signed agreements delegating the administration of the Federal Municipal Wastewater Treatment Construction

Table 4.2 Occurrence of Water Resource Problems by States

State	Inadequate Surface Water Supply	Overdraft of Ground Water	Pollution of Surface Water	Pollution of Ground Water	Quantity of Drinking Water	Flooding	Erosion and Sedimentation	Dredge and Fill	Wet Soils, Drainage, and Wetlands	Degradation of Bay, Estuary, and Coastal Waters	Intergovern-mental Cooperation	Planning and Evaluation Improvements	State
AL	√		√	√		√	√				√		AL
AK	√								√		√	√	AK
AZ		√				√					√		AZ
AR		√											AR
CA				√		√							CA
CO			√			√					√		CO
CT	√					√					√	√	CT
DE	√	√		√							√	√	DE
FL				√		√			√		√	√	FL
GA	√					√						√	GA
HI					√							√	HI
ID						√					√		ID
IL		√										√	IL
IN				√		√						√	IN
IA		√				√							IA
KS	√	√				√							KS
KY		√	√	√		√	√					√	KY
LA			√						√			√	LA
ME	√		√	√		√						√	ME
MD	√										√	√	MD
MA				√								√	MA
MI											√	√	MI
MN				√		√	√		√		√	√	MN
MS	√					√	√						MS
MO		√					√				√	√	MO

MT	√					√					√		MT
NE		√	√	√		√	√				√	√	NE
NV	√											√	NV
NH	√			√					√			√	NH
NJ						√						√	NJ
NM		√											NM
NY	√										√		NY
NC	√					√				√	√	√	NC
ND	√		√			√			√				ND
OH						√							OH
OK		√				√							OK
OR	√	√	√								√	√	OR
PA	√					√						√	PA
RI						√							RI
SC		√		√		√					√	√	SC
SD		√										√	SD
TN			√			√	√						TN
TX	√			√								√	TX
UT			√									√	UT
VT		√				√						√	VT
VA						√							VA
WA	√			√							√		WA
WV				√					√				WV
WI					√								WI
WY	√										√	√	WY
DC	√												DC
Total	21	15	10	15	2	28	7	0	7	1	20	29	Total

Source: Water Resources Council (1980c).

Table 4.3 Status of Planning Activities of the States

Type of Effort	*Number of States*	*States*
"Omnibus" planning and management	2	DE, FL
Integrated, comprehensive water quantity and quality planning	11	CT, MO, NY, OK, PA, TX, VA, VT, WA, WV, WI
Integrated, comprehensive water quantity and quality planning and management	6	ID, IA, MD, MN, MT, OR (OK and TX could be in this category instead of above)
Comprehensive water quantity planning only	10	AR, CA, HI, KS, NE, NV, SC, TN, UT, WY
Integrated, comprehensive water quantity management only	5	AK, AZ, MS, ND, SD
No express legislative mandate to undertake comprehensive water resources planning or management	17	AL, CO, DC, GA, IL, IN, KY, LA, ME, MA, MI, NH, NJ, NM, NC, OH, RI

Source: Water Resources Council (1980c)

Grants program, and 19 had fully certified areawide waste treatment management plans for control of nonpoint sources under Section 208 (Water Resources Council, 1980d). All of that activity has been elevated by passage of the 1987 amendments to the Clean Water Act and the funding that has been forthcoming for nonpoint source pollution cleanup under its §319 (Chapter 8).

Some Examples

There are obvious hazards in selecting a few states from the list of 50 to serve as examples. Criteria might include success in effecting water resources management programs, variety in approaches, geography, or history, a range of federal cooperation and/or funding, and so forth. The three states selected, California, Colorado, and New York, have very different laws, histories, traditions, and governments. Their situations are presented neither as extremes nor as being representative of all states, but as examples with different organizational and technological approaches to resolution of those problems. There are some similarities, too, between the states chosen.

California

In the mid-1950s, California embarked on a course that would prevent projected major deficits in the southern, more populous portion of the state, especially in the southern San Joaquin River Valley and the Los Angeles area, and the centrally located San Francisco region. The California Water Plan (Division of Resources Planning, 1957) proposed to bring water 600 miles from the Feather River to the Los Angeles area via a 434-mile-long aqueduct 300 feet wide and 33 feet deep, large enough to float an ocean-going vessel. The aqueduct had a capacity of 12,000 cfs or 8 billion gallons per day. The principal storage unit is Oroville Dam, a 770-foot-high Earth dam with reversible turbines that permit filling from the dam's after bay when power is not needed to pump the south-bound water over the Tehachipi Mountains into the Los Angeles basin. The arrangement in regard to power production and usage is to everyone's advantage, as power is produced during peak demand periods and sold to private power companies. Then, when power demand is slack, power is bought back by the state for use in pumping. As a consequence, the private power companies do not have to build (and charge customers for) excess installed capacity, as they can rely on the state's excess at low cost. Thus the state, electricity consumers, and taxpayers all pay less. Most of the California Water Project was completed ahead of schedule as a result of the 1964 decision in *Arizona v. California*. The plan embraces a series of projects that are, in part, parallel to and interconnected with BR projects in the Central Valley, with COE activities, and with municipal systems, many of which antedate the plan by half a century or more (Smith and Brewer, 1964).

The entire state is involved in many other projects and programs to make effective use of and to conserve water (California Department of Water Resources, 1957). The Peripheral Canal has not been built to date. It was designed to conduct fresh Sacramento and Feather River water around the environmentally sensitive San Joaquin/Sacramento River Delta to the Tracy Pumping Plant. It has been delayed by concerns over the ability of the system's operation to keep salt water out of that fertile agricultural region, as well as by general concerns over environmental quality (Cook, 1982; Western Water Education Foundation, 1982, 1984), and by financial and environmental costs.*

* An entire issue (May/June 1999) of *Western Water* was devoted to a roundtable on all sides of the Peripheral Canal issues in "Where Science and Public Policy Meet: a Roundtable Discussion." This publication is the latest embodiment of what originally was a strongly biased newsletter of the Irrigation Districts Association of California. The organization is now known as the Water Education Foundation and its mission is "to develop and implement education programs leading to a broader understanding of water issues and resolution of water problems."

Organizationally, the Department of Water Resources is located within the Resources Agency of the state and is an active and effective agency. There is a separate Water Rights Board and an Office of the State Engineer. California is unique in that it is nearly geographically isolated insofar as its borders and natural drainages are concerned. To her considerable benefit, the state has a small drainage in the Colorado River watershed, and receives runoff from Oregon via the Klamath River. Both interstate streams are governed by interstate compacts (see Appendix D for List of Interstate Compacts and Chapter 2 for discussion of the Colorado River Compact). By and large, the state has been able to operate independently with regard to water resources management, although it has been the beneficiary of major development programs of the BR's Central Valley Project's Shasta Dam and its associated irrigation and power production units. Older than the California Water Project, it manipulates its power requirements in the same way, transferring power with private and industrial customers at times that lead to overall economic management of installed capacities. The Central Valley Project includes a massive Delta bypass channel that maintains fresh water at the Tracy federal pumping station (not far from the state pumping facility). Thus, the waters of the Delta are already controlled and would be subject to even greater control and potential impairment if the Peripheral Canal were to be built. The COE has also built and now maintains numerous flood control dams, especially in the Central Valley and the Los Angeles area. The state's early, heavy dependence upon the waters of the Colorado River have made development in the southern portion of the state possible. Without such development, the money to replace that source with Feather River water via the California Water Project would undoubtedly not have been available.

The Central Valley Project Improvement Act (CVPIA) of 1993 formalizes new arrangements for water rights and contracts in the Central Valley (McClurg, 2000). A particularly controversial portion of the act, referred to as "b2") after that section's designation, provides for 800,000 acre-feet of water for instream fish flows and water quality control. No details were provided as to how the reservation was to be accomplished, and a long-running and complex partnering process has begun to achieve practical solutions. The act further defined the coordination of state and federal water development plans that were already in operation in what is referred to as "CalFed" (McClurg, 1999a, 2000). As with other partnerships described in Chapter 5, it is constrained by external conditions and is not considered to be a true grass roots partnership.

One of the oldest water battles in the western states has been over the waters of Mono Lake, the Owens Valley, and the City of Los Angeles. The "Owens Valley War" was, in fact, violent at times, as irrigators and municipal users and developers fought over the precious and poorly managed resource.

The history of the conflict is well documented by Reisner (1986) and Heppenheimer (1991) and was the subject of the movie *Chinatown*, Owens Valley aqueduct architect and engineer William Mulholland is highlighted in a fascinating story behind the failure in 1928 of the associated St. Francis municipal supply dam that caused the deaths of more than 500 (Pattison, 1998). There have been other dam failures as well, caused by poor design or earthquakes, as well as other tragic battles over water resources.

California continues to undergo severe strife with regard to its water and related land resources. Included in this saga has been conflict over spending funds for construction of interstate highways to serve the part of the state north of San Francisco, and its trade-off of developing northern waters for the part of the state south of the Tehachipi mountains. The southern part of the state was ready to secede over the issue until the mutual benefits of investing the funds in both enterprises became apparent. Severe drought has periodically raised concerns over the ability of the state to provide the water necessary to meet municipal and industrial needs, even as irrigation has been maintained and recreational uses increase. Santa Barbara, on the coast north of Los Angeles, declined to take part in the California Water Project, relying on its existing water supply system that included Cachuma reservoir (Graham, 1998). Cachuma was drawn down sufficiently in early 1991 to (1) institute drastic price restructuring to persuade users to conserve; (2) trigger purchasing and hold at ready oil tankers for transport of water from the Columbia River; and (3) agreement to benefit from the California Water Project.

With the creation and unique adaptation of the Correlative Rights Rule (see Chapter 2), California needed to codify its complex arrangements before making effective and efficient use of its extensive, intensively used, and poorly distributed water resource. Because many water sources were stressed and "full streamflows help maintain water quality," the recodification (78,702 pages) took place,* resulting in more effective management of its resources both in and out of the streambed (Lilly, 1980). Voters in California voted to approve $1.75 billion in general obligation bonds to support safe drinking, water quality, flood protection, and water reliability projects throughout the state.** That reportedly is the largest water bond act enacted by any state, surpassing both New York's Environmental Bond Act and California's earlier legislation authorizing the State Water Project.

Ranking as the number one agricultural state with its unique geography and water resources, its enormous investment in water conservation and delivery systems, its industry, its recreation, and its financial resources,

* Available at http://www.leginfo.ca.gov/cgi-bin/calawquery?codesection=wat&codebody= (August, 1999).

** Additional information is available at http://www.swrcb.ca.gov/prop13/ (June, 2000).

California exhibits a breadth of water management challenges, frustrations, and opportunities.

Colorado

In contrast to California, Colorado is one of the least isolated states, its artificial, rectangular boundaries cutting across the Colorado, Green, Laramie, Platte Republican, Arkansas, and San Juan Rivers, and the Rio Grande. The state has compacts that involve all of these, either individually or as part of a larger drainage. With an average elevation of 6,800 feet, the state receives a great amount of precipitation and furnishes large amounts of irrigation water to 18 downstream states (Upper Colorado River Commission, no date). Annual precipitation is much greater on the western, windward side of the Rocky Mountains. The eastern plains generally receive less than 15 inches, and therefore need irrigation in order to grow crops.

Owing to an inability of east- and west-slope (of the Continental Divide) interests to agree on how to share and finance development of the undeveloped west slope in the 1950s, the state nearly lost valuable waters to downstream appropriators, especially California on the lower Colorado River. A major public relations effort was launched to unite the state and thus make it capable of joining with other Upper Basin states to obtain funding for the Upper Colorado River Development Project (Stratton and Sirotkin, 1959). As successful as that effort was in achieving the immediate goal,* east-west-slope conflict remains to this day, as evidenced by continuing squabbles reported almost daily in the media. Unification of interests in the state was essential to all of the states that receive runoff from Colorado's high country, as well as to Colorado itself (Young and Terrell, 1957). The majority of Colorado's population lives on the east slope and wants the west slope water. That water is allocated by compact and, pending substantial development on the west slope, interests property holders in that region are not likely to give away their vested interests in water rights. In many cases those appropriations antedate the eastern irrigation and municipal supply appropriations because the first developments in the territory were for gold and other precious mineral development. Additional issues were the growing concerns over environmental quality, the potential for oil shale and coal development, especially in the western portion of the state, and groundwater contamination and mining in some regions. Denver

* Its success was led by an excellent propaganda film, "The Last Water Hole," produced in the mid-1950s by the Cooperative Extension at Colorado State University. While the film achieved its goal, it only discussed surface waters and completely ignored the potential of the state's ground water resources to meet growing needs. In fact, in 1961, the state coordinated its surface and ground water appropriation systems.

is expecting a population of 2.6 million people by the year 2010, and it is estimated that the present firm supply of 413,000 acre-feet will have to be nearly doubled "to meet an expected 700,000 acre-feet demand by the year 2035" (Denver Water Department, 1985).

The principal water resources organization in the state is the Water Conservation Board, which has no single or major project on which to focus, as does California. The Board "formulates policy and administers flood plain regulations and water project construction funds" (League of Women Voters, 1982). The Colorado Water Resources and Power Development Authority's major activity is financing water projects, and the Division of Water Resources, under the state engineer, governs both surface and ground water resources. Major water developments in the state are carried out by the Bureau of Reclamation (Folk-Williams, 1985). These are mostly dams constructed under provisions of the Colorado River Storage Project (Upper Colorado River Commission, no date). There are also several spectacular trans-Continental Divide diversions, including the superlative, highly visible, and accessible Colorado-Big Thompson Project on the east slope, and the Moffat and Blue Mountain Tunnels for the city of Denver. In addition, there are COE projects, such as the John Martin Dam on the Arkansas River and numerous other federal, private, quasi-public, and municipal units.

Current problems center around politically hot issues such as annexation for the city of Denver as the growing population seeks new water supplies, and the management of the Denver flood plain of Cherry Creek. The flood threat along the portion of the stream in southeast and downtown Denver is exacerbated by suburban development on the portion of the watershed upstream of the Cherry Creek Dam, along with encroachment of flood-vulnerable development in the flood plain itself. These are classic urban-water development problems.

New York

With drainage areas in five major river systems, the St. Lawrence, Hudson, Delaware, Susquehanna, and Ohio (Allegheny) Rivers, the state has numerous interstate agreements, much like Colorado. These range from the federal-Inter-Agency type agreements on the Delaware and Susquehanna Rivers to the international treaty on the St. Lawrence River. The state is also party to the New York Harbor Tri-State Compact.

New York has a bountiful supply of water. The state is blessed with 4,000 lakes that have approximately 3.5 million acres of water surface (about 11 percent of the state) and 70,000 miles of streams, including estuaries, Niagara Falls, all but a tiny fraction of the entire Hudson River drainage area, and hundreds of miles of coastal zone. Long Island presents a glacial moraine origin with little relief and attendant groundwater management problems. The state has recently completed groundwater and drought emergency management plans, including separate documents for Long Island. The principal problems in New York are those associated with water quality and management. As many as 50 governmental units, including sewerage, water supply, flood control, and drainage districts, serve metropolitan areas of 1 million people or more (Hennigan, 1968). Altogether, there are approximately 1,600 counties, cities, towns, and villages statewide, and coordination of water services — supply, treatment, sewerage, and waste disposal — is a complex undertaking.

The history of the early New York City municipal supply system is described in the context of the relationship between Aaron Burr and Alexander Hamilton, who initially supported the creation of a construction company, but not with the powers of a banking institution (Koeppel, 1994). State Assemblyman Burr secretly altered early drafts, and falsely reported to the full Assembly the approval of New York City's Common Council and *an ad* hoc committee of which he was chair so that the construction and financial segments would be operational. That villainous action resulted in the creation of the Manhattan Company that was authorized to finance the construction of the original Croton reservoir system. At the time, the only chartered New York bank was the Bank of New York, led by Hamilton; the Burr-engineered proposal apparently led to the deterioration of Burr and Hamilton's earlier friendly and productive relationship. The financial institution Burr helped create exists today as the Chase Manhattan Bank.

Since 1967, when there was a substantial restructuring of the water resources organization (and the old Conservation Department) at the state level, the state's planning and management of water resources has been divided among three multi-county regions. Water quality management and control is centered in the Division of Pure Waters and the Department of Health, and is coordinated statewide with the Department of Environmental Conservation (DEC). Problems particular to one area are in large part dealt with by that county's government, either through its planning department, its department of health, or its interdepartmental committee that coordinates activities. This reflects the strength of county government in the state. In 1971, both Environmental Analysis and Water Resources Planning Programs were assigned to the new Office of Environmental Analysis in DEC (Curran and King, 1974). In parts of the state, an intermediate regional planning development board is interposed between the county and water resources planning region entities. These boards (or for certain counties, the planning departments) are the A-95 Clearinghouses* mandated under the Intergovernmental Coordination Act of 1968.

* This name is derived from the designation of the Office of Management and Budget Circular that enforced the clearinghouse requirement of the act.

The Pure Waters Program, started in 1964 (within a few years of the $1.75 billion California bond act that financed the California Water Project), was a $1 billion program aimed at supporting the state and local shares of wastewater treatment plants mandated by federal legislation. The willingness of the state to proceed with construction of waste treatment facilities in the early 1970s in advance of actual granting of federal cost-sharing funds was a major cause of the fiscal crisis experienced in the mid-1970s. After making the investments in waste water treatment facilities, environmental concerns, rising interest rates, and impoundment of funds by President Nixon for the EPA share of those facilities all contributed to delayed reimbursement, with attendant critical and devastating financial shortages for the state.

One of the state's major water resources, the State Barge Canal,* which links the Great Lakes and the New York Harbor, is under the jurisdiction of the Department of Transportation (DOT). Many of the state's lakes have been created or had their water levels raised in order to provide water for the canal system. This means that transportation is often in conflict with conservation, as the DEC is responsible for permits on waters controlled by the DOT, whereas the DOT has become accustomed to doing what it pleases, by and large, without having to be told how, what, or when.

The water supply for the metropolitan New York City area and Long Island is the major water quantity and quality problem that plagues a large portion of the state. The Catskill system west of the Hudson River, which supplies high quality drinking water, is largely within the state's forest preserve boundaries, and access to the many major reservoirs is not permitted (in contrast to most other states). Land management activities (development, mining, forest management) in both the Catskill and Adirondack Preserves are restricted by law and subject to approval by overseeing commissions. The older Croton system east of the Hudson River is stressed by suburban population growth pressures on the watersheds of several reservoirs. Long Island's rich groundwater resources are being both mined and contaminated, threatened also by increased population pressures. Billions of dollars are currently being expended in order to build a new water tunnel to bring water into New York City (Chiles, 1994). The old underground tunnel is in such poor condition that officials are wary of turning it off for inspection because they may not be able to turn it back on, and the surface aqueduct is inadequate. Droughts still plague the state as well. A principal problem is how to impress upon a disinterested public the severity of drought, as well as how to deal effectively with drought

* This was formerly the Erie Canal, which was replaced with the larger State Barge Canal System when floods destroyed portions of the older, historic Erie Canal and a larger capacity was desired. In places, the two are the same canal.

management from an organizational standpoint. A Drought Preparedness Plan (New York State Drought Management Task Force, 1982) went into effect in 1982. Review and refinement continues (White and Wood, 1985), but no amount of planning can provide water if the water isn't there.

New York State is a leader in the application of watershed management principles to effect control over water quality; it was one of the first states to enact soil and water conservation districts, enabling legislation in the 1940s. The state's program of agricultural nonpoint source pollution control (AgNPS) in the state is quite extensive. The expenditures in support of incentive-based programs in the state have grown exponentially (Figure 4.4). One example of the state's foresight is that the legislature passed an act in 1975 (S. 3421/A. 4384) requiring every farm in the state in excess of 25 acres to apply for a conservation plan by January 1, 1978, and that the completed plans be issued by the districts no later than January 1, 1980. Anticipating the 1994 *Southview Farm* decision,* the act included a provision that the word "farm" takes into account "concentrated agricultural operations … including feedlots … less than twenty five acres." At the time, the legislation identified no oversight agency for any enforcement process. Consequently, the full provisions of the act were never carried out, although the soil and water conservation districts continued to prepare and aid in the implementation of conservation plans for farms of any size, as requested by the operator.

New York has sought to present a program that is balanced in engineering, ecological, and political approaches and solutions to its problems. This is in contrast to the emphasis on engineering in California and politics in Colorado. The Federal Cooperative Extension Service provides a continuous listing of laws relating to water resources in newsletter format. Topics of these bills range from protection of scenic water resources to disaster relief, regulatory processes, funding issues and appropriations, and disposal of hazardous wastes (Cooperative Extension, 1984). It presents a host of working partnerships, some of which are described more fully in Chapters 5 and 6.

Summary

In summary, the states vary considerably in the nature of the problems they face and in the kinds of institutions they create in order to resolve those problems. The three states reviewed are merely examples of some different problems, approaches, and solutions. While the states vary, the role of the federal government's agencies is relatively constant, insofar as function is concerned. For instance, the COE is almost universally present

* See Concerned Area Residents for the Environment, Appendix D.

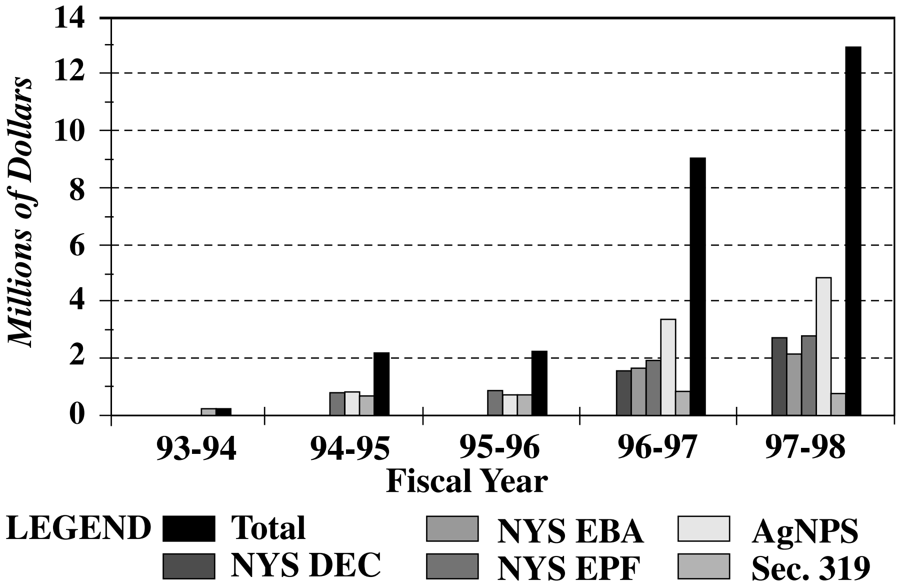


Figure 4.4 Five-year growth of expenditures for control of agricultural nonpoint sources of pollution in New York State.

in the capacity of flood control, navigation, and environmental restoration. But the degree to which the agencies participate also varies from state to state. Local populations may favor or disapprove of certain federal agencies and/or their missions, or may not even need them. For example, the BR's irrigation expertise is not needed in most of the humid east. Funding methods also vary, as does the ability of local governments to raise and fund major water resources development projects, with state and federal help or without it.

Local Organizations

The term "local organizations" implies small organizations, small watersheds, little or no staff, and run by volunteers. Those characteristics apply to the two primary forms of local organizations, namely districts and associations. Because the district typically has a structural base, for example, a legal extension of state government, it often has a paid (professional) staff as well. The association may also have a staff and even be incorporated, but it is not a legal extension of state government.

Eight particularly useful sources of information on both formal and informal local organizations that may be found on the Internet are shown listed alphabetically in Table 4.4. All these information centers provide access to newsletters, links to partners and related organizations, and in-house links to definitions, maps, and other information. These relatively stable sites are shown along with their mission, address, phone numbers, and World Wide Web addresses.

Formal Organizations

The primary type of formal organization at the local level that manages water and related land resources is the **district**. It is a legal extension of state government, enabled by the legislature.

Districts may be any of several types, as illustrated by their names: irrigation districts, flood control districts, water districts, drainage districts, soil conservation districts, conservancy districts, sewer districts, and various combinations and alterations thereof. Districts have distinct boundaries, within which some specified percentage of the land-owning residents must agree to the formation of these governmental units. Once established, a district has the power of state government, including the power to levy taxes, hold referenda, enter into contracts, incur debt, and condemn property in the public interest through proceedings of eminent domain. Often the members of the board of directors of a district are volunteers.

The boundaries of a district may coincide with county boundaries (see Chapter 1). This is often the case either in states where the county governments are strong and constrain the state legislature from doing otherwise, or where the boundary lines are consistent with the district's purpose (in the case of water management districts, they would ideally coincide with the watershed divide). As a result, specific pieces of property are normally in several different districts, paying taxes to each district based upon different tax rates. Through such a complex mechanism, each piece of property pays for the services its owner needs and receives from local governments.

The Miami Conservancy District in southwestern Ohio is generally considered the first of its type. The district was created in 1915 following passage of the Ohio Conservancy Act in response to flooding at Dayton and all along the Miami Valley. As is often the case, action followed a disastrous flood that killed 300 and caused more than $100,000,000 in damages. But the action was not an automatic response; the passage of the enabling legislation was the result of a long battle that culminated in the creation of the first water management district (Morgan, 1951). In the words of Edward E. Deeds, first President of the Board of Directors, from the Foreword to Morgan (1951),

> As I see it, there are two stories in the record of flood control in the Miami Valley. One is what we might call the technological story … The other was the enactment of legislation which made it possible to have such an agency of public service as a Conservancy District. From the legal standpoint, even more than from engineering, this was a pioneering effort.

The district's goals include control of erosion and sedimentation, improved farming and forestry methods, and provision for water storage and recreation.

Another district was also in Ohio in 1933. The Muskingum Conservancy District consists of about 8,000 square miles and drains nearly one-fifth of the state, including all or part of 18 counties. The river flows into the Ohio River at Marietta, which, like Dayton, had suffered severe flooding. Resisting the pressure to have the COE build one large dam which would have flooded out numerous acres in order to prevent flooding downstream and which would not have prevented floods, the residents organized themselves to do the job locally. They received federal assistance through the Civilian Conservation Corps, the Public Works Administration, and the COE, and the federal government paid 83 percent of the total construction bill (Leopold and Maddock, 1954). The storage in lower portions of reservoirs is administered by the district for local flood control, while storage at higher levels in the reservoirs is coordinated by the COE. Other federal cooperators include the SCS, the ARS, the FS, and the state recreation agencies (Craig, 1949; Templeton, 1952). The Muskingum has been a showcase of the land management approach to flood control (Struble and Croft, 1956). The effort today would be characterized by the word "partnership."

The district concept grew rapidly. The first soil conservation district created was the Brown Creek District in North Carolina in 1937 and, only 12 years later, one billion acres were included in more than 2,600 soil conservation districts in the U.S. (Partain, 1955). Districts may also be used to take advantage of provisions of P.L. 566, the Watershed Protection and Flood Prevention Act (Perry, 1958) and Watershed Protection Districts (Cooperative Extension, 1985). Hauser (1978) suggests and Holmes (1979b) documents that soil conservation districts may also be used to achieve the water quality goals in Section 208 of the 1972 Water Pollution Control Amendments. By the end of the 1940s, most of the states had enacted district-enabling legislation.

Table 4.4 Information Centers for Formal and Informal Local Organizations

Name	*Mission*	*Address, Telephone, and URL*
American Heritage Rivers	A multi-agency initiative to help communities find support for their rivers.	Council on Environmental Quality 722 Jackson Place NW Washington, DC 20503 USA (202) 395-7427 http://www.epa.gov/rivers/services/
Conservation Technology Information Center	A nonprofit, public-private partnership working to equip agriculture with realistic, affordable, and integrated solutions to environmental concerns.	1220 Potter Dr., Room 170 W Lafayette, IN 47906 USA (765) 494-9555 http://www.ctic.purdue.edu/CTIC/CTIC.html
Information Technology Center	This site is your web window to the people and projects providing information technology service and support for the USDA partnering agencies.	2625 Redwing Road, Suite 110 Fort Collins, CO 80526 USA (970) 282-1974 http://www.ftc.nrcs.usda.gov/
International Rivers Network	Linking human rights and environmental protection.	1847 Berkeley Way Berkeley, CA 94703 USA (510) 848-1008 http://www.irn.org
Know Your Watershed	The national watershed clearinghouse working to help watershed partnership coordinators facilitate tangible progress toward local goals.	1220 Potter Dr., Room 170 W Lafayette, IN 47906 USA (765) 494-9555 http://www.ctic.purdue.edu/KYW/KYW.html
National Association of Conservation Districts	Your on-line resource for the latest conservation news, legislative updates, and on-line links to other natural resource-related sites.	509 Capitol Court, NE Washington, DC 20002-4946 USA Tel: (202) 547-6223 http://www.nacdnet.org/

Table 4.4 Information Centers for Formal and Informal Local Organizations (Continued)

Name	*Mission*	*Address, Telephone, and URL*
River Network	River Network's mission is to help people organize to protect and restore rivers and watersheds.	P. O. Box 8787 Portland, OR 97207 USA (503) 241-3506 http://www.rivernetwork.org/
Surf Your Watershed	A service to help you locate, use, and share environmental information about your place.	Mail Code 4503F, 401 M Street SW, Washington, DC 20460 USA (202) 260-7087 http://www.epa.gov/surf2/

Source: World Wide Web on August 13, 1999.

Districts appear to be successful if they enjoy characteristics such as those identified by Mendenhall (1963):

1. Widespread and continued local understanding and support.
2. A broad and worthwhile purpose.
3. Dedicated local leadership.
4. A sound technical program.
5. Ability to attract outside help when needed.
6. Willingness to assume local responsibilities.
7. Financial capability.

Mendenhall cites inadequate leadership, financial capability, size of area, project justification, and "limited or strictly local objectives" as primary reasons for district failure. Indeed, the previous list is appropriate for informal as well as formal organizations. Cox (1969) underscores the importance of the first-listed characteristic: "total community involvement is the more successful approach." In recent years, the public has become better informed, legally and technically better equipped, and more interested in participating in virtually all aspects of water and related land resources planning and management.

In a historical context, the development of the district as a vehicle for soil and water conservation has maintained a counterbalance to the big dam approach to flood control and is the essence of local participation (Leopold and Maddock, 1954). Success in Ohio on both the Miami River (for which the state's enabling legislation was originally enacted) and the Muskingum River kept a "think small" approach in the fore. The creation of the SCS and the inclusion of upstream land treatment in the Omnibus

Flood Control Act (of 1936) are ramifications of that thought. The culmination of the approach is P.L. 566, the Watershed Protection and Flood Prevention Act of 1954. Ultimately, the resolution of flood problems must be the combination of upstream and downstream control methods, along with floodplain management. Floods are not simplistic phenomena, nor can their control be achieved by simplistic solutions.

Districts do provide the means to get a local job done locally, at the lowest administrative level with appropriate outside assistance, especially where there are beneficiaries beyond the district's boundaries. They also provide the ideal opportunity for an effective approach to all water resources management and to watershed management in particular. That, in part, explains the phenomenal growth in the number of local watershed organizations of all types in the last decade or so. In short, the district — and its informal cousin, the association — is where the action is in watershed management.

Informal Organizations

There is, as with informal regional organizations, no set way to categorize the range of informal local structures. The primary vehicle for the informal organization is the **association**, which is a group of individuals (and/or other organizations) who have banded together to achieve a common goal. Usually, the goal is limited to what can be achieved by education and dissemination of information. Sometimes coordination is a goal and, on numerous occasions, the goal is to raise sufficient support to create a more formal organization.

The association has none of the legal powers that the district has, although it may incorporate under state laws as may any group. There are no boundaries nor land ownership requirements to delineate membership (although there are associations of landowners). The association may set its own requirements for membership, such as an interest in cleaning up local water supplies. In California, there was a need for the irrigation districts to communicate with each other over normal operational, fiscal, and political issues. Their federation was known as the Irrigation Districts Association of California (IDA), and it frequently played a political role in the development of both the federal (BR) and state water development plans. As political issues waned and the IDA saw fit to change, it metamorphosed into the Association of California Water Agencies, now known as the Water Education Foundation. Its goals and the interest and bias of its articles in its monthly newsletter have changed accordingly over the years (Duncan, 1987).

Selecting Some Examples

As was the case with selecting states as examples, there are the inevitable pitfalls of being provincial, or upsetting someone because their favorite organization is omitted, or forgetting a truly important organization. It is not difficult these days, with the power of the Internet, to find information on almost any watershed association, council, or committee. Some organizations provide lists of watershed groups on the Internet. There are also groupings of groups. An attempt at listing all the groupings would likely be futile, as the number of groupings is constantly increasing. The more stable listings, however, are shown in Table 4.4.

Brandywine Valley Association

The first small watershed association in the nation was the Brandywine Valley Association, founded in 1945. A nonprofit organization, the Brandywine Valley Association's educational and promotional program is supported by dues and gifts of its members, most of whom live on the 330-square-mile watershed that straddles the Pennsylvania-Delaware boundary. Brandywine Creek discharges runoff from forest, agricultural, suburban, and urban areas into Delaware Bay after flowing through Wilmington. The organization is managed by 30 directors, who set policy and direct the staff, and it serves as a catalyst for a wide variety of conservation activities by agencies and individuals throughout the valley. It accomplishes its goals through tours, demonstrations, field days, a newsletter, an informational film, and use of the media.

The association's goals were quite specific: (1) a sewage treatment plant for every community, (2) a waste treatment plant for every industry, and (3) a conservation plan for every farm. As suggested above, the association promoted formation of a soil conservation district in Pennsylvania (Struble and Croft, 1956). Having accomplished a massive cleanup on Brandywine Creek, the association has broadened its goals and now "urges and helps the people of [the] area to unite their efforts to make the Brandywine Valley a more pleasant and profitable place in which to work and live."* The association is, in this particular case, much like the Connecticut River Watershed Council, which buttresses the observation that informal organizations can take almost any form. Similarities, though, are often as great or greater than their differences.

* From the Membership and Informational Brochure, Brandywine Valley Association, Inc., 1760 Unionville-Wawaset Road, West Chester, PA 19380.

The Brandywine Valley itself went through a traumatic experience in the late 1960s. The Institute for Environmental Studies at the University of Pennsylvania invested 3 years in developing a widely acclaimed regional plan for the Valley. The plan was overwhelmingly rejected by a strongly provincial group of residents who wished no outside control over their land use. The contentious issue focused on the proposal for conservation easements (Thompson, 1969). Although the Brandywine Valley Association was not directly involved (nor was it representing the residents), the reaction of the landowners was a timely reaction to threats of over-centralization of planning and related regulatory activities. This type of reaction is not surprising for an area in which a local, informal organization has accomplished so much. (This negative reaction in more recent years has been duplicated at other locations; it was probably in response to concern over big government, Watergate, and other high government corruption.) Currently, the Brandywine approach is a model of successful partnering.

Summary

In a larger context, then, the reaction of Brandywine residents to the Institute for Environmental Studies' plan was a ramification of widespread public dissatisfaction with all types of government organizations, of distrust for centralization of authority in regard to water and related land resources planning, and of a failure to build effective, responsive institutions.

As public distrust reached a peak over Vietnam and Watergate in the 1970s, the likelihood of combining the federal agencies for natural resource management under one roof faded. Even if a super-agency could be set up politically, it is likely to fail for lack of public trust. If the public even suspected that collusion and corruption existed in an organization, that organization could not be at all effective. Now, the public clamors for — and is required by law to provide — a greater degree of significant input into the planning process and, on occasion, into management itself. Simultaneously, apathy allows government to proceed on its traditional mission. Thus, a cycle is spawned that reflects the degree of public interest and the magnitude of the public's frustration and effectiveness.

Edwin H. Clark II, Senior Associate of the Conservation Foundation, cited some of the diversity of institutional portfolios described above, under the topic, "Defend or Share? Forging a Regional Water Supply Strategy." He observed that "the institutions we have set up to manage our water are really institutions designed to promote water use; we cannot rely on these institutions to solve our water problems."* Narrow mission and bureaucratic inertia prevent wholesale changes in agencies such as the Bureau of Reclamation. Some agencies, however, such as the Corps of Engineers and Soil Conservation Service, have undergone considerable change in mission direction and breadth, as well as strategy. Whatever Water Resources Council coordination existed at one time needs redefinition and a home. The focus of future organizational coordination will, in all likelihood, need to be regional in scope where a coalition of government levels can share responsibility and express legislature-mandated authority.

Examples of successful watershed management programs are provided in Chapter 5, and, much of that activity — focused on water quality — is discussed in Chapter 6. Houck (1999) points out that the partnership is probably the most effective, and ultimately satisfying, way in which to empower people in the necessary and often distasteful job of water pollution control. Ultimately, the public is probably best served by a multitude of organizations with different responsibilities and at different levels, even if it is served more slowly and less efficiently. The pluralism that is a characteristic of the nation also demands a diverse approach to the resolution of its varied problems with water and related land resources.

Activities and Questions for Critical Thinking

1. As you enter each major organizations' initials on the timeline, Plate 1, (found on page 8 after Introduction) on the appropriate dates, think about the conditions that brought about each organization's creation.
2. How does your state compare with California, Colorado, or New York in relation to the administration of water and related land resources?
3. How does it relate to regional and local organizations within your state?

* From comments at "Water for Millions: at What Cost?," a symposium sponsored by Scenic Hudson, Inc., considering the status and future of water supply within the watersheds of New York City. The symposium was held at American Museum of Natural History in New York City, New York on June 4, 1987.

4. Consider what changes might result from having the state boundaries re-defined on the basis of river basins. How might you organize it? What do you think would be the consequences (to land and water resources)?
5. Draw a diagram like that of Figure 1.3 for the city, town, and/or watershed within which you live showing overlapping government organizations.
6. Make a list of all the formal and informal organizations that are involved in the watershed within which you live. Set up a table that also lists for each organization its mission, membership, leadership, headquarters, and whether it is formal or informal. You might include their Web addresses, and other information of interest.

Chapter 5

Policy, Planning, and Partnerships

Partnerships provide means for effecting policies and plans

The recent recognition and proliferation of partnerships have provided means for focusing and implementing water and related land resources polices and planning.

These three important topics, policy, planning, and partnerships, are combined in one chapter because they are inextricably linked for most natural resources management situations. That observation is especially applicable and important in the case of water and watershed management, "water and related lands resources" as in the book title. Currently, common practice is for an organization to launch a strategic planning process that follows, or may actually include, creation of a "mission statement" and/or statement of "vision." This healthy exercise, in addition to providing an updated set of goals and objectives for the organization, provides an all-important and purposeful series of sessions that improves communications both within the organization and with its typical partners. Strategies that emanate from the process effect policies. Partnerships already have been, or can be, established (or expanded and updated) and directed to carry out the objectives identified in the mission. It is also common to find statements of policy mixed with basic planning objectives, planning concepts tied to water quality management goals, and some statements where it is difficult to separate them.

The current U.S. emphasis on water quality links the topic of pollution as well. However, the topic of pollution is taking on new dimensions in human health and global environmental issues, and acutually deserves its own chapter.* An additional reason for separating pollution is that establishment of policy and the planning processes are still largely *ad hoc* in that there are no hard and fast rules for periodic review and re-evaluation. Pollution control, on the other hand, is very much a matter of specific litigation, legislation, and enforcement.

Policy

Policy is an agreed-upon or widely accepted course of action that guides all actions pertaining thereto. More specifically, water resources policy generation is a dynamic process through which the objectives of water management practices are periodically reassessed, as stated by Viessman.** Maintaining that policy is "the product of choice." Schad (1972) states that:

> Water policy is not, and should not be, autonomous and self-referring; it cannot be considered apart from other national policies, particularly when these other policies are more fundamental or more comprehensive — for instance, policies on national economic growth and policies on comprehensive environmental protection. If the nation should decide to pursue a policy of maximum economic development — with all its consequences for industrialization, population growth, agricultural production, and unprecedented consumption (or export) of goods and services — there will be a tremendous drain on our water resources … and we may have to pay handsomely for it. On the other hand, if the nation gives priority to a vigorous and ambitious program of environmental protection and restoration — with its probable concomitants of less production, less reproduction, and less consumption — there will be little need to develop and extend the nation's usable water resource: the need for interbasin transfers, desalting plants, cloud seeding, and so forth will be quelled.

* In the previous editions of this book, this chapter included policy, planning, and pollution.

** This was paraphrased from a definition given at a panel discussion on national water policy at the Fifteenth Annual Meeting of the American Water Resources Association in Las Vegas, Nevada, September 24, 1979.

And Trelease (1965) holds that "policies and principles are merely the starting points of legal reasoning, and do not automatically generate specific rules and decisions."

Overall, statements of water resources policy may be found in four general types of locations or sources:

1) Declarations of policy at the beginning of legislation.
2) A variety of public documents in which the author/agency is sometimes blatant and at other times subtle about basic policy.
3) Utterances at conferences and at hearings before the various federal water study commissions, congressional committees, and other groups.
4) In the proclamation of Presidents and other elected or administrative officials who hope, in some way, to influence the course of water and related land resources activities through control over policy.

Legislative Sources

Normally, for a congressional act to be declared constitutional, the opening statement of policy must somehow conform to the identified responsibilities of the legislative branch in the U.S. Constitution. Thus, "In order to protect the flow of navigable streams…" meets that requirement. However, a similar statement in the 1936 Omnibus Flood Control Act proclaims "that flood control on navigable waters or their tributaries is a proper activity of the Federal Government in cooperation with the States." That statement includes a judgment ("proper") that is not solidly based on the science or engineering that underlies "navigation." Such a statement of policy can easily lure one into forgetting that there are alternatives, such as *not* having the federal government provide flood control. Another more recently acceptable approach, for example, would be passing a law that precludes any development in the flood plain that would cut flood losses and be more effective than building levees.

Document Sources

United States flood control policy appears to be based upon the opening quotation in the Geological Survey study (Jarvis et al., 1936) that launched the 1936 Act: "The ideal river, which would have a uniform flow, does not exist in nature." That ambiguous and incomplete* pronouncement has

* Personal observation to the author by Gilbert White, 1985.

been the underlying policy of our flood control program for almost 40 years; it still is, and based on at least one interpretation, it is not necessarily true. Not all the government document declarations regarding water and related land resources policy are so irresponsible: many competent suggestions and statements have been set forth, some of which are discussed later on in this chapter.

Meeting Sources

In this age of the sound byte and politically correct language, it is easy to fall victim to pseudo phrases. The media is particular vulnerable to utterances at hearings that can make news and respond to the public's demand for quick information, or misinformation. Consider, for example, the simplified but catchy phrases that the media pick up from both valid and questionable sources. One such example is "dead lakes," brought up in association with the (otherwise serious) acid rain problem. While the ecological character of a lake may be drastically changed by acid rain, or by processes associated with acid rain, killing all biotic life in a lake is unlikely and, in most cases, quite difficult. Yet, we are following an unofficial policy of spending millions of dollars to prevent "dead lakes." That policy may or may not be appropriate; it may not even be practical or desirable. The point is, the decision to do so was not part of a conscious decision-making policy process.

Executive Sources

Finally, an example of an executive declaration, is the series of directives issued by President Carter in 1978 known as the "Water Policy Initiatives." These directives, although they have not been formally adopted, represent a variety of courses of action and associated goals that are currently being pursued, even by a politically different administration. Other Presidents — or cabinet members often speaking for the President — have promulgated similar lists.

A definite lack of coherence is evident with respect to water resources policy in the U.S. (Mosher, 1984). That lack is evident throughout the many pieces of legislation dealing with flood control, soil conservation, public works, flood insurance, coastal zone protection, water resources planning, study commission creation, river and harbor projects, floodplain management guidelines, environmental protection, and water quality. Many legislative statements conflict with those of other policy statement sources, sometimes inherently, as in the Coastal Zone Management Act of 1972, which declares "that it is the national policy to preserve, protect, develop and, where possible, to restore or enhance." Confusion abounds.

Many of the individuals who testified at hearings or were on the staffs of these study commissions and committees had considerable influence on legislation and funding for a variety of water resources activities. Thus, the policies of the President, Congress, or individual congressional committees (and sometimes of the individual legislators) were expressed and given substance and means. As the public is drawn more and more into the policy-making process, constituents must also be included.

Historical Perspective

Reports of explorers and government officials during the 19th century were sporadic and reactive. For example, the acquisition of the Louisiana Purchase and Lewis and Clark's subsequent expedition enabled both a sea-to-sea scope view of the fledgling nation, and an opportunity to base justification for transportation and commerce on navigation and national defense. Thus, Lewis and Clark on the Missouri River and Powell on the Colorado River spanned the century, leading to the further exploration, settlement, and development of the western region's resources as well as the federal agencies that administer them.

A report by Albert Gallatin, Secretary of the Treasury under Jefferson and Madison, called for water resources development with the authority of the commerce and navigation clauses of the Constitution. According to Holmes (1972), the 1808 report "Proposed a nation-wide system of canals and river improvements justified on grounds of economic development, political unity, and national defense." This important report and others throughout the 20th century are summarized in Table 5.1. As noted, many of these were launched under the authority of the President. Others were the consequence of congressional legislation which, with the strength and follow-through potential of the legislative branch, often led to major policy change.

In affirmation of the earlier findings of the Senate Select Committee on National Water Resources, the League of Women Voters (1975) stated, "The present approach to federal responsibility for the nation's land and water resources has not yet produced an overall resources policy." Indeed, since 1900, more than 20 commissions or committees have studied and made recommendations regarding water resources policy. In 1959, the Senate Select Committee on National Water Resources tried to make order out of the many commissions and study groups that had been in existence up to that point. The list of formal national policy organizations shown in Table 5.1 is augmented by some recent efforts.

Table 5.1 Water Policy Commissions, Committees, and Studies

Organization Name	*Date*	*Authority*	*Remarks*
Gallatin Report	1808	President	National view of transportation and national defense
Inland Waterways Commission	1907	Sen. Doc. 325, 60th Congress	Recommended dual purpose (transportation and defense) navigation
National Governors' Conference	1908	President	Alleged start of conservation movement, focused on natural resource inventory
National Waterways Commission	1909	Exec. Order No. 809	Recommendations regarding forestry on watersheds of navigable streams, canals, and dams for navigation
Waterways Commission	1917	40 Stat 250	Studies comprehensive water management, watersheds for flood control
Joint Committee on Reorganization of the Executive Branch	1920	Sen. Joint Resolution 191, 66th Congress	Made attempt to reorganize, assign, and combine agency responsibilities
"308 Report"	1925	43 Stat 1186	Surveyed and listed (H. D. 308, 69th Congress) all streams with hydropower potential and flood needs
Mississippi River Valley Committee	1934	H. D. 395, 73rd Congress, 2nd Session	Made report to the Public Works Administration on long-range comprehensive plans
President's Water Resources Policy (Cooke) Commission	1949	Exec. Order No. 10095	Made comprehensive reports; recommended river basins as the basic water resources management unit
President's Materials Policy (Paley) Commission	1951	None	Produced five-volume report emphasizing water development and integrated regional management

Table 5.1 Water Policy Commissions, Committees, and Studies (Continued)

Organization Name	*Date*	*Authority*	*Remarks*
Missouri Basin Survey Commission	1952	Exec. Order No. 10318	Decided on principles by which Missouri River would be developed
Presidential Advisory Committee on Water Resources Policy	1954	H. D. 315, 84th Congress	Made another recommendation for a comprehensive, "sound water policy"
Senate Select Committee on Water Resources	1959	Sen. Resolution 48, 86th Congress	Conducted comprehensive, in-depth study via hearings; issued series of reports and recommendations
First National Assessment	1968	79 Stat 244	Surveyed national and regional water resources (WRC)
National Water Commission	1973	82 Stat 868	Study by nonfederal establishment via hearings and reports on conditions; made recommendations
Second National Assessment	1978	79 Stat 244	Updated 1968 assessment, included forecasts and identification of critical problems
National Water Alliance	1983	None	Bipartisan Congressional group trying to formulate national policy in absence of Water Resources Council
Western Water Policy Review Advisory Commission	1992	P.L. 102-575, Title XXX	Congress directed the President to undertake a comprehensive review of Federal activities in the 19 Western States

Starting in 1795, Congress created committees that had jurisdiction over different segments of the water resources management arena. The number of such committees grew to a maximum of 33 in the Senate and 48 in the House. In 1946, a Legislative Reorganization Act reduced the number to 15 and 19, respectively. Schad (1968) concluded his review of Congress' complex involvement in water resources by noting that that involvement "illustrate[s] the widespread nature of the water problem itself and its complicated pervasiveness into almost every aspect of government policy." By 1984, the committees that had a major role in water resources activities in Congress had been reduced to a total of 12, but the subcommittees number 23, as shown in Table 5.2. Chairs, committee members, and telephone numbers may be identified in a current edition of *The Almanac of American Politics* (Barone and Ujifusa, 1998), in commercially available computer databases, online at legislator's home pages, and in any of several online databases.

The chaotic creation of the subcommittees provides multiple opportunities for alternate procedural routes around a senior, well-entrenched committee chair who is set on blocking a piece of legislation from ever reaching the floor for decision. Some confusion is created and maintained by overlapping committee names. Both the confusion and alternate routing provide a persistent member of Congress with a variety of scenarios for getting the proposed bill to the floor of the legislature. A public uninformed about the detailed workings of Congress was necessary for the establishment and maintenance of the multiple committee structure. As the inner workings of Congress are exposed, the public's access to the policy-making process improves.

A typical example of the continuing battle over the funding of water projects was aired July 22, 1985 on National Public Radio's "All Things Considered." It reported on the status of major water projects, and how passage of funds for them was tied to proposed aid to the Nicaragua anti-Sandanista rebels as well as to the administration's campaign for a greater dgreee of budget control. But the issue was further complicated by the Administration's attempt to have Congress* approve the so-called "line-item" veto authority so that, in the absence of a Congressionally-approved buget,** the alleged runaway spending of the Congress might be controlled. Approval of the line-item veto would represent a major shift of fiscal control from the Congress which, years ago, thrived on the individual appropriations bills, to the executive, including the pork barrel projects. The executive does have the ultimate responsibility for the behavior of the executive branch, even if Congress helped create both the agencies and their portfolios. This supplemental spending bill (for the Nicaraguan aid and the water projects) was thus subject to the power of long-term Representative Jamie Whitten, Chairman of the powerful House Appropriations Committee, who said:

* The House had recently voted by a 203–202 vote to cut 31 Corps of Engineers projects (out of a total of 62 projects carrying a total price tag in excess of $4 billion).

** The budget process was actually initiated under President Nixon in the early 1970s.

Table 5.2 Current Congressional Committees Concerned with Water Resources

Chamber	*Committee*	*Subcommittees*
House	Agriculture	Conservation, Credit, and Rural Development
	Appropriations	Energy and Water Development
		Interior and Related Agencies
	Energy and Commerce	Energy Conservation and Power
		Health and Environment
	Government	Environment, Energy, and Operations Natural Resources
	Interior and Insular Affairs	Commerce, Transportation, and Tourism
		Public Lands and National Parks
		Water and Power Resources
	Merchant Marine and Fisheries	Fisheries and Wildlife Conservation and the Environment
		Oceanography
	Public Works and Transportation	Water Resources
	Science and Technology	Natural Resources, Agriculture Research, and Environment
Senate	Agriculture, Nutrition, and Forestry	Soil and Water Conservation, Forestry, and Environment
	Appropriations	Energy and Water Development
		HUD-Independent Agencies
	Energy and Natural Resources	Energy Conservation and Supply
		Public Lands and Reserved Water
		Water and Power
	Environment and Public Works	Environmental Pollution
		Water Resources
		Toxic Substances and Environmental Oversight
		Regional and Community Development

The desire is to have a clean bill, which just takes care of what we have to have. Then our Commodity Credit Corporation has to operate, so I have produced a separate bill there, which was passed last week. I don't think the President signed it; I don't know why. Those are two things that I did so that if we did not get an agreement, we could do those things that *had* to be done. [Transcription from radio; emphasis inferred]

The National Public Radio commentator then observed:

> A spending bill that just does what has to be done would mean no water projects; no aid to the Nicaraguan rebels, Israel, Egypt, and Jordan, all of which have funds provided in this bill. It's not a bill the Administrator's likely to sign on to, and Whitten is likely to get another [chance at a] compromise on the water projects. It's the kind of bill that's possible when Congress can write omnibus spending bills that wouldn't be possible with the line-item veto that lawmakers warn would cripple legislation, while a lot of Administration ideas would go by the wayside, as well.

Such are the convolutions surrounding the funding of major water and related land resources engendered by the Congressional committee system, the Office of Management and Budget, and the President.

Congressional reform regarding term limits and limiting chairmanship terms has diminished the necessity of and the opportunity for surreptitious maneuvering. And, with better and wider news coverage of and interest in congressional activity, the public has a clearer picture of how its natural resources concerns are being addressed. Thus relationships between legislators and their constituents include the legislators' need to address environmental and natural resource issues in order to be elected, although it has been pointed out that once elected their priorities may change. Sometimes, those election platform planks lead to major policies, more often, though, they do not. Nevertheless, the legislators must communicate with their constituents so that the latter can play their mandated role in the many policymaking processes. In a study in the state of Washington and from information gathered in an extensive survey, Menzel (1978) hypothesized the following three hypotheses that describe such relationships:

H-1: As water resource problems become increasingly severe in a legislator's district, he becomes more involved with water resource issues.

H-2: As constituents become increasingly capable of articulating their preferences and demands, the more responsive a legislator will be in all issue areas, including water resources.

H-3: As a legislator's constituency becomes increasingly middle-class, that legislator becomes more involved with water resources issues.

In many instances, the water resources conservation policy issues are inherently or politically tied to other issues that are more important or demanding, and the legislators may not only be at odds with each other, but with the President. Usually, environmental issues are cast opposite economic issues, and in the ensuing debate, environmental and conservation measures lose out to the taxpayers' pocketbook. In recent years, however, that scenario has been undergoing some change as citizens — and their elected officials — have seized on opportunities to advance both economic activity and environmental quality. Whether that is a short-term fix is a matter of major interest, and is taken up later in Chapter 8.

In 1975, at a National Water Conference sponsored by the WRC, WRC Chairman Rogers C.B. Morton stressed the urgent need to consider the adequacy of present water policy (Water Resources Council, 1975). One apparent trend was that the federal government would be looking more and more toward "partnerships" with the states and regional organizations for resolution of water resources problems. This is in contrast to the mid-century trend (only 20 years earlier) that had been toward a definite (federal) centralization of water resources planning and activities (Holmes 1972). This trend was a response to:

1. The increasing unwillingness of administration(s) to fund big government, especially big public works projects.
2. The growing public distaste for environmentally damaging water projects.
3. Higher interest rates.
4. Public distrust of big (centralized) government.
5. The fact that most of the best developable project sites had already been developed.

In spite of these trends, Congress stubbornly persists in retaining that age-old institution known as the pork barrel, aptly named and graphically illustrative of the nature of the fiscal and political bond that tightly binds legislators and constituents. The resultant scaling down of the federal activity, therefore, leaves a major policy gap that must be filled in order to satisfactorily resolve water and related land resources issues.

The issues often boil down to the fact that comprehensive management has usually been the nationwide goal of the joint agencies, the WRC, or the President, all of whom take a broader view of the role of natural resources in the economy, life, and detailed security of the nation. And Congress, often protected from the direct scrutiny of the public, is interested in projects, not in granting broad power to the President, some coordinating council, or the executive branch agencies the brood power to coordinate everything.

Further, and remarkably, Congress itself is traditionally split as to where the power to control should be. Traditionally, the House of Representatives is states' rights-oriented, and tends to hold out for power at the state level, whereas the Senate, opting for support of individual, local, and municipal rights, tends to support locally oriented plans, programs, and projects. Of particular interest is the observation that the focus of the two chambers, then, is diametrically opposed to that of their respective constituencies. The senatorial interest in projects identified earlier affirms at the federal level what Menzel (1978) hypothesized for institutions at the state level: "Senators are more likely to be involved with water resources issues than members of state house of delegates/representatives." One reason for this may be the pork barrel itself, which thrives in the Senate where a fewer number of lawmakers need be involved in a "scratch my back, I'll scratch yours" approach to spending federal dollars in local communities. A classic example of the pork barrel in operation was the Senate vote on November 4, 1981, spearheaded by Senator Howard Baker of Tennessee. The issue was the approval of remaining funding of the Tennessee-Tombigbee Project in the amount of $180 million. Earlier in the year, Senator Baker helped trim the budget on behalf of fellow Republican, President Reagan, by eliminating the WRC to save $45 million dollars. Another flagrant example of Congress' self-serving behavior is the fact that it took a scant 43 seconds to exempt the Tellico Dam from the provisions of the Rare and Endangered Species Act.

Based on continuing conflicts in all water areas project and policies, a comprehensive review of policy and organizations, including the recurring recommendation for consolidation of all the resource-managing agencies, was undertaken by President Carter. Specifically identified in this review were consideration of water conservation and nonstructural alternatives to water resources project proposals, further refinement of the WRC's *Principles and Standards* (*P&S*), independent project review, creation of project selection criteria, and reduced cost sharing by the federal government.* The basic objectives were reiterated in the detailed message on water policy on June 6, 1978, when President Carter officially presented basic Water Policy Initiatives (WPI). The underlying concepts were:

1. Improved planning and efficient management of federal water resources programs.
2. A new, national emphasis on water conservation.
3. Enhanced federal-state cooperation and improved state water resource planning.
4. Increased attention to environmental quality.

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* Note the terminology. Both Carter and Reagan sought reduced federal cost sharing. Carter put this forth in terms of "enhanced federal-state cooperation;" Reagan, in terms of "budget cutting." See also Franceshi and Sudman (1983).

The WPI were designed to achieve the objective review of the current federal water resources policy presented earlier in the President's environmental message (Simms, 1980b). Recognizing a severe water shortage in 21 of the 106 sub-regions of the U.S., the WPI called for specific, detailed programs and practices by the agencies in order to influence water demand. Several proposals in the WPI would enable the goals of having the states be "the focal point of water resource management," and of initiating negotiations between the state and federal governments over the persistent problems of their water rights, as well as negotiations over the rights of Native Americans.

By and large, most water resources experts could probably agree on these (WPI) proposals (Office of the White House Press Secretary, 1978). However, the means of achieving the goals set forth, the speed with which the changes would be made, and the degree of the changes, would be the source of debate for some time.

Specifically, the WPI (Carter, 1978) included the following:

- Projects should have net national economic benefits unless there are environmental benefits that clearly compensate for any economic deficit.
- Projects should have widely distributed benefits.
- Projects should stress water conservation and appropriate nonstructural measures.
- Projects should have no significant safety problems involving design, construction, or operation.
- There should be evidence of public support including support by state and local officials.
- Projects will be given expedited consideration where state governments assume a share of costs over and above existing cost sharing.
- There should be no significant international or intergovernmental problems.
- Where vendible outputs are involved, preference should be given to projects that provide for greater recovery of federal and state costs, consistent with project purposes.
- The project's problem assessment, environmental impact, and costs, and benefits should be based on up-to-date conditions.
- Projects should comply with all relevant environmental statutes.
- Funding for the mitigation of fish and wildlife damages should be provided concurrently and proportionately with construction funding.

The WPI flew in the face of the long-standing tradition of presidential deference to the pork barrel as employed by Congress and the COE (Graff, 1978). Carter's bid for re-election in 1980 was certainly influenced more by the Iranian Hostage Crisis than by concern for water. However, his lack of support by members of Congress was due in no small part to his “hit list” and the crippling blow he intended to deliver to the traditional pork barrel. Graff (1978) pointed out that although environmentalists had supported Carter’s promised stand on restricting COE and BR access to the Congressional pork barrel during his election, his response to their continuing demand for major water project reform would “be a major factor in determining environmentalists’ support for a Carter re-election in 1980.” Apparently both contributed to his loss.

In an assessment of the WPI, Viessman (1978a) noted the deficiencies in funding for high-priority needs, in timetables for completion of research, in state-federal research cooperation, in manpower training, and in research into technology transfer (especially as it pertained to information dissemination at local and state levels). In a parallel review of pending and possible legislation to amend the 1965 Water Resources Planning Act and the attendant options for strengthening and/or replacing the WRC, none of the alternatives called for elimination of the WRC, or for submerging it within the Department of the Interior (Viessman, 1978b). Veissman analyzed several choices for location, function, and structure for a revised WRC or of its successor, following Secretary Watt’s suggestion of putting the WRC in the Interior. One option, an Office of Water Policy reporting to the Assistant Secretary for Land and Water Resources, did suggest that possibility (Viessman, 1981) and was executed; but, recently, that policy organization, too, has to be abolished.

Viessman (1978c) concluded “these criteria [the WPI] are essentially a reinforcement of the P&S combined with more explicit considerations of safety, cost sharing, and enforcement of environmental statutes.” He added that they could “place poorer States at a disadvantage when competing for project authorizations,” which would offset the drive for increased water management activity at the state level. MacDowell (1979) concluded that the Water Policy Initiatives “contain necessary improvements” in water resources management, but they are so generalized as to encourage laxity on the part of both the agencies and the states, “leaving the most important problems unsolved.” By 1983, the point was moot, as the *P&S* were then replaced by the even less powerful *Principles and Guidelines*.

Wilson (1985) contended “Ronald Reagan had no hit list. He had no list at all. … That [his] administration actively opposes the articulation of a national water resources policy.” Yet, some of the language of the current *Principles and Guidelines*, and some of the principles maintained therein, such as the increased activity at the state and local levels, persist. One reason for this continuity is that there are several long-term trends in water and related land resources policy development (as is the case, too, with law, planning, pollution, and evaluation). This maintenance of principles may be seen in the seven major trends that were identified as "themes" in an analysis by Schad* (1985) of the fate of the recommendations of the National Water Commission:

1. The demand for water in the future is not on an inevitable growth trend, but depends in large part on policy decisions within the control of society.
2. The Commission saw a shifting of national priorities away from water development toward preservation and enhancement of water quality.
3. There is a need to tie water resources planning more closely to land use planning in spite of the fact that responsibilities for land use planning are in state and local governments, while water planning activities have been largely dominated by federal agencies.
4. There is a need for conservation of water through reduction of losses and increased efficiency [in face of] the inexorable laws of economics.
5. Beneficiaries of water projects should pay for them through user charges.
6. Problems needing revision of laws and institutions are being dealt with piecemeal.
7. Development, management, and protection of water resources should be controlled at that level of government nearest to the problem, with powers that give it the capacity to represent all the vital interests involved.

Schad pointed to the Reagan administration's budget-cutting as a driving force behind these trends which, in fact, are really long-term changes in policy that have been advocated by a variety of individuals and organizations over the years.

The effort to achieve a unified national water policy by the informal National Water Alliance (NWA) was "an attempt to unify responses to common water resource issues by providing a framework for unifying regional concerns" (Magner, 1985). In the hands of a small but growing group of interested citizens and members of Congress, the NWA was a worthy effort generally directed at accepting the region as that level at which problems are best resolved. If the effort to involve all interested parties had been successful, the NWA might have succeeded. If the informal parent organization, made up of dedicated legislators, could have

* Schad served as staff director for the Senate Select Committee on National Water Resources and was executive director of the National Water Commission.

provided the coordination needed at the top level through its everyday and extra-curricular Congressional activities, the long-term needs of the nation might have been defined and met. A conference in September 1985 was scheduled to consider position statements and recommendations drawn by four NWA task forces, Groundwater, Infrastructure Finance and Development, Supply and Wastewater Treatment, and Public Information and Education. The task forces met in the fall of 1986 and reported at the Second Annual Conference in February 1987 (National Water Alliance, 1986). The NWA approached the water resources problems on a broad front. Recognizing that there existed a diversity of interests and solutions, such an effort will always undoubtedly require the coordinated efforts of many groups, approaches, and policies (Wilson, 1985). On the other hand, Ingram (1971) stated, "At the point where the natural world makes water a national issue, a different pattern of politics may well emerge." The context of this observation was that (1) the environmental movement was at its peak, (2) the WRC was compiling the final version of the *P&S*, and (3) the NWC was formulating its thoughtful and far-reaching recommendations. Most likely the NWA failed because the well-intended, dedicated, and far-sighted leadership was not able to meet even the minimum requirements of a viable partnership as described below.

Models

The development and use of models and simulation is an emerging field in the evaluation of policy decisions as a framework for planning. Policy models are, for the most part, adaptations of planning models (benefit cost analysis, risk analysis, sensitivity analysis) to assist in the identification of viable courses of action and decision-making.

Computers can (1) rapidly display the effects of a variety of potential strategies on water and related land resources development; (2) aid in the determination of those situations that are most likely to yield desired results; (3) assist planners in experiencing and understanding the decision-making process; and (4) illuminate the institutional arrangements necessary to carry out a particular strategy. The Congressional Office of Technology (OTA) conducted a study reported by Friedman et al. (1984) that discussed some of the more successful models and the agencies in the federal government that use them. The authors point out that "the role of models in managing water resources has grown dramatically over the past decade. … Yet many feel that these tools have not yet lived up to earlier expectations." As water and related land resources decision-making is abandoned by the federal government and developed more and more at the regional, state, and local levels, the expertise necessary to effectively utilize these models will have to be transferred as well. Several of the OTA report recommendations consider that this important shift must also take place.

One example of application of a model to policy formulation is the Environmental Management System (EMS), and is described by Schramm and Rubin (1999). Their presentation describes how the system adapts to and invokes the ISO* 14001 EMS to watershed management situations, and includes examples from the Philippines and Egypt. The common principles that apply are:

- A policy that articulates a commitment to a specific level of environmental performance.
- Specific measurable quantity and quality objectives and performance targets.
- A planning process and strategy to meet the commitment.
- An organized institutional structure to execute the strategy.
- Implementation programs and support tools to meet objectives.
- Communications and training programs.
- Measurement and review process to monitor progress.

More simply, each management challenge needs to be reviewed in terms of its policy commitment, objectives, planning, structure, implementation, communication, and review monitoring. These are the essential components of a successful water resources management system. And one or more of them has often been ignored or abused or is missing in the history of water resources management programs and projects in the U.S. The authors recommend pilot projects to evaluate the approach.

Benefit-cost models are tools currently available for analysis of policy alternatives. Uncertainty and risk analysis are two tools that are frequently used to recommend courses of action. The high degree of reliability in hydrologic data makes the use of models to predict risk attractive for flood control models. Reliability is not as high in other hydrologic components, and is fast becoming more risky as we see less precise estimation of norms, owing to greater variability associated with global change (Schultz, 1993). The recommendation of the *Water Quality 2000* report that the watershed be used as the basis for management (Water Environment Federation, 1992) establishes the justification for delimiting the watershed with Geographic Information Systems models and makes the latter a valuable planning tool in formulating and evaluating watershed management policy (see Chapter 6).

* International Organization for Standardization, Geneva, 1996.

There is a long-term trend in water resources policy. Commencing during the nation's expansionist period, which demanded water development for industry, settlement, and defense, the unstated policy was to support projects, usually single-purpose, as state-of-the-art technology would allow. As resource horizons were expanded, quantified, and found to be limiting, multi-purpose projects became the vogue (Hines, 1953). Then, as divergent water resources problems were recognized, the call came for "cooperation, collaboration, and coordination" (Thomas, 1957). This grew into a more intensive call for comprehensiveness in water resources planning and management, a policy that peaked in the 1965 Water Resources Planning Act and the 1973 *Principles and Standards*. Simultaneously, the growing distrust in big government, the energy crisis of 1973, the lasting strengths of the environmental movement, and a swing toward-deregulation, decentralization, and reduction of federal spending in the 1980s have left the U.S. in policy limbo. The result is a serious gap that current organizations and individuals are attempting to address.

Currently

The most recent water resources policy effort has been the Western Water Policy Review Advisory Commission (Table 5.1).* In the authorizing legislation, "Congress directed the President to undertake a comprehensive review of Federal activities in the nineteen Western States affecting the allocation and use of water resources, and to submit a report of findings to the President and Congress. The President appointed the Western Water Policy Review Advisory Commission. … The Commission [was] composed of twenty-two members and was chartered by the Secretary of the Interior on September 15, 1995."** The report was issued in 1997 and is available online. The commission was not constrained to the region embraced by its name, and it addressed national concerns. In a summary article, Dworsky and Allee (1998) identify four fundamental premises that illustrate the complexity of water policy issues, and how they can be addressed, in light of the opportunity presented by that commission's report:

* Not included in this discussion is substance of the report (issued in draft form as of this writing) of the National Drought Policy Commission, launched by the 1998 National Drought Policy Act, PL 105-199. Members of the commission include representatives of several federal agencies, tribes, states, a bank, other private interests, and municipal, state, and local water supply managers. The group is chaired by the Secretary of Agriculture.

** As reported on 1/7/00 at http://www.den.doi.gov/wwprac/.

1. "The nation has been unable to develop an effective form of institutional arrangement for the control of regional or national water resources." This is not for lack of interest, dedication, and scholarly attention. The idea that "fragmentation of institutions is inevitable in a nation that embraces decentralized government and diffused power" provides a "uniquely American playing field."
2. In spite of this, the U.S. continues to hold to the view, articulated by Jefferson's Secretary of the Treasury Albert Gallatin, that: "the allocation of projects and resources could best be left to the debate on the floor of the Congress."
3. And, as articulated by former Director of the Water Resources Council Leo Eisel, "states and state water law will continue to be the main forces in the management and allocation of the nation's water resources … [and] members of regional entities … or agencies … of government will continue to have reluctance to give up authority… ."
4. Finally, that "national water policy and effective water management must evolve from a partnership."

The authors have examined over 30 legislative proposals to replace, or more often, to modify the 1965 Water Resources Planning Act. The fact that Congress has not replaced or modified the act is evidence of the complexity of the situation. Dworsky and Allee (1998)

> suggest the only alternative is to create arrangements that facilitate an educational process that leads to a working consensus on what to try next and how to react to consequences that are unforeseen or unmitigated or uncompensated. … What is needed is a process to assist and facilitate a loose flexible management arrangement, determined in various ways to fit the various needs of the several regions (or water basins) of the country.

Such a flexible arrangement will depend upon the American public taking on the responsibility of creatively and constructively determining "the management characteristics of water, land, and related environmental resources that play direct roles in their lives and the lives of their future generations" (Dworsky and Allee, 1998). Such is the essence of partnerships, which are the means of constructing and effecting policy, as presented in the last section of this chapter. The authors, among others, recommend re-establishing a reconstituted Water Resources Council.

More progress has been made at the state and regional levels, as is evident in the discussion on planning, the description of partnerships later in this chapter, and the discussion of programs in Chapter 6.

Summary

One conclusion that may be drawn from this section is that it may indeed be impossible to ever have a unified national water policy. Assuming that the inequities, divergent interests, and political and economic greed could be eliminated or controlled, there is still the fact that the nation embraces many different types of water and related land resources problems. These require different types of solutions at different times, and are (legitimately) affected by so many external factors that unification may be undesirable, as well as impossible. If that is so, then it is apparent that the best that can be done at the national level is effective coordination to ensure elimination of duplicate and conflicting efforts and expenditures. The WRC was not empowered to do this, nor did the short-lived Cabinet Council on Natural Resources and Environment make any progress in this regard. This conclusion is derived quite naturally from extrapolation of the League of Women Voters' headline: there are – and of necessity probably always will be "many different policies." We may never achieve a comprehensive, unified water resources policy. That may just be a good thing, fitting quite nicely with the earlier observation about boundaries, and the importance of pluralism.

Another conclusion that may be drawn from this section is that the essence of U.S. water policy is conflict. On the one side is the President, seeking to resolve national and regional problems, and often to use appropriations for water to achieve regional income distribution, affect the economy generally, and/or improve national security. On the other side, the members of Congress seek to direct national dollars to local (usually the Senate) and state (usually the House) projects and programs in order to respond to their constituencies. While both sides are likely to continue to make concessions, it is more than likely that this conflict will continue to be the essence of the nation's water policy for the foreseeable future.

Planning

According to former WRC Director Leo Eisel,* planning "is a vehicle for rational resolution of conflicts." A more apocryphal, yet appropriate,

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* Director Eisel was a participant in a panel discussion on national water policy at the Fifteenth Annual Meeting of the American Water Resources Association in Las Vegas, Nevada, September 24, 1979.

definition is, "incremental steps providing movement toward permanently shifting goals using constantly variable resources." An even more concise definition of planning is, "organization for the future," which implies that there is some purpose for the organization, and that the *process* of organization will provide, or will actually be, the framework of the plan that will achieve some objective.

Planning, then, is a means of achieving goals. The goals can be identified as problems, such as resolving conflict, providing some needed infrastructure, improving the standard of living, or obtaining some amenity. In the most general of terms, the problems are identified as "problem-sheds" (Viessman, 1999). This concept allows flexibility in defining the scope of the problem, whether it is extending a sewer main in a small community or managing the agricultural lands on a large municipal watershed. The context here, of course, is water resources, however, the basic concepts apply to most natural resources planning enterprises and, to a greater or lesser extent, any kind of planning. In keeping with the title of the book, this section focuses on water and related land resources.

What's With Planning?

Individual agencies do plan, as do virtually all governments, businesses, and individuals. Many organizations have well-identified planning departments, divisions, or offices. However, there have been only three national-level agencies with the word "planning" in their title. These are: (1) the National Resources Planning Board (no longer in existence); (2) the National Capitol Planning Commission, the activities of which are rather limited; and (3) the Office of Emergency Planning, also limited in scope, and now known as the Federal Emergency Management Agency. This dearth of agencies specifically formed for planning reflects capitalism's philosophy of *laissez faire* development. And, in tandem with that underlying philosophy, planning constrains the flexibility inherent in a frequently replaced legislature whose members need to be free of restrictions as to how and for what purpose they appropriate funds. Similarly, the President needs to react to crises and current issues that confront the citizenry. At the state and local levels, offices of planning coordination or similar agencies have seen varied existences.

Business organizations plan, but also need flexibility to take advantage of new technologies, changing markets, and the potential to lobby governments to protect or enhance their interests. Lobbying often reflects the business community's desire to have governmental regulations imposed in order to control competition. This plays an important role in water resources, especially when the influence-peddling involves long-range management of natural resources. Ultimately, individuals plan in a wide variety of ways important for personal survival, as well as survival of the system as well.

Planning in the U.S., therefore, has been an anathema. The diverse interests all but guarantee that there will be no one vehicle for planning the use and development of natural resources. Of course, the scientific resource managers, regulators, politicians, and future-minded citizens still need to accommodate ("plan") the future, which is guaranteed to produce growth that will demand more resources for an ever increasing and demographically changing population.* Strategic planning and critical thinking can be used to effectively prepare for the challenges and conflicts that await us.

Historical Perspective on the Planning Objectives

There are often conflicts between those who would develop and those who would preserve, a heritage from the Hetch-Hetchy battle between Pinchot and Muir (Chapter 1). An attribute of an affluent society such as the U.S. includes the concept of conservation; a sufficient stock of resources must exist so that we can postpone the use of or, more simply, save them. This applies, in particular, to the aesthetic and recreational use of water resources. Although recreation was included as a use in the 1916 creation of the National Park Service and its preserved parklands, there is no consideration of aesthetics in the early planning documents (Table 5.3). Aesthetics first became a factor under the influence of the Secretary of the Interior Stewart Udall, and proceed to become more and more important. By the 1960s, aesthetics and recreation were capable of evaluation so that they could be included along with other project purposes as a legitimate planning objective planning for water and related land resources.

The evolution of the planning objectives can be understood as a continuing conflict between the executive and legislative branches of the government. Thus, the principal documents/events are arranged in chronological order in Table 5.3, with remarks in the center column relating that item to the appropriate governmental branch. The objectives are presented in the right-hand column as well, showing the changing attitudes toward water resources during the last three-quarters of the 20th century. It is worth noting, too, that the National Environmental Policy Act (NEPA) of 1970 was not a piece of legislation that sprang forth without its own, unique prior development.** The NEPA, in spite of — or perhaps because of — all the gyrations involving the development of the planning objectives

* If civilization ever figures out and agrees on a humane way to limit population growth, we will see some major changes in the institution of planning! This chapter would certainly need to be rewritten under those circumstances.

** The NEPA, in fact, derives in large part from principles in the 1946 Administrative Procedures Act, the 1946 Fish and Wildlife Coordination Act, the 1967 Freedom of Information Act, and the 1968 Intergovernmental Coordination Act (Black 1981).

Table 5.3 Evolution of Water and Related Land Resources Planning Objectives

	Action by			
Date	*Congress*	*Executive*	*Remarks*	*Objectives*
1936	Omnibus Flood Control Act		Divides flood control pie; started benefit-cost analysis	Economic: B>C
1943		Federal Inter-Agency River Basin Committee	Attempt by agencies at self control over geographic jurisdictions	
1944	"Pick-Sloan Plan"		To control executive branch	
1946	Fish and Wildlife Coordination Act		To control executive branch	
	Administrative Procedures Act		To control executive branch	
1949		Hoover Commission	Proposal to re-organize executive branch	
1950		FIARBC Subcommittee's *Green Book*	Public viewpoint required; but "intangibles" were not to be included in analysis	Political: a comprehensive public viewpoint must be the basis for planning
1958	Fish and Wildlife Coordination Act Amendment		Strengthened 1946 Act	
1962	Senate Document No. 97	President's Water Resources Council	Interior Secretary Udall's influence	Development, Preservation, and Well-Being of People
1965	Water Resources Planning Act (see Appendix A)	Creates statutory Water Resources Council	To coordinate executive; mandates overhaul of evaluation procedures	
1967	Freedom of Information Act		To control executive branch	
1968	Intergovernmental Coordination Act		To control executive branch	
1969		WRC Task Force	Recommends to WRC delete intangibles, use nonmarket valued benefits	National Income, Regional Development, Environmental Enhancement, and Well-Being of People

Table 5.3 Evolution of Water and Related Land Resources Planning Objectives (Continued)

	Action by			
Date	*Congress*	*Executive*	*Remarks*	*Objectives*
1970	National Environmental Policy Act		To control and coordinate executive branch agencies' environmental impacts	
1971		WRC's "Proposed Principles and Standards"	Public comments	National Income, Regional Development, and Environmental Quality
1973		*Principles and Standards* (P&S)	Adopted by concerned agencies	National Economic Development (NED), and Environmental Quality (EQ)
1978		President Carter's Water Policy Initiatives	Apply to *all* agencies	NED and EQ are "co-equal"
1983		President Reagan's *Principles and Guidelines*	Supersede P&S; apply only to construction agencies BR, COE, SCS, and TVA	NED only; contribution to EQ evaluated by environmental impact statement process

remains the only comprehensive legislation dealing with the environment. Nor, of course, was it uniquely concerned with water resources.

Although it took a long time, the planning effort that has existed in the U.S. is ramified in the legislation and documents that relate to evaluation of project proposals. The evolution of these planning objectives commenced in 1936. That year's landmark Omnibus Flood Control Act, Congress declared:

> it is the sense of the Congress that flood control on navigable waters or their tributaries is a proper activity of the Federal Government [and] that the Federal Government should improve or participate in the improvement of navigable waters or their tributaries, including watersheds thereof, for flood-control purposes, *if the benefits to whomsoever they may accrue are in excess of the estimated costs.*

This first reference in a public document to using benefits and costs as a basis for decision-making (Major, 1977) evinces policy and demands the planning that is necessary to carry out that policy in the form of designs for levees, dams, and channel improvements. In fact, the bulk of the act enumerates the specific projects and their appropriations. Only a few short sentences in the opening section set forth the innovations of the act (see Chapter 1). Until 1950, there was no further refinement of the concept that, for a given project proposal, benefits ought to exceed costs. The language of the act did not include definitions of the terms, but left that to the next entry.

The Federal Inter-Agency River Basin Committee published the "Green Book" (Subcommittee on Benefits and Costs, 1950), which elaborated extensively on what was meant by "the benefits to whomsoever they may accrue:"

> It is apparent that in federal practice a comprehensive public viewpoint should be taken; that is, a viewpoint which would include consideration of all effects, beneficial or adverse, short-range or long-range, that can be expected to be felt by all persons and groups in the entire zone of influence of the project.

The *Green Book** established the yardstick against which project proposals or plans should be evaluated:

> The adequacy of results obtainable in project formulation and in evaluation of the justification and relative desirability of projects depends on how completely a comprehensive public viewpoint can be realized.

The existence of the *Green Book* and its several successors is the concrete evidence that planning was, indeed, edging into the arena of water resources development. This coincided with the general opinion that planning water resources at the federal level ought to be coordinated and centralized (Holmes, 1972).

Many of the *Green Book's* Inter-Agency guidelines and recommendations for evaluation of river basin projects** were absorbed into agency

* The publication's long title, *Proposed Practices for the Economic Analysis of River Basin Projects*, encouraged users to refer to the booklet by the color of its cover.

** Close scrutiny of the language of the actual titles of the documents reveals the changing attitude toward planning, conservation, and the march of water and related land resources project development, in general. The specific definitions of terms are presented in Chapter 7 on Evaluation.

procedures via in-house manuals and directives that interpreted or adopted the general rules for day-to-day practices. Based upon sound economic principles, these procedures remain. But the overall objectives changed, reflecting the trends in water and related land resources development. The first time was by the President's Water Resources Council, created in 1961 in order to begin the job proposed in the pending Water Resources Planning Act (Weber, 1964). The council completed and presented a revised set of objectives for planning in 1962. This work, entitled *Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for the Use and Development of Water and Related Land Resources*, and a political scoop by the Senate, led to a document identified as "Senate Document No. 97" (President's Water Resources Council, 1962). *Senate Document 97* (as it is now known) embodies the combined thinking of the then-heads of water resources agencies (the same agencies as those involved earlier in "Firebrick" and "Icewater") concerning the planning objectives and coordination of executive branch activities. The greatly expanded objectives were identified as follows:

> The basic objective in the formulation of plans is to provide the best use, or combination of uses, of water and related land resources to meet all foreseeable short- and long-term needs. In pursuit of this basic conservation objective, full consideration shall be given to each of the following objectives and reasoned choices shall be made between them when they conflict:

1. **Development**. National economic development, and development of each region with the country is essential to the maintenance of national strength
2. **Preservation.** Proper stewardship in the long-term interest of the nation's bounty
3. **Well-Being of People.** Well-being of people shall be the overriding determinant in considering the best use of water and related land resources.

The first objective was an economic one, as it had evolved from the *Green Book*. Added to it is preservation, due in large part to the influence of Chairman (as Secretary of the Interior) Stewart Udall, and in response to growing public concern over environmental quality. The elaboration of objective 3 included a call for open space, green space, and "wild areas of rivers, lakes, beaches, mountains, and related land areas" as well as a resolution that "areas of unique natural beauty, historical and scientific interest be preserved and managed primarily for the inspiration, enjoyment and education of people." These clearly reflected Udall's views as expressed in *The Quiet Crisis* (Udall, 1963). The objective of the public's well-being is a broadening of the "comprehensive public viewpoint;" the elaboration of this objective included an assertion that "care shall be taken to avoid resource use and development for the benefit of a few or the disadvantage of many." Thus began the evolution of terminology to meet the definition for what is today known as sustainable development or preferably "sustainability."

Under the subheading "General Setting, Viewpoint, and Procedures" for the section "Standards for Formulation and Evaluation of Plans," *Senate Document 97* set forth a slight revision of the earlier statement in the *Green Book*:

> A comprehensive public viewpoint shall be applied in the evaluation of project effects. Such a viewpoint includes consideration of all effects, beneficial and adverse, short-range and long-range, tangible and intangible, that may be expected to accrue to all persons and groups within the zone of influence of the proposed resource use of development.

The continuing difficulties of dealing with the "intangible attributes" of a proposed project were at the center of the problem. The term "intangible" is self-defeating, at once acknowledging that there is some real value to be counted as a benefit or cost, and simultaneously conceding that it cannot be "touched" or even measured. *Senate Document 97* plows ahead:

> C. Standards for the formulation of plans:
>
> 1. All plans shall be formulated with due regard to all pertinent benefits and costs, both tangible and intangible. Benefits and costs shall be expressed in comparable quantitative economic terms to the fullest extent possible.
> 2. Comprehensive plans shall be formulated initially to include all units and purposes which satisfy these criteria in quantitative economic terms.
>   a. Tangible benefits exceed project economic costs.

There is no further mention of "intangible benefits" in *Senate Document 97*. However, incorporation of the intangible (aesthetic) values in the economic analysis, and therefore in plans for development, was essential in order to effect current policy. That policy was believed to reflect public opinion while the environmental movement began its decade-long surge from Rachel Carson's *Silent Spring* to Earth Day in 1970. The state of the art with regard to wild land recreation management and economic evaluation of aesthetic attributes was not yet up to providing the means that would elevate Secretary Udall's pleas for preservation to a national goal. Adopted in 1963 by all agencies involved (Weber, 1964), and with the rescinding of the *Green Book*-enforcing Circular A-47 by the Bureau of the Budget, a second major stage of planning objectives — *Senate Document 97* — was in place. Ironically, there were no major proposals that were evaluated according to this document; Glen Canyon dam was already built, and the outcome of the battle over the Bridge and Marble Canyon dam proposals was that they would not be built either. The protectors of environmental quality had finally taken over control or at least made their presence known and secured a place in the overall water resources management policy.

In 1968, the new, statutory Water Resources Council appointed a task force as a result of substantial public response to a proposed revision of the interest rate at which projects were to be evaluated. The task force took on the added job of making recommendations "for revisions in current planning policies and practices." In its charge to the task force, the WRC responded to the 1965 Water Resources Planning Act mandate that it establish "principles, standards, and procedures for federal participants in the preparation of comprehensive regional or river basin plans and for the formulation and evaluation of federal water and related land resources projects" (Title I, Section 103). The report of the Task Force (Water Resources Council, 1969) recommended four national objectives for water resource development, abstracted as follows:

1. **National Income.** National income measures the nation's output as the aggregate earnings of labor and property which arise from current and future production. The increase in national income attributable to a project or plan is the measure of its contribution to this objective.
2. **Regional Development.** The regional development objectives embrace several related components, such as (1) increased regional income, (2) increased regional employment, (3) improved regional economic base, (4) improved income distribution within the region, and (5) improved quality of services within the region.
3. **Environmental Enhancement.** Environmental objectives include the conservation, preservation, creation, or restoration of natural, scenic, and cultural resources in order to enhance or maintain the quality of the environment.

4. **Well-Being of People.** In addition to national income, regional development, and environmental objectives, other well-being objectives consider the personal, group, and community effects of the project or program activity. Included are security of life and health, national defense, personal income distribution, and inter-regional employment and population distribution.

It is interesting to note that there is considerable detail for the regional development objective: it is, perhaps, more readily definable and measurable than the others, which are rather vaguely defined. There is also a translation of the previous "preservation" objective to new terminology, "environmental enhancement." This further evolved into the term commonly-used today, "environmental quality." One of the essential ingredients of successfully implementing these new objectives — in particular, the environmental one — was a new way of looking at "intangibles." Thus, three especially important and innovative recommendations were presented by the task force:

1. Eliminate the terms "tangible" and "intangible," and substitute "market valued benefits" and "nonmarket valued benefits," respectively.
2. Acknowledge that the public can establish a value for nonmarket valued benefits.
3. Evaluation of plans could take place through "reasoned judgment based on a systematic display of information" for each of the four accounts (objectives).

The first two recommendations provide a constructive means out of the dilemma presented by the term "intangible." This was an important first step in the eventual inclusion of aesthetic values in the planning process. The second step established that the public viewpoint could be measured and relied upon to give a reasonable approximation (or better) of what previously were known as "intangibles." The third, according to Major (1977), led the WRC "to a full commitment to the use of multi-objectives in the process of project and program formulation: no one objective has any inherently greater claim on water and land use than any other." Taken together, all three constitute a major milestone in the trend of planning objectives, not to mention subsequent project construction and program implementation. The transition from single-purpose, single-evaluation proposals could now seriously advance to multi-purpose proposals that considered the contribution(s) of many water and related land resources values.

Presenting the proposed P&S for review and comment by the public, the WRC (1971a) reduced the number of objectives to three.

> The overall purpose of water and land resources planning is to reflect society's preferences for attainment of the objectives specified below:
>
> 1. To enhance the national economic development by increasing the value of the nation's output of goods and services and improving national economic efficiency.
> 2. To enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.
> 3. To enhance regional development through increases in a region's income, increases in employment, and distribution of population within and among regions.*

The public response (Water Resources Council, 1972b) to the proposed P&S was largely in favor of having the environmental quality (EQ) objective listed above the national economic development (NED) objective, and for dropping the regional development (RD) objective. Reasons given reflected the growing concern with environmental quality, and included the observation that economic benefits to the region would automatically be reflected in the national account as well as in the regional one. Thus this would cause double-counting. Another reason was equity — there were two *economic* objectives and only one *environmental* objective.

Thus, the evolutionary floundering had finally come into focus. The debate was, and would continue to be, between economics and environment. Consequently, when the WRC promulgated the final version of the P&S in 1973, the objectives had been further reduced to two: National Economic Development and Environmental Quality.** The degree to which a proposal or plan is expected to contribute to the NED objective is evaluated by Benefit-Cost Analysis. The degree to which a proposal or plan is expected to contribute to or detract from the EQ objective is evaluated by the process known as Environmental Impact Analysis, reported in the Environmental Impact Statement. Nevertheless, the relative

* Note especially, the addition of "and among regions" vis-a-vis the statement in the WRC's "First National Assessment," quoted in Chapter 3.

** The other two, regional development and well-being of people, were relegated to "accounts," to be displayed along with those of the principal objectives.

weighting of the two objectives remained open, until President Carter, in his Environmental Message of 1978, made them “co-equal.”

Nor is the evolution finished. The Reagan Administration rescinded the P&S (Water Resources Council, 1983a), replacing them with the Principles and Guidelines (Water Resources Council, 1983b) “because they [the P&S] are too complicated, rigid, and cumbersome” (Water Resources Council, 1981). Officially, then, the Principles and Guidelines consider only the National Economic Development objective, and apply only to the four principal construction agencies: the Bureau of Reclamation, Corps of Engineers, Soil Conservation Service (now Natural Resources Conservation Service), and the Tennessee Valley Authority. Prior to its 1983 demise, the WRC also published the Procedural Manuals for the NED and EQ objectives (Water Resources Council, 1979b; 1980b), which superseded the P&S for Level C (local) planning, while the P&S were restricted to Level B (regional and river basin) activities. These developments do not mean that the Environmental Quality objective has been ignored. On the contrary, it is still evaluated by the procedures set forth by the Council on Environmental Quality (1978) in keeping with the original mandate in the 1970 National Environmental Policy Act. In fact, it is likely that those regulations will continue to be untouched by the Washington regulation cutting enthusiasts. Ironically, the EIS regulations survived deregulation owing to the EQ objective elimination from the P&S. Thus, as part of the CEQ regulations (now guidelines, even though the agency rules and regulations they initiated continue to be honored), environmental quality considerations are considered an essential component of the planning process. Consequently, their cost is incorporated in regular agency budgets, not in a separate line item that is subject to budget reductions (Black, 1981).

Nevertheless, the relative weighting of the two objectives is the subject of continuing debate, since economic and environmental values are not always mutually compatible. Perhaps it should be that way, since decisions are made on the basis of a number of considerations, including economics, environmental quality, national defense, welfare, politics, personal preferences, etc. The display or consideration of any factor impacting policy or a specific action decision will not guarantee it being the deciding factor (Daneke and Priscoli, 1979). Ideally, the informed decision maker would have all available reports on these considerations when making the decision. To whatever extent that occurs, better informed decisions, and hopefully better plans, should result. Separating the two objectives (and having them evaluated by different and fully appropriate technologies) puts considerable added pressure on those who prepare EISs, since their extensive and detailed reports often have to compete for the attention of decision makers with a simple economic ratio of benefits divided by costs. In view of the fact that the two objectives are often in conflict, that may not be all bad.

Equally as important in the decision-making process involving plans for water and related land resources is the involvement of the public. Public values, which, as the task force suggested, should be used to aid in the evaluation of plans for projects and programs, can also be employed in basic policy decisions about resources development and preservation.

With the 1983 elimination of funds for §208 planning organizations (under the Water Pollution Control Amendments of 1972) and the river basin commissions (under Title II of the 1965 Water Resources Planning Act), long-range, comprehensive planning for water and related land resources in the U.S. came to a screeching halt. A notable exception is the Delaware River Basin, for which the comprehensive compact provisions provide a continuing planning process. Other interstate compact commissions are used, by and large, for rather limited purposes; the old Federal Inter-Agency River Basin Committees for the Columbia, New England-New York, and Southeast River Basins have long since passed from view, replaced either by Title II Commissions or other arrangements. Whatever comprehensive planning remains is the result of cooperative efforts on the part of states, agencies, and interested citizens' groups. It is the agencies that must provide leadership and guidance to the public so that it can be effectively involved in planning: "the process required to win public acceptance of land use plans are more difficult to complete than the development of the plans themselves" (Watts, 1964).

This deletion of funding support came in the face of what was heralded by the Senate Select Committee on National Water Resources as an era much in need of — and ripe for — a river basin viewpoint as the basis for planning (Brown, 1963):

> Planning for comprehensive river basin development is a team effort. It requires the coordinated assistance of many disciplines and agencies at various levels of government — local, state, and federal (Nobe, 1961).

Recently

In the 1980s, the only continuing comprehensive effort at developing river basin planning was represented by the three-stage series of symposia sponsored by the American Water Resources Association in cooperation with the Tennessee Valley Authority, the Universities Council on Water Resources, the Office of Water Research and Technology, and the WRC. Since the last organization was no longer functional, the Corps of Engineers' Institute of Water Resources participated in its place (Greeson, 1982). In a conference-opening background paper, Norman Wengert (1981) pointed out, after noting the adoption of the Water Resources

Research and the Water Resources Planning Acts, "it is ironic that almost immediately on their enactment the processes of disintegration and fragmentation of the concept began to set in." Attributing this decline to a "new pluralism," Wengert (1981) identified several other factors that also contributed to it. These included the environmental movement itself with its new and different values; the scientific community's rising and divergent doubts about the inherent value of growth, and an increasing lack of confidence in the ability of the federal agencies to administer the land and water resources assigned to their care. In addition,

> The Vietnam War was also undoubtedly a preoccupation contributing to the shift away from the stress on river basin development. Equally important, and not unrelated, was the fact that in a prosperous America resource development seemed often out of date and irrelevant. At the same time, as urban problems — eliminating poverty and racial discrimination, and providing opportunities for urban poor — moved to front and center of public attention, river basin development, relatively at least, receded. Since rural constituencies were losing political clout, in part because of reapportionment based on one man/one vote, the essentially rural or nonurban aspects of water projects reduced their political appeal in Congress (Wengert, 1981).

Eisel (1981) recalled that the WRC was created for planning, not for management, which is ultimately what is needed. He added that with 50 years having elapsed since the creation of the TVA and no clone for any other river basin to date, "we go forward and make changes in our planning to fit the real world as it is likely to exist in the 1980s."

Planning Models

Despite the lack of enthusiasm* for planning among institutions in the U.S., there were attempts at implementing organized (as opposed to *ad hoc*) planning prior to the 1965 Water Resources Planning Act. Ironically, 5-year strategic plans are now required of all federal agencies due to the 1993 Government Performance and Results Act.

One of the earliest computer-based planning models was a complex and challenging undertaking to ascertain whether a computer could answer questions about sequencing construction of various components

* During the Cold War of the 20th century, there was a distinct negative connotation concerning planning, generally associated with the "five year plans" common in the Soviet Union; planning was considered to be part of communist plot.

of flood control, irrigation, and hydropower facilities. The report by Maas and Hufschmidt (1960) established a model with variable project design parameters, wet and dry season flows, and variable operation procedures. The model was based on the Clearwater River above Orofino, Idaho, and was based in part on actual records. The research yielded more information about the process than specific answers for the development of the modeled river basin. This early attempt "launched a wide interest in the potential value of systems analysis methods in addressing complex water resources planning problems. For the first time, we had the computing capability to do long-term simulations of reservoir operations and find optimal solutions using mathematical programming to evaluate complex watershed problems" (Heaney, 1993).

Moser (1996) points out "water related engineering has a long history of using risk analysis methods." Most of the experience with hydrologic risk analysis has been accomplished by the Corps of Engineers and encompasses flooding in flood plains and coastal regions. Frequent conferences and proceedings, short courses, and academic programs on the topic are available. With the likelihood of climate change in the future, risk analysis is being used with greater frequency and, with greater understanding of hydrologic processes and climate variability, it is becoming more useful as well.

Soil and water conservation districts throughout the U.S. have prepared conservation plans for farms (and other private and industrial properties) since the middle of the 20th century. Such plans were provided free of charge upon request and, subject to available time and personnel, were an important service of the Soil Conservation Service in that they helped educate land operators and furthered soil and water conservation. The plans are often an integral part of PL 566 projects, and of the Soil Bank and Conservation Reserve Programs. Modernized, on-the-ground conservation planning is based on "knowledge of the relations among those factors that cause loss of soil and water and those that help to reduce such losses" (Renard et al., 1997).

The current embodiment of the conservation plan is Whole Farm Planning, a four-tiered process originally developed for nonpoint source pollution control on the New York City Catskill watersheds. The partnership* program is voluntary, and farmers are able to obtain funding for help with installation of Best Management Practices (BMPs) that provide benefits to downstream interests as well as the land operator. Particularly important components of the program are pathogen management, manure management, and monitoring (Watershed Agricultural Council, 1995).

* See further discussion on partnerships in this chapter, incentive programs in Chapter 6, and the role of the organizations in Chapters 3 and 4.

Concurrently, the maturation of geographic information systems (GIS) technology has revolutionized the planning process for the management of water and related land resources. One has only to attend a national symposium to learn of the vast number of applications of GIS to challenging planning problems. In addition to the typical routing of highways and utilities, GIS have been used to control growth direction and extent, delimit surface and groundwater resources, identify critical habitat and riparian zones, and even identify property owners in buffer zones in critical areas draining into Chesapeake Bay. The possibilities are limited only by the available data and the quality of the data.

Summary

Without federal participation, river basin planning is stuck in a holding pattern. Nevertheless, there are ways in which the federal government continues to assist. These include research and operational programs of the State and Private Branch activities of the Forest Service, construction (PL 566) projects and a host of programs of the Natural Resources Conservation Service, information and education activities of the Extension Service, project planning by the Corps of Engineers, water quality control research, assistance, and enforcement by the EPA, and cooperative water resources investigations by the Geological Survey. But, again, these may not be comprehensive. More likely, the federal and regional agencies will play a helping-hand role rather than assume a big-brother stance. The states are becoming more and more active, especially in partnership with land operators and local and federal agencies.

Bridging the gap between policy and planning, Lord (1981) suggested that the National Economic Development and Environmental Quality objectives (and the Regional and Social accounts) should be considered as national objectives. He further suggested that the NED and EQ objectives are not necessarily co-equal, and that “by making NED and EQ the only permissible objectives, … plan formulation was made largely irrelevant to the needs which gave rise to it.” Lord called for a water resources planning process that begins with a problem analysis and then establishment of relevant planning objectives, and, most importantly, effective public participation if the public is going to play its mandated role (as required by the Water Pollution Control Amendments of 1972). That participation must take place at a level that permits effectiveness where the public feels that it can be effective. That is best done at a local — or lowest possible — level. Given the ever-present difficulties with boundaries, it may be that the best basis for water resources planning and management is at the river basin or regional level.

Partnerships

The partnership approach to water resources management is a relatively recent development on the water management scene. It is particularly well adapted to complex water resource issues and can be applied to a wide variety of geographic and cultural scales. It also works. Examples and dynamics of successful partnerships illustrate practical applications of the roles and responsibilities of many local, state, regional, and national organizations. To set the stage for examination of the examples, partnership characteristics are presented first.

The dictionary definition of *partnership* is "the combination of two parties or individuals involved in some common activity." Traditionally, the term has been used for marriages or for business associations, both of which imply some legal entity. Often, however, the partnership consists of more than two members or partners. The modern use of the term implies a much more flexible number of partners who do have common, sometimes conflicting, interests. The modern partnership concept is particularly useful for the resolution of conflicting goals and views regarding any complex management situation. In fact, Lee (1993) presents the goal of using the partnership approach under the name "adaptive management." His book *Compass and Gyroscope* clearly defines and proposes this flexible approach to resource management combined with the benefits of democratic pluralism for effective use. Only under the science and democracy that the title highlights as *direction* and *process* can a large population fix the complex ecosystem problems with which humankind is faced as it enters the 21st century.

Partnerships are particularly well adapted to "watershed initiatives." This term is given to include "a wide variety of group efforts usually possessing broad and open participation, resource management scope, informal structure, collaborative process, or action orientation" (Kenney, 1999). These characteristics are considered essential and effective components of a watershed management program. They conform to the concept of ecosystem management, fit in well with management models, and meet the informal definition of a partnership as well.

Griffin (1999) identifies four attributes that result in the formation of a watershed council. These are: (1) focus on a problem, (2) watershed delineation, (3) active involvement, and (4) a broader view than traditional agency-defined and mandated problems. If the council is initiated by an agency, then Griffin asserts that "a fifth defining attribute is that the group tries to coordinate the efforts of multiple government agencies and local residents work with agencies to propose programs, rather than just reaction to them."

Mullen and Allison (1999) identify three social factors that play a role in the success of watershed management initiatives. The factors are stakeholder involvement, availability of social capital in the watershed, and a real or perceived concern or problem ("problemshed"). The last is an essential underlying component in water resources management that belies the popular grass roots concept that has often been equated with partnerships. It is, in fact, the only essential partnership-starting factor* and is a defining development constraint sometimes in the form of a "big stick." The problemshed may be in the form of an environmental, financial, political, public health, regulatory mandate, or technological (engineering) constraint. Cultural factors may also provide constraints, but they are usually accompanied by one of the other types of constraints. From the preceding information and other literature about ecosystem management, watershed management, watershed councils, and watershed initiatives (e.g., Lant, 1999), it is apparent that the management of water resources is certainly fertile ground, and that there is a multitude of examples from which to choose case studies or demonstrations.

Elmore (2000) identifies three additional characteristics of successful partnerships: (1) partnerships must be based on a common vision, which is another way of stating that partners need to identify their common goals, (2) mutual trust in the partnership is required, which is a corollary of having mutual respect, and (3) when the partners know that their viewpoints have been listened to and that a consensus has been reached, they can take pride in ownership. In response to a query concerning partnership financing, Elmore added the thought that "the most successful [partnerships] are the ones without money." He offered this opinion citing that "the biggest failures are the ones that do have the money, because they do a lot of things they wouldn't so if they didn't have any money." He may very well be correct.

Watershed Management

The context of this book focuses on the relationship between the integrated management of land and water resources, the term for which has been in existence since the early 20th century: *watershed management*. This term has grown in usage and popularity since the 1970s and might best be defined as the "planned manipulation of one or more factors of a natural or disturbed drainage so as to effect a desired change in or to maintain a desired condition of the water resource" (Black, 1996). The use of the word "resource" calls attention to its definition,** "a thing that has utility and scarcity." Both of those properties represent value to people

* With the exception of the Potomac River Basin cleanup operation as noted below. That operation was started at the lower levels and, in responding to a perceived environmental problem, was a grass roots campaign.

** See, also, Chapter 9 on Conservation.

individually and to mankind collectively. The use of the word "planned" and the implication of the syllable "man" in *man*ipulated, *man*agement, and *man*kind demand that watershed management include people: those who live on the watershed as well as those who benefit from the resource even though they may be far away. Different terms have been used to define the challenges of soil and water conservation. For example, Viessman (1997) defined "Integrated Water Resource Management" (IWRM) as

> … putting all of the pieces together. Social, environmental and technical aspects must be considered. Issues of concern include: providing the forums; reshaping planning processes; coordinating land and water resources management; recognizing water source and water quality linkages; establishing protocols for integrated watershed management; addressing institutional challenges; protecting and restoring natural systems; reformulating existing projects; capturing society's views; articulating risk; education and communicating; uniting technology and public policy; forming partnerships; and emphasizing preventive measures. The challenge is to guide water management decision-making into flexible, holistic, and environmentally sound directions.

Perhaps IWRM is a little broader in that the original concept of watershed management dealt primarily with headwater drainages. Its definition, however, clearly embraces the explicitly broad concept of IWRM.

Putting the people in watershed management* involves combining partnerships and facilitated workshops for group decision making. This is true for most human endeavors, but it is especially applicable wherever there are a large number of diverse and legitimately interested stakeholders working on a complex physical and sociological problem. Partnerships, therefore, and the associated tool of facilitated workshops, are particularly appropriate for watershed management because the situations are unique and complex, and because they invariably demand an interdisciplinary approach to which the partnership is very well suited. Viessman (1998) calls for the partnership approach to consent building, for without such, political feasibility cannot be achieved. Loucks (1998) points out that as national policies call for greater payment of costs by project and program beneficiaries, the users have a greater voice in the process both in advancing their own interests and limitations and because of the basic paradigm, "no taxation without representation." What stronger foundation than that for a partnership!

* This is the theme of the inaugural issue of *Water Resources Impact* (Black, 1999).

Most natural resources management situations demand *inter*disciplinary activity, where the representatives of different disciplines work together, integrating their efforts into a comprehensive and cohesive whole. This is in contrast to a *multi*disciplinary effort, where each representative of the requisite disciplines for a problem-solving situation does his own thing, without the integration. Truly interdisciplinary organization requires four characteristics. First, there should be a number of individuals or organizations who have no vested interest in the process or outcome. Second, no one individual or organization should be able to control the administration or product. Third, there should be a strong leader with the vision and influence — and no aspiration for "empire-building" — to ensure that all the stakeholders come to the table and truly believe that their views will be valued. And, fourth, the product should be a seamless solution, where the identities of the contributors are merged into fully supported consensus.

It is important to recognize that the concept of having no one individual or organization control the process or the outcome does not preclude having a vested interest in either. Quite the opposite. Stakeholders, by definition, have vested interests. It is when a participant is a stakeholder for personal, political, or financial gain and seeks to control the partnership for nonresource management ends that the partnership is likely to fail in its mission.

There is rarely a yardstick for evaluating the ability of a partnership to achieve its goals; that may change as the members of the partnership adjust individual objectives in order to achieve a satisfactory outcome of the process for the larger community the partnership represents. Objectives may also reflect changing planning horizons as immediate goals are achieved. The measure of success of an effective partnership, then, is that it accomplishes its mission.

Many recent watershed initiatives have tackled interactions between existing infrastructure of civilization and "natural" disasters caused by climate change and mankind's intrusions on the hydrological domain. Probably the most prevalent challenges are those with important environmental, social, or economic missions that involve land use and water quality. The term "watershed management" has grown in usage and popularity since the 1970s. It is used in this book to include any planning and management effort directed at water and related land resources. The mission of watershed management is incorporated in its definition, *the planned manipulation of one or more factors of a natural or disturbed drainage so as to effect a desired change in or to maintain a desired condition of the water resource* (Black, 1996).

Partnering

Partnerships can be developed at any level. They may be just as effective at the local level as among the large government agencies, and they can be just as successful. Seven characteristics of partnerships are rather simple — and simultaneously elegant.

1. **Objectives** must be clear and usually include:
   - What are our common goals?
   - What can we accomplish together better than separately?
   - On what do we disagree?
   - Can we agree on an initial objective or set of objectives?
   - When initial objectives have been met, the partnership can move on to the next set of concerns — the objectives on which there currently may be disagreement — with the same questions, often with a shift in the makeup of stakeholders involved.
2. **Participation:** all stakeholders must have the opportunity to participate in the decision-making process, and must know that their viewpoints are listened to and are valued.
3. **Control:** no one participant (individual or organization) can exercise control — fiscal, organizational, political, or social — over the whole operation. It is only with this underpinning that individual members can feel that they have ownership and take pride in it. Minimum funding may have a positive impact on the partnership's success.
4. **Constraint:** as illustrated in the following examples, there is usually some factor that defines the partnership.
5. **Leadership:** an enthusiastic, innovative, positive, "can do" attitude, individual or group, without personal empire-building goals.
6. **Formality:** regular meetings, notices, formats, and opportunities for participation that are made known to all potential participants.
7. **Cordiality:** treating all participants with respect and mutual trust, which includes listening to their positions and concerns. Mutual trust grows out of mutual respect and open communication.

These characteristics, then, are not unlike the fundamental requirements of a working interdisciplinary team such as one responsible for preparing an environmental impact statement. Those requirements include:

1. The team is made up of two or more members.
2. Members have equal status.
3. Members have no vested interest in the process or outcome.
4. Members have common objective(s).
5. There is on-site communication.

6. Members respect views of other members' disciplines.
7. Members often assume other members' disciplinary viewpoints.
8. Members do together that which cannot be done separately.
9. The final report is seamless, that is, not recognizable as being authored by any one person.

In uncomplicated terms, then, a successful watershed management partnership requires that all stakeholders relinquish any demand or expectation of control over both the *process* and the *outcome* of the resolution of the conflict. In short, no stakeholder may possess financial, organizational, political, or social dominance over the collective partners. Each stakeholder must invest commitment to and faith in the process. The commitment derives from the words of Thomas Jefferson:

> I know of no safe depository of the ultimate powers of society but the people themselves: and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion.

Faith that the process will work is based on the recognition of each partnership participant's opportunity to express his views equally with all others, and that the outcome will reflect those views in the best collective and individual interests of the participants. While such an attitude may leave some individuals with less than what they might have initially desired, it is more likely to produce an acceptable "win-win" situation.

Facilitated Workshops

Facilitated workshops antedate the modern problem-solving concept of partnerships. They are often presented as techniques in academic or off-campus short courses under the name of "creative problem solving" or "conflict resolution." Facilitated workshops are a potent tool in the arsenal of resolutions of complex problems, and are a vitally important part of the successful partnership. Although a variety of procedures may be employed to attain the goals of the partnership, the oldest and best known is the Delphi Process. It is ideally suited to identifying and establishing common objectives as well as to ranking them. Essential to the process is a disinterested* leader who is respected and accepted by the assembled participants. That individual announces the rules of the meeting, and

* One who has no vested interest in the outcome.

arranges for all participants to name personal objectives (or whatever else is being identified, evaluated, and ranked), one at a time, without any judgmental comments from other participants or the leader. The process continues until no further entries are identified, often listed on easels and taped to the walls for all to see. Time may be devoted to speaking for or against each entry, but without ongoing debate as to their value. Successive rounds of ranking the entries by posted voting weeds out the low priority entries until a consensus is reached, thus accomplishing the goal of identifying common objectives. One remaining question is whether each *individual* at a workshop has a single vote or whether each stakeholder *group* has a single vote. That question is best settled by the participants in the workshop itself; there are too many variables to set forth some rule that is cast in stone. The resolution of both process and substance are important components of the communications value of the session and, indeed, the entire partnering experience.

There are numerous variations of the Delphi Process, with some workshop leaders equipped to handle one type better than another. Variations of the Delphi Process, as well as other techniques that, have been developed by facilitators'; work because the individuals involved have experience and confidence in the method employed. If many stakeholders are present, there may be several parallel workshops. If there really are common goals, the fact that the top (or occasionally all) of the list is the same for all the workshop sessions is solid evidence to all in attendance that the process itself works. The outcome is the same: a prioritized list to which all contributed, and to which all participants can lend support. A recorder reports the results to the whole group and summarizes viewpoints in a report that is essentially circulated to all stakeholders.

One of the benefits of such a process is that the stakeholders, usually not well acquainted with the viewpoints of other participants, gain a greater understanding and personal acquaintance with their fellow workshop members. It is in this process that they begin the building of mutual respect and trust so essential to the partnership. It is not surprising that this process is central to the successful partnership as it both accomplishes the first important goal and provides the foundation for a viable group of determined individuals.

Working Partnerships: Some Examples

There are three recognized dangers in putting together a list of this type. The first danger is that current partnerships' situations and conditions are very likely undergoing change. This is a normal occurrence since a partnership is dynamic, and if it is achieving any of its objectives, it is more than likely to move on to new decision-making pastures. In a long-term historical perspective, the list will remain valid; at any given point in time, it may not. To see a comprehensive listing and assessment of partnerships (and other) programs, see the *Proceedings* of CONSERV96 (American Water Works Association, 1995).

The second danger in compiling this list is that some reader is going to decry having a pet partnership not included. The examples reviewed are relatively high profile situations, either in terms of history, magnitude, or publicity. But they also were selected from what might be considered an almost limitless list of partnerships to be representative of geography, scale, time, and types of problemshed. The list most certainly will not please everyone.

The third danger is that familiarity with local partnerships will lead to excessive examples from the author's home state with the subsequent label of "provincialism" applied with all its attendant faults and shortcomings. On the other hand, an objective examination of the list of partnerships leads to the conclusion that a disproportionate number of them exist in New York State. The reasons for this are several. First, New York is, along with North Carolina and Ohio, one of the first three states to enable soil and water conservation districts. Thus, organizations in these three states have a long history of legislative and elective successes and failures from which to draw experience. Second, New York has been blessed with effective local, state, and federal leadership in the soil and water conservation arena, largely brought on by the geography of the state involving numerous drainage basins that include other states and Canada. Third, that leadership has been prodded by the fact that of the five largest *unfiltered* surface municipal water supply watersheds in the U.S. (Syracuse, Boston, Portland, OR, Seattle, and New York City), two are in New York State.* And, New York City and Syracuse are the only two with agricultural land use on the watersheds; all the others are almost entirely forested. This presents severe human health, economic, and technological concerns; thus, the challenge. Indeed, the local examples chosen include some scales of watershed management operations not evidenced elsewhere. Many other states have not satisfactorily resolved conflicts between business interests and environmental quality issues.

Finally, the urgency presented by nonpoint source pollution on municipal supply reservoirs and pressure from the EPA has prompted competent reaction on the part of individuals and institutions. The following list of examples has been compiled from several such situations.

* This observation was made by Ron Entringer, NYS Department of Health at the first meeting of the Skaneateles Lake Watershed Agricultural Program Advisory Committee, February 4, 1993, Skaneatleles, New York.

The Potomac River Basin

The Interstate Commission on the Potomac River Basin (ICPRB) was created by Congress in 1940. It maintains membership from the original states of Maryland and Virginia and the District of Columbia, and has since added Pennsylvania and West Virginia. The federal government is also a signatory member. A presidential committee and the Washington Board of Trade gave impetus to the problems associated with rapid urbanization of the lower portion of the basin around the Washington, D.C. area during the first half of the 20th century. The ICPRB has also been involved in the efforts to clean up Chesapeake Bay. The cleanup effort was at the river basin scale.

Originally concerned with water quality, the ICPRB expanded its scope to include "all facets of water and associated land resources" (Interstate Commission on the Potomac River Basin, 1979). Storm water runoff has developed as a major problem in the Anacostia watershed that drains the southeastern part and suburbs of Washington, D.C. The commission has a program that emphasizes interstate and basin-wide coordination, stimulation of federal and state action, basin-wide water quality monitoring evaluation and conducting other water-related studies, meaningful liaison with citizen and government groups, dissemination of information about the Potomac, and unique services and technical support to the compact members.

Major changes in the basin have occured since the ICPRB's formation. "The basin's population has grown from 1.7 to 4.6 million; floods, droughts, and issues have come and gone; we've gone from the lean times of a nation at war to an affluent society; public attitudes have gone from accepting the rivers as the logical place for waste disposal to a clean water commitment; and our understanding of the ecosystem of the basin has grown enormously accelerated with the help of new technology. With all of these changes, the purpose of the commission to serve, and to help create a national showcase of the Potomac River has remained the same" (Interstate Commission on the Potomac River Basin, 1990).

While grass roots citizen involvement characterized the pre-commission efforts of the League of Women Voters efforts in the 1940s, the commission has formalized the effort. The ICPRB continues to be an enabling force in the basin, taking part in ongoing environmental programs and initiating education materials and appearances at meetings in order to achieve the common goals of citizen awareness and action. This is clearly not the purely grass roots development that characterized the league's effort in the 1940s, but the government-mandated efforts of citizens have sanctioned — and ensure — the original group's long-term goals.

Quabbin Reservoir Watershed (Boston, Massachusetts)

First proposed in 1895, the site on the Swift River in west central Massachusetts was not developed until the 1930s (Greene, 1981). At that time, the growth of the Boston metropolitan area was demanding more fresh water supplies not available from local wells. In addition, the Depression provided the opportunity for the faraway municipality to exert its muscle against the defenseless residents of the four towns of Dana, Enfield, Greenwich, and Prescott, MA,* especially by labor-level employment. All four are now under water. The construction of the dams, gates, control structures, aqueducts, and distribution system were all accomplished by the Metropolitan District Commission (MDC) following a 1931 Supreme Court decision that held that the greater public good would be served by the reservoir. About 340 to 440 million gallons per day are piped into the city of Boston and 46 surrounding communities, serving a population of over 2.2 million. Only through extensive and repeated personal contact have the differing viewpoints of these special interests been reconciled. A watchdog organization, the Water Supply Citizens' Advisory Committee (WSCAC), was created at the time when the MDC was attempting to extend the Boston water supply by tapping the Connecticut River, to which the Swift is a downstream tributary.

The more recent watershed management operations on the 81,000 acres of forested watershed are of interest here. Managed by MDC forester Bruce Spencer, the public pressures include those from:

- Environmentalists who wish to see no trees cut at all.
- Animal rights activists who do not wish to have deer or other wildlife harvested.
- Recreational users who wish to have free access to "undisturbed" forest for hiking, birding, or hunting.
- Recreational users who desire open grassy space for outdoor activities such as picnics, scenery, and sports.
- Reservoir users who wish to fish without motorized vessels.
- Reservoir users who wish to have unlimited access to the reservoir's waters.
- Technical advisors who identify constraints on certain conditions for survival and maintenance of certain wildlife species, such as loons, eagles, deer, fish, beaver, and muskrat, many of which also have impacts on water quality.

* An excellent 1981 film, "The Old Quabbin Valley," tells the story of the water resources development project. The film was produced by Lawrence R. Hott, Inc., P.O. Box 476, Haydenville, MA 01039.

- Technical advisors who stress the need for diversity of ecological conditions in order to maintain a more stable environment for the protection of the watershed.

A combination of regulation and education has been the mainstay of the watershed management program.* Faced with managing a large public natural resource, the MDC watershed manager must rely on the free and open expression of all stakeholders' views at public meetings and in one-on-one sessions with individuals and special interest groups. Twelve towns have area within the watershed as well, and thus have a vested interest in every decision that affects the local economy. Finally, there are loggers who administer the plan for the management of the forest — they must exhibit sensitivity to appreciate the public's viewpoints and to operate in a way that does not alienate those people. This is a very focused and limited partnership. Focused because of the scope of the mission of the watershed's management needs; limited because it is locally implemented without much upper management involvement other than, "OK, we'll go along with it unless it impairs water quality or costs too much money."

In this complex, multi-faceted situation, the WSCAC was on the "outside" of the overall management activity, the MDC on the "inside." That balance, along with the sensitive work of the MDC forester, rounded out the views and provided the opportunity for a viable partnership of all concerned. The WSCAC knows that the MDC could clamp down, the MDC knows that it must have public support. The bottom line is that many people feel that they have both a stake and a voice in the management of the reservoir and its watershed. That is what provides the necessity of the balance over control and outcome among stakeholders.

Cedar River Watershed (Seattle, Washington)

The Cedar River watershed system has been providing Seattle with high quality municipal water since 1901. With the Tolt River system, water is provided for about 1.2 million people in the greater Seattle area. The system was financed by revenue bonds in 1895, which have been used to construct a dam and reservoir, condemn and move residents out (much like the Quabbin Reservoir development for Boston), and construct a hydroelectric plant. Care has been taken to minimize contamination from human sources, including discharge from toilets on the railroad that traverses the system. From the system website: "The Lower Cedar River Basin and Nonpoint Pollution Action Plan describes current conditions in the basin and proposes

* This is based on personal communication with Superintendent Bruce Spencer, Forester, Metropolitan District Commission, New Salem, MA on November 11, 1998.

solutions to the problems of flooding, property damage and declining salmon and steelhead runs. It also recommends preventive measures to protect and maintain water quality, groundwater supplies and habitat as the basin planning area continues to develop. Preventing problems in the watershed is much more cost-effective in the long term than trying to correct problems once they occur. … The Cedar River Basin Plan presents a unique opportunity and challenge to allow for urban development and to support rural industry and lifestyles, while providing for reduced flood damages, long term salmon and steelhead runs, and high water quality."*

There is also an effective partnership between the logging community and the watershed managers. The constraints on this partnership include the modern concerns over flooding, salmon, and property value issues. Long-standing constraints include the desire for revenue from the sale of timber products on the watershed, control over BMPs to minimize sediment, nutrient, and pathogens in the municipal water supply, and the need to maintain the young, healthy forest that is considered desirable for a safe municipal water supply. The complex arrangements were strained during the ban in the northwest on commercial logging on National Forests, some land of which is included on the watershed, and the concern over habitat for the northern spotted owl.

Like the Quabbin Valley development for Boston's municipal water supply, the Cedar River is a visible partnership operating under constraints circumscribing its actions. It is essential that partnership objectives be identified and sought because, if not attained, the "big stick" constraint in the form of threatened regulations might be an unwelcome alternative. No other approach will meet the many needs of the population for high quality water. That, indeed, is the bottom line.

New York State Soil and Water Conservation Committee (S&WCC)

The New York State Soil and Water Conservation Committee (S&WCC or "Committee") advises both the Department of Agriculture and Markets and the Department of Environmental Conservation on soil and water conservation policy. Its authority comes from the Soil and Water Conservation Districts Law (Laws 1940, c. 727, approved April 23, 1940, as amended, c. 9(b) of the Consolidated Laws of New York). Historically, its scope has been primarily agricultural and, until the adoption in the mid-1980s of the "no net loss of wetlands" policy, it focused on drainage projects. However, any soil and water concern was addressable, including urban runoff, forestry, recreation, and related land uses. The committee is clearly statewide in scale, but is organized by within-state regions that foster coordi-

* As found 1/8/00 at http://splash.metrokc.gov/wlr/BASINS/cedarpln.htm#intro.

nation of the state's 57 soil and water conservation districts. Its combination of statewide operation coupled with decentralization is a model for a viable state approach to soil and water conservation.

The S&WCC is made up of five voting members, usually landowners appointed by the Governor. They also represent farm organizations and nonfarm interests. The nontechnical *voting members* are advised by a team of technical, nonvoting *advisory members* who represent a variety of state and federal agencies, citizen's groups, and educational institutions.* The S&WCC *professional staff* includes a director and an assistant director of soil and water conservation, water quality specialists, six regional coordinators, two full-time engineers, an information/education coordinator, a water quality program analyst, and office staff. The advisory members develop criteria for ranking proposals for agricultural nonpoint source control in incentive programs, evaluate and rank several "rounds" of proposals for incentive grants, and make recommendations to the S&WCC related to funding and technical issues. In addition, a four-way memorandum of understanding divides responsibilities that relate to the S&WCC mission: (1) policy, (2) employee training, (3) technical assistance, and (4) lobbying. The professional staff also communicates the deliberations of the committee to other state agencies, the district personnel, and the public.

The committee identified its vision and mission:

> One of the great sociotechnical challenges of our times is to maintain and manage our lands and waters. Where increased human activities stress the land, these resources are compromised. Both those who live on and away from the site suffer direct consequences and all citizens suffer added taxes and higher costs of living. Because water quality degradation often occurs at some distance from the site of the land mistreatment, government shares both cost and responsibility. That responsibility is ramified in the Committee's general mission, which is … To develop a responsible Soil and Water Conservation Program for the State of New York that will be implemented through Soil and Water Conservation Districts. The Committee establishes policy to guide the Soil and Water Districts' programs, to assist the state's soil and water conservation districts in organizing, developing and implementing programs, to advise all agencies of government on matters related to soil and water conservation, and to work in concert with state and federal agencies to reduce pollution of the state's water

* I have had the privilege of representing the College since 1985. That experience has provided the opportunity and information for classroom teaching and this book.

> resources and improve the quality of these resources (NYS Soil and Water Conservation Committee Strategic Plan, adopted 9/21/93).

Although sanctioned by law, the S&WCC is an excellent example of a successful, working partnership. Operationally, it exhibits all the important characteristics of a partnership. Voting members, staff, or advisory members do not control the operations and outcomes of the committee. Nor do the interactions of the individuals in the full committee or the technical subcommittee in any way compromise the operations of the groups they represent. Indeed, the ongoing operations of all the members and the groups they comprise provide a model partnering organization. This is true even though advisory members include officials within the two state departments of Environmental Conservation and Agriculture and Markets who play multiple roles in the meetings and in all communications with the S&WCC. That is, they are advisory members, administrators, and executors of the S&WCC's operations. The constraint for the S&WCC is a legal one: the enabling legislation. The partnership participants also meet all the essential characteristics, including lack of control over the process or outcome.

Economics, Endangered Species, and Logging (Quincy, California)

While not strictly a water resources challenge, the re-establishment of commercial logging as the economic backbone of Quincy, California involved an ecosystems approach that applies to watershed management (Kiester, 1999). The federal injunction on clear-cut logging on National Forests — largely owing to the concern over the spotted owl — resulted in economic disaster for the town. In response to the drastic decline of the industrial base, the town suffered loss of tax revenues and jobs, the local community deteriorated, and violence erupted. Faced with the environmental, financial, and legal constraints, a group of citizens met informally and found that they did indeed have common ground and launched the Quincy Library Group (QLG). The QLG eventually reached a compromise program in the form of a Community Stabilization Proposal. This program — through habitat protection, buffer zones, group selection logging and fire salvage operations, and forest restoration — met majority needs and enabled the Forest Service to secure small test appropriations. Then, with the assistance of California Senators Feinstein and Herger, the QLG introduced a bill on the House floor in 1997 that passed both houses in October 1998 and enabled the restoration of the community.

Here, the constraint was complex, involving environmental, regulatory, and economic issues. This last issue was the driving force. While none of the constraints were watershed management issues, the resolution of the primary problem was one that involved habitat and potential damage from logging activity, thus water quality did serve as a focus. Interestingly, the partnership of individuals, town, interest groups, federal agency, and Congress was surprisingly varied, yet people refer to the effort as a grass roots campaign. It certainly was when the individuals launched and persisted in the campaign to the fix the problem. However, the opportunity for that effort would not have arisen without the economic crisis. It is often pointed out that the symbol in Chinese for crisis and opportunity is one and the same.

Skaneateles Lake Watershed Agricultural Program (Syracuse, New York)

This program, begun in 1994, administers the cooperative activities of the watershed farmers, the Natural Resources Conservation Service, the City of Syracuse, three soil and water conservation districts, and Cornell Cooperative Extension Associations in Onondaga, Cortland, and Cayuga Counties. The Skaneateles Lake Watershed Agricultural Program (SLWAP) involves a headwaters watershed that is the primary supply for the city of Syracuse. In 1991, the Syracuse corporation counsel called an informal, get-acquainted, information and organization meeting for all interested stakeholders to express their interests and problems in managing the lake and its watershed. What resulted was a large, well-attended meeting that overflowed the reserved meeting hall. The impetus — as was the case for New York City — was that in 1986, EPA (concerned about pathogens, nutrients, and sediment) had demanded that Syracuse filter its water or maintain performance criteria that would assure a high quality drinking water supply for the 250,000 customers. The system, developed in the 1890s, uses the fourth largest Finger Lake, with its unusually small watershed-to-lake area ratio of 4.3:1. The lake is oligotrophic, with clear water of high quality and little aquatic vegetation, and is highly valued for drinking water and recreation. The city decided that maintaining a responsible program on the watershed's 18,190 agricultural acres (48 percent of the 59.3 square-mile watershed) was a more economical alternative (SLWAP, 1999).

Syracuse's situation, however, is different in two other ways from the New York City and Boston situations. First, virtually all of the land is privately owned, and second, nearly 1,000 homeowners (both seasonal and permanent) live on the lakeshore and have an interest in how the lake's water level is managed. A 4-year evolution, including an *ad hoc* task force, culminated in the creation of the SLWAP in 1994. The SLWAP office is located off the watershed in Onondaga County. Since most of the watershed's area is located in Onondaga County, that location may take out some of the stigma attached to noncounty interests and organizations that might feel as "strangers" to the watershed itself.*

Simultaneous to the development of New York City's watershed management program,** the partnership of national, state, county, and local interests developed the concept of Whole Farm Planning in which farmers receive customized plans based on needs. This approach is "cost effective for the city and helps keep farmers and their agricultural enterprises viable" (SLWAP, 1999). It puts into operation the concept that "we cannot have environmental quality unless we invest in our private lands" (Swenson, 1999). The overall goal of SLWAP is to have 100 percent participation among the watershed's 55 farms by the year 2001. It is accomplishing that goal by utilizing an educational, voluntary, incentive-based approach in place of regulations. The program was awarded one of two Awards of Excellence by the Northeast Cooperative Extension Directors for 1999 (Thornton, 2000).

In both the New York City and Syracuse situations, there continues to be a potential regulatory club held at the ready by the state's Department of Health. Under that threat, both municipalities have agreed to enable – and even play a noncontrolling role in – a partnership designed to respond to the needs of the farmers, to continue to provide taxes to the county, and to maintain a viable farm entity in the community.

The bottom line of this successful, viable partnership is that Syracuse's water won second place (first in the lower 48 states) out of 163 overall entrants in the 1998 Conference of Mayors' annual "USA City Taste Test." And it was the only unfiltered water supply among the six finalists.

Chesapeake Bay Critical Area Commission (CBCAC)

Sixty-one jurisdictions are included in the CBCAC, comprising 64,000 square miles of the Susquehanna River Basin watershed. The CBCAC was created in 1984 by the Maryland General Assembly (Chesapeake Bay Critical Area Commission, 1993). Prior to that date, concern was focused on nonpoint source pollution control in a one-mile-wide strip of land bordering the bay where most of the damaging development was located.

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* Refer to Figure 1.3, which poses some of the inter-organizational issues that may arise when geography and politics are complicated.

** The New York City situation is more complex as well as much larger in geographic, financial, and organizational scope. In fact, the city's Department of Environmental Protection relinquished fiscal and organizational control when it signed its initial agreement with the New York State Soil and Water Conservation Committee on July 20, 1992. That instrument provided funds to the committee to administer a 3-year program of education, demonstration farms, water quality monitoring, and the development of Whole Farm Planning (see Chapter 6) as a process that enables local-level partnerships.

Later, concern broadened to focus on the aquatic ecosystem of the bay and was expanded to include the bay's entire watershed. Thus, the states of Maryland, Virginia, and Pennsylvania, and the EPA are signatory members of the 1983 first Chesapeake Bay Agreement. A second Chesapeake Bay Agreement was signed in 1987 and included specific goals to restore water quality based on criteria adopted in 1986. The entire Critical Area Commission is river basin-wide in scale, and involves an extensive combination of state and private lands, with widely scattered federal holdings.

The overall program goal is a 40 percent reduction in the nitrogen and phosphorous being flushed into the bay. This is to be met "through the development of Tributary Strategies — watershed-based plans to reduce nutrient pollution through wastewater treatment plants, agricultural best management practices, and resource protection, and growth management activities."* In fact, the law mandates that the establishment and 4-year reviews of each jurisdiction's Critical Area Program be the responsibility of the citizens of that jurisdiction. One of the ways in which the program works is that priority is given to otherwise equal project proposals. One such is to areas within New York that are inside the watershed's boundary.**

The 1986 Criteria Act gave the false impression that the commission was a super zoning board. Overcoming that public misperception was an important part of implementing the partnership that resulted. Working with an assortment of innovative *areas* — Intensely Developed Areas, Limited Development Areas, and Resource Conservation Areas — the Commission looks to local jurisdictions to adopt, implement, and enforce minimum standards and for a public education program to promote stewardship and responsibility in resource use throughout the watershed.***

Here, in spite of both legislation and intergovernmental agreements and a high degree of resultant regulation, the Chesapeake Bay program's partnership flourishes because control is left to the local level. In addition, a strong educational component enables and encourages the public to exercise its dominion. While enforcement is an option at the local level, it is still left up to the very individuals who can avoid it if they cooperate. Here again, the effectiveness of an imposed partnership was supported by a benevolent government that pooled relevant and important information essential to the survival of an aquatic resource.

* As found on the EPA website http://www.epa.gov/owow/watershed/lessons/ex1_1.html as of March 18, 1999.

** Other priority areas include the Peconic Bay watershed on eastern Long Island and certain other hydrologically sensitive areas throughout the state.

***Including, of course, the Upper Susquehanna River Basin Coalition discussed below.

Upper Susquehanna River Basin Coalition (USRBC)

The Upper Susquehanna River Basin Coalition (USRBC) continues to build, but does not interfere with the Susquehanna River Basin Commission, which ministers to the interstate compact. The USRBC represents 13 counties in Pennsylvania and New York, all or part of which embrace the 7,375 square miles of this important Chesapeake Bay tributary. The USRBC vision focuses on those areas of the watershed that most effectively reduce nonpoint source pollution. The scale of this example is regional in scope, and the program is constrained by the interstate compact. The great majority of the land is administered by state or private entities.

Although the coalition's strategic plan states that, "it was formed as a multi-disciplinary watershed approach," it clearly is *inter*disciplinary. The Coalition's five objectives are:

1. To develop a networking organization that provides service and focuses its efforts on local, state, and federal nonpoint source pollution issues "with ultimate decisions and control being at the local level." To achieve this, political boundaries will be crossed in order to develop expertise, infrastructure, and funding.
2. To provide information that will help basin residents understand the issues.
3. To develop an information base sequestered at the local level in order to assist in achieving objective 2.
4. To develop water quality projects at the local level.
5. "To facilitate the implementation of projects by identifying and seeking local, state, and federal funds that target regional perspectives. Using funding in place, in-kind work, and other avenues leverage dollars that may not be otherwise available" (Upper Susquehanna River Basin Coalition, 1998).

The USRBC structure is typical of many effective watershed management organizations, and mimics the State Soil and Water Conservation Committee described above. The 13 *voting members* — one from each county — are, in many cases, members of local county water quality coordinating committees (in New York) and local Chesapeake Bay committees (in Pennsylvania). Such cross-memberships, or pluralism, are an efficient way in which to coordinate programs and projects at different levels of government. In addition, there are *advisory members* and representatives from technical and formal federal, state, and local organizations, including the Susquehanna River Basin Commission and the Chesapeake Bay Program. Four standing committees — Executive, Education, Evaluation, and Implementation — guide operations. Professional leadership is provided by a member of the centrally located Tioga County Soil and Water Conservation District pending sufficient funding for a full-time *professional staff*. Subscription to the goals and objectives of the USRBC involves having the members sign a memorandum of understanding, and the operational bylaws are embraced in the Strategic Plan. As a recently formed operation, the USRBC needs to gain financial support for the long-range goals and objectives; it already has the professional respect of the local, state, regional, and federal organizations with which it must interact.

Here, the interdisciplinary nature of the membership, its geographic and political dispersal, and the pressure from meeting a goal that is completely outside the watershed as well as the states involved, ensure that no one individual, group, or governmental unit has control. What's more, the overriding legal instrument of the interstate compact has not been empowered with the degree of legal control over river discharge, for example, as is the case with the Delaware River. The result is that even though the local interests are theoretically at the mercy of the compact and its provisions, the effect of the existing structure is to resemble in both appearance and effectiveness a true partnership.

Edwards Aquifer Authority (San Antonio, Texas)

The centerpiece of this situation is the Edwards Aquifer, the 6,400 square miles which underlie in all or part of 11 counties that extend in an east-west arc north of San Antonio. This arc gets all of its water from the Karst limestone aquifer. The primary recharge area is about 1,500 square miles,* mainly in the two western-most counties. Annual recharge is estimated at 640,000 acre-feet. The aquifer supplies nearly 1.5 million people, as well as a major crop irrigation industry in the western portion of the region (Keplinger and McCarl, 1996). Uncontrolled urban sprawl to the north of San Antonio is encroaching on some of the recharge area that is necessary to provide the urban and suburban water supply. Some of the world's largest springs emanate from the limestone in the southern portion of the region. Spring discharge and return flows from irrigation contribute to instream flows that are, in places downstream, appropriated and must be maintained. Some of the springs provide habitat for endangered species and are used for recreation.

"The threat of a federal takeover of the Edwards to protect endangered species (the result of one in a long series of lawsuits) finally provided the impetus for the region to quit bickering and begin to solve the problem" (Hughes, 1999). Established state water law and current lawsuits provide the necessary background to understanding how the management of the

* This and other information was obtained on 1/9/00 from http://www.edwardsaquifer.net/intro.html.

recharge and discharge areas, and of the aquifer itself, can be organized. In 1996, the mayor of San Antonio launched the San Antonio Committee which sought consensus, if not complete satisfaction, by all stakeholders to work on a regional plan that would resolve the multiple problems and challenges.

The diversity of the people living in and relying on this hydrographic sub-region, and the complexity of the constraints, provide an ideal and extraordinarily challenging opportunity for a partnership. Regulation of and control over the aquifer's recharge area, condition, and discharge quantity and quality are at stake, along with the economic viability of the region. Here is an example of extreme complexity, with simultaneous financial, environmental, legal, organizational, and cultural constraints. Presently, partnering is seen as the best and perhaps the only solution. Paul Frazier* likened partnering (in the face of Native American waternights and salmon recovery conflicts) to "being a marriage counselor and an auto salesman on a conference call," the Edwards Aquifer problemshed demands a partnership be that and more.

Analysis

The land ownership, hydrographic scale, and responsible organization for each of the nine cases are shown in Table 5.4. The nine examples illustrate a variety of land administrators and a variety of scales at which the partnership operates. They also present situations from small headwaters and municipal supply watersheds to regional ground water aquifers and from local to interstate organizations and challenges from state to national policy. Some of the rows in Table 5.4 have more than one entry in each set of columns owing to overlapping authorities and unclear partnership definitions. The responsible organization or level is also shown. There are many variations, too, in the nearly 2,000 watershed initiatives around the nation, along with some similarities. For example, Wisconsin works similarly to New York, but the division of the state is by river basins not counties, and teams of stakeholders are assigned to each drainage basin. Twenty teams hold from two to four meetings each year and work on a consensus basis — the "essence of democratic participatory management" (Shepard, 1999a). Suggestions for agency positions and attitudes to foster effective partnerships are presented by Shepard (1999b). The sampling of initiatives used in this paper does not permit statistical analysis; one would have to characterize and properly sample all of the nation's watershed initiatives to accomplish such a review. Nevertheless, some conclusions may be drawn.

* Unpublished, transcribed comment on "Unique Partnerships: How an Indian Tribe and an Irrigation District Approached Salmon Recovery," Session 20, Annual Conference of the American Water Resources Association, Seattle, WA, Dec. 8, 1999.

Table 5.4 Characteristics of Selected Partnership Examples

		Scale or Scope			*Level or Responsible Organization*			
Drainage	*Land Administrator*	*River System*	*Regional Drainage*	*Headwater Watershed*	*Federal*	*State*	*Municipal*	*Local*
Potomac River	Private	√			ICPRB			
Quabbin Reservoir (Boston)	Boston MDC and private			√			Boston MDC	MDC forester
Cedar River Watershed (Seattle)	Seattle, USFS, and some private	√	√	√			Seattle	
Town of Quincy, California	Private, town, and federal		√	√				Quincy Library Group
NYS Soil & Water Conservation Committee	Private, state, and small federal	√	√	√	NRCS	State and federal programs		S&WC districts
Skaneateles Lake Watershed Agricultural Program	Private			√	EPA	NYS DOH	Syracuse, counties, towns	SLWAP
Chesapeake Bay Critical Area Commission	Private, and some state and federal	√			Interstate agreement			
Upper Susquehanna River Basin Coalition	Mostly private		√			Multi-state agreement		USRBC
Edwards Aquifer Authority	Mostly private		√	√				EAA

The characteristics of the watershed management efforts at the conclusion of each partnership's description are summarized in Table 5.5. These judgments concerning the characteristics are an attempt to classify and evaluate the partnerships. The examples may be representative of the types of partnerships found, but they should not be considered as being necessarily typical either; they succeed to varying degrees in achieving the characteristics of partnerships, but for varying reasons, and they may or may not persist in their current success. Or, as Schad (1998) suggests, they may find intractable conflicts that lead to their demise or restructuring so as to maintain the benefits of partnering without loss of a humanized approach to conflict resolution. It must be remembered that partnerships do not only apply to watershed management efforts. Partnerships may be utilized effectively in a variety of problem-solving situations. Thus, the summary tables should not necessarily be extended to other types of conflict resolution without similar, or more stringent, analysis. Again, some conclusions may be drawn from the observations in Table 5.5.

Partnerships appear to be of three types. The first is a *true partnership*, in which case the establishment of the group of stakeholders was a grass roots operation. The second is an *apparent partnership*, in which case some constraints are putting the pressure on to resolve an ongoing problem. Finally, there is a *paternalistic partnership*, in which case some existing authority has discovered that the most effective (or economical) way out of a complex problemshed is to put up with the inefficient democratic process of partnering. In the absence of any hard and fast characteristics of partnerships that universally meet these definitions, the nine situations have been identified by appearances (which, as the saying goes, can always be deceiving).

Interestingly, the only true partnership seems to be the one on the Potomac River Basin, under the tutelage of the League of Woman Voters. Seattle's Cedar River municipal watershed is clearly managed by the city, as is the Quabbin by Boston's MDC, although in both there is a high degree of cooperation between forest land administrators and the logging community. All the others are apparent partnerships; they operate as if they were in fact true partnerships, but the ability of the group to function constructively and cooperatively is made possible by some external constraint or a "big stick." These take the form of environmental, financial, legal, organizational, or other (e.g., interstate) constraints that permit regulators, administrators, managers, and the public to operate in what appears to be a true partnership. (Another excellent example of a partnership established in response to an environmental catastrophe is the Barataria–Terrebonne National Estuary Program in Louisiana (Black, 2000).) There does not seem to be any consistent pattern as to whether an apparent or paternalistic partnership results from one particular type

Table 5.5 Analysis of Selected Watershed Management Efforts

	Type of Partnership			*Constraint*				
Drainage	*True*	*Apparent*	*Paternalistic*	*Financial*	*Legal or Organizational*	*Environmental*	*Other Influence*	*Status of Control*
Potomac River	√				Commission	Public opinion	League of Women Voters	Voluntary
Cedar River Watershed (Seattle)		√	√	Seattle	Endangered Species Act	Healthy forest cover	Federal restriction on logging	Total
Quabbin Reservoir (Boston)		√	√	MDC	Safe Drinking Water Act	Healthy forest cover	Public opinion	Total
Town of Quincy, California		√		Economic crisis			Federal restriction on logging	Voluntary
NYS Soil & Water Conservation Committee		√			NYS Cons. District Law			NA
Skaneateles Lake Watershed Agricultural Program		√		Incentives, §319, EPF, and EBA	EPA, DOH	EPA		Voluntary
Chesapeake Bay Critical Area Commission		√	√	Fishing and other industries	Interstate agreement	Chesapeake Bay		Voluntary
Upper Susquehanna River Basin Coalition		√	√	Incentives, §319, EPF, and EBA	Interstate compact	Chesapeake Bay		Voluntary
Edwards Aquifer Authority		√	√	Regional economics	Water law; Endangered Species Act	Karst aquifer	Urban sprawl	Under establishment

of constraint. Thus, for example, "voluntary" control status can lead to any of the three partnership types.

Summary

Constraints dominate and define partnerships. In declaring defeat of securing a national water policy, Theodore Schad (1998) supports the substitution of local partnerships for overriding policy:

> While the watershed had always been the obvious focus of the planning activities of the old-line water management agencies of the federal government, the Bureau of Reclamation, Corps of Engineers, Natural Resources Conservation Service, and the Tennessee Valley Authority, their approach, with the exception of NRCS, had the appearance of being from the top down, under policies formulated in Washington. The redefined watershed approach purports to start from the bottom, coordinating public and private sector efforts to address problems at the grass-roots level, with preservation of the environment as the primary objective. The watershed groups or organizations, which have been formed frequently, have no governmental powers, so they are unable to enforce their decisions or deal with tractable problems such as irreconcilable conflicts among stakeholders within or outside the watershed, or conflicts with the interests of other watersheds.

The several examples included herein certainly confirm Schad's observations. The effectiveness of partnerships in watershed management is best served by having a combination of the best characteristics of partnerships. They appear to be the desirable way to achieve and to plan objectives of effective water policy, and therefore, constitute the best approach to achieving water policy goals to be adopted and implemented in our geographically varied and pluralistic society.

Conclusion

The linkage between water policy and planning, and the partnerships necessary to successfully implement them, is an example of the serendipitous coming together of need and method. It is best put in the words of Bates et al., (1993), "Never before have people understood better the social and ecological consequences of water policies and decisions. A commitment to make water use sensitive to the realities of natural and human communities can be rooted in this knowledge and ethically driven by the principles of conservation, fairness, and ecology."

Activities and Questions for Critical Thinking

1. Include the dates of development of the partnerships described in this chapter on the timeline, Plate 1 (found on page 8).
2. Can you identify any other constraints that define partnerships?
3. How is your hometown or local water supply administered? Does the public have any role in its management? What means does the management unit have in communicating with its public?
4. In 500 to 750 words, describe the organization that is most like a partnership in the vicinity of your home, and compare it with those described herein.

Chapter 6

Pollution, Programs, and Permits

Pollution control programs are evolving into permits

Pollution is the primary linkage between the quality and quantity of water and related land resources, so much so that established pollution control programs are evolving into permits. This chapter briefly reviews the mid-20th century establishment and growth of control over point sources of pollution and focuses on the nonpoint sources of pollution as appropriate to the book's title. Point sources are those that are clearly identified as "end of the pipe" effluents as opposed to the diffused pollutants from pervasive, managed (and mismanaged) lands as civilization invades the natural landscape.

History clearly shows a federal establishment reluctant to exercise control over point sources until the environmental movement demanded action. Regulation followed periods of a *laissez faire* approach to casual investigation, then research, and minimum standards for coliforms, nitrates, and a few contaminants. When public pressure became sufficiently great, Congress first provided incentives in the income tax code. These incentives gave breaks to manufacturers who installed processing facilities to reduce the dumping in water bodies. Subsequently, the manufacturers often found that the materials recovered amply reimbursed them for their investment, and simultaneously saved valued chemicals that could be recycled. Then, Congress approved federal dollars to match local public waste treatment plant expenditures. With most of the point sources cleaned up through a combination of federal and local dollars, regulation, and more stringent provisions of the 1972 Water Pollution Control Amendments, the percentage contribution to pollution in the U.S. by nonpoint sources increased. Also, the prediction of the 1973 report of the National Water Commission (1973) that billions of dollars would be needed for point and nonpoint source cleanup redirected attention and funds to the nonpoint source pollution challenge, especially runoff from urban areas.*

The contribution of construction activity to urban runoff is just one of the several, clearly identified nonpoint sources of pollution. Seven sources of nonpoint pollution were initially identified in the 1972 Water Pollution Control Amendments: agriculture, silviculture, mining, construction, saltwater intrusion, residual waste, and on-land disposal of pollutants. The title of §208 was "Areawide Waste Treatment Management," a term that has evolved into "nonpoint sources of pollution," and sometimes simply "section two-oh-eight" plans.** Agriculture actually turned out to be the most visible and serious source of pathogens, nutrients, and sediment. This development provides much of the focus for this chapter, since it is currently a prime focus of nonpoint source pollution control.

In fact, the same historical development involving a sequence of research, funding, and regulation that applied to point sources is now being applied to nonpoint sources. Thus, the title for the chapter: the long-time protection of economically shaky and exigency-vulnerable agriculture by Congress is losing support due to a change from nearly 75 percent agricultural population around 1900 to less than 5 percent 100 years later. There are a variety of programs currently aimed at controlling nonpoint sources of pollution. The first erosion [sic!] of the protection for that preferred land use on which we depend for food and fiber has already occurred, in the form of the 1994 *Southview Farm* decision. Pollution control programs aimed at agricultural and urban construction nonpoint sources are giving way to permits. Can other land uses be far behind?

Pollution

Water pollution control and abatement in the U.S. has been slow. It also has not been tremendously effective, although there have been noticeable results in recent years. The trend has progressed, through a series of stages,

* This is uncontrolled, surface runoff, not the discharge from sanitary sewer systems.

** As noted in Chapter 4, one of the types of formal regional organizations was "208 Planning Organizations."

from ignoring any need for pollution control to the federal government's undertaking more and more efforts to clean up the nation's waters. Armed with the responsibility to protect the nation's navigable waters, the 1899 Refuse Act* initially sought to merely control dumping in navigable waterways. The law was (probably unintentionally) loose in its definition of what constituted "dumping," and it wasn't until the 1960s that the 1899 Refuse Act was first used for pollution control (Roalman, 1969).

Recognizing the need for water quality improvement in the post-World War II period, Congress divided the responsibilities for pollution abatement between the states (control responsibility) and the federal government (responsibility for investigations, surveys, and research). The 1948 Water Pollution Control Act is the act which subsequent federal legislation amends. Congress attempted to interest the states in doing the necessary job; if the states failed to do so, the federal government would have to step in. Not that the states necessarily objected to that threat: presumably, if the federal government ended up doing the job, the federal government and not the states would pay for it. On the other hand, the states did not want the federal government to tread too heavily, and the members of Congress did not want to be known for increasing federal regulation. Thus, progress was indeed slow.

Initially, jurisdiction for pollution control rested with the Public Health Service, but the organizations evolved with the several acts (amendments), and the Federal Water Pollution Control Administration, the Federal Water Quality Administration, and the Environmental Protection Agency have all had pollution control responsibilities at one time or another. In fact, many of the current requirements of the law are actually administered by the states, but watched very carefully by the EPA.

Subsequent amendments of the law accomplished the following:

1. Started grants to municipalities for waste treatment plant** and complex enforcement regulations in 1956.
2. Created the Federal Water Pollution Control Administration (later the Federal Water Quality Administration) that strengthened the enforcement procedures, and established ambient ("surrounding" or "receiving waters") standards for certain water quality parameters in 1965.
3. Strengthened or made minor modifications in the general subsidy-and-regulation approach that developed according to Kneese and Schultze (1975).

* This is a popular title for an amendment to the Rivers and Harbors Act of that year.

** Waste treatment plants are officially referred to as publicly owned treatment works, or POTW.

Gradually, the federal government took on more and more of the control job as it became apparent that the states didn't have the technical expertise, money, or the political clout to do the job locally. As new federal standards for receiving waters were added or increased, some states implemented standards that equaled or fell short of (and rarely exceeded) the federal standards.

In 1972, on the crest of the wave of public support and pressure for high-quality water and better control, Congress enacted the Water Pollution Control Amendments (PL 92-500). The legislation was enacted in the midst of a presidential campaign involving pollution control advocates Senator Henry M. Jackson (Chairman of the Interior and Insular Affairs Committee) and Senator Edmund S. Muskie (Chairman of the Public Works Subcommittee on Air and Water Pollution). PL 92-500 innovatively accomplished the following:

1. Set national goals that would eliminate discharge of pollutants into navigable waters by 1985 and set an interim goal that would make waters "fishable and swimmable" by 1983.
2. Changed the covering definition for waters covered by the act from "interstate" to "navigable."
3. Changed the standards from "ambient" to "effluent."
4. Established the best practicable control technology (BPT) standard (by 1977) and the best available technology (BAT) standard (by 1983) for point sources.
5. Established in Section 402 a permitting process, known as NPDES (National Pollutant Discharge Elimination System).
6. Initiated the planning process for areawide waste treatment management (known by its section number, 208) aimed at local plans to control pollution from nonpoint sources, including agriculture, construction, forestry, mining, salt-water intrusion, urban stormwater runoff (construction), and on-land disposal of wastes.
7. Assigned the responsibilities for the administration of the foregoing to the Environmental Protection Agency (created in 1970 from several other agencies).
8. Extended the original provisions of the 1899 Refuse Act insofar as permits for the discharge of dredged or fill material in the nation's navigable waters are concerned and assigned administration to the Corps of Engineers. Particular attention has been given to this section (404) as it pertains to wetlands, especially coastal wetlands and how they relate to lands under various federal and state coastal zone management acts.

The Clean Water Act, as the entire body of law is now known, is a combination of all previous residual legislation and the 1977 amendment to PL 92-500. The 1977 law was the result of the recommendations of the National Water Quality Commission (also known as the "Rockefeller Commission," since Vice President Nelson A. Rockefeller was legislatively designated as chairman in PL 92-500, which mandated the review). It embodied the "mid-course corrections"* on the way to the first national objective in 1983 and initiated the title "Clean Water Act." The Clean Water Act (CWA) also contained many innovative provisions: stiff fines, extension of the 12-mile limit to 200 miles, public participation, better enforcement, toxic waste standards, pre-treatment of toxic wastes before discharge by a generator to a public waste treatment plant, and continued grants to local governments. Interestingly, included in Section 101 is the following statement that relates to the question of legal rights in regard to allocation of water supplies (cf., Chapter 2):

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated, or otherwise impaired by this Act. It is the further policy of Congress that nothing in this Act shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce, and eliminate pollution in concert with programs for managing water resources.

The BPT and BAT standards of PL 92-500 were extended by the 1977 amendments to the Clean Water Act to 1984 and 1987, respectively. While some applications of these standards (and the very attainment of the two national goals) are considered unrealistic, the deadlines remain. On the one hand, the setting of goals with deadlines that are unrealistic seems to be irresponsible. No matter where we put our wastes, for example, they or their by-products end up in the water. Thus, to set a discharge limit of zero is to establish an impossible task. More significantly, waste discharge is one of the basic functions of all aquatic systems (Black, 1996) and regulation in violation of that natural function is definitely inadvisable. On the other hand, not setting deadlines tempts laziness and lack of progress toward the goal. Ultimately, once the goal deadlines have passed, there is absolutely no incentive to make progress toward those goals.

* The phraseology derived from the space age language associated with space craft missions: the easiest corrections could be effected at the gravitational mid-point between the Earth and the Moon, and were referred to as "mid-course corrections."

Kneese and Schultze (1975) maintained that the principal shortfall of PL 92-500, and all the preceding legislation, was the failure to build institutions that effectively implement programs necessary to achieve whatever goals are set. That is not entirely the fault of the act and the federal government; some of the responsibility lies with the states, which were not equipped technologically, fiscally, or organizationally to do the job. A second failure was one of cost. The NWC (1973) estimated that achieving the BAT standard would cost $220 billion between 1972 and 1983, and that controlling the nonpoint urban stormwater runoff could easily cost another $248 billion. Ultimately, the failure to control pollution rests with the public, which must be willing to support it.

The 1972 Water Pollution Control Amendments set forth policy. The several statements of policy in Section 101 pertain to a wide range of resources management. Other sections of the amendments deal with "water and related land resources," planning, and the regulations that govern the vehicle that readily moves between aquatic and terrestrial ecosystems. Water's solubility and mobility are recognized as critical to the dissolution and conveyance of pollutants, nutrients, contaminants, and sediment. Some of these statements of policy are as follows:

- It is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited.
- It is the national policy that federal financial assistance be provided to construct publicly owned waste treatment works.
- It is the national policy that areawide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each state.
- It is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into navigable waters, waters of the contiguous zone, and the oceans.
- It is the policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of states to prevent, reduce, and eliminate pollution, and to plan the development and use (including restoration, preservation, and enhancement) of land and water resources.
- It is the policy of Congress that the states manage the construction grant program under this act and implement the permit programs under Sections 402 and 404 of this act.

The 1972 Water Pollution Control Amendments' policies are like other statements of policy in that the Presidents and the executive branch agencies have variously "followed" the mandates of the act. Where the

Supreme Court has been asked to resolve disputes between Congress and the President with regard to this policy, the court has, by and large, sustained Congress. Note the interlocking use of the words *policy*, *plan*, and *pollution* throughout the act. That observation no doubt prompted Ackerman (1976) to state that "land use regulations … seem to be close at hand and, coupled with the pollution program, lead one to conclude that the status quo of soil and water conservation is in for a change." The status of this observation is included in the discussion of the Natural Resources Conservation Service in Chapter 3 and under "water-based land management" in Chapter 8, and is central to the theme of this chapter.

In an early attempt to confront Congress and to hold federal spending down, President Nixon withheld $18 billion in funds already appropriated by PL 92-500 for waste treatment plants. New York City Mayor Lindsay successfully challenged the President, although Lindsay was unable to sue the President directly and had to go through the administrator of the EPA (*New York City v. Train*, 1974). In another timely decision, the court determined that the definition of "waters of the United States" includes wetlands; that the Corps of Engineers had the right (as stated in the amendments) to require a permit application for dredging and filling, and the right to deny it (*Avoyelles Sportsmen's League v. Alexander*, 1981). The court held that permits under Section 404 were required for vegetation clearing and ditching activities on cleared wetlands (National Wetlands Technical Council, 1981).

As in 1972, but 14 years later, confrontation over passage of an $18 billion extension of the Clean Water Act made front-page headlines, in this case, between President Reagan and Congress. When faced with signing a $16.3 billion water projects bill in November 1986, President Reagan vetoed the 1986 version of the Clean Water Act that had been passed without dissent in both houses of the 99th Congress the same month. The 100th Congress overwhelmingly passed the re-introduced legislation (carefully identified as "H.R. 1"), and then convincingly overrode the President's second veto as well. When finally enacted, the bill became referred to as the 1987 amendments to the Clean Water Act.

A major inclusion in the 1987 amendments was the addition of §319 that provided a 4-year expenditure of $400 million for nonpoint source pollution (as it had by then come to be known) control plans and aid to the states. Funding for that popular and effective program has continued, and much of the federal assistance to the states for implementation of Best Management Practices* (BMPs) to clean up nonpoint sources of pollution is now funneled

* The concept of the term derives from the use of the word "best" in the original version of the Clean Water Act to define "Best Available Control Technology" and "Best Practicable Control Technology," the so-called BCT and BAT standards that were applicable to point sources of pollution.

through this important section. The funds are widely referred to as "Section 319 funds." States (by counties or in-state regions) must establish Priority Water Problem Lists (PWPL or simply PWL) that reflect problems and vulnerable water bodies, and must regularly report on progress toward meeting cleanup goals. In the absence of such documentation, or by submission of an unacceptable report identifying degraded water quality, §319 funds may be cut off. Thus, this provides the first incentive-based step of regulating nonpoint source pollution control. New York — among other states — has assessed the state's water resources in terms of the water body's best usage and "maintains information regarding how well specific individual waterbodies support these best uses and, where they do not, the degree of *use impairment*" (Myers, 2000) [emphasis in the original].

Reauthorization of the Clean Water Act — the Continuing Congressional Controversy over Water Resources Policy

The Clean Water Act

As noted in preceding sections, the Clean Water Act is the principal federal statute (33 USC §1251 *et seq.*) that governs pollution in the nation's lakes, rivers, streams, and coastal waters. Originally enacted in 1948, the Act was significantly revised in 1972 (PL 92-500), 1977 (PL 95-217), 1981 (PL 97-117), and was last amended in 1987 (PL 100-4). These amendments are now being implemented by states, cities, the federal government, and regulated industries.

Since 1972, implementation of the law and application of pollution abatement technology by industries and municipalities has led to significant water quality improvements. About 60 percent of waters surveyed by states are clean enough to support basic uses such as swimming and fishing; however, approximately 40 percent of the nation's surface waters fail to meet the "fishable, swimmable" goal stated in the 1972 amendments (Copeland, 1998). Additionally, a great deal of progress has been made in controlling so-called "conventional pollutants" (e.g., bacteria, biodegradable oxygen-consuming organic wastes, suspended solids). Almost 75 percent of assessed waters comply with water quality standards for these pollutants. Success at controlling discharges of key toxic pollutants (inorganic and organic chemicals and heavy metals), which are more insidious and may cause adverse environmental and human health effects; even when present in minute amounts in the environment, has been mixed at best (Copeland, 1999).

The act is comprised of three major components. First, there are regulations that impose stringent requirements on industries and municipalities to abate water pollution in order to achieve the statutory goal of zero discharge of pollutants (33 USC §1251). Second, there are provisions that authorize federal financial assistance for municipal wastewater treatment plant construction (§1281). Third, there is a prohibition against discharge of "dredged or fill" material into navigable waters (§1344). The primary provisions of the act are supported by research activities, and include permit and enforcement provisions. In the past, Congressional efforts to amend the CWA have dealt with all aspects of the law, with the objective of strengthening water quality programs (Copeland, 1999).

Authorizations for appropriations for the most current water quality programs expired on September 30, 1990, but Congress has continued to appropriate funds to carry out the act, as needed on an *ad hoc* basis. The CWA has been viewed as one of the more successful environmental laws in terms of achieving its statutory goals. Lately, however, it has been criticized on a number of fronts, such as whether the benefits of cleaner water have been worth the costs, and, in particular, whether the environmental benefits of future changes that would strengthen the law will be worth the economic costs (Copeland, 1998). Such criticisms have come from private industry, which has been the long-standing focus of the act's regulatory requirements to control point sources and which opposes imposition of additional stringent and costly program requirements. Criticism of the CWA has also come from the development community and private property rights groups who contend that the act's wetlands permit program, administered by the U.S. Army Corps of Engineers (the §404 program), is a costly and burdensome intrusion on private land ownership and land-use decisions. Most municipalities have supported water quality programs and favored reauthorization in order to obtain funding to carry out the law, but have opposed CWA measures that might impose new unfunded mandates on local governments (Zinn and Copeland, 1999).

H.R. 961 — Legislative Action in the 104th Congress

Following enactment of the 1987 amendments, no major CWA legislative activity occurred until the 104th Congress, when the Clean Water Act was one of the first environmental statutes to receive attention in 1995. A subcommittee of the House of Representative's Committee on Transportation and Infrastructure began oversight hearings on clean water issues in February 1995, and concluded hearings in early March 1995. Committee Chair, Bud Schuster (R-PA), introduced a comprehensive CWA reauthorization bill which was approved by the full House of Representatives on May 16, 1995 (subject to revisions based on testimony and received comments). H.R. 961, as the bill was known, reflected conservative efforts to make the act more flexible and to address regulatory relief issues raised by municipalities, industries, and private property groups, who had criticized what they viewed as excessive and proscriptive regulation.

Although supported by industry, state, and local governmental groups, H.R. 961 was strongly opposed by the environmental community and the Clinton Administration. The controversy surrounding the bill centered on two key issues: (1) the revised §404 wetland permit program and provisions regarding wastewater funding, and (2) the administration of the State Water Pollution Control Revolving Funds, or state loan programs (SRFs) that replaced the old categorical grant programs from PL 92-500. H.R. 961 proposed to establish a three-tiered classification system for wetlands according to their ecological significance and function, ranging from type A (the most environmentally valuable and receiving the most protection) to type C (the least valuable), and regulating them accordingly. The wetland scientific community opposed such a classification scheme as being overly rigid and felt it would not adequately take into account the variation in size and diversity of function of wetlands, and that it would exclude a great deal of wetland acreage from federal protection. The CWA's §404 program has been a flashpoint of controversy to the private property rights movement, as an estimated 75 percent of wetlands in the U.S. are located on private land. H.R. 961 provided for federal government compensation to private wetland landowners, if a federal agency action under §404 diminished the fair market value of their property by 20 percent or more. If the reduction to the landowner in value was 50 percent or more, the bill required the government to purchase the affected portion of the property (Copeland, 1995).

While H.R. 961 did pass the House, President Clinton indicated his intent to veto the bill, had it reached his desk (Copeland, 1999). The Senate did not consider CWA reauthorization legislation in the 104th Congress and no Senate hearings were held on H.R. 961.

Future Prospects

As of late 1999, neither the House nor the Senate had scheduled any significant legislative activity on the CWA, and no major reauthorization bills had been introduced in Congress. Prospects for reauthorization of the CWA remain uncertain in the 106th Congress and legislation may not be enacted until well after the presidential election in November 2000. EPA Administrator Carol Browner has been quoted in several press reports as indicating that the agency will not be proposing any major, new environmental legislation (thus relying on compliance and regulatory advances under existing law) for fear that the Republican-held Congress and subsequent Congressional action would weaken the Clinton Administration's principles for protecting water supplies and wetlands (Copeland, 1999). As has been the case for several years, the reauthorization effort for the CWA faces significant challenges that are financial, political, programmatic, and substantive. Thorny issues that might be addressed during reauthorization are not, for the most part, easily amenable to straightforward consensus solutions among conflicting legislators. Many issues involve making difficult trade-offs between impacts on different sectors of the economy, taking action where there may be considerable technical or scientific uncertainty about what constitutes the "best" solution to a given water quality problem, or trying to resolve which level of government should assume responsibility for implementing certain provisions of the law. If clean water issues receive any attention in the 106th Congress, those of interest in any reauthorization attempt will include managing animal wastes to minimize water quality problems (CAFOs), additional measures to preclude nonpoint source runoff from agricultural and urban environments (see Permits section of this chapter), private property rights, and the §404 wetlands permitting program. Also to be included will be total maximum daily loads (TMDLs), state water quality standards, and uncertain funding mechanisms for the construction of municipal wastewater treatment plants (Copeland, 1998).

Thus, there has been an 8-year hold on the anticipated 1992 reauthorization of the CWA. The delay has been caused by: (1) lack of agreement among specialists as to the impact of changing the definition of "wetlands," which are the subject of §404 permits, (2) disagreement among responsible parties as to the interactions between the CWA and the Endangered Species Act, and (3) lack of agreement between the President and the majority in Congress. In response to the need for clean water without the benefit of formal extension of the CWA, the Clinton Administration issued its Clean Water Action Plan.

Water Resource Policy Initiatives in the Clinton Administration

Progress Since 1972

Over the past quarter century, since the passage of the 1972 amendments to the Federal Water Pollution Control Act (PL 92-500), the U.S. has made significant progress in cleaning up its rivers, lakes, streams, reservoirs, coastal estuaries, and other water bodies. Throughout much of the 1960s and into the early 1970s, Lake Erie was considered to be "ecologically dead" by many environmental activists, and beyond any attempt at restoration. The Potomac River, a major recreational waterway in close proximity to the nation's capital, was considered too filthy for swimming or other contact recreation. Ohio's Cuyahoga River was so polluted it burst into flames and "burned" for several hours. Many rivers and beaches were little more than open sewers throughout the late 1960s (Environmental Protection Agency, 1999). The subsequent improvement in the health of the nation's waters has been a direct result of a coordinated effort to implement water resource protection measures through federal, state, and local laws, considerable public spending on water pollution abatement and water treatment facilities, and an enhanced national policy of stewardship of the nation's water resources.

Despite tremendous progress in water pollution abatement over the past three decades, 40 percent of the nation's waterways assessed by the states are still unsafe for fishing and swimming (Environmental Protection Agency, 1998). Aggregate water pollution from municipal sewage plants, point source industrial discharges, soil erosion, and forestry operations has been dramatically reduced. However, urban runoff from city streets, agricultural runoff from rural areas, polluted irrigation water, stormwater discharges, and contaminated wells continue to degrade the environment and put potable drinking water at risk from insidious pathogens such as fecal coliform bacteria, *Cryptosporidium* and *Giardia*. Additionally, surface and groundwater supplies are also under assault from more conventional contaminants including nitrates, phosphorus, increased salinity, and industrial compounds. Fish populations in many waters still contain dangerous levels of polychlorinated biphenyls (PCBs), mercury, and other toxic contaminants (Environmental Protection Agency, 1999).

Clean Water at the Crossroads

After over 25 years of progress, the country's policies and programs for clean water are at an important, historical crossroads. Further implementation of existing water policies and programs may not necessarily improve public health or preclude new or ongoing threats to the environmental integrity of our nation's waterways. Current programs often lack the strength, focus, proper institutional framework or structure, and (all too often) the fiscal resources to adequately complete the unfinished task of restoring and conserving rivers, lakes, streams, coastal areas, and other degraded water bodies. To fulfill the original goal of the Clean Water Act (PL 92-500's "fishable and swimmable water for every American"), the Clinton Administration in early 1998 embarked upon a bold, new policy and program initiative in water resources conservation, focusing on watersheds, to revitalize the nation's historical commitment to protecting our precious water resources.

The Clean Water Action Plan

In his 1998 State of the Union Address, President Clinton announced a major, new "Clean Water Initiative" to speed the restoration, mitigation, and protection of the nation's invaluable water resources. This federal initiative attempts to provide for cleaner water resources on a national basis by providing state, local, and tribal communities with additional resources to combat polluted runoff and enhance resource stewardship efforts by strengthening public health programs, and by targeting community-based watershed protection efforts at so-called "high priority" areas.

To commemorate the 25th anniversary of the Clean Water Act, Vice President Gore directed the Department of Agriculture and the Environmental Protection Agency to work with seven other federal agencies* and state, tribal, and local partners to develop and implement a comprehensive water resources "Action Plan" to meet the promise of clean water for all Americans in the 21st century. This *Clean Water Action Plan* forms the basis of the Clinton Administration's Clean Water Initiative, in which President Clinton proposed spending $2.3 billion over 5 years on some 111 key "actions" designed to address the critical water quality issues and problems facing our watersheds. Congress, however, in fiscal year (FY) 1999, only funded $171 million for the Action Plan, one-third of the President's requested amount of $568 million (Environmental Protection Agency, 1999). In implementing this Action Plan the federal government is committed to:

- Support locally led partnerships that include a broad array of federal agencies, states, tribes, communities, private sector businesses, and individual citizens and stakeholders coming together in a nonregulatory partnership approach to meet clean water and public health goals.
- Increase financial and technical assistance to state and local governments, tribal governments, farmers, and others.
- Help states, tribes, and local governments restore and sustain the health of aquatic systems on a watershed basis.

Action Plan Tools for Clean Water

The Action Plan envisions a new, collaborative effort by federal, state, local, private, and tribal actors and the public to restore and maintain the health of the nation's water that builds on the success of the Clean Water Act.

* These agencies are the Department of the Interior, Department of Defense, including the Army Corps of Engineers, Department of Commerce, Tennessee Valley Authority, Department of Energy, and the Department of Justice.

Regulation, economic incentives, technical assistance, research, education, and accurate monitoring information are the "policy levers" to be used in meeting clean water goals for the future. The Action Plan is built around four important tools or approaches to clean up and maintain the health of the nation's waters.

1. **A Watershed Approach.** Working collaboratively at the watershed level encourages the public and other water stakeholders to get involved in restoration efforts and is the foundation for building strong partnerships in protecting water supplies on a regional basis. As political and ecological boundaries rarely coincide, the watershed is a natural focal point in identifying both point and nonpoint sources of pollution, protecting potable water sources, conserving wetlands, and setting priorities for ecosystem restoration efforts. The Action Plan calls for a national coordinated assessment of watershed conditions and statement of priorities (Unified Watershed Assessments) to develop lists of impaired water bodies; define source water protection areas; identify priority areas for agricultural protection programs and coastal priority programs; and target key critical areas for watershed restoration and protection efforts.
2. **Stronger Federal and State Standards.** The plan also calls for federal, state, local, and tribal actors to revise water quality standards where needed, to make existing programs more effective. This is to be done through expanding control of urban stormwater runoff, defining nutrient reduction goals, reducing pollution from animal feeding operations, ensuring safer beaches, and improving standards for fish and shellfish consumption.
3. **Natural Resource Stewardship.** The plan calls on federal, state and local conservation agencies to apply their collective resources and technical expertise to state and local watershed restoration and protection efforts. These include greater efforts at land stewardship, for example, increased riparian and stream buffer protection, decommissioning federal roads and trails, and restoring abandoned mine sites; protecting and restoring diminishing wetlands, by achieving a net increase of 100,000 acres of wetlands per year by the year 2005; affording more protection to coastal waters; and providing additional incentives for private land stewardship.
4. **Informed Citizens and Public Officials.** Effective public management of water resources requires reliable scientific information and data for the public and other decision makers. The Action Plan calls for all federal agencies, led by the Geological Survey, to work with states, tribes, and local entities to improve monitoring and assessment of water quality, nutrient loading, and related

improvements. Greater effort will be made to utilize EPA's Index of Watershed Indicators (and other data bases) on the Internet that describes watershed programs and the health of more than 2,000 watersheds throughout the U.S. This database* may be used to communicate meaningful information to the public about water quality problems in their communities or respective watersheds (Environmental Protection Agency, 1999).

Key Elements

The Clinton Administration's Clean Water Action Plan proposed a watershed approach to water policy that was built on several key elements:

Unified Watershed Assessments. States, tribes, and federal agencies would be encouraged to take the lead in developing lists of impaired water bodies and defining source water protection areas for drinking water. They would also be involved in identifying coastal water protection priorities and defining priority areas for agricultural assistance programs. Unified watershed assessments are the vehicle to identify:

- Threatened watersheds that need an extra layer of protection effort.
- Pristine or sensitive watersheds on federal lands where core federal and state programs can be merged to prevent degradation of water quality.
- Watersheds that were targeted to receive significant, new fiscal resources from the President's FY 1999 budget and beyond — to clean up waters not currently meeting water quality standards.

Water Restoration and Action Strategies. The Action Plan encourages state, tribal, and local entities to work aggressively with federal land management agencies toward restoring watersheds not currently meeting clean water and natural resource goals. Restoration Action Strategies focus on the most important causes of pollution and degradation, detail the actions all parties need to take to solve the problem, and set targeted milestones by which to measure progress.

Watershed Pollution Prevention. Taking preventative action to protect pristine or sensitive waters in the watershed *before* clean water can be threatened with new activities or degradation may be the best and most cost-effective approach to meeting clean water goals. The Action Plan encourages the identification of pollution

* This database, http://www.epa.gov/OWOW/watershed, was accessed on 3/20/00.

sources in the watershed before receiving waters are adversely impacted.

Watershed Assistance Grants. The Action Plan also provides for small financial grants from federal agencies to local conservation organizations that want to take a leadership role in building local, grassroots efforts and working coalitions to restore and protect watersheds. These grants are designed to ensure the inclusion of local community interests and stakeholders in the process of setting goals, setting program objectives, and devising solutions to restore their watersheds. Financial assistance on the local level is another mechanism to ensure that effective watershed conservation is a "bottom up" and not a "top down" mandated process.

Key Principles

Essentially, the Clinton Administration's Clean Water Plan contains 10 key principles to guide watershed conservation efforts in the decades to come:

1. **Strong Clean Water Standards.** These standards encourage all levels of government to strengthen existing programs to attack water quality problems through a renewed adherence to discharge and ambient water quality standards.
2. **Clean Water, Healthy People.** Employing a watershed framework to link clean water and safe drinking water programs reduces the negative impacts of water borne pathogens such as *Cryptosporidium*, *Giardia*, and *Pfiesteria*.
3. **Watershed Management: The Key to the Future.** Watershed Management makes the transition from water conservation for a single purpose (e.g., water supply, safe drinking water, nonpoint source pollution control, wetlands conservation) to coordinating all programmatic aspects of water quantity and quality issues on a watershed geographic basis involving the grassroots, "bottom up" partnership approach.
4. **Watershed Restoration for those Watersheds not Meeting Clean Water Act Goals.** In the early 1970s water pollution seemed to be a ubiquitous problem. Today, serious pollution problems remain, but most water quality problems are found in discrete problem areas or clusters (e.g., in rural areas with agricultural nonpoint problems, along industrial basins, in areas with heavily irrigated agriculture). Improved monitoring, computer mapping, and GIS "geo-referencing" of polluted waters is making identification of water quality problem areas much easier than in the past. The EPA is working with

governmental entities to identify these problem areas and watersheds that do not meet clean water goals.

5. **Building Bridges Between Water Quality and Natural Resource Programs.** Much of the focus of the nation's clean water program over the last several years has been the attempt to reduce chemical contamination of water. Chemical contamination, however, is just one of several parameters in the Clean Water Act's charge to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." As the clean water program moves to address water issues on a watershed basis, other serious impairments to aquatic systems (e.g., stream corridor destruction, wetland losses, and damage to fish habitat) have become of greater concern. Natural resources such as forests, wetlands, croplands, rangelands, and riparian areas are the building blocks of most of the nation's watersheds. Stewardship of these key areas is an important first step in clean water protection efforts.
6. **Responding to Growth Pressures on Sensitive Coastal Resources.** In the early years of federal involvement in water pollution abatement, little effort was made to protect coastal waters or sensitive estuaries. Over the last two decades, however, with the passage of the Coastal Zone Management Act and a shift of the nation's population to coastal areas and sharp growth rates in coastal communities (Environmental Protection Agency, 1999), there is a renewed understanding that coastal estuarine waters play a vital role in flooding, aquatic fish production, recreation, and estuarine habitat. The Action Plan provides for a stepped up effort to protect coastal waters and to prepare for the changes that will occur in coastal areas subject to greater population pressures.
7. **Preventing Polluted Runoff.** After a quarter century of water pollution management, many of the most serious industrial and municipal point source or "end-of-pipe" discharges have been addressed. The most serious remaining water pollution problems tend to be nonpoint source runoff from urban stormwater and agricultural lands such as animal feeding operations. A hallmark of the Action Plan is a renewed effort to prevent polluted runoff through better control of nonpoint source pollution.
8. **Better Stewardship of Federal Lands.** The federal government manages land and related water resources that cover over 800 million acres and include many of the nation's most valuable water resources (Environmental Protection Agency, 1999). In many watersheds, these lands are important headwaters of streams and rivers, and are valued fisheries and sources of recreation and water supply. Past federal land management has greatly contributed to significant watershed

restoration and protection efforts throughout the nation (e.g., the Northwest Forest Plan and Columbia River Ecosystem Assessment, the Tennessee Valley Authority's Clean Water Initiative, and protection of the Everglades). The Action Plan encourages additional federal stewardship of federal lands and water-related resources.

9. **Improving Water Information and the Citizens' Right to Know.** As the nation moves toward a watershed approach to clean water, good information about the condition of water and the health of aquatic systems is an absolute necessity. Better information and data can be incorporated through citizen-monitoring programs to empower citizens to get involved in restoring and protecting water supplies. The Action Plan calls for a series of citizen-monitoring initiatives focused under the leadership of the National Council on Water Quality Monitoring, recently established by the Department of the Interior (Environmental Protection Agency, 1999).
10. **Ensure Compliance and to Protect All Citizens Fairly.** Full and fair implementation of clean water programs requires strong compliance and enforcement efforts and a commitment to protect all citizens equally. As President Clinton said in his presentation of the Clean Water Plan in May 1995, "Americans have stood as one in saying 'no' to things like dirty water, and 'yes' to giving our children an environment as unspoiled as their hopes and dreams" (Environmental Protection Agency, 1999). The Action Plan provides for a strengthened federal role in sharing better information with minorities, and in considering environmental justice concerns when setting priorities for the restoration of waters and watersheds, when allocating federal funds earmarked for pollution abatement.

Summary

Control over management activities related to land and many natural resources cannot, by and large, be attained in this country by direct legislation or by long-range, comprehensive planning. The only viable way in which to maintain a healthful, livable, enjoyable environment for the benefit of future generations as well as for ourselves is through control over water quality.

Policy, planning, and pollution control come together in PL 92-500, as do the water and related land resources, after a long journey from the 1911 Weeks Forest Purchase Act. Additional trends are:

1. A shift from single-purpose to multi-purpose projects, to comprehensive planning, to multi-objective planning, to no planning.

2. A shift toward including aesthetic and other nonmarket-valued benefits in project and program evaluation.
3. A gradual shift from minimum federal water quality control to maximum state and local control.
4. An assumption of a greater fiscal burden by state and local governments.
5. A consolidation of nearly all the research, standard-setting, monitoring, and enforcement into one agency, the EPA.
6. Increasing restrictive standards, strict enforcement, and, overall, greater control over water quality.

There is a generally acknowledged trend that at least some of the waters of the U.S. are cleaner than they used to be. Rogers (1993) states

> For the first time in its existence, the country has reversed the trend of ever-increasing water consumption. Total water use has declined since 1980 and per capita use is now less than it was in 1965. … But, even at these reduced levels, the U.S. still uses more than twice as much water per capita as any other country in the world. … Over the past 25 years gross water pollution due to municipal and industrial discharges into the nation's waterways has also declined, although the accompanying toxic chemical contamination has not decreased as much, and nonpoint source pollution has become the major source of contaminants.

But the CWA still has not officially been reauthorized. It is still in operation and functions effectively, albeit not without controversy. A strong Clean Water Action Plan completes the current picture of the nation's progress over control of point and nonpoint sources of pollution. Since most of the point sources have indeed been cleaned up, attention has now turned to the nonpoint sources and, since they are intimately and by definition associated with land use, there is the covert question, "How many land use controls are going to be required to effect clean-up of diffussed runoff?"

Programs

Land use regulation to control water quality is no longer just around the corner. Numerous incentive-based programs relating land and water resources and are currently in effect. Some more stringent approaches also exist. Land use regulation to control water resources was actually predicted a half-century ago, and incentives that can achieve the same goals of stricter regulatory programs have existed for more than a decade. Incentive-based policies are working, ramified in federal, state, and local programs, so there is good reason to be optimistic about their success. But there is also reason to be apprehensive about their continued success. An appropriate question is, "What can we do if the incentive-based policies and follow-up implementation plans fail?"

This section explores:

1. Some recent developments in incentive-based approaches.
2. What these limitations are and why they might not achieve universal success.
3. Some thoughts on the challenges to and the opportunities for watershed managers and the public.

Its purpose is to lay the groundwork to provoke some discussion and consider some alternatives that might be needed to meet future goals.

History of Incentive-Based Water Programs

Based on the 19th century flooding that resulted from deforestation throughout the eastern states (see Chapter 1) and on consequent research at Wagon Wheel Gap by the Forest Service and the Weather Bureau, Congress enacted the Weeks Forest Purchase Act in 1911. This landmark legislation enabled the federal government to get into the forest management business "in order to control runoff to navigable streams." It was later extended to include the lands of the western states in the Clarke-McNary Act in 1924. Much of the ensuing activity in watershed management was directed at hydrologic processes, but over the past quarter century major attention in this discipline has been directed at water quality management.

Earlier

In the 1940s, the Assistant Chief of the U.S. Forest Service, Ed Munns, is reported to have said, "Land use regulation, if it ever comes about, will be to control water." He implied the thought in his 1945 *Journal of Forestry* article entitled "Watershed Flood Control: Performance and Possibilities," which he co-authored with Bernard Frank, where he pointed out:

> Because most land is in private ownership and upstream owners seldom participate in benefits accruing downstream, full consideration must be given to their economic interests so their participation in a program may be readily obtained.

The authors focused on the economic issues surrounding flood and sediment control, the principal objectives of the 1936 Omnibus Flood Control Act. In so doing, they cited a 1940 Forest Service survey of state and local watershed lands used for water supply purposes, which maintains that both "voluntary transactions and court condemnation proceedings" of "nuisance" values "reveal that the necessity for safeguarding water supplies is often great enough to warrant expenditures over and above those warranted by purely financial considerations alone."

Further on in the same section, Munns and Frank continued:

> Public ownership is therefore recognized as the most effective, if not the only, guarantee that the money spent for installing a program in such areas will not be lost through subsequent failure to protect and especially to maintain the measures year in and year out.

Whether Munns uttered the phrase or not, the implication was clear. And over the past 50 years, several legal methods have been employed more frequently to exercise control over land use, including zoning, purchase of easements for rights of way and conservation, and outright condemnation. More recently, there have been numerous attempts at achieving water quality control* by incentive programs.

Recently

Three particularly important pieces of mid-1980s legislation explicitly provided incentives for land use regulation to control water quality. First, in 1985, the Food Security Act (PL 99-198, 99 Stat. 1354, 16 USC 3801 *et seq.*) included the "swampbuster" and "sodbuster" clauses that would stop all payments to farmers should new, highly erodible lands or wetlands be brought into production. Second, the 1986 amendments to the Safe Drinking Water Act (42 USC 300) mandated protection plans for public wellheads with loss of federal planning funds if such protection plans were not in force. Finally, in 1987, the amendments to the Clean Water Act (33 USC 466) provided planning funds for control of nonpoint sources of pollution if the state filed cleanup plans and reports based on the Priority Water Problems List,** and showed continued progress toward their cleanup goals.

* Note that horizons from flood and sediment control have been extended to water quality control in general. This is quite proper, since the primary concern over water quality prior to the 1972 Water Pollution Control Amendments (33 USC 66) was sediment. Many of the other pollutants could not be readily seen (aside from sudsing phosphorus) and, until color photographs in *LIFE* magazine and color television were commonplace, water pollution was not a common topic of conversation.

** This is now often referred to as the "PWP list."

One must add to this rapidly expanding list of legislation the extensive programs of the Natural Resources Conservation Service (NRCS) and the Farm Services Agency (FSA), a wide variety of incentive options that are now being developed and used. Often referred to in a politically derogative tone as “unfunded mandates,” these programs include the Conservation Reserve Program (CRP) (16 USC 3831-3836), a broad program most recently authorized by the Food Security Act of 1985. The CRP was originally created in the 1930s and is widely known, through its second incarnation, as the 1956 Soil Bank Act (74 Stat. 188). The purpose of the CRP is “to cost effectively assist owners and operators in conserving and improving soil, water, and wildlife resources by converting highly erodible and other environmentally sensitive acreage normally devoted to the production of agricultural commodities to a long term vegetative cover.”

Other related programs include:

- Environmental Quality Incentive Program (EQIP), authorized by the 1996 Farm Bill amendment to the Food Security Act of 1985 (16 USC 3839aa-3839aa-7).
- Forestry Incentive Program (FIP), authorized by the Food Security Act of 1985 (99 Stat. 1354).
- Wetlands Reserve Program (WRP), authorized by the Food Security Act of 1985 (16 USC 3837-3837f).
- Wildlife Habitat Incentive Program (WHIP), authorized by the Federal Agricultural Improvement and Reform Act (FAIR) of 1996 (PL 104-127 and 7 CFR Part 636).
- Conservation Reserve Enhancement Program (CREP), authorized in Title XII of the Food Security Act, which seeks to enroll 95,000 acres of hydrologically sensitive riparian lands, about half of which would be enhanced for water quality protection, by designation as riparian buffers or treatment as filter strips and/or grass waterways.

Several of these programs seek to retire — or for short periods remove — from agriculture lands acres that are inappropriately suited to that purpose or might be better used for other land use products or services.

The common operational threads among all these programs involve

1. Administration by the NRCS and/or FSA.
2. Control over lands that contribute to nonpoint sources of pollution.
3. Federal and/or state monies to assist in purchase of easements, removal from production, or development and/or implementation of plans and/or BMPs that include major planning activities.

In all cases, and including §319 funding (Clean Water Act, 43 USC 1251 *et seq.*) water quality improvements are given preference where the impaired water body is on the county's PWP list or within the basins that have been designated as high priority watersheds. In New York the lists were prepared by the County Water Quality Coordinating Committee under the leadership of the S&WCC and the local soil and water conservation districts, the latter by consensus in the NRCS State Technical Committee. The coordination was according to the umbrella agreement between the state and EPA in accordance with §319 of the Clean Water Act. The same approach applies where state funds are granted under the Clean Air – Chyphen Clean Water Environmental Bond Act (EBA) and/or the Environmental Protection Fund (EPF), and the Agricultural Environmental Management (AEM) program. This program of "concepts, partnerships, and materials … grew from many sources, including the watershed projects … and the national Farm*A*Syst program" (New York State Soil and Water Conservation Committee, 1998). It is now being formalized in proposed legislation (2000 Legislative Proposal #2RR).

Currently: The New York City Situation

New York City most recently has committed millions of dollars to effect incentive-based policies that actually go beyond incentives into the realm of land use regulation and control.* These funds are being used to compensate private land operators, towns, villages, and counties that are within the 2,000-square-mile municipal water supply watersheds of the Catskill Mountains for expenses or loss of income resulting from water quality control measures. Thus, the city's Department of Environmental Protection is currently:

1. Purchasing easements, especially along stream rights-of-way.
2. Paying rent to farmers to compensate for loss of agricultural crop income in order to develop buffer strips in hydrologically sensitive areas (especially riparian zones and the variable source area).
3. Helping to pay for implementation of Best Management Practices (BMPs).
4. Purchasing hydrologically sensitive watershed areas.

* This was done through the Watershed Memorandum of Agreement (MOA) of January 21, 1997, signed by New York State Department of Environmental Conservation, New York City Department of Environmental Protection, U.S. Environmental Protection Agency, and the Hudson Riverkeeper.

These measures are all being planned and implemented in order to ensure — and restore — the city's high quality water supply. These funds will be used in a variety of productive ways that include demonstration farms and practices, educational programs, waste treatment facilities, and whole farm plans on critical watershed lands that are tied to the farm business plans whereby economic and environmental concerns can be jointly managed. In sum, the city is willing to participate as a partner in incentive programs where some funding is available from other sources in addition to hoping to stave off excessive expenditures for filtration.

This all came about because in 1990, the New York City Department of Environmental Protection (DEP) sought to unilaterally upgrade its long-standing Watershed Rules and Regulations governing land use in the 2,000-square-mile Catskill watersheds from which more than 10 million people get their water supply. The proposed rules were not realistic in terms of continuing reasonably profitable farmland use in the Catskills. The action was largely in response to EPA pressure on the city to filter the water supply (at no small cost) as an alternative. In addition, the 1922 watershed rules and regulations had not been changed since 1953; new information about land and water management practices was available, and its implementation was advisable. About a year previously, a statewide Joint Legislative Commission on Rural Resources organized a facilitated workshop concerning the New York City watersheds for all interested groups and individuals at a Catskill retreat. The DEP action stopped the Joint Commission's efforts cold. Reactive opposition by disgruntled landowners suggested the need for coordinated technical assistance from the districts. As the districts' policy coordinator, the S&WCC was called upon for oversight as well as for moral support.

The city's DEP withdrew its proposed rules when the S&WCC and the DEP successfully negotiated a creative watershed management approach that involves New York City, the state, five counties on the watershed, and the landowners. The program, paid for by DEP, involves a two-phase, 10-year Watershed Agricultural Program that will lead to better management on the Catskill watersheds. It caps a decade-long growth in the number of personnel and in the breadth of their disciplines (Janus, 1996).

The program was executed by two Memorandums of Understanding (MOUs). The first, between the S&WCC and the DEP, is a document that establishes the coordination and fiscal management roles of the S&WCC on behalf of the DEP. The second, between the S&WCC on one hand and the SCS, Cornell Cooperative Extension, and the Delaware County S&WCD on the other, administers operations, technical support, education and training programs, and disbursement of operational funds. The DEP is neither involved in the technical micro-management of BMPs nor in the process necessary to establish, maintain, and evaluate them; it is concerned only with results. This structure makes it possible to monitor water quality holistically, in its natural setting, where management of all important water quality constituents *in toto* is preferred to traditional, provincial, and single-substance testing schedules (Wilcher, 1992).

The first agreement provided for a Phase I Agricultural Program that, upon its completion by September 20, 1994, included 10 pilot farms. Phase II is being implemented with a target of 85 percent participation of the farm communities; it includes establishment of a Watershed Agricultural Council and technical support teams that will develop: (1) 10 demonstration farms and forests to show Whole Farm Planning and BMPs, (2) education and training manuals, and (3) education regarding technical and procedural aspects of the program. This represents a $35.2 million investment by the city. Protection of riparian zones and development, and planning and implementation of BMPs in the context of the watershed and in relation to other measures, are likely to be cost-effective as well as practical. It is also an approach recommended by the 1991 report of the Forum of Scientists of the Environmental Protection Agency. The three-legged stool approach to water quality control: (1) pollution prevention, (2) collective responsibility; and (3) watershed planning and management, is recommended by Water Quality 2000 and certainly is evident in this example (Water Quality 2000 Steering Committee, 1992).

DEP Commissioner Appleton, at the official signing meeting on July 20, 1992, chose this integrated, wide-ranging, and complex watershed management approach over a straight regulatory program as "an investment," with "a lot of hope." The overall objective was to preserve the economic integrity of the farms of the region while implementing enhanced regulations that would lead to higher quality water and better control over nonpoint sources of pollution throughout the region. Intent counts strongly for negotiated agreements, and in this case provides the positive insurance the entire operation needs to succeed. Subsequent commissioners have enthusiastically followed through with the program.

Whether a state authority could solve the city's water quality problems on the Catskill watersheds is problematic; neither city nor watershed residents would be likely to tolerate the top-down authority. Both the EPA and the State Department of Health have the authority, but they are reluctant to alienate the millions of people who would be affected if they, the EPA and the Department of Health, strong-armed the construction of the filtration plant. The Joint Legislative Commission on Rural Resources does not have the authority to resolve the issues either, although that organization provided the impartial arena for the initial communication among individuals and organizations that were ultimately involved in the current approach, albeit with different allegiances. Resolution of the issue could not be peacefully accomplished by the DEP, either, owing to lack of support from watershed residents. Finally, the state's EBA and EPF funds are not sufficient to underwrite the watershed protection programs (without protest from the rest of the state), much less filtration plant construction. Thus, the programs are being directed to the lands of the Catskill watersheds as they are, in part preserved by the state and in part developed and used by speculators, landowners, and the city, all of whom accept the indirect approach. It has all the trappings of a grass-roots partnership (Black, 2000), and it's working.

As the initial 2-year, $35.2 million program ended, the DEP negotiated an additional $260 million settlement with individuals and town, village, and county governments.* To broaden the watershed management activity in New York beyond the New York City and Syracuse watershed boundaries and to simultaneously address water quality problems in statewide PWP list water bodies, the New York State Department of Environmental Conservation issued several useful publications. These include the *Best Management Practices Manual* (1992-6), *A Guide to the Selection of Best Management Practices to Improve and Protect Water Quality* (1991), and the *Watershed Planning Handbook for the Control of Nonpoint Source Pollution* (1996). These and other publications have been prepared in cooperation with the state committee, soil and water conservation districts, NRCS, Cornell Cooperative Extension, other state departments, and various municipalities and individuals. Numerous responsible organizations have also provided support through their newsletters and pamphlets. The NRCS incentive programs described in Chapter 3 add to the widespread use of this approach to nonpoint source pollution control.

Here, then, in the 2,000-square-mile Catskill mountain watersheds for the city of New York, incentive programs are being employed to ensure high quality water for a population of over 9 million. As noted in Chapter 5, the apparent grass roots partnership is in fact constrained — even defined — by economics, geography, human health, law, and performance criteria imposed by EPA.

Land use regulation to control water quality is already here.

* This was a notice of "conceptual settlement proposal covering all issues related to New York City's watershed" between the Executive Committee of the Coalition of Watershed Towns and the city (Daniel A. Ruzow, Whiteman Osterman and Hanna, One Commerce Plaza, Albany, NY 12260, November 1, 1995). Actual dollar figures reported herein may not match precisely with other references, owing to changes from time of proposal of agreement to binding document.

Limitations of Incentive-Based Approaches

It is relatively easy to be optimistic about the success of incentive programs to minimize the occurrence of sediment and nutrients in agricultural runoff. The responsibility to control pathogens and contaminants weighs somewhat heavier on practitioners and regulators, owing to the severity of the consequences. It is also realistic to expect that population increases will result in development of new organisms, new carriers thereof, and new and more extensive sensitivities to old reactions. Further, with the potential for more extensive and prolonged climatic changes that will significantly affect hydrological processes and timing, we can expect to have significantly different hydrologic regimes in the future. Not all of these will be harmless to our health, but it will only take a few serious outbreaks of organisms to cause an epidemic that triggers the demand for filtration plant construction. In view of the potentially long time for approval and construction, it is also realistic to be prepared for that eventuality at least. In fact, the requirement to build filtration plants for municipal water supplies in the absence of some innovative biological control, that may itself take years for evaluation, is inevitable. Assuming that to be true, what are the alternatives for control over those contaminants if the incentive programs do not live up to the highest expectations of those responsible for their implementation and performance?

Why Alternatives to Incentive-Based Programs Need to be Considered

When incentives no longer entice land operators to give up land or land uses that are the source of conflicts with water quality goals, the government will have to exercise new powers over the landscape. Thus, in anticipation of the inability of incentive-based policies to achieve water quality control, or in the circumstances where there is severe threat ("real and present danger") to water quality standards, the next step has already been taken. The EPA has required the preparation of filtration plant plans for New York City and Syracuse in anticipation of failure to meet the performance criteria that may endanger public health. The original Memorandum of Agreement (MOA) included a filtration waiver from the EPA to December 15, 1999, that has since been renewed.*

The most obvious need for adopting a stricter approach to regulating land use to control water quality will come about because of conflicting

* An interesting point to ponder is that had the EPA prevailed in forcing New York City to build a filtration plant, there would have been a lot less watershed management activity on the watersheds.

demands for the two resources that are frequently considered in one breath, namely "soil" and "water." Thus, "soil and water conservation" has a righteous connotation, one that appeals to the long-term conservation ethic with which many sympathize. However, with increasing population, the phrase "soil *and* water" may be more likely to become "soil *or* water." For example, highly sensitive stream corridors are being targeted in the current NRCS Conservation Buffers program. The identified BMPs include buffer strips, filter strips, and grass waterways, all of which (correctly) apply to these sensitive riparian zones. But these lands are also often the most productive agricultural lands, the farmer's "bread and butter" portion of the farm. While these riparian lands make up a small percentage of the total land base, they have a disproportionate impact on runoff water quality. It is also probably true that only a small percentage of all the riparian zone lands are in high demand for both agricultural production and water quality protection. This suggests that these lands may require special consideration in seeking satisfactory management for both objectives.

Probably the most obvious scenario will be the development of mandatory controls by the federal government, administered (perhaps) by the states. This has been the pattern of development in the point source pollution control arena, as discussed earlier in this chapter. In early legislation (the 1948 Water Pollution Control Act, 62 USC 115), the federal government assumed the role of watchdog: monitoring, conducting, and sponsoring research on water quality, and requesting the states to secure water quality. With the gradual increase in (1) pressure on the land due to population growth, (2) numbers and levels of new pollutants, and (3) public awareness and clamor for a greater degree of environmental quality, the government gradually increased its regulatory role in the control of pollution. There is little reason to expect otherwise in the long-term history of nonpoint sources. Grounded in the welfare clause of the Constitution, and brought up anew in the Public Trust Doctrine (Chapter 2), the federal government will have little choice other than to enact laws that enable regulatory taking (Council on Environmental Quality, 1973) in order to preserve human health. The Supreme Court will of necessity comply with approval of the laws' constitutionality. The process, of course, will not be so tidy; the attempt at land use control will be met with hostility and, perhaps, even violence, as those who feel their property rights are being compromised will react in accord with those who resisted taxation at the founding of the nation.

Whether the traumatic change in attitudes that such a scenario would require will be generally acceptable is problematic — and highly unlikely. Recent militant responses to government authority bear witness to the impact on individuals and organizations with extreme anti-government sentiments. It is all too clear that there is a growing problem with authority, as evidenced by an increasing number of dissatisfied individuals joining militia, and violent confrontations including train derailments, individual-directed mail bombing, and bombing of government facilities. A 1995 television news interview showed a farmer on a tractor who was asked to respond to recent increasing government regulatory activity. The farmer's hatred and the vehemence of his response was electric and overwhelming. It dramatically illustrated what regulators of the future are up against: it was a frightening interview.

What may have to be overcome is the long-held view in the U.S. that individuals can "own" the land. The American Dream is to own that "little place in the country," a single-family home, a small empire. As unpopular as this reminder may be, we are not landowners. One cannot own real property by definition (see Chapter 2). One only owns the right to the *use* of the land and, as many a mid-century writer (e.g., Leopold, 1949; Udall, 1963) has proclaimed, there is an obligation to employ good stewardship in its management for time-limited goals and to ensure the future productivity of the land for future citizens. Overcoming this challenge of attitude with respect to land ownership is the first and biggest challenge to accepting government regulation to control water quality. It could also be the last. It is clear that if this viewpoint can be acknowledged, then accepting the necessary land use controls will also be supportable.

Changing views on the relative importance of agriculture in the U.S. may also play an important role. There has already been some change in nonpoint source programs. A national precedent was set in western New York by the *Southview Farm* decision, which effectively moved the Concentrated Animal Feeding Operations (CAFO) from the nonpoint source to the point source category (Martin, 1997). Indeed, the court found that a single manure spreader was a point source. Goldfarb (1994) feels that the application of the name "nonpoint sources of pollution" to control agricultural runoff is an extension of a well-entrenched, politically supported farm policy in the U.S., and that it may not be justifiable in the future as the percentage of our population that is farm-based continues to decline.

Finally, it may be that climate change will occur a great deal more abruptly than our current thinking suggests (Black, 1998). In that event, the BMPs may not work at all or at least not well. Practices that work in rainy seasons may be hazardous to the environment or to our health during periods of drought.* BMPs for non-irrigated agricultural lands may

* Drought has already had serious effects on annual runoff from several northeastern rivers and has dramatically reduced the fresh water contribution to Chesapeake Bay, resulting in drastically altered aquatic ecosystems with attendant regional economic impacts.

not be appropriate for irrigated fields. The potential impacts of short-term climatic change on water resources management are a pressing area for consideration of the challenges, identification of potential opportunities, and development of alternative strategies.

Challenges for New Approaches

The first challenge is to ensure the continuation of agricultural activity on the municipal watersheds. The DEP asserts that "agriculture is a preferred land use." The city prefers not to have to (1) buy up the lands and/or easements that would take land off the tax rolls, (2) increase its land management liability, or (3) deal with potentially damaging, more intensive land uses. Development speculators and subsequent increased pathogen problems from subdivisions with inadequate regional sewer facilities would most certainly make matters worse. And, on the local (watershed) government level, tax revenues need to be maintained to meet the bill for services that serve both on-site and off-site land management beneficiaries.

Second, there is the challenge to identify what it is that we are trying to restore by BMPs in the way of watershed (or wetland) functions, when those functions weren't identified prior to their modification by land uses that are now considered ill-advised. Even if the land were economically secured and returned to native forest cover, there is no guarantee that the hydrologic and water quality characteristics would be better than the farming land use or the original characteristics. The argument is that the land currently in farms was selected for that land use because it was inherently — *hydrologically* — different from the land that remained in forest cover. It is, therefore, not reasonable to expect that the soil and hydrologic properties of abandoned agricultural land would be either desirable or the same as land that is still in forest from the standpoint of municipal water supply requirements. One must also consider the objectives of the land ownership.

A third challenge involves the attitude of the farmer whose income base is going to be diminished in the name of improved water quality. For example, New York State's enhancement of the CRP incentive entails a commitment to USDA for a conservation plan in order to include a few acres within a larger acreage context. Is it worth it? Will the farmer "knuckle under?" Will the farmer stay in business? Most importantly, will the farmer feel that his action is truly voluntary? The incentive may be a clear benefit to the farmer, but unless there is solid feeling of support, any incentive program will fail. Tying the Whole Farm Planning process to the farmer's business plan is a response to this challenge.

A fourth major challenge will be to counter the "land ownership" attitude. To successfully make such a transition, citizens are going to have to begin to think in terms other than “landowner” and of land “ownership” as inalienable rights. This can only be done by educating a wide variety of groups and ages. That alone is no small challenge and may in fact never be embraced by all. In the interim, there are some other opportunities.

Opportunities for New Approaches

There are a number of practical steps that can be taken to implement the new approaches that will be necessary to achieve land use regulation in order to control water quality. But none will be effective, much less accepted or implemented, unless the underlying attitude about land ownership is changed first. New York State Conservationist Richard Swenson said at a recent meeting of the State Technical Committee, “If voluntary conservation is going to work, we have to give it the maximum opportunity to do so.”

For example, in the absence of incentive-based approaches, the soil and water conservation districts can fall back on the fact that they are extensions of state law, and therefore have the power to invoke regulations where necessary to achieve their goals. But, being a near-grass roots organization, and recognizing the importance of its mandate and the potential for erosion of political and economic support at the local level, the district cannot afford the loss of public support by unpleasant confrontation over issues of sovereignty with its constituents.

These are some of the current identifiable strategies for coping with the challenges of nonpoint source pollution control. There are others as well.

Strategies for New Approaches

Better incentives. Certainly, one of the most obvious approaches would be to increase existing rewards to participants in order to attract greater participation in the existing incentive-based program. Clearly, economic arguments will be the strongest incentive to farm owners and operators. Thus, the 1996 Farm Bill mandate “to maximize the environmental benefits for each dollar expended” will be attractive to farmers if they can see and value the environmental benefits. Noting an intermediate set of “mixed property rights” (between wholly private property rights on the one hand and public rights on the other), Poe (1997) identifies a combination of opportunities and challenges to establish innovative policy that will encourage incentive programs. Since many of those who make their living off the land have a particularly strong affinity for environmental quality, it is important to build on that personal preference.

The EPA has recently commenced a stepped-up campaign of controlling nonpoint sources. This campaign is identified in its homepage* as "Picking up the Pace." The "Draft Proposed Strategy for Strengthening Nonpoint Source Management" was presented at the Wye River Conference (October 14, 1997) and includes the following goals: (1) broaden citizen awareness; (2) upgrade planning and implementation of state nonpoint source programs; (3) forge partnerships; and (4) strengthen existing federal partnerships as a central part of the proposed national strategy. In addition, there are parallel programs that include a higher level of risk management, regulatory authorities, financial tool development, and a progress monitoring program. For example, it is likely that §319 programs will continue to strengthen.

"Back door" incentives. In the event that "good stewardship" is insufficient to garner support to maintain existing incentive programs, there is always the indirect incentive, "Nutrient management planning is a benefit to farmers in that [because, if implemented] it provides protection from citizens' suit."** Thus, adoption of planning and implementation of BMPs to control water quality can provide a legal protection for the farmer, who is already hard-pressed to satisfy odor-sensitive neighbors while making economic ends meet. This is a bit like a "trick or treat" approach, but in light of the Corps of Engineers' approach to flood control, is nothing new in the water policy arena. The back door incentive applies also to permits, since the permit holder obtains protection if there is compliance with the terms of the permit. This derives from the legal doctrine whereby legal standing may be granted if all administrative channels are exhausted: the concept applies equally well as a defense.

Selective high grading. Permanently retiring from production hydrologically sensitive agricultural lands removes the principal threat to runoff water quality. This approach focuses on the disproportionate distribution of riparian lands, especially, as discussed previously. The retirement of a small percentage of lands from agriculture is likely to be a more effective and efficient expenditure of public funds than the implementation of uncertain or inadequate BMPs. Compromising water quality in such high risk zones by a half-hearted program or by the lack of follow-up during subsequent contract periods, as might occur in the Conservation Reserve Enhancement Program, must be weighed against the cost of a filtration plant.

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* As of publication, the EPA's nonpoint source homepage could be found at http://www.epa.gov/ OWOW/NPS/nsfsnsm/index.html.

** Statement by Deputy Commissioner of the New York State Agriculture and Markets, Nathan Rudgers, at a New York State S&WCC meeting on April 21, 1998.

Permits to pollute. Applying Poe's (1997) designation of a spectrum of property rights (private, mixed, and public rights) to the problem, a system of economic value transfers would provide a basis for determination of an appropriate fee schedule for the right to pollute. The idea of permitting pollution was given serious thought in an article by Westman and Gifford (1973). The authors suggested that each individual be assigned a certain number of Natural Resource Units (NRUs) at birth, and that organizations, including corporations, could be assigned NRUs under a different schedule. Individuals could subsequently spend their NRUs dependent upon individual preferences such as number or horsepower of cars, vacations, number of children, and other lifestyle choices. The authors further suggest that NRUs could not be transferred, but that is exactly what is occurring currently under a private program initiated by the Niagara Mohawk Power Corporation (NIMO) in central New York. Having bettered its target SO_2 emission allowances, NIMO has contributed permanently retired emissions to the Adirondack Council and traded some of its allowance credits with Canadian firms.

The concept of this approach relies on rejection of the second goal of the Clean Water Act, namely, "zero discharge of pollutants." That goal is not only unachievable, it is ecologically unwise if we accept the fact that one of the primary functions of most of our aquatic environments is to assimilate, convert, and dissipate waste products (Black, 1997). Abandonment of that goal might pave the way for consideration of some water bodies to fulfill their natural function of flushing waste products. If certain water bodies were dedicated, at least in part, to the natural function of assimilating or flushing waste products, then it would be appropriate to clean up other water bodies that might be more attractive for other purposes where potable water was not a required product.

Taxes. The first of several financial approaches invokes financial penalties in the form of taxes. Using the power of the government to tax pollution-producing behavior and to simultaneously reduce taxes on behavior that is more socially responsible is the focus of tax shift (Durning and Bauman, 1998):

> In general, economics tells us that when you tax something, you get less of it. Our problem is that we tax things we want more of, such as paychecks and enterprise, instead of things we want less of, such as toxic waste and resource depletion. Naturally, we get less money and more messes. Tax Shift is about doing the opposite — removing taxes from "goods" and putting them on "bads." … In economic terms, a tax shift would take taxes off labor and capital and put them on the third factor of production — resources; … taxing the gifts of nature (or,

> more precisely, taxing actions that degrade the gifts of nature) tells people to conserve these gifts. Taxes on resources correct one of the most glaring flaws of market economies: blindness to environmental costs.

One of the many relevant impacts that a tax shift would have on nonpoint sources of pollution would be the increasing cost of urban sprawl which, with its inability to finance regional sewer systems, is a major contributor to nutrient and potential contaminant runoff from scattered septic tanks. More generally, taxing wasteful uses of land and water resources would have important benefits to nonpoint pollution control.

Increasing taxes may also be the means for retiring valuable buffer strip lands (as in the CREP). These are often the best agricultural lands. Government has the responsibility for maintaining agriculture as a viable and valuable economic activity and simultaneously assuring high quality water supplies and a healthy environment for the growing population. There are no easy solutions.

Increasing the price. This is a second financial approach. Most of the problems with water in the U.S. might be easily resolved if they were properly evaluated. Currently, it is seriously undervalued (Rogers, 1993). As with other utilities, increasing price reduces consumption, encourages conservation, and eliminates unnecessary strains on the natural resource, public supply works, and waste treatment facilities. Hirshleifer et al., (1960) argued for raising the price of water to alleviate many management problems 40 years ago. Their arguments are still valid, and will remain so until it happens. The nature of the pricing system for municipal supply water is discussed in Chapter 8.

Fines. This third approach is already in effect. In the event that neither incentive-based programs nor permits to pollute suffice in cleaning up the nonpoint sources of pollution, it is inevitable that the existing provision for stiff financial penalties will be extended to cover other nonpoint source violations. These will, of course, be much more difficult to monitor, evaluate, and standardize, but it is likely that early moderate attempts will be followed by ever-increasing standards and fines. At present, violation of various sections of the Clean Water Act that govern point source discharges are punishable by fines up to $25,000 per day of violation (43 USC 1251 §309(c)1).

The issue goes further than "farmers polluting their own wells," and ultimately is a problem of polluted groundwater wells and evaluation of the costs of preventing such pollution (Poe, 1996). Increasing the awareness of the potential pollution problems from nonpoint agricultural runoff may be needed to increase farmers' willingness to pay (Wright et al., 1997). Thus another potential strategy is education.

Public education. In response to the challenge in New York, the NRCS State Technical Committee has created an *ad hoc* education subcommittee, which has established the following objectives that are universally applicable:

1. Provide policy advice to the NRCS/FSA technical committee concerning education programming related to implementation of Farm Bill conservation programs.
2. Outline outreach/education strategies for Farm Bill conservation program.
3. Assist in capitalizing on other outreach efforts from various partners (FWS, CCE, state agencies, etc.).
4. Provide coordination regarding the development of education strategies for all the Farm Bill conservation programs.
5. Seek assistance from the Farm Bill conservation program subcommittee in thinking about and developing outreach strategies for their respective programs.
6. Assist NRCS/FSA in the development of a competitive grants approach in determining resource allocation for selected Farm Bill conservation program education initiative.
7. Review and make recommendations to the technical committee regarding education proposals.
8. Collaborate with the AEM outreach committee regarding actual implementation for Farm Bill education strategies.

With the 1994 reorganization of the Soil Conservation Service into the Natural Resources Conservation Service, each state was to establish a State Technical Committee. This means that the primary mechanism should already be in place in each state to effect such a program.

Since many of the nonpoint source control BMPs are cost effective,* educating those that may make use of them is a prime choice for

* It is worthy of note, at this point, that a detailed study (Wolf, 1995) in Wisconsin reported that the answer to the question, “Does the NPS program provide a cost-effective means of reducing NPS pollution in the state of Wisconsin?” is, “Not yet.” As a matter of fact, the author notes that insufficient participation may be the cause of the ineffectiveness of the pollution control effort, which is consistent with the observation above concerning perception of the extent of an individual’s contribution to the cleanup effort. In contrast, Park et al., (1994) reported, (1) “rainfall-runoff relationships based on the computed curve numbers for individual storms … were reduced by approximately 5 percent”; (2) a 20 percent reduction in sediment concentrations; and (3) substantial reductions in nitrogen and phosphorus levels in runoff from 175 storms from a 5.6 square mile (1450 ha) watershed since 1985 when monitoring commenced.

administrators and regulators. This is necessary because polluters and perceivers of pollution may not see the same problem. Wright et al., (1997) point out that:

> Nonpoint sources by their definition are hard to see. The effects of nonpoint pollution are often off site so the people contributing to the problem may not realize it. Nonpoint pollution prevention may be perceived as futile since each individual potential source is such a small part of the problem.

Awareness of the nature and extent of the pollution problem, as well as the opportunities for prevention and control, is the ultimate target of public education about nonpoint sources of pollution. It is also absolutely necessary that (1) the public be given an opportunity to play a meaningful role in the process, and (2) that all stakeholders feel that they have been contributors to the control process.

Two excellent examples of recent public education efforts include an attractive publication for the general public by the NRCS. Nearly every page of the new bimonthly publication *Backyard Conservation* (Natural Resources Conservation Service, 1998) documents how the backyard conservationist can relate to similar practices of farmers and ranchers. On page 5, a sidebar proclaims:

> Conservation efforts by many farmers and ranchers keep the air clean; maintain good-quality water for drinking, recreation, and fish and wildlife; provide homes for wildlife; ensure healthy soil; and sustain a diversity of plants. These benefits help people, wildlife, and the environment.

In addition to its more scientific publication (*Journal of Soil and Water Conservation*), the Soil and Water Conservation Society, the major organization for soil and water conservation practitioners (see Chapter 4), also recently started a similar publication directed at the lay public entitled *Conservation Voices*.

This positive approach to the cultivation of public opinion is essential to the future attitudes that will support incentive-based programs. Public participation in water quality management is mandated by law. It provides the public with the information necessary to be responsibly involved, and it is a low cost investment that has other benefits as well. "The time and energy required to develop a good public information program is well spent because an effective program can play a significant role in improving the quality of governmental decisions through increased citizen involvement, precluding sometimes costly citizen opposition" (Grisham, 1988).

Changing attitudes and behavior. This is a very important subtopic of the general public education issue. It will require a major, long-term effort relating to a whole spectrum of unrelated fundamental attitudes that will not be easy to change. Perhaps Bartlett (1998) expresses the most pessimistic viewpoint on this issue, when he states that "Democracy cannot survive overpopulation." If we accept that overpopulation is a problem that underlies water quality management, then we — *everyone* — must face up to that issue. The "population question" overrides many of the other policy issues raised in this volume and its cited references, including the U.S.'s "ownership attitude" problem discussed in the preceding section of this chapter.

Preparing for future confrontations. The exacerbation and continuation of conflicts between individual and public rights over land use and water quality are very important and sobering portions of the effort in public education that must take place. For this audience, however, the effort will require a greater degree of expertise than those typically involved in the water resources professions have available. The potentially volatile context of the subject demands a judicious approach that may, in fact, have meager chances of broad success. Any success, however, would be welcome, and could potentially play a major role in allaying the fears of those who otherwise would be directly affected by those confrontations.

The ostrich alternative. Suppose no one ever measured the effectiveness of incentive-based programs and, therefore, we never knew whether they had failed (or succeeded). This opportunity is not so far-fetched as one might at first imagine.* It is based on the following observations:

1. There have been very few follow-up reports on the effectiveness of BMPs (e.g., Wolf, 1995; Park, et al., 1994).
2. It is quite difficult to evaluate success or failure because the definition — limits — of water quality is highly variable, difficult to quantify, and even more difficult to statistically guarantee.
3. As long as the federal dollars keep on coming in, state and local officials may not really want to know the answer to the question.

This assumption has some attractiveness in the idea that nonpoint source pollution control is being practiced by the best methodology known — not unlike that for human health or legal relationships — and there is no point in incurring incredibly large expenditures to find out what we already know, or are at least convinced we know: BMPs are a Good Idea. More importantly, it is likely that the variability of water quality in time and

* This strategy was suggested by John Herring, representative to the State Soil and Water Conservation Committee from the NYS Department of Health, on May 19, 1998.

space is so great that it probably would exceed our capacity to confidently draw conclusions concerning the success — or failure — of nonpoint source control efforts.*

Summary

People walk a tightrope between the threat of land use regulation to control water quality, and effective and cooperative partnerships that may achieve the degree of water quality compliance that we desire and demand. A successful program of watershed management will include obligatory public participation in all aspects of water quality control.

Since public education is a key strategy in effecting successful incentive-based programs, ensuring their continued success, and precluding failure of incentive-based efforts, all involved individuals and levels of government, including a wide variety of professional disciplines and agencies, must be prepared to work constructively with the public to assure that success.

Permits

To understand the difference between permits and programs as applied to nonpoint source pollution control, it is necessary to first differentiate between the two types of pollution and to recognize the consequences associated with each. The primary characteristics of the two general types of pollution are shown in Table 6.1.

The point of control for point sources is the granting of a ***permit***, under the National Pollutant Discharge Elimination System (NPDES) (§402) if administered by EPA, and the State Pollutant Discharge Elimination System (SPDES) if administered by the state under agreement with the EPA. Permits are written to include *conditions* that are either specified by law, written into established standards, or detailed in the specific permit. The water body is cleaned up (restored) by virtue of monitored and controlled effluent

The nonpoint source control, on the other hand, is enforcement of a ***process***. Here, a series of *procedures* are undertaken that ensure the

* This raises an important issue that is often clouded by misinformation or lack of information. Monitoring water quality for determination of environmental *ecosystem* health has less stringent demands (for example in statistical verification) than does monitoring for *human* health. The latter may require court appearances where control over data, analysis, and reporting demands strict chain-of-custody records, not to mention greater precision and often greater accuracy as well.

Table 6.1 Point and Nonpoint Source Pollution Control Characteristics

Point Source Pollution	*Nonpoint Source Pollution*
• Pollutants measured at end of pipe	• Pollutants measured in water body
• Effluent is readily identifiable and quantifiable from: • Municipal treatment works • Manufacturing treatment works	• Effluent from diffuse sources may be unquantifiable *in toto*
• Control by: • Methods that are technology based (*more science than art*) • Enforcement of effluent standards through permit system • Monitoring effluent • Fines or incentives achieved by spending money on waste treatment plans and/or pre-treatment of toxic and hazardous wastes	• Control by: • Methods that are management-based (*more art than science*) • Enforcement of • BMP process • Performance criteria • Achieved by utilizing those land management practices that minimize erosion, sedimentation, and movement of nutrients and other pollutants to water bodies
• Cost borne by taxpayers or customers of manufactured products	• Cost borne primarily by landowners, taxpayers, and customers of products

opportunity for success in any of numerous possible practices that have a known track record (and often research to back them up) of minimizing or eliminating diffused pollution from various land uses. The water body is cleaned up (restored) by exercising the BMP process (Table 6.2) that is designed to minimize runoff and to maximize containment of nutrients, sediments, contaminants, and pathogens.

To comply with the 1972 Clean Water Act (CWA), then, one must have EPA approval to discharge point source pollutants to an interstate stream. That approval is in the form of a permit. Until recently, permits were not applicable to nonpoint sources. In compliance with court decisions and the subsequent issuance of stormwater runoff and concentrated animal feedlot operations regulations, the EPA (as administrator of the CWA), or appropriately designated state departments must issue permits prior to release of pollutants to covered water bodies.

Table 6.2 The Best Management Practice Process

- Triage (*by professional judgment and experience*)
  1. Identification and evaluation of nonpoint sources of pollution
  2. Delineation of critical and vulnerable watershed areas
  3. Identification of candidate BMPs
- Action (*by public participation and political process*)
  4. Public education
  5. Implementation of selected BMPs
  6. Evaluation of process (back to step one)

Sample standards for a draft conservation practice (*Streambank and Shoreline Protection*) by the Natural Resources Conservation Service and for two best management practices (*Grassed Waterways* and *Filter Strips*) are shown in Appendix B. Design definition and standards are periodically proposed, reviewed, and revised in a continuing program of pollution control by the NRCS. Consultants include many of the personnel who are represented on the NRCS Technical Review Committee in each state (see description of the NYS Soil and Water Conservation Committee in Chapter 5).

Future expansion of administrative and judicial interpretation of the CWA will most assuredly result in an increasing number of appropriately listed subsections as the control over nonpoint sources of pollution are moved from nonpoint to the point source category. At present, permits are necessary for discharge from ***stormwater*** construction facilities, for ***concentrated animal feedlot operations***, and for certain specified nonpoint sources in the form of ***Total Maximum Daily Load*** (TMDL) limits for receiving waters.

Stormwater Permits

Stormwater discharge permits have three water quality impacts in addition to the effect of their primary target, increased flood peaks from developed sites. First, there is a direct contribution of urban developments (and highways) to storm sewer conveyance and, therefore, problems with combined sewer overflows (CSO). CSOs occur when sanitary sewer capacity, designed to treat wastes from a given population, is overtopped during runoff-causing events (rainstorms and snowmelt). This occurs because the storm sewers are connected to the sanitary sewers. Under such conditions, the waste treatment plant's capacity is exceeded, and untreated or inadequately treated effluent is discharged into some receiving water body.

Second, there is the direct contribution to sediment loads, and inadvertent and uncontrolled flushing of surface runoff that may include salt, petroleum derivatives, and other construction activity-generated pollutants.

Third, there is interference with the flushing function of aquatic systems (Black, 1996). Here the natural pattern of peak pollutant flush on the rising limb of the storm hydrograph is likely to be drastically increased in magnitude and reduced in length of time of occurrence, resulting in adverse impacts downstream on both pollutant rates and quantities.

Legal compliance for the application for and the awarding of stormwater permits is contained in the Clean Water Act (CWA), Article V, Section 1362(14), wherein it states that the "term 'point source' means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling, stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture." Specific regulations are not appropriate here, but may be retrieved at the EPA website.*

Concentrated Animal Feedlot Operations (CAFO) Permits

Following the 1994 *Southview Farm* decision, the NRCS established CAFO permit conditions and standards that may be implemented through the SPDES permit systems in each state. The permit "is a 'zero-discharge' permit, i.e., there can be no discharge to *any* natural surface water, from the area where the animals are confined, bedded, fed, or otherwise managed in a *concentrated* manner unless a 25-year 24-hour storm event occurs" (NYS Department of Environmental Conservation, 1999), and the runoff therefrom is retained.

CAFO permits are regulated under the National Pollutant Discharge Elimination System (NPDES) of the 1972 Clean Water Act as amended. As with other pollutants, regulation may be accomplished through EPA cooperation and coordination with the appropriate state natural resource management agency. Since the permit requirements and conditions have only recently been formulated, and are undergoing, and will undoubtedly continue to undergo, substantial modification, current information is best obtained from each state's regulating department, or from the EPA. Regular postings of CAFO standards and regulations are available on the EPA Web site.

* The website, as accessed on March 21, 2000, can be found at http://www.epa.gov/docs/epacfr40/chapt-I.info/subch-D/.

Current regulations refer to a minimum of 1,000 (cattle) animal units as the threshold for CAFO permit application by the farm operator. Equivalents are specified for other livestock. It may be expected that the threshold number will be revised downward as the severity of the CAFO problem dictates. Given the viewpoint expressed in the preceding section, it is likely that we will see an extension of the *Southview Farm* decision designating CAFOs of 1,000 or more animal units* to be point sources. How about 150 animal units? One hundred animal units? One animal unit? One person? We need to consider — although it is unlikely that we will act on regulating — an individual human as being a point source (Black, 1994).

Total Maximum Daily Loads (TMDL)

Under the EPA's agreements with each state to establish plans for water pollution control that would satisfy compliance with the Clean Water Act, water bodies were identified as impaired if they could not meet particular standards with regard to sediment, nutrients, oxygen-demanding substances, toxic substances, and pathogens. Since the 1977 amendments to the CWA, the EPA has worked with the states to establish a program of nonpoint source pollution control, commencing with the identification of water body status. The diffused nature of the nonpoint sources prolonged the implementation of receiving water body quality as a basis for permitting pollution. As a consequence of citizen lawsuits launched because of continuing poor water quality in spite of a largely successful point source program in the later decades of the 20th century (Anonymous, 2000; Environmental Protection Agency, 2000; Houck, 1999), the EPA has now moved to implement water quality standards through the application of TMDLs for a variety of substances (Jones, 1999). The result was the establishment of TMDLs in August 1999 (64 *Fed. Reg.* 46012) and the important linkage to the National Pollution Discharge Elimination System (64 *Fed. Reg.* 46058) through §303(d) of the CWA, thereby moving the relatively informal process of nonpoint source pollution control to a permit process. This is a reversal from the CWA's original emphasis on control over effluent to the earlier legislation's concern with receiving water quality. In fact, it is probably an appropriate mix of the two methods for controlling pollution from both point and nonpoint sources.

Considerable debate has followed the EPA action, especially in the silvicultural and agricultural communities that are now subject to regulation

* An animal unit was originally defined by the NRCS as the equivalent of 1,000 pounds of live weight of any species or combination of species of livestock. It is currently reduced to 300 animal units or 200 head of cattle.

through the use of TMDLs that give clear, if notably controversial, guidance to land managers (Akobundu and Riggs, 2000). There is, as a consequence of the EPA/USDA action, a new necessity for cooperation among land management personnel and regulators for the maintenance of public support for nonpoint source pollution control, and a variety of approaches by states actively seeking to comply with the new regulations (Edgens, 2000). In a letter to Representative Bud Shuster, Chairman of the Committee on Transportation and Infrastructure, Assistant Administrator of the EPA J. Charles Fox stated:

> Our goal is to provide a common-sense, cost-effective, framework for making decisions on how to restore more than 20,000 miles of rivers and streams and 300,000 acres of lakes that States identified as polluted in 1998. Over 200 million Americans live within 10 miles of one or more of these polluted waterbodies. … Clearly, despite all the progress we have made toward clean water, we still have a long way to go. …
>
> I regret the confusion about treatment of diffuse runoff in our August TMDL proposal. I would like to clarify that EPA remains committed to relying on voluntary approaches to reduce runoff from diffuse sources of water pollution. The proposed rule would not require Clean Water Act permits for polluted runoff. Instead, States would identify these sources when they cause waterbodies to be polluted. The States would identify voluntary or incentive-based programs through which these sources can help meet the "pollution budget" for the waterbody. The statutory basis for including these sources in the TMDL process was recently affirmed by the Federal district court in California. Since the majority of polluted waters are polluted in whole or in part by these diffuse sources, a management framework that does not address them cannot succeed in meeting our clean water goals. Voluntary and incentive-based approaches, which are often supported by financial assistance from the Federal government, are the preferred way to address these problems.

To confirm this viewpoint, the EPA proposed and the President requested an increase from $200 to $250 million in FY 2001 to support those voluntary programs described earlier in the chapter. The April 5, 2000, press release by the EPA and the Department of Justice (Environmental Protection Agency, 2000a) quoted from the decision:

> The American Farm Bureau Federation and other agriculture and timber groups filed suit, claiming that the EPA and the states should calculate TMDLs only for pollutants that are discharged from pipes, or point sources. The court rejected this argument, holding that the Clean Water Act is designed to provide a comprehensive solution to the nation's water quality problems "without regard to the sources of pollution."

Between the solid affirmation of the CWA goals by the court, the cooperation between the EPA and USDA in resolving differences of opinion during the comment period for the August 1999 TMDL proposal (Environmental Protection Agency, 2000b), and the desire on the part of EPA to continue — and even enhance — the voluntary approaches to nonpoint source pollution control even with the implementation of permits, it is clear that this application of permits is here to stay.

A thoughtful and eloquent summation of this addition to the permitting processes under the Clean Water Act is presented by Houck (1999):

> Something large is happening here. The nation is coming to grips with its huge, residual problem of water pollution, as it has with air pollution and, to an extent, with the use of the land itself — in much the same way. … Programs to restore and sustain the three great resources of the country — the air, the land, and the water — are now evolving convergently around the same principles, presenting the same heartaches, and limping toward the same overall goal.
>
> One longs for a more direct approach. …

In a succinct summary of the heart of the material presented in earlier chapters of this volume, Houck continues:

> Congress could have done the same for nonpoint source pollution, but it deferred to the feeling that nonpoint sources were essentially small, local, not all that damaging, unmanageably diverse, and beyond remedy through simple technological controls. … Whatever its additional motives — and one suspects that in 1972 Congress had enough on its hands regulating discharges from industrial pipes without reaching for direct nonpoint controls as well — these reasons have not stood the test of time. It is now apparent that nonpoint source industries are anything but small, and in fact are led by multinational mining companies, timber corporations, agribusinesses the size

> of Archer Daniels Midland, and prominent members of the Fortune 500. It is also apparent that their contaminants make long journeys to both oceans, the Great Lakes, and the Gulf of Mexico, that they can be serious to the point of life-threatening, that they are no more diverse than the several hundred categories and subcategories of point source industries regulated under the CWA, … and that they are far easier than most point source industries both technologically and economically to regulate — but not politically, and that of course, is the rub. …
>
> All of this said, TMDLs retain the upside potential for significant nonpoint source pollution control because they *sound* logical, they remain flexible, they defer largely to state prerogatives, and, most importantly, they, too, are enforceable.
>
> The logic is political. As imperfect as their assessments may be — and all environmental assessments are imperfect — TMDLs provide both a bottom line and their own reason to get there, a reason that everybody can understand: the creek is dirty, so clean it up [emphasis in original].

The most recent development in this ongoing, changing situation is that the EPA and USDA rescinded the order including silvicultural activity* from the proposed rule change that would have shifted agriculture and silviculture activities from nonpoint sources to point sources, thereby requiring permits.** This development was based in large part on a report (National Association of State Foresters and Society of American Foresters, 2000) that documents that the EPA "has relied on inadequate and unscientific data, misinterpreted the information provided by the states, and ignored the effectiveness of state programs to ensure water quality." The report also pointed out that in one state alone, 2,257 TMDLs would have to be established; an overwhelming task. While it is likely that this reconsideration will be reversed at some future date, about the only sure prediction is that change will continue.

* This fact is based on a letter from Dr. Vernon R. Hayes, Jr. (vhayes@forestland.org) to the author, dated June 9, 2000.

** Information regarding this may be found at http://www.epa.gov/OWOW/tmdl/proprule.html, as of August 1999.

Summary

Permits are designed to control point sources of pollution. The Best Management Practices process has been developed to control nonpoint sources of pollution. The two methodologies highlight fundamental differences between point and nonpoint sources of pollution. These include differences in how the pollutant is characterized, controlled, monitored, and funded. In some cases, the differences are almost superficial; in others, the two types of pollution are clearly distinguished from one another. As the recent technologically based methodology for point sources has produced results in cleaning up nonpoint sources by a traditional management-based methodology, the percentage of the nation's pollution by the nonpoint sources has increased even while the actual pollutant level may have decreased. Add to that the public perceptions of polluting culprits and the public's long-standing concern with management of public resources that has been heightened since the late 1960s, and the effect is certainly being felt in high places.

Two principal nonpoint sources of pollution that were identified in §208 of the Clean Water Act, urban and agricultural runoff, were the first to be converted to consideration under the permit system of the same legislation. The stormwater discharge permits primarily target flood peak discharges, but also are concerned with and are linked to combined sewer overflows and BMPs that control urban construction sediment discharges. Sediment, nutrients, contaminants, and pathogens are all of likely concern in agricultural runoff. The long-standing concerns over diffuse sources of pollution from silvicultural and agricultural land uses have now produced the additional signs of erosion as well.

Houck (1999) concludes, attesting to the importance of the partnership approach set forth in Chapter 5, "And if ever there [was] a stakeholder program likely to produce more results than bologna, it is §303(d). Because it has numerical targets and prescribed steps to achieve them, and because it empowers people with the energy and the ability in law to see that they take place."

Conclusions

Pollution control in the U.S. has undergone a century-long transformation from quite casual to quite intensive levels. The point source pollution problems have largely been alleviated as the federal role changed from one of mild interest to intensive research, to setting standards, to incentive programs, to control by permitting, fines, and strict enforcement. The less easy to control nonpoint sources have already shown indications that the evolutionary pattern will apply there as well. Process control programs will give way to permitting, where they haven't already. Nonpoint source pollution from selected construction and agricultural activities is already under permit control in the form of stormwater runoff, runoff from concentrated animal feedlot operations, and TMDLs.

Activities and Questions for Critical Thinking

1. At what point should the culvert that discharges from surface runoff captured by a highway's surface and adjacent drainage ditches be considered as a point source?
2. What nonpoint pollutant is likely to be next on the list of sources to come under the permitting process?
3. Identify and discuss the "on-site and off-site land management beneficiaries" of maintaining valuable municipal water supply watershed lands in agriculture.
4. How can we protect the economic integrity of agriculture as a land use while simultaneously protecting water quality?
5. What do you think ought to be the limit of nonpoint source designation for animals on farms? For humans?
6. Can you think of a more politically correct and more acceptable term than "land use regulation to control water quality?"
7. How would you respond to the following argument? "We should no more spend billions of dollars on monitoring the results of BMP implementation, which we know to be a good idea, than we should spend similar sums of money on monitoring the degree to which a B1 bomber contributes to the national security. (By coincidence, some states have invested about $1.5 billion in cleaning up nonpoint sources of pollution, which is about the same as the cost of a B1 bomber.)

Chapter 7

Evaluation

Benefit-Cost Analysis is fundamental

Introduction

Benefit-Cost Analysis is fundamental as the process for evaluating policy and planning choices as well as for analyzing and, in some cases, formulating the projects they generate. The evaluation of projects involving water and related land resources is accomplished with a model that derives from and reflects traditional economic theory with respect to the individual firm. Understanding the assumptions behind the model and its normal method of application is helpful in understanding the shortcomings and values of this evaluation process. Benefit-Cost Analysis (BCA) is a "useful way of roughly assessing the promise of a proposed project, ..." (Hammond, 1966). It serves two functions, "It establishes which public projects are *prima facie* likely to yield economic benefits, ... and it furnishes a basis for the apportionment of the costs of such projects between the federal government and others" (Hammond, 1966).

The fundamentals of BCA (the simple underlying assumptions and analytical procedures) are economic fact, not the exclusive property of one economic system or government. How the BCA is used, that is, the *application* of fundamental economic theory, is the decision of politics, customs, emotions, welfare, and the governmental system. Hammond (1966) states, "One must never forget that though pure economics is a matter of logic, applied economics is a matter of informed common sense."

The logical economics may be expressed as a model; how the model is used is the stuff of policy, whether based on common sense or not. More specifically, Mishan (1976) states:

1. The general question that cost-benefit analysis* sets out to answer is whether a number of investment projects, A, B, C, etc., should be undertaken. And, if funds capable of being invested are limited, which one, two, or more among these specific projects that would otherwise qualify for admission, should be selected.
2. The economist engaged in the cost-benefit appraisal of a project is not, in essence then, asking a different sort of question from that being asked by the accountant of a private firm.
3. The realization of practically all proposed cost-benefit criteria … implies a concept of social betterment.
4. Finally, the reader should bear in mind that the techniques employed in cost-benefit analysis could be put to related uses.

The simplest definition of the BCA process is set forth by Sander (1981): "federal water resources planning agencies such as the Army Corps of Engineers and the Bureau of Reclamation use benefit-cost analysis to assess the economic feasibility of potential projects." The tenacious verity of fundamental BCA concepts bridge time in that the application of economic theory to practical project evaluation, as was the goal of the 1950 *Green Book*, appear verbatim — in many cases — in more recent economic evaluation documents, such as the 1983 Principles and Guidelines.

The Model

The **marginal analysis model** rests on an assumption of pure competition and is useful because it fits water and related land resources better than any other model (Wantrup, 1955). This is due primarily to the fact that, although the assumptions underlying it are unrealistic insofar as the water resource is concerned, one assumption fills a key requirement in the model's list of characteristics. Thus, the effect of the assumption of pure competition is obtained, making the model available and useful for analysis.

* Since the bottom line in a Benefit-Cost Analysis is the Benefit-Cost Ratio (simply, B/C), the author prefers the form "Benefit-Cost Analysis" that has the same (alphabetical) sequence of words but, of course, maintains integrity of quoted works that use "cost-benefit analysis." Both indicate the same process.

Assumptions

The circumstances on which the marginal analysis model is based, that is, the assumptions underlying pure competition, are:

1. There are many buyers and sellers.
2. It is easy for sellers to get into and out of the business.
3. The action of any one buyer or seller has no effect on the market or price.
4. There is perfect knowledge about the market by all.
5. There is a uniform product.

There are examples of some products that fit, or come close to fitting, these criteria. One example of a uniform product is dimension lumber two-by-fours, which come in standard lengths, and have industry-wide dimensions. If a customer wants a two-by-four, it can be obtained at any lumberyard, with some variation of price according to efficiencies of management, economies of large-scale buying, and, perhaps, some variation in quality.

It is necessary to consider the verity of these assumptions with regard to the water resource so as to assess the applicability of the model.

1. While there are many buyers of water, for example, in a municipality or water supply district of one type or another, there is usually only one seller. Thus the first assumption does not apply.
2. Since the majority of most water supply projects involve very large initial investments, that is, their fixed costs* are very high, it certainly is not easy to get in and out of the business. To do so also takes a long period of time. This time is necessary for planning, raising funds, obtaining legal rights to water, and so forth. Thus, the second assumption does not apply either.
3. Clearly, if there is only one seller, it is possible (and usually happens that) the supplier can influence market and price. The third assumption is, therefore, also not applicable.
4. The public is definitely not well informed about the economic, political, or physical aspects of water supplies. The greater the number of people in large cities and, consequently, the more removed they are from both the water source and the seat of government, the less well informed they become. So, the fourth assumption is not applicable either.

* The Corps of Engineers and some other agencies use the term "first costs."

5. The product *is* relatively uniform, especially insofar as domestic water supplies are concerned and if one tends to overlook water quality within some tolerable range. Thus, the fifth assumption applies.

But, all five assumptions must hold if the model is to apply. Thus, the model will only be useful if the *effect* is the same as if all five *did* apply. That is the case with water. The effect of the five assumptions acting together in the classical application of the marginal analysis model is to have each supplier face a horizontal demand curve, that is, each supplier under "pure competition" provides the product for a (small) part of the entire market.

How does Water Fit the Assumptions?

Overall, water fits the previous assumptions pretty well. There is certainly no doubt that a water supply project does not operate as a private firm would were it involved in pure competition. Far from it. However, two characteristics of the public's comprehension of water supply (based on imperfect knowledge) enable pure competition characteristics to be in evidence and to play a role.* First, the public generally expects the government to provide the water. While there used to be a large number of private water supply companies, municipals and other local governmental water supply units have grown rapidly. Private firms have taken over the job of providing water for domestic use and many municipal services for the 75 percent of the U.S. that in 1990 was urban.**

Second, people generally expect the government — or even the municipal water supply purveyor — to provide the water for free or at very low cost. In most cases, the cost is so low — in the range of 10 to 50 cents per 1,000 gallons — that it costs the supplier more (in public education and answering complaints) to change the price than to make up any deficit by general revenues. Instituting a direct relationship between price (*P*) and quantity (*Q*) is unrealistic and, in addition, changing the price may cause a negative public reaction. There is also considerable doubt that a pricing policy for water that reflected demand in the traditional sense (Figure 7.1c) would have any conservation effect at the low levels prevalent (Brewer, 1961; Howe, 1971).

* These facts may change in the future as we value water more. Such a change will require re-evaluating the usefulness of the model for analysis, but not necessarily for descriptive purposes, as is done herein.

** U.S. Bureau of the Census at http://www.census.gov/population/censusdata/urpop0090.txt on March 26th, 2000.

The single water supplier, then, has certain attributes that mimic those of the marginal analysis model and useful because it permits definition, description, and determination of average cost pricing, which is the usual utility practice. Unacceptable alternatives are the full or regulated monopoly models, which do not exhibit the same usefulness because (1) they assume marginal cost pricing, and (2) the profit motive dictates model solution and output prediction. The fact that private companies supplying water declined dramatically in the mid-20th century was evidence of the lack of utility company interest — and profit — in supplying water. However, private interest in municipal water supplies is beginning to grow again as the price of water increases and makes the business financially attractive. Another factor is the desire of many governmental units at all levels to privatize. To understand how the marginal analysis model can be useful in comprehending evaluation of the water supply industry and in selected cases, water in general, it is essential to examine the model and the peculiarities of the water resource that make it possible.

Peculiarities of Water Resources

It is difficult, incidentally, to accurately document the number of private water supply companies. Many rural systems are extensions of an individual's own supply, well-supplied industries may sell water to nearby users, and some private concerns are really quasi-public. In 1973, there were approximately 5,900 investor-owned water utilities out of a total of 30,000 serving 175 million people in the U.S. (National Water Commission, 1973). One private company currently operates water supplies in 20 states and serves over 5 million residents, mostly from small (50 to 2500-acre), forested watersheds that are often owned by the municipality. In 1997, there were 3,721 water supply businesses in the U.S.*

In addition, both the private company and the system-operating municipality itself, are regulators in the sense of controlling the rate of flow of water from the source to the point of use. That observation conforms to one basic concept of water as a resource. According to Wantrup (1951), water is a **flow resource** for which "different amounts become available in different time periods." But, Wantrup also pointed out that water is legitimately considered a **stock resource** since there is a fixed amount on the planet. To put these two seemingly contradictory concepts in perspective, it should be noted that only a very small percentage of the total supply is in circulation, and that only a very small percentage of that is available for the public's use. This dual nature of water, as both a flow

* See http://wwww.census/gov/prod/ec97/t22-us.pdf, accessed by the author on 3/23/00.

and a stock resource, and the maldistribution in time and space, constitute two of several significant peculiarities of the water resource.

Another peculiarity of the water resource is its often high fixed cost of development. High fixed cost is typical of most natural resource developments, but it is exaggerated in water projects by virtue of the extremely low variable costs that are incurred (Eckstein, 1958). This is primarily due to the fact that once dams and distribution systems are constructed, the water flows by gravity to points of use. Distribution systems are expensive and expansions cause quantum jumps in costs (the so-called "lumpy costs"). Thus, it is not only difficult to get in and out of the business of water supply because of the high fixed cost; it is also difficult to analyze the economics of a project because of the lumpiness associated with having to invest in large works as output is expanded beyond the current system's capacity. Since such changes may take a long time and considerable planning, forecasting demand based on population and per capita usage becomes essential.

Elasticity of Demand

Given these special economic characteristics of water projects and water resources in general, it is important to consider into which of the examples of elasticity (shown in Figure 7.1) water "fits." **Elasticity** of demand, the percentage change in *Q* divided by the percentage change in *P* at any point on the curve, actually varies along (and between different) demand curves (Koivisto, 1957). In addition, it is important to recognize that the water resource actually fits across the entire spectrum of elasticities (another peculiarity of the resource), because it has uses in all elasticity categories.

Thus, in Figure 7.1a, **Perfectly Elastic** demand is shown, where the supplier faces a constant price over the entire range of production and has no effect on price or quantity sold. An example is a product under pure competition. While water supply is not considered as being in a purely competitive market, the average variable cost curve (in Figure 7.5) is so low and so nearly flat over such a large range of output that the effect is to mask the pure competition conditions. Specifically, the water purveyor can supply a level of *Q* over a wide range and, as discussed below under "Average Cost Pricing," still show an excess of operating income over expenses while meeting the fixed cost by other means such as property taxes.

Figure 7.1b shows an **"Elastic"** demand curve, where a small change in price leads to large changes in quantity demanded. Water for lawn watering is an example (National Water Commission, 1973). This is not an essential use, in that the lawn may be allowed to wilt in the face of a severe water shortage where more important health concerns hold sway.

In Figure 7.1c, the typical industry-wide **demand curve** indicates that where price is high, demand is low, and vice versa. Some uses of water might be considered as being in this category where the interaction of price and quantity actively play a role in the exchange of the resource and money.

Figure 7.1d shows an **Inelastic** demand curve, where a change in price leads to very little change in the quantity demanded. Water for most domestic uses falls in this category (National Water Commission, 1973).

Finally, a **Perfectly Inelastic** demand is shown in Figure 7.1e where price has no affect whatsoever on the quantity demanded. An example in this category is a product for which there is no substitute or which is essential to life. Water for drinking and health purposes is such a situation. There is no substitute for that minimum of four to five pints of water per day for each individual's survival; it is essential for life. Similarly, and especially under conditions of dense population, hygiene is a matter of survival, and the price of water has no effect on the amount that will be demanded.

But water also has nonessential luxury uses, so it is a resource that really fits over the entire spectrum of elasticities of demand; it exists at either end of the spectrum. In sum, water "fits" and everyone involved is blissfully happy. Thus, the supplier "faces" a horizontal or perfectly elastic demand curve. In other words, regulation of price over the range of production accomplishes the effect of all five of the Pure Competition Assumptions, and the model may be used, albeit, not without care, to consider some important aspects of the economics of water resource development projects. It is also important to return to the assumptions for discussion in the following sections.

The "Market"

The place where buyers and sellers come together to arrange for transfer of goods or services in return for monetary consideration is certainly different for the municipality and for the purely competitive market. Once the conditions and ramifications of that observation are understood, the degree to which the water "market" does or does not apply can be discussed, and the impact on analyses can be considered in that light. "The market is a man-made institution," say Castle and Stoevener (1970), and "the literature … tends to focus on price as the signal for the allocation of resources as well as a means of distributing income." Price is that "monetary consideration," the element in the market that links buyers and

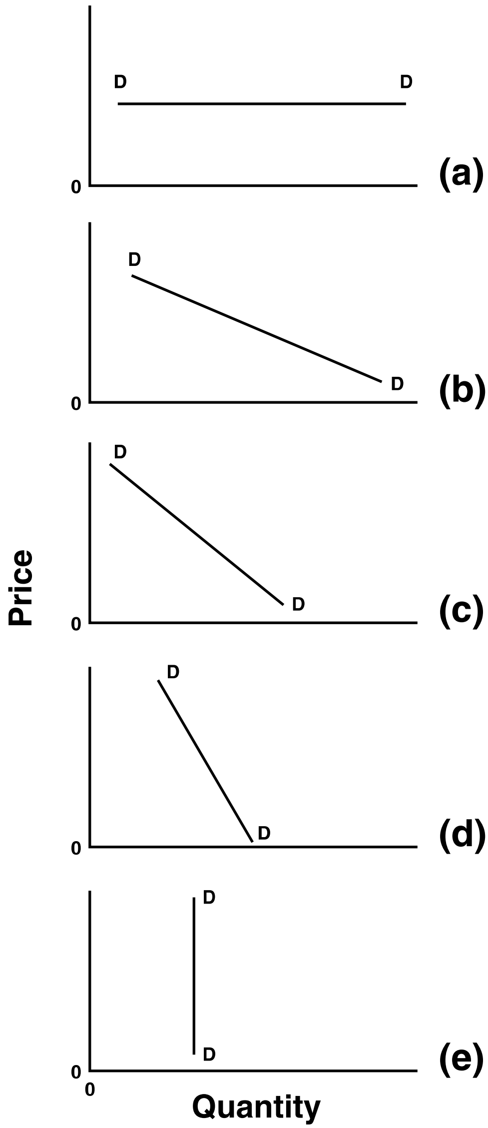

Figure 7.1 Elasticity of demand.

sellers, goods and services. In the case of water, however, price does not always do a good job of making that link.

The term **demand** simply refers to *the relationship between price and quantity of a product in a market where individuals stand ready to buy.* Similarly, **supply** is defined as the schedule of prices at which a *supplier* *will put various quantities of a product up for sale in a market.* As we have seen, for the constant-price municipal supplier, the amount supplied may have no effect on price. This is consistent with the typical condition of high fixed cost and low variable cost, already discussed. Normally, in the marginal analysis model with many buyers and sellers, the intersection of supply and demand curves establishes the price for the product at the industry level. Then the many individual firm suppliers typical of the purely competitive market, each of whom provides *some* of the product, *all* together face a horizontal demand curve for their particular range of production (Figure 7.2).

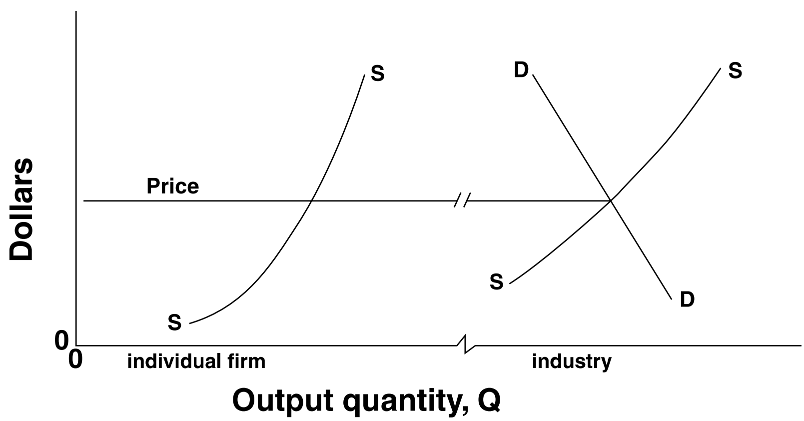

Figure 7.2 Supply, demand, price, and the marginal cost curve.

The supply curve, however, is not so easily defined as is the demand curve. In fact, in the purely competitive market, the supply curve for the industry is the *horizontal sum of all of the supplier's curves*. Each of these is actually the individual supplier's marginal cost curve for the supplier's unit of production.

The **marginal cost** is *the change in cost of production per unit change in output at the level of production at which the increment of output is added*. It is a characteristic of each individual unit of production and, for a particular manufacturing plant, reflects complex interactions between all the various inputs of the production process. In the purely competitive market, the individual producer will, as prices rise or fall, respond by adjusting output (Q) dependent upon the intersection of the marginal cost (MC) and price (P) curves. The resultant level of production is the output that maximizes net benefits, indicated by Q_{mnb}. This conclusion is the result of applying rationality to the production process. Since price (P) is equivalent to **marginal revenue** (*MR*), the supplier will increase output until the amount recovered by selling the last unit of production just equals the cost of producing it (*MC* = *MR*). That is what the rational supplier attempting to maximize net revenue will do when involved in a purely competitive market.

Development of the Model Graphs

Even though managers of (governmental) water supplies may not be attempting to maximize net revenues, and may not even be using marginal cost pricing, they should be striving for minimum losses, or minimum costs. The principle is the same. The reason that net revenues are maximized when *MC* = *MR* is due to the basic shape of the original total **physical product curve** that expresses the underlying relationships between production inputs and outputs. This relationship, for all natural (and, consequently, human-controlled) processes, is a typical S-shaped curve reflecting diminishing returns. This ever-present **Law of Diminishing Returns*** is: *if, to a fixed factor of production, successive increments of input are added, output will increase at an increasing rate, increase at a decreasing rate, reach a maximum, and then decline*. It never fails. A typical total physical product curve is shown in Figure 7.3, and it exhibits the essential properties of the law of diminishing returns.

Instead of expressing cost as a function of input, cost is normally expressed as a function of output.** There are several cost curves shown. The first is the variable cost (*VC*) curve, which is simply the curve shown in Figure 7.4a with the axes reversed. Given the one input that is allowed to vary (all others are presumed to be fixed as required in the definition of the Law of Diminishing Returns), the *VC* curve is therefore defined as *the cost of the variable input*. Since a fixed factor has already been assumed,*** there must also be a fixed cost (*FC*), which is similarly defined as *the cost of the fixed input*. This is shown as a horizontal line, since it is a cost that must be paid regardless of how much *Q* is produced. The third curve in Figure 7.4a is the total cost (*TC*) curve. It is defined as *the total cost of production*, and may be determined (and defined) as: *TC* = *VC* + *FC*. The *TC* curve has the same basic shape as the *VC* curve. Thus,

* The current terminology is Law of Diminishing Marginal Productivity, which relates more practically to the Total Physical Product Curve.

** The convention is to show the dependent variable on the vertical axis, thus output is a function of (dependent on) input and shown on the vertical axis in Figure 7.3, and cost is a function of (dependent on) output, as shown in Figure 7.4a.

***The fixed factor is actually assumed twice: once explicitly in the Law of Diminishing Returns, and once implicitly in holding all other inputs constant.

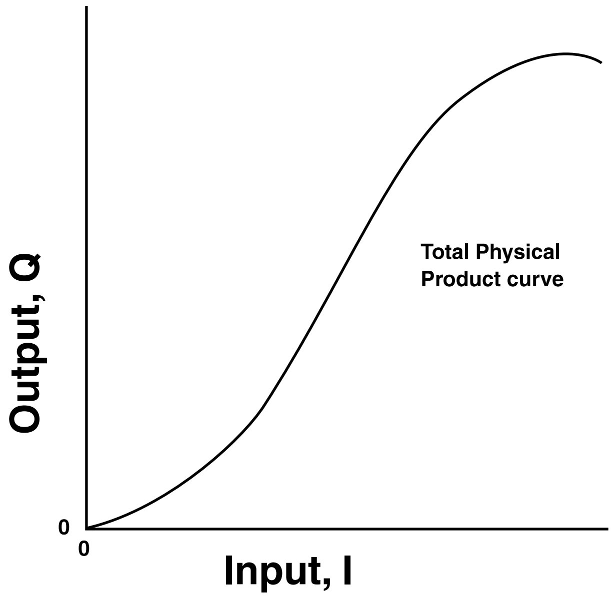

Figure 7.3 Total physical product curve.

either *TC* or *VC* may be used to derive the marginal cost (*MC*) curve, which is defined as *the change in cost per unit change in output*, or more specifically, *the slope of the TC* (or *VC*) *curve*.

Figure 7.4a also shows the **total revenue** (*TR*) curve, the revenue received from selling the output over the range of production output. Since **price** is a constant, this "curve" is a actually a straight line, increasing indefinitely as more and more output is sold. Where the slope of the *TR* curve just equals the slope of the *TC* curve (and *TR* > *TC*), the output that will maximize net benefits (Q_{mnb}) is determined. Note, that since in the purely competitive model price equals **marginal revenue** to maximize net benefits, the Q_{mnb} is determined specifically by the point at which marginal cost just equals marginal revenue, as expressed above.

The *VC*, *FC*, *TC*, and *TR* curves are for *all* of the firm's production, whereas the MC curve is *per unit* of production by the firm. The *MC* curve and some other unit curves are shown in Figure 7.4b. The other curves are the average total cost (*ATC*), average variable cost (*AVC*), and average fixed cost (*AFC*) curves. They reflect what happens to costs as output is expanded over the firm's range of production. Generically, the curves are derived from the amount indicated by the corresponding curve in Figure 7.4b divided by the level of output (*Q*), so, for example, *AVC*

= *VC*/*Q*. Note that the marginal cost curve intersects the *AVC* and *ATC* curve at their minimum points.*

The *MC* curve in Figure 7.4b may be considered to be the same as the *firm's* supply curve (as shown in Figure 7.2). The firm's rational manager will (as noted previously) adjust output so that the cost of the last added unit of production just equals the revenue derived from its sale, that is to say, where *MC* = *MR*. For the purely competitive situation, there are a large number of individual firms, each facing the horizontal demand (*P* or *MR*) curve. Figure 7.4b represents a nonequilibrium situation in pure competition. Since price is substantially above average total cost, new suppliers would enter the market to benefit from the excess profits. This, in turn, expands total supply, shifting the industry supply curve in Figure 7.2 to the right, thereby lowering the intersection of the supply and demand curves and simultaneously lowering the price.

Fitting the Water Purveyor to the Model

For the water supply situation, there is only the one "firm," usually a unit of government (municipality, district, or water supply board), but it still faces a horizontal demand curve, even though the fact that it is horizontal is the consequence of the supplier's own doing and public opinion. Thus, some of the same observations may be made about the economics of water supply situations that are made about firms in purely competitive situations. For example, if price falls below the minimum point on the *ATC* curve, production can continue as long as revenues remain high enough to cover the average cost of production (*AVC*), and as long as the fixed costs can be either delayed or paid by another revenue source. The latter is typically what happens; general tax revenues (or general obligation bond income) may be used to pay the fixed costs, while direct sales will be used to cover the variable (production) costs. The fixed costs may also simply be deferred, leading to deficit financing and long-term economic stress. If price falls below the minimum point on the *AVC* curve, the water supply unit will be operating at an absolute loss, and the situation demands a different solution, such as raising the price.

* The reason for this is that the *MC* curve is the slope of the *VC* curve at each point along it: at one of those points, extending the (instantaneous) slope will intersect the origin of the graph. This is the same line representing the *AVC*, that is, a line drawn from the origin to a point moving along the *VC* curve (*VC/Q*). The point, upon inspection (and more rigorous proof, if desired), will be seen to be the minimum point on the *AVC* curve. Since the *shape* of the curve is what is important, and the shape of the *VC* and *TC* curves are the same, the observation that the *MC* curve passes through both minimums is valid.

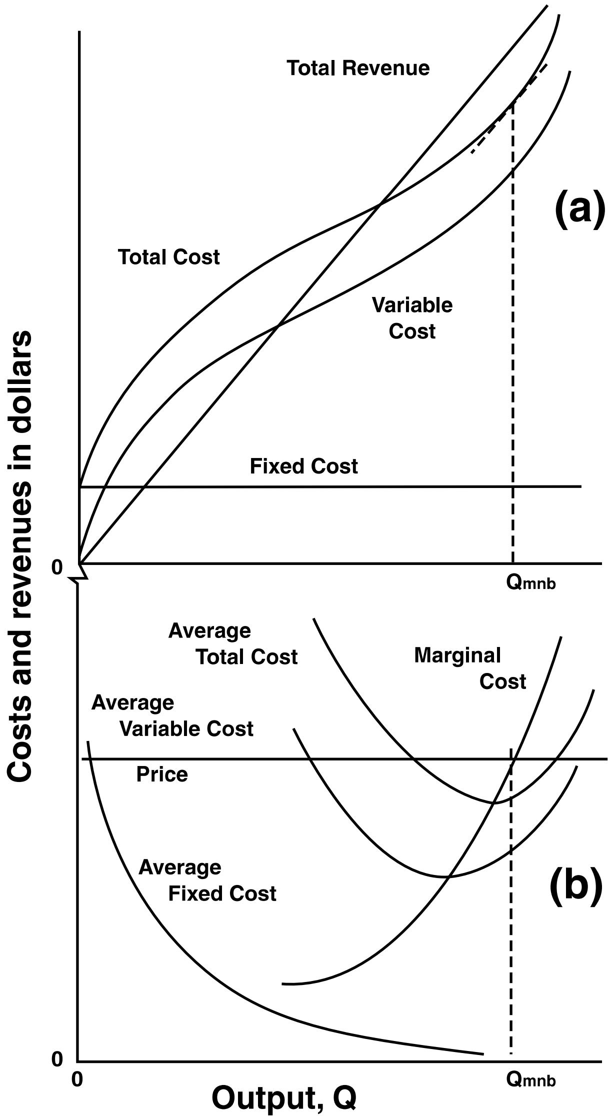

Figure 7.4 Marginal analysis model: total (a) and unit (b) curves.

It is important at this point to recall that water has a unique economic characteristic, namely, that fixed costs are typically high and variable costs are very low. This "water closet analogy"* demands consideration of two changes in the typical depiction of the costs curves shown in Figure 7.4.

* It costs several hundreds of dollars to install a toilet, but only pennies to flush it.

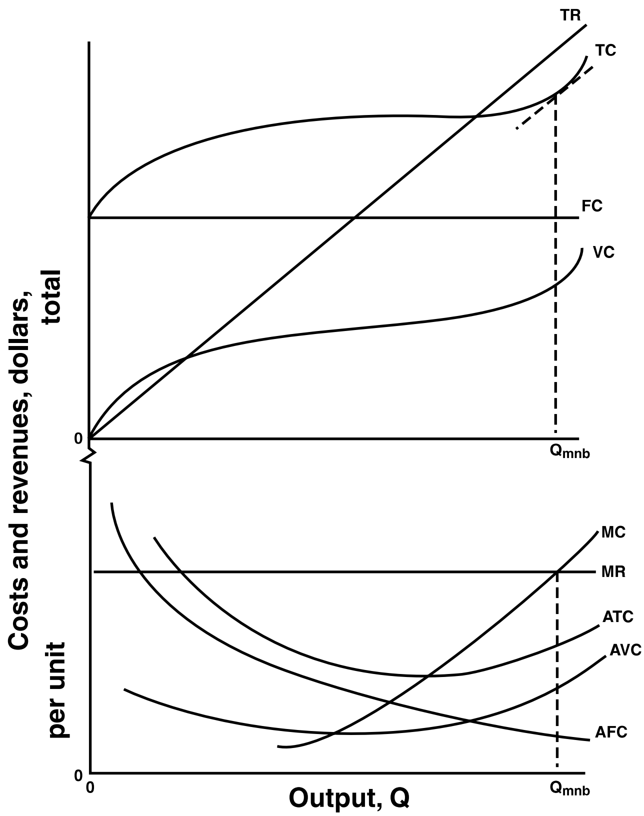

Figure 7.5 The model's cost curves as affected by high fixed and low variable costs.

First, positions of the all-production-cost curves are different as shown in Figure 7.5, but the *relative* positions and shape remain the same. Second, the *ATC* and *AVC* curves are now spread out, each like a broad, shallow dish. This is of considerable importance to long-range planning.

Extending the Model's Applicability

The marginal analysis model may also be applied to either multiple-input or multiple-output situations. The former has been developed in great detail by Maas and Hufschmidt (1960), while the basic theory and application for multiple, complementary outputs (where it is cheaper to produce two or more products together rather than separately) for natural resources management was developed by Gregory (1955). The constraint here is that there is a sizeable joint cost which, for water resources projects might be a dam and reservoir providing multiple services and water supply. It has also been applied to timber and water production from a municipal watershed (Black, 1963) where the joint cost of production is in the land, and to a variety of purposes of river basin management schemes (Krutilla and Eckstein, 1958). The theory underlying the solution is the same in either problem, with the major difference being in the complexity of the mathematics needed to achieve solutions.

The many possible combinations of outputs and inputs in a scheme for river basin management require computer solutions to the problem. Even with high-speed, large-capacity modern computers, however, the underlying total physical product curve expressing the basic relationship(s) must be known. That is often the most difficult piece of information to obtain. The availability of modern computer programs permits approximating the basic total physical product relationship even if its fine detail is unknown. Sensitivity analysis can then be performed with multiple "runs" to evaluate the range of system scenarios and to provide guidelines for extending research and management. Such analyses can be of considerable help, too, in evaluating the impact of imprecise predictions and/or planning based on uncertain population and demand data.

Wantrup (1955) concludes "that there is no substitute for benefit-cost analysis in public resource development. Its role in the actual course of affairs may be unspectacular, but properly used is worthwhile." The basic concepts of BCA are founded upon the model that is developed above; Wantrup's conclusion and cautions apply to it as well.

Before examining the Benefit-Cost Analysis procedures, it is necessary to examine interest, which is a major component cost of water development projects and consequently has a profound impact on the final interpretation of the model and other water resource economic issues.

Interest

Some Basics

The rate at which money is discounted from future values to present values is the reciprocal of the interest rate, sometimes referred to as the "discount rate." The two words are often used interchangeably, which is unfortunate because the term **discount rate** officially refers to the interest rate at which loans are offered to prime customers by leading banks, set or limited by the Federal Reserve Board. A better, and simple, definition of **interest** is *the cost of using money*. It is expressed as a percentage.

The Formulae

Convention establishes a formula for determination of the future value (V_n) at n years of a present value (V_0) using an interest rate (i), compounded each n. Thus, the *future value, compound interest formula* is determined by:

$$V_n = V_0[(1 + i)^n] \tag{1}$$

This formula could be used to determine the value of an investment as an alternative to a current expenditure on a water works. In each of the formulae, the literal translation is in the form of "the future value of the present value" where the word "of" represents the equal sign. To complete the operation, one multiplies the value in the brackets by the quantity on the right of the equal sign. For example, a basic concern in using Formula (1) is to translate values from one point in time to another. Thus, an applicable question might be, "What is the value to the community of this high-fixed-cost flood control project 25 years from now, as compared to setting the money aside to provide flood relief if and when it is needed?"*

Formula (1) may be solved for V_0 to determine the *present value of a future sum:*

$$V_0 = V_n[1 \div (1 + i)^n] \tag{2}$$

This formula might be used to answer, for example, "What is the present value of a day's worth of lake-trout fishing after a proposed reservoir has stabilized following construction and stocking?" That value might be compared with a current value for some other, readily available recreation opportunity that a recreation user might consider spending money on, so as to assist in making a decision about the reservoir investment.

Formula (1) may also be used to determine the future value of a stream of equal periodic benefits (a), for example, from the sale of a project's service such as hydroelectric power. The value of a is substituted for V_0 and, when all the results of using the formulae for each n years are added, a new formula may be derived that can be used to directly (and more efficiently) evaluate the *future value of a series of equal annual terminable payments*:

$$V_n = a[((1 + i)^n - 1) \div i] \tag{3}$$

* This is a rather simplistic example, which will be discussed more completely later.

The entire Formula (3) can be discounted to the present by applying Formula (2) to both sides, yielding yet another formula that can be used to determine the *present value of a series of equal annual terminable payments*:

$$V_0 = a[((1 + i)^n - 1) \div (i(1 + i)^n)] \tag{4}$$

This is a very useful formulation of the fundamental interest equation. For example, one can calculate the present value of a bond that has a life of 17 years and pays \$1,000 per annum. At 7 percent, the current value would be equal to:

$$\$1{,}000[((1.07)^{17} - 1) \div (0.07(1.07)^{17})]$$

$$= \$1{,}000[(3.1588 - 1) \div (0.07(3.1588))] = \$9{,}432.58$$

Note, that if 9 percent were used, the present value would be \$8,543.70, lower because the higher interest rate *discounts the future more*. This observation becomes particularly important when considering conservation alternatives, as discussed in Chapter 9.

The reciprocal of Formula (4) is useful for the determination of life insurance premiums and yields another useful formula that equates an annual amount (annuity) with its present value. It can be used, for example, to reduce a series of annual recreational benefits from a project to a present value. This current value can then be added to similarly-calculated current values for other project benefits, and the sum of the present values can then be compared with the current value of all costs to determine the benefit-cost ratio, *B/C*. Or, if the question is, "What will the managerial unit have to pay lenders each year over the economic life of a project in order that the high fixed cost may be paid now?," using Formula (4) to solve for the annual payment, *a*, yields the *annuity formula*:

$$a = V_0[(i(1 + i)^n) \div ((1 + i)^n - 1)] \tag{5}$$

Adding that value to the annual (variable) costs may then be compared with annual project revenues to determine whether the project's *B/C* is greater than some given value or that of an alternative investment.

A special application of the formula for the present value of a series of equal annual terminable payments is useful when n is allowed to become infinite. As n gets very large, the value in the brackets approaches the value of 1, and the formula reduces to the *capital value formula*:

$$V_0 = a \div i \tag{6}$$

Formula (6) can be used when the market value of a farm or some other income-producing unit is desired. Such information is needed for determining the purchase price of farm land, which presumably can produce an income in perpetuity, that will be inundated by a reservoir, for example. The answer from this formula can be the starting point for negotiation of that price at which the land will change hands, although it must be realized that the buyer and seller in all likelihood will be using different interest rates. Thus, the governmental buyer typically will be using a lower interest rate* than will the private seller. The latter will be expecting the dollars received from the sale to provide an investment with a similar or better rate of return.

Note, finally, that Formula (6) may also be solved for i, thereby defining the interest rate as the (percentage) income from an investment or, as stated at the outset of this section, the rental (cost) of money:

$$i = a \div V_0 \tag{7}$$

In sum, these formulae are essential for effective evaluation of water resource development projects. Different formulas may be used to equate with present value a string of annual benefits that accrue to a project, or to find the annual amount necessary to equal a present fixed (first) cost, such as the annual payment that will have to be made to pay off a public loan or bond issue. The values of the portions of the first five formulae enclosed in brackets ([ ]) were tabulated in an appendix to the *Handbook of Chemistry and Physics*, but lately any of them — with any combination of values — may be readily determined on hand-held calculators and/or applied in original or commercially available computer software.

"Parts" of the Interest Rate

The interest rate, represented by i, is actually made up of five "parts," although they are indistinguishable within the overall expression. These are (1) the pure rate, (2) the risk rate, (3) the profit rate, (4) the individual time preference rate, and (5) the inflation rate.

The **pure rate** is the low interest rate typically available from long-term, sure investments, such as the original government E bonds.** This value has increased from the post-World War II period, when it was under

* The reasons for the lower interest rate are twofold: first, the government typically has more money available and thus values it less, reflected in the lower cost (rental) of funds, and second, the government isn't planning on using the land for producing income once it is purchased: it will be under water and completely unproductive.

** These bonds keep the government rate low.

3 percent, to the current (2000) rate on Series EE bonds of 8.36 percent.* The official rate established by the Director of the Water Resources Council according to the formula in Section 80 of the 1974 Water Resources Development Act has been very close to this value. For example, the rate for the 1981 fiscal year (October 1, 1980 to September 30, 1981; also the *Water Year*) was 7.375 percent (Water Resources Council, 1980b). The rules do not permit the WRC to change the rate by more than 0.25 percent in any year; thus the official discount rate has changed at a much slower pace than the typical home loan or prime rates banks made available to preferred customers. This legislatively slowed formulation had a tendency to dampen the observable interest rate fluctuations which, in turn, helped keep the interest rates low after World War II, when water (and other public works) projects made up a significantly larger proportion of the federal budget than is now the case: entitlements make up a much larger proportion of the federal budget today. With the decline in structural projects in the last quarter of the 20th century and the reduction in the percentage of the total federal budget earmarked for big projects, the significance of the WRC's annual pronouncement had much less effect on the overall economy of the nation.

For any investment that involves some risk of loss over and above that normally associated with long-term government bonds, a **risk rate** should be added to the pure rate. This is rarely, if ever, done for large government projects, yet the risks — especially for water resources development projects — are great. Risks to water resources projects may derive from obsolescence, market failure, or physical loss. For example, technological developments during the long economic life of a project may be readily expected to render a particular type of hydroelectric turbine obsolete. Or the market for a particular product from a project may fail, that is, demand may deteriorate for any of a number of reasons. Finally, and perhaps most prevalent, the design capacity of the hydrologic project may be exceeded, causing physical failure of the structure or appurtenant facilities.** Interestingly, science and technology have probably provided a better assessment of hydrologic phenomena than any other environmental variable; the actuarial data is of high quality and long duration.***

The risk of loss may be *predictable* (in which case the likelihood of occurrence is known and actuarial data are available), or *uncertain*

* As of this writing, the Federal Reserve has increased the "prime" rate to 9.25 percent.

** This is not the same as physical failure owing to faulty design or construction, but that is also a possibility.

***Significantly, the long duration may work against the solidity of the actuarial base since the longer the period of record, the more likely is the chance of observing unusual events, some of which may be from long term and hitherto undetected natural climatic cycles or anthropomorphic climate change, or both.

(in which case no precise methods to insure against loss may be taken). In the first instance, the risk of loss may be accounted for in the project's evaluation by increasing the interest rate to accommodate the risk by an appropriate amount. In the second case, less definitive methods are available and will be discussed in the section on Risk and Uncertainty.

The **profit rate** and the **individual time preference** rate are largely confined to the private sector of the economy and thus do not play a role in the large water and related land resources projects analyzed according to the WRC interest rate. Profit rate can be generally defined as the rate that the market will bear, largely as the result of imperfect knowledge, and the individual time preference rate is the rate that reflects each person's unique financial circumstances.

The **inflation rate** is the rate that is influenced by the government in order to control economic growth, owing to the interaction among interest rates, generally, the money supply and the current rate of inflation (Ross, 1981). With a large money supply and low interest rates, inflation is apt to occur; the way to control it, according to Ross, is to reduce the money supply. But to do so and to simultaneously maintain the necessary balance to keep the nation's economy healthy and out of a major recession, the Federal Reserve Board restricts the reserves (the banks' limit on lending). The effect is to increase competition for money, and therefore increases in the cost of borrowing occur, hence, the "inflation" rate. Since the interest rate generally expresses the rate at which the future is discounted, runaway inflation with attendant increases in the discount rate works against any kind of saving, including conservation. With large projects in water and related land resources representing a major investment in the future, the inflation rate could have a dramatic effect on spending, especially for capital-intensive (high fixed-cost) projects.

Note that the inflation *rate* is not the same thing as the word "inflation." Inflation has a profound impact on project economics. For example, a municipality may decide to proceed with a water treatment plant this year because it anticipates that costs will rise dramatically in the years immediately ahead due to inflation. However, the costs of capital-intensive projects are "up front" as fixed costs, while most of the benefits are not receivable until well into the project's economic life. Furthermore, the benefits are often spread out rather than lumped together. Finally, the value of money, expressed in the discount rate and reflected in inflation, will have an important influence on the evaluation of the project. For the practical purposes of pre-construction planning and evaluation, inflation is often assumed to have no net effect because it affects both benefits and costs equally. That assumption is not always true for capital-intensive projects, however, since current fixed cost is not affected by inflation, unless the fixed cost is spread out over the project's life by bond repayments. "The impact of inflating prices in [one] procedure is fully and exactly offset by the inflationary component of the discount rate. For this reason, general inflation, affecting all prices equivalently, is not a substantive concern in project evaluation" (Fortin and McBean, 1984). Hanke, Carver, and Bugg (1975) suggest that using real prices can minimize the effects of inflation on the analysis and real opportunity costs, as opposed to "nominal financial interest rates."

The bottom line is that with the higher risk of water resources projects, the interest rate utilized in pre-project construction and planning *ought* to be higher. However, as shown below, the exponential increase in present value of costs associated with even a small increase in the interest rate often renders the benefit cost ratio unacceptable.

Interaction of Interest Rate and B/C

With high fixed costs, interest charges become a major portion of the total project cost. In one case, a change from 3.25 to 5.33 percent in the interest rate used for project evaluation caused a one-third decline in the ratio of benefits to costs (*B/C*). In light of this calculation, Whipple (1968) states, "the choice of interest or discount rates is not a minor item. … What would happen to this and other capital-heavy projects if the rate of discount of 10 percent were to be applied would be too distressing to contemplate." The discount rate was at that level in the 1970s, and the result was that many "capital-heavy" projects were not economically justified by BCA.

The interest rate can be a significant portion of the costs of a project, especially where the fixed cost is high and the economic life is long. Using the "Rule of 70" allows one to quickly calculate how much the interest on a borrowed amount will be. The Rule of 70 yields the approximate doubling time (in years) when the number 70 is divided by the specified interest rate. For example, if the interest rate on a $100,000,000 project loan (or bond) is 7 percent, then the doubling time is $70 \div 7 \cong 10$ years. That means that over the course of an economic life of 50 years, there will be $50 \div 10 \cong 5$ doublings of the amount loaned, or a total cost of $3,200,000,000. With the low interest rate set by the Water Resources Council, for example 3 percent, the doubling time is $70 \div 3 \cong 23.3$ years and there are only slightly more than 2 doubling periods during a 50-year economic life, substantially reducing the final total expenditure. Thus, it is clear why builders of big projects wish to keep the interest rate low.

It is acceptable, in the conduct of a pre-project evaluation using Benefit-Cost Analysis, to use different interest rates for different components (e.g., private and public sectors) of the analysis procedure. And, the choice of the project design or even the basic approach to resolving a resource problem, may be selected in light of the alternative use (opportunity cost) of the capital (Nudds and Bottomly, 1976).

Summary

An excellent summary statement on interest appears in the *Green Book* (Subcommittee on Benefits and Costs, 1950) and is reproduced here in its entirety:

> Interest and discount arise because of the competing demands that exist for limited supplies of savings available for capital investments yielding returns in the future. The demand for saving stems largely from the opportunities for productive use of capital. With the supply of existing capital and savings limited, opportunities exist for new capital investment that over a period of time will yield a return in excess of the initial investment involved. Thus, the opportunities of obtaining net returns over costs from utilization of income-yielding goods constitute a major source of demand for savings. The supply of individual savings available for investment is limited principally by the preference of individuals for present over future goods. Because of higher valuations that individuals place on present goods, a payment in the form of interest is needed to induce savings and compensate for the current use that is foregone. Consequently, interest rates may be considered as an expression of the exchange relationship between present and future goods. This premium or interest rate is the added value of having resources presently available in comparison with future values. For comparison with present costs, the determination of the present worth of goods available in the future involves scaling down or discounting future values.

Since many of the definitions and fundamental concepts enunciated in the *Green Book* have been readily — and quite logically — used in the later *Principles and Standards* and in the more recent *Principles and Guidelines*, it is important and instructive to examine the basic principles of benefit-cost analysis as well as some analytical implications.

Benefit-Cost Analysis

Introduction

Benefit-Cost Analysis (BCA) is simply the comparison, at some common point in time, of all the benefits and all the costs associated with a proposed project (Bromley, 1980b). If the ratio of all benefits to costs is high enough and at least exceeds unity except in special circumstances, the project is economically justified. Whether it is actually constructed or not is dependent upon a number of additional factors, such as aesthetics, economic priorities, environmental quality, national defense, and political considerations. It is important to keep differences between fundamental economic analysis and the policies that apply to the results of that analysis clear. Confusion between the two has resulted in "[C]riticism of federal policy in the field of resource use [that] has likewise concentrated on supposed abuses of the technique rather than its inherent limitations" (Hammond, 1966). "Benefit-Cost Analysis," continues Hammond, "even though conducted with refinement and sophistication, [is] unable to replace judgment in the making of decisions, but it depends at every point on judgment in the choice of assumptions. It is the creature of policy, and *to treat it as a determinant of policy is to argue in a circle*" [emphasis added].

The discount rate is what is used to compare the benefits and costs at a common point in time, usually the present, although the evaluation may be accomplished on an annual basis. There remain many additional details, most of which are identified and discussed in the *Green Book*. While that document has officially been superseded, the agency rules and regulations it spawned for compliance have not necessarily changed, nor have any of the fundamental economic concepts. Thus, many of the original definitions and procedures remain in force. The language in which some of these basic concepts were expressed in the *Green Book* has carried through to present-day manuals, guidelines, and even the current *Principles and Guidelines*. In some situations, the language is locked in by court decisions (Brookshire et al., 1983). Furthermore, the economic model basic to many of the guidelines has not changed either, and interpretations of the *Green Book*'s pronouncements may be comprehended in the light of that model. Several of these are discussed in this section, although the actual method by which BCA takes place — the allocation of joint costs — is not covered. The problem is one of accounting and detailed agency procedures, and is very often the deciding component of BCA, even to the point where one or more of the fundamental principles is overridden.

Principles

There are several principles discussed in the *Green Book*. There is no official list of principles, rather, eight fundamental concepts are highlighted and, herein, are called "principles." The first of these is the one relating to the overall evaluation objective, the **comprehensive public viewpoint** discussed in Chapter 6. The remaining seven are as follows.

B/C Greater Than Unity

Intuitively, this principle is one to which all could subscribe. However, it should be remembered that it wasn't until passage of the 1936 Omnibus Flood Control Act that a piece of legislation mandated no action unless "the benefits to whomsoever they may accrue exceed the estimated costs." Further, the methods by which costs and benefits are defined and evaluated are critical to being inclusive and accurate, respectively. Finally, there are some projects, such as those dedicated to national defense, for which a "negative interest rate" may be used, that is, the project may be justified even though the *B/C* value is less than unity.

Separable Segments

The *Green Book* further mandates that each separable segment of the proposed project will not be acceptable unless the value of *B/C* for each unit also exceeds unity. It is clear, then, that exactly how large fixed costs of a project are allocated to each segment or purpose becomes critical in the determination of the *B/C* for each separable segment. Manipulation (creative bookkeeping) can provide the opportunity of adjusting the allocation of joint costs (normally, the high "first" cost or *FC*) so that each separable segment can exhibit a favorable *B/C*. The current *Principles and Guidelines* (Water Resources Council, 1983), refer to **separable features**, each defined as an "element that can be implemented or constructed independently of other features and that does not depend on other features for its structural (or other) integrity."

With-and-Without

The first principle in the *Green Book* under the heading "Objectives of Economic Analysis" is stated as follows:

> The ultimate purpose of an economic analysis of a project is to ascertain the extent to which the use of economic resources

> such as the land, labor, and materials necessary for a project is more or less effective than would be the case if the project were not undertaken.

This statement caused sponsors of all project proposals to include an analysis of benefits (primarily) with and without the project. Essentially, and using the basic economic model (see Figure 7.4), this meant comparing situation economics at the zero level of output, and at some other level of *Q*, presumably, at the level that would maximize net benefits (that is, at Q_{mnb}, or where $MC = MR$). Whether that one point was always the proposed project's design output level, and whether there were other levels of output (alternatives) that might be considered on the basis of criteria other than economic ones, was a matter of chance or good planning by the designer of the project. Good engineering often can specify the level of output, based on a given topographic resource such as a dam site, that will maximize net benefits with the aid of the best computer available, the human brain.

In fact, the consideration of alternatives, the basic issue that this statement of principle addresses, is at the center of many controversies over the development of water and related land resources. It is also declared to be the "heart of the environmental impact statement" (EIS) in the CEQ's regulations (Council on Environmental Quality, 1978). The current *Principles and Guidelines* (Water Resources Council, 1983) continue the with-and-without principle, identifying the without condition as that expected "in the absence of the plan." Under the CEQ EIS regulations, it is more specifically referred to as "the null alternative."

Goods and Services

All project goods and services must have value, that is, there must be a demand for the product. This proclamation precludes attributing dubious benefits to a project proposal, and is elaborated upon insofar as the "market" is concerned, as follows.

Market Pricing

The market-pricing system for determination of values of goods and services provided by the proposed project is imperfect, but it is the only method available and thus is a starting point for analysis. Using the term "intangible" that was in common use at the time, the *Green Book* adds that all intangible values should be evaluated as far as possible in the market:

> All project effects, both tangible and intangible, should be fully considered in making project recommendations. Project effects should be evaluated in monetary terms to the maximum extent possible. If market prices are not available, estimated or derived values may be appropriate in some cases. In other cases, intangible effects will need to be considered on a qualitative basis. If the recommended degree of project development is influenced in either direction by specific intangible effects, the minimum value attaching to such effects should be clearly indicated. It is suggested that agencies concerned adopt uniform procedures for the treatment of these effects.

The concept still applies to the nonmarket valued benefits, which include those identified in the *Green Book* as intangibles: national security; strengthening of the national economy; shifting from nonrenewable to renewable resources for power production; disbursement of industry; scenic, recreational, and wildlife values; and human life.

The *Principles and Standards* adopted a willingness to pay standard based upon (1) actual or simulated market price, (2) change in net income, (3) cost of the most likely alternative, or (4) administratively established values. The practice is a ramification of the Water Resources Council Task Force's observation that the public can establish a value for nonmarket-valued benefits. The rationale in the form of public comments and the WRC responses thereto were discussed in the *Principles and Standards*, as published (1972b; 1973).

Maximizing Net Benefits

The *Green Book* clearly states that marginal analysis — the model developed earlier in this chapter — is necessary "to achieve the most effective use of resources." Yet there are inherent contradictions. These are (1) in the increments to be added (the so-called "separable segments"), which "are the smallest segments or increments on which there is a practical choice as to inclusion or omission from the project" (the with-and-without principle), and (2) in the resolution of the ambiguous problem presented by project selection according to marginal analysis versus rate of return. The *Green Book* actually makes the statement that "the ratio of benefits to costs … is the recommended basis for comparison between projects. The dilemma is illustrated in Table 7.1, which presents benefits and costs for five hypothetical projects proposed to achieve some purpose.

Clearly, from the standpoint of *B/C*, Project 1 is to be favored; yet the initial statement dictates that Project 5, which provides the greatest net benefits, is the alternative to be preferred on the basis of marginal analysis.

Table 7.1 Hypothetical Project Economics Comparing Net Benefits and Benefit-Cost Ratios

	Project Number				
Present Value of:	*1*	*2*	*3*	*4*	*5*
Benefits	64	64	150	175	545
Costs	40	44	100	125	485
Net benefits	24	20	50	50	60
B/C	1.6	1.45	1.5	1.4	1.12

Each project has its own strong points and arguments can be made on behalf of both. The dilemma is not resolved in the *Green Book* and is, in fact, made more complex by the application and use of *B/C*. "The authors of the *Green Book* have failed to recognize that there is absolutely no difference in principle between comparing two separate projects and comparing a larger and smaller version of the same project. Hence their recommendations are not merely mistaken but each nullifies the other," says Hammond (1966). He further suggests that "the contradiction is easily removed if one assumes, as the general case, that capital resources are limited. … [I]f the benefit-cost ratio is calculated in such a way as to separate capital costs from running costs and exclude the latter from the denominator of the ratio, the project having the highest ratio will also show the maximum net benefit." Since operation and maintenance costs for major water projects do tend to be small, especially in comparison with the fixed costs, the basic principle of calculation accordingly will be correct.

Ranking

In a subsequent sentence, the *Green Book* states, "The relative desirability of a number of projects can be satisfactorily determined by comparing their ratios of project benefits to project costs." This is referred to as the **Ranking Principle**. Ranking projects by *B/C* value has been used by both agencies and Congress to provide a priority list of projects. Congress presumably will not fund projects that are below some specified *B/C* value, for example, 1.3 and, when necessary, can restrict or enlarge project spending by adjustment of that value. This is what was done under the Eisenhower Administration's "No New Starts" policy, wherein the limit was raised to exclude most projects, thereby halting major government expenditures, which was a political issue. This use of *B/C* masks the earlier lip service to marginal analysis. The choice among reasonably viable alternatives can be accounted for by considering the opportunity for capital investment elsewhere and using the interest rate (in general) to aid in determination of a project's desirability. There was nothing in the 1973 *Principles and Standards* (Water Resources Council, 1973) to contradict, override, or resolve the continuing dilemma. In fact, some of the *Principles and Standards* language has a familiar ring to it, harking back to the birth of BCA in the 1936 Omnibus Flood Control Act, "For purposes of accounting, the distribution of beneficial and adverse effects will be shown to whomsoever they shall accrue."

The vexing choice between evaluation by maximization of net benefits or by highest benefit cost ratio may be made somewhat easier. This is done by application of the former to the analysis of a particular project, so as to be as efficient as possible in the allocation of resources *within that project*. Then, given the best possible scale of each selectable alternative to achieving a particular objective, the choice *between projects* can be reliably identified by selection of the alternative that will produce the maximum rate of return. That way, both principles are applicable and, in fact, useful.

Definitions

Many terms defined in the *Green Book* have been reiterated or refined in the more recent documents on BCA. These include "costs" and "benefits," which are of foremost importance, since net benefits of both the overall project and its separable segments are critical components in the evaluation process.

Recognizing the need for complete definition and knowledge prior to applying the definitions in any sort of analytical framework, the *Green Book* defines key terms. They are abstracted here to show how application of several of the principles is accomplished:

> *Project costs* are the value of the foods and service (land, labor, and materials) used for the establishment, maintenance, and operation of the project, including allowance for induced adverse effects.
>
> *Associated costs* are the value of goods and services needed, over and above those included in the cost of the project itself, to make the immediate products or services of the project available for use or sale.
>
> *Secondary costs* are the value of any goods and services (other than those covered by project and associated costs) which are used as a result of the project.

> *Primary benefits* are the value of the immediate products or services from the measures for which project costs and associated costs were incurred.
> *Secondary benefits* are the values added over and above the value of the immediate products or services of the project as a result of activities stemming from or induced by the project.

Summarizing the section on definitions, the *Green Book* states that "the costs charged to a project must be all costs necessary to produce the benefits attributable to the project," and "conversely, the benefits claimed as project benefits must be net of all costs other than those designated as project costs. Project benefits comparable to the project costs previously defined are the primary benefits attributable to the project plus any net secondary benefits."

Few, if any, project sponsors have conducted analyses that follow these definitions. Most claim irrelevant and questionable benefits, and fail to include adverse effects or **opportunity costs**, defined as revenues forgone due to a decision (Conservation Foundation, 1980). Hammond (1966) pointed out that *Senate Document No. 97* "allowed that national secondary benefits, net of their associated (nonproject) costs, may be included in the benefit-cost ratio. This is an anomalous practice, inasmuch as it excludes secondary costs from the denominator of the ratio and hence gratuitously improves it: secondary benefits thus become more desirable than primary benefits." According to the *Principles and Standards* (Water Resources Council, 1973), secondary benefits were not to be included in the determination of *B/C*, yet current practice contradicts this, even to the extent that "excess power revenues (from other projects) would pick up any deficit" (Burness et al., 1980). Many of the Bureau of Reclamation's irrigation projects are paid for in large measure by sale of electrical power from the same dam.

The *Principles and Standards* (as revised) utilized the same definitions, although not all the elements were identified by the same or standardized nomenclature. The *Manual of Procedures* (Water Resources Council, 1979a) that implemented the *Principles and Standards* revisions applied the basic principles and definitions. It also provided analytical examples for a "cook-book" approach to the complex task of plan and project evaluation. One exception to the wholesale adoption of the earlier definitions is that of "separable features." This represents a major departure from the earlier concept of separable segments, which was profoundly affected by the allocation of joint costs. The current *Principles and Guidelines* (Water Resources Council, 1983) do not contain these definitions *per se*, but do apply the concepts to purpose-specific costs and benefits as discussed throughout the document. Again, some of the original language can be identified all the way through the 50 years of evaluation evolution, testimony to the fact that the basic economic principles are immutable; it is their application, priorities, and emphasis that vary with the changing political climate.

Period of Analysis

The **period of analysis** or **economic life** was, in the *Green Book*, to be "determined by the point in time at which [physical depreciation, obsolescence, changing requirements for project services, and time discount and allowances for risk and uncertainty] cause the costs of continuing the project to exceed the additional benefits to be expected from continuation." The economic life was not to exceed the physical life, and an upper limit of 100 years was recommended. Projects have frequently been analyzed on the basis of a 50-year economic life, and agencies have occasionally presented analyses for both the 50- and 100-year periods. The longer period, of course, exhibits a larger *B/C* value since more time brings in more benefits.

In the *Principles and Standards*, the specifications for the period of analysis are limited to two: (1) "the time required for implementation plus the lesser of (a) the period of time over which any alternative plan would serve a useful purpose, or (b) a period not to exceed 100 years, and (2) consideration of environmental factors "that may extend beyond the period of analysis." Some projects are now evaluated on a more realistic 25-year life, which is especially acceptable for nonstructural alternatives that have been in favor since the 1970s.

There is a tendency to keep the period of analysis as long as possible for structural alternatives because (most of the major) costs are incurred at the beginning of the period, and benefits continue as long as the project remains useful. Thus, the longer the analysis period, the greater the total benefits to the project. Three countering forces tend to keep the period of analysis short. First, the high interest rates currently in effect offer strong competition for investment dollars. Second, there is a trend away from capital-intensive projects and toward nonstructural alternatives that embrace the environmental movement and were articulated in the Water Policy Initiatives of 1978, as well as in the current *Principles and Guidelines* (Water Resources Council, 1983b). The third, one way of compensating for the increased risk and uncertainty associated with massive projects in water and related land resources is to limit the economic life (or to raise the interest rate, which has the same effect).

Discounting

The *Principles and Standards* state simply that "discounting is to be used to convert future monetary values to present values." The same language is used in the 1983 *Principles and Guidelines*. Interest rates are better understood today than they were when the *Green Book* was written.

Unfortunately, in its press releases, the WRC repeatedly used the term "Discount Rate" when it annually fulfilled its mandate to establish the rate at which economic analyses would be conducted. Hoggan (1970) described the confusion and inequities that prevailed prior to standardization when different agencies used different interest rates for calculation of B/C values, different projects were evaluated with different rates as mandated by Congress, and different rates were used for different purposes even within a single project evaluation.

The interest rate that is used to determine how discounting is accomplished in the BCA is set each year by the WRC (see earlier discussions). The formulation reaffirmed the original version of the *Principles and Standards*, which ended one of the two biggest battles over the revised *Principles and Standards*.* Note, again, this applies to the public sector; the private sector uses considerably higher rates to entice investment (Whipple, 1975).

Risk and Uncertainty

We have already seen that the interest rate may include some consideration(s) of risk of loss of the project, or of its goods and services. Accounting for the predictable risk is feasible if actuarial data are available, as would likely be the case if that risk is defined in terms of predictability. Accounting for uncertainty is possible only by providing a contingency fund, by increasing the interest rate, or by shortening the period of analysis. These recommendations of the *Green Book* are echoed in the 1973 *Principles and Standards*, but are not included in the 1983 *Principles and Guidelines*, and state that "risk and uncertainty arise from measurement errors and from the underlying variability of complex natural, social, and economic situations." While this does lead to the suggestion that one way to reduce the potential loss is "increasing safety factors in design" (which is almost the same as providing a contingency fund), it also leads to the suggestion of "collecting more detailed data to reduce measurement error." On the constructive side, the *Principles and Guidelines* define and suggest

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* The other battle was over "grandfathering," that is, applying the new *Principles and Standards* to projects that had already been authorized but had been neither funded nor built.

sensitivity analysis to assist in the determination of loss potential. In addition, the general methods of dealing with risk and uncertainty through using (not necessarily more) better data, refining analytical techniques, using better performance standards, and "reducing the irreversible and irretrievable commitments of resources"* are suggested.

Methods for calculating and allowing for the more improbable occurrences are now becoming available, and recommendations have been made to include disasters as a part of Benefit-Cost Analysis (Mark and Stuart-Alexander, 1977). For instance, better data on unsafe dams were collected, prompted by the rash of dam failures in the 1970s (Jansen, 1980). As a result, methods for calculation of risk rates have been published for dam failures (Baecher, Pate, and Neufville, 1980), for flood risks and insurance (Karlinger and Attanasi 1980), and for new dams (Pate-Cornell and Tagaras, 1986). A method for approximation of uncertainty in the value of *B/C* is presented by Dandy (1986), but even here, some assessment of the degree of risk must be made before a value can be assigned.

Problems

The first and most troublesome problem with Benefit-Cost Analysis appears to be confusion over whether it is considered as a process (the method or analysis) or a criterion (the "bottom line" or *B/C* value itself). Bromley (1980a), who discusses the difference at length, notes that "while I am pessimistic about the benefit-cost analysis in the conventional sense of that phrase, do not assume that I am critical of a benefit-cost approach." Some of the more obvious problems associated with the application of BCA are evident in the previous sections. Scholars of economics in the public sector have detailed others. These problems may be organized according to whether they relate to the BCA's basic assumptions, institutional constraints, or related concerns of national scope.

Basic Assumptions

The marginal analysis model in theory, and the *Principles and Standards* in fact, assume full employment as a condition of analysis. Full employment is not always a characteristic of the economic situation. However, the *Principles and Standards* do call for "an adjustment to the adverse effects of a plan" to whatever extent "unemployed or underemployed

* The wording is taken directly from the National Environmental Policy Act of 1969; this was one of the five original topics to be addressed in an Environmental Impact Statement.

labor resources are limited to labor employed on site in the construction or installation of a plan" (Water Resources Council, 1980a).

Conflicting demands on land, labor, and materials are noted to be dependent upon whether the management objective is efficiency or equity (Kalter et al., 1969). The inability of the BCA approach to divest itself of an almost exclusive efficiency approach is the subject of continuing debate. In a response to a letter to the editor about their original article (Cicchetti et al., 1973) critiquing the 1973 *Principles and Standards*, Cicchetti, Davis et al., (1975) state that "it seems unwarranted for water resource planners to establish a set of standards emphasizing nonefficiency effects and secondary impacts, when their performance in accurately appraising the relative easy-to-measure primary efficiency effects has been so inadequate." Major's (1975) contention is that "according to multiobjective theory, public projects should be designed explicitly in terms of a wide range of social, economic, and environmental objectives." While this is certainly true and desirable in terms of efficient use of natural — and financial — resources, it also provides the opportunity to mask financial finagling in a morass of policies, diverse interests, and political shenanigans.

The debate ultimately focuses on the relative weights applied to the *B/C* developed for each of the objectives. Eventually (and, perhaps, idealistically), the weighting is done by the public through their elected representatives and administrators, and in the hearing process. What project reviewers need is simple, effective, and accurate means to express the benefits and costs from the standpoint of each objective. Considering the two *Principles and Standards* objectives as co-equal as recommended by President Carter in his Water Policy Initiatives, Black (1981) maintained that BCA should be utilized to evaluate the contribution of a proposal to the NED objective, and that the EIS process should be utilized to evaluate the contribution of the proposal to the EQ objective. When combined with President Reagan's removal of the EQ objective from the *Principles and Standards*, this consideration perpetuates the existence of environmental impact analysis, for which no agency operational funds were appropriated since the process was supposed to be included in all planning operations. The two are, of course, inextricably linked.

From this perspective, it is likely that a simple series of *ex post* studies of projects would resolve some of the difficulties of predicting benefits and costs. Yet only a few such studies have been published, and those have not always confirmed the widely held hypothesis about agencies "selling" their own projects by overestimating benefits and underestimating costs. Oyen and Barnard (1975), for example, point out that "actual benefits … were about one-third greater than the projected benefits." On the other hand, an *ex post* evaluation of a flood control project in North Dakota showed flood control benefits 37 times the anticipated value, and water supply benefits at zero instead of the anticipated 92 percent (Palanisami and Easter, 1984). The precision with which predictions are made would affect post mortem evaluation as well, and given a wide enough range, any prediction could be declared to be correct. Hanke and Walker (1974) report that different analysts of an irrigation project differ on the value of the *B/C* value owing to "disputes over basic assumptions and widely divergent choices as to the "correct" solutions to difficult issues such as the level of interest rates, the value of wildlife, the effect of government programs on agricultural markets, and the impacts of political and administrative expedients." Even with greater precision of prediction, effects would be difficult to verify in the absence of statistical control studies or replications.

Another implicit assumption is identified by Westman (1972) in a discussion of water pollution control legislation, namely that "clean water has been identified more with public welfare than with public health [and safety]." That attitude is clearly changing, but because water quantity and quality are so closely interrelated, the same may be said of virtually all projects in water (and related land) resources. The public and legislators consider the standards and urgency of programs aimed at health and safety in very different lights than are those involved with welfare. The implication is that concerns of health and safety deserve higher priority than those of welfare to whatever extent the latter term excludes the former two. Some of the difference can be accommodated in the use of different interest rates, thus reflecting the government's (or its citizens') values. Westman elaborates on the economics-environmental issue, "The question is in fact a question of personal values and how much a clean environment and the survival of the species, including man, is "worth" to an individual. … it is time to settle the issue of where in our priorities [on] environmental health will be placed." One can readily formulate this tradeoff in terms of the individual time preference (interest) rate.

Baram (1980) concludes that "for regulatory decision making on health, safety, and environmental problems … cost-benefit analysis is an inappropriate tool" and that "it should be replaced by the judicious use of cost-effectiveness analysis." Cost-effectiveness analysis generally entails finding the alternative that provides the least costly path to a desired goal. More specifically, it entails finding the alternative that has the minimum average cost per unit of desired output when the output is quantified in nonmonetary terms. Cost effectiveness is most frequently, and perhaps was originally, applied to military problems (Alchian, 1967; Fisher, 1973).

Finally, there is a built-in contradiction with any model that makes use of fixed costs in analyzing a long-term production process involving water and related land resources projects or programs to evaluate maximum net benefits, maximum benefit-cost ratio, cost effectiveness, or even just how much to produce. The problem concerns the *long run* which, ironically, is defined as that period of time in which no factor of production is fixed. While a typical 50-year period of analysis may not be officially defined as "the long run," it is certainly a long period of time in which to rely on fixed factors. Yet, the high initial investment in water and related land resources projects does in fact reflect the high fixed-cost (the cost of the fixed factor) and, inevitably, an escalation of the cost in the form of interest charges on the borrowing necessary to effect the project. The ultimate consequence is to shift away from structural alternatives.

Institutional Constraints

There are five constraints that are exemplary of their source. These include constraints from legal, happenstance, or historical events, grouped in the economic, legislative, and political arenas.

Economic. Two serious problems arise in project evaluation economics: one in the "market" for public water, and one inherent in the current application of BCA. The first relates to the verity of price as basis for evaluation of water. Wantrup (1959) maintains that there is a "breakdown and malfunctioning of the price system" because "(1) price signals do not exist; (2) price signals are not received by the agent who makes decisions but are received by others; and (3) price signals are 'distorted' in a defined sense." Wantrup's reasons behind this inability of the price system to provide a base for evaluation of decision making is that the watershed is a natural unit of production and supply, not of consumption, and that the watershed is not always the best unit for policy making. The natural/artificial boundary problem persists.

The problem inherent in BCA is abetted by the mandated inclusion of land enhancement values in the evaluation of flood control projects. The inclusion of this benefit leads to a vicious cycle that ultimately results in greater life and property losses, as well as loss of valuable food-producing floodplain lands. The cycle is started when a flood control project causes an increase in value of the protected lands. Subsequently, those lands are shifted to a higher income-producing use in order to return more rent to the land and thus to pay the higher taxes that are assessed because the land is worth more. The higher value use requires (and can afford) more protection; thus the cycle is continued (Black, 1973). There are other, less obvious built-in deficiencies in the application of BCA (Haveman, 1965).

Allee and Chapman (1973) summarize several economic dilemmas. First, "benefit-cost analysis rests on the reasonableness of marginal analysis and the notions of welfare economics." The former is not necessarily inclusive, and the latter "is in some disarray." Second, since most water goods and services are not marketed under competitive conditions and are usually highly regulated, prices do not function to ration production or consumption. Third, public investment is biased toward higher income groups, owing to different evaluation by recipients of the benefits from applying national income or welfare criteria. And, fourth, since the economic gains and environmental damages from water development projects are likely to be received by different groups, it is usually the people in low-income groups who once again bear the brunt of the environmental costs.

Legislative. The principal legislative constraints on water projects appear, at present, to be two particularly western regional problems. The first is the question of water rights for Native Americans (and its extension to all "reserved" rights discussed in Chapter 2). This issue is having a profound effect in its own right but, when combined with the related inclusion of instream uses as an official beneficial use in Appropriation Doctrine states, it makes economic evaluation of western water projects even more complex.

The other constraint is the 160-acre limitation that was initially a part of mid-19th century legislation aimed at disposal of the public domain lands and settlement of the West. The limitation was considered reasonable for a dry-farm enterprise, but inappropriate for irrigation because water must be developed for areas larger than 160 acres (National Water Commission, 1973). Larger agricultural equipment has led to economies of scale that tend to favor larger tracts of land as well, thus squeezing the one-family farm of 160 acres (320 for a household). The limitation has been widely, repeatedly, and innovatively circumvented (Jones, 1978). Large corporate interests hold vast properties in California and elsewhere, thereby controlling an extensive agribusiness and having a disproportionate impact on labor, especially migrant labor, on immigration, relations with Mexico, and on highest-level politics (Barnes, 1971). The National Water Commission (1973) recommended that the 160-acre limitation be eliminated "if direct beneficiaries pay, in full, costs of projects allocated to irrigation." The recommendation has not been acted upon,* nor has the 160-acre limitation been eliminated. The problems of growing inequities — and loss of "mom and pop farms" — thus remain an influence in large irrigation project evaluation.

Political. The principal problem in the political arena is that water projects, especially, lend themselves to the institution known as the "pork barrel." The institution is variously defined. In one article, Hanke (1980) defines the term, "If the 'objective' benefits of a public works project are anticipated to be less than its 'objective' costs, the project is referred to as a pork barrel project." In a parallel editorial, Bromley (1980a) reports,

* This remains true; although in the fall of 1985, Utah voters accepted responsibility for an increased share of the costs of the Central Utah Project.

"Political scientists consider a Pork Barrel undertaking to be one in which decisions in a legislative body are made without regard for the combined benefits and costs" and emphasizes that it is the process in which the decision is made that is important to the definition. Water projects are particularly good pork barrel subjects for "a dam or levee is, literally, a concrete symbol the congressman can point [to] to show he can bring home the bacon" (Senate staffperson, quoted in Moody, 1983b). L.J. Carter (1977) defines it as "the long-standing congressional practice of logrolling, of mutual back scratching and accommodation, of putting good, bad, and mediocre projects into one big bill, then resolutely fending off those who would tear the bill and the pork barrel apart. Party lines mean nothing here, for the pork barrel is a nonpartisan institution." The most familiar and somewhat degrading definition is a *quid pro quo*.

This is the institution that President Carter had attempted to modify or, in part, set aside in favor of some sane economic and environmental *B/C*s at the start of his presidency. His political losses were substantial; his celebrated "hit list" played a role in his 1980 defeat because he could not obtain the necessary congressional support in many parts of the country. In the face of such a strong institution, "straight" economic analysis of project benefits and costs, such as that proposed in the entire BCA process, may be severely compromised.

One astonishing example of pork barrel abuse was reported by Moody (1983a): "Not content to rest his oars with Tenn Tom,* Tom Bevill [D. Alabama] also lobbied for the Coosa Waterway, a 197-mile project north from his Birmingham District. Estimated cost: $1.3 billion. The best the Corps could do was to figure the BC ratio — benefit to cost — would be 0.55." Moody quoted one Corps official as saying, "The only way to get a positive BC on the Coosa is to fly over it and kick money out of the plane." It is no surprise that an accordingly accurate definition surfaced in a network TV news report on November 23, 1981, which identified the pork barrel as "funneling federal tax dollars into a local legislator's home district." Somewhat more facetiously, another TV report identified the pork barrel as "spreading government money on local improvements to please the voters." It should be pointed out, in light of this last definition, that while it is the legislators who perpetrate the institution, it is the voters who either encourage it or turn their backs on the practice.

The water resources pork barrel is not dead. The reduced federal spending associated with Reaganomics and the end-of-the-century emphasis on nonstructural alternatives has canceled much of the pork barrel effect (Moody, 1983a), but has not eliminated it. A *New York Times* story date-lined November 6, 1986, reported the veto by President Reagan of

* Tennessee — Tombigbee Project.

the $18 billion extension of the Clean Water Act after the bill had been passed by both houses of Congress without dissent. The major provisions of this bill were to provide continued waste treatment grants, and to begin new programs directed at nonpoint sources, especially urban and farm sources. A scant 11 days later, President Reagan signed into law a $16.3 billion water projects bill, the first comprehensive water projects bill since 1970. The bill required only a small change toward having local beneficiaries pay their share of the costs (the bill mandates that local interests pick up 25 percent of the costs and introduces new user charges), nevertheless, the small change is a step in the right direction.

One recommendation that might indeed eliminate or severely curtail the pork barrel calls for an independent board of review, as suggested by the National Water Commission (1973) and Carter (1973).

Problems of National Scope

In addition to ubiquitous problems of floodplain management and environmental quality, which relate to the already-discussed public health and safety problems, several other nationwide concerns were identified and discussed at a National Conference on Water sponsored by the Water Resources Council in 1975. Included were interrelationships between water development and comprehensive planning, energy conservation, food production, population, and transportation. In addition to these concerns, one of particular importance is the alarming disappearance of high-quality farmlands as urban populations grow and seek suburban living space (Council on Environmental Quality, 1974). About one million acres of prime farmland are lost each year to various uses. The Soil Conservation Service (1980) reported that 800,000 acres were being given over to housing, airports, highways, and industries; 200,000 acres are inundated. It is expected that at current rates, "there will be no prime farmland left in Florida, New Hampshire, and Rhode Island in less than 20 years" (American Farmland Trust, 1981). The last orange grove in Orange County, California was abandoned to development pressures in 1991.

Utility of Benefit-Cost Analysis

Using the models developed in the last 20 years to approximate or evaluate what were identified in the *Green Book* as "intangibles," the recommendation of the Water Resources Council Task Force to utilize the concept of nonmarket-valued benefits has produced positive results in project evaluation. Consequently, proponents of social well-being and quality-of-life values for water resources projects may have helped push BCA beyond its previous limits. The choice of indicators is critical (Brown, 1976), unsettled, and often not subject to moral, much less economic equity. Modern economic models and research regularly make use of willingness-to-pay methods of determining project benefits and costs and, since the public is the principal player in the process, it is more likely to accept the conclusions. An example is the Montana change-over to recognition of instream recreation benefits that led to modification of the Appropriation Doctrine.

Davis (1965) made the following timeless points:

1. There may be real benefits from enlarging the state and regional role in water resource planning and management if this can be done without spreading the qualified people too thinly.
2. We must be prepared to enter into much more elaborate analysis of water resource systems.
3. The organization with the responsibility for making choices must be able to function effectively so that planners themselves do not end up making the choices.
4. Particular information problems exist: (a) on predicting demands, (b) on developing techniques, (c) on measuring recreation demands, and (d) on the alternative legal and institutional conditions that affect performance of the water economy.
5. There is much to be gained from associating charges with users who benefit from a water service.

Two summary statements help to put BCA's limitations in perspective. First, Bromley (1980b) noted that "the basic dilemma of benefit-cost analysis is that it gives the impression of rigor and precision when in fact the truth is largely otherwise." In light of this observation, it is well to keep in mind that BCA is simply an (imperfect) analytical tool. Just because it "gives the impression" doesn't mean that it is correct; however, it can be used with discretion. Second, Burness et al., (1983) point out "that there is no single, objective measure for economic feasibility." It is wise, therefore, to look for alternative means of evaluating project proposals, not only in economic terms, but in terms of environmental quality, national security, welfare, and so forth. "In essence," says Baram (1980), "the Constitution does not require that governmental decision making be premised on simplistic economic analysis." He continues:

> Nevertheless, a strong argument can be made that providing the greatest good for the greatest number remains one of the essential purposes of government, and that cost-benefit analysis represents a potentially workable method to reach this objective.

> The Executive and [federal] agencies have the responsibility to manage the federal enterprise rationally in order to achieve optimal use of our limited resources and optimal protection of our diverse interests. If cost-benefit analysis continues as a basis for regulatory agency decision-making, it must be accompanied by meaningful public participation, diligent congressional, executive, and judicial supervision, and agency "best efforts" to structure their discretion to meet the issues presented by this economic approach to the problems of health, safety, and environmental protection.

Given these foregoing problems and institutional constraints, together with some inherent characteristics of the water resource, people's attitudes about water, and shortcomings of the marginal analysis model and of the BCA itself, it is instructive to apply the model to a project for water resource development.

Bennie Kost Creek

The economic evaluation of this contrived model project is shown in Table 7.2. The project is set up to illustrate the effects of *B/C* on the interest rate, the period of analysis, and the percentage of the total costs that is fixed. The contrived portion of the data includes the 5 percent and 7 percent interest rates, and the data for Situation B, where most of the costs are annual costs by virtue of the somewhat questionable means of having to purchase the land for the project on time rather than as a fixed cost: the effect is correct. The actual project benefits data are, in fact, abstracted from a real proposal.

Benefits

The annual benefits are shown, and the present values are computed based on the interest rate and economic life shown. Note that, as expected, the string of benefits exhibits a lower present value at higher interest rates, reflecting the fact that higher interest rates discount the future more than do low rates. As the economic life gets longer, present value of net benefits becomes larger, but there is less of a difference at the higher interest rate than at the lower rate. The "current" value of the annual benefits is $1,000 from prevention of floods; $4,000 from sale of power; $14,000 from the sale of irrigation water; and $6,000 in recreation benefits, for a total of $25,000. Applying the appropriate interest formula to this total annual benefit, the present value of benefits shown in the first line of Table 7.2 is derived.

Costs

In both Situation A and B, the organization of the costs is the same. The only difference (presumed) is that the cost of the land is paid over the economic life of the project in B, whereas it is a fixed cost in A. In both situations, an interest cost is charged to the project that reflects the opportunity cost of investing the capital in some alternate enterprise. The total annual costs in each situation are brought to the present by the same formula as used for the benefits. The present value of all costs is then simply the sum of the present value of the annual costs and the value (already in the present) of the fixed costs.

B/C and Net Benefits

For each situation, interest rate, and economic life, the values (in "present" dollars) of the net benefits and the *B/C* are shown. The *B/C* may be graphed to visually illustrate the effects that appear. First, it is apparent that the value of *B/C* decreases as the interest rate increases. Second, the value of *B/C* increases as length of economic life increases. Third, the value of *B/C* decreases as a greater proportion of the costs is fixed. On a subtler note, the value of *B/C* is more sensitive to the interest rate under the longer economic life and in situation A (where the majority of the costs are fixed).

Conclusions

Two important conclusions may be drawn from the Bennie Kost Creek example. First, water resource development projects, with their inherent high fixed costs, are at a disadvantage when competing for funding, especially at high interest rates. Second, if a project does have a high fixed cost, which requires borrowing over a long repayment period, the interest rate ought to be even higher to reflect the greater risk of loss of project benefits. The result would be that the project is at a further disadvantage, owing to an even lower *B/C*.

Also, in order to plan a water development project that will have the highest *B/C*, the project should be evaluated at a low interest rate, over a long economic life, and with a majority of the costs variable. Since the first criterion is out of the question under current (and foreseeable) conditions, and since incurring a debt requires a long economic life that

Table 7.2 Bennie Kost Creek Water Resources Project: Benefit-Cost Analysis

	Period of Analysis					
	50 Years			*100 Years*		
Analysis Component	*2.5%*	*5%*	*7%*	*2.5%*	*5%*	*7%*
Benefits*	$709,058	$456,398	$345,018	$915,353	$496,198	$356,732
	Situation A – High Fixed Cost					
Costs						
Fixed:	400,000	400,000	400,000	400,000	400,000	400,000
Annual:						
O&M	1,000	1,000	1,000	1,000	1,000	1,000
Contingency	100	100	100	100	100	100
Interest	28	55	77	28	55	77
Subtotal	1,128	1,255	1,177	1,128	1,255	1,177
Present value**	31,993	21,086	16,423	41,301	22,924	16,795
Total	431,993	421,086	416,423	441,301	422,924	416,795
Net benefits (*B/C*)	277,065	35,312	–71,405	474,052	73,274	–60,063
Ratio (*B/C*)	1.64	1.08	0.83	2.07	1.17	0.86

* See text for derivation of benefits. The formula used is the same as that applied to the costs in the next footnote.

** Sample calculation: the present subtotal of the values of the annual costs for 50 years at 5% is calculated by Formula (4): $V_0 = a[((1 + i)^n - 1)/(i(1 + i)^n)]$, where a is $11,550, n is 50, i is 0.05, so that $(1 + i)^n$ is 11.467. The value in brackets is 18.256, so that V_0 is $210,856.

Table 7.2 Bennie Kost Creek Water Resources Project: Benefit-Cost Analysis (Continued)

	Period of Analysis					
	50 Years			*100 Years*		
Analysis Component	*2.5%*	*5%*	*7%*	*2.5%*	*5%*	*7%*
Benefits*	\$709,058	\$456,398	\$345,018	\$915,353	\$496,198	\$356,732
	Situation B – Low Fixed Cost					
Costs						
Fixed:	100,000	100,000	100,000	100,000	100,000	100,000
Annual:						
O&M	1,000	1,000	1,000	1,000	1,000	1,000
Land	9,000	9,000	9,000	9,000	9,000	9,000
Contingency	100	100	100	100	100	100
Interest	275	550	770	275	550	770
Subtotal	11,275	11,550	11,770	11,275	11,550	11,770
Present value**	319,785	210,856	162,434	412,824	229,243	167,950
Total	419,785	310,856	262,434	512,824	329,243	267,950
Net benefits (*B*/*C*)	289,273	145,542	82,584	402,529	166,955	88,782
Ratio (*B*/*C*)	1.69	1.47	1.31	1.78	1.51	1.33

* See text for derivation of benefits. The formula used is the same as that applied to the costs in the next footnote.

** Sample calculation: the present subtotal of the values of the annual costs for 50 years at 5% is calculated by Formula (4): $V_0 = a[((1 + i)^n - 1)/(i(1 + i)^n)]$, where a is \$11,550, n is 50, i is 0.05, so that $(1 + i)^n$ is 11.467. The value in brackets is 18.256, so that V_0 is \$210,856.

further demands a higher rate of interest, the obvious solution is to plan a low-fixed-cost project or, as President Carter called for in the 1978 Water Policy Initiatives, a nonstructural alternative. Thus, the economics of project evaluation clearly supports policies that reflect the growing concern with environmental values.

Summary

Bennie Kost Creek is a greatly oversimplified example. The value of *B/C* could be considerably different (and more complex) if: (1) costs or benefits were phased in over a reasonable construction and development period; (2) the percentage of project capacity were to fluctuate, thereby producing variable benefits; (3) risk and uncertainty commensurate with the longer period of analysis were included in the analysis; or (4) separable segments, joint costs, or other time-dependent variables were to be introduced. The principles still apply, although some of the suggested manipulations might impact the value of *B/C* and mask the fundamental relationships.

Fundamental principles of economics pervade benefit-cost analysis. Policy impacts how and when and under what circumstances they are applied.

The interest rate (only the public "parts") plays a major role in project economics. Often, small changes in the interest rate can have a profound impact on the benefit-cost ratio.

Since the principles still apply and the model works, albeit with appropriate limitations, benefit-cost analysis is likely to continue to be used, and abused.

Finally, Seitz (1984), after a thoughtful discussion of "who should pay how much for soil and water conservation," falls back on pluralism as the basis for observing that there is "no one correct answer." The thought was more colorfully articulated by Winston Churchill, who remarked that "the democratic form of government was a horrible system for making decisions of this type, but that it was better than any other system available."

Activities and Questions for Critical Thinking

1. Identify different manufactured products that have different elasticities as shown in Figure 7.1.
2. Identify several uses of water and associate each with the elasticities (except unitary) shown in Figure 7.1.

3. Discuss with classmates whether you would rather have \$100 now or \$110, \$120, \$130, \$140, or \$150 a year from now. The differences you find represent your individual time preference rate. What factors affect the way you and your classmates evaluate time?
4. Graph the *B/C* values in Table 7.2 with *B/C* on the y-axis and the interest rate on the x-axis. The graph should show four lines, two for Situation A and two for Situation B, each for 50- and 100-year periods of analysis. What do you observe from these graphed values?
5. How does a high interest rate affect conservation?

Chapter 8

Water Resource Projects

Project objectives exhibit different characteristics

Introduction

Different types of water resource development, restoration, and preservation projects exhibit different and distinctive characteristics.

The purpose of this chapter is to consider characteristics of common project and program purposes in light of the constraints and opportunities presented in the previous chapters. All is not quite as simple as suggested by the Bennie Kost Creek example. A similar chapter in the *Green Book* "illustrates the application of the recommended principles and practices to the measurement of benefits and costs of selected project purposes to the extent that there are special considerations peculiar to each purpose," and also gives specific scope to the defined terms.

During the first half of the 20th century, water development projects rapidly lost their single-purpose character and became multi-purpose. Seven major reasons supported this trend. First, technology was improving in dam construction and modeling techniques. Improvement was also due to the inclusion of hydropower equipment. Hydropower, in particular, could be readily included both from a technical and economic standpoint. Second, demand for and use of electricity was increasing. Third, there was a trend that involved growing water shortages and gradual realization that resources of all types are limited. Fourth, multi-purpose projects blended with comprehensive planning concepts and technology that made for efficient and effective use of resources. Fifth, the trend paralleled developments in evaluation techniques, including the establishment of guidelines (the *Green Book*) and the state of the art of resource economics in general. Sixth, the high fixed-cost water development projects were "naturals" for application of the multi-purpose theory, because the allocation of joint costs permitted producing two (or more) goods and services from a single project less expensively together than separately. Seventh and finally, the gradual growth of the environmental movement supported the idea of (a) making better use of resources and, (b) shifting toward nonstructural alternatives, a propitious development, since the best dam sites and most profitable water projects were already completed. In addition, the fact that soaring interest rates exacerbated construction of high-fixed cost projects led to an even greater shift away from structural projects.

On the other hand, multi-purpose projects are not all that simple, either. Combining the output of different goods and services requires some sacrifice of optimum output for each purpose. The principal reason for this is that different purposes require different construction characteristics or different operation procedures, or both. Thus, hydroelectric power requires the water to be high, whereas navigation requires it to be low. Supply reservoirs need to be full so as to provide storage for normal drought and high-use periods such as late summer, whereas flood control requires the reservoir to be empty. Recreation needs a stable shoreline, whereas hydroelectric power demands often create a widely fluctuating shoreline that is in direct conflict with most recreation uses. Despite these conflicts, uses can be combined on occasion. For example, if the normal flood control season in the spring is caused by snowmelt runoff, reservoirs may be emptied following the recreation and summer-use period, to be filled by spring floods by the time storage is again needed for those purposes.*

Potential conflicts in construction and operation procedures are illustrated in Figure 8.1, which shows four different control patterns that result from manipulating the same input hydrograph for a year, depending upon the purpose for which the reservoir and dam are operated. Even though

* This is not always a viable operational alternative, however. In June, 1972, maverick Hurricane Agnes produced record rainfall in south central New York and north central Pennsylvania, causing major flooding on tributaries of the Susquehanna River, and other streams. Had two proposed flood control dams and associated reservoirs been operational, they would have been full for the summer recreation season and overtopped, with far more drastic downstream flooding than that which did occur.

the fulfillment of each purpose may be less than the maximum, a project providing some fulfillment of each purpose is usually more economical than building four different projects.

Reservoir operating policy can be guided by a dynamic programming optimization model that allows consideration of environmental constraints (Austin and Glanville, 1979). Many of our traditional development projects, however, have purposes that could be satisfied by other, less costly and less environmentally damaging alternatives (Black, 1973). Blackwelder (1984) succinctly states that: "Traditional dam building approaches have held sway for most of this century. It is time for a change." Anderson (1986) points out that:

> [One] concern often voiced about water markets is that capital markets are not sufficient to build the necessary infrastructure projects. This concern first surfaced at the turn of the century after most economically efficient projects had been undertaken by the private market. Government subsidies were necessary to build the massive irrigation projects because most could not pass private capital market profitability tests. Today this argument is even less valid because *the days of large water projects appear numbered* [emphasis added].

Some purposes for which water development projects were constructed have certain modifications or peculiarities that require special interpretation and consideration in light of the economic model or of their own characteristics. The more important of these follow in the next sections.

Flood Control

Division of responsibility for reduction of flood damages at the federal level was addressed in the 1936 Omnibus Flood Control Act. Upstream prevention was the responsibility of the (then) Soil Conservation Service, and downstream control was the responsibility of the Corps of Engineers (Chapters 1 and 3). The solutions haven't worked well: despite billions of dollars invested in flood damage reduction programs, the annual losses continue to rise. One of the reasons behind this is the nature of flood control benefits and how they and associated costs are handled in the economic analysis of flood damage reduction projects. The expenditures

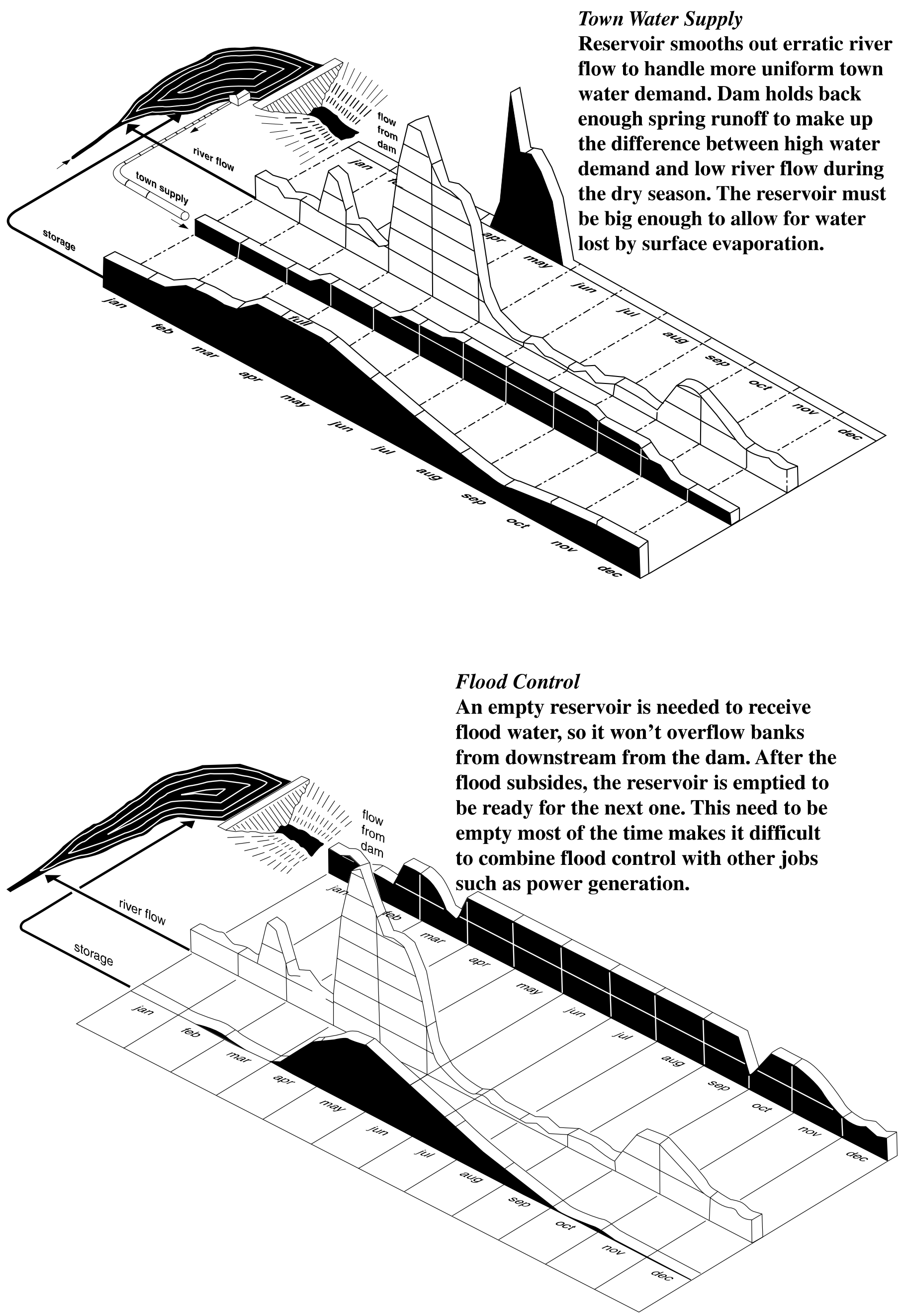
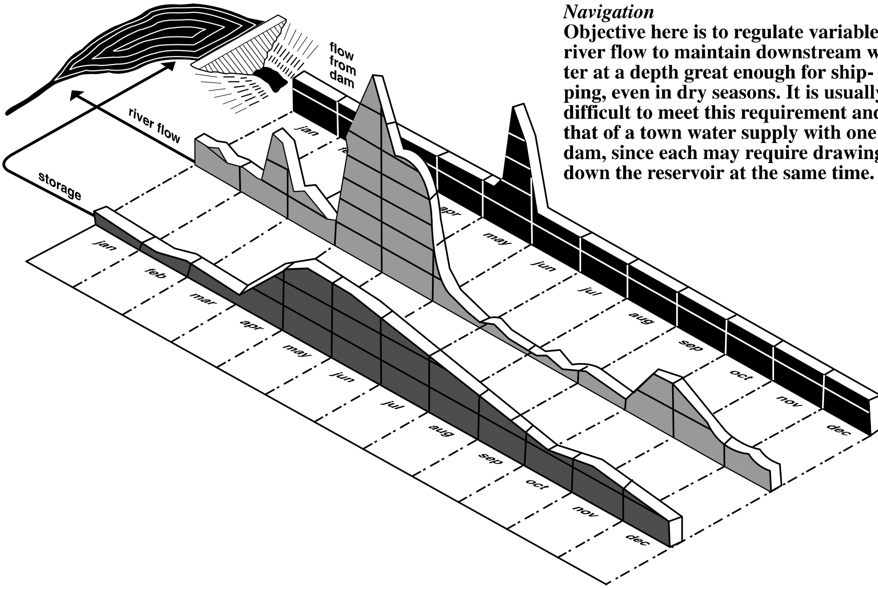
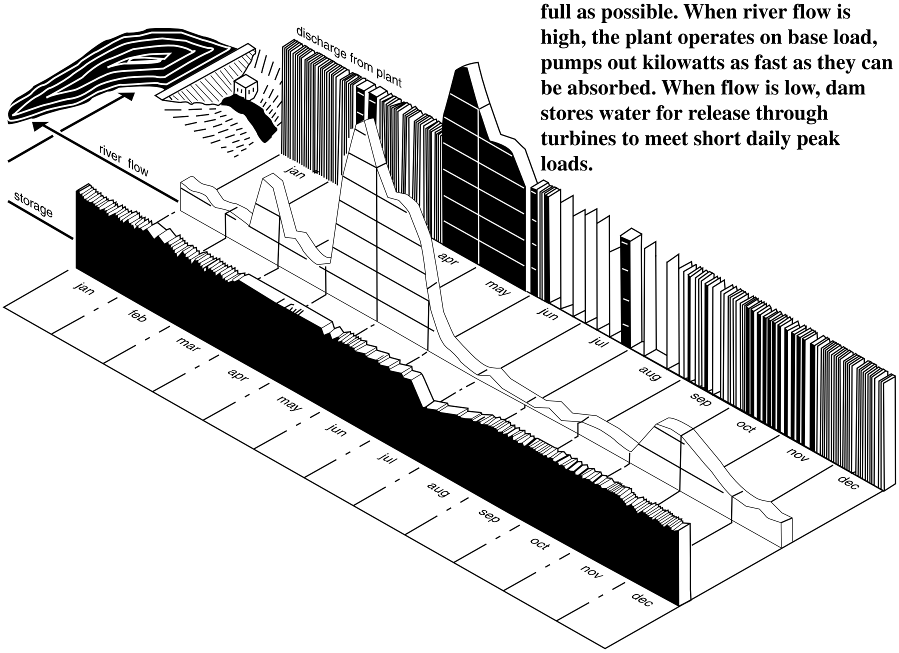


Figure 8.1 Conflicting purposes for a dam and reservoir. (Reprinted with permission from Power Magazine, Copyright McGraw-Hill, Inc. 1966.)



Navigation
Objective here is to regulate variable river flow to maintain downstream water at a depth great enough for shipping, even in dry seasons. It is usually difficult to meet this requirement and that of a town water supply with one dam, since each may require drawing down the reservoir at the same time.



Power Generation
Since this calls for water at a high level, the reservoir should be kept as full as possible. When river flow is high, the plant operates on base load, pumps out kilowatts as fast as they can be absorbed. When flow is low, dam stores water for release through turbines to meet short daily peak loads.

Figure 8.1 Continued.

induce conditions that produce greater losses. The other reason has to do with the very nature of the problem; civilization gets in harm's way. This section also presents an example of an economic analysis and discussion of alternatives.

Nature of the Benefits

The principal difference between flood control project purposes and all other water projects is in the nature of the benefits. For a flood control project, the majority of the benefits accrue from the damages that the project prevents. Land enhancement and local and regional income benefits may augment the primary benefits, but the name of the game really is "protection." Essentially some government agency, usually the Corps of Engineers, is saying, "support our proposal and we will protect you." In most cases, the original request for a flood control project comes from local sources and is transmitted to the COE through elected officials or a local interest group. Such an original request is usually cloaked in respectability, legitimate concern over a serious local flood problem, and a high degree of confusion over the nature of floods themselves.* Nevertheless, the bottom line is that for all other uses there are some goods or services that are provided.

Flood control benefit determinations commence either with on-site flood flow records (usually derived from continuous stream flow records collected by the Geological Survey) or with regional flood-frequency data that are to be extrapolated from a similar, nearby stream.** In either case, the flood-frequency curves that are constructed from the data show the likelihood of occurrence of floods of given magnitudes. These magnitude figures are referred to as *discharge*, expressed in cubic feet per second (*cfs*) or cubic meters per second ($m^3\ m^{-1}$). They can, for a given reach of stream for which the cross-section and slope dimensions are known,

* The issue is further muddied by the nature of the protection that, due to the characteristic of flood occurrence, is good only up to a point, usually expressed as some seemingly unlikely-to-occur event like the "100-year flood." People tend to believe that given protection to that level, they are safe when, in fact, they will be worse off when the larger-than-100-year flood occurs, a highly likely event during a normal lifetime.

** For areas without on-site stream discharge measurements. In that case, the discharge data are often expressed in terms of units of discharge per unit area, such as cubic feet per square mile (*csm*) or cubic meters per square kilometer ($m^3\ km^{-1}$).

be translated into or calculated from water velocity, width, and depth. The latter two figures can be transferred to a topographic map of the flood plain to delineate the area and depth of flooding at a given frequency.

The 100-year flood frequency is the common design where life and property are involved,* but highway departments traditionally have used 25- or 50-year flood frequencies to design culverts. Ideally, all structures that attempt to control (or, like highway culverts, inadvertently control) floods should be designed to the same limit within a watershed so as to preclude adverse interaction between the projects. Standards have been set forth by the WRC (Water Resources Council, 1971b, 1972a).

Problems

There are five traditional major categories of flood control project failures (Black, 1973).

First, dams that are built to control floods often inundate the best (bottomland) crop lands in order to save other lands. Both lands then lose the agricultural value derived from the normal nutrient-rich sediments that are deposited by the regularly occurring floods.

Second, there is the land enhancement-protection cycle already referred to, and identified further by Langbein and Hoyt (1959) as "induced development," which encourages more intensive use of the flood plain lands, thereby driving annual flood losses ever higher (Hanke, 1972). Consequently, once a flood control project is started, the inclusion of land enhancement benefits ensures a continued need for protection and, in most cases, increased flood damages in the future as well.

* In fact, the 100-year flood can be expected to be observed, on the average, once in 100 years. Stated another way, the chance of observing it in any given year is one in 100, a pretty unlikely occurrence. However, in any given year, there is also a discrete chance of having floods of other, *larger*, magnitudes (less frequent events) occur; thus, the proper way to express the likelihood of flooding involves whether the 100-year flood will be *equaled or exceeded* in any given year. The chance of having the 100-year flood equaled or exceeded in any given year is about 1 in 40, a much more likely event. The WRC states unequivocally that "the probability is about one in four that the one percent chance flood will be exceeded during the life of a 30-year mortgage" (Water Resources Council, 1978a). To add to the confusion, however, the WRC itself equated the "equaled or exceed" value to the value of the "100-year flood" (Water Resources Council, 1979a).

Third, the physical encroachment on the flood plain itself restricts the cross-sectional area through which the flood must pass, thereby increasing the height of the flood flow (Belt, 1975; Perrey, 1959).*

Fourth, dams (and other flood control measures) can actually increase flood peaks, owing to the resynchronization of peak arrival times at some point on the river. Travel time of the peak may be less through a straightened channel or reservoir than through the sinuous river it replaced, thus decreasing advanced warning times and increasing the risk of loss as well (Linsley, Kohler, and Paulhus, 1949).

Fifth and finally, it is often pointed out that protection instills a sense of false security (Wisler and Brater, 1949) in those persons protected, which can be disastrous if the design capacity of the improvements is exceeded, and a fast-moving flood wave rather than a gradually-rising stage inundates the low lands of the flood plain. Another type of failure that has and will continue to change over the years as more and more development takes place in the flood plain itself and on upper reaches of watersheds is that flood damages on small, upstream watersheds will be much greater than downstream damages (Ford, 1964).

De facto integration of all of these factors has resulted in some rather shocking statistics about the nation's flood control program:

> Thirty years have passed since the enactment of the Flood Control Act [of 1936], and the Army Corps of Engineers and Soil Conservation Service have invested over $7 billion in flood damage reduction measures. The annual expenditure is now approximately $500 million and increasing. Yet today's floods cost the nation an average of $1 billion a year, twice the 1936 figure, and losses are expected to jump to $5 billion a year by 2020 (Hanke, 1972).

Continuing problems with flood control programs include: (1) the ease of obtaining disaster relief funds, as opposed to disaster prevention funds, (2) implementation of land use regulations as required by insurance and relief regulations, (3) a cost-sharing bias that favors upstream impoundments as approaches against alternative flood control, and (4) refusal of the Office of Management and Budget to make allocations to agencies in

* Note that the term is flood *control*, in recognition of the fact that nothing is being done to diminish the amount of water moving through the stream system. This was (and continues to be) the basis of the argument between upstream and downstream flood control. Upstream works are often aimed at flood *prevention*, or reduction of excess runoff that causes downstream floods, whereas the traditional flood control project is aimed at containing the existing flow, not diminishing it and, in reality, aimed at reducing flood *damages*, not the flood itself.

compliance with Congressional mandates, especially cost-sharing for non-structural flood control measures (Muckleston, 1976). Changes that occurred over the last half of the 20th century include (1) a major flood insurance program that provided government subsidy to homeowners previously unable to pay high flood insurance premiums,* and (2) changing from a policy of denying flood damage benefits unless the property is rebuilt to providing benefits only if the relief funds are used to re-locate residences outside the flood plains. These concepts are implied throughout the "Minimize, Restore, and Preserve" sections of the Floodplain Management Guidelines (Water Resources Council, 1979a).

The High Creek Example

All of these problems notwithstanding, there are innumerable projects constructed for flood control, including dams, levees, flood walls, stormwater detention basins, and emergency or bypass channels. An example of one of these is given in Table 8.1.

High Creek is a composite example drawn from a real proposal for levee construction and bank stabilization work to control flood and bank erosion losses. The original analyses were made at the 1962 (date of authorization) interest rate of 2.375 percent, as shown for the 50- and 100-year economic life of the project. The present values of annual benefits were re-calculated with the rate at 3 percent to show how even a small increase in the interest rate can dramatically lower the value of *B/C*. Advancing from the Bennie Kost Creek example, High Creek illustrates separable segments and the with-and-without principle.

The average annual benefits and costs shown are derived from the upper portion of Table 8.1, the 50-year/2.375 percent benefits that are used are marked with an asterisk (*). Similar addition is used for each successive column. The local labor benefit is based on an experience figure, wherein a certain proportion of the project's first cost is typically labor, and a certain proportion of that figure is typically local labor. Funds appropriated by Congress for this element may be counted as a regional benefit to the project.

In the summary of the *B/C*s at the bottom of Table 8.1, the values show that the flood control portion of the project is only barely justified, while the higher value of the *B/C* for the overall project reflects the influence of the extremely high value of *B/C* for the recreation segment. Having a secondary project purpose "carry" the entire project is not

* Flood insurance loss, if covered by one company in an area, is likely to be incurred by all neighbors with attendant high company payouts, in contrast with fire insurance, which normally affects only one or a few individuals at a time.

Table 8.1(a) Analysis of High Creek Project Benefits and Costs

	Present Value				*Present Value Creditable to Project*			
	Without Project		*With Project*		*50 Years*		*100 Years*	
Analysis Component	*50 Years*	*100 Years*	*50 Years*	*100 Years*	*2.35%*	*3.00%*	*2.35%*	*3.00%*
Annual Benefits								
Flood damages[a]	$355,000	$435,000	$38,000	$38,000	$317,000*	$317,000	$397,000	$397,000
Bank erosion	20,000	20,000	0	0	20,000*	20,000	21,000	21,000
Land enhancement[b]	998,000	2,150,000	1,928,000	3,360,000	287,566*	212,133	88,908	48,360
Recreation	0	0	97,000	142,000	97,000	97,000	142,000	142,000
Local labor[c]	0	0	5,193,500	5,193,500	178,656	136,589	202,027	164,115
Total benefits					900,222	782,722	850,935	772,475
Annual Costs								
First costs								
Flood control			16,640,000	16,640,000				
Recreation			360,000	480,000				
Total first cost			17,000,000	17,120,000	584,000	661,300	447,100	537,200
Annual costs								
Flood control								
I and A[d]					572,416	647,296	437,632	525,824
O&M[e]					33,000	33,000	33,000	33,000
Subtotal					605,416	680,296	470,632	558,824

Recreation				
I and A[d]	12,384	14,004	9,468	11,376
O&M[e]	15,000	15,000	20,000	20,000
Subtotal	27,384	29,004	29,468	31,376
Total costs	632,800	709,300	500,100	590,200

Notes: (a) Computed in 1962 prices; data is in "present" values.
(b) Present value of V_n as in Formula (1) in Chapter 7.
(c) Common practice is to use a percentage of total cost.
(d) Interest and amortization, as in Formula (4) in Chapter 7.
(e) Operation and maintenance, assumed to be a fixed amount.
* Example of source of 2.35%, 50-year benefits, shown below.

Table 8.1(b) Benefit-Cost Ratios of High Creek Project

	Flood Control				*Recreation*			
	50 Years		*100 Years*		*50 Years*		*100 Years*	
Values of Average Annual	*2.375%*	*3.00%*	*2.375%*	*3.00%*	*2.375%*	*3.00%*	*2.375%*	*3.00%*
Benefits	$624,556*	$549,133	$506,908	$466,360	$97,000	$97,000	$142,000	$142,000
Costs	605,416	680,296	470,632	558,824	27,384	29,004	29,468	31,376
B/C	1.03	0.81	1.07	0.83	3.54	3.34	4.82	4.52

Note: * Example of source of 2.35%, 50-year benefits, is shown in Table 8.1(a) above.

Table 8.1(c) Benefit-Cost Ratios of Overall Project

	Flood Control and Recreation Combined			
	50 Years		*100 Years*	
Values of Average Annual	*2.375%*	*3.00%*	*2.375%*	*3.00%*
Benefits	\$900,212	\$782,722	\$850,935	\$772,475
Costs	632,800	709,300	500,100	590,200
B/C	1.42	1.10	1.70	1.31

acceptable. Note, too, that evaluation at the only slightly higher interest rate reduces the *B/C* value to less than unity for the flood control portion of the project, which commands a higher percentage of the fixed costs than does recreation.

Within the marginal analysis model's concept of the range of output, that is, the degree of flood protection afforded, the demand curve for flood control is probably not perfectly elastic, as individuals are likely to be willing to pay more for higher degrees of protection. (This is true especially immediately following a flood.) The with-and-without principle applies here, however, and dictates comparison of the two levels of output (Q_0 and the design Q, which may or may not be Q_{mnb}), not all-intermediate increments. Thus, while it may not be feasible to determine the Q_{mnb} for a given flood control situation, the model is helpful in understanding the application and interpretation of the values of *B/C* in discrete, noncontinuous — or "lumpy" — situations.

The High Creek example is presented using *average annual benefits*, whereas the Bennie Kost Creek example is presented in *present value* terms. Either is acceptable, and translation from one to the other is accomplished by utilizing the appropriate interest formula. If that translation is done correctly, the actual value of *B/C* will be the same regardless of which format is used in the computations.

Alternatives

There are, of course, alternatives to flood control structures. The purpose of flood control is to minimize or eliminate flood damages, and this may be readily accomplished by other methods, such as flood proofing, flood-plain management, and flood-plain zoning.

Flood proofing requires that buildings and other structures be designed so as to be undamaged by occasional high flows and so as not to increase flood stage (height) by occupying water storage space in the flood plain (Corps of Engineers, 1972). "The addition of flood proofing to other (structural and nonstructural) flood damage reduction measures," report Willis and Alkiku (1974), "broadens the choice among existing alternatives for decision makers and consequently enables the possibility of improved expected net benefits from an overall flood damage reduction scheme." Note that the basic concept is *reduction* of the flood damage, recognizing that the high water will, in fact, be there.

Flood Plain Management may employ a variety of methods to minimize losses due to floods. The key to devising an efficient flood management program lies in the ability to separate the private costs and benefits of floodplain occupancy from public (social) costs and benefits. If private and public costs and benefits can be associated with specific land uses and flood management practices, the economic efficiency of various proposed management schemes could be evaluated (Raitt, 1969).

In addition to public and private economic components, temporal and geographical considerations are important in evaluating the public's attitudes toward flood control and floodplain management. Of course, interest in flood control, flood relief expenditures, and flood insurance all change dramatically if there is personal and immediate involvement in, or experience with, a flood event.

Floodplain management is the prime alternative to traditional structural methods (dams, levees, flood walls, channel straightening) and was acclaimed by the environmental community in the 1970s, coincidentally with the rising interest rates that discouraged structural methods of flood control. Floodplain management guidelines came out of a joint effort of the federal agencies (Water Resources Council, 1979a) and, as noted in Table 3.1, have become a focal point of the Corps of Engineers' activity in the 1974 Water Resources Development Act. Thus, the Corps has two prime historical responsibilities in the floodplain. First, in the demarcation of the Standard Project Flood, with the aid of the Geological Survey, as the basis for project design and for flood insurance implementation. Second, the Corps is mandated to manage floodplain lands with the purpose of reducing flood damages, often in conjunction with flood proofing and zoning.

Zoning is traditionally a local government option, and can be an effective damage reduction measure. Lind (1967) maintains that zoning is inappropriate: "From an economic point of view, flood zoning is not a desirable method of coping with flood losses. Flood zoning could be justified only on the grounds that it is politically or administratively feasible." The use of zoning is prerequisite to a community where individuals wish to purchase subsidized flood insurance (Water Resources Council, 1978a) under the 1968 Flood Insurance Act. Typically, zoning is the means of economic — and sometimes cultural and political — control, exercised by those in power and seeking to control competition or ethnic distribution. It rarely is purely an environmental issue: that topic often is a smokescreen for issues for which many do not wish to see the light of reason and sense of community.

Ultimately, there is only one sure way of preventing flood damage! Stay out of the flood plain.

Water Supply

Water supply projects differ from flood control projects in that the benefits of the water supply project (revenues from the sale of water supplied) are used to repay the costs of the project. Water supply projects (and most other types of projects) produce a salable commodity, one usually paid for by project beneficiaries. While water may be supplied for a wide variety of purposes, it is helpful to split this section into only two parts, one dealing with irrigation water supplies, and one with all others under the general heading of municipal supplies. There are three reasons for such a split: consumptive use, administration, and economics and the nature of the benefits. This section focuses on the characteristics of these two major water supply uses and presents alternative pricing methods that might be used to resolve some water supply difficulties. It also presents an example of an economic analysis of a municipal water supply that illustrates some of the unique problems associated with this use and addresses some additional considerations of import to municipal water supply systems.

Irrigation

Irrigation is the largest consumptive use of water and is the least efficient: as little as 40 percent to as much as 95 percent of the diverted water is actually used for irrigation (Gleick, 1998). Evaporative and conveyance losses from surface sources or pumped from groundwater reservoirs may be as high as 60 percent of the water diverted.

The amount of irrigation water used for food production as a percentage of the world's fresh water is critical to the population that the Earth can support, leading to estimates of world-supportable population estimates from 1.1 billion to 30.2 billion people (Cohen, 1995). Also, from an administrative standpoint, virtually all federal irrigation projects involve contracts between the Bureau of Reclamation and irrigation districts that coordinate and manage the water distribution system, handle finances and some water rights, and act on behalf of the district residents. An additional reason involves the amount paid for water. For example, water for irrigation typically costs from about $20 per acre-foot (National Water

Commission, 1973) to $60 or more in the Central Arizona Project, whereas municipal water priced at 55¢ per 1,000 gallons is equivalent to 3 to 10 times that much, $179 per acre-foot. The value of the end product plays a role: Campbell (1986) reported that Colorado irrigation water yielded $503 in direct and indirect income, but that "the same acre-foot consumed by high-tech electronics industries would generate $4.2 million, an income yield 8,000 times higher than that of agriculture."

For the U.S., irrigation accounted for only 35 percent of the total water withdrawals, but 83 percent of the consumptive use in 1970 (National Water Commission, 1973).* The total irrigation figures are 130 billion gallons withdrawn per day and 73 billion gallons (56 percent) consumed or "lost" through evapotranspiration and conveyance losses in the course of application to irrigated acres.**

Irrigation beneficiaries are not as readily able to repay the costs of an irrigation project as are municipal supply beneficiaries. Reasons include the following: (1) poor growing weather, which may negate irrigation efforts, resulting in little if any income for the farmer; (2) crop failure due to disease; (3) market failure because all the farmers in a particular irrigation service may be growing the same crop (a likely occurrence since climate and soils, not to mention availability of irrigation water, will be uniform); (4) the marginal nature of farming, which produces minimal profits so that there are often insufficient returns to pay for irrigation water; and (5) a rainy season that precludes the need for irrigation water at all. Any of these may result in the irrigation district that contracts with the Bureau of Reclamation being left holding the bill for water it cannot deliver and from which it cannot realize enough revenues to cover expenses.

Irrigation districts meet many of these problems for irrigation services in two ways: first, by charging a small fee per unit of water delivered (which is why the $20 figure cited above is as low as it is) and, second, by charging an *ad valorem* tax on all property in the district. The logic behind the latter is that all residents of the district benefit from having the water available and from the higher standard of living that the added business (and, on occasion, recreation) brings into the district; it ensures continuous income to the district.

As much as 80 percent of the costs of BR projects that are built primarily for irrigation are repaid through the sale of hydroelectric power. Although "the provisions for the use of power revenues to aid irrigation were both innocuous in appearance and ingenious in effect" (Burness et al., 1980),

* This water was used on about 53 million acres of land in 1980, up from 38 million acres in 1966 according to Long (1985), who sees a practical upper limit to U.S. dry farm lands of about 320 million acres, and no such limit on irrigated acres.

** Criddle (1953) created widely used formulae and nomograms for predicting this consumptive use.

this amounts to a subsidy for the irrigation user and for all beneficiaries of that use. Nevertheless, to whatever extent the fixed costs for each purpose are reduced by having the two products (irrigation water and hydroelectric power) produced together rather than separately, joint production of hydropower and irrigation water amounts to a viable business arrangement that is to the advantage of all project users. On the other side, there have been some political, economic, and technological disasters with irrigation projects.

Political problems abound. In the case of the Glen Elder Irrigation Project in Kansas, the prime justification for the project was the increased need for greater food production in the Midwest during World War II; the project was a part of the Pick-Sloan Plan (Chapter 1). As the project was finally being considered in the Senate Appropriations Committee in 1962, Congress passed a bill to take one million acres of farmland out of production. Both measures were directed at feed grains. To make matters worse, during the years between project authorization and construction, the project's first cost increased from \$17 to \$78 million; the storage capacity needed to irrigate less acreage increased and, as a consequence, the unit cost skyrocketed. Specifically, it was estimated that the project cost \$1,720 per acre for the water, which is more than the land was reportedly worth; the farmers would be paying back only \$191 per acre at the proposed \$4 per year over the project's economic life (Haveman, 1965). Similar cost increases have been noted for the Central Arizona Project (Welsh, 1985). The increases are not solely due to inflation: "from 1975 to 1982, 75 to 80 percent of increased ground water irrigation costs were due to higher nominal energy prices and interest rates. In real dollars, adjusted for inflation, these costs have risen faster than other irrigation costs and the real rise in commodity prices has been very small" (Slogget and Mapp, 1984).

A major economic consideration is that of the 160-acre limitation, defined in Section 46 of the Omnibus Adjustment Act of 1926, and upheld by the Supreme Court in *United States v. Imperial Irrigation District*, "The acreage limits of Section 46, which apply only to individual landowners, cannot impair any present perfected water rights of the District itself" (Lackman, 1977). Thus, the continued abuse of the 160-acre limitation continues to play a role in the irrigation supplies of the nation.

Another economic consideration is that concerned with the relative production capacities of an acre-foot of water in different production enterprises. As noted previously, water in high-tech industries may yield thousands of times more than the income from irrigation agriculture. As land in the Pacific Southwest (especially Arizona and California) is transferred from growing citrus crops to subdivision, the amount of water used per acre is often reduced, making the conversion profitable in terms of having additional water available in addition to the profitable use of the land. The Appropriation Doctrine permits the transfer of the water right, provided the transfer can take place in an open market, that is without interference. But the water markets *are* interfered with: "All in all, more water will move from low-value to high-value uses if we quit subsidizing it and allow it to be priced at its real cost" (Sax, 1986). Methods of control and means to evaluate project costs and benefits are discussed by Gindler and Holburt, (1969).

Technologically, there are examples where irrigation waters laden with salts from the area they were withdrawn have interacted with the soils at the irrigation site to produce an impervious surface, thus making the soils infertile and negating the value of the entire project (Langbein and Hoyt, 1959). Postel (1999) reports that worldwide, 47.7 million hectares or about 21 percent of the world's irrigated land has been damaged by salt. Salinity is also a problem in the water body from which water is being diverted or through which it is being conveyed. One of the more spectacular technological disasters in recent years was the failure of the BR's Teton Dam, under construction for irrigation. Alleged slipping standards and inadequate inspection resulted in the loss of 11 to 14 lives and $400 million in property damage (Jansen, 1980). Incorporating the cost of such risks in BCA is not an easy task.

A different type of technological problem is the development of new irrigation technologies that have rendered some projects obsolete. Most important of these is the center pivot irrigation system which, between 1970 and 1975, grew to include about 225,000 acres in a five-county region of the Columbia Basin alone (Muckleston and Highsmith, 1978). The giant circles may be widely seen from the air, spreading rapidly over the high plains and intermountain regions, as well as intermittently wherever irrigated crops can provide more income to the landowner. Typically covering a quarter section (160 acres), these 15-foot-high overhead, computer-controlled pipe systems* have numerous advantages over other irrigation methods:

1. They can irrigate land that is not level (as must be the case for ditch systems), thus bringing many more acres of land into productive agriculture.
2. Center pivot irrigation systems use water more efficiently because (a) in a flooding system, excess water must be applied to get sufficient water to the farthest point in the field, thus over-irrigating

* These systems can now be fitted with articulated arms that may reach the corners of the fields, extend around residences and other buildings, or adapt to any local topographic characteristics.

the field adjacent to the ditch, and (b) water can be timed for night delivery to minimize evaporation loss.
3. Precise control over the amount and rate of water delivery permits simultaneous application of fertilizer, herbicides, rodenticides, and pesticides, thus cutting costs while reducing the potential for non-point source pollution.
4. By building small hills for the wheels, the rotating pipe may be safely driven up and over pump jacks, thus permitting oil or gas production and irrigated agriculture on the same acres.
5. Finally, the investment is not permanent as is the case with a ditch system (and, compared with ditch irrigation, may be considered as a nonstructural alternative), thus, while the initial investment may be high (upwards of $25,000 for a quarter section, plus water supply), it is without the high risk of irrecoverable ditch installation.

Perhaps the major disaster is yet to occur. As rising energy costs and falling groundwater tables drive water costs ever higher, failure to deal effectively with the institutions that permit western water to be transferred at competitive prices may "constrain irrigation's growth and, in some places, eliminate it altogether" (Frederick, 1981). Maintenance of a low user fee for irrigation water exacerbates this problem. Frederick continues: "The worst social costs associated with the changing water situation will arise if we attempt to keep water cheap when it is not." Transfer of water uses accompanying land use changes may be tied to BR contracts (McHugh, 1974) and "requires the resolution of certain institutional problems concerned with land and water management method" (Cluff and DeCook, 1975). Wyckoff (1980) summarizes,

> There have been federal subsidies involved in the development of irrigation in the western states. However, the total amount of the subsidies involved are insignificant compared to the total federal budget and the size of subsidies under other subsidy programs. The real question is the distribution of these subsidies and a desire for land reform among certain elements of the population. If land reform is the issue, the policy should be national and all agricultural land should be involved rather than merely land under federal irrigation projects. Such a national policy has not as yet been seriously considered.

Some of "those certain elements of the population" have not always had the political clout to ensure their own interests: Mann (1972) points out that:

> Agricultural communities that prosper on the basis of cheap migrant labor that lives in indescribably miserable hovels and receives minimal services are hardly communities that should be rescued by federal dollars. To give a specific and current illustration, should federal dollars be used to assist a community in providing local services when the white citizenry (accounting for only 40 percent of the population) virtually monopolize the town's sewers, fire hydrants, water mains, and street lights?

Finally, there is a national problem with the transfer of high quality farmland to urban and other high-intensity uses. Currently, as the volume of agricultural exports has risen both in percentage per year and in terms of percentage of total U.S. agricultural production, "three million acres of agricultural land are taken out of production each year in the United States" (Rose, 1984). Speculation, increased demand for food, and positive economic attractiveness have combined to cause large numbers of acres to be converted from grassland to dry farming (Huszar and Young, 1984). The interaction of these trends, the increase in irrigation costs, the economic squeeze currently being experienced by many farmers across the nation, and the increase in demand for food for a growing domestic population, pose some critical problems for the future. Presently, several pieces of legislation and protection strategies are developing with varying degrees of success (Dunford, 1982). The future of farmland protection policies and legislation has important ramifications for both land and water use in the U.S. (Madsen et al., 1973)

Municipal Water Supply

Public water utilities withdraw about 28 billion gallons per day (Bureau of the Census, 1980) for urban domestic, municipal, and industrial uses. Another 54 billion gallons must be added for rural, domestic, and industrial uses, respectively, in order to account for *all* domestic, municipal, and industrial use (except steam electric utilities). Actual consumption in 1970 was 5.9, 3.4, and 5.3 billion gallons, respectively (National Water Commission, 1973). Both municipalities and industries consume a great deal less than is withdrawn, owing to other uses such as cooling, cleaning, and (for municipalities) fire control. The 1975–1985 period was expected to represent a maximum use level, with rates declining in the future as a result of conservation, recycling, and improved efficiency programs (Bureau of the Census, 1980) and current usage reflects that change. Per capita consumption remains close to 150 gallons per person per day. If industrial and irrigation use is added, average use in the U.S. is nearly 2,000 gallons per capita per day. These figures vary considerably from one region of the country to another. For the U.S., where there has been a major campaign to install new or retrofit old toilet fixtures, "this one change saves nearly 25 percent of the total residential indoor water demand projected in 2020" (Gleick, 1999).

A most profitable, natural, and readily available way in which to increase water supplies, especially for municipalities, is through complementary management of forest and water resources (Black, 1963, 1996; Hibbert, 1981; Ponce, 1983). Cities and towns of all sizes across the nation either own their own watersheds or use runoff from National Forests or other public or private lands, and they consequently control or strongly influence all management decisions on the land for maintenance and enhancement of both water quality and quantity. The use of forested watersheds for municipal supply purposes is of longstanding concern in light of protection and reforestation programs (Munns, 1933). A prime example is illustrated in the Frontispiece photograph of Boston's Quabbin Reservoir and watershed. Even here, Boston's use exceeds the safe yield of the watershed, and the city had sought to divert Connecticut River water to ease the shortage* (Sherman, 1979) prior to implementation of effective water conservation strategies (see Chapter 5). This section focuses on the extent of the problems and opportunities in managing municipal water supply watersheds.

In the more densely populated eastern states alone where there is a greater demand for high quality water from intensively managed lands, there are over 1,900 watersheds tapped as water sources. More than half are under 10 square miles, which is considered too small for extensive forest management. Dissmeyer et al. (1975) consider that the practical size limit is around 100 square miles, with 62 percent of the watersheds in the Southeast smaller than that, and 92 percent of the watersheds in the Northeast under that size limit. "In the Northeast, approximately 29 percent of 2,000,000 acres of the total watershed areas was owned or controlled by 750 municipalities, private water companies, and state and federal agencies." The holdings average 4.2 square miles, and 87 percent are in government ownership. Most of the acres are forested, with 26 percent of the watersheds 100 percent forested; another 25 percent are 90 to 99 percent forested. The land is used for a variety of purposes that range from limited recreational use to mineral exploration and development. Minimal data are collected on most of these lands and, as a consequence, administrative research that might lead to intensive management for improved water yields is limited as well. One large private company

* A fine film presenting the history of the Quabbin and insightful discussions of the current controversy is entitled, "The Old Quabbin Valley." The film clarifies the issues and is particularly useful for prompting discussion wherever water conflicts exist. The film was produced in 1981 by Lawrence R. Hott, Florentine Films, Box 486, Northampton, MA 01060.

operates water supplies in 20 states, serving five million residents. Many of these residents are supplied by forested watersheds of 50 to 2,500 acres where the company intensively manages the timber resource with careful attention to protection of the water quality.

This is not to say that municipal watersheds in the western states are not from managed watersheds. The oldest continuously managed watershed to provide both forest products (and the revenue derived therefrom to help defray costs of protection and maintenance of a healthy forest cover that maintains high quality water yield) is Seattle, Washington. Other major forested watersheds include the cities of Denver, Colorado Springs, Portland, Oregon, and San Francisco. Several of these and other watersheds are excluded from any forest management plans other than protection, as discussed elsewhere in this volume.

A major concern of recent years is the restoration of forested and agricultural watersheds. In particular, the New York City watersheds in the Catskill Mountains have been the focus of programs to remove hydrologically sensitive areas (e.g., riparian zones, steep and thin soiled areas, etc.) from active land use that jeopardizes the maintenance of high quality water. In fact, a national symposium was held to deal exclusively with the issues, problems, and opportunities of watershed restoration management (McDonnell, et al. 1996a; McDonnell et al., 1996b; Black, 1997b).

Spangenberg (1969) noted the importance of a communications link between public and private watershed managers and the public for whom these watersheds are managed, "Watershed managers are essentially concerned with the public, and they must ultimately manage their areas of responsibility to satisfy the real or imagined needs of the people."

Domestic use of water is the most inelastic of all uses (see Chapter 1). The amount of water necessary to survive is about 5 to 6 pints per person per day, an absolute necessity that will command any price. Nevertheless, the marginal analysis model may be used to analyze project economics here, because the government unit in most cases maintains a constant price over the entire range of water provided, generally the entire capacity of the water supply system. The price-setting unit of government has several options available to it.

Pricing

Several different pricing methods are treated in this section because they apply primarily to water supply. Most other uses of water do not, at present, charge for the use of water per unit. There are four different traditional methods of pricing: postage-stamp pricing, zonal price differentiation, average cost pricing, and marginal cost pricing (Brewer, 1961).

In addition, some innovative pricing methods have been proposed. All are discussed herein.

Postage-stamp pricing is a consequence of a number of forces at work, most noticeable of which are (1) the relatively low proportion of the total cost of production that is variable, in other words, any low value for price will cover a wide range of average variable costs; and (2) resistance to change, in that people would prefer to pay a fixed amount per unit than to have the inconvenience of figuring the real values of a change of a few pennies per 1,000 gallons. The term (postage-stamp pricing) comes from the world of mail-handling, where a single stamp price is preferred whether we are mailing a letter across the state or all the way across the country; the major cost is handling the mail, not transporting it. The same situation clearly applies to the water resource and the water closet analogy, since once the treated water is flowing in the pipe, it really does not add significantly to the cost to have it transported a short distance farther.

Zonal price differentiation is an attempt to reflect costs of transportation, diversion, and use. It has been adopted in water sales in California, but even there, postage-stamp pricing is applied within each zone. The convenience of postage-stamp pricing is so great largely because water is so undervalued that other factors will be manipulated by other means so as to provide the opportunity to use it within certain ranges or zones.

Average cost pricing means adopting the lowest point on the average unit cost curve to determine price. If the minimum point on the *ATC* curve (see Figure 7.5) is used, all costs are presumably repaid by the sale of the water. If the *AVC* minimum point is used, an additional source of funds must be obtained to cover the fixed costs, as is the case with the irrigation district's *ad valorem* tax. Another alternative is that the repayment of fixed costs can be delayed, but this is not a good long-term solution in that eventually the fixed costs do have to be repaid.

Marginal cost pricing is accomplished in the purely competitive market via the interaction of the industry's supply and demand curves and the intersection of the resultant *MR* and (the firm's) *MC* curve, as shown in Figure 7.4. "In setting water prices and in determining the impact of water price changes, the marginal use is the relevant concept" (Cassuto and Ryan, 1979). That is, in the range of water uses where there is an element of choice, where there is relative elasticity, or "where alternatives to water use do exist," the "marginal use of water will be influenced by price change." Noting, however, that water is severely undervalued, substantial increases in price would have to be achieved in order to influence the amount demanded. Further, Bonem (1968) noted that marginal cost pricing as a means of determining the social optimum price for water depends in large part on the size of "third party" benefits and, since these are not generally present for commercial and industrial consumers, the method is inappropriate for that sector of the water market. For residential markets, Howe (1982) reported that seasonal differences in elasticities are smaller than previously estimated, but that "the theory of residential demands for water and other services has advanced substantially and can now guide us to more appropriate model specifications that at least partially account for the effects of the entire rate structure."

Two more recent pricing methods are peak demand and average demand pricing. These methods have been adopted in certain regions of the nation in response to electric power requirements that have outstripped supply and, with insufficient time to build new supply units before brownouts or severe outages occur, the power company has sought to influence the use of electricity (and gas) by charging higher prices. The methods can be used, too, for water pricing. The practice, even in the electric power industry, may have a direct effect on water resources. If consumer behavior with regard to power consumption is altered, the capability to store energy (for a time when consumers are more inclined to buy) is provided by the water resource in the form of pumped-storage projects (Jackson, 1973).

Peak demand pricing is characterized by a price per unit set during the time demand is highest and. In many cases, that higher rate sets the rate for the consumer across the board, that is, for *all* use of electricity. In other words, the rate the consumer pays is determined by the highest applicable rate during the period of use. Feldman (1975) suggested that consumer use of household water might be substantially affected by remote monitoring of water use, demand, and price. "Such a method of remote control would be most useful in that a seasonal charge could be made variable by having different rates for the days of the week as well as for different hours." This practice is technically feasible and available to municipalities where metering is accomplished over telephone lines and controlled by computers, as is the case in New York City. The sudden demand for water by fire fighting activities, for example, could trigger a programmed price increase, dependent upon time of day, season, and general water availability, that would be reflected in the homeowner's display of current price for water. Carver and Boland (1980) confirm that there is a seasonal effect but that, as with marginal cost pricing, it is smaller than had been previously assumed. In any case, the price of water in general is not yet sufficiently high to warrant the high expense of monitoring use in order to remotely communicate or control price.

Average demand pricing, as the name implies, is the rate that is set by the average quantity of water demanded for the period. In this situation, the entire community must be metered. In one study of peak demand pricing, Gyst (1981) observed that the cost of metering was still well below the interest cost of the loan necessary to build a treatment plant expansion, and that:

> The benefit-cost ratio of a metering program by comparison is many times better. The benefit would be the assured delay in capacity expansion requirement, keeping water bills lower than they would have been for all future years. A second important benefit would be the redistribution of costs to the consumers in proportion to their responsibility. Finally, a completely metered utility would allow the management to not only find out where its treated water goes, but to use conservation pricing in the future to reward conservative customers with lower unit rates, and give a strong financial incentive for customers to not use excess water during peak periods.

Conservation Pricing is a practice that establishes price so as to effect reduction of use (hence, conservation of supplies). A variety of methods are available, including **increasing block rates** (as opposed to the currently prevalent **declining block rate**), **summer differential rate** (as opposed to **constant price rate**), as studied by Gyst (1971), and **peak pricing**. An increasing rate structure has been shown to reduce water use (Young et al., 1983), and overall, "conservation pricing policies were advocated as means of lowering the long-run cost of water, using the water price-demand function as a planning tool" (Gyst, 1971). In a later study, Gyst (1972) confirmed "that varying incremental (conservation) pricing policies not only reduces the risk of shortages, but also lowers the average price to the community while rewarding the low consumption user with lower rates." Carey and Haan (1976) conclude: "It was found that the use of conservation pricing policies substantially reduced storage requirements while providing demonstrable net benefits to the community and a large average supply. The conservation pricing policies substantially lowered the average price paid for water." Moncur (1987) reported that short-run elasticities were, in fact, influenced by conservation programs, "even during a drought episode." While the study was limited in that the drought was short-lived and mild, and only single family residential housing units were studied, it appears that demand is affected by price at one end of the elasticity spectrum.

"The major problem of instituting a pricing policy for both water withdrawal and water discharge is that of ensuring more economically efficient investments without sacrificing social welfare objectives" (Tinney and O'Riordan, 1971). This reflects the fact that elasticity varies over the range of water use, and to set price too high will inflict hardship on the indigent. An alternative is to set the price for the minimum use of water per capita at a rate that is low enough to avoid such hardship, and start some other method of pricing over and above that minimum so as to reflect the varying elasticity of demand for water. Recognizing the lack of price signals in the municipal water market, Moncur (1987) observed that "in periods of drought, urban water systems commonly rely on nonmarket programs to induce temporary conservation, leaving the marginal price of water unchanged; an alternative is to raise the price." Restrictions, especially of luxury uses of water, are also effective (Anderson et al., 1980) and have been widely used in times of severe drought. In a 1978 study, Sharpe reported that conservation devices provided a more effective alternative than conservation pricing and metering. Obviously, many approaches exist, but one must not lose sight of the fact that municipal supplies should not be the lone targets of conservation measures whether by pricing, metering, or regulation. The chief use of water in the U.S. today is still for irrigation.

An Example

Three important points are illustrated in the cost and revenue curves in Figure 8.2, the economics of an expanding municipal water supply system. First, the "lumpiness" inherent in a high-fixed-cost system is apparent. It demands long-range prediction, procurement of legal rights, and construction necessary to assure satisfactory supplies of municipal waters (Hirshliefer, DeHaven, and Milliman, 1960). Other difficulties associated with the lumpy nature of the supply curve for water include the related problems of planning, so as to assure intersection of the demand and supply curves at a reasonable price at some distant time in the future, as well as the difficulties of maintaining, and periodically changing, a given price by either average or marginal cost pricing methods.

Second, the water closet analogy supports the concept of postage-stamp pricing in that the average unit costs curves are very flat over the wide range of the system's design capacity. This allows some uncertainty in the long-range planning that is necessary in order to ensure an adequate supply in the municipality's distant future. Since the actual forecast of population and water usage may vary over a fairly wide range of Q without altering the average variable cost, the amount demanded won't be likely to have a disastrous economic impact on the supply system.

Third, economies of scale may actually bring down the price at which the water may be sold. Such is the case (Figure 8.2) where a large, gravity-feed, transmountain diversion has a lower average unit cost than the older (but still-to-be-used) ground water pumping system. The curves shown are derived from actual data for Denver, Colorado, following implementation of a transcontinental divide diversion.

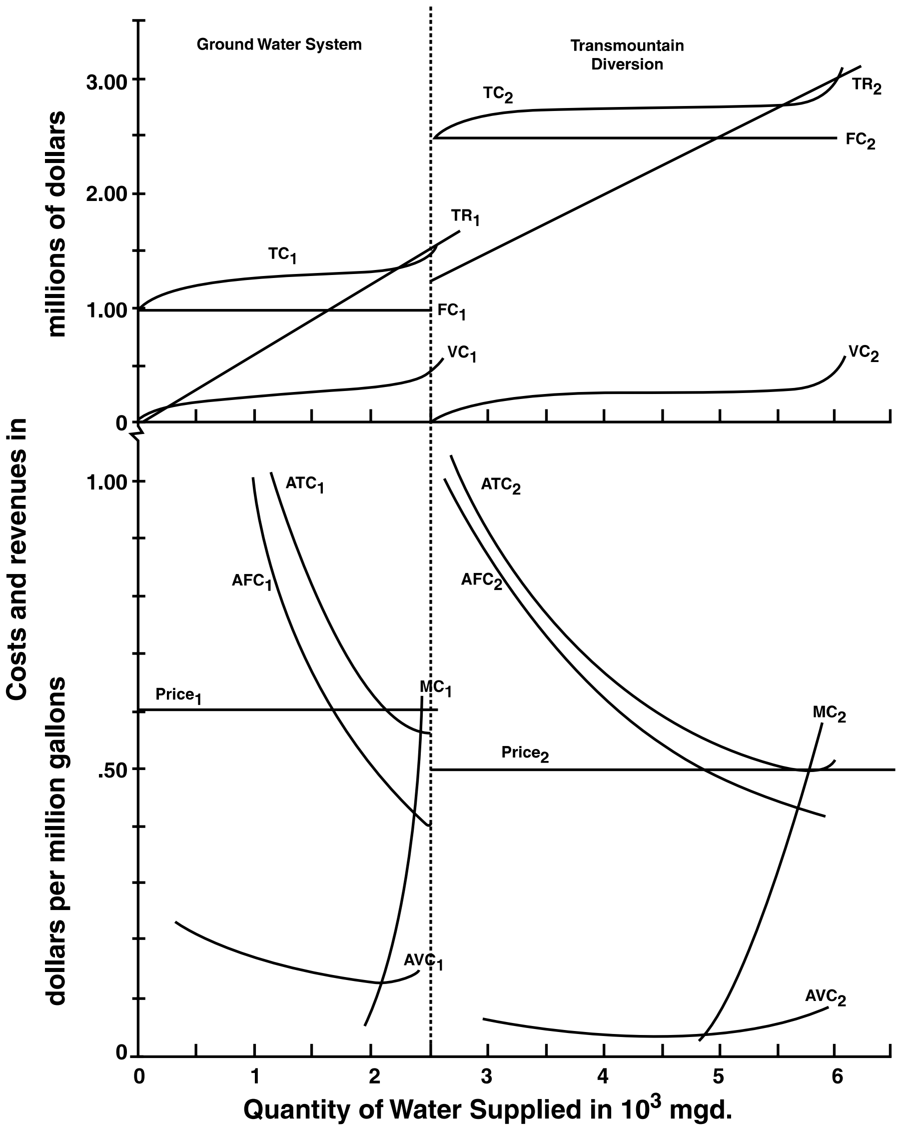


Figure 8.2 The economics of an expanding municipal water supply system.

Other Municipal Concerns

Several other important considerations in municipal water supply systems include health, safety, and other economic issues.

As a general operating principle, a municipality must maintain a certain minimum buffer of water in reservoirs. This is done so that at times of drought and/or excess demand and usage, the aquatic system will not succumb to stagnation with its attendant unhealthy environmental conditions, and to insufficient aqueduct flow to maintain low contaminant concentrations, or, where the sole source aquifer is a surface watershed, to disproportionate runoff from land uses that discharge pathogens. In older systems, sanitary sewer leakage and contaminants from urban nonpoint source runoff may cause seepage into supply mains, demanding supply flows be large enough to dilute dangerous concentrations. Local health departments and water departments need to establish and maintain effective communication about these potentially harmful situations. Industrial pollution is also a major concern in a variety of settings, such as where manufacturing activities are in close proximity to residential areas (Harr, 1995).

In addition, considerable economic pressure may be brought to bear on municipalities to create and maintain adequate fire-fighting water supplies to ensure public safety. The National Board of Fire Underwriters rates cities on the basis of one-third each for equipment, training, and water supply. The last demands special considerations, including adequate pressure, system looping, and reserve capacity. The issue is ultimately one of economics, for the rating, from 1 (highest) to 10 (lowest), determines fire insurance premiums. Since fire insurance premiums may be a significant portion of business expenses, the fire rating and water supply are quite important to economic viability of municipalities.

In many municipalities, there is also a need to integrate management of municipal supply and waste treatment systems. This means the consolidation of various government units that manage different aspects of the water resource in and around cities, and the renovation of the older distribution systems in the nation. There are a number of government units (Hennigan, 1968) that minister to the needs of the populace, but they often work at cross purposes, or their combined efforts are inefficient, conflicting, or duplicative (Water Resources Council, 1968). Much of the expertise needed for supply and treatment systems may be redundant and, if they were consolidated, could be better equipped and funded. Some of the difficulties associated with the physical and chemical attributes of water with regard to supply and treatment might also be resolved. The Sidney, Australia Metropolitan Water and Sewerage Board is a model of administrative challenge, operations, and administrative and political structure. Responsible for the supply from the Snowy Range 100 miles to the west as well as the water treatment, distribution, infrastructure management, sewers, and waste treatment or the city's water, the board is also responsible for the management of city parks that are built over underground waste treatment facilities.

Antiquated distribution systems, especially in the older cities, are in urgent need of replacement. Large mains that break as a result of long wear are becoming more and more expensive to repair and replace: the loss of water is also expensive and potentially dangerous to human health and safety. Newspaper reports and feature articles that appear frequently in national magazines attest to the continuing shortages caused by bad weather and drought, growing populations, and the increasing demand for water. These problems and others were all identified in the *Second National Assessment* (Water Resources Council, 1978b), but neither it nor its predecessor, the *First National Assessment* (Water Resources Council, 1968), the National Water Commission's 1973 report, nor the reports of the 1959 Senate Select Committee on Water Resources identify the mammoth water main replacement faced by older cities, estimated to cost billions of dollars (Adler et al., 1981). Municipalities are also vulnerable to acts of vandalism, hooliganism, and terrorism, and random acts of stupidity.

To alleviate real or anticipated supply shortages, a variety of innovative supply plans are continually presented for consideration. These include (1) offshore pipelines to bring Columbia River water to the Los Angeles region (Adler et al., 1981); (2) a massive towing program to bring pollutant-free, fresh water icebergs to the arid Mideast (Holden, 1977); and (3) the most ambitious of all engineering plans, the North American Water and Power Alliance (NAWAPA) proposed in 1964 to bring Yukon River water down the Front Range of the Canadian and U.S. Rocky Mountains to the high plains, southern and southwestern states, and to Mexico (Sewell et al., 1967; Worsnop, 1965). The project is periodically revisited as if to test the political waters,* however, so far it has been a fruitless dream. As a *Newsweek* article (Adler et al., 1981) points out, there is plenty of water; it is the needs, supplies, and use that are badly out of balance. That observation is often an opening statement in professional and college text books on hydrology and general water resources. With the continually increasing population and demands for water, viable political and economic solutions are needed, not solely physical ones. Allee (1971) clarifies the difficulties of cutting across governmental jurisdictions to achieve efficient management of urban water supplies. One of the most troublesome problems is that the multitudinous water agencies have statutory authorities that would have to be radically changed, along with the assured reduction of each agency's personal political and economic power networks. Reconsider Figure 1.3: the lack of coincidence between natural and artificial boundaries is a continuous and ubiquitous problem.

* Literally and figuratively!

Finally, there is the equally pervasive problem of personal habits, customs, and the long-standing expectation that water should be free — or inexpensive at best — and readily available. Water supply problems can, for the most part, be alleviated by raising the price. For example, speaking on a panel at the 1984 Annual Meeting of the American Association for the Advancement of Science on "Dams: Considerations for Future Water Management," Brent Blackwelder of the Environmental Policy Institute suggested that water conservation, leak repairing, meters, and revised rate structures could effect a possible 75 percent reduction in water use, without personal habit change at the low elasticities of water demand now prevalent. Per capita water use in the U.S. has decreased over recent decades as citizens have come to reduce wasteful uses in the face of the expense of leaky and inefficient systems. Low flush toilets and low-use shower heads are popular and promoted — and even required — for new construction, especially in arid areas. But the most effective conservation programs seem to be more common among the more affluent members of society who have the education — and the wherewithal — to support conservation measures with their check books as well as in their community spirit. Given a financial cushion, that support for conservation measures will be maintained. In its absence, the support may also disappear. With the consumption level already near zero in developing countries (Katzman, 1977), conservation efforts are even less effective. Cassuto and Ryan (1979) point out that "conservation efforts tend to be most effective in times of severe difficulties and do not have lasting effects."

Hydroelectric Power

Production of electricity from falling water is a relatively new use of water, about 120 years old. This section treats historical, technological, and modern problems and challenges of the industry.

The first hydroelectric facility in this country was built in 1882 (Linsley, 1971). Since that time, the use of electric power has grown rapidly. Nevertheless, production by hydropower does not exceed 5 percent of the total U.S. electricity production. It is highly dependent upon the existence of natural sites for high dams and/or diversions that make use of great height differences so as to capture the power of the falling water.

Hydroelectric power must, with one exception, be produced where a head of falling water is available, not near the larger municipality in which most of the consumers may be located.* There is a high transmission

* Fossil-, waste-, and nuclear-fueled steam plants may be located wherever there is sufficient water.

charge for electricity produced by hydropower because the dam sites are often located at great distance from the point of use, with an attendant considerable loss of energy. There are also high environmental costs associated with right-of-way maintenance and high-energy transmission lines. The exception to the rule is the pumped-storage project. During the latter half of the 20th century, high-tech pumped storage projects were constructed to recover some of the energy used to pump water up to holding reservoirs when demand for electrical power is low (for example, in the early morning hours), and then use that same water and reversible pumps (generators) to produce power when demand is high. Pumped-storage projects do not usually require the long-distance transmission, but the downside of such projects located near the point of major usage is that the cost of real estate and environmental quality concerns are often major construction blocking issues.

Several states do not use hydroelectric power, but Washington has the nation-wide high, 63 percent, of hydroelectric power usage (Bureau of the Census, 1980). Residential and domestic sales account for about 30 percent of all power and light sales. In 1940, 33 percent of all power was provided by hydropower plants. By 1970, that figure was down to less than 20 percent. The reasons for the decline include the fact that the best hydropower resources had already been developed (National Water Commission, 1973), and the fact that there is greater growth in fossil- and nuclear-fueled steam electric plants (Office of Science and Technology, 1970). It may be estimated from the *Statistical Abstract of the United States* (Bureau of the Census, 1980) that roughly 35 to 40 percent of the installed capacity is actually developed. Nevertheless, all types of electric power use in the U.S. have been doubling each decade (Office of Science and Technology, 1970).

In a strong attack on electric companies in general (not just the hydropower production companies), Metcalf and Reinemer (1967) pointed out that while retail sales had increased along with profits, costs had actually decreased as a result of greater efficiency and new technology. Consumer prices are highly variable and are more likely to be influenced by and regulated with interstate prices for fossil fuels than by the real costs of production. Prices have increased dramatically as a result of the energy crisis in the 1970s and the consequent increase in the cost of all types of fuels. Current practice in most jurisdictions still is for the consumer to pay less per unit (e.g., kilowatt-hour) for larger amounts of power used,* which is certainly not conducive to conservation of energy.

Although it is more expensive, hydroelectric power is desirable because it is relatively pollution-free and because it can be produced at a facility that responds rapidly to changes in demand. With the exception of the

* These are known as Decreasing Block Rates. See Pricing, this chapter.

approximately 37 percent efficient pumped-storage projects, electricity cannot be stored. Since demand fluctuates within regular limits and in regular patterns, hydropower is used particularly to meet peak demands, while less expensive power from fossil- and nuclear-powered steam plants is used to provide the base demands. Since steam plants operate at greater efficiencies at or near maximum design output levels, and since it takes a long time for their output to be adjusted, this is a most beneficial arrangement.

North et al., (1985) examines the impact that higher user fees would have on federal revenues. They report "that prices for hydropower from federal projects have been priced too low when compared to either market prices or alternative costs, for both firm and peak energy. … That market or near market prices for power produced by federal projects would provide sufficient revenue to fund substantial water projects, programs, and provide upkeep, that the most lucrative source of funding from user fees is in the generation of hydropower," and that "having studied these data, incomplete and rough as they are, we conclude that higher user fees are both necessary and imminent."

In the case of large projects, such as the Bureau of Reclamation's Central Valley Project and the California Water Project systems, power is produced for sale to private power companies to meek peak demands. When demand is low, private company excesses are bought (at a lower cost) to pump water back via reversible turbine/generators into reservoirs for storage until again needed to meet peak demands. Other intensive and efficient power development includes that of private power companies, such as the Pacific Gas and Electric Company on the North Fork of the Feather River in California, and the Wisconsin Power and Light Company on the Wisconsin River. Both of these streams have been completely stair-stepped to utilize water and thus to energize turbines as many times as possible while simultaneously regulating the stream flow to a high degree. (This process is often to the severe detriment of aquatic ecosystems and to the preservation of conditions conducive to the maintenance of economic and recreational fishery resources.)

On the other hand, and over the long run, electric power demand is a steady, predictable, and dependable source of revenues to a project. These attributes are the same as those of a good tax base (or of income that any individual would desire) and, as a consequence, building hydroelectric power production capability into a project is viewed favorably. With the decrease in available hydropower sites and the continuing increase in demand for electric power, nuclear power is seen as a means of meeting demand (Council on Environmental Quality, 1973). This type of facility is single-purpose, however, and is highly controversial insofar as the potential for accidents is concerned either with nuclear fuel, with the transportation and storage of waste materials, or in steam explosions

(Shea, 1976). Nuclear plants are steam plants that use nuclear instead of fossil fuel and require enormous quantities of water for cooling, up to 500,000 gallons per minute. Here again, consideration of the waste heat (thermal pollution) as a resource would (1) solve some waste problems; (2) provide a means of compliance with Section 318 of PL 92-500, which encourages aquaculture (the heat could be used for year-round greenhouses, for instance), and (3) put nuclear power facilities in the multipurpose category.

Navigation

Transportation by water has been a continuing activity in the U.S. (Chapter 1). This section briefly summarizes the history, statistics, and current navigation activity in the U.S.

Initial navigation activity served the nation's settlement and exploration; control was effected by force or stealth during this early period of the nation's history. The ultimate control over navigation is governed by the "commerce clause" (Section 8 of Article 1) of the U.S. Constitution, which reserves control over interstate commerce to the federal government. Since most commerce in the late 18th century was by canoe and barge, control over the nation's rivers by the federal authorities was essential. The 1808 Gallatin Report "proposed, together with other internal improvements, a complete, nationwide system of canals and river improvements justified on the grounds of economic development of the West, political unity, and national defense needs" (Holmes, 1972). Since that time, people (and, to a lesser extent, goods) have demanded more rapid transportation than leisurely boats can offer. However, in spite of the development of higher speed and mass transportation, both commercial and leisure navigation traffic is increasing. In anticipation of a 24 to 51 percent increase in traffic, Reuss (1983) reported that the estimated cost of upgrading the nation's locks and navigation systems through 2003 would be \$13.6 billion.

Navigation accounted for about 16 percent of the intercity ton-miles and only about 0.3 percent of the intercity passenger-miles between 1950 and 1980, and 1960–1980 outlays for navigation were only about 6 percent of the total transportation expenditures (Bureau of the Census, 1980). These data may not reflect the higher expenditures for water-based transportation systems at the time of their construction and the rather low variable and annual costs. What is more significant is that the rates for intercity transportation of freight are governed by complex regulations that depend, in part, on the rate by barge if the cities involved are served by a water transportation system. Thus, it is often more costly to ship goods short distances between cities without ports than between cities connected by a canal or navigable river system. In addition, with no charges for the use of the inland waterways navigation network, other modes of transport are at a competitive disadvantage, an inequity that could be eliminated by navigation user charges and lock fees (National Water Commission, 1973). On the other hand, Kelnhofer (1978) points out that:

> The questions raised about the financing of our inland navigation system are an example of the problems encountered in costing and evaluating the economic merits of our resource development programs. The growing awareness of the intangible costs is raising questions about the importance to be attached to the economist's measures of economic efficiency, in which optimal use of resources produces maximum increments to national income. For reasons of economic efficiency, it is alleged, the inland navigation facilities should be financed entirely by those who use the locks, which are installed, operated and maintained by the national Government. … The assertion about the lack of any substantial public benefit is an important one in the efficiency argument. It is used to support the demand that a user charge be imposed to recover the investments made by the public to serve these private user groups. ... A nation needs to make the most effective use of all the natural resources available to it in providing for the common welfare. Large rivers connect its population centers, make raw materials accessible to producers of commodities, and give inland enterprises outlets to coastal markets. These rivers are a freely available and low-cost means of transportation and those who settle in the vicinity will put them to use for that purpose.

The principal deficiencies of inland navigation, as summarized by the National Water Commission (1973), are: (1) procedures by which waterways projects are authorized and funded; (2) beneficiaries' not sharing in the costs of the program; and (3) the fact that "waterways are not planned, evaluated, or regulated as a part of the national transportation system." These concerns and difficulties may increase as the Corps of Engineers strives for a 20 percent increase in navigation by inland waterways, adding 5,000 miles of new 9-foot-deep channels (McCloskey, 1973) to the already existing 15,000 miles of 9-foot-deep channels and 9,000 miles of 12-foot-deep channels. The recommendations of the NWC pertain largely to planning and evaluating of navigation projects in light of the problems identified and to charging for the use of navigation facilities.

Like flood control, navigation projects provide a service. They are, therefore, very much a traditional part of the pork barrel. One of the worst examples was the $1.8 billion (Viessman, 1979) Tennessee-Tombigbee Project. Designed to shorten the trip between the Gulf of Mexico and the Midwest, the 253-mile waterway required 10 locks that became obstacles instead of efficiencies (Hanson, 1975). Barge tows had to be disassembled before entering each lock, restricting barge combinations, and making a trip take longer than the more sinuous but lock-free portion of the Mississippi River route (Smith, 1981). The “Tenn-Tom” was authorized in 1942, and construction commenced in 1972. It was evaluated with minimum compliance to BCA rules: the estimated value of its benefit-cost ratio fell from 1.6 in 1971 to 1.08 in 1976, at interest rates that were in effect at the time of authorization (Smith, 1981).

One recently quantified aspect of the navigation problem, associated with correctly identifying and evaluating all costs of navigation, is the revenue lost to power production as a result of navigation releases. Pleasure boats alone accounted for 21 percent of the estimated 161,742,000 kilowatt loss in 1979 on the Snake-Columbia River complex, with a replacement cost of over $1.3 million (Culver and Millham, 1981). Some of this loss, obviously, could be borne by those who use the locks. Again, “user fees and congestion tolls can be used to improve the efficiency and equity with which the inland waterway system is managed” (Hanke and Davis, 1974). Another recent alternative is a vehicle licensing fee that was considered by Congress. Such a fee “would be relatively easy to collect … [and would] require little new bureaucracy” (Martin, 1984).

Watershed Protection and Flood Prevention Projects

The heading for this section is the official title given to projects more generally known by the familiar “PL 566” label, the actual title of that 1954 law as amended. PL 566 is the legislation that began the trend in shifting a greater share of funding, initiative, and operation and maintenance costs to the state and local watershed districts (Steele and Sandals, 1955). The considerable amount of effort and funds spent on these projects — which also serve water quality goals — demands some attention to their unique characteristics, contained herein, and exemplified in an example of an economic analysis of one hypothetical project.

Origin of PL 566

The Pilot Watershed Act was enacted in 1953 to find "the best ways of developing a local-state-federal partnership in planning and carrying out a watershed-protection and flood-prevention program." As of 1955, it included 60 demonstration watersheds in 34 states, at a combined cost of $58 million (Brown, 1955). The demonstration value was ramified in the passage of PL 566. It was welcomed by the states, evidenced by the fact that within 1 year, 20 states had enacted 37 pieces of legislation to enable state and local participation in the PL 566 program (Brown 1955), "One of the most significant experiences that has come from the small watershed approach to date … *has been the incentive which a community undertaking provides to nearly every member of the community in pushing further and faster with his own individual efforts*" [emphasis in the original].

Benefits of a Federal-State-Local Partnership

In a series of articles published in 1966, several authors assessed the benefits of PL 566 from five widely scattered projects (Andresen; Badger et al.; Graham; Oertel; and Sasser). Williams (1966) gives an excellent summary:

1. The small watershed program has become a strong tool in resource development. Its benefits are many and varied; they are measurable and readily visible.
2. The watershed program has proven effective in halting floods, reducing sedimentation, and controlling erosion. It has accelerated land treatment practices and caused a shift of land ill suited for crops to other uses. These are the roots of the program.
3. While working together to solve the mutual problem of flood prevention, rural and urban interests in watershed organizations found a common basis for moving toward solution of other problems. As water was impounded in watershed reservoirs, it became obvious that here was a source of water for agricultural, municipal and industrial uses. Here also was an opportunity for developing outdoor recreation facilities for a growing population.
4. In one area after another, communities have been taking advantage of these opportunities. More than 40 percent of the approved watershed projects now have multi-purpose objectives. And where watershed projects have been completed, local communities are already beginning to enjoy the benefits.

The principal benefit of this type of project is that local people and organizations are directly involved — and must take the initiative — in taking advantage of the federal program.

Administration of PL 566

Administered by the Natural Resources Conservation Service (originally the Soil Conservation Service) and sometimes in conjunction with provisions of the 1954 Soil Bank Act Program, PL 566 projects offer several advantages. First, the cost-sharing characteristics ensure a local investment in which local residents have a greater interest and for which they provide, along with the initiative for the project in the first place, a greater degree of activity and support. Second, the relatively small structures that are usually a part of the project have lower fixed costs than do major flood control works,* and are directed largely at flood *prevention* as opposed to flood *control*. Third, higher incomes from improved and high-value crop yields may be counted as benefits to the project, along with flood damages prevented, thereby enhancing the value of the *B/C*. And, fourth, recreational benefits may be included, as is the case with all water resource development projects, under provisions of the Land and Water Conservation Fund Act of 1965.

The Soil Bank programs enhance project revenues by reducing sediment losses and attendant crop yield reductions and by providing erosion and sedimentation benefits; they do so by temporarily removing excess crop land acres from production (**the Acreage Reserve**), or by removing acres from production altogether for up to 15 years and planting trees (**the Conservation Reserve**) (Gilman et al., 1958). The modern, reconstituted Conservation Reserve Program (CRP), embodied in the Food Security Act of 1985, and its amendments, continues the basic precepts of the original CRP. Farmers receive payments for acres thus removed from production, and they and the nation therefore benefit from increased prices for farm products as a result of reduced supplies as well as from the benefits of reduced erosion and sedimentation.

Areas Covered

Of about 12,000 watersheds in the continental U.S. that are within the 250,000-acre limitation for PL 566 projects, only 543 such projects were completed by 1980, that is, during the first 26 years of the act's existence.

* PL 566 projects are restricted to watersheds less than 250,000 acres, although multiple watersheds may be combined into a larger, manageable unit where feasible.

Under construction are 416, 224 are in more preliminary stages, and another 41 have been de-authorized (Soil Conservation Service, 1980). Assuming project completion, these 1,183 projects constitute less than 10 percent of the watersheds that could be developed, in spite of the high praise for PL 566 projects by Williams (1966). At the time of its report (1973), the National Water Commission noted that there were 3,000 projects pending. Several projects have been withdrawn because of controversy over channel straightening that was included as part of the flood control measures, and about 200 are included among the 543 projects already completed.

In terms of acreage, the number of completed projects also represents less than 10 percent of the total number of acres included in the 12,000 delineated watersheds; thus, there is a potential for a large number of additional productive soil and water conservation activity. In the meantime, primary SCS (NRCS) activity has been directed elsewhere, and the PL 566 program is considered less urgent. Many of its benefits — especially those dealing with improved water quality as a consequence of upstream watershed management practices — are the focus of nonpoint source pollution control (as noted in Chapter 6). It is worth noting that while small, headwater runoff improvements may not have much of an effect individually on stream behavior, collectively the effect may be considerable.

The Mud Creek Example

A variety of evaluation techniques are utilized in project formulation, and these are abstracted in the Mud Creek Watershed Project shown in Appendix C. The Mud Creek Project, fabricated from several real projects and from examples of and recommendations for procedures of evaluation (Soil Conservation Service, 1964), illustrates a typical, if fictitious, small watershed project, with erosion, loss of crop yields, flood damages, and sedimentation damages, all of which become benefits to the project when they are prevented. The locations of the specific problem areas and suggested solutions in the form of various programs are shown in the accompanying map of the watershed. The evaluation techniques illustrated include straight-line depreciation, decreasing annuities, adjustment periods, capitalization, and composite- and average-acre methods of computing crop yield losses. Different interest rates are sanctioned for the government's and private sector's portions of the project, and a variety of costs (which would normally be derived by the project evaluator from experience or bid data) are itemized. The economic analysis example of Mud Creek also illustrates the relative complexity of economic analyses in general, as contrasted with the earlier greatly simplified Bennie Kost Creek and High Creek examples.

A major difference between the Mud Creek proposal and a real one is the greater degree of accompanying text, analysis, and development of each of the parts; only the essence and extent of the material present in a PL 566 project are covered. The overall project *B/C* value is unusually low for PL 566 projects.

Problems

Noting that the PL 566 program had a "lackluster approach" in its second decade, Williamson (1977) suggested the need to overcome three PL 566 myths:

1. Myth number one: a small watershed program is strictly a flood control program.
2. Myth number two: the structural program needs to be eliminated — floods can be controlled by proper floodplain zoning.
3. Myth number three: installation of land treatment measures or best management practices, as they are now called, can eliminate all flooding.

Clearly, the challenge is to maintain the valuable portions of the PL 566 program, as well as other approaches, by a "combination structural/non-structural program." Nor does everyone agree *in toto* with Williamson's myths.

Although designed to retard rainwater and snowmelt runoff temporarily on the land, where they will both prevent flooding downstream and benefit on-farm values, the PL 566 program was criticized because it lacked "an ecological dimension" and should have been better planned and coordinated in conjunction with other flood control and wetland protection programs (Jahn, 1973). In response, the basic concept of watershed integrity as the basis for management was addressed by the 1977 National Watershed Congress, held in Washington, D.C., which "enthusiastically supported the watershed approach," and led to the formation of a special study committee "charged with developing recommendations for administrative and legislative actions needed to improve the effectiveness of the small watershed program" (Hamilton, 1977). That endorsement was by all 30 participating organizations. Again, as previously noted, current NRCS programs embrace many of the original PL 566 flood prevention objectives while simultaneously addressing important water quality issues and pollution control.

One set of changes that would aid PL 566 — and all other district-based — projects, were such changes politically feasible, would be alterations in the state laws that restrict the formation of watershed districts to coincide with county boundaries. Currently, the support of several counties must be secured in order to form the watershed district that will contract with the SCS for technical assistance and funding. Any state that enacted district-enabling legislation on a county boundary basis presumably did so because the county government in the state was strong and the state undoubtedly did not wish to undermine that power. As a consequence, a county may have to repeatedly contract with the NRCS and/or other counties in order to effect watershed-based plans and each watershed organization has to negotiate with several counties (see Figure 1.3). Thus, the county-based, district-enabling legislation actually may result in the weakening of county clout by spreading it out over several overlapping jurisdictions and consuming valuable time and money in duplicate arrangements.

Within certain hydrographic regions, the artificial/natural boundary problem is once again apparent. Inconsistencies in some states' district laws don't help. For some purposes, such as drainage, and especially within municipalities, districts may be formed along natural watershed boundaries but soil and water districts cannot. As noted in Chapter 1, however, there can be disadvantages to natural boundary-based districts, too.

Even in states where there were different philosophies and strategies for implementation of the original Section 208 requirements, water quality improvement had progressed even before the passage of the 1987 amendments to the CWA (Champney, 1979). Assistant Secretary of Agriculture Cutler recognized the most important aspect of PL 566's overall type of approach to this problem in 1977:

> We intend to put more emphasis on evaluating land treatment. I am convinced that the land treatment part of the watershed program has not been recognized for its real contribution toward improved water quality. … This concern leads me to place heavy emphasis on rural water quality management, 208 planning (Section 208 of PL 92-500), and land treatment. You will notice I mentioned rural water quality, 208 planning, and land treatment in the same context. It is done deliberately. These three terms related strongly to each other. ... A rural water-quality "program" is emerging in the United States through the combined efforts of many organizations and under diverse authorities. There is new awareness of the importance of non-point source pollution control. ... Along with this awareness, we see an emerging partnership among conservation districts, the U.S. Environmental Protection Agency, the Soil Conservation Service and state and local water-quality agencies in meeting

> the 208 challenge. We believe that this partnership will become the dominant institutional strategy for effecting nonpoint pollution control in rural America.

As point source programs effectively reduced that source of pollutants to the nation's water bodies, this type of approach remains the most viable strategy for nonpoint source pollution control (see Chapter 6).

Water Quality Control

Much of what we accomplish in the form of water projects for varied purposes has profound influence on water quality. For most of the past century, this realization has been a principal part of water resources planning and management, but not all. Integrated water resource management addresses this topic, and many symposia by government agencies, professional societies, citizens' groups, and partnerships have dealt with it. This section focuses on singular water quality control programs in light of their unique economic characteristics. (For historical, organizational, and programmatic coverage, see the appropriate chapters and the section in this chapter on municipal supply.)

Regulation and Subsidy

As the federal government found itself effecting pollution abatement programs more and more by regulation and carrot-and-stick financing, it became necessary to evaluate new proposals for cleaning up the nation's waters.

The wide need for quality control was not initially recognized, primarily because the magnitude of the job and of the actual costs was unknown. The 1948 Water Pollution Control Act merely established an advisory board in the Public Health Service (Worsnop, 1965) and started the job;* it was only in the last three decades that the nature and magnitude of pollutants, as well as of the cleanup costs, were assessed to some reasonable extent. Programs in the 1970s provided 50 to 90 percent of systems for sewerage collection costs (depending upon community population size) and up to 75 percent of the costs of wastewater treatment facilities. Federal expenditures were (and still are, for nonpoint sources) justified on the theory that downstream water users on interstate streams are neither responsible for nor able to pay cleanup costs. Since the 1899 Rivers and Harbors Act

* For a more complete discussion on this topic, see the topics of water pollution and water quality control in Chapter 6.

rests on the commerce clause of the U.S. Constitution and on the federal responsibility for navigability, state and local community governments were (and still are) most willing to have Uncle Sam pick up the tab for pollution abatement. However, local governments are quite cognizant of the price they pay for federal intervention.

An outline of the 48-page chapter in the NWC report (National Water Commission, 1973) on water pollution control indicated the scope, if not the magnitude, of the water quality problem at the time. Topics ranged from the broad importance of clean water to specific geographical areas or technical problems. Needs and approaches to nonpoint sources, technical adequacy, innovative economic approaches to resolve residual problems, and the likely roles of federal, state, regional, and local governments were of prime concern. Problems not likely to be resolved by legislation were highlighted in the discussion, and all topics (as throughout the rest of the NWC report) were peppered with recommendations. The coverage and details are still timely.

The 16 recommendations were concerned with a wide variety of questions, and included discussion and summary of many of the topics raised. There was special emphasis on and estimates of the costs of cleaning up the nation's water bodies.* The nature of pollution control costs as a relationship between the index (percentage) of total control cost and percentage of pollution reduction achieved by each level of expenditure, as shown in Figure 8.3, clearly indicates the difficulty in trying to achieve "zero discharge of pollutants" as mandated by the 1972 Water Pollution Control Amendments. The marginal cost of removing successive increments of pollutants, measured in percentage reduction, becomes very high as the last few percentage points of pollutants are removed, especially when innovative and state-of-the-art technologies are mandated** and utilized. The dollar values to remove the last few percentage points of pollutant *a* become astronomical.

Costs of pollution control vary considerably from industry to industry. For instance, the incremental cost of removing the last 10 percent of biochemical oxygen demand (BOD) in sugar beet refining is 5¢, whereas in the petroleum industry it was reported at 22¢ (Kneese and Schultze, 1975). The authors point out several alternatives to high-cost pollutant removal: (1) generating fewer pollutants; (2) treating pollutants prior to

* The magnitude of just two of the costs of pollution control were estimated by the NWC at about $500 billion, split almost evenly between attaining the "zero discharge of pollutants" goal and eliminating nonpoint source pollutants from urban runoff. Again, as the point sources have been cleaned up, other nonpoint sources have emerged as being of critical concern, especially agricultural runoff problems.

** Best Available Control Technology (BAT) and Best Practicable Control Technology (BPT) standards, for example, are mandated by PL 92-500.

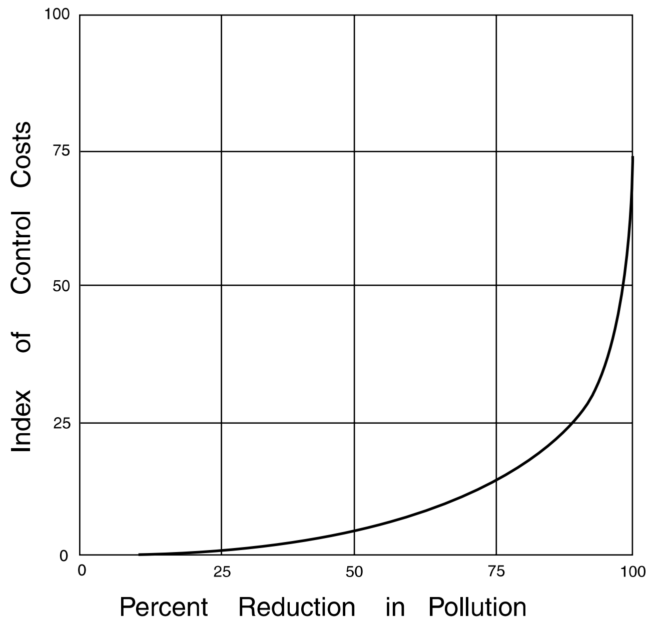


Figure 8.3 The relationship between cost and degree of pollution control achieved.

discharging (that is, changing them in such a way that they are not classified as pollutants); (3) increasing the capacity of the environment to assimilate pollutants; and (4) diverting pollutants from one medium to another: inevitably, however, they end up in the water.

Estimated total 1978 expenditures for both the public and private sectors were in excess of $19 billion, 44 percent of the total pollution bill (which include air, noise, and solid waste). Of this, $18.6 billion (96.7 percent) went for pollution abatement (57 percent by business, 43 percent by government); $397 million for regulation and monitoring (all federal); and $231 million (about 1.2 percent, split evenly between the public and private sectors) for research and development (Bureau of the Census, 1980).

Alternatives and Vested Interests

Several innovations, such as effluent standards, permits, and stringent toxic waste standards are included in PL 92-500. The high interest rates, recession, and energy crisis of the 1970s, however, along with concurrent local community economic pressure to circumvent environmental quality regulations, eroded enforcement proceedings, thus delaying the long-range goals. Parenteau and Tauman (1976) maintained that "careless draftsmanship" of the section of PL 92-500 that dealt with standard-setting meant that "the prospects for even approaching the Act's goals within the allotted time frame are bleak indeed." Not only were they bleak, but once the deadlines for the two virtually unreachable and unreasonable national goals had come and gone, there was little that could be done other than extend the deadline. That has not been a happy solution to an unfortunate problem that could have been readily avoided in the Water Pollution Control Amendments of 1972. Goal-setting was a panacea of the times, however, and notably successful in the case of the race for a manned landing on the moon, so perhaps it is not surprising that the CWA included such a proviso, especially in a pollution-dominated election year.

Several other possibilities, such as taxes and recycling, were not included: these are strategies that entail shifting the burden of proof to polluters. Recycling was lobbied against by industry, yet the tax relief for installation of pollution controls in the 1960s had repeatedly led to rapid recovery of valuable waste materials that could be re-used, as well as to recovery of the investment. Recycling requires that pollutants be considered as resources, a fundamental concept that has yet to be universally acknowledged. Incentive-type-strategies (Kneese and Schultze, 1975) — as identified in Chapter 6 — are generally more acceptable. One example is in Boulder, Colorado, where an incentive-based program ordinance was adopted. The program internalizes many of the normally external costs for flood control and, consequently, urban runoff water quality. Thompson (1982) reported success with this program and a simultaneous and welcome reduction in surface runoff.

With similar innovation, effluent charges have been instituted in the Federal Republic of Germany with some success (although long-term evaluation was not possible as late as the mid 1980s). "An effluent charge law could be enacted in the U.S. to operate in tandem with the existing CWA standards/permit system," according to Brown and Johnson (1984). Harrison and Derrick-Sewell (1980) reported on the effluent fee program in France, and noted reasons for lack of success: (1) effluent fees were too low ("polluters prefer to pay rather than clean up"), and (2) "high levels of pollution are tolerated in some activities." Industry has always had high standards for their input water, "for this reason, industry must assume its share of responsibility in a nation-wide water pollution abatement program" (Smith, 1966). While water quality has generally improved in the U.S., "there is no doubt that industrial water use changed over the 25 years of record. Although the evidence is circumstantial, it appears that the Clean Water Act and the environmental ethic which spawned it have played an important part in some aspects of these shifts in industrial water use" (David, 1984).

One traditional, inexpensive method of water quality control has been low-flow augmentation, in which, as in indoor plumbing systems, water is stored in a reservoir until it is needed to dilute and flush pollutants to the sea. This extension of flush-toilet philosophy is frowned upon technologically (Black, 1973) and economically (Branhall and Mills, 1966), and it was to be eliminated theoretically under PL 92-500's zero-discharge goal. But stream flushing is a natural process and, like biological water treatment, may be a partial, appropriate, and nature-emulating strategy after all. Black (1995) contends that since flushing is a natural function of all aquatic systems, some water bodies might be appropriately maintained for that purpose. Putting it bluntly, the goal of zero discharge was not even environmentally sound.

Furthermore, in an orderly and comprehensive survey of strategies in water quality, McFarland (1972) concludes, "in a changing and imperfect world, there can be no ideal strategy for all situations." New carcinogenic compounds are found regularly (Council on Environmental Quality, 1980), and some treatments, such as chlorinating, can release toxic substances or make safe ones harmful. For example, premature disclosure of research results on release of mercury by chlorinating was used as a justification for passage of the Safe Drinking Water Act of 1976 (Wade, 1977). Chlorination, a routine treatment used to kill pathogenic bacteria in most water systems can, in the presence of excess organic matter in the water, produce chloroform, one of the carcinogenic compounds on the EPA's toxics list of 96 organic and inorganic chemicals, contaminants, radionucleides, and microorganisms (Environmental Protection Agency, 1986).*

Given a decade of experience with PL 92-500, Rothfelder (1982) noted that:

> The present water pollution regulation system focuses on treatment by the individual and ignores the aggregate cost of pollution control. Economists have proposed three methods to create pollution control systems that cost less than the present one: effluent charges, marketable effluent permits, and private ownership of the waterway. Of these methods, only the marketable permit system has any potential for use within the Clean

* This list is updated and identified as follows (at http://www.epa.gov/OGWDW/Pubs/, accessed 6/13/00): "National Primary Drinking Water Regulations (NPDWRs or primary standards) are legally enforceable standards that apply to public water systems. Primary standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health and are known or anticipated to occur in public water systems. Table 1 [in the above Web site] divides these contaminants into Inorganic Chemicals, Organic Chemicals, Radionucleides, and Microorganisms."

> Water Act. Under the Act, EPA could not implement an initial sale of such permits, but a state administering its own permit system could.

As if in echo, the application of the BAT and BPT standards (see footnote, page 387) were tested in the courts, and the role of EPA and the appropriate state agency administering the NPDES program was clarified, although more work was needed (Wayland, 1977). Industry compliance was requested even before PL 92-500, and reported by Zimmerman (1973), in which

> it was found that the degree of compliance to state abatement action by industry in the [New York] Region is positively related to organization size, the extent of waste generation, the wealth and size of the town in which the firm is located, and the availability of waste treatment facilities in the town. The age of the firm was not related to compliance. The structure of state abatement scheduling also influences the degree of compliance.

Simplistic solutions to the varied problems of water quality are unlikely. For example, regional sewer system planning is not the simple matter that was once envisioned. No longer is it sufficient to mark out an area on a map and then to hire a consulting firm to develop estimates for a single treatment plant and interceptor sewers to serve it. Economies of scale of larger sewer systems may turn to diseconomies when the service system is too widely extended, particularly in highly populated regions. Moreover, the indirect consequences of encouraging growth along the interceptor sewer lines must be evaluated in a planning context. The extension of sewer services to areas previously served by septic tanks inevitably diminishes the percolation of water into the aquifers, and this in turn is apt to decrease stream flow (Whipple, 1978).

Perhaps more of a challenge is the combination of rising taxes on and the basic purchase cost of rural lands. For affluent and upwardly mobile citizens, large building lots that are not as economically served by regional sewer systems, leave even more, and larger, rural subdivisions without interceptor sewers. The increased necessity for regionalization of sewer systems as development in such an area intensifies simultaneously with exponentially increasing costs of land, taxes, and utilities, all of which work against early, economical, and effective pollution control. Modern technologies that separate sanitary and “gray” water (which could be combined with stormwater runoff) lead to potential efficient use of runoff, often minimizing downstream impacts of uncontrolled stormwater runoff and associated water pollution concerns. They are particularly attractive in the arid sunbelt areas where extensive open spaces, golf courses, and public recreation areas require large amounts of irrigation water that often cannot be purchased at normal water supply rates. Problems such as these are ongoing headaches for planning boards and regulators while simultaneously appearing as boons to developers. Perhaps the primary benefit of such conundrums is that there will be growing awareness of the issues surrounding conservation of water and related land resources. Perhaps more productive solutions will be forthcoming with regard to sustainability and, hopefully, a better informed public will be able to play a more effective — and ultimately, a more mutually satisfying — role in the decision-making process concerning water quality control.

Water-Based Land Management

Water-based land management might best be recognized as a euphemism for "land use regulation in order to control water quality." It is. Although such regulation is needed, there is considerable difference of opinion about the rate at which it occurs and, to many, whether it should even be a part of U.S. water resource management. Evolving originally from §208 of PL 92-500, the concept of water-based land management was proposed as a means of controlling pollution and, more generally, of managing instream water quality (Osteen et al., 1981).

Water-based land management — like the incentive programs it spawned (described in Chapter 6) — required identification of water quality problems, control of sources, feedback and monitoring of water quality data, and continuous reassessment of management plans. This especially important development exhibited a hiatus when federal funding for the 208 programs was cut in the 1980s, and only the state enforcement of the Best Management Practices (BMP) for nonpoint sources remains, along with any economic incentives to use them by landowners on a "voluntary" basis.

The potential institutional problem associated with water-based land management was identified as a loss of coordination of sediment control management practices between 208 agencies and local soil and water conservation districts. This might come about as a consequence of any change in existing district law in that it "could bring about strong political resistance from landowners" (Osteen et al., 1981). One early response, with the unified goals of improving rural water supplies and reducing agricultural nonpoint sources, was the Rural Clean Water Program of the Agricultural Stabilization and Conservation Service (1979). The program operated under individual 3- to 10-year contracts with participants who could receive up to $50,000 in cost-sharing funds for implementation of BMPs (comparable to the BPT standard) in cooperation with the SCS and local soil and water conservation districts. This approach is clearly what evolved into the federal §319 program and similar state programs based on bond acts and environmental protection funds, such as those described in Chapter 6.

Pollution from nonpoint sources is only one of several little-understood causes of contamination that had serious political implications through the 1970s (Conservation Foundation, 1981), not to mention health hazards and lesser, aesthetic ills. Like other effects of pollution from nonpoint sources, such contamination requires considerable outlay of funds for acceptable water quality control and, as noted in the permits section of Chapter 6, may not suffice without enforceable standards such as TMDLs.

Land Use Regulation to Control Water Quality

This unpopular phrase receives much attention, as well it should. Regulation of land use is coming to the fore as nonpoint sources of pollution are shifted to the point source category by virtue of the creation of permit processes that control them.

The first developments in this fast-changing arena were (1) the 1985 Food Security Act, (2) the 1986 Safe Drinking Water Act Amendments, and (3) the 1987 amendments to the Clean Water Act. The first of these, also known as the "Farm Bill," contained sections that were nonchalantly but accurately referred to as the "Sodbuster" and "Swampbuster" provisions of the act. These required that the SCS (at the time) verify to the Agricultural Commodity and Stabilization Service that a farmer who brought highly erodible lands or newly-converted wetlands into production would be ineligible for federal benefits.* Enforcement was in the forfeiture of non-obligatory benefits. Thus, if a farmer wished to till soil that was highly erodible or supported wetland vegetation, and to forego financial support from the federal government for any purpose, he was free to do so. This was clearly a first step of land use regulation for water quality control, albeit a "voluntary" approach.

The 1986 Safe Drinking Water Act Amendments included a section mandating that the states create protection plans for the area surrounding wellheads of any public water supply. The wellhead may be variably defined: it may be that area which contributes to the "cone of depression" surrounding a well when water is withdrawn by pumping, or it may be the entire natural surface/subsurface watershed of the well. The purpose of the provision is to protect vulnerable groundwater and public water supply aquifers. Protection is far less expensive than post-contamination clean up. While the total percentage of lands in most states that come

* Highly erodible lands or wetlands that had been or were already in production were not affected.

under such protection plans is quite small, regulating land use in the areas in question may be controversial because they are likely to be lands that are in close proximity to dense population and intensive water use. Obviously, water for domestic purposes is quite important and highly vulnerable. As with the Farm Bill, there are currently no proactive, negative sanctions for noncompliance.

Finally, the 1987 Amendments to the Clean Water Act solidified both expenditures and BPT standards for the application of BMPs for the control of nonpoint sources of pollution. The establishment of a means for funneling federal funds to individual land operators through the states in §319, and the subsequent addition in many states of additional local funding (see Chapter 6), provide for the Best Management Practice Process (see Table 6.2). Here again, the focus is on voluntary incentive programs, in contrast to the enforcement processes that exist under the regulatory provisions of the CWA. Thus, as discussed in Chapter 6, the current trend is to shift toward a greater degree of regulation through re-definition of nonpoint sources as point sources as a consequence of citizen concern over the nation's water quality. There are other provisions of the act that are linked to the wellhead protection plans, as well.

As one looks at the long history of our relationship with water and related land resources, one is impressed by the gradually increasing degree of regulation of land use in order to control water quality. We can expect to see increasing regulation for the water quality control purpose in the future as financial incentives shift to mandated controls in the form of performance criteria, compliance with standards, TMDLs, fines, and even criminal penalties.

As the Federal Role Changes ...

Regardless of a project's purpose or combination of purposes, some level of government — meaning some identifiable group of taxpayers — has to pay for water quality control. If some unit of local government is involved, translating policy into projects via expenditures of real dollars poses problems, especially for projects in water and related land resources with their traditional high-fixed costs. As federal programs were phased out and/or are strengthened anew, economic benefits to local areas are also affected, along with whatever inequities result from the changes, such as the varied attempts to clean up water supplies by the water treatment grants program (Kalter and Gosse, 1974). During the last quarter of the 20th century research had indicated:

- That the local district could "be effective in carrying out water quality projects" (Morrison, 1977).

- That "surface water management decreased the effect of unpredictable weather … and brought more of the system under the control of the operator," along with indications that the practices would be returning $3.73 on each dollar invested, with increased production paying for the practices in 2 years (Caldwell and McPherron, 1971).
- That cost-sharing could be an incentive to improve water quality through conservation tillage (Tice and Epplin, 1984).*
- That once standards had been set and specified dairy farms identified, economic control systems could be established (Ashraf and Christensen, 1974).
- That impoundment water quality could be affected and predicted by land use activities (Burt and Gentry, 1974).

But, while one study (Parent and Lovejoy, 1982) showed that farmers felt "individual landowners should be responsible for controlling erosion and agricultural nonpoint source water pollution, ... over 60 percent of the study farmers indicated that the federal government should play an important role, in terms of both technical and financial assistance." Another study showed that implementation of uniform rules could invoke inequities on "income of different size firms in different topographic regions" (Miller and Gill, 1976).

As citizen concern and activity in agricultural and manufacturing practices has increased, the courts have become more and more involved. Cases involving hazardous wastes have made use of state-of-the-art water quality monitoring and modeling and have been presented in the media, for example, the well-known "Woburn case" celebrated in book (Harr, 1995) and film as well as at professional symposia (Nix and Black, 1987).

Thus, while the biological/chemical/physical processes are being understood and can be manipulated technologically, institutional capability is not up to problem resolution requirements, largely owing to the artificial/natural boundary problem and inherent complexity. Further, Lord (1985) points out that:

> The lesson to be drawn is that technology and institutions are inseparable, that technology cannot be developed or applied except within the framework of social institutions, and that institutions must work through technology to make a difference in the state of the nonhuman world. Good water management, or any similar public policy goal, can be achieved only through the coordinated use of technology and social institutions.

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* Although there may be offsetting factors such as adverse policy and price supports.

The situation for urban surface runoff is much more complex (Black, 1983; Pitt, 1985) and will be a lot more expensive to clean up (National Water Commission, 1973). Currently, it is agricultural land use and associated nonpoint sources of pollution that are feeling the pressure; water quality control will probably remain in a state of change for a long time, especially with the current expectations for climatic change.

Recreation

The use of water for recreation purposes is not far behind water quality control in terms of timeliness and citizen interest; its priority, of course, is considerably less.* Affluence and the leisure time for recreational activities that wealth engenders are growing rapidly in developed countries, and will continue to grow in demand and, as a consequence, in the land and water resources dedicated to the purpose.

As noted in Chapter 2, western water rights for the purpose of recreation generally were not recognized until late in the 20th century. The exception was where there was a *bona fide* diversion, for example, a trout pond or a new water playground. Thus, for nearly two centuries, water rights for recreation in the natural water body could not be protected against other, recognized beneficial uses in the western states. However, in the west, as well as throughout the nation, instream recreation has become an ever-increasing activity, providing significant stimulation to the economy and, in some cases, providing more dollars to communities than traditional natural resource uses.

Since the early 1950s, *in situ* uses had been capable of becoming perfected rights where there had been a commercial development. In a 1959 article, Stroud (1959) noted that the value of reservoir fishing could easily be $50 per acre and urged that reservoir construction be adjusted to enhance limnological characteristics. Stroud also urged that upstream watershed management might be practiced to help control water quality, thus incorporating fishery management into major water resource development projects. Significant economic inputs to the local economy from reservoir projects have been noted (Saitta and Bury, 1973), and means to resolve conflicts of water use, primarily with regard to water quality, have been investigated (Hughes, 1984). In the absence of commercial value, research establishing aesthetic values by innovative means has been sought (Wyckoff, 1971). The ability to evaluate aesthetic recreation ("re-creation") comes about because the increase in volume permits scientific research, that is, replicable, objective studies (instead of one-shot, anecdotal evaluation), and because

* To assess the pulse of water resource issues, see a current issue of *U.S. Water News*.

of the “willingness to pay” concept, recommended even for municipal water supply project analysis (Griffin and Stoll, 1983). The foundation for this approach was set by the WRC Task Force in its dual suggestion to replace “intangible with nonmarket-valued benefits,” and to “allow the public to establish a value, therefore (see Chapter 6). This alternate technique for considering noncommensurate, subjectively identified objectives … relates the objectives in terms of real trade-off costs and eliminates the need for *a priori* estimates of objective worth” (Croley, 1974).

In the eastern states, more abundant and widely distributed supplies of water do not generally present a problem with regard to either the amount or quality of the water, but there are considerable difficulties with regard to *access*. Thus, the essence of the riparian right is control of the land/water interface and, even though the public has fishing rights, for example, the only way in which to exercise that right is for the fisherman to walk up and down the stream without trespassing on the (owned) banks. This is often a problem for the courts, as property titles are drawn to the center of the stream (or other waterbody) in some jurisdictions. In a 1994 confrontation in upstate New York, a prominent citizen who had title to lands on both shores of a portion of the Salmon River (tributary to Lake Ontario), alledged to control the stretch of the river between the two banks. The state’s highest court upheld his allegation, thereby effectively removing that section of the stream from the free public recreation resource inventory.* This type of conflict has included white-water sports as well as fish habitat control through reservoir construction and stream access. Unresolved complexities are reported by Cox and Agrow (1979), but are not covered in depth here.

Financing Public Improvements

Methods for financing public improvements such as water development projects are varied, but tend to fall into a few simple categories, cash on hand, current income, and borrowing. These three are guided overall by a few simple concepts.

Any government with **cash on hand** to spend is rare. Having sufficient cash to pay for the high fixed cost of a major water development facility is, therefore, virtually unheard of. Local jurisdictions are often not interested in sinking funds into projects anyhow, since recovery of the investment is not guaranteed, and new needs for immediate cash are almost always on the horizon. This necessitates other means of financing public improvements.

* *Douglaston Manor, Inc. v. George Bahrakis, et al., Respondents*, 1997.

Current income is often a source of government funds, but it is also insufficient to finance developments of the magnitude of typical water projects, especially with growing populations and overall increases in the standard of living that tend to require more high quality water. This must be considered in light of the water closet analogy, since that ubiquitous characteristic of a water supply system is a perpetual trap for government. The high fixed cost precludes receipts from taxes, fines, rentals, and investments being great enough for immediate investment in a multi-million-dollar project.

The third source of funds, **borrowing**, is the preferred means of securing funds for local government. Bonding (1) spreads out the costs of project construction, (2) allows local government to demonstrate a commitment if outside (normally federal) funding is contracted for, and (3) offers several attractive options all of which usually, under current law, involve low-interest municipal bonds that are tax-free for the private investor and that are sold at discount by most financial houses. There are three types of bonds.

General obligation bonds are those secured against the full faith and credit of the government unit's assessed valuation of property within its jurisdiction. Any monies received by the government may be used to repay the debt. State law typically regulates the percentage of the assessed value that may be put up as collateral. In recent years, many municipalities have reached the mandated bonding limits, driving bond rates higher as the risk of loss for the investor increases, which increases the interest rate to cover for the risk (Chapter 7). Much of the financial stress in New York in the 1970s was due to the state's committing funds for wastewater treatment plants in advance of the federal government's providing its cost-sharing funds, and, as pointed out in Chapter 6, President Nixon exacerbated the process by impounding the funds approved for waste treatment by Congress. The pressure on local government to utilize the general obligation bonding limit is often excessive, and committing long range repayments is difficult to sell to the public.

Revenue bonds are a more conservative approach, requiring that monies derived only from the use of the project be used to repay the bond debt. For commodity-producing projects, such as water supply, this is a suitable approach. However, for service-oriented projects, such as sewage or flood control projects, there may be considerable lag between the time the bond indebtedness is incurred and the time the revenues start rolling in, if at all.

Special assessment bonds are used in service-type projects where revenues may be derived directly from the users both in the form of a hookup charge (as is the case in sewer projects) and user fees.

Summary

Water resource projects are planned, constructed, and operated for a variety of purposes. As a consequence, many of their peculiarities are ramified in their politics and economics.

Different project purposes have varying inherent economic evaluation characteristics, depending upon whether the product is a good or service. Sometimes, they are dependent upon independent and highly variable factors such as weather, which can complicate the desired smooth repayment of costs. The purpose for which the water is used or developed may also display some unique economic or political characteristic or unusual condition. Some of those unique characteristics or conditions may conflict with one another. In other situations, water use and development may complement each other.

Events in the last 100 years have been important in the history of water resources development and use. The role of electrical power in the 20th century has influenced project economics and provided many opportunities as well as spawning conflicts between developers and preservationists. The attention paid to pollution control and prevention has been a major factor in the latter part of the century. The 1962 use of the expression “water and related land resources” was timely, clairvoyant, and fortuitous: the need for control over water quality is intimately associated with the land from which the water flows, as well as with the banks of the streams through which it travels. Water-based land management will, indeed, be the pattern of water and related land resources in the future. Land use regulation to control water quality is definitely at hand, and will continue to provide vexing and controversial issues that challenge our ingenuity and our ability to cope with them.

Owing to the high fixed cost, projects are often economically justified only if the project is multi-purpose, a development supported by the trend toward comprehensive planning, the dwindling of resources, the need for greater efficiency, and the growth of the environmental movement. The trend in the last quarter century was away from high-fixed-cost, awe-inspiring concrete projects, and toward nonstructural alternatives.

Finally, the interest rate, which provides the means of translating monetary values between the present and some future time, has become an important factor in conservation.

Activities and Questions for Critical Thinking

1. Following announcement of a first-stage water conservation advisory that invoked suggested reducing nonessential water use, a

resident declared to a radio reporter, "I'm gonna water my lawn. When the city pays for my water, then they can tell me how to use it." As the water department's public affairs official, draft a letter to this person with the goal of winning her support of the early drought warning message.

2. What *is* the price that local governments pay for being beneficiaries of federal financial largesse?
3. What do you think the next federal squeeze on nonpoint source pollution will be?
4. What do you think the principal features of the water pollution control picture will be in the year 2050?

Chapter 9

Conservation

Conservation is the cornerstone of sustainability

The concept of sustainability is typically used in the popular phrase "sustainable development." That is an oxymoron. The 1992 Earth Summit defined sustainable development as resource management "... to meet the needs of the present without sacrificing the ability of future generations to meet theirs."* Although that is a noble goal, it is clearly not feasible in the long run. It implies continued increase in economic activity concurrent with the population increase necessary to support the economic growth. Development, equivalent to growth, cannot be sustained indefinitely in the face of limited resources. True, we do not know which resource is going to limit human population first, but there is a good chance that it will be — may already be — fresh water. Instead of "sustainable development," we need to consider *sustainability* in the light of conservation. How can we define conservation?

* In 1992, more than 100 heads of state met in Rio de Janeiro, Brazil for the United Nations Conference on Environment and Development to address urgent problems of environmental protection and socio-economic development. The assembled leaders signed the Framework Convention on Climate Change and the Convention on Biological Diversity, which endorsed the Rio Declaration and the Forest Principles. See http://www.un.org/esa/sustdev/csdgen.htm, accessed 1/16/00.

The Term

The term "conservation," adopted by Theodore Roosevelt upon the recommendation of Gifford Pinchot (1947), has been variously defined and erroneously equated with several other terms (Herfindahl, 1961). In fact, the term existed prior to Roosevelt's application of it to natural resources; that was his significant contribution. The fact that so many contemporary quotations used in earlier chapters of this book confuse conservation with *preservation* or *development* are evidence of (1) continuing fuzziness about the term, and (2) the rather common use of the word conservation as a buzzword. Ackerman (1968) was correct when he said that the word conservation is one of the most elastic in the English language. Herfindahl (1961) states:

> That a conservative act may or may not be desirable, depending on all the associated benefits and costs and perhaps on the redistribution of real incomes involved. But this downgrading of the term, if it should be called that, does not carry with it any implication that conservation issues are unimportant. Rather, insistence that acts of conservation should not be undertaken simply because something is conserved reflects a view that conservation problems are so important that it is unwise to deal with them on the basis of slogans.

Because the use of the term has been so elastic and inexact, it is important to tighten up the definition.

Definitions of "conservation" include the catchy but impossible-to-define phrases "greatest good for the greatest number in the long run," "wise use," and "preservation." The term "wise" is subject to an innumerable many individual tastes, views, prejudices, and economic situations. The same is true for "conservation" itself, just as the term "preservation" is definitely a matter of an individual's point of view, for each potential user wishes to see the item that is to be preserved, saved for his or her own particular desires. There is a long-standing tendency to equate "water conservation" with a strategy to alleviate drought (Clouser and Miller, 1980; Moomaw and Warner, 1981; Maier et al., 1981; and Whipple, 1981). This means saving water for future needs by reducing waste and use, by storage, and by recycling.

The term "conservation" is usually applied to all natural resources; thus, it is helpful to commence with this term. Resources are most simply defined as *things* that have *utility* and *scarcity*. **Natural** implies that these things occur or are produced without benefit of human interference or assistance. Thus, quite generally, **conservation** may be defined in light of those naturally occurring things that have utility and scarcity. Another definition of conservation is slowing rates of resource use, or "shifting rates of use towards the future" (Wantrup, 1951). Fusing the two concepts means that conservation may be defined simply as "controlling use over time." This is a particularly useful definition, since it incorporates the two terms that are essential to the definition of the word "resource," **use** (utility) and **time** (scarcity). Undoubtedly, the definition should include, or at least should imply, that there is some "benefit to human beings" or some cultural reference point (Smith and Hogg, 1971). While there is no single objective of natural resource management any more than there is or can be one definitive example of conservation, that management must have a purpose. Kennington (1955) implied that important cultural viewpoint by stating that soil conservation meant "treating the land in such a way that it will be made secure for high productivity," a statement from which we may infer that there is some beneficiary of that productivity.*

Now, if the oft-equated terms "conservation" and "preservation" are separated, conservation may be viewed as a wide spectrum of practices that may be employed to achieve goals ranging from exploitation to preservation. **Exploitation** implies immediate depletion or consumption, that is, use with no element of time. **Preservation** implies postponing consumption indefinitely, that is, extended time and no use.** Conservation is not found at either end of this spectrum; conservation is the spectrum (Black, 1969).

Generally, then, *conservation* may be defined *as a balance of policies, programs, plans, projects, and practices that run the gamut from exploitation to preservation in order to manipulate (manage) the rate of using natural resources in the interests of humankind.* Fortunately, a variety of solutions to problems and development opportunities present themselves in the case of water and related land resources. There is no dearth of means by which the management of water and related land resources can be made more effective, efficient, equitable, meaningful, and beneficial. Nor is there any uniformity of situations wherein we might find a universal solution or panacea to our water and related land resources ills. As we have finally come to accept this fact, we note that our changing attitudes have been reflected in the institutions (see Chapters 3 and 4) we have

* Kennington also published under a title that would be controversial today: "What Women and Children Can Do to Promote Soil Conservation." In a series of practical suggestions for schools and other groups, she emphasized a "basic philosophy of soil conservation work," an idea, of course, that should not be restricted to women and children.

** This is, of course, a bit of an oversimplification. Preservation might be considered as a different kind of use, or we might simply substitute "development" for "use," which makes the distinction clearer.

created to resolve our problems. We must include and maintain in our conservation effort a strong federal role, especially a nationwide, uniform set of standards for environmental quality where appropriate, and a balance of activities by the several lower levels of government in resolving conservation problems (Glick, 1982). On the other hand, Assistant Secretary of Agriculture Peterson, in 1957, eloquently warned us of the dangers of allowing government's role to become too strong:

> A major question of our time is this: "Shall man be master of his government and thereby of himself, or shall he, by his silence, allow himself to become so dependent upon government that he is master neither of it nor of himself?"
>
> To the extent that citizens as individuals deny their individual responsibilities of citizenship, so they make more difficult the functioning of representative government. Freedom as we know it is indivisible — all must have it or *none* can have it.
>
> If as individuals we increasingly turn to government for a solution to our problems, we must surrender correspondingly our right to make decisions for ourselves. This is the road to bigger government.
>
> Ours is a complex society. Ours is a big nation. Big organizations wielding great power, both economic and political, are commonplace. Big problems appear and reappear. In this kind of situation we can either become a nation of big individuals measuring up to the needs of our time, or by our own indifference turn to government for answers to more and more problems which we are capable of solving for ourselves. We can — even unwittingly — substitute big government for big problems and find no solution.
>
> The proper function of government is to unleash the creative capacity of its citizens. Working cooperatively, it is within our capacity to achieve perpetual use of our natural blessings of soil and water. It is within our capacity to achieve a nationwide natural resource policy within which there is a creative place for everyone — conservation is everyone's business.

The last paragraph is ambiguous. We take "working cooperatively" to mean that individuals and governments take on the job together, or else why would "conservation be everyone's business"? There is disagreement on this point, as there should be, for the pluralism of our society and the variability of the environment and our natural resources demand a multiplicity of approaches. So does our approach to the term itself.

Bauman et al., (1984) consider the term "conservation" as applied specifically to the water resource, noting that

> The essence of conservation is reduced use. ... Water conservation, as we have said, implies a reduction in water use or in water losses. Reduction, in this sense, is logically defined in a with-without framework. Conservation practices are those which result in a level of water use less than the level that would be [used] had the practice not been implemented.
>
> Combining these considerations, it can be said that a water management conservation practice constitutes conservation when it meets two tests: (1) it conserved a given supply of water through reduction in water use (or loss); (2) it results in a net increase in social welfare, i.e., the resources used have a lesser value than those saved. The first test ensures that the practice results in a reduction in use, while the second establishes that overall benefits exceed costs. We are thus led to the following definition, "Water conservation is any beneficial reduction in water use or losses."

Note the relationship between phrase "the resources used have a lesser value than those saved" and the application of the interest rate to resources that are used now (exploited) and those that are set aside (preserved).

An interesting aspect in considering this terminology involves several interpretations of the word "conservation," which derives from the same root as the word "conserve." In the days of Theodore Roosevelt and "rugged individualism," when the word "conservation" was coined for application to natural resources, it meant "wise use," with more emphasis on "use" than on "wise." Under Franklin D. Roosevelt, the term was used to reflect preservation and economic reconstruction during the Depression. Teddy Roosevelt was a member of the Republican Party, the more *conserv*ative (cf. Chapter 1) of the two major political parties; Franklin Roosevelt was a Democrat, with a more liberal bent. In a very broad and over simplistic way, we can say that the more conservative Republican Party members are against big government, and for big business and free enterprise with the present economic benefits that attend exploitation. Liberals and socially concerned affluent members of society are the ones who are willing to and can afford to "shift rates of use towards the future" and consider themselves as "conservationists." Which is which?

Conservatives are faced with the dilemma that hinges on the term itself. The conflict is built upon the exploitive nature of free enterprise and the need to "hold back," a characteristic of the conservative's approach to economics and regulation; but that, too, can also be interpreted as being conservation. Liberals are faced with a great internal dilemma as well, since they often support fiscal aid to developing countries and minorities, as well as to preservationist causes. They cannot conserve in their preservationist sense and simultaneously deny resources to developing peoples. Perhaps the fuzziness of these two dilemmas is a good thing; without them the battle lines would be clearly drawn and it would be easier to take sides. Conservation is too important an issue for easy solutions. Glick (1982), coming to the same conclusion, turns a neat phrase: "We must, therefore, include not only the politics of conservation, but also the conservation of politics." The concept is echoed in a practical example by Taylor and Young (1985) discussing conservation tillage, "Results showed that the shallower the topsoil and/or the longer a farmer's planning horizon the lower the level of the policy instruments necessary to achieve erosion control goals."

The change in concepts of conservation over the century since the term was first used by Gifford Pinchot and Theodore Roosevelt to refer to our relationships with natural resources is just of one of many trends that can be identified. Some of those discussed in earlier chapters and are summarized here.

The Trends

Perspective implies a degree of distance and detachment. Many dates from the past century have been discussed throughout this book. Examining the sequence of these dates will help illustrate certain themes or topics. For example, the presentation in Table 5.3 (Evolution of Water and Related Land Resources Planning Objectives) reflects the policies of several administrations and Congress, as well as public attitudes. There is another, shorter sequence of federal legislation that chronicles the basic relationship between land and water:

1911 – the Weeks Forest Purchase Act protected the waters of navigable streams by means of some forest management.
1924 – the Clarke-McNary Act extended its geographical scope.
1936 – the Omnibus Flood Control Act attempted to coordinate the activities of two agencies (SCS and COE) in accordance with their upstream and downstream responsibilities.
1954 – the Watershed Protection and Flood Prevention Act (PL 566) put greater strength into the upstream land management role in runoff control.

1972 – the Water Pollution Control Amendments linked land and water quality in Section 208 "areawide waste treatment plans."

1987 – the Clean Water Act amendments establish a funding mechanism to enable land operators to implement best management practices for control of nonpoint sources of pollution.

The 1936 Omnibus Flood Control Act is also a component of several other trend-series, for it addressed many issues, including economic analysis, flood control, the Corps of Engineers, public works, and the concept of the watershed itself. Similarly, PL 566 was an important part of the trend that has seen the shift of fiscal responsibility from the federal to local and state governments and to individuals. The federal tax laws have not been as helpful in achieving conservation as they could be (Collins, 1982). They represent one of several means to effect change in fiscal responsibility for water and related land resources projects if a national policy can ever be agreed upon, or is ever actually desired. Tax laws affect both individuals and corporations and, as a result, governments, especially local ones and, to a lesser extent, state coffers. As noted earlier, this shift is producing some particularly difficult questions regarding equity and environmental justice. For example, the financial, and cultural burdens put upon those who previously were either not ready or were incapable of taking advantage of federal largesse and must now foot the bill themselves. That bill is now higher because of inflation, the costs of environmental considerations, higher technological costs and, of especial importance for high-fixed-cost projects, higher interest rates.

A part of this shift in cost-sharing is a major shift in federal activity in water and related land resources. The Reagan Administration's deregulation campaign affected land and water directly as well as indirectly through changing control of interstate commerce, banking, interest rates, deficits, corporate mergers, and environmental quality. These factors are, of course, interrelated. For example, the large amounts of money that are required to replace aging municipal water mains are a major part of city financing, which is affected by interest rates. These leaking water mains are simultaneously an important factor in conservation. We have seen, too, that the de-emphasized federal role was not exclusively a policy of the Republican Reagan Administration, but was started, albeit with a different name and rationalization, by the Democratic Carter Administration (Wilson, 1985).

A trend in the range of purpose of water resource development projects is also evident. In the early part of the 20th century, projects were largely single-purpose, a characteristic that changed as fixed costs grew larger in response to greater engineering capability and larger dams. As projects became multi-purpose, there was a parallel trend in both the public's and professionals' attitudes about the need for comprehensive planning of water and related land resources. From small, local projects to large river basins and regions, the scope of planning changed as people were better able to understand the interconnectedness of the world around them. The continuing reduction in the numbers of large, structural (federal) projects is a consequence of three end-of-the-century changes. First, people became aware that environmental quality was endangered by the traditional "dams of pork." Second, the best dam sites had already been developed and those that remain were marginal at best. Third, the high interest rate that inevitably interacts with structural alternatives' high fixed costs and long repayment periods reduce the benefit-cost ratio. New technologies such as the center pivot irrigation systems (described in Chapter 8) both reflect and benefit from these trends and may play an important role in developing countries' new irrigation projects (Postel, 1999) by meeting population needs without compromising environmental quality.

During the 20th century there has also been a transition from a rural, largely farming population with considerable representation in Congress to a population that is mostly urban and a growing contingent of rural dwellers who do not have the ecological understanding of their farmer forebears. In 2000, farmers in Congress are virtually non-existent. The shift in occupation accompanies a different view of the resource professions in general. In 1900 the effects of deforestation on floods and sediment were evident in the support of the forestry profession on environmental grounds in contrast to the European attitude that a forester was an engineer. Related disciplines in agriculture, soil conservation, fisheries, range, and wildlife management followed the same pattern. Consequently, professional educational opportunities and programs reflected this difference and U.S. natural resource management programs are more management than engineering oriented. The trends have been accentuated by population growth and pressures on rural resources, and are of special interest at the rural-urban interface, where land use transition takes a heavy toll on hydrological processes and water quality. This trend is part of the context within which the shifts in water resources policies, planning, and pollution control need to be studied and assessed.

Currently, in the U.S., we are back to considering the local river basin as a unit of planning, a fortuitous development that probably relates more realistically to 208 planning and water-based land management, and to a growing future emphasis on water quality rather than quantity. For example, the 1979 Rural Clean Water Program provided "long-term technical assistance to owners and operators having control of agricultural land. The purpose of this assistance is to install and maintain best management practices to control agricultural nonpoint source pollution for improved water quality" (Department of Agriculture, 1979). Of even greater significance is the growing number of watershed or river basin initiatives — the watershed councils, commissions, and committees — that illustrate the unparalleled growth of partnerships among private individuals and local, regional, state, and federal organizations to resolve practical problems at the lowest possible level and with maximum public participation and support.

These trends mesh with concurrent public attitudes and the historic needs of the nation. Exploitation was "natural" toward the end of the 19th century as the U.S. filled in the land between the oceans and as the Industrial Revolution crested and wound down. Subsequent concern for environmental quality came about along with an expanding world concern and view during the 20th century, and with color television, which brought to everyone's home pictures of defoliation in Vietnam and pollution at home, the verity of environmental impact (pollution) could not be denied. A particularly noteworthy trend, brought about in large part by the environmental movement and, in part by federal legislation,* is the increasing degree of participation by the public in water and related land resources decisions. It is important for this participation to continue by both professionals and the public and for it to be responsible and constructive (Baum, 1985). It is especially important for the public to participate more aggressively since the emasculation and demotion of the "final form" (Eisel et al., 1982) of the *Principles and Standards* to the *Principles and Guidelines* that apply only to the four major construction agencies. Indifference will result in more water resource decisions being made without public scrutiny.

Water in the U.S. is undervalued largely because people want it that way and, owing to the supporting circular tenet, we won't conserve until the price rises considerably. Thus, the principal water using industry, irrigation, accounts for 80% of the nation's total water use (and misuse), and "at low rates, customers have little incentive for conservation" (League of Women Voters, 1945). When the price of water gets high enough, (and it has started the slow climb upwards), we will, no doubt, see another major trend: conservation. Until then, Schad (1985) holds that the seven "themes" of the National Water Commission 1973 report are "recurrent" ones: they "are still the driving force behind progress on water resources policy." The themes dealt with water development and growth; a shifting of priorities from development toward preservation and environmental quality; the relationship between land and water; the "inexorable laws of

* This legislation refers especially to the National Environmental Policy Act of 1969 and to the Water Pollution Control Amendments of 1972 and subsequent amendments.

economics:" the changing procedures of economic analysis and payment by beneficiaries; recent court decisions and institutional changes; and the need to control water and related land resources problems "nearest to the problem." The themes are, in fact, ramifications of the trends in which we find ourselves and that have made up our past. As such, they represent the essence of the challenges of successful water and related land resources management. In many ways cited above, we are already responding positively.

The Challenges

Conservation of water and related land resources presents two challenges. The first general water conservation challenge entails understanding the nature of the supply and the scientific relationships between water and related land resources; evaluating the demand for water goods and services; identifying, creating, and supporting the institutional framework within which management will take place; planning so as to assure efficient resource use and integration of different resource use demands; and, finally, achieving a balance of conservation practices so as to satisfy the needs and wants of the public.

The second challenge is a more specific, current (and perhaps continuing) one that concerns conservation and the interest rate. Under the pressure of societal goals expressed in high interest rates and the simultaneous desire for high environmental quality for our descendents, new ways must be found in order to justify saving resources and shifting rates of use toward the future, which, ironically, is discounted more and more by the high interest rates. With increasing costs of energy and "additional pressures on our soil and water resources, conservation practices are rapidly becoming production inputs" (Larson et al., 1981). The high interest rate, therefore, is a formidable obstacle to conservation.* For example, Willey (1979) pointed out that "Congress must either eliminate the water subsidy in the public works authorization bill … or redirect it to spending on lower cost conservation alternatives. Huge and unnecessary water projects waste taxpayers' money, enlarge the federal deficit, and fan the flames of inflation." While the water subsidy has diminished over the last quarter century, it is by no means gone. It is clear that, given the choice between conservation and other public investments, our profit-motivated

* Miller and Erickson (1975) note an exception where, in a rather limited study, high interest rates tended to encourage an urban surface runoff drainage system that would readily "fit" with the requirements for open space and enhanced environmental quality.

society will shun conservation to its long-term detriment unless innovative policies and practices are developed.

But, conservation is not a luxury; it is a necessity.

Again, whether maximizing net revenues or minimizing losses, rationality is a basic premise. Whipple (1981), echoed by Bauman et al., (1984) cited earlier, asserted that “water conservation should be employed only when the value of the water saved exceeds the cost of effecting the saving.” Our economy-based society needs some freedom from economic evaluation constraints, an independence of decision on behalf of the EQ objective. Yet, there also must be a realization that to do so without consideration of the NED objective would be foolish and, in the long run, counterproductive.

An essential need, then, is the need for institutions to do the job. That thought is at the heart of much of the content of the foregoing chapters and is elegantly put by the Leonardo Scholars (1975):

> Once the decision to utilize the resource was made, a social organization was devised to accommodate that decision.
>
> For a more complex example, consider that many serious students of environmental policy today recommend the allocation of resources by the use of a “free market,” which allows prices to find their own natural levels. The reasoning is that if people were forced, as the free market presumably would force them, to absorb the cost of their own impact on the environment, they would alter their behaviors rather than pay the costs. Apart from any evaluation of whether this would have the desired environmental effect, we should recognize that we are talking about a new social institution, the workability of which is yet untested. The free market, in the sense envisioned by classical economic theory, has probably never existed. And it certainly has never existed for long on a large scale. There is no history of a time in which there was a sufficient number of buyers and sellers, each possessing sufficient information, that no one (or no small group) could dictate price. Nor do we have any history of a period in which the government did not, in one way or another, intervene in the market mechanism. Accordingly, free market proposals must be regarded as proposals for innovation. And, considering the actual web of restraints working against it, a free market would introduce the most remarkable uncertainties into the industrial picture.

> In short, an imagined policy such as the creation of a total free market will not be adopted merely because it has been judged "good" or "rational" or "desirable" by some single criterion. Nor, if adopted, will all of the policy's results immediately be good. Adverse side effects are to be considered quite seriously, and decisions about natural resources should be guided by the maxim "first, do no harm." The possibility that unexpected outcomes will follow a policy decision cannot legitimately be ignored. They cannot be ignored because natural resources decisions - despite the technocratic language in which we express them - are exercises of power in which a group A seeks to compel group B to do what A prefers, and what B would not do except for A's intervention.
>
> Because resource policy decisions are political decisions, they are not made in a vacuum. Rather, a matrix consisting of a people's biophysical setting, their social myths and values, and their formal institutions molds them.*

The historical, legal, political, and economic institutions that provide an imperfect framework within which to realize the objectives of soil and water conservation abound. They need to be enabled, used, modified, diversified, and supported in order to achieve the multiple objectives of a pluralistic society.

It is difficult to preserve, since the greatest conservation challenge civilization faces is shifting rates of use toward the future when interest rates are high, as they tend to be when people are affluent enough to afford saving. As we have seen, high interest rates discount the future more, thus placing lower present worth on far-off future values. We, also, cannot exploit excessively. How can we justify using up a resource for our own satisfaction while not leaving some of it for future generations? And how can we justify setting resources aside when that practice denies development to those who are in need of resource exploitation to enhance their standard of living. In the face of the earth's rapidly expanding population that demands more natural resources, and of developing minorities and nations that demand higher quality natural resources, conservation becomes an issue of utmost importance.

The ultimate challenge of conservation in our own communities is in finding a broadly acceptable balance of exploitation and preservation activities. That can only be accomplished through dialogue. Conservation is everyone's business. Consequently, disagreement on how the environment should be conserved is to be expected. This is as it should be, since our society's pluralism and the variability of the environment demand a multiplicity of approaches to conservation. The answer lies in deliberately and delicately combining, exploiting, and preserving practices to ensure resources in quantity and quality to satisfy all. The balance will continually shift as conservation policy is reviewed and revised to meet the ever-changing needs of civilization: that is conservation.

Question for Critical Thinking

1. In view of what you now know about the laws, organizations, policy, planning, pollution, programs, and benefit-cost analysis, how would you suggest we change our institutions in the U.S. so as to ensure sustainability?

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Appendix A: The 1965 Water Resources Planning Act

Water Resources Planning Act

Public Law 89-80
89th Congress, S. 21
July 22, 1965

An Act

To provide for the optimum development of the Nation's natural resources through the coordinated planning of water and related land resources, through the establishment of a water resources council and river basin commissions, and by providing financial assistance to the States in order to increase State participation in such planning.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That:

Water Resources Planning Act.

SHORT TITLE

Section 1. This Act may be cited as the "Water Resources Planning Act".

STATEMENT OF POLICY

Sec. 2. In order to meet the rapidly expanding demands for water throughout the Nation, it is hereby declared to be the policy of the Congress to encourage the conservation, development, and utilization of water and related land resources of the United States on a comprehensive and coordinated basis by the Federal Government, States, localities, and private enterprise with the cooperation of all affected Federal agencies, States, local governments, individuals, corporations, business enterprises, and others concerned.

EFFECT ON EXISTING LAWS

Sec. 3. Nothing in this Act shall be construed—

Federal or state jurisdiction.

(a) to expand or diminish either Federal or State jurisdiction, responsibility, or rights in the field of water resources planning, development, or control; nor to displace, supersede, limit or modify any interstate compact or the jurisdiction or responsibility of any legally established joint or common agency of two or more States, or of two or more States and the Federal Government; nor to limit the authority of Congress to authorize and fund projects;

Federal official.

(b) to change or otherwise affect the authority or responsibility of any Federal official in the discharge of the duties of his office except as required to carry out the provisions of this Act with respect to the preparation and review of comprehensive regional or river basin plans and the formulation and evaluation of Federal water and related land resources projects;

79 STAT. 244.
79 STAT. 245.

Federal agencies and international commissions.

(c) as superseding, modifying, or repealing existing laws applicable to the various Federal agencies which are authorized to develop or participate in the development of water and related land resources or to exercise licensing or regulatory functions in relation thereto, except as required to carry out the provisions of this Act; nor to affect the jurisdiction, powers, or prerogatives of the International Joint Commission, United States and Canada, the Permanent Engineering Board and the United States Operating Entity or Entities established pursuant to the Columbia River Basin Treaty, signed at Washington, January 17, 1961, or the International Boundary and Water Commission, United States and Mexico;

TIAS 5638.

River basin commissions

(d) as authorizing any entity established or acting under the provisions hereof to study, plan, or recommend the transfer of waters between areas under the jurisdiction of more than one river basin commission or entity performing the function of a river basin commission.

TITLE I – WATER RESOURCES COUNCIL

Sec. 101. There is hereby established a Water Resources Council (hereinafter referred to as the "Council") which shall be composed of the Secretary of the Interior, the Secretary of Agriculture, the Secretary of the Army, the Secretary of Health, Education, and Welfare, and the Chairman of the Federal Power Commission. The Chairman of the Council shall request the heads of other Federal agencies to participate with the Council when matters affecting their responsibilities are considered by the Council. The Chairman of the Council shall be designated by the President.

Duties.

Sec. 102. The Council shall—

(a) maintain a continuing study and prepare an assessment biennially, or at such less frequent intervals as the Council may determine, of the adequacy of supplies of water necessary to meet the water requirements in each water resource region in the United States and the national interest therein; and

(b) maintain a continuing study of the relation of regional or river basin plans and programs to the requirements of larger regions of the Nation and of the adequacy of administrative and statutory means for the coordination of the water and related land resources policies and programs of the several Federal agencies; it shall appraise the adequacy of existing and proposed policies and programs to meet such requirements; and it shall make recommendations to the President with respect to Federal policies and programs.

Federal projects procedures.

Sec. 103. The Council shall establish, after such consultation with other interested entities, both Federal and non-Federal, as the Council may find appropriate, and with the approval of the President, principles, standards, and procedures for Federal participants in the preparation of comprehensive regional or river basin plans and for the formulation and evaluation of Federal water and related land resources projects. Such procedures may include provision for Council revision of plans for Federal projects intended to be proposed in any plan or revision thereof being prepared by a river basin planning commission.

Review of plans.

Sec. 104. Upon receipt of a plan or revision thereof from any river basin commission under the provisions of section 204(3) of this Act, the Council shall review the plan or revision with special regard to—

79 STAT. 245,
79 STAT. 246.

(1) the efficacy of such plan or revision in achieving optimum use of the water and related land resources in the area involved;

(2) the effect of the plan on the achievement of other programs for the development of agricultural, urban, energy, industrial, recreation, fish and wildlife, and other resources of the entire Nation; and

(3) the contributions which such plan or revision will make in obtaining the Nation's economic and social goals.

Based on such review the Council shall—

(a) formulate such recommendations as it deems desirable in the national interest; and

Report to President and Congress.

(b) transmit its recommendations, together with the plan or revision of the river basin commission and the views, comments, and recommendations with respect to such plan or revision submitted by any Federal agency, Governor, interstate commission, or United States section of an international commission, to the President for his review and transmittal to the Congress with his recommendations in regard to authorization of Federal projects.

Administrative provisions.

Sec. 105. (a) For the purpose of carrying out the provisions of this Act, the Council may: (1) hold such hearings, sit and act at such times and places, take such testimony, receive such evidence, and print or otherwise reproduce and distribute so much of its proceedings and reports thereon as it may deem advisable; (2) acquire, furnish, and equip such office space as is necessary; (3) use the United States mails in the same manner and upon the same conditions as other departments and agencies of the United States; (4) employ and fix the compensation of such personnel as it deems advisable, in accordance with the civil service laws and Classification Act of 1949, as amended; (5) procure services as authorized by section 15 of the Act of August 2, 1946 (5 U.S.C. 55a), at rates not to exceed $100 per diem for individuals; (6) purchase, hire, operate, and maintain passenger motor vehicles; and (7) incur such necessary expenses and exercise such other powers as are consistent with and reasonably required to perform its functions under this Act.

63 Stat. 954;
78 Stat. 400.
5 USC 1071 note.
60 Stat. 810.

(b) Any member of the Council is authorized to administer oaths when it is determined by a majority of the council that testimony shall be taken or evidence received under oath.

(c) To the extent permitted by law, all appropriate records and papers of the Council may be made available for public inspection during ordinary office hours.

Records, public inspection.

(d) Upon request of the Council, the head of any Federal department or agency is authorized (1) to furnish to the Councils such information as may be necessary for carrying out its functions and as may be available to or procurable by such department or agency, and (2) to detail to temporary duty with such Council on a reimbursable basis such personnel within his administrative jurisdiction as it may need or believe to be useful of carrying out its functions, each such detail to be without loss of seniority, pay or other employee status.

(e) The Council shall be responsible for (1) the appointment and supervision of personnel, (2) the assignment of duties and responsibilities among such personnel, and (3) the use and expenditures of funds.

TITLE II—RIVER BASIN COMMISSIONS

CREATION OF COMMISSIONS

Sec. 201. (a) The President is authorized to declare the establishment of a river basin water and related land resources commission upon request therefor by the Council, or request addressed to the Council by a State within which all or part of the basin or basins concerned are located if the request by the Council or by a State (1) defines the area, river basin, or group of related river basins for which a commission is requested, (2) is made in writing by the Governor or in such manner as State law may provide, or by the Council, 79 STAT. 246. and (3) is concurred in by the Council and by not less than one-half of the States within 79 STAT. 247. which portions of the basin or basins concerned are located and, in the event the Upper Colorado River Basin is involved, by at least three of the four States of Colorado, New Mexico, Utah and Wyoming or, in the event the Columbia River Basin is involved, by at least three of the four States of Idaho, Montana, Oregon, and Washington. Such concurrences shall be in writing.

Duties.

(b) Each such commission for an area, river basin, or group of river basins shall, to the extent consistent with section 3 of this Act—

(1) serve as the principal agency for the coordination of Federal, State, interstate, local and nongovernmental plans for the development of water and related land resources in its area, river basin, or group of river basins;

(2) prepare and keep up to date, to the extent practicable, a comprehensive, coordinated, joint plan for Federal, State, interstate, local and nongovernmental development of water and related resources: *Provided*, That the plan shall include an evaluation of all reasonable alternative means of achieving optimum development of water and related land resources of the basin or basins, and it may be prepared in stages, including recommendations with respect to individual projects;

(3) recommend long-range schedules of priorities for the collection and analysis of basin data and for investigation, planning, and construction of projects; and

(4) foster and undertake such studies of water and related land resources problems in its area, river basin, or group of river basins as are necessary in the preparation of the plan described in clause (2) of this subsection.

MEMBERSHIP OF COMMISSIONS

Sec. 202. Each river basin commission shall be composed of members appointed as follows:

Federal chairmen.

(a) A chairman appointed by the President who shall also serve as chairman and coordinating officer of the Federal members of the commission and who shall represent the Federal Government in Federal-State relations on the commission and who shall not, during the period of his service on the commission, hold any other position as an officer or employee of the United States, except as a retired officer or retired civilian employee of the Federal Government;

Federal agencies.

(b) One member from each Federal department or independent agency determined by the President to have a substantial interest in the work to be undertaken by the commission, such member to be appointed by the head of such department or independent agency and to serve as the representative of such department or independent agency;

States.

(c) One member from each State which lies wholly or partially within the area, river basin, or group of river basins for which the commission is established, and the appointment of each such member shall be made in accordance with the laws of the State which he represents. In the absence of governing provisions of State law, such State members shall be appointed and serve at the pleasure of the Governor;

Interstate agencies.

(d) One member appointed by any interstate agency created by an interstate compact to which the consent of Congress has been given, and whose jurisdiction extends to the waters of the area, river basin, or group of river basins for which the river basin commission is created;

International commissions.

(e) When deemed appropriate by the President, one member, who shall be appointed by the President, from the United States section of any international commission created by a treaty to which the consent of the Senate has been given, and

79 STAT. 247.
79 STAT. 248.

whose jurisdiction extends to the waters of the area, river basin, or group of river basins for which the river basin commission is established.

79 STAT. 248.

ORGANIZATION OF COMMISSIONS

Sec. 203. (a) Each river basin commission shall organize for the performance of its functions within ninety days after the President shall have declared the establishment of such commission, subject to the availability of funds for carrying on its work. A of the States composing the commission. Upon such termination, all property, assets, and records of the commission shall thereafter be turned over to such agencies of the United States and the participating States as shall be appropriate in the circumstances: *Provided*, That studies, data, and other materials useful in water and related land resources planning to any of the participants shall be kept freely available to all such participants.

Disposition of records.

(b) State members of each commission shall elect a vice chairman, who shall serve also as chairman and coordinating officer of the State members of the commission and who shall represent the State governments in Federal-State relations on the commission.

Vacancies.

(c) Vacancies in a commission shall not affect its powers but shall be filled in the same manner in which the original appointments were made: *Provided*, That the chairman and vice chairman may designate alternates to act for them during temporary absences.

Chairman, final authority.

(d) In the work of the commission every reasonable endeavor shall be made to arrive at a consensus of all members on all issues; but failing this, full opportunity shall be afforded each member for the presentation and report of individual views: *Provided*, That at any time the commission finals to act by reason of absence of consensus, the position of the chairman, acting in behalf of the Federal members, and the vice chairman, acting upon instructions of the State members, shall be set forth in the record: *Provided further*, That the chairman, in consultation with the vice chairman, shall have the final authority, in the absence of an applicable bylaw adopted by the commission or in the absence of a consensus, to fix the times and places for meetings, to set deadlines for the submission of annual and other reports, to establish subcommittees, and to decide such other procedural questions as may be necessary for the commission to perform its functions.

DUTIES OF THE COMMISSIONS

Sec. 204. Each river basin commission shall—

(1) engage in such activities and make such studies and investigations as are necessary and desirable in carrying out the policy set forth in section 2 of this Act and in accomplishing the purposes set forth in section 201(b) of this Act;

(2) submit to the Council and the Governor of each participating State a report on its work at least once each year. Such report shall be transmitted through the President to the Congress. After such transmission, copies of any such report shall be sent to the heads of such Federal, State, interstate, and international agencies as the President or the Governors of the participating States may direct;

Report to President and Congress.

(3) submit to the Council for transmission to the President and by him to the Congress, and the Governors and the legislatures of the participating States a comprehensive, coordinated, joint plan, or any major portion thereof or necessary revisions thereof, for water and related land resources development in the area, river basin, or group of river basins for which such commission was established. Before the commission submits such a plan or major portion thereof or revision thereof to the Council, it shall transmit the proposed plan or revision to the head of each Federal department or agency, the Governor of each State, and each interstate agency, form which a member of the commission has been appointed, and to the head of the United States section of any international commission if the plan, portion or revision deals with a boundary water or a river crossing a boundary, or any tributary flowing into such boundary water or river, over which the international commission has jurisdiction or for which it has responsibility. Each such department and agency head, Governor, interstate agency, and United States section of an international commission shall have ninety days from the date of the receipt of the proposed plan, portion, or revision to report its views, comment, and recommendations to the commission. The commission may modify the plan, portion, or revision after considering the reports so submitted. The views, comments, and recommendations submitted by each Federal department or agency head, Governor, interstate agency, and United States section of an international commission shall be transmitted to the Council with the plan, portion, or revision; and

Joint plan, transmission.

79 STAT. 249.

(4) submit to the Council at the time of submitting such plan, any recommendations it may have for continuing the functions of the commission and for implementing the plan, including means of keeping the plan up to date.

POWERS AND ADMINISTRATIVE PROVISIONS OF THE COMMISSIONS

Sec. 205. (a) For the purpose of carrying out the provisions of this title, each river basin commission may—

(1) hold such hearings, sit and act at such times and places, take such testimony, receive such evidence, and print or otherwise reproduce and distribute so much of its proceedings and reports thereon as it may deem advisable;

(2) acquire, furnish, and equip such office space as is necessary;

(3) use the United States mails in the same manner and upon the same conditions as departments and agencies of the United States;

(4) employ and compensate such personnel as it deems advisable, including consultants, at rates not to exceed $100 per diem, and retain and compensate such professional or technical service firms as it deems advisable on a contract basis;

(5) arrange for the services of personnel from any State or the United States, or any subdivision or agency thereof, or any intergovernmental agency;

(6) make arrangements, including contracts, with any participating government, except the United States or the District of Columbia, for inclusion in a suitable retirement and employee benefit system of such of its personnel as may not be eligible for or continuing in another governmental retirement or employee benefit system, or otherwise provide for such coverage of its personnel;

(7) purchase, hire, operate, and maintain passenger motor vehicles; and

(8) incur such necessary expenses and exercise such other powers as are consistent with and reasonably required to perform its functions under this Act.

Oaths.

(b) The chairman of a river basin commission, or any member of such commission designated by the chairman thereof for the purpose, is authorized to administer oaths when it is determined by a majority of the commission that testimony shall be taken or evidence received under oath.

Records, public inspection.

(c) To the extent permitted by law, all appropriate records and papers of each river basin commission shall be made available for public inspection during ordinary office hours.

(d) Upon request of the chairman of any river basin commission, or any member or employee of such commission designated by the chairman thereof for the purpose, the head of any Federal department or agency is authorized (1) to furnish to such commission such information as may be necessary for carrying out its functions and as may be available to or procurable by such department or agency, and (2) to detail to temporary duty with such commission on a reimbursable basis such personnel within his administrative jurisdiction as it may need or believe to be useful for carrying out its functions, each such detail to be without loss of seniority, pay, or other employee status.

Personnel.

(e) The chairman of each river basin commission shall, with the concurrence of the vice chairman, appoint the personnel employed by such commission, and the chairman shall, in accordance with the general policies of such commission with respect to the work to be accomplished by it and the timing thereof, be responsible for (1) the supervision of personnel employed by such commission, (2) the assignment of duties and responsibilities among such personnel, and (3) the use and expenditure of funds available to such commission.

COMPENSATION OF COMMISSION MEMBERS

Sec.206. (a) Any member of a river basin commission appointed pursuant to section 202(b) and (e) of this Act shall receive no additional compensation by virtue of his membership on the commission, but shall continue to receive, from appropriations made for the agency form which he is appointed, the salary of his regular position when engaged in the performance of the duties vested in the commission.

(b) Members of a commission, appointed pursuant to section 202 (c) and (d) of this Act, shall each receive such compensation as may be provided by the States of the interstate agency respectively, which they represent.

(c) The per annum compensation of the chairman of each river basin commission shall be determined by the President, but when employed on a full-time annual basis shall not exceed the maximum scheduled rate for grade GS-18 of the Classification Act of 1949, as amended; or when engaged in the performance of the commission's duties on an intermittent basis such compensation shall be not more than $100 per day and shall not exceed $12,000 in any year.

Sec. 207. (a) Each commission shall recommend what share of its expenses shall be borne by the Federal Government, but such share shall be subject to approval by the Council. The remainder of the commission's expenses shall be otherwise apportioned as the commission may determine. Each commission shall prepare a budget annually and transmit it to the Council and the States. Estimates of proposed appropriations from the Federal Government shall be included in the budget estimates submitted by the Council under the Budgeting and Accounting Act of 1921, as amended, and may include an amount for advance to a commission against State appropriations for which delay is anticipated by reason of later legislative sessions. All sums appropriated to or otherwise received by a commission shall be credited to the commission's account in the Treasury of the United States. Expenses. 79 STAT. 251. 42 Stat. 20. 31 USC 1.

(b) A commission may accept for any of its purposes and functions appropriations, donations, and grants of money, equipment, supplies, materials, and services from any State or the United States or any subdivision or agency thereof, or intergovernmental agency, and may receive, utilize, and dispose of the same.

(c) The commission shall keep accurate accounts of all receipts and disbursements. The accounts shall be audited at least annually in accordance with generally accepted auditing standards by independent certified or licensed public accountants, certified or licensed by a regulatory authority of a State, and the report of the audit shall be included in and become a part of the annual report of the commission. Annual audit.

(d) The accounts of the commission shall be open at all reasonable times for inspection by representatives of the jurisdictions and agencies which make appropriations, donations, or grants to the commission. Accounts, Inspection.

TITLE III—FINANCIAL ASSISTANCE TO THE STATES FOR COMPREHENSIVE PLANNING GRANT AUTHORIZATIONS

Sec. 301. (a) In recognition of the need for increased participation by the States in water and related land resources planning to be effective there are hereby authorized to be appropriated to the Council for the next fiscal year beginning after the date of enactment of this Act, and for the nine succeeding fiscal years thereafter, $5,000,000 in each such year for grants to States to assist them in developing and participating in the development of comprehensive water and related land resources plans. Appropriation Authorization.

(b) The Council, with the approval of the President, shall prescribe such rules, establish such procedures, and make such arrangements and provisions relating to the performance of its functions under this title, and the use of funds available therefor, as may be necessary in order to assure (1) coordination of the program authorized by this title with related Federal planning assistance programs, including the program authorized under section 701of the Housing Act of 1954 and (2) appropriate utilization of other Federal agencies administering programs which may contribute to achieving the purpose of this Act. 73 Stat. 578. 40 USC 461.

ALLOTMENTS

Sec. 302. (a) From the sums appropriated pursuant to section 301 for any fiscal year the Council shall from time to time make allotments to the States, in accordance with its regulations, on the basis of (1) the population, (2) the land area, (3) the need for comprehensive water and related land resources planning programs, and (4) the financial need of the respective States. For the purposes of this section the population of the States shall be determined on the basis of the latest estimates available form the Department of Commerce and the land area of the States shall be determined on the basis of the official records of the United States Geological Survey. 79 STAT. 252.

(b) From each State's allotment under this section for any fiscal year the Council shall pay to such State an amount which is not more than 50 per centum of the cost of carrying out its State program approved under section 303, including the cost of training personnel for carrying out such program and the cost of administering such program.

STATE PROGRAMS

Sec. 303. The Council shall approve any program for comprehensive water and related land resources planning which is submitted by a State, if such program—

(1) provides for comprehensive planning with respect to intrastate or interstate water resources, or both, in such State to meet the needs for water and water-related activities taking into account prospective demands for all purposes served through or affected by water and related land resources development, with adequate provision for coordination with all Federal, State, and local agencies, and nongovernmental entities having responsibilities in affected fields;

73 Stat. 678.
40 USC 461.
78 Stat. 897.
16 USC 460l-4 note.

(2) provides, where comprehensive statewide development planning is being carried on with or without assistance under section 701of the Housing Act of 1954, or under the Land and Water Conservation Fund Act of 1965, for full coordination between comprehensive water resources planning and other statewide planning programs and for assurances that such water resources planning will be in conformity with the general development policy in such State;

(3) designates a State agency (hereinafter referred to as the "State agency") to administer the program;

(4) provides that the State agency will make such reports in such reform and containing such information as the Council form time to time reasonably requires to carry out its functions under this title;

(5) sets forth the procedure to be followed in carrying out the State program and in administering such programs; and

(6) provides such accounting, budgeting, and other fiscal methods and procedures as are necessary for keeping appropriate accountability of the funds and for the proper and efficient administration of the program.

Notice of hearing.

The Council shall not disapprove any program without first giving reasonable notice and opportunity for hearing to the State agency administering such program.

REVIEW

Noncompliance. Curtailing of payment.

Sec. 304. Whenever the Council after reasonable notice and opportunity for hearing to a State agency finds that—

(a) the program submitted by such State and approved under section 303 has been so changed that it no longer complies with a requirement of such section; or

(b) in the administration of the program there is a failure to comply substantially with such requirement,

the Council shall notify such agency that no further payments will be made tot he State under this title until it is satisfied that there will no longer be any such failure. Until the Council is so satisfied, it shall make no further payments to such State under this title.

79 STAT. 253.

PAYMENTS

Sec. 305. The method of computing and paying amounts pursuant to this title shall be as follows:

(1) The Council shall, prior to the beginning of each calendar quarter or other period prescribed by it, estimate the amount to be paid to each State under the provisions of this title for such period, such estimate to be based on such records of the State and information furnished by it, and such other investigation, as the Council may find necessary.

(2) The Council shall pay to the State, from the allotment available therefor, the amount so estimated by it for any period, reduced or increased, as the case may

be, by any sum (not previously adjusted under this paragraph) by which it finds that its estimate of the amount to be paid such State for any prior period under this title was greater or less than the amount which should have been paid to such State for such prior period under this title. Such payments shall be made through the disbursing facilities of the Treasury Department, at such times and in such installments as the Council may determine.

DEFINITION

Sec. 306. For the purpose of this title the term "State" means a State, the District of Columbia, Puerto Rico, or the Virgin Islands.

RECORDS

Sec. 307. (a) Each recipient of a grant under this Act shall keep such records as the Chairman of the Council shall prescribe, including records which fully disclose the amount and disposition of the funds received under the grant, and the total cost of the project or under taking in connection with which the grant was made and the amount and nature of that portion of the cost of the project or undertaking supplied by other sources, and such other records as will facilitate and effective audit. Maintenance.

(b) The Chairman of the Council and the Comptroller General of the United States, or any of their duty authorized representatives, shall have access for the purpose of audit and examination to any books, documents, papers, and records of the recipient of the grant that are pertinent to the determination that funds granted are used in accordance with this Act. Audit.

TITLE IV—MISCELLANEOUS

AUTHORIZATION OF APPROPRIATIONS

Sec. 401. There are authorized to be appropriated not to exceed $300,000 annually, to carry out the provisions of title I of this Act, not to exceed $6,000,000 annually to carry out the provisions of title II, and not to exceed $400,000 annually for the administration of title III: *Provided*, That, with respect to title II, not more than $750,000 III: *Provided*, That, with respect to title II, not more than $750,000 annually shall be available for any single river basin commission.

79 STAT. 254.

RULES AND REGULATIONS

Sec. 402. The Council is authorized to make such rules and regulations as it may deem necessary or appropriate for carrying out those provisions of this Act which are administered by it.

DELEGATION OF FUNCTIONS

Sec. 403. The Council is authorized to delegate to any member or employee of the Council its administrative functions under section 105 and the detailed administration of the grant program under title III.

UTILIZATION OF PERSONNEL

Sec. 404. The Council may, with the consent of the head of any other department or agency of the United States, utilize such officers and employees of such agency on a reimbursable basis as are necessary to carry out the provisions of this Act.

Approved July 22, 1965.

Appendix B: Best Management Practices

Following are reproductions of two examples of standard – and well-known – best management practices from the *Best Management Practices Manual* by the Department of Environmental Conservation (1966) of New York State. Grassed Waterways and Filter Strips are common methods utilized to control erosion and sedimentation along with excess runoff. The *Manual* thoroughly documents all important aspects of the BMPs in a standard format that permits comparison among the various BMPs. In the loose-leaf book, the two pages are arranged front-and-back, for easy removal and updating. Here, the two pages for each BMP are arranged on facing pages for easy review. A third BMP – Sediment Basin – is presented from the list prepared by the Natural Resources Conservation Service as well.

MANAGEMENT PRACTICE SUMMARY SHEET

GRASSED WATERWAY

DEFINITION	A natural or constructed channel of parabolic or trapezoidal cross-section that is below ground level and is established in suitable vegetation for the stable conveyance of runoff.
WATER QUALITY PURPOSE	To control erosion and convey runoff from concentrated agricultural operations.
SOURCE CATEGORY	Agriculture / Surface Runoff.
POLLUTANTS CONTROLLED	Sediment and nutrients.
WHERE USED	In agricultural fields and below livestock areas where concentrated runoff could cause erosion.
PRACTICE DESCRIPTION	Grassed waterways control surface runoff by safely conveying surface runoff volumes to protected outlets, thereby preventing gully erosion. Grassed waterways are designed to confine and carry the peak rate of runoff from a 10-year frequency, 24-hour duration storm, as a minimum. On slopes of less than 1% where out-of-bank flow will not cause erosion or property damage, the requirement for confinement of flow is not a design requirement.
PRACTICE EFFECTIVENESS	Very little is known about grassed waterways' effectiveness for pollutant reduction. Although grassed waterways are effective in controlling runoff volumes, sediment and nutrient-laden runoff would require treatment using five times the length of a comparable overland-flow system (filter strip) to obtain equivalent reductions in pollutant concentrations. Computer modeling indicates that grass waterways reduce erosion by about 65%, total N by nearly 30%, and total P by 50%.
IMPACT ON SURFACE WATER	Variable. Although effective in controlling runoff volumes, pollutant reductions are unknown. Impacts could be mitigated by incorporating an overland-flow treatment system before outletting the discharge to a waterbody. Grassed waterways reduce gully erosion and trap sediment and sediment-bound pollutants on-site, reducing sediment delivery to streams.
IMPACT ON GROUNDWATER	Slight. Computer modelling indicates slight leaching of nitrates to groundwater.
ADVANTAGES	•Grassed waterways control surface runoff and gully erosion. •Grassed waterways are relatively easy to design and install. •When surface runoff flow in the channel is shallow, they function like filter strips and produce the same benefits.
DISADVANTAGES	•Not suitable for areas where a base flow exists (sustained wetness prevents adequate vegetative cover) unless a stone-center lining and a subsurface drain are installed. •Grassed waterways below high sediment-producing areas will trap excessive amounts of sediment and become useless. •Waterways take a relatively small percentage of land out of crop production.
PRACTICE LIFESPAN	Ten years.
COST	Approximately \$2.00-\$3.00 per ft.

OPERATION AND MAINTENANCE

Performed annually and after large storm events. Inspect channel cross-section for stable side slopes, points of scour, rodent holes, and breaches. Check channel bottom for erosion or excessive scour, deposition of sediment or other obstructions. Outlets should be checked to ensure that they remain adequate, show no sign of erosion or loss of structural integrity.

MISCELLANEOUS COMMENTS

Practice may be eligible for ASCS cost-sharing.

REFERENCES

Chesapeake Bay Nonpoint Source Program Evaluation Panel. Overview of the Effectiveness of Best Management Practices. Background Paper. June, 1990.

Empire State Chapter, Soil and Water Conservation Society. New York Guidelines for Urban Erosion and Sediment Control. Syracuse, NY. March 1989. **(Management Practice Design Standard and Specification)**

Federal Highway Administration. Office of Research, Development, and Technology. Management Practices for Mitigation of Highway Stormwater Runoff Pollution. McLean, VA. June 1985.

NWQEP. a. Best Management Practices for Agricultural Nonpoint Source Control: III., Sediment. Biology and Ag. Engineering Department, North Carolina State University, Raleigh, NC. 1982.

NYS Department of Environmental Conservation. Longabucco, P., Controlling Agricultural Nonpoint Source Water Pollution in New York State: A Guide to the Selection of Best Management Practices to Improve and Protect Water Quality, Albany, NY. 1991.

USDA Soil Conservation Service. National Handbook of Conservation Practices, Grassed Waterway. Syracuse, NY. June 1985. **(Management Practice Design Standard and Specification)**

USDA. Soil Conservation Service, Effects of Conservation Practices on Water Quantity and Quality. October, 1988.

Virginia Polytechnic Institute, Dept. Ag. Engineering, Dillaha, Theo A., Role of Best Management Practices in Restoring the Health of the Chesapeake Bay: Assessments of Effectiveness. Blacksburg, VA. April 1990.

MANAGEMENT PRACTICE SUMMARY SHEET

FILTER STRIPS

DEFINITION	A strip of perennial grasses, legumes, or shrubs and trees planted across the slope, established adjacent to areas of high pollutant delivery potential, and managed for pollutant removal by overland flow.
WATER QUALITY PURPOSE	To reduce velocity and increase infiltration of runoff water, and agricultural waste effluent so that sediment, nutrients and organic matter can be retained, and utilized by the vegetation.
SOURCE CATEGORY	Agriculture / Surface Runoff.
POLLUTANTS CONTROLLED	Sediment, solid phase nutrients, organics, some heavy metals and pathogens.
WHERE USED	Riparian zones, agricultural fields, barnyards, feedlots, milkhouse effluent fields, road corridors, sand and gravel pits, etc.
PRACTICE DESCRIPTION	Filter strips are seeded to grasses, legumes, or a mixture of both. New plantings of trees and shrubs as filter strips require temporary cover to be effective. Occasionally, existing stands of trees, or shrubs can be used for their filtering ability. Designed filter strip widths vary with land slope, type of vegetative cover, watershed area, soil suitability and type of pollutant to be filtered. Filter strips reduce the delivery of pollutants from runoff water or agricultural waste effluent by filtration, deposition, infiltration, absorption, adsorption, decomposition and volatilization.
PRACTICE EFFECTIVENESS	Filter strips are most effective when used in conjunction with erosion reducing management practices. Filter strips are very effective for sediment and sediment-bound pollutant removal (i.e., lead), with trapping efficiencies exceeding 50%. Filter strips in riparian zones have trapped 85-90% of the sediment and up to 50% of the phosphorus leaving cultivated fields. Filter strips do not remove soluble phosphorus or nitrates effectively. Filter strips are very economical for treating milking parlor wastes. When the wastes are applied by overland flow, much of the pollutant load can be trapped on the surface of the filter strip vegetation and biodegradation can take place.
IMPACT ON SURFACE WATER	Beneficial.
IMPACT ON GROUNDWATER	Slight. Practice may increase transport of pollutants to groundwater by increased infiltration.

ADVANTAGES	•Filter strips are inexpensive, easy to install and maintain. •Unobtrusive. •Benefits for wildlife. •Filter strips control surface runoff.
DISADVANTAGES	•Filter strips do not reduce pollutant generation within a field. •Filter strips are ineffective in hilly areas, areas receiving concentrated flows, during larger runoff-producing storms, and when the ground is frozen and vegetation is snow-covered. •Filter strips do not effectively remove all pollutants from effluent. •Filter strips lose effectiveness when sediment accumulates in the filter.
PRACTICE LIFESPAN	Short. Estimated at 5 years or less.
COST	Relatively inexpensive for herbaceous filter strips. Slightly higher costs for trees and shrubs.
OPERATION AND MAINTENANCE	Removal of trapped sediment every year, or after larger runoff-producing storms. Herbaceous vegetation should be harvested and removed each year.
MISCELLANEOUS COMMENTS	In some cases, the practice may be eligible for ASCS cost-sharing and/or enrollment in the Conservation Reserve Program (CRP).
REFERENCES	Federal Highway Administration. Management Practices for Mitigation of Highway Stormwater Runoff Pollution, Vol. II. McLean, VA 1985 **(Management Practice Design Standard and Specification)** NWQEP. a. Best Management Practices for Agricultural Nonpoint Source Control, III, Sediment. Biology and Agricultural Engineering Department, North Carolina State University, Raleigh, NC 1982. NYS Department of Environmental Conservation. Longabucco, P., Controlling Agricultural Nonpoint Source Water Pollution in New York State: A Guide to the Selection of Best Management Practices to Improve and Protect Water Quality, Albany, NY. 1991. U.S. Department of Agriculture. Soil Conservation Service. National Handbook of Conservation Practices: Filter Strip. Syracuse, NY 1982. **(Management Practice Design Standard and Specification)** USDA. Soil Conservation Service. Effects of Conservation Practices on Water Quantity and Quality. October, 1988. USEPA. Chesapeak Bay Program. Annapolis, MD. January 1988.

July 1991

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

SEDIMENT BASIN

(No.)
CODE 350

DEFINITION

A basin constructed to collect and store debris or sediment.

SCOPE

This standard applies to the installation of all basins where the primary purpose is to trap and store waterborne sediment and debris.

PURPOSE

To preserve the capacity of reservoirs, ditches, canals, diversion, waterways, and streams; to prevent undesirable deposition on bottom lands and developed areas; to trap sediment originating from construction sites; and to reduce or abate pollution by providing basins for deposition and storage of silt, sand, gravel, stone, agricultural wastes, and other detritus.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where physical conditions or land ownership preclude treatment of a sediment source by the installation of erosion-control measures to keep soil and other material in place or where a sediment basin offers the most practical solution to the problem.

PLANNING CONSIDERATIONS

Water Quantity

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and groundwater recharge.

2. Effects on downstream flows and aquifers that would affect other water uses and users.

3. Effects on volume of discharge flow on the environmental, social, and economic conditions.

4. Effects on the water table downstream and the results of changes of vegetative growth.

Water Quality

1. Effects on erosion, movement of sediment, pathogens, and soluble and sediment-attached substances that could be carried by runoff.

2. Effects on the visual quality of onsite and downstream water resources.

3. Effects of construction and early establishment of protective vegetation on the surface and ground water.

4. Effects on wetlands and water-related wildlife habitats.

DESIGN CRITERIA

The capacity of the sediment basin shall equal the volume of sediment expected to be trapped at the site during the planned useful life of the basin or the improvements it is designed to protect. If it is determined that periodic removal of sediment will be practicable, the capacity may be proportionately reduced.

The design of dams, spillways, and drainage facilities shall be according to SCS standards

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.

for ponds (378) and grade stabilization structures (410) or according to the requirements in TR-60, as appropriate for the class and kind of structure being considered.

Temporary basins having drainage areas of 5 acres or less and a total embankment height of 5 ft or less may be designed with less conservative criteria if conditions warrant. The embankment shall have a minimum top width of 4 ft and side sloped of 2:1 or flatter. An outlet shall be provided of earth, pipe, stone, or other devices adequate to keep the sediment in the trap and to handle the 10-year-frequency discharge without failure or significant erosion.

Provisions shall be made for draining sediment pools if necessary for safety and vector control. Fencing and other safety measures shall be installed as necessary to protect the public from floodwater and soft sediment. Due consideration shall be given to good visual resource management.

PLANS AND SPECIFICATIONS

Plans and specifications for installing sediment basins shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

Appendix C: An Exemplary PL 566 Project, Mud Creek

WATERSHED IMPROVEMENT PLAN: THE MUD CREEK WATERSHED*

The Mud Creek watershed, comprising 250,000 acres, is within the size limitation specified for projects under Public Law 566, the Watershed Protection and Flood Prevention Act of 1954.

The landowners of the watershed have cooperated in the formation of the Mud Creek Soil and Water Conservation District (MCS&WCD) and have requested the aid of this agency (NRCS), which herewith fulfills that request with the report on the Watershed Improvement Plan for the Mud Creek Watershed and the MCS&WCD.

Mud Creek typifies a multiple-use watershed, with land use ranging from urban to wildland forest. Intensive use of the land has resulted in severe gullying and sheet erosion on the range lands, and on dry farm lands, respectively, and consequent bank erosion downstream near the metropolis of Citytonville. If prevented, losses due to sedimentation of Silt Lake and consequen reduced on-site values represent benefits accruable to the project. The lower reaches of Mud Creek are zoned, and flood damages there are virtually nil. The only other tributary to Silt Lake is Clear Creek, which does not contribute to the lake's problems; thus, all the benefits may be attributed to the Mud Creek Watershed Improvement Program.**

The problems on the Watershed and the Watershed Improvement Program are shown in Figure C1. The Program consists of:

1. **Gully Control Program**. On the overgrazed portion of the watershed, number of animal unit months must be reduced while gully control takes effect. Control will consist of grading and seeding gully headcut areas, and building small dams with outflow ditches at 3 percent grade to spread water back into the upland soils to improve vegetative growth.
2. **Dry Farm Lands**. Terracing to improve infiltration of precipitation and to trap sediment in runoff waters.
3. **Flood Control**. Small flood retarding dams, plus the peak attenuation value of the Mud Creek Dam, designed for irrigation water supply, with ditches.
4. **Forest Lands**. Closing of abandoned access roads by out-sloping, scarifying, and seeding, and by building road-blocking structures.

The favorable Benefit-Cost Ratio for the overall project and its two separable segments justify authorization, as summarized in Table C1. Calculations and details of the analyses are in Tables C2 to C6.

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* This is a fictitious example based, however, on some real data and examples from the Soil Conservation Service (1964) manual for economic practices. The detailed analyses have been condensed for clarity in the tables presented in this appendix. The subject matter, language, and organization, of this introduction is typical of a PL 566 project proposal though, like the detailed analyses, is considerably condensed.

** Note that another (nonstructural) flood management practice, e.g., zoning, is in use, complementing the proposed structural project, and that all the damage is conveniently attributed to Mud Creek, while the other tributary to Silt Lake, Clear Creek is obviously not involved.

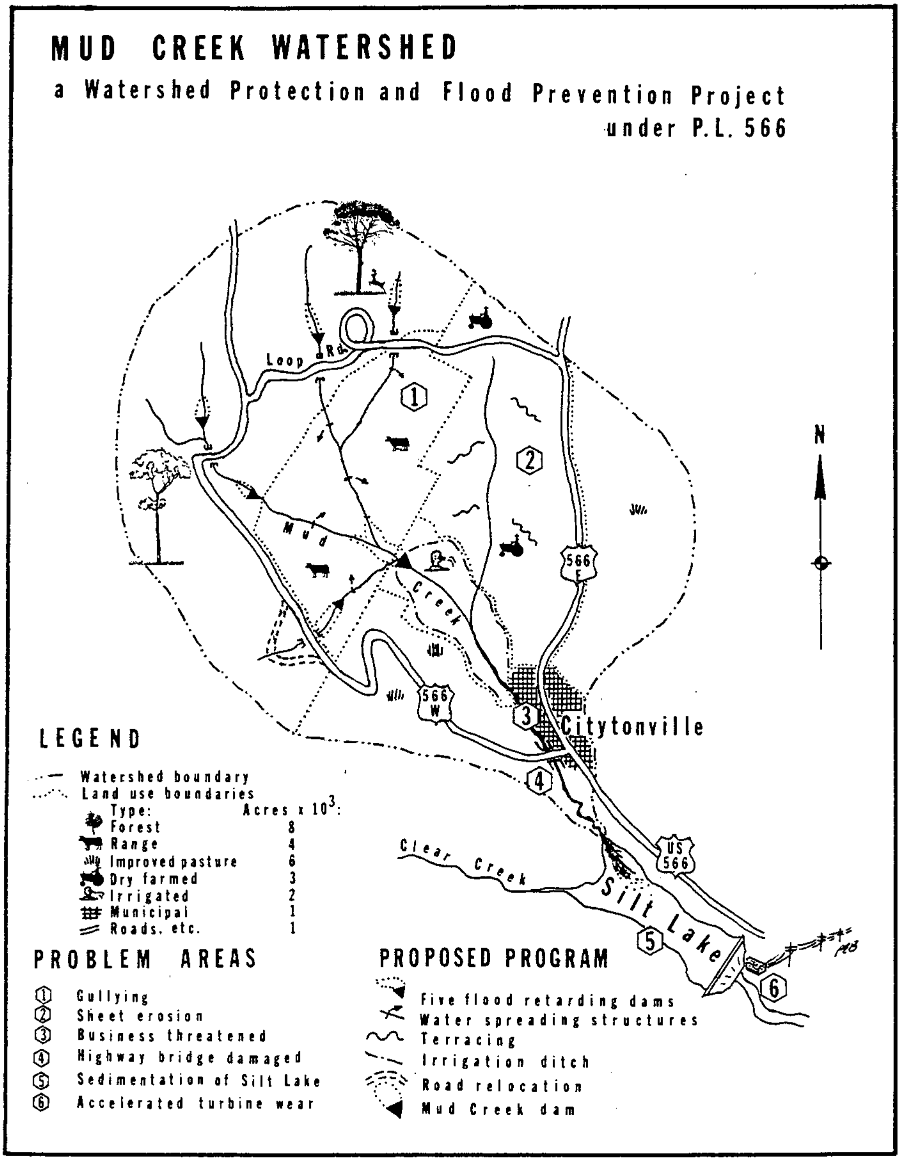
MUD CREEK WATERSHED
a Watershed Protection and Flood Prevention Project under P.L. 566
Loop Rd.
Mud Creek
566 E
566 W
Citytonville
US 566
Clear Creek
Silt Lake
N
LEGEND
Watershed boundary
Land use boundaries
Type: Acres x 10³:
Forest 8
Range 4
Improved pasture 6
Dry farmed 3
Irrigated 2
Municipal 1
Roads, etc. 1
PROBLEM AREAS
1 Gullying
2 Sheet erosion
3 Business threatened
4 Highway bridge damaged
5 Sedimentation of Silt Lake
6 Accelerated turbine wear
PROPOSED PROGRAM
Five flood retarding dams
Water spreading structures
Terracing
Irrigation ditch
Road relocation
Mud Creek dam

Table C1 Benefit-Cost Analysis: Summary

Component		Average Annual Amount
Summary of Benefits		
Gully erosion of range lands (Table C2)		$15,134
Loss of production on eroded dry farm lands (Table C3)		26,195
Relocation of residences & loss of business (Table C4)		6,002
Repair of US 566W (Table C4)		2,503
Reduction of sedimentation in Silt Lake (Table C5)		36,766
Reduction in sediment damage to power house (Table C5)		5,452
Total, average annual benefits (damages prevented)		$97,052
Summary of Costs		
Total for all practices (Table C6)		$86,709
Benefit Cost Ratios		
Overall Project	1.06	
Average annual benefits		$92,052
Average annual costs		86,709
Separable segment: range lands	1.03	
Average annual benefits		$15,134
Average annual costs ($206,075 x 0.0713)		14,693
Separable segment: dry farm lands	3.67	
Average annual benefits		$26,195
Average annual costs ($100,000 x 0.0713)		7,130

Table C2 Benefits (dollars per composite acre): Rangelands (Erosion Damage Evaluation)

Line No.	Component	Income values With project	Without project	Damage [a]
	Annual Returns and Costs per Composite Acre of Gullied Area			
1.	Gross income	$60.00	$4.00	$56.00
2.	Cash operating cost	15.00	1.00	14.00
3.	Adjusted gross income	45.00	3.00	42.00
4.	Real estate taxes	1.50	.20	1.30
5.	Returns to land after deducting taxes	13.50	1.80	11.70
6.	Remaining returns	30.00	1.00	29.00
	Present Worth of Annual Damaged per Composite Acre			
	Loss of income during 10-year adjustment period [b] ($29.00 declining rate of $2.90 per year at 9.5%) [c]			$113.59
	Market value of loss to landowners ($11.70 capitalized at 9.5%)			123.15
	Value of tax base source-of-income loss ($1.30 capitalized at 6.875%)			18.91
	Market value of loss to economy ($11.70 capitalized at 6.875% - private loss of $123.15)			47.03
	Total gully erosion damages per composite acre			$302.68
	Total Rangeland Losses Due to Gullying			

Based on present rates of erosion and anticipated acceleration thereof, an average rate of loss of 50 acres per year is estimated over the next 50 years without the project. The estimated total annual benefit, therefore, is:

$302.68 per acre per year x 50 acres = $15,134 (to Table C1)

[a] The damage-per-acre figures, computed from changes with and without the project, are considered as annual benefits that accrue to the gully control project in perpetuity. From them must be deducted the annual operation and maintenance costs (or, as herein handled, included in evaluation of costs).

[b] The 10-year adjustment period is a reasonable period with which to allow the landowner realization of changing situation and consequent shift of resources of labor, capital, and management to more productive areas. Interest rates for government, 6.875%; private, 9.5%.

[c] This is obtained by the formula for a decreasing annuity. If the entire area were to be voided and depreciated (without the project) in a given number of years, then the damage figure is treated as an annuity, discounted to the present by the Formula (4) in Chapter 7.

Table C3 Benefits (dollars per average acre in damage classes): Dry Farm Lands

Yield reduction (%)	Gross income ($)	Cost of production ($)	Net return ($)	Loss ($)	Acres damaged (acres)	Total damages ($)
			Average acre			
Undamaged	$80.00	$45.00	$35.00	$0.00		
10	65.00	35.00	30.00	5.00	$1,200	$6,000
30	50.00	32.00	18.00	17.00	600	10,200
50	37.00	28.00	9.00	26.00	300	7,800
70 [a]	22.00	18.00	4.00	31.00	60	1,860
90 [b]	7.00	5.50	1.50	33.50	10	335
Totals:					$2,170	$26,195

The average annual benefit would be equivalent to the average annual damage in present prices: $26,195

[a] Shift to a lower value crop.

[b] Low grade pasture.

Table C4 Benefits: Citytonville and U.S. Highway 566W

Component	Computation values	Benefit (damages prevented)
Relocation of Residences and Loss of Business in Citytonville		
A. Where relocation of multifamily residences will be necessary without the project in five years:		
Cost of Relocation	$18,000	
Years until erosion necessitates relocation	5	
Present value of relocation ($18,000 x 0.7172)	$12,909	
Average annual cost of relocation ($12,909 x 0.071) [a]	$916	$916
B. Where it is not feasible to relocate a business:		
Value of structure, business, and property less salvage value	$100,000	
Years until destruction or abandonment	7	
Present value of loss ($100,000 x 0.5298)	$52,980	
Average annual value of loss ($52,980 x 0.096) [b]	$5,086	5,086
C. Subtotal: average annual damages to Citytonville:		$6,002
Repair and Replacement of Highway Bridge		
Cost to replace and repair pavement and bridge	$60,000	
Years until expenditure will be necessary	8	
Present value of repair cost ($60,000 x 0.5875)	$35,250	
Average annual cost of repair ($35,250 x 0.071)	$2,503	$2,503

[a] Government bears cost, therefore 6.875 percent is used.

[b] Business bears cost, therefore 9.5 percent is used.

Table C5 Benefits: Damages to Silt Lake and Powerhouse

Component	Computation values	Benefit (cost)
Sedimentation of Silt Lake		
A. Loss of reservoir storage due to sedimentation calculated by straight line method:[a]		
1. Adjusted[b] cost per acre-foot of storage	$60.80	
2. AF of sediment deposited per year without project	345	
3. AF of sediment deposited per year with project	168	
4. Average annual damage without project	$20,976	
5. Average annual damage with project	$10,766	$10,766
B. Improved quality of municipal water:		
1. Gross value of product without sediment damage	$490,000	
2. Gross value of product with damage	$450,000	
3. Difference	$40,000	
4. Added cost of processing, distributing, and marketing higher-value product	$15,000	
5. Net; average annual damages	$25,000	$25,000
C. Water treatment costs:		
1. Total average annual expenditures	$3,000	
2. Expenditures not attributable to sediment removal	$2,000	
3. Attributable annual treatment costs	$1,000	$1,000
Total average annual benefits, Silt Lake:		$36,766
Sediment Damage to Powerhouse		
A. Machinery repair costs:		
Average annual expenditure for repairs due to sediment scouring	$4,000	$4,000
B. Reduction in useful life of turbines:		
1. Useful life without damage, years	15	
2. Useful life with damage, years	12	
3. Cost of replacing turbines	$100,000	
4. Salvage value of turbines	$10,000	
5. Difference	$90,000	
6. Annual replacement charge with damage 12 years @ 6.875%: ($90,000 x 0.12506)	$11,256	
7. Annual replacement charge without damage 15 years @ 6.875% ($90,000 x 0.10893)	$9,804	
Difference: average annual damage	$1,452	$1,452
C. Total average annual damages to powerhouse:		$5,452

[a] Three other common methods are Sinking-Fund, Sinking-Fund-Plus-Service-Loss, and Cost-of-Sediment Removal.

[b] Original storage cost per acre-foot adjusted to present prices.

Table C6 Costs

Component	Cost	Subtotal	Total
Rangelands			
Gully control:			
Structures, gully plugs; 50 @ $100	$5,000		
Headcut control:			
Grading; 25 acres @ $25	625		
Waterspreading, 2,000 acres @ $100	200,000		
Seeding on overgrazed area, 150 acres @ $2.50	375	$206,075	
Dry Farm Lands			
Terracing, 2,500 acres @ $40	100,000	100,000	
Flood Control			
Flow retardation dams (5):			
Rights-of-way, 1,000 acres @ $75	75,000		
Dams and appurtenances, 5 @ $20,000	100,000		
Bank stabilization:			
Structural, 0.7 miles @ $10,000	7,000		
Relocation of US 566W:	100,000	282,000	
Water Supply			
Mud Creek Dam:			
Rights-of-way (including ditches)	45,000		
Dam and appurtenances	40,000		
Ditch, 8 mi @ $30,000	240,000	325,000	
Forest Lands			
Road rehabilitation (abandoned access):			
Outsloping, 10 miles @ $50	500		
Scarifying, 10 miles @ $50	500		
Seeding, 10 miles @ $25	250		
Road blocks, 7 @ $150	1,050		
Stream channel clearing, 3 miles @ $1,000	3,000	5,300	
Overall Project			
Construction costs			$918,375
Overhead, 15%			137,756
Project design (including field surveys)			10,000
Project cost			1,066,131
Average Annual Charges			
Amortization, $1,066,131 x 0.062			66,100
Operation and maintenance, 2% of construction costs			18,368
Replacement, $15,000 each 25 years @ 6.875% (((\$15,000 x 0.190) + (\$15,000 x 0.036)) x 0.071)			241
Contingencies			2,000
Average Annual Costs (to Table C1)			$86,709

Appendix D: Cases, Statutes, and Compacts

CASES

STATUTES*

* See also in text, Table 1.2 for water-related legislation of the 1970s, Table 3.1 for statutes pertaining to creation or modification of certain agencies and programs, Table 4.1 for statutes pertaining to policy commissions, and Table 5.3 for those relating to changing planning objectives.

INTERSTATE COMPACTS

River	Date	Citation	Type [a]	States	Page
Colorado [b]	1922	45 Stat 1057	WAC	AZ/CACO/NM/UT/WY	61, 70, 178
La Plata	1922	43 Stat 796	WAC	CO/NM	61
South Platte	1923	44 Stat 195	WA	CO/NE	Not cited
New York Harbor	1935	49 Stat 932	PCC	CT/NJ/NY	179
Ohio	1936	49 Stat 1490	PCC	IL/IN/KY/NY/OH/PA/TN/WV	63, 156
Red River of the North	1937	52 Stat 150	PFC	MN/ND/SD	63
Rio Grande	1938	53 Stat 785	WAC	CO/NM/TX	Not cited
Potomac	1939	54 Stat 748 [c]	PCC	DC/MD/PA/VA/WV	Not cited
Republican	1942	37 Stat 86	WAC	CO/KS/NE	Not cited
Belle Fourche	1943	58 Stat 94	WAC	SD/WY	Not cited
Costilla Creek	1944	60 Stat 246 [d]	WAC	CO/NM	61
New England	1947	61 Stat 682	PCC	CT/MA/ME/NH/RI/VT	167
Upper Colorado	1948	63 Stat 31	WAC	AZ/CO/NM/UT/WY	66, 72
Arkansas	1948	63 Stat 143	WAC	CO/KS (OK in 1965 and 1973)	Not cited
Pecos	1948	63 Stat 159	WAC	NM/TX	Not cited
Snake	1949	64 Stat 69	WAC	ID/WY	Not cited
Missouri-Illinois	1950	64 Stat 608 [e]	FIC	MO/IL	Not cited
Canadian	1950	66 Stat 74	WAC	AR/NM/OK/TX	Not cited
Yellowstone	1950	65 Stat 663	WAC	MT/ND/WY	Not cited
Connecticut	1951	67 Stat 45	PCC	CT/NH/VT	Not cited
Sabine	1953	68 Stat 690 [f]	WAC	LA/TX	Not cited
Great Lakes	1955	82 Stat 414	PCC	[g]	Not cited
Bear	1955	72 Stat 38	WAC	ID/UT/WY	Not cited
Tennessee	1955	72 Stat 823	CC	[g]	Not cited
Klamath	1957	71 Stat 497	WAC	CA/OR	63
Thames	1957	72 Stat 364	PFC	CT/MA	Not cited
Delaware	1961	75 Stat 688	FIC	DE/NJ/NY/PA	41, 63, 157
Arkansas Basin	1963	80 Stat 149	WAC	KS/OK	Not cited
Wheeling Creek	1967	81 Stat 553	PFC	PA/WV	63
Upper Niobrara	1969	83 Stat 86	WAC	NE/WY	Not cited
Susquehanna	1970	84 Stat 1509	FIC	MD/NY/PA	65, 157
Big Blue River	1971	86 Stat 194	WAC	KS/NE	Not cited

FOOTNOTES:

a. Compact classification abbreviations:

FIC	Federal-Interstate	PCC	Pollution Control
PFC	Planning Flood Control	WAC	Water Allocation

b. Perfected by the Boulder Canyon Project Act of 1928
c. Amended, 84 Stat 856
d. Amended, 77 Stat 350
e. Amended, 73 Stat 582
f. Amended, 76 Stat 34
g. Open to basin members

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