DRAFT

STRATEGIC DIRECTIONS FOR THE WATER RESOURCES DIVISION, 1998–2008

April 1998

USGS
science for a changing world

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FOREWORD

This document articulates a shared vision of the future directions for the water-resources activities of the U.S. Geological Survey (USGS) for the years 1998-2008. The word "shared" is critical here for three reasons. First, the vision must be shared among the leadership and all employees of the Water Resources Division (WRD). WRD has a highly distributed workforce and a management structure that delegates major responsibility for program development and for scientific, fiscal, and workforce management to field-based units. If we are to move in new directions, headquarters leaders, field-based leaders, and the entire workforce must be involved in the process of setting the directions and must fully understand and support them.

Second, we want to make sure that the vision is shared across the whole of the USGS. We believe that the future success of the USGS in fulfilling its mission depends on drawing on the strengths of all divisions to fulfill the Nation's needs for information on issues of hazards, environment, and resources. Biologic, geologic, and mapping expertise must be brought to bear on water-resource issues, and conversely, we should bring our hydrologic expertise to bear on the mission needs of those programs.

Finally, our hope is to present a vision that can be shared by the wide range of our stakeholders—the potential and current customers, partners, and users of the water information we produce. Stakeholder views were represented to some extent in setting our strategic vision through participation of WRD managers who interact with these stakeholders on a regular basis. We will get more direct input during the review process when this draft document is presented to a wide range of outside entities for review and comment. Through this process we hope to get their reactions and hear their concerns and (or) agreement and then consider modifications to incorporate their views about the USGS and about the future. It is our hope that the final document will be as much their vision as it is ours.

What are some of the major thoughts that define our strategic directions?

We believe that WRD is a strong and healthy organization. We have a talented and motivated workforce that is able to address a wide range of important issues. Water is vital to the Nation; thus, there will continue to be significant demands for the kind of information we produce.

We have made major changes in what we do and how we do it in recent years. We will continue to make major changes in the years to come. Examples of recent innovations include—

- Delivery of realtime streamflow data.
- Research on bioremediation.
- Integration of geographic information system technology into virtually every study we do.
- Capability to sample and analyze for many chemicals at environmentally relevant concentrations.
- Ability to age-date young ground water to help predict the movement of contaminants and to quantify recharge.
- Incorporation of biology into many investigations.
- Use of the Internet to disseminate many of our products (realtime and historical data, models, and reports).
- Use of new acoustic methods for measuring streamflow and river-bed scour that allow us to provide data that were virtually impossible to collect in the past.
- Streamlining of many administrative and publication policies and procedures so that we do our work and deliver our products in a more timely manner.

We come to this process of charting our strategic direction with a view that we are a strong and resilient organization, doing highly relevant work. It is important, however, not to be complacent. This planning process is designed to get us to take stock, to look around at the world in which we operate today and the changes we might expect in the next few years. We see real challenges. The role of government at all levels is questioned by some, and funding has not matched inflation in recent years. As a result, we have had to reduce the level of our programs. We also need to clarify the role of WRD in a time when the private sector has greater skills in hydrology than ever before.

We believe we have strengths that will allow us to meet the challenges.

1. The first strength is our people with their motivation, skill, and the broad and deep scientific and technical knowledge that they embody from many years of experience and education.

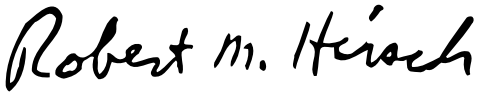
2. Our infrastructure of monitoring capabilities and instruments, data bases, models, standards, and special purpose facilities for chemical analysis and field instrumentation serves as a solid base for future work.

3. We are part of the USGS, a strong scientific organization with the capability to address a broad range of natural science issues that involve hazards, resources, and environment. Our ability to collaborate with our colleagues in the Geologic Division, the Biological Resources Division, and the National Mapping Division gives us strength through the breadth of capabilities present in the USGS.

4. We have strong and growing opportunities for collaboration with other Federal Agencies, most notably the U.S. Environmental Protection Agency, the National Weather Service, and the Federal Emergency Management Agency; with the resource-management agencies in the U.S. Department of the Interior; and with the academic community, especially through the Water Resources Research Institutes.

5. The many customers and partners—whose numbers and fiscal contributions to WRD continue to grow even during this time of general downsizing of government—are an important source of strength.

This strategic planning document sets forth where we want to be in 10 years. Our intent in drafting it was to make sure that we capitalize on our existing strengths to be even more successful 10 years from now than we are today. We believe that this document contains ambitious goals that will cause all of us to reach beyond and exceed our expectations. The document is not a detailed implementation plan. Attaining the goals set forward will come about through internal planning efforts, working with others to find resources to achieve some of the goals, and making the right choices about what new activities to begin when old activities end. Even now, as this draft is being completed, the strategic planning process has already had many impacts on decisions that division leadership has made regarding staffing issues, program priorities, and scientific and technological investments. For each of the directions and activities described here, we will continue to draw heavily on the good ideas of teams of our employees to help us prepare implementation plans that will describe the exact path to our future.



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STRATEGIC DIRECTIONS FOR THE WATER RESOURCES DIVISION, 1998-2008

EXECUTIVE SUMMARY

The Water Resources Division of the U.S. Geological Survey is a strong and healthy organization. We do important and highly relevant work and have many strengths that will help us to meet the challenges and take advantage of the opportunities before us. This document presents three major premises that will guide the division over the next 10 years (1998–2008): (1) we will maintain and strengthen our scientific excellence and our partnerships; (2) we will make adjustments in skill mix, program emphasis, and approaches to staffing; and (3) we will maintain the flexibility to respond appropriately to unforeseen events.

As we look into the future, we believe that nine water-resource issues will receive increased emphasis—

- Effects of urbanization and suburbanization on water resources.
- Effects of land use and population increases on water resources in the coastal zone.
- Drinking water availability and quality.
- Suitability of aquatic habitat for biota.
- Waste isolation and remediation of contaminated environments.
- Hydrologic hazards.
- Effects of climate on water-resources management.
- Surface-water and ground-water interactions as related to water-resources management.
- Hydrologic system management, including optimization of ground-water and surface-water use.

We will make changes in our existing major program components--long-term data collection, interpretation and assessment, and research and development--to make them more effective. We recognize the strength that comes from having these program components in the same organization and will take action to improve linkages among them. We will make important short-term investments in new tools and capabilities to improve our field and laboratory methods, instruments, hydrologic models, data-base software, and information dissemination. We will significantly improve transfer of technology to our operational program.

We also will take action to restore balance among programs and among discipline areas. During the last 15 years, there has been significant growth in the interpretation and assessment component of our program. This is a very important part of our work and should be a significant percentage of the overall program because the products of our interpretive studies are directly and immediately relevant to decisionmakers. Our program in long-term data collection, however, has decreased as an overall percentage of our work to the point where we are almost out of balance. Therefore, we will work with the U.S. Department of the Interior, the Office of Management and Budget, and the Congress to shift our program balance to increase the percentage of funds available for long-term data collection. Similarly, we will work to increase the percentage of our overall effort directed toward assessment and modeling ground-water and surface-water quantity so that we can improve our ability to meet both current and future needs.

Water Resources Division's business practices have served the division and its customers and partners well, and significant change is not warranted. Nevertheless, to better fulfill our mission, we plan some changes in the way that we carry out our work. Examples of change include the following:

- We will strengthen our partnerships with other U.S. Geological Survey divisions.
- We will encourage co-location of our offices with other U.S. Geological Survey divisions, universities, and other scientific organizations.
- We will provide a small amount of Federal funding to district offices to support short-term data-collection efforts, efforts required to develop new partnerships, outreach activities, and other efforts that contribute to our mission but have no clear Federal or State funding source.

- We will give special attention to the needs of other Department of the Interior bureaus for hydrologic information.
- We will do more work internationally.
- We will increase the percentage of total funds available for equipment, supplies, travel, training, and other operating expenses.
- We will increase the percentage of other than permanent employees.
- We will revitalize our training program and institute a formal mentoring program.
- We will make alternative work schedules and alternative work places available to all cost centers.
- We will increase the diversity of our workforce.

This document identifies goals and outlines strategic directions; it is not a detailed implementation plan. Ideas in this document will be implemented over time with the insight and guidance of our employees, our colleagues, and our customers and partners.

INTRODUCTION

In July 1996, a planning team that consisted of 17 senior managers, 4 field managers (district chiefs or equivalent), and 1 senior scientist, in the Water Resources Division (WRD) of the U.S. Geological Survey (USGS) began the process that has resulted in defining the goals and outlining the strategic directions for WRD for the period 1998–2008. This document represents the team's view of the mission of WRD, their external scan of forces that affect WRD, and their view of the future of the division.

This document is considered as preliminary and will be reviewed extensively within the USGS, by U.S. Department of the Interior (DOI) management and bureaus, and by our customers and partners before it is finalized. It is now offered to WRD employees and the whole USGS for review and comment and will be revised on the basis of comments from this internal review. It will then be shared with stakeholders external to the USGS; their concerns and support will be factored into a final version of the document. Throughout this review process, all reviewers' voices will be heard, and their ideas will be incorporated where appropriate. After all review and revisions have been completed and the document is finalized, detailed plans for achieving the strategic directions will be designed and implemented throughout the division.

This document will help guide the division through the challenges and opportunities of the next 10 years. It presents three major premises. First, we will maintain and strengthen those characteristics of scientific excellence, strong partnerships, and program balance that have been key to past successes and will be key to future success. Second, we will make adjustments in skill mix, program emphasis, and approaches to staffing that will improve our current and future position as a leader in hydrologic data collection, investigations, and research. Finally, we will maintain the flexibility that will allow us to anticipate and respond appropriately to unforeseen events. This document combined with other policy documents, is a compass that can be used by division decisionmakers to steer the organization in a positive direction.

This document also complements and shares many of the attributes highlighted in the 1996 USGS Strategic Plan; however, the two documents differ in their scope. The USGS Strategic Plan gives general guidance for the bureau as a whole, whereas the WRD document provides detailed and specific directions applicable to the WRD.

Although this document establishes the principles that will guide WRD during the period 1998-2008, we will probably make midcourse corrections and changes during the next several years as unforeseen events occur. Because most of the decisions that affect our customer base and human and financial resource allocations are made in WRD district offices, research branches, and other major field offices, it is important that all of these decisionmakers share a common understanding of who we are, what we stand for, and what our goals are for the future. Only then can WRD move in the directions outlined here and respond appropriately to signals in the external and internal environments that might require a shift in course.

This document begins with a statement of the mission, activities, and success factors of the WRD in 1998 and then proceeds to consider changes in the global environment and in water-resources management that are likely during the next decade. Given a changing world, the section "Strategic Directions in Scientific Activities" of this document outlines water-resource issues that need increased emphasis, planned evolution of ongoing programs, and some short-term investments that are necessary to enhance current capabilities. In addition to changes in our scientific program, some of WRD's business practices will be modified; these are detailed in the last major section of the document.

WRD IN 1998

WRD's mission and activities define the organization and distinguish it from other scientific or governmental organizations.

Mission

The mission of WRD is to provide reliable, impartial, timely information that is needed to understand the Nation's water resources. WRD actively promotes the use of this information by decisionmakers to—

- Minimize the loss of life and property as a result of water-related natural hazards, such as floods, droughts, and land movement.
- Effectively manage ground-water and surface-water resources for domestic, agricultural, commercial, industrial, recreational, and ecological uses.
- Protect and enhance water resources for human health, aquatic health, and environmental quality.
- Contribute to wise physical and economic development of the Nation's resources for the benefit of present and future generations.

Activities

Consistent with the accomplishment of our mission, WRD provides impartial, credible, and excellent science that is applied to issues relevant to water-resources management, protection from hydrologic hazards, environmental protection, and other public policies. In a world with many competing demands on water resources and considerable public attention to water issues, it is important for WRD to identify its primary strengths, establish priorities, do the things necessary to best serve the Nation, and do them extremely well.

Primary WRD activities include—

- Collecting, storing, and disseminating basic hydrologic data on the quantity and quality of water.
- Conducting assessments of availability of water, quality of water, and water-related hazards at scales that range from single data-collection sites to regional and national scale.
- Conducting interpretive studies and developing predictive models that describe the potential consequences of water-related management actions.
- Providing knowledge and expertise to assist various levels of government (Federal, State, and local) in understanding and solving critical water-resources problems.
- Developing new methods for acquiring water-resources information, including methods of data collection, quality assurance, data management, laboratory analysis, data analysis, and simulation modeling.
- Producing new understanding that describes or explains processes important to water-related issues.

Success Factors

There are several success factors upon which WRD depends for current and future success.

- WRD does high-quality and cost-effective work. We produce products that are timely and useful to their intended audience.
- WRD is responsive and relevant to the information needs of its many partners and of the Nation. We anticipate important issues and develop knowledge of them in advance of public concern; this strategy allows rapid response when issues emerge.
- WRD has a workforce with both long-term stability and flexibility to address the Nation's water-resource issues. Careful hiring, availability of training, and a rewards system establishes a base of dedicated permanent employees whose skills are supplemented with those of a nonpermanent staff.
- WRD's data are reliable and have continuity over time and space.
- WRD has strong programs in long-term data collection, interpretation and assessment, and research and development. The continuing strength of all three elements is a critical success factor.

WRD has been successful because it possesses all of these attributes. Our future success depends on maintaining and improving these critical success factors.

ABOUT A CHANGING WORLD

WRD has a responsibility to look into the future and to anticipate emerging issues. This responsibility requires evaluating how events taking place today or projected for the future might influence existing programs or the development of future programs.

In looking outward, the single most important global trend that underlies many issues is population growth accompanied by economic growth. United Nations projections suggest that the world could reach a population of 8 billion people by 2025 (compared to today's 5.5 billion people). A growing world population and world economy will increase the global demand for food. U.S. agriculture could become more intensive, with an increased use of chemical and biological products that could affect the environment and create a greater demand for water. The use of genetically engineered plant species and other aspects of biotechnology may reduce fertilizer and pesticide use but create problems with which we have little experience.

The influences of global-scale issues will be especially important in situations where human pressure on ecosystems and health systems is greatest. For example, significant impacts from global climate change could be exacerbated where the world or a continent are most crowded, where aspects of the civilization are least flexible, and (or) where effects are added to other stresses.

Although population growth will not be as rapid in the United States as in less-developed nations, growth will likely lead to more rapid suburbanization around major cities and of once sparsely populated areas. Recent trends in U.S. demographics indicate that people have and will continue to relocate in areas at risk from hydrologic hazards, such as coastal areas, flood plains, the base of hillslopes, and alluvial fans. Increasing development in the United States will result in increased pressure to use terrestrial and aquatic resources of all types.

There is likely to be increasing concern about human and environmental health. This concern could be driven by an environmental catastrophe, such as a significant waterborne disease outbreak somewhere in the United States, or by conclusive proof that chemicals in the environment are causing reproductive stress or other significant but sublethal effects in animals or humans. Environmental concerns also could be driven by an accretion of smaller challenges. Even in the absence of significant new environmental issues, the costs of monitoring and treating drinking water, cleaning up existing contamination, preventing future contamination through effective isolation of municipal and industrial waste, and taking precautions to prevent accidental releases of contaminants will exert pressure on the U.S. economy.

Advances in technology, such as instrumentation, models, and biotechnology, will enhance our ability to detect, analyze, mitigate, remediate, and disseminate solutions to water-resource problems. Advances in analytical chemistry are allowing improved detection of contaminants, while increased knowledge of biology and ecology brings greater understanding of the impacts of environmental perturbations. Improvements in measurement of streamflow in realtime and improvements in models for decision-makers will facilitate new abilities to manage water more effectively but also will demand the highest degree of reliability and availability of those data. The recent tremendous increase in use of the Internet and other advances in communication make it possible to disseminate hydrologic and other scientific information to both the scientific community and the general public instantly and inexpensively.

Within the context of the broad trends described above, five requirements for successful water-resource management are likely:

1. Active management for multiple uses.—Water resources will need to be managed simultaneously to provide water for human consumption, agriculture, industry, power generation, recreation, and habitat for fish and wildlife. These competing demands are already generating disputes in many parts of the country. In the future, needs for information will be greatest in arid regions, near the coasts, and in areas where water moves across State borders or between ground water and surface water.
2. Effectiveness and efficiency.—The public will demand greater efficiency and effectiveness in environmental regulation and resource management. Issues that will be increasing in importance include (1) prevention of pollution, thereby avoiding the high costs of environmental cleanup, (2) site-specific evaluation of risks to water-resources that will justify more flexibility in enforcing regulations, and (3) use of watershed-based management that will build on local interests and minimize the inefficiencies that come from managing only a part of the resource.

3. Shift away from engineered solutions.—There will be less dependence on engineering solutions to water-resource problems and increasing reliance on conservation and natural systems. Few new large water projects, such as dams or interbasin transfer systems, are underway or planned. Instead, water managers are using water conservation to reduce demand for water for irrigation, public supply, and industrial uses. Conservation has the added benefit of reducing the amount of water that must be treated after use. Water-resource managers are beginning to take advantage of natural systems to remove contaminants from water. For example, the use of natural or artificial wetlands in attempts to remove heavy metals from mine drainage is underway, and natural bacterial processes are being used to remediate contaminated ground water.
4. Demand for timely information.—The public expects warnings of flood events and other hydrologic hazards. Farmers, public water systems, recreational boaters, and environmentalists all want near realtime information on the quantity and quality of the water they use. Water data must be provided in a timely fashion. They must also be accurate. Yet, increasing accuracy often requires more time. Water-resource managers and those who supply water data will need to be aware of and address this dynamic tension between accuracy and timeliness.
5. Increasing interest from the public.—People are concerned about the availability and quality of water. Few major water-resource decisions will be made without coverage by the media and the attention of interested citizens. It is expected that citizen action and monitoring efforts across the country, which include watershed-management associations, farmers and growers associations, and environmental interest groups, will play an increasing role in managing and monitoring water resources.

STRATEGIC DIRECTIONS IN WRD SCIENTIFIC ACTIVITIES

WRD must continue to be relevant and responsive. To do this, some changes in the nature of our scientific activities and the way we conduct our work are necessary. First, several water-resource issues will require increased emphasis. Second, our ongoing scientific program will evolve to be more effective and to achieve needed balance among program components. Third, we will make short-term (2–5 years) investments in technology and methodology to improve current capability. This section describes these necessary changes.

Priority Water-Resource Issues

Nine water-resource issues have been identified for increased emphasis during the next 10 years. Other issues and technical areas still have much value, and WRD will continue to collect data and conduct projects related to them. As projects end and new projects begin, however, more human and financial resources will be directed to the nine high-priority issues. For each issue, some examples are provided of activities that may be started or strengthened. Because of the importance of these issues to water-resource managers and the public, support for increased effort is expected from the Administration, Congress, cooperators, and partners.

WRD has a scientific infrastructure and much of the expertise needed to address these issues. We will build upon and enhance these strengths by forming partnerships with other USGS divisions, Water Resource Research Institutes, the academic community, and scientists from State, local, and other Federal Agencies. We also will work closely with land and water managers in the public and private sectors to identify their information needs better. Through these partnerships, we will form interdisciplinary teams to address the priority water-resource issues.

Issue 1. *Effects of urbanization and suburbanization on water resources*

Urbanization and suburbanization change the natural flow and recharge of water; introduce sediment, nutrients, and contaminants to surface and ground water; and increase demand for freshwater.

To address these changes, WRD will do the following:

- Develop tools necessary to manage watersheds effectively as the complex systems that they truly are. For instance, within the next 10 years WRD will work with the National Mapping Division (NMD) and others to populate a quality-assured, user-friendly geographic information data base

that contains coverages relevant to the understanding and management of water resources.

- Determine the effects that various land- and water-management practices have upon existing water-quality and quantity conditions. We will provide information to policymakers and resource managers as a basis for decisionmaking on issues, such as use of buffer zones along streams and around lakes, pesticide and fertilizer application rates, and other management practices.

Issue 2: *Effects of land use and population increases on water resources in the coastal zone*

Scientists estimate that by the year 2010, 75 percent of the United States population will live within about 50 miles of the Atlantic and Pacific coast or one of the Great Lakes. Pressures on the coastal zone include an aging urban infrastructure, as well as demands for additional supplies of drinking water and a safe means to dispose of human and industrial waste that result from new growth. Population growth in the coastal zone also will add to stress on coastal ecosystems that provide recreation and critical habitat for waterfowl, shellfish, and finfish.

WRD will make an important contribution to coastal-zone water issues through the following:

- Provide, on an annual basis, estimated fluxes of major chemical species (especially nutrients) at key inflow points to the Nation's estuaries, coastal zones, and the Great Lakes.
- Conduct studies of saltwater intrusion into aquifers, movement of saltwater upstream in tidal rivers, and the effects of water withdrawals on coastal wetlands. For example, a synthesis of the extent and methodologies for analysis of saltwater intrusion into ground water along the Atlantic coast will be published within 3 years.

Issue 3. *Drinking water availability and quality*

Drinking water in the United States is safe and abundant in most places. Maintaining a safe supply of drinking water in the future will require considerable expenditure of money for protecting drinking water sources, treating drinking water, and monitoring drinking water quality. Drinking water is a necessity, and major population centers will certainly continue to be supplied, but there will be intense competition between cities and agriculture for water. Disputes will also arise in cases where withdrawal of ground water or surface water for public supply may impact aquatic habitat.

WRD will make a valuable contribution to the issue of drinking water availability and quality through the following activities:

- In cooperation with Geologic Division (GD), provide an ongoing assessment of the availability and sustainability of the Nation's ground-water resources and of the major factors that affect these resources. As part of this effort, we will provide annual reports on the change in storage (of freshwater) for each of the Nation's major aquifers.
- Provide better descriptions of the quality of water available in aquifers under various management and growth scenarios. This function includes development of models that will help decision-makers evaluate the consequences of management alternatives.
- Provide empirically based ground-water and surface-water quality vulnerability assessments, with a known level of accuracy that can be used by others to optimize monitoring expenditures for drinking water sources and for controls on land-use practices to protect source waters.
- Work with the U.S. Environmental Protection Agency (EPA), the Centers for Disease Control (CDC), and others to establish effective detection and monitoring methodologies for infectious, waterborne pathogens, such as *Giardia* and *Cryptosporidium*. We will relate the occurrence of these pathogens to land use and other factors.
- Work with Biological Resources Division (BRD) on the connections between infectious disease in animal populations and potential human pathogens in water.

Issue 4. *Suitability of aquatic habitat for biota*

Aquatic habitat in this country has been severely altered by human activities, including construction, agriculture, and deforestation that increase sediment loads in rivers; construction of dams that impede migration of fish and other aquatic species; construction of dams and diversions that change the flow regime and modify habitat; drainage of wetlands areas; and increases in concentrations of nutrients and other chemicals.

Over the next 10 years, WRD will contribute to the understanding of the suitability of aquatic and riparian habitats for biota through the following activities:

- Study the effects of changes in flow regimes on aquatic and riparian communities as a result of reservoir operation and diversions or removal of dams and levees.
- Relate changes in sediment transport characteristics to riverine habitats, such as gravel and sand bars, backwater areas, and flood plains.
- Study the functioning of natural and constructed wetlands.
- Determine the effects of ground-water withdrawals on wetlands.
- Pay special attention to water-quality studies that include effects of low-level chronic exposure to multiple chemicals. In this and all other efforts that are focused on this issue, we will pursue opportunities for collaborative work with BRD.

Issue 5. *Waste isolation and remediation of contaminated environments*

There are several hundred thousand sites in the United States where the environment has been contaminated by past industrial, mining, military, agricultural, and commercial activity. The estimated cost of cleaning up these sites is as high as almost a trillion dollars. Costs of preventing future contamination are also significant for Federal, State, and local government, and the private sector as they attempt to manage industrial and domestic waste and find a suitable repository for radioactive waste.

WRD can make important contributions to risk evaluation, waste isolation, and remediation through its combination of knowledge of hydrology, chemistry, and biology and its ability to conduct complex interdisciplinary studies of environmental contaminants. Specifically, WRD will—

- Continue to conduct studies of the basic processes that control the transport and fate of contaminants.
- Increase emphasis on understanding the factors that make a system more or less vulnerable to contamination, thereby, providing valuable information for those who design waste-disposal sites.
- Work with partners in the private and public sector to provide the scientific basis for evaluation of the effectiveness and efficiency of remediation alternatives in the field.

Issue 6. *Hydrologic hazards*

Every year hydrologic hazards (floods, droughts, subsidence, landslides, and tsunamis) result in the death of about a hundred people, in the loss of hundreds of millions of dollars in damages, and in the disruption of thousands of lives. Better understanding of hydrologic hazards, better warning systems, and better risk information can minimize the consequence of these hazards.

Over the next 10 years, WRD will provide the information and understanding that will allow land and water managers, land-use planners, emergency management officials, including the Federal Emergency Management Agency, and the general public to understand the nature of risk before a hazardous event occurs to monitor development of hazardous events as they occur, and to take action to minimize the effects of future hazardous events. Examples of specific activities that WRD will undertake to address these issues include the following:

- Increase the percentage of stream gages that are equipped to deliver realtime data. The entire system for delivery of stage and streamflow data will be made more reliable. We will take measures to ensure that data are delivered on a realtime basis 24 hours a day, 7 days a week, even during floods and other adverse conditions.
- Develop the capability to rapidly identify changes in flood-plain areas as a result of changes in land-use, climate, or engineering modifications and to revise estimates of flood frequency for these sites.
- In cooperation with the National Weather Service, we will develop a near realtime flood-warning system that will identify areas at risk by using watershed-based hydrologic, hydraulic, and digital-elevation models.
- Lead Federal Agencies to a new agreement on the methods for computing flood- and low-flow frequency statistics for both unregulated and regulated flow conditions.

Issue 7. *Effects of climate on water-resource management*

Recent extreme climatic variations have demonstrated that water-resource managers must develop their management systems in a context that assumes a wide range of possible climatic conditions, including the potential for significant and long-lasting departures from historically normal conditions.

WRD will provide some of the ingredients for a robust water-management strategy, which include—

- Conduct studies of long-term climate and proxy-climate records that cover several centuries in duration to bring a wider range of climatic variability into water-resource managers' plans.

- Provide hydrologic expertise and insights to interdisciplinary teams that are attempting to model future climate.
- Design river-basin simulation models that are useful for predicting flow conditions on the basis of climate, topography, land use, and engineering.
- Complete an assessment of the effects of development and climate variability on the interactions of ground water and surface water in the Southwestern United States.

Issue 8. *Surface-water and ground-water interactions as related to water-resource management*

Management of water resources has focused traditionally on either surface water or ground water as if they were separate entities. Yet, nearly all surface-water features, including rivers, lakes, wetlands, and estuaries, interact with ground water. Development of either water source affects the quantity and quality of the other.

WRD will provide leadership on this important issue through the following activities:

- Increase the number of studies of (1) effects of ground-water withdrawals on streamflows, surface-water levels, and aquatic ecosystems; (2) ground-water recharge from surface-water bodies; (3) effects of climatic variations on the discharge from shallow ground-water systems; and (4) effects of ground-water/surface-water interactions on efforts to restore wetlands or construct new wetlands.
- Improve tools for simulating interactions between ground water and surface water to quantify the effects of human activity.

Issue 9. *Hydrologic-system management, including optimization of ground-water and surface-water use.*

Recent experience with resolution of difficult water-management and allocation problems has shown that a capability to simulate the characteristics of the hydrologic system, at watershed scale, is critical. What is needed are water-management models that are accepted by the various competing interests in water conflict; these models must be capable of showing the consequences of various water-management decisions over a wide range of hydrologic and climatic conditions.

In recent years, simulation models have been combined with techniques of optimization to address various water-resources problems. Combined simulation and optimization models account for the complex physical processes of the hydrologic system and identify the best management strategy for a particular objective(s) and set of constraints. The approach offers a rigorous way to provide information of management relevance. As applied in USGS studies, management agencies and others provide information on the objectives and management constraints, whereas USGS scientists provide expertise in simulation and optimization techniques and help to formulate the management problem in a simulation-optimization context.

- WRD will continue to be a neutral party in water-management disputes and to provide scientific information to help resolve the dispute by improving models to simulate the physical processes of hydrologic systems.
- WRD will select a few Federal or State partnerships to develop and use simulation and optimization (decision-support) models to help solve management problems, such as mitigation of seawater intrusion, allocation of water to users, and maintenance of optimal ground-water levels.

Evolution of Ongoing Scientific Programs

Overall, WRD's ongoing scientific and technical program can be described as a mix of (1) long-term data collection, (2) interpretation and assessment, and (3) research and development. During the next 10 years, these program components will evolve to be more effective, and we will work to achieve a better balance among them and among discipline areas.

Each of the three components has its own base of customers and constituencies, and each makes an important contribution to hydrologic understanding and the knowledge base needed for water-resource management and regulation. The real strength of WRD, however, comes from the combination of all three components and the linkages among them. For example, our ability to conduct assessments of the status of the Nation's water resources would be hindered without the long-term data-collection program. Similarly, our long-term data-collection program would be adversely affected without the new tools and understanding of

hydrologic processes that come from research and development conducted by WRD scientists. Although the linkage and interdependence of the three program components are recognized, for purposes of this document each component and the new directions specific to that component will be described separately.

Long-Term Data Collection

The objectives of WRD's long-term data collection program are to collect, manage, and provide unbiased, scientifically based information that describes the quantity and quality of waters in the Nation's streams, lakes, reservoirs, and aquifers. This long-term program provides fundamental support for resource planning, development, management, and protection activities, as well as conflict resolution, scientific research, and warnings for water-related hazards throughout the Nation. WRD remains uniquely qualified to provide the basic hydrologic data to characterize the Nation's water resources. Important attributes of our long-term data-collection program include—

1. National scope, with associated economies of scale, including the infrastructure to support high-quality data collection and to manage and disseminate those data.
2. Nationally standardized field and laboratory methods and equipment, including procedures for quality assurance.
3. Research and methods development to improve data-collection methods and instruments.
4. Accurate and unbiased data and information products.

During the last several years there has been a decline in the long-term data-collection program. The number of continuous-record streamflow stations has been reduced; the number of stations included in the National Stream Quality Accounting Network (NASQAN) program and Hydrologic Benchmark Network program has decreased; and the ground-water-level network does not provide adequate national coverage.

The decline in basic hydrologic data collection is inconsistent with the increasing need for more comprehensive monitoring to support the intensive management and protection of water resources that will be needed as the Nation's population grows.

During the next 10 years, WRD will give high priority to redesigning and rebuilding its program of basic hydrologic data collection. Specific program issues, initiatives, and priorities are discussed below.

Surface Water

WRD will undertake the following strategic efforts in the next 5 years to enhance the streamflow data-collection program:

- Design and implement a national network of at least 7,000 streamflow monitoring stations. The network will include index stations that represent the physiography of the Nation; stations that document the flow of each of the 352 hydrologic accounting units; stations that are mandated by River Basin Compacts and Supreme Court decrees; and stations that are used for river forecasting, water quality and aquatic habitat management, and Federal project operations. All gages in the network will provide realtime data that will be available on the Internet. Reliability of data delivery will be greater than 99 percent.
- Switch our manner of providing streamflow data from being primarily daily average flows at specific gage locations to being continuous time series of flow data.
- Significantly reduce the cost of providing streamflow information. Getting the man or woman out of the stream and simplifying and streamlining records computation in the office are potential means of reducing cost. As a first step, we will design and conduct a comprehensive internal review of the streamflow-gaging program processes and methods to identify opportunities for cost reductions through streamlining and modernization.
- Evaluate the feasibility of using a national-level contract(s) for the routine construction, inspection, and maintenance of streamgaging infrastructure, such as gage houses and cableways, to achieve economies of scale and reduce the use of Federal employees to perform these ancillary functions.
- Conduct a comprehensive analysis of the national streamflow network to assess the value of individual Federally funded gages in meeting program objectives. The findings will be used to explain the value of the streamflow network in a quantitative fashion to customers and cooperators. This analysis will also provide a basis for funding allocations for network operations and maintenance.

Ground Water

Strategic efforts WRD will undertake in the next 5 years to enhance the ground-water data-collection program include the following:

- USGS ground-water data will be more accessible over the Internet. This accessibility will provide an efficient and ready source of ground-water data to agencies and private consultants who need such information on a day-to-day basis.
- Implement a long-term, spatially distributed network of wells whose water levels primarily reflect natural recharge conditions and climatic variability.
- Evaluate the need for 5- to 10-year synoptic water-level measurements of major aquifers that cross state boundaries and that are conducted on a rotational basis as part of the development of future plans for the Ground-Water Resources Program.

Water Quality

To enhance the water-quality data base, the WRD will undertake the following strategic efforts over the next 5 years:

- Increase collection of water-quality data that directly relate to highly visible and critical human-health and aquatic-health issues, such as hypoxia or toxic algal blooms or mercury in fish tissue.
- Lead in the integration of small, pristine basin networks of USGS and other agencies (U.S. Forest Service, National Science Foundation, and Agricultural Research Service) as reference sites for comparison to basins that have been directly affected by human activities.
- Interpret existing and new data from small basins to demonstrate the relation of stream quality to the quality of atmospheric deposition.
- Explore the wider use of immunoassays, field sensors, and other techniques to collect high-quality water-quality data at reduced costs.

Interpretation and Assessment

WRD interpretive and assessment studies allow us to make contributions to issues that are useful to decisionmakers at all levels and to the general public. They keep us relevant and highlight emerging issues of importance to society. An important aspect of these studies is that data are turned into information of direct use to decisionmakers.

WRD has a key role to play in the water-resource community because we maintain a national perspective and can describe hydrologic systems that cross political boundaries. We are able to integrate data-collection and interpretive studies that are conducted across the country to build the bigger picture. These synthesis efforts are made possible because data are produced in a standard fashion and stored in a common data base. The synthesis are made easier when there is an overall framework for local projects.

WRD will undertake the following strategic efforts in the next 5 years to enhance interpretation and assessment studies:

- Design study products that will be more useful and relevant to solving problems that are faced by water managers and other decisionmakers. For example, we will increase the development of models and other decision-support tools, including evaluation of alternative management scenarios, in interpretive and assessment studies.
- Develop a system to track the use and usefulness of interpretive products to determine who uses them and how they are used. This feedback will form the basis for producing products that are more useful and relevant to decisionmakers.
- Increase the level of coordination among WRD regions to identify national issues that can be addressed by the Federal-State Cooperative Program and, thereby, increase opportunity for national synthesis products.
- Work directly with decisionmakers at all levels to provide the best available understanding of emerging issues. Often, decisions have to be made rapidly, and as a result, there is a need to make decisions that are based on incomplete understanding. In those cases where decisions are going to be made, regardless of the level of understanding, we will work with decisionmakers so that their decisions will be based on the best scientific knowledge available.
- Interpret and analyze data in our national water data bases to accomplish information-synthesis objectives. An example of such an analysis is an assessment of trends in the annual and seasonal average flow of streams throughout the Nation. These types of analyses of our national data base will be done on a recurring basis.

Research and Development

Research and development provide the scientific infrastructure (expertise, accumulated knowledge, tools and techniques) that keeps WRD in the forefront of the hydrologic sciences and helps us to achieve our mission. Our scientists conduct both fundamental research that has long-term payoff and immediately relevant, problem-solving research that has short-term benefits. WRD's overall research effort has two components—(1) a centrally managed research program that is located primarily at three USGS regional centers and (2) a distributed research program that is located primarily in District offices. In the future, these two components, or research program models, will retain their unique structural characteristics but will increasingly collaborate, communicate, and build on their commonalties.

While maintaining the internationally recognized quality of our research, we will continue to balance expenditures on research with other needs of the division. Decisions to hire new researchers in either of the research program models described above will consider needs of the operational program, the national balance of discipline expertise, and new directions in hydrologic sciences. The concept that every major subdiscipline in hydrology should be covered in WRD must be reconsidered if resources shrink. If resources grow, then covering the base of subdisciplines that are relevant to the WRD mission will become more important than growing great depth in any single subdiscipline. In either case, our research staff will be developed around the principle of maintaining a balanced distribution of discipline expertise, rather than developing expertise solely on a geographic or issue-by-issue basis.

WRD will undertake the following strategic efforts to enhance research and development:

- Research will be more interdisciplinary in the future and will be conducted more by teams.
- Linkages between research advisors and discipline specialists in the technical offices, in regions, and in districts will be improved. This linking will lead to a common understanding of the division's research capabilities and the needs of the operational program, which will influence the directions of research.
- Studies of emerging issues will take advantage of the accumulated knowledge base that has been developed from long-term studies of specific ecosystems or specific hydrologic problems.
- Research activities will increasingly include collaboration with the academic community, postdoctoral research associates, scientists on term and sabbatical appointments, and students.

Balance Among Major Program Components

The keys to WRD's future success are a strong long-term data-collection program, a strong program of interpretive investigations and national and regional assessments, and a strong research and development program. We must also maintain an appropriate balance among these scientific activities. Ideally, the percentages of total available funds for the three components should be about 40 percent for long-term data-collection, about 45 percent for interpretation and assessment, and about 15 percent for research and development. The relative proportion of these three components will be out of balance if either long-term data collection or interpretation and assessment funding falls below 30 percent of total program or if research and development falls below 15 percent.

These three program components are not really separate; they are interdependent and linked. For example, projects with a primary focus on research or assessment may collect hydrologic data systematically over a long time period. Similarly, long-term data collection and interpretive investigations rely on the scientific infrastructure and accumulated knowledge that has been developed by researchers. Therefore, the percentages given above are approximate.

The history of the mix among program activities is as follows:

Percentage of overall funds for—	1982	1989	1997
Long-term data collection[1]	44	40	34
Interpretation and assessment	43	42	51
Research and development	13	18	15

[1]Long-term data collection is defined as data that are collected consistently over a period of at least 5 years and typically for a much longer period of time. Thus, even though almost all projects collect basic hydrologic data, only those sites that are monitored continuously for at least 5 years are included in calculating the percentage of funds spent on long-term data collection.

From 1982 to 1995, there was only modest growth above inflation for streamgages and real declines in funding for NASQAN. During the same period, there was growth in the interpretation and assessment component primarily because of the growth of the National Water Quality Assessment (NAWQA) program and the growth in interpretive studies that were conducted for other Federal Agencies on a reimbursable basis. Together, these changes have resulted in the percentage of funds for long-term data collection that is near the minimum level.

- WRD will work with DOI, Office of Management and Budget (OMB), and Congress to begin to shift its overall program to increase the percentage of funds available for long-term data collection.

Balance Among Discipline Areas

WRD must also maintain a balance among the water-resource discipline areas. Ideally, this balance would be about 30 percent of total program funds spent for data collection and investigations that are related to surface-water quantity (includes floods), and about 25 percent for data collection and investigations that are related to ground-water availability. Of the remaining funds, about 25 percent would be spent for data collection and investigations of surface-water quality, including geomorphology, and ecology, and about 20 percent for ground-water quality. The ideal funding level for surface water is higher than that for ground water because hydrologic hazards are important and because ground-water data that is collected by others often meet USGS standards and, thus, can be used to augment the national data base. Overall, there is a bias towards quantity and availability of water resources because of WRD's unique position as the Nation's primary collector of these data. WRD's overall program will be out of balance if any one of the four components falls below about 20 percent or rises above about 35 percent.

WRD will institute a system to track the percentage of scientific effort devoted to each of the four discipline categories described above—surface-water quantity, ground-water availability, surface-water quality, and ground-water quality. This is a different discipline breakdown than the one that has been used during the last 15 years when we used the categories ground water, surface water, water quality, and general hydrology to track our work. The history of the mix of disciplines in WRD programs is as follows:

Percentage of overall funds for—	1982	1989	1997
Ground water	24	24	15
Surface water	37	34	33
Water quality	23	23	26
General hydrology	16	19	26

During the last 7 years (1991-97), there has been growth in the water-quality area. This growth primarily results from increased work for the Department of Defense and the growth of the NAWQA program. It is also possible that NAWQA contributed to the growth of the general hydrology category because NAWQA projects are interdisciplinary. Although the surface-water component has had only a small decrease between 1982 and 1996, the number of interpretive studies has decreased dramatically. The discipline that had the most significant decrease was ground-water resources, primarily because of completion of the Regional Aquifer-System Analysis Program.

As competition for water increases nationwide, the importance of ground-water and surface-water data, assessments, and models will continue to increase. The water-management community continues to point out the important role they believe the USGS should play in describing ground-water and surface-water systems and the relation between them, as well as in modeling these systems so that various management scenarios can be simulated to provide for sound long-term water-management decisions. WRD's ground-water and surface-water assessment programs are currently too small to meet all these needs.

- WRD will work with DOI, OMB, and Congress to seek opportunities to increase the ground-water and surface-water assessment and modeling components of its program mix over the next several years.

Investments in New Capabilities

WRD will make significant investments in new tools and capabilities to improve our field and laboratory methods, instruments, hydrologic models, database software, and information dissemination. An important aspect of this investment strategy is that we will significantly improve the transfer of new capabilities to our operational program so that we can better address priority water-resource issues and improve the effectiveness of our work and products.

The process of investing depends on the availability of the underlying scientific knowledge and technology. This process is a major responsibility of the research staff of WRD and also requires an understanding of the need for the tools. This comes about through communication among all parts of the WRD—district staff, regional staff, National Research program (NRP), and headquarters units. The responsibility for providing a focus for the discussion and prioritization of needs and for assigning the individuals and needed resources for the development, testing, documentation, and training associated with these investments rests primarily with the Offices of Surface Water, Ground Water, and Water Quality, Federal program managers, and the Offices of the Assistant Chief Hydrologists.

The following discussions describe some of the top investment priorities for the next 2 to 5 years as opposed to the 10-year range that is the general rule for this document. These priorities must be reevaluated on a frequent basis.

Field and Laboratory Methods

The greatest needs for field and laboratory methods are (1) faster and less expensive ways to collect samples for chemical analyses that adequately represent the environment being characterized and (2) development of laboratory methods for analysis of contaminants at the very low concentrations at which they may affect human and aquatic health.

High-priority methods for development are described below:

- Investigate alternative approaches for collection of surface-water samples to reduce costs and limit contamination. Alternative approaches that will be evaluated include point samples or dipped samples as surrogates for discharge-weighted samples.
- Develop standard procedures for separation of aqueous and solid phases of trace elements in ground water and surface water to help evaluate the effects of these elements on human and aquatic health.
- Improve analytical methods for pesticides and pesticide degradation products.

Instruments and Technology

Although WRD buys almost all of its instruments from the private sector, division scientists and technical experts have an important role to play in working with private sector partners to design or modify instruments and to field test them. In the next 5 years, we will increase our efforts to identify promising technology developed in other scientific or engineering fields that could be modified to collect data on water quantity or quality. We will also work with instrument designers and developers in other Federal Agencies and the private sector to bring them to our field sites where the instruments can be tested.

High-priority instrument development needs are described below:

- Develop nonsubmersible instruments to measure water depth, streambed elevation, and stream velocity to improve the efficiency, accuracy, and reliability of the streamgaging program.
- Develop, or work with others to develop, and test instruments that are able to sense chemical constituent concentrations continuously or to integrate the concentrations over some period of time. In the near term, advances in sensor technologies are expected for chemicals that occur at high concentrations. Reliable in-situ determination of the very low concentrations that characterize most trace metals and organic compounds is a more significant technical challenge.
- Invest in state-of-the art instrumentation and emerging technologies to ensure that USGS groundwater science will meet present and future needs for information. Technologies that will get special attention include (1) passive systems and in-situ measurements that use fiber optics, laser technology, and spectroscopy and (2) advanced surface and borehole geophysical techniques.

Hydrologic Models

WRD is an international leader in the development and application of hydrologic modeling software, which is developed by our scientists to meet the mission of the division and then made available at no cost to the entire hydrologic science community. As water-resource issues evolve, new modeling capabilities and enhancements to existing modeling software are needed on a continuing basis to keep us on the forefront of quantitative hydrology.

To meet this increasing demand, we will do the following:

- Develop a new generation of computer models to simulate (a) watershed-scale responses to climate and land-use changes; (b) open-channel surface-water flow; (c) the interaction of ground water and surface water, including lakes, streams, and wetlands; (d) water chemistry and sediment transport; and (e) water-use models. These models will be linked with decision-support systems for science-based water-management decisions. The models will be designed to become the models of choice for the scientific community.
- Integrate results of surface and borehole geophysical surveys for scientific visualization and produce data in a format that can be directly used in ground-water flow modeling.
- Connect all of our core hydrologic models to graphical user interfaces and scientific visualization software. These tools make models easy to use, facilitate hypothesis testing during model calibration, and greatly enhance the visualization of model results. To allow modifications of USGS modeling software over time, the scientific core of these models will remain cleanly separable from the preprocessing and postprocessing software, which is expected to be commercial software, and will be coded to maximize portability across computer platforms.

Data-Base Software

The goals for WRD data-management systems are to (1) eliminate any duplication of data-entry activities, (2) automate data transfer as much as possible, (3) provide powerful and easy-to-use tools for data-processing and data-quality control, and (4) provide tools to easily retrieve data in the volumes and formats that are useful to USGS employees, cooperators, and the general public.

Principles for development of a national water-information data base for WRD are as follows:

- To the extent possible, use commercially available software and contractor support for data-base development.
- WRD data should be easily accessible to other organizations and the general public.
- The primary means of access to the data for all users other than those that are directly involved in creating the data will be through the Internet. Use of the Internet ensures that the access systems will be virtually independent of the user's computer platform or operating system.
- Data retrievals for multiple states should be as simple as retrievals from single-states. Users should not have to navigate among a set of USGS servers to find the data they need.
- There should be only one official site for any data value or set. However, release of copies of specialized subsets of the whole data base through the Internet or a CD-ROM is encouraged provided that the metadata associated with the data set contains a disclaimer that explains when the data were copied from the official files.
- Users should have access to the full information content of WRD monitoring data sets. Users should be able to reproduce the continuous record or a record that is very close to it.
- The system should comply with the minimum data elements as defined by the Intergovernmental Task Force on Monitoring and comply with data exchange or metadata requirements of the Federal Geographic Data Committee. This compliance should ensure the ability to import and export data between the WRD system and other data systems.
- WRD will tightly control entry of data into its data base and will make the decision to enter other agency data on the basis of direct knowledge of the methods and quality assurances used by the data producer. We will vigorously promote the use of our data-base software by other data producers with a goal of making it easy to access the producer’s data.

Information Dissemination

The goal of WRD's information dissemination activities is to get our data, reports, methods, and models to our customers and partners in a form and within a timeframe that will allow them to use our products to demonstrably affect society's needs; in other words, to make a better world. As a science bureau, the USGS does not have within its mission the responsibility to take the final steps to ensure that USGS products impact

society. It is essential, therefore, that we actively work with our customers and partners to do the following:

- Identify high-priority users of WRD products. This identification will proceed by systematically defining desired outcomes and mechanisms to realize these outcomes, and by developing complete lists of possible customers and partners.
- Develop and implement launch strategies to ensure that WRD products are effectively delivered to high-priority users.
- Continue to use emerging technologies to improve the delivery of products to high-priority users.
- Use feedback mechanisms to assess and improve product delivery.

Examples of specific goals for the information-dissemination activities include the following:

- WRD will drastically reduce the time it takes to produce reports. We live in an information age, and we must get reports out to our customers much sooner. WRD will reduce by one-third the current average elapsed time between the author submitting the first draft of the report for review and the final approval of the report.
- USGS will provide the capability, through the Internet, for anyone to obtain realtime streamflow, ground-water levels, and water-quality characteristics and data from all of our monitoring stations in the Nation. The same software will provide the capability for obtaining long-term hydrologic characteristics from locations with historical data and estimates of hydrologic characteristics from any other location in the Nation.
- Within 2 years, WRD will develop and adopt prescribed formats for serving selected hydrologic information over the Internet that will be used by every district. The result will be a series of pages that have an identical appearance, regardless of where they originate, and provide easy access to the types of data that are typically collected by all WRD districts. This consistency will greatly facilitate access to our products by both external customers and our employees.
- Within 5 years, we will have a National Aquifer Digital Data Base available on the Internet that will provide information and digital coverages for the Nation's principal regional aquifer systems.

STRATEGIC DIRECTIONS IN WRD BUSINESS PRACTICES

WRD's business practices have served the division and its customers and partners well over the years. Nevertheless, the changing world and the new scientific directions foreseen in this document will require some modifications in the way we carry out our work. These modifications, along with looking back 15 years for perspective, are provided in this section.

Business Model

Most of the key attributes of WRD's business model will continue to serve the division well and do not need to be changed. A few small modifications to some will bring greater flexibility to district management and enhance the capability for research and development.

Attribute 1. *WRD is a decentralized and distributed organization.*

District offices and field offices associated with districts facilitate access to field sites, encourage close contact with local resource managers, and allow employees to be knowledgeable about local issues and local hydrology. Given the important role of the States in water-resources management, the presence of WRD is needed in every State; however, it is not necessary that the presence be the same in every State. Today and in the future, district offices will be of different sizes and will offer a different mix of skills and expertise. At a minimum, every district office must have a primary contact point for State and local water-resource interests and provide the base for national, long-term data-collection networks and national programs, such as NAWQA. Beyond that, the range of expertise available in districts will vary widely.

Many district offices are already sharing work across State boundaries. In particular, the trend towards optimizing the field offices' responsibilities for data collection, regardless of State lines, is a trend that will continue. Districts will also share scientific, technical, and administrative expertise to a greater extent. This will result in cost savings and also provide opportunities for career development. In addition to sharing human resources, districts will share specialized equipment or instrumentation that is not used on a routine basis.

- Modification to be implemented.—WRD will establish and support an active philosophy to encourage the co-location of its offices nationwide with institutions of higher learning or with other scientific organizations. This will expand WRD's internal scientific expertise and further its growth and involvement in national water-related issues. In particular, co-location with other USGS divisions is strongly encouraged because this will facilitate sharing of resources across division lines and allow for new multidisciplinary studies. In some cases, this will mean the placement of a few people from BRD, GD, or NMD in predominantly WRD offices or vice versa. Establishment of offices, including multidivisional offices on the campuses of colleges and universities, is also encouraged because this will provide an opportunity for the exchange of technical and educational information and possible development of cooperative research endeavors among scientists, faculty members, and students. Locating offices on campuses that also house a Water Resources Research Institute is especially encouraged as a way of further enhancing collaboration.

Attribute 2. *In the primary business unit of the WRD, the district office, there is a close linkage between funds and an interested customer. These customers include USGS Federal program coordinators, State and local cooperators, or other Federal Agencies.*

This attribute has ensured that districts remain responsive to their customers and has helped to keep district programs relevant, effective, and productive. Historically, activities not associated with a specific project or customer, such as outreach, program development, or participation in projects that were conducted jointly with other USGS divisions, were generally funded through district common services accounts. Increased constraints on the use of common services accounts, the concern for keeping common services assessments low, and the increasing demand on districts for a variety of unfunded activities, however, requires some modification to this attribute.

- Modification to be implemented.—WRD will provide Federal funds to district offices to support short-term data-collection efforts, as well as efforts required to develop new partnerships, outreach activities, State Representative responsibilities, and other relatively short-term and focused efforts that have no specific funding source but contribute to WRD's mission. These funds will allow districts to collect critically important data during a flood, to synthesize data sets, to prepare fact sheets, to maintain an Internet site, or to undertake other forms of communication with stakeholders. These funds are likely to be less than 1 percent of total operating funds for the district. Although this is a small amount of money, it can make an important difference.

Attribute 3. *WRD conducts research in a centrally managed model, the NRP, and in a dispersed model managed through districts and other operational units.*

The NRP is mostly internally funded, whereas research in the dispersed model is funded by both USGS programs and external customers. Both research models support the mission of WRD. Scientists in the NRP focus more on long-term research problems, whereas researchers in the dispersed model focus more on short-term needs of USGS programs and non-USGS customers. Under both models, individuals provide valuable products and expertise to WRD programs. The current arrangement serves the division well. It keeps the division at the cutting edge of science and encourages collaboration with a goal of minimizing competition for funds among organizational units.

- Modifications to be implemented.—
  a. When technical offices or Federal programs have funds for developmental activities that are not already associated with a project or an organizational unit, all WRD scientists who have the capability to conduct the activities will be given the opportunity for consideration. This may or may not require a proposal. It is expected that the funds available for these kinds of activities will be small and that the amount of competition generated in the division will be minimal.
  b. New research positions will be announced so that all qualified scientists will have an opportunity for consideration. In many cases a national search, including advertisement outside WRD, will be conducted. Note that this modification applies to newly created research positions. It will not restrict the ability of WRD personnel to move into or out of the Research Grade Evaluation (RGE) system.
  c. WRD will leverage its research funds by collaborating with Water Resources Research Institutes and other academic institutions when it is in the best interests of the program

or project. When WRD requires specialized expertise for periods of a few years, but not necessarily to meet long-term goals, it will seek that talent in the academic community rather than through hiring new permanent personnel.

Attribute 4. *WRD managers of districts and NRP branches have considerable autonomy in personnel decisions, including decisions about permanent hires and promotions, depending on the grade level.*

This attribute is important because local managers are the individuals who are most aware of the needs in their organizational unit; however, decisions cannot be entirely local. A national oversight is necessary to avoid unnecessary duplication of expertise and to ensure that the skills of newly hired individuals will be needed by the division for the long term. This national oversight on personnel decisions is provided by members of the WRD Human Resources Management Committee who establish hiring policies for all organizational units, make recommendations on vacancies at higher grade levels, and help to move qualified personnel from one organizational unit to another.

- Modification to be implemented—Because of budget pressures and other considerations, it is expected that in the future, fewer individuals will be hired by WRD and that there will be more use of national searches for applicants, especially for new hires at higher grade levels.

Customers, Partners, and Constituencies

The primary customers for WRD information and technology are (1) water managers with operational, day-to-day responsibilities for public-water supply and distribution, wastewater treatment, reservoir operation, power generation, and flood forecasting; (2) environment and natural resource managers and planners in local, State, and Federal Government and nongovernmental organizations; and (3) the science and engineering community, including universities, water supply and treatment industries, mining and energy industries, agriculture and irrigation industries, and engineering and consulting firms.

During the last 15 years, the following have occurred:

- There has been an increase in the number of State and local cooperators. The total number of cooperating agencies, which are defined as those agencies that provide resources to help achieve the WRD mission, has grown from 697 in 1982 to 1,040 in 1989 to 1,238 in 1997. The cooperator base is a strength because as the number of cooperators increases, there are more avenues for identifying emerging water issues. The expanded base of contributors also helps to leverage resources and ensure the availability of unbiased high-quality data and information.
- There has been an increase in the percentage of total cooperators that are local cooperators, such as cities, townships, county agencies, or regional planning agencies as opposed to State agencies. Because of the difference in scale and scope of cooperator responsibility and interest, projects cooperatively funded by local cooperators tend to be smaller and have shorter time frames for completion. As a result, WRD managers expend considerable effort to develop small-scale projects that are consistent with and contribute to the national mission of WRD.
- There has been a significant increase in work funded by other Federal Agencies, primarily resulting from the growth in investigations of environmental contamination at numerous Department of Defense installations and in work that is funded by the Department of Energy at the proposed high-level radioactive waste repository at Yucca Mountain, Nevada. The percentage of total WRD funds derived from other Federal Agencies increased from 18 percent in 1982 to 25 percent in 1989 and then decreased to 23 percent in1997. In a time when all Federal Agencies are facing stable or declining budgets, funds from other Federal Agencies have made some units of our organization vulnerable to sudden cuts in projects funded by other Federal agencies.
- There has been an increase in the amount of work that WRD does to support DOI bureaus. Expressed in constant dollars (with a 1982 base), the level of WRD effort that directly supports other DOI bureaus has grown from $7.9 million in 1982 to $10.2 million in 1989 to $11.0 million in 1997. In 1982, virtually all of the work that WRD did for other DOI bureaus was paid for by these bureaus. In 1997, about 45 percent of all work for DOI was supported by funds that were

appropriated to the USGS; the remaining 55 percent was funded through reimbursements from other DOI bureaus.

During the next 10 years, the following are likely:

- Cooperators in State and local government will continue to be important customers and partners. There are two good reasons for this projection. First, most plans and policies that are related to the availability of water will continue to be set at the State or local level. Second, although many policies that are related to water quality and environmental quality are set at the Federal level, State and local officials will continue to have a key role in implementing these policies.
- WRD will build on the strengths of the current workforce and expand scientific capabilities through partnerships with other USGS divisions; local, State, and Federal Agencies; the private sector; and the university community. Partnerships with other USGS divisions provide a special opportunity to advance the state of the science in the areas of hazards prediction and risk reduction, health of aquatic ecosystems, and use of advanced mapping techniques for assessing water resources. For example, within the next 5 years, we will have developed integrated approaches to combining GD and State Geological Survey expertise in geologic mapping with WRD expertise in groundwater hydrology to develop better three-dimensional geologic frameworks for hydrogeologic studies and ground-water modeling.
- Most of WRD's products will continue to be directed toward members of the technical community who manage and regulate the Nation's water resources. Because of increased public attention to water-resource issues and increased costs from environmental regulations and hydrologic hazards, we will work with and provide timely data and information to Federal regulatory, emergency management, and land and water-management agencies to assist them in their public safety activities. Although the general public, educators, and students at the K–12 levels, and elected officials and their staffs are important audiences for some WRD information and products, our primary focus will be to get information into the hands of those who manage and regulate the Nation’s water resources.
- WRD will provide timely and concise information to Congress to assist them in their efforts to establish and monitor the success of national policies. Water-resource decisionmakers at the regional and national level will also continue to be an important constituency.
- WRD will give special attention to the hydrologic information needs of other DOI bureaus that must fulfill their responsibilities for public land and water management. WRD has recently (fiscal year 1998) developed a new cost-sharing program with DOI bureaus to help reduce the cost of projects that are directed towards high-priority DOI needs. Although our relationships with other DOI bureaus will be stronger in 2008 than they are in 1998, it is important that we continue to serve the water-information needs of the entire Nation.
- WRD's relationship with certain Federal Agencies will change as a result of changes in environmental priorities and growth of expertise within the private sector. For example, in the area of environmental contamination, WRD will shift from site-specific characterization of contaminated sites to more complex studies of bioremediation and other processes responsible for removal of contaminants. Because of increasing concerns about human health, we will do more national and regional work with the EPA and the CDC.
- WRD will establish partnerships with private-sector and other interest groups if the issue to be addressed is in the public interest, is consistent with WRD's mission, and does not compromise WRD's reputation for unbiased and impartial science.
- WRD will do more work internationally to support USGS science goals, U.S. foreign policy and national security, and to benefit U.S. interests abroad. The great majority of international work will be funded, on a reimbursable basis, by the U.S. Department of State, agencies of the United Nations, the World Bank or the governments of the countries where the work is being done. The exceptions to this principle are those instances where international involvement would expand scientific capabilities by offering the opportunity to study a unique environment or water issues that are related to the borders of the United States. The objectives of WRD's expanded international role will be to use its expertise and products to—
  - Improve management of water resources.
  - Address water-related environmental problems.

- Develop effective transfer of technology and assist in building water-management institutions in developing countries.
- Help U.S. interests, particularly private sector interests, abroad.

Funding Issues

WRD achieves its mission by using funding from three distinctly different sources: (1) Federal program funds, which provide 100 percent support for certain efforts; (2) Federal-State Cooperative program funds, which are a combination of Federally appropriated funds (up to 50 percent) and funds from cooperating agencies at the State and local level; and (3) reimbursable funds, which are contributed by various partners without any Federal match. Each source of funding brings its own benefits. The Federal program provides the foundation that allows WRD to address important national issues, provides comprehensive national data sets, and provides for the conduct of regional and national synthesis of data and information, which is unlikely to be funded by local, State, and other Federal Agencies. Federal programs also provide the primary source of funds for research and development, which is necessary for the long-term productivity of WRD and the hydrologic science community.

The Federal-State Cooperative program and the reimbursable program ensures the relevance of WRD work and helps WRD to identify emerging issues. The programs provide a base of support for long-term data-collection networks and interpretive projects that can be integrated to give regional and national understanding of the Nation's water resources. These programs and the Federal program also provide a network of field sites in diverse geographic and hydrologic environments where we and others can test new scientific approaches, methods, and instruments under real-world conditions. Our access to well-characterized field sites is a valuable asset and helps us to move the science of hydrology forward.

Between 1982 and 1994, WRD had only modest growth above the rate of inflation in its programs (fig.1). Much of the growth in the early 1990's came from increases in reimbursable funding (fig. 2). Note that the downturn in total funds in 1996 can be attributed entirely to decreases in reimbursable funding from the Departments of Defense and Energy. Because total funding has been fairly constant in recent years and has not kept up with inflation, WRD has felt significant funding pressures. These funding pressures may continue for several years. Under this scenario, our challenge will be to manage funds effectively, so that our work and products continue to be important and relevant to decisionmakers at the Federal, State, and local level.

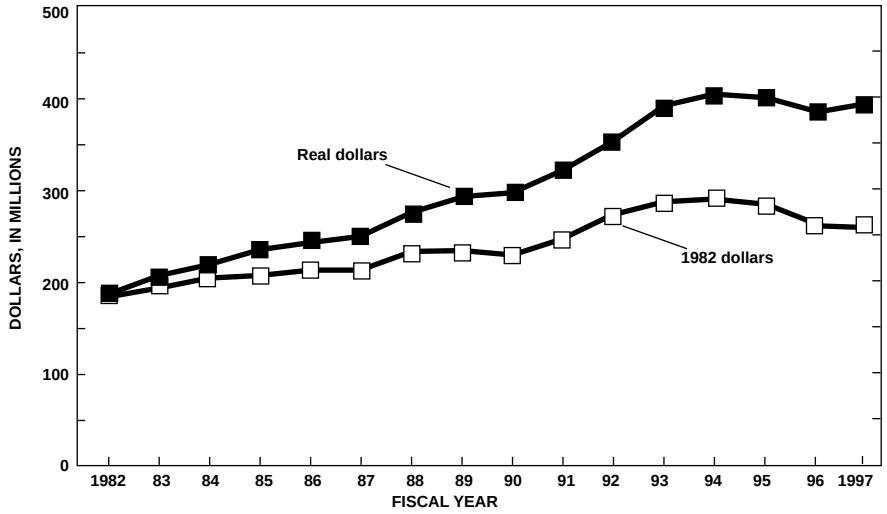

Figure 1.—Water-resources investigations total funds, in real dollars and constant dollars, FY's1982-96.

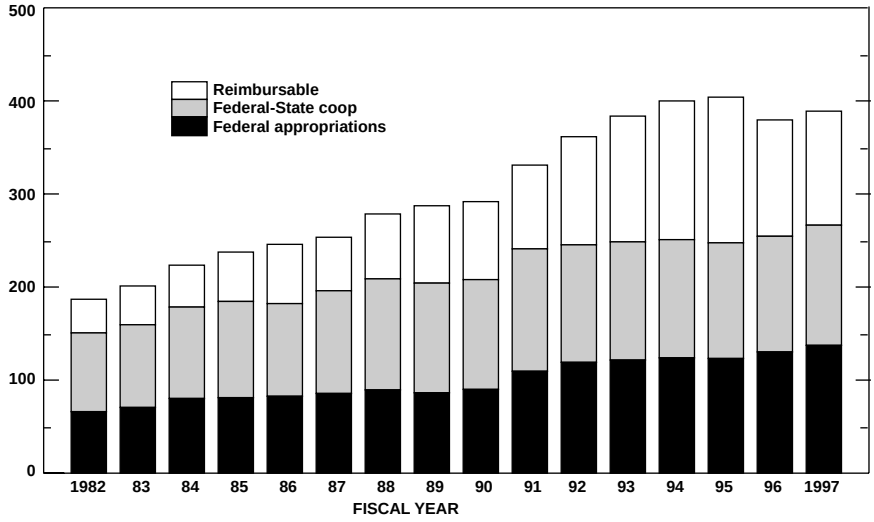

Figure 2.—Water-resources investigations, all funding sources, FY's 1982-97.

Note: Reimbursable includes OFA and unmatched Federal-State Cooperative funds.

Although we do not anticipate significant decreases in funding, each district should make every effort to ensure that its sources of funding are balanced. Problems can arise when one or two cooperators or funding sources become too dominant within a district. When this happens, district operations become vulnerable to changing interests of the cooperator or sudden decreases in cooperator funding. A healthy balance of funding sources with a number of cooperators will allow a district to better manage changes in cooperator interests without diminishing our ability to assess the water resources of the State and achieve our national mission. This is particularly important when a district relies too heavily on reimbursable work. Experience has shown that it can be difficult to sustain key WRD mission responsibilities, such as long-term data collection, with reimbursable funds.

Although cooperative and reimbursable programs will remain vital to the overall mission of the WRD, we must be mindful of avoiding work more appropriately done by the private sector. WRD must be responsive to the requests and interests of potential partners, but at the same time set limits on the type of work undertaken on their behalf. We must approach our potential customers with the viewpoint that our role is to form true partnerships that meet both Federal and non-Federal needs. Projects undertaken for customers must be conducted with impartiality and be consistent with WRD's mission.

Through its cooperative and reimbursable programs, each USGS district office should continue to develop an ever-expanding understanding of the water resources of their State(s) and contribute to WRD's leadership in providing new approaches, technology, and research for solving water-resources problems. Therefore, cooperative and reimbursable projects should provide an enhancement of knowledge or an enhancement of hydrologic methodology that is likely to be useful beyond the immediate needs of the customer. Examples of such broader goals are:

- Advancing knowledge of regional hydrologic systems.
- Advancing field or analytical methodology.
- Advancing understanding of hydrologic processes.
- Providing data or results useful to multiple parties in potentially contentious interjurisdictional conflicts over water resources.
- Furnishing hydrologic data required for interstate and international compacts, Federal law, court decrees, and Congressionally mandated studies.
- Providing water-resources information that will be used by multiple parties for planning and operational purposes.
- Furnishing hydrologic data or information that contributes to protection of life and property.
- Contributing data to national data bases that will be used to advance the understanding of regional and temporal variations in hydrologic conditions.

Human Resources

In the last 10 to 15 years there has been a significant change in the way that both employers and employees think about employment and the workplace. Organizations of all types are using more contractors and temporary and part-time employees. Flexible work schedules have become the norm, job sharing is becoming common, and many organizations are testing alternative workplaces, including formation of work units with members located in different cities or States. In the future, few individuals will have the opportunity to work for the same company or organization for 25 or 30 years before retirement. These trends are challenging WRD to think about its future workforce and to reconsider some of its traditional policies regarding temporary employment, contracting, alternative work schedules, and other personnel issues.

Staffing

The total number of people working for WRD increased during the 1980's and peaked in 1994. Complete data on numbers of employees are given in figure 3; the numbers are expressed as total full-time personnel equivalents (FTE), which include both permanent and other than permanent Federal employees but do not include contract employees. The decrease in permanent personnel during the last few years can be attributed, in part, to the bureauwide program that provided incentives for individuals who chose to retire or leave Government service. Because of anticipated budget constraints, few newly hired permanent personnel were added to replace those who left the division because of the incentives or through normal attrition. Thus, the number of permanent FTE reached a peak in 1993 and has since declined.

Because our work—data collection, interpretation of scientific findings, and research and development—requires skilled people, we will always spend a significant part of our total budget on human resources. Ideally, about 55 percent of our total funds should be spent on salary and benefits for permanent and "other than permanent" employees. The category, other than permanent, includes personal service contracts, individuals on temporary appointments, postdoctoral and other fellowships, intergovernmental personnel agreements, and other types of appointments. Of the remaining 45 percent of our funds, about 35 percent should go for operating expenses, such as equipment, supplies, travel, and training, and about 10 percent for rent, bureau assessments, and other fixed costs. If the percentage of funds available for operating expenses falls below about 20 percent, WRD will be in a position where it has the people with the skills to accomplish its mission but too little money to allow those people to work effectively.

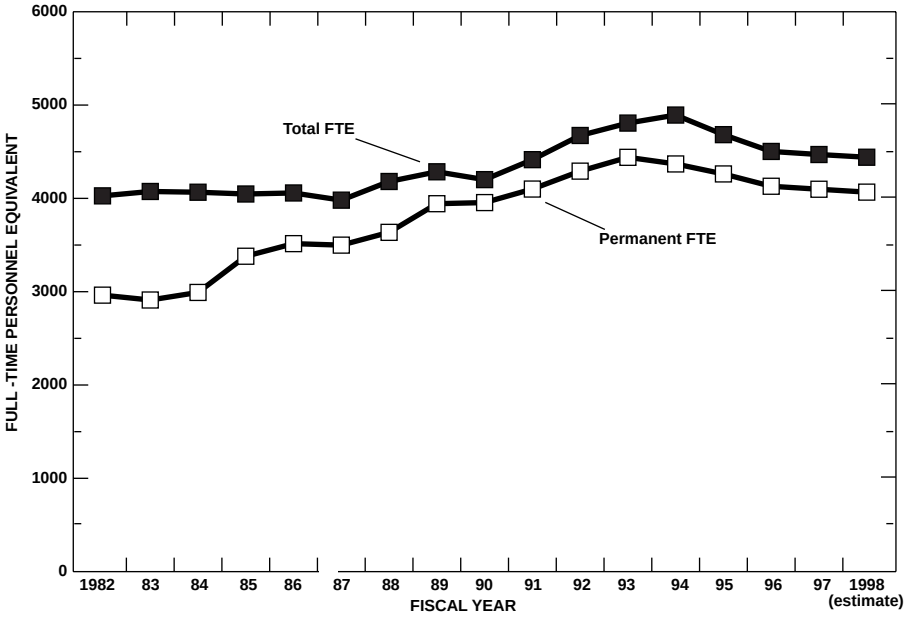

Figure 3.—Water Resources Division total full-time personnel equivalent and permanent full-time personnel equivalent, FY's 1982-98.

Trends in percentage of total funds that are devoted to salary (both permanent and other than permanent) and operating expenses are as follows:

	1982	1989	1997
Salary	58	56	62
Operating expenses	32	32	25

These data clearly show that the percentage of total funds spent for salary has been above the target level of about 55 percent for a number of years (1982, 1989, and 1997) and that the funds for operating expenses have been below the target level of 35 percent. Furthermore, the trends in both cases are moving in the wrong direction. Although the percentage of funds for operating expenses is still above the level that would cause significant concern, it has decreased over the last 9 years.

We have traditionally relied on permanent Government employees to fulfill a large part of our mission because our work requires a high degree of skill and job-specific training; this will continue. There are good reasons to maintain permanent employees as a significant part of the workforce. Over time, permanent staff gain both general hydrologic knowledge and detailed knowledge of specific hydrologic systems that is extremely valuable to WRD and its cooperators. Further, the costs associated with constantly training a large number of nonpermanent employees would be prohibitive and inconsistent with prudent resource management. It is also prudent, however, to supplement the permanent workforce with nonpermanent staff that will provide flexibility and some of the new skills needed to address emerging water-resource issues.

Maintaining an appropriate balance between permanent and other than permanent employees is important for our future success. Ideally, about 80 percent of total FTE usage should be associated with permanent employees. If this percentage falls below 75 percent, we are in danger of losing the continuity and experience provided by long-term permanent employees. Ideally, about 20 percent of total FTE usage should be associated with other than permanent employees. If this percentage falls below 15 percent, we may not have the flexibility we need. The FTE distribution between permanent and other than permanent, during the last several years is as follows:

	1982	1989	1997
Permanent employees	74	92	92
Other than permanent (does not ‘include contracts)	26	8	8

The ability of WRD to meet the ideal targets described above is contingent on the budget. If there are increases in total budget, it will be easier to meet the targets than if funds are stable. We do not expect to achieve the ideal targets for percentages of funds for salary and operating expenses or the ideal division of FTE between permanent and other than permanent employees within the 10-year horizon of this plan; nevertheless, small steps will be taken to set us on the path to meet those targets. Even as we move to increase the percentage of other than permanent employees, we will always hire some new permanent employees because these individuals are the key to our future.

- WRD will increase the percentage of funds available for operating expenses so our personnel have the means to accomplish our mission. As employees retire or leave Government service, we will use judicious hiring practices to prevent further increases in the percentage of funds required for salary. Careful hiring, availability of training, and a rewards system will establish a base of dedicated permanent employees whose skills are supplemented with those of other than permanent staff.
- Over the next several years, WRD will increase the overall percentage of other than permanent employees in the division. This will provide greater flexibility in recruiting talent for short-term projects or new studies that may or may not become a permanent part of WRD's mission activities and will provide a mechanism for achieving WRD's mission during times of funding volatility. This increase will be accomplished in different places at different rates, depending on local needs for specific skill mixes.

Training

A goal for WRD is that all employees in the division will be able to do their jobs at the state of the art in their field and at the highest possible level of quality. Clearly, training to enhance the skills of WRD personnel is one approach to achieving this level of excellence.

At the present time there is considerable concern in WRD over the decreased level of training activity and how to reinvigorate the process. There are several hypotheses about the general decline in the amount of training taking place. These include the lack of new staff in the past 4 years (that is, most of the staff has had the training they need), the increased cost of WRD supplied training that takes place primarily at the National Training Center (that is, the increased airfares and per diem rates, as well as a shift to more training costs being paid by user), and the reluctance of management to allow staff members the time for training because of the pressure to produce timely products on current project assignments.

Adjustments to the current situation will require some combination of approaches. These include—

- Increase the use of advanced educational technology to facilitate distance learning through classes on the Internet and other computer-aided techniques.
- Increase the number of classes taught in regional centers and district offices to reduce travel costs.
- Increase the use of university courses and private vendors.
- Provide a subsidy for selected National Training Center courses when the Training Center provides unique capabilities, and the course is viewed as vital to upgrading WRD capabilities.

The continuation of the knowledge and experience of the WRD workforce is an essential factor in realizing the goals discussed in this document. This knowledge and experience cannot be completely learned through traditional training methods. More knowledgeable and experienced employees must help to train and develop new employees.

- WRD will develop and implement a formal, yet flexible, mentoring program to be used at all levels within the organization.

Alternative Work Schedules and Work Places

About 12 organizational units within WRD have conducted pilot studies of alternative work schedules (AWS), which allow employees, with supervisory concurrence, to work something other than an 8-hour day and 5-day week. Some of these units have been in the pilot phase for more than 3 years. The results of these pilot studies have been positive after employees and supervisors gained experience in the use of AWS. The division now plans to expand the use of AWS to other organizational units. A key condition for additional use of AWS is that it cannot interfere with our ability to achieve our mission. When an organizational unit participates in AWS, supervisors will establish work schedules so that vital office and project functions are always covered, and teams can continue to work together. Based on experiences with the pilot studies, AWS should be available to most employees in organizational units that chose to participate in AWS. For some employees, however, AWS may not be an option. In no case will anyone be forced to use AWS, if they do not wish to do so.

In contrast to AWS, WRD has had little experience with the alternative work place program (AWP). At present, the procedure for gaining official approval for AWP is somewhat complex, and final authority for approval is held at headquarters level. WRD will work with senior USGS managers to delegate that authority to the local level so that field supervisors can use this tool when it is appropriate. Because of the need to maintain teams that work together and the need to meet with cooperators, we do not expect that AWP will be widespread or permanent. Although the final decisions will be made at the local level, we expect that AWP will be used selectively and for periods of a few weeks at a time. Examples of the kinds of situations where AWP might be appropriate include working with colleagues at a university or cooperator facility, analyzing data or writing a report at a library or at home, or working at a site away from the office during periods when injury or illness restrict an employee's ability to travel but do not prevent him or her from working at a desk.

- Beginning in FY 1998, AWS will be available to all organizational components.
- Beginning in FY 1999, organizational component chiefs will have authority to authorize AWP.

Diversity

Over the past several years, WRD has made scant progress toward achieving a diverse workforce. From 1992 to 1997, the number of employees in permanent positions who belong to ethnic minorities decreased from 9.8 percent of the total workforce to 9.5 percent. The average grade of these employees increased from about 7.9 in 1992 to about 8.7 in 1997. During the same period, the average grade of all full-time employees in WRD decreased from about 10.2 to about 9.5.

From 1984 to 1997, the number of women in full-time positions in the WRD workforce increased from about 20 percent of the total workforce to about 29 percent. The average grade of these women increased from about 7.5 in 1984 to about 8.9 in 1997. Among women in WRD, 9 percent were at GS-12 and higher grades in 1984; in 1997, almost 21 percent of women in WRD were at GS-12 and higher grades. In looking at the total pool of permanent WRD employees (men and women) at GS-12 and higher grades, about 2 percent were women in 1984, and about 6 percent were women in 1997.

Achieving a diverse workforce is a high-priority goal of the USGS. To attain this goal in the WRD, it is essential that (1) each manager make a commitment to improve representation of all under-represented groups in the division, (2) there is no tolerance for workplace discrimination, and (3) the division pursues the objectives of the USGS Strategic Plan for Workforce Diversity to create and retain a workforce that reflects the diversity of the Nation's labor force. This plan is based upon strategies and methodologies that are presented in the DOI Diversity Strategic Plan.

The immediate challenge is to approach parity with the civilian labor force in the representation of women and minorities in those occupational series that are identified as under-represented in WRD, particularly the hydrologist and hydrologic technician occupational series. Once they are on board, WRD will work to retain these employees. Despite the dearth of new hires in the division, it is imperative that creative solutions be found to address diversity issues.

WRD's diversity strategy will be focused on four primary goals:

- Improve diversity by using targeted recruiting and hiring from under-represented groups, consistent with available opportunities. Targeted recruitment does not discriminate against other groups because it does not deny members of those groups the same access to vacancies that they have always had. Targeted recruitment ensures that members of under-represented groups have access to vacancies that might not have been available to them in the past.
    - WRD will develop a recruitment plan that will present mechanisms for improving diversity of our applicant pools. The plan will also include suggestions on how to work with secondary and higher level schools to develop internships and employment opportunities for recruiting entry-level employees, including hydrologic technicians and summer students.
    - WRD will work with DOI to expand mechanisms, such as the Outstanding Scholar Program, to include all occupations in an effort to assist the division in hiring members of under-represented groups.
- Provide opportunities for the development and full use of employee potential.
- Retain employees through a work environment that is rewarding, values diversity, and respects employees.
- Ensure that the division meets its diversity commitments through continuous program evaluation and management accountability.

NEXT STEPS

A shared understanding of strategic directions is especially important for an organization like WRD because we have a distributed management structure. Many, if not most, decisions that affect our customer base and human- and financial-resource allocations are made in district offices, research branches, and other major field offices. Accordingly, the new directions contained in this document will be implemented at all levels of the organization. In some cases, special groups of individuals, such as the Computer Advisory Committee or the Laboratory Advisory Committee, will be asked to develop specific implementation plans to move us forward in a specific area. Other directions will be implemented as district personnel discuss new project opportunities with cooperators or as research scientists decide future directions for their work. Participation by headquarters staff will be important in developing the ideas for investments and for our business practices.

The process of developing this strategic directions report has caused WRD senior management to debate, evaluate, and reach new understanding on a wide range of issues. Many directions, priorities, and activities described in this document are being implemented even before the document is finalized. Other strategic directions will be implemented over a longer period of time through the combination of many decisions by WRD management on topics, such as budget formulation, internal budgeting decisions that are related to investments, program development, and divi-

sion policies. Within the first 6 months after the final report is released, we will prioritize the remaining directions and activities, and appropriate groups will develop plans for rapid implementation of the highest priority items.

As WRD moves into the 21st century, we must be positioned to take advantage of new opportunities and successfully respond to new challenges. In the next 10 years, some changes are expected in what we do and how we do it. New water-resource issues will emerge; we will be prepared to meet them. There will be new customers and partners who have needs for water-resource information; we will be open to them. New technology will be developed that will allow us to do our jobs more effectively and efficiently; we will work to acquire this technology. It is the hope of the authors that this document represents a significant step toward defining our future and moving toward it.