



Maryland-Delaware-District of Columbia District
U. S. Geological Survey

**District Science Plan
Fiscal Year 2003 Update**

Prepared by Bob Shedlock, Bill Guertal, Jim Gerhart, and Fred Tenbus

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Introduction

The states of Maryland and Delaware and the District of Columbia form an organizational unit in the Water Resources Discipline of the USGS. The headquarters of the MD-DE-DC District is in Baltimore, MD, with a Subdistrict Office in Dover, DE, and Field Offices in LaVale, MD, and Annapolis, MD. The District has about 95 federal employees and several contract employees. Approximately 50 of the federal employees are hydrologists or other science series employees. The other federal employees include hydrologic technicians, computer and database support staff, geographers, and administrative staff.

The Biological Resources Discipline's Patuxent Wildlife Research Center, near Laurel, MD, is within the geographic boundaries of the District. The District is also close to the BRD Science Center in Leetown, WV, and to the many regional and national program functions of all USGS disciplines at the USGS National Center in Reston, VA.

Setting

The District spans five major physiographic provinces, which from east to west includes the Atlantic Coastal Plain, the Piedmont, the Blue Ridge, the Valley and Ridge, and the Allegheny Plateau Provinces (fig. 1). This gives the District a diversity of geologic and hydrologic landscapes ranging from coastal beaches and coastal lowlands to foothills areas and mountainous areas. The coastal areas contain both freshwater and saltwater wetlands, while the inland provinces contain a variety of freshwater wetlands. These diverse settings support a rich variety of both aquatic and terrestrial ecosystems. The District is also along major flyways for a number of important migratory bird species.

Most of the District is in the drainage area of Chesapeake Bay (fig 1), one of the most economically productive and ecologically valuable estuaries in the Nation. In fact, Chesapeake Bay essentially runs through the middle of the District. Parts of eastern and northern Delaware are in the drainages areas of two other important estuaries, Delaware Bay and the Atlantic Coastal Bays. The very eastern edge of Maryland is also in the Atlantic Coastal Bays drainage area. The south-central and most of the western parts of the District are in the drainage area of the Potomac River. The very western end of the District is in the Ohio River drainage area, whereas a small area of the northern part of the District is within the Susquehanna River Basin.

Land use in the District has evolved into a diverse and interspersed mixture of urban, residential, agricultural, and natural areas (fig. 2). The Coastal Plain and the Piedmont Provinces have the highest percentages of agricultural land among the five physiographic provinces. Urban and suburban areas have grown rapidly in the last several decades, extending into areas that were agricultural lands or forests. A large part of the urban corridor that extends from Richmond to Philadelphia is contained within the District, including the Baltimore and Washington, D.C. metropolitan areas, as well as the Wilmington, DE metropolitan area. The urban areas, the water resource needs of the population, and agricultural activities are important influences on flow and water quality in many areas of the District.

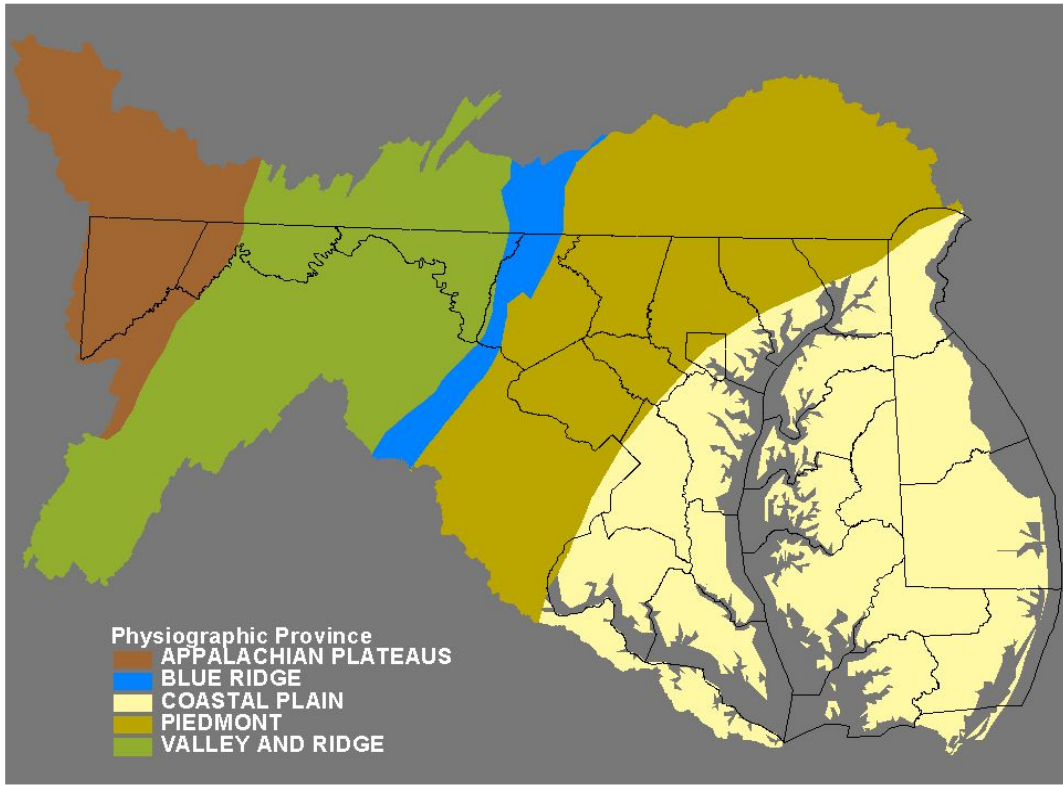


Figure 1. Physiographic provinces of the MD-DE-DC District.

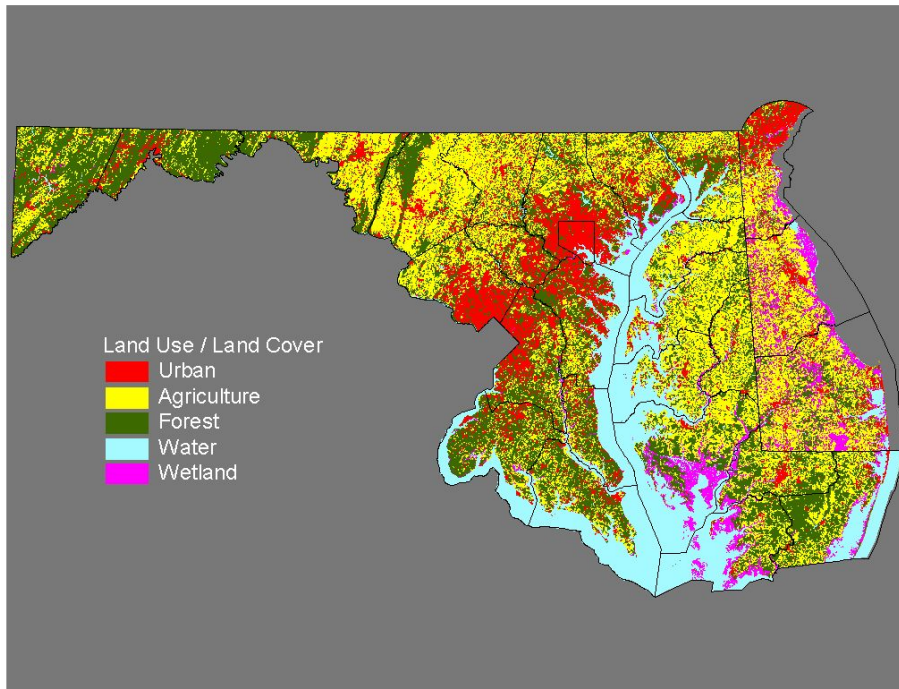


Figure 2. Land Use/Land Cover in the MD-DE-DC District

The natural landscape and its influence on human development patterns have led to a high degree of interspersed developed lands and ecologically sensitive natural areas. Another unique aspect of the area is that tidal waters connected to Chesapeake Bay extend for tens of miles up the valleys of major streams and their tributaries. Thus, first- and second-order streams drain into tidal rivers over much of the Coastal Plain resulting in transitions from freshwater to estuarine systems in many small watersheds throughout the District.

Most of the population in the District is concentrated in the Piedmont and Coastal Plain Provinces, with the main urban corridor running along the boundary between the two provinces. Baltimore, Washington D.C., and Wilmington obtain their water supplies from surface water, either from reservoirs or intakes on the major rivers. However, in most areas of the Coastal Plain and small towns and rural areas of the other physiographic provinces, ground water is the dominant source of water supply.

Baltimore has a unique supplementary source of water supply outside of the metropolitan area. An old compact permits Baltimore to divert water from the Susquehanna River during periods of drought. The Susquehanna Aqueduct was constructed in the early to middle 1950's and extends from about 500 ft. above the Conowingo Dam near Havre de Grace, MD to the Montebello water-treatment plant in Baltimore City.

There are several major environmental and water resources issues in the District. In spite of being in a temperate region, water supply is a concern over most areas of the District, as attested to by the droughts of 1999 and 2002. Although most municipalities and communities have current supplies that are adequate, many are concerned that their current sources will not be adequate to meet their future needs, especially in high growth areas. The quality and ecological health of Chesapeake Bay and its tributary streams are also major issues in the District because of the economic and aesthetic value of the Bay to Maryland and the surrounding states. Although the transport of nutrients and sediment out of the tributary watersheds is the major concern, the environmental community is also concerned about the fate and transport of toxic metals and organic compounds. Other prominent issues include urban sprawl, a topic that is being covered quite heavily in the popular press and in environmental science meetings in the Mid-Atlantic. In addition, the quality of drinking water and protection of source water areas are also very prominent issues for both EPA and the States.

Environmental Community in MD-DE-DC

A variety of federal, state, and local agencies have responsibilities to monitor or manage natural resources and deal with environmental issues in the Maryland, Delaware, and DC area. Several regional commissions and academic institutions are important players in the environmental science community in the District, as well. The Mid-Atlantic Region also has several significant interagency coordination bodies.

The largest is the Chesapeake Bay Program (CBP), a consortium of federal, state, and local agencies, universities and other organizations that are partnering to restore and protect Chesapeake Bay and its natural resources. The Bay Program was created in the early 1980's and is supported by agreements signed by several states and local

governments, officials of which form an executive council. The Environmental Protection Agency has the largest federal agency role in the Bay Program, but other agencies, including the USGS, provide full or part-time scientific staff support to the Bay Program through a series of committees and workgroups that link scientific and resource management activities. Several District scientists and managers serve on some of these workgroups and committees.

Another significant coordinating body in the District is the Maryland Water Monitoring Council (MWMC). This council was formed in 1995 and was created to foster communication, cooperation, and collaboration amongst water monitoring agencies and organizations in Maryland. MWMC includes representatives at all levels of government and was the first such state water monitoring council to be established in the Nation. The Council holds a large annual meeting and several technical workshops each year. District scientists serve on the Executive Board of the Council and on several of its standing committees. The Council is particularly active in performing interagency assessments of the adequacy of hydrologic data networks. Several years ago such an assessment was done for the stream gage network in Maryland and one is currently being done for the ground-water observation well network.

Through these and other external coordination efforts the District is able to be aware of the scientific information needs of the broad environmental community. In its first strategic plan, the District articulated that providing hydrologic information and the scientific understanding needed to support the optimum use and management of natural resources in the Mid-Atlantic region is the primary mission of the Maryland-Delaware-D.C. district. To meet this mission the district has entered into cooperative partnerships with a wide range of organizations. These partnerships include federal, state, local agencies, regional commissions, and academic institutions that are responsible for monitoring or managing natural resources and dealing with environment issues (table 1). The District is committed to establishing and maintaining effective working relationships with our customers and partners by providing timely and responsive results to their hydrologic and earth science issues.

For several decades, the District has provided basic water information such as stream flow, ground water levels, and water quality to many partners and customers. During the past ten years the District has worked to be the leading source of hydrologic and earth science research and information through the implementation of programs such as NAWQA, Chesapeake Bay Critical Ecosystem study, and studies at various military bases. More recently the District has increased its emphasis on interdisciplinary studies by working with EPA and other agencies on regional assessments of multistate areas and stream restoration research.

During the next five years, we hope to continue building a program-development culture that focuses on identifying current and emerging issues that will lead to new program opportunities, partnerships, and meet the needs of our customers. For example, we expect to interact and develop joint projects with public health agencies or agencies that deal with public health issues dealing with water. We also expect to be collaborating more with scientists in other USGS disciplines on a number of interdisciplinary projects

and programs, as well as with scientists in the National Research Program in the Water Discipline.

Federal	Regional/Interstate	State	County and Municipal	Academic
U.S. Environmental Protection Agency	Susquehanna River Basin Commission	MD-DNR: Maryland Geological Survey	Baltimore City Dept of Public Works	University of MD, Baltimore County
Army Corps of Engineers	Interstate Commission of the Potomac River Basin	MD-DNR: Resource Assessment Service	Baltimore County, MD	<i>Johns Hopkins Applied Physics Laboratory</i>
U.S. Army	Upper Potomac River Commission	MD-DNR: Chesapeake and Coastal Watershed Service	Prince George's County, MD	NSF Long-Term Ecological Research Program (Baltimore Urban Ecosystem Study)
U.S. Air Force	Delaware River Basin Commission	MD Dept of Environment	Harford County, MD	<i>Maryland Water Resources Research Center</i>
U.S. Navy	Washington Suburban Sanitation Commission	Maryland State Highway Administration	Anne Arundel County, MD	<i>University of Delaware</i>
National Park Service	Washington Metro Area Transit Authority	Delaware Geological Survey	Montgomery County, MD	
U.S. Forest Service-USDA	Metropolitan Washington Council of Governments	Delaware Dept of Natural Resources and Environmental Control	DC Dept of Public Works	
National Aeronautics and Space Administration	Canaan Valley Institute	Delaware Dept of Transportation	DC Dept of Consumer and Regulatory Affairs	
<i>National Institute of Health</i>	Mid-Atlantic Federal Partners for the Environment	<i>Delaware Center for Inland Bays</i>	D.C. Department of Health	
U.S. Fish and Wildlife Service	<i>Maryland Water Monitoring Council</i>	<i>Maryland Water Monitoring Council</i>	<i>Maryland Water Monitoring Council</i>	<i>Maryland Water Monitoring Council</i>
Natural Resource Conservation Service-USDA				
<i>Mapping Partnership Office (USGS)</i>				

Table 1. Agencies and organizations that are involved in or provide funding for cooperative programs with MD-DE-DC District. Agencies and organizations that do not provide funding are in italics.

Cooperators and Partners with the MD-DE-DC District

The scientific program of the MD-DE-DC District includes both data collection projects and investigative projects. Funding for these projects (fig. 3) is either allocated by Congress directly to USGS, or is obtained through projects partially or fully funded by

other Federal agencies or State and local agencies. The total funding level of the District has grown over the last several years rising from \$6.9 million in fiscal year 1998, to the current projected \$10.6 million in fiscal 2003 (fig. 4). While some of the increase was from growth in our USGS federal program and growth in programs with State and local cooperators, most of the increase was from increases in our programs with other Federal agencies.

The remainder of this document will present a more detailed topical description of our program and the way the District has organized its program development efforts. The document also includes a description of the topical areas that we see as most promising and appropriate for future work as well as discussion of the ways in which we coordinate our interactions with other external agencies and other scientists and program managers within USGS.

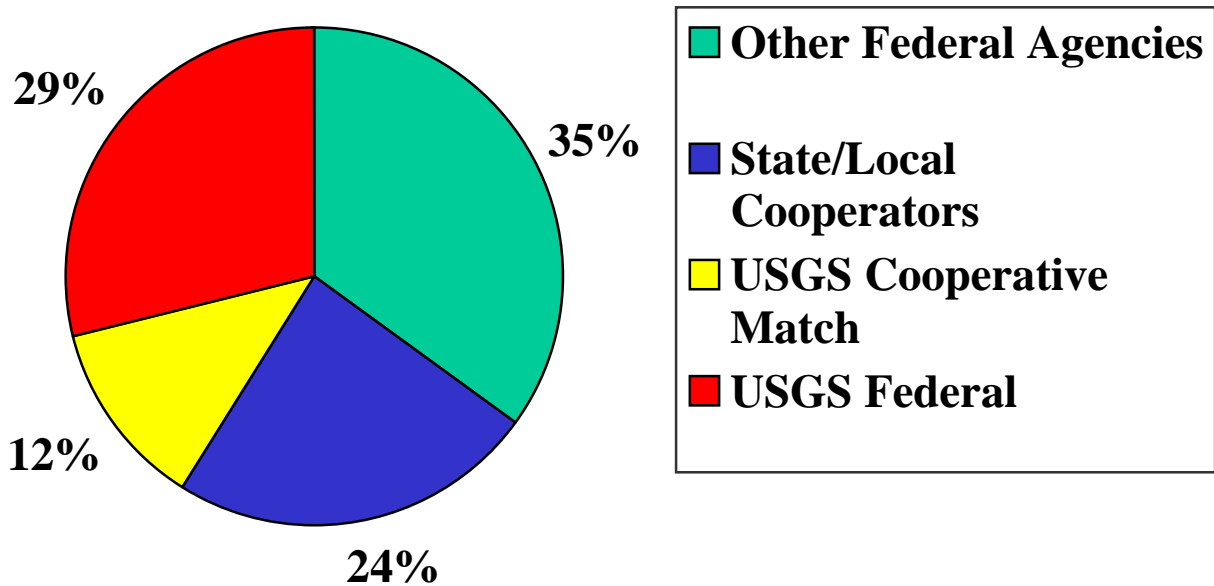


Figure 3. Funding sources for MD-DE-DC District, fiscal year 2003.

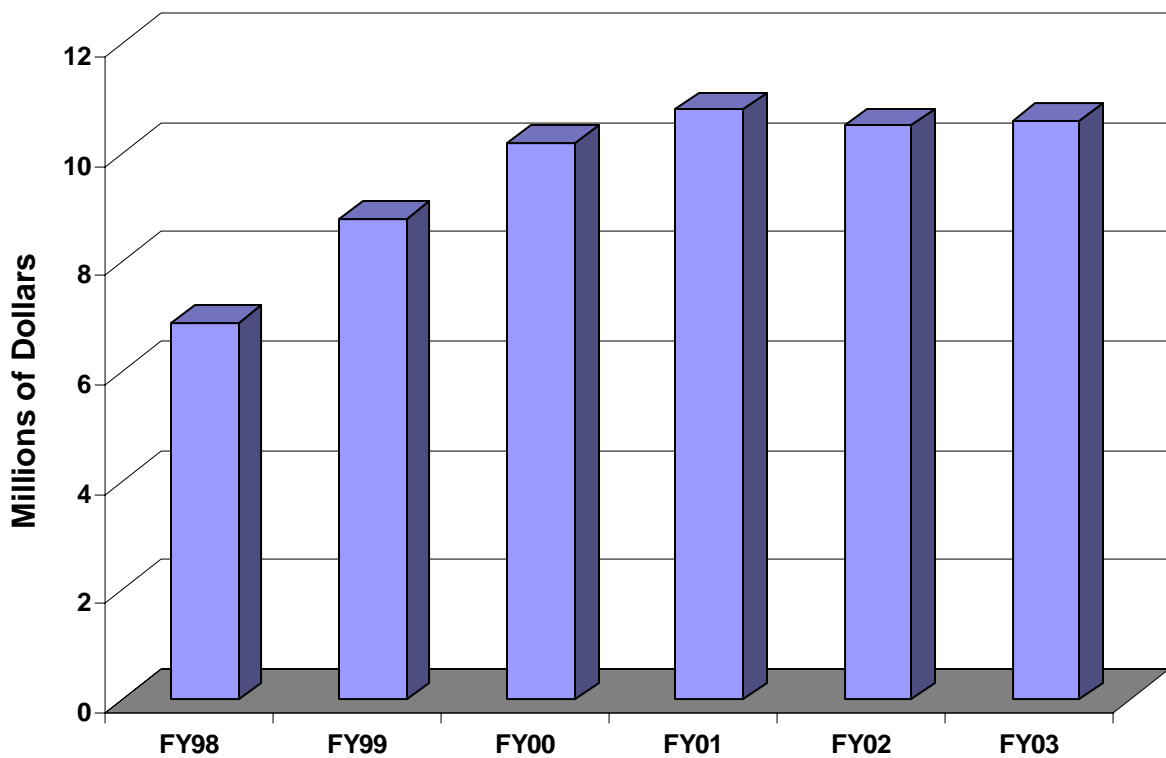


Figure 4. District funding, fiscal years 1998 through 2003.

Partnerships Activities with Other Organizations and USGS Disciplines

Almost any perusal of annual company reports or organizational strategy documents will show how important partnerships and strategic alliances have become in the last ten to twenty years. This is essentially true in government as well as in business as most modern organizations now address multi-dimensional problems that require multidisciplinary approaches. The District now devotes considerable time and energy to partnership activities, but this wasn't always the case. In the 1980's the District developed some of its program by writing proposals that were presented and marketed to a number of our traditional cooperators. Often these proposals were based mostly on our impressions of the information needs of our cooperators. In the mid-1990's, we gradually changed our strategy to a partnership approach.

The main idea of the strategy is to interact with our cooperators on a more regular basis by participating in various committees and councils with them. This has allowed us to get a more informed understanding of the information needs of the environmental community in the District. It has also lead to opportunities for discussion of the kinds of work that needed to be done to address a particular issue and what sort of role the USGS could play in providing relevant information. In essence, the partnership approach has given us opportunities to "come to the table" in a variety of interagency forums to address environmental issues. This has lead to the development of projects and programs

that are jointly conceived and designed by USGS scientists and scientists or resource managers from other agencies.

Our program grew significantly in the mid-1990's and we believe that our partnering activities and increased level of interaction with our cooperators were the main reasons for this growth. This partnering approach has allowed us to participate in the planning and development of several large multi-disciplinary studies, particularly with EPA. Our partnering activities have allowed us to be in contact with our cooperators at key times in the development stages of their activities. We have been able to emphasize the importance of understanding not only the hydrology and water quality, but also the earth-science framework for their particular programs.

Partnering has also promoted an increase in the transfer of our technical information. In recent years we have been very active on organizing committees for workshops and other technical meetings conducted in our District and in the Mid-Atlantic. In the last year we have hosted interagency workshops on such diverse subjects as watershed modeling, ground-water monitoring network design, stream restoration research, hydrogeology of the Atlantic Coastal margin, and bioremediation of contaminants in ground water. We also sponsor a technical seminar series that is broadly advertised to the environmental community. We normally have eight to ten seminars each year that draw scientists and environmental professionals from other agencies and universities.

These technical forums, particularly the ones we have hosted in our office, have created a lot of good will in the environmental community and have exposed the people from other organizations to our literature, our staff, and our capabilities. They have also given us a more visible role in the natural science community of the District.

Internal Partnerships and Collaboration

Much of the internal collaboration between District staff and other USGS scientists involves working with the National Research Program (NRP) or with the Biological Resources, National Mapping, and Geologic Divisions. Some of our work, however, involves collaboration with personnel from other WRD Districts. For example, some of the program themes we developed several years ago were conceived in meetings involving senior staff from the Pennsylvania and Virginia Districts.

The District also is active in the Department of Defense Environmental Conservation (DODEC) program. The chief of our Contaminant Hydrology Studies Section is involved in setting up the annual DODEC conference, and District staff members have occasionally been partially funded by the national DODEC program. Additionally, District personnel have attended or given presentations at the DODEC conference each year since its inception.

Working with the National Research Program

The District has a long history of collaborating with researchers from the Water Discipline's National Research Program (NRP). The USGS National Center in Reston,

VA, is the site of one of three centers for the NRP. Because we are only 70 miles from Reston, it is easier for our staff to interact with the research staff there than for most Districts. However, over the last several years, we have also had collaborations with researchers in the Denver and Menlo Park research centers. These collaborations have been on a number of topics such as trace element chemistry, natural attenuation of contaminants, nitrogen transport in ground water and streams, and radionuclides in ground water.

Our interactions with NRP have been strong for several reasons. First, the District always seems to have two or more RGE grade scientists. These individuals naturally interact with other researchers. In addition, our technical specialists and section chiefs have nurtured relationships with NRP staff over the years. In addition, a few of our staff have actually worked in the Reston NRP center and know the researchers and their capabilities quite well. Our staff also makes presentations at USGS technical meetings that are attended by researchers and some of our collaborations with NRP have been initiated at such meetings.

Our current work with includes the following NRP researchers and topics:

--Mary Voytek and Elizabeth Jones on bioremediation of organic contaminants.

--Allen Shapiro on fractured rock hydrology.

--Briant Kimball and Rob Runkel on the use of stream tracers to study hyporheic zone processes.

--Owen Bricker and Cliff Hupp on sediment transport processes.

Interdivisional Collaboration

We continue to have an active relationship with all other program divisions through the Chesapeake Bay Ecosystem Project. However, we have also been developing collaborative projects and project activities in other areas.

For the last several years, we have been working with staff from the Geologic Division's Marine and Coastal Geology Program on the hydrogeologic framework of the Atlantic Coastal margin and ground-water discharge of nutrients into the Atlantic coastal bays of the Delmarva Peninsula. Since 1999 we have collaborated with scientists from GD's Eastern Regional Mapping team to develop a maps of the geology and hydrogeology of surficial sediments in the Atlantic Coastal Plain from New Jersey to North Carolina. More recently, we have acquired an RGE scientist who is working on geochemical methods of sediment source tracking with Geologic Division scientists in the Chesapeake Bay Ecosystem Project. The list below is a summary of our most recent collaborations.

- Involvement with all disciplines in the USGS Chesapeake Bay Science Program
- Workshops with GD and BRD scientists on coastal and wetland issues
- Work with BRD scientists on water-quality and fish pathology

- Collaboration on Atlantic Coastal Plain maps with Geologic Division
- Innovative drilling techniques with Geologic Division using the Hoverprobe
- Workshops and interagency workgroups involving individuals from all USGS divisions on urban dynamics and urban sprawl

External Partnerships and Collaboration

The District partners and collaborates with external agencies at the Federal, State, and Local levels of government. Most of the activities with external agencies involve some sort of project work, but some activities are done to maintain a presence within the environmental community in the District area. We maintain our presence through outreach efforts and press releases (some of which are done jointly with other agencies). As mentioned, we also hold seminars in which we invite cooperators that might have an interest, and topical sponsor or co-sponsor workshops that address issues of interest to many environmental organizations.

One of the visible external collaborations that the District is involved in is the Maryland Water Monitoring Council, or MWMC. The Council is an organization created in 1995 to foster cooperation among groups involved in all types of water monitoring activities, including physical, chemical, and biological monitoring. The council also is interested in the evaluation of land use factors that affect changes in aquatic habitat quality and quantity. MWMC includes representatives from federal, state, and county agencies as well as river basin commissions, private consulting firms, and non-government organizations including volunteer monitoring groups.

The District involvement in MWMC has increased our visibility among agencies that are or should be interested in the kind of work that we do best. In addition, it allows us to see the types of activities that are being done by other agencies involved in water monitoring, as well as their needs and desires for data collection and analysis. The increased communication between District personnel and personnel from other agencies has increased awareness and facilitated collaboration between our District and other agencies active in Maryland.

While there is no equivalent organization in Delaware, our subdistrict office makes a strong effort to communicate with other agencies in Delaware. In the last year, our office held a technical workshop with the state agencies to brief them on the scope and findings of our recent studies and data collection programs. In addition, we normally have our major cooperators present at our semi-annual project reviews in the Delaware subdistrict.

Our coordination with the District of Columbia has mostly been through the Anacostia Watershed Toxics Alliance (AWATA). This organization is an interagency group that meets quarterly to discuss contamination issues and remediation programs in the Anacostia watershed, which includes a good part of the southern and eastern parts of the District of Columbia. Our participation on this group has led to a closer working relationship with the DC Department of Health and has resulted in funded studies in the Lower Anacostia River Basin and a likely new study of ground water in the Rock Creek Basin.

Other Collaborative Activities

The District is also involved in a number of important collaborative activities with others agencies as enumerated in the bulleted list below.

Federal Agencies

- Chesapeake Bay Program—significant interaction with other Federal agencies; in addition the USGS now has three individuals who serve in liaison positions, staff positions in the Bay Program that are funded by EPA
- NAWQA Liaison Committees—interactions have resulted in many spin-off projects
- Mid-Atlantic Federal Partners for the Environment (MAFPE) Smart Growth Workgroup—collaboration with EPA, NPS, Forest Service, FWS, NOAA, USDA, HUD, FEMA, and Federal Highway Administration.
- Collaboration with EPA’s Office of Research and Development on Ground-Water Vulnerability Assessments Methods, Landscape Ecology, Wetlands, and Stream Restoration Research
- EPA Mid-Atlantic Integrated Assessment (MAIA)—several District senior staff members have served as members on the interagency MAIA team

State and Local Governments

- Close working relationship with Maryland Geological Survey and other Maryland Department of Natural Resources divisions
- Active involvement with other Maryland and Delaware agencies such as Maryland Department of the Environment, Delaware Department of Natural Resources and Environmental Control, Delaware Geological Survey, Maryland State Highway Administration, and Delaware Department of Transportation
- Maryland Water Monitoring Council—One senior manager is serves as vice chair of the Council’s Board and several District scientists are members of subcommittees
- NAWQA Liaison Committees—State and local groups also are involved
- Partnering with District of Columbia agencies such as the Department of Health, Department of Public Works, the Washington Metropolitan Area Transit Authority, and the Department of Consumer & Regulatory Affairs
- Interstate agencies such as the Interstate Commission for the Potomac River Basin and the Metropolitan Washington Council of Governments—USGS can cross political boundaries, allowing collaboration with interstate agencies
- Baltimore Urban LTER enables collaboration with the City of Baltimore and other local jurisdictions
- Anacostia Watershed Toxics Alliance (see discussion above)

International Liaisons

Ingrid Verstraeten, the Chief of our Contaminant Hydrology Section is working with Dr Thomas Heberer of Germany on the remediation of trace organics in drinking water by bank filtration.

Gary Fisher, our surface-water specialist, is a co-investigator on the NSF-funded Long-Term Ecological Research Study in Baltimore. The research team for this study is working with a group of French scientists who are performing a similar study in France.

District Core Competencies

The District’s science program is diverse and its technical staff represents a broad array of natural science disciplines and technical areas. Most of our scientists are classified as hydrologists or supervisory hydrologists. The staff also has several geographers and one biologist. Two of our senior hydrologists are Research Grade (RGE) employees. We also have over twenty hydrologic technicians distributed over 4 office locations. These individuals have somewhat different types of on-the-job experience and training. The table below is description of our current expertise in different areas of hydrology and environmental science.

Current Competencies

Surface Water	Ground Water Hydrogeology	Water Quality	Biology/Ecology	Geographic and Spatial Analysis	Other
Flow gaging	Water Level Networks	Regional Assessment	Aquatic Invertebrate Surveys	Vulnerability Assessment	<i>Wetland Hydrology</i>
Channel morphology	Flow System Analysis	Natural Attenuation	Fish Community Surveys	Spatial Statistical Analysis	
HSPF modeling	Flow Modeling	Loads Estimates	Habitat Assessment	Geographic Data-Base Management and Quality Assurance	
Flood Measurements	Flow in fractured rock	Geochemistry	Community Metabolism		
Sediment Dynamics	GW/SW Interactions	<i>SPARROW Modeling</i>	Aquatic Food Web Dynamics		
Tide gages	Well Hydraulics		Bioaccumulation of toxics		
Real-time networks	<i>Transport modeling</i>				
Tracer Studies	Coastal hydrogeology				
Time of Travel					

The senior managers of district would also like to strengthen and increase our core competencies to meet the demands of the types of projects we are being asked to perform by some of traditional as well as new cooperators. For example, we anticipate needing more people capable of doing spatial statistics. We would also like to have scientists that can work with public health professionals. We also need to bolster some our traditional

core competencies such as ground-water modeling, because our main expertise in this area resides in a few individuals who may not be on the staff several years from now.

Additional or New Core Competencies

In order to maintain a versatile and flexible workforce capable of meeting the needs of our customers and partners, the District must develop additional core competencies. These new core competencies will support and enhance the District's current scientific and technical programs. Potential new competencies are provided in the bulleted list below.

- Human Health and Emerging Contaminants
- Quality and Ecology of Streams
- Hydrologic Activities in the Vadose Zone
- Sediment Transport Studies
- Ground water flow and contamination

Training, recruitment, and enhancement of core competencies

The development of these new core competencies requires an investment in time, skill, and resources and is one of the District's strategic goals. Achieving excellence in these new areas is one of the District's priorities. Potential new competencies that may be strengthened or developed by training, recruitment, or enhancement of an existing program are provided in the bulleted list below.

- Integration of GIS/Internet/Publications processes
- Improved Statistical Analysis Capabilities
- Hydrologic Activities in the Vadose Zone
- Data Integration Issues/Data Mining
- Remote Sensing/Spatial Data Interpretation

Partnership Needs

The District will continue to partner with the many environmental organizations with which we have current interactions. Some of the new program opportunities that we have will require us to establish new relationships with the public health community and with agencies and groups involved in protection of natural resources for homeland security.

Program Development in MD-DE-DC District

As shown above, much of the funding of a USGS District office comes from reimbursable or fixed-cost projects that are paid for in whole or in part by an external cooperator. For this reason, a District needs to foster a culture of program development among its scientists, managers, and support staff. The MD-DE-DC District devotes

considerable time and resources to program development. These efforts can be divided into two main categories, 1) internal communication and coordination, and 2) external participation in committees, workgroups, and councils.

The District has found reasonable success in securing new projects by working as partners with a variety of environmental science and regulatory agencies at all levels of government. In most cases, the agencies ask us to write proposals for new studies and data collection programs through our participation on external groups through interactions that display our science capabilities and competencies. We prefer this sort of passive program development approach because it puts us in the role of a partner rather than the role of a contractor

Scientists are encouraged to build and maintain program that takes advantage of their skills and interests within the overall strategic needs of the District and USGS. Under the leadership of the Associate District Chief, District personnel participate in program development by attending meetings, participating in work groups, making presentations to existing or potential cooperators, and writing proposals.

The culture of program development enables the District to stay relevant to the needs of the agencies that have a stake in the products and services we provide. It enables the employees to be aware of the strategic goals of USGS and the District, and provides them with mechanisms for enhancing their skills to maintain their own usefulness within the organization. It enables management staff to maintain an awareness of the types of work being done within the District, and the ways in which the skills and interests of their employees can best be utilized. In addition, it enables nearly all employees to have some choice in their own career development.

There are several key steps in the District's approach to program development. These steps are outlined below.

- *Identification and understanding of important local water issues in the District*—Scientists and managers participate in this step through discussions with cooperators, attendance at scientific meetings, and other professional development activities that keep them current with the issues.
- *Selection and prioritization of local issues based on USGS mission and initiatives*—This activity is coordinated by the District Chief and Associate District Chief with help from the discipline specialists, management staff, and scientists. Project ideas and other initiatives are screened to ensure that they are compatible with the goals of the District and USGS.
- *Development of partnerships with agencies who are responsible for addressing priority issues*—Partners and potential cooperators are identified, and relationships with them are cultivated at the appropriate level (in USGS and the partnering agency). Formal or informal meetings and presentations frequently are a part of this activity.
- *Preparation of project proposals and funding agreements where appropriate and necessary*—This step requires coordination among scientists (potential project chiefs or project staff), managers (coordination of personnel, assistance with proposals and budgets), discipline specialists (technical advice and/or proposal

review), support staff (budgeting and other administrative tasks), and the District Chief and Associate (final approving authority).

Internal Coordination of Program Development

Internal coordination of program development is the responsibility of the Associate District Chief (ADC); in fact, program development is one of the primary duties of the ADC position. Some funds from District overhead have been set aside for program development as part of the District Strategic Plan. These overhead funds are used at the discretion of the Associate District Chief for salary and other expenses associated with program development activities.

One such program development activity is the District's internal web page for program development. This web page includes several resources that are useful to District employees working on developing new projects, including reference material for calculating budgets, guidance on avoiding competition with the private sector, and information on strategic directions for District program.

In addition, the District often convenes Program Action Teams consisting of scientists, managers, and discipline specialists to try to set the stage for program growth to address key environmental issues. In the past we have created teams for urban hydrology, emerging contaminants, drinking water, coastal zone hydrology, and climate change. These teams meet periodically to define problems within these key areas, determine potential cooperators and partners, and provide potential strategies for approaching cooperators and partners with project ideas or with concepts that might lead to future program.

External Program Development Activities

District personnel engage in many external activities that can be included under the umbrella of program development. Most District scientists and managers maintain a network of contact people in other government agencies or in universities. Such personal contacts can be extremely useful in program development situations, because a level of professional respect and trust is established prior to the actual project discussions. This minimizes the difficult and often unproductive practice of "cold calling" potential cooperators. It essentially allows District staff to develop program by building professional relationships with their contacts from other agencies.

Other external District activities that aid in program development include

- Outreach activities (monthly and episodic press releases, media events and interviews, several participants in the Ask-A-Geologist program, office open houses)
- Scientific meetings and workshops, District seminar series
- Participation on standing and ad hoc workgroups and committees for other agencies or interagency organizations
- Topical meetings with cooperators or potential cooperators

Technology and Infrastructure Needs

- Improved Laboratory Facilities
- Special Needs Field Vehicles – Emerging contaminants/biological sampling
- Computing needs for remote sensing activities
- Data Integration Issues/Data Mining in surface/ground water sections
 - Wireless communication needs
 - Additional realtime ground-water wells
 - Other ??
- Realtime water-quality sensors

Concluding Remarks

The District considers this plan to be a flexible document. Our program consists of many activities with other agencies with a variety of evolving issues and concerns. Even our own USGS priorities change from year to year, so we have to periodically reassess the issues that we will choose to pursue. We feel that we can be successful at making appropriate changes in program directions if we are actively involved in the water resources and environmental communities in our area. We also will continue to interact with scientists and program managers from other USGS offices so that we can bring the appeal and strength of multidisciplinary scientific capabilities to discussions with potential cooperators and partners. We also will strive to educate our District staff in the details of this plan so that they can be better representatives of the USGS to our customers.

APPENDIX Program Themes from FY 1999-2002

Program Themes

Almost all of the projects and data-collection activities in the District fall into one or more of the following program themes. The program theme concept was developed as a framework for describing and summarizing our technical program and to provide guidelines for program development in areas that are important to the overall District strategic plan. Seven major program themes (fig. 6) were initially developed (hydrologic network analysis; ground-water flow system analysis; regional hydrologic analysis; drinking water; water quality and geomorphology of streams; hazardous waste, toxics, and emerging contaminants; and hydrology of wetlands and coastal areas). In FY 2000, an eighth theme (urban hydrology) was added as a result of new program opportunities and regional priorities of USGS and other Federal agencies.

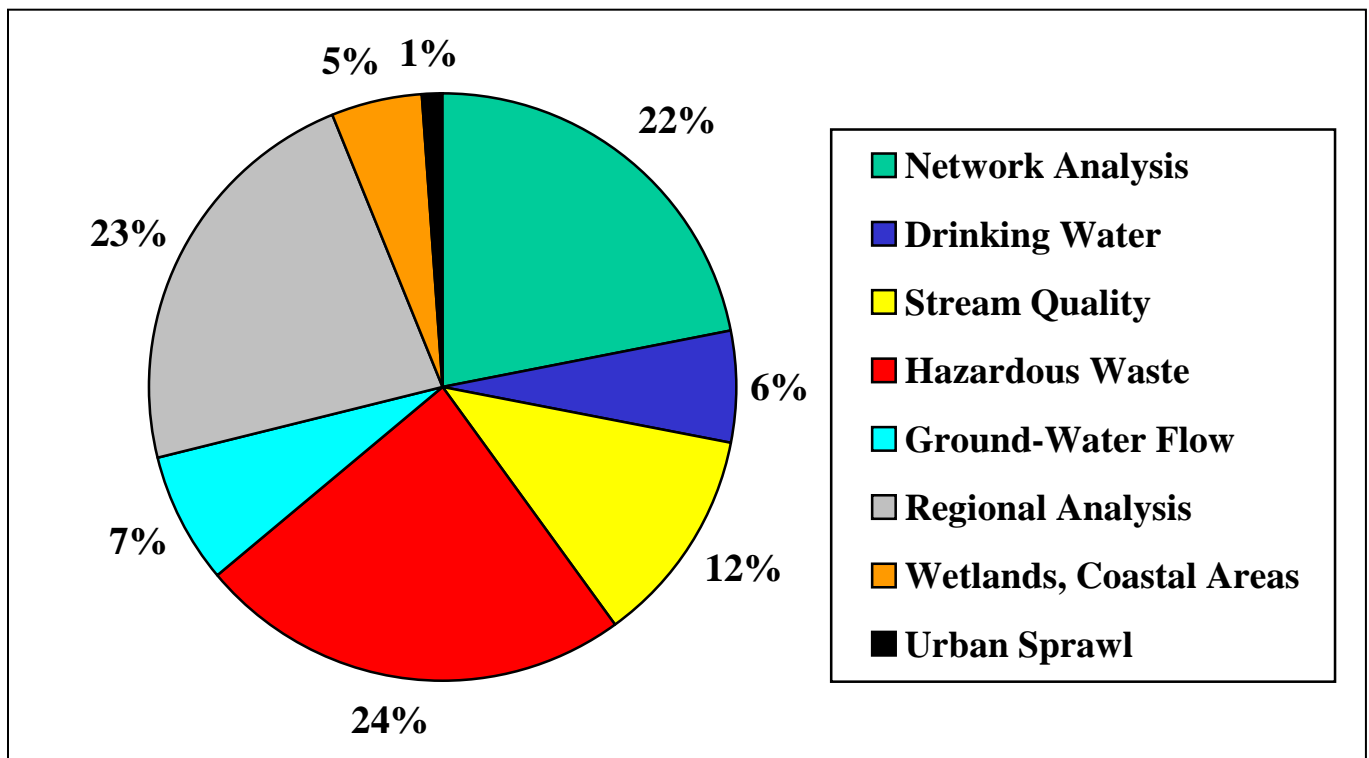


Figure 6. Amount of work in each program theme, based on level of projected funding in fiscal year 2001.

1) **Hydrologic Network Analysis**—The District has traditionally had strong programs in the monitoring of stream flow and ground-water levels. We expect to continue to have strong networks in each of these resource areas. Over the last several years, we completed evaluations of the stream gage networks in both Maryland and Delaware and participated in a multi-agency workgroup to analyze the stream gage network in Maryland and solicit support amongst agencies that use the information. This group surveyed users of the stream flow data and developed a strategy to solicit more support for the network. We are also working on a concept of hydrologic system monitoring, in which a network of sites with water-table monitoring wells near stream gages and rain gages. We hope to set up such sites in each of the major physiographic regions in the District to develop long-term records on the relations among different components of the hydrologic cycle in different hydrologic settings.

In the summer of 1998, we began discussions with the Maryland Geological Survey to start building a small watersheds research program. A major part of this program would be the establishment of a number of watersheds in which long-term monitoring of both stream flow and water-table fluctuations would be an essential part of the research. Both ground-water and surface-water quality would be studied at many of these sites and ideally, each site would have a precipitation gage. Our long-term goal is to establish such “whole hydrologic system” monitoring sites in all the major hydrologic settings in the District.

Program activities in fiscal year 2000 include:

- *Expansion of stream gage network*
- *Evaluation of ground water level network*
- *Expansion of real-time data capabilities*
- *Drought index analysis*
- *Water-use data applications*
- *Small watershed monitoring*

Activities in FY 2001 and 2002 will include:

- Further expansion of stream gage network
- Continued evaluation of ground-water network
- Increase number of real-time stream gage sites
- Increase number of real-time observation wells
- Application of hydroacoustic techniques to selected stream gages

2) **Ground-Water Flow System Analysis**—Many of our cooperators need good information on the ground-water flow systems in their areas of jurisdiction. Nearly all of our military base customers have needed such investigations in the past and continue to need this information. We also have new cooperators that need to understand contributions of ground-water to nutrient loads in streams and estuaries. All of these customers need good ground-water simulation models to better understand the flow systems in their areas of concern and discharge rates of ground water to surface water. These customers also have been asking us to do optimization modeling and to display ground-water simulations with visualization techniques.

Our expertise and variety of ground water flow system studies increased throughout FY 1998. Late in FY 1998, we developed a new optimization project with Aberdeen Proving Grounds. We also finished a flow net analysis of ground-water discharge to the Atlantic Coastal Bays. In FY 1999, we continued the optimization work and picked up new work collaborating with Geologic Division to understand hydrostratigraphic controls on ground-water discharge to the Atlantic Coastal Zone. We are continuing to pursue this collaboration with Geologic Division.

Program activities for ground-water flow system analysis during fiscal year 2000 include:

- *Regional flow model of Dover Air Force Base*
- *Site-specific flow models at Aberdeen Proving Ground*
- *Optimization of ground-water withdrawals at Aberdeen Proving Ground and Patuxent Naval Air Station*
- *Exploration of deep aquifers in southern Maryland*
- *Flow properties in the Chester River Basin*
- *Ground-water and surface-water interactions in Pocomoke River Basin*
- *Fracture flow near the Washington Metro system*
- *Ground-water flow in urban areas*

Activities in FY 2001 and 2002 include:

- Continuation of investigation of hydrogeologic framework in fractured Piedmont rock aquifer system near the Washington Metro Subway in Bethesda, MD.
- Development of optimization models for southern Maryland Coastal Plain aquifer system
- Base flow analyses and hydrograph separation studies in Baltimore metropolitan area to investigate ground-water discharge to streams in urban and suburban areas
- Simulation of ground-water discharge into coastal bays and coastal ocean along Atlantic Coast in Delaware and Maryland

3) **Regional Hydrologic Analysis**—Several major regional projects are in progress within the District. These regional projects have given the District considerable visibility among other federal agencies and regional consortiums of agencies such as the Chesapeake Bay Program. These groups are turning to the USGS to provide information on a number of regional environmental issues. The largest of these projects in scope is the Chesapeake Bay Ecosystem project, which covers the entire drainage area of the Bay.

The others include the restart of the Delmarva NAWQA project, the NAWQA Coastal Plain Regional Synthesis Project (covering parts of Delaware, Maryland, New Jersey, North Carolina, and Virginia), the NAWQA-EMAP joint assessment, and the low-intensity phase of the Potomac River Basin NAWQA project. These studies are all multidisciplinary water-quality assessments covering several states. EPA has continued to request that we write proposals for more regional assessment work, particularly for ground-water quality assessments. The District is working with Headquarters staff and scientists from other divisions and agencies to develop approaches for these studies, including appropriate uses of modeling methodologies such as the SPARROW surface water model.

Our collaboration with EPA in their Mid-Atlantic Integrated Assessment Program (MAIA) has led to many discussions about how to conduct regional environmental assessments. Our EPA colleagues in Annapolis, MD have many connections to other EPA offices and one these connections produced the development of a large multi-state study to assess the distribution of pesticides and nutrients in streams and ground water in different landscape conditions. This project, referred to below as “Relationships between landscapes and water quality in the Mid-Atlantic Coastal Plain,” is being done in collaboration with research scientists from EPA’s Landscape Ecology Branch. The ultimate goal of this study is to develop landscape indicators for pesticide levels in streams.

Regional hydrologic analyses for fiscal year 2000 include the following:

- *Potomac and Delmarva NAWQA study units*
- *Coastal Plain NAWQA synthesis*
- *Chesapeake Bay and national SPARROW modeling*
- *Relationships between landscapes and water-quality in the Mid-Atlantic Coastal Plain*
- *USGS/EPA joint assessment*
- *Regional ground-water vulnerability analysis in Mid-Atlantic region*

Activities planned for FY 2001 and 2002 include:

- Start of Potomac-Delmarva Study Unit
- Continuation of Chesapeake Bay Ecosystem Study
- Completion of Landscapes and Water-Quality study in Mid-Atlantic Coastal Plain and start of similar work in the Piedmont
- Completion of Delmarva 1997 Study Unit activities
- Hydrogeologic characterization of Mid-Atlantic Region for EPA MAIA and ReVA programs
- Work with Geologic Division to update geologic maps of Atlantic Coastal Plain

4) **Drinking Water**—With the exception of southern Maryland and the Delmarva Peninsula, most of the urban/residential areas in the District are supplied by water from reservoirs or large rivers. Smaller towns and rural residential areas rely heavily on ground water. Compliance with the Safe Drinking Water Act (SDWA) holds promise for future cooperative work. We expect to participate in studies involving the delineation of source water protection areas as specified in the SDWA and identification of potential

contaminants in these areas. We have just completed an assessment of the loss of reservoir capacity due to sedimentation in the reservoirs serving the Baltimore area. We have been cooperating with Maryland Geological Survey and the Maryland Department of Environment on levels of carcinogenic compounds in ground water in Anne Arundel County. During this study, we found many exceedances of the MCL for radium in wells in the northern third of the county. This study is being expanded to several other counties in the Coastal Plain. We also hope to develop studies of the occurrence and distribution of organic compounds that are precursors for disinfection byproducts.

We have had success in working with the Maryland Department of the Environment (MDE) to develop a series of studies aimed at meeting their needs in the area of source water protection. We have finished a study of pathogens in ground water in the Atlantic Coastal Plain Province and we started a similar study in the Piedmont in FY 2000. Potential future studies include a study of source water protection for ground water in karst regions of Maryland and a study on the impacts of land use on drinking water quality for major surface water supplies. We are also preparing proposals to study the geochemical factors that influence the distribution of radium in coastal plain aquifers.

Fiscal year 2000 program activities involving drinking water include:

- *Reservoir sedimentation analysis*
- *Radium in shallow ground water*
- *Viruses in shallow ground water*
- *Southern Maryland ground-water supply*
- *Pesticides in selected national reservoirs*
- *Potomac River supply and demand analysis*

Fiscal Year 2001 and 2002 activities include:

- Completion of reports on viruses in water-supply wells in Coastal Plain and Piedmont aquifer systems in Maryland
- Completion of report on drinking water quality of Coastal Plain aquifers in Delaware
- Collaboration with Maryland Geological Survey on resampling of domestic wells in Baltimore county
- Collaboration with Maryland Geological Survey on exploration of drinking water supplies in deep Coastal Plain aquifers in Southern Maryland

5) Water Quality and Geomorphology of Streams—Several aspects of stream hydrology are important concerns for the water resources and environmental communities in the District. The quality of stream water and its potential for delivering pollutant and nutrient loads to reservoirs and the major Bays and tidal rivers are major issues in the District. In addition, the effects of contaminants on stream ecosystems is of great interest at present, owing largely to the fish kills in the Lower Eastern Shore streams reportedly caused by *Pfiesteria*. Concern over endocrine disruption in stream and wetland ecosystems is also a great concern.

Several state and local agencies are attempting to restore impacted stream reaches to "natural" or minimally impacted conditions. These agencies need basic hydrologic and

geomorphic information on the extent to which restoration is possible and what measures will have the desired effects. County environmental agencies and citizen groups in the greater Baltimore-Washington area are particularly interested in this topic. In some areas, pumpage of ground water may reduce stream flow by amounts that could affect the stream ecosystems.

Impacts of human development on stream flow, water quality, and ground-water recharge-discharge relationships are of concern to municipal, county, and state agencies. Resource managers and planners are also in need of information on the role of hydrologic conditions in the maintenance or restoration of stream and wetland ecosystems in urban areas.

In fact, the Baltimore area has been chosen as one of two locations for establishment of urban Long-Term Ecological Research Sites (LTER). These sites are funded by NSF grants and are designed to bring environmental researchers from a variety of disciplines together to study ecosystem functions and dynamics in an area over a long period of time. Our role initially has been to establish and run a stream flow monitoring network in the program. We are currently working with the academic researchers in the study team to develop a more interpretive role for us as the monitoring proceeds. The principal investigators for the Baltimore LTER are hoping that the USGS can assist them in studying interactions between ground water and surface water in urban areas with a lot of public works infrastructure.

Another urban monitoring project we have started is a water quality assessment of Rock Creek Park in Washington, D.C. This project is being funded by the NAWQA funds set aside to investigate water quality conditions in and around national parks.

We are also currently developing new work with EPA's National Risk Management Research Lab to investigate the discharge of nutrients from ground water to small streams in the Atlantic Coastal Plain. This work includes activities that will hopefully contribute to understanding the geochemical and hydrochemical framework of areas in which denitrification is occurring.

A third new element of this program theme is the progress in our cooperative project with MD-DNR called the "Maryland Non-Point Source Project. We have gradually been moving the focus of this study from the Patuxent River Basin to a system of rotational studies of water quality in basins throughout the state. In the last two years, we have established moveable water quality stations on two streams of the Eastern Shore, the Nanticoke and the Nassawango. The plan is to collect several years of data at each station and then move the monitoring equipment to a new site, probably in another physiographic setting. Over time, we hope to collect such data from each of the major hydrologic settings in the state.

Program activities for fiscal year 2000 include:

- *River inputs to Chesapeake Bay*
- *Nonpoint sources in Maryland streams*
- *Pocomoke River quality*

- *Streamflow for total maximum daily load (TMDL) calculations*
- *Rock Creek water quality and ecology*
- *Baltimore ecosystem study (LTER)*
- *Stream hydraulics for restoration*

Activities in FY 2001 and 2002 include:

- Continuation of studies of nutrient and sediment loadings to Chesapeake Bay from tributary streams
- Implementation of a new study design for state-wide project on nonpoint sources of nutrients to streams in Maryland
- Completion of water-quality study of Rock Creek National Park
- Continue large water-quality monitoring project for development of TMDL's in Potomac River Basin
- Write proposal for a project to construct and calibrate an HSPF model for the Potomac River Basin
- Continue work with FWS on channel characteristics of streams in Maryland
- Start HSPF modeling study of Atlantic Coastal Bays Drainage area of Delaware

6) Hazardous Waste, Toxics, and Emerging Contaminants—While the District contains many small CERCLA and RCRA sites and has been involved in a few site evaluations, most of these are overseen by State regulatory agencies and EPA. However, the migration of toxics in ground water and eventually to surface water from disposal of hazardous material at military bases is a great concern in the District because of the proximity of most of these bases to fragile ecosystems. Most are within the drainage area of Chesapeake Bay. The District has major programs with two military bases and has minor programs with two others. Two of these studies deal with natural attenuation of contaminants in the ground-water system or in wetland discharge areas.

Over the last several years, we have been conducting studies of the role of wetland and other organic sediments in the natural attenuation of chlorinated solvents in ground water. Until this year, all of this work has been at Aberdeen Proving Grounds, northeast of Baltimore. However, DOD is very interested in the transfer value of our findings and in FY 1999, we started a project to examine these processes at a number of other military bases in an attempt to assess if these natural attenuation processes will occur at sites other than Aberdeen.

We are also starting several new efforts dealing with contaminants on the Eastern Shore. One is a small effort to verify concentrations of trace metals and pesticides in parts of the Pocomoke Basin. Another is to develop a study to investigate the occurrence and distribution of arsenic, mainly in streams and stream sediments. Arsenic is in an additive to chicken feed and it is estimated that each chicken excretes 150 milligrams of arsenic in its lifetime. The fate and transport of this arsenic flux is a question of great concern.

Another new area of participation in this program theme is a collaboration we have agreed to with EPA to provide water samples for a study of antibiotics released into the environment from Confined Animal Feeding Operations. We will be sampling many

stream sites on the Eastern Shore over the next two fiscal years and we will provide a number of samples to an interagency team (led by EPA) to study migration of antibiotic residues offsite of feedlot and poultry houses. This team will also study the development of resistant bacteria along the antibiotic residue migration paths.

Program activities for fiscal year 2000 include:

- *Occurrence and transport of contaminants at Aberdeen Proving Ground and Dover Air Force Base*
- *Natural attenuation at APG and DAFB*
- *Organics and metals in the Pocomoke River*
- *Metals in the South River*
- *Antibiotics on the Delmarva Peninsula*

Activities in FY 2001 and 2002 include:

- Continuation of contaminant transport studies at military sites, Aberdeen Proving Grounds in Maryland and Dover Air Force Base in Delaware.
- Continuation of studies on military bases of natural attenuation of contaminants in ground water discharging to wetlands
- Ground-water/surface water relationships in the fractured rock hydrogeologic setting of Fort Detrick in west-central Maryland
- Negotiations for work on ground-water contamination at Fort Meade, Maryland
- Start of new studies with EPA on pharmaceuticals in ground water and surface water
- Negotiation of bacterial-source tracking studies on beaches in Baltimore County
- Redox studies at Norman, Oklahoma landfill using microelectrode techniques
- Development of genetic techniques for assessing biodegradation potential of VOC's in wetlands (proposal to USGS Toxics Program)
- Comparison of natural attenuation potential of natural and constructed wetlands at Aberdeen Proving Grounds

7) Hydrology of Wetlands and Coastal Areas—Most areas of the District contain riparian wetlands in stream valleys. While some special wetland areas are found in the central and western parts of the District, most of the wetland areas in the District are distributed throughout the Coastal Plain. This province contains a vast "network" of wetlands ranging from large tidal marshes along the major Bays to isolated wetlands in topographic depressions in small watersheds. Preservation and protection of the hydrologic and water quality functions of these wetlands is a major concern to other federal, state, and local agencies. The hydrology of coastal areas, especially the potential for nutrient discharge to estuaries from both streams and ground water, is becoming an issue for the Atlantic Coastal Bays as well as Chesapeake Bay. EPA, NPS, and state agencies are turning to the District to develop projects to investigate the inputs of nutrients from streams and ground water into the Coastal Bays. The District is currently performing one such study funded by the Maryland National Estuary Program and has written two other proposals for such work, one in collaboration with Geologic Division.

As mentioned above, we continue to work with Geologic Division to develop a joint earth-science based approach to studying ground-water discharge of nutrients into the

Atlantic Coastal Bays. We are also coordinating these efforts with the Office of Ground Water through Paul Barlow of the Ground Water Resources Program.

Although we are not close to developing any new studies together, we are meeting two to three times a year with staff from BRD's Patuxent Wildlife Research Center to look for opportunities to develop and work on joint studies in wetlands and coastal zones. If USGS national funds ever become available, we are optimistic that these liaisons will help us to develop integrative studies with our BRD colleagues.

Program activities for fiscal year 2000 include:

- *Hydrology of constructed wetlands*
- *Ground-water inputs to coastal bays*
- *Ground-water nutrient inflow at Assateague Island National Seashore*
- *Saltwater intrusion at Ocean City*
- *Brackish-water intrusion at Patuxent Naval Air Station and Indian Head Naval Surface Warfare Center*

Activities in FY 2001 and 2002 include:

- Continuation of monitoring of water levels at constructed and natural wetlands in southern Delaware
- Completion of water-quality studies of ground water and streams in Coastal Bays Drainage area near Assateague Island National Seashore
- Start of Office of GW study of ground-water discharge to coastal bays and coastal ocean along Atlantic Ocean in Maryland and Delaware (in collaboration with Geologic Division and University of Delaware)
- Publication of journal article on variable-density simulations of fresh/saline water relationships along the barrier islands and Atlantic Coastal bays of Maryland

8) Urban Hydrology—The Baltimore-Washington metropolitan area has been subjected to large population pressures in the recent past. This large population growth with the associated migration of people from city centers to suburban and rural-residential areas has attracted the attention of EPA, the Governor of Maryland, and the Chesapeake Bay Program. Increases in residential and commercial development and the attendant increases in impervious surface area can stress the environment in many different ways. The MD-DE-DE District and USGS in general have organizational strengths that can be used in collaborative efforts to study the environmental stresses associated with population pressures.

The District maintains long-term data bases on stream flow and water quality throughout the Maryland-Delaware-D.C. area, and has the expertise to design and implement new data collection networks as they are needed. Partnerships with other agencies and within USGS can maximize the strengths of each organizational unit in addressing the complex issues associated with urban sprawl. Collaborations and partnerships that have been developed between USGS and other agencies through programs such as the Chesapeake Bay Program, NAWQA Liaison committees, the Maryland Water Monitoring Council, and various EPA projects can be used to help build program in the area of urban sprawl.

In addition, the District has provided staff support for the urban sprawl subcommittee and urban sprawl science workgroup of the Mid-Atlantic Federal Partners for the Environment (MAFPE), a consortium of Federal agencies that meet to mutually support the Clean Water Action Plan (CWAP). The MAFPE agencies have targeted urban sprawl as their highest priority issue.

Activities in FY 2001 and 2002:

- Continued operation of stream gage network for Baltimore Urban LTER study (BES)
- Synoptic studies of water quality in streams in the BES study area
- Development of methods to study ground water in urban areas
- Development of riparian zone research studies with EPA in Baltimore County, Maryland

Emerging Issues and New Program Areas

If the District is to maintain a stable program size, new program has to be developed as old projects reduce in scope or are completed (fig. 7). Part of our culture of program development is to anticipate the need for new program, and to plan for it. Because it takes time to cultivate relationships with new cooperators and to develop the skills needed for new scientific directions within the District, we have taken the initiative in the past year to focus our program development efforts in a strategic fashion.

In summer 1999, a workshop was held to come up with areas in which to focus our program development activities in the near term (one or two fiscal years). Nearly half of the District participated in the meeting, and it was decided that the focus would be on the following topics—Urban sprawl, emerging contaminants, drinking water, climate change, and coastal zones.

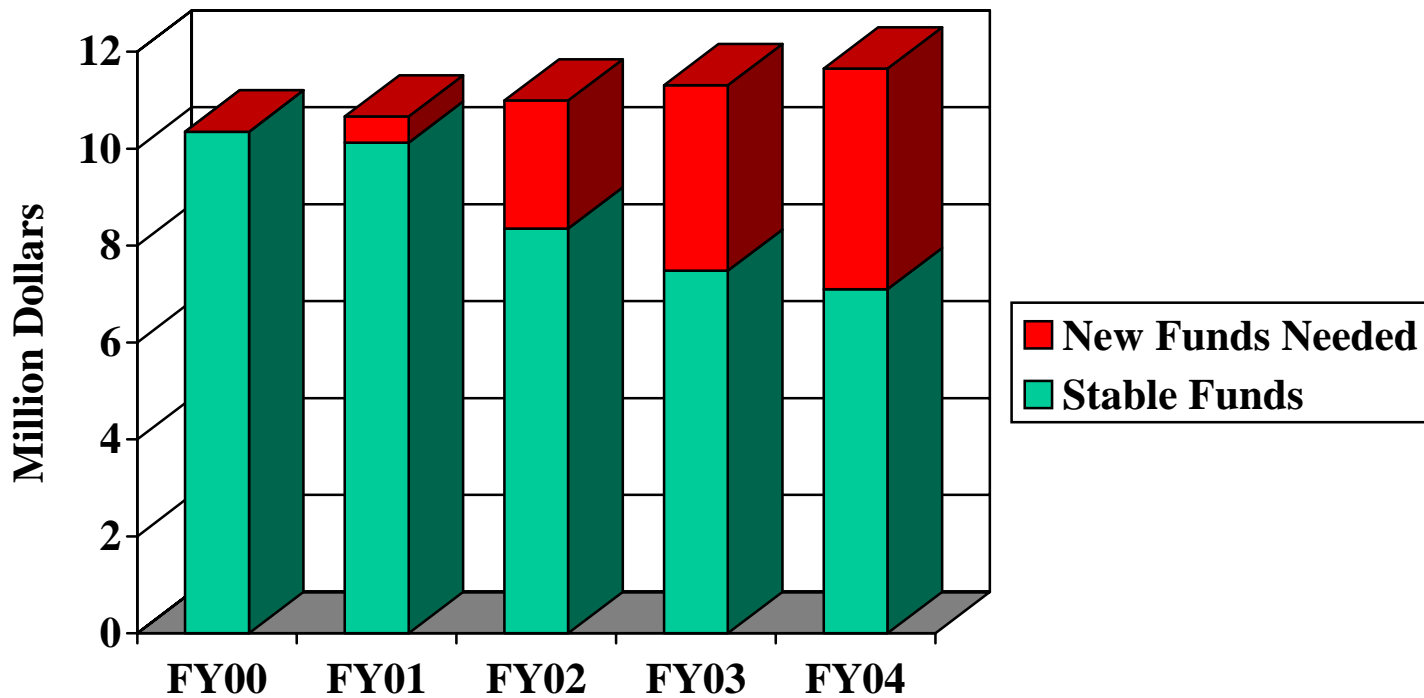


Figure 7. Funding projections for the MD-DE-DC District, fiscal years 2000 through 2004.

A program action team, consisting of District scientists, managers, and/or discipline specialists, was assigned to each of the topics. The goals of the program action teams were to:

1. Identify the appropriate cooperators and partners for their respective topic.
2. Do some research to understand the issues and the people and organizations affected by the impact.
3. Identify ways that we should interact with the cooperators and partners.
4. Write a plan that outlines a logical progression of projects with respect to cooperator interest and likelihood of funding.
5. Write proposals for these projects.
6. Archive all documents in the assigned electronic files.

Some details about each of the topics are provided in the following sections.

Urban Sprawl

Urban sprawl is an issue that affects many areas of the environment. Population growth and the outward migration of people away from city centers like Baltimore and Washington have caused the issue to be an important one within the District. Urban sprawl changes many aspects of the environment, including stream baseflow, sediment runoff, flood frequencies and peaks, nutrient yields, biological diversity, and ground-water recharge.

District program growth in urban sprawl is logical for several reasons. As mentioned before, the District is centered within the Mid-Atlantic urban growth corridor. The topic is already a thrust area for EPA and with the state of Maryland (through the governor's Smart Growth initiative). Urban sprawl issues are important to the Chesapeake Bay program and to local government agencies, some of which we have program with. Finally, the District has involvement with urban issues through the Long Term Ecological Research (LTER) program.

Emerging Contaminants

Emerging contaminants include such chemicals as pharmaceuticals, certain metals and pesticides, endocrine disruptors, disinfection by-products (drinking water), de-icing compounds (at airports), biotoxins, radionuclides, carcinogens, and MTBE. Emerging contaminants tend to represent "new" problems in that they can be hard to detect or to analyze for, they may have been an unrecognized problem in the past, or they may have only been introduced into the environment within the past few years.

Potential project areas include:

- Confined animal feeding operations (CAFO's). On the Delmarva Peninsula, manure from chicken farms can contain feed amendments such as antibiotics and growth and sex hormones, which then can impact water quality.
- Disinfection by-products in drinking water. This could be a problem for the Baltimore City municipal water supply because of the open-air impoundments that store the water after it has been chlorinated. Interest in disinfection by-products might be higher now than in the past because of recent amendments to the Safe Drinking Water Act.
- MTBE (methyl tert butyl ether). MTBE is a gasoline additive designed to improve automobile emissions. It is much more soluble in water than other gasoline components, and it is becoming a serious ground-water issue. Its use is mandated at certain times of the year in Maryland and Delaware to improve air quality in the region. There currently is a lot of interest in MTBE due to recent television programs on the subject.

Drinking Water

Drinking-water issues tend to relate either to the quantity or to the quality of the water supply. The recent drought brought many of the quantity issues into the forefront, and provided opportunities for contacts between USGS and the public through media events, press releases, and interviews. The drought also highlighted one of the best reasons for USGS involvement in water-supply issues—water problems do not always stop at jurisdictional boundaries. State agencies that manage drinking water programs and issue permits for drinking water supplies are required by EPA to conduct assessments of source water areas to determine adequate protection strategies for the source water. These agencies will have a need for source water assessments over the next several years so we believe that this type of work and related studies should be a priority in our program.

Current program development efforts include:

- Viruses in drinking water (with MDE)
- Drinking water supply at Patuxent Naval Air Station—Can enough water be obtained from the aquifers without saltwater intrusion and without adversely affecting offsite water supplies?
- Disinfection by-products in the Baltimore municipal water supply (overlaps with Emerging Contaminants issue)

Climate Change

Climate change is an issue that might affect the environment of the Mid-Atlantic area in many different ways over the long term. If sea level rises significantly, there will be many direct and indirect changes in the coastal and estuarine landscapes. There also may be changes in weather and precipitation patterns. The uncertainty over the potential effects and the long-term nature of the potential problems make this issue scientifically interesting but difficult for cooperators to support, especially in light of many other important environmental issues.

Current program development efforts are centered on a project to develop a drought index for the areas covered by the District. The drought and hurricane that affected the region in 1999 are seen as ways of sparking interest in the topic, as are other climate-related events such as *El Nino* and *La Nina*. Otherwise, the program development efforts at this time consist of developing some resources that could be used to pursue new projects on the topic of climate change if a potential cooperator shows interest.

Coastal Zones

The District is bounded on the east by the coastlines of the Atlantic Ocean and Delaware Bay. These coastal zones, along with the Chesapeake Bay coastlines are important aesthetic, economic, and recreational resources to Maryland and Delaware. Coastal zones are dynamic areas under completely natural conditions and changes can be accelerated by human development along the coasts. Protection of the physical and ecological resources of coastal areas is important to existing and potential cooperators in Maryland and Delaware. Current program and program development in coastal zones is centered on the following issues:

- Streamflow and nutrient loads to Atlantic Coastal Bays
- Ground-water inputs to the Atlantic Coastal Bays
- Ground-water nutrient inflow at Assateague Island National Seashore
- Saltwater intrusion at Ocean City, MD
- Brackish-water intrusion at Patuxent Naval Air Station and Indian Head Naval Surface Warfare Center (overlaps with Drinking Water issue)

Over the last 18 months, we have also been participating in a variety of workshops with scientists from other USGS divisions and resource managers from coastal parks in the National Park Service. These workshops have been forums for discussing the earth science and ecological information needed for protection of coastal parks and coastal zones, in general. We will continue to participate in these types of meetings as a means of developing the professional liaisons needed to respond to a coastal initiative that we hope will develop over the next several years.

