



BUDGET The United States Department of the Interior **JUSTIFICATIONS**

and Performance Information
Fiscal Year 2006

U.S. GEOLOGICAL SURVEY

NOTICE: These budget justifications are prepared for the Interior and Related Agencies Appropriations Subcommittees. Approval for release of the justifications prior to their printing in the public record of the Subcommittee hearings may be obtained through the Office of Budget of the Department of the Interior.



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**U.S. GEOLOGICAL SURVEY
FY 2006 BUDGET JUSTIFICATION**

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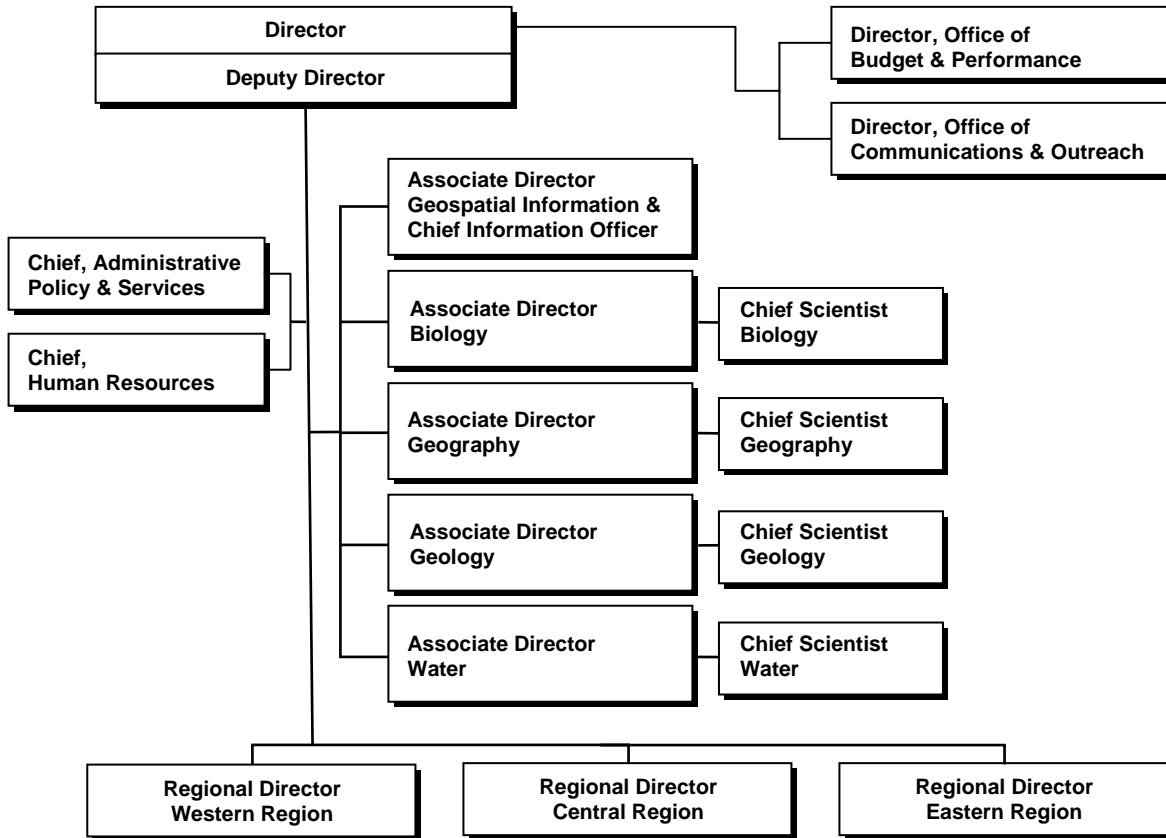
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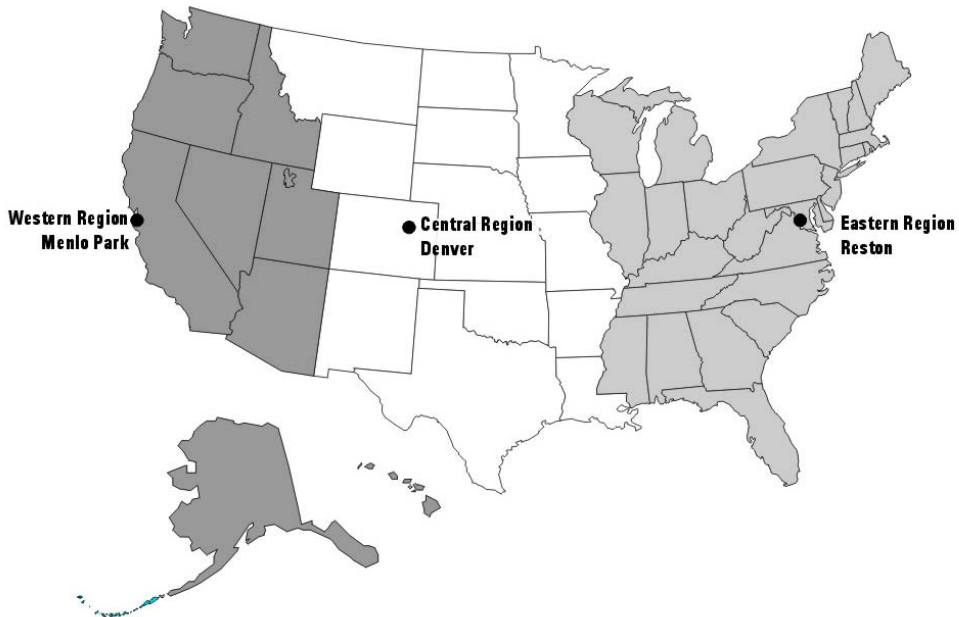
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U.S. Geological Survey



USGS Regional Structure



General Statement

Introduction

Since March 3, 1879, the U.S. Geological Survey (USGS) has provided the people and communities of the United States with the science information they need to make important individual and public decisions and to safeguard society.

The USGS is the Earth and natural science research bureau for the Department of the Interior and the only integrated natural resources research bureau in the Federal Government. USGS research and data products support the Department's resource and land management needs, and also provide the water, biological, energy, and mineral resources information needed by other Federal, State, Tribal, and local government agencies to guide planning, management, and regulatory programs. Emergency response organizations, natural resource managers, land use planners, and other customers use this information to protect lives and property and to make informed decisions through the application of science. Natural resource and environmental managers apply USGS science research in answering public health questions and in promoting public prosperity for the future well being of our country.

The USGS conducts research, monitoring, and assessments to contribute to understanding the natural world—America's lands, water, and biological resources. The USGS provides reliable, impartial information to the citizens of this country and to the global community in the form of maps, data, and reports containing analyses and interpretations of water, energy, mineral, and biological resources; land surfaces; marine environments; geologic structures; natural hazards; and dynamic processes of the Earth. USGS data and information are used daily by managers, planners, and citizens to understand, respond to, and plan for changes in the environment. For example, the USGS is:

- Developing a real-time earthquake monitoring capability to provide information needed to save lives and to reduce the economic costs of natural disasters,
- Assessing erosion, wetland loss, and environmental changes to the Nation's coasts and bays, such as the Chesapeake Bay, Puget Sound, and the Great Lakes, to assist in evaluation, protection, and restoration efforts,
- Analyzing the geologic setting and genesis of the Nation's mineral resources in a global context, to ensure a sustainable supply of minerals for the Nation's future,
- Conducting research on the fundamental processes that lead to accumulation of energy resources (oil, natural gas, coal, and others such as geothermal) and the environmental and human health impacts of energy usage, to inform decisions by land and resource managers and policymakers,
- Managing a nationwide streamgaging program that provides vital information on flow in the Nation's rivers that is used for flood forecasting, resource management, and environmental protection,
- Synthesizing existing and new information about birds, mammals, fishes, plants, and other species to inform decisionmakers about the health of the Nation's biological resources,

General Statement

- Analyzing population growth, urban spread, and other land use changes; relating these to other natural-science trends; and displaying the results in narrative maps and other products;
- Working with State and Federal agencies to assess existing and potential environmental impacts, such as nutrient loading and release of pharmaceuticals/antibiotics from intensive animal feeding operations, and developing state-of-the-art technology needed to identify sources of contaminants;
- Working with the Centers for Disease Control and Prevention (CDC), the U.S. Department of Agriculture (USDA), State public health departments, and natural resource agencies to track the West Nile virus, and setting up a surveillance network across the country; and
- Serving as a repository for remotely sensed data and global land surface information.

Revolutionary technological advances, demographic growth, competing demands for resources, and increased awareness of the interconnectedness and global scale of many natural science issues are shaping science needs. Managers, planners, and citizens are demanding more and better scientific information, delivered more rapidly, that will help them make decisions about the world around them. To meet the critical science needs of the 21st Century, the USGS is building on its traditional core strengths, as well as developing new capabilities that will allow more flexibility and responsiveness in meeting new challenges.

The more than 9,000 scientists, technicians, and support staff of the USGS are located in nearly 400 offices in every State and in several foreign countries. The USGS leverages its resources and expertise in partnership with more than 2,000 agencies of Federal, State, local, and Tribal governments; the academic community; non-governmental organizations; and the private sector. Field investigations, direct observations of Earth processes, and monitoring and data collection at the local scale are the scientific hallmarks of the USGS. When siting new facilities, the USGS endeavors to co-locate with potential collaborators or customers to maximize opportunities for joint scientific ventures, share expertise, and ensure that products are relevant and focused.

Budget Request by DOI Mission Component (dollars in thousands)			
	2005 Estimate	2006 Request	Change From 2005
Resource Protection	147,700	148,776	1,076
Resource Use	77,014	48,699	-28,315
Recreation	0	0	0
Serving Communities	710,750	736,040	25,290
Total	935,464	933,515	-1,949

Overview of the 2006 Budget Request

Overview of the 2006 Budget Request (dollars in thousands)					
Budget Authority	2004 Actual	2005 Estimate	2006 Request	2006 Request Change from 2005	
				Amount	Percent
Current	937,985	935,464	933,515	-1,949	-0.21%
Permanent	1,695	805	801	-4	-0.50%
Total	939,680	936,269	934,316	-1,953	-0.21%
<i>FTEs</i>	6,349	6,214	6,003	-211	-3.40%

The USGS budget request for FY 2006 addresses the outcomes of the Department's Strategic Plan and ensures the implementation of the President's Management Agenda, as adapted by the Secretary of the Interior in her vision for Citizen-Centered Governance and organized around achieving conservation through consultation, cooperation, and communication.

Major areas of emphasis for USGS science in FY 2006 include science for Interior land and resource management bureaus, expanded studies of water availability in areas where concerns about water supply are growing, adaptive management research and long-term resource monitoring in the Grand Canyon, deepwater fisheries research in the Great Lakes, research on invasive plants, the Landsat Data Continuity Mission, a permanent solution for the Landsat revenue shortfall, enhancements to the Advanced National Seismic System to help reduce the physical losses and economic impacts of earthquakes and tsunamis, and a new Science Impact initiative to improve and expand the use of USGS science information to support decisionmaking by the Department, by other Federal, State, and local government organizations, and by the public. In the area of information technology, the budget includes additional resources for Disaster.gov and other E-Gov initiatives, as well as for certification and accreditation of information systems and support for the Interior Enterprise Information Network.

Resource Protection — USGS biological studies assist in maintaining healthy ecosystems and natural resources so that these habitats can continue to provide food, energy, medicine, transportation, and recreation. The USGS will continue to serve the biological research needs of Interior bureaus and others by providing scientific information through research, inventory, and monitoring investigations. Information generated by the Biological Research program contributes to achieving the Department's goals for improved management of the Nation's land and water resources and improved decisionmaking regarding land and resources use.

Resource Use — The USGS is a primary Federal source of objective resource assessments and unbiased research on mineral, oil, gas, and alternative energy potential, production, consumption, and environmental effects. The USGS will continue to conduct national and global energy resource assessments of oil, natural gas, coalbed natural gas, gas hydrates, and coal resources, as well as evaluate the risks of environmental and ecological degradation associated with the production and use of energy resources. These investigations enable the Nation to make sound decisions regarding domestic energy production with an understanding of potential impacts on the environment.

Serving Communities — The USGS places a special emphasis on providing science to the land and resource management bureaus of the Department of the Interior. USGS hazards programs produce information and understanding that reduce the impact of natural hazards and disasters on human life and the economy. USGS analyses of availability and quality of water resources help to develop, regulate, and monitor management practices to ensure the continued availability of water resources for human consumption, agriculture, business, recreation, and environmental stability. The USGS mapping program is expanding its partnerships with Federal agencies and State and local governments to develop and promote the use of geographic data and mapping products that are essential for economic and community development, land and natural resource management, and health and safety services. The FY 2006 budget request continues science programs that generate relevant, objective information for land managers and for communities throughout the Nation.

This budget request preserves the ability of the USGS to support specific, well-established customer bases and constituencies across the Nation, in addition to the Department's land and

General Statement

resource management bureaus. The USGS will continue to support the Earth and natural science needs of Federal, State, Tribal, and local government agencies; industry groups; agricultural interests; academia; non-profit organizations; and the general American public.

The FY 2006 budget includes a number of new program directions and opportunities. Most prominent among these is a request for \$6.0 million to address the Landsat Program revenue shortfall resulting from a May 2003 failure of the scan line corrector. The budget also includes a one-time request of an additional \$6.0 million to address the program activities that had to be deferred to provide resources to address the Landsat shortfall during FY 2005. In addition to addressing the funding issues with Landsat 7, the budget also requests \$7.45 million to initiate development of the ground processing system to receive, process, and archive data that will be delivered from the Landsat Data Continuity Mission. This follow-on mission to Landsat 7 is a collaborative effort between the USGS, the National Aeronautics and Space Administration, and the National Oceanic and Atmospheric Administration (NOAA) to place a Landsat-like sensor onto the first of NOAA's National Polar Orbiting Environmental Satellite System (NPOESS) missions, scheduled to launch in December 2009. The LDCM mission will ensure the continuation of consistently calibrated, repetitive acquisition of observations over the Earth's land mass, coastal boundaries, and coral reefs; and will ensure the data acquired are of maximum use in supporting the scientific objectives of monitoring changes in the Earth's land surface and associated environment.

The budget request provides opportunities to address several critical program needs related to monitoring natural hazards and mitigating their impacts. Most significantly, the Administration requests \$5.4 million for the USGS to install and maintain additional seismic monitoring stations to serve the dual purposes of supporting development of a global tsunami warning system and enhancing earthquake monitoring and warnings. The USGS and NOAA are collaborating on the development of the global tsunami warning system, with the USGS contributing additional and more real-time earthquake monitoring and NOAA expanding its network of sea-level monitoring buoys. The Administration plans to request \$8.1 million in the 2005 emergency supplemental funding request for tsunami assistance for the USGS to begin procuring and installing additional seismic monitoring stations and to enhance the existing seismic monitoring network. Greatly increased volcanic unrest in several U.S. volcanoes has prompted the Administration to request additional funding to expand monitoring at the volcanoes most threatening to American lives and property.

In support of the natural resources monitoring and assessment mission, the USGS is requesting \$912,000 to expand interdisciplinary studies needed for habitat restoration in the Puget Sound nearshore ecosystem; \$500,000 to begin a 3-year investigation of the nature and extent of geothermal systems in the western United States capable of generating electricity; \$400,000 to begin a broad, multi-State assessment of ground-water depletion; \$250,000 for ecological systems mapping; \$252,000 for the Great Lakes Deepwater Fisheries Program; \$750,000 to support improved decisionmaking in the Glen Canyon Dam Adaptive Management Program; \$750,000 for the Science on the DOI Landscape Program; \$300,000 for the development of innovative control methodologies for invasive plants; \$1.5 million to ensure certification and accreditation of information system security; \$1.235 million in support of the Departmentwide implementation of the Enterprise Services Network; \$680,000 for a Disaster.gov project; and \$371,000 for other E-Gov initiatives.

To provide the resources for these initiatives, as well as other Department of the Interior priorities, the USGS budget request includes decreases of \$28.5 million in the Mineral Resources Program; \$500,000 to reduce USGS research on carbon sequestration; \$227,000 for

a lower priority project that addresses petroleum-related contamination; \$6.4 million to eliminate Federal support for the 54 Water Resources Research Institutes that have been generally successful in generating non-Federal sources of funding; \$2.0 million for reduced travel and transportation; \$1.5 million to reduce expenditures for facilities commensurate with FTE reductions anticipated as a result of the Mineral Resources reduction listed above; and nearly \$13.0 million in unrequested earmarks from the FY 2005 appropriation.

More specific information regarding some of the more significant increases and decreases in the FY 2006 budget are provided in the following sections.

Crosscutting Activities — This budget submission reflects the USGS's commitment to Department priorities and crosscutting activities. Science support for strategic crosscutting activities is preserved and enhanced within funding levels in this budget submission. Additional efforts will be provided through the Department's Invasive Species Crosscut initiative, Science on the DOI Landscape, the Glen Canyon Dam Adaptive Management Plan, and the Great Lakes Deepwater Fisheries Program. Within its base, the USGS will continue support for the Everglades restoration, the National Invasive Species Management Plan, Geospatial One-Stop and other electronic government initiatives, and the Klamath River Basin Federal Working Group, to name but a few. Resources to execute some of these efforts will be provided by reducing minerals information efforts and minerals assessments.

Landsat Data Continuity Mission — The Land Remote Sensing Policy Act of 1992, P.L. 102-555, directs Landsat Program Management to develop a successor system to Landsat 7. On August 13, 2004, the Office of Science and Technology Policy issued a memorandum on "Landsat Data Continuity Strategy." In it, the Administration mapped out a long-term plan that calls for integrating a "Landsat imager" (currently known as the Operational Land Imager or, OLI) onto the first of NOAA's National Polar Orbiting Environmental Satellite System missions. This mission is scheduled to be launched in December 2009 and will fulfill the data continuity requirements of P.L. 102-555. (<http://ldcm.usgs.gov>). In preparation for the NPOESS launch and the receipt of data from the OLI, the ground data processing systems currently used for both Landsat 5 and Landsat 7 will undergo major upgrades. A \$7.5 million increase requested in the President's budget will enable the USGS to begin the ground processing system upgrades during FY 2006, in time for the 2009 launch.

Landsat 7 — Beginning in FY 2006, the USGS expects to cover all of the Landsat 7 operation and data collection and distribution costs through data sales and additional appropriations. The budget request includes \$6 million to cover the portion of the program's functions formerly funded through data sales. The USGS continues to monitor sales for Landsat products. Based on historical sales data, the program would have expected to sell 14,000 Landsat scenes on average annually. The demand for land-image data from Landsat 7 has fallen by approximately 30 percent (10,000 scenes sold annually) since the component failure on board Landsat 7 in May 2003. The USGS expects data sales to stabilize at about \$3.3 million per year. Income from international cooperator fees has also declined. However, the USGS expects an estimated annual income of \$1.5 million from international cooperator fees. The USGS will request to reprogram up to \$6 million during FY 2005 to cover the FY 2005 revenue shortfall through redirection of proposed working capital fund contributions. The reprogrammed funds are to be reimbursed during FY 2006 through a one-time appropriation of \$6 million.

Volcano Monitoring — The Volcano Hazards Program addresses the Department's Serving Communities strategic goal of protecting lives, resources, and property by making information available to communities to use in developing volcano hazard mitigation, preparedness, and

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avoidance plans. The FY 2006 budget includes an increase of \$864,000 for volcano monitoring at the highest priority volcano sites such as Mount St. Helens, the Cascades, and the Commonwealth of the Northern Mariana Islands.

Minerals — To refocus USGS science on the highest priority needs of land and water managers, the budget proposes a funding level of \$25.0 million for the Mineral Resources program that will keep the core Mineral Resources Program in place, focusing on those needs that are inherently Federal.

Tsunami — The coastal communities of the United States, its island territories, and many other countries are vulnerable to damaging tsunamis generated by large earthquakes, submarine landslides, volcanic slope failures and severe tropical storms. Within the United States, key populated areas at risk include the entire West Coast, southern Alaska coast, territories in the Pacific and Caribbean, and the Eastern Seaboard. Increasing the safety of coastal communities requires a broad program of monitoring, warning system development and public education, accompanied by research into earthquake and tsunami sources and processes. The Indian Ocean tsunami starkly illustrates the potential dangers of earthquake-generated tsunamis, and highlights opportunities for increasing the United States ability to: (1) rapidly determine the location, size and depth of large earthquakes, (2) discriminate those likely to have caused a tsunami, and (3) work with Federal, local and foreign partners to ensure timely warnings can be issued. The President's budget includes an increase request of \$5.4 million to enhance the capabilities of the Advanced National Seismic System and the National Earthquake Information Center within the United States, to expand the Global Seismographic Network worldwide, and to increase coastal studies around the United States that will provide improved regional assessments of tsunami hazard potential.

Geographic Research / Geospatial Information Transfer — A new direction proposed for FY 2006 is the significant programmatic transition in the area of geographic research and geospatial information. In a strategic move to strengthen geographic research and to consolidate management of several existing geospatial programs, the USGS has focused geographic research programs and created a National Geospatial Programs Office. The decision to reorganize is in direct response to discussions with constituent groups about how best to meet their geospatial data needs and recommendations from a report by the National Research Council of the National Academies. In FY 2005 and FY 2006, the USGS will work with Congress to make commensurate budget structure adjustments to align funding with program management. Specifically, most of the Cooperative Topographic Mapping Subactivity funding will be moved from the Mapping, Remote Sensing, and Geographic Investigations Activity to the Enterprise Information Activity. The transition is described in detail in section E, "Geographic Research / Geospatial Info Transition."

Program/Project Support of Bureau, Department, and Governmentwide Costs

External Administrative Costs

The Department's Working Capital Fund was established pursuant to 43 U.S.C. 1467, to provide common administrative and support services efficiently and economically at cost. The Fund is a revolving fund, whereby capital is expended to provide services for customers who pay for the services. Customers consist of the Department's bureaus and offices, as well as other Federal agencies. Through the use of centrally provided services, the Department standardized key administrative areas, such as commonly used administrative systems, support

services for those located in and around the Main and South Interior building complex, and centrally managed departmental operations that are beneficial to the bureaus and offices.

Centralized billing is used whenever the product or service being provided is not severable or it is inefficient to bill for the exact amount of product or service being procured. Customers are billed each year using a pre-established basis that is adjusted annually to reflect change over time. The following table provides the actual centralized billing to the USGS for FY 2004 and estimates for FY 2005 and 2006. The change between 2005 and 2006 is fully funded through a mixture of uncontrollable and program changes.

General Statement

**FY 2006 WORKING CAPITAL FUND
CENTRALIZED BILLING
U.S. GEOLOGICAL SURVEY**

(dollars in thousands)

Activity/Office	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate
Other OS Activities			
Invasive Species Program	161.4	183.4	196.9
Invasive Species DOI Coordinator	27.1	30.2	32.2
Secretary's Immediate Office	188.4	213.6	229.1
Alaska Field Office	9.8	10.3	10.9
Secretary's Immediate Office	9.8	10.3	10.9
Alaska Resources Library and Information Services	128.7	156.8	167.2
Secretary's Immediate Office	128.7	156.8	167.2
Lewis and Clark Bicentennial		29.1	30.6
Secretary's Immediate Office		29.1	30.6
Secretary's Immediate Office			
Document Management Unit	5.6	5.6	5.7
Office of the Executive Secretariat	5.6	5.6	5.7
Departmental News and Information	10.0	20.5	21.9
Departmental Newsletter	67.8	71.4	68.9
Hispanic Media Outreach	12.2	20.3	23.0
Office of Communications	90.0	112.1	113.8
California Desert Managers Group Coordinator		37.1	41.4
Fish, Wildlife, and Parks		37.1	41.4
Financial Management Training	19.8	26.9	27.5
Activity Based Costing/Management		141.1	142.3
Travel Management Center		70.5	71.4
Office of Financial Management	19.8	238.5	241.2
Quarters Program	2.0	2.1	0.6
Office of Acquisition and Property Management	2.0	2.1	0.6
SBA Certifications		1.5	0.4
Small and Disadvantaged Business Utilization		1.5	0.4
Planning and Performance Management	112.5	168.5	172.1
Volunteer.gov		13.1	13.1
Office of Planning and Performance Mgmt.	112.5	181.5	185.2
Center for Competitive Sourcing Excellence	34.6	49.1	49.9
Office of Competitive Sourcing	34.6	49.1	49.9
Firefighter and Law Enforcement Retirement Team	0.0	0.0	0.0
Employee Assistance Programs	0.0	0.0	0.0
Employee Counseling	56.0	19.0	19.3
CLC – Human Resources		3.5	5.0
OPM Federal Employment Services		20.3	20.4
Office of Personnel	56.0	42.8	44.6
Special Emphasis Program	4.8	4.9	4.9
Recruitment/Outreach	3.3	3.3	
Office of Educational Partnerships	8.1	8.2	4.9

**FY 2006 WORKING CAPITAL FUND
CENTRALIZED BILLING
U.S. GEOLOGICAL SURVEY**

(dollars in thousands)

Activity/Office	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate
Other OS Activities (continued)			
Occupational Safety and Health	161.7	154.1	160.2
Safety & Health Training Initiative	44.9	41.8	42.0
Office of Occupational Health and Safety	206.6	195.9	202.2
Classified Information Facility	24.1	44.0	44.8
Emergency Preparedness	70.4	92.2	137.2
Watch Office	107.1	136.3	169.6
Office of Law Enforcement and Security	201.6	272.5	351.7
IT Security	451.8	466.7	696.4
IT Security Certification and Accreditation			432.7
Information Technology Architecture	347.8	507.9	511.3
Capital Planning	106.2	111.1	132.2
Data Resource Management Program	38.6	39.2	39.4
Office of the Chief Information Officer	944.5	1,124.9	1,812.1
Frequency Management Support	106.6	115.8	219.5
Web & Internal/External Comm	76.0	79.1	79.9
DOINET – ESN	20.4	1,227.9	1,539.5
DOINET – ESN UNDISTRIBUTED			1,235.3
ARTNET	57.2	58.7	-0.0
NTIA Spectrum Management		501.1	503.6
Office of the Chief Information Officer	260.2	1,982.6	3,577.8
DOI FOIA Tracking & Reporting System	14.0	14.2	49.4
GPEA	49.3	50.2	50.5
Office of the Chief Information Officer	63.3	64.4	99.9
Ethics Training Departmentwide	6.5	6.6	6.7
ALLEX Database		3.0	3.0
Solicitor	6.5	9.6	9.7
WCF Management		18.7	19.5
Coop ECO Study Units (CESU)		73.4	73.7
Contingency Reserve	9.4	9.5	9.5
Departmentwide Activities	9.4	101.6	102.7
CFO Financial Statement Audit		565.8	568.6
Departmentwide Activities		565.8	568.6
E-Government Initiatives		412.0	371.0
Departmentwide Activities		412.0	371.0
Subtotal Other OS Activities	2,347.7	5,817.8	8,221.2

General Statement

**FY 2006 WORKING CAPITAL FUND
CENTRALIZED BILLING
U.S. GEOLOGICAL SURVEY**
(dollars in thousands)

Activity/Office	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate
National Business Center			
Executive Forums	31.1	38.3	51.1
Departmental Library	216.3	300.4	330.8
ALLEX Database	3.3		
Departmental Museum	165.3	187.3	190.0
Learning and Performance Center Management	39.5	51.1	48.7
Washington Learning Center	109.4	66.5	48.4
Denver Learning Center	97.0	97.3	86.3
Albuquerque Learning Center	4.7	9.4	8.5
Anchorage Learning Center	55.5	14.7	9.4
Leadership Institute	133.2	108.5	72.9
On-Line Learning	53.5	61.6	61.5
DOI Recruitment/Outreach			3.3
NBC Human Capital Directorate	908.8	935.1	910.9
Computer Applications and Network Services	19.6	20.0	21.2
Telecommunications Services	9.4	4.7	7.2
Voice/data switching	4.0	1.7	1.8
New PBX Telephone System	8.0	1.9	2.0
ADP Operations	336.2		
Hardware/Software Customer Service Center	3.1		
Records Management/FOIA	65.3	58.1	58.2
Aviation Management – Information Technology		15.9	0.0
NBC CIO	445.7	102.2	90.4
FPPS-Application Management Office	168.8	96.1	97.5
FPPS – Payroll Operations	882.4	856.4	871.5
FPPS – Payroll Systems	1,241.9	1,091.5	1,100.2
NBC – E-payroll	2,293.1	2,044.0	2,069.2
Interior Complex Management and Services	4.9	2.1	3.1
Family Support Room	0.2	0.0	0.1
Space Management Services	3.6	0.5	0.6
Shipping and Receiving		0.9	1.5
Moving Services		0.5	0.9
OWCP Coordination	11.1	1.3	
Drug testing - intra department	30.4	32.7	2.8
Security	11.7	11.6	20.2
Accessible Technology Center	36.7	42.9	40.7
Health Unit	1.5	0.7	0.8
Federal Executive Board	32.0	33.6	32.5
Photographic Services	0.7		
DOI Space Management Initiative			32.9
Blue Pages	18.3	79.5	83.5
Mail Policy	33.8	33.0	42.5
Mail and Messenger Services	50.5	69.5	74.0
Property Accountability Services	11.8		
NBC – Administrative Operations	247.2	308.6	336.2
Financial Systems (inc Hyperion)	1,848.8	2,460.2	2,518.2
Financial Management Services (Dept. Offices)		16.6	
IDEAS	468.7	380.0	380.0
Quarters Program	0.7	0.7	0.7
NBC E-Payroll	2,318.2	2,857.5	2,898.9
Aviation Management Directorate	183.2	150.2	160.4
Aviation – Mandatory Services	183.2	150.2	160.4
NBC – Appraisal Services			
Subtotal National Business Center	6,396.2	6,397.6	6,466.0
TOTAL	8,743.8	12,215.4	14,687.1

Direct billing is used whenever the product or service provided is again severable, but is sold through a time and materials reimbursable support agreement or similar contractual arrangement. The following tables provide the actual direct and reimbursable billing to the USGS for FY 2004 and estimates for FY 2005 and 2006.

**FY 2006 WORKING CAPITAL FUND
DIRECT BILLING
U.S. GEOLOGICAL SURVEY**
(dollars in thousands)

Activity/Office	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate
Other OS Activities			
<u>Departmental Direction Activity Coordination</u>			
<u>Departmental Direction</u>			
Management and Coordination Initiatives			
MRPS CTA A&E Contract	1,493.9	1,455.2	1,455.2
Financial Management Activities		31.1	
Acquisition and Property Initiatives		15.7	16.1
SBA Certifications		0.3	
Volunteer.gov		12.5	
EEO Training	1.0	5.0	2.9
Learning Management System (LMS)	10.0		
PPM Classification Appeals	5.5	8.2	5.5
Executive Resources Personnel Management Services	7.5	2.2	2.2
Diversity Intern Program		31.3	
Management and Coordination	1,517.9	1,561.5	1,481.9
Information Resources Initiatives			
Bureau Travel Reimbursements	0.4	0.3	0.2
Oracle License & Support Contract	863.1	685.9	719.7
Microsoft Enterprise Licenses	2,006.2	1,445.0	1,461.0
Anti-Virus Software Licenses	104.4	44.7	47.8
IT Security – Reimbursement BLM	384.4	354.0	325.5
Popkin System Architect		0.1	0.4
Information Resources Initiatives	3,358.5	2,530.0	2,554.5
Office of Acquisition and Property Management			
Central Services	0.0		
CFO Financial Statement Audit	300.5	4.9	
Federal FSA Program	88.1	86.4	86.4
Central Services	388.6	91.3	86.4
Subtotal Other OS Activities	5,265.0	4,182.8	4,122.8

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**FY 2006 WORKING CAPITAL FUND
DIRECT BILLING
U.S. GEOLOGICAL SURVEY**
(dollars in thousands)

Activity/Office	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate
National Business Center			
Strategic Management of Human Capital Directorate			
Career, Balance, and Diversity Forums		3.7	3.8
Financial Management Intern Program	7.0		
Financial Management Intern Program 2	10.3	12.0	
Washington Learning Center	6.3		
Anchorage Learning Center	0.7		
Denver Learning Center	17.0		
Online Learning	0.4	51.3	109.9
NBC – Human Capital/DOIU	41.6	67.0	113.7
Information Technology Directorate			
Direct Telecom Services	0.3		
ADP Operations – Director's Office	166.1		
Enterprise Infrastructure		371.3	382.4
Technology Services		1.0	1.0
E-Applications		0.0	
Information Technology	166.4	372.3	383.4
Federal Personnel Payroll Systems and Services Directorate			
FPPS – Application Management Office	13.3	6.8	7.0
FPPS – Payroll Systems	222.6	288.8	299.9
NBC - E-payroll	235.9	295.6	306.9
Administrative Operations Directorate			
Building Alteration Services		0.1	0.1
Reimbursable Moving Services	0.3		
Flags & Seals	1.0	1.4	1.4
Creative Communications	12.4	69.8	72.0
Reimbursable ATC Services		0.4	0.4
Acq Svc Div – Southwest Branch	2.0		
Southwest Acquisitions Branch Contracts	78.0		
Overseas Mail Services	2.7	7.5	8.4
Aviation Management – Acquisitions		22.7	
NBC-Administrative Operations	96.4	101.8	82.3
Budget and Finance Directorate			
IDEAS		120.0	120.0
Financial Systems	12.5		
Aviation Management – Finance		24.1	0.0
NBC AMD	12.5	144.1	120.0
Aviation Management Directorate	2,021.0	2,175.2	2,292.4
Aviation – Discretionary Activities	2,021.0	2,175.2	2,292.4
Appraisal Services Directorate			
NBC – Appraisal Services			
NBC Direction			
NBC – Management			
Subtotal National Business Center	2,573.8	3,156.0	3,298.6
TOTAL	7,838.8	7,338.8	7,421.3

Payments to other Federal agencies include the following:

	2005 Budget	2005 Revised	2006 Change
Worker's Compensation Payments	\$3,462	\$3,414	-\$37
Amount Absorbed.....		[\$48]	

The adjustment is for actual charges through June 2004, in the costs of compensating injured employees and dependents of employees who suffered accidental deaths while on duty. Costs for 2005 will reimburse the Department of Labor, Federal Employees Compensation Fund, pursuant to 5 U.S.C. 8147(b) as amended by Public Law 94-273.

	2005 Budget	2005 Revised	2006 Change
Unemployment Compensation Payments	\$317	\$317	+\$274
Amount Absorbed.....		[\$241]	

The adjustment is for estimated changes in the costs of unemployment compensation claims to be paid to the Department of Labor, Federal Employees Compensation Account, in the Unemployment Trust Fund, pursuant to Public Law 96-499. The amount absorbed in 2005 is due to changes between the estimate of payments for unemployment compensation between the time the 2005 budget was formulated and enacted. The 2006 uncontrollable change includes a catch-up adjustment for the unbudgeted 2005 costs.

	2005 Budget	2005 Revised	2005 Change
Rental Payments to GSA and Others	\$76,196	\$75,137	+\$1,509
Amount Absorbed.....		[\$1,059]	

The adjustment is for changes in the costs payable to General Service Administration (GSA) and others resulting from changes in rates for office and non-office space as estimated by GSA, as well as increases in the cost per square foot under revised occupancy agreements; rent increases associated with USGS leases; and escalations for space provided under interagency and cooperative arrangements. Costs of mandatory office relocations, i.e., relocations in cases where due to external events there is no alternative but to vacate the currently occupied space, are also included.

Internal Bureau Overhead/Cost Allocation Methodology

The USGS manages overhead/administrative costs at two levels—the bureau and science center. Bureau-level costs include headquarters and regional support for executive, managerial, supervisory, administrative, and financial functions and related bureauwide systems. At the bureau level, funding appropriated to the Science Support and Enterprise Information budget activities pays the bureauwide overhead costs in the same proportion as appropriated funding is to total funding. For this reason, bureauwide overhead costs collected on reimbursable support agreements are deposited within the Science Support and Enterprise Information program areas, as well.

The USGS charges a bureau overhead rate (12 percent in FY 2005 and FY 2006) on reimbursable work from non-Interior customers to cover their share of bureau-level costs. In some cases, the USGS does apply reduced or special rates when it can be demonstrated that indirect costs are substantially and consistently less than the norm and the amount collected covers the full costs, such as with pass-through funding where the Survey does not perform any

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of the actual work. The following table shows the funding available to the Science Support and Enterprise Information programs, including the anticipated overhead collections to pay for bureauwide costs.

Source of Funding (dollars in thousands)	FY 2006 Appropriation	FY 2006 Bureau Overhead Distribution	FY 2006 Total
Science Support Budget Activity	66,337 ^{1/}	28,974	95,311
Enterprise Information Budget Activity	47,767	8,655	56,422
Total Funding	114,104	37,629	1,517,334

^{1/} Does not reflect the addition of \$6 million requested in FY 2006 to replace the working capital fund contributions that will be redirected in 2005.

At the science center level, because there is not an appropriated funding source to pay the local overhead (common services) costs, both the appropriated and reimbursable funding are assessed a percentage to cover their share of science center level costs. Science center common services costs include center costs that are not directly attributable to a specific activity or project, such as managerial, supervisory, administrative, and financial functions and related systems, as well as costs incidental to providing services and products, such as postage, training, miscellaneous supplies and materials, etc. The cost during FY 2004, for the local overhead, totaled \$132 million from both appropriated and reimbursable funds.

In recognition of the USGS role as the science bureau for the Department of the Interior, the USGS is continuing to give Department bureaus and offices a "preferred" customer rate on overhead charges for a significant portion of reimbursable work, to the extent that matching funds are available within the USGS budget. The maximum rate that cost centers may charge other Department bureaus for common services and bureau costs combined remains 15 percent net. In FY 2006, of the 15 percent, 9 percent is applied to bureau costs, and the remaining 6 percent is applied to common services costs. Cost centers must fund the common services costs not recovered (e.g., the difference between the cost center's standard common services costs and the 6 percent) from USGS appropriated funds. In FY 2005, the bureau began a glide path to share the combined 15 percent overhead more equitably. Under this distribution, the cost centers are required to fund a lesser amount from science program funds and the bureau is required to use a greater proportion of science support funding for the total bureau overhead costs. In this way, the USGS is partnering on the science needs of Interior from both the bureau and cost centers.

- The Chief Financial Officer establishes the USGS bureau special rate for each fiscal year. The special rate for FY 2005 is 3 percent. Cost centers do not charge more than the bureau special rate for facilities-related costs or their standard common services rate when funding is approved for a bureau-level special rate. Special rates are applied under the following circumstances.
- A bureau special rate of 3 percent net is applied to cover reduced administrative costs when the USGS receives funds from a non-USGS organization and awards a grant to a third-party entity.
- A bureau special rate of 3 percent net is applied to cover reduced administrative costs when the USGS receives funds from one or more non-USGS organizations to support,

under USGS leadership, a strategic science objective which includes the USGS passing through funds to one or more third party entities.

- A bureau special rate of 3 percent net is applied to cover reduced administrative costs when the USGS receives funds from a non-USGS organization for the purpose of the customer acquiring services through the Cartographic Services or the Remotely Sensed Data Contracts. The special rate helps encourage other Federal agencies to use these contracts for cartographic services and remotely sensed data, rather than establishing and managing their own contracts, and ensures greater data consistency through the use of common service providers.
- A bureau special rate of 3 percent net is applied to cover reduced administrative costs when the USGS receives funds from a non-USGS organization for the purpose of passing through the customer's funds to State and local governments for the direct purchase of geospatial data.
- Biology Cooperative Research Units (CRUs) are supported by a three-way partnership including the USGS, a State, and a university. The academic institutions where CRUs are collocated provide significant administrative support. In recognition of the direct services support received from the non-USGS partners, CRUs only recover one-half of the bureau rate (6 percent) normally recovered from reimbursable customers or partners.

Governmentwide Management Reform (President's Management Agenda)

Budget and Performance Integration

The integration of budget and performance is critical to the planning for and evaluation of success achieved by the USGS in the application of its science to building long term bodies of data and ensuring their relevance to partner and customer need. Since FY 2002, USGS has worked with the Department and the Administration to establish accurate and meaningful performance measures for its programs in accordance with the President's Management Agenda. The USGS has been particularly successful in this endeavor, owing to the physical integration of its budget, regional, and planning and performance teams in its Office of Budget and Performance Management. Working in constant contact, these teams jointly develop and produce budget and performance documents that are fully integrated with respect to description of base programs and analyses, their funding and FTE implications, what the standards of their performance will be and how they will be evaluated. The three teams work closely with bureau program staff to understand, evaluate, and plan the science programs' budget and performance levels, ensuring responsiveness to USGS executive management decisions, departmental concerns, and Administration policies.

The result of this close coordination has been a commendation by the Assistant Secretary for Policy, Management and Budget on the functional organization and coordination of budget and planning for USGS within the Office of Budget and Performance Management, and asking the Department's Office of Budget and Office of Planning to provide the USGS submission as an example to the Department's nine other bureaus of how to complete their submissions as successfully.

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A summary of USGS status in Budget and Performance Integration follows.

1. Program Assessment Rating Tool (PART) — The USGS has a long and rigorous record of conducting external peer reviews for research, performance evaluations for programs, and management control reviews. To this suite has been added the OMB's PART. Both peer and management reviews as well as PART evaluations are conducted to improve the accountability and quality of programs; identify and address gaps in programs; redirect or reaffirm program direction; identify and provide guidance for development of new programs; and reward and (or) motivate managers and scientists. The National Academy of Science/National Research Council has conducted recent program reviews of the Landslide Hazards Program, Coastal and Marine Geology Program, and Water Resources Research. Recent Scientific Advisory Committee reviews include Earthquake Hazards, National Cooperative Geologic Mapping Program, Cooperative Water Program, and Water Resources Research Institutes. The PART was introduced in FY 2002 by the Administration as a means to evaluate program level performance across Government with a goal of reviewing 20 percent of our programs each year. The first year, *The National Map* was reviewed. In FY 2003, Hazards, Minerals and Energy Programs were PARTed, all scoring in the 80s (moderately effective).

In FY 2004 for the FY 2006 Budget, USGS PARTed Water Resources programs in addition to rePARTing *The National Map*. In prior PARTings, science programs with 5-year science plans and direct linkage to the budget structure have served as the unit of assessment. In a departure from this process, the Water Resources PARTs are constructed after the OMB's Business Reference Model for Government Services Delivery, Knowledge Creation and Management resulting in two evaluations: (1) Research programs and (2) Information collection and dissemination programs. The disadvantage of this approach is that these are not programs in the sense that they have a program manager and science plans, creating some difficulty in collection of evidence. The advantage of this approach is looking across programs to the delivery of science and the opportunity that affords to think and evaluate outside historical perspectives. The USGS received a score of 73 percent (moderately effective) for each of the two Water PARTs and is working with the OMB on an action plan for carrying out the PART analysis recommendations. New performance measures resulting from the PART are shown in the performance table for the Water programs.

The USGS worked closely with OMB and the Department in the 2 years after the initial PARTing of *The National Map* to achieve significant improvements in the program, resulting in a significantly improved rePART score of 90 percent (effective). After an in-depth analysis of its financial and workforce structure, USGS also undertook restructuring of the workforce to both decrease the overall size of the Government workforce and transition to new skills needed to meet future requirements. The new and retrained workforce will be collocated with other USGS operations and partner organizations. The Department of the Interior and Office of Personnel Management approved a Voluntary Separation Incentive Payment (buy-out) and Voluntary Early Retirement Program (early out) for use in the first quarter of FY 2004 (FY 2004) for selected functions. In FY 2004, 162 employees took the buy-out resulting in a 2004 savings of approximately \$2.0 million. Subsequent savings are planned to increase partnerships with States and locals and increase funds available to contract for geospatial data.

The Director has further enhanced *the National Map's* ability to achieve its goals by forming a single portfolio of USGS national geospatial data programs under unified leadership and management. Placing *the National Map* together with the Federal Geographic Data

Committee, the Geospatial One Stop E-Gov project, and the Interior Enterprise Geospatial Information Management activity, under the oversight of the newly established Geospatial Information Office will further leverage resources and develop synergies.

2. Cost and Performance — The Department and its bureaus crafted a set of common goals for Departmentwide application in a Unified Strategic Plan and are now developing key tools for Activity Based Cost/Management, Performance Tracking, and Financial and Business Management. For FY 2004, the Department began simultaneously implementing the Unified Strategic Plan and activity based costing. The efforts that USGS has undertaken in evolving common business practices such as reducing the number of accounts in FFS served the bureau well in implementing this new performance and accounting approach. Implemented in FY 2003, the common project planning tool, BASIS+ (Budget and Science Information System), associating work processes with projects, helped us transition in FY 2004 to linking work activities to outputs and associating these with costs. Cyber seminars were used to train employees in Department-shared categories of work and coding to ensure they had the appropriate information and tools to integrate performance, budget, and accounting on October 1, 2003. The standard set of ABC work activities that USGS implemented in FY 2004 included:

- 15 indirect work activities
- 42 direct science activities (6 per USGS/Department shared goals)
- 6 indirect science program management activities (1 per USGS/Department shared goal)

At mid-year USGS began to analyze, verify, and validate ABC data and performance data to aid scientists and managers in planning, formulation, and execution of their budgets. Several years of implementation will be needed to standardize processes, ensure consistency of interpretation and application of work activity definitions across the organization and across the scientific disciplines, and to identify trends in the data that can lead to programmatic decisions.

In FY 2004 USGS actively participated in the Department's ABC oversight efforts to "get the work activities right," by reviewing 326 Department work activities for commonality/distinctions, challenging models and assumptions to define common ground, defining outputs, and realigning bureau work activities with a revised set of Department activities. In FY 2005 USGS will collect the same science work activities as FY 2004 but with improved definitions and indirect work activities will increase slightly (including 6 indirect IT work activities); however, for the Department ABC analysis, 65 of our 73 work activities are transferred because the departmental process merged "collect data" with "manage and distribute data and information," so the 16 USGS work activities aggregate to 8 work activities for each of the 7 shared USGS/Department goals. The standard set of ABC work activities that USGS implemented in FY 2004 included:

- 19 indirect work activities
- 48 direct science activities (6 per USGS/Department shared goals)
- 6 indirect science program management activities (1 per USGS/Department shared goal)

In FY 2004, USGS conducted internal processes to standardize ABC and Strategic Plan outputs so that a single set will be used for both. This effort led to a substantial refinement

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in the distinctions among work activities and products, and a new approach to analyzing work fashioned after the OMBs Business Reference Model for Knowledge Creation and Management. Analysis of program outputs against the new standards resulted in some target revisions for this budget request. Integrating the two management processes with more descriptive definition templates will result in a more meaningful and reliable cost and performance tool for project managers.

3. Capital Asset Planning and Control — Interior is also implementing Capital Planning and Investment Control processes to ensure investments (costs) in capital assets best advance mission goals with minimal risk and lowest life-cycle costs. In FY 2004 the USGS enhanced its Capital Planning and Investment Control operations with the establishment of a full time IT Capital Planning Coordinator position responsible for developing a maturity framework and goals to ensure effective capital planning procedures and policies are developed and implemented consistently throughout the bureau. The IT Capital Planning Coordinator manages the process to review and submit USGS Capital Plans for major IT investments, non-major IT investments, and contributions to Department and E-Gov initiatives. This review includes validation of business cases against current plans by the following USGS subject matter areas: Records Management, Privacy, IT Security, IT Budget, and IT Architecture. Since December 2003, the USGS Investment Review Board (IRB) has met to review both IT and construction investments. USGS IT portfolio business cases approved by the USGS IRB are provided to the Department for inclusion in the Department IT portfolio and reviewed by the Department ITMC/IRB. Successful business cases are then included as part of the Interior budget submission to OMB.

Under the direction of the IRB, the USGS has adopted the GAO Information Technology Investment Management (ITIM) Framework as the USGS maturity model. In FY 2004, the USGS completed an ITIM self assessment and developed an ITIM plan and maturity goals for enhancing IT investment management within USGS to coincide with the Department ITIM Strategic Plan goals. The USGS expects to achieve compliance with Stage 2 of the GAO ITIM Framework by the end of FY 2005.

4. GPRA Performance Data Validation and Verification — In keeping with departmental and OMB policy for performance data verification and validation, USGS has complied with requirements for performance data credibility. USGS approach to achieving performance data credibility includes providing Budget and Activity Based Cost Management training, SES performance measure assignment, and implementation of the Department Data Validation and Verification Assessment Matrix. During FY 2004, USGS expanded the initial scope for Data Validation and Verification to include USGS-specific measures, outputs, all PART and Management Excellence performance measures. This extends assurance of credibility to more performance data ensuring usability for management decisionmaking and oversight.

5. Validation — During FY 2004, USGS GPRA coordinators for each Budget Activity/scientific discipline completed and certified validation criteria in the Department Validation and Verification Assessment Matrix for the key and non-key performance measures of the Department Strategic Plan, PART measures, USGS-specific measures and outputs. USGS demonstrated accountability by establishing a clear connection among mission, work, and work accomplishments for the funds that have been authorized and appropriated. Criteria include scrutiny to determine that goals are realistic and measurable, understandable to users, and ultimately used in decisionmaking. In addition, several of the Strategic Plan measures were assessed by the PART during FY 2004 including Water

Resources programs and a re-PART for The National Map. This provided additional documentation and assurance of credibility and usability of USGS performance measures for management decisionmaking.

6. Verification — During FY 2004, USGS GPRA coordinators for each Budget Activity/scientific discipline completed and certified verification criteria in the Department Validation and Verification Assessment Matrix for the key and non-key performance measures of the Department Strategic Plan, PART measures, USGS-specific measures and outputs. This included assessing data accuracy, completeness, consistency, availability, and inter-control practices that serve to determine the overall reliability of the data collected. GPRA coordinators documented any inconsistencies, inaccuracies or anomalies in performance data to ensure that problems are addressed so that integrity of the performance data is ensured.

During FY 2005 and FY 2006, the above process and procedures will continue for performance validation and verification. Completion of Department Data Validation and Verification Assessment Matrix for all performance data is vital to support audits ensuring that quality assurance measures are in place to verify and certify performance data accuracy.

Strategic Management of Human Capital

A critical aspect of achieving USGS science goals is an effective human capital management strategy for recruiting, developing, retaining, and managing a highly skilled, flexible, motivated, and diverse workforce. The workforce planning strategy implemented by the USGS aligns with USGS science goals; identifies areas in which the USGS needs to build internal capacity, contract with the private sector, and partner with other organizations; uses workforce planning to forecast future critical skill needs and identify mechanisms for recruiting, developing, and retaining a diverse workforce with those critical skills; aligns individual employee performance and rewards with organizational performance; and makes effective use of technology. These programs support the President's Management Initiatives on Human Capital, Competitive Sourcing, Budget and Performance Integration, and Expanded E-Government; and, the Department of the Interior's Strategic Human Capital Management Plan.

In FY 2004, the USGS initiated workforce planning efforts in various segments of the bureau by science discipline, geographic region, integrated science center, and functional occupation. The bureau continued the development of workforce planning capabilities and baseline data to include the automated skills assessment tool and an online workforce demographic and data warehouse to bring all workforce planning tools to managers' desktops via the USGS Intranet.

In FY 2005, learning from the prior years' experience, the USGS will expand its workforce planning efforts to include additional science centers in each region and discipline. The USGS will also include the development of succession planning strategies that include bureau developed core management competencies. The USGS will develop workforce strategies that support the new Equal Employment Opportunity Commission (EEOC) Management Directive 715 that shifts the focus on improving diversity to an identification of barriers that are inhibiting growth in diverse employment. Finally, the USGS will focus on workforce issues related to the organizational realignment of the Geography and Geospatial Information programs.

A reduction of -250 FTE has been identified for the USGS in FY 2005 for uncontrollable and pay raise absorption. Maximum discretion will be used to reduce FTE. Hiring of temporary positions

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and field season staff may be reduced where possible; however, adverse action may be necessary to achieve the reduced target.

In FY 2006, the USGS will complete a bureau workforce plan that will identify future skill needs based on 5-year science/business program plans and future science directions; determine the gap between current skills and future skill needs; and develop recruitment, retention, training, competitive sourcing, succession planning, and other strategies for addressing the skills gap. Regional managers will aggregate science center plans at the regional level to identify regional strategies for acquiring critical skills, and the USGS will prepare a bureau workforce plan that identifies critical skill needs at the bureau level and strategies for meeting those needs. Workforce planning training, tools and consulting will be provided to managers, in addition to further refinement of a workforce planning and analysis Web site that assists managers in doing scenario planning, projecting attrition, and determining skills gaps in critical occupations. Recruitment and retention strategies will be developed and implemented to attract and retain a highly skilled workforce, and special programs will continue to address retention, diversity, and enhancement of the work environment for all employees. Efforts will continue to achieve a more flexible workforce that provides the specialized skill sets necessary to achieve short-term objectives and to meet periodic heavy workload demands. It is anticipated that these initiatives will be funded as ongoing efforts.

The accountability for achieving the outcomes of a viable workforce plan in the bureau is featured under the Management Excellence performance goals for the SES members in the USGS. These goals align the workforce plan outcomes to other PMA initiatives such as diversity, E-Government, and the linkage of budget and performance.

Competitive Sourcing

The USGS performs its scientific and support activities through a combination of Federal employees and external capabilities and staff. The current workforce balance will require competitive sourcing of aspects of scientific and administrative activities in response to mandates contained in the FAIR Act.

The USGS completed the study of the Warehousing and Building and Grounds Maintenance positions in FY 2003. Based on results of a planning team which convened in FY 2004, USGS prepared a Competitive Sourcing Green Plan that has been coordinated and approved by the Department.

The anticipated accomplishment in FY 2005 is the completion of the business strategy review (BSR) of the Visual Information publishing component function comprising approximately 278 FTEs and to begin the BSR of the Science Technicians and science support functions comprising approximately 477 FTEs. In addition, USGS will initiate a study of geospatial data production functions, comprising approximately 266 FTEs. Based on the outcome of these reviews, funds will be required for the next phase of the reviews. USGS expects to spend out of its base funds \$405,000 for Competitive Sourcing activities in FY 2005. These are contractor costs (support of Performance Work Statement and Most Efficient Organization development teams), travel, and training in support of the President's Management Agenda. Other Government personnel costs are not calculated in the total cost. The Library and Information Services and Information Technology functions will be reviewed in FY 2006 in accordance to the Green Plan. These functions are comprised of approximately 571 FTEs. The USGS will spend \$500,000 from within base funding in 2006 for competitive sourcing activities.

Financial Management

Enhanced communications and coordination with field operations, revised policies and procedures, increased training for administrative staff and a more skilled and knowledgeable workforce have enabled the USGS to make substantial improvements in its financial management activities. The results of these endeavors are an unqualified financial audit opinion issued by our independent auditors on the bureau's Fiscal Year 2003 Consolidated Balance; and an unqualified opinion on the bureau's Fiscal Year 2004 Annual Performance and Accountability Report. During FY 2004, the bureau successfully downgraded all previously issued material weaknesses, having received two reportable conditions on the 2004 independent auditors report. The bureau was substantially in compliance with FFMA and needs to remedy an IT reportable condition that affected full compliance with FFMA.

USGS will continue to pursue excellence in financial management, identifying opportunities to streamline and automate functions and improve internal controls. The bureau is developing a comprehensive training plan to ensure that administrative officers and other financial staff received on-going training in various bureau specific procedures as well as general areas such as appropriation law and management skills.

The Department awarded a contract in January 2004 to Bearing Point as the integrator to implement the Department's new Financial and Business Management System (FBMS). The USGS is actively participating with the Department Secretarial Offices and other bureaus in the Blueprinting process. FBMS will replace current systems for Budget Formulation, Core Finance, Personal and Real Property, Financial Assistance, Acquisition, Fleet Management, and Executive Management Information System. Budget formulation and project planning at the highest level currently exists in the Strategic Enterprise Management (SEM) module where "what if" scenario building can be performed. The USGS is scheduled to deploy FBMS effective October 1, 2007.

Expanding Electronic Government

Geospatial One Stop — The Department serves as the managing partner of the Geospatial One-Stop (GOS) Governmentwide E-Government Initiative. The USGS provides the operational and technical support and overall executive management for the GOS Project on behalf of the Department. GOS is a focused set of collaborative activities designed to accelerate the development and advance the use of the National Spatial Data Infrastructure (NSDI) as a fundamental building block for Electronic Government and to make access to geospatial information access easier, faster, and less expensive.

In FY 2004, the inventory of planned geospatial data acquisitions among Federal, State, and local governments (as required in OMB Circular A-11) increased substantially to over 200 planned acquisitions. This GOS inventory allows government agencies to identify where needed data may already exist or to collaborate and share costs on acquisition of data that are of mutual interest. In early FY 2004, GOS initiated automated "harvesting" of metadata from NSDI Clearinghouse nodes throughout the country at all levels of government. All Federal agencies that invest in geospatial data acquisitions will be using the GOS Portal for all data acquisition planning beginning in FY 2006. The portal allows a GIS user to identify which Federal, State, or local agency owns what type of geospatial data using an on-line "card catalogue," and often allows the user to directly pull down that data over the Internet, creating digital maps made up of datasets coming from any number of servers owned by disparate organizations across the country. The portal is averaging about 400,000 hits per week. One of

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the most dramatic applications was in the 48 hours before Hurricane Isabel hit the East Coast in September 2003, as a number of southeastern Federal and State agencies used the portal to exchange and share data for emergency preparedness and response.

In FY 2005, the GOS project will develop a "second generation" portal that will make it easier for citizens to find and integrate the Nation's spatial data assets and geographic data services over the Internet and focus on developing the collaborative tool development for data channel communities to enhance sharing of data, geospatial activities, and partnership opportunities.

In FY 2004, the GOS project also identified key Federal agency experts to serve as "stewards" for each of the major data categories available in the GOS portal. These stewards provide leadership to data category communities consisting of Federal, State, and local theme experts for identifying and featuring premier spatial data resources within the GOS category. Fostering a collaborative community by data themes is expected to result in easier access to quality data in FY 2005 and increased partnerships in both FY 2005 and FY 2006.

The USGS also provides operational support for the executive management of the Federal Geographic Data Committee (FGDC). This leadership role is specified as a Department responsibility under OMB Circular A-16. The FGDC is an interagency and intergovernmental committee that encourages Federal, State, local, and Tribal governments, academia, the private sector, and nonprofit organizations to work together within a geographic area to make geospatial data available through the NSDI.

In FY 2004, FGDC provided key technical support for development of draft national data standards for 13 NSDI Framework data themes that will underpin GOS. These draft standards were submitted to the International Committee for Information Technology Standards (INCITS), which is leading the first step of the American National Standards Institute (ANSI) standards review process. It is anticipated that ANSI will approve these draft standards in mid to late FY 2005. Use of these standards will be mandatory for Federal agencies beginning in FY 2006, and it is anticipated the standards will also be widely used among State and local government agencies. The GOS Portal will complete new features in FY 2006 that give enhanced visibility to NSDI Framework data and foster its growth in use throughout government agencies at all levels.

The USGS also contributes (with funding, in-kind technical expertise and collaboration, and scientific data) to other E-Government Initiatives, including: Disaster.Gov, Recreation One-Stop, SAFECOM, and E-Records Management.

Enterprise Geospatial Information Management — USGS has a leadership role in developing two of the five initiative areas identified as high priorities under the Department E-Government Strategy: Geographic Information Management (EGIM) and Analytical Tools to Support Advanced Integrated Science. Key focus areas of EGIM include: reduced overall GIS training costs, consolidated GIS Help Desk operations, consolidated GIS software Test lab functions, more effective software release/update distribution mechanisms, easy access across bureaus to information on best management practices for GIS, and increased emphasis on cross-bureau sharing and reuse of GIS tools, techniques, and data. It is estimated that implementation of EGIM within the Department over the next 5 years will result in reduced costs for the Department of approximately \$9.5 million in cumulative savings. Savings will also be achieved by leveraging capabilities of Geospatial One-Stop, ensuring that Department bureaus will not have to develop duplicative GIS portals, servers, and services.

Information Security — In FY 2004, the USGS developed and implemented an action plan to achieve compliance with the Federal Information Security Management Act. The resulting improvements to the USGS security infrastructure include: improved information technology security plans, enhanced computer incident response capabilities including reporting of security incidents to Federal Computer Incident Response Center, annual incident response training of all personnel, and standard procedures for system configuration and patch management.

The USGS continued with deployment of the "demilitarized zone" (DMZ) architecture, begun in FY 2003, and made significant progress in reducing the number of public servers accessible from the public Internet through consolidation of public servers and the use of reverse-proxy capabilities. To enhance the security of non-public systems used by USGS personnel and partners, the USGS implemented standards requiring encryption and strong authentication for all internal systems and devices.

In FY 2004, the USGS also initiated a vulnerability assessment activity to identify vulnerable systems and devices in the internal network used by USGS personnel and partners. This activity regularly scans all internal systems and devices for vulnerability with the most commonly exploited vulnerable services. This activity is an extension of the FY 2003 assessment of publicly accessible systems and contributes to the bureau's overall "defense-in-depth" security strategy by helping to minimize the risks associated with compromise of internal desktop and server systems and devices. Security and reliability were also further strengthened by the expansion of the National Web Server System, a reliable, consolidated, and failure resistant Web server infrastructure that ensures that critical USGS public Web sites will remain available during emergency situations. Approximately 87 more USGS Web sites were incorporated into the system.

The primary objectives for FY 2005 are full implementation of a highly secure perimeter network architecture; separation of publicly accessible information systems and their associated data and information content from sensitive systems and information that are only accessible to USGS employees and partners; enhancement of the gateway virus and unsolicited commercial e-mail blocking capabilities and deployment of a single access point for Internet messaging; ongoing security operations, including incident response; regular vulnerability assessment (including vulnerability scanning, scan mitigation, intrusion and virus detection); and deployment of software tools to allow management and rapid update of security controls on individual computers. The acquisition, management, and oversight of these technologies and tools in a comprehensive, integrated, enterprise-wide basis will provide significant long-term cost and operational efficiencies to the bureau, as opposed to a piece meal or ad hoc implementation of certain tools in certain USGS offices or programs. Acquisition and deployment of a patch management tool as well as establishment of a penetration testing schedule for IT systems is planned.

Security Certification and Accreditation — In FY 2004, the USGS completed certification and accreditation of all IT systems. USGS plans to complete remedial work on weaknesses identified during the certification and accreditation process by the end of FY 2005. In addition to achieving the initial certification and accreditation for USGS systems, it is necessary to continually monitor and maintain certification and accreditation status for operational information systems and to support the re-certification of systems on a regular and continuing basis, as required by OMB and the National Institute of Standards and Technology.

Federal Enterprise Architecture — The Department of the Interior Enterprise Architecture (IEA) is being developed in conformance with the OMB Federal Enterprise Architecture (FEA).

General Statement

During FY 2004, the USGS actively participated in the development of the IEA. The Departmental Enterprise Architecture Repository (DEAR) is now the official systems inventory of the Department and the USGS. USGS also has developed a strategy to implement a USGS Enterprise Architecture beginning in FY 2005. The USGS Enterprise Architecture will build upon the FEA and IEA frameworks and also will identify the unique requirements of the USGS. This will include defining lines of business for the USGS scientific and administrative "business" of high strategic value and identifying major USGS IT investment projects and business process re-engineering efforts that are planned or underway. Major emphases for FY 2005 will include: supplementing the departmental effort to develop architectural components for important crosscutting lines of business not covered in the initial IEA effort; defining architectural components for strategic lines of USGS business that also cut across Department bureau lines; defining architectural components for USGS-unique business lines; and acquiring and populating the Department's standard architecture repository tool.

Capital Planning and Investment Control — In FY 2004 the USGS enhanced its Capital Planning and Investment Control (CPIC) operations with the establishment of a full time Information Technology (IT) Capital Planning Coordinator position responsible for ensuring that effective capital planning procedures and policies are developed and implemented consistently throughout the bureau. The USGS Investment Review Board (IRB) is responsible for overseeing the development of the FY 2006 IT investment portfolio. This includes ensuring that the approved IT investment requests in this portfolio conform to the bureau's initial FY 2006 budget request to the Department and, subsequently, with the Secretary's FY 2006 budget decisions. The IRB makes recommendations to the USGS Director on all new and ongoing IT (and facilities) capital investments in order to create and maintain a bureau investment portfolio which best supports the USGS and Department mission and strategic goals, leverages existing capital assets, and promotes investment integration opportunities within USGS, across the Department, and with other Federal agencies. Exhibit 300 business cases for all major USGS IT investments were reviewed and approved by the IRB prior to their formal submission to the Department by the bureau Director. The IRB also approved the non-major IT investments that are included in the overall FY 2006 USGS IT investment portfolio. These include non-major bureau-specific investments, bureau contributions to major and non-major IT investments reported at the Department level, and bureau contributions to selected E-Government initiatives. The IRB also provides quarterly progress reviews of current (funded) investments to ensure they are on schedule and budget and are well-managed.

Enterprise Services Network — In FY 2004, the USGS actively participated in requirements analysis and technical design of the Interior Enterprise Services Network (ESN). USGS and the Department negotiated an agreement to support the implementation of ESN by transferring ownership of the USGS wide area network infrastructure to the Department to serve as the backbone of Phase 1 of ESN. In addition, the USGS will provide funding, beginning in FY 2005, to the Department to support operation of Phase 1 of ESN, and will make USGS technical expertise and network engineering support available to the Department.

Asset Management

USGS Fleet Management Efficiencies — The USGS has developed reports for our vehicle utilization data collection system; these reports will give local managers and the bureau fleet manager the information needed to identify under-utilized vehicles and opportunities to share vehicles and (or) dispose of vehicles no longer fully utilized. To facilitate improved utilization of vehicles, a Web page bulletin board for USGS excess vehicles is under development. Procedures for implementing GSA AutoChoice were developed, and all vehicle orders are being

processed electronically. Information on strategies to reduce the fleet is being developed and will be issued to all offices. Development is underway of realistic and specific goals for fleet fuel efficiency, or other performance indicators depending on how a given vehicle is used; field offices will be required to meet these goals. Field offices must identify opportunities to share vehicles across discipline lines and bureau lines wherever possible, and to reduce the number of trips taken and miles driven to the lowest number possible without adversely affecting mission-critical programs. Efforts are ongoing to replace our older fleet (50 percent of our current fleet is at least 10 years old and 80 percent of the fleet is at least 5 years old) with more fuel-efficient vehicles. Additional changes under consideration include requiring vehicle justifications for new vehicles and requiring cost center managers to ensure that they order the smallest, most fuel-efficient vehicle they can that will still meet the mission requirement. The bureau fleet manager's role is being reevaluated to consider authorizing that individual to take appropriate action when offices fail to meet clearly identified goals.

Space Management:

CPIC — USGS has implemented Capital Planning and Investment Control procedures to manage more effectively the entire USGS real property portfolio. The USGS Investment Review Board is now reviewing real property investments in facilities construction and renovation valued at \$2 million or more and in leases or GSA occupancy agreements with life cycle costs of \$5 million or more.

Strategic Facilities Management Plan — In FY 2003, USGS prepared this plan as a central part of the USGS strategy to control costs and establish funding priorities for all USGS real property. This plan added needed focus to cost containment through the adoption of principles governing operations and maintenance, integrated science/facility planning, cost analysis, limits on space changes, and performance measurement.

Space Consolidation Efforts — When possible, USGS invests in efforts to consolidate space to reduce costs. Unfortunately, it is often expensive to fund such cost reduction actions. In FY 2004, we closed the Ocala Water Lab, resulting in the elimination of nearly 20,000 square feet of space and over \$150,000 in annual rent. We rearranged space at the Rocky Mountain Mapping Center in Denver to allow us to return nearly 10,000 square feet to GSA and reduce rent by over \$185 thousand.

USGS Strategic Facilities Master Plan — In FY 2004, USGS awarded a contract to produce a bureau Strategic Facilities Master Plan (SFMP). This effort is focused on improving the decisionmaking process for facilities investments, identifying specific cost-control opportunities, and strengthening our budgeting process. In particular, the contractor will:

- Determine the adequacy of USGS facilities, individually and in the aggregate, in meeting USGS current and planned mission needs.
- Review the current mix of facilities sources (e.g., owned, rented, and cooperator space) to determine if the mix is balanced properly to meet USGS science needs.
- Recommend mechanisms for improving the integration of science/facilities planning.
- Recommend performance metrics and tracking processes for use in measuring the effectiveness, economy, and efficiency of USGS facilities and supporting programs.

General Statement

- Develop a new business case model for the USGS to apply to decisions about facilities investments.
- Apply the business case model to identify priority opportunities for reducing current USGS facilities costs with due consideration of science program impact.

Research & Development — The current R&D investment criteria were developed in response to limited financial resources and the multitude of R&D opportunities that exist Governmentwide. The criteria are used to rigorously justify new programs and to reevaluate existing programs for modification, redirection, or termination, in keeping with national priorities and needs. The investment criteria evaluate the relevance, quality, and performance for all R&D programs.

The Department reviews R&D investments across its bureaus and weighs the value of existing programs against changing needs and priorities. Estimated R&D funding Departmentwide for 2006 is \$593 million, a \$27 million decrease from 2005. The Department conducts quarterly Departmentwide R&D meetings with senior R&D managers to plan, coordinate, assess, and if necessary, redirect agency R&D activities.

The bureau reviews R&D investments across its disciplines and weighs the value of existing programs against changing needs and priorities. In general, the USGS Director establishes program priorities for the budget year and issues a call for new initiatives in response to those priorities. He also accepts recommendations for all new ideas, regardless of whether they address the priorities. The Director prioritizes the proposed initiatives on the basis of the following criteria: interdisciplinary science; collaboration and partnerships with Department bureaus, other government agencies, and universities; results of program evaluations; and demonstration of progress toward meeting the Department's performance goals and objectives. He selects from among the prioritized initiatives those that he feels he can accommodate within the funding target. The amount of increase is directly related to whether there is an allowance within the target for growth, whether all increases must be offset, whether the target itself requires reductions from base, and whether uncontrollable cost increases can be requested or must be offset. The request also addresses those items specifically required by the Department. The Capital Planning and Investment Control process provides support for decisions on technology necessary to support science and the business processes of the bureau.

The USGS FY 2006 R&D funding is \$533 million, a decrease of \$19 million from FY 2005 largely related to the decrease in the Minerals program. Research and development is the core of USGS mission spanning basic (6 percent) and applied (84 percent) research and development (10 percent). The USGS's primary product is scientific information. Quantitative measures of our performance are tangible and directly related to inputs, but they are primarily outputs (e.g., number of scientific papers published, data collected) that convey little sense of the true benefits gained by the American people from the information we produce. The outcome related to our providing scientific information is that a stakeholder has the information (land manager's inputs) with which to make an informed decision. Quantitative impact measures (e.g., the acreage of ecosystems restored by a land manager) are only indirectly linked to USGS outcomes. USGS provides the Knowledge Creation and Management mode of delivery for the Government's Environmental Management, Natural Resources, and Disaster Management services for citizens as defined by the OMB's Business Reference Model.

Our science is being used more and more in decisionmaking, and this is essential to our success in demonstrating relevance. That doesn't mean that all of what we do needs to be

applied; as former Director Walter C. Mendenhall said, "There can be no applied science unless there is science to apply." The following example demonstrates the relationship of USGS development and applied research in Alaska, the most seismically active State in the Nation. Today, Alaskans have a better network of seismic stations and therefore an improved ability to monitor earthquake activity as a result of USGS partnerships with the State, the University of Alaska Fairbanks Geophysical Institute and the City of Anchorage. This past March, as part of the commemoration of the anniversary of the great Good Friday earthquake of 1964 in Anchorage, USGS and partners installed a 32-channel strong motion instrument array in the Atwood Building, one of the tallest structures in Alaska, and installed instrument packages in six nearby boreholes in the ground. The borehole sensors and the instrumentation in the building will determine how the ground and the building respond to earthquake shaking, information essential for engineers to mitigate property damage and loss of life. This is a critical first step in making the cities and people in Alaska safer from the devastating effects of earthquakes. This enhanced seismic network will allow USGS and its partners to implement ShakeMap in the City of Anchorage, to provide first responders with the information they need to assess the intensity and distribution of strong ground shaking in the critical minutes following an earthquake. The USGS scientist that developed ShakeMap—a rapidly generated computer map that shows the location, severity, and extent of strong ground shaking within minutes of an earthquake—earned the prestigious Legacy Award for his work. He not only developed the methodology behind ShakeMap, but also coordinated implementation of the system in emergency response centers across the western United States.

Science in a Time of Need

December 26, 2004 saw one of the worst natural disasters in recent history, as an incredibly powerful earthquake and subsequent tsunami caused widespread destruction throughout the Indian Ocean. The loss of life and property was astounding, and concerned individuals and organizations worldwide have resolved to assist the victims and mitigate the impacts. USGS is no exception.

We provided real-time earthquake info to government authorities in the Indian Ocean. We are freely distributing many types of tsunami-related satellite imagery and geospatial data to support the needs of U.S. and international aid organizations. Our scientists are and will be in the Indian Ocean basin, working to assess impacts and assist in the creation of systems to deal with possible future events. USGS staff members nationwide are fielding countless phone calls and media requests to further understanding of the situation.

In a time of crisis and need, our science has been brought to the forefront and is having a direct and beneficial impact. The President has announced plans for a new tsunami detection and warning system that includes USGS R&D.

Our efforts in restoring the Everglades, is an outstanding example of basic research with science applications that address issues resulting from nearly a century of wetland drainage and impoundment and that provide the information needed to restore the health of this unique ecosystem. The USGS provides the primary science support to the Department for resource management and restoration in South Florida. These and other studies are providing the highest quality scientific research and scientific information so that our partners at Interior and State and local agencies can fulfill their resource management and technical responsibilities.

Peer review has been the quality standard for USGS scientific publications and a documented component of USGS policy throughout our 125-year history. Our programs are cyclically evaluated to ensure the quality and timeliness of our science. The evaluations not only improve the accountability and quality of programs, but also identify and address gaps in programs; redirect or reaffirm program directions; identify and provide guidance for development of new programs; and review and (or) motivate managers and scientists. All of USGS programs evaluated by OMB's PART process have received a "moderately effective" rating or better.

General Statement

These evaluations are the foundation on which USGS gages performance relative to the Department End Outcome measure for soundness of methodology, accuracy, and reliability of science.

Performance Summary

Science as a foundation for making sound decisions is one of the underpinning elements of the Department's Strategic Plan and one of the principal strategic directions for the USGS mission. The USGS focuses efforts throughout the Department strategic mission areas.

The USGS vision, mission, and strategic direction focus on responsiveness and customer service in the application of science to customer, partner, and other stakeholder needs. They direct the combined expertise of the bureau's scientific disciplines and define the bureau's commitment to pursuing an integrated approach to providing science for a changing world.

As the Department's science bureau, the USGS provides information and technologies that are critical to achieving the missions of the Department's land and resource management bureaus. The USGS collaborates with these bureaus to provide science support that ensures the increasingly complex management requirements of Interior's vast resources are informed by credible science. These collaborations support the Administration's commitment to base land and resource management decisions on sound science, as stated in the Departmental Manual, section 305–2.2: "It is the policy of the Department of the Interior that science shall be fully integrated and effectively used in the land and resource regulatory and management policies, practices, and decisions of the Department and its bureaus."

The USGS leverages its resources and expertise in partnership with more than 2,000 agencies of Federal, State, local, and Tribal governments; the academic community; non-governmental organizations; and the private sector. Field investigations, direct observations of natural science processes, and monitoring and data collection at the local scale are the scientific hallmarks of the USGS. When siting new facilities, the USGS endeavors to collocate its facilities with those of potential collaborators or customers to ensure that opportunities for joint scientific ventures and sharing of expertise are maximized to the fullest extent possible and to ensure that products are relevant and focused.

USGS employs a robust and cyclic requirement for science planning, program reviews, cost center reviews, management control reviews, and peer reviews and continues to refine these processes. This array of tools is now supplemented further and coordinated with PART evaluations, and is also beginning to include the results of ABC/M to further instruct our planning processes. In keeping with departmental and OMB policy for performance data verification and validation, USGS has complied with requirements for performance data credibility. USGS GPRA coordinators for each Budget Activity/scientific discipline completed and certified validation criteria in the Department Validation and Verification Assessment Matrix for the key and non-key performance measures of the Department Strategic Plan, PART measures, USGS-specific measures and outputs. USGS demonstrated accountability by establishing a clear connection among mission, work, and work accomplishments for the funds that have been authorized and appropriated.

In keeping with the Administration's budget priorities for research and development (OMB Memorandum M–04–23, August 12, 2004), USGS has focused on interagency efforts, proposed offsets by elimination or reduction of lower priority programs, and continues to build on the intergovernmental Earth Observation Summit in July 2003.

The FY 2006 Budget includes \$148.8 million for Resource Protection, an increase of \$1.1 million from 2005 including increases for ecological systems mapping, Great Lakes Deepwater Fisheries, Glen Canyon Dam Adaptive Management, development of innovative control methods for invasive species and consolidates funding for science on the Interior's Landscape. Resource Use requested funding of \$48.7 million is a decrease of \$28.3 million from 2005. The Mineral Resources program was reduced to refocus USGS funding on the highest priority science needs. The proposed funding will maintain a core program focusing on inherently Federal functions. The decrease will be most evident in data collection and management work activities with all growth eliminated in "Average square miles of the U.S. with non-energy mineral information available to support management decisions." This will result in a decline in customer satisfaction with data timeliness and the data's usefulness for decisionmaking as the focus and role of the Mineral Resources Program changes. Serving Communities mission area is proposed to increase by \$25.3 million to support development of a global tsunami warning system, volcano monitoring, development of the ground processing systems to receive process and archive data from the Landsat Data Continuity Mission and a permanent solution to maintaining critically needed Landsat data in spite of revenue loss due to failure of the scan line corrector, enterprise information security and technology. Funds from program completions and elimination of the Water Resources Research Act Program are also proposed to contribute to offsetting these proposed increases.

Actual historical performance and the cumulative impact of proposed funding changes on key Department Strategic Plan performance measures are summarized in the following table.

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Resource Protection Goal Performance Summary:

End Outcome Goal: PEO.1. Improve health of watersheds, landscapes and marine resources that are DOI managed or influenced in a manner consistent with the obligations regarding the allocation and use of water.							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Restore and maintain proper functions to watersheds and landscape Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Restored Fire Adapted Ecosystem:</i> X% satisfaction with scientific and technical products (SP)	97%	100%	≥80%	≥80%	≥80%	0	≥80%
Intermediate Outcome: Improve information base, information management and technical assistance Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Forge Effective Partnerships:</i> Satisfaction score (# score) on resource protection partnerships (SP)	97%	97%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality:</i> X% of watershed and landscape-related research studies validated through appropriate peer review or independent review (SP)	100%	100%	100%	100%	100%	0	100%

End Outcome Goal: PEO.2. Sustain biological communities on DOI managed or influenced lands and waters in a manner consistent with the obligations regarding the allocation and use of water.							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Improve information base, information management and technical assistance Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Forge Effective Partnerships:</i> Satisfaction score (# score) on biological research partnerships (SP)	97%	98%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality:</i> X% of biological research studies validated through appropriate peer review or independent review (SP)	100%	100%	100%	100%	100%	0	100%
<i>Facilities Condition:</i> Conservation and biological research facilities are in fair to good condition as measured by the Facilities Condition Index (lower FCI is good) (SP)	UNK	0.19	0.19	0.19	0.19	0	0.19

Resource Use Goal Performance Summary:

End Outcome Goal: UEO.1. Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value - Energy							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Improve information base, information management and technical assistance Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Baseline Information:</i> Number of targeted basins with oil and gas resource assessments available to support management decisions (SP) (PART)	7	5	6	6	6	0	5
<i>Quality and Utility of Information:</i> X% of energy studies validated through appropriate peer review or independent review (SP) (PART)	100%	100%	100%	100%	100%	0	100%

End Outcome Goal: UEO.2. Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value – Non-Energy Minerals							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Improve information base, information management and technical assistance Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Baseline Information:</i> Average square miles of the United States with non-energy mineral information available to support management decisions (SP) (PART)	2,368,794	2,401,329	2,587,318	2,987,340	2,987,340	0	2,987,340
<i>Quality and Utility of Information:</i> X% of mineral studies validated through appropriate peer review or independent review (SP) (PART)	100%	100%	100%	100%	100%	0	100%

General Statement

Serving Communities Goal Performance Summary:

End Outcome Goal: SEO.1. Protect Lives, Resources and Property							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
<i>Hazards: X% of communities using DOI science on hazard mitigation, preparedness and avoidance for each hazard management activity (SP)</i>	39.5%	43.2%	44.8%	45.9%	47.5%	+1.6%	49.21%
<i>Decision Maker Satisfaction: Met need for information to help achieve goal of reduced risk (SP)</i>	98%	98%	≥80%	≥80%	≥80%	0	≥80%
Intermediate Outcome: Improve public safety and security and protect public resources from damage							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Facilities Condition -- Hazards: Buildings (administrative, employee housing) are in fair to good condition as measured by the Facilities Condition Index (FCI) (SP)</i>	UNK	0.20	0.20	0.20	0.20	0	0.20
Intermediate Outcome: Provide information to assist communities in managing risks from natural hazards							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Adequacy: Percent of sampled stakeholders reporting adequacy of science base to inform decisionmaking for each hazard management activity (volcanoes, earthquakes, etc.) (SP)</i>	97%	98%	≥80%	≥80%	≥80%	0	≥80%

End Outcome Goal: SEO.2. Advance knowledge through scientific leadership and inform decisions through the application of science.							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
<i>Research: Soundness of methodology, accuracy, and reliability of science (program evaluation) (SP)</i>	100%	80%	100%	100%	100%	0	100%
<i>Inform decisions through the application of science: Improved access to needed science information (# score) (SP)</i>	92%	90%	90%	90%	90%	0	90%
<i>Inform decisions through the application of science: Stakeholders reporting that information helped achieve goal (# score) (SP)</i>	94%	93%	90%	90%	90%	0	90%

Intermediate Outcome: Improve information base, information management and technical assistance Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Content and expanse of knowledge base: % of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (SP) (total of all 8 Program)</i>	UNK	54.74%	59.73%	59.76%	65.03%	+5.27%	74.4%
<i>Quality: X% of studies validated through appropriate peer review or independent review (SP)</i>	100%	100%	100%	100%	100%	0	100%
<i>Facilities Condition: Facilities are in fair to good condition as measured by the Facilities Condition Index (FCI) (SP)</i>	NA	0.17	0.17	0.17	0.17	0	0.17

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Performance Budget – Goals Overview

Resource Protection

PEO.1. Improve the health of watersheds, landscapes, and marine resources that are DOI managed or influenced in a manner consistent with obligations regarding the allotment and use of water.

The Department has natural resource direct jurisdiction over about 20 percent of the U.S. land area. Within that area, Interior administers resource protection programs on thousands of upland, wetland, and aquatic parcels. Just as the land and water resources that Interior protects are varied and large, so are the influences that pose threats to the continued viability of those resources. A principal protection concern is environmental degradation. The causes of degradation on Interior lands are both internal and external. In addition to threats posed by invasive species, illegal disposal of waste materials onto or near public lands is an all too common occurrence. The U.S. Geological Survey (USGS) provides the natural resource management community with scientific information to improve the health of watersheds and landscapes. USGS biologists work toward program goals in collaboration with other scientists, customers, and partners. Biologists combine their expertise with that of the other USGS disciplines in interagency ecosystem initiatives across the United States, from South Florida to the Puget Sound, where scientists are working together to understand, evaluate, and provide options for better resource management decisions.

PEO.2. Sustain biological communities on DOI managed and influenced lands and waters in a manner consistent with obligations regarding the allocation and use of water.

Interior's responsibilities to protect fish, wildlife, and plant communities are diverse and often without geographic bounds. The Department is responsible for protecting literally thousands of native plant and animal species. Among those species, more than 1,200 (from ambrosia to wallflower and albatross to wolf) have special status under the Endangered Species Act. In addition, Interior plays a major role in helping to ensure the continued viability of hundreds of species of waterfowl, songbirds, and shorebirds that periodically migrate to or through the United States.

Just as the biological resources that Interior protects are varied and large, so are the influences that pose threats to the continued viability of those resources. Invasive species adversely affect over 40 percent of our endangered species, and impose substantial costs on the U.S. economy. The USGS

provides scientific information through research, inventory, and monitoring investigations to the natural resource management community to support sound resource management decisions for sustaining biological communities on DOI managed and influenced land and waters. Biological

One of the most inspiring thoughts emerging from the *Future Challenges* workshop was that the USGS and FWS are two bureaus with one mission—a commitment to the use of good science in resource management. It is in this spirit of partnership that we will continue this journey, recommitting ourselves to science excellence in addressing the grand challenge of conserving America's vast heritage of biological resources.

Charles Groat, Director USGS,
August 27, 2004, Memo to All Employees,
USGS/FWS Future Challenges Workshop

studies develop new methods and techniques to identify, observe, and manage fish and wildlife, including invasive species, and their habitats; to inventory populations of animals, plants, and their habitats; and to monitor changes in abundance, distribution, and health of biological resources through time. The development of new methods and techniques allow USGS scientists to work more efficiently and cost effectively. For example, USGS has developed data collection protocols for use with palm pilots/personal digital assistants (PDAs) in the field for collecting amphibian information. This technology allows field scientists to collect data in real time for the Amphibian Research and Monitoring Initiative (ARMI) database without having to return to their office to enter the data on computers.

Because resources and species cross many jurisdictional boundaries and often have little short-term commercial appeal, no other entity has the capability or interest to ensure continuity of these long-term research and information management priorities. The Federal Government is the only entity engaged in such long-term, non-profit-driven research and monitoring, such as the Breeding Bird Survey, and amphibian research and monitoring.

Resource Use

UEO.1. Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value – Energy.

The Energy Resources Program conducts national and global energy resource assessments of oil, natural gas, coalbed methane, gas hydrates, coal, and geothermal resources; evaluates risks for environmental and ecological degradation associated with production and use of energy resources; and provides information upon which prediction, mitigation, and remediation technologies can be based. These investigations enable the Nation to make sound decisions regarding significant increases in domestic energy production with an understanding of potential impacts on the environment. The Federal Government manages about one-third of the Nation's land area. It also manages the Exclusive Economic Zone, which extends 200 nautical miles from the Nation's coasts and encompasses an area that exceeds the Nation's land area. The USGS is the primary provider of earth science energy resource information and assessments for Federal agencies such as the Bureau of Land Management (BLM) and the U.S. Forest Service, who are responsible for managing these areas.

The USGS cooperates with many local and State agencies and coal and electric power producers to assess the availability and quality of coal resources. Regional consortia are being developed between the USGS and the State geological surveys, electric utilities, coal producers, and with the Electric Power Research Institute to assess coal quality in several coal-producing basins.

The Energy Resources Program works closely with the Department of Energy in implementation of the National Energy Policy through implementation of Section 604 of the Energy Act of 2000, by estimating volumes of undiscovered oil and gas resources on Federal lands. Every 5 years, the USGS publishes an assessment of the Nation's oil and natural-gas resources; land managers, energy producers, utility managers, and policymakers, among others, use the assessment. The USGS World Petroleum Assessment assessed the 76 most productive oil and gas provinces of the world that contain about 95 percent of the world's oil and gas resources. This assessment was the first of its kind to include a rigorous geologic foundation for remaining resource volumes and the first to make those data available to the entire geoscience, business, and research community. The U.S. Department of Energy, Department of Defense,

Department of State, U.S. Agency for International Development, Energy Information Administration, International Energy Agency, the intelligence community, and over two dozen industry partners assisted in this effort.

The Energy Resources Program uses advanced technologies such as multi-dimensional seismic reflection technology to provide subsurface structural and stratigraphic information detailed enough to resolve unique questions relating to hydrocarbon resource assessment, geologic framework, petroleum system definition, and hydrocarbon and aqueous reservoir identification—information not easily obtained through the use of more traditional surface and subsurface mapping techniques. Results produced directly and indirectly from this technology support decisions concerning land use and management at the Federal, State, and local levels.

Work proposals submitted to the Energy Resources Program for funding are reviewed annually by a panel composed of senior energy scientists, both internal and external to the program. The panel makes recommendations on project progress and ensures that the targets are appropriate, ambitious, and obtainable so that they will support the accomplishment of the long-term goals. The OMB Program Assessment Rating Tool (PART) review of the Energy Resources Program for the FY 2005 budget process found the program to be working effectively with partners and fulfilling its mission and as a result received a score of 84.

The 1999 National Research Council review of the Energy Resources Program recommended that the program broaden its portfolio to include geologically based energy resources beyond oil, gas, and coal. This recommendation is fully consistent with the program's mission to provide information on energy resources, and as a result, the program has focused on and developed expertise in methane hydrates. USGS research on gas hydrates also gets reviewed every year as part of the National Research Council's purview to review work related to the Methane Hydrate Research and Development Act 2000.

UEO.2. Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value – Non-energy Minerals.

The United States is the world's largest user of mineral commodities. Processed materials of mineral origin accounted for over \$418 billion in the U.S. economy in 2004 (an increase of 13 percent over 2003); U.S. manufacturers and U.S. consumers of mineral products depended on other countries for 100 percent of 17 mineral commodities (an increase of 18 percent over 2003) and for more than 50 percent of 42 mineral commodities (an increase of 14 percent over 2003) that are critical to the U.S. economy. Making informed decisions about supply and development of mineral commodities requires current and reliable information about both mineral resources and the consequences of their development. The Mineral Resources Program (MRP) is the sole Federal provider of scientific information for objective resource assessments and unbiased research results on mineral potential, production, consumption, and environmental effects for use by land managers and policymakers to support resource use decisions to enhance public benefit, promote responsible use, and ensure optimal value. For example, the Federal Reserve relies on USGS commodities data to complete their economic reporting and forecasting. USGS collaborates with State geological surveys, universities, and mineral industry interests involved in research and development (R&D). The framework data and process understandings provided by the Mineral Resources Program are used by land managers and industry to identify and address site-specific mineral resource and mineral environmental issues and challenges ranging from determining the feasibility of new mine

Performance Budget

development to remediation of long-abandoned mine sites. The USGS also cooperates with hundreds of domestic and international producers and users of mineral commodities to compile reports on the supply and utilization of these resources for purposes of economic development and national security.

The Mineral Resources Program (MRP) comprises two major functions, a research and assessment function that provides information for land planners and decisionmakers about either known or expected locations of mineral commodities in the Earth's crust, and a data collection, analysis, and dissemination function that describes current production and consumption of about 100 mineral commodities, both domestically and internationally for approximately 180 countries. Among the many tools and technologies available in each of these functions are new robotic technologies that automate geochemical analyses, saving both time and money, and Web-based data delivery tools that serve 125 years of geochemical and geophysical data to land managers, the public, and other research scientists. Each function supports the other, and each meets the needs of different parts of the diverse community of mineral resource information users. Together these activities provide information ranging from that required for land planning decisions on specific management units to that required for national and international economic decisions.

The MRP was reviewed in 2003, for the FY 2005 budget, using the PART and was found to work effectively with partners, fulfilling its missions, and as a result received a score of 80. As described in the PART review, the MRP role is clearly defined and unique from other Federal, State, local, or private entities. Recommendations of the National Research Council (NRC) in its 2003 review of the Mineral Resources Program will be considered in developing a new 5-year plan for the program, with completion of that plan expected in FY 2005.

Serving Communities

SEO.1. Protect lives, resources and property.

Through its programs within the Geologic Hazards, Resources, and Processes Activity, the USGS provides for the Earth science information needs of a wide variety of partners and customers, including Federal, State, and local agencies, non-government organizations, industry, and academia. This information is used by the USGS and its partners and customers in evaluating resource potential, defining and mitigating risks associated with natural hazards, and characterizing the potential impact of natural geologic processes on human activity, the economy, and the environment. A comprehensive science strategy, entitled "Geology for a Changing World," was developed with program partners and customers and sets forth the science goals, objectives, strategic actions, and products expected to result from scientific activities through 2010. Each year, all ongoing and new project work and results undergo peer and management review for progress toward meeting the goals of the science strategy. Also reviewed are the accomplishments of each individual program's detailed 5-year plan that directly supports the science strategy.

USGS geologic hazards programs conduct basic and applied research, gather long-term data, operate monitoring networks, perform assessments and modeling, and disseminate findings to the public, enabling the Nation's emergency response capabilities to warn of impending disasters, better define risk, encourage appropriate response, and mitigate damage and loss. These programs are designed to produce information and understanding that will lead to a

reduced impact of natural hazards and disasters on human life and the economy. The United States is subject to a variety of natural hazards (earthquakes, volcanic eruptions, landslides, tsunamis) that can result in considerable human suffering and billions of dollars in property and business losses. The occurrence of these hazardous events is inevitable and uncontrollable. However, the extent of damage and loss of life can be reduced through preventative planning; social, economic, and engineering adaptations; provision of real-time warning capabilities; and more effective post-event emergency response. Central to this preplanning is the availability of accurate, scientifically based geologic hazards assessments and real-time warning systems that define the nature and degree of risk or potential damage. The more precisely risks can be defined the greater the likelihood that appropriate mitigation strategies will be adopted (e.g., building codes for new construction and retrofitting; land-use plans; and design and location/routing of critical infrastructure such as highways, bridges, subways, water, sewer, gas, electric, local zoning regulations, and petroleum-distribution networks). The sooner information reaches emergency response centers the sooner teams can be dispatched to resolve time sensitive medical, utility, or other infrastructure problems.

The USGS has sole Federal responsibility for recording and reporting earthquake activity nationwide. The USGS fulfills this role by operating the U.S. National Seismographic Network (USNSN), the National Earthquake Information Center (NEIC) and the National Strong Motion Program (NSMP) and by supporting 15 regional seismic networks. The USGS is building the Advanced National Seismic System (ANSS), a nationwide network of modern seismometers and data linkages. Through the ANSS, emergency-response personnel are provided with real-time earthquake information immediately following an earthquake. In regions with sufficient seismic stations, emergency response personnel receive—within minutes—a ShakeMap showing the distribution of potentially damaging shaking, information used to target post-earthquake response efforts. In addition, scenario ShakeMaps for likely future earthquakes, combined with the USGS's National Seismic Hazard Maps, help land-use planners develop safer building practices in earthquake-prone regions.

The OMB PART review of Geologic Hazard Programs, for the FY 2005 budget process found the program to have a clearly defined role unique from other Federal, State, local, or private entities, to be working effectively with partners and fulfilling its mission and as a result received a score of 82.

SEO.2. Advance knowledge through scientific leadership and inform decisions through applications of science.

The Department recognizes the value of science as the foundation for informed decisionmaking on natural resources and land-use planning. As the Department's science bureau, USGS provides knowledge through research and scientific information and leadership in transferring knowledge to decisionmakers. This goal also recognizes that science information is used by a broad community of decisionmakers, including DOI, other Federal agencies, State and local agencies, industry, academia, and the public.

The science programs of the Department focus on data collection and understanding, modeling and predicting how multiple forces affect natural systems. To improve public input, USGS meets with customers, cooperators, and others who have a major role or interest in science to help define needs and priorities. USGS also participates in interagency and intergovernmental programs designed to assess, document, and monitor ecological and socio-economic conditions and trends. The USGS uses the input received and communicates the results of the research

and monitoring in the form of new scientific knowledge that contributes to the Nation's health and welfare, helps resolve environmental issues, and assists in effective Federal land management and natural resource decisionmaking.

The USGS is committed to making available the data and information that are critical to scientific discovery and application. Databases, maps, and publications are vital sources of this information. In addition, the USGS is committed to the development and easy accessibility of tools, models, visualizations, and applications to aid policy and resource managers in the analysis and synthesis of scientific data to support decisionmaking.

The USGS works in cooperation with many organizations across the country to provide critical information to partners, stakeholders, customers, and the general public (see the Partnership section, page B-62, for examples). Through electronic infrastructures, the USGS delivers relevant data and information faster, and in more interoperable formats than in the past, leading to better stewardship of our natural resources. An example is the creation of on-demand regional scale assessments of invasive species patterns and vulnerable habitat, based on inputs of invasive species monitoring protocols, predictive models, and remote sensing data. The end product will be a dynamic and flexible system for generating electronic and paper maps of hotspots for potential exotic species invasions. This forecasting system will be available to the natural resource management community through the Internet-based National Biological Information Infrastructure (NBII).

Society needs to develop knowledge of the Earth's natural processes and cycles—their rates, frequencies, magnitudes, and how they affect each other. The USGS provides scientific data to understand issues such as coastal erosion and pollution, sea-level rise, loss of wetlands and marine habitats, the geologic processes controlling the invasion of cheat grass, and the role of dust in desert ecosystem health. Armed with this knowledge, decisionmakers can respond better to both natural and human-induced changes. Extreme changes in the environment are less costly if their likely effects can be mapped, quantified, and anticipated. Resources can be more efficiently used if the impacts of their extraction can be predicted and mitigated. Damaged or endangered ecosystems can be repaired more effectively if the natural processes that form and maintain them are accounted for in remediation and restoration plans. Strategies for conserving and using the Nation's lands and resources are improved when the natural processes at work are incorporated into predictive models and management plans in an adaptive manner.

USGS science programs work collaboratively to assist land and resource management agencies with specific research and information needs, by providing information to inform their decisionmaking and advancing the overall knowledge of the science at the same time. The USGS brings all pertinent science to bear on each issue addressed for each organization. Examples of specific areas where Serving Communities programs are related to other programs include:

- Water Resources Investigations programs often work collaboratively with the Resource Protection program, Contaminants, in investigations of the transport and fate of contaminants and hazardous materials through water systems;
- Several of the Serving Communities programs, especially the Earth Surface Dynamics Program, work cooperatively with a number of the Resource Protection programs on place-based studies in selected geographic areas around the country on a number of issues;

- The USGS Serving Communities program, Biological Information Management and Delivery, obtains a broad spectrum of biological information from the Resource Protection programs, providing information on the Nation's biological resources through database nodes, which are centers of excellence that are organized around a regional, thematic, or infrastructure focus;
- The National Cooperative Geologic Mapping Program has strong ties to the Resource Use energy and mineral resources programs, providing basic information related to the distribution of geologic formations that may lead to an understanding of the location of energy and mineral resources; and
- Several Water Resources Investigations programs are supported by Resource Use energy and mineral resources programs in their analyses of the impacts of mining and oil and gas extraction on water quality.

USGS Serving Communities programs contribute significant scientific analyses and data to assist DOI bureaus and other agencies in addressing the specific issues relevant to each of a variety of programs. USGS Serving Communities programs contribute a broad spectrum of products and research for use by Federal, State, local, and Tribal organizations and public and private entities and individuals to advance knowledge in the earth and natural sciences and to inform decisionmaking affecting land and natural resources. Some of the Serving Community programs work with partners to leverage resources in providing data and other products. The USGS and Microsoft, working under a Cooperative Research and Development Agreement (CRADA), are using the TerraServer to demonstrate *The National Map* concepts for data management and data services to other government agencies, as well as to other USGS disciplines. Specifically, the CRADA researches the online sharing of both old and new orthoimagery data among agency participants of the National Digital Orthophoto Program and the use of the TerraServer technology in serving other USGS data such as earthquake and streamgage information.

Budgeting for Performance

Base Analysis

Processes: In general, the USGS Director establishes program priorities for the budget year and issues a call for new initiatives in response to those priorities. He also accepts recommendations for all new ideas, regardless of whether they address the priorities. The Director prioritizes the proposed initiatives on the basis of the following criteria: interdisciplinary science; collaboration and partnerships with DOI bureaus, other government agencies, and universities; results of program evaluations; and demonstration of progress toward meeting the Department's performance goals and objectives. He selects from among the prioritized initiatives those that he feels he can accommodate within the funding target. The amount of increase is directly related to whether there is an allowance within the target for growth, whether all increases must be offset, whether the target itself requires reductions from base, and whether uncontrollable cost increases can be requested or must be offset. The request also addresses those items specifically required by the Department and those that are part of a Departmental crosscut request. The Capital Planning and Investment Control process provides support for decisions on technology necessary to support science and the business processes of the bureau.

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At the project level, the program coordinator and Regional Executives, in collaboration with the Bureau Program Council and any advisory boards, establish program priorities for the budget year based on the program's 5-year plan, and issues a call for projects to address those priorities. A panel of subject-matter experts reviews the proposals and recommends a suite of projects for funding.

The USGS regularly conducts management control reviews of its programs and organizations. Selected programs are reviewed each year, with the objective of all programs being reviewed once every 5 years for program management, accountability to program goals and objectives, and responsiveness to customer requirements. Regular cost-center reviews examine cost-center management, fiscal responsibility, program management, and customer satisfaction.

Although the USGS monitors the use of multi-year and no-year funding, these funds generally do not impact the planning for the next budget year. Multi-year funds are usually planned for work that extends over more than the first year of the appropriation and are generally expended within the first or second quarter of the following fiscal year. Project plans are developed accordingly. Analyses of carryover and obligation rates have not yielded results that could be translated into budget requests.

Change: The USGS requested increased funding for strategic initiatives focused on:

- Customer-driven, specifically identified needs for science support on the landscape;
- An initiative to examine ways to effectively link existing science information to the decisionmaking process to address and resolve difficult socio-economic issues related to natural resources, such as Western water disputes;
- An initiative to ensure the continuity of Landsat data availability to support research applications and change detection; and
- Presidential priorities such as tsunami research

An increase of \$7.45 million is requested for the Landsat Data Continuity Mission (LDCM). The rePARTing of *The National Map* for the FY 2006 budget process resulted in a score of 90. Among the findings, the assessment suggested that while the USGS had met its responsibilities for collecting and distributing medium and high resolution land remote sensing data, it needed to develop some long term measures for the land remote sensing program in consultation with the Department and OMB. In FY 2006, with interagency coordination and increased funding, USGS will begin the design phase of the ground systems needed for the Landsat 7 follow-on mission, set to launch in 2009. USGS will continue to carry out the role of downloading, storing, and distributing the Landsat data. In a similar vein, a \$12 million increase is requested to offset loss of revenue to the Landsat program due to sensor degradation to enable continued collection of critically needed data until a successor is launched; \$6.0 million of this increase is to restore funds that are reprogrammed in 2005 to cover the shortfall. A \$5.4 million increase is requested to support development of a global tsunami warning system and additional funding is requested for tsunami research. Additional increases support various interdisciplinary studies that support habitat restoration, ecological systems mapping and development of methods to ensure that science better informs decisionmaking.

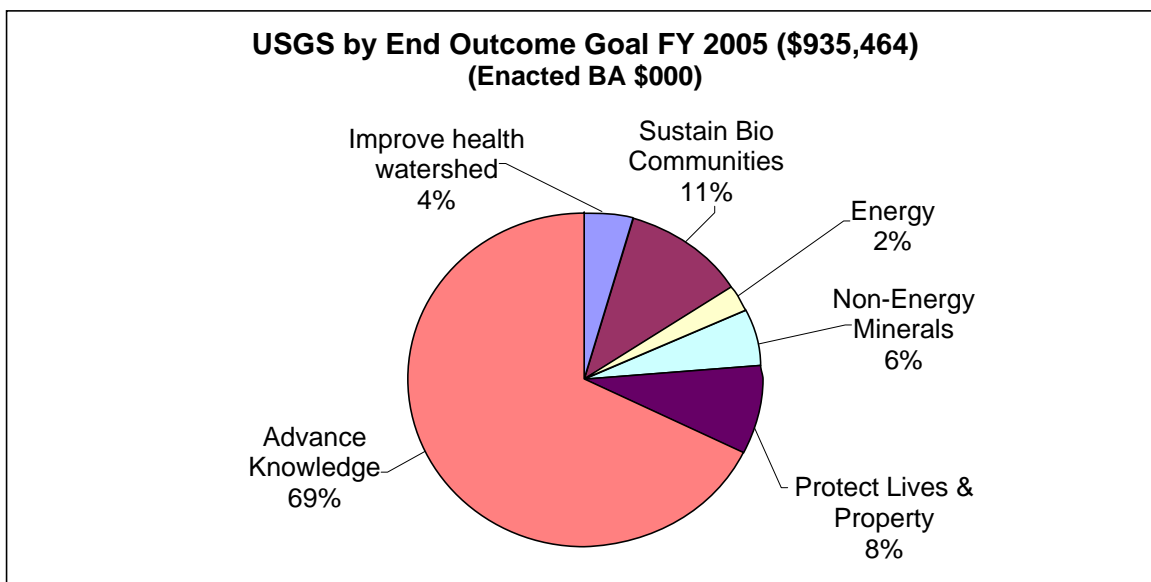
FY 2006 decreases are proposed to offset requested increases. In considering which programs to decrease and by how much, the USGS analyzed the productivity that would remain after proposed decreases, the program's remaining effectiveness for meeting its goals and objectives, customer and partner expectations for base efforts, and the impact of base

reductions on reimbursable income and receipt of in-kind services. It was concluded that the incremental absorptions of uncontrollables over the years have eroded the buying power of base funding within the bureau to the extent that marginal reductions in many programs could leave them with staff and no operating expenses. A similar situation resulted in a reduction-in-force (RIF) in 1995, from which USGS has yet to fully recover. Any new initiative or increased emphasis would therefore have to be offset by a focused, surgical program reduction.

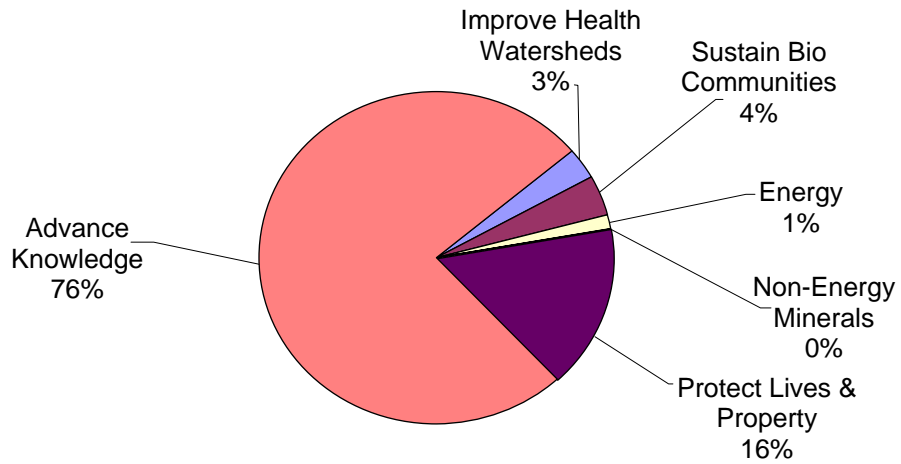
In FY 2006, the Mineral Resources program is proposed for reduction—not because the program is ineffective or inefficient—because the budget environment continues to be constrained. This reduction preserves funding for other priorities. The Minerals Program was recently evaluated by the National Research Council and by OMB through the PART process for FY 2005 (scoring 80). The program is in the process of revising its 5-year plan and has an opportunity to refocus itself to address issues within both of these evaluations. The effect of the proposed funding decrease will be most evident in data collection and management work activities with all growth eliminated in "Average square miles of the United States with non-energy mineral information available to support management decisions." This will result in a decline in customer satisfaction with data timeliness and the data's usefulness for decisionmaking—all are reflected in the targets for the DOI Strategic Plan measures.

To further reduce costs and increase efficiencies, USGS is making increased use of video/audio teleconferencing capabilities, consolidating meeting venues, evaluating co-location of staff to enhance interdisciplinary studies, and reducing USGS vehicle fleet.

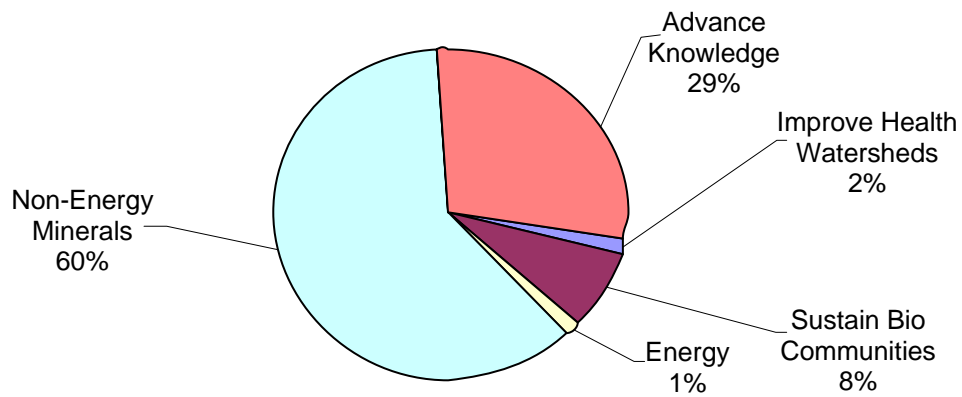
Four pie charts are provided to portray distribution of funding by goal for FY 2005 and the increases, decreases, and total proposed funding level for FY 2006. Increases are dominantly in Serving Communities – Advance Knowledge, followed by Protect Lives and Property, with the remainder collectively balanced among Resource Protection – Healthy Watersheds and Sustain Biological Communities and Resource Use Energy. Decreases are focused in Resource Use – Minerals but also include Serving Communities – Advance Knowledge and redistributions in Resource Protection.



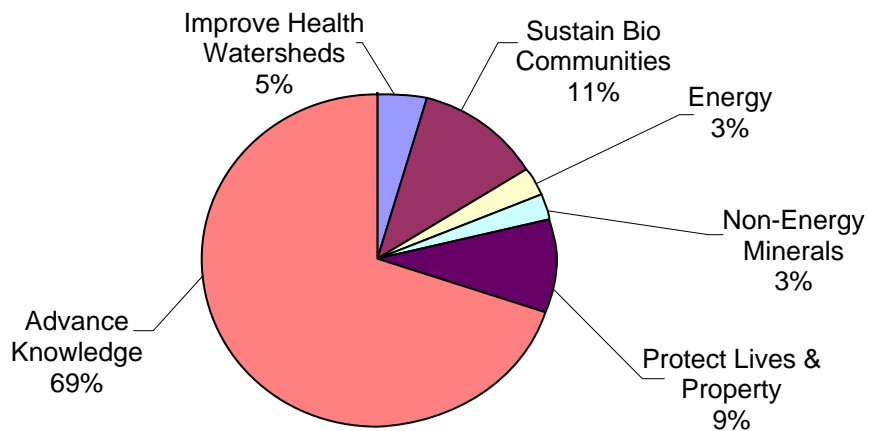
FY 2006 Proposed Program Increases by DOI Goals (\$33,439,000)



FY 2006 Proposed Program Decreases by DOI Goals (\$48,722,000)



FY 2006 Request by DOI Goals (\$933,515,000)



FY 2006 REQUEST - BA in thousands
 Crosswalk of DOI Goals to Budget Activities
 (in thousands of dollars)

Account/Budget Activity	RES. PROTECTION		RESOURCE USE		SERVING COMMUNITIES	TOTAL
	1.1 Improve health of watersheds and landscapes	1.2 Sustain biological communities	2.1 Provide access to responsible use and optimum value-energy	2.2 Provide access to responsible use and optimum value-non-energy	4.1 Protect lives, resources, and property	4.2 Advance knowledge through scientific leadership
Surveys, Investigations, and Research						
Mapping, Remote Sensing, and Geographic Investigations						133,453
Geologic Hazards., Resources, and Processes			23,615	25,084	82,209	77,228
Water Resources Investigations						204,171
Biological Research	42,194	106,582				24,149
Enterprise Information						47,767
Science Support						72,337
Facilities						94,726
SIR Appropriation, Total by End Outcome Goal <i>Mission Area Total</i>	42,194	106,582 148,776	23,615	25,084 48,699	82,209	653,831 736,040

Please note that the following DOI goals were not applicable to USGS and therefore were not displayed in the table above: Resource Protection 1.3; Resources Use 2.3, 2.4, 2.6, and 2.7; Recreation 3.1, 3.2, and 3.3; Serving Communities 4.3, 4.4, and 4.5; and Other.

Base/Redirection: Within its base program, the USGS will maintain energy development (gas hydrates) research, studies in the Pacific Northwest to improve understanding of the physical and biological factors that affect endangered species in Upper Klamath Lake, and partner development grants for *The National Map*. USGS will absorb increased operational costs for streamgages within base as well, affirming the important role they play in both environmental and hazard monitoring as underscored in the PART findings on water information collection and dissemination. USGS is requesting increased funding for half of the DOI designated level of support for the Glen Canyon Dam Adaptive Management Program, redirecting base funding to support the other half of the requirement. Redirections within base are relatively balanced among Resource Protection – Sustain Biological Communities, Resource Use – Energy, and Serving Communities – Advance Knowledge.

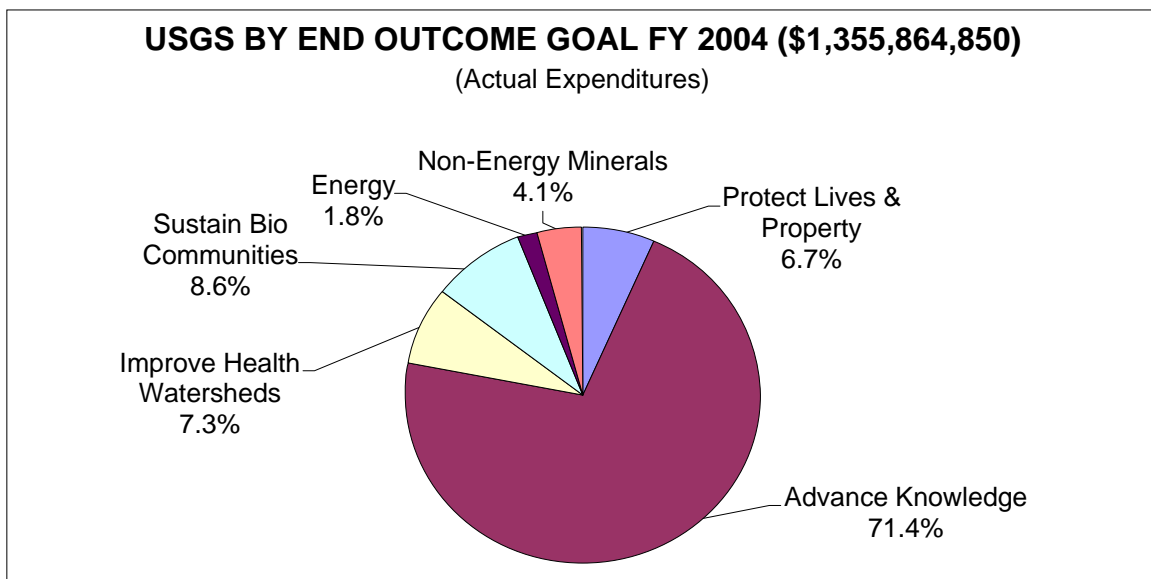
Analysis: ABC data presented in this analysis are the product of 1 year of implementation. Several years of implementation will be needed to standardize processes, ensure consistency of interpretation and application of work activity definitions across the organization and across the scientific disciplines, and to identify trends in the data that can lead to programmatic

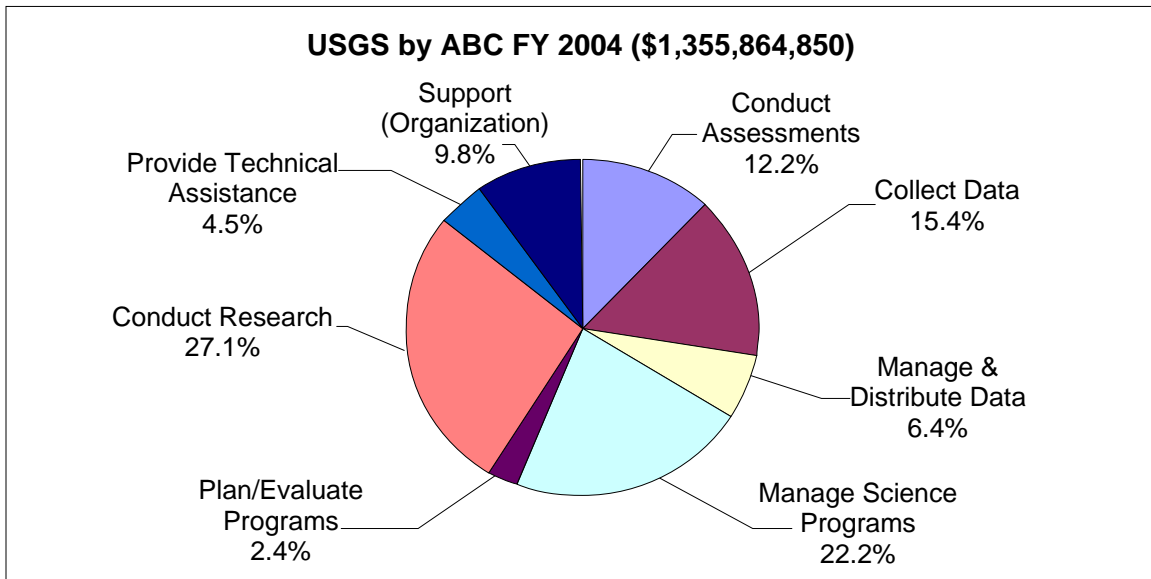
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decisions. The results of this analysis are being factored into changes in implementation, systems, and processes as well as working toward a common set of outputs for GPRA and ABC/M for FY 2005.

USGS began initial analysis of ABC/M data mid-year FY 2004, verifying and validating USGS work activity data by comparing them with year-end FY 2003 results by Budget Activity and goal. The data used for the reports were pulled from the Federal Financial System (FFS). "Unknown" codes representing those costs that were not assigned an ABC code were eliminated in FY 2004—due to our verification and validation process (reduced from 6 percent in FY 2003). "Manage programs" is a "direct" distributable cost within a Budget Activity/discipline. Science Support / Facilities / and IT are actual cost of all indirect activities Sustaining the Organization for the DOI Strategic Plan.

The next two pie charts show the bureau's actual distribution of expenditures to goals and to work activities for FY 2004. The Serving Communities goal has by far the most funding because it comprises USGS geologic hazards programs supporting "Protect lives, resources and property" end outcome goal and a collection of programs for "Advance knowledge through scientific leadership and inform decisions through application of science" end outcome goal including information programs such as Biological Information Management and Delivery, as well as all of Geography, Water Resources, and Science Support and all the remainder of Geology except Minerals and Energy, which are the sole components of Resource Use. Resource Protection includes the Biological Monitoring and Research subactivity and the Cooperative Research Units subactivity.

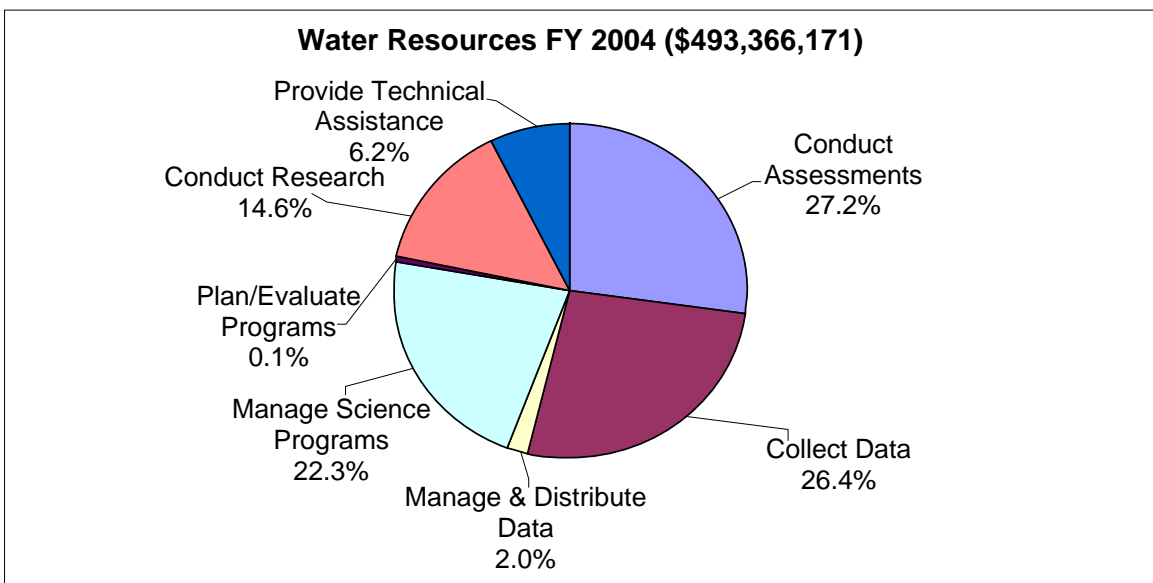
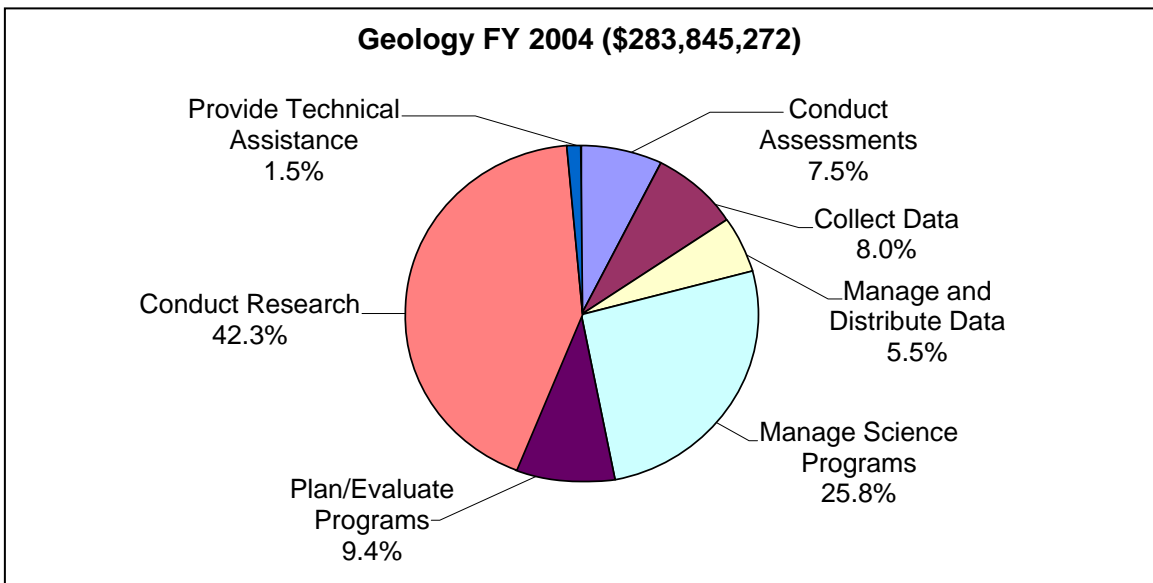
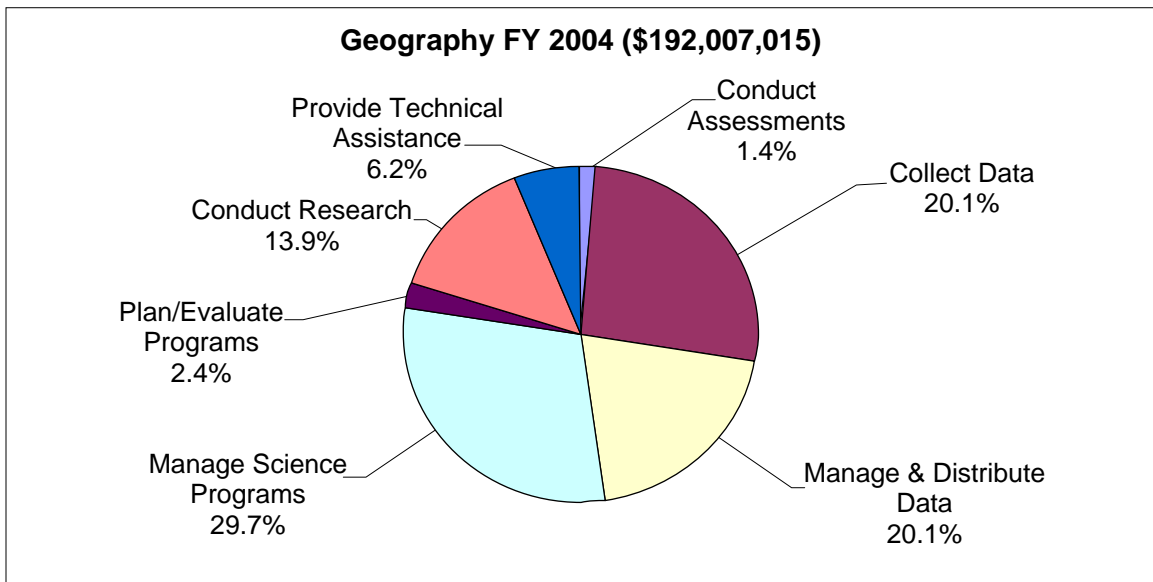


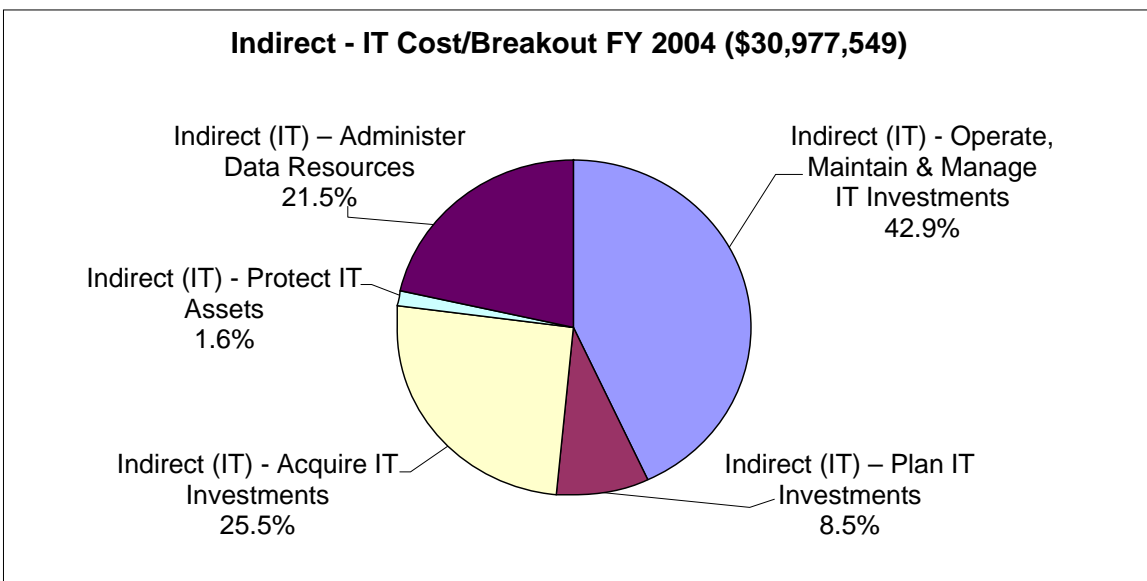
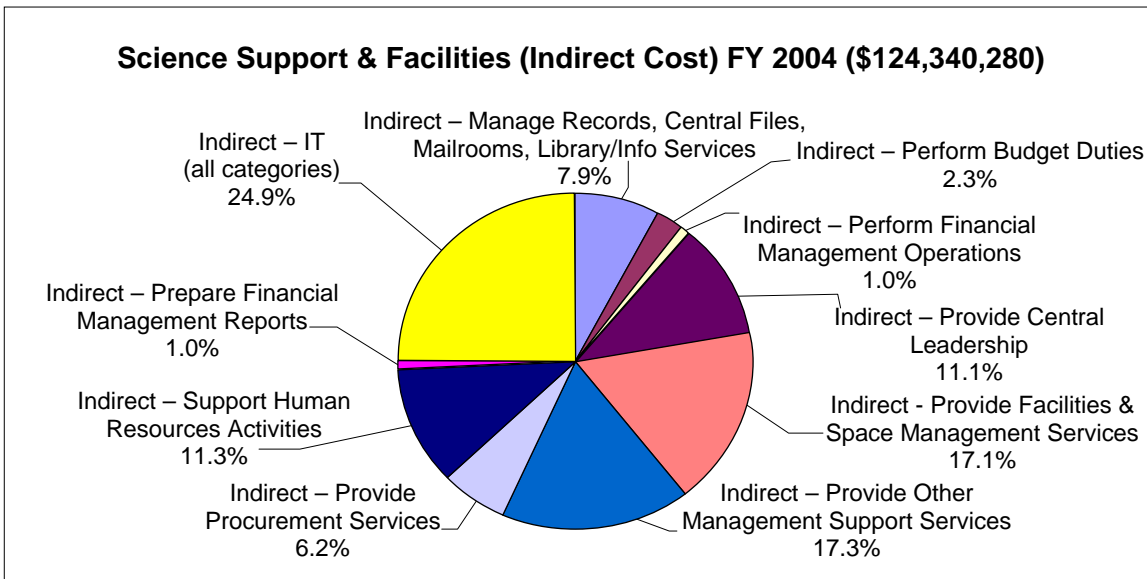
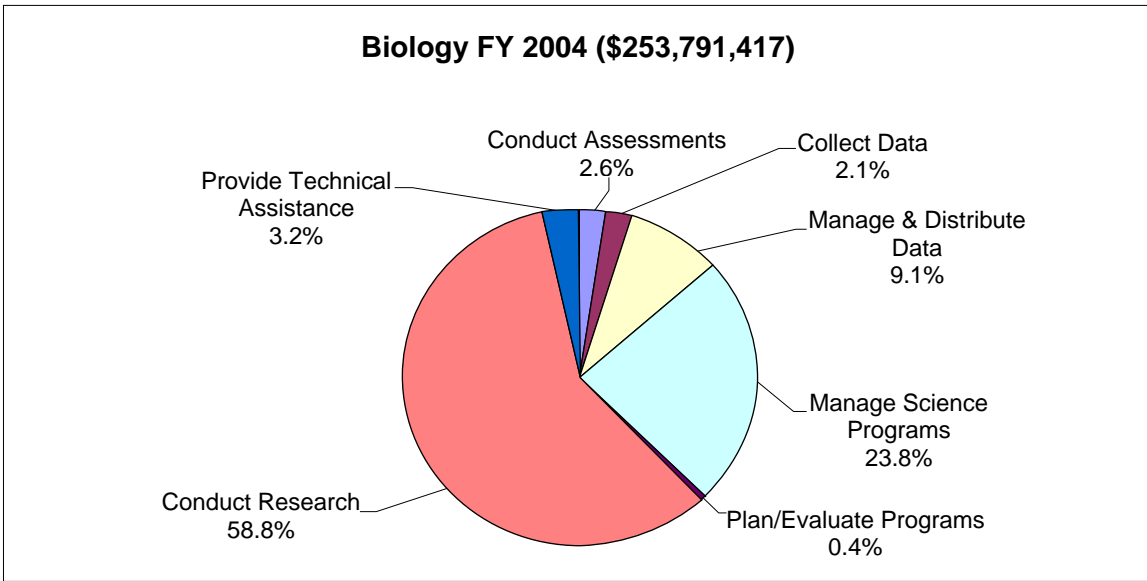


For FY 2004, the bureau as a whole reasonably balanced research with long-term data collection and management. Organizational support functions were about 10 percent while direct planning, management and evaluation of science programs totaled 25 percent of total expenditures. Technical assistance came in at 5 percent but may be registering lower than anticipated due to the cost being included in research projects. This approach means that the only technical assistance costs that were captured would be those resulting from projects dedicated specifically to technical assistance. This reveals that we will need to restructure projects and level of ABC coding to better capture cost of outputs. Our project planning tool, BASIS+ (Budget and Science Information System), is being studied to see how best to accomplish this.

Drilling down to the bureau's actual distribution of expenditures to Budget Activity or discipline for FY 2004 helps to pinpoint areas to question project structure as well as noticing apparent distinctions among programs. Immediately noticeable in the following pie charts are the differences of the Water Resources and Geography programs as compared with the Geology and Biology programs. The latter are heavily weighted to research with a much smaller long-term data collection and data management effort. The former are heavily weighted to long-term data collection and technical assistance, but with Water programs demonstrating a much higher component of assessments (due to the National Water Quality Assessment program) than any of the other science disciplines. Drilling down into the data indicate that Geology has a fairly large component as well, but focused more in the hazards and natural resource areas. ABC enables demonstration of what formerly was intuitive. It also leads to questions regarding the small percentage of technical assistance recorded for Biology—a small number is counterintuitive given the programs' direct support for the DOI land and resource management bureaus and is worthy of further investigation as to whether the work activity definition is being consistently applied or would benefit from review of project structure. Analysis of these data can have implications for managing funding resources/object class and staff deployment.

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Information Technology (IT) represents 25 percent of the entire indirect cost category. These indirect IT costs are for infrastructure and enterprise systems supporting the science mission delivery systems, but do not include the cost of the mission delivery systems such as the National Water Information System (NWIS) or National Biological Information Infrastructure (NBII) which are a part of full cost accounting for the relevant science programs. The indirect IT cost will not total the IT investment portfolio (Exhibit 53). Within these indirect IT costs, the largest component is O&M (operation and maintenance) followed by system acquisition and data administration.

In addition to continuing to verify and validate data and improve understanding and process application, USGS is also in the process of attempting to standardize ABC, Strategic Plan, and PART outputs. USGS believes that close linkages will enable better costing of outputs, understanding of relationships, and leveraging of management information. The process of developing these standardized outputs will further refine the definition templates and further contribute to more consistent application.

More detailed analysis of base funding by goal is provided in "Section II D. Achieving DOI Mission Goals."

Means and Strategies

USGS employs a robust and cyclic requirement for science planning, program reviews, cost center reviews, management control reviews, and peer reviews and continues to refine these processes. This array of tools is now supplemented further and coordinated with PART evaluations, and is also beginning to include the results of ABC/M to further instruct our planning processes.

Science Planning: During the past year, a subcommittee of the Bureau's Program Planning Committee drafted a *Science Planning and Implementation Handbook* to provide USGS managers and scientists with information needed for annual science planning and implementation, including entering information into the Budget and Science Information System Plus (BASIS+), reviewing project work plans and funding requests, and allocating funds to accomplish the work. It is based on the Bureau Planning Model and includes information about how USGS fits into the larger Federal Budget Process, the development of new initiatives, and budget and performance integration. The Handbook has been designed to be used on the Intranet, rather than to be printed. Taking advantage of the Web format, it provides not only general information but also, through the use of hyperlinks, layers of more detailed information for those who want or need to learn more. The recommended approach to using the handbook is through the links imbedded in the boxes of the *Annual Science Planning and Implementation Timeline*.

Strategic Change: To further the objectives of Budget and Performance Integration, increasing focus on and accountability for the planning process, the Director has elevated planning responsibility to the senior executive level and created a Bureau Program Council.

In a strategic move to strengthen geographic research and to consolidate geospatial data programs, the Director has begun a bold and forward-looking program realignment. The decision to reorganize is in direct response to:

- Discussions with constituent groups about how best to meet their geospatial data needs, and
- Recommendations from a report by the National Research Council of the National Academies.

The realignment builds on the program improvements generated in response to the FY 2002 PART assessment of *The National Map*. As the Director stated:

"The Geographic Information Office created in 2000, while retaining CIO responsibilities, will now serve as the bureau focal point for science data integration, synthesis, and delivery, particularly geospatial data. The office will be renamed the Geospatial Information Office (GIO) and a new National Geospatial Programs Office (NGPO) will be established within the GIO. This office will oversee the entire portfolio of national geospatial programs for which the USGS has responsibility, including the Federal Geographic Data Committee, the Geospatial One Stop E-Gov project, and the Department of the Interior Enterprise Geospatial Information Management activity. *The National Map* and GEODE, will be transferred to the NGPO as the first step in bringing USGS national geospatial data programs under unified leadership and management.

The National Research Council report on Research Opportunities in Geography at the U.S. Geological Survey recommends, 'The Geography Discipline should now expand its activities to assume its proper role among the other disciplines at the USGS by engaging in fundamental geographic research... A strong Geography Discipline with a productive research component will ensure recognition of the USGS as scientifically credible, objective, and relevant to society's needs.' The Associate Director for Geography will now focus efforts on developing USGS research and applications activities with the Geographic Analysis and Monitoring, Land Remote Sensing, and Science Impact programs as the centerpieces."

The Geographic Research and Geospatial Information Transition section further describes this strategic change.

Science Integrity: Integrity remains the foundation of all DOI science: impartiality, honesty in all aspects of scientific enterprise, and a commitment to ensure that information is available to the public as a whole. The Department is committed to common standards for peer review for all scientific research across the Department. Departmental standards and practices, developed through an exercise in the 4-C's among Interior scientists, have been introduced as *A Code of Scientific Conduct* with new, commonly agreed upon guidelines on information quality, objectivity, utility, and integrity. The USGS took a leadership role in the development of the Code, which has undergone rigorous review by all bureaus and external stakeholders. The Code was announced on March 24, 2004, and a DOI Manual Chapter is being drafted. As part of the code of scientific conduct, each bureau and office is required to establish procedures to provide appropriate scientific expertise to investigate allegations of misconduct and provide for due process in the conduct of such investigation. The Department asked the USGS to create a model procedure to handle allegations of misconduct. A USGS team of scientists, managers, and human resource specialists has been working with human resource specialists and

solicitors from DOI to craft the model. A draft policy was completed by USGS and briefed to the Senior Science Advisor to the Secretary and submitted to the Department for final review and implementation. When revisions are completed the policy will be released as a Personnel Bulletin by the DOI Personnel Office for use by all bureaus. The USGS also developed a process to readily identify employees covered by the code of scientific conduct using the personnel information system and a second Personnel Bulletin will be issued to assist the bureaus in identifying which employees will be affected by the new policies.

The USGS has been similarly engaged in a departmental task force for the development of a policy on peer review, the quality assurance procedure for research. The task force reviewed the current status of peer review policies in DOI bureaus and the adequacy of the guidelines developed and implemented in 1996. A new peer review guidance document is being developed in consideration of the current guidelines, the draft Code of Scientific Conduct, the growing interest in peer review by Congress, and OMB memorandum M-05-03, "Final Information Quality Bulletin for Peer Review." The departmental task force is writing flexible guidance under which the bureaus can develop more specific peer review guidance. DOI will issue a Departmental Manual release on both Scientific Conduct and Peer Review.

It is the policy of the USGS to conduct its activities and to make the results of its scientific and engineering investigations available in a manner that will best serve the whole public, rather than the interest or benefit of any special group, corporation, or individual.

From the *U.S. Geological Survey Manual (500.14)*

Thorough and broad scientific review is central to the quality of USGS products. The Executive Leadership Team has developed a set of fundamental science practices, philosophical premises, and operational principles that are the foundation for all USGS research and monitoring activities. These fundamental science practices do not address what work the USGS should do but rather how the science is carried out and how the resulting information products are developed, reviewed, approved, and released. USGS is now developing the necessary bureauwide policies and guidelines for these fundamental science practices. We intend to recognize and incorporate the best of our current practices as we implement the optimum overall program for our science. No matter what policies and guidelines are developed, the responsibility for science excellence remains where it has always been—in the hands and minds of the outstanding scientists of the USGS.

Program Evaluations: Program evaluations are an important tool in analyzing the effectiveness and efficiency of our programs, and evaluating whether they are meeting their intended objectives. These evaluations are the foundation on which USGS gages performance relative to the DOI End Outcome measure for soundness of methodology, accuracy, and reliability of science. Our programs are evaluated through a variety of means, including performance audits, Program Assessment Rating Tool (PART—discussed further in the Budget and Performance Integration section), financial audits, management control reviews, and external reviews from Congress, OMB, Office of the Inspector General (OIG), and other organizations, such as the National Academy of Public Administration and the National Academy of Science. These reviews, which may take several years to complete, are critical to maintaining the USGS's reputation for scientific excellence and credibility as well as providing guidance for future research needs. The evaluations not only improve the accountability and quality of programs, but also identify and address gaps in programs; redirect or reaffirm program directions; identify and provide guidance for development of new programs; and review and (or) motivate managers and scientists. For example, based on a number of factors, including the

recommendations of the External Scientific Advisory Committee on Scientific Services (as contained in the March 2004 report, The Future of Regional and National Scientific Services of the Water Resources Programs), the USGS has decided to close the water-quality laboratory in Ocala, FL, and transfer most of its functions to the National Water Quality Laboratory in Denver, CO. Given the recent budget shortfalls at the Ocala Lab and projected continuing shortfalls, the USGS has determined that consolidation of this function is more cost effective than maintaining two separate laboratories.

Examples of program reviews completed in FY 2004, and planned for completion in FY 2005 and FY 2006, by external entities such as National Academy of Science, Scientific Advisory Committees and OMB (PARTs) follow:

FY 2004

National Academy of Science/National Research Council

- Landslide Hazards Program
- Coastal and Marine Geology Program
- Water Resources Research Act Program

Scientific Advisory Committees

- National Coop Geologic Mapping Program
- Earthquake Hazards Program
- Cooperative Water Program
- Water Resource Research Institutes

OMB PART

- Water Resources Research
- Water Information Collection & Dissemination
- *The National Map* (Geography) - RePART

FY 2005

National Academy of Science/National Research Council

- Economic Benefits of Improved Seismic Monitoring
- River Science
- Research Priorities in Earth Sciences and Public Health
- Geomagnetism Hazards Program
- Assessment of Water Resource Research
- Cost Benefit Analysis of WRD Streamgaging Program (Nat. Hydrologic Warning Council)
- Geography External Program Review (AAG annual conference)
- Geography Science into K-12 Curriculum
- Review of USGS Cooperative Water Program (Advisory Committee on Water Information)
- Earth Science Applications from Space

Scientific Advisory Committees

- National Coop Geologic Mapping Program
- Geomagnetism Hazards Program
- Earthquake Hazards Program

OMB PART

- National Cooperative Geologic Mapping
- Biology Research and Monitoring
- Biological Information Management and Delivery

FY 2006

National Academy of Science/National Research Council

- River Science
- Geologic Record of Ecological Dynamics

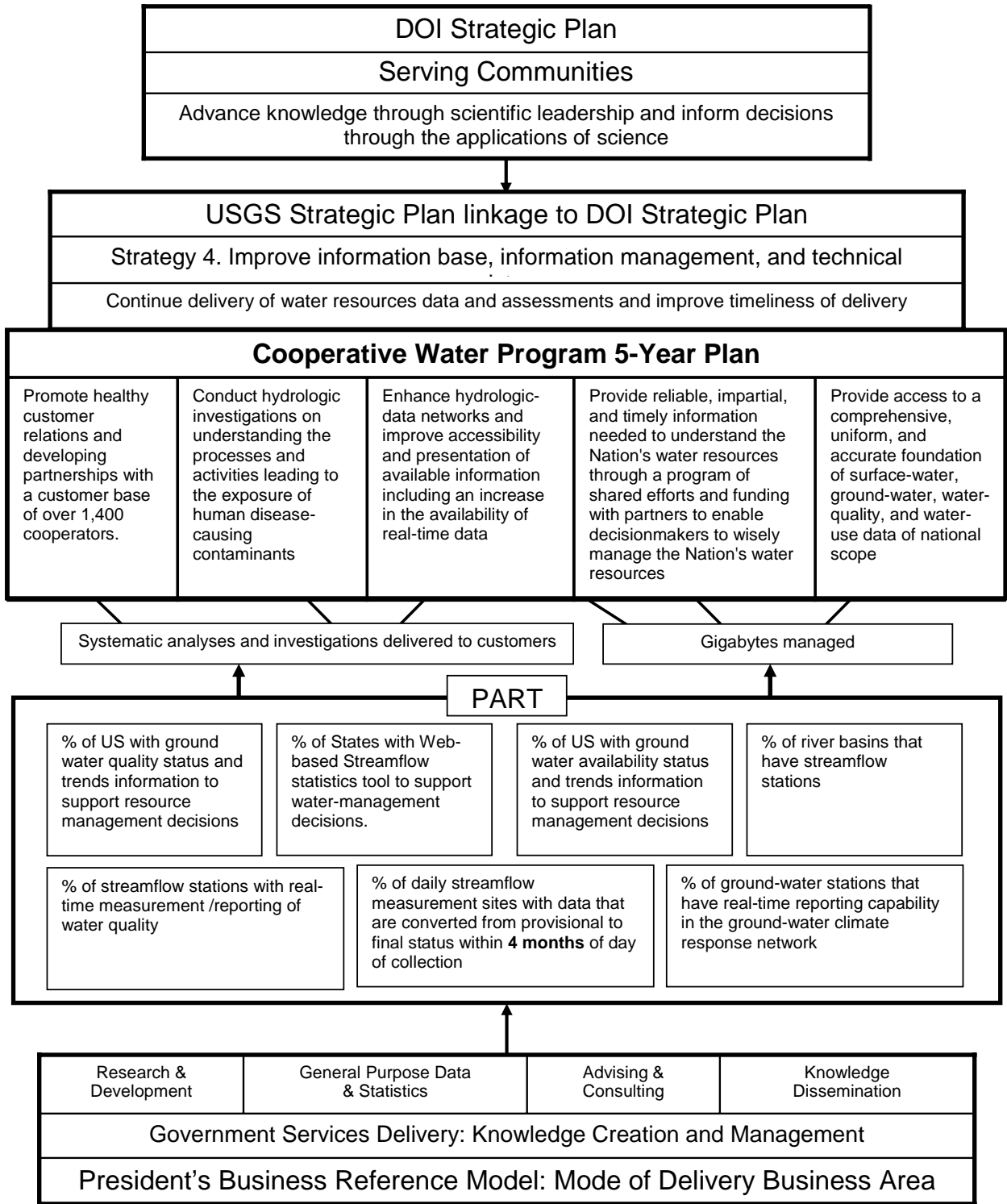
Scientific Advisory Committees

- National Cooperative Geologic Mapping Program
- Earthquake Hazards Program

OMB PART

- Earth Surface Dynamics Program
- Coastal & Marine Geology Program
- Water Resources Research Act Program
- Biology Cooperative Research Units
- Deferred Maintenance and Capital Improvement

Both program evaluations and the DOI Strategic Plan instruct the development of 5-year science plans for all programs. A diagram depicting relationships follows on the next page.



Activity Based Costing/Management (ABC/M): Another tool that USGS is just beginning to implement in concert with the Department in FY 2004 is ABC/M. ABC/M will help USGS explain how we serve the public and what they get in return for the money they, as taxpayers, invest in us to provide them with the quality products and services that they reasonably expect. Capturing cost of work will also help USGS better document the basis for cost-share projects, assessment, and cost recovery. Analysis done on End of Year 2004 ABC data, revealed the need to restructure projects to better capture cost of outputs. Our project planning tool, BASIS+, is being studied to see how best to accomplish this. ABC/M is discussed further in the cost and performance section and the base analysis sections.

Workforce Planning Strategy: The workforce planning strategy implemented by the USGS aligns with USGS science goals and ties to GPRR goals; identifies areas in which the USGS needs to build internal capacity, contract with the private sector, and partner with other organizations; uses workforce planning to forecast future critical skill needs and identify mechanisms for recruiting, developing, and retaining a diverse workforce with those critical skills; aligns individual employee performance and rewards with organizational performance; and makes effective use of technology.

GAO Information Technology Investment Management: USGS has adopted the GAO Information Technology Investment Management (ITIM) Framework as the USGS maturity model and is developing ITIM maturity goals for investment management within USGS to coincide with the DOI ITIM Strategic Plan goals. The USGS anticipates compliance with achieving Stage 2 of the GAO Framework by the end of FY 2005.

Working Smarter

USGS Science Initiatives: The following FY 2006 USGS Science Initiatives build on collaborative partnerships with DOI bureaus, Federal and State agencies, Tribes, and universities to identify management and resource issues at regional and local levels and the science needed to address these complex issues. The increased involvement of multiple partners leads to efficiencies of a coordinated science response on the landscape, thus reducing potentially redundant work; joint planning and sharing of resources, including leveraging of funds, in-kind contributions, and co-location; and technical transfer of existing information that addresses similar issues on multiple sites.

Initiated in FY 2004, **Science on the DOI Landscape** has garnered significant support from DOI bureaus as they determine their regional science priorities. Examples of successful collaborative projects that have leveraged USGS and bureau funding include Mancos Shale landscape studies with BLM; coalbed methane research to meet the needs of BLM, BIA, and Indian Tribes; a workshop on environmental effects of mercury in which speakers representing USGS, NPS, FWS, MMS, Indian Trust Lands, EPA, NOAA, and others shared information on mercury mitigation practices; and a project in the Mojave Desert on desert tortoise habitat conducted with NPS and BLM managers. As an outgrowth of Mancos shale and coalbed methane projects, the USGS, BLM, and FWS held joint workshops and field trips in western Colorado and in Wyoming to explore other areas of collaboration such as invasive species, sage grouse habitat, and land-use and recreation issues. Emphasis in FY 2006 will build on some of these accomplishments with a focus on sustainable ecosystems in sage grouse habitats impacted by invasive species and fire in the northern Front Range; continued work on mercury as one of many impacts on water quality; and additional work in the Lower

Colorado River basin that addresses history and rates of landscape and ecologic change. These interactions will continue to bring scientists and department resource managers together on the ground to promote collaboration among the DOI bureaus and to determine jointly how USGS can best address complex management needs.

Science Impact provides collaborative processes used with DOI bureaus, university partners, and stakeholders to examine ways in which existing science information can effectively be linked with the decisionmaking process to address and resolve difficult socio-economic issues related to natural resources, such as Western water disputes. Institutional analysis and economic evaluations such as benefit-cost analysis provide additional context, information, and perspective on the effective and cost-efficient use of science.

Glen Canyon partnership initiative supports biological and geological research activities designed to better understand the Colorado River ecosystem within Grand Canyon National Park and provide input related to decisionmaking regarding Glen Canyon Dam operations. With this initiative, USGS will be able to develop and refine fisheries stock assessment models, provide information on critical habitat for the endangered humpback chub, and support experiments on non-native fish removal from the Colorado River. The results from this initiative would be shared with 25 stakeholders to include Federal, State and Tribal governments and NGOs.

Great Lakes partnership initiative provides information critical to State, Federal, and Tribal agencies for their management of valuable fishery resources and aquatic habitats in the Great Lakes. USGS provides quantitative scientific knowledge for assessing, protecting, and rehabilitating these resources and habitats to assist partners in better predictions of recruitment, growth, and survival of these fish communities.

Puget Sound initiative provides critical scientific information needed by local, State, Tribal and Federal decisionmakers for protection and restoration of coastal ecosystems of the Sound. The initiative will ensure collaboration with these and other partners and will provide insights into the complex, cumulative effects on watershed and marine ecosystems and fisheries restoration. Further, the results will document ecosystem recovery and help to minimize adverse affects on people, fish, and wildlife.

The Landsat Data Continuity Mission (LDCM) initiative will enable the USGS to begin the upgrades to the Landsat 5 and Landsat 7 ground processing systems in time to receive, process and archive data from a new "Landsat Imager" being developed by NASA that will be launched with the first of NOAA's National Polar Orbiting Environmental Satellite System missions in 2009. This mission will fulfill the data continuity requirements of P.L. 102-555 The Land Remote Sensing Policy Act of 1992, which directs Landsat Program Management to develop a successor system to Landsat 7. The LDCM Project will ensure continuation of a collection of consistently calibrated imagery of the Earth's land mass, coastal boundaries, and coral reefs ensuring maximum utility in supporting the scientific objectives of monitoring changes in the Earth's land surface and associated environment. Image data from satellites, such as the Landsat series, are one of the most efficient, cost-effective sources of essential geospatial information for the scientific and operational land and resource management communities.

Enterprise IT Investments (ESN, Messaging, Web Active Directory, E-Authentication): In FY 2004, the USGS supported the Department's IT Infrastructure Transformation Strategy, which consists of several integrated enterprise IT projects designed to consolidate and enhance DOI network, messaging, directory services and Web infrastructures. The consolidated infrastructure will replace existing independent bureau IT infrastructures while providing cost sharing and enhancement opportunities to all bureaus. The potential benefits gained by migrating to a single enterprise infrastructure include centralized, standardized and efficient operations; enhanced accountability for performance; a uniformly high level of security; and improved technical support for managers.

In FY 2004 the USGS dedicated FTE to each DOI Enterprise Investment to lead and (or) participate on the project teams including: Enterprise Architecture, Enterprise Messaging, Enterprise Services Network, Active Directory, and DOI Enterprise Web. In support of the Enterprise Messaging project, the USGS dedicated a full-time Program Management Institute (PMI) certified Project Manager. In support of the Active Directory project, the USGS developed a comprehensive Configuration Management Plan and conducted a Server Security Pilot Study. The USGS actively participated in the requirements analysis and technical design of the Enterprise Services Network (ESN) and negotiated an agreement to transfer ownership of the USGS Wide Area Network (WAN) to serve as a foundation for ESN. The USGS contributed to the DOI Enterprise Architecture (EA) through participation on the EA Domains Teams and the development of the Department Enterprise Architecture Repository (DEAR).

In FY 2005, the USGS will continue to support and lead the DOI Enterprise Investments. Goals and objectives include fully converting the USGS WAN to ESN Phase I, connecting the USGS Active Directory "forest" to the DOI root directory, participating in the development of a detailed requirements analysis, alternatives analysis and project plan for Enterprise Messaging, participating in the development of the DOI Enterprise Architecture Modernization "Blueprints," and developing a consolidation strategy for DOI Enterprise Web. USGS plans to complete implementation of Active Directory by the end of calendar year 2006 and to migrate to Microsoft Exchange (DOI Enterprise Messaging) in the third quarter of FY 2006. USGS plans to direct approximately \$730,000 from existing resources in FY 2006 to implement the DOI E-Authentication initiative.

FBMS: USGS is actively participating in the Department of the Interior's Financial and Business Management System (FBMS) by staffing five key positions to the Project Management Office on a reimbursable basis. USGS is scheduled to implement FBMS effective October 2007 (FY 2008). The USGS will work with the Department to develop initiatives for additional resources to accomplish data clean-up/mapping and conversion to the new administrative modules, including budget, acquisitions, property, and core financial data.

Customer Service

Standard Customer Satisfaction/Outcome Surveys began in FY 2001. Since then, more than 1,500 customers, mostly scientists and resource managers, have described their satisfaction with various aspects of more than 30 different USGS science products. Many enhancements have been made to these products in response to the expressed needs of our customers. Because a different set of products is sampled each year, one year's aggregate measurement is not directly linked to the following; that is, these should not be considered strictly comparable time series measurements. Regardless of the set of products sampled, however, the intent is to maintain at least a 90 percent overall satisfaction level. Responses are collected online or via e-mail from samples of specific science product users. While the surveys

all follow the same format, each one is modified to meet a specific program's customer information needs. The final result of each survey is immediately useful to the program manager as well as being formatted for combined bureau analysis and reporting of satisfaction ratings and usage by product type and discipline area. The results meet the goals of the DOI strategic plan and support PART evaluations.

The science programs/products surveyed in FY 2004 include:

- *The National Map*
- *Atlas of Natural Hazards in the Hawaiian Coastal Zone*
- *National Cooperative Geologic Mapping Program Web site*
- *The Communicator* (a weekly Web-posting of activities from the Director's Office)

Use of customer feedback from Customer Satisfaction/Outcome Survey on the Atlas of Natural Hazards in the Hawaiian Coastal Zone.

We received very valuable information on how the atlas is being used and many suggestions on how to improve its usability. One improvement we have already made has been to include on the atlas Web site ArcView/GIS compatible shape files of the data for each main Hawaiian island (<http://pubs.usgs.gov/imap/i2761/>). This is the first comprehensive, multi-hazard coastal atlas produced by the USGS for a section of U.S. coastline. We are considering producing similar products for other areas of the United States and your comments will help tremendously with our planning efforts.

FY 2004 USGS Customer Service Plan Accomplishments

Customer Action Team: The Customer Action Team (CAT) assists programs in gathering, measuring, and analyzing customer information. The team is promoting the use of a common customer information framework among the bureau's programs. While all programs have a wide range of customer data, the data are not in easily accessible or easy-to-combine forms and require significant effort via data calls and aggregation to get information that can be used at a bureau level. A key goal for the CAT is to help programs gather and manage customer data in a common way while ensuring there is immediate value to the programs as well as the bureau. This information is being made available to all bureau programs by means of an Intranet Web site.

Collect Customer Satisfaction Information: The USGS continued a 3-year information collection program, approved by the Office of Management and Budget (OMB) in 2002. In addition to the formal Customer Satisfaction/Outcome surveys, feedback was obtained by means of Customer Listening Sessions, external program reviews, counter surveys at Earth Science Information Centers, customer response cards, and feedback buttons on Web sites.

Support DOI Strategic Plan: Several of the outcome measures in the DOI Strategic Plan incorporate customer satisfaction metrics. The bureau devised and reported such measures in the areas of Resource Protection, Resource Use, and Serving Communities.

Leadership of Interior's Customer Forum: USGS continued to participate in the DOI Customer Forum, an intradepartmental working group consisting of representatives from each Interior bureau and office. The USGS representative serves as the technical advisor for DOI information collection submissions to OMB under the Department's generic customer satisfaction survey clearance.

Internal Customer Feedback: Science support offices and products were assessed using e-mail-administered employee opinions surveys. Standardized Management Control Surveys were conducted at six programs/science centers/teams doubling the three conducted in FY 2003.

Use of Management Control Survey Results

Great Lakes Science Center, Grand Canyon Monitoring and Research Center, and Alaska Integrated Science Center: The results of the employee opinion survey assisted the science center review panels to identify apparent strengths and weaknesses of the Centers, and issues that merit further investigation by the review panels.

Global Change Program: "There is widespread agreement among all PI's (principal investigators) that they would like to learn more, interact more, and be more involved with global change scientists/activities."

Safety, Health, and Environmental Program: "Customer Survey results and comments will be reviewed and discussed within the Bureau OSHE Council and Regional Safety Committees to establish OSHE program enhancement/improvement initiatives/actions based on areas of significant disagreement or adoption of customer suggestions. OSHE initiatives arising out of this process will be incorporated into the USGS OSHE Program Action Plan that is forwarded to the Department annually."

Business Leaders Team: "We used the survey and report as the foundation of a very productive half-day meeting. At that meeting, based on the results, we agreed on our purposes, clarified roles and responsibilities, examined and revised our membership, changed the meeting format, determined to have quarterly face-to-face meetings, identified an executive secretary role for the group, set priorities, and determined a work style."

FY 2005 USGS Customer Service Plans: The Customer Action Team (CAT) plans to conduct pilot projects with three bureau programs to develop the Intranet Web site as a clearinghouse for program customer information.

Customer Satisfaction Surveys: On an on-going basis, two to three science products will be surveyed each quarter. The methodology will be extended to a broad survey of Biology discipline research projects.

Employee Feedback: Customized Management Control Surveys will be conducted in at least five programs/science centers.

Achieving DOI Mission Goals

The USGS vision, mission, and strategic direction focus on responsiveness and customer service, underscoring the application of science to customer, partner, and other stakeholder needs. They direct the combined expertise of the bureau's scientific disciplines and define its commitment to pursuing an integrated approach to providing science for a changing world.

The USGS leverages its resources and expertise in partnership with more than 2,000 agencies of Federal, State, local, and Tribal governments; the academic community; non-governmental organizations; and the private sector. Field investigations, direct observations of natural science processes, and monitoring and data

It is the policy of the Department of the Interior that science shall be fully integrated and effectively used in the land and resource regulatory and management policies, practices, and decisions of the Department and its bureaus.

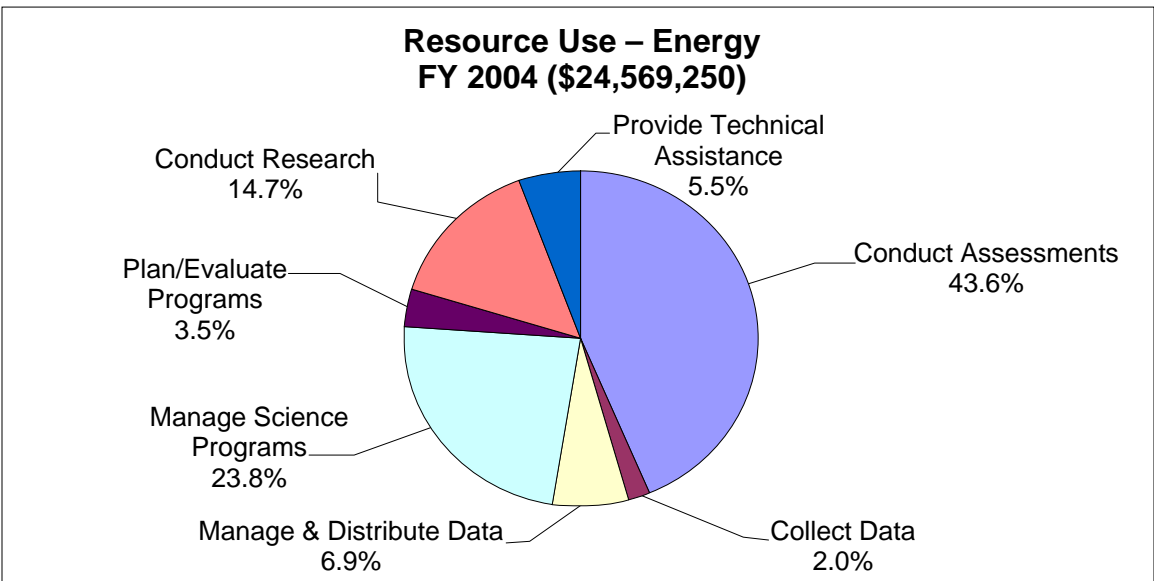
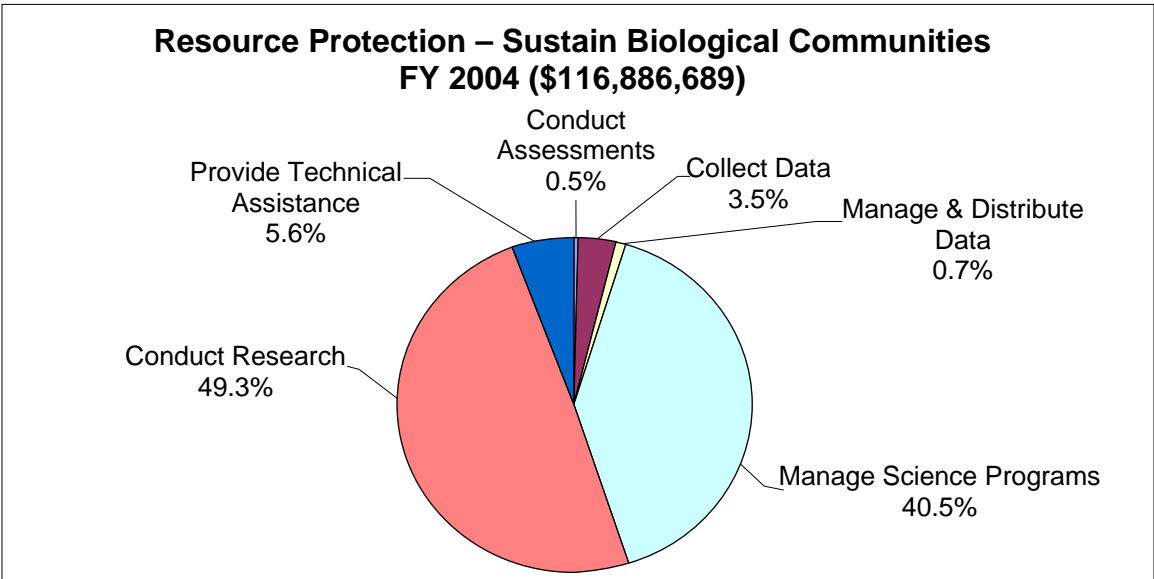
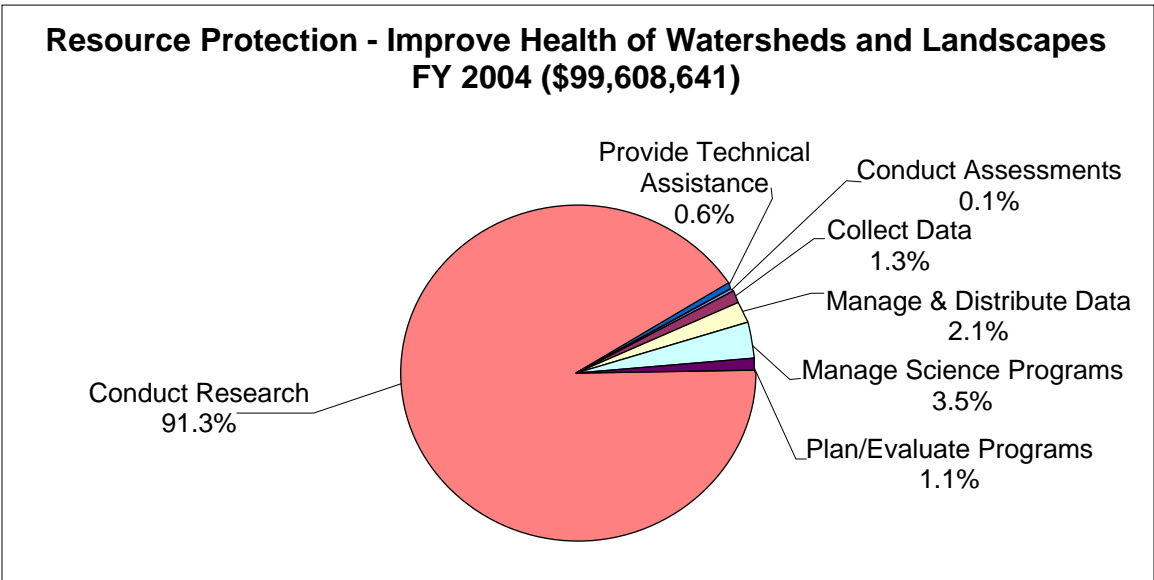
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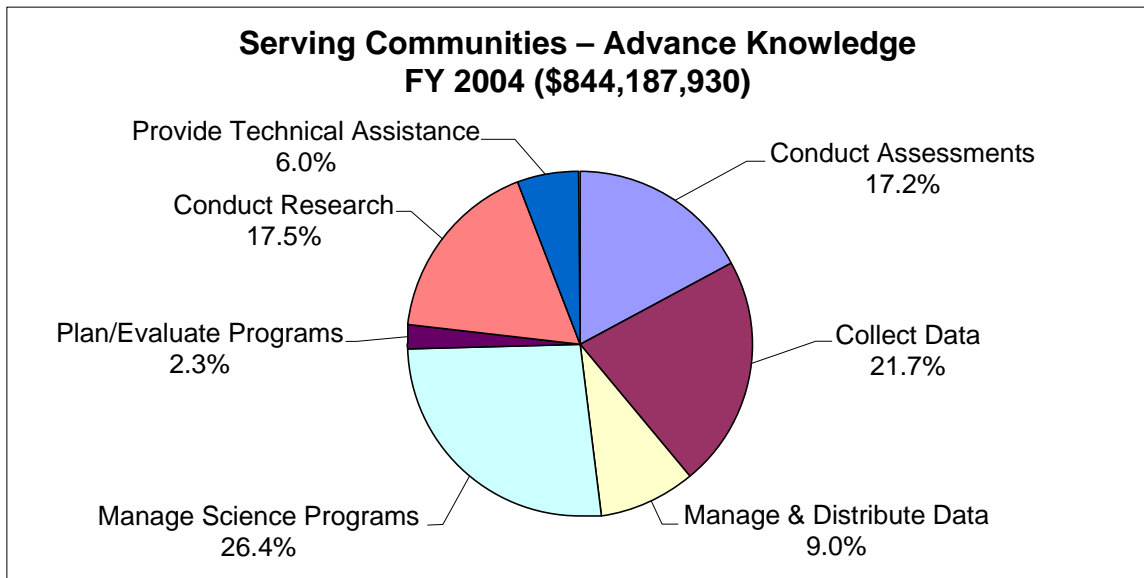
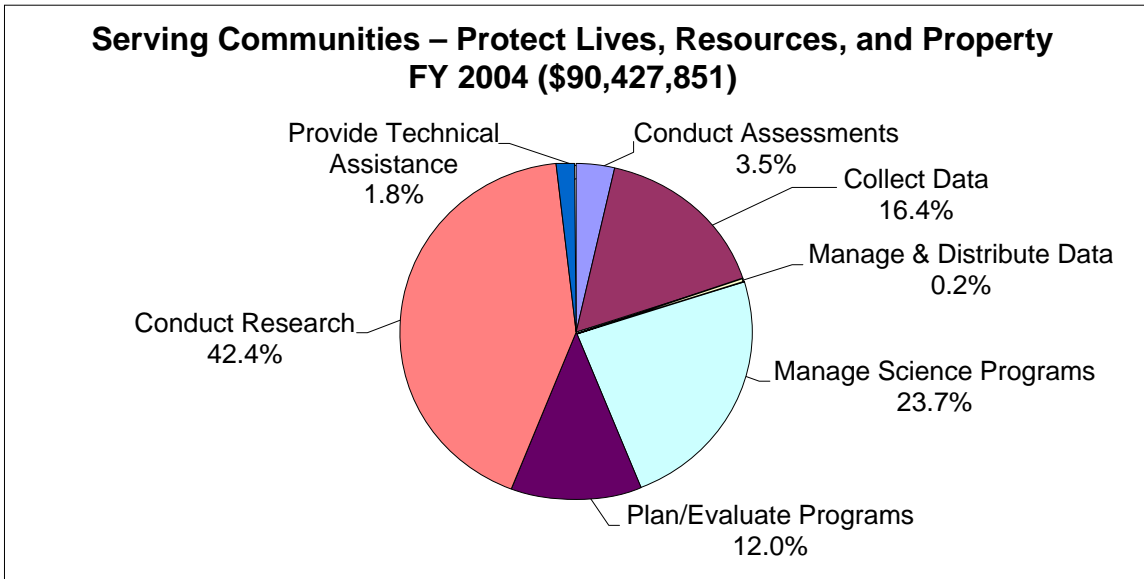
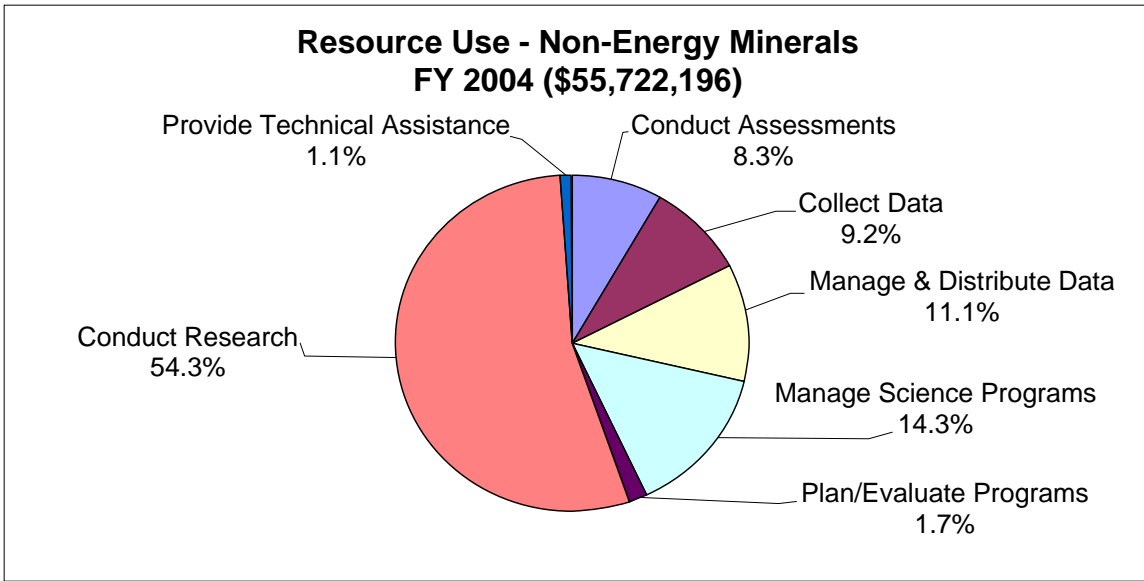
collection at the local scale are the scientific hallmarks of the USGS. When siting new facilities, the USGS endeavors to collocate with potential collaborators or customers to ensure that opportunities for joint scientific ventures and sharing of scientific expertise are maximized.

As the science bureau of the Department of the Interior (DOI), the USGS provides information and technologies that are critical to achieving the missions of the Department's land and resource management bureaus. The USGS collaborates with these bureaus to provide science support that ensures that the increasingly complex management requirements of Interior's vast resources are informed by credible science. These collaborations support the Administration's commitment to base land and resource management decisions on sound science. Science is the cornerstone for all DOI land management decisions undertaken to achieve resource protection, resource use, recreation, and serving communities goals. The USGS focuses efforts in three of these DOI Strategic Plan mission areas: resource protection, resource use, and serving communities.

In achieving our mission, USGS is beginning to use cost management information to help our employees and the public that we serve better understand what it costs to deliver quality products and services, such as the cost of producing geospatial data or monitoring for volcano and earthquake hazards. Capturing the cost of work will also help the USGS better document our basis for cost-share projects, assessment, and cost recovery. The USGS is collecting baseline data that will help to improve classification and capture of cost data, which will lead to use of these cost data in decisionmaking.

Six pie charts are provided to portray fund distribution by work activity within each end outcome goal. As in previous sections, actual expenditures for FY 2004 are provided. The data used for these reports are pulled from FFS. **Any analysis using these data is preliminary, pending continued efforts to standardize processes, and to ensure consistency of interpretation and application of work activity definitions across scientific disciplines.**





Performance Budget

In general, the distribution of work activities follows the distribution of the science discipline that supports the effort as well as logical assumptions that were made in the original construct of the goal. For example, "Serving Communities – Advance Knowledge through Scientific Leadership and Inform Decisions through the Application of Science" has a large data collection and management component relative to others because the information intensive programs— Geography and Water Resources programs and the information component of the Biology program—are logically included in this goal.

ABC demonstrates what formerly was intuitive. It also leads to questions. For example, the two Resource Protection goals are wholly supported by Biological Research programs, but as seen in the pie charts, differ widely in the "Manage Program" work activity. Possible causes might include the need for more management for the larger proportion of cooperative activities in the "sustain biological communities" end outcome goal, or activities are being captured at too high a level or simple coding errors. The data lead to questions that require further investigation and ultimately better management.

The Strategic Goals and Performance Data tables that follow provide the USGS contribution as a whole to the goals and key outcomes of the Department's strategic plan, as well as non-key DOI measures and bureau-specific measures (outputs) that change with program planning as a result of proposed funding changes. PART measures are also included for those programs that have been assessed by OMB. In addition, the DOI key measures are included in the General Statement, a summary of performance targets associated with proposed funding changes is included in the Program Change section, and each Budget Activity includes a summary of performance targets for the programs it supports. Some of the output measures carry over from the previous GPRA Strategic Plan. For the new measures, an attempt was made to baseline and (or) research a prior year result so that change and trend comparisons can be made where possible.

Resource Protection Goal

Goal Funding Table:

(Dollars in Thousands)

	2005 Enacted	2006 Request	Change From 2005
Improve Health of Watersheds and Landscapes and Marine Resources	40,478	42,194	1,735
Sustain Biological Communities	107,222	106,582	-659
Total	147,700	148,776	1,076

The FY 2006 budget for Resource Protection includes a net increase of \$1.076 million from the FY 2005 budget, including an increase of \$2.908 million for uncontrollables and an increase of \$0.828 million in technical adjustments. Program change net decreases total \$2.66 million with \$0.127 million increase to Improve health of watersheds and landscapes and a \$2.787 million decrease from sustaining biological communities end outcome goal.

Initiated in FY 2004, **Science on the DOI Landscape** has garnered significant support from DOI bureaus as they determine their regional science priorities. Examples of successful collaborative projects that have leveraged USGS and bureau funding include Mancos Shale landscape studies with BLM; coalbed methane research to meet the needs of BLM, BIA, and

Indian Tribes; a workshop on environmental effects of mercury in which speakers representing USGS, NPS, FWS, MMS, Indian Trust Lands, EPA, NOAA, and others shared information on mercury mitigation practices; and a project in the Mojave Desert on desert tortoise habitat conducted with NPS and BLM managers. As an outgrowth of Mancos shale and coalbed methane projects, the USGS, BLM, and FWS held joint workshops and field trips in western Colorado and in Wyoming to explore other areas of collaboration such as invasive species, sage grouse habitat, and land-use and recreation issues. Emphasis in FY 2006 will build on some of these accomplishments with a focus on sustainable ecosystems in sage grouse habitats impacted by invasive species and fire in the northern Front Range; continued work on mercury as one of many impacts on water quality; and additional work in the Lower Colorado River basin that addresses history and rates of landscape and ecologic change. These interactions will continue to bring scientists and department resource managers together on the ground to promote collaboration among the DOI bureaus and to determine jointly how USGS can best address complex management needs.

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Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD = Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Resource Protection Goal Performance Summary

End Outcome Goal: PEO.1. Improve health of watersheds, landscapes and marine resources that are DOI managed or influenced in a manner consistent with the obligations regarding the allocation and use of water.							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Restore and maintain proper functions to watersheds and landscape							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Restored Fire Adapted Ecosystem: X% satisfaction with scientific and technical products (SP)</i>	97%	100%	≥80%	≥80%	≥80%	0	≥80%

Performance Budget

Resource Protection Goal Performance Summary (continued)

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
# of systematic analyses & investigations delivered to customers	11	4	11	8	8	0	8
# of formal workshops or training provided to customers (instances/issues/events)	1	1	1	1	1	0	1
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Forge Effective Partnerships:</i> Satisfaction score (# score) on resource protection partnerships (SP)	97%	97%	≥80%	≥80%	≥80%	0	≥80%
<i>Customer Satisfaction:</i> X% satisfaction with scientific and technical products and assistance (NK)	97%	97%	≥80%	≥80%	≥80%	0	≥80%
<i>Customer Satisfaction:</i> Timeliness of scientific and technical products (BUR)	93%	93%	≥80%	≥80%	≥80%	0	≥80%
<i>Customer Satisfaction:</i> Usefulness of scientific and technical products (BUR)	97%	97%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality:</i> X% of watershed and landscape-related research studies validated through appropriate peer review or independent review (SP)	100%	100%	100%	100%	100%	0	100%
<i>Facilities Condition:</i> Conservation and biological research facilities are in fair to good condition as measured by the Facilities Condition Index (lower FCI is good) (NK)	UNK	.24	.24	.24	.24 ¹	0	.24

¹ For all buildings owned and operated by USGS, FCI equals the total deferred maintenance for all buildings, divided by the current replacement values of the buildings.

Resource Protection Goal Performance Summary (continued)

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
# of systematic analyses & investigations delivered to customers	151	107	155	177	189	+12 ²	189
# of formal workshops or training provided to customers (instances/issues/events)	63	**	63	23	27	+4 ³	27

**See Total in PEO.2.

End Outcome Goal: PEO.2. Sustain biological communities on DOI managed or influenced lands and waters in a manner consistent with the obligations regarding the allocation and use of water.							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Create habitat conditions for desired biological communities to flourish							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Invasive Species: Prevention: X% of invasive species research focused on pathways and prevention methods (BUR)</i>	8%	7%	6%	6%	6%	0	10%
<i>Invasive Species: Early Detection: X% of invasive species research focused on detection and assessments of new invasions (BUR)</i>	3%	8%	5%	5%	5%	0	10%
<i>Invasive Species: Rapid Response: X% of invasive species research focused on rapid management response to new invaders (BUR)</i>	<1%	1%	2%	2%	2%	0	6%
<i>Invasive Species: Control & Management: X% invasive species research focused on providing information and methods for control and management of established invasive species (BUR)</i>	89%	84%	87%	87%	87%	0	74%

² Represents increased outputs as a result of research initiated in FY 2004 and a technical adjustment in FY 2006. There is a 2-year lag between initiating research and obtaining results. Research initiated with additional FY 2006 funding for Ecological Systems Mapping and Science on the DOI Landscape Initiatives will produce 4 systematic analyses in FY 2008. Results will also include 4 less systematic analyses and investigations in FY 2008 due to the proposed decreases in funding for the Mark Twain National Forest lead mining study.

³ This change represents additional funds for science on the DOI Landscape initiative and a technical adjustment in FY 2006.

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Resource Protection Goal Performance Summary (continued)

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Intermediate Outcome: Create habitat conditions for desired biological communities to flourish							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Invasive Species: Forge Effective Partnerships:</i> Satisfaction score (# score) on biological research partnerships (BUR)	97%	99%	≥80%	≥80%	≥80%	0	≥80%
PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
# of systematic analyses & investigations delivered to customers	20	51	24	24	30	+6 ⁴	34
# of formal workshops or training provided to customers (instances/issues/events)	1	1	1	1	1	0	3
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Forge Effective Partnerships:</i> Satisfaction score (# score) on biological research partnerships (SP)	97%	98%	≥80%	≥80%	≥80%	0	≥80%
<i>Shared Data:</i> X% of DOI databases with species information that is available throughout DOI and other partners (NK)	100%	100%	100%	100%	100%	0	100%
<i>Customer Satisfaction:</i> X% satisfaction with DOI scientific and technical information (NK)	99%	98%	≥80%	≥80%	≥80%	0	≥80%
<i>Customer Satisfaction:</i> timeliness of scientific and technical information (BUR)	97%	97%	≥80%	≥80%	≥80%	0	≥80%
<i>Customer Satisfaction:</i> Usefulness of scientific and technical information (BUR)	98%	98%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality:</i> X% of biological research studies validated through appropriate peer review or independent review (SP)	100%	100%	100%	100%	100%	0	100%

⁴ This change represents the results of research initiated in FY 2004. There is a 2-year lag between initiating research and obtaining results. Research initiated with additional FY 2006 funding for the Invasive Species Initiative will produce two systematic analyses in FY 2008.

Resource Protection Goal Performance Summary (continued)

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Facilities Condition:</i> Conservation and biological research facilities are in fair to good condition as measured by the Facilities Condition Index (lower FCI is good) (SP)	UNK	.19	.19	.19	.19 ⁵	0	.19
PART Efficiency and other Output Measures							
# of systematic analyses & investigations delivered to customers	796	797	838	838	846	+8 ⁶	898
# of formal workshops or training provided to customers (instances/issues/events)	97	70**	125	55	55	0	58
**See Total in PEO.2.							

Resource Protection Goal Summary:

The specific resources Interior is entrusted to protect fall into three main categories: lands and waters, biological communities, and cultural and natural heritage resources. Interior's ability to achieve these goals depends greatly on the availability and application of high quality scientific information. For that reason, a commitment to quality science is a key ingredient of all Interior resource protection programs. DOI land and resource managers use USGS biological science to maintain the health, diversity, and ecological balances of biological resources while meeting public needs, such as game harvests and the use of public lands and waters. USGS biological studies assist in maintaining healthy ecosystems and natural resources so that these habitats can continue to provide food, energy, medicine, transportation, and recreation. The USGS will continue to serve the biological research needs of DOI bureaus and others by providing scientific information through research, inventory, and monitoring investigations.

Changes in living resources, from individual species to overall ecosystem health, can only be detected and evaluated through careful, long-term monitoring and a continuing research commitment that together form the baseline of the environmental and ecological health of the Nation. Without such a baseline, subtle and even more obvious changes in natural resource conditions can go relatively unnoticed, whether they are caused by human population growth, bioterrorism, increases in ultraviolet radiation, or some other source. USGS research and information activities are integral to the Nation's long-term research and monitoring capabilities and critical to sound resource management decisionmaking. USGS specialists also provide

⁵ For all buildings owned and operated by USGS, FCI equals the total deferred maintenance for all buildings, divided by the current replacement values of the buildings.

⁶ Represents increased outputs as a result of research initiated in FY 2004. Also, there is a 2-year lag between initiating research and obtaining results. Research initiated with additional FY 2006 funding for the Glen Canyon Adaptive Management Plan and Great Lakes Deepwater Fisheries will produce 5 systematic analyses in FY 2008. Results also include 16 less systematic analyses and investigations in FY 2008 due to the proposed decreases in funding for Pallid Sturgeon Research, a multidisciplinary water study at Leetown, Manatee Research, Diamondback Terrapin Research, Molecular Biology at Leetown, Delaware River Basin Water Project, and Grizzly Bear DNA Assessment would have been delivered in FY 2008.

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technical assistance to DOI bureaus and other customers in applying the information, methodologies, and tools developed by the USGS in addressing resource management problems.

The USGS is working closely with its sister bureaus in the DOI and with other resource management agencies to ensure that our science is relevant to societal needs and useful to resource managers in policy and decisionmaking. A prime example of this is with the FWS Science Support Program (SSP), through which the FWS identifies science needs so that USGS scientists and managers can plan their SSP-related activities prior to the start of a new fiscal year. The result is increased coordination between the two bureaus and the development of USGS science plans that directly support FWS research needs.

The USGS also attempts to design project plans to meet research and information requirements of multiple users or for multiple applications to more efficiently serve customers. For example, the USGS works closely with the National Invasive Species Council to plan projects and goals in invasive species science to meet the needs of multiple users.

PART and Other Program Evaluations

Biological Research Programs are scheduled to undergo PART evaluations in FY 2005 for the FY 2007 budget process. All programs are in the process of compiling and (or) finalizing their 5-year strategic plans, which will be completed in the FY 2005 timeframe. These plans, written and reviewed by a variety of scientists, partners, and end-users from both within and outside of the USGS, will guide program and project development in future years and ensure that the bureau's science is meeting real-world needs of resource managers and other customers.

Science Making a Difference – Relevance, Performance and Productivity

The USGS has incorporated IT, Web-based technology, and computerized record keeping and tracking in contracting, financial processes, personnel management procedures, and communications with cooperators. By designing systems to meet information requirements for multiple purposes, the USGS has been able to contain costs and administrative burden to sustain staffing and operations of the Cooperative Fish and Wildlife Research Units in the field. More streamlined processes for performance review, research grade evaluation, and annual accomplishment reporting of Cooperative Research Units have reduced time and effort in the tracking and reporting of graduate research, graduate education, and technical assistance activities by Unit scientists.

The USGS uses cost sharing or matching funds from other bureaus or organizations with similar research needs or interests. For example, the National Park Service (NPS) provides additional funding for the implementation of USGS park-oriented Biological Research projects within park boundaries that are of mutual interest and benefit to the NPS and USGS. Linking of science results to online tools and Web sites allows a wider audience of potential users to be reached and supplies analysis tools for utilizing our data. For example, a comprehensive database has been created for analyzing sea otter mortality to help scientists identify disease outbreaks. These data will be linked to a geographic information system, permitting scientists to determine the spatial patterns of mortality in relation to population and habitat distribution, evaluate patterns of disease mortality relative to potential sources of disease agents, and assess the importance of disease mortality to specific age and sex groups. Managers will use the information provided by this study to identify and minimize the underlying causes for increased levels of mortality, an important first step toward the recovery of southern sea otter populations.

The Northern Continental Divide Ecosystem (NCDE) in northwestern Montana is one of the last strongholds of the grizzly bear in the lower 48 States. Managers and biologists are working to determine population size, trend, and survival and to identify the corridors that link separate populations. USGS advances in genetic technology have enabled the identification of species, sex, and individuals from DNA extracted from bear hair collected along survey routes and from systematically positioned hair snag stations. Resulting statistical models will be used to estimate the number of grizzly bears inhabiting the NCDE and to provide an independent calibration of the population index developed from survey routes. This information will be used to address future bear conservation issues. In addition to being almost completely non-invasive to the bears, this methodology provides a significant cost savings over conventional population sampling methods and greatly reduces potential threats to human safety.

Resource Use Goal

Goal Funding Table:

(Dollars in Thousands)

	2005 Enacted	2006 Request	Change From 2005
Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value - Energy	23,250	23,615	365
Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value – Non-Energy Minerals	53,764	25,084	-28,680
Total	77,014	48,699	-28,315

The FY 2006 budget for Resource Use includes net decreases of \$28.315 million from the FY 2005 budget, including an increase of \$1.584 million for uncontrollables and a decrease of \$0.025 million in technical adjustments. Program change net decreases total \$29.874 million with \$0.054 million from the "manage or influence resource use – energy" end outcome goal and \$29.82 million from "manage or influence resource use – non-energy minerals" end outcome goal.

The Mineral Resources program is proposed for reduction in FY 2006—not because the program is ineffective or inefficient—because the budget environment and flexibility continue to be constrained. This reduction preserves funding for other Interior priorities. The Minerals Program was recently evaluated by the National Research Council and by OMB through the PART process for FY 2005 (scoring 80). The program is in the process of revising its 5-year plan and has an opportunity to address both of these evaluations. The affect of the FY 2006 proposed funding decrease will be most evident in data collection and management work activities with all growth eliminated in "Average square miles of the United States with non-energy mineral information available to support management decisions." This will result in a decline in customer satisfaction with data timeliness and the data's usefulness for decisionmaking—all are reflected in the targets for the DOI Strategic Plan measures. Only core capabilities will be maintained as the evaluations are addressed and the 5-year plan developed.

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Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD = Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Resource Use Goal Performance Summary

End Outcome Goal: UEO.1. Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value - Energy							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance - 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Baseline Information:</i> # of targeted basins with oil and gas resource assessments available to support management decisions (SP) (PART)	7	5	6	6	6	0	5
<i>Quality & Utility of Information:</i> X% of customers satisfied with timeliness of data (BUR)	100%	100%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality & Utility of Information:</i> X% of data is accessible (NK)	95%	95%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality & Utility of Information:</i> X% of customers for which energy data meets their needs (BUR)	93%	93%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality and Utility of Information:</i> X% of energy studies validated through appropriate peer review or independent review (SP) (PART)	100%	100%	100%	100%	100%	0	100%
PART Efficiency and other Output Measures							
# of systematic analyses & investigations delivered to customers (assessments)	7	5	6	6	5	-1	5
# of formal workshops or training provided to customers (instances/issues/events)	9	8	8	8	7	-1	8
X% of targeted analyses/investigations delivered which are cited by identified partners within 3 years of delivery (PART)	UNK	80%	80%	80%	80%	0	80
Average cost of a systematic analysis or investigation (PART Eff. Measure)	\$2.75M	\$2.2M	\$2.75M	\$2.75M	\$2.75M	0	\$2.75M
# of annual gigabytes collected	UNK	0.745	42.038	42.038	20.038	-22	TBD
# of cumulative gigabytes managed	2.713	211.458	253.496	253.496	273.534	+20.038	TBD

Resource Use Goal Performance Summary (continued)

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Baseline Information:</i> Average square miles of the United States with non-energy mineral information available to support management decisions (SP) (PART)	2,368,794	2,401,329	2,587,318	2,987,340	2,987,340	0	2,987,340
<i>Quality & Utility of Information:</i> X% of U. S. with geologic, geochemical, geophysical and mineral locality data (BUR)	67%	68%	73%	84%	84%	0	84%
<i>Quality & Utility of Information:</i> X% of customers satisfied with timeliness of data (BUR)	78%	78%	70%	78%	50%	-28%	50%
<i>Quality & Utility of Information:</i> X% of customers for which minerals data meets their needs (BUR)	84%	84%	70%	84%	40%	-44%	40%
<i>Quality & Utility of Information:</i> X% of mineral studies validated through appropriate peer review or independent review (SP) (PART)	100%	100%	100%	100%	100%	0	100%
PART Efficiency and other Output Measures							
# of systematic analyses & investigations delivered to customers (assessments)	4	5	3	3	2	-1	3
# of cumulative gigabytes managed	1.818	15.420	16.021	16.021	16.121	+0.1	16.5
# of formal workshops or training provided to customers (instances/issues/events)	9	8	5	8	2	-6	2
# of mineral commodity reports available for decisions	UNK	733	700	720	700	-20	700
X% of expected responses for which canvass forms have been converted to electronic format	UNK	58%	70%	80%	80%	0	80%
X% of targeted analyses delivered which are cited by identified partners within 3 years after analysis delivered (PART)	80%	80%	80%	80%	80%	0	80%

Resource Use Goal Performance Summary (continued)

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Average cost of a systematic analysis or investigation (PART Eff. Measure)	\$4.13M	\$4.31M	\$4.18M	\$4.18M	\$11.40M	+7.22M	\$8M

Resource Use Goal Summary:

Throughout its history, the Nation has faced important, and often controversial, decisions regarding the competing uses of Federal lands, the environmental consequences of resource development, and the supply of energy and mineral resources to sustain development and enable growth. The availability and cost (both economic and environmental) of energy and mineral resources and their extraction and use are limiting factors to human development. Federal land-management agencies are required to develop plans that reconcile competing demands for resource development with other human activities, while recognizing environmental values and providing for the sustainability of resources and natural environments. Interior is responsible for providing access to energy, mineral, forage, and forest resources on Federal lands to help meet societal needs. Interior plays a key role in providing access to these resources while maintaining resource protection goals. Determining where, when, and to what extent the public's renewable and non-renewable economic resources on public land should be made available is a complicated and controversial task. Interior's ability to make sound resource use decisions depends greatly on the availability and application of high-quality scientific information. The USGS provides unbiased, scientifically valid resource assessments of the potential energy and mineral supply of the United States and the environmental consequences of developing these resources.

Historically, emphasis within the USGS energy and mineral resource programs on ore genesis and the formation of mineral and energy deposits has provided a foundation for the programs' evolution to modern resource studies and probabilistic assessments. The USGS energy and mineral resource programs currently focus on (1) developing and applying improved quantitative methods for oil, gas, coal, and mineral assessments through the use of advanced computer modeling, (2) assessing resource quality and availability to enable more informed decisions by public and private entities involved in energy and mineral resource extraction and use, and (3) gathering and disseminating periodic, census-style information on the production and use of mineral resources, both domestically and internationally, for use by government agencies such as the Federal Reserve and Department of Defense and by the private sector.

The Energy and Mineral Resources programs have strong ties to the Serving Communities' National Cooperative Geologic Mapping Program for basic information related to the distribution of geologic formations that may lead to a methodology for locating energy and mineral resources. The Energy and Mineral Resources programs support several Serving Communities programs under Water Resources Investigations in their analyses of the impacts of mining and oil and gas extraction on water quality.

PART and Other Program Evaluations

The National Research Council (NRC) routinely evaluates both the Energy Resources Program and the Mineral Resources Program. The Energy Resources Program (ERP) was most recently evaluated in 1999; the Minerals Resources Program underwent evaluation in 2003. One of the ERP PART recommendations was to: "Work to continue to make reports and data more accessible and user-friendly." As a result, the ERP PART Action Plan now includes:

- The ERP collects feedback from customers and partners—a Web-based questionnaire was created for ERP customers and partners.
- The ERP captures and interprets statistics from Web sites and product access tools at the program and team levels. Web statistics are examined, and reports provide overall usage information including top users, downloads, product types, and file types requested.
- To better serve the needs of USGS energy customers in a more streamlined manner, the ERP has undertaken efforts to serve more information and products digitally, via three Web sites (the Energy Resources Program, the Central Energy Resources Team, and the Eastern Energy Resources Team). The three webmasters are working together to make USGS energy information seamless and more easily accessible to the customer. To track information concerning customers, statistics of users are downloaded quarterly, and a questionnaire has been installed to continuously obtain customer feedback.

The National Academy of Sciences, in recent reviews of the Mineral Resources Program, recommended developing an external grants program to assist MRP's basic research function. In March 2004, the Mineral Resources External Research Program (MRERP) was introduced, and research-based proposals that supported the goals of MRP were solicited. The new MRERP was announced and managed using the Grants.gov system, as mandated by the President's Management Agenda (<http://www.grants.gov>). In June 2004, the USGS announced that 6 of the 34 proposals received would be funded for mineral-resources research; total funding awarded was \$200,000 from within MRP base funding. The grant recipients were researchers at Oregon State University, University of Florida, Colorado School of Mines, University of Alaska at Fairbanks, Southern Illinois University, Washington State University, and the Idaho Geological Survey. The overall quality of the proposals that were peer reviewed by a panel of six research scientists (five from the USGS and one external to the USGS) was high; and the USGS has high expectations that the grants program will offer opportunities for collaborative research and synergy. The same level of effort would likely continue in FY 2005; however, this program will be discontinued with the proposed funding reduction in FY 2006.

Science Making a Difference – Relevance, Performance, and Productivity

The Central Energy Data Management Project, "Environmental Systems Research Institute Special Achievement in GIS," recognizes Web sites' capabilities and content. The Central Energy Team (1) manages petroleum data for the United States (and abroad, USGS World Petroleum Assessment 2000), (2) provides timely Web access to oil and gas assessment information, geologic maps and reports, oil and gas cells (wells per unit area), and other geologic data by province for the United States and the world, (3) implements an enterprise ArcSDE system, and (4) fulfills an obligation to the public by serving natural resource information on the Internet via ArcIMS. The Central Energy Team (1) uses GIS to sustain

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transparency and security in serving public data of high quality and currency with a small, focused, and dedicated team and (2) helps build community by freely sharing their experiences with private industry.

Parallel processing computer technologies are used to develop (with the medical community) models of the endemic zone for Valley Fever. Neural networks enhance the mineral deposit models required for mineral resource assessment. Web-based data delivery tools make 125 years of geochemical and geophysical data available to land managers, the public, and other research scientists. New robotic technologies automate geochemical analyses, saving both time and money.

"Minerals in Your World," an interactive CD-ROM, has been developed through a Cooperative Research and Development Agreement (CRADA) between the USGS and the Minerals Information Institute. The CD contains brief descriptions of the sources and major uses of more than 100 minerals and materials. Included are maps showing locations of mines and mineral processing plants in the United States, and photos of minerals and items produced using minerals.

Serving Communities Goal

Goal Funding Table:

(Dollars in Thousands)

	2005 Enacted	2006 Request	Change From 2005
Protect Lives, Resources and Property	75,979	82,209	6,230
Advance knowledge through scientific leadership and inform decisions through the application of science	634,771	653,831	19,060
Total	710,750	736,040	25,290

The FY 2006 budget for Serving Communities includes net increases of \$25.29 million from the FY 2005 budget, including an increase of \$12.563 million for uncontrollables and a decrease of \$0.8 million in technical adjustments. Program change net increases total \$13.53 million with \$5.154 million going to Protect Lives Resources and Property, and \$8.376 million to Advance Knowledge and Inform Decisions.

Science Impact supports collaboration with DOI bureaus, university partners, and stakeholders to examine ways in which existing science information can effectively be linked with the decisionmaking process to address and resolve difficult socio-economic issues related to natural resources, such as Western water disputes. Institutional analysis and economic evaluations such as benefit-cost analysis provide additional context, information, and perspective.

The ability to measure, monitor, and forecast the U.S. and global supplies of fresh water is another high-priority concern. Agencies, through the NSTC, should develop a coordinated, multi-year plan to improve research to understand the processes that control water availability and quality, and to collect and make available the data needed to ensure an adequate water supply for the Nation's future.

John H. Marburger, Director OSTP and Joshua B. Bolten, Director OMB, August 12, 2004, Memo to Agency Heads Updated Administration Research and Development Budget Priorities M-04-23

The **Puget Sound** initiative provides critical scientific information needed by Federal, State, Tribal, and local decisionmakers for protection and restoration of coastal ecosystems of the Sound. The initiative will ensure collaboration with these and other partners and will provide insights into the complex, cumulative effects on watershed and marine ecosystems and fisheries restoration. Further, the results will document ecosystem recovery and help to minimize adverse effects on people, fish, and wildlife.

The rePARTing of *The National Map* for the FY 2006 budget process resulted in a score of 90. Among the findings, the assessment suggested that although the USGS had met its responsibilities for collecting and distributing medium and high resolution land remote sensing data, the bureau needed to develop some long-term measures for the Land Remote Sensing Program in consultation with the Department and OMB. In FY 2006, with interagency coordination and increased funding, the USGS will begin the design phase of the **Landsat Data Continuity Mission** to follow Landsat 7 and, when the sensors are launched in 2010, will continue

The highly successful intergovernmental Earth Observation Summit in July 2003 resulted in the commitment to develop a coordinated 10-year plan for global Earth observations. Agencies should continue to support the NSTC-coordinated development and implementation of a 10-year U.S. plan for a comprehensive and sustained global Earth observation system, identifying key areas for implementing solutions that will minimize data gaps and maximize the utility of the data.

John H. Marburger, Director OSTP and Joshua B. Bolten, Director OMB, August 12, 2004, Memo to Agency Heads Updated Administration Research and Development Budget Priorities M-04-23

to carry out the role of downloading, storing, and distributing the Landsat data. This increase is consistent with the joint guidance on FY 2006 Research and Development priorities issued by OMB and the Office of Science and Technology Policy (OSTP) as well as the PART.

Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD =Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Serving Communities Goal Performance Summary

End Outcome Goal: SEO.1. Protect Lives, Resources and Property							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
<i>Hazards:</i> X% of communities using DOI science on hazard mitigation, preparedness and avoidance for each hazard management activity (SP)	39.5%	43.2%	44.8%	45.9%	47.5%	+1.6%	49.1%
<i>Decisionmaker Satisfaction:</i> Met need for information to help achieve goal of reduced risk (SP)	98%	98%	≥80%	≥80%	≥80%	0	≥80%

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Serving Communities Goal Performance Summary (continued)

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Intermediate Outcome: Improve public safety and security and protect public resources from damage							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Facilities Condition:</i> <i>Hazard:</i> Buildings (administrative, employee housing) are in fair to good condition as measured by the Facilities Condition Index (FCI) (SP)	UNK	0.20	0.20	0.20	0.20	0	0.20
Intermediate Outcome: Provide information to assist communities in managing risks from natural hazards							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Use Rate: Earthquakes:</i> X% of communities using DOI science on hazard mitigation, preparedness and avoidance for each hazard management activity (NK)	56.5%	62.7%	63.9%	63.4%	63.9%	+5%	63.9%
<i>Use Rate: Landslides:</i> X% of communities using DOI science on hazard mitigation, preparedness, and avoidance for each hazard management activity (NK)	3.3%	3.7%	4.2%	3.9%	4.4%	+0.5%	5.4%
<i>Use Rate: Volcanoes:</i> X% of communities using DOI science on hazard mitigation, preparedness, and avoidance for each hazard management activity (NK)	58.6%	63.3%	66.4%	70.3%	74.2%	+3.9%	78.13%
<i>Use Rate: Landslide Hazards:</i> # of responses to inquiries from the public, educators, and public officials to the National Landslide Information Center on hazard mitigation, preparedness and avoidance strategies for landslide hazards (BUR)	1,600	1,600	1,600	1,600	1,600	0	1,600 (100%)
<i>Adequacy:</i> X% of sampled stakeholders reporting adequacy of science base to inform decisionmaking for each hazard management activity (volcanoes, earthquakes, etc.) (SP)	97%	98%	≥80%	≥80%	≥80%	0	≥80%
<i>Adequacy: Earthquake Hazards:</i> X% of customers for which earthquake hazards data meets their needs (BUR)	97%	97%	≥80%	≥80%	≥80%	0	≥80%

Serving Communities Goal Performance Summary (continued)

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
# of systematic analyses & investigations delivered to customers (risk/hazard assessments)	4	3	6	5	7	+2	32
# of real-time ANSS earthquake sensors (reported yearly and cumulative at the end of the year) (old ANSS)	51 (cum 476)	75 (cum 511)	Procedures were changed, resulting in improvements to the scope of this measure. See new data below and explanation of procedures.				
# of real-time earthquake sensors (reported yearly and cumulative at the end of the year) (new)	46 (cum 428)	95 (cum 523)	11 (cum 534)	40 (cum 563)	21 (cum 584)	+21	Targets set annually
% of earthquake monitoring global seismic network stations that have telemetry (Increase reporting speed from 1 hour to 20 minutes) (new)	UNK	80%	80%	80%	96% ⁷	+16%	Targets set annually
# of formal workshops or training provided to customers (instances/issues/events)	13	14	14	14	14	0	14
# of sites (mobile or fixed) monitored for ground deformation to identify volcanic activity (VHP)	75	85	85	86	101	+15	130
Adoption of National Seismic Hazard Maps by NEHRP provisions and International Building Codes (PART long-term) (EHP)	1	0	0	0	0	0	Maps revised every 5 years; adopted within 2 years
# of urban areas for which detailed seismic hazard maps are completed (PART) (EHP)	1	2	3	3	3	0	26
# of areas or locations for which geophysical models exist that are used to interpret monitoring data (PART) (LHP)	3	4	4 1/3	4 1/3	4 2/3	+1/3	5
# of metropolitan regions where Shakemap is incorporated into emergency procedures (PART) (EHP)	4	5	5	5	5	0	26
# of volcanoes for which information supports public safety decisions (PART) (VHP)	48	49	50	51	53	+2	57

⁷ Includes adding 8 new telemetry stations, and upgrading 20 dial-up with telemetry.

Performance Budget

Serving Communities Goal Performance Summary (continued)

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
X% of potentially hazardous volcanoes with published hazard assessments (x number of 70) (PART) (VHP)	61.4%	61.4%	64.3%	62.8%	65.6%	+2.8%	68.6%
X% of potentially active volcanoes monitored (PART) (VHP)	66%	67%	70%	72%	73%	+1%	73%
# of counties, or comparable jurisdictions, that have adopted improved building codes, land-use plans, emergency response plans, or other hazard mitigation measures based on USGS earthquake hazards information (PART) (03 Baseline is 891 at risk counties)	503	559	569	565	569	+4	569
# of counties, or comparable jurisdictions, that have adopted improved building codes, land-use plans, emergency response plans, or other hazard mitigation measures based on USGS landslide hazards information (PART) (Baseline is 1,800 counties and parks with moderate to high landslide susceptibility in the United States (FY 1999-FY 2003, 60 adopted measure)	60	68	76	71	80	+9	98
# of counties, or comparable jurisdictions, that have adopted improved building codes, land-use plans, emergency response plans, or other hazard mitigation measures based on USGS volcano hazards information (PART) (Baseline is 256 at risk counties)	162	162	170	180	190	+10	200
X% data availability for real-time data from the GSN (PART)	90%	90.5%	90%	90%	90%	0	90%

Serving Communities Goal Performance Summary (continued)

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Data processing and notification costs per unit volume of input data from earthquake sensors in monitoring networks (in cost per gigabyte) (PART Eff. Measure)	1.007 \$/Gb	0.90 \$/Gb (-1%)	0.990 \$/Gb	0.990 \$/GB	TBD	0	TBD

End Outcome Goal: SEO.2. Advance knowledge through scientific leadership and inform decisions through the application of science.							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
<i>Research:</i> Soundness of methodology, accuracy, and reliability of science (program evaluation) (SP)	100%	80%	100%	100%	100%	0	100%
<i>Inform decisions through the application of science:</i> Improved access to needed science information (# score) (SP)	92%	90%	90%	90%	90%	0	90%
<i>Inform decisions through the application of science:</i> Stakeholders reporting that information helped achieve goal (# score) (SP)	94%	93%	90%	90%	90%	0	90%
<i>Inform decisions through the application of science:</i> Improved access to needed science information, # of USGS science publications cataloged in master USGS publications database (BUR)	56,086	66,626	65,000	67,000	67,500	+500	72,500
<i>Inform decisions through the application of science:</i> Improved access to needed science information, # of associated USGS science publications accessible online (BUR)	3,533	25,909	35,000	35,000	45,000	+10,000	65,000
<i>Inform decisions through the application of science:</i> Improve access to needed science information (# of cumulative biological partnership links) (BUR)	32,500	36,000	36,000	38,500	41,000	+2,500	46,000

Performance Budget

Serving Communities Goal Performance Summary (continued)

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
<i>Inform decisions through the application of science: X% of IT customers reporting that information helped achieve goal (BUR)</i>	91%	86%	≥70%	≥70%	≥70%	0	≥70%
Intermediate Outcome: Improve information base, information management and technical assistance Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Content and expanse of knowledge base: X% of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (SP) (total of all 8 Program)</i>	UNK	54.74%	59.73%	59.76%	65.03%	+5.27%	74.4%
<i>Content and expanse of knowledge base: X% of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (SP) (# of square miles assessed by Gap analysis)</i>	UNK	82%	83%	83%	83%	0	85%
<i>Content and expanse of knowledge base: X% of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (SP) (NCGMP)</i>	5.5%	7.9%	9.8%	10.1%	12.2%	+2.1%	16.5%
<i>Content and expanse of knowledge base: X% of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (% of proposed NSIP sites currently in operation) (SP)</i>	65%	64%	63%	63%	62%	-1%	58%

Serving Communities Goal Performance Summary (continued)

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Content and expanse of knowledge base: X% of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (SP) (satellite data collected over global land surface)</i>	UNK	100%	100%	100%	100%	0	100%
<i>Content and expanse of knowledge base: X% of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (SP) (PART) (2001 Nat'l dataset – 66 mapping units across the country)</i>	17%	45%	60%	60%	75%	+15%	100%
<i>Content and expanse of knowledge base: X% of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (SP) (PART) (Number of completed eco-region assessments out of a total of 84 eco-regions)</i>	18%	31%	38%	38%	48%	+10%	68%
<i>Content and expanse of knowledge base: average % of coverage for 6 data themes in <i>The National Map</i> at medium resolution; does not measure currentness (SP) (PART)</i>	67%	67%	70%	70%	78%	+8%	92%
<i>Content and expanse of knowledge base: average % of coverage for 7 data themes in <i>The National Map</i> at high resolution; does not measure currentness (SP) (PART)</i>	33%	41%	54%	54%	62%	+8%	78%

Performance Budget

Serving Communities Goal Performance Summary (continued)

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Content and expanse of knowledge base:</i> X% of data accessible: X% of satellite data available from archive within 24 hours of capture (PART)	95%	90%	90%	90%	90%	0	90%
<i>Quality:</i> X% of studies validated through appropriate peer review or independent review (SP)	100%	100%	100%	100%	100%	0	100%
<i>Access:</i> For information products surveyed X% of mapping, water, and biology customers are satisfied with ease, timeliness of access (BUR)	92%	90%	≥80%	≥80%	≥80%	0	≥80%
<i>Access:</i> Customer satisfaction (# score) with ease, timeliness of delivery of science support services (BUR)	81%	82%	≥70%	≥70%	≥70%	0	≥70%
<i>Ease of use:</i> Customer satisfaction (# score) with documentation and ease of usability of science support services (BUR)	81%	74%	≥70%	≥70%	≥70%	0	≥70%
<i>Facilities Condition:</i> Facilities are in fair to good condition as measured by the Facilities Condition Index (FCI) (SP)	NA	0.17	0.17	0.17	0.17	0	0.17
<i>Learning Approach:</i> X% of instructor proficiencies in select subject areas GIS, Earth Science) (BUR)	20%	30%	30%	30%	30%	0	30%
X% of time that all WAN and internet access locations are up and running and accessible (BUR)	99.8%	99.7%	98%	99%	98%	-1%	99%
<i>IT Investment:</i> X% of major IT investment projects for which cost estimates, established in project or contract agreement, meet actual costs with a variance of X% (established in Exhibit 300 business case meet actual costs within a variance of 5%) (BUR)	100%	100%	100%	100%	100%	0	100%

Serving Communities Goal Performance Summary (continued)

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
Online transactions: Increase online transactions to X% relative to a baseline inventory of all USGS transactional services (BUR)	51%	58%	80%	80%	88%	+8%	100%
PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
# of annual gigabytes collected (Geography/ <i>The National Map</i>)	UNK	34,815	62,622	62,622	28,028	-34,594	28,389
# of cumulative gigabytes managed (Geography/ <i>The National Map</i>)	51,042	85,857	148,479	148,479	176,507	+28,028	233,285
# of annual terabytes collected (Geography/satellite data) ⁸	UNK	527.2	527.2	527.2	534.0	+6.5	589.0
cumulative # of terabytes managed (Geography/satellite data)	1,921.1	2,448.3	2,975.8	2,975.8	3,509.8	+534.0	4,641.8
# of annual gigabytes collected (Geology)	UNK	407.2	210.8	210.8	212.8	+2	TBD
# of cumulative gigabytes managed (Geology)	491	898.2	1109	1109	1,321.8	+212.8	TBD
# of cumulative gigabytes managed (Biology)	400	360	440	380	400	+20	440
# of systematic analyses and investigations delivered to customers	573	571	558	557	552	-5	527
# of formal workshops or training provided to customers (instances/issues/events)	61	107	105	104	107	+3	115
# of conceptual or numerical models developed (Puget Sound)	0	2	2	2	2	0	4
# real-time streamgages reporting in NWIS-Web	5,621	5,978	5,187	5,187	5,120	-67	4,738
# real-time ground-water sites reporting in NWIS-Web	697	799	700	700	697	-3	656
# real-time water-quality sites reporting in NWIS-Web	891	1,062	900	900	896	-4	843
X% of river basins that have streamflow stations (PART)	UNK	77%	79%	79%	81%	+2%	85%

⁸ The output measure "Gigabytes collected annually" is measured by the change in the number of gigabytes of data maintained at the end of a fiscal year.

Serving Communities Goal Performance Summary (continued)

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
X% of streamflow stations with real-time measurement/reporting of water quality (PART)	UNK	6%	7%	7%	8%	+1%	11%
X% of daily streamflow measurement sites with data that are converted from provisional to final status within 4 months of day of collection (PART)	UNK	0% (baseline)	10%	10%	20%	+10%	40%
X% of proposed streamflow sites currently in operation that meet one or more Federal needs (PART)	65%	64%	63%	63%	60%	-3%	55%
X% of WRD streamflow stations with 30 or more years of record (PART)	UNK	60% (baseline)	61%	61%	62%	+1%	65%
X% of ground-water stations that have real-time reporting capability in the ground water climate response network (PART)	UNK	57% (baseline)	62%	62%	67%	+5%	77%
X% of the Nation's 65 principal aquifers with monitoring wells used to measure responses of water levels to drought and climatic variations to provide information needed for water-supply decisionmaking (PART)	UNK	60%	61%	61%	62%	+1%	65%
X% of United States with ground water quality status and trends information to support resource management decisions (PART)	UNK	0	12%	12%	18%	+6%	30%
X% of States with Web-based Streamflow statistics tools to support water management decisions (PART)	UNK	4%	11%	11%	18%	+7%	40%
X% of United States with ground water availability status and trends information to support resource management decisions (PART)	UNK	5%	7%	7%	8%	+1%	10%
X% of targeted contaminants for which methods are developed to assess potential environmental and human health significance (PART)	UNK	10%	20%	20%	30%	+10%	50%

Serving Communities Goal Performance Summary (continued)

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Average cost per analytical result, adjusted for inflation, is stable or declining over a 5-year period (PART Eff. measure)	UNK	\$8.64	\$8.64	\$8.64	\$8.64	0	\$8.64
X% improvement in accuracy of watershed (SPARROW) model prediction for total nitrogen and total phosphorus (measured as reduced error) (PART)	UNK	40%	36%	36%	32%	-4%	25%
# of mapping nodes (publicly available Web mapping services available through <i>The National Map</i>)	50	90	140	140	155	+15	250
LDCM: X% of ground system designed, built, and tested	UNK	UNK	UNK	UNK	11%	+11%	73%
# of partnerships formed with decisionmaking organizations (Science Impact)	UNK	UNK	3	3	4	+1	5
# of partnerships for <i>The National Map</i> built with State and local governments that collect and maintain higher resolution, more current data (PART)	10 new partner ships	30 new partner ships	27 new partner ships	28 new partner ships	27 new partner ships	-1 partnerships	27 new partner ships
# of data standards used in implementing <i>The National Map</i> partners (PART)	17	17	22	22	22	0	22
X% of the Nation's surface for which hydrography, elevation, and orthoimagery data are available through the National Spatial Data Infrastructure Clearinghouse and supported through partnerships (PART)	41%	62%	83%	83%	87%	+4%	93%
X% of total cost saved through partnering for data collection of high resolution imagery (PART eff. measure)	UNK	71%	42%	42%	44%	+2%	50%

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Serving Communities Goal Performance Summary (continued)

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
X% of the area of 11 Western States for which orthoimagery have been acquired through a FSA/USGS partnership with other entities to achieve a 5-year cycle for 1-meter NAIP imagery	UNK	UNK	UNK	Baseline	36%	+36%	56% (none flown in FY 2008)
X% of total cost FSA and USGS saved through partnering with other entities for imagery acquisition of 1-meter NAIP orthoimagery	UNK	UNK	UNK	Baseline	40%	+40%	UNK (no Western States flown in FY 2008)
# of summer workshop provided to Tribal Colleges & Universities (TCUs) instructors	2	4	2	2	2	0	2
# of academic year short courses and mini-workshops provided to TCUs	9	8	8	8	8	0	8
# of summer internships	4	5	5	5	5	0	5
# of academic year internships	3	3	4	4	4	0	4
# of bureau conditional assessments in progress or completed (within a 5-year cycle)	39	41	41	41	41	0	41
# of deferred maintenance and capital improvements (cumulative)	24	36	46	54	64	+10	88
# of bureauwide data integration practices and/or policies adopted	UNK	1	3	3	3	0	5
# of new NSDI Clearinghouse nodes established for serving data	41	82	50	50	50	0	25
# of informal NSDI conference outreach exhibits	52	52	50	50	50	0	50
# of new NSDI standards developed (cumulative)	2 (cum 20)	0 (cum 20)	5 (cum 25)	5 (cum 25)	5 (cum 30)	0	2 (cum 34)
# of new NSDI partnership agreements	51	52	60	60	60	0	150
# of significant Web sites co-located on consolidated hardened, secure, and redundant Internet servers	61	167	100	200	225	+25	280
X% of total legislatively mandated narrowband radio transition achieved	34%	100%	100%	100%	100%	0	100%

Serving Communities Goal Performance Summary (continued)

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
# of IT help desks operational in major USGS offices	8	5	4	4	4	0	3
X% of Internet hosts potentially vulnerable to unauthorized access	UNK	5%	<1%	<1%	<1%	0	<1%
# of NBII nodes	10	14	14	14	14	0	18
# of cumulative NBII Clearinghouse metadata records	6,600	7,500	7,300	8,000	8,500	+500	9,500

Serving Communities Goal Summary:

In serving the Nation's citizens and communities, the Department is responsible for:

- Providing the public with scientific information needed to manage individual and community risks related to natural hazard, and
- Developing quality science to expand the knowledge base and to support sound resource management decisions and actions.

Hazards are unpreventable natural events that, by their nature, may expose our Nation's population to the risk of death or injury and may damage or destroy private property, infrastructure, and agricultural or other developed land. USGS activities describe, document, and increase understanding of natural hazards and their risks. These activities include long-term monitoring and forecasting, short-term prediction, real-time monitoring, and communication with civil authorities and others during a crisis. Other significant activities are (1) post-crisis analysis to develop strategies to mitigate the impact of future events and (2) coordinated risk assessments for regions vulnerable to natural hazards. The USGS provides scientific information that individuals and communities can use to reduce risks from landslides, volcanoes, earthquakes, and other natural hazards.

Our environment—the air, water, soil, and plant and animal life – is constantly changing as a result of natural processes and human actions. Changes in demographics also affect the competition for and use of the renewable and nonrenewable natural resources – land, water, minerals, and energy—needed to sustain life, and to maintain and enhance our Nation's economic strength. As land and resource management issues become increasingly complex, cross-discipline, integrated science is increasingly needed to inform decisions, predict outcomes, and monitor results. USGS advances the knowledge base with research on natural, physical, chemical, and biological processes and on the results of human actions.

To achieve the goal for Serving Communities, Interior collaborates with myriad constituents and applies the Secretary's Four C's Vision— "Conservation through Cooperation, Consultation, and Communication." The Four C's not only communicate the Secretary's vision for effective program management in the Department, they clearly reflect her goal of involving others in carrying out our mission. By actively working with communities, partners, customers, contractors, volunteers, and stakeholders to obtain their input and feedback, we are confident that our delivery of services and products will improve and the public's confidence in our ability

to serve them will correspondingly increase. Emergency response organizations, resource managers, planners, and other customers use our information to minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. The USGS is at work in every State in the Nation, cooperating with more than 2,000 organizations to provide information for resource managers in the public and private sectors. The bureau's strengths, which rely on the reputation for objectivity and scientific excellence, as well as a strong heritage of collegial relationships and partnerships with customers, include a multidisciplinary workforce; the ability to develop, design, and maintain long-term national and global databases; and the capability to conduct long-term, broad-scale, multidisciplinary, and interpretive natural science studies.

Quality science that is both relevant and effectively communicated is the most important USGS product. The USGS delivers reliable and impartial information that describes the Earth, its natural processes, and its natural species. All information systems have been reviewed and approved through the Capital Planning and Investment Control process. The bureau will continue to measure research quality and relevance through peer reviews and program evaluations including both National Research Council reviews and OMB PART evaluations.

PART and Other Evaluations

In FY 2003 PARTs were conducted for the FY 2005 budget for USGS Geologic Hazards programs, which were scored "moderately effective." As a consequence of the PART evaluation, the Volcano Hazards Program (VHP) has undertaken a major planning exercise to rank volcanic centers in the United States in terms of the threat they pose and to design a comprehensive monitoring effort. This effort, the National Volcano Monitoring System, will distribute USGS monitoring resources to volcanoes according to the threat posed and will incorporate all Federal volcano monitoring data. USGS has requested an increase of \$0.86 million for equipment purchases and deployment costs to expand modernization of the volcano monitoring network at the most threatening volcanoes within the United States and its territories, in particular Mount Saint Helens and other Cascades volcanoes, the Aleutian Islands, and the Commonwealth of the Northern Mariana Islands.

In FY 2004, for the FY 2006 budget, Water Resources was PARTed and *The National Map* was rePARTed. *The National Map* received a preliminary score of 90, showing improved performance and management from OMB's previous PART score of 57.

Rather than conducting the PART for eight individual programs, the USGS Water discipline conducted two PARTs that cover almost 100 percent of its activities, divided into two categories: (1) research and (2) data collection and dissemination. This approach was in keeping with the President's Business Reference Model and positions the USGS to demonstrate leadership in performance measurement and management. The USGS received a score of 73 for each of these two PARTs and will be working with the OMB over the coming months to develop an action plan for carrying out the PART analysis recommendations. New performance measures resulting from the PART are shown in the performance table for the Water programs.

The National Academies of Science finished its review of the USGS National Landslide Hazards Mitigation Strategy and published a report early in 2004 entitled, *Partnerships for Reducing Landslide Risk*. The report resoundingly supported virtually all the recommendations made in the Landslide Hazards Program (LHP) national strategy and provided a number of excellent recommendations. Although many of the recommendations would require significant new funding, the program has begun to implement other recommendations within base funding.

Relationships are being strengthened with Federal Emergency Management Agency (FEMA), National Weather Service (NWS), Earthquake Engineering Research Institute, and the National Science Foundation (NSF).

Science Making a Difference – Relevance, Performance, and Productivity

The USGS Landslide Hazards Program (LHP) has responded with critical life saving information in the greater Seattle area and southern California when winter rains exceeded critical thresholds and posed a major threat of causing dangerous landslides. USGS scientists also were important members of Burned Area Emergency Response Teams in Colorado and southern California, when those areas experienced devastating fires. In southern California, USGS scientists quickly produced maps that estimated peak discharges of fire-related debris flows in critically burned areas. These maps are tools used by local emergency managers to plan for the consequences of intense rainfall after a fire.

In a partnership agreement between the USGS and the National Science Foundation (NSF), 17 new stations will be added in FY 2005 and FY 2006 to the ANSS Backbone national seismic network, and 8 additional stations will be upgraded. As part of the NSF Earthscope initiative (<http://www.earthscope.org>), the NSF will purchase the equipment, and the USGS will install it with funding from the NSF. The USGS will focus on earthquake monitoring and reporting, and the NSF will focus on long-term Earth science research. NSF contributions represent significant leveraging of USGS funds with a cost offset to the development of the ANSS Backbone of approximately \$1.5 million. The NSF will also pay for the operation and maintenance of the 25 stations until FY 2008. The FY 2006 budget also proposes an increase of \$5.416 million to provide for operation and maintenance of seismic monitoring equipment to support development of a global tsunami warning system.

Engineers at the USGS EROS Data Center streamlined the Landsat 5 data reception flow and cut the time between reception of data and availability from 24 hours to less than 4 hours. In FY 2004 the project converted several processing systems from older, proprietary systems that required paying high maintenance fees to newer, open systems platforms that provide greater throughput at a lower cost.

The National Water Information System (NWIS) is undertaking process improvements to improve productivity. NWIS is developing failover and recovery capabilities to minimize costly disruption and recovery of lost data. The USGS water resources programs are gaining efficiencies in timeliness and cost by serving digital data and analysis tools through common Web portals.

The USGS is achieving efficiencies in water data collection and dissemination through software advances. In FY 2003 the USGS developed a new tool to detect rare but significant anomalies in real-time water-level data that are publicly available on the Internet through the National Water Information System Web interface (NWISWeb). The use of this software, combined with increased vigilance by data maintainers, has dramatically reduced the number of real-time water-level gages with large data spikes on NWISWeb. Because of this success, a new real-time data quality assurance tool was developed during FY 2004 to check for possible erroneous data in other types of real-time data, including selected water-quality parameters. Results of the modified tool are sent by electronic mail daily to the USGS Water District Offices whenever a publicly available spike is detected for that District. This tool allows staff to focus their attention on identified problem areas, thereby reducing the time needed to quality assure the vast amounts of water data that the USGS collects daily.

Performance Budget

The USGS has developed an online "Publications Warehouse" (available at <http://pubs.usgs.gov>) that is an easy-to-use facility for finding and accessing over 67,000 citations describing scientific documents published by the USGS over its 125-year history. As a result of this activity, thousands of legacy USGS scientific and technical reports, formerly available only in paper, are now available in electronic form. The USGS has converted more than 25,000 of these legacy paper reports and anticipates having converted more than 35,000 by the end of FY 2005 and 45,000 by the end of FY 2006.

The National Petroleum Reserve - Alaska (NPR-A) consists of a 23-million-acre reserve on the North Slope that was established in 1923 because of the region's promising petroleum potential. Currently, the BLM is responsible for proposed oil and gas leasing as well as analysis of environmental impacts of proposed oil well placement. Key to this analysis is accurate high-resolution digital elevation data. In 2003, the BLM acquired USGS Interferometric Synthetic Aperture Radar (InSAR) data as part of an ongoing collection cycle over the NPR-A area.

In 2003, USGS scientists worked closely with BLM-Alaska scientists to provide experimental InSAR-based products for use in analytical studies. For example, USGS researchers used the latest hydrographic modeling tools to model flow in an extremely low-relief area of the NPR-A and presented the results to BLM as a potential solution in their catastrophe simulation. New data-fusion and three-dimensional perspective products created from combinations of InSAR, color infrared DOQ, Landsat 7 ETM+ imagery, Digital Line Graph, and Digital Raster Graphic data sources now exist for several sample areas within NPR-A. The USGS and BLM cooperators are evaluating the research results and new products to determine which are most useful to the BLM analyses.

Workforce Planning

In 2003, the USGS performed an in-depth analysis of its Geography finances and workforce, determining the need to decrease the overall workforce size and transition to new skills necessary for future requirements. During FY 2004, the USGS offered a targeted buyout to realign the Geography workforce as part of the strategy for *The National Map*. The resulting salary savings will be used to develop long-term partnerships with State and local agencies and the private sector for collecting and integrating geospatial data.

In FY 2004 the USGS Colorado Water District offered a targeted buyout to accommodate changes in the workforce skill sets needed to keep pace with changes in the technology of water data collection.

Management Excellence

Mission performance is well measured in the DOI Unified Strategic Plan. Partnerships and management support the mission of the Department and are also recognized in the plan. Management is held accountable as well with a series of metrics based on the President's Management Agenda. The following table documents USGS performance in pursuit of management excellence.

Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD = Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Management Excellence Goal Performance Summary

End Outcome Goal: Workforce Has Job-related Knowledge and Skills Necessary to Accomplish Organizational Goals							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
X% of managers who indicate that their workforce has the job-relevant knowledge and skills necessary to accomplish organizational goals (SP)	65%	65%	70%	70%	70%	0	70%
Strategy 1: Human Capital Management							
<i>Human Capital Plan Implementation: Performance-based management – X% of SES executives and direct reports that have performance agreements containing GPRA performance-based elements (SP)</i>	SES Members 100% Direct Reports NA	100%	100%	100%	100%	0	100%
<i>Human Capital Plan Implementation: Enhanced Management Skills – %of all managerial/supervisory positions (SES/non-SES) with training involving the Secretary's 4C's (including use of volunteers) (SP)</i>	260 cum	360 cum	460 cum	460 cum	560 cum	+100	760 cum
<i>Diversity: women & minorities is X% over baseline levels (BUR)</i>	42.0%	42.2%	43%	43%	43%	0	43.5%
<i>Diversity: people with disabilities is X% over baseline levels (BUR)</i>	7.2%	6.8%	7.92%	7.92%	7.92%	0	7.93%
<i>Safety: Number of fatalities and serious injuries per 10,000 employees at DOI (lower number is good) (SP)</i>	0	0	0	0	0	0	0
<i>Safety: Reduce OSHA total injury/illness Case Rate by 3% per year from base year (3.57) (NK)</i>	3.57%	2.19%	3.11%	3.35%	3.25%	-.10% (-3%)	3.08%
<i>Safety: Reduce OSHA lost time injury/illness case rate by 3% per year from base year (Initial FY 2004 baseline is 0.06) (BUR)</i>	0.82%	0.97%	0.58%	0.77%	0.74%	-.03% (-4%)	0.70%

Performance Budget

Management Excellence Goal Performance Summary (continued)

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Strategy 1 (continued): Human Capital Management							
<i>Human Resources:</i> Reduce the rate of lost production days due to injury by 1% each year (per 100 employees) (BUR)	10.75%	6.73%	5.98%	10.35%	10.25%	-1.10% (-1%)	10.05
<i>Human Resources:</i> Increase the timely filling of OWCP claims by 5% per year (higher number is good) (BUR)	31.10%	34.80%	44.1%	34.28%	35.99%	+1.71% (+1%)	38.16%
End Outcome Goal: Accountability							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Obtain unqualified audit (SP)	Unqualified Opinion on Consolidate Balance Sheet	Unqualified Opinion	Unqualified Opinion	Unqualified Opinion	Unqualified Opinion	0	Unqualified Opinion
Strategy 2: Improved Financial Management							
<i>Corrective Actions:</i> Complete implementation of X% of OIG and GAO recommendations by their original target date as reported in the Annual Accountability Report (NK)	80%	97%	90%	100%	100%	0	100%
<i>Corrective Actions:</i> Complete X% of corrective action plans for FMFIA and audited financial statement material weaknesses by their original target data as reported in the Performance & Accountability Report (NK)	80%	100%	95%	100%	100%	0	100%
<i>Account Delinquency:</i> Refer X% of eligible delinquent debt to Treasury for cross-servicing (SP-NK)	93%	94%	95%	100%	100%	0	99.5%
<i>Payment Timeliness:</i> X% of invoices (subject to Prompt Payment Action) paid on-time (NK)	97%	97%	97%	98.8%	98.8%	0	98%
<i>Core Competencies Training for Fiscal Community:</i> X% of fiscal community personnel trained in core competencies (BUR)	UNK	UNK	50%	25%	25%	0	100%

Management Excellence Goal Performance Summary (continued)

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Strategy 3: Performance-Budget Integration							
<i>Cost Management:</i> X% fully implementing accurate, activity-based cost accounting systems in compliance with Departmental guidelines (SP)	Awaiting DOI System Implementation	100%	100%	Implement Interim System 100%	Implement Interim System 100%	0	Implement FBMS
End Outcome Goal: Modernization							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
X% of mission critical IT systems completing the IT security certification and accreditation process (SP)	25%	100%	100%	100%	100%	0	100%
Strategy 4: Citizen-Centered E-Government and Information Technology Management							
<i>IT Investment Management:</i> X% of IT investments reviewed/approved through the CPIC process (SP)	100%	100%	100%	100%	100%	0	100%
<i>IT Investments meet business/program needs:</i> Business cases established for X% of USGS IT Investments (BUR) (NK)	100%	100%	100%	100%	100%	0	100%
Strategy 5: Competitive Reviews and Contract Management							
<i>Competition:</i> # of commercial-type FTE involved in competitive sourcing studies completed during the Fiscal Year (SP)	42 FTE	0 FTE	278 FTE	0 FTE	743 FTE	0	571 FTE
Strategy 5: Performance/Process Improvement							
<i>Facilities Management:</i> X% of facilities that have a calculated Facilities Condition (SP)	50%	95%	95%	95%	95%	0	100%

Partnerships

The USGS values partnerships and actively seeks out opportunities to build mutually productive relationships. The value of partnerships in keeping science relevant and in leveraging scarce resources has been demonstrated throughout the description of achieving mission goals. Various types of partnership vehicles are advertised and described at <http://www.usgs.gov/partnerships.html> to encourage and facilitate cooperative endeavors.

USGS also employs a formal "listening session" approach and takes quite seriously the opportunity for dialog that regular engagement with customers and partners affords us. We want to strengthen that foundation of partnership and relationship and to make the opportunities for collaboration readily available and more robust. As evidence of our commitment to our partners and customers, the entire USGS Executive Leadership Team is involved in the listening sessions, as each of them is vigorously involved with its constituents throughout the year. The Director has charged each member of that team to actively pursue the feedback provided at the listening sessions and to address how we might meet customer needs and input, underscoring this commitment with partnership-focused measures in their performance plans. The USGS also provides for participant evaluation of Listening Sessions so that we can continuously improve the venue and the quality of experience. Customer satisfaction surveys are routinely conducted for partnerships throughout our organization. This year we have also worked with one of our partners, U.S. Department of Agriculture's Farm Service Agency, to develop shared performance measures. Examples of the depth of our partnerships are legion throughout the budget document. The breadth of USGS coordination may be demonstrated in the following representative listing of USGS crosscutting relationships with Federal, State, local, non-government, and international organizations.

It is only through the support of our science and its value to all who use it that we can be sure that we are fulfilling the trust placed in us by the citizens who make the considerable investment by their taxes in the conduct of public science. We take that role of wise steward of the public dollars invested in science very seriously, and seek to ensure those who are direct users of our science, or those who benefit indirectly, that their investment is wisely spent and that the science in which we are engaged provides the solutions that society needs to confront the issues and problems before it.

Chip Groat, Director USGS

Federal
National/Governmentwide: Federal Geographic Data Coordination, National Spatial Data Infrastructure, National Biological Information Infrastructure, National Earthquake Hazards Reduction Program, U.S. Global Change Research Program, National Atlas, Geographic Names, Imagery, elevation and hydrography data collection programs, Civil Applications Committee, lead implementation of Commercial Remote Sensing Space Policy for civilian agencies
Agriculture/Forest Service: Endangered Species, Conservation genetics, Habitat management, Forest plan, Wildlife, Invasive species, Fire science, National Forest maps, Drought/Fire fuel monitoring, Energy and mineral resources, Natural hazards, Mine lands, Land cover characteristics, Hydrologic data collection/studies. Topographic maps, digital orthophoto and elevation data and National Hydrography Dataset
Agriculture: Natural Resources Conservation Service: Global crop assessment
Commerce: Web-based interactive mapping system, Hydrologic data collection/studies, digital geospatial data to support the Census
Commerce/NOAA: Endangered Species, Salmonid restoration, Coral reefs, Hazards monitoring and research, Geomagnetism, Vegetation change, Coastal erosion, Fish habitat, Marine sanctuaries, GIS, Commerce/NIST: Earthquake Hazards, coastal and bathymetric mapping
Commerce/Census Bureau: TIGER database

Federal (continued)
Defense: Endangered Species, Salmonid restoration, Coral reefs, Coastal erosion, Backup mapping during conflict, Natural hazards, Test ban monitoring, Strategic minerals and energy resources, Geomagnetism, Terrain visualization, Hydrologic data collection/studies. Environmental contamination and remediation studies on military bases, NORTHCOMM, High-resolution imagery over urban areas
Defense/Army Corp of Engineers: Endangered Species, Habitat assessment, Fish behavior, Fish physiology, Dam impacts, Wetlands restoration, Seafloor mapping, Shoreline stability, Floodplain morphology, Mine lands, Energy resources, Natural Hazards, Hydrologic data collection/studies
Energy: Endangered Species, Bio-resource monitoring, Contaminant cause and effects, Gas Hydrates, Mining technology, Energy resources, Geologic hazards, Groundwater framework, Coalbed methane, Hydrologic data collection/studies
EPA: Endangered Species, Endocrine disruption, Contaminant effects, Status/Trends, Mine lands and drainage, Emissions modeling/clean air, Water quality, Seafloor mapping, Geochemical analyses, Coal resources and mining, Urban dynamics/land characterization, Hydrologic data collection/studies Remote sensing, Mineral baselines, GAP Analysis, National Hydrography Dataset
Federal Aviation Administration: Printing maps
Homeland Security/Federal Emergency Management Agency: Hazards monitoring and mitigation, Hydrologic data collection/studies, Floodplain mapping, providing emergency maps
FEMA/Federal Insurance Administration: Hazards assessment, elevation data
Health and Human Services: Chemical Analyses
Intelligence Community: Information coordination, Environmental/ resource studies, Hazards Support, Geospatial data
Interior/BIA: Integrated Resources (water, geology, vegetation inventory, remote sensing)
Interior/BLM: Rangeland Health, Wild Horse Management, Invasive Species, Abandoned Mine Lands, Air Quality, Threatened and Endangered species, Water Quality, Mineral Resource Assessments, Prescribed Fire, mapping of National Petroleum Reserve/Alaska (NPR/A), mapping and geospatial data, National Hydrography Dataset
Interior/BOR: Water quality, Ecological models, Decision Support Systems, Seismic Monitoring
Interior/FWS: Inventory and Monitoring, Aquatics and Contaminants, Biological resources, Threatened and Endangered species, Water Quantity/Quality, GAP Analysis, Geospatial data
Interior/MMS: Gas hydrates
Interior/NPS: Water quantity/quality, Geologic mapping, Biological resources, Volcano hazard assessment, mapping and geospatial data, National Hydrography Dataset
Interior/OSM: Acid mine drainage
Justice: GIS
Labor: Energy resources
National Academy of Science: Hazards studies, Geographic research, Evaluating licensing of geospatial data, K-12 geography curricula.....
National Aeronautics and Space Administration (NASA): Planetary research, Landsats 5 and 7 operations, design of Landsat Data Continuity Mission (follow-on to Landsat). Natural hazards, Earth Science research, Data management, Land Processes Distributed Active Archive Center, GIS, United Nations Environment Program clearinghouse, Remote sensing
NASA/Jet Propulsion Lab: Spaceflight support; Shuttle Radar Topography Mission
National Institutes of Health: Human health and environment, West Nile virus mapping with CDC
National Science Foundation: Hazards studies, Antarctic research and mapping, Global seismology
Smithsonian Institution: North American vertebrate collections, Volcanic hazards
State: Natural hazards, Energy resources, Global seismology, Hydrologic data collection/studies, Famine Early Warning System, Pan American Institute of Geography and History
Tennessee Valley Authority: Hydrologic data collection/studies
Transportation/Federal Highway Administration: Hazards studies, Hydrologic data collection/studies
Transportation/Federal Aviation Administration: Volcanic hazards
U.S. Agency for International Development: Geologic hazards, Hydrologic data collection/studies, Energy resources, Atmospheric moisture index

Performance Budget

State and Local Government
Airports: Volcanic hazards
American Indians/Alaska Natives: K-12 educational resources, Streamgaging, Water quality/ quantity, Technical training and capability upgrade, Environmental hazards, Fisheries research, Invasive species, NativeView for American Indian colleges and universities
Civil Defense: Hazards mitigation
Departments of Natural Resources/Geographic Information Councils: Volcanic hazards, Map data integration, Hydrologic data collection/studies
Departments of Environmental Protection/Quality/Health: Hydrologic data collection/studies
Departments of Fish and Game/Conservation Commission/Wildlife and Parks: Endangered species, Population dynamics, Habitat requirements, Fire management, Fisheries, Wildlife disease, Invasive species, Waterfowl surveys, Bird banding, Aquaculture, GAP Analysis
Offices of Emergency Management: Hazards monitoring and mitigation, Providing emergency maps
Planning Commissions/Transportation/Engineering/Municipalities: Conservation plans, Hydrologic data collection/studies, Topographic mapping, Hazards monitoring/assessment, Creating decision support systems for local decisionmaking
State Geological Surveys: Geologic and topographic mapping, Hazards assessment
Higher Education: University participation in AmericaView
Water Resources Authorities/Public Works/Sanitation: Contaminant Transport, Hydrologic data collection/studies
Non-government Organizations
American Farm Bureau/American Society of Civil Engineers/Chemical Manufacturers Association/etc.: Coordination of hydrologic programs
American Red Cross: Hazards monitoring and mitigation
Electric Power Research Institute: Coal quality
FERC permittees/licensees: Hydrologic data collection/studies, Restoration of Threatened and Endangered migratory fish
Industry: Spatial data modeling, Spatial data browsing and retrieval, Product development, registration, and production, Environmental monitoring, Acid rain deposition program, Hazard monitoring, research and assessments
The Nature Conservancy: Endangered species, Species at Risk, Ecological research, Biological Status/Trends, Coordination of hydrologic programs, GAP Analysis
National Geographic: Print-on-demand studies
National Park and Conservation Association: Ecosystems assessments, Biological information
Universities/Cooperative Fish and Wildlife Research Units/State Water Resources Research Institutes: Planetary research, Space-based instrumentation, Natural science information delivery, Natural science research and applications, Hazards research and monitoring networks, Training/education, Geologic mapping, Hydrologic data collection/studies, GAP Analysis
Southern California Earthquake Center (University consortium): Earthquake hazard research and assessment
Utilities: Seismic studies, Hydrologic data collection/studies
Woods Hole Oceanographic Institute: Marine research
Nature Serve: NBII
International Association of Fish and Wildlife Agencies: chronic wasting disease
Ducks Unlimited: database development and data access for Latin American And Caribbean waterfowl surveys
The General Public: Breeding bird survey, Bird banding, Water resources education/outreach, topographic maps, topographic mapping
International
Global: The USGS has conducted earth science studies and provided natural hazards support in foreign countries for over 50 years. Authorization is provided under the Organic Act, as revised, and the Foreign Assistance Act and related legislation when such studies are deemed by the U.S. Department of the Interior and Department of State to be in the interest of the U.S. Government.
Africa: Ecological monitoring, Famine Early Warning System

International (continued)
Canada: Hydrologic data collection/studies, Scientific/technical cooperation
Central America: Hazards mitigation, Database development, GIS
China: Scientific/technical cooperation
International Civil Aviation Administration: Volcanic Hazards
International Organization for Standardization: Standards activities
Mexico: Border mapping, Habitat Restoration, Environmental Education, Water quantity/quality, Landscape health, Fish species
United Arab Emirates: Hydrologic data collection/studies
United Nations: United Nations Environment Programme/Global Resources Information Database, Geographic names activities

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Analysis by Activity
(Dollar Amounts in Thousands)

Activity	2005 Enacted FTE a/	Amount	Uncontrol. and Related Changes b/ FTE	Amount	Program Changes c/ FTE	Amount	2006 Budget Request FTE a/	Amount	Inc.(+) Dec.(-) from 2005 FTE	Amount
Mapping, Remote Sensing, and Geographic Investigations	736	118,751	0	2,144	3	12,558	739	133,453	3	14,702
Geologic Hazards., Resources, and Processes	1,411	229,246	0	3,385	-217	-24,495	1,194	208,136	-217	-21,110
Water Resources Investigations	1,839	211,200	0	4,930	-2	-11,959	1,837	204,171	-2	-7,029
Biological Research	1,220	171,699	0	3,953	4	-2,727	1,224	172,925	4	1,226
Enterprise Information	281	44,373	0	475	0	2,919	281	47,767	0	3,394
Science Support	461	65,584	0	582	0	6,171	461	72,337	0	6,753
Facilities	60	94,611	0	1,586	0	-1,471	60	94,726	0	115
SIR Appropriation, Total	6,007	935,464	0	17,055	-212	-19,004	5,795	933,515	-212	-1,949

a/ The FTE's depicted in the FY 2005 and 2006 columns are only the staff-years associated with appropriated funding. Reimbursable FTE's are 2,736 and 2,821 and Working Capital Fund FTE's are 207 and 208 for FY 2005 and 2006 respectively. USGS total FTE's for FY 2005 and 2006 are 9,002, 8,950 and 8,824 respectively. FTE may not add to totals, due to rounding.

b/ Included in this account's funding is a one-time technical adjustment that moves \$828 associated with the Science on the DOI Landscape initiative to the Biological Research Activity from the Geologic Hazards, Resources, and Processes Activity (-\$462) and from the Water Resources Investigations Activity (-\$366).

c/ Program changes for this account include a reduction of -\$2,000 for travel and -\$250 for vehicle fleet savings. The impact of these changes are described in the Program Changes section beginning on page G - 1.

United States Geological Survey

Federal Funds

General and special funds:

SURVEYS, INVESTIGATIONS, AND RESEARCH

For expenses necessary for the United States Geological Survey to perform surveys, investigations, and research covering topography, geology, hydrology, biology, and the mineral and water resources of the United States, its territories and possessions, and other areas as authorized by 43 U.S.C. 31, 1332, and 1340; classify lands as to their mineral and water resources; give engineering supervision to power permittees and Federal Energy Regulatory Commission licensees; administer the minerals exploration program (30 U.S.C. 641); [and] publish and disseminate data relative to the foregoing activities; and to conduct inquiries into the economic conditions affecting mining and materials processing industries (30 U.S.C. 3, 21a, and 1603; 50 U.S.C. 98g(1)) and related purposes as authorized by law and to publish and disseminate data; [\$948,921,000] \$933,515,000, of which [\$63,262,000] \$63,770,000 shall be available only for cooperation with States or municipalities for water resources investigations; [and] of which [\$7,901,000] \$7,791,000 shall remain available until expended for satellite operations; [and] of which [\$21,971,000] \$21,720,000 shall be available until September 30, [2006] 2007, for the operation and maintenance of facilities and deferred maintenance; [and] of which \$1,600,000 shall be available until expended for deferred maintenance and capital improvement projects that exceed \$100,000 in cost; and of which [\$174,219,000] \$172,925,000 shall be available until September 30, [2006] 2007, for the biological research activity and the operation of the Cooperative Research Units: *Provided*, That none of these funds provided for the biological research activity shall be used to conduct new surveys on private property, unless specifically authorized in writing by the property owner: *Provided further*, That no part of this appropriation shall be used to pay more than one-half the cost of topographic mapping or water resources data collection and investigations carried on in cooperation with States and municipalities. (*Department of the Interior and Related Agencies Appropriations Act, 2005.*)

[For an additional amount for "Surveys, Investigations, and Research", \$1,000,000, to remain available until expended: *Provided*, That such amount is designated as an emergency requirement pursuant to section 402 of S. Con. Res. 95 (108th Congress), as made applicable to the House of Representatives by H. Res. 649 (108th Congress) and applicable to the Senate by section 14007 of Public Law 108-287.] (*Emergency Supplemental Appropriations for Hurricane Disasters Assistance Act, 2005.*)

Justification of Proposed Language Change

1. Deletion: [For an additional amount for “Surveys, Investigations, and Research”, \$1,000,000, to remain available until expended: *Provided*, That such amount is designated as an emergency requirement pursuant to section 402 of S. Con. Res. 95 (108th Congress), as made applicable to the House of Representatives by H. Res. 649 (108th Congress) and applicable to the Senate by section 14007 of Public Law 108-287.] (*Emergency Supplemental Appropriations for Hurricane Disasters Assistance Act, 2005.*)

This change removes language that had provided funding to repair or replace USGS equipment and property damaged by the hurricanes during calendar year 2004. Since this funding was provided on a one-time basis, this funding is not being requested as part of the FY 2006 budget and its associated language is no longer needed.

Appropriation Language and Citations

1. For expenses necessary for the United States Geological Survey to perform surveys, investigations, and research covering topography, geology, hydrology, biology, and the mineral and water resources of the United States,
 - **43 U.S.C. 31(a)** provides for establishment of the Office of the Director of the Geological Survey, under the Interior Department, and that this officer shall have direction of the Geological Survey, and the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain.
2. its territories and possessions, and other areas as authorized by law.
 - **43 U.S.C 31(b)** provides that, "The authority of the Secretary of the Interior, exercised through the Geological Survey of the Department of the Interior, to examine the geological structure, mineral resources, and products of the national domain, is expanded to authorize such examinations outside the national domain where determined by the Secretary to be in the national interest."
 - **43 U.S.C. 1332(a)** provides that, "It is the declared policy of the United States, that the subsoil and seabed of the Outer Continental Shelf appertain to the United States and are subject to its jurisdiction, control, and power of disposition as provided in this subchapter."
 - **43 U.S.C. 1340** provides that, "Any agency of the United States and any person authorized by the Secretary may conduct geological and geophysical exploration in the Outer Continental Shelf. ..."
3. classify lands as to their mineral and water resources;
 - **43 U.S.C. 31(a)** provides that, "The Director of the Geological Survey, ... shall have the direction of the Geological Survey, and the classification of public lands and examination of the geological structure, mineral resources, and products in the National domain. ..."
4. give engineering supervision to power permittees
 - **43 U.S.C. 959** provides that, "The Secretary of the Interior is authorized and empowered, ... to permit the use of right of way through the public lands, forest, and other reservations of the United States ... for electrical plants, poles, and lines for the generation and distribution of electrical power, ...**Provided**, that such permits shall be allowed within or through any of said parks or any forest, military, Indian, or other reservation only upon approval of the Chief Officer of the Department under whose supervision such park or reservation falls and upon a finding by him that the same is not incompatible with the public interest ..."
 - **43 U.S.C. 961** provides that, "The head of the department having jurisdiction over the lands be, and he is, authorized and empowered, ... to grant an easement for right of way, ... over, across and upon the public lands and reservations of the United States for

electrical poles and lines for the transmission and distribution of electrical power ... upon a finding by him that the same is not incompatible with the public interest ..."

5. and Federal Energy Regulatory Commission licensees;
 - **16 U.S.C. 797(c)** states that, "To cooperate with the executive departments and other agencies of States or National Governments in such investigations; and for such purposes the several departments and agencies of the National Government are authorized and directed upon the request of the commission, to furnish such records, papers and information in their possession as may be requested by the commission, and temporarily to detail to the commission such officers or experts as may be necessary in such investigations."
6. administer the minerals exploration program;
 - **30 U.S.C. 641** provides that, "The Secretary of the Interior is hereby authorized and directed, in order to provide for discovery of additional domestic mineral reserves, to establish and maintain a program for exploration by private industry within the United States, its territories and possessions for such minerals, excluding organic fuels, as he shall from time to time designate, and to provide Federal financial assistance on a participating basis for that purpose."
7. publish and disseminate data relative to the foregoing activities;
 - **43 U.S.C. 41** provides for the publication of geological and economic maps, illustrating the resources and classification of the lands, and reports upon general and economic geology and paleontology. This section also provides for the scientific exchange and sale of such published material.
 - **44 U.S.C. 1318** provides for publication, by the Geological Survey, of various reports, including a report of mineral resources of the United States, bulletins and professional papers, and monographs. This section also specifies, in some instances, numbers of copies to be printed and the distribution thereof.
 - **44 U.S.C. 1320** provides for the distribution by the Director of the Geological Survey of copies of sale publications to public libraries.
8. and to conduct inquiries into the economic conditions affecting mining and materials processing industries...and related purposes as authorized by law and to publish and disseminate data;
 - **30 U.S.C. 3** provides for inquiry into the economic conditions affecting the mining, quarrying, metallurgical, and other minerals industries. This section also provides for the dissemination of information concerning these industries.
 - **30 U.S.C. 21(a)** provides for an annual report on the state of the domestic mining minerals, and mineral reclamation industries, including a statement of the trend in utilization and depletion of resources.

Appropriation Language and Citations

- **30 U.S.C. 1603** provides for ...improved collection, analysis, and dissemination of scientific, technical and economic materials information and data from Federal, state, and local governments, and other sources as appropriate.
 - **50 U.S.C. 98g(1)** provides for scientific, technologic, and economic investigations concerning the development, mining, preparation, treatment, and utilization of ore and other mineral substances.
9. of which () shall be available only for cooperation with States or municipalities for water resources investigations;
- **43 U.S.C. 48** provides that, "...amounts received by the Geological Survey from any State, Territory or political subdivision thereof in carrying on work involving cooperation to be used in reimbursing the appropriation from which the expense of such work was paid, was from the act making appropriations for the Department of the Interior for the fiscal year ending June 30, 1928, and for other purposes, act January 12, 1927, ch. 277, 1, 44 Stat. 963, and has not been repeated in subsequent appropriation acts."
 - Similar provisions were contained in the following act: 1926--May 10, 1926, ch. 277, 1, 44 Stat. 487.
10. of which () shall remain available until expended for satellite operations;
- **P.L. 107-43, Department of the Interior and Related Agencies Appropriation Act, 2002**
11. of which () shall be available until September 30, (), for the operation and maintenance of facilities and deferred maintenance;
- **P.L. 106-291, Department of the Interior and Related Agencies Appropriations Act, 2001**
12. of which \$1,600,000 shall be available until expended for deferred maintenance and capital improvement projects that exceed \$100,000 in cost;
- **P.L. 108-447, Consolidated Appropriations Act, 2005 (Interior and Related Agencies portion)**
13. and of which () shall be available until September 30, (), for the biological research activity and the operation of the Cooperative Research Units;
- **P.L. 104-208, Omnibus Appropriations Act, 1997 (Interior and Related Agencies portion)**
14. *Provided*, That none of these funds provided for the biological research activity shall be used to conduct new surveys on private property, unless specifically authorized in writing by the property owner:
- **P.L. 104-208, Omnibus Appropriations Act. 1997 (Interior and Related Agencies portion)**

15. Provided further, That no part of this appropriation shall be used to pay more than one-half the cost of topographic mapping or water resources data collections and investigations carried on in cooperation with States and municipalities.
- **43 U.S.C. 50** provides that, "The share of the Geological Survey in any topographic mapping or water resources investigations carried on in cooperation with any State or municipality shall not exceed 50 per centum of the cost thereof. ..."

Permanent authority:

16. Provided further, that in fiscal year 1984 and thereafter, all receipts from the sale of maps sold or stored by the Geological Survey shall be available for map printing and distribution to supplement funds otherwise available, to remain available until expended.
- **43 U.S.C. 42a** Provided further, That in fiscal year 1986 and thereafter, all amortization fees resulting from the Geological Survey providing telecommunications services shall be deposited in a special fund to be established on the books of the Treasury and be immediately available for payment of replacement or expansion of telecommunications services, to remain available until expended.
 - **43 U.S.C. 50a** with the establishment of the Working Capital Fund (WCF) in FY 1991, the Telecommunications Amortization Fund account and its end of year FY 1990 balances were included in the WCF.
17. Provided further, that, heretofore and hereafter, in carrying out work involving cooperation with any State, Territory, possession, or political subdivision thereof, the Geological Survey may, notwithstanding any other provisions of law, record obligations against accounts receivable from any such entities and shall credit amounts received from such entities to this appropriation.
- **43 U.S.C. 50b**
18. Provided further, That in Fiscal Year 1987 and thereafter the Geological Survey is authorized to accept lands, buildings, equipment, and other contributions from public and private sources and to prosecute projects in cooperation with other agencies, Federal, State, or private.
- **43 U.S.C. 36c** This authority for contributions was in the appropriation language annually from FY 1983 through FY 1986 and was made permanent in FY 1987.
19. Provided, That upon enactment of this Act and hereafter, final costs related to the National Petroleum Reserve in Alaska may be paid from available prior year balances in this account.
- **P.L. 100-446, Department of the Interior and Related Agencies Appropriations Act, 1989**

Appropriation Language and Citations

20. Established a Working Capital Fund which is detailed in the Working Capital Fund section of this book.
- **P.L. 101-512, Department of the Interior and Related Agencies Appropriations Act, 1991**
21. Provided further, That beginning October 1, 1990, and thereafter, funds received from any State, territory, possession, country, international organization, or political subdivision thereof, for topographic, geologic, or water resources mapping or investigations involving cooperation with such an entity shall be considered as intragovernmental funds as defined in the publication titled "A Glossary of Terms Used in the Federal Budget Process."
- **P.L. 101-512, Department of the Interior and Related Agencies Appropriations Act, 1991**
- This authority exempts non-Federal cooperative funds from sequester as defined in 1985 amendments (P.L. 99-177) to the Budget Impoundment and Control Act of 1974.
22. Provided further, That beginning in fiscal year 1998 and once every five years thereafter, the National Academy of Sciences shall review and report on the biological research activity of the Survey:
- **P.L. 104-208, Omnibus Appropriations Act, 1997 (Interior and Related Agencies portion)**

Uncontrollable and Related Cost Changes

(Dollar amounts shown in thousands)

Additional Operational Costs from 2005 and 2006 January Pay Raises

	2005 Budget Change	2005 Revised Change	2006 Change
2005 Pay Raise	+\$3,067	+\$3,025	+\$4,949
Amount Absorbed.....	[\$3,066]	[\$11,285]	
			2006 Change
2006 Pay Raise			+\$10,004

These adjustments are for an additional amount needed in 2006 to fund the remaining 3-month portion of the estimated cost of the, on average, 3.5 percent pay increases effective in January 2005 and the additional costs of funding an estimated 2.3 percent January 2006 pay increase for GS-series employees and the associated pay rate changes made in other pay series.

Other Uncontrollable Cost Changes

	2005 Budget	2005 Revised	2006 Change
Worker's Compensation Payments	\$3,462	\$3,414	-\$37
Amount Absorbed.....		[\$48]	

The adjustment is for actual charges through June 2004, in the costs of compensating injured employees and dependents of employees who suffered accidental deaths while on duty. Costs for 2005 will reimburse the Department of Labor, Federal Employees Compensation Fund, pursuant to 5 U.S.C. 8147(b) as amended by Public Law 94-273.

	2005 Budget	2005 Revised	2006 Change
Unemployment Compensation Payments	\$317	\$317	+\$274
Amount Absorbed.....		[\$241]	

The adjustment is for estimated changes in the costs of unemployment compensation claims to be paid to the Department of Labor, Federal Employees Compensation Account, in the Unemployment Trust Fund, pursuant to Public Law 96-499. The amount absorbed in 2005 is due to changes between the estimate of payments for unemployment compensation between the time the 2005 budget was formulated and enacted. The 2006 uncontrollable change includes a catch-up adjustment for the unbudgeted 2005 costs.

	2005 Budget	2005 Revised	2005 Change
Rental Payments to GSA and Others	\$76,196	\$75,137	+\$1,509
Amount Absorbed.....		[\$1,059]	

The adjustment is for changes in the costs payable to General Service Administration (GSA) and others resulting from changes in rates for office and non-office space as estimated by GSA, as well as increases in the cost per square foot under revised occupancy agreements; rent increases associated with USGS leases; and escalations for space provided under interagency and cooperative arrangements. Costs of mandatory office relocations, i.e., relocations in cases where due to external events there is no alternative but to vacate the currently occupied space, are also included.

Uncontrollable and Related Cost Changes

Other Uncontrollable Cost Changes (continued)

	2005 Budget	2005 Revised	2006 Change
Department Working Capital Fund Changes	\$13,543	\$12,215	-\$1,031

The change reflects expected changes in the charges for Department services and other services through the centralized billing portion of the working capital fund (WCF). These charges are displayed in the Budget Justification for Department Management. In addition to the 2006 uncontrollable change, the 2006 budget includes requested program changes (e.g., ESN). The change between 2005 budget and 2005 revised is attributable to bureau requested changes in billing methodologies, 2005 requested program increases for E-Government payments that will be collected and paid centrally through the WCF, and changes that were approved by the WCF Consortium. These changes are reflected in the Departmental Management Justification.

	2005 Budget Change	2005 Revised Change	2006 Change
Employer Share of Federal Health Benefit Plans	\$32,664	\$32,188	+\$3,902
Amount Absorbed.....	[\$1,555]	[\$2,030]	

The adjustment is for changes in the Federal government's share of the cost of health insurance coverage for Federal employees. The increase is estimated at 11 percent, the average increase for the past few years.

	2006 Change
One Less Payday.....	-\$2,515

This adjustment reflects the decreased costs resulting from the fact that there is one less payday in 2006 than in 2005.

Technical Adjustments

Science on the DOI Landscape Budget Realignment	2006 Change
Geologic Hazards, Resources, and Processes	-\$462
Water Resources Investigations	-\$366
Biological Research	+\$828
Net Change	\$0

Appropriating all funding to Biological Research, which already receives the largest share of funding, provides more flexibility in allocating funds appropriately to meet current and future priority requests for DOI science at the time of appropriation. All projects are interdisciplinary, and funds will continue to flow to appropriate USGS programs to meet changing priorities.

Summary of Requirements
(Dollar amounts in thousands)

Appropriation: Surveys, Investigations, and Research

	<u>FTE</u>	<u>Amount</u>	<u>FTE</u>	<u>Amount</u>
Budget estimate, 2005			6,007	935,464
Uncontrollable and Related Cost Changes:				
Additional Cost in 2006 of January 2005 Pay Raise		+4,949		
Additional Cost in 2006 of January 2006 Pay Raise		+10,004		
Worker's Compensation Payments		-37		
Unemployment Compensation Payments		+274		
Rental Payments to GSA and Others		+1,509		
Department Working Capital Fund Charges		-1,031		
Employer Share of Federal Health Benefit Plans		+3,902		
One Less Payday		-2,515		
Subtotal, Uncontrollable Cost Adjustments				+17,055
Technical Adjustment			0	0
Subtotal, Uncontrollable and Related Cost Changes				+17,055
Program Change			-212	-19,004
TOTAL REQUIREMENTS			5,795	933,515

Summary of Requirements (continued)

(Dollars in thousands)

Comparison by Activity/Subactivity/Prog Element	2004 Actual		2005 Enacted		Uncontrol. and Related Changes b/		Program Changes c/		2006 Budget Request		Inc.(+) Dec.(-) from 2005	
	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
MAPPING, REMOTE SENSING, AND GEOGRAPHIC INVESTIGATIONS												
Cooperative Topographic Mapping	607	80,843	528	71,393	1,560			-1,071	528	71,882	0	489
Land Remote Sensing	108	33,678	102	32,730	259		2	13,407	104	46,396	2	13,666
Geographic Analysis and Monitoring	107	15,238	107	14,628	325		1	222	108	15,175	1	547
TOTAL	822	129,759	736	118,751	0	2,144	3	12,558	739	133,453	3	14,702
GEOLOGIC HAZ., RESOURCES, & PROC.												
Geologic Hazard Assessments												
Earthquake Hazards	231	47,401	226	46,898	694		20	3,745	246	51,337	20	4,439
Volcano Hazards	138	19,785	133	20,714	247			826	133	21,787	0	1,073
Landslide Hazards	22	2,620	22	3,043	51			-6	22	3,088	0	45
Global Seismographic Network	7	3,434	7	3,335	42			595	7	3,972	0	637
Geomagnetism	14	2,043	14	1,989	42			-6	14	2,025	0	36
Subtotal	412	75,283	401	75,979	0	1,076	20	5,154	421	82,209	20	6,230
Geologic Landscape & Coastal Assessments												
Earth Surface Dynamics	89	14,022	84	13,634	-53			-277	84	13,304	0	-330
National Cooperative Geologic Mapping	144	25,901	139	25,162	400			-74	139	25,488	0	326
Coastal and Marine Geology	236	38,428	231	37,457	403		3	576	234	38,436	3	979
Subtotal	469	78,351	453	76,253	0	750	3	225	456	77,228	3	975
Geologic Resource Assessments												
Mineral Resources	408	55,481	398	53,764	1,140		-240	-29,820	158	25,084	-240	-28,680
Energy Resources	165	25,068	160	23,250	419			-54	160	23,615	0	365
Subtotal	573	80,549	557	77,014	0	1,559	-240	-29,874	317	48,699	-240	-28,315
TOTAL	1,454	234,183	1,411	229,246	0	3,385	-217	-24,495	1,194	208,136	-217	-21,110
WATER RESOURCES INVESTIGATIONS												
Hydrologic Monitoring, Assessments & Research												
Ground-Water Resources Program	49	5,967	44	6,998	49			370	44	7,417	0	419
National Water-Quality Assessment	396	63,285	381	61,645	1,669			-182	381	63,132	0	1,487
Toxic Substances Hydrology	62	14,902	62	14,476	367			-1,723	62	13,120	0	-1,356
Hydrologic Research & Development	305	17,112	295	15,997	363			-1,932	295	14,428	0	-1,569
National Streamflow Information Program	41	14,179	41	13,814	379			-41	41	14,152	0	338
Hydrologic Networks and Analysis	240	29,852	212	29,524	392			-1,764	212	28,152	0	-1,372
Subtotal	1,093	145,297	1,035	142,454	0	3,219	0	-5,272	1,035	140,401	0	-2,053
Cooperative Water Program	860	63,995	802	62,337	1,711			-278	802	63,770	0	1,433
Water Resources Research Act Program	2	6,422	2	6,409	0		-2	-6,409	0	0	0	-6,409
TOTAL	1,955	215,714	1,839	211,200	0	4,930	-2	-11,959	1,837	204,171	-2	-7,029

Summary of Requirements (continued)

(Dollars in thousands)

Comparison by Activity/Subactivity/Prog Element	2004 Actual		2005 Enacted		Uncontrol. and Related Changes b/		Program Changes c/		2006 Budget Request		Inc.(+) Dec.(-) from 2005	
	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
BIOLOGICAL RESEARCH												
Biological Research and Monitoring	1,046	135,110	1,007	133,130		3,393	4	-2,175	1,011	134,348	4	1,218
Biological Information Management & Delivery	85	24,662	80	23,999		217		-67	80	24,149	0	150
Cooperative Research Units	138	14,757	133	14,570		343		-485	133	14,428	0	-142
TOTAL	1,269	174,529	1,220	171,699	0	3,953	4	-2,727	1,224	172,925	4	1,226
ENTERPRISE INFORMATION												
Enterprise Information Security and Technology			155	22,714		256		2,267	155	25,237	0	2,523
Enterprise Information Resources			109	16,989		185		-21	109	17,153	0	164
Federal Geographic Data Coordination			17	4,670		34		673	17	5,377	0	707
TOTAL	0	0	281	44,373	0	475	0	2,919	281	47,767	0	3,394
SCIENCE SUPPORT												
Bureau Operations	584	89,849	461	64,636		582		6,171	461	71,389	0	6,753
Payments to the National Business Center		962		948		0		0	0	948	0	0
TOTAL	584	90,811	461	65,584	0	582	0	6,171	461	72,337	0	6,753
FACILITIES												
Rental Payments	1	68,899	1	71,368		1,509		-1,471	1	71,406	0	38
Operations & Maintenance	57	19,959	57	19,820		77		0	57	19,897	0	77
Deferred Maintenance & Capital Improvement	2	4,131	2	3,423		0		0	2	3,423	0	0
TOTAL	60	92,989	60	94,611	0	1,586	0	-1,471	60	94,726	0	115
SIR Appropriation, TOTAL	6,144	937,985	6,007	935,464	0	17,055	-212	-19,004	5,795	933,515	-212	-1,949

a/ The FTEs depicted in the FY 2004, 2005, and 2006 columns are only the staff-years associated with appropriated funding. Reimbursable FTEs are 2,653, 2,736 and 2,821 and Working Capital Fund FTEs are 205, 207 and 208 for FY 2004, 2005 and 2006 respectively. USGS total FTEs for FY 2004, 2005, and 2006 are 9,002, 8,950 and 8,824 respectively. FTE may not add to totals and subtotals, due to rounding.

b/ Included in this account's funding is a one-time technical adjustment that moves \$828 associated with the Science on the DOI Landscape initiative to the Biological Research Activity from the Geologic Hazards, Resources, and Processes Activity (-\$462) and from the Water Resources Investigations Activity (-\$366).

c/ Program changes for this account include a reduction of -\$2,000 for travel and -\$250 for vehicle fleet savings. The impact of these changes are described in the Program Changes section beginning on page G - 1.

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Authorizations

43 U.S.C. 31 et seq. The Organic Act of March 3, 1879, as amended, established the United States Geological Survey. This section provides, among other matters, that the USGS is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the Department of the Interior. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285, Sec. 10(a) establishes United States Geological Survey as its official name.

2 U.S.C. 681-688 Congressional Budget and Impoundment Control Act of 1974 et seq. This section discusses the general Federal budget process, including rescissions, reservations, and deferrals of budget authority.

5 U.S.C. 305 Title 5 deals with Government Organization and Employees. It includes personnel matters (classification, pay rates, benefits, etc.), the Freedom of Information Act, the Privacy Act, the Computer Matching and Privacy Act, and other issues related to general Federal functions and employment. The Appendices to Title 5 include the Federal Advisory Committee Act (FACA) of 1972, Inspector General mandates, and other matters that include Federal entities such as the USGS.

7 U.S.C. 136 Federal Environmental Pesticide Control Act of 1972 (P.L. 92-516), amended the 1947 Federal Insecticide, Fungicide and Rodenticide Control Act (P.L. 80-102) program for controlling the sale and distribution of "economic poisons". The law requires registration of pesticides to avoid unreasonable adverse affects to humans or the environment.

7 U.S.C. 2201 Rural Development and Policy Act of 1980. Requires the Secretary of Agriculture to obtain the advice of the Secretary of the Interior as to whether certain lands that are being patented, disposed of, or exchanged are mineral in character.

7 U.S.C. 2204 Authorizes the Secretary of Agriculture to enter cooperative agreements with other Federal agencies and other organizations concerning water management for rural areas.

15 U.S.C. 631, 631a Small Business Acts. Fosters the economic interests of small businesses and sets forth procedures. Federal agencies are encouraged to use small businesses for services and other contracted activities.

15 U.S.C. 2901, 2908 The National Climate Program Act of 1978 established a national climate program to assist the Nation and the world in understanding and responding to natural and human-induced climate processes and their known and potential effects. The Department of the Interior has a mandated role in this Program.

15 U.S.C. 2921-2953 The Global Change Research Act of 1990 (P.L. 101-606) established the United States Global Change Research Program aimed at understanding and responding to global change, including the cumulative effects of human activities and natural processes on the environment, to promote discussions toward international protocols in global change research, and for other purposes.

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15 U.S.C. 5631-5658 The Land Remote Sensing Policy Act of 1992 enables the United States to maintain its leadership in land remote sensing by providing data continuity for the Landsat program. The Act assigns responsibility for the "National Satellite Land Remote Sensing Data Archive" to the Department of the Interior. The Act also authorizes and encourages the Department of the Interior and other Federal agencies to carry out research and development programs in applications of these data and makes Landsat data available to the public.

16 U.S.C. 17 et seq. Parts of Title 16, Conservation, such as National Park Service Organic Act, as amended and supplemented, apply to the USGS. Notably, the Outdoor Recreation Act of June 23, 1936, authorizes the Secretary of the Interior to sponsor, engage in, and assist in research relating to outdoor recreation, directly or by contract or cooperative agreements, and make payments for such purposes; undertake studies and assemble information concerning outdoor recreation; and cooperate with educational institutions and others in order to assist in establishing education programs and activities and to encourage public use and benefits from outdoor recreation.

16 U.S.C. 350 et seq. Coastal Barrier Resources Act of 1992. Designates various underdeveloped coastal barrier islands depicted by specific maps for inclusions in the Coastal Barrier Resource System.

16 U.S.C. 661 et seq. Fish and Wildlife Coordination Act of March 10, 1934 (P.L. 79-732) authorizes the Secretary of the Interior to prepare plans to protect wildlife resources, to conduct surveys on public lands, and to accept funds or lands for related purposes; authorizes the investigation and reporting of proposed Federal actions that affect the development, protection, rearing, and stocking of all species of wildlife and their habitat in controlling losses, minimizing damages, and providing recommendations to minimize impacts on fish and wildlife resources.

16 U.S.C. 703-711 Migratory Bird Treaty Act of 1918, as amended, implements four international treaties that individually affect migratory birds common to the United States, Canada, Mexico, Japan, and the former Soviet Union. This Act establishes Federal responsibility for protection and management of migratory and nongame birds, including the establishment of season length based on scientific information relative to zones of temperature, distribution, abundance, breeding habits and times and lines of migratory flight of migratory birds. It also establishes the Secretary of the Interior's responsibility for bag limits, and other hunting regulations, and issuance of permits to band, possess, or otherwise make use of migratory birds.

16 U.S.C. 715 Migratory Bird Conservation Act. Establishes the Migratory Bird Conservation Commission; authorizes the Secretary of the Interior to conduct investigations and publish documents related to North American birds.

16 U.S.C. 742 et seq. Fish and Wildlife Act of 1956 authorizes the Secretary of the Interior to conduct investigations, prepare and disseminate information, and make periodic reports to the public regarding the availability and abundance and the biological requirements of fish and wildlife resources; provides a comprehensive national fish and wildlife policy and authorizes the Secretary of the Interior to take steps required for the development, management, advancement, conservation, and protection of fisheries and wildlife resources through research, acquisition of refuge lands, development of existing facilities, and other means.

16 U.S.C. 753a The Fish and Wildlife Improvement Act of 1978 as amended by P.L. 95-616, authorizes the Secretary of the Interior to enter into cooperative agreements with colleges and universities, State fish and game agencies, and nonprofit organizations for the purpose of developing adequate, coordinated, cooperative research and training programs for fish and wildlife resources.

16 U.S.C. 931-939 Great Lakes Fishery Act of 1956 implements the Convention on Great Lakes Fisheries between the United States and Canada; authorizes construction, operation and maintenance of sea lamprey control works; and established the Great Lakes Fisheries Commission.

16 U.S.C. 1131 The Wilderness Act of 1964 and numerous subsequent related Acts requires the USGS to assess the mineral resources of each area proposed as wilderness or established as wilderness. The studies are to be on a planned and recurring basis. The original series of studies have been completed and no recurring studies have been requested or funded.

16 U.S.C. 1361 et seq. Marine Mammal Protection Act of 1972, as amended, establishes a responsibility to conserve marine mammals with management authority vested in the Department of the Interior for the sea otter, walrus, polar bear, dugong, and manatee.

16 U.S.C. 1531 et seq. Endangered Species Act of 1973, as amended, provides for the conservation of threatened and endangered species of fish, wildlife, and plants; and authorizes establishment of cooperative agreements and grants-in-aid to States that establish and maintain active and adequate programs for endangered and threatened wildlife and plants.

16 U.S.C. 1600 et seq. Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act of 1976. The USGS is a party in an interagency agreement with the Forest Service to assess the mineral resources of National Forests.

16 U.S.C. 2801 et seq. National Aquaculture Act of 1980 directs the Secretary of the Interior to participate in the development of a National Aquaculture Development Plan and authorizes research, development, and other activities to encourage the development of aquaculture in the United States.

16 U.S.C. 3141 et seq. The Alaska National Interest Lands Conservation Act of 1980. Section 1008 of the Act authorizes the Secretary of the Interior to conduct studies, or collect and analyze information obtained by permittees, of the oil and gas potential of non- North Slope Federal lands. Section 1010 of the Act requires that the Secretary of the Interior assess the oil, gas, and other mineral potential, and expand the minerals data base, for all public lands in Alaska. Section 1011 of the Act requires an annual minerals report be presented to Congress. These responsibilities have been delegated to the USGS. The Geological Survey has made and may be called upon to make water studies pertinent to implementation of the Act.

16 U.S.C. 4701 et seq. Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646), establishes a Federal program to prevent introduction of and to control the spread of introduced aquatic nuisance species.

22 U.S.C. 3201 et seq. The Nuclear Non-Proliferation Act of 1978 provides that under Title V, United States Assistance to Developing Countries, the USGS assists, through the State

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Department and the Agency for International Development, in evaluation of nuclear facilities sites in other countries.

25 U.S.C. 450 et seq. The Tribal Self-Governance Act of 1994. The USGS participates in the Tribal Self-Governance Program by identifying USGS activities that may be available for Tribal operation under the Self-Governance Act. The USGS discusses its programs and activities with interested Tribal governments.

29 U.S.C. 651 Occupational Safety and Health Act of 1970.

30 U.S.C 21(a) The Mining and Minerals Policy Act of 1970 and The National Materials and Minerals Policy, Research and Development Act of 1980, emphasizes the USGS' responsibility to assess the mineral resources of the Nation.

30 U.S.C. 201 The Federal Coal Leasing Amendments Act of 1976 provides that no lease sale may be held on Federal lands unless the lands containing the coal deposits have been included in a comprehensive land-use plan. The Act provides that the Secretary is authorized and directed to conduct a comprehensive exploratory program designed to obtain sufficient data and information to evaluate the extent, location, and potential for developing the known recoverable coal resources within the coal lands. The USGS provides data and information from its coal research and field investigations, which are useful to the BLM to meet the requirements of the coal leasing program.

30 U.S.C. 1026 Section 6 of the Geothermal Steam Act Amendments of 1988 requires the Secretary of the Interior to (1) maintain a monitoring program for significant thermal features within units of the National Park System and (2) establish a research program to collect and assess data on the geothermal resources within units of the National Park System with significant thermal features in cooperation with the USGS. Section 8 of the Geothermal Steam Act Amendments of 1988 requires the USGS to conduct a study of the impact of present geothermal development in the vicinity of Yellowstone National Park on the thermal features within the park.

30 U.S.C. 1028 The Energy Policy Act of 1992 directs the USGS to establish a cooperative government-private sector program with respect to hot dry rock geothermal energy resources on public lands, to convene a workshop of interested governmental and private parties to discuss the regional potential for hot dry rock geothermal energy in the eastern United States, and to submit a report to Congress containing a summary of the findings and conclusions of the workshop. The Act also supports recurring assessments of the undiscovered oil and gas resources of the United States.

30 U.S.C. 1121 The Geothermal Energy Research, Development, and Demonstration Act of 1974 provides that the Department of the Interior is responsible for the evaluation and the assessment of the geothermal resource base, including the development of exploration technologies.

30 U.S.C. 1201 et seq. Surface Mining Control and Reclamation Act of 1977, as amended, established the Office of Surface Mining Reclamation and Enforcement (OSM). OSM depends in part upon the USGS for a determination of the probable hydrologic consequences of mining and reclamation operations.

30 U.S.C. 1419 et seq. The Deep Seabed Hard Mineral Resources Act of 1980 provides authorization for conducting a continuing program of ocean research that "shall include the development, acceleration, and expansion, as appropriate, of the studies of the ecological, geological, and physical aspects of the deep seabed in general areas of the ocean where exploration and commercial development are likely to occur...." The USGS, based on expertise developed in regional offshore geologic investigations, provides geological and mineral resource expertise in responding to the requirements of the Act.

30 U.S.C 1601 et seq. The Mining and Minerals Policy Act of 1970, National Materials and Minerals Policy, Research and Development Act of 1980, reemphasize the responsibility of the USGS to assess the mineral resources of the Nation.

31 U.S.C. 97 Fees and Charges for Government Services and Things of Value. This section directs that each service or thing of value provided to a person be self-sustaining to the extent possible. Further, the head of each agency may prescribe regulations establishing the charge for each service or thing of value. Each charge is to be fair, based on the costs to the Government or the value of the service or thing to the recipient, public policy or interest served, and other relevant facts.

31 U.S.C. 901 note Chief Financial Officers Act of 1990.

31 U.S.C. 1535 Economy Act of 1932, as amended, authorizes any agency to obtain goods and services from and reimburse any other agency.

31 U.S.C. 3302 The custody and possession of public money by Federal officials is dealt with in this section.

31 U.S.C. 3501 et seq. Budget Accounting and Procedures Act of 1950. Federal Managers' Financial Integrity Act of 1982.

31 U.S.C. 3901-3906 Prompt Payment Act.

31 U.S.C. 6301 et seq. Federal Grant and Cooperative Agreement Act of 1977 provides criteria for distinguishing between contract, grant and cooperative agreement relationships and provides discretionary authority to vest title to equipment or other tangible personal property purchased with contract, grant or cooperative agreement funds in nonprofit research or higher education institutions.

31 U.S.C. 7501 Single Audit Act of 1984 (P.L. 98-502).

31 U.S.C. 9701 Independent Office Appropriations Act of 1952; Title 5 - Fees and charges for Government services and things of value. This Act encouraged Federal services and products ("things of value") to be as financially self-sustaining as possible. It authorized costs to be charged for Federal services and products based on the costs to the Government, the value of the service or thing to the recipient, and the public policy or interest served.

33 U.S.C. 883(a) The Great Lakes Shoreline Mapping Act of 1987 in Section 3202(a) requires that the Director of the National Oceanic and Atmospheric Administration "... in consultation with the Director of the United States Geological Survey, shall submit to the Congress a plan for preparing maps of the shoreline of the Great Lakes under section 3203." The act further requires in Section 3203 that "... subject to authorization and appropriation of funds, the

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Director, in consultation with the Director of the United States Geological Survey, shall prepare maps of the shoreline areas of the Great Lakes."

33 U.S.C. 1251 et seq. Federal Water Pollution Control Act Amendments of 1972 and its successors, the Clean Water Act of 1977 and the Water Quality Act of 1987, authorize extensive water quality planning, studies, and monitoring under the direction primarily of the Environmental Protection Agency (EPA). The USGS is called upon to participate in many of these activities, partly by EPA and partly by State agencies in the Federal-State Cooperative Program. The act of 1987 includes new water quality work concerning Chesapeake Bay, the Great Lakes, Estuary and Clean Lakes Programs, and studies of water pollution problems in aquifers.

33 U.S.C. 1401 The Marine Protection, Research, and Sanctuaries Act of 1972 provides that the Secretary of Commerce must consult with the Secretary of the Interior prior to designating marine sanctuaries. The USGS provides information regarding the energy and mineral resource potential in areas being considered for designation as marine sanctuaries.

33 U.S.C. 2201 et seq. Water Resources Development Act of 1990, authorizes a program for planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement; cooperative effort and mutual assistance for use, protection, growth, and development of the Upper Mississippi River system; implementation of a long-term resource monitoring program; and implementation of a computerized inventory and analysis systems.

33 U.S.C. 2701 et seq. The Oil Pollution Act of 1990, provides enhanced capabilities for oil spill response and natural resource damage assessment. Includes the identification of ecologically sensitive areas and the preparation of scientific monitoring and evaluation plans. Research is to be directed and coordinated by the National Wetlands Research Center.

40 U.S.C. 471 Federal Property and Administrative Services Act of 1949.

40 U.S.C. 601 Public Buildings Amendment Act of 1972.

40 U.S.C. 606 Public Buildings Act of 1959.

41 U.S.C. 252 Competition in Contracting Act of 1984.

41 U.S.C. 601-613 Contract Disputes Act of 1978.

42 U.S.C. 300f et seq. Pursuant to the Safe Drinking Water Act, as amended, the USGS and EPA have an interagency agreement covering aquifer studies conducted by the USGS relating to sole source aquifers.

42 U.S.C. 1006 et seq. Solid Waste Disposal Act of 1976.

42 U.S.C. 2021b et seq. Low-Level Radioactive Waste Policy Act (1980) required intra-State or multi-State (regional) arrangements for disposal of low-level radioactive waste by July 1, 1986. The USGS provides geohydrologic research and technology to Federal and State agencies developing plans for low level waste management. The amending Act of 1985 included approval of seven interstate compacts.

42 U.S.C. 2210b, 2231 The Nuclear Regulatory Commission Authorization Act requires the Secretary of Energy to monitor and report to the President and Congress on the viability of the domestic uranium industry. Under a Memorandum of Understanding between the Department of Energy and the Department of the Interior, the USGS provides information on domestic uranium resources to the Energy Information Agency.

42 U.S.C. 4321 et seq. The National Environmental Policy Act of 1969, as amended. The USGS reviews Environmental Impact Statements (EIS) prepared by other agencies under the authority of this Act. The USGS reviews EIS for nuclear power plant sites and other critical facilities. The USGS is called upon to provide technical review or inputs to resource-related actions proposed by other Federal agencies.

42 U.S.C. 5201 et seq. The Disaster Relief Act of 1974, Section 202(a), states that "The President shall insure that all appropriate Federal agencies are prepared to issue warnings of disasters to State and local officials." In addition, Section 202(b) states that "The President shall direct appropriate Federal agencies to provide technical assistance to State and local governments to insure that timely and effective disaster warning is provided." The Director of the Geological Survey, through the Secretary of the Interior, has been delegated the responsibility to issue disaster warnings "... for an earthquake, volcanic eruption, landslide, or other geologic catastrophe."

42 U.S.C. 5845(c) The Energy Reorganization Act of 1974 directs all other Federal agencies to "... (2)... furnish to the (Nuclear Regulatory) Commission... such research services... for the performance of its functions; and (3) consult and cooperate with the Commission on research development matters of mutual interest and provide such information and physical access to its facilities as will assist the Commission in acquiring the expertise necessary to perform its licensing and related regulatory functions." The USGS conducts geological mapping in areas where future nuclear reactor construction is anticipated and conducts topical investigations of various geologic processes that could imperil the safe operation of the reactors or other critical energy facilities.

42 U.S.C. 6901 et seq. Resource Conservation and Recovery Act of 1976 and the Hazardous and Solid Waste Amendments of 1984 require EPA to promulgate guidelines and regulations for identification and management of solid waste, including its disposal. The expertise of the USGS is a present and potential source of assistance to EPA in defining and predicting the hydrologic effects of waste disposal.

42 U.S.C. 7418, 7470, et seq. The Clean Air Act of 1977, as amended, requires Federal facilities to comply with air quality standards to the same extent as non-governmental entities; and establishes requirements to prevent significant deterioration of air quality and, in particular, to preserve air quality in national parks, national wilderness areas, national monuments and national seashores.

42 U.S.C. 7701 et seq. The Earthquake Hazards Reduction Act of 1977 sets as a national goal the reduction in the risks of life and property from future earthquakes in the United States through the establishment and maintenance of a balanced earthquake program encompassing prediction and hazard assessment research, seismic monitoring and information dissemination. P.L. 101-614 reauthorizes the National Earthquake Hazards Reduction Act. Note P.L. 106-503.

42 U.S.C. 8901 et seq. The Clean Air Act Amendments of 1990 (P.L. 101-549) called for continuation of the National Acid Precipitation Assessment Program (NAPAP) that was

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established under the Acid Precipitation Act of 1980. The Secretary of the Interior is renamed as a member of the task force that directs NAPAP. The USGS is an active participant in the research program and coordinates interagency monitoring of precipitation chemistry. The USGS National Coal Resources Data System was named by the Environmental Protection Agency (EPA) as the official data base for information on coal quality. The EPA, utility companies, and coal mining industries use the data base to estimate the amount of air pollution derived from coal combustion.

42 U.S.C. 9601 et seq. Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) established a Superfund to help finance the massive cleanup programs needed at sites that are heavily contaminated with toxic wastes. The USGS is called upon by the EPA and State agencies to investigate and determine the extent of contamination and remedial measures at some of these sites. The amendments of 1986 reauthorize for 5 years EPA's program to clean up the Nation's worst toxic dump sites.

42 U.S.C. 10101 et seq. Nuclear Waste Policy Act of 1982 on disposal of high-level radioactive wastes defines DOE as lead agency with responsibility for siting, building, and operating high-level radioactive waste repositories. The law requires participation by the USGS in a consultative and review role to the DOE. The Nuclear Waste Policy Amendments Act of 1987 (Title V of the Omnibus Budget Reconciliation Act of 1987) identifies the Yucca Mountain, NV, site as the first site to be studied to see if it is suitable for disposal of high level nuclear waste. The 1987 Act also provides that the Department of Energy conduct a survey of potentially suitable sites for a monitored retrievable storage (MRS) facility.

42 U.S.C. 10301 et seq. The Water Resources Research Act of 1984, as amended, provides for water resources research, information transfer, and student training in grants and contract programs that will assist the Nation and the States in augmenting their science and technology to discover practical solutions to water shortage and quality deterioration problems.

43 U.S.C. 31 et seq. The Organic Act of March 3, 1879, as amended, established the United States Geological Survey. This section provides, among other matters, that the USGS is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the Department of the Interior. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285, Sec. 10(a) establishes United States Geological Survey as its official name.

Particularly: Section 4 of the Continental Scientific Drilling and Exploration Act of 1988 requires that "The Secretary of the Department of Energy, the Secretary of the Department of the Interior through the United States Geological Survey, and the Director of the National Science Foundation assure an effective, cooperative effort in furtherance of the Continental Scientific Drilling Program of the United States."

And: 43 U.S.C. 31c. National Geologic Mapping Act of 1992 (P.L. 102-285). Establishes in the USGS a National Cooperative Geologic Mapping Program. Section 4(c) states "The objectives of the geologic mapping program shall include (1) determining the Nation's geologic framework through systematic development of geologic maps at scales appropriate to the geologic setting and the perceived applications, such maps to be contributed to the national geologic map database; (2) development of a complementary national geophysical-map database, geochemical-map database, and a geochronologic and paleontologic database that provide value-added descriptive and interpretive information to the geologic-map database;

(3) application of cost-effective mapping techniques that assemble, produce, translate and disseminate geologic-map information and that render such information of greater application and benefit to the public; and (4) development of public awareness for the role and application of geologic-map information to the resolution of national issues of land use management." Note P.L. 106-148.

43 U.S.C. 36c, acceptance of contributions from public and private sources; cooperation with other agencies in prosecution of projects, states, "In fiscal year 1987 and thereafter the United States Geological Survey is authorized to accept lands, buildings, equipment, and other contributions from public and private sources and to prosecute projects in cooperation with other agencies, Federal, State, or private."

43 U.S.C. 38 Topographic surveys; marking elevations. This section provides for the establishment and location of permanent benchmarks used in the making of topographic surveys.

43 U.S.C. 41 Publications and reports; preparation and sale. This section provides that the publications of the USGS shall consist of geological and economic maps illustrating the resources and classification of lands and other reports.

43 U.S.C. 42 et seq. Distribution of maps and atlases, etc. This section authorizes and directs the Director of the Geological Survey, upon the approval of the Secretary of the Interior, to distribute topographic and geologic maps and atlases of the United States. The prices and regulations are to be fixed by the Director with the approval of the Secretary. This Section further provides that copies of each map or atlas, not to exceed five hundred, shall be distributed gratuitously among foreign governments, departments of our own Government, literary and scientific associations, and to educational institutions or libraries. It also section authorizes all receipts from the sale of maps sold or stored by the USGS to be retained by the USGS to supplement other available funds.

43 U.S.C. 43 Copies to Senators, Representatives and Delegates. This section provides that one copy of each map and atlas shall be sent to each Senator, Representative, and Delegate in Congress, if published within his term, and that a second copy be placed at the disposal of each.

43 U.S.C. 44 Sale of transfers or copies of data. This section provides that the Geological Survey may furnish copies of maps to any person, concern, institution, State or foreign government.

43 U.S.C. 45 Production and sale of copies of photographs and records; disposition of receipts. This section authorizes the USGS to produce and sell on a reimbursable basis, copies of aerial or other photographs, mosaics, and other official records. It also discusses the disposition of the receipts from those sales.

43 U.S.C. 49 Extension of cooperative work to Puerto Rico. This section authorizes the making of topographic surveys in Puerto Rico by the USGS.

43 U.S.C. 50 The share of the USGS in any topographic mapping or water resources investigations carried on in cooperation with any State or municipality shall not exceed 50 percent of the cost thereof.

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43 U.S.C. 364 et seq. U.S. Board on Geographic Names. This law, approved July 25, 1947, establishes the U.S. Board on Geographic Names to provide for uniformity in geographic nomenclature and orthography throughout the Federal Government, and to promulgate in the name of the Board official geographic names as well as decisions and principles with respect to geographic names. The Secretary of the Interior provides staff assistance to the Board under the law.

43 U.S.C. 371 note Reclamation Projects Authorization and Adjustment Act of 1992.

43 U.S.C. 506 et seq. The Reclamation Safety of Dams Act of 1978 requires the USGS to participate in direct interchange of science information with other agencies. Geologic data developed under the Geologic Hazards Surveys are applicable to dam safety analyses.

43 U.S.C. 1334 et seq. Outer Continental Shelf (OCS) Lands Act, authorizes the Secretary of the Interior to prescribe rules and regulations to provide for the prevention of waste and conservation of the natural resources of the OCS; to conduct geological and geophysical explorations of the OCS; directs the Secretary of the Interior to conduct a study of any region in any gas and oil lease sale to obtain information necessary for assessment and management of environmental impacts on human, marine and coastal areas which may be affected by oil and gas development on such areas.

43 U.S.C. 1701 et seq. The Federal Land Policy and Management Act (FLPMA) of 1976 specifically requires that the USGS do a wilderness mineral survey by 1991 of each area the Bureau of Land Management (BLM) recommends for wilderness suitability. The studies are to be on a planned and recurring basis. The original series of studies have been completed. As part of the implementation of the FLPMA, the BLM enlists the USGS hydrologic database and expertise in connection with BLM's responsibility regarding coal reserves on and beneath Federal lands.

43 U.S.C. 1865 The OCS Lands Act Amendments of 1978 provide for management of oil and natural gas in the Outer Continental Shelf and for other purposes. The Minerals Management Service is responsible for carrying out all functions in direct support of management of the OCS program. The USGS provides indirect support to the Department's management activities through its basic mission to examine the geological structure, mineral resources, and products of the national domain, which, offshore, includes the EEZ.

44 U.S.C. 35 Paperwork Reduction Act.

44 U.S.C. 1318 Classes and sizes of publications; report of mineral resources; number of copies; reprints; distribution. This section gives very specific and detailed instructions concerning the numbers of copies to be printed and the distribution of certain USGS publications.

44 U.S.C. 1319 Specific appropriations required for monographs and bulletins. The scientific reports known as the monographs and bulletins of the USGS may not be published until specific, detailed estimates, and specific appropriations based on these estimates, are made for them.

44 U.S.C. 1320 Distribution of publications to public libraries. The Director of the USGS shall distribute to public libraries that have not already received them, copies of sale publications on

hand at the expiration of 5 years after date of delivery to the Survey document room, excepting a reserve number not to exceed two hundred copies.

44 U.S.C. 1903 Distribution of publications to depositories; notice to Government components; cost of printing and binding. Upon request of the Superintendent of Documents, components of the Government ordering the printing of publications shall either increase or decrease the number of copies of publications furnished for distribution to designated depository libraries and State libraries so that the number of copies delivered to the Superintendent of Documents is equal to the number of libraries on the list.

46 U.S.C. 31(a) and (b) The Coastal Zone Management Act of 1976 provide that each department, agency, and instrumentality of the Executive Branch of the Federal Government may assist the Secretary of Commerce, on a reimbursable basis or otherwise, in carrying out research and technical assistance for coastal zone management.

50 U.S.C. 98 The Strategic and Critical Materials Stock Piling Act of 1946 as amended by its Revision Act of 1979. Section 8 of the Act supports the USGS programs for assessment of domestic minerals, especially for strategic and critical minerals, to complement the Federal mineral stockpile program.

P.L. 81-82, P.L. 82-231 Arkansas River Compact and Yellowstone River Compact, respectively. Congress has granted its consent to many interstate water compacts. For such compacts, the USGS provides administrative support for the Federal representative, usually appointed by the President. Also, the USGS collects hydrologic data for 25 interstate compacts. The data collection is supported partly by the Federal Program and partly by the Federal-State Cooperative Program.

P.L. 93-322 Special Energy Research and Development Appropriation Act, 1975, provided funds "for energy research and development activities of certain departments" The USGS water resources investigations in coal hydrology support that legislation.

P.L. 102-580 Water Resources Development Act of 1992 establishes a National Contaminated Sediment Task Force, with USGS as a member, to conduct a comprehensive national survey of aquatic sediment quality.

P.L. 104-106 Federal Acquisition Reform Act of 1996 mandates the continued career development and training of the acquisition workforce.

P.L. 104-134 Debt Collection Improvement Act of 1996.

P.L. 104-208 FY 1997 Omnibus Appropriations Act.

P.L. 105-47 An Act to authorize appropriations for carrying out the Earthquake Hazards Reduction Act of 1977. Note P.L. 106-503.

P.L. 105-83 FY 1998 Interior and Related Agencies Appropriations Act.

P.L. 105-97 National Wildlife Refuge System Improvement Act of 1997.

P.L. 106-148 National Geologic Mapping Reauthorization Act of 1999. Amends the National Geologic Mapping Act (NGMA) of 1992.

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P.L. 106-193 Methane Hydrate Research and Development Act of 2000. Authorizes appropriations for the establishment of a methane hydrate research and development program within the Department of Energy (DOE). DOE is directed to carry out this program in consultation with the U.S. Navy, USGS, Minerals Management Service, and NSF, through grants, contracts, and cooperative agreements with universities and industrial enterprises. The purpose is to study the use of methane hydrate as a source of energy. Deposits of methane hydrate occur in deep ocean and permafrost areas of the world and consist of methane-water ice-like crystalline material. This Act sunsets the methane hydrate research and development program at the end of FY 2005.

P.L. 106-291 FY 2001 Interior and Related Agencies Appropriations Act.

P.L. 106-374 Water Resources Research Act. Reauthorizes appropriations for the Water Resources Research Act of 1984 (P.L. 98-242, as amended by P.L. 101-397) through September 30, 2005, to provide for water resources research, information transfer, and student training through grant and contract programs that will assist the Nation and the States in augmenting their science and technology to discover practical solutions to water supply and water quality problems..

P.L. 106-390 Disaster Mitigation Act of 2000. Amends the Robert T. Stafford Disaster Relief and Emergency Assistance Act to authorize a program for predisaster mitigation, to streamline the administration of disaster relief, to control the Federal costs of disaster assistance, and for other purposes. Section 102, Predisaster Hazard Mitigation, defines a "multi-hazard advisory map," stating that the maps will be developed in consultation with States, local governments, and appropriate Federal agencies (i.e., USGS), and, to the maximum extent practicable, the most cost-effective and efficient technology available will be used. The multi-hazard advisory maps will be made available to the appropriate State and local governments for the purposes of informing the general public about the risks of natural hazards in certain areas.

P.L. 106-457 Estuaries and Clean Waters Act of 2000. Amends the Federal Water Pollution and Control Act (commonly known as the Clean Water Act) to include authorization for: Title I, Estuary Restoration; Title II, Chesapeake Bay Restoration; Title III, National Estuary Program; Title IV, Long Island Sound Restoration; Title V, Lake Pontchartrain Basin Restoration; Title VI, Alternative Water Sources; Title VII, Clean Lakes; and Title VIII, Tijuana River Valley Estuary and Beach Cleanup. (The Clean Water Act charges States and tribes with setting specific water-quality criteria appropriate for their waters and for developing pollution control programs to meet the criteria. States and tribes utilize USGS hydrologic data collection and monitoring to help meet Clean Water Act requirements. The USGS also is a key Federal partner in both the Chesapeake Bay Program and the National Estuary Program.)

P.L. 106-469 Energy Act of 2000. Extends energy conservation programs under the Energy Policy and Conservation Act through FY 2003. Specifically for the USGS, Section 604, "Scientific Inventory of Oil and Gas Reserves," instructs the Secretary of the Interior, in consultation with the Secretaries of Agriculture and Energy, to conduct and update regularly an inventory of all onshore Federal lands. The inventory will identify (1) USGS reserve estimates of the oil and gas resources underlying these lands; (2) restrictions or impediments to development of such resources; and (3) furnish such inventory data to the House Committee on Resources and the Senate Committee on Energy and Natural Resources. Authorizes appropriations as necessary for implementation.

P.L. 106-498 Klamath Basin Water Supply Enhancement Act of 2000. Authorizes the Bureau of Reclamation to conduct feasibility studies to augment water supplies for the Klamath Project, Oregon and California, and for other purposes. The Secretary of the Interior is directed to complete ongoing hydrologic surveys in the Klamath River Basin that are currently being conducted by the USGS. Since 1992, USGS scientists have been conducting hydrological and biological research on many of the factors affecting Klamath Basin water resources. These studies include water-quality and quantity issues, endangered species and other fishery issues, and decreased water supply to wetland areas in National Wildlife Refuges.

P.L. 106-503 Earthquake Hazards Reduction Authorization Act of 2000.

P.L. 106-514 Coastal Barrier Resources Reauthorization Act of 2000. Reauthorizes and amends the Coastal Barrier Resources Act of 1999. Section 6 authorizes cooperative efforts between the Secretary of the Interior and the Director of FEMA to provide existing digital spatial data, including digital orthophotos, and shoreline, elevation, and bathymetric data of the John H. Chafee Coastal Barrier Resource System maps. If data do not exist to carry out this pilot project, the USGS, in cooperation with other Federal agencies, as appropriate, will obtain and provide the data required to the Secretary. In addition, all data used or created to carry out this section shall comply with the National Spatial Data Infrastructure established by Executive Order 12906 (59 Fed. Reg. 17671 (April 13, 1994)); and any other standards established by the Federal Geographic Data Committee established by Office of Management and Budget Circular A-16.

P.L. 106-541 Water Resources Development Act of 2000. Authorizes appropriations to the Secretary of the Army for the conservation and development of water and related resources to construct various projects for improvements to rivers and harbors of the United States, and for other purposes. Sections of this Act that are of interest to the USGS are: Sec. 313, Missouri River Valley, Missouri (Missouri River Valley Improvement Act); Sec. 440, Upper Mississippi River Basin Sediment and Nutrient Study (see H.R. 4013 below); Sec. 502, CALFED Bay-Delta Program Assistance, California; Sec. 542, Lake Champlain Watershed, New York and Vermont; and Sec. 601, Comprehensive Everglades Restoration Plan.

P.L. 107-63 FY 2002 Interior and Related Agencies Appropriations Act.

P.L. 108-7 FY 2003 Interior and Related Agencies Appropriations Act.

P.L. 108-108 FY 2004 Interior and Related Agencies Appropriations Act.

P.L. 108-447 FY 2005 Consolidated Appropriations Act.

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Geographic Research and Geospatial Information Transition



Introduction

In direct response to National Academies' National Research Council (NRC) recommendations in 2002 to redefine priorities in geographic research, USGS has realigned and honed the focus of geographic research and geospatial data programs.

In August 2005, the Director announced an organizational and management realignment that—

- Positions the Geographic Analysis and Monitoring, Land Remote Sensing, and Science Impact programs to be the centerpieces of USGS geography research and applications and
- Consolidates key elements of the USGS portfolio of national geospatial programs, such as the Federal Geographic Data Committee, the Geospatial One-Stop project, and *The National Map* into a National Geospatial Programs Office.

"The location and distribution of resources and the people who depend upon them, the patterns of the natural and built landscapes, and the processes at the interface of nature and society are essential geographic issues that face the United States and the USGS."

Research Opportunities in Geography
at the U.S. Geological Survey
National Research Council, 2002

A New Vision for Geographic Research

The NRC report recommended that the USGS should give higher priority to fundamental geographic research to:

- Improve citizen involvement in decisionmaking for issues related to natural sciences by applying all the USGS primary spatial data sets,
- Expand the utility and application of place-based science by conducting integrative place-specific research in addition to topical research in individual disciplines, and
- Enhance the effectiveness of decision-support systems with increased geographic input and more effective map-like products as output.

To address these recommendations and to define the future of USGS geographic research, a "Geography Summit" was held in Washington, D.C., in January 2005. Outcomes of the summit include refined vision and mission (see box) and articulation of the desired future state.

USGS Geography Research Framework

Vision: To lead the Nation in advancing geographic science by improving and expanding Earth observation and by integrating natural and social science knowledge for more informed decisionmaking.

Mission:

- Understand the human and environmental dynamics of land change.
- Provide leadership in sustaining the Nation's core geography competencies: regional geography, the integration of natural and social sciences, and GIScience, including modeling and remote sensing of Earth systems.
- Develop and apply innovative methods to understand and improve linkages between science and decisionmaking.
- Establish creative and synergistic partnerships nationally and globally to create new knowledge, leverage resources, and support the geographic mission of the USGS.

The core purpose of USGS Geography is to improve people's ability to prosper as the land changes.

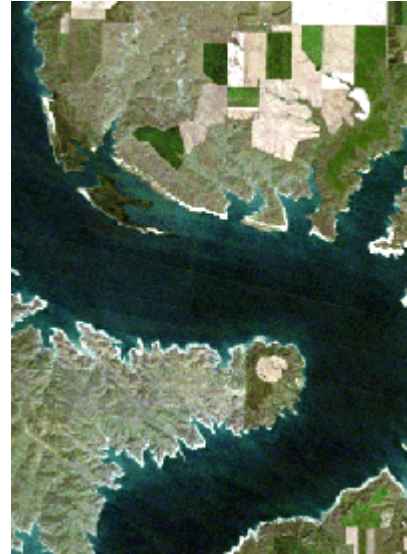
— *Geography Summit, January 2005*

A Science Planning Team (SPT) was charged with creating a succinct strategy to define, organize, manage, and grow the scientific efforts of the Geography Discipline (Mapping, Remote Sensing, and Geographic Investigations Activity) over the next 10 years within the broad outlines of the USGS Strategic Plan. The SPT compiled testimony from more than 175 representatives from all levels of government, academia, and the private sector. In addition to crafting vision and mission statements, the SPT outlined nine goals:

- Characterize and quantify land surface status and trends to provide a framework for understanding change patterns and processes from local to global scales.
- Identify local, regional, national, and global drivers of land change to forecast plausible land change scenarios over the next 20-50 years.
- Understand past, present, and future environmental consequences of land change to support better management of their effect on people, environment, economy, and resources.
- Improve the scientific basis for vulnerability and risk assessment, mitigation, response, and recovery related to the human and environmental dynamics of land change.

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- Apply credible and accessible geographic research, tools, and methods to support decisionmaking related to the human and environmental consequences of land change.
- Develop and test hypotheses about the use of geographic regions to understand the human and environmental dynamics of land change.
- Observe the Earth at all scales using remote sensing to understand the human environmental dynamics of land change.
- Provide timely, intelligent access to new and archived USGS geographic data needed to conduct science and support policy decisions.
- Develop innovative methods of modeling and information synthesis, fusion, and visualization to improve our ability to explore geographic data and create new knowledge.



The vision for the Geography Discipline in 10 years is:

- Science Directions — The Geography Discipline is recognized worldwide for its research, leadership and expertise in understanding the landscape and its relationship to society, predicting change, and applying integrated science information to inform societal decisions.
- Scientific Leadership — Scientists worldwide, the Congress, government organizations, non-government organizations, and individual citizens recognize the Geography Discipline as a center of excellence in unbiased, policy-neutral scientific research and as a critical national resource in societal decisionmaking.

For the latest information on USGS geographic research activities, go to <http://gam.usgs.gov/gamcurrentstudies.shtml>.

**National Geospatial Programs Office —
A Bold Step for the National Spatial Data Infrastructure**

The geospatial community has an unprecedented opportunity to contribute substantially to the economic growth, environmental quality, stability and social progress of the Nation as has been envisioned for more than a decade. E-Government and Geospatial One-Stop are at the forefront of the President's Management Agenda. State and local business processes are being transformed by the use of geospatial information. *The National Map* has made measurable progress toward a seamless, current geospatial data framework for the Nation. The Federal Geographic Data Committee, in its long-standing role for policy and standards, is positioned to support a broad, multifaceted governance mechanism for the National Spatial Data Infrastructure (NSDI). The need has never been greater for ensuring that timely and accurate geospatial information is available to users and for guaranteeing them the improved ability to make proactive, well-planned decisions.

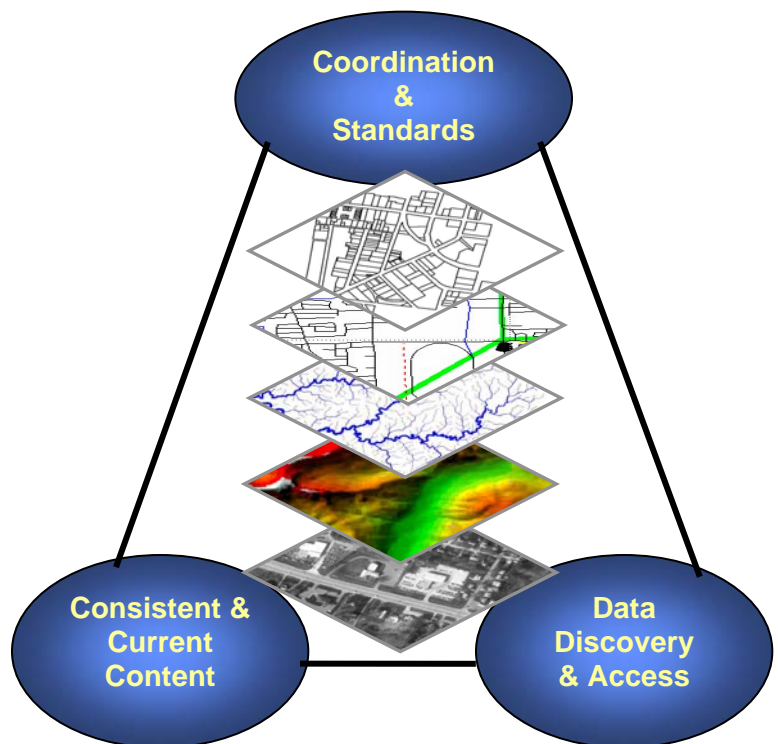
Therefore, informed by the NRC recommendations and by discussions with constituent groups on how to best serve their geospatial data needs, USGS geospatial data programs have been organized into a new National Geospatial Programs Office (NGPO) under the Enterprise Information Activity.

This realignment brings *The National Map*, Geospatial One-Stop, and the Federal Geographic Data Committee into a single program office. Related activities under the NGPO umbrella include The National Atlas, Department of the Interior Enterprise Geographic Information Management, and GEODE (Geologic Data Explorer; see the Geologic Hazards, Resources and Processes section, page I - 2).

With the creation of the NGPO, the essential components of delivering the NSDI will be managed as a unified effort that serves the needs and interests of the geospatial community throughout the Nation.

The NGPO aligns national geospatial activities and responsibilities, assesses USGS geospatial products and services, and expands partnership offices and engages partners throughout the geospatial community.

The NGPO will work with programs inside and outside the USGS to improve access to USGS geospatial data and information resources.



By connecting the components of *The National Map* (integrated base data), FGDC (coordination, policy, and standards), and Geospatial One-Stop (information discovery and access), and by embracing and communicating the message of the importance of the NSDI, the geospatial community and the Nation will realize the vision of current and accurate geospatial data readily available for local, national, and global economic growth, environmental quality and stability, and social progress.

Accomplishments and Next Steps — The NGPO immediately established multiagency study teams to lead focus groups, workshops, and interviews with the goal of moving the USGS forward aggressively toward achieving the new program vision and mission. The teams and their efforts are:

- **Unified Geospatial Enterprise Architecture** — Accommodate the needs of the non-Federal community by unifying disparate geospatial architecture efforts and aligning them with the Federal Enterprise Architecture.
- **Geospatial Technology Integration** — Develop a technical vision, "modernization blueprint," and an integration plan for NGPO geospatial data systems. *FY 2005 Accomplishment:* Sponsored a workshop in Denver, CO, November 2004, to develop methodology and seek advice from primary stakeholders who have expertise in one or more of the areas of targeted technology.
- **Unified NSDI Web Presence** — Develop a plan to unify Web activities of the individual entities of the NGPO and create a unified NSDI Web presence. *FY 2005 Accomplishment:* Hosted a workshop, "Developing a Strategy for a NSDI Web Presence," December 2004, at the Environmental Protection Agency in Washington, D.C.
- **Geospatial Investment** — Develop strategies on how the NGPO can assist in measuring geospatial investments across the Nation. *FY 2005 Accomplishment:* Conducted interviews with experts in investment strategies, mechanics of investment strategies, and current best practices.

National Geospatial Programs Office

Purpose: Provide leadership to put reliable geographic information at the fingertips of the Nation

Vision: By June 30, 2006, transform the processes of Government necessary to implement key components of the National Spatial Data Infrastructure (NSDI)

Mission:

Provide leadership and guidance for key stakeholders

- Facilitate policy development
- Provide incentives
- Facilitate the development of key standards and data models
- Coordinate and facilitate the governance structure for the NSDI
- Negotiate collaborative agreements with stakeholders
- Facilitate the development of a national Geospatial Enterprise Architecture
- Provide a forum for technology transfer, best practices, and program guidance

Implement key components of the NSDI

- Produce map products
- Host spatial data sets, Web sites, knowledge base, and tools for discovery and access
- Provide data integration and quality assurance of spatial data
- Staff enterprise architecture, governance body, and spatial operations
- Conduct and sponsor research for geospatial information science
- Provide contract management
- Train, educate, and consult
- Be a data producer of last resort

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- **USGS Geospatial Products and Services** — Develop recommendations for a suite of 21st century geospatial products and services that USGS is uniquely positioned to offer. *FY 2005 Accomplishment:* Hosted a December 2004 meeting to canvass opinions from the Alabama State Geologist and representatives from the U.S. Forest Service.
- **Partnership Offices** — Restructure and re-scope USGS Mapping Partnership Offices to represent the full portfolio of NGPO activities. *FY 2005 Accomplishment:* Met with established partners such as the National States Geographic Information Council, the National Association of Counties, and individual State agencies to assess current and future partner needs.

For the latest information on the progress of NGPO activities, go to <http://www.usgs.gov/ngpo/>.

URISA Joins FGDC

Partnership made official

The Urban and Regional Information Systems Association (URISA), which represents nearly 8,000 urban and regional professionals using information technology to improve their communities, was recently accepted as a stakeholder on the Steering Committee of the Federal Geographic Data Committee (FGDC), a long-standing national consortium working to advance policy and standards for the development of the National Spatial Data Infrastructure (NSDI).

"We welcome URISA in this national effort to improve coordination of geospatial data and information. Coordination and effective partnerships are key to the development of the NSDI and the sharing of geospatial information. URISA's unique role as the premier professional association for those involved in geospatial technology in urban and regional environments enhances the work of the FGDC as a coordinating body and adds a critical local voice to FGDC's partnership efforts."

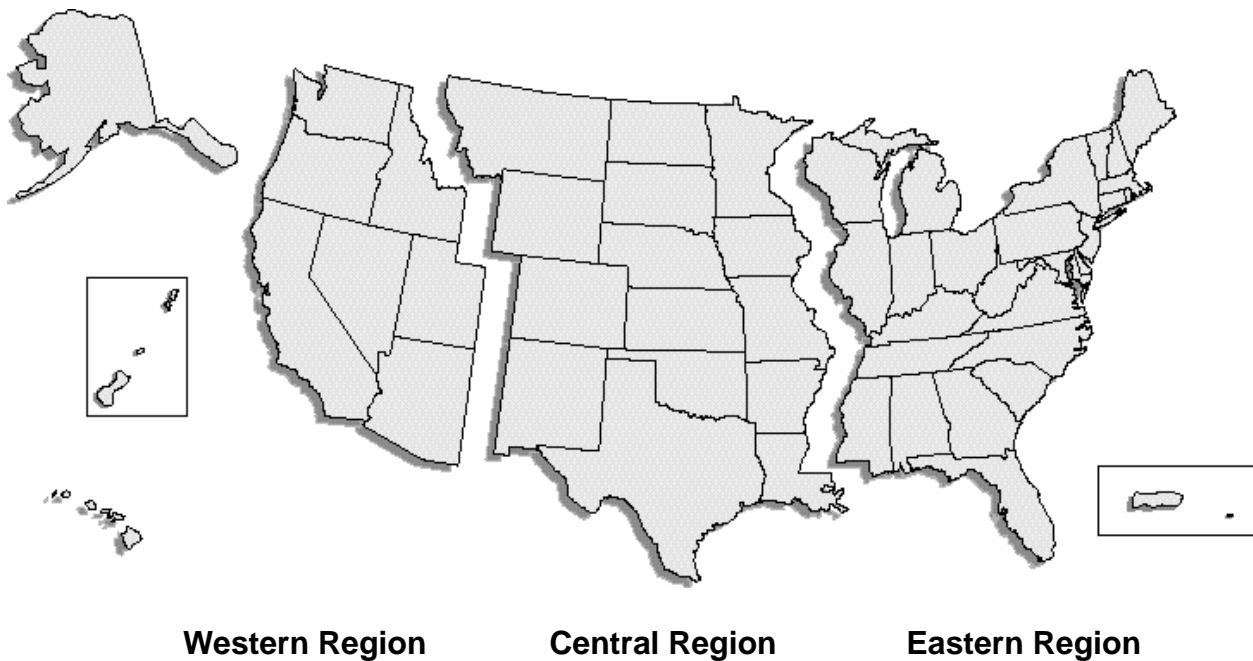
J. Steven Griles,
Former Deputy Secretary of the FGDC Steering
Committee
January 2005

Urban areas and State and local governments need accurate data to provide public services and emergency response. URISA, through its professional membership and their activities, supports development of local and regional data access points, which provides a greater opportunity for smaller local governments to network and become data providers in the NSDI. Without that regional support and coordination their participation may otherwise be too costly.

Proposed Budget Restructure

The USGS instituted the new management model for geographic research and geospatial data programs in the fall of 2004. In FY 2005 and FY 2006, the USGS will work with Congress to make commensurate budget structure adjustments to align funding with program management. Specifically, most of the Cooperative Topographic Mapping Subactivity funding will be moved from the Mapping, Remote Sensing, and Geographic Investigations Activity to the Enterprise Information Activity.

Regional Activities



Introduction

USGS regionalization brings bureau leadership and programs closer to customers and their issues, facilitates a citizen-centered approach, strongly supports Department goals, and delivers science results for on-the-ground solutions. The USGS has steadily increased its ability to focus the bureau's national-scale science expertise and information on regional- and local-scale societal issues. Regional staff is successfully meshing the world-renowned capabilities of USGS with the high-priority, often real-time, land management, urban planning, and heightened security needs of local, Federal, State, Tribal, and community managers. Strengthened relationships with regional partners provide unique opportunities to leverage USGS resources and science that not only benefit the immediate partners and customers of USGS but also enable the USGS to apply the results of these efforts to address similar issues across the country and into the future.

Pressing science issues in FY 2006 include water use and availability, fire, landscape change, coastal and river processes, human health, and ecosystem processes. Although these issues are of concern nationwide, specific partner concerns require a specialized local approach due to nuances such as unique geography, geology, hydrology, and biology.

Progress in forwarding an integrated-science response to regional issues has been made possible by an increased number of partnerships with Department bureaus and other stakeholders; an increased number of workshops and interagency stakeholder meetings that identify shared interests in resource issues and science; use of integrated science centers that facilitate collaborative and integrated science and improve operational practices; and continuing development of innovative approaches to resource sharing and co-location that increase cost efficiencies. Additional activities such as the regionally-focused Science on the DOI Landscape initiative, the Priority Ecosystems Science program, and the Science Impact projects highlight important partnership efforts with Department bureaus and other partners.

Regional Activities

Eastern Region

The Eastern Region (ER) is composed of 26 States, the District of Columbia, the Commonwealth of Puerto Rico, and the U.S. Virgin Islands. Approximately 3,300 employees are distributed across 175 duty stations east of the Mississippi River.

The ER has the longest urbanized coastline extending from the Gulf Coast of Mississippi to the Atlantic coastline of Maine, and along the Great Lakes from New York to Wisconsin. Only four States do not have a coastline on the Atlantic Ocean, the Gulf of Mexico, or one of the Great Lakes. The ER includes sixty percent of the U.S. population, or 168 million people. Nearly 50 percent of the growth in U.S. population since 1990 has occurred in the East. The ER includes an area that represents the longest record of human-induced change in the Nation. Eastern Region is characterized by numerous, high-density, urban population centers located along or in close proximity to shorelines, hardwood forests, and the Appalachian Mountains. Continued expansion of coastal and riverine urban centers into rural areas of the Region will impact the Nation's ability to use and enjoy natural resources while increasing the number and difficulty of the challenges to protect the welfare of citizens from natural disasters and other health risks. As the coastal urban centers within the ER continue to expand, a delicate balance must exist between resource use and development and implementation of ecosystem management strategies for preserving natural resources. This balance must be maintained while concurrently promoting human health and the overall quality of life.

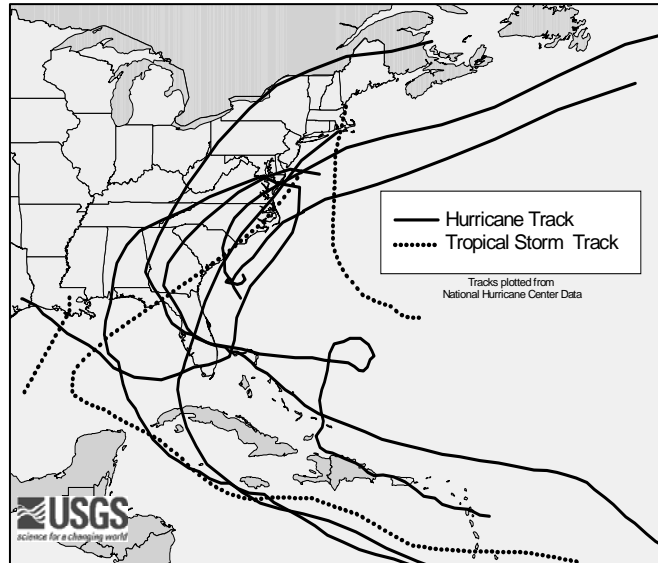
Promoting effective management at the Eastern Regional Director's Office (ERDO)

In June and July 2004, the ERDO surveyed a broad selection of USGS employees (both inside and outside the Eastern Region) having dealings with the office. Respondents were asked about the extent to which they knew about, use, and value major products developed by the ERDO. The expressed opinions of these "customers" of the ERDO were used to identify and prioritize possible actions to shape the future areas of emphasis for the Eastern Region. The resulting Action Plan has been placed on the Eastern Region Intranet to facilitate continued communication with employees on the future direction of the Region.

The ER manages its human resources, facilities and infrastructure to provide the best science and information possible. During FY 2004, ER continued to meet with the Department bureaus' regional leadership to foster future partnerships on various projects and encourage and advocate timely and effective communication on issues. The regional bureaus are working together to identify emerging science issues and opportunities to leverage complimentary capabilities. The success of these meetings has enabled the USGS to link science priorities with the regional Department bureaus' science and resource needs.

The USGS conducts a variety monitoring activities around the country and maintains readiness to respond to extreme events that impact people and the Nation's resources. For six weeks from mid-August to the end of September, the eastern United States, Puerto Rico and the Caribbean were battered by multiple storms during a very active 2004 hurricane season. Scientists from USGS Science Centers across the ER responded to hurricanes Bonnie, Charley, Frances, Gaston, Ivan and Jeanne to monitor and document flooding, tidal surge and coastal erosion.

Storm teams were repeatedly established and coordinated through conference calls that included Department partners. Thanks to dedicated, well-trained staff, the USGS was able to conduct its mission even though the monitoring infrastructure was heavily damaged. Streamflow information, used to document runoff and provided to the National Weather Service, permitted flooding and inundation forecasts to continue throughout the events. Multiple coastal over-flights were conducted to document beach erosion and coastal change before and after the storms.



Hurricane/Tropical Storm Tracks 2004.

The National Science Foundation repeatedly has stated the importance of Federal agencies providing leadership necessary to increase the number of women and minorities in the earth sciences. This year the USGS continued to play a very active role continuing a long-term partnership that has existed since 1993 with Fort Valley State University (FVSU), an historically black university. The ER placed multiple summer interns across the country for employment and experience. Thirty minority high school students were hosted by ER as part of a math, science, and engineering academy conducted by FVSU encourage their interest in the sciences. These activities support the USGS goals to (1) increase the number of women and minorities in under-represented job series and (2) increase the number of women and minority students in the math, science and engineering pipeline for future career opportunities.

In late 2003, responding to a National Research Council study, the ER established an office for Regional Geospatial Information (RGIO). In 2004, in addition to standing up the new organization, the RGIO addressed multiple Administration challenges to increase accountability in IT Security, reduce infrastructure for Web services, and consolidate wide-area telecommunications. The RGIO coordinated IT Security Awareness Training with a 100 percent employee completion. An "active directory" team was established for implementation of single sign-on authentication services for access to IT systems. E-mail servers/infrastructure was consolidated throughout the region.

As USGS works to reduce facilities costs, in FY 2004 ER provided the first projects for consideration by the bureau's newly formed investment review board. In one instance the review board provided preliminary approval to an up-front investment and savings strategy that could lead to \$0.5 million dollars in savings annually at the Upper Midwest Environmental Science Center in Lacrosse, WI.

Central Region

The USGS Central Region (CR) is composed of 15 States between the Mississippi River and the western slope of the Rocky Mountains. Approximately 2,550 employees and 980 on-site contractors are distributed in 88 cities and 21 field offices across the region.

Regional Activities

Priority science issues of CR resource managers are agricultural practices, fire science, invasive species, water availability and use, and landscape change. The physical characteristics – from a mostly pristine montane ecosystem in the northwest and arid high plateaus and desert in the southwest, to sub-tropical coastal plains along the Louisiana coast and vast agricultural lands in the Great Plains and Mississippi River Valley – create a complex environment where resource managers and planners struggle with these issues. Though largely rural, the region has some of the fastest growing population centers in the United States. Quality of life issues create a societal challenge to find a balance between conflicting priorities of recreation, urbanization, agriculture, development of needed resources, safety from hazards, and maintenance of ecosystem health. Competition for natural resources creates a challenge for Federal, State, and local natural resource managers and urban planners who require a scientific basis for sound decisionmaking.

Rewarding Work Environment

Employees at the Columbia Environmental Research Center (CERC) were surveyed in FY 2002 as part of a self-assessment on organization management. Survey results indicated a high level of support for their respective management structures. To enhance an already strong relationship between management and staff, CERC enhanced its Intranet site by adding a calendar of "what is happening" around CERC and updating information about services provided at CERC. Staff have been notified of planned on-site improvements and kept informed throughout the process. Renovations included new carpet, tile, and paint in one building and improving the exercise facility. Work was accomplished with as little disruption to normal work schedules as possible.

Although earthquakes and tsunamis do not pose as great a risk to the Central Region as they do to the west coast and Alaska, the USGS National Earthquake Information Center (NEIC) in Golden, CO, plays a key role in providing near-real-time data to National Oceanic and Atmospheric Administration's (NOAA) tsunami warning centers, and supports tsunami monitoring in the Pacific Rim and disaster alerts in Alaska, Hawaii, Washington, California, and U.S. territories in the western Pacific. Earthquake information generated by the NEIC is critical to United States and foreign governments, State and Federal response agencies, and the public. This is reflected in the number of e-mailed earthquake alerts sent out (>25,000), the hits to the Web site (120 million in seven days), and the overwhelming request for TV and radio interviews from local, national, and international news agencies following the December 26, 2004, Sumatra-Andaman 9.0 earthquake. Seismic data from the Global Seismographic Network (GSN), supported jointly by the USGS and NSF, are used daily in the routine operations of the NEIC to determine the locations, depths, magnitudes, and other parameters of earthquakes worldwide.

Among many science support accomplishments in FY 2004, the USGS Central Region (1) completed the Louisiana Science and Facility Expansion Study, (2) continued to increase workforce diversity, and (3) initiated new training opportunities.

- The Lower Mississippi Valley-Gulf Coast area is one of the Region's areas where natural resource managers have an increasing number of science issues. USGS worked with partners and USGS staff to identify current and future science growth areas and to evaluate the need for additional facilities. The study recommended multidisciplinary opportunities and integrated science activities to address programmatic and client bureau's science needs through the synergies of co-located scientific staff.
- Central Region expanded its partnership with GateWay Community College in Phoenix, AZ, through two recruitment trips and is realizing the benefits of changes in core curricula inspired by USGS scientists and implemented by GateWay faculty. This partnership has resulted in graduates who are fully trained for entry-level hydrologic

technician work in the USGS. As an added benefit, recruiting from GateWay has broadened the applicant pool in a job series that is under-represented in many of the USGS work force categories. In FY 2004, 20 graduates were hired; half were in under-represented categories. USGS will expand this program in FY 2005, through partnerships with Western Dakota Technical Institute (SD) and Vermillion Community College (MN), where the faculty will implement similar core curricula inspired by USGS scientists. These new opportunities will significantly enhance the diversity and geographic availability of the applicant pool.

- New training opportunities were provided to scientists throughout the region in a variety of support areas. Procurement staff delivered two cyber-seminars on service contracting, one each in the Central and Western Regions. A similar seminar will be conducted in FY 2005 for Eastern Region. The fiscal services staff hosted periodic teleconferences for fiscal staff throughout the region and also provided hands-on-training to managers on BASIS+ (USGS budget system). The personnel staff conducted a week-long Supervisory Challenge Class for supervisors in the region. They also traveled throughout the region conducting two condensed (3-day) supervisory classes, 13 position management sessions, 3 benefits training sessions, 1 one-day supervisory class, and 17 work force planning training sessions. The regional safety office trained 377 employees in the areas of Occupational Safety, Health and Environmental Programs using staff certified instructors in Basic Aviation, Standard First Aid, Motorboat Operation, Firearms Training, and Environmental Management System Training. Thirty-three employees received Property Management Training. Tribal Relations Training was conducted for the first time using video conferencing and allowed field staff to attend the training without incurring the cost of travel.

Western Region

The Western Region (WR) is composed of nine western States, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands. Approximately 2,500 employees are distributed in 33 cities and 64 field offices across the region. The WR emphasizes coordinating and addressing priority research needs with its many land management partners and working closely with natural resource managers throughout the Region.

A key element of the WR approach to providing science support has been through building linkages with Interior and other landscape agencies to bring science to the science needs. This has been developed through extensive coordination meetings at upper and middle management between USGS leadership and its counterparts in the State and regional offices of the Department bureaus. As one outcome of these consultations in FY 2004, WR started a series of briefings on landscape science for the Department regional offices; these briefings have been well received. Flexibility projects have also served as a key new tool to develop and provide research projects that serve the Department bureaus' management science needs. Three new projects launched in FY 2004 apply multidisciplinary science to regional scale, land management-related issues in

Listening to employees at the Alaska Science Center (ASC)

In July 2004, the ASC surveyed its employees regarding their use of and satisfaction with the administrative services provided by the Center. In response to concerns expressed by employees, the ASC has modified policy to communicate administrative policy to all ASC employees, and has added administrative information and contacts to an internal ASC Web site. In addition, again in response to employee requests, the ASC review team has taken the lead in promoting administrative policy changes to the bureau's Configuration Management Committee.

Regional Activities

the WR. In Hawaii, the Ridge to Reef project addresses multiple science disciplines with terrestrial sources that are impacting coral reef health. This project has become a focal point for coordinating WR science with its resource management partners. In the Great Basin and Upper Columbia River Basin, respectively, projects were designed and implemented that would develop and enhance the capacity of information management, such as data and online map serving for problems related to resource management issues (e.g., Sage grouse, water availability, invasive species, and others). These new and expanded information portals are increasing the ability of USGS' partners and stakeholders to access and analyze USGS information as they attempt to deal with landscape and ecosystem restoration issues.

In the information technology (IT) arena, WR has had important accomplishments on Federal Information Security Management Act (FISMA) modernization, including partnering with other bureaus. WR was instrumental in implementing all FISMA Security Scorecard requirements in a timely manner that resulted in a USGS security score of 99 (out of a possible score of 100), and overall Department security score of 97. Training, workshops, listening sessions, and on-site support resulted in the successful completion of certification and accreditation of 12 enclave systems (e.g., Financial Management, Inventory/Property Management, National Map Reengineering Project, Advanced National Seismic System, etc.). In addition, WR employees were the first to complete the mandatory annual security awareness training ahead of the USGS projected schedule. Implementation of security requirements with the least disruption to scientific research continues to be a top priority. In the area of IT modernization, WR acquired and implemented video conferencing systems in Sacramento, CA and Tucson, AZ, in addition to upgrading the Menlo Park, CA system. Telecommunication infrastructures in Hawaii and the Pacific Northwest are being upgraded to enhance network capability in the region. This modernization will improve communications while reducing requirements for travel and travel-related expenses. The WR is partnering with other bureaus (FWS) to address common infrastructure requirements in an effective and efficient manner while enhancing the management and dissemination of scientific information. This will result in streamlining overall costs for years to come.

Natural hazards are a fact of life in the WR. Although FY 2004 was a busy year for natural hazards, no event brought more attention than the eruption of Mt. St. Helens (MSH) in southwestern Washington State, the most active and explosive volcano in the Cascade Range. Volcanic unrest occurred at numerous centers in the WR throughout this past year keeping all of the USGS volcano observatories busy. In addition to MSH, the Cascade Volcano Observatory continues to monitor other Cascade volcanoes, including the Three Sisters volcanic area of central Oregon, where a swarm of earthquakes occurred in late March, 2004, at the center of an area of uplift, which has been inflating for the last seven years, possibly as a result of deep subsurface movement of magma. In FY 2004, USGS closely watched significant volcanic unrest at Mount Veniaminoff, Mount Shishaldin, and Mount Spurr, while extending the number of monitored Alaskan volcanoes to 28. At the Hawaiian Volcano Observatory (HVO), monitoring continued for



Steam and ash emission at Mount St. Helens in early October 2004.

the Kilauea Volcano and the Mauna Loa volcano. Monitoring data collected by USGS volcano observatories are interpreted by USGS scientists, and advisories summarizing conditions at United States volcanoes are issued to the public on a regular basis. In a typical year, more than 1,000 such advisories are prepared and distributed by fax, e-mail, and news outlets and are posted on the Web at <http://volcanoes.usgs.gov/>.

While volcanic eruption was a heated topic in the past year, the western United States was also busy with earthquakes. On September 28, 2004, Parkfield, CA had a moderate-size earthquake that registered at a magnitude 6. Parkfield is the site of the Parkfield Experiment, led by the USGS and the State of California, which is a comprehensive, long-term earthquake research project on the San Andreas fault. Its purpose is to better understand the physics of earthquakes. Ultimately, scientists hope to better understand the earthquake process and, if possible, to provide a scientific basis for earthquake prediction.

Science on the DOI Landscape

Program	2004 Actual	2005 Enacted	2006 Budget Request	Change from 2005
Science on the DOI Landscape	\$1,482	\$1,461	\$2,211	\$750

2006 Overview

The Science on the DOI Landscape initiative continues to be a successful collaboration between each Region and the regional Department offices. Department bureaus have collaborated with USGS in project planning and implementation by leveraging funds or in-kind services to make this venture a true partnership. Although issues vary among regions and Department bureaus, the common theme among all of the projects is recognition of Department priority needs and quick response in providing information to answer questions and issues posed by Department bureaus.

In FY 2006, USGS is requesting an increase of \$750,000 to expand work in the regions for Department bureaus. Criteria for initiating new, or continuing specific, studies will be based primarily on Department bureau needs, as well as on funding availability, partnership opportunities and urgency, as determined closer to the time of the appropriation. Studies completed in FY 2004 and FY 2005 will allow some base funds to be reallocated to meet additional identified priorities for FY 2006. Based on current knowledge of priority needs, USGS will focus on studies that address regional issues such as those described below. The increase request for this effort is located in the Biological Research and Monitoring subactivity on page K - 53.

USGS is also requesting a technical adjustment in FY 2006 that will appropriate all funding, current and new, to Biological Research and Monitoring subactivity. Placing the funds for this initiative in a single budget line item provides more flexibility in allocating funds appropriately to meet current and future priority requests for Department science at the time of appropriation. All projects are interdisciplinary, and funds will continue to flow to appropriate USGS programs to meet changing priorities. Biological Research and Monitoring is the most appropriate budget line item as it receives the largest share of the funding and most of the projects have a biological or ecological component. Performance data will be collected by the regions and

Regional Activities

reported under the DOI Resource Protection strategic goal of sustaining biological communities on Interior managed and influenced lands and waters. For additional information regarding this proposed technical adjustment, go to the Science on the DOI Landscape section in Biological Research and Monitoring on page K - 53.

Eastern Region — For the BLM, FWS, NPS, MMS, Office of Surface Mining:

- Implement one or more of the following studies to understand:
 - the threats to ecosystem sustainability and solutions for restoring degraded habitats related to eastern U.S. forest, stream, lake, wetland, estuarine, and coastal habitats including corals reefs,
 - factors that affect water quantity and quality,
 - physical alteration of habitats and geomorphic processes, and
 - biological influences on emerging diseases.

Central Region — For the BIA, BLM, FWS, NPS:

- Initiate a new project to provide land managers with information on sustainable ecosystems in the sage habitats and riparian areas that are impacted by development, invasive species, and fire in the northern Front Range.
- Expand the FY 2004 rapid response pilot project to address immediate technical assistance needs of more Department bureaus over a broader geographic range.

Western Region — For the BLM, FWS, NPS, BOR:

- Continue work started in FY 2005 in the Lower Colorado River basin to address history and rates of landscape and ecologic change, and links to geologic and hydrologic processes. Habitats in the lower Colorado River are changing in response to water regulation and to invasive species.
- Expand coral reef science by developing integrated "ridge-to-reef" approaches to understanding the sources and impacts of land-based threats as a basis for planning, implementing, and monitoring regional and local conservation actions. Department funds in FY 2006 will be leveraged with other internal and reimbursable sources to design integrated "ridge-to-reef" studies specifically tailored to provide science support for Local Action Strategies, which prioritize "ridge-to reef" units on Maui, Molokai, and Kauai.
- Identify a set of indicators and develop a monitoring to provide critical information on ecological condition of natural systems in the Great Basin and Columbia Plateau ecoregions.
- Expand successful FY 2004–05 project within the northeastern portion of the National Petroleum Reserve, Alaska (NPRA). With additional funding in FY 2006, the GIS-based predictive models developed in FY 2005 will be expanded to include coastal erosion processes, lake drainages, resulting saltwater intrusion, and associated shifts in vegetation communities.

2004 Accomplishments

Eastern Region

Mercury Workshop to Inform DOI Land Managers on Mercury Mitigation Practices —

Land-management practices such as controlled burns, agricultural fertilization, and flooding, can alter the rate of conversion of mercury deposited from the atmosphere to methylmercury, the form that accumulates in the food web and the form most potent as a neurotoxin. Whereas some aspects of mercury sources, transport, and conversion in the environment are still unknown, investigations have indicated that land-management practices that alter wetlands and change levels of natural dissolved organic carbon, pH, and sulfate can alter methylmercury concentrations in water and accumulation in fish. Landscape characteristics and management practices can alter the effects of widespread atmosphere deposition of mercury on wildlife and human health, even causing extinction in high-level predators of fish. To disseminate information on land management practices and the mitigation of mercury environmental effects, USGS sponsored a mercury workshop in collaboration with other Department bureaus in August 2004. The workshop featured speakers representing Department bureaus (USGS, NPS, FWS, MMS), Indian trust lands, EPA, NOAA, State agencies, and universities. Department land and resource managers will use information from the workshop to make informed decisions on the land practices that influence mercury processes in the environment. The workshop proceedings will be published in 2005 along with a factsheet summarizing workshop information. This project was supported through the Biological Research and Monitoring program.

"On behalf of the New England Interstate Water Pollution Control Commission (NEIWPCC), I want to thank the USGS Eastern Region for sponsoring the 2004 USGS Mercury Workshop. Two of my staff, as well as staff from our member states, attended and indicated it was both productive and informative."

Ronald Poltak, Executive Director
New England Interstate Water
Pollution Control Commission
September 2004

Investigating the Declines of Corals and Seagrasses in South Florida and Caribbean —

Healthy coral reef and associated seagrass communities are extremely valuable resources to local communities and to the Nation. The economic benefits of coral reefs from tourism, recreation, and shoreline stabilization services are significant. Unfortunately, these benefits are diminishing. Recent studies suggest that the inherent values of two-thirds of the 26,000 sq. kilometers of coral reefs in Florida and the Caribbean have been lost or are threatened by human activities. The loss of these valuable living resources has resulted in an unprecedented, collective call for help by park managers in Biscayne Bay National Park, Florida; Virgin Islands National Park, St. John; and Buck Island National Park, St. Croix. Resource managers require information on why the marine communities are dying and what measures can be implemented to prevent further losses. Funding has been leveraged with contributions from NPS, FWS, NOAA, the University of the Virgin Islands, the State of Florida, and the Disney Wildlife and Conservation Fund. In partnership with NPS, USGS and academic scientists refocused sampling and analyses on corals and seagrasses in Biscayne National Park and the Virgin Islands National Park. Disturbed, diseased, recovering, and healthy coral and seagrass habitats are being compared and contrasted using remote sensing, mapping, and disease diagnoses. NOAA is also using this information to evaluate the status of elkhorn coral and the possible association of disease and degraded water quality. USGS has partnered with the State of Florida to determine whether certain species of algae hinder recovery of coral populations. Ongoing research will evaluate whether management techniques can bring about a reversal of algae dominated reefs. Related experiments are evaluating the role that herbivores (plant eaters) play in controlling fundamental food web and metabolic processes.

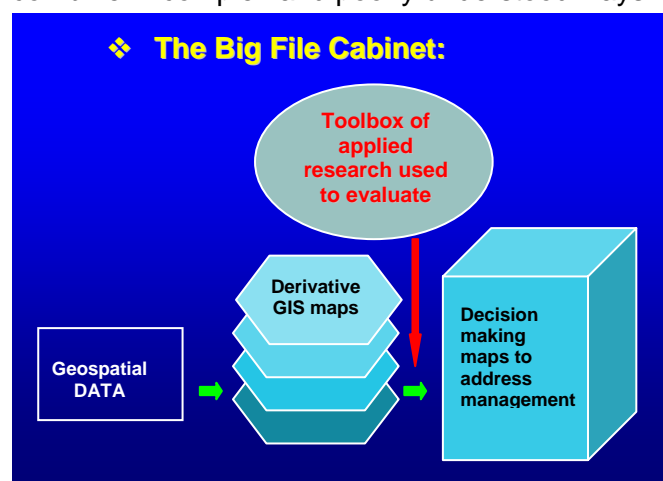
Regional Activities

Combined with remotely sensed map information these data will enable USGS to model impacts of grazing and other stressors on reef functions. Park and refuge managers will make important use of the new knowledge, perhaps by restocking sea urchin herbivores. Other studies in Biscayne Bay National Park use recent advances in molecular biology to identify the causes of disease in turtle grass, to understand temperature and salinity tolerances of key estuarine and marine species, and to test the effects of pollutants on corals. These techniques can rapidly evaluate physiological changes in key indicator organisms and provide Park managers with early warnings about declining trends in the health of marine communities.

Central Region

Science to Support Development and the Environment — Coalbed methane (CBM) is playing an increasingly significant role in meeting the energy needs of the United States. One of the most active areas for CBM production in the country is in the Powder River Basin (PRB) of Montana and Wyoming. The rapid pace of development in the PRB is taxing regulatory and land management agencies in both States and raising concerns about the environmental impact of CBM development. CBM is produced by pumping water from subsurface coal beds (a single CBM well pumping continuously at 10 gallons per minute for one year would produce more than 16 acre-feet of water). Depending upon the source coal, the produced water may be unsuitable for direct disposal into streams, for use by livestock and wildlife, or for irrigation. In FY 2004, USGS started an interdisciplinary study of CBM impacts in support of the Bureau of Land Management (BLM). USGS scientists are examining invasive plant species and their relationship to land uses including CBM development, conducting a landscape change analysis in 200 km² area where CBM development is occurring and conducting a focused study of geochemical changes in groundwater caused by disposal of CBM-produced water. Results of this work will be used by BLM and the States of Montana and Wyoming in decision regarding CBM development.

Integration of Science and Land Management: The BIG FILE CABINET — Federal land managers increasingly must use the best available science in reaching land-use decisions and in formulating plans for continued stewardship of Federal lands. The interface between science and land management can be difficult to penetrate especially in the vast tracks of western lands where human impacts and natural processes combine in complex and poorly understood ways to affect land health as well as water and air quality. USGS, BLM, and BOR scientists and land managers are collaborating on an effort to understand the complex systems responsible for harmful concentrations of selenium, salt and sediment in portions of the upper Colorado River basin. They are jointly developing the "Big File Cabinet" (BFC) concept to penetrate the science - land management interface. The BFC is a dynamic data management and analysis concept that will allow interactive use of multiple data layers to answer scientific and management questions.



Building blocks of the Big File Cabinet.

The basic building blocks of the BFC are a dynamic collection of geospatial data and a toolbox comprising science-based software that is used to evaluate GIS (geographic information

system) maps derived from the original data. The analyses result in maps used by land managers for science-based land-management decisions. The system's flexibility allows the inclusion of revised and new data and additional and upgraded science-based interpretive tools to permit better informed decisions.

A prototype BFC system was developed and tested in FY 2004 using existing Internet-accessible and very diverse USGS and BLM databases. In FY 2005, the prototype system will be refined with additional data and tools and will be field-tested in the Gunnison Gorge National Conservation Area by BLM project personnel. By the end of FY 2006, the BFC will be available for general use by the BLM. This evolving technology is designed to be flexible and transferable to other BLM management units and to other USGS projects. More project information can be found on the Web at http://minerals.cr.usgs.gov/projects/mancos_shale.

Rapid Response to DOI Land Managers' Science Needs — Department land managers have need for short-term response to science questions related to land management decisions. In FY 2004, USGS responded to this need by initiating a pilot project limited in geographic extent to Colorado, Wyoming, and Montana, and focusing on the FWS, BLM and NPS. To ensure a rapid response, tasks were limited to the intellectual property of USGS scientists, technical assistance, and off-the-shelf data synthesis. Tasks were identified by an ad-hoc call for proposals from land managers matched with availability and expertise of USGS scientists. Twelve tasks were completed, with deliverables and schedules negotiated between the land managers and the scientists. Examples of accomplishments are: hydrologic technical assistance for storm-water modeling at Rocky Mountain Arsenal for FWS; literature search on Gunnison sage grouse for BLM; and avalanche monitoring and forecasting for Glacier National Park, which helped determine when a high-altitude road could be opened without a safety risk. In FY 2005 and FY 2006, the process will be improved and expanded using the lessons learned from the pilot project. The regional offices of the land management bureaus will filter their priorities and limit the scope to projects that do not require field or lab work.

Western Region

The Mojave DOI Science Program — During 2004, the Mojave DOI Landscape Science project progressed through multiple formal and informal meetings with desert managers to identify their most pressing issues, to formulate strategies with them to meet these needs, and to update them on USGS activities. Major issues identified by managers in these meetings included roads, weeds, desert tortoise habitat, and common monitoring protocols. This work is being conducted in collaboration with BLM and NPS managers. The project efforts this year focused on: Tortoise habitat, environmental monitoring protocols, and soil-texture modeling. A 3-year process was begun to develop indicators of high quality tortoise habitat, to use these indicators to map currently existing high quality habitat, and to project how these habitat boundaries are likely to change in the future, given expected changes in land use and climate conditions. In the initial phase, data sets and currently-existing models have been collected and evaluated and the initial models developed for testing. On development of protocols for monitoring Mojave desert ecosystems, in FY 2004 a substantial literature review was completed of currently used desert monitoring methods using easily and cheaply measured indicators of ecosystem condition. The protocols will be tested and published in the coming year. In addition, for each indicator thresholds have been established that, when exceeded, indicate management action is needed. FY 2004, investigation began into ways of indicating the health of the nitrogen cycle (using stable isotopes), decomposition cycles, local hydrologic cycles, and plant health. In addition, experiments were conducted to ascertain what soil compaction levels were detrimental to plant growth. Long-term plots will be established at two sites to test

Regional Activities

indicators and monitoring methods, as well as to develop other indicators. A study plan is under development for these plots. Because plot fatigue is a major issue for any long-term monitoring effort, the use of high-resolution infrared photography (taken from a helicopter) has been investigated, with excellent success, to use as a monitoring tool for shrubs species, size, and cover. Because water is so important in deserts, the sites will be instrumented with a climate station and soil moisture probes to detect soil moisture patterns after precipitation events of varying intensities and frequencies. Finally, soil texture is instrumental in determining the availability of water to desert plants, and thus there is a great need for this information over large areas. However, it will never be possible to obtain these data through conventional mapping techniques. Therefore, FY 2004 activities included a substantial effort at finding ways to model soil texture based on existing surficial maps, topographic maps, and geologic maps. This was accomplished with the textural analysis of over 400 soil samples from different geomorphic surfaces.

Predicting Wildlife Response to Ecological Change along the Arctic Coastal Plain — The Arctic Coastal Plain extends along some 1,000+ km of Northern Alaska. Most of this environment is under the jurisdiction of Federal land management agencies and Alaska native organizations. In FY 2004, USGS conducted a demonstration project within the northeastern portion of the National Petroleum Reserve, Alaska (NPRA) to develop GIS-based predictive models to assist Federal and Native management agencies assess how recent environmental changes influence the distribution and abundance of important bird species in the region. Such models will allow better application of adaptive management approaches in specially designated areas or for species of concern during management of resource development activities. Using the interdisciplinary talents of USGS, initial work focused on BLM and FWS priority populations of geese on the Teshekpuk Lake Special Area (TLSA) within NPRA. Analyses of the long-term distribution of the four species of geese reveal that they have shifted significantly since the original designation of the TLSA in 1979. The area has become significantly more important for some species of interest while less for others. Habitat change is hypothesized as a core reason. Analysis of a time-series of aerial photographs of lakes used by geese showed significant changes over the last 2 decades in structure and landcover characteristics. Important feeding habitats near the margins of lakes have decreased some 80 percent. These results are consistent with higher evaporative water loss due to elevated temperatures in recent decades. Also, lake structures have been breached by the Beaufort Sea due to significant shoreline erosion. In some areas of the NPRA, hundreds of meters of shoreline were lost between 1979 and 2002, with as much as 70 meters in just 2004. High rates of coastal erosion have resulted in saltwater intrusion in freshwater habitats, particularly in the northeast part of the TLSA. Saltwater intrusion is expected to quickly alter foraging habitats for geese, important subsistence species for Alaska Natives.

2005 Planned Performance

Eastern Region

USGS Eastern Region has committed funds in FY 2004 and FY 2005 for the initial development of an integrated ground-water/surface-water interaction and circulation model for Biscayne Bay, Florida that can effectively link with a multitude of long-standing geological and biological research on the estuarine environments of the bay as well as the related coral reef track. Since coral reefs are currently in serious decline, a comprehensive understanding of the physical and biological factors related to coral reef health is of critical importance to the future of this ecosystem resource. The USGS water circulation model is an important keystone in establishing an accurate understanding of many important processes, such as:

- Salinity and temperature thresholds for coral reef vitality,
- Causes of coral reef diseases,
- Terrestrial sediment flux into the reef environment,
- Water quality degradation,
- Biodiversity of reef fish communities,
- Biodiversity and health of seagrass in reef and estuary ecosystems, and
- Health of the reef food web.

Products: Development of a fully functional integrated ground-water/surface-water interaction and circulation model for use by USGS, NPS, and other agencies for incorporation into a broader USGS-led coral reef ecosystem study in Biscayne National Park. The model (and results from it) will have a high degree of transferability to other coral reef ecosystems worldwide. A peer-reviewed scientific report will accompany the model as well, and will likely lead to the development of many ancillary scientific and resource management publications in FY 2005 and beyond.

Central Region

Projects initiated in FY 2004 will continue in FY 2005: Mancos Shale landscapes (in partnership with BLM); coalbed methane (in partnership with BLM, the BIA, and the Montana and Wyoming Departments of Environmental Quality); and rapid response to Interior land manager's needs (in partnership with BLM, NPS, and FWS). Anticipated products include an expanded Big File Cabinet system with additional data and tools that will be field-tested in the Gunnison Gorge National Conservation Area by BLM project personnel, reports from the Mancos Shale landscape, and completion of additional rapid response tasks as determined by Department bureaus.

Western Region

Work on the Mojave desert will continue in FY 2005 with emphasis on developing indicators of high quality tortoise habitat, to use these indicators to map currently existing high quality habitat, and to project how these habitat boundaries are likely to change in the future, given expected changes in land use and climate conditions. One of the study sites will have a climate station and soil moisture probes installed to detect soil moisture patterns after precipitation events of varying intensities and frequencies.

Western Region will initiate work in the Lower Colorado River to assist with the Multi-Species Conservation Program (MSCP). This plan, which designates a growing list of endangered species within the lower basin, is a 50-year initiative to address the long-term survival of native ecosystems and species in the Lower Colorado River and was developed by the Department and other agencies. Changing habitats and the introduction of invasive species along this highly regulated river have led to serious concerns about the long-term viability of native species and river corridor habitats. USGS will develop information and tools land managers need to

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successfully implement the Lower Colorado's MSCP. These new tools will give resource managers a way to greatly improve their decisionmaking ability by better understanding complex ecosystem interactions and by more accurately being able to predict the future effects of their decisions. In addition, one of the primary benefits of proposed research is that it would help the agencies involved determine where along the river corridor to best apply their management efforts for the greatest return on investment.

The USGS will continue and expand upon its successful FY 2004 demonstration project within the northeastern portion of the National Petroleum Reserve, Alaska (NPRA). This effort is to develop GIS-based predictive models to assist Federal and Native management agencies assess how recent environmental changes influence the distribution and abundance of important bird species in the region. Such models will allow better application of adaptive management approaches in regards to specially designated areas or species of concern during management of resource development activities. Findings from FY 2004 will be shared with BLM, FWS, and Native interests to refine study objectives and support adaptive management. A prototype decision support framework will be developed to better share findings and predictions. Supporting science will be expanded through field experiments with geese as a focal species to address the relative preference and value of habitats that are changing over time as climate patterns influence shoreline erosion rates and water dynamics. Further photographic interpretation is needed to complete the analysis of change among lakes and along the coastline of the Teshekpuk Lake Special Area (TLSA). To understand the factors that are driving such change, we will enhance hydrological sampling and employ data from USGS climate monitoring stations in the NPRA to generate predictive models of landscape evolution.

Science Issues

USGS research addresses numerous societal issues, at national, regional and local scales, that require integrated and interdisciplinary scientific study. USGS expertise is critical to providing the science that is needed to fully understand and resolve these issues while addressing the needs of Federal, State, and local government, and non-government partners and stakeholders. Current regional high-priority issues and associated accomplishments are Water Use and Availability, Fire, Landscape Change, Coastal and River Processes, Human Health, and Priority Ecosystems Science. These accomplishments link USGS regional science issues and partnerships with the expertise and goals of USGS national programs.

Partnerships Associated with Issues/Accomplishments¹

Most regional scientific results and accomplishments are achieved in cooperation with partners and customers. Partners associated with these accomplishments are shown below.

	Water Use and Availability	Fire	Landscape Change	Coastal and River Processes	Human Health	Ecosystem Resources
Department of the Interior						
Bureau of Indian Affairs (BIA)		X		X		
Bureau of Land Management (BLM)		X	X	X	X	X
Bureau of Reclamation (BOR)	X			X	X	X
Fish and Wildlife Service (FWS)	X	X	X	X	X	X
National Park Service (NPS)	X	X	X	X	X	X
Minerals Management Service (MMS)	X					
Other Federal Agencies						
Environmental Protection Agency (EPA)	X			X	X	X
Federal Emergency Management Agency (FEMA)			X			
National Aeronautics and Space Agency (NASA)				X		
National Oceanic and Atmospheric Administration (NOAA)				X		
U.S. Army Corp of Engineers (USACE)	X		X	X		X
U.S. Department of Agriculture (USDA) ²	X	X	X	X		
Other Organizations						
Academia	X			X		X
State and Local Governments	X		X	X	X	X
Tribal Governments	X			X		X
Non-governmental Organizations				X		X
Private sector/Others	X			X	X	

¹ The organizations listed are a small subset of the organizations served by USGS science.

² Includes the U.S. Forest Service, Natural Resources Conservation Service, Agricultural Research Service, Cooperative State Research Education and Extension Service, and Farm Service Agency.

Water Use and Availability

Increased population, environmental and physical constraints of water withdrawal, drinking water needs, and waste assimilation have caused most areas of the country to face questions of quality water supply. Municipalities contend with saline-water intrusion problems for coastal cities during drought conditions, contaminated streams and aquifers, and decreasing water

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resources. At the urban-agricultural interface, water for crops withdrawn at rates that exceed recharge can cause large water-level declines in aquifers that supply water for large geographic areas. Water managers need (1) information on how water use can mimic natural processes and sustain normal ecosystem functions while maintaining appropriate conditions for power generation, navigation, water supply and public recreation and (2) tools to predict impacts and develop viable water management strategies. These factors point to the growing requirements for basic water budget analyses and refined understanding of the water cycle and human and ecological needs for fresh water.

Water Use and Availability — Accomplishments

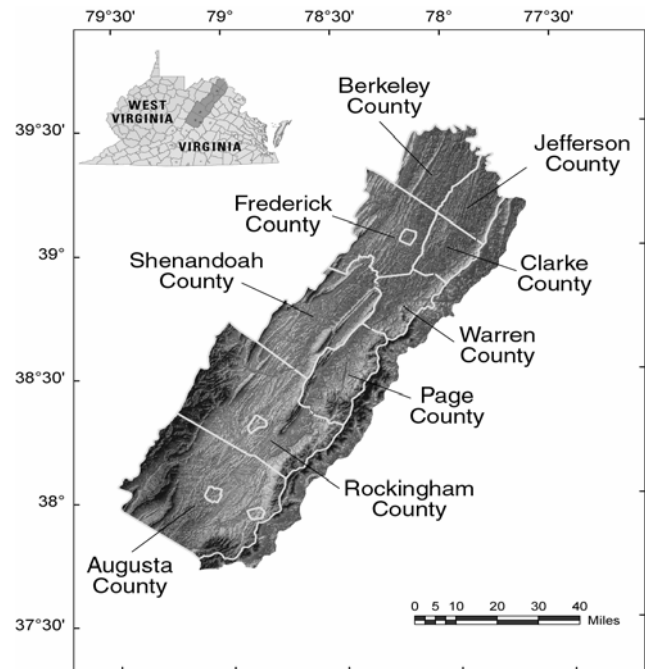
Framework for Assessing Water Availability in the Atlantic Coastal Plain — The Atlantic Coastal Plain (ACP), extending from Long Island, New York to northern Florida is one of the largest unified coastal environments in the Nation and is unified by similarities in geology, hydrology, ecology, land use and population. The ACP is home to over 40 million people. In the past few years, the availability of water and sustainability of water supplies has become a critical regional issue throughout the ACP and a coordinated multidisciplinary effort from the USGS can provide the essential information needed to develop, manage, and preserve the region's important natural resources. Studies conducted will develop an improved understanding of the ACP, the sustainability of current water supplies, and the optimization of the development of new water supplies to the benefit of both humans and ecosystems. In FY 2004, a study of the volume of water and nutrients via ground water to the Neuse River estuary in North Carolina was undertaken and committees were formed to help manage and guide the study. In FY 2005 efforts will include the synoptic collection of ground-water levels from all major aquifers within the ACP from Long Island to northern Florida in order to compare them at historical levels. USGS is planning to bring together scientists from all USGS disciplines actively working in the ACP as well as the Department, other Federal agencies, and State and local partners. A variety of activities are planned for FY 2006 including development of a chloride monitoring network to track the effects of ground-water withdrawals, ground-water management policies on aquifer levels and salt water intrusion, and development of variable density models to assess saltwater intrusion and management strategies for mitigation. An integrated ground-water level monitoring network will be designed and models will be developed to assess the availability of water within the Coastal Plain Aquifer System, to evaluate the ACP aquifers sustainability as a long-term water supply, and to optimize and guide development of future water supplies. An accounting of withdrawals from aquifers, streams and reservoirs will be performed to provide a measure of current water withdrawals and assess future trends. Investigations will be conducted of the geologic framework and properties of the ACP Aquifer System to determine the availability and sustainability of water supplies. Investigations will be conducted of water interconnections with assessments of how withdrawals affect stream flow, water quality, and the integrity of the riverine and near shore aquatic ecosystem. A determination will be made of the minimum flows needed to sustain ecosystems and establish which wetlands are at risk. Partners include the NPS and FWS. Also, Federal and State environmental regulatory agencies will benefit from USGS integrated efforts in the Atlantic Coastal Plain. State and local level water purveyors will be able to use the information produced to better manage their ground-water resources and minimize the effects of their operations on the environment. Contributing programs include Geographic Analysis and Monitoring, Coastal and Marine Geology, Earth Surface Dynamics, National Cooperative Geologic Mapping, Cooperative Water, Ground-Water Resources, and Biological Research and Monitoring.

Multidisciplinary Assessment of Hydrogeologic Systems and Water Resources of the Shenandoah Valley Region — The northern Shenandoah Valley is underlain by karst (a type of topography that is formed over limestone and dolostone by dissolving the bedrock, and is characterized by closed depressions or sinkholes, caves, and underground drainage), and fractured-rock aquifers that are being relied upon to provide a reliable water supply to a rapidly increasing population. The recent prolonged drought of 1998-2002 has focused attention in this region on the quantity and sustainability of its water resources for human and ecological needs. In FY 2004, the USGS began constructing ground-water-flow models to better define the availability of ground water and its response to current and future development. These models are being constructed using environmental data that define age distributions of water in discharge from karst springs; hydrologic data derived from research seismic imaging techniques in karst areas, and updated geologic

information. The USGS provided updated geologic information from detailed geologic mapping, fracture analysis, and karst studies to better define bedrock geology, faults, bedding attitudes, and fractures. National Systems data were used to delineate sinkholes and other karst features and to provide digital elevation models. The final report of the North Fork Shenandoah Minimum Instream Flow (MIF) investigation will be provided to the Northern Shenandoah Valley Regional Commission and local stake holders in FY 2005. Results of this study, conducted by the USGS and Virginia Tech, will serve as the technical foundation for decisionmaking by local communities to manage water withdrawals from the North Fork during critical low flow periods. Field data collection will continue to provide information needed for development of ground-water flow models. In FY 2005, particular emphasis will be placed on completing elevation data for Clarke and Warren Counties in Virginia and Berkeley and Jefferson Counties in West Virginia. In FY 2006, the ground-

water flow models will be refined and updated to include data collected in 2005. USGS will continue to meet semi-annually with State and local decisionmakers through the Great Valley Water-Resources Science Forum to share new information resulting from the study. Principal cooperative funding partners and regular Forum participants include the Northern Shenandoah Valley Regional Commission; Clarke, Warren, and Frederick counties in Virginia; and Berkeley and Jefferson counties in West Virginia. Contributing USGS programs include Land and Remote Sensing, National Cooperative Geologic Mapping, Cooperative Water Program, National Research Program, and the Ground-Water Resources Program.

Understanding the Importance of Ground Water at the Great Lakes Coastline — Great Lakes nearshore areas are a focal point for water quantity and quality issues. An evaluation of the potential effects of human appropriation of fresh ground water in nearshore areas of the Great Lakes is in need of improved scientific understanding to support wise water-resource management. The USGS is studying linkages between ground-water hydrology and fish and invertebrate communities in nearshore areas along the western shoreline of Lake Erie.



Map of the Shenandoah Valley Region of Virginia and West Virginia.

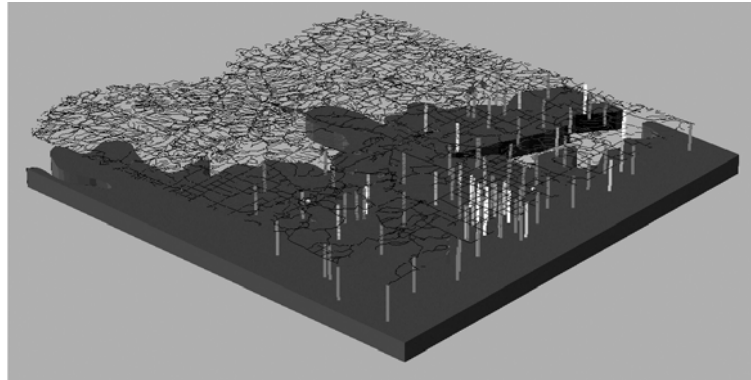
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The study is a comparison of the geology, chemistry of ground water, lake water and sediment, and fish and invertebrate communities at two contrasting study sites, both underlain by fractured dolomite and thin glacial materials. This study demonstrated that critical ecosystem processes described for marine coastlines also occur in the Great Lakes. Invertebrate and young fish community structure, abundance and type of emergent vegetation, and abundance of an invasive species (Zebra mussels) all differed between the two sites, suggesting important roles for ground water in development of the economically-important Lake Erie recreational and commercial fishery, and in the success of native and invasive nearshore biota. The monitoring and analysis for this study was conducted in FY 2004. Also in FY 2004 one of four reports on ground water in the Great Lakes Basin was presented at the recent bi-national State of the Lakes Ecosystem Conference. In FY 2005, study findings will be documented in the *Journal of Great Lakes Research*. Partners for this effort included the Michigan Department of Natural Resources and the Department of Environmental Quality, as well as The Nature Conservancy. Customers of the studies include the Great Lakes Commission, Council of Great Lakes Governors, The International Joint Commission. The National Cooperative Geologic Mapping program, Cooperative Water Program, Ground Water Resources Program, and Biological Research and Monitoring program contribute to this effort.

Sustaining Ecological and Economic Values in the Connecticut River Watershed — A variety of human activities have resulted in alterations to freshwater ecosystems. Impacts result from reduced flows and water levels, excess nutrients, contaminants, invasive species, shoreline change, habitat loss, urbanization, and suppression of natural disturbance (e.g., seasonal flooding). Resource managers seek to maintain adequate supplies of quality water to meet increasing human needs and economic growth, as well as to sustain healthy ecosystems. The Connecticut River, as one of fourteen designated "American Heritage Rivers" and the largest river system in the northeast United States. The Connecticut watershed encompasses over 11,000 square miles of wild, rural, and urban lands in parts of four States. The River is ideal for developing and implementing integrated "headwaters-to-estuarine" research, management, and information methodologies that can eventually be applied to other regions throughout the east. In September 2004, the USGS held a workshop to begin develop a research framework for scientists and managers concerned with the ecological and economic sustainability of the Connecticut River watershed. Participants in the workshop included the New England Interstate Water Pollution Control Commission, the Connecticut River Joint Commission, the Connecticut River Watershed Council, the Pioneer Valley Planning Commission, natural resource management agencies from all four States (Vermont, New Hampshire, Massachusetts and Connecticut), The Nature Conservancy, and Trust for Public Lands. Other key partners include FWS, University of Massachusetts, USFS, NRCS, USACE and EPA. The two-day workshop consisted of both plenary and breakout sessions designed to highlight the science needs associated with three themes (Dams, Development, and Design). Five science and management needs were the top priorities identified by the workshop participants. These priorities included water budgets/allocations, water quality, ecological flow determination, data-sharing systems and developing a shared public vision for the watershed. Draft science framework documents are being drafted and distributed for comment by all participants and invitees. These results will be used to develop Requests for Proposals with the goal of addressing one or more of the first four priority needs in FY 2005 and FY 2006. The final need is being evaluated by the interagency (USGS, FWS, University of Massachusetts) Steering Committee to determine best approaches to meet it. The Coastal and Marine Geology and Biological Research and Monitoring programs contribute to this effort.

A Native View Prototype — USGS is partnering with Sinte Gleska University (SGU) to establish proof-of-concept projects on the Rosebud Sioux Reservation as models to transfer

USGS earth science information and technology to Tribal colleges and universities (TCUs). USGS scientists assisted with the opening of the Geospatial Applications Center at SGU, including a 9-workstation instructional GIS lab. Along with the lab opening, USGS and SGU teamed with the Rosebud Sioux Tribe (RST) to develop pilot projects demonstrating the use of USGS resources for Tribal resource management. USGS scientists leveraged a long-standing relationship with RST to develop a hydrological information partnership between the USGS, RST and SGU and conducted a workshop on the use of National Water Information System's (NWIS) on-line resources for applications such as water quality studies. Other USGS scientists demonstrated field data collection methods used to map invasive plant species at the nearby LaCreek Wildlife Refuge for use in ethnobotany (how and why people use and conceptualize plants in their local environments) research conducted by the Lakota Studies Department at SGU. This will result in a database of all archaeological sites in the five county region (Todd, Mellette, Tripp, Gregory and Lyman), the original area of the Rosebud Sioux reservation and will be used to document changes that have occurred at the sites over time. USGS staff provided guidance to SGU staff and faculty on the development of proposals to fund the continuation and expansion of these pilot projects. This effort will serve as a template for USGS scientists to work with TCUs through NativeView, a consortium founded to develop geospatial technologies at TCUs for managing natural, cultural and economic resources on Tribal lands. The Cooperative Topographic Mapping, National Water Information System, and Biological Research and Monitoring programs contribute to this effort.



Water quality data shown with base map layers in a GIS example to present water data in a manner broadly interpretable by Tribal community members.

Competing Uses for Water in the Klamath Basin — The competing needs of people, agriculture and ecosystems is a major issue throughout the western United States, especially in the Klamath Basin. Water quality conditions in Upper Klamath Lake can become quite severe in the summer months due to massive blooms of blue-green algae and can lead to periodic mass mortalities of two endangered fish species, the Lost River and shortnose suckers. Understanding how these suckers respond to poor water quality, and the development of severe water quality conditions, are critical information needs for BOR and FWS natural resource managers in the Klamath Basin. The USGS is conducting a study to determine if the behavior, distribution, and movements of radio-tagged adult Lost River and shortnose suckers are influenced by water quality conditions in the Upper Klamath Lake, to document the presence and location of any water quality refuges, and determine if suckers are able to locate these refuges. In addition, USGS is collecting data on water quality dynamics in the lake to improve understanding of how conditions that lead to mass mortalities of suckers develop. Results to date indicate both species will move to avoid areas with low dissolved oxygen concentrations, but conditions must be quite extreme. During these events, most suckers moved into or just off the mouth of Pelican Bay, a water quality refuge on the western shore of Upper Klamath Lake while another nearby refuge, the Williamson River, remained largely unused. USGS findings have also led to a re-thinking of how extreme water quality events develop. In the past, these events were thought to occur after periods of calm weather that stabilized deeper parts of the

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lake and isolated a lower layer of water, which then became depleted of oxygen due to high oxygen demands in the water column and bottom sediments. A recent poor water quality event was observed to develop in the northern portion of the lake during a period of moderate to high winds. Water quality and current data indicate that these conditions may have developed in the south end of the lake and then transported north to areas where suckers reside during the summer months. Information from this study is being used by natural resource managers to make informed decisions regarding the effective management of water and fisheries resources in the Upper Klamath Basin. The Hydrologic Networks and Analysis, Cooperative Water and Biological Research and Monitoring programs contribute to this effort.



A biologist displays a female Lost River sucker captured at Sucker Spring, Upper Klamath Lake. This fish has been recaptured several times during monitoring efforts and is likely 30-35 years old.

Fire

The damage and severity of recent wildland fire seasons demonstrate the critical need for informed control and management response; mitigation of the impact of fires on people, property, and public resources; and better understanding of the role of fire as a natural disturbance process. Fire removes fuel accumulations, decreases impacts of insects and diseases, stimulates regeneration, recycles critical nutrients, and provides a diversity of habitats for plant and animal communities. Assessment of post-fire impacts and mitigation alternatives, the role of fire in the restoration of rangeland health on degraded landscapes, and fire-fuel mapping capabilities using remote sensing technology and real-time integrated information of current fire situations provide managers with tools and information for prescribed fires, management and control of wildlife, and restoration from wildfire incidents.

Fire — Accomplishments

Fire Support—Web-based Tools available to Managers — Sponsored by the National Interagency Fire Center, the USGS-developed GeoMAC is a Web-based mapping application for accessing data depicting the near real-time wildland fire situation across the country. While FY 2004 was a relatively slow fire year, except for the southern California wildfire late in 2003, usage of GeoMAC doubled to almost 50 million requests in FY 2004. Of these requests, the majority came from the public with requests from Europe, Asia, and Australia. GeoMAC continues to be used and its user base continues to grow. For more information: <http://www.geomac.gov>.

LANDFIRE is a multibureau, interdisciplinary application to develop consistent and accurate methods for producing geospatial data of vegetation conditions, fire fuels, risks, and ecosystem status at the national, regional, and local scales for implementation of the National Fire Plan. LANDFIRE provides partners with data to support fire management planning, prioritization of fuel treatments, collaboration, community and firefighter protection and effective resource

allocation. Included in LANDFIRE is a rapid assessment tool that will map and model fire regime condition class at a broad-scale resolution for the coterminous 48 States by the summer of 2005. For more information <http://www.landfire.gov>. The Land and Remote Sensing program contributes to this effort.

Mountain Yellow Legged Frogs Rescued after Southern California Fires — The 2003 fires in San Bernardino County devastated many of the natural areas that support many endemic or threatened and endangered species. One of the species that USGS scientists have been monitoring is the federally endangered mountain yellow-legged frog (*Rana muscosa*). The mountain yellow-legged frog previously had a global distribution of eight creeks, all in southern California across three mountain ranges. The only creek that supported this species within the San Bernardino Mountains, City Creek, was completely burned, and surveys in 2004 confirmed the local extirpation there. This population was one of the largest and likely comprised 25 percent of the total population.



After the fires burned, USGS scientists recognized that the mountain yellow-legged frogs could be devastated by the debris flows that would follow with the winter rains. A joint effort by the USFS, FWS, and the USGS was initiated to recover as many frogs from the City Creek site as possible. Eleven frogs were rescued and taken to the Los Angeles Zoo. As predicted, the following winter rains caused massive mud slides in City Creek. Frog habitat was buried under as much as 15 feet of sediment. The eleven endangered frogs remain at Los Angeles Zoo. USGS scientists will work with the USFS and FWS to prepare a restoration plan for the creek in hopes that the rescued frogs can be returned to City Creek in the future. The Biological Research and Monitoring program contributes to this effort.

Landscape Change

The Earth's surface changes rapidly at global to local scales. Habitat fragmentation, agricultural practices, engineering of landscapes, and environmental "restoration" are increasing the complexity of natural tectonic, aeolian, fluvial, chemical, and biological process at work around us. Widespread declines in marine fishery communities and increasing persistent desertification are just a few of the signs that have called into question the resilience of ecosystems to natural and human-induced stress. Human changes to the Earth's land surface are a principal ecosystem stressor, and insight into how human and natural forces affect the land surface is critical for understanding, modeling, forecasting, and managing ecosystem change. Land management practices that maintain healthy, sustainable ecosystems are only possible with better understanding of how Earth surface changes modify ecosystem processes and how ecosystems function and respond to stress.

Landscape Change — Accomplishments

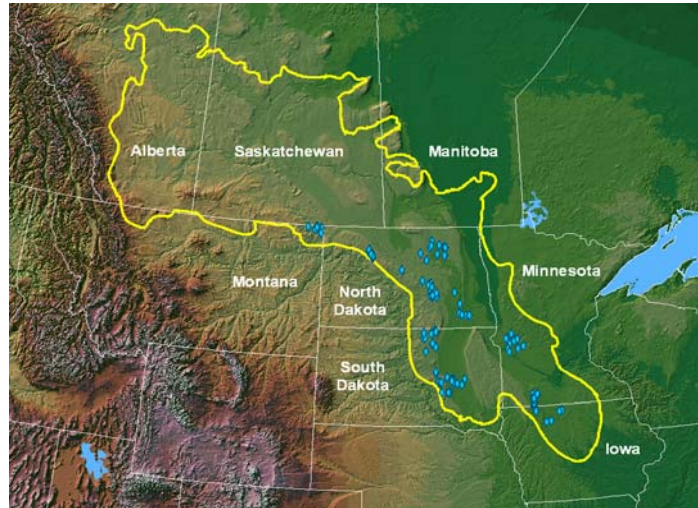
U.S. Geological Survey Gulf of Mexico Data and Information Management System — The Gulf of Mexico region is defined by environmental and economic conditions that transcend State and country boundaries, representing a host of critical integrating and conflicting factors such as mineral resources, fisheries production, ecological habitats for marine life and waterfowl, and human demands with subsequent impacts. Understanding the gulf's ecosystems and its

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changes is dependent on the quality of documenting and modeling the interrelationships of physical, chemical, and biological parameters. USGS personnel are developing a system for accessing this data and information. Information, once inaccessible on-line, is being converted to digital formats; geologic data for the region are being placed on the Internet to allow a user to view data and generate maps (<http://energy.cr.usgs.gov/oilgas/gulf/gcgonline>). For the entire gulf region, information from all USGS projects is being converted for inclusion into the on-line system. Contacts have been made to Federal, State, and local government agencies and academia institutions located in the five-State region (Texas, Louisiana, Mississippi, Alabama, and Florida) to build partnerships for enhancing the system. The addition of an offshore component and the further conversion of paper information to digital formats are being considered. As more research is being conducted in the region, it is crucial to make research results, information, and data accessible to help resource managers understand the conditions and factors and to provide them with the information they need in making resource decisions. The Biological Research and Monitoring and Biological Information Management and Delivery programs contribute to this effort.

Reaching Out on Agriculture Land Use — The USGS is increasing collaboration and delivery of scientific knowledge and data to aid stakeholders responsible for agricultural land management. Stakeholders include Department land management agencies, Tribes, EPA, USDA and its associated agencies (especially Natural Resources Conservation Service, Agricultural Research Service, Cooperative State Research Education and Extension Service, and Farm Service Agency), States, Interstate compact organizations, State Land Grant Universities, and numerous national, regional, and local farm interest groups (such as Farm Bureau, Soil Conservation Districts, Water-Supply Districts, Drainage Districts). They have requested that the USGS continue to play a leading role in performing reliable resource assessments, analysis, monitoring, and data management in order to help assess the environmental effects of agricultural practices on natural resources, particularly water quality, water availability, and wildlife habitat. In FY 2004, a database was compiled of USGS researchers who are conducting various aspects of related research across the bureau. In FY 2005, listening sessions will be held with external partners, and the results will be used to develop USGS science priorities and future directions based on stakeholder needs, existing programs, and interdisciplinary expertise and capabilities. By proactively working, both internally and with stakeholders, USGS is increasing collaborative monitoring, assessment, and research opportunities and improving delivery of existing environmental science and data for use by land managers that plan and implement agricultural practices. These activities will benefit all major stakeholders and the general public. For more information: <http://agpractices.cr.usgs.gov/>. The Hydrologic Networks and Analysis and Biological Research and Monitoring programs contribute to this effort.

Restored Prairie Wetlands and Grasslands Sequester Atmospheric Carbon — Collectively, more than 2 million hectares of wetland and grassland habitats have been restored on privately owned agricultural lands in the prairie pothole region (PPR; see figure) by Department and USDA programs. The most notable Federal restoration programs in the PPR include the USDA Farm Bill Conservation Reserve (CRP) and Wetlands Reserve (WRP) Programs, and the FWS Partners for Fish and Wildlife Program. Considerable Federal resources have been expended to restore habitats that provide a variety of ecological benefits such as fish and wildlife habitat, water quality improvement, carbon sequestration, sediment and erosion reduction, floodwater retention, and biological diversity. However, there has been minimal quantification of these ecological benefits. The USGS has developed partnerships with the USDA to document the status and quantify the ecological benefits from Department and USDA restoration programs. During FY 2004, the USGS conducted an extensive survey of 270 wetlands (see figure) and their adjacent grasslands to quantify various ecological benefits. Starting in FY 2005, the USGS will expand this work by initiating a 3-year study on a small sample of farmed and restored wetlands to enable more intensive measurement of attributes related to wetland functions and ecological benefits derived from restoration programs. The Biological Research and Monitoring program contributes to this effort.



Extent of the Prairie Pothole Region (outline) in North America and locations (diamonds) of wetlands sampled during 2004.

Urban Earth Collaboration in Southern California — The USGS Urban Earth collaboration integrates the expertise of all scientific disciplines of the USGS to investigate the complex interactions of Earth processes with the urban environment in southern California. These investigations study the effect of the city on the Earth and of the Earth on the city, from the causes and consequences of earthquakes to the management of ground water resources, to the restoration of riparian and coastal habitats, capitalizing on areas of shared expertise and overlapping goals to most effectively achieve the missions of USGS programs. During the southern California fires in October 2003, and in the aftermath, multiple programmatic efforts of USGS geography, geology, water, and biology science disciplines were focused on providing critical information for resource managers. These programs have been studying the natural processes of southern California, in many cases for decades, and thus have the baseline data that we have begun to integrate and from which we can understand the changes brought about by the fires. Despite the tragedy of these recent fires we have had an unprecedented opportunity to collect data necessary to help predict some of the catastrophic flood and landslide impacts that followed shortly after the fires. Data and information from this experiment will also aid the effective mitigation of future events. The fires occurred in a great variety of ecosystems, and geologic and topographic settings. The information collected in the burned areas was in many cases transferable to most of the susceptible fire areas of southern California. During the fires and in the aftermath, USGS provided information for principal partners/stakeholders that included USFS, FEMA, California Office of Emergency Services, city

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and county governments, NRCS, FWS and other land management agencies, water districts, and the public. Some key accomplishments include BAER team participation, multi-agency emergency task force member, debris flow probability mapping, installation of precipitation alert network gages, and congressional hearing in Lake Arrowhead, and congressional briefing in Washington, DC. The Geographic Analysis and Monitoring, Earthquake Hazards and Landslide Hazards, National Water-Quality Assessment, and Biological Research and Monitoring programs contribute to this effort.

Coastal and River Processes

Coastlines and riverbeds are naturally dynamic. Attempts to protect a coastline or river may actually make a situation worse if natural processes are disturbed. Many species have adapted to coasts and rivers so that human-induced changes may have a substantial impact on indigenous species. A more thorough understanding of the physical processes of coastal areas and river systems, including sediment erosion, transport, and deposition, will make predictive models quantitative, not just qualitative, so that issues of vulnerability can be more completely and reliably described.

Coastal and River Processes — Accomplishments

New Regional Model of Nutrients in Rivers of New England to Assist with Nutrient Management Strategies

Excessive nutrient (nitrogen and phosphorus) levels are common in rivers throughout the Nation and New England. The EPA and States in the region are working to improve the quality of rivers by reducing nutrient levels through controls on both point and non-point sources. To assist with these efforts, the USGS and the New England Interstate Water Pollution Control Commission (NEIWPCC) have completed a project under the Cooperative Water Program to produce the New England regional *Spatially Referenced Regressions on Watershed Attributes* (SPARROW) model. Results of the New England SPARROW model were described in a USGS publication in 2004. This model estimates the levels of total nitrogen and total phosphorus and the sources of these nutrients in 42,000 stream reaches throughout New England. The model explains about 95 percent of the variation in observed nitrogen and phosphorus levels and indicates that atmospheric deposition, urban and agricultural land uses, and municipal wastewater discharges are the dominant sources of nitrogen, while urban, forest, and agricultural land uses and municipal wastewater discharges are the dominant sources of phosphorus. The results of the New England SPARROW model are now being applied to a variety of water-quality assessment and management activities in the region. EPA's Long Island Sound Program is using the model to help define nitrogen control strategies for Long Island Sound. The regional EPA total maximum daily load (TMDL) program is encouraging the States in the region to use SPARROW developing load reduction strategies and load allocations. EPA's Office of Research and Development is also using model results to help assess nitrogen inputs to coastal waters and explain results of their National Coastal Assessment in New England. The State of Vermont has applied SPARROW results to help explain mercury levels in fish and water in lakes throughout the State. In FY 2005 further applications of the model are planned. The New England SPARROW Model input and output data will be formatted and packaged with a

"The use of the New England SPARROW Model in this new study and in future research will increase our region's understanding of nutrient load distributions, nutrient transport, and the relative contributions of various sources to nutrient loading"

Laura Blake
Staff Environmental Analyst
NEIWPCC newsletter
July 2004

graphical user interface on CD-ROM and instructional materials for retrieving and understanding the information will be provided. Several workshops will be conducted for users of the model in FY 2005 and FY 2006. In FY 2006, development of a New England SPARROW Web page is planned for displaying and distributing the information that will allow users to point and click on any stream reach and obtain all SPARROW data and predictions. Federal partners include EPA and NOAA. USGS program support comes from the National Water Quality Assessment Program.

Tampa Bay Study — A major focus of concern in the Gulf of Mexico is the environmentally threatened Tampa Bay. Continued growth and development throughout the Bay watershed and including construction of an underwater gas pipeline, construction and operation of a major desalinization plant, three expansions of port facilities, and dredging of Tampa Bay to support commercial vessel traffic continue to add to the stress of the Bay. The USGS was directed in FY 2001 to develop a pilot program to address critical issues facing the region. The pilot program is designed to continue through FY 2007. Major goals are to assess the geological, ecological, and water quality history of the Bay; to develop monitoring programs to assess the current health of the bay; and to provide the scientific understanding and tools to evaluate future changes in the Bay ecosystem. Predicting changes in estuarine health that result from natural and anthropogenic changes will allow USGS to provide decision aids to managers planning restoration efforts and balancing multiple uses of Bay resources. To accomplish this, the USGS is modeling the structural setting of the historic Bay to provide the basis for assessing change; identifying, quantifying, and modeling the impacts of urbanization on benthic habitat distribution, health, and restoration; and developing and maintaining a decision support system to facilitate science information exchange. In FY 2006, scientists will undertake a major effort to integrate hydrodynamic and wetlands models into a Tampa Bay Integrated Coastal Model (TBICM) that will be used to provide managers with information on the impacts of engineering structural changes and urban development on the broad range of water quality, habitat, ecological, public health, and coastal safety issues necessary to develop management strategies for coping with increasing urbanization around the bay. The results of this study are important to a number of organizations, ranging from local to Federal, including the Gulf of Mexico Program, the Southwest Florida Water Management District, the Tampa Bay Estuary program, the USACE, and NOAA. In order to accomplish the work, the USGS is partnering with a large number of organizations including the University of South Florida, Eckerd College, the Federal Alliance for Safe Home, Pinellas County (Florida), the City of Tampa, The Tampa Bay Regional Council, the Florida Department of Environmental Protection, NASA and NOAA. Numerous products were delivered in FY 2004 in each of the several components of the Tampa Bay Project. Those that focused on outreach included several workshops and conferences to people having an interest in the management and restoration of the Bay. The three USGS programs that provided funding for the Tampa Bay project include Coastal and Marine Geology, Earth Surface Dynamics, and Biological Research and Monitoring.

Science to Support Adaptive Ecosystem Management in Rehabilitation Projects, Lower Missouri River — During the last decade, more than \$85 million was spent by Federal agencies to support habitat rehabilitation on the Lower Missouri River (811 miles from Yankton, SD, to St. Louis, MO). Although this investment indicates strong support for rehabilitation activities, the complex interactions among the many physical, chemical, biological, and social processes operating in river corridors limit predictability of rehabilitation outcomes. Adaptive management promises a mechanism to accommodate uncertainty by turning management actions into explicit scientific experiments, the results of which can be used in future design modification and management. On the Lower Missouri River, USGS scientists are working collaboratively with the FWS and USACE to assess effects of a constructed

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side-channel chute at Overton Bottoms, MO (see figure). The study uses the rehabilitation project to explore how the chute affects ground water, surface water, and consequently, riparian vegetation community dynamics. A critical component of the interdisciplinary approach is an understanding of the surface of the valley bottom. A three-dimensional model is being developed through collaboration with the University of Texas, Arlington and the EDMAP component of the USGS National Cooperative Geologic Mapping program. Although the chute provides aquatic habitat as originally designed, results to date indicate that it substantially alters ground-water flow patterns, and considerably draws down the water table in wetlands adjacent to the chute. In FY 2005, an exploratory assessment of tree growth rates will show whether measurable effects of the chute extend to vegetation communities. Tree ring growth rates will also be compared with land cover change at the site from five different time periods, and with patterns in the surface geology. The National Geologic Cooperative Mapping, Hydrologic Networks and Analysis, and Biological Research and Monitoring programs contribute to this effort.

Construction (below) and result (right) of the Overton Bottoms side-channel chute rehabilitation project. A USGS interdisciplinary team is assessing the integrated effects on ground water, surface water, and vegetation community dynamics.



0 1 2 Km

Puget Sound Nearshore Ecosystem Restoration — In response to ongoing pressures on the nearshore of Puget Sound, the USGS has joined State natural resource agencies, other Federal agencies (FWS, USACE, NOAA, and EPA), Tribes, the commercial sector, non-governmental organizations, universities, and numerous local governments to form the Puget Sound Nearshore Ecosystem Restoration (PSNER) partnership. The goal of PSNER is to restore and preserve nearshore habitat and help rehabilitate the health of the Puget Sound ecosystem. USGS coordinates closely with PSNER partners to identify major data and information gaps to restoration and building the organization linkages needed to identify and integrate science with resource management and restoration needs. USGS accomplishments during FY 2004 include initiating pilot studies on sediment dynamics and habitat change on the Skagit River delta;

characterizing nearshore marine habitat adjacent to the Elwha River prior to dam removal; identifying sources of low dissolved oxygen in Hood Canal; and experiments to understand the physical processes associated with healthy seagrass habitat. USGS continues to provide scientific leadership in support of PSNER goals by co-sponsoring national meetings linking science and restoration management, by co-leading the formulation of the PSNER Research Plan and by actively participating in all levels of PSNER governance. Finally, USGS also lead a successful PSNER effort to complete the draft science plan designed to help scientists focus on the region's highest priority research needs. The Geographic Analysis and Monitoring, Coastal and Marine Geology, Toxic Substances Hydrology, National Streamflow Information, and Biological Research and Monitoring programs contribute to this effort. An increase request for the \$912,000 is included in the Coastal and Marine Geology program on page I - 126.

Ridge-to-Reef Assessment of Land-based Pollution Impacts on Hawaiian Coral Reefs —

The United States Coral Reef Task Force identified land-based pollution as one of six priority threats on which to focus efforts to protect coral reefs. The Coral Reef Task Force commissioned regional partnerships to plan Local Action Strategies (LAS's) to reduce or eliminate threats to coral reefs. Land-based pollution threats are identified for action in the LAS for Hawaii, American Samoa, Northern Mariana Islands, Guam, and other former territories in Micronesia. Hawaii's LAS partners (including FWS, NPS, USGS, EPA, NRCS, NOAA, Hawaii natural resource, health, and coastal zone management agencies, and local non-governmental organizations) developed a strategy based on the traditional native Hawaiian natural resource management systems that encompass the entire ecosystem from the high island ridges to the near-shore reef. In FY 2004, USGS initiated Ridge-to-Reef Study that provides monitoring and research support for priority ridge-to-reef restoration sites identified by the LAS on Molokai, Kauai, and Maui. USGS began baseline monitoring activities based on previous accomplishments and directed at watershed restoration actions implemented by other LAS partners. The Molokai reef is strongly affected by land-based sedimentation. USGS began baseline-monitoring activities directed at watershed restoration actions implemented by other LAS partners. USGS installed the first of a proposed network of stream gauges and sediment monitoring devices in critical watersheds. It collected remote sensed imagery and began analysis to produce high-resolution vegetation maps of watersheds currently designated for feral animal control. It began assembling a network of instruments to monitor seasonal and inter-annual variability in turbidity on the sediment impacted back reef along the south shore of Molokai. Together, this monitoring will characterize the sediment cycle, allowing for further assessment and modeling of changes in vegetation and soil retention on the landscape, changes in stream flow and sediment load issuing into the sea, and changes in turbidity in relation to influx of sediment from the land. Ultimately, restoration of native watershed ecology, reduction of sediment delivered to the sea and reduction of turbidity on the reef flat will be metrics for evaluating the efficacy of restoration activities. Monitoring and modeling will be coupled with process studies to understand impacts of sediment on coral physiology and mortality. The initial USGS investment in this study is being leveraged with support from the Hawaii Department of Transportation, Molokai Soil Conservation District, NPS, Nature Conservancy, Kamehameha Schools, and several USGS programs to expand and continue scientific monitoring and assessment effort into future years. The Ridge-to-Reef Project also is providing science support for the priority LAS restoration areas on Kauai and Maui. The Geographic and Analysis and Monitoring, Coastal and Marine Geology, and Biological Research and Monitoring programs contribute to this effort.

Multi-species Conservation Program on the Lower Colorado River — The agencies implementing the Multi-Species Conservation Program (MSCP) on the Lower Colorado River have a critical need for scientific information to guide their management decisions and to

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evaluate the effectiveness of any conservation actions taken within that program. This refers to the native fishes of the region, among the most prominent are the bonytail chub, razorback sucker and flannelmouth sucker. It also is concerned with native vegetation such as cottonwood, willow, honey mesquite and a variety of shrub species. Further, it is attempting to protect habitat for migratory birds such as the Southwest willow flycatchers, Yuma clapper rail and other birds. The USGS has worked with the Federal (BOR, FWS and BLM) and State agencies and the Colorado River Indian Tribe to develop a prioritized list of research and monitoring efforts needed to support the MSCP. In FY 2004, the USGS implemented the first three study efforts from this science support priority list. These studies included a geospatial analysis of the changes in the river channel and riparian vegetation over time that will help the agencies determine where to focus restoration efforts; soil moisture and salinity study in Cibola National Wildlife Refuge to guide re-vegetation planning efforts; and a very-high resolution image mapping of riparian habitat in Cibola National Wildlife Refuge to provide a baseline for the native vegetation restoration effort in the Refuge. This important work is continuing in FY 2005. The Biological Research and Monitoring program contributes to this effort.

StreamStats in the Upper Columbia Basin — USGS has been investing in multiple sciences to provide tools that aid land and resource managers. One objective of the Upper Columbia project is to provide a Web-based data and map integrations tool that can be used to improve the efficiency of planning and evaluation of land management actions. BOR has asked for better models to predict streamflow needs for juvenile fish survival near the spawning areas in the Upper Columbia River basin. The USGS has partnered with BOR and State water and resource managers to estimate flow requirements to protect endangered species. However, models are inadequate for some life-stages. BLM has expressed a need for tools to more efficiently evaluate the effect of landscape changes, such as fire or vegetative treatments. Current approaches require extensive site visits and are labor intensive. The USGS has started development of tools that make use of remotely sensed data to reduce the time and cost of process evaluations without reducing their scientific quality and accuracy. In FY 2004, the USGS released for public use an online program called StreamStats (streamflow statistics) in the Upper Columbia River Basin. This online application brings together commercial geographic technology, landscape data, and streamflow models to enable the user to calculate streamflow probabilities for ungaged streams. The combination of the technical capabilities of the StreamStats tool and its online accessibility have led to its extensive use by the USFS, Nez Perce Tribe, Idaho Transportation Department, Idaho Department of Water Resources, and other agencies to quickly attain answers at a greatly reduced cost. The Biological Research and Monitoring program contributes to this effort. Additional information is available on the Web at <http://cruise.wr.usgs.gov/website/cruise/viewer.htm> and <http://streamstats.usgs.gov/idstreamstats/>.

Human Health

Many disease threats to humans can be spread through contaminated food, soil, and water as well as wildlife. The rapid spread of the deadly West Nile virus in a variety of bird species throughout the United States and the associated impact to humans is a reminder of the possible wildlife pathogen and disease threats to humans. As State and local communities make critical decisions on prevention and remediation, they require information from a unique combination of expertise to identify and understand the factors that affect contamination of soils, surface water, and groundwater; describe potential water transport; develop models to predict pathogen concentrations; and map potential distribution and spread.

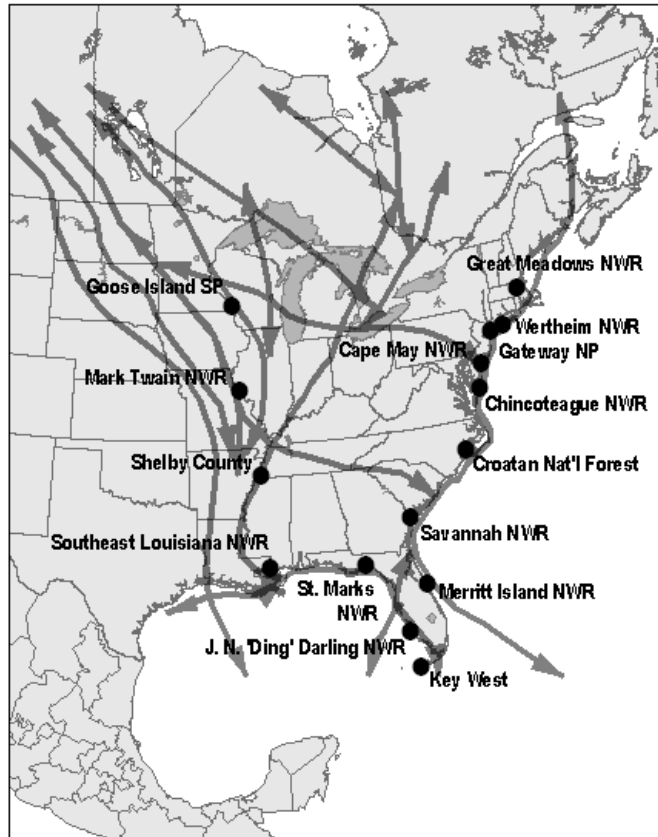
Human Health — Accomplishments

Environmental Health in the U.S.-Mexico Border Region — The border region of the United States and Mexico encompasses a diverse array of physical settings and habitats that are unique in terms of their water, mineral, and biological resources. Rapid population growth, economic development, and land-use changes are pushing the limits of environmental sustainability and quality. Lagging infrastructure development has resulted in a shortage of water for municipal, agricultural, and industrial uses. To allow for continued economic growth while protecting the area's natural resources and fostering a high quality of life, the United States and Mexico need an improved understanding of the threats posed by these changes. Issues of particular concern include (1) contaminants in ground water, surface water, and biota from agricultural, municipal, and industrial activities, (2) airborne pollutants from fossil-fuel combustion and other activities, (3) contaminants from past and present mining activities and mineral deposits, and (4) pathogens, pharmaceuticals, hormones, and other contaminants released in treated and untreated human and animal wastewaters. In FY 2004, through partnerships with local, State, and Federal agencies in the United States and Mexico, a geospatial, bi-national, data management system of biologic, geologic, hydrologic, environmental, public health, and demographic data sets for the lower Rio Grande was developed and provided to partners. Base cartographic data representing anthropogenic themes provide a location-based foundation for analyzing the human interaction with the environment. Demographic data and health statistics provide information to study the relationships between reportable health incidences and population trends. Geologic maps, soil maps, and geochemical and geophysical data provide information on environmental contamination from naturally occurring toxic materials in soil and underlying rocks. Bi-national hydrography data and the locations of water quality and quantity monitoring sites facilitate the understanding of linkages between the physical environment and public health issues. Data on the presence of contaminants in ground water, surface water, sediments, and biota, and the presence of development-related stressors such as raw and under-treated sewage have additional implications to public health concerns. Stakeholder meetings were held in the study area during early FY 2004 to gain support for the project. A Fact Sheet is in review and meetings with partners to demonstrate the utility of the system are being held in early FY 2005. New efforts in FY 2005 will include additional data incorporation, development of real-world applications with local partners, and selection of subsequent study areas. This data management system will further the understanding of the linkages between the condition of the physical environment and public health issues and provide decisionmakers the information they need to address the complex issues along the U.S.-Mexico border. Additional information is available on the Web at (<http://borderhealth.cr.usgs.gov>). The Ground-Water Resources Program contributes to this effort.

Understanding the Geography and Pathways of West Nile Virus — Nearly two-thirds of all known human pathogens originated from wildlife and livestock sources. Threats from these new diseases are increasing because of growing contacts between humans and animals, and because expanding global travel and trade create new pathways for disease introduction and transmission. As an example, West Nile virus (WNV) was discovered in New York in 1999. Infection of humans with West Nile fever and the rapid spread of the disease in birds across the continent, substantiate the need to effectively detect, predict, and control the spread of WNV and other potentially devastating wildlife diseases. USGS along with partners at the Centers for Disease Control and Prevention, began a multiyear effort in 2001 to understand the introduction and spread of WNV in North America. Experts are evaluating hypotheses about the WNV outbreak and its transmission, spread and control. During 2001, 2002 and 2003, more than

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13,000 songbirds were captured, sampled, and released after banding at 21 study sites along the Atlantic coast and Mississippi River. Results from 2004 substantiate that WNV is still growing and that migratory birds are a principal agent involved in its spread across North America. Geographic information about the disease, coupled with information about the landscape and weather conditions, provide the foundation for developing models that are assisting USGS and other Federal, State, and local health officials in understanding when and where future outbreaks may occur. WNV surveillance will continue through 2005 and 2006, and USGS will continue working with partners to determine the geographic distribution and carriers of the disease and refine new models and provide information to resource agencies to better manage vulnerable species. In addition, of special concern to the FWS, BLM, NPS, and State wildlife agencies is the impact of WNV on species of special concern such as sage grouse, raptors, pelicans, and threatened and endangered species. USGS is working with the Hawaii Department of Health to determine the potential role of birds introduced to Hawaii as reservoirs for the disease, and is investigating the susceptibility of native birds. The Cooperative Topographic Mapping, Land Remote Sensing, Geographic Analysis and Monitoring, and Biological Research and Monitoring programs contribute to this effort.



West Nile virus study sites in relation to migratory bird routes.

Priority Ecosystems Science

Through the Priority Ecosystems Science (PES) activities, the USGS provides integrated science support for adaptive management of priority ecosystems. Activities include collaboration and integration of expertise from the Earth Surface Dynamics, Geographic Analysis and Monitoring, Toxic Substances Hydrology, and Hydrologic Networks and Analysis Programs and from Biological Research and Monitoring to achieve a system-scale understanding of the natural and anthropogenic factors affecting ecosystems and to better understand the interactive nature of resources and the environment. PES addresses the DOI Serving Communities mission area of "advancing knowledge through scientific leadership and informing decisions through the application of science" by improving stakeholder access to needed science information through databases and methodologies. Additionally, PES activities expand the scientific base by providing temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements, as well as support the DOI mission area of Resource Protection by providing information, assessments and technical assistance for decisionmaking. Planned outputs include systematic analyses and

investigations delivered to customers and formal workshops and training that facilitate exchange and use of knowledge, and long-term monitoring.

The PES study units include the Greater Everglades, San Francisco Bay, Chesapeake Bay, the Mojave Desert, and the Platte River. Three of the criteria used to make these ecosystem selections are Department interest, active partner and stakeholder support, and near-term societal concern with long-term societal value. Another criterion, from a national science perspective, is the opportunity to analyze ecosystem characteristics and functions in different climates and physiographic settings so that knowledge, techniques, and methods gained from these study areas can be transferred to similar ecosystems.

Priority Ecosystems Science — Accomplishments

USGS Science Used to Restore the Nation's Largest Estuary-Chesapeake Bay — The commercial, economic, and recreational value of the Chesapeake Bay, the Nation's largest estuary, has been degraded by poor water quality, loss of habitat, and over harvesting of living resources. Excess nutrients and sediment from the watershed have resulted in fish kills, toxic algal blooms, and loss of underwater grasses and other important habitats. The restoration of the Bay has recently been estimated to cost over \$15 billion and is overseen by the Chesapeake Bay Program (CBP), a multi-State Federal partnership (including USGS, FWS, and the NPS). The USGS has the critical role to provide unbiased scientific information that is utilized to help formulate, implement, and assess the effectiveness of restoration goals in the Bay and its watershed.

"Over the past dozen years we have seen more than 3 million acres in the Bay watershed put under nutrient management plans. This improved scientific understanding provided by the USGS will help us better estimate when we'll see the benefits from these efforts and how much more is needed to bring back the Bay."

Rebecca Hanmer, Director,
Chesapeake Bay Program, 2004

In 2004, USGS science was instrumental in assessing the degree of improvement of water-quality conditions in major rivers entering the Bay. USGS findings revealed very slow improvement of nutrient and sediment levels in many of the rivers in the Bay watershed due to changes in stream flow, lack of sufficient nutrient-source reductions, and the influence of watershed characteristics including the slow movement of nitrogen through ground water. The findings, which were presented to Congress during staff briefings and at a hearing in August 2004, have contributed to an effort by resource managers to accelerate the actions needed to reduce nutrients to the Bay. The USGS also led an effort to establish a water-quality monitoring network in the Bay watershed to document the degree of water-quality improvements as the nutrient-reduction strategies are implemented. Agencies from six States, the District of Columbia, and two Federal agencies (the EPA and USGS) signed a Memorandum of Understanding to begin implementation of the monitoring network.

Using customer feedback to enhance partnerships in the Chesapeake Bay

In 2003, the USGS ecosystems program surveyed a random sample of 75 resource managers and scientists cooperating on Chesapeake Bay issues. Respondents were asked about their use of and satisfaction with the USGS Chesapeake Bay Program Web site. In response to the partners' suggestions, numerous enhancements were made to the Web site in 2004. These enhancements include expanding the available data series, adding new links to relevant related sites, and providing access to past reports in pdf format.

In FY 2005 and FY 2006, the USGS will continue to provide critical science to help the CBP and the Department restore water quality and other vital habitats in Chesapeake Bay and its

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watershed. In addition to its leadership in addressing nutrients and coordinating the nontidal network, the USGS will better define the sources and delivery of sediment to the Bay to help improve strategies for reducing sediment that cause loss of underwater grasses in the Bay. The USGS is also partnering with the CBP and FWS to expand the use of the "Resource Lands Assessment" (RLA), which identifies areas of high economic and habitat value (agricultural lands, forests, wetlands, and stream corridors) that may warrant future protection and restoration.

Science Supports Restoration Efforts in San Francisco Bay — The USGS continues to be a key participant in two multi-agency restoration programs in the San Francisco Bay and freshwater Delta (SFBD). The first program, the Bay-Delta Program of the California Bay-Delta Authority (CALFED), is a stakeholder-driven, multibillion-dollar, 30-year plan to restore ecosystem function, improve water supply reliability, and sustain the quality for California's water and watersheds. The USGS has provided leadership for CALFED's scientific program and contributes research to improve program decisions and expand the body of knowledge relevant to CALFED's proposed actions. Restoration success for all in the SFBD depends on the ability to use freshwater wisely and require a greater understanding of sea level changes and hydrologic changes in the system resulting from climate change. USGS scientists completed papers on the most likely, as opposed to the most extreme, climate change scenarios for central California as part of a strategy for designing the most insightful scenarios for analysis by resource and restoration scientists and managers. Field studies, done in parallel with modeling efforts, reveal a progressively earlier spring snowmelt with 2004 having the earliest snowmelt in 88 years. This hydrographic change in spring freshwater flow has required and will continue to require water managers to alter storage strategies. Recent publications summarize how the form of precipitation (snow and (or) rain) has shifted the hydrography such that more freshwater runoff comes earlier in the year, and less during the peak agricultural usage period. A model predicting how this shift is likely to play out in the next 50 years is proving useful for resource managers.

Restoration projects in Suisun Marsh, the largest and least altered marsh system have been accelerated. The Marsh, home to several endangered and threatened species has provided a good laboratory to study food web structure, contaminant transport and accumulation in organisms, saltwater and freshwater dynamics, and sediment transport. USGS scientists witnessed the response of the system to an exotic clam and have worked with land managers to help mitigate potential damage from the exotic species in newly restored areas. Suisun Marsh is also experiencing a re-emergence of buried mercury-laden hydraulic mining debris. Mercury is being re-introduced into the system from old deposits as the sediment cap is eroded in the bay, uncovering the mining debris buried in the bay during the 1800s. USGS studies and models that track the age of near-surface sediment are being used to understand sources and sinks of mercury contamination in the system and show areas where these historic accumulations of mercury are now surfacing. The same models and field programs are also being used to track the sources and the volume of sediment available for restoration in this heavily subsided system.

PES activities also support the South Bay Salt Pond Restoration Project (SBSP), which covers fifteen thousand plus acres of former commercial salt ponds in South San Francisco Bay, which were purchased by State, and Federal agencies in March of 2003. The FWS and conservation organizations have supported conversion of salt ponds and other baylands to tidal wetlands to benefit species of concern. However, no guidelines, models, or management strategies for such conversions exist. It is known that salt evaporation pond systems have become integral habitat for wildlife in the estuary during the past century and currently support diverse and

unique communities of migratory birds, invertebrates, and fishes. A number of concerns face resource agencies responsible for managing or converting salt ponds to tidal marsh, such as the lack of scientific guidelines for conversion or management of an ecosystem that is poorly understood, deteriorating water-exchange capability, toxic hyper-saline water, levee integrity, sediment supply to fill in ponds, and invasive species. This study, through monitoring of the salt pond ecosystems, is supplying managers with the first comprehensive information about the birds, which are the most visible wildlife affected by restoration efforts. Additionally, by monitoring their habitat we will incorporate the status of many plants and animals as well as physical changes in sediments, levee integrity, and mercury cycling. Long-term continuous records of salinity and temperature are being supported by this study as is a model of the sediment budget of the salt ponds and surrounding bay. An analyses of the sedimentation and erosion patterns for South San Francisco Bay from 1858-1983 has uncovered a major cause of concern as the bay is eroding at present and sediment is needed to fill in old salt ponds. The sediment source for such accretion in the salt ponds is likely to be the South Bay and PES scientists have recently been asked by the restoration managers to supply restoration engineers with model-derived and field verified information on the likely sources and sinks of resuspended sediment surrounding these restoration activities.

The SFB PES program also supports hydrographic data collection in San Francisco Bay that continues as the longest sustained program of research and observation in a U.S. coastal ecosystem. During FY 2004, the USGS conducted 23 sampling campaigns to measure water quality and plankton biomass along a 145-km estuarine transect. These data provide a rich data set that is mined by researchers and decisionmakers who apply the lessons learned from USGS investments in San Francisco Bay to science-based management of other coastal ecosystems. All data are archived on the USGS San Francisco Bay Water Quality Web site (<http://sfbay.wr.usgs.gov/access/wqdata>). In FY 2005, PES activities will focus on the effects of the changing hydrology on the physical, chemical, and biological processes of the system; the interaction between, and important processes of, Suisun Marsh and adjacent bays; and the restoration of salt ponds to ecosystems compatible with the needs of the SFB.

Vulnerability of Desert Ecosystems — PES activities continue to support the Desert Managers Group to provide practical guidance for land managers aimed at restoring damaged ecosystems and minimizing future disturbances. At the request of the Desert Managers, the USGS has initiated several studies on roads, including investigating roads as corridors for weed invasions, documenting the proliferation of roads in targeted areas, and developing criteria to assist managers in deciding routes to open or close. USGS scientists are documenting small drainage basin sediment yield and runoff frequency with the goal of creating vulnerability and recoverability maps. Extensive monitoring of long-term vegetation plots in disturbed and undisturbed areas have provided tremendous insight into the effects of climate change versus those resulting from local land uses, as well as time to recovery. This monitoring has provided best management practices for active restoration of disturbed sites and in finding ways to decide which sites need active restoration versus those that can recover on their own.

Restoration of the Nation's Greater Everglades in South Florida — The restoration of the Nation's greater Everglades in South Florida is the largest environmental restoration project ever attempted in the United States. The USGS is a key player in providing fundamental scientific information, developing process-based ecosystem models, and integrating baseline and monitoring data into decision support tools to aid in restoration-related planning and design decisions. Over the past few years, the USGS used the development of process-based hydrologic models to help guide and integrate experimental and monitoring research essential for understanding the complex factors that control hydrologic patterns in the Everglades. In

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FY 2004, the USGS worked with the South Florida Water Management District (SFWMD) to link hydrologic models providing a better understanding of restoration alternatives on flows through the Everglades. Technical reports documenting the model were produced and can be accessed at <http://sofia.usgs.gov>. In FY 2005, the model will be used to evaluate various restoration alternatives on hydropattern, coastal salinity and ecological response. In FY 2005 and FY 2006, in partnership with the Florida Audubon Society, the model will be used to evaluate Spoonbill migration and habitat needs.

In FY 2004 much progress was made in linking ecological models to the hydrologic model; however, additional research and especially monitoring is needed to better calibrate the model with field data. The American Alligator is a 'keystone' indicator species for the Greater Everglades. The USGS, in partnership with NPS, USACE, SFWMD, and Florida Fish and Wildlife Conservation Commission, has been conducting research, monitoring and modeling on the American Alligator. In FY 2004 an Alligator Model was used to test various restoration-related scenarios and indicates that current restoration plans will result in a relative increase in alligators in the currently dry outer regions and a slight decrease in wetter regions. The challenge is to make all ecological models an integral part of planning and assessing strategies. An Interagency Modeling Center (IMC) is being developed and the Department of the Interior has made a commitment to become an integral partner. In FY 2005 and beyond, USGS will be integrating ecological models into the IMC. Although USGS primary focus is on the research and development of models, participating in the IMC allows for improving and increasing the relevance and utility of models through implementation.

Restoring water quality remains a major goal of the Greater Everglades restoration. USGS's research has clearly linked an increase in the production of methylmercury with increased sulfate levels in the water and sediments leading to the bioaccumulation in animals. In FY 2004, USGS scientists briefed the Department, OMB, and Congress on mercury and other water quality contaminants. Research in FY 2004 has shown that the "hot spot" for methylmercury has migrated and additional studies in FY 2005 will allow the USGS to track the movement of the methylmercury 'hot spot' and better understand the processes linking methylmercury production and sulfur. Previous USGS research traced the source of sulfur in the Greater Everglades to agriculture practices. Although the use of elemental sulfur has long been a standard agriculture practice, the scale of use in the Everglades region has increased significantly in the past and development and implementation of 'best management practices' for sulfur use by agriculture could significantly reduce the amount of sulfate entering the Everglades. Additionally, in collaboration with Florida's Department of Environmental Protection and the SFWMD, in FY 2005 and FY 2006, the USGS will conduct additional field and experimental research to develop a better understanding the movement, distribution and biogeochemical process on the legacy and bioaccumulation of sulfur in the natural system.

In FY 2004, the USGS expanded its water quality research into Loxahatchee National Wildlife Refuge to assess the impact of canal waters on water quality trends internal to Loxahatchee and associated ecological impacts. Preliminary results in FY 2004 show that the water quality of canal water affects various water quality components of internal marshes. Additional research in FY 2005 and FY 2006 will focus on specific response of the biota, especially periphyton and key indicator plants, to altered water quality of the internal marshes.

In recent years, USGS has conducted paleoecological studies of Florida Bay, and the tree islands and ridge-and-slough system of the freshwater Everglades. Knowledge of the recent ecological history of the Greater Everglades and coastal ecosystems is critical not only for understanding how the system has changed in the recent past in response to water

management practices, but it also provides an understanding of the historical setting the natural Everglades system, and helps to provide a target for restoration. Research has shown that tree islands throughout the Greater Everglades were affected by 20th century hydrologic changes, but that impacts on plant community composition and tree island size vary throughout the region. Recently, in partnership with Biscayne National Park and SFWMD, the USGS expanded its ecosystem history research into Biscayne Bay. Recent results indicate that Biscayne Bay appears to be evolving toward a more marine environment that, when coupled with sea-level rise, may continue to change the character of the system unless results from implementation of the Comprehensive Everglades Restoration Plan (CERP) succeed in delivering more surface and groundwater flows to the Bay. In FY 2004, a 2-year report on the paleoecology of Biscayne Bay was produced and delivered to the SFWMD. Additional research is planned for FY 2005 and FY 2006 to better link the ecosystem history patterns to altered surface and subsurface freshwater flows, and to expand the zone of the study into the critical coral patches at the outer fringes of Biscayne Bay. In addition, since the southwestern portion of Everglades National Park in the out-flow regions of Shark River Slough is expected to realize the greatest change in flows resulting from implementation of CERP, in FY 2005 the research into ecosystem history is being expanded into that region of the Park. This expanded research will not only help us better understand the recent history of the area, but will also allow us to establish a baseline of current conditions of the coastal system upon which we can assess the impacts of CERP implementation.

Other major accomplishments of USGS's Greater Everglades PES in South Florida included science integration and synthesis activities in support of Everglades restoration adaptive management decisions; activities in support of CERP/DOI restoration technology transfer; and support of CERP/DOI partnership liaisons. The USGS continues to be an active participant in multiple Everglades restoration work groups and committees including the South Florida Ecosystem Restoration Task Force's Working Group and Science Coordination Group, select CERP Project Delivery Teams, CERP RECOVER teams and sub teams. USGS staff also participated in multiple workshops to integrate science towards specific Department, CERP and (or) RECOVER science needs, and helped develop the DOI Everglades Restoration Science Plan. USGS staff served as USGS liaisons with Department, SFWMD, and COE partners to ensure technology transfer and science synthesis. The USGS liaisons provided Department-specific immediate response for critical information needs. USGS staff helped guide the development of the CERP integrated assessment plan. In addition, USGS staff, in collaboration with COE and other restoration partners nationwide, continues to be instrumental in organizing and coordinating the First National Conference on Ecosystem Restoration to be held in December 2004.

Platte River Ecosystem Resources and Management — The Central Platte River Valley (CPRV) is best known for the annual migration of nearly one-half million sandhill cranes and several million waterfowl and provides habitat for endangered species including the whooping crane, piping plover, and least tern. Changes in water and land use have transformed the river channel and altered the structure of riparian habitats. The USGS has worked with FWS, BOR, and a variety of State agencies to develop successful adaptive management strategies to increase the habitat available to migratory birds. Habitat for the waterfowl is increasingly threatened as the CPRV is in the fourth year of a deep drought. USGS gaging stations indicate that flow completely ceased at a couple of gaging sites along the river. To assess the impact of the drought on the waterfowl, USGS scientists radio-marked 87 sandhill cranes with VHF transmitters in 2004 to monitor the length and pattern of stay of the birds. Findings show that the average length of stay declined by 36 percent from 2001 to 2004. Loss of the Platte River staging area would have adverse consequences for the mid-continent waterfowl population,

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which depend on this ecosystem for a major part of their nutrient needs for spring migration and reproduction. In October 2004, the USGS organized the Mid-continent Sandhill Crane Workshop to address the information needs of Federal and State partners, to present the latest results of USGS studies, and to provide updates on long-range management plans for the CPRV. In FY 2005, the USGS will continue to operate stream and gaging stations along the river; continue monitoring radio-marked sandhill cranes to determine length and pattern of stay as well as fidelity to roosts and reproductive success; and will begin studies using Electro-Magnetic and Surface Nuclear Magnetic Resonance Sounding techniques to better link surface and ground water levels that will aid strategies to improve riparian habitat for all CPRV waterfowl.

Science Impact

The Science Impact program is a focused effort to improve and expand the use of USGS science information to inform decisionmaking at the Department, other Federal, State, and local government organizations, and by the public. This effort encompasses developing, testing, evaluating, and applying improved methods and processes to enhance linkages between science and decisionmaking. For additional information regarding Science Impact, go to the Geographic Analysis and Monitoring subactivity on page H – 74, as well as an increase request on page H – 84.

Science Impact — Accomplishments

Linking Resource Management and Science in the Colorado Plateau — The USGS is working with Mesa Verde National Park and the Colorado Plateau Cooperative Ecosystem Study Unit to facilitate more effective use of science by resource managers. Methods are being developed to use collaborative approaches and adaptive modeling tools to frame the appropriate science questions needed to optimize resource management and evaluate tradeoffs. The Colorado Plateau was selected as a pilot because of its abundance of Federal lands and because land management strategies are being re-evaluated as ecosystem change is driven by the current drought. Initial efforts are focusing on management of pinyon-juniper woodlands.

Developing Natural Resource and Environmental Vulnerability Maps — The USGS is working with the University of Wisconsin and a collaborative review panel of Federal, State, and local government decisionmakers and citizen groups to develop more effective ways of using science information to characterize natural resource and environmental vulnerability and to communicate this information to resource managers. Thematic vulnerability maps with a flexible user interface are being developed and evaluated to describe vulnerability resulting from methyl-mercury in surface water and nitrate in ground water. A standardized map interface allows resource managers to examine spatial scales of interest and to develop different scenarios affecting the pattern or severity of vulnerability.

Using Science in Developing and Applying Environmental Indicators in the Colorado Front Range — The USGS and Colorado State University are collaborating with resource managers and other stakeholders in the Colorado Front Range to use science and socio-economic information in developing a set of integrated human and environmental indicators to inform resource management decisions. Criteria are being developed to define useful, credible, and objective indicators. Important indicators describing condition are being identified for five Colorado Front Range systems: urban, grassland, agricultural, waters, mountains and forests.

Workshops with stakeholders will be held to link indicators with major issues in the Colorado Front Range to inform resource management decisions.

Improving Linkages Between Science and Wind Energy Development Decisions in the Eastern Seaboard — The USGS is working with the Department's Office of Environmental Policy and Compliance, the Minerals Management Service, and Massachusetts Institute of Technology through the MIT-USGS Science Impact Collaborative to improve linkages between science and management decisions relating to permitting offshore wind energy sites. Research is focusing on using a collaborative problem solving approach incorporating scientific and technical information using joint fact-finding to develop procedures for permitting offshore alternative energy projects. Three products resulted from the first year's efforts: (1) the report, "Joint Fact Finding for Public Involvement in Wind-Permitting Decisions: Beyond NEPA," (2) the report "DOI Offshore Wind Energy Roundtable Report" that presents the results of DOI Roundtable on Offshore Wind Energy along Northeastern United States (Virginia to Maine) Seaboard workshop, and (3) the "Offshore Wind Energy Game," a role play simulation.

Integrating Science into Conservation Planning for Sage Grouse Populations in the Western United States — The USGS is collaborating with BLM, USFS, FWS, Stanford University, and State wildlife agencies to develop a tool to facilitate integration of scientific information into conservation strategies for the imperiled greater sage grouse in the western United States. The tool, called an Information Dissemination Framework (IDF), has three components: a risk assessment model, a decision scenario model, and a geographic information system. Together the IDF will provide decisionmakers and other stakeholders a mechanism to better use science in developing and implementing sage grouse conservation strategies and in evaluating the effectiveness of alternative strategies.

Crosscuts

As the Department of the Interior's science bureau, USGS research is foundational to numerous intradepartmental and interagency crosscutting activities, primarily in ensuring that sound science is available to assist decisionmakers in the profoundly complex natural resource issues facing the country. These crosscutting activities range from environmental issues such as the Everglades restoration and coral reef protection in the Pacific Islands to resource management issues such as salmon recovery in the Pacific Northwest. The following table provides a list of the crosscutting activities in which the USGS plays a prominent role and identifies the contributing USGS programs.

(dollars in millions)

	FY 2004 Enacted	FY 2005 Enacted	FY 2006 Request
CALFED Bay-Delta	\$4.9	\$4.9	\$4.9
Columbia River Basin Salmon Recovery	4.4	4.4	4.4
Coral Reef Protection	3.5	3.5	3.5
Global Change	29.5	29.5	29.5
Greater Everglades Ecosystem Restoration	7.8	7.8	8.0
Invasive Species	11.0	11.2	11.6
Klamath River Basin	1.0	1.9	1.9

CALFED Bay-Delta — The Bay-Delta Program of the California Bay-Delta Authority (CALFED) is a multi-agency, stakeholder-driven, multi-billion dollar, 30-year plan to restore ecosystem

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functions, improve water supply reliability and sustain water quality for California's water watersheds. The plan, which is beginning its fifth year of implementation, called for science-based decisionmaking. The USGS works with many Federal and State partners including BOR, FWS, BLM, USACE, EPA, Department of Commerce, National Marine Fisheries Service, USDA (USFS, Natural Resources Conservation Service), the Western Area Power Administration, California Department of Water Resources, California Department of Fish and Game, Reclamation Board, California EPA, State Water Resources Control Board, California Department of Food and Agriculture, and the Delta Protection Commission. The USGS provides leadership for the scientific aspects of the program, and specific studies that develop new knowledge to improve program decisions and expand the body of knowledge relevant to CALFED's proposed actions. A rigorous external peer review process, mostly for studies of ecosystem processes relevant to water management/restoration issues continued for research proposals from academia, government agencies and the private sector. Through both traditional interdisciplinary studies and science leadership, USGS has helped with creation, implementation and continued advances of one of the Nation's most innovative new approaches to managing water. The Geographic Analysis and Monitoring, Toxic Substances Hydrology, Hydrologic Research and Development, and Biological Research and Monitoring programs contribute to this effort.

In FY 2006, USGS will continue work on identifying the effects of the changing hydrology on the physical, chemical, and biological processes of the system; the interaction between, and important processes of, Suisun Marsh and adjacent bays; and the restoration of salt ponds to ecosystems compatible with the needs of the San Francisco Bay and freshwater Delta.

Columbia River Basin Salmon Recovery — Juvenile salmon make downriver migrations to grow in the food-rich north Pacific Ocean, and adults return to spawn their eggs in natal streams and tributaries. In the Columbia River Basin, salmon migrate more than 1,500 km to the ocean. Due to hundreds of dams that have been built over the last century to harness water for irrigation, flood control, and hydroelectric generation, it has hindered the salmon survival and spawning rate. USGS has been studying juvenile salmon's behavioral responses to various man-made structures; their migration patterns in order to understand the impact that large hydroelectric dams have on the fish; conducting studies to examine juvenile salmon movements in relation to water velocity and flow patterns; studying spawning populations to understand how their behavior allows them to successfully reproduce in the shadow of a large hydroelectric dam; conducting studies to identify how Pacific lamprey use their sensitivity to certain compounds to guide their behavior; and studying how the lamprey's ability to swim may restrict behavior when confronted with culverts.

USGS's strategic directions using base resources over the next several years will begin to address (1) the population effects of multiple environmental stressors (e.g., contaminants, flow and temperature changes) on fish health, (2) habitat effects of aquatic invasive species (e.g., American shad, numerous invasive plants), and (3) technical assistance to managers regarding influences of salmonid hatcheries on wild and native salmon populations in the Pacific Northwest. USGS collaborates with many partners including the Bonneville Power Administration, USACE, FWS, BLM, BOR, Department of Commerce, National Marine Fisheries Service, USDA, USFS, Washington and Oregon State government agencies, Umatilla Tribe, and citizen advisory groups. The Biological Research and Monitoring program contributes to this effort.

In FY 2006, USGS will use radio tagged salmon to determine the impacts of water management and structure changes on salmon from the Lower Granite dam on the Snake River down to

Bonneville dam on the Columbia River. In the Yakima Basin, the USGS will examine how water management can alter habitat, strand juvenile salmon, and influence spawning habitat and effects on salmon. USGS work in the Wind River will involve life history research, evaluation, and monitoring of the steelhead and salmon populations in the sub-basin.

Coral Reef Protection — Coral reefs worldwide are in decline. The Department of the Interior alone has responsibility for more than 3.5 million acres of coral reef habitat. Further, the U.S. scientific and management communities are only now becoming aware of the value, diversity and extent of deep reefs under Department responsibility.

Coral reefs are being degraded from local stressors (sediment and pollution from adjacent watersheds, disease, overfishing, storms) and global-scale influences (climate change). These complex issues, confounded by uncertain degrees of natural change and human influence, require rigorous mapping, monitoring, and multidisciplinary experimental approaches to evaluate the relative role of various disturbances on the health and productivity of reef ecosystems. Local Action Strategies have been developed for various regions under Department and NOAA management (e.g., Hawaii, Florida, Caribbean, etc.) to combat coral reef degradation. The scientific knowledge resulting from the USGS coral reef research is being translated into useful and timely information products requested by managers so they can make informed decisions as they implement these strategies.

Databases, maps, GIS visualization tools, USGS factsheets, technical reports, oral presentations at stakeholder meetings and technical/professional conferences, and peer-reviewed publications are planned and are essential products that will transfer information to decisionmakers and the scientific community. Resource managers with the NPS, FWS, MMS, NOAA and coastal States have called upon USGS to help them understand the processes involved in reef decline so that local-scale stressors can be mitigated or removed, and reef recovery encouraged. USGS products are being and will continue to be used by members of the Coral Reef Task Force as they implement the various Local Action Strategies. The Coastal and Marine Geology program contributes to this effort.

In FY 2006 USGS research on will include understanding conditions needed for productive and healthy reef communities, understanding terrestrial contributions to reef health in support of U.S. Coral Reef Task Force resolutions, and assessing abiotic and biotic factors contributing to coral disease and decline. In addition, USGS scientists will be evaluating human activities and management options in marine parks and refuges and their influence on reef integrity and biodiversity.

Global Change — The USGS supports multidisciplinary studies of past environmental and climatic changes (climate history); process studies that explore the sensitivity of the Earth's surface, the hydrologic cycle, and ecosystems to climate variability; and forecasting of potential future changes and their effects on landscapes and ecosystems (particularly on public lands). The combination of these studies provides integrated long-term perspectives on the effects of climatic change and variability and on the interactions through time among climatic, geologic, and biologic systems on regional and landscape scales.

USGS Global Change Research activities strive to achieve a whole-system understanding of the interrelationships among Earth surface processes, ecological systems, and human activities. Activities of the program focus on documenting, analyzing, and modeling the character of past and present environments and the geological, biological, hydrological, and geochemical processes involved in environmental change so that future environmental changes and impacts

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can be anticipated. Specifically, USGS focus is on global warming, acid rain, oceanography and weather and climate data.

The U.S. Global Change Research Program integrates research carried out under the auspices of a number of agencies of the U.S. Federal Government, including the National Science Foundation, Department of Commerce, Department of Energy, Environmental Protection Agency, National Aeronautics and Space Administration, Department of State, Agency for International Development, Department of the Interior, Department of Agriculture, Department of Health and Human Services, National Institutes of Health, Department of Transportation, Department of Defense and Smithsonian Institution. The Geographic Analysis and Monitoring, Earth Surface Dynamics, Hydrologic Research and Development, and Biological Research and Monitoring programs contribute to this effort.

In FY 2006 USGS will conduct multidisciplinary studies of past environmental and climatic changes (climate and environmental history), process studies that explore the sensitivity of the Earth-surface and associated ecosystems to climate change and variability, and forecast potential future changes and their effects on landscapes, land use and ecosystems (particularly on public lands).

Greater Everglades Ecosystem Restoration — USGS conducts scientific investigations in south Florida to improve society's understanding of the environment and assist in the sustainable use, preservation, and restoration of the greater Everglades and adjacent coastal ecosystems. The USGS Greater Everglades Priority Ecosystems Science (PES) initiative provides scientific information on which to base informed resource management and restoration-related decisions. Scientists from all USGS disciplines (hydrology, geology, biology, mapping) work together to address this complex and challenging task. USGS involvement in Greater Everglades restoration science began in 1995. With the development and publication of the DOI Science Plan, the USGS is restructuring and redirecting its studies to address the questions and priority science information needs identified in the Plan. The USGS has conducted numerous studies that provide significant baseline, monitoring and empirical research required for developing modeling and other decision support tools used in developing and implementing the Comprehensive Everglades Restoration Plan (CERP) and other Greater Everglades restoration projects. The studies are categorized according to the major information needs identified in the DOI Science Plan. The Geographic Analysis and Monitoring, Earth Surface Dynamics, Toxics Substances Hydrology, and Hydrological Research and Development programs contribute to this effort.

Additional research is planned for FY 2006 to better link Everglades ecosystem history patterns to altered surface and subsurface freshwater flows, and to expand the zone of the study into the critical coral patches at the outer fringes of Biscayne Bay. In addition, since the southwestern portion of Everglades National Park is expected to realize the greatest change in flows resulting from implementation of CERP, the research into ecosystem history is being expanded into that region of the Park. This expanded research will provide a better understanding of the recent history of the area, but will also allow establishment of a baseline of current conditions of the coastal system upon which the impacts of CERP implementation can be assessed.

Invasive Species — The economic impact of costs associated with invasive species in the United States exceeds \$100 billion per year. Invasive plants, animals, and disease organisms harm native species and ecosystems and reduce productivity and the beneficial use of forests, croplands, rangelands, and aquatic resources. Many species introduced decades ago have

begun to spread rapidly in U.S. ecosystems and pose increasing threats to lands and waters across the Nation.

To ensure the strategic allocation of resources to combat invasive species, the National Invasive Species Council (NISC), co-chaired by the Secretary of the Interior, the Department of Agriculture, and the Department of Commerce, developed an interagency performance budget on invasive species that links spending levels with specific performance targets. On the basis of common goal statements, strategies, actions, and performance measures, the NISC selected priority topical and geographical areas, and member agencies developed their budget requests accordingly. Department efforts support the DOI's Resource Protection strategic goal of sustaining biological communities.

Department bureaus work in partnership with Federal, State, local, and Tribal agencies and private sources to perform the seven functions of invasive species management as established in the NISC National Invasive Species Management Plan (established by Executive Order 13112): prevention, early detection and rapid response, control and management, restoration, research, education and public awareness, and leadership and international cooperation.

To meet the goals of the Management Plan, the USGS Invasive Species program provides management-oriented research and delivers information needed to prevent, detect, control, and eradicate invasive species and to restore impaired ecosystems. Facilitating these efforts is the National Institute for Invasive Species Science (NISS), a growing consortium of government and non-governmental members that is administratively housed in the USGS Fort Collins Science Center in Colorado. USGS researchers are leading or cooperating in efforts to integrate the capabilities of the USGS and partners, including Federal and State resource agencies, to help provide the information, methods, technologies, and technical assistance needed for effective responses to terrestrial and aquatic invaders threatening U.S. ecosystems and native species. Key outputs include models that can predict the probable spread and impacts of invaders. USGS collaborates with many partners including the National Invasive Species Council, Department of Agriculture, Department of Commerce, National Institute for Invasive Species Science, U.S. Department of Agriculture, U.S. Forest Service, U.S. Fish and Wildlife Service, U.S. National Park Service, Long-Term Ecological Research (established by NSF, a collaborative effort of more than 1,800 scientists and students investigating ecological processes over long temporal and broad spatial scales), Colorado State University, Natural Resource Ecology Laboratory, University of California, Davis North Carolina Botanical Garden, The Biota of North American Program, The Nature Conservancy, National Aeronautics and Space Administration and Goddard Space Flight Center. The Biological Research and Monitoring program contributes to this effort. More detailed information is available in the Invasive Species program description, beginning on page K - 34. A request for increased funding can be found on page K - 55.

In FY 2006 USGS will put emphasis on understanding the impact of climate change and land use on the carbon cycle and carbon sequestration in soils and sediments as a contribution to the Carbon Cycle Science Program of the U.S. Global Change Research Program.

Klamath River Basin — The Departments of the Interior, Commerce, and Agriculture are involved in a variety of activities throughout the Klamath River Basin. These activities span two States – Oregon and California – and focus on environmental, economic, and statutory concerns. USGS is working closely with the BOR, BLM, FWS, NOAA Fisheries, Natural Resources Conservation Service, several Tribes, the Oregon Departments of Water

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Resources, Fish and Wildlife, and Environmental Quality, California Department of Water Resources, and Siskiyou and Modoc Counties in California to address basin issues. Since 1992, USGS has been conducting hydrological and biological research on many of the factors affecting the basin's resources. USGS has studied endangered Lost River and shortnose suckers in Upper Klamath Lake since 1994. Part of this research has been the monitoring of adult sucker spawning populations in shoreline areas of the lake and in two major tributaries. USGS' biological work includes monitoring of adult sucker populations, evaluating near-shore habitat use by juvenile suckers and examining the movements and behavior of adult suckers with respect to water quality conditions in Upper Klamath Lake. USGS' hydrologic work includes research in the Upper Klamath Basin to quantify the regional ground-water flow system in order to identify developable ground-water resources, provide the analytical capability to predict effects of increased ground-water pumping, and determine how groundwater can best be used to supplement water supplies in the Basin without causing new problems. In addition, USGS is collaborating with Natural Resource Conservation Service to improve the accuracy of seasonal forecasts of inflows to BOR's Klamath Project to help with water allocations among all beneficial uses. The Hydrologic Networks and Analysis, Cooperative Water, and Biological Research and Monitoring programs contribute to this effort.

In FY 2006, USGS will continue the work that is started in FY 2005, which is to help determine the water-quantity and water-quality benefits that can be expected in the Lake in response to various restoration activities. These activities span two States—Oregon and California—and focus on environmental, economic, and statutory concerns. Further, USGS will investigate habitat used by juvenile and adult fish, movement, behavior, and survival in response to water availability, water quality, sediment, wetland, and watershed contributions to the ecological status of the Upper Klamath River basin and Klamath Lake.

Program Increases

(dollars in thousands)

Component	FY 2006 Program Change (\$000)	Page Reference
Landsat	\$12,000	H - 70; M - 20
Landsat Data Continuity Mission	\$7,450	H - 71
Science Impact	\$250	H - 84
Tsunami Activities	\$5,416	I - 41; I - 76; I - 126
Volcano Monitoring	\$864	I - 59
Puget Sound	\$912	I - 126
Geothermal Assessments	\$500	I - 160
Water Availability	\$400	J - 22
Great Lakes Deepwater Fisheries	\$252	K - 51
Glen Canyon Adaptive Management Program	\$750	K - 51
Ecological Systems Mapping	\$250	K - 52
Science on the DOI Landscape	\$750	K - 53
Invasive Species	\$300	K - 55
Certification and Accreditation of Systems	\$1,059	L - 18
Enterprise Services Network	\$1,235	L - 19
Disaster Management	\$680	L - 36
E-Government	\$371	M - 19
Total	\$33,439	

Landsat

+\$12,000,000

Land Remote Sensing Subactivity (+\$6,000,000) — This increase of \$6 million will provide the additional base funds necessary to continue operations of Landsat 7 through the launch of LDCM in 2009. The Landsat data is vital for numerous scientific and operational activities, including many programs within the Department of the Interior. The additional funds will enable USGS to meet requirements under the Land Remote Sensing Policy Act of 1992 (P.L. 102–555) and continue to provide moderate resolution data to the Nation at the cost of fulfilling user requests. Since the failure of the scan line corrector aboard the Landsat 7 satellite, the USGS has been unable to generate sufficient revenue to cover operational costs. Since 2004, the USGS has experienced an annual shortfall of approximately \$6 million in revenue, necessitating the need for a reprogramming of funds. As Landsat data are vital to many programs, for example, wildland fire, global crop assessments, and monitoring of the coastal and near shore

Program Changes

environment, it is important to keep the program intact. The \$6 million will allow the Landsat Program to continue providing medium resolution imagery to the Nation.

Bureau Operations Subactivity (+\$6,000,000) — As part of the budget proposal to provide a long-term solution to the funding shortfall problem with Landsat 7, the USGS will propose a reprogramming in FY 2005 to cover the anticipated shortfall in revenue due to the failure of Landsat 7's scan line correction. This funding will ensure that Landsat 7 data continues to be received, processed, and archived. The USGS reprogramming request will redirect proposed working capital fund contributions in FY 2005 to the Land Remote Sensing program to cover up to \$6.0 million. The budget requests a one-time increase in FY 2006 of \$6.0 million to replace the working capital fund contributions that are redirected in 2005. The replacement of these deferred contributions is critical to ensuring that the USGS is able to remain on track to replace aging mission-critical equipment. The Bureau Operations program will distribute the \$6.0 million increase among the working capital fund investments that were originally scheduled for FY 2005.

Landsat Data Continuity Mission

+\$7,450,000

Land Remote Sensing Subactivity — This increase will enable the USGS to start system development activities that ensure capabilities are in place to ingest, archive, process and distribute LDCM data for a launch on the first NPOESS satellite in 2009. The majority of the work will be done at the USGS National Center for EROS using in-house Technical Support Services Contract (TSSC) staff to provide systems engineering, algorithm development, software development, requirements management, documentation control, testing support, and management needed to modify existing software, as well as to implement new systems and software that support LDCM ground system functions. A portion of the ground system development may be contracted to commercial system builders.

During FY 2006, the development effort will encompass the following activities and deliverables for the NPOESS/LDCM system:

- Documentation of operational concepts for each ground sub-system,
- Documentation of sub-system requirements, and formal review,
- Preliminary ground system design and formal review,
- Documentation and exchange of interface requirements,
- Documentation of interface design and data formats,
- Documentation of a security plan,
- Identification of sub-systems or components for outsourcing,
- Initiation of critical design for the ground system,
- Acquisition of some hardware components for in-house software development,
- Participation with NASA and NOAA in coordination meetings and design reviews,

- Coordination with other potential Landsat-continuity partners, including International Cooperators, and
- Communication and coordination with USGS and DOI management.

This project's deliverables directly support USGS strategic objectives by making high-quality remotely sensed data widely and inexpensively available without restrictions to a global community of international, Federal civil, defense, NGO, State, local, academic, commercial, and individual users in both operational and research environments. The project directly supports the DOI's role in Landsat Program Management as outlined in Presidential Decision Directive NSPD-3. The LDCM Project will ensure continuation, post Landsat 7, of a collection of consistently calibrated imagery of the Earth's land mass, coastal boundaries, and coral reefs. It will also ensure that LDCM data are of maximum utility in supporting the scientific objectives of monitoring changes in the Earth's land surface and associated environment. Image data from satellites, such as the Landsat series, are one of the most efficient, cost-effective sources of essential geospatial information for the scientific and operational land and resource management communities.

Science Impact

+\$250,000

Geographic Analysis and Monitoring Subactivity — A new Science Impact project is proposed in FY 2006, focusing on ways that science can better inform decisionmaking relating to western water issues. The project will complement existing DOI efforts and will build upon the capabilities and capacity developed during FY 2004 and 2005 (see page F - 36). Studies will be conducted in locations where water availability issues have included citizen involvement in deciding difficult water management choices. The first set of studies will address issues associated with the lower Colorado River in California and Arizona.

The proposed project will include structured contact with the institutions, stakeholders, and sources of conflict. Collaborative processes will be applied to examine ways in which science can effectively be linked with the decision making process. Science Impact integrated tools will be developed and implemented to link natural science data with socio-economic and institutional analyses of alternative policy decisions. These integrated products will be evaluated for their effectiveness in addressing implications associated with critical water management decisions and in their acceptance and use in different settings with different sets of stakeholders. Integrated tools will be developed and implemented to link natural science data with socio-economic and institutional analyses of alternative policy decisions.

Tsunami Activities

+\$5,416,000

The Administration plans to request +\$8.1 million in the 2005 emergency supplemental funding request for tsunami assistance for the USGS to begin procuring and installing additional seismic monitoring stations and to enhance the existing seismic monitoring network. In 2006 the USGS is requesting +\$5.4 million as follows:

Earthquake Hazards (+\$3,816,000) – Improved seismic monitoring and information delivery is critical to expanding tsunami warning capability globally and in the United States. The NEIC systems are 15-20 years old and in need of upgrade. Similarly, the staffing levels need to be strengthened if NEIC is to provide the best earthquake information possible. Software systems under development will bring a dramatic improvement in the time required to detect large

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earthquake and accurately determine their location, magnitude, and probable impacts. This will then allow USGS to deliver a suite of timely and authoritative earthquake information products to sister agencies, State and local emergency managers, and decisionmakers.

Information generated by the NEIC is critical to United States and foreign governments, State and Federal response agencies, and the public. This is reflected in the number of e-mailed earthquake alerts sent out (>25,000), hits to the Web site (120 million in the first week alone), and overwhelming request for TV and radio interviews from local, national, and international news agencies following a damaging event such as the December 26, 2004, Sumatra-Andaman 9.0 earthquake.

Increased funds address both system development costs for an enhanced NEIC as well as long-term maintenance needs for the system. These needs are in agreement with existing ANSS planning documents, and thus reflect long-standing and broadly recognized needs for a truly robust, reliable earthquake notification and response system. The activities summarized below contribute to the program performance measure of "hazard monitoring networks maintained." Currently USGS has no measure that captures improved timeliness and accuracy of seismic information as an aspect of performance, but is working with other Federal agencies to develop an appropriate, coordinated measure. Elements of the improved system are as follows:

- **NEIC software development** — USGS has begun the process of upgrading its 20-year-old legacy system for real-time earthquake detection and notification. The beta version of the new system, Hydra, is currently operating in test mode. Additional investments in FY 2005 are speeding the development and implementation of Hydra as the primary operational earthquake analysis system. EHP is also purchasing and completing development of the EDGE server needed to replace antiquated hardware with modern servers that integrate a number of different seismic data sources from USGS and international partners in support of USGS and NOAA monitoring activities. NEIC is the brain center for regional, national, and international monitoring integration and data assimilation but lacks a modern National Operations Center (NOC) software package for cataloging, databasing and reporting functions. The development of such a system is critical to both international and domestic response efforts. It is critical that specialized analysis modules be revamped to integrate seamlessly into the core Hydra system. Moreover, this enhancement is necessary to insure reliable operations, performance, and long term operational cost efficiencies. The principal costs covered by the increased funding are for a software development team. Improvements in this area will result in more rapid earthquake detection and notification in tsunamagenic source areas that border the United States and its territories.
- **Full implementation of PAGER** — The Prompt Assessment of Global Earthquakes for Response (PAGER) system uses information about an earthquake's source (e.g., ground shaking, rupture length, depth), combined with information regarding population and infrastructure in the affected region, to estimate potential impact (both damage and loss of life) of a major ground shaking event. PAGER is ideal for both domestic and international earthquakes in areas where a dense seismic network is not available, but where a rapid assessment is critical for estimating impact. Funding for PAGER will provide for additional research scientists, technical support and computer programmers needed to fully implement the PAGER program. The outcome of this investment will be improved algorithms for Global ShakeMaps, finite fault modeling, rapid aftershock identification and association, and loss estimation. PAGER will also allow for integration

and evaluation of impact of secondary hazards such as liquefaction, landslides, and tsunamis.

- **Establish robust 24/7 operations** — NEIC optimally requires a full-time, 24 x 7 staff of seismologists to quickly respond to potentially damaging events. To accomplish this, additional FTE will be used to augment the current duty seismologist staff in order to operate on a 24 x 7 schedule versus the current 8 x 5 (work-day) schedule with evening, nights and weekends covered by staff on stand-by status. NEIC also requires a commensurate level of commitment to oversee the computer and network operations to insure continuity of operations 24 x 7. Currently a small group of research scientists volunteer on an ad hoc basis to respond when computer systems fail in the off hours. A significant number of NEIC-supported field sites are critical to NOAA operations as well as NEIC's. Specifically, data from the GSN and the ANSS backbone are primary data sources for NOAA in their tsunami evaluations and reporting. With the requested increase, NEIC will decrease reporting time for global earthquakes (currently over one hour) and reliably deliver a complete suite of earthquake products including PAGER to 20 minutes.
- **Improved tsunami warning distribution** — Software developed by the California Integrated Seismic Network (a USGS university and State partnership) to speed USGS-generated earthquake information directly to local emergency managers has a dual use capability to also provide NOAA tsunami warnings. This system, designed to provide a mechanism for instantaneous transmission of seismic information, complements existing NOAA delivery mechanisms. Investment in this area will allow emergency managers to respond to earthquakes as well as tsunamis.

Global Seismographic Network (+\$600,000) — Improved global seismic monitoring and rapid information delivery is critical to expanding earthquake notification and tsunami warning capabilities, including for the United States and its territories. Seismological data generated by the GSN is critical to United States and foreign governments, State and Federal response agencies, and ultimately the public. The importance of the USGS earthquake notification service is reflected in the number of e-mailed earthquake alerts sent out (>25,000), the hits to the Web site (575 million in 4 days), and the overwhelming request for television and radio interviews from local, national, and international news agencies following a damaging event such as the December 26, 2004 Sumatra-Andaman 9.0 earthquake.

With the proposed FY 2006 increase, critically-needed improvements to the GSN are planned in two areas: (1) improved telemetry connections so that all GSN stations provide data in real time and (2) more frequent maintenance for enhanced station uptime. Because the global distribution of GSN stations is used to accurately determine the location and magnitude of the largest earthquakes, telemetry upgrades are required system-wide in order to improve the timeliness and accuracy of earthquake analyses for rapid response. Partnerships will be key to further strengthen seismic coverage using existing networks maintained by other countries. The outcome of this investment will be a state-of-the-art, real time earthquake detection and notification system that is both timely and robust and enables delivery of a suite of value-added earthquake information products that emergency managers want (e.g., products such as PAGER and ShakeMap). The increased network uptime, data quality and availability will enhance rapid earthquake notification, support improved tsunami warning and rapid delivery of disaster impact assessments, by USGS and its Federal and State partners.

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Coastal and Marine Geology (+\$1,000,000) — Efforts will be expanded to develop enhanced geological and geospatial information to improve regional assessments of tsunami hazard potential. FY 2006 activities will focus on tsunami hazards in the Caribbean, particularly Puerto Rico and the U.S. Virgin Islands, through enhancement of coastal and marine mapping activities and application of tsunami models. The USGS will acquire existing high-resolution elevation data for nearshore and coastal regions of Puerto Rico and the U.S. Virgin Islands and begin development of improved elevation models to constrain tsunami inundation models. Coastal mapping in Puerto Rico will assess the potential to identify and characterize past tsunami events in support of probabilistic hazards assessments. Marine geophysical surveys in regions associated with past tsunami events will be undertaken to assess future tsunami source potential. Computer simulations from these potential tsunami sources will help identify coastal regions vulnerable to inundation. Synthesis of this new information with available data, along with characterization of regional seismic activity, will result in improved tsunami hazard assessments and maps for Puerto Rico and the U.S. Virgin Islands. As a result, one additional workshop will be supported in FY 2006.

Volcano Monitoring

+\$864,000

Volcano Hazards — The \$864,000 increase for VHP will be used for equipment purchases and deployment costs to complete modernization of the MSH monitoring network, to initialize the improvement of monitoring capability at other Cascade volcanoes, and to expand monitoring capability in the CNMI. Improvements will be implemented without addition of FTE in FY 2006.

The program's recent evaluation of U.S. volcanoes that forms the basis for a National Volcano Early Warning System indicates: (1) large gaps in monitoring capability occur in the Cascades, where together with Hawaii, the volcanoes pose the greatest threat to lives and property within the United States, and (2) volcanoes of the Mariana Islands, which are virtually unmonitored, are capable of generating ash clouds and tsunamis, which could impact Guam, the CNMI, and military deployment and international air traffic in the western Pacific. Among the most threatening of these volcanoes, the greatest deficiencies in monitoring capability exist at Glacier Peak, Mount Rainier, Mount Hood, Three Sisters, Mount Baker, Mount Adams, and Crater Lake in the Cascades, and at Pagan and Agrigan in the Mariana Islands. In FY 2006 and subsequent years, priority will be given to improved monitoring of those volcanoes in eruption or those which have recently erupted, followed by volcanoes showing significant unrest, followed by volcanoes in repose in the order of the level of threat they pose to citizens and property. MSH, Anatahan, and Mauna Loa are priorities in FY 2005. Completion of the network at MSH will continue to be a priority in FY 2006, but upgrades to the monitoring networks at Three Sisters and Mount Rainier will be performed, and progress will be made toward providing monitoring of Pagan and Agrigan.

The recent eruption of MSH demonstrated that, during an eruption, the need for more adequate ground-based networks resulted in increased expenses and increased risk to USGS personnel. At MSH, a sparse GPS network and the lack of modern broadband seismometers resulted in the failure to capture important seismic and geodetic information during the early weeks of the eruption. Looking to the future, the failure to capture adequate information during the onset of unrest could translate into reduced warning time for people on the ground and aircraft in the air. Approximately \$10,000 per week was spent on helicopter and fixed wing support through the first two months of FY 2005 because the ground-based monitoring network was not sufficient to fully track the eruptive activity. USGS personnel were placed at risk making these observations and upgrading the monitoring network.

The additional funds will allow the program to increase its performance goals by more rapidly expanding the monitoring network to unmonitored volcanoes. For the past several years, two volcanoes per year have been added to the monitoring network in Alaska. This rate will continue in Alaska and will be augmented by an additional volcano per year in the Mariana Islands. The number of sites (mobile or fixed) monitored for ground deformation to identify volcanic activity will be increased to an addition of 15 sites per year. The program will continue according to plan to increase the percentage of communities using DOI science on hazard mitigation, preparedness, and avoidance. Not adequately captured by this metric will be the increased ability of the VHP to detect volcanic unrest, forecast eruptive behavior as a result of improvements to the monitoring of Cascade volcanoes through addition of seismic and geodetic stations. Communities on both flanks of the Cascades, including the increasingly populated I-5 corridor from Puget Sound to Mount Shasta, will benefit from the improved detection and interpretation of volcanic unrest.

Puget Sound

+\$912,000

Coastal and Marine Geology — The increase will provide funding to expand the USGS participation in the Puget Sound Nearshore Ecosystem Restoration study. Determining the extent of degradation to nearshore environments will require a significant, dedicated effort. The increase will provide the science required by the Puget Sound Nearshore Ecosystem Restoration Partnership (ACOE, other Federal agencies, State resource agencies, local governments, commercial and non-governmental organizations) to evaluate critical habitat restoration and preservation solutions. The increase will support engagement of broad multidisciplinary research expertise in an effort to provide the integrated science needed for local and regional habitat restoration efforts. This represents a further implementation of the comprehensive USGS National Coastal Plan and project activities will be developed collaboratively with regional leadership, local partners, and the USGS Priority Ecosystems Science program. Efforts will build on FY 2005 activities focused on priority ecosystem components in the Skagit Delta, the Elwha River, and throughout the Puget Sound ecosystem. As a result, one additional workshop will be supported in FY 2006.

Geothermal Assessments

+\$500,000

Energy Resources Program — The increase will provide funding to begin investigating the nature and extent of geothermal systems capable of producing electric power and to produce updated assessments of available geothermal resources in the western United States. The USGS proposes to conduct studies that will advance understanding of the thermal, chemical, and mechanical processes that lead to the co-location of high temperatures and high permeability necessary for the formation of geothermal systems and that will develop improved techniques for locating, characterizing, and exploiting these systems. The available data on the potential geothermal resources of the western United States indicate the presence of substantial undeveloped geothermal energy resources that could be tapped to help provide for the growing energy requirements of the western United States. The National Research Council review of the ERP recommended broadening the Program's energy portfolio to include alternative geologic energy resources, such as geothermal. This will be the first year of a 3-year study.

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Water Availability

+\$400,000

Ground-Water Resources Program — The USGS would begin a broad multi-State effort on assessment of ground-water depletion. During the past 50 years, depletion of ground water has spread from small, isolated pockets to large areas of the country, as ground-water use has intensified. Ground water is currently the source of drinking water for about half the U.S. population and provides much of the irrigation water that supports the Nation's agricultural economy. Despite its importance, information about long-term changes in ground-water reserves remains patchy, and a systematic approach to presenting what is known about depletion of water available from the Nation's aquifers does not exist. To begin to fill this information gap, the USGS would develop a Web-based system to display and analyze information on long-term changes in ground-water reserves for a multi-State area in the western United States. The system would enable the general public, water-management agencies, policymakers, and others to readily obtain information about the status and trends in ground-water levels, as well as to identify information gaps. A prototype system and analysis would be available for the study area within 2 years, with extension to other areas thereafter.

Great Lakes Deepwater Fisheries

+\$252,000

Biological Research and Monitoring Subactivity — This initiative focuses on deepwater fisheries research to assist USGS partners in understanding the mechanisms that drive the wide fluctuations in the Great Lakes prey fish communities. Specifically, the prey fish studies would be enhanced to provide more accurate abundance estimates and to allow better predictions of recruitment, growth, and survival. Sampling designs and models would be developed and enhanced to improve the accuracy of biomass and abundance estimates and to allow statistical comparisons of data through time within and between the lakes. Efforts would focus on remote sensing technology, particularly hydro-acoustics (scaled echo soundings through water to assess fish assemblages), to complement bottom trawl information and provide more information about pelagic (open water) fish.

The proposed increase supports the DOI Resource Protection strategic goal of sustaining biological communities on DOI managed and influenced lands and waters in a manner consistent with obligations regarding the allocation and use of water. While there is a 2-year lag between initiating research and obtaining results, research initiated with FY 2006 funding would produce two systematic analyses (a Vessel Replacement Capital Improvement Plan and a Vessel Safety Management Plan would be developed for the Great Lakes Research Center and the region) in FY 2008.

This initiative would require two additional FTE in FY 2006 to support additional work related to the Deepwater Fisheries program.

This initiative relates to the Secretary's priorities in that it requests funding for an activity that directly addresses the needs of the DOI land management bureaus, particularly the FWS, the NPS, and the Bureau of Indian Affairs.

Glen Canyon Adaptive Management Program

+\$750,000

Biological Research and Monitoring Subactivity — The GCDAMP is largely supported by power revenues from the operation of Glen Canyon Dam. Statutorily, these funds are capped, although the workload of research and monitoring mandated by the Adaptive Management

Work Group increases. Among the new requirements for this program are (1) implementing recommendations from the Humpback Chub Ad Hoc committee of the Adaptive Management Work Group, charged with arresting the decline of this federally-endangered fish in the Grand Canyon, and (2) developing a long-term core monitoring plan that would assess the effects of dam operations on natural and cultural resources for the next 10 years.

The increased funding requested will be used to support biological and geological research activities designed to better understand the Colorado River ecosystem within Grand Canyon National Park and to provide input related to decisionmaking regarding Glen Canyon Dam operations. Experimental flow regimes are key to understanding the future operations of this important western dam. The outputs will provide a decision support framework for 25 stakeholders in the GCDAMP, including 6 Federal bureaus, 5 Indian Tribes, 7 western States, and several non-government organizations.

The funding would allow the USGS to develop and refine fisheries stock assessment models, particularly as applied to endangered large river fishes. These funds would also provide information on critical habitat for the endangered humpback chub and support experiments on non-native fish removal on a 17-mile reach in Grand Canyon National Park near the confluence with the Little Colorado River. Predation by non-native fishes is thought to be a major cause of the continued decline in the humpback chub within Grand Canyon National Park.

The proposed increase supports the DOI Resource Protection strategic goal of sustaining biological communities on DOI managed and influenced lands and waters in a manner consistent with obligations regarding the allocation and use of water. Outputs include the number of systematic analyses and investigations delivered to customers. While there is a 2-year lag between initiating research and obtaining results, research initiated with FY 2006 funding will produce three completed systematic analyses in FY 2008.

For this initiative, no additional FTE are needed because work will be accomplished with existing FTE.

Ecological Systems Mapping

+\$250,000

Biological Research and Monitoring Subactivity — Under this initiative, the USGS would support Federal, regional, State, and local partnerships by leading development and synthesis of ecological information at a new level. It would build on the foundation of existing partnerships represented by the Gap Analysis program, National Biological Information Infrastructure, and *The National Map*. Partners would provide the requisite species and ecological community data needed to achieve ecological systems mapping. Representative examples of partners in the new synthesis include all DOI bureaus, State natural resource agencies, the Multi-Resolution Land Characterization Consortium, NatureServe, the Biodiversity Conservation Information System, the Heinz Center for Science, Economics, and the Environment, the Missouri Botanical Garden, the Smithsonian Institution, The Nature Conservancy, the American Bird Conservancy, the Ecological Society of America, and universities. The support from NatureServe and other NGOs would be access to their databases and the contribution of some staff time during the initial phase of completing a comprehensive assessment of current activities and developing a plan.

Ecological Systems Mapping would entail the spatial integration of information on biodiversity and ecological information at different organizational scales (species, assemblage, and

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ecosystem characteristics) and would be coupled with information on landscapes and resources to generate maps of terrestrial, fresh water, and coastal ecological systems for the Nation. Dynamic and interactive maps would, for the first time, represent biological data in the holistic context needed by resource managers, policymakers, and research scientists. Such products would build on, and integrate, the traditional skills for which the USGS is widely known in the fields of biology, geography, geology, and hydrology. The mapping of critical biological assemblages in the context of their geologic and hydrologic underpinnings can portray what is known and understood about their distribution, importance, magnitude, and other key characteristics at local, regional, and national scales, with the ability to manipulate the base layers in real time for making management decisions. These map products would directly support decisionmakers implementing Administration priorities on managing wild land fire, managing invasive species, restoring healthy forests, improving monitoring, restoring landscapes, and coordinating spatial data. The Multi-Resolution Land Characterization Consortium (USGS, EPA, NOAA, USFS, NRCS, BLM, NPS, and NASA) is coordinating Federal land cover mapping activities. NOAA's Coastal Change Analysis program, the USGS Gap Analysis program, and the Land Cover Mapping Project have pooled resources and are producing the National Land Cover Database. Ecological Systems Mapping would build on and integrate these efforts, add significant information content to the multiagency land cover databases, and incorporate State and local mapping databases. The initiative would benefit DOI land managers by providing access to quality biological and ecological information for improving resource management decisionmaking.

In FY 2006, the USGS requests \$250,000 to initiate a comprehensive assessment of current ecological systems mapping activities across the Nation. This assessment would provide the framework for the development of strategic Science and Business Models/Plans to implement mapping and would establish priorities for the new mapping information needed. As soon as feasible but before full implementation, pilot activities will be required at regional and national scales. The regional pilot would focus on management application needs for biological data of high interest to DOI, such as sage grouse habitat, and should take advantage of data-rich regions or focus on a region identified by resource managers and partners as having high levels of concern over specific issues. A national pilot will be needed to demonstrate and test the ability to synthesize and use ecological data, in conjunction with remote sensing, physical, and thematic map data, to map across multiple scales: ecoregions, ecosystems, species assemblages, and species. This would build on a largely untapped strength of the USGS to manage a rich national and global spatial database, and our ability to analyze these data to support ecological mapping at scales ranging from local to national. Partners would be full participants in deciding what to map (species, habitats, or other environmental indicators), how to map it (approaches to display data most effectively), and where to conduct the pilot effort.

Beneficiaries of Ecological Systems Mapping would include DOI land and resource management bureaus, and many partners such as State natural resource agencies, the Multi-Resolution Land Characterization Consortium, NatureServe, the Biodiversity Conservation Information System, the Heinz Center for Science, Economics, and the Environment, the Missouri Botanical Garden, the Smithsonian Institution, The Nature Conservancy, the American Bird Conservancy, the Ecological Society of America, and universities.

This initiative supports the DOI Resource Protection strategy to improve health of watersheds, landscapes and marine resources that are DOI managed or influenced in a manner consistent with the obligations regarding the allocation and use of water. To clearly measure USGS progress in supporting the intermediate outcome goal of improving the information base, information management, and technical assistance, the USGS supports Federal, State, and

local partnerships by providing resource managers with information on landscapes and resources to generate maps of terrestrial, fresh water, and coastal ecosystems for the Nation. Outputs would be one additional systematic analysis. This includes a report on the comprehensive assessment of current ecological systems mapping activities across the Nation and a draft strategic science and business plan and implementation strategy for Ecological Systems Mapping.

Science on the DOI Landscape

+\$750,000

Biological Research and Monitoring Subactivity — An increase in FY 2006 of \$750,000 for Science on the DOI Landscape will provide funds to enhance science support to meet regional priorities identified by DOI bureaus. Criteria for initiating or continuing specific studies in FY 2006 will be based on DOI bureau needs, as well as on funding availability, leveraging and partnership opportunities, and urgency as determined nearer the time of the appropriation. Based on current knowledge of priority needs, the USGS will focus on studies that address the following regional issues.

Eastern Region will conduct studies for the BLM, FWS, NPS, MMS, and OSM on understanding the threats to ecosystem sustainability and solutions for restoring degraded habitats, water quantity and quality for both human and ecological needs, and biological and physical influences on emerging diseases.

Central Region will conduct studies for the BIA, BLM, NPS, BOR, and FWS, in cooperation with the U.S. Army Corps of Engineers and other agencies, on sustainable ecosystems in the sage habitats and riparian areas that are impacted by development, invasive species, and fire in the northern Front Range. Other focus areas will include rapid response to short-term science needs, such as synthesis of existing scientific knowledge and data or consultation, and continued work on coal bed methane and Mancos shale landscapes.

Western Region will conduct studies for the BIA, BLM, BOR, FWS, and NPS on landscape and biological issues related to the ecological condition of natural systems in the Great Basin and Columbia Plateau ecoregions, history and rates of landscape and ecologic change, and links to geologic and hydrologic processes, in the Lower Colorado River basin, and ridge-to-reef habitats in the Hawaiian islands. Alaska, as a component of the Western Region, will conduct work under the North Slope Science Plan to expand landscape forecasting work initiated in 2004 and 2005 and will expand energy assessment, hydrologic network analysis, surficial geologic mapping, permafrost studies, and aquatic populations and habitat assessment for the entire North Slope region.

These regional projects address the outcome goal of improve health of watersheds, landscapes and marine resources that are DOI managed or influenced in a manner consistent with the obligations regarding the allocation and use of water under Resource Protection in the DOI Strategic Plan. Products will include three systematic analyses and investigations delivered in FY 2008 and two workshops in FY 2006. The FY 2006 request will allow the USGS to collect more data and conduct additional assessments and research to address the science issues of the DOI bureaus. To achieve this, two additional FTE will be required.

This initiative has successfully leveraged funding and in-kind support from DOI bureaus in FY 2004; this sharing of resources indicates the interest of the bureaus to partner with USGS in the planning and development of work that addresses their important issues. Collaboration

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between USGS and DOI bureaus begins with discussions of management challenges and the scientific information needed to inform land and resource decisions. Collaboration continues through setting priorities for work, planning and implementing projects, conducting field work to collect data and share information, and disseminating the results of work through jointly-hosted workshops, stakeholder meetings, and other venues. Collaboration results in sharing monetary resources and in-kind support, such as personnel and equipment to promote efficient use of resources and reduce duplication of effort, field data and site information to assist USGS scientists in data gathering and analysis, and shared office and laboratory space to facilitate analysis and dissemination of results. From priority setting to products that help meet performance goals, DOI bureaus are partnering with USGS and with each other to share resources and results, and to make a difference in managing resources. This initiative relates to the Secretary's priorities in that it requests funding for an activity that directly addresses the needs of DOI bureaus.

Invasive Species

+\$300,000

Biological Research and Monitoring Subactivity — With additional funds, the USGS would address critical research needs for specific invasive species identified in three geographic areas: tamarisk research in the Rio Grande Basin, Brazilian pepper tree research in South Florida, and leafy spurge research in the Northern Great Plains. Efforts in these three geographic areas are part of a Departmentwide initiative to collaboratively address invasive species issues in specific geographic regions across all DOI agencies.

The proposed change will enhance USGS performance in meeting the DOI Resource Protection outcome goal of sustained biological communities on DOI managed and influenced lands and waters, in a manner consistent with obligations regarding the allotment and use of water, and will support interagency implementation of the National Invasive Species Management Plan, approved by the interagency National Invasive Species Council. While there is a 2-year lag between initiating research and obtaining results, research initiated with FY 2006 funding will produce two systematic analyses in FY 2008.

The following activities are projects that were not identified as priorities in the President's budget, and the Administration proposes to bring these projects to a close in FY 2006, as they do not address the highest priority science needs of the USGS and the Department. This will keep the core program intact while allowing the USGS and the Department to make the best use of limited resources and ensure that the highest priority programs are funded.

As a result of the following proposed decreases, the number of systematic analyses and investigations delivered to customers would decrease by 16. These systematic analyses and investigations would have been delivered in FY 2008. The proposed decreases do not impact FTE totals.

Certification and Accreditation of Systems

+\$1,059,000

Enterprise Information Security and Technology Subactivity — In 2006, the Department will continue to focus on improving IT security. The 2006 budget includes \$12.8 million DOI-wide for coordinated certification and accreditation (C&A) activities, including \$2.9 million collected through the Department's working capital fund. The USGS share of this funding in 2006 includes a total of \$1,059,000, of which \$432,700 will be collected through the DOI working capital fund to support centralized activities to enhance efficiencies; reduce overall costs;

enhance the quality, consistency, and documentation supporting accreditations; and prioritize remediation activities.

In 2004, Interior strengthened its IT security program by accelerating the timeframes for completing C&A using government-wide standard processes. As of November 15, 2005, Interior had significantly improved its security posture, having certified and accredited 161 of its 165 production systems, or 98 percent. Now that a preponderance of systems are formally managed with regard to security, challenges remain to schedule and remediate weaknesses discovered through C&A, Inspector General, or annual reviews. Furthermore, once established, accreditation status must be maintained through system functional releases and infrastructure modernization. During 2005 and 2006, the Department and its bureaus are completing third party reviews of completed certification and accreditations; remediating identified risks; and establishing the necessary security program infrastructure to allow ongoing maintenance of accreditation status in an efficient and effective manner. These activities include:

- Establish or update C&A package contents including risk assessments, planned controls, and testing of controls,
- Where controls are deficient, institute new or upgraded management, operational, or technical controls,
- With adequate rigor, test controls for effectiveness,
- Establish prioritized inventory of items to resolve (plan of action & milestones - POA&M) and resolve in a prioritized manner such that residual risk is acceptable for Authority To Operate,
- Establish standards, procedures, tools, and training to enable the cost effective maintenance of accreditation packages, and
- Improve security activates involving contracted/outsourced IT operations.

In 2004, USGS completed Certification and Accreditation (C&A) of its remaining 8 system categories, resulting in a greatly improved security posture. All 12 system categories have completed the C&A process and follow DOI/NIST requirements. In 2005, USGS is working through resolution of outstanding residual risks identified in the C&A process, and other internal risk assessment processes, based on priority. These items are documented in Plan of Actions and Milestones reports that are managed, monitored, and submitted to DOI on a quarterly basis. In addition, C&A security documentation is maintained and updated as appropriate, Information Technology (IT) Standards are being developed as needed, and C&A related training is being conducted. In 2005, USGS has implemented acquisition guidance, assigning security activities directly to contracts and outsourced operations.

Enterprise Services Network

+\$1,235,000

Enterprise Information Security and Technology Subactivity — Interior is deploying the Enterprise Services Network to provide secure, state-of-the-art internet and intranet connections and a fully functional operational center for data communications that will be used by the entire Department. In addition to providing better services for many Interior offices, the system will provide a uniformly secure environment, standardized and efficient 24 hour/7 day operations, and improved technical support. The USGS budget includes \$3,521,000 for ESN of which

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\$986,000 was new funding in FY 2005 and \$1,300,000 is an estimated amount that will be redirected from legacy network systems to the ESN project. The Department is working with its bureaus to finalize the amounts that will be redirected, and will provide the subcommittees updates to the amounts in the spring.

In 2004, Interior began to implement Phase I of ESN, which will be completed in December 2005, with deployment of a modern, integrated network backbone that supports telecommunications within the Department. This includes access to the internet, a Departmentwide Intranet, and a fully operational technical support center. Phase I also transitions management of the National Park Service's wide area network to managed services and thereby simplifies and modernizes a geographically dispersed and outdated architecture.

The return on investment for this system is high. Up-front investments, including the redirection of bureau telecommunication savings, will, in the long term, result in reduced costs with elimination of duplicative networks, improved performance of data services with less "down time" for many offices, skilled and knowledgeable staff trained to operate standardized and centralized operations, and better support for E-Government initiatives.

Phase I of ESN reduces the Department's current 13 wide area networks to one and 33 Internet access points to 5. For NPS, Lotus Notes maintenance sites were reduced from 253 to 7.

During 2005, the Department will also plan Phase II to expand secure connections to approximately 150 sites located primarily in large cities and approximately 1,500 hubs at other Interior locations.

ESN will also facilitate efforts to consolidate directory services, web hosting, messaging, data warehousing, and other applications and systems.

Over the past 2 years, USGS has actively supported the transition to the DOI Enterprise Services Network (ESN). To date, USGS has

- Ordered and deployed the four enterprise high-speed Internet 1 nodes that will serve as the consolidated DOI Internet access points. This action moves the Department toward its goal of consolidating 33 access points to 4 (operational 12/9/2004),
- Ordered and is deploying Metropolitan Area Network service (i.e., Yipes) for connecting all bureaus in the Washington, DC, area to the Internet access point and is positioning MAN services in other large sites to the same end,
- Developed the strategy and applied the technical expertise to the ESN Alaska (aka, "ESN-AK") transition, which offers consolidated high-speed service in Alaska and gateways to the lower 48 with access to the ESN Intranet, and
- Worked with DOI and several bureaus in Denver for the planning and deployment of the ESN Intranet (operational 12/18/2004). USGS has benefited directly from the Internet 1 high-speed access with three-times more bandwidth than was previously available.

Disaster Management

+\$680,000

Federal Geographic Data Coordination Subactivity — Interior is an active participant in many E-Government initiatives, providing leadership, funding, and in-kind technical and staffing support. These initiatives strive to eliminate redundant systems and significantly improve the Government’s quality of customer service for citizens and businesses. The budget includes an increase of \$680,000 to support Disaster Management.

The Disaster Management Initiative will improve the delivery of disaster assistance information and services to government agencies and the private sector by creating a single Internet-based portal. The public side of the portal will be a single location where the public and businesses can access disaster information and services provided by government agencies and non-governmental organizations. The Government side of the portal will provide a layered, secure environment providing access to disaster information and the means to exchange information on disaster preparedness, response, mitigation, and recovery.

E-Government

+\$371,000

Bureau Operations Subactivity — Interior is an active participant in many E-Government initiatives, providing leadership, funding, and in-kind technical and staffing support. These initiatives strive to eliminate redundant systems and significantly improve the Government’s quality of customer service for citizens and businesses. The Department is the managing partner for two E-Government projects – Recreation One-Stop and Geospatial One-Stop. Interior is serving as one of the Governmentwide service providers for the E-Payroll initiative and is a leader in the E-Authentication project.

Departmentwide spending for E-Government activities that will benefit the USGS (excluding fee for service payments) reflected in the 2006 President’s budget follow. In addition, the Department is also implementing E-Travel in an integrated fashion with the FBMS. Funds to support E-Travel are included in the FBMS budget under Departmental Management. The 2006 USGS budget includes \$371,000 to support these E-Government initiatives.

(Dollars in Thousands)

	Billing Method	2006 Estimate
Integrated Acquisition	C-WCF	397
Grants.gov	C-WCF	453
E-Authentication	C-WCF	450
E-Rulemaking	C-WCF	825
E-Training	C-WCF	185
Business Gateway	C-WCF	322

Billing Method Notes. The billing and payment methods of the E-Gov projects vary as follows:

C-WCF. The Department has established a centralized WCF account for purposes of billing bureaus and paying managing partners for certain E-Gov payments. The Departmental management budget justification includes a description of this account.

D-WCF. Indicates a dedicated WCF account has been established for a single E-Gov project. The only current project that falls in this category is Recreation One-Stop.

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TBD. The billing methodology for two E-Government projects, SAFECOM and Disaster has yet to be determined. Funding to support SAFECOM and Disaster are included in bureau budgets as noted below.

Direct. Direct means that a bureau makes direct payments to managing partners. In 2006, both recreation one stop and geospatial one stop have a direct component.

The Departmental Management budget justification includes justifications of the programs funded through the working capital fund.

**FY 2006 Priority Goals and Resources by DOI Goal
(\$000)**

Resource Protection

End Outcome Goal: PEO.1. – Improve health of watersheds, landscapes, and marine resources that are DOI managed or influenced in a manner consistent with the obligations regarding the allocation and use of water.			
Biological Research, Biological Research and Monitoring	Science on the DOI Landscape	\$750	+3 systematic analyses/investigations delivered to customers in FY 2008 +2 formal workshops or training provided to customers (instances/issues/events)
Biological Research, Biological Research and Monitoring	Ecological Systems Mapping	\$250	+1 systematic analyses/investigations delivered to customers in FY 2008

End Outcome Goal: PEO.2. – Sustain biological communities on DOI managed or influenced lands and waters in a manner consistent with the obligations regarding the allocation and use of water.			
Biological Research, Biological Research and Monitoring	Glen Canyon Adaptive Management	\$750	+3 systematic analyses/investigations delivered to customers in FY 2008
Biological Research, Biological Research and Monitoring	Great Lakes Deepwater Fisheries	\$252	+2 systematic analyses/investigations delivered to customers in FY 2008
Biological Research, Biological Research and Monitoring	Invasive Species	\$300	+2 systematic analyses/investigations delivered to customers in FY 2008

Resource Use

End Outcome Goal: UEO.1. – Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value - Energy			
Geologic Resource Assessment, Energy Resources	Geothermal Assessment	\$500	+1 systematic analyses/investigations delivered to customers in FY 2009

Serving Communities

End Outcome Goal: SEO.1. – Protect lives, resources, and property			
Geologic Hazard Assessments, Earthquake Hazards	Tsunami Activities	\$3,816	Timeliness and quality of seismic information will be improved. Currently USGS has no measure that will capture this aspect of performance, but is working with other federal agencies to develop a coordinated measure.
Geologic Hazard Assessments, Global Seismographic Network	Tsunami Activities	\$600	+16% (cumulative 96%) of earthquake monitoring global seismic network stations with telemetry added (increase reporting speed from one hour to 20 minutes)
Geologic Hazard Assessments, Volcano Hazards	Volcano Monitoring	\$864	+10 counties or comparable jurisdictions that have adopted improved building codes, land-use plans, emergency response plans, or other hazard mitigation measures based on USGS volcano hazards information +15 sites (mobile or fixed) monitored for ground deformation to identify volcanic activity

Program Changes

End Outcome Goal: SEO.2. – Advance knowledge through scientific leadership and inform decisions through the application of science.			
Mapping, Remote Sensing, and Geographic Investigations, Land Remote Sensing	Landsat Data Continuity Mission	\$7,450	+11% ground system designed, built and tested % of data available from archive within 24 hours of capture will be tracked after launch in 2009
Mapping, Remote Sensing, and Geographic Investigations, Land Remote Sensing	Landsat	\$6,000	These funds replace lost revenue and enable continuation of data collection that would otherwise be terminated.
Mapping, Remote Sensing, and Geographic Investigations, Geographic Analysis and Monitoring	Science Impact	\$250	+1 partnership formed with decisionmaking organizations +2 formal workshops or training provided to customers (instances/issues/events)
Geologic Landscape & Coastal Assessments, Coastal and Marine Geology	Puget Sound	\$912	+1 mapping nodes (publicly available Web mapping services through <i>The National Map</i>) +1 formal workshop or training provided to customers (instances/issues/events)
Geologic Landscape & Coastal Assessments, Coastal and Marine Geology	Tsunami Activities	\$1,000	+1 formal workshop or training provided to customers (instances/issues/events)
Water Resources Investigations, Ground-Water Resources Program	Water Availability	\$400	+1 systematic analyses/investigations delivered to customers in FY 2008
Enterprise Information, Enterprise Information Security and Technology	C&A of Systems	\$1,059	--
Enterprise Information, Enterprise Information Security and Technology	Enterprise Services Network	\$1,235	--
Enterprise Information, Federal Geographic Data Coordination	Disaster Management	\$680	--
Science Support, Bureau Operations	E-Government	\$371	--
Science Support, Bureau Operations	Landsat	\$6,000	These funds replace working capital fund contributions that will be redirected in FY 2005 to replace lost Landsat revenue.

Program Decreases

(dollars in thousands)

Component	FY 2006 Program Change (\$000)	Page Reference
North Carolina Flood Mapping	-\$986	H - 44
Global Dust Monitoring Study	-\$247	I - 87
Coastal Erosion Studies	-\$1,248	I - 126
Minerals Research and Assessment Activities	-\$28,478	I - 141
Alaska Minerals Resource Assessment	-\$1,134	I - 141
Alaska Geologic Minerals Center	-\$98	I - 141
Energy and Environment Program	-\$500	I - 160
Roubidoux Aquifer	-\$1,460	J - 49
Study of Petroleum-Related Contamination	-\$227	J - 49
Berkeley Pit Lake	-\$195	J - 58
Potomac River Basin Ground-Water Study	-\$296	J - 58
Spokane Valley / Rathdrum Prairie Aquifer Study	-\$493	J - 59
Chesapeake Bay	-\$247	J - 59
Hood Canal Fish Mortality	-\$345	J - 59
San Pedro Partnership	-\$247	J - 59
Lake Champlain Monitoring	-\$291	J - 81
Monitoring Water in Hawaii	-\$437	J - 81
Tongue River Coalbed Methane	-\$877	J - 81
Water Resources Research Institutes Grants	-\$6,409	J - 99
Mark Twain National Forest Study	-\$731	K - 55
Pallid Sturgeon	-\$296	K - 55
Diamondback Terrapin	-\$195	K - 55
Bear DNA Sampling Study	-\$974	K - 55
Multidisciplinary Water Study	-\$292	K - 55
Molecular Biology Research	-\$779	K - 56
Manatee Research	-\$493	K - 56
Delaware River Basin Water Project	-\$247	K - 56
General BRM Reduction	-\$50	K - 55
Nebraska Cooperative Research Unit	-\$395	K - 83
Cooperative Research Unit General Reduction	-\$55	K - 84
Space Management	-\$1,471	N - 9
Fleet Management	-\$250	G - 26
Travel	-\$2,000	G - 27
Total	-\$52,443	

Mapping, Remote Sensing, and Geographic Investigations Cooperative Topographic Mapping Subactivity

North Carolina Flood Mapping -\$986,000

Reduction of a site-specific Congressional add-on for flood plain mapping in the State of North Carolina. In conjunction with USGS and other Federal agencies, the State of North Carolina has been gathering and coordinating up-to-date geospatial data over its lands.

Geologic Hazards, Resources, and Processes Geologic Landscape & Coastal Assessments Subactivity

Global Dust Monitoring Study -\$247,000

Earth Surface Dynamics — The decrease of -\$247,000 reduces an unrequested earmark. \$500,000 remains for studies documenting the micro-organisms and chemical contaminants associated with dust in source regions and areas of dust deposition in the United States and territories.

Coastal Erosion Study -\$1,248,000

Coastal and Marine Geology — The South Carolina Coastal Erosion study will be brought to completion with final year efforts exclusively focused on generation of final products by research staff within the USGS and cooperating agencies. No funding will be provided for field work by either the USGS or cooperators and efforts to develop and validate regional models synthesizing previously developed geological and oceanographic information will be eliminated. As a result one fewer analysis will be delivered in FY 2006 and one fewer workshop will be held.

Geologic Resource Assessments Subactivity

Minerals Research and Assessment Activities -\$28,478,000

Mineral Resources — The reduction will allow for implementation of higher priority projects within the USGS and the Department. The budget request provides MRP with \$25,084,000 in FY 2006. This amount will maintain the core capabilities of data gathering for 100 mineral commodities in the United States and research projects that provide information tailored for Federal land managers. The reduction will result in the elimination of 240 occupied positions.

- **Research and Assessment (-\$26,478,000)** — The reduction of \$26,478,000 in the Research and Assessments function of MRP will discontinue 38 projects including collection of comprehensive basic geologic, geochemical, geophysical, and mineral deposit data for the Nation; the USGS-led, internationally coordinated global mineral resource assessment to provide predictions of worldwide distribution of undiscovered deposits of critical metallic and non-metallic mineral commodities; research on

aggregates and industrial minerals; research on inorganic toxins, such as mercury, arsenic, and selenium; and the Mineral Resources External Research Grants Program. Coverage for the United States in geology, geochemistry, geophysics, and mineral deposit information will end and remain at 84 percent complete. USGS will delay delivery of analyses currently underway in Alaska and the Great Basin by 1-2 years and end 28 current projects, resulting in the non-delivery of 28 systematic analyses scheduled for delivery between 2006 and 2010. The reduction will result in the elimination of 220 occupied positions in nine locations across the United States.

- **Minerals Information (-\$2,000,000)** — The reduction of \$2,000,000 in the Minerals Information function of MRP will terminate data collection and analysis for 100 mineral commodities in 180 countries outside the United States. The reduction will eliminate approximately 20 mineral commodity reports each year, end efforts to convert mineral commodity canvass forms to electronic formats, and reduce 20 occupied positions. Employees occupying these positions have expertise in global production and consumption of mineral commodities.

Alaska Minerals Resource Assessment

-\$1,134,000

Mineral Resources — This is a reduction of an unrequested earmark that will bring to a close cooperative work with Alaska Division of Geologic and Geophysical Survey and academia to accelerate collection of basic geologic, geochemical, and geophysical data to encourage economic development in Alaska.

Alaska Geologic Minerals Center

-\$98,000

Mineral Resources — This is a reduction of an unrequested earmark that supports a State of Alaska facility that preserves cores, samples, maps, and descriptive materials relating to the energy and mineral resources within the State.

Energy and Environment Program

-\$500,000

Energy Resources — This activity does not address the highest priority science needs of the USGS and the Department. This decrease will reduce research on potential geologic sequestration options for carbon dioxide (a greenhouse gas emitted to the atmosphere during fossil fuel combustion) and will terminate the development of an assessment methodology for geologic sequestration of carbon dioxide. As a result, one fewer analysis on carbon sequestration will be delivered in FY 2006 and one fewer workshop will be held. The ERP will sustain efforts in CO₂ sequestration by serving in an advisory role to other Federal, State, and international groups. Although this reduction significantly reduces USGS geologic research for carbon sequestration, the USGS is conducting research on carbon sequestration under the Biological Research and Monitoring Program, which starts on page K - 15.

Program Changes

Water Resources Investigations Hydrologic Monitoring, Assessments and Research Subactivity

Roubidoux Aquifer **-\$1,460,000**

Toxic Substances Hydrology — This is a reduction of an unrequested earmark that will bring to a close a study with the University of Oklahoma to characterize the Tar Creek Superfund site in Oklahoma, including characterization of mine drainage discharges, characterization of waste pile and pond drainage runoff, assessment of in-stream contaminant loading, characterization of asphalt road runoff, assessment of surface water impacts, and air quality and meteorological monitoring.

Study of Petroleum-Related Contamination **-\$227,000**

Toxic Substances Hydrology — The USGS will end a study of petroleum-related contamination at Skiatook Lake in the southeastern part of the Osage Indian Reservation in northeastern Oklahoma. The decrease of -\$227,000 for the Skiatook Lake study will result in the loss of 1 systematic analyses and investigations in FY 2006, compared to the FY 2005 level. There is no change in FTE or other resources associated with either of the decreases described above.

Berkeley Pit Lake **-\$195,000**

Hydrologic Research and Development — A pass-through grant to Montana Tech at the University of Montana, for the study of extremophilic life at Berkeley Pit Lake. The University is conducting this work independently, without USGS oversight or collaboration.

Potomac River Basin Ground-Water Study **-\$296,000**

Hydrologic Research and Development — Funding of a joint effort with the Interstate Commission on the Potomac River Basin to study ground water in the Potomac River basin. Project funds to date have been used to install and operate ground-water monitoring wells, and to begin development of more detailed water supply simulation tools for two interstate watersheds in the basin where demand on water resources is increasing most rapidly.

Spokane Valley / Rathdrum Prairie Aquifer Study **-\$493,000**

Hydrologic Research and Development — A study with the States of Washington and Oregon of the Rathdrum Prairie / Spokane Valley aquifer system. The USGS would cease data collection and stop development of a flow model that would be used by water managers in Washington and Oregon.

Chesapeake Bay **-\$247,000**

Hydrologic Research and Development — A portion of the work in the Chesapeake Bay Program, which was augmented in FY 2005 by the addition of funds by the Congress, will stop. Work in the Chesapeake Bay that is part of the USGS long-term program planning, will continue through the interdisciplinary Priority Ecosystems Studies program, which is described in the Regional Activities section, which begins on page F - 1.

Hood Canal Fish Mortality **-\$345,000**

Hydrologic Research and Development — Research to help determine the causes of low dissolved oxygen levels and fish mortality study in Hood Canal, WA.

San Pedro Partnership **-\$247,000**

Hydrologic Research and Development — USGS participation in the interagency Upper San Pedro Partnership and the reporting requirements of P.L. 108-136, Section 321 will not be funded.

Lake Champlain Monitoring **-\$291,000**

Hydrologic Networks and Analysis — Expanded water-quality monitoring for mercury and other toxic substances in Lake Champlain.

Monitoring Water in Hawaii **-\$437,000**

Hydrologic Networks and Analysis — Expanded monitoring of water resources (especially ground water) in Hawaii, in cooperation with the State Department of Natural Resources.

Tongue River Coalbed Methane **-\$877,000**

Hydrologic Networks and Analysis — The USGS would stop the collection of hydrologic data that was begun in FY 2004 to document and establish a baseline for current conditions in the streams in the Tongue River watershed.

Program Changes

Water Resources Research Act Program Subactivity

Grants to the State Water Resources Research Institutes **-\$6,409,000**

The decrease eliminates USGS funding for each of the 54 State Water Resources Research Institutes. The decrease also eliminates USGS support for research projects under the national competitive grant program authorized by section 104 (g) of the Water Resources Research Act. This USGS support amounts to less than 6 percent of their total funding. Most of the Institutes have been very successful in generating funding from non-USGS sources and no longer need USGS funding to continue operating.

Biological Research

Biological Research and Monitoring Subactivity

General BRM Reduction **-\$50,000**

Of a \$247,000 general increase received in FY 2005, the USGS requests a decrease of \$50,000 to maintain higher priority funding elsewhere in the USGS.

Mark Twain National Forest Study **-\$731,000**

A study to determine potential impacts of lead mining in the Mark Twain National Forest in Missouri in cooperation with the USFS will end in FY 2005.

Pallid Sturgeon **-\$296,000**

The decrease would discontinue scientific investigations to locate and monitor pallid sturgeon in the Missouri River Basin and document their habitat relationships and requirements for all life stages for population growth.

Diamondback Terrapin **-\$195,000**

The budget discontinues funding to study the decline of diamondback terrapins in the Chesapeake Bay. The decrease would discontinue research on the Chesapeake Bay populations that is coordinated with the Maryland Department of Natural Resources and the University of Maryland Cooperative Research Unit.

Bear DNA Sampling Study **-\$974,000**

The proposed reduction would end an assessment of the grizzly bear population using genetic technology to identify species, sex, and individuals from DNA extracted from bear hair to address bear conservation issues.

Multidisciplinary Water Study **-\$292,000**

The proposed reduction would eliminate funds that would be used to study the quantity and quality of the Leetown Science Center's ground water supply.

Molecular Biology Research **-\$779,000**

The decrease reduces funding to conduct fishery genetics research projects along the Northeast and Mid-Atlantic coast, in the Great Lakes and Finger Lakes, and in northern Appalachia. These projects include systematics in support of percid and salmonid fisheries restoration, systematics of mussel (bivalve) species, and identification of disease agents.

Manatee Research **-\$493,000**

The budget reduces funding for research that addresses science needs identified by the FWS Manatee Recovery Team. The change being proposed would reduce efforts to develop improved methods of estimating manatee numbers using aerial surveys.

Delaware River Basin Water Project **-\$247,000**

The proposed reduction would stop current field work, discontinue modeling efforts to determine ecologically-based flow relationships for the Upper Delaware River main stem and tributaries, and eliminate development of a decision support system to analyze and interpret water management and reservoir operations alternatives.

Cooperative Research Units

Nebraska Cooperative Research Unit **-\$395,000**

In FY 2003, FY 2004, and FY 2005, Congress included funding for a new cooperative research unit in Nebraska. The reduction eliminates implementation of this Unit.

Cooperative Research Unit General Reduction **-\$55,000**

Of a \$247,000 general increase received in FY 2005, the USGS requests a decrease of \$55,000. This will keep the core program intact while allowing the USGS and the Department to make the best use of limited resources and ensure that the highest priority projects are funded.

Other Decreases

Space Management

-\$1,471,000

Annually Interior spends \$300 million to lease space from the General Services Administration and others. Because of the long-term commitment contained in most leases, savings from this initiative will accrue to a large degree in future years. The 2006 budget assumes initial savings of \$6.0 million.

Recognizing the potential for improved effectiveness and efficiency in the management of space in the long-term, Interior and its bureaus are undertaking reforms in space management. These reforms, which are part of its Asset Management Plan under E.O. 13327, include a more centrally controlled process to manage space, multiyear planning to consolidate dispersed space and co-locate to promote interagency collaboration, and adoption of more equitable allocations of space that adhere to security and safety and health standards. Long-term benefits are expected to result from Interior's space management reform, which will utilize best practices now in place. Multi-year plans will be used to focus on improved effectiveness and efficiency in supporting bureau missions and guide future lease arrangements and the use of owned space in order to maximize consolidation and co-location. By strategically analyzing and planning space management needs and opportunities, the Department will also be able to consider workforce changes such as telecommuting, information technology solutions, and other factors in making future arrangements for facilities.

The FY 2006 President's budget request for the USGS includes \$1,471,000 in space cost reduction. The proposed decrease supports the Department's efforts to reduce space costs across the bureaus through consolidations and increased management efforts. The reduction of the Mineral Resources Program includes a reduction of 240 FTE, and with the elimination of this many positions, the USGS will close offices in Spokane, WA; Reno, NV; Seattle, WA; Mounds View, MN; and Reston, VA.

In addition to the reduction in rental payments described above, the USGS is also undertaking facilities management actions intended to result in space cost savings over the long term. The USGS is reducing space utilization in several locations through consolidations of existing facilities and closure of unneeded space. Additionally, the USGS expects that its contract for a Strategic Facilities Master Plan and the assignment to the Investment Review Board of the review of all space-related actions, including lease renewals, will generate additional opportunities for reducing USGS space requirements over time. The USGS expects that actions taken during FY 2005 and FY 2006 will generate savings in FY 2006 from reduced space costs, with more significant savings beginning in FY 2007. Between program reductions and management actions regarding space management, the USGS expects to reduce space costs in FY 2006 by \$1,471,000.

Fleet Management

-\$250,000

In 2004, the Department began a collaborative initiative to improve fleet management, developed a strategic plan, and began to implement recommendations from a review of the program conducted by the Office of Inspector General. The initiative focuses on economic-based strategies, including implementation of life-cycle replacement schedules, disposal of underutilized vehicles and vehicles that have surpassed their lifecycle, use of fleet performance

measures, energy-saving practices and expanded use of alternate-fueled vehicles, and expanded leasing. The Departmentwide strategy for improved fleet management includes migrating fleet management programs to a more standardized operational model that promotes energy-saving technologies, the development of fleet composition baselines and multi-year plans, improved performance metrics that address efficiency and effectiveness, vehicle and motor pool sharing, and purchase and lease arrangements that consider seasonal workforces.

On an annual basis, Interior spends over \$160 million to operate and maintain its fleet of approximately 31,000 vehicles. Interior's improvement plan provides a goal for reduction to fleet expenditures of \$11 million in 2005 and an additional \$2 million in 2006.

The USGS has developed reports for our vehicle utilization data collection system; these reports will give local managers and the bureau fleet manager the information needed to identify under-utilized vehicles and opportunities to share vehicles and (or) dispose of vehicles no longer fully utilized. To facilitate improved utilization of vehicles, a Web page bulletin board for USGS excess vehicles is under development. Procedures for implementing GSA AutoChoice have been developed, and all vehicle orders will be processed electronically as of October 1, 2004. Information on strategies to reduce the fleet is being developed and will be issued to all offices. Development is underway of realistic and specific goals for fleet fuel efficiency, or other performance indicators depending on how a given vehicle is used; field offices will be required to meet these goals. Field offices must identify opportunities to share vehicles across discipline lines and bureau lines wherever possible, and to reduce the number of trips taken and miles driven to the lowest number possible without adversely affecting mission-critical programs. Efforts are ongoing to replace our older fleet (50 percent of our current fleet is at least 10 years old and 80 percent of the fleet is at least 5 years old) with more fuel-efficient vehicles. Vehicle justifications will be required for new vehicles and cost center managers must ensure that they order the smallest, most fuel-efficient vehicle they can that will still meet the mission requirement.

Travel

-\$2,000,000

The USGS will continue to enhance the use of available telecommunications technology across the bureau to reduce its reliance on travel to accomplish its mission in 2006. This includes an increased reliance on telemetry for near-real-time transmissions at seismographic stations and streamgages, video-conferencing, cyber-seminars, and telephone bridges. The USGS will also continue to consolidate meetings when possible, monitor conference planning and attendance, use local training sites when possible, and fund customer-related travel reimbursably when feasible. The Survey anticipates saving \$2.0 million in travel costs in 2006 through these mechanisms.

Travel is an essential tool used by the majority of the Survey's programs to assist them in accomplishing their work goals. Therefore, the reduction will be shown in every end outcome goal that the USGS is a part of in the DOI Strategic Plan. The travel reduction has been distributed to all programs in the Survey, based on the relative proportion of the programs' individual travel expenditures to the overall bureau travel expenditures.

Program Changes

**FY 2006 Program Decreases by DOI Goal
(\$000)**

Resource Protection

End Outcome Goal: PEO.1. – Improve health of watersheds, landscapes, and marine resources that are DOI managed or influenced in a manner consistent with the obligations regarding the allocation and use of water.			
Biological Research, Biological Research and Monitoring	Mark Twain National Forest Study	-\$731	-4 systematic analyses/investigations delivered to customers in FY 2008

End Outcome Goal: PEO.2. – Sustain biological communities on DOI managed or influenced lands and waters in a manner consistent with the obligations regarding the allocation and use of water.			
Biological Research, Biological Research and Monitoring	Molecular Biological Research	-\$779	-4 systematic analyses/investigations delivered to customers in FY 2008
Biological Research, Biological Research and Monitoring	Pallid Sturgeon	-\$296	-2 systematic analyses/investigations delivered to customers in FY 2008
Biological Research, Biological Research and Monitoring	Diamondback Terrapin	-\$195	-1 systematic analyses/investigation delivered to customers in FY 2008
Biological Research, Biological Research and Monitoring	Bear DNA Sampling	-\$974	-5 systematic analyses/investigations delivered to customers in FY 2008
Biological Research, Biological Research and Monitoring	Multidisciplinary Water Study	-\$292	-1 systematic analyses/investigation delivered to customers in FY 2008
Biological Research, Biological Research and Monitoring	Manatee Research	-\$493	-2 systematic analyses/investigations delivered to customers in FY 2008
Biological Research, Biological Research and Monitoring	Delaware River Basin Water Project	-\$247	-1 systematic analyses/investigation delivered to customers in FY 2008
Biological Research, Biological Research and Monitoring	Biological Research and Monitoring	-\$50	--
Biological Research, Cooperative Research Units	Nebraska Coop Research Unit	-\$395	--
Biological Research, Cooperative Research Units	Biological Research and Monitoring	-\$55	--

Resource Use

End Outcome Goal: UEO.1. – Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value - Energy			
Geologic Resource Assessments, Energy Resources	Energy & Environment Program	-\$500	-1 systematic analyses/investigations delivered to customers -1 formal workshop or training provided to customers (instances/issues/events)

End Outcome Goal: UEO.1. – Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value – Non-Energy Minerals			
Geologic Resource Assessments, Mineral Resources	Minerals Research & Assessment Activities	-\$26,478	-20 mineral commodity reports available for decisions -1 systematic analyses/investigation delivered to customers
Geologic Resource Assessments, Mineral Resources	Minerals Research and Assessment Activities (Minerals Information)	-\$2,000	-6 formal workshop or training provided to customers (instances/issues/events) +7.22M Average cost of a systematic analyses/investigation -28% of customers satisfied with timeliness of data -44% of customers for which minerals data meets their needs
Geologic Resource Assessments, Mineral Resources	Alaska Minerals Resource Assessment	-\$1,134	--
Geologic Resource Assessments, Mineral Resources	Alaska Geologic Minerals Center	-\$98	--

Program Changes

Serving Communities

End Outcome Goal: SEO.2. – Advance knowledge through scientific leadership and inform decisions through the application of science.			
Mapping, Remote Sensing, and Geographic Investigations, Cooperative Topographic Mapping	North Carolina Flood Mapping	-\$986	-1 partnership for <i>The National Map</i> built with State and local governments that collect and maintain higher resolution, more current data (PART)
Geologic Landscape & Coastal Assessments, Earth Surface Dynamics	Global Dust Monitoring Study	-\$247	--
Geologic Landscape & Coastal Assessments, Coastal and Marine Geology	Coastal Erosion Studies	-\$1,248	-1 systematic analyses/investigation delivered to customers -1 formal workshop or training provided to customers (instances/issues/events)
Water Resources Investigations, Toxic Substance Hydrology	Study of Petroleum-Related Contamination	-\$227	-1 systematic analyses/investigation delivered to customers
Water Resources Investigations, Toxic Substance Hydrology	Roubidoux Aquifer	-\$1,460	--
Water Resources Investigations, Hydrologic Research & Development	Berkeley Pit Lake	-\$195	--
Water Resources Investigations, Hydrologic Research & Development	Potomac River Basin Ground-Water Study	-\$296	--
Water Resources Investigations, Hydrologic Research & Development	Spokane Valley/Rathdrum Prairie Aquifer Study	-\$493	--
Water Resources Investigations, Hydrologic Research & Development	Chesapeake Bay	-\$247	--
Water Resources Investigations, Hydrologic Research & Development	Hood Canal Fish Mortality	-\$345	--
Water Resources Investigations, Hydrologic Research & Development	San Pedro Partnership	-\$247	--
Water Resources Investigations, Hydrologic Networks and Analysis	Lake Champlain Monitoring	-\$291	--
Water Resources Investigations, Hydrologic Networks and Analysis	Monitoring Water in Hawaii	-\$437	--
Water Resources Investigations, Hydrologic Networks and Analysis	Tongue River Coalbed Methane	-\$877	--
Water Resources Investigations, Water Resources Research Act Program	Water Resources Research Institutes Grants	-\$6,409	--

Mapping, Remote Sensing, and Geographic Investigations

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Cooperative Topographic Mapping	80,843	71,393	+1,560	-1,071	71,882	+489
FTE	607	528	0	0	528	0
Land Remote Sensing	33,678	32,730	+259	+13,407	46,396	+13,666
FTE	108	102	0	2	104	+2
Geographic Analysis and Monitoring	15,238	14,628	+325	+222	15,175	+547
FTE	107	107	0	+1	108	+1
Total Requirements \$000	129,759	118,751	+2,144	+12,558	133,453	+14,702
FTE ^{b/}	822	736	0	+3	739	+3

a/ Changes for this activity include a reduction of -\$152 for travel and -\$4 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

b/ FTE may not add to total, due to rounding.

Activity Summary

Introduction

The FY 2006 budget requests \$133,453,000 for the Mapping, Remote Sensing, and Geographic Investigations Activity reflecting program increases totaling \$13.7 million. Additional information on program changes is provided in each subactivity of this document.

The Mapping, Remote Sensing, and Geographic Investigations Activity will transition into two unique activities, the National Geospatial Programs Office and Geographic Research. This will enable the USGS to strengthen geographic research and consolidate its geospatial activities. As a part of the USGS National Geospatial Programs Office, the Cooperative Topographic Mapping program will continue efforts to improve the Nation's geospatial databases and their access, integration, and applications through implementation of *The National Map*, a network of integrated, high quality geospatial information covering all 50 States and Commonwealths, Territories, and Freely Associated States. Partnerships with other Federal, State, and local agencies, the private sector, and academia are the keystone for accomplishing this mission. The Geographic Research Program comprises the Land Remote Sensing (LRS) Subactivity, Geographic Analysis and Monitoring (GAM) Subactivity, and Science Impact program focused on providing scientific information to describe and interpret America's landscape by mapping the Nation's terrain, monitoring changes over time, and

Use of Cost and Performance Information

- Workforce restructure – After a workforce analysis in FY 2003, a buyout/early out was offered in FY 2004; this action resulted in reducing FTEs by 160 and saving nearly \$10 million in labor costs in FY 2005. This buyout authority has been extended into FY 2005, which may result in anticipated savings of about \$1 to \$2 million that would be available for partnering.
- PART findings – A cost-efficiency was achieved in FY 2004 such that 40 percent of total costs were saved in Federal dollars through partnering for data collection of high resolution imagery.

Mapping, Remote Sensing, and Geographic Investigations

analyzing how and why these changes have occurred. The knowledge gained through these activities is used to model the changes occurring across the Nation's land and to forecast future changes.

Implementation of *The National Map* within the **Cooperative Topographic Mapping (CTM) program** is underway and focused on providing geospatial data and information using current technologies. The major goals of the program are to: (1) improve the value of the geospatial data available to natural resources decisionmakers and the public by building *The National Map* through partnerships with Federal, State, and local governments that collect and maintain higher resolution, more current data, (2) ensure the availability, currentness, and archive of nationally consistent and integrated geospatial data across the country, and (3) lead the development and promote the use of international, national, and Federal Geographic Data Committee National Spatial Data Infrastructure standards among *The National Map* partners.

Most of the critical eight data themes (orthoimagery, elevation, hydrography, land cover, transportation, man-made structures, boundaries, and geographic names) are now available. Prototypes for the rest are being implemented. Geospatial data models and applications are being built from the higher resolution data sets. Availability of *The National Map* allows the USGS science programs and those of other Federal agencies to concentrate on producing information unique to their mission needs and to avoid expending resources to duplicate, develop, and integrate basic spatial data each time they are needed.

The **Land Remote Sensing (LRS) program** acquires, archives, disseminates, and promotes the application of remotely sensed data of the Earth's land surface. The program operates the Earth-observing satellites (Landsats 5 and 7) and acquires additional data through a multimission ground station. The LRS program procures commercial data from both aircraft and spacecraft operators and maintains a robust data archive at the USGS EROS Center in Sioux Falls, SD. Data from this archive are distributed to Business Partner retailers and customers. The LRS program manages the National Civil Applications Program, including the Global Fiducials Library, rapid exploitation applications, and source management for classified and unclassified data. It also promotes the application of remotely sensed information and advances the state of remote sensing technology. Data acquired and managed by the LRS program are vital to applications such as support for national defense; global agricultural crop monitoring; monitoring and assessing the impacts of natural disasters; aiding in the management of water, biological, energy, and mineral resources; and analyzing the impacts of climatic and other global changes.

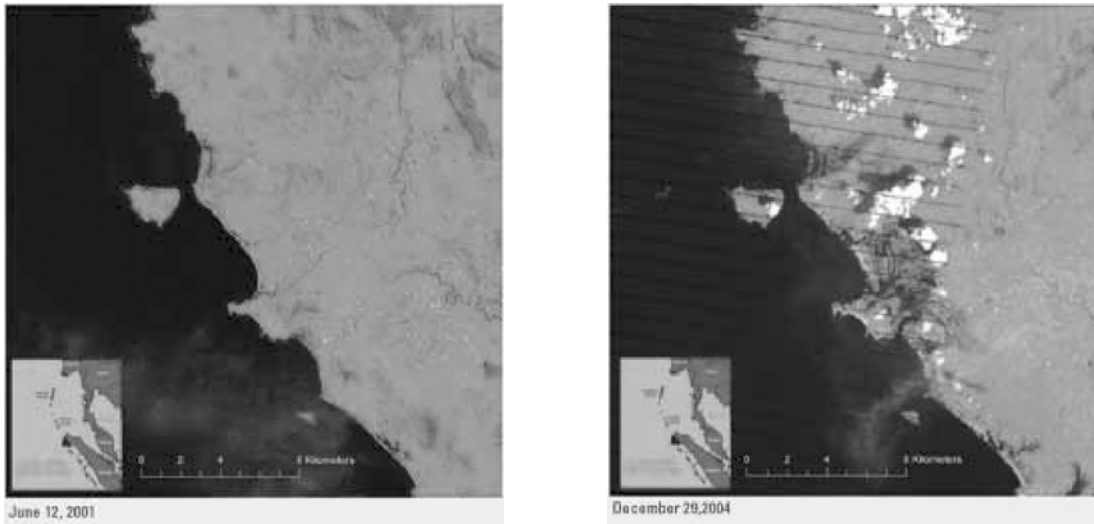
The **Geographic Analysis and Monitoring (GAM) program** provides the analysis and applications needed to address natural and human-induced changes on the landscape. Activities conducted in this program include producing a series of Status and Trends reports documenting a national assessment of land surface change, global change research, ecosystems research, and land cover applications. The **Science Impact program**, part of GAM activities, is a nascent, cross-discipline effort to increase the use and value of USGS science in informing decisionmaking at DOI, at other Federal, State, and local agencies, and by citizens. The effort encompasses developing, testing, evaluating, and applying improved methods and processes to enhance linkages between science and decision-making.

Together, these programs directly support the President's Management Agenda and priorities of the Secretary of the Interior for: (1) science-based decisionmaking, by making available to scientists and the public accurate and reliable base geospatial data and information produced through partnerships with organizations in every sector, and (2) electronic government, by

simplifying and enhancing the delivery of geospatial data, information, and tools to citizens. They also support the FY 2003 – FY 2008 Department of the Interior (DOI) Strategic Plan's mission theme of Serving Communities and outcome goal of advancing knowledge through scientific leadership and informing decisions through the application of science. Serving geospatial data to all of the Nation's communities is a vital and fundamental role for the programs and *The National Map*, and is consistent with the National Research Council's 2003 review that "events such as the September 11, 2001, terrorist attacks and recent natural disasters have shown that current information can save lives and protect public and private property. The demand is great for up-to-date information in real time for public welfare and safety." (See *Weaving A National Map: Review of the U.S. Geological Survey Concept of The National Map*, National Research Council, 2003, 128 p.) The DOI Strategic Plan echoes this important role: "Whether we are dealing with issues concerning resource protection, resource use, recreation, or serving communities, the relevance of our scientific information to the needs of society is recognized and valued by our customers, stakeholders, and partners."

National Center for Earth Resources Observation and Science (EROS) — In August 2004, the Director established the EROS Data Center as a "national capability" of the USGS. Formerly known as the Earth Resources Observation Systems Data Center, the Center will rededicate its resources and capabilities to become the National Center for Earth Resources Observation and Science (EROS). As the research facility for remotely sensed data and other forms of geographic information, EROS provides national satellite data reception, processing, archiving, and product distribution. It holds the world's largest collection of civilian remotely sensed data covering the Earth's land surface, archiving millions of satellite images and aerial photographs. This archive, co-located with its attendant engineering and scientific expertise, provides a unique capability for developing and promoting science applications of remotely sensed data to identify, monitor, and understand changes on the landscape and across the interface between nature and society. As a national capability, EROS will focus on the development and implementation of remote-sensing-based terrestrial monitoring capabilities to address national and international science and land management issues of concern to the Department of the Interior, other Federal agencies, and the public.

Before and After Landsat Imagery of the Northwest Sumatra Coast



The National Map Hazards Data Distribution System (HDDS)/Asian Tsunami – The USGS is playing a vital role through its National Center for Earth Resources Observation and Science (EROS) in relief efforts to nations impacted by the Asian tsunami disaster of December 26, 2004. Within hours after the disaster occurred, EROS began providing relief organizations worldwide with pre- and post-tsunami satellite images, as well as image-derived products that incorporate information on population density, elevation, and other relevant topics. These images and image-derived products are being used by relief organizations to make practical, well-informed decisions as to where relief efforts are most urgently needed and how best to carry out those efforts.

OMB PART Review — In FY 2004, the OMB Program Assessment Rating Tool (PART) for the FY 2006 Budget was re-applied to the Geography Program. OMB classified the Geography Program as a research and development program, scoring it at 90 percent overall: 100 percent for programmatic purpose and design, 100 percent for strategic planning, 100 percent for program management, and 80 percent for program results/accountability. Overall, OMB rated the Geography Program as "effective." The USGS is further increasing its effectiveness by pursuing partnerships with other DOI bureaus to improve the use of imagery collected through the Land Remote Sensing subactivity. The score for the program is greatly improved from that assigned for the FY 2004 Budget when the program was characterized as "results not demonstrated."

Geographic Research Program and the National Geospatial Information Office Reorganization — In August 2004 USGS Director Groat announced a reorganization to consolidate and strengthen USGS leadership in geospatial programs and strengthen geographic research. Activities funded through the Cooperative Topographic Mapping program (such as *The National Map* and *The National Atlas of the United States®*) are consolidated with USGS activities that support the Federal Geographic Data Committee, Geospatial One-Stop electronic government initiative, and the Department of the Interior's Enterprise Geospatial Information Management project to form a National Geospatial Programs Office managed by the Associate Director for Geospatial Information.

The new Geographic Research Program, managed by the Associate Director for Geography, will focus on geographic research. It includes Land Remote Sensing, Geographic Analysis and

Monitoring, and Science Impact programs. The redesignated National Center for Earth Resources Observation and Science (formerly the Earth Resources Observation Systems (EROS) Data Center) concentrates on extending the use of remote sensing and geographic information science beyond the Geography Discipline. The Center supports all USGS Programs with its unique land remote-sensing archive and engineering and scientific expertise. The Center will expand and enhance the use of remote sensing as a tool for Earth and biological sciences, ensuring that monitoring efforts enable integrated science at regional and national scales. It will also provide a variety of remote-sensing education and training opportunities. It also applies remote sensing technologies to help address science and land management issues facing other bureaus at the Department of the Interior, other Federal agencies, international organizations, and the public.

FY 2005 Congressional Directives — In the FY 2005 conference Committee report language for the USGS, the Committee managers expressed concern regarding funding and future of the Landsat Program. The FY 2006 budget request for the USGS responds to these concerns by requesting an increase of \$6 million to continue satellite operations for Landsat 7 and \$8.2 million for the Landsat Data Continuity Mission to ensure a collection of consistently calibrated imagery of the Earth's land mass. The USGS continues to monitor product sales for Landsat 7 data and will provide the Committee with quarterly reports to display Landsat operations costs, revenues, and funds required to supplement as requested in Senate report language (S. Rpt. 108-341). The USGS EROS Center has been working to develop new products by using software to generate a "gap-filled" product that combines multiple Landsat 7 scenes visually creating a pre-anomaly improved image.

The USGS is also continuing efforts to develop a new generation of orthoimagery and elevation data for the National Petroleum Reserve in Alaska.

Federal Role

Land managers, policymakers and decisionmakers, researchers, and the public depend on a common set of current, accurate, and consistent base geographic information that describes the Earth's land surface and its dynamics. The USGS has the mission responsibility to meet this need.

In the 21st Century, several factors provide an opportunity for the USGS to accomplish its mission to provide current and consistent geospatial data for the Nation in a new way. These factors include increased demand for more current and accurate geographic data; new technologies and lower costs to collect, maintain, and disseminate data; and partnership opportunities with Federal, State, and local agencies, and the private sector. Through *The National Map*, the USGS Cooperative Topographic Mapping program is taking advantage of this opportunity by organizing sustainable partnerships to develop, integrate, access, and archive map information. Roles for the USGS are (1) guarantor of national data completeness, consistency, and accuracy, (2) catalyst and collaborator for creating and sustaining partnerships, (3) integrator and certifier of data from participants, (4) owner and data producer when no other sources for needed data exist, and (5) leader in the development of geospatial data standards.

The Geography Discipline is reorganizing its activities to focus on fundamental geographic research. A strong Geography Discipline with a productive research component will ensure recognition of the USGS as scientifically credible, objective, and relevant to society's needs. The GAM, LRS, and Science Impact (SI) programs will become the centerpieces of USGS

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geography research and applications. Geography will continue to provide leadership for U.S. land remote sensing activities in natural science data acquisition, preservation, and application and maintaining natural resource data archives; be the leader in Federal civil agencies in the access, management, exploitation, and dissemination of information derived from U.S. classified remote sensing assets; and provide new understanding of land cover change and other Earth surface processes for use by land managers in the public and private sectors.

Customers and Partners

Ensuring public access to remotely sensed and other geospatial data is an important aspect of the USGS mission. To maximize public access to these data, enhance the understanding of the science of remote sensing, and encourage development of remote sensing curricula, the USGS has entered into an agreement with *AmericaView*, a national group of State university consortia and other institutions that are seeking improved, affordable access to land remotely sensed data for research, education, and other applications. *AmericaView* is the outgrowth of the successful *OhioView* pilot project, initiated as a prototype for high-speed processing and rapid delivery of remotely sensed data to State and local users. Under the original project, the State of Ohio purchased and received all of the Landsat 7 images acquired over that State within 36 hours of the time the data were collected at the USGS-operated receiving station. In turn, through an in-State consortium of research universities and computer facilities, the data were made publicly available through digital library facilities. Today, researchers, educators, students, land managers, and the general public increasingly have local access to Landsat images of Ohio and other USGS geospatial data sets at no cost, with no restrictions on further use.

The National Map is built by ongoing cooperative partnerships between the USGS and many public and private sector organizations. By doing so, it helps DOI both leverage its resources and achieve the DOI Strategic Plan's science and partnership goals, especially in strengthening ties to Federal, State, and local governments and facilitating the use of scientific information by citizens. *The National Map* data framework is enabling government agencies, private industry, and the public to link additional data to form the Nation's geospatial data infrastructure. Geographic data being developed through *The National Map* are being used by other Federal agencies such as DOI bureaus, the Department of Homeland Security, the Federal Emergency Management Agency (FEMA), the Environmental Protection Agency, the U.S. Census Bureau, the Department of Defense (DoD), and others to support analysis and applications in carrying out their mission responsibilities. Many State and local governments produce, at considerable expense, base geographic data for a variety of applications, including land use planning, emergency preparedness and response, and natural resource management. By working with these partners, the USGS aims to provide the Nation with access to current, accurate, and nationally consistent digital geospatial data and maps derived from these data. Federal, State, and local data are usually collected for mission specific purposes and to meet local requirements. These data vary widely in terms of how or whether they are kept current, how often they are revised, and whether they are collected using nationally consistent standards.

Additional Information

Emergency Response Coordination — The USGS coordinated with the DoD to provide USGS data and applications support for homeland security and homeland defense missions at the U.S. Northern Command (NORTHCOM). In addition, the USGS and the Civil Applications Committee (chaired by USGS) collaborated with NORTHCOM to co-sponsor and jointly lead the

efforts of three interagency groups established to address policy issues, information needs, and technology solutions related to NORTHCOM Homeland Security and Military Assistance to Civil Authorities missions. The USGS provided personnel support to the Office of the Chief Information Officer of the Department of Homeland Security (DHS) to lead the development of the proposed DHS Geospatial Management Office; and provided additional personnel support to the DHS Geospatial Enterprise Architecture Task Force to integrate the development of *The National Map* with the DHS enterprise architecture. In addition, the USGS provided scientific cross-discipline data and analytical support to a broad spectrum of civil, law enforcement, DoD, and intelligence community customers to support emergency planning and response, homeland security, and homeland defense activities.

National Spatial Data Infrastructure (NSDI) — *The National Map* operates within the national policy context of the National Spatial Data Infrastructure (NSDI) and takes advantage of capabilities offered by the Geospatial One-Stop electronic government initiative. The NSDI is defined as the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve the use of geospatial data. Under OMB Circular A-16, the Federal Geographic Data Committee leads and supports the NSDI strategy and spatial data policy development. Geospatial One-Stop is an electronic government initiative sponsored by OMB to enhance government efficiency and improve citizen service through easier, faster, and less expensive access to geospatial information for all levels of government and the public. *The National Map* provides trusted, integrated, seamless, and continually maintained geospatial base data and archives, along with related models and applications.

In summary, the relationship among the NSDI, the Federal Geographic Data Committee, Geospatial One-Stop, and *The National Map* is:

- NSDI is a concept defined as including all aspects of geospatial data.
- The Federal Geographic Data Committee is an interagency committee charged with coordinating the development of the NSDI.
- Geospatial One-Stop is a communications portal for all kinds of geospatial information content and related information.
- *The National Map* is the means through which USGS carries out its mission of providing current and consistent basic geospatial information content in the form of data and applications.

The USGS applies NSDI principles in partnerships to coordinate the maintenance of and access to eight data layers. It provides access to these data, and other USGS scientific data that have a spatial component, through Geospatial One-Stop. Geospatial One-Stop relies on *The National Map* to provide underlying base geographic data for all other data provided through the initiative.

National Civil Applications Program (NCAP) and Civil Applications Committee (CAC) — The activities conducted through the NCAP and CAC are funded separately at a level of \$8.5 million and \$0.65 million, respectively. The NCAP is managed within the Land Remote Sensing Program (LRS), and funding for the program is split equally between the Cooperative Topographic Mapping and LRS Programs. The Civil Applications Committee (CAC) Secretariat, chaired by the USGS Director, is a headquarters function. The NCAP facilities, information technology, and staff support the CAC. By order of the President, the CAC was first chartered

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in 1975 under the signatures of the National Security Advisor to the President, Director of Central Intelligence, Director of the Office of Management and Budget, and Secretary of the Interior to coordinate and assist civil Federal agencies' use of classified collections, including many applications central to civil Federal agency missions.

The NCAP provides the Federal civil community with access to and use of the Nation's classified assets including source collection and management, data exploitation, product generation, and archiving. The USGS has a network of distributed secure facilities to support the complex infrastructure of information technology (hardware, software, networks, etc.) necessary to enable the civil use of classified systems and capabilities. Through this infrastructure the NCAP serves as the focal point for the civil community to gain access to the significant resources the Intelligence Community has dedicated in areas such as technology transfer and awareness of advanced image processing and analysis techniques, sensor research, and applications research. The NCAP is committed to a proactive and relevant role in addressing the USGS mission-related requirements associated with Federal lands management, natural hazards research, and emergency planning and response activities.

During FY 2005 the CAC will evaluate emerging and ongoing policy issues related to the use of classified data and national systems in support of civil agencies. The USGS will continue to upgrade the infrastructure required to transfer imagery-derived products, classified data, and products to serve USGS and other CAC member agencies. These upgrades are necessary to meet the standards required by the next generation of classified systems architecture being implemented by the intelligence community. In addition, NCAP continues to operate and expand the holdings of the Global Fiducials Library in support of civilian agencies' needs for classified data covering environmentally sensitive national and international sites.

Funding, Strategic Goals, and Performance Data

All funding for the Mapping, Remote Sensing and Geographic Investigations Activity addresses the DOI Strategic Plan's Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science.

FY 2003 and prior year performance and targets capture the metrics from the prior GPRA Strategic and Annual Plans (largely in outputs) and where possible, prior year performance actuals were also derived for the new metrics. "SP" coded measures relate to specific measures in the DOI Strategic Plan and contribute to the aggregate bureau outcome as shown in the General Statement and the aggregate DOI outcome in the Department's unified plan. Outputs are only included in bureau plans.

The USGS customer satisfaction metrics are developed on the basis of information collected in an ongoing series of customer satisfaction/outcome surveys. Each survey collects information on satisfaction with various aspects of one specific USGS science product. Information is collected from a random sample of the customers of that specific product. The satisfaction ratings for the individual products are extracted or combined to create the cited customer satisfaction metrics. The individual satisfaction ratings used to create the metrics are replaced on a 3-year cycle. The metrics for any two consecutive fiscal years, therefore, have about two-thirds of the specific science products in common on average. This has the effect of making the data series more stable than if all products were replaced each year. It also makes the metrics more closely aligned with USGS science products as a whole, since it approximately triples the number of specific products included in each metric.

2004 Revised Final Plan Compared to 2004 Actual

The Geography Discipline has successfully achieved its planned performance measure targets for FY 2004 within a 5 percent variance with the following exceptions:

- A decrease in the percent of the Nation's surface for which hydrography, elevation, and orthoimagery data are available through the National Spatial Data Infrastructure Clearinghouse and supported through partnerships. This decline of 6 percent resulted from staff taking the buyout.
- An additional 17 partnerships were established with State and local governments resulting from a changed emphasis to create more but smaller projects to encourage broader participation in *The National Map*.
- A total cost savings of 71 percent was achieved through partnering for data collection of high resolution imagery. The USGS was more successful than anticipated in partnering with local governments, resulting in a 31 percent increase over plan.

2005 Revised Final Plan Compared to 2004 Actual

- For percent of the Nation's coverage for high resolution geospatial data, the accelerated rate of increase of 13 percent was due to the emphasis on obtaining first-time coverage of high resolution orthoimagery over urban areas.
- For Partnerships with State and local government, the decline of 3 is the result of absorbing uncontrollable costs that are not fully funded in the budget.
- For systematic analyses and investigations, the decrease of one research publication is due to an expected decline in the number of research publications expected to be delivered in 2005.
- For geospatial data layers available through the NSDI Clearinghouse, the high rate of geospatial data ingested in FY 2004 and 2005, and the large increase in gigabytes managed is due to the one-time increase in capacity for providing online seamless access to orthoimagery for urban areas and the Nation.
- For cost savings due to partnering for data collection of high resolution imagery, the amounts are expected to decline due to an unusually high volume of cost-sharing partnerships USGS brokered in FY 2004. The increase is due to a one-time supplemental funding received by a partner Federal agency and thus is unique to 2004.

2005 Plan Compared to 2005 Revised Final Plan

- For Partnerships with State and local governments, the additional partnership reflects a Congressional earmark for flood mapping with the State of North Carolina.

2006 Plan Compared to 2005 Revised Final Plan

- For percent of coverage for medium resolution geospatial data, the accelerating rate is due to the first-time ingestion of data for transportation (roads) and boundaries from the Bureau of the Census.

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- For partnerships with State and local governments, the decline of one partnership reflects the decrease of the Congressional earmark for flood mapping in North Carolina.
- Percent of ground system designed, built and tested reflects LDCM system development activities to ensure capabilities are in place to ingest, archive, process, and distribute data.
- For partnerships formed for decisionmaking organizations, a new science impact project will focus on ways that science can better inform decisionmaking relating to western water issues.
- The USGS is increasing its cooperation with the Department of Agriculture's Farm Service Agency (FSA) in western States where the agencies' technical needs coincide. In this effort to coordinate data acquisition, USGS will fund acquisition of imagery over Interior and other Federal lands (except those of the U.S. Forest Service (USFS)) and the FSA will concentrate on agricultural lands. Joint measures have been developed starting in FY 2006 for the percent of area (of 11 western States) for which orthoimagery has been acquired and the percent of total cost saved through partnering.
- For geospatial data layers available through the NSDI Clearinghouse and the collection and management of geospatial data and databases, the rate of geospatial data ingested is projected to drop precipitously due to the end of the one-time increase in capacity for providing online seamless access to orthoimagery for urban areas and the Nation. The rate is projected to resume its previous rate of 28,000 gigabytes in the out years.

2003 to 2006 Performance Summary

Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD = Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Serving Communities Goal:

End Outcome Goal: Advance knowledge through scientific leadership and inform decisions through the application of science.							
End Outcome Measures	FY 2003 Actual	FY 2004 Actual	FY 2005 Plan/Budget	FY 2005 Revised Final Plan	FY 2006 Plan	Change in Performance FY 2005 to Planned FY 2006	Long-term Target (FY 2008)
<i>Research: Soundness of methodology, accuracy, and reliability science (program evaluation) (SP)</i>	100%	100%	100%	100%	100%	0	100%
<i>Inform decisions through the application of science: Improved access to needed science information (# score) (SP)</i>	80%	92%	90%	90%	90%	0	90%
<i>Inform decisions through the application of science: Stakeholders reporting that information helped achieve goal (# score) (SP)</i>	80%	94%	90%	90%	90%	0	90%
Intermediate Outcome: Improve information base, information management and technical assistance							
<i>Content and expanse of knowledge base: % of land with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (SP) (satellite data collected over global land surface)</i>	UNK	100%	100%	100%	100%	0	100%

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<p><i>Content and expanse of knowledge base: % of land with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements</i> (SP) (Land Cover assessment of 2001 Nat'l Land Cover data set – 66 mapping units across the country; GAM) (PART)</p>	17%	45%	60%	60%	75%	+15%	100%
<p><i>Content and expanse of knowledge base: % of land with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements</i> (SP) (Number of completed eco-region assessments out of a total of 84 eco-regions) (PART)</p>	18%	31%	38%	38%	48%	+10%	100%
<p><i>Content and expanse of knowledge base: average % of coverage for 6 data themes (orthoimagery, hydrography, elevation, landcover, transportation, & boundaries) in <i>The National Map</i> in national databases at medium resolution; does not measure currentness</i> (SP) (PART)</p>	67%	67%	70%	70%	78%	+8%	92%
<p><i>Content and expanse of knowledge base: average % of coverage for 7 data themes (orthoimagery, hydrography, elevation, landcover, transportation, boundaries & structures) in <i>The National Map</i> in national databases at high resolution; does not measure currentness</i> (SP) (PART)</p>	33%	41%	54%	54%	62%	+8%	78%

Activity Summary

<i>Content and expanse of knowledge base: % of data accessible: % of satellite data available from archive within 24 hrs. of capture (BUR) (PART)</i>	95%	90%	90%	90%	90%	0	90%
<i>Quality: X% of studies validated through appropriate peer review or independent review (SP)</i>	100%	100%	100%	100%	100%	0	100%
<i>Access: For information products surveyed X% of mapping, water, and biology customers are satisfied with ease, timeliness of access (BUR)</i>	92%	90%	≥80%	≥80%	≥80%	0	≥80%
PART Efficiency Measures or other Outputs	FY 2003 Actual	FY 2004 Actual	FY 2005 Plan/Budget	FY 2005 Revised Final Plan	FY 2006 Plan	Change in Performance FY 2005 to Planned FY 2006	Long-term Target (FY 2008)
# of systematic analyses and investigations delivered to customers (PART)	97	98	78	78	77	-1	87
# of formal workshops/training provided to customers	16	20	21	21	23	+2	29
LDCM: % of ground system designed, built, and tested	UNK	UNK	UNK	UNK	11%	+11%	73%
# of partnerships formed with decisionmaking organizations (Science Impact/GAM)	UNK	UNK	3	3	4	+1	5
# of mapping nodes (publicly available Web mapping services available through <i>The National Map</i>)	50	90	140	140	155	+15	250
# of partnerships for <i>The National Map</i> (TNM) built with State and local governments that collect and maintain higher resolution, more current data (PART)	10 new partnerships	30 new partnerships	27 new partnerships	28 new partnerships	27 new partnerships	-1	27
# of data standards used in implementing <i>The National Map</i> (TNM) (PART)	17	17	22	22	22	0	22

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% of the Nation's surface for which hydrography, elevation, and orthoimagery data are available through the National Spatial Data Infrastructure Clearinghouse (NSDI) and supported through partnerships (PART)	41%	64%	83%	83%	87%	+4%	93%
% of total cost saved through partnering for data collection of high resolution imagery (PART)	UNK	71%	42%	42%	44%	+2%	50%
% of the area of 11 Western States for which orthoimagery has been acquired through a Farm Service Agency (FSA)/USGS partnership with other entities to achieve a 5-yr cycle for 1-meter Nat'l Agricultural Imagery Program (NAIP) imagery	UNK	UNK	UNK	Baseline	36%	+36%	56% (none flow in FY 2008)
% of total cost FSA and USGS saved through partnering with other entities for imagery acquisition of 1-meter NAIP orthoimagery	UNK	UNK	UNK	Baseline	40%	+40%	UNK (no Western States flow in FY 2008)
# of terabytes of data collected annually (satellite data)	UNK	527.2	527.5	527.5	534.0	+6.5	589.0
Cumulative # of terabytes of data managed (satellite data)	1,921.1	2,448.3	2,975.8	2,975.8	3,509.8	+534.0	4,641.8
# of gigabytes of data collected annually (orthoimagery, hydrography, elevation, landcover, and geographic names)	UNK	34,815	62,622	62,622	28,028	-34,594	28,389
Cumulative # of gigabytes of data managed (ortho-imagery, hydrography, elevation, landcover, and geographic names)	51,042	85,857	148,479	148,479	176,507	+28,028	233,285

Cooperative Topographic Mapping Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Cooperative Topographic Mapping	80,843	71,393	+1,560	-1,071	71,882	+489
FTE	607	528	0	0	528	0
Total Requirements \$000	80,843	71,393	+1,560	-1,071	71,882	+489
FTE	607	528	0	0	528	0

^{a/} Changes for this subactivity include a reduction of -\$83 for travel and -\$2 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for the Cooperative Topographic Mapping (CTM) program is \$71,882,000.

The Cooperative Topographic Mapping program addresses the Department's Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science. To measure progress in achieving intermediate outcomes to improve the information base, information management and technical assistance, the USGS tracks the percent of U.S. land coverage at both medium and high resolution for *The National Map* data themes of elevation, orthoimagery, and hydrography.

The CTM program coordinates activities that ensure the development, maintenance, and availability of base geographic data for the Nation by means of *The National Map*. The major goals of the program are:

- Improve the value of the geospatial data available to natural resources decisionmakers and the public by building *The National Map* through partnerships with Federal, State, and local governments that collect and maintain higher resolution, and more current data,
- Ensure the availability, currentness, and archive of nationally consistent and integrated geospatial data across the country, and
- Lead the development and promote the use of international, national, and Federal Geographic Data Committee (FGDC) National Spatial Data Infrastructure (NSDI) standards among *The National Map* partners.

The USGS is implementing *The National Map* by developing a network of up-to-date distributed digital databases, combining Federal, State, and local information, to provide a single consistent mapping framework for the country. *The National Map* will provide the basis for analyzing and solving geographically based problems. *The National Map* supports the goals of the Administration's Geospatial One-Stop initiative by providing leadership on the development of standards for three critical layers of geospatial information: elevation, hydrography, and

Cooperative Topographic Mapping Subactivity

orthoimagery. *The National Map* will be the geographic backbone to spatially enable electronic government services.

The USGS is committed to making *The National Map* easily accessible to customers and partners through increased use of advanced computing, archiving, and communication tools and through innovative collaboration with public and private organizations. This goal is being accomplished via the Internet using *The National Map* viewer for information access and delivery. In addition, Geospatial One-Stop provides an Internet portal linking *The National Map* viewer and the USGS databases to other organizations' geospatial, natural science, and socio-economic databases. This capability will greatly improve communication tools for responding to public inquiries and expanding cooperation with private industry in product development and dissemination.

Implementation of *The National Map*

Implementation of *The National Map* consists of two components: National Databases and Partnerships. In general, National Databases component includes converting, integrating, providing for quality control and assurance, managing, providing access to, archiving, applying, and (when necessary) acquiring geospatial data for *The National Map* and *National Atlas of the United States*® and related work on standards and other support activities. These activities occur through the USGS or organizations under contract to the USGS. The Partnerships component includes providing for USGS geospatial liaisons (and some support personnel) who develop partnerships and data-sharing consortia directly with State, local, and Tribal government agencies, field offices of Federal agencies, and others; and projects that result from these partnerships.

"The notion of The National Map as a set of services may hide the fact that it is also a series of partnerships between the U.S. Geological Survey (USGS), other Federal agencies, States, counties, municipalities, and commercial companies. There is a two-way relationship between the electronic map and the partnership. Without the contributions from the many partners, there would be no electronic map. Without the electronic map, there would be no forum in which to partner. The focus on partners is enhanced by USGS' new way of doing business introduced during the past few years. Instead of grouping staff at a few facilities, USGS is stationing field liaisons across the country to create relationships and develop partnerships for The National Map and other work.

"What makes all of this possible? Certainly a strong vision from USGS is part of the equation, as are willing partners. Underlying both of these is a technology enabler – open standards. The technology of the partners publishing data, and those accessing that data, is not restricted in any way. Both groups can use whatever software, hardware, and formats they chose. The glue holding The National Map together is a set of standards from the Open GIS Consortium (OGC) [now named the Open Geospatial Consortium]. The implementation and use of these standards make The National Map literally open for business, with data that are ready to employ and integrate."

Geospatial Solutions, June 1, 2004

National Databases

(Estimates for FY 2004, \$70.2 million; FY 2005, \$57.8 million; FY 2006, \$ 58.3 million)

The USGS develops and maintains critical, comprehensive databases to ensure the integration, availability, preservation, and dissemination of geospatial data to serve the natural sciences' needs for systematic analyses and investigations. These databases help provide a foundation for the USGS to respond to present and anticipated needs to understand environmental and natural resource issues on local, regional, and national scales and to enhance predictive and forecast modeling capabilities. These databases also support the national infrastructure for managing and sharing these types of data at all levels of government.

Private sector firms provide a number of essential products and skills needed to achieve the goals and objectives of the CTM program, including production of base geospatial products, such as orthoimagery, elevation and vector feature data, revised maps, and the development of a wide range of value-added products that meet public needs. The USGS uses these services for data acquisition when necessary and to offer a contract vehicle for State and local governments to use to achieve economies of scale on projects. The USGS is committed to contracting its map production activities and related services, thereby meeting expectations of both the Congress and OMB for Federal use of private sector services.

USGS efforts emphasize five data themes that are available through *The National Map*, plus topographic maps. The National Databases component coordinates the requirements of constituents, cooperators, and partners to set priorities for orthoimagery, elevation, hydrography, land cover, and geographic names data. Based on these requirements, the current emphasis on elevation, hydrography, and land-cover data will continue. For orthoimagery, the primary focus is on high-resolution imagery for major population and administrative centers in the Nation; USGS also will support partners for maintaining nationwide medium resolution imagery. Implementation is beginning for databases of transportation and boundary data featuring the use of data becoming available from the Bureau of the Census, and a database for structures data featuring data from Federal, State, and local government agencies.

New Joint Performance Goal Documents Interagency Imagery Efforts

A joint performance goal, new for FY 2006, between USGS and the Department of Agriculture's Farm Service Agency, will support both agencies' need for medium resolution orthoimagery. The agencies will cooperate in the development of imagery over eleven western States where the agencies' technical requirements are the same. USGS participation will be in support of Interior bureaus, which manage much of the land in these States.

Data Integration and Maintenance

After attaining national coverage for these data themes, it is important to establish a mechanism to update the coverages to maintain currentness. To attain maximum current coverage, partnerships must be developed to maintain and make available the geospatial data. A critical measure of success for *The National Map* will be the progress in establishing maintenance partnerships to expand coverage and maintain currentness.

The USGS contributes to *The National Map* by coordinating requirements for collection, integrating data from various sources for the national databases, taking an active role in quality assurance and quality control activities for each data theme, and maintaining a small production capability for those areas for which there is no partner for updating geospatial data; that is, the USGS is the producer of last resort. The USGS also has the responsibility for building and maintaining integrated seamless databases for partner-generated data.

Data Themes of *The National Map*

The National Map is comprised of eight data themes: orthoimagery, elevation, hydrography, land cover, transportation, structures, boundary, and geographic names. At medium resolution, elevation, orthoimagery, and hydrography are 100 percent complete for first-time coverage. Work focuses on extending high-resolution coverage for these data themes. The data themes below are grouped as priority data themes (i.e., those for which the USGS will target its data integration and development activities) and secondary data themes (i.e., those for which the USGS depends on others for data). Most effort is devoted to integrating data from data sources and providing access to the resulting seamless coverage of data.

Priority Data Themes

National Orthoimagery Databases — An orthorectified image is an aerial photograph or satellite image for which most distortions caused by terrain relief and sensor geometry have been corrected. The result combines the image characteristics of a photograph with the geometric qualities of a map. Orthoimagery is used for field reference in Earth science investigations and analyses. Emergency responders, farmers, and environmental scientists use orthoimagery to assess local conditions. Orthoimagery also serves as a source of information for collecting other geographic feature content such as transportation data. This data theme includes data from Federal, State, local, and private sector partners, and is made available in *The National Map*.

Age and Availability of Orthoimagery in <i>The National Map</i>				
	2003	2004	2005	2006
Medium Resolution ^{a/}				
Less than 5 years	25%	17%	6%	25% ^{d/}
5-10 years	62%	49%	48%	39%
More than 10 years	13%	34%	46%	36%
Urban areas				
2 years or less	34%	58% ^{b/}	49% ^{c/}	56%
More than 2 years	0%	5%	51%	44%
^{a/} First time coverage of orthoimagery at medium resolution (1-meter) for the United States (including Puerto Rico and portions of Alaska) was completed in 2001.				
^{b/} This coverage was accomplished largely due to the emergency supplemental funds the National Geospatial-Intelligence Agency received and provided to USGS for establishing State and local partnerships to acquire imagery. This source of funding has ended.				
^{c/} USGS anticipates using savings from employee buyouts to complete first-time coverage for urban areas and to improve its ability to meet 2-year currentness requirements. Coverage is lacking for approximately eight percent of the area.				
^{d/} Improvement in relative age of medium resolution orthoimagery is due in part to partnership with Department of Agriculture's Farm Service Agency for imagery over 11 western States.				

Medium resolution (typically one meter) (see fig. 1), orthoimagery is updated on a 5-to-10-year cycle, depending on the rate of change in any particular area. The USGS is increasing its cooperation with the Department of Agriculture's Farm Service Agency (FSA) in western States where the agencies' technical needs coincide. In this effort to coordinate data acquisition, USGS will fund acquisition of imagery over Interior and other Federal lands (except those of the U.S. Forest Service (USFS)) and the FSA will concentrate on agricultural lands. This approach will be documented through a joint performance metric that starts in FY 2006 between USGS and the FSA. In other areas, particularly in eastern States, USGS participates in consortia that operate on a Statewide or regional basis, and typically receives imagery with a resolution finer than one meter. For example, in 2006 USGS will continue participation in multiyear orthophoto consortia in the States of New York and Florida. In such arrangements, these consortia provide imagery for urban and other areas. For data access, national coverage of this imagery is available in *The National Map* data viewer through an arrangement with the TerraServer Internet service. The USGS plans to complete a seamless data download service for the entire data set by early FY 2006.

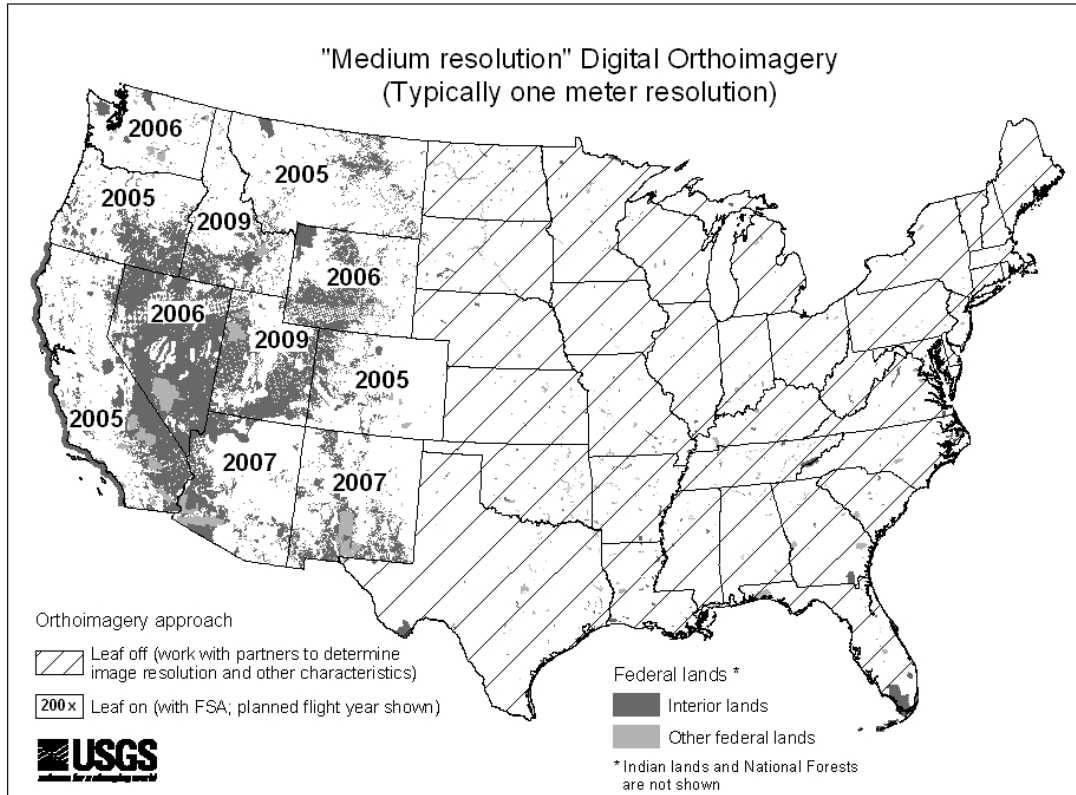


Figure 1. The map shows the underlying strategy for maintaining medium-resolution orthoimagery. In 11 western States, USGS will work with the Farm Service Agency and other partners. In the East, USGS will use a more adaptive strategy by working with Federal, State, and local partners to identify needs.

For the Nation's urban areas, the orthoimagery has a resolution finer than one meter and requires updating on a 2-year cycle to capture these constantly changing areas. The data support a number of homeland security, public safety, and other applications. The focus is on 133 of the Nation's most populous and administratively important urban areas. State, regional, and local governments participate in the acquisition of these data; in 2004 partners funded more than 60 percent of the acquisition costs. When these data are received, USGS immediately makes them available to the Federal homeland security, defense, and intelligence communities. They also become available for viewing and (or) download via seamless download services available as part of *The National Map* and through commercial partners, such as TerraServer. Imagery from the private sector is also playing a more prominent role, as data from commercial high-resolution satellites become available. Candidate areas for work in FY 2006 are shown in fig. 2.

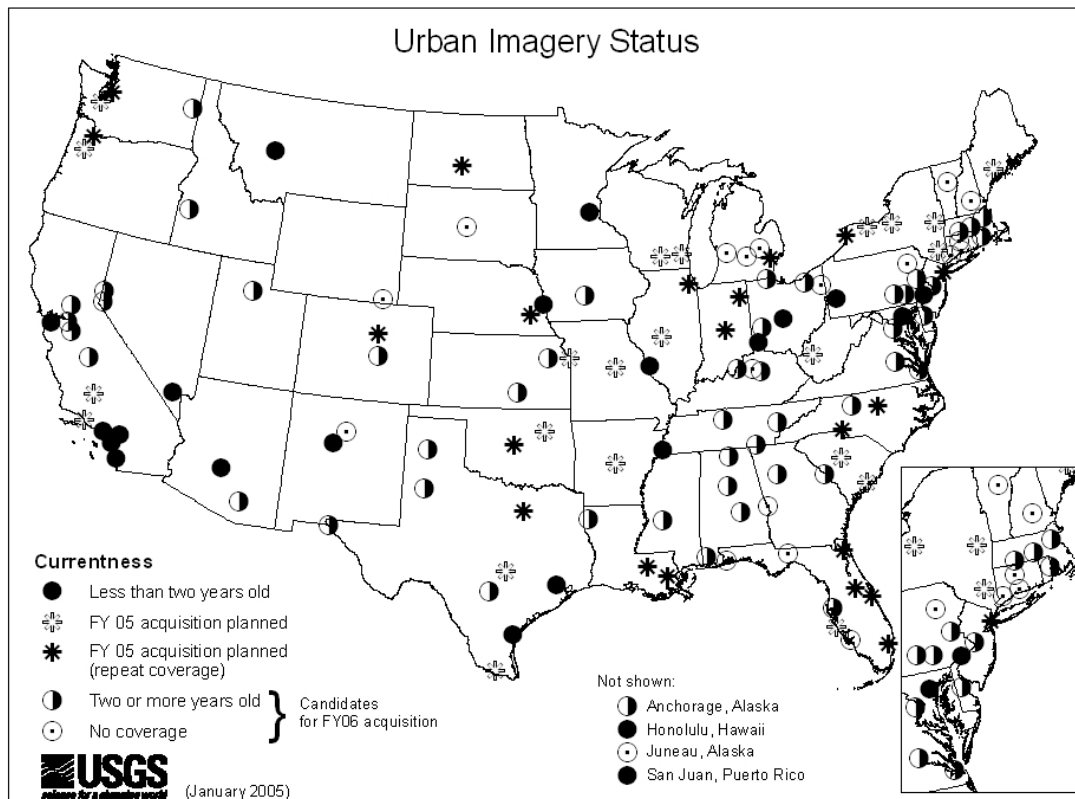


Figure 2. Map of 133 of the Nation's most populous or administratively important cities, and the currentness of imagery for these areas. Areas for which there is no high-resolution imagery or for which imagery is more than two years old are candidates for FY 2006 activities.

National Elevation Dataset (NED) — Elevation data provide three-dimensional surface models of the Earth's surface. USGS makes elevation data available both for land areas and, in cooperation with the National Oceanic and Atmospheric Administration (NOAA), under coastal waters. The heights (or depths), referenced to a vertical datum, are organized in a grid. Elevation data support modeling of drainage networks and geometric correction of remotely sensed data. Elevation data are critical to decision-support systems, such as hydrologic studies in support of flood mitigation and response; dispersion modeling to predict and respond to events that spread over land or in surface water; and for predicting wildfire behavior. The growing demand in populated areas, and flood plains in particular, drives USGS investments for integrating detailed elevation data into national data holdings.

USGS identifies digital elevation data based on the resolution (spacing between the points) of the grid. One arc-second (equivalent to 30-meter) posted elevation data are complete and available for the entire United States. Current USGS efforts concentrate on providing finer resolution of elevation data at 1/3- and 1/9-arc-second (equivalent to 10- and 3-meter respectively) post spacing. The data are developed from a variety of sources, including State and local governments and the private sector.

Status of NED in <i>The National Map</i>			
	2004	2005	2006
High Resolution ^{1/} (1/3 arc-second (10 meter))	50%	58%	66%
^{1/} The high-resolution dataset is focusing on first-time coverage for 49 States (excludes Alaska), Puerto Rico, and the Virgin Islands.			

The elevation theme includes best available data from Federal, State, local, and private sector partners and is made available in the NED, the elevation component of *The National Map*. USGS anticipates continuing to work closely with the Federal Emergency Management Agency (FEMA) to incorporate elevation data acquired through that agency's flood plain map modernization program and to continue the program of exchanging elevation data with the USFS. The 1/9 arc-second elevation data, which focus on the Nation's urban areas, have become a vital tool for supporting homeland security efforts. USGS anticipates incorporating 1/9 arc-second data acquired by other Federal agencies over urban areas into the National Elevation Dataset. The data are organized in a seamless data format so that customers can define the area for data they wish to access.

National Hydrography Dataset (NHD) — The hydrography data theme contains naturally occurring and manmade bodies of water, paths through which water flows, and related features. The hydrographic data contain positional and descriptive information that support applications such as referencing observations, modeling the flow of waters and transport of materials in stream networks, and making maps.

Status of NHD in <i>The National Map</i> ^{1/}			
	2004	2005	2006
High Resolution ^{2/} (1:24,000 scale)	60%	75%	92%
^{1/} The medium resolution dataset covering 49 States (excludes Alaska), is available in <i>The National Map</i> . The dataset was completed in 2002; it is not updated as work is focused on higher-resolution data.			
^{2/} The higher-resolution dataset will include first-time coverage for all 50 States (Alaska at 1:63,360 scale), Puerto Rico, and the Virgin Islands.			

USGS organizes these data in the National Hydrography Dataset, the hydrography component of *The National Map*. The NHD contains comprehensive and detailed data about America's surface waters. The NHD assigns unique identifiers for each segment of the country's surface waters. This approach provides a common map base through which different organizations georeference their water-related business data. This approach is used by the Environmental Protection Agency (EPA) as part of its Watershed Assessment, Tracking & Environmental Results (WATERS) system, State agencies for meeting reporting requirements under the Clean Water Act, and the USFS in its Natural Resource Information System (NRIS) water module. The NHD also is used by the Bureau of the Census in its map modernization activities, the USGS Water Resources Discipline in its StreamStats project and other activities, and many other organizations.

Current efforts concentrate on completing the "high" resolution version of the data, which typically are created from USGS 1:24,000-scale topographic maps and similar sources (see fig. 3). Also available is "medium" resolution for the conterminous United States and Hawaii,

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data created from less detailed 1:100,000-scale maps, and "local" resolution data from very detailed maps for Vermont and selected other places.

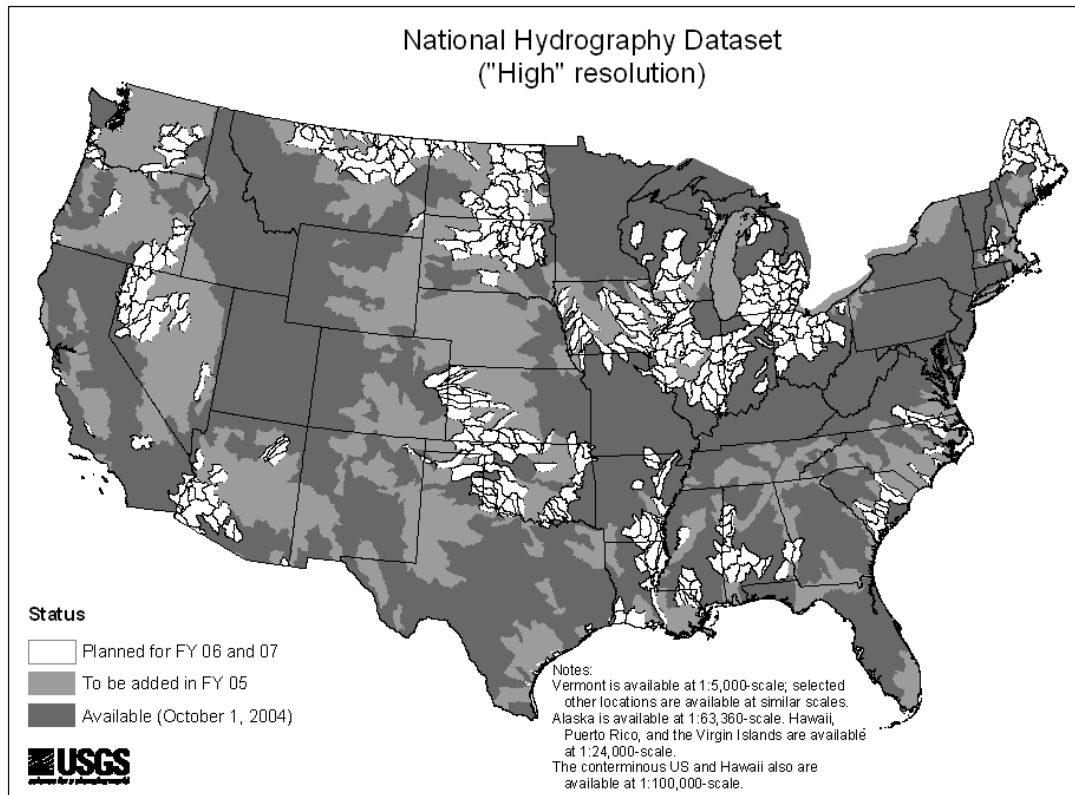


Figure 3. Status of "high resolution" data coverage in the National Hydrography Dataset. The priority for data development has been based on interest of partners (notably the USFS, but also including the National Park Service and other Interior bureaus and State agencies), needs of Interior bureaus, and coverage over urban areas.

These data are derived through partnerships with Federal agencies such as the USFS, National Park Service (NPS), Bureau of Land Management (BLM), and EPA, and State and local government agencies. In FY 2006, USGS anticipates nearing completion of the initial collection of these data and transitioning to working with partners interested in more detailed "local" resolution data and to organizing data maintenance partnerships.

Geographic Names — Geographic names include the names of natural features, populated places, civil divisions, areas and regions, and cultural features such as mines, churches, schools, cemeteries, hospitals, dams, airports, and shopping centers. Geographic names are an important reference component for scientific investigations, emergency responders, and land and resource management operations. The data are developed from decisions made by the Board of Geographic Names and its partnerships with Federal and State names authorities.

The names component of the Geographic Names Information System is the definitive repository of federally approved names for features. Map displays of these names are made available in *The National Map*. For FY 2006, USGS plans to maintain the database in support of the Board on Geographic Names and add one of the four remaining "Phase 2" States (which improves the resolution of the names data) to the database.

Land-cover Information – Plans for the National Land Cover Database are found in the Geographic Analysis and Monitoring subactivity.

Secondary Data Themes

Transportation Feature Data — The transportation data theme consists of roads, railroads, airports, and miscellaneous transportation features. This information is important for highway departments, land managers, and utility companies in applications such as calculating distance along a specific path or the proximity of roads to power lines. It is also crucial for determining evacuation routes for emergency response and other applications. The transportation theme includes best available data from Federal partners such as the Census Bureau and the Department of Transportation, State and local agencies, and private industry. In FY 2006 the USGS will continue to make available for seamless viewing and downloading data being developed by the Census Bureau. It also will work with Federal, State, and local governments to develop strategies to maintain these data.

**AR-KS-MO Regional National Map Project—
No Edge at the State Line**

February 2004

The *AR-KS-MO Regional National Map Project* has provided a fundamental building block to *The National Map* by stitching together different geospatial data residing on servers in Arkansas, Kansas, and Missouri. The data are from different sources and are based upon different schemas, but are styled in such a way that they appear as one source. This achievement has eliminated a common barrier found in many approaches in solving geographic problems where the data ends at the State borders.

Structures Feature Data — The structures data theme is comprised of manmade features important to planners, land managers, utility companies, and the general public for a broad range of analyses and applications. This theme is key for the locations of critical structures, which are of vital interest to emergency responders. The data include those from Federal partners including agencies of the Departments of Homeland Security and Defense, and State and local government agencies. In FY 2006 the USGS will continue to integrate data from these sources and make them available for seamless viewing and downloading.

Boundary Feature Data — The boundary data theme depicts administrative and jurisdictional information. The theme is critical for government agencies and other organizations requiring jurisdictional information. It is also important to State planners, land managers, the general public, and utility companies for a broad range of applications. The boundary theme relies on data from Federal partners such as the U.S. Census Bureau, other Federal agencies, and State and local agencies. In FY 2006, for boundaries of jurisdiction, the USGS will continue to make available for seamless viewing and downloading data being developed by the Census Bureau. It also will work with Federal, State, and local governments to develop strategies to maintain these data. For boundaries of Federal and other publicly-owned land, USGS will work with agencies responsible for these lands on data maintenance strategies. USGS will integrate these data, and make them available for seamless viewing and downloading.

Topographic Maps

The most widely known form of topographic information is the USGS primary series topographic map, which gives a complete and consistent picture of the Nation's lands. The maps, complemented by digital forms of the mapped information and aerial and satellite imagery, support numerous government activities, including aiding other Interior bureaus in carrying out their stewardship and regulatory responsibilities, saving lives and property in natural and

Cooperative Topographic Mapping Subactivity

human-induced disasters, and providing a basis upon which other programs can present their information. These spatial data continue to be used widely by State, regional, and local governments, the private sector, and other organizations. Citizens use the maps in educational, recreational, environmental, and conservation activities, and to explore and understand natural resource issues. The maps help people connect with the Earth through the power of place and geography.

The USGS completed large-scale map coverage for the United States in the 1990s. The topographic map revision program has been unable to maintain the currentness of this national database of graphic products. Instead, resources are directed toward supporting the building and implementation of *The National Map*. USGS is implementing a process to generate maps from data in *The National Map* and is exploring options for working with the private sector in this area. For example, USGS worked with the National Geographic to develop map-printing kiosks based on static USGS topographic maps. These new efforts might result in similar kiosks that draw on more current and continually updated information in *The National Map*.

Access

The USGS provides public access to data and ensures that geospatial data and map products are accessible and available to partners and customers. Access activities include those to integrated national databases held by the USGS and a catalog of Web mapping services made available by partners. For national databases, the USGS focuses on providing around-the-clock, free, or low-cost access to elevation, hydrography, orthoimagery, transportation, boundaries, structures, land cover, and geographic names data. Users can browse, select, and retrieve geographic data and information for their area of interest. For data made available by partners, USGS provides means for viewing these data through *The National Map*. National databases and partners' Web mapping services are documented using the Federal metadata standard and are made available through the NSDI clearinghouses.

In FY 2006, USGS will support and upgrade (as needed) continued access to the seamless national databases it hosts and Web mapping services made available by partners (see box at top of page H - 35).

Archive

The USGS provides for archive and retrieval systems and the development of procedures to maintain original data sets such as high-resolution orthoimagery quadrangles, digital raster graphics, digital line graphs, and digital elevation models. The USGS geospatial data archive provides public access to historical source data that are important for analyzing trends over time. The archive supports maintenance and dissemination of geographic information to users that serve as a source for the production of derivative topographic maps. In FY 2006 USGS will continue to maintain archives of these materials.

Standards

Access to data is easier and more efficient using the technological advances of the Internet and open geospatial standards and protocols. This approach allows USGS geographic data to be used more readily by all levels of government, private organizations, and the public. These open interfaces and protocols "geo-enable" the Internet and allow distributed complex spatial information and services to be accessible to a wide range of applications. As these interfaces and protocols mature, the USGS expects to realize its vision of interoperable, distributed,

multilevel databases forming *The National Map* component of the NSDI. Standards development is coordinated with the FGDC, consistent with requirements of the NSDI and Geospatial One-Stop initiative, to help ensure that data from *The National Map* and other sources can be integrated. Standards development was identified in the FY 2004 Office of Management and Budget Performance Assessment Rating Tool review of the USGS Geography Discipline and Exhibit 300 documentation as one of the major goals of the program.

The USGS is identified in Office of Management and Budget Circular A-16 and the Geospatial One-Stop Initiative as the lead Federal agency responsible for the elevation, hydrography, and orthoimagery data themes. This responsibility includes the development, maintenance, and promulgation of standards for the collection of nationally consistent geospatial data. In addition, the USGS establishes digital cartographic and geospatial data quality control procedures for collecting data in a form that meets these standards. The USGS has also led the development of NSDI standards for metadata, data accuracy, and data transfer.

The USGS coordinated the development of standards for digital orthoimagery, hydrography and elevation as part of its participation in the Geospatial One-Stop initiative. In FY 2006, USGS will support the American National Standards Institute's (ANSI) process for adopting these and other standards developed through Geospatial One-Stop as national standards.

The USGS promotes standards development through its management of, and technical participation in, the work of international, national, and interagency efforts. These efforts include participation in the ANSI, International Organization for Standardization, and the National Digital Ortho Program and National Digital Elevation Program. The USGS is participating with the Open Geospatial Consortium to develop specifications enabling diverse geospatial databases and systems to work together. In FY 2006, USGS participation will emphasize improved ability for semantic interoperability among data, which will allow greatly improved ways of integrating and graphically portraying dissimilar data sets. Advances in this area will allow USGS more flexibility in integrating existing data from Federal, State, and local government agencies that do not follow national standards.

Geographic and Cartographic Information Science

Applied research to achieve *The National Map* vision includes development of methods necessary to derive and display seamless, generalized, consistent data and topographic maps from "best available" data from a variety of distributed Federal, State, county, and local government and private sector data sources. Extraction and long-term maintenance of feature information, including capabilities for individual feature identification and transactional update, Internet-based data collection and editing, metadata population and maintenance, and integration of open-source and proprietary systems and data also are research themes.

Research on these topics extends the boundaries of theoretical and applied knowledge in the geographic sciences and provides updating capabilities that will make all the planned capabilities for *The National Map* possible. The results support data maintenance and archive responsibility shared by the USGS and partners and the access and use of data by users who will employ combinations of technologies such as miniaturized digital display and processing devices (e.g., personal digital assistants), wireless broadband Internet communications, and global positioning satellite capabilities.

This component also includes development of technologies to integrate laser- and microwave-based technologies, combined with airborne global positioning system capabilities, into the

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production of *The National Map* data. Other investments include data processing, inventory, business management, and other systems that support data and mapping operations essential to managing *The National Map*.

***The National Atlas of the United States*[®]**

The National Atlas provides basic and thematic geographic data and information at scales that are best suited to national-scale investigations and assessments. The National Atlas is a partnership with other Federal agencies and industry that makes it easier for users to find, get, and use reliable and authoritative geographic information. More than 20 Federal agencies and business partners are cooperatively building the National Atlas. The atlas also serves as a gateway to those who need the very detailed, basic map information provided by *The National Map*.

The Web site *Nationalatlas.gov*[™] contains a remarkable range of products and services to meet the diverse needs of people who are looking for maps and geographic information about America. The Atlas features a Map Maker that lets citizens easily design, explore, and print their own maps. There are dynamic maps that show changes in America over time. The Atlas makes available page-size printable maps for those who just need simple, prepared maps to print at home, at school, or in the office. For those who want to know the stories behind the maps and how geographic data are used, the National Atlas includes interesting and informative articles. Continuing the USGS legacy of publishing high-quality paper maps, the Atlas also includes accurate and attractive Wall Maps covering diverse topics. For professional consumers of geographic information, the National Atlas project offers more than 2,000 authoritative, documented, and integrated digital geospatial (map) layers.

The project makes data available through a number of channels, including *The National Map* Web viewer, the National Atlas node of the NSDI Clearinghouse, the National Atlas node in the Environmental Systems Research Institute's Geography Network, and through the Geospatial One-Stop. The Atlas project provides online interactive map services that adhere to Open Geospatial Consortium specifications. This means that professionals can include National Atlas maps and functions on their own Web sites or use them in their own mapping applications without having to download the raw data.

Partnerships

(Estimates for FY 2004, \$9.0 million; FY 2005, \$13.6 million; FY 2006, \$13.6 million)

The success of USGS geospatial activities depends on partnerships and cooperation with the geospatial community. There are many potential partners because the business practices of nearly every Federal, State, and local agency and many private organizations have at least some tie to geospatial information. Some of these are long-standing partnerships that have been going on for decades, and others are new relationships developed in response to evolving opportunities, technology, and demands for geospatial information.

By leveraging partner participation, Federal funds can go further in collecting, analyzing, disseminating, and applying geospatial data needed by many Federal programs. USGS partnerships activities ensure the development and maintenance of base geographic data consistent with national content specifications by seeking new partnership opportunities, building relationships with geospatial organizations, and working collaboratively to prepare the base geospatial data. Although partner organizations collect, manage, and store basic geospatial data in response to their specific needs, in general they have no mission

requirements to make these data available for secondary use, nor are they generally capable of data integration on a national scale. Within the Federal Government, the USGS has this role. Furthermore, USGS provides leadership in forming partnerships with these organizations to provide access to their data at a variety of scales, developing protocols for data integration, developing processes for data maintenance, serving data to a variety of users, and assisting in improving applications of these data.

Partnerships might not include data delivery. For example, partnerships support research and development with the private sector, the development of standards, or support for meetings and developing and printing reports with public interest organizations and State, local, and Tribal government personnel.

Federal Partnerships — USGS seeks to leverage its resources with other Federal agencies both for cooperation with other agencies and to improve the interactions of the Federal Government with other sectors of partners, especially State and local governments. In FY 2006, USGS will accomplish these partnerships through formal mechanisms such as the interagency FGDC, Geospatial One-Stop initiative, National Digital Orthophoto Program, National Digital Elevation Program, and Board on Geographic Names and through bilateral interactions with agencies. Examples include support for Interior bureaus' geospatial data needs; ongoing agreements with the National Geospatial-Intelligence Agency to develop high-resolution imagery and elevation data over urban areas and to act as an intermediary with State and local governments; USGS personnel working with the Department of Homeland Security to identify how geospatial techniques can aid that agency in its new mission; interactions with bureaus in the Department of Agriculture for the development of imagery, elevation, and hydrography data, topographic maps, and participation in *The National Map*; and work with the Census Bureau in the exchange of imagery and hydrography data for road and boundary data, the EPA for hydrography data, the FEMA for elevation data, and the NOAA for bathymetry data.

State, Local, and Tribal Government Partnerships — The USGS has a long history of partnering with State, local, and Tribal government agencies to increase the coverage of geographic data. USGS is transitioning from its relationship with these organizations from cost-share agreements with State and local entities to produce standard data themes that met USGS technical specifications to taking advantage of these organizations' data production activities to share data production costs and to make available a greater range of geographic data. USGS interacts with these organizations by participating in State and regional geospatial information coordination groups, bilaterally through relationships with State, local, and Tribal government agencies, and through public interest organizations such as the National States Geographic Information Council and National Association of

Montana Implements *The National Map*

The implementation of *The National Map* for Montana supports E-commerce, rural development, and health and safety for the State. Sixty-six percent of Montana's population lives in rural or non-metropolitan areas. As a rural State, Montana requires a border-to-border land information infrastructure. Without comprehensive land data and the ability to distribute this information to every household, economic development and the daily health and safety of its citizens are at risk.

In support of this need, the USGS has created partnerships with seven stakeholders at the State, county, city, and private entity levels to implement *The National Map*. These partnerships will provide the leadership, support, technical knowledge, and infrastructure to distribute consistent land information across the State and to the Nation.

During a July 2004 ceremony in Bozeman, Barbara Ryan, the Associate Director for Geography, recognized these *National Map* partners. These partnerships will initially provide geographic data covering 7,042 square miles and 194 1:24,000-scale USGS topographic maps. The Montana partnerships are the latest effort to provide public access to quality geospatial data and information through *The National Map*.

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Counties that represent State and local government agencies. In FY 2006, USGS will continue to develop partnerships such as those described in the FY 2004 Accomplishments and FY 2005 Planned Program Performance sections below.

Private Sector Organizations — Engaging the private sector enables the USGS to leverage private sector resources to develop *The National Map* and the NSDI more broadly. These partnerships, such as those provided through USGS participation in the Open Geospatial Consortium, involve the initial research and development that provide the essential technology. Other activities involve the collection and analysis of geospatial data; the distribution of data, either electronically or in hard copy; or the use of geospatial data to develop value-added products that meet the needs of a wide variety of users.

Public Interest Organizations — Public interest organizations offer an opportunity to reach out to many potential partners. These organizations represent a very broad sector of the geospatial community and help coordinate a variety of issues with national program stewards. In FY 2006, the USGS will build on experience gained in working with the National States Geographic Information Council and National Association of Counties to work more closely with the National Governors Association, the Western Governors Association, and the National League of Cities.

This component provides funds needed to support partnerships for *The National Map* and NSDI in two ways. The first is funding to support the USGS partnership personnel, especially for liaisons that work with State, local, and Tribal agencies and field offices of Federal agencies to address geospatial needs and promote long-term partnerships. In response to the Office of Management and Budget FY 2004 Performance Assessment Rating Tool review of the USGS Geography Discipline, the development of the liaison staff is part of USGS's transition to new approaches and development of a more suitable workforce. USGS locates liaisons across the country where they can most effectively interact with partners. As part of a departmental initiative, USGS will also be training and mentoring staff in the use of collaborative strategies and actions that will serve to encourage partnering. A suite of resources will be available including policy implementation guidance, techniques to facilitate collaboration, sample documents, and examples of best practices and success stories. Liaisons with strong partnering and collaboration skills are essential to the success of the program. With the establishment of the National Geospatial Programs Offices, their responsibilities have expanded to include not only *The National Map* but also to support broader efforts to implement the NSDI by the FGDC, Geospatial One-Stop, and other efforts.

The liaisons organize, maintain, and document the partnerships with State and local governments and Federal agency field offices listed above under National Databases. They evaluate State and local government agencies and others, and help those organizations make their Web mapping services and data available through *The National Map*. They also identify needs within the areas they represent, participate in State and regional geospatial data councils, and provide for outreach to local communities of users. As a result of the organization of the National Geospatial Programs Office, their duties were expanded to include support for implementation of the NSDI in addition to *The National Map*.

While USGS provides for liaison with all States, some liaisons are not located in their State(s) or provide liaison for multiple States. In FY 2006, the USGS will continue liaisons located in areas served in FY 2005 (see list under FY 2005 Planned Program Performance: Partnerships below). USGS plans to supplement this staff with additional personnel.

The remaining funds provide incentives to organizations, most often State and local government agencies that engage in partnerships with USGS, especially those that aid the development, maintenance, and application of national databases. This funding may take the form of grants, cooperative agreements, or other mechanisms that enable the USGS to leverage the resources of the partner to accomplish these shared goals. Funds for partnership projects are allocated based on needs (such as lack of current data for urban areas), opportunities (such as the availability of willing partners), and merit (projects are awarded on a competitive basis). In FY 2006, projects will help to meet needs identified under National Databases above, and be similar in approach to projects described under FY 2004 Accomplishments and FY 2005 Planned Program Performance below.

Management Actions

In January 2005 the Associate Director for Geospatial Information announced a plan to consolidate existing USGS mapping centers and other geospatial production activities and technical services into a National Geospatial Technical Operations Center. The center will be considered a national capability. The Center will support all production activities and technical services associated with the National Geospatial Programs Office, including the CTM Program, FGDC, Geospatial One Stop, and Interior Enterprise Geospatial Information Management activities. Services to be provided by the Center include geospatial data integration and quality assurance, cartographic production, contract management, software and applications development, and hosting of geospatial data and applications. The Center will be managed by a single leader who will report directly to the Associate Director. Implementation of this plan, initiated in FY 2005, will continue into FY 2006.

2004 Program Performance Accomplishments

The FY 2004 program accomplishments summarized below demonstrate the utility of USGS engineering, data, and products that are included under the following measures: content and expanse of knowledge base – average percentage of coverage at medium and high resolutions; number of workshops and training provided to customers; number of mapping nodes; number of partnerships for *The National Map*; number of data standards used; percentage of hydrography, elevation, and orthoimagery available through NSDI clearinghouses; percentage of total costs saved through partnerships for high resolution imagery; and number of gigabytes of data added annually and managed.

National Databases

National Petroleum Reserve – Alaska (NPR-A) — The development of a new generation of orthoimagery and elevation data for the National Petroleum Reserve – Alaska represents a new era in the production of orthoimagery and high resolution elevation data for Alaska. USGS anticipates that the products generated for NPR-A will set the standard for all of Alaska's next generation of digital cartographic map products.

Exploration and extraction of new mineral and oil resources and continued development of new facilities to enhance the living conditions of all Alaskans are important national and local activities. This especially is true for the North Slope where oil reserves have yet to be developed. However USGS topographic maps for the State in general, and of the NPR-A specifically, are more than 40 years old and do not meet national map accuracy standards. In addition, no aerial photography is available to meet current needs for detailed orthoimagery (see fig. 4). Development of these data are further hindered by the lack of high resolution, current

Cooperative Topographic Mapping Subactivity

digital elevation data required for production of orthoimagery and detailed analysis of the land surface in the State.

The primary goal of the current initiative is to contract for 2-to-5-meter elevation data and orthoimagery for NPR-A (see fig. 5) and other development corridors on the North Slope. The USGS Alaska Science Center will provide for overall coordination between other Federal, State, and nongovernmental organizations for input and agreements for reimbursable funding to assist in data acquisition and production.

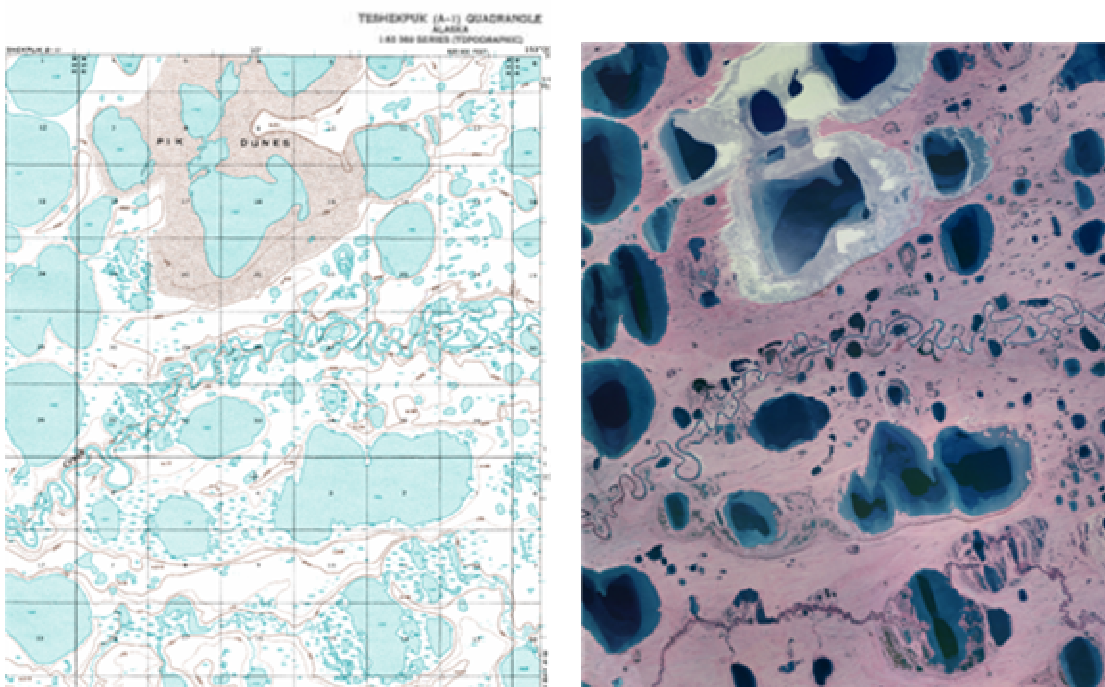


Figure 4. Comparison of a USGS topographic map from 1955 and orthoimagery from 2002 for a small area in the NPR-A.

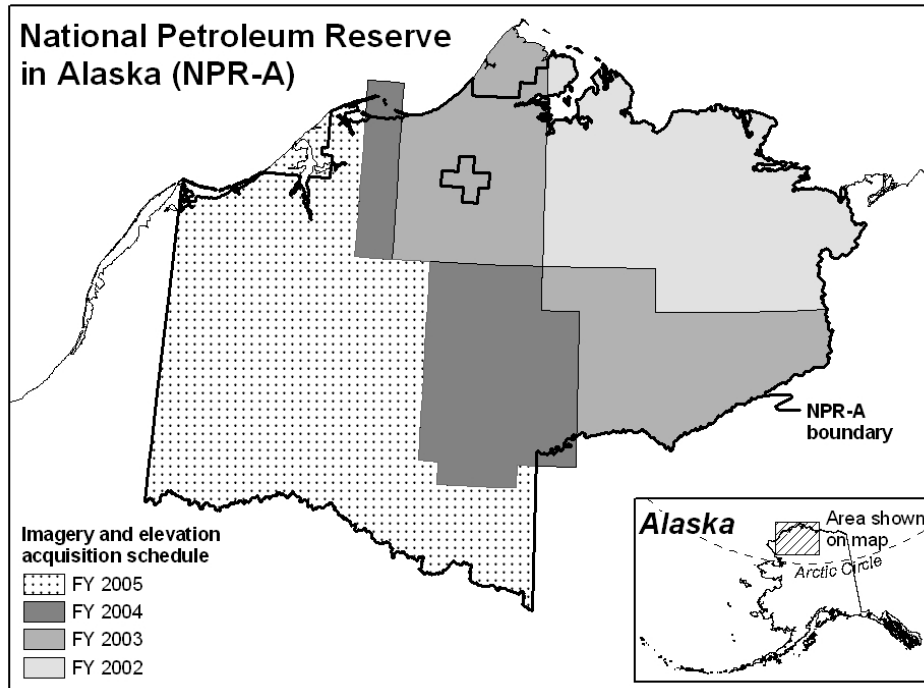


Figure 5. Current status of acquisitions over the NPR-A, with data acquisition beginning in FY 2002.

Activities to date include (1) delivery of new orthoimagery for about one-third of NPR-A, (2) a data and needs assessment conducted by USGS and the BLM, and (3) the award of contracts for collecting data using radar techniques for the production of elevation data. In addition, a new Memorandum of Understanding with BLM was executed that allows interagency funding for future project work.

Popularity of *The National Atlas of the United States* Continues to Increase — A greatly improved Internet-based Map Maker was introduced in FY 2004. Improvements were based on the suggestions received from many National Atlas users through electronic mail, surveys, and in-person testing of software prototypes. *Nationalatlas.gov*TM satisfied an average of more than 12 million requests for services each month. A new map was drawn every 2.8 seconds.

The National Atlas published more than 100 new page-size printable maps (see fig. 6). The American public has responded favorably to these new products. Demand for these has more than doubled in the past 12 months. More than 88,000 printable maps were downloaded in September 2004.

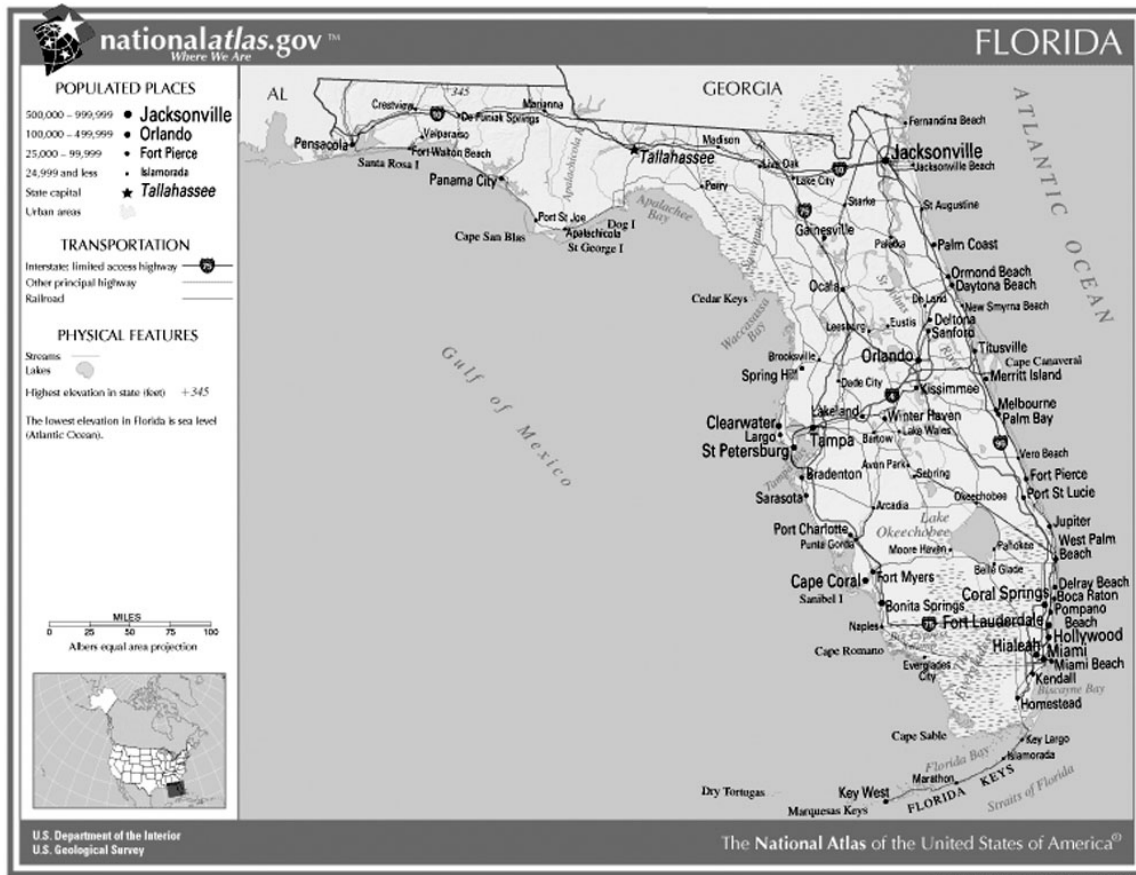


Figure 6. New State maps from *The National Atlas of the United States* show urban areas, transportation routes, and physical features. These maps can be downloaded through the Internet for display and printing at work, school, and home.

The National Atlas of the United States formed strategic partnerships with the Atlas of Canada and the Mexican National Institute of Statistics and Geography to begin work on an Atlas of North America. This year, the collaboration resulted in the production of a high quality, trilingual wall map of North America. All three nations distributed integrated framework data for Canada, the United States, and Mexico along with trilingual data documentation, and released Web Mapping Services that comply with national and international standards of open access and use.

Partnerships, Data Integration, and Coverage Continue to Expand for National Data Sets — (See tables and maps under National Databases (beginning on page H - 16) for additional detail about FY 2004 activities.) Partners continue to help the USGS improve coverage of data available through national data sets. For the National Hydrography Dataset, an additional 364 sub-basins were added in FY 2004. Complete coverage is available for several States, including Utah, Kentucky, Minnesota, Pennsylvania, West Virginia, Idaho, Connecticut, and Missouri (although some sub-basins still need to be completed along the borders with adjoining States). Approximately 80 percent of the USFS lands and 75 percent of NPS lands were complete by the end of FY 2004. Nearly all data are produced through partnerships with other organizations (see fig. 7 for a sample of participating organizations). A new database provides for improved Internet-based viewing and downloading of data. Since the startup of the new database in March 2004, more than 43 gigabytes of data have been transferred to users.

Current status and planning information for National Hydrography Dataset is also available at this Web site, which is registered in Geospatial One-Stop.

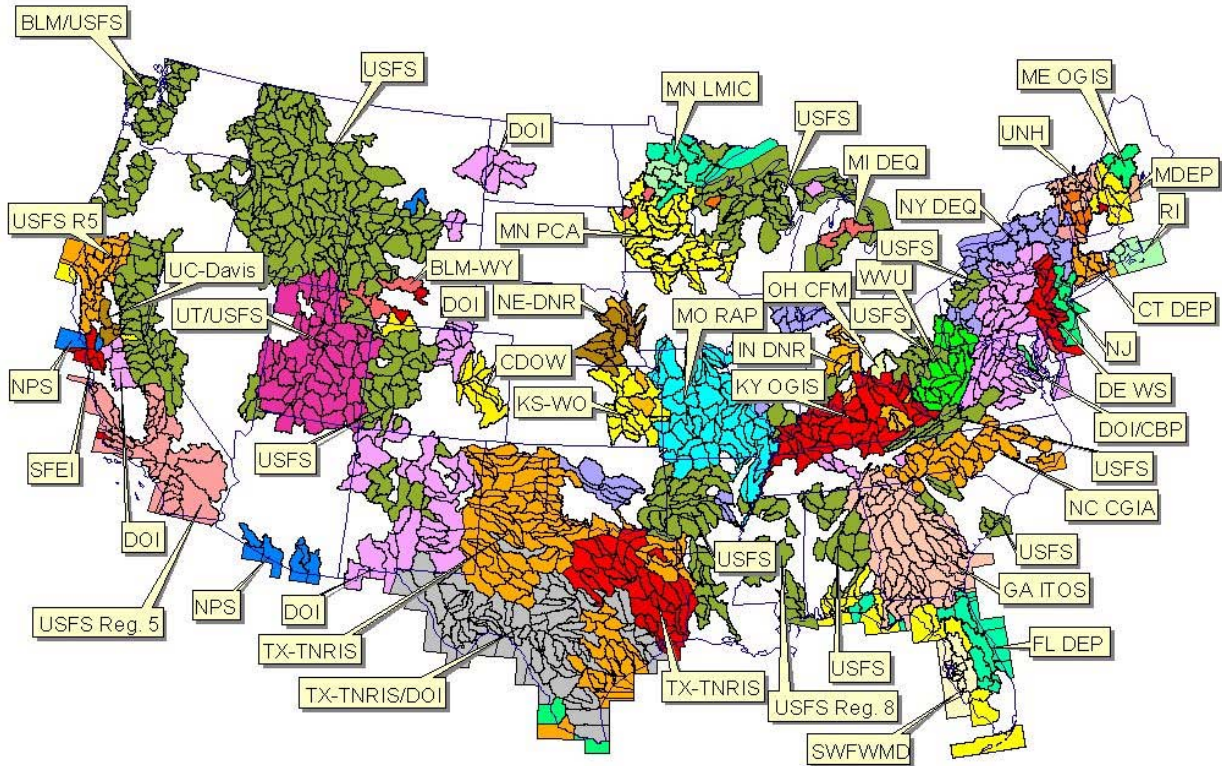


Figure 7. Partners working with the USGS to develop and integrate high-resolution data in National Hydrography Dataset, the integrated, nationally consistent surface water component of *The National Map*. Notable among the partners is the USFS, which has adopted the high resolution version of the data for its corporate activities.

For the National Elevation Dataset, the nationally consistent, integrated elevation coverage for *The National Map*, data at one-third arc-second (10-meter) post spacing is available for approximately one third of the contiguous 48 States (see fig. 8). For the first time, elevation data from very high resolution data sources were incorporated into the National Elevation Dataset at one-ninth arc-second (3-meter) post spacing for the Puget Sound area and at one-third arc-second (10-meter) post spacing for eastern North Carolina. The data for Puget Sound area were funded in part through appropriations to the USGS Coastal and Marine Geology program.

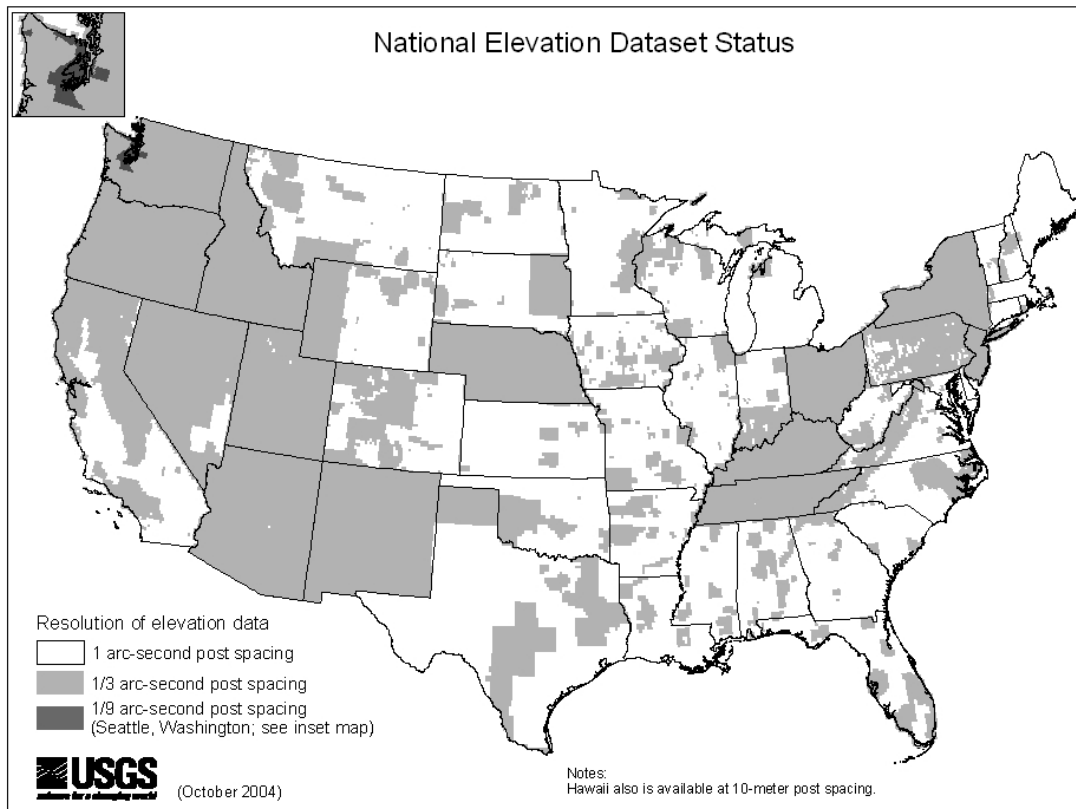


Figure 8. Status of data coverage in the National Elevation Dataset on October 1, 2004.

High Resolution Image Data Support Public Safety in America's Urban Areas — During responses to emergencies, difficult-to-access, incompatible, and out-of-date base geospatial data hamper and degrade communications among organizations that respond to emergencies, thus endangering lives and property. To help ensure that Federal responders and support personnel have quick and easy access to the same detailed and current data as do local first responders, the USGS is working with State and local governments and other Federal agencies to integrate data for America's urban areas into *The National Map*. In FY 2004, Federal agencies and other public safety and security organizations used the data to plan public security measures for activities such as President Reagan's funeral, the national political party conventions, and the Presidential debates.

Initial efforts focused on developing and integrating detailed and accurate imagery for America's largest urban areas. Interest in these data has grown over the last three years. During FY 2002, data for 20 percent of the cities sought by USGS were developed in partnership with local governments; in FY 2003 the figure was 65 percent of the cities sought and in FY 2004 the figure was 84 percent of the cities sought. Local governments and the USGS received the resulting data, and USGS forwarded copies to Federal agencies that support homeland security efforts. In addition, during FY 2003 USGS purchased commercial off-the-shelf data for 12 urban areas and in FY 2004 purchased data for one urban area. These purchases, using funds from partners, make data immediately available for viewing, downloading, and ordering online from *The National Map*.

Free Internet Distribution of Digital Data

In FY 2002, more than 3.7 terabytes of data were distributed free of charge via the Internet.

In FY 2003, more than 13.6 terabytes of data were distributed free of charge via the Internet.

In FY 2004, more than 19.9 terabytes of data were distributed free of charge via the Internet.

In FY 2004, the Seamless Data Distribution System added a substantial number of products for free distribution. The elevation category added the National Elevation Dataset 1/9 arc-second data over a limited area and increased the coverage of 1/3 arc-second data. Three products from the National Land Cover Dataset 2001 became available for limited areas. The orthoimagery category offering increased through the addition of a Landsat 7 satellite mosaic, MODIS satellite data, Bureau of Land Management 0.5-meter data over northern New Mexico, State of New Jersey 1-foot resolution color infrared imagery, and 1-meter orthoimagery for Washington, DC, and Tampa, FL, areas. Availability of high resolution orthoimagery increased by 28 urban areas.

The system (<http://seamless.usgs.gov>) allows a customer to obtain seamless data download for free. Users can define their area of interest and obtain seamless coverage of that area for elevation, orthoimagery, land cover, and transportation data. Up to 1.6 gigabytes of data can be downloaded for free; larger requests are referred to an E-commerce capability so that the USGS can recover the costs of handling and distributing data on media.

Partnerships

State and Local Governments Find *The National Map* Useful to Their Activities

— The successes of the cross-sector partnership in North Carolina demonstrate the power and potential of the NSDI Partnership Offices to seize and build upon opportunities with State and local partners. The USGS is working with the North Carolina Center for Geographic Information and Analysis and local partners to implement NC OneMap, a Statewide geospatial data infrastructure that has been developed to align with and feed into *The National Map*. In the spring of 2004 the NC OneMap - *National Map* Internet data viewer application was officially released. The USGS liaison in North Carolina collaborated on the project and served as a point of contact between the State and technical experts located within the USGS. The USGS contribution to the project complemented the work of the State and numerous supporters from local government and regional councils of government.

USGS Trains First Responders on Advanced Mapping

From Rolla Daily News, MO – Training involved the use of the USGS Map Viewer software that displays detailed map information in many forms for all of Phelps County on their computer screens. The first responders can use this data for various uses in emergency and rescue and recovery operations. The workshop is a variation of presentations given by the USGS in recent months to local police departments, the State Highway Patrol, the Sheriff's Department, and the Department of Corrections.

Directions Magazine, January 26, 2004

One of the cornerstone objectives is to link local communities into the NC OneMap – *National Map* program. More than 50 communities are providing 185 locally-produced geospatial data layers and Federal agencies are providing another 30 layers. For example, aerial imagery from 15 counties valued at \$4.5 million is now available to the public through the application. They are also accessible to Geospatial One-Stop and other Internet map portals.

North Carolina's Council has proposed a budget to enhance and sustain the NC OneMap – *National Map* program to include full participation from all counties, cities, and regional groups for 20 critical data layers. Cross-sector collaboration on the program and the allocation of

Cooperative Topographic Mapping Subactivity

Federal resources to the project have brought focus and success to the State's contributions to the NSDI.

The success of the program has led to increasing interest in the coordination efforts in the State, and plans are in place to link another 40 communities that are interested in participating. The program has even attracted participation by local governments in neighboring South Carolina. York County, SC, Council members, who are in the process of revising their 20-year growth management plan, voted unanimously to join the NC OneMap and *National Map* programs. The York County Manager spoke to a reporter after a meeting of the County Commissioners and stated, "This program could help us determine how our land-use plan fits in with other governments and how their plans tie in with ours," adding that it would only enhance the county's own online geographic information system.

Federal Agencies Partner in Developing *The National Map* — USGS worked with Interior bureaus to identify needs for geospatial data, and participated in partnerships with Interior, other Federal, and State and other organizations to meet these needs. USGS worked with National Geospatial-Intelligence Agency to develop priorities for high-resolution imagery and elevation data over urban areas, acted as an intermediary with State and local governments, and provided imagery to the agency. USGS worked with Department of Homeland Security, Northern Command, and other public safety and defense agencies to identify how geospatial techniques can aid agencies in their new mission. It exchanged resources and data with bureaus in the Department of Agriculture in the development of imagery, elevation, and hydrography data, topographic maps, and participation in *The National Map*. Notable examples include early coordination of orthoimagery acquisition, joint development of the National Hydrography Dataset, and exchanges related to elevation data and topographic maps. The USFS added roads for all National Forests to *The National Map*. The Census Bureau used USGS imagery and hydrography data as part of its geospatial data modernization efforts, and plans were laid for road and boundary data from the project to become part of *The National Map*. USGS continued work with its original partner for the National Hydrography Dataset, the EPA, to improve tools for using the data. Other efforts included those with the FEMA for elevation data and the NOAA for bathymetry data.

***The National Map* Participation Continues to Grow** — *The National Map* provides a virtual national map by making available data from many Web map services provided by other organizations. In FY 2004 the number of data layers in the system increased from 900 to more than 2,300 (see fig. 9).

These layers are served from 151 map services, which are owned by 71 partner organizations. The rate of growth is strong proof not only that the partner-based approach is valid, but also that the data management infrastructure is robust and capable of growth. The USGS resources needed to manage and display these data grow very slowly compared to the growth of the data holdings.

Several significant improvements were made in the technical infrastructure for access to Web mapping services made available through *The National Map*. The database at the core of the system, which tracks the locations and characteristics of contributing services, was mirrored at another USGS site to improve system reliability. Similar actions have been taken with some of the USGS-managed critical national databases although more work in this area remains. The ease of using the map viewer was improved through additional features to zoom to user-specified locations, like street addresses and coordinates.

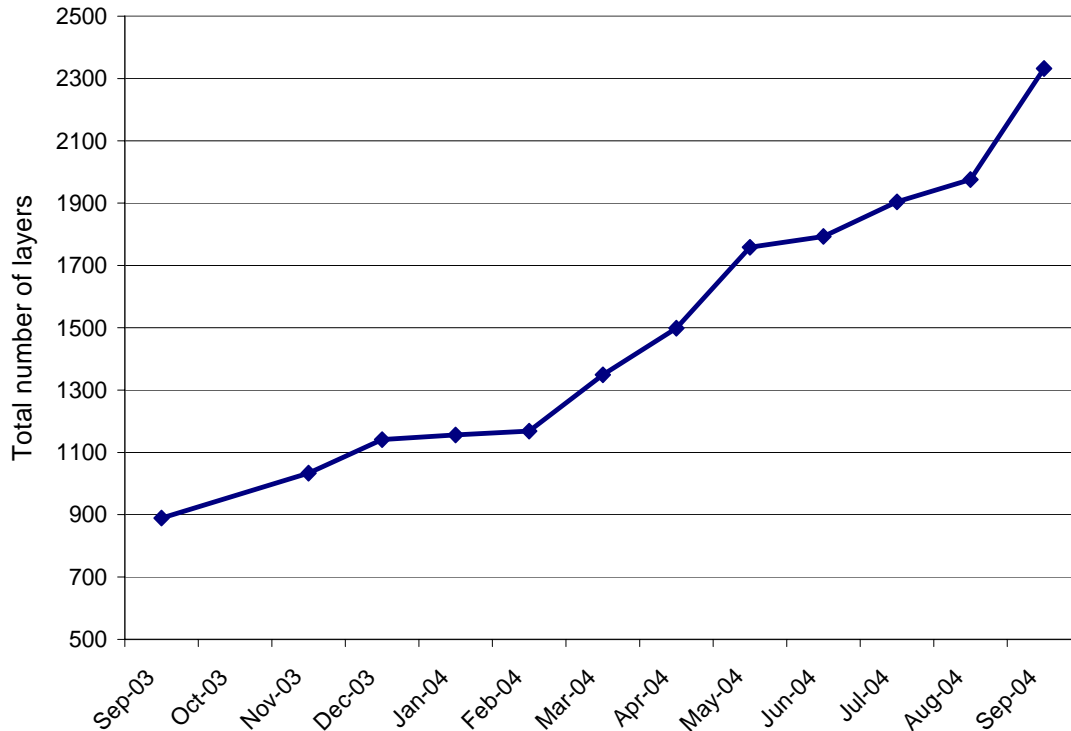


Figure 9. Growth of data layers in the National Map during FY 2004.

Tribal Participation in *The National Map* — The USGS liaison in Idaho developed a cooperative agreement with the Coeur d'Alene Tribe in FY 2004 to implement *The National Map* over Tribal lands using geospatial data developed and maintained by the Tribe's GIS Department. The Tribe will make available its boundary, structure, and transportation data through *The National Map*. The USGS is also supporting the Tribe's efforts to use these data as a base for developing wildfire fuels mapping over their lands. USGS also provided training to aid the Tribe's efforts to reduce the threats from wildfires.

Public Interest Organizations Design Partnership Strategies — USGS signed agreements with the National States Geographic Information Council, National Association of Counties, Urban and Regional Information Systems Association, and International Cities and Managers Association to formally create and set forth the goals of partnerships and indicate areas of focus and cooperation among the organizations. The relationship with the National States Geographic Information Council and National Association of Counties is yielding information about how partnerships might best be organized. A team established through the agreement identified critical factors and successful models for cross-sector collaboration, and addressed partnership issues for implementing and maintaining partnerships. Though the team's work is still in progress, this partnership is providing focus and direction to USGS planning to accelerate development of *The National Map* and the NSDI. The broad participation and interest in this partnership from the organizations' memberships has already strengthened the credibility of the Federal commitment to leveraging and improving State and local governments' geospatial investments.

Cooperative Topographic Mapping Subactivity

Management Actions

USGS began to restructure its workforce to achieve the correct skill mix of employees and to ensure better communication with partners through separation incentives and relocations of duty stations. By late winter, more than 160 employees, most of whom were funded by the CTM Program, accepted the USGS buy out offer and left Federal service. Incentives for participation in *The National Map* by State and local governments and the private sector were provided from reduced labor costs associated with the downsizing of the Federal workforce. USGS will continue to reinvest savings from employee separations into partnership efforts.

The program was included in Office of Management and Budget's FY 2006 Performance Assessment Rating Tool (PART) review of the USGS Geography Discipline during the spring of 2004. The review resulted in an overall score of 90 percent and a rating of "effective." More information is in the Activity Summary for Mapping, Remote Sensing, and Geographic Investigations.

In August 2004 the USGS Director announced a reorganization of the USGS Geography Discipline and the Geographic Information Office. The reorganization consolidates the USGS geospatial programs under the new National Geospatial Programs Office located within the Geospatial Information Office (GIO). The National Geospatial Programs Office will oversee the portfolio of national geospatial programs for which the USGS has responsibility, including the FGDC, the Geospatial One-Stop project, the Department of the Interior Enterprise Geospatial Information Management activity and *The National Map*. Through this action the CTM Program (including *The National Map*) is being transferred from the Geography Discipline. The new organization enhances USGS leadership in geospatial programs. The decision to reorganize was in direct response to discussions with constituent groups about how best to meet their geospatial data needs and recommendations from a report by the National Research Council.

FY 2005 Planned Program Performance

The FY 2005 planned program performance summarized below demonstrates the utility of USGS engineering, data, and products that are included under the following measures: content and expanse of knowledge base – average percentage of coverage at medium and high resolutions; number of workshops and training provided to customers; number of mapping nodes; number of partnerships for *The National Map*; number of data standards used; percentage of hydrography, elevation, and orthoimagery available through NSDI clearinghouses; percentage of total costs saved through partnerships for high resolution imagery; and number of gigabytes of data added annually and managed.

DOI High Priority Base Data Program

A major partnership effort of *The National Map* is the USGS responsibility for satisfying the highest priority digital geospatial needs of Department of the Interior (DOI) bureaus. The USGS provides this service through the DOI High-Priority Base Data Program. Key objectives of the program include minimizing redundancy in the production of digital data and maximizing the number of customer needs satisfied for each product generated. Annually, DOI bureaus work together at the regional level and through an interagency working group to identify data requests that satisfy the highest priority program activities of the Department. Although the funding for this program directly supports data needs of the Department, DOI product needs often coincide with the needs of other Federal agencies. All products funded by the DOI program are made available to the public through *The National Map*.

National Databases

(See tables and maps under National Databases (beginning on page H - 16) for additional detail about FY 2005 activities.)

General:

- Geographic areas of special emphasis are urban areas (all themes) and those requested by Interior bureaus.
- Data activities are assumed to maximize partner and contractor participation.
- Continue online seamless viewing, access, delivery, and application of data, including data obtained in FY 2005, through *The National Map*.

Orthoimagery:

- Pursue completion of urban imagery coverage, and replace data that are more than two years old, through partner arrangements.
 - See maps and tables under National Databases (beginning on page H - 16) for more detailed examples.
- Continue 1-meter (or finer) activities (including support for Interior bureaus) through partner arrangements.
 - Planned efforts include those in the States of California, Colorado, Florida, Georgia, Idaho, Illinois, Indiana, Montana, Maine, New York, Oregon, South Carolina, Utah, and Wisconsin. See maps and tables under National Databases (beginning on page H - 16) for more detailed examples. Several of these efforts include the FSA as a partner.
 - Provide for seamless access to 1-meter orthoimagery.
- Support Geospatial One-Stop leadership obligations for orthoimagery.
- Develop long-term funding and activity profile.

Elevation:

- Add 1/3 arc-second (10-meter) elevation coverage (including support for Interior bureaus and urban areas) for eight percent of the conterminous United States through partnerships:
 - Complete or increase coverage of 1/3 arc-second data for the States of Alaska, California, Kansas, Iowa, Maine, Minnesota, Missouri, Nevada, and West Virginia. These efforts support a mix of Interior bureaus' needs and cooperative efforts with the FEMA and State agencies.
 - Develop higher-resolution data in the States of Idaho, Utah, and Washington on behalf of Interior bureaus.

Cooperative Topographic Mapping Subactivity

- Support cooperative work with the USGS Water Resources Discipline, and the Department of Agriculture's Natural Resources Conservation Service and USFS.
- Complete agreements and begin integration of elevation data from the FEMA and the National Geospatial-Intelligence Agency.
- Complete agreement and develop plans for integration of elevation and bathymetry with the NOAA.
- Complete operational methods for updating lower resolution and accuracy data from higher quality sources.
- Support Geospatial One-Stop leadership obligations for elevation data.
- Develop a plan to meet needs for improved elevation data by image orthorectification activities.

Hydrography:

- Reach coverage of high resolution data for 75 percent of Nation, including support for Interior bureaus and urban areas.
 - See maps and tables under National Databases (beginning on page H - 16) for more detailed examples.
 - Federal agencies included in this effort include the USFS, the NPS, and the BLM.
- Maintain seamless online database as the basis for hydrography data access and archive through *The National Map*.
- Begin transition to transaction-based data maintenance.
- Support Geospatial One-Stop leadership obligations for hydrography.

Geographic names:

- Pursue one Phase 2 State (increase the resolution of names information for one of the four remaining States).
- Continue maintenance of the Geographic Names Information System.
- Support the U.S. Board on Geographic Names.
- Develop and pilot local data maintenance partnerships.

Transportation, structures, and boundaries:

- Implement databases that provide seamless access for viewing and downloading data from *The National Map* for transportation, structures, and boundaries. The approach implements the standards being developed for transportation and boundaries through Geospatial One-Stop.

Cooperative Topographic Mapping Subactivity

- Load initial national data coverage for transportation and boundaries with data provided by the Census Bureau's data improvement project.
- Work with partners to plan transition to transaction-based data maintenance and begin development of a strategy for data maintenance.
- Participate in Geospatial One-Stop activities.

Topographic maps:

- Pilot graphics generation from data available in *The National Map*.
 - Pursue technology developments needed to support this approach.
 - Produce maps for portions of Colorado, Delaware, Hawaii, and Texas.
- Develop a "map-on-demand" capability with participation by the private sector and others.
- Continue to support the "single map" program between the USFS and USGS in which maps produced by the Forest Service also meet demands for topographic maps from USGS.

Access

- Continue to provide and develop seamless online data viewing and downloading for data themes as described above.
- Complete convergence between similar functions of *The National Map* and the Geospatial One-Stop portal. Participate in the planning, testing, and implementation of "phase 2" of that portal.
- Maintain the catalog of Web mapping services so that services provided by partners can be viewed through *The National Map*.

Standards

- Provide support for adjudicating comments received from the public about orthoimagery, elevation, and hydrography standards developed through Geospatial One-Stop.
- Work with the Open Geospatial Consortium to develop specifications for open Web services that are important to *The National Map* and a common architecture for open services that reduce technical barriers to data sharing.
- Implement open standards in *The National Map* as needed to support activities described above.

The National Atlas of the United States®

- Complete development and release the new version of the public interface to *The National Atlas of the United States®* through *Nationalatlas.gov™*.

Cooperative Topographic Mapping Subactivity

- Continue efforts to work with counterparts in Canada and Mexico to provide a common data framework for the countries. This framework will be the basis for a new map of North America's watershed and compatible online mapping services.
- Build on the printable page-sized State reference maps released in FY 2004 to provide a series of State-based thematic maps on natural resource and energy topics, and congressional districts.

Partnerships

The partnership activity includes USGS staff that provides geospatial liaisons to State, local, and Tribal governments, field offices of Federal agencies, and other organizations. While USGS provides liaisons with all States, some liaisons are not located in their State(s) or provide liaisons with multiple States. Liaisons are more effective when they are located in the States with which they interact. The USGS will continue liaisons located in Alaska, Arkansas, California, Colorado, Delaware (part time), Florida, Hawaii, Idaho, Kansas, Kentucky, Louisiana, Minnesota, Missouri, Montana, Massachusetts, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Utah, Virginia, Washington, and Wisconsin. It will add or strengthen liaisons in Delaware, Michigan, Mississippi, and New England (some locations are tentative).

The partnership activity also provides funding for projects that result from partnerships, especially those through which USGS partners with State and local governments. Examples of such efforts in FY 2005 are listed above under FY 2005 Planned Program Performance: National Databases.

Other FY 2005 partnership activities include:

Working with Tribes — Engaging Tribes in partnerships at the field level enables the USGS to enhance the Nation's access to geospatial data while serving the needs of the Tribes in managing their land and resources. Building on progress made in FY 2004, a formal Memorandum of Understanding is being developed between the USGS and the Coeur d'Alene Tribe to display in *The National Map* the updated high-resolution imagery and elevation data procured by the Tribe. The USGS is also working with the Tribe regarding the display of Native American names on *The National Map*. A new joint research effort is planned to identify and mitigate threats from multiple potential natural hazards over Tribal lands. USGS activities with the Coeur d'Alene Tribe are being reported jointly by Tribal and USGS personnel at several Native American conferences and venues in FY 2005. Sharing the successes of this partnership has led to increasing interest among other Pacific Northwest Tribes to engage in similar collaboration.

Private Sector Partners — The USGS has established a number of research partnerships with private businesses and universities, to the mutual benefit of the USGS and its partners. An example of an ongoing partnership is with the National Geographic Society to evaluate map kiosk technology. The kiosk incorporates scanned USGS topographic maps to allow customers to create seamless topographic maps and print their selections on a self-service basis through a simple touch-screen interface. The partnership will continue by exploring the addition of other data types and the most effective network infrastructure to support customer demands and the expanding number of kiosks.

Through a research partnership with Florida International University's High Performance Database Research Center, the USGS is cooperating to develop techniques for archiving, dispensing, and displaying geospatial data produced by the USGS. The university's TerraFly Web site demonstrates seamless data presentation, automatic E-commerce delivery of data, and applications combining USGS data with data available from other sources.

The partnership between the USGS and Microsoft Research resulted in the creation of the TerraServer, which provides more than 4 terabytes of image data to all Internet users. The research conducted by Microsoft resulted in proven techniques that apply database methods and the latest computer hardware to serve digital orthophoto imagery and other geospatial data in a seamless manner. The TerraServer project has provided USGS geospatial data and Web services to other government agencies, the commercial sector, as well as the general public. The TerraServer receives more than eighty thousand users and serves one and one-half million images a day and its usage is growing. The TerraServer demonstrates many of *The National Map* concepts, and the USGS/Microsoft partnership will continue to be maintained in order to transfer proven technologies into *The National Map* implementation and to investigate new research concepts.

The 1,900 USGS retail partners who distribute USGS maps make it possible for USGS to transition out of retail sales and move to a wholesale distribution model. There is a new emphasis on both "as-is" and "value-added" product distribution by partners, an upgraded Web referral capability to direct customers to retail partners, and an increased focus on print-on-demand technology in support of NSDI. The USGS is continuing to work with partners in this transition through ongoing workshops and focus groups.

Public Interest Organizations — Working groups established through the relationship with the National States Geographic Information Council and National Association of Counties will yield information about how partnerships might best be organized. Deliverables due in FY 2005 will include insights on the relevance of USGS geospatial activities and the NSDI more broadly to State and local partners, a best practices model that clarifies roles and communicates successful approaches from across the country, a State-by-State analysis of implementation opportunities and challenges, and recommendations for a systematic process to actively gather and use information from the broad community for annual and long-term programmatic and technical planning.

The USGS also is working with the National Association of Counties to frame a project to address the geospatial needs of rural America. These areas often lack the resources, including technical capability, equipment, and telecommunications capacity, that can be found in urban areas. *The National Map*, through collaboration with local and regional interests, might address many of the needs in rural America.

The USGS is working with the Urban and Regional Information Systems Association to facilitate the collaboration among stakeholders interested in developing an "addressing and street centerline" layer that would build on *The National Map*.

Management Actions

Based on a renewal of authority granted by the Office of Personnel Management to the Department of the Interior, USGS continued to restructure its workforce through separation incentives. The USGS offer to employees expires on February 28, 2005. As of January 2005, this offer was accepted by more than 20 employees, most of whom were funded by the CTM

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Program. USGS will continue to reinvest savings from employee separations into partnership efforts.

In January 2005 the Associate Director for Geospatial Information announced a plan to consolidate existing USGS mapping centers and other geospatial production activities and technical services into a National Geospatial Technical Operations Center. The center will be considered a national capability. The Center will support all production activities and technical services associated with the National Geospatial Programs Office, including the CTM Program, FGDC, Geospatial One-Stop, and Interior Enterprise Geospatial Information Management activities. Services to be provided by the Center include geospatial data integration and quality assurance, cartographic production, contract management, software and applications development, and hosting of geospatial data and applications. The Center will be managed by a single leader who will report directly to the Associate Director. A business strategy for the center is to be developed by June 2005. USGS also is developing recommendations on sizing and scoping the geospatial production activities and technical services functions appropriately. A likely outcome is a reduction in the size of the Federal workforce and use of these resources to increase the number of partnerships with State, local, and Tribal governments and other organizations, and to increase the use of contractors.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Cooperative Topographic Mapping (\$000)	\$71,882	-\$1,071
FTE	528	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006 budget request for the Cooperative Topographic Mapping program is \$71,882,000 (includes adjustments for uncontrollable costs) and 528 FTE, a net program increase of +\$489,000 and 0 FTE from the 2005 enacted level.

North Carolina Mapping (-\$986,000) — Reduction of a site-specific Congressional add-on for flood plain mapping in the State of North Carolina. In conjunction with USGS and other Federal agencies, the State of North Carolina has been gathering and coordinating up-to-date geospatial data over its lands.

Land Remote Sensing Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Land Remote Sensing	33,678	32,730	+259	+13,407	46,396	+13,666
FTE	108	102	0	+2	104	+2
Total Requirements \$000	33,678	32,730	+259	+13,407	46,396	+13,666
FTE	108	102	0	+2	104	+2

^{a/} Changes for this subactivity include a reduction of -\$42 for travel and -\$1 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for the Land Remote Sensing (LRS) program is \$46,396,000. The President's FY 2006 budget requests an increase of \$6.0 million to ensure continuity of data from Landsat 5 and Landsat 7 and a \$7.4 million increase to begin augmentation and expansion of ground data processing systems in preparation for receiving data from the Landsat follow-on instrument to be launched with National Oceanic and Atmospheric Administration's (NOAA's) National Polar Orbiting Environmental Satellite System (NPOESS; <http://www.ipo.noaa.gov/>).

"Landsat is a national asset, and its data have made – and continue to make – important contributions to U.S. economic, environmental, and national security interests."

Dr. John H. Marburger III
Science Advisor to the President
August 13, 2004

Landsat 7 and Landsat 5 flight operations, data collection, and archiving will be accomplished using appropriated funds. The Committee is concerned that the Survey is not adequately planning for the future of the Landsat 7 program. Generation and distribution of Landsat data products and support for international ground stations will be funded through data product sales and reimbursable agreements.

The NPOESS program will launch 6 satellites, two of which will be equipped with the Operational Land Imager (OLI) that will employ a solid-state sensor and collect data in one panchromatic and eight multispectral bands (see Table 1) over the entire Earth's land surface (85° North latitude to 85° South latitude). This effort will fulfill the requirements of the Landsat Data Continuity Mission (LDCM) as called for in Public Law 102-555, the Land Remote Sensing Policy Act of 1992 (<http://thomas.loc.gov/cgi-bin/bdquery/z?d102:HR06133:|TOM:/bss/d102query.html>).

The USGS expects this successor to the Landsat 7 Enhanced Thematic Mapper Plus (ETM+) sensor to be operational on board NOAA's NPOESS by early calendar year 2010. While the OLI uses different sensor technology than the previous Landsat satellites, its spectral bands, combined with a rigorous calibration, will ensure continuity with millions of Landsat scenes collected and archived by the USGS over the past 34+ years.

Land Remote Sensing Subactivity

Table 1. Spectral Bands to be acquired by the OLI sensor onboard two of the NPOESS satellites.

Band	Band Type	Scientific Applications	Heritage	Resolution
1	Coastal Aerosol	Useful in water studies	ALI/MODIS	30 m
2	Blue	Useful for water body penetration (bathymetric mapping), distinguishing soil from vegetation, and forest type mapping	ETM+ Band 1	30 m
3	Green	Useful to measure green reflectance peak in vegetation	ETM+ Band 2	30 m
4	Red	Useful to help discriminate vegetation types	ETM+ Band 3	30 m
5	Near IR	Useful for differentiating vegetation types, biomass content and water/land interfaces	ETM+ Band 4/ALI	30 m
6	Shortwave IR 1	Useful for looking at moisture content of soil and vegetation	ETM+ Band 5	30 m
7	Shortwave IR 2	Useful for discriminating mineral and rock types	ETM+ Band 7	30 m
8	Panchromatic	Useful as a sharpening band	ETM+ Pan Band/ALI	15 m
9	Cirrus	Useful for cirrus clouds and aerosols	MODIS	30 m

Landsat data are a national and global resource for environmental research, land management, natural hazard analysis, and resource development, with applications in agriculture, geology, forestry, desertification, and firefighting that extend well beyond America's borders. No other system provides as much global, repetitive, multispectral, calibrated, digital data from a single mission. The Landsat program provides a baseline chronology of change, both natural and human-induced, that makes it truly invaluable for scientific assessment and prediction.

The Land Remote Sensing (LRS) program acquires, archives, disseminates, and uses remotely sensed data of the Earth's land surface. The program operates the Nation's premiere land remote sensing satellites (Landsat 5 and Landsat 7); coordinates the purchase of and procures commercial remotely sensed data for civil agencies; maintains a long-term archive of aerial and other photography, maintains the National Satellite Land Remote Sensing Data Archive (NSLRSDA), which preserves and distributes remotely sensed data to the worldwide community, and operates the Land Processes Distributed Active Archive Center (LPDAAC) in cooperation with NASA; promotes the application of remotely sensed information; creates interagency partnerships; and advances the state of remote sensing technology. The program is vital to applications such as support for national defense; for global agricultural crop monitoring; monitoring and assessing the impacts of natural disasters; aiding in the management of water, biological, energy, and mineral resources; and analyzing the impacts of climatic and other global changes (<http://remotesensing.usgs.gov>).

Recently stated by the White House Office of Science and Technology Policy (OSTP):

"Specifically, Landsat Images are the principle source of global, medium resolution, spectral data used by Federal, state, and local government agencies, academia, and the private sector in Land use/Land cover change research, economic forecasting, disaster recovery and relief, and the scientific study of human impacts on the global environment."

Dr. John H. Marburger III
Science Advisor to the President
August 13, 2004

In FY 2006, the program will begin development of a ground data processing capability for the OLI, continue to operate Landsat 5 and Landsat 7, and investigate the direct reception of data from other Earth observing systems. In support of the President's Commercial Remote Sensing

Space Policy, the program will determine Federal civil agency requirements for high-resolution commercial satellite data and facilitate the use of such data. The LRS program will make archived photographic data more accessible, develop criteria for accepting commercial data into the NSLRSDA and continue to work with NASA to receive archive and distribute land remote sensed data from sensors on the Earth Observing System satellites. The Land Remote Sensing program will sponsor research in areas including advanced data processing and visualization, fire fuels mapping, the use of hyperspectral data for land cover applications, and the use of interferometric synthetic aperture radar data for hazard prediction, response and monitoring.

The Land Remote Sensing program addresses the DOI's Serving Communities strategic goal of advancing knowledge through scientific leadership and information decisions through the application of science using the strategy of improving the information base, information management, and technical assistance.

Satellite Mission Operations and Data Acquisition

(Estimates for FY 2004, \$13.3 million; FY 2005, \$12.8 million; FY 2006, \$20.3 million)

The Land Remote Sensing program acquires remotely sensed data to support the global Earth science community and to fulfill the mandate to grow the NSLRSDA. This is accomplished by operating the Landsat system, leveraging the Survey's infrastructure to receive data from other satellites (e.g., EO-1, Terra and Aqua) and by coordinating Federal purchases of commercial data.

A program to gather Earth resource data using satellites began in 1966 as an initiative of the Department of the Interior. Landsat 1 was launched in 1972; the more recent, Landsat 7, was launched in 1999. Over the years, leadership of the project shifted between various agencies and into and out of the private sector. On October 16, 2000, Presidential Decision Directive/NSTC-3 designated the Department of the Interior and NASA as Landsat Program Management with vested leadership assigned to the USGS. Landsat is the longest-running enterprise for acquisition of moderate resolution imagery of the Earth's land surface.

Landsat's global survey mission is to establish and execute a data acquisition strategy that ensures consistently calibrated, repetitive acquisition of observations over the Earth's land mass, coastal boundaries, and coral reefs; and to ensure the data acquired are of maximum use in supporting the scientific objectives of monitoring changes in the Earth's land surface and associated environment (<http://landsat.usgs.gov>).

The Land Remote Sensing Policy Act of 1992, P.L. 102-555, gave responsibility for building and operating Landsat 7 to the Federal Government and also directed Landsat Program Management to develop a successor system to Landsat 7. On August 13, 2004, the Office of Science and Technology Policy issued a memorandum on "Landsat Data Continuity Strategy." In it, the Administration mapped out a long-term plan that calls for integrating a "Landsat imager" (currently known as the Operational Land Imager or, OLI) onto the first of NOAA's National Polar Orbiting Environmental Satellite System missions. This mission is scheduled to be launched in December 2009 and will fulfill the data continuity requirements of P.L. 102-555. (<http://ldcm.usgs.gov>).

In preparation for the NPOESS launch and the receipt of data from the OLI, the ground data processing systems currently used for both Landsat 5 and Landsat 7 will undergo major upgrades:

Land Remote Sensing Subactivity

- Enhance capabilities for data reception — The sensor on OLI will produce 167 percent more data per scene than Landsat 7. As planned, the data will be downloaded from the NPOESS platform and captured by a NOAA-operated network of ground receiving stations. The OLI data will be transmitted to the USGS National Center for Earth Resources Observation and Science (EROS) via high bandwidth commercial data communications lines. In order to receive the large volume of data, the USGS will need to upgrade its communications infrastructure, circuits, switches, and routers, and integrate into the existing communications backbone. EROS will be the sole reception and processing site for OLI data.
- Expand data storage — Based on current plans OLI will collect and deliver 300 scenes (230 gigabytes) per day to the USGS ground processing station, resulting in a 5-year mission archive of approximately 4.25 terabytes. This is a substantial 66 percent increase over the existing Landsat 7 archive. High-speed, high-capacity storage devices will be added to safely archive a primary and off-site copy of the data. The Congress and the National Academy of Sciences have identified the current lack of an off-site backup as a deficiency.
- Improve data access — Improvements will be made to the USGS information access capability to enable users to more quickly find and get exactly the data and products they need. These will include enhancements to the search and order, billing and accounting, and other components that will support the OLI and previous Landsat missions.
- Develop algorithms for product generation — The characteristics of the OLI sensor are more complex requiring a higher level of processing than previous Landsat systems, in order to correct for effects of terrain relief on band-to-band alignment. For example, the current Landsat 7 instrument has less than 200 detectors, while the OLI instrument will have over 70,000 that will need to be processed into fully calibrated products. These data are more detailed requiring development of sophisticated algorithms and software modifications to generate new products.

OLI on NPOESS will directly support USGS strategic objectives by making high-quality remotely-sensed data widely and inexpensively available to a global community of operational and research users. The Landsat-continuity community encompasses international, Federal, civil, defense, non-governmental organizations, State, local, academic, commercial, and individual users. The project directly supports DOI's role as the Program Manager for Landsat data.

The USGS maintains a satellite ground station at its EROS facility in Sioux Falls, SD. The ground station has two fully redundant antennas that are capable of sending commands to and receiving data from Earth observing satellites. The ground station is the primary command, control and reception facility for the Landsat satellites. In addition the facility also provides direct reception for MODIS data for the AmericaView consortium. Under a fully reimbursable agreement with NASA, the USGS provides tasking, command uplink, and data downlink support for the EO-1 spacecraft.

The USGS is leading the Federal civil community in implementing the President's Commercial Remote Sensing Space Policy (CRSSP). CRSSP goals include advancing and protecting U.S. national security and foreign policy interests by maintaining the Nation's leadership in remote

sensing space activities and by sustaining and enhancing the U.S. remote sensing industry. The policy directs the U.S. Government to rely to the maximum practical extent on U.S. commercial remote sensing space capabilities for filling the imagery and geospatial needs of military, intelligence, foreign policy, homeland security and civil users (<http://crsp.usgs.gov>). The "U.S. Commercial Remote Sensing Space Policy: Civil Agency Implementation Plan" was approved by the civil agencies in December of 2003 and implementation began in January 2004. In accordance with that plan the USGS has responsibility for leading the development of:

- Short and long-term remote sensing data requirements,
- Budget and procurement strategies,
- Infrastructure for accessing, archiving, producing, and distributing data, and
- The interagency civil Senior Steering Committee and Implementation Working Group with 21 agencies and the Federal Geographic Data Committee participating.

The USGS has a longstanding role in providing critical geospatial information to Federal, State, and local agencies, the private sector, and the general public. As a part of the CRSSP, the USGS must be able to assess the quality and accuracy of commercial remotely sensed data in the same way that it has historically calibrated and certified film cameras in the past. The USGS will build upon the knowledge gained in characterizing U.S. commercial satellite data through the Joint Agency Commercial Imagery Evaluation conducted with NASA and the National Geospatial-Intelligence Agency (NGA). The USGS will also expand the use of its recently established Digital Camera Calibration Laboratory.

2004 Program Performance Accomplishments for Satellite Mission Operations and Data Acquisition

The LRS Program ensures consistently calibrated, repetitive acquisition of observations over the Earth's land mass, coastal boundaries, and coral reefs, and ensures the data acquired are of maximum use in supporting the scientific objectives of monitoring changes in the Earth's land surface and associated environment. The program accomplishments for FY 2004 are demonstrated in the performance measures to provide "satellite data collected over global land surface" and ensuring "satellite data available from archive within 24 hours of capture."

Landsat — Mission Operations: Landsat 7 and Landsat 5 continue to collect data globally (300 scenes per day in the case of Landsat 7 and over 48 contiguous States (60 scenes/day) for Landsat 5). The mission operations teams maintain orbital position and velocity to mission parameters.

New Products: The USGS released a new product for Landsat 7 ETM+ data captured after the Scan Line Corrector (SLC) anomaly. This new product uses Landsat 7 data collected before the anomaly to fill the missing areas due to the non-functional SLC. Two scenes are geometrically registered and a histogram matching technique is applied to the pixels that provide the best-expected radiance values for the missing data. This product increases the utility of the Landsat 7 data affected by the anomaly. More information on the merged products as well as examples can be found on the USGS Landsat Web site (see fig. 1) (<http://landsat.usgs.gov/>).

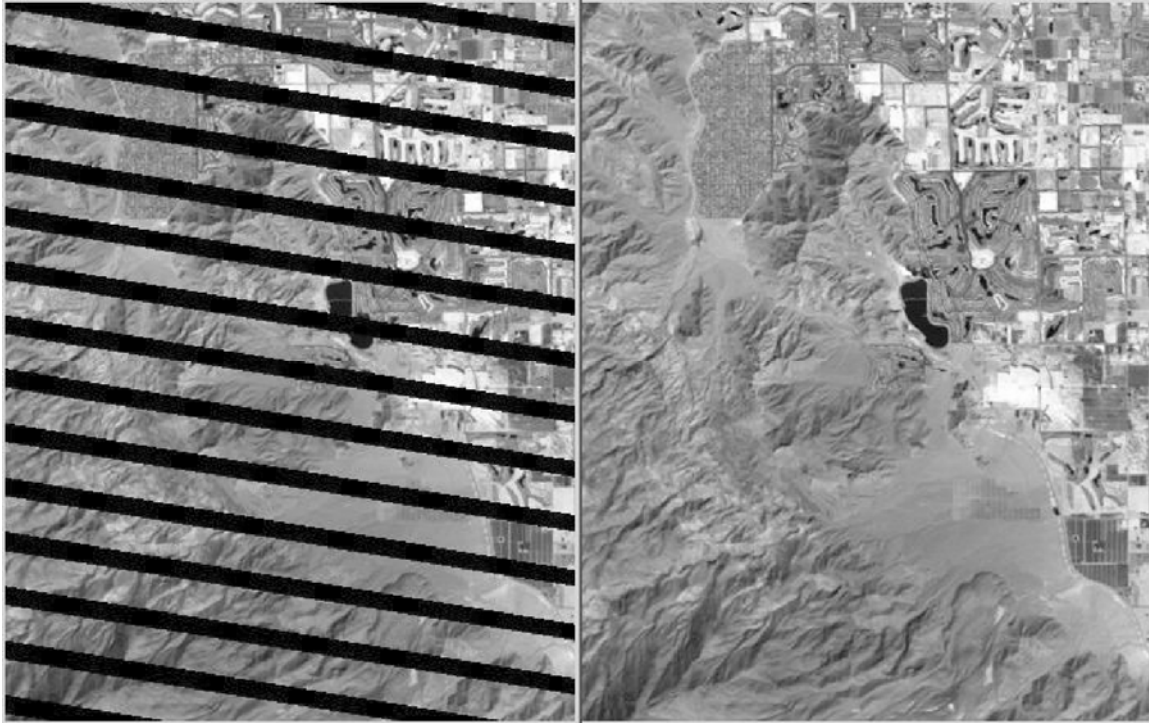


Figure 1. Left: image subset of a Landsat 7 ETM+ post anomaly scene acquired September 17, 2003 (Salton Sea, CA). Right: image subset of the same post anomaly scene after using image data from a separate SLC-off scene acquired September 1, 2003.

Enhancing the value of the data: The USGS entered into a cooperative agreement with South Dakota State University (SDSU) to use SDSU's unique skills in Landsat calibration to develop and operate a Multispectral Scanner (MSS) and Thematic Mapper (TM) calibration system for Landsat 1, 2, 3, 4 and 5. Because of this agreement, the Landsat user community benefits from the improved radiometric and geometric calibrations on over 30+ years of Landsat data.

Improving data access: The Landsat project completed major upgrades to the data capture and processing systems. These upgrades have improved the capture and processing time of Landsat 7 data by approximately 40 percent.

Landsat Data Continuity Mission — The Land Remote Sensing Policy Act of 1992 (P.L. 102-555) directed Landsat Program Management to ensure the continued acquisition and availability of Landsat-quality data. The USGS and NASA cooperated to this end by evaluating alternatives for a Landsat 7 follow-on mission while ensuring that the Federal Government retains continuous access to Landsat-like observations that are necessary to support long-term global monitoring. On August 13, 2004, the President's Science Advisor released a memo on Landsat Data Continuity Strategy. At that time, the USGS and NASA released a Request for Information (RFI) to solicit innovative approaches for the development and incorporation of a new Operational Land Imager and also for a potential stand-alone mission (<http://ldcm.usgs.gov>). Several LDCM accomplishments for FY 2004 include:

- The USGS LDCM team co-led an Interagency Working Group (USGS, NASA, NOAA, NGA, National Reconnaissance Office) that developed LDCM "way-forward" recommendations to the White House,

- The USGS LDCM team participated in the NASA RFI on LDCM options, and
- USGS and NASA jointly developed a prototype image data calibration and validation system for the OLI instrument. OLI will be the replacement for the Enhanced Thematic Mapper+ sensor, which has flown on Landsat 7.

Commercial Remote Sensing (CRS) — In FY 2004 the USGS made significant progress in the implementation of the President's Commercial Remote Sensing Space Policy (CRSSP) (<http://crsp.usgs.gov>). Collection, analysis, and reporting were completed on the civil agency short-term data requirements. A paper was also presented on these requirements at the fall American Society for Photogrammetry and Remote Sensing (ASPRS) Technical conference in Kansas City, MO. In addition, the requirements were used to determine three primary focus areas for civil agency data needs: Alaska, the Great Lakes region, and economically significant ports.

The USGS has established Commercial Remote Sensing Data Contracts with all three U.S. commercial high-resolution satellite data providers. Over \$1 million in Federal agency purchases were completed in FY 2004. These data were added to the USGS archive.

The USGS has responsibility for characterizing and calibrating the Nation's aerial mapping sensors, for the calibration and validation of satellite data, and for validating products to ensure the quality of image-derived products. Since 1973, the USGS Optical Science Laboratory has been responsible for calibrating cameras used by the aerial mapping community. During FY 2004, the USGS lab calibrated over 115 cameras (<http://erg.usgs.gov/tsb/osl/>).

The USGS also maintains a Digital Camera Calibration Laboratory to research the digital imaging technologies that are replacing film-based systems (see fig. 2). During FY 2004, the project developed an in-situ calibration test range and associated software to evaluate the combined platform-camera system end-to-end. The range is used to obtain imagery with ground control and proper instrumentation. The resulting digital images are entered into software programs to assess the sensor and product qualities.



Figure 2. The new Digital Camera Calibration Lab established at the USGS National Center for EROS.

Land Remote Sensing Subactivity

The USGS has been working with NASA and the NGA, industry, and academia, to validate and characterize commercial remote sensing space data products since 2000 through the Joint Agency Commercial Imagery Evaluation (JACIE). Findings are presented annually at the High Spatial Resolution Commercial Imagery Workshop. The 4th annual workshop was held November 8-10, 2004, at USGS Headquarters, in Reston, VA. The workshop featured analysis of Space Imaging, DigitalGlobe, and ORBIMAGE satellite.

In December 2003, USGS co-sponsored the International Workshop on Radiometric and Geometric Calibration, in conjunction with NASA, the International Society for Photogrammetry and Remote Sensing (ISPRS), and Committee on Earth Observation Satellites Working Group on Calibration and Validation (CEOS). The results from the workshop were documented in a publication, "Post-Launch Calibration of Satellite Sensors."

The USGS has established joint agency agreements with NOAA and the United States Department of Agriculture to become part of seven different networks, locating in-situ instruments at the USGS EROS campus. The instruments collect key Earth surface properties needed to parameterize land and atmospheric process models, as well as validate results derived from process models and (or) remotely sensed imagery. The site supports: (1) NOAA National Ocean Service National Geodetic Survey's Continuously Operating Reference Station network, (2) NOAA Forecast Systems Laboratory's GPS Surface Observation System network, (3) USDA Natural Resources Conservation Service's Soil Climate Analysis Network, (4) NOAA Surface Radiation Research Branch's Surface Radiation Budget Network, (5) NOAA National Climatic Data Center's Climate Reference Network, (6) USGS carbon flux tower supporting NOAA and USDA networks, such as Ameriflux and Fluxnet, and (7) USGS Cimel instruments supporting the NASA AERONET network.

2005 Planned Program Performance for Satellite Mission Operations and Data Acquisition

The FY 2005 planned program performance examples listed below are linked to performance measures for "satellite data collected over global land surface" and ensuring "satellite data available from archive within 24 hours of capture."

Landsat — Data acquisition will continue for Landsat 7 for the U.S. archive at a rate of 300 scenes/day per the Long Term Acquisition Plan. The Plan has been modified to acquire scenes that are good candidates for later combining into the new gap-filled products. Orbital position and velocity will be maintained to specification through weekly delta-velocity and yearly delta-inclination spacecraft maneuvers. A software gyroscope for use onboard the spacecraft is under development to mitigate the risk of operation without hardware gyroscope redundancy.

Landsat 5 data acquisitions will continue for the U.S. archive over the 48 contiguous States (60 scenes/day). Data over the continent of Australia is also processed into the U.S. archive and is available through a U.S.-Australia Cooperative Agreement (30 scenes/day). Orbital position and velocity will be maintained to specification through weekly delta-velocity and yearly delta-inclination spacecraft maneuvers. A large increase in International Cooperator stations wishing to receive Landsat 5 data downlinks has created a scheduling bottleneck; upgrades to the scheduling system and software are planned to alleviate this issue. The Landsat 5 Flight Operations Contract enters its last year during FY 2005. A contract re-compete effort will be started in FY 2005.

Development and delivery of new Landsat 7 products to help mitigate the impact to the users of the Scan Line Corrector (SLC) loss will continue. The current collection of SLC-off Landsat 7 data will be reprocessed to provide new information (gap location statistics, higher resolution browse) to aid the user in effective selection of SLC-off products. Migration of old Silicon Graphics, Inc. (SGI) systems to PC/Linux systems will continue to hold down operating costs and increase throughput (the new SLC-off GAP-filled products are very computationally complex). The historic Landsat 1 - Landsat 5 data on old tape media continue to be migrated to new media. Due to the number of tapes involved, and the condition of the old tapes, this data migration effort will take over 2 years to fully complete. A Landsat 5 TM calibration capability will be developed and delivered into operation.

Landsat Data Continuity Mission (LDCM) — At the direction of the Administration, the USGS/NASA team that has been working to develop the Landsat Data Continuity Mission joined forces with staff members from the NOAA NPOESS Integrated Program Office to work out a long-range plan for the transition of Landsat into an operational program to ensure data continuity. Consequently, Dr. John Marburger, Director of the White House Office of Science and Technology Policy (OSTP), issued a memorandum calling for integration of future Landsat sensors on NPOESS satellites. The USGS role is to acquire, archive, provide access to, produce, and distribute remote sensing data and products, and perform data calibration for this mission (<http://ldcm.usgs.gov>).

The first NPOESS satellite is currently scheduled for launch in December 2009 – possibly later if problems occur during the satellite’s construction and testing.

In FY 2005, the USGS will work with NASA to select winning bidders from industry to build an OLI sensor. The USGS will continue engineering analysis in order to prepare procurement for an upgraded ground data processing facility. This will lead to an initial procurement for OLI ground processing hardware and software in FY 2006. Additional procurements, installation, launch-readiness testing, and preliminary staffing would take place during the following years.

Commercial Remote Sensing Space Policy (CRSSP) Implementation — A Web-based tool will be released in January, 2005 that will allow Civil Agencies to input their near-term remotely sensed data requirements. An additional release in March will allow querying and reporting of the requirements submitted. Work will continue on the tools for the remainder of the fiscal year in preparation for the 2006 requirements data call. Augmentations to support the unique requirements of commercial data including license management will be implemented. Continued support of the CRSSP Senior Steering Committee and the Implementation Working Group will also continue in FY 2005.

A Memorandum of Agreement (MOA) will be signed with the National Geospatial-Intelligence Agency (NGA). Activities under the MOA will include the role of the USGS in distributing NGA commercial data licensed for civil users, the process to identify similarities in civil data requirements with NGA planned acquisitions, and the investigation of NGA infrastructure for possible reuse.

Long-Term Data Preservation and Access

(Estimates for FY 2004, \$7.5 million; FY 2005, \$6.9 million; FY 2006, \$12.9 million)

The Land Remote Sensing program has the responsibility to preserve, provide access, and distribute products from the Long Term Archive of aerial and satellite data in the USGS National Center for EROS’ archives, the National Satellite Land Remote Sensing Data Archive

Land Remote Sensing Subactivity

(NSLRSDA) and the NASA-sponsored Land Processes Data Active Archive Center to a worldwide community of Federal and scientific users. Currently over 107,000 rolls of aerial and satellite imagery containing in excess of 13 million frames are archived at EROS. This includes a digital inventory of over 1,300,000 scenes on 25,000 magnetic tapes totaling nearly 500 terabytes (see fig. 3). The USGS National Center for EROS is a world leader in archiving remotely sensed data, and in providing those data to users quickly, affordably, and in the most accessible format.



Figure 3. Historic data archive (left) and automated silo storage (right) located at the USGS National Center for EROS.

The archive holdings are used for environmental research, homeland security, land management, natural hazard analysis, and natural resource management and development, with applications that extend beyond America's borders. The worldwide community of users includes personnel in Federal, State, and local governments, researchers at academic institutions, and private enterprise.

Through the Land Remote Sensing Policy Act of 1992 the Congress directed the Department of the Interior to establish a permanent government archive containing satellite remote sensing data of the Earth's land surface, and to make them available for study. This collection, formally known as the NSLRSDA is managed and maintained at the USGS National Center for EROS.

While initiated to ensure the preservation of the Earth's natural history as captured by the Landsat program, the law mandates that the archive should include other valuable land data acquired by satellite. To fulfill that mandate, the archive has been augmented with data from a number of sources, including data purchased from the commercial sector and declassified images acquired by national reconnaissance systems long before the inception of the Landsat program. An Archive Advisory Committee, chartered under the Federal Advisory Committee Act, evaluates the state of the archive and provides expert advice to the Secretary on how to manage and prioritize the ever-growing volume of data (<http://edc.usgs.gov/archive/nslrda>).

The USGS projects an exponential growth in satellite data archival volume of the NSLRSDA (see fig. 4). The core of NSLRSDA consists of Multispectral Scanner (MSS) and Thematic Mapper™ image data (1972 to present) from Landsat 1-5 satellites; Advanced Very High Resolution Radiometer (AVHRR) data (1986 to present) over the Earth's land surface from NOAA weather satellites; and more than 880,000 declassified intelligence satellite photographs (1960-1972). As stated in an MOU between NASA and the USGS dated February 18, 1993, the NLRSDA will eventually hold satellite data sets from NASA's EOS missions, such as MODIS data from Terra and Aqua. Archiving and distribution of these data sets from the Land

Processes Distributed Active Archive Center will continue through FY 2006 and beyond as defined by the NASA-USGS agreement.

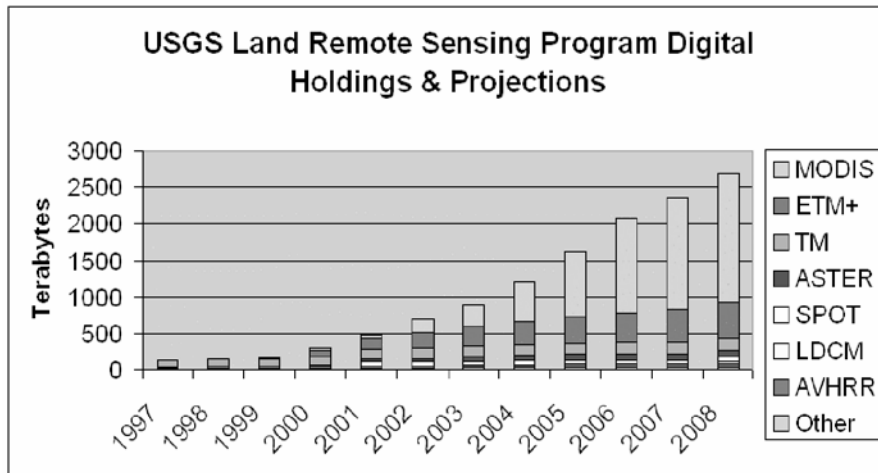


Figure 4. The projected exponential growth in the volume of satellite data archived by the USGS.

FY 2004 Program Performance Accomplishments for Long-Term Data Preservation and Access

The program accomplishments for FY 2004 are demonstrated in the performance measure to provide "satellite data available from archive within 24 hours of capture."

Aerial Photography — Since the early 1970s the USGS has offered a variety of photographic products (both print and film); however, for the last few years there has been a decline in customer demand for these types of products. The USGS discontinued offering photographic products September 3, 2004, and began to offer a new digitized product starting October 1, 2004. This new digitized medium-resolution product is created using a camera system developed by USGS (see fig. 5). The USGS holds thousands of rolls of film containing several million frames of historical aerial and satellite photographs dating back to the 1930s gathered from various Federal agencies. This digitized product will also be used to generate a digital browse to improve access to the USGS historical aerial photographic archive <http://edc.usgs.gov/products/aerial/medresdig.html>.

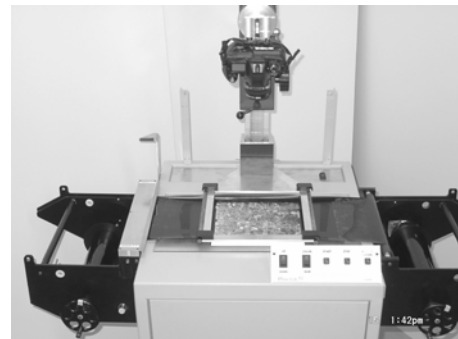


Figure 5.

SRTM — The Shuttle Radar Topography Mission (SRTM) successfully collected Interferometric Synthetic Aperture Radar (InSAR) data over 80 percent of the landmass of the Earth between 60 degrees North and 56 degrees South latitudes in February 2000. The mission was co-sponsored by the NASA and NGA. Extensive post-processing by NGA was required to make a product appropriate for the user community. In FY 2004 all of this data has been delivered to the USGS and are available to customers through an ftp server (see fig. 6). (<http://edc.usgs.gov/products/elevation/srtmbil.html>)



Figure 6. Perspective of Mount St. Helens combining Landsat with SRTM data.

Greenness Products — AVHRR data directly received by the USGS from NOAA weather satellites is used to generate 7- and 14-day greenness composite image maps of the conterminous United States and Alaska (<http://edc.usgs.gov/greenness/whatavhrr.html>). Early in FY 2004, the NOAA 16 satellite began experiencing a serious scan motor mechanical problem indicative of end-of-life. To ensure data continuity to USGS scientists and customers, greenness mapping was successfully transitioned to the NOAA 17 satellite on April 28, 2004 (http://lpdaac.usgs.gov/1KM/stitched_orbits.asp).

Land Processes DAAC — The Land Processes (LP) Distributed Active Archive Center (DAAC) was established at the USGS National Center for EROS as part of NASA's Earth Observing System (EOS) Data and Information System (EOSDIS) initiative to process, archive, and distribute land-related data collected by EOS sensors, thereby promoting the interdisciplinary study and understanding of the integrated Earth system (<http://lpdaac.usgs.gov/main.asp>).

The LP DAAC recently incorporated the NASA EOS Data Clearinghouse, making data available to USGS scientists, users, and Earth science client developers through a new NASA capability. It also made all of the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) (<http://edcdaac.usgs.gov/aster/asteroverview.asp>) and the Moderate Resolution Imaging Spectroradiometer (MODIS) (<http://edcdaac.usgs.gov/modis/dataproducts.asp>) data available through the USGS Global Visualization viewer. Mosaics of Terra/MODIS 16-day 1km vegetation indices for the conterminous United States are now available as part of *The National Map* through the Seamless Data Distribution system (<http://seamless.usgs.gov/>).

The LP DAAC continues to collect, archive, and distribute massive amounts of Earth science data. In FY 2004 the LP DAAC collected and archived over 5.6 million products or 472 terabytes of data, in one quarter almost 150 terabytes of data from NASA satellites through Japan and NASA's Goddard Space Flight Center were ingested, with a record of 2.5 terabytes in one 24-hour period. Over the space of the year, the LP DAAC distributed about 2.4 million products or over 270 terabytes of data.

The LP DAAC held a number of workshops and poster sessions to teach users how to use ASTER and MODIS data. As an example, the LP DAAC held an ASTER and MODIS Data for Land Process Studies workshop at the USGS National Center for EROS. Fifteen individuals attended from the Bureau of Reclamation, Bureau of Land Management, Bureau of Indian Affairs, and NASA.

FY 2005 Planned Program Performance for Long-Term Data Preservation and Access

The FY 2005 planned program performance examples listed below are linked to performance measures for ensuring "satellite data available from archive within 24 hours of capture."

Earth Observing System (EOS) Support — In FY 2005, EOS Support will continue to operate data collect, archive, and distribution at extremely high volumes and customer satisfaction rates. Approximately 2.75 million products will be distributed to the public out of the Land Processes Distributed Active Archive Center's growing archive, which will reach 1.5 petabytes in FY 2005. EOS Support is also actively investigating new, lower cost, archive and distribution technologies, looking at both NASA and USGS requirements, with the intention of producing a state of the art design and operations concept in FY 2005. Given the changing user preference for product delivery, the emphasis will be on real time on-line access and download for users. In addition to applying this to the evolution of NASA's EOSDIS system, EOS Support will look for opportunities to enable the transfer of NASA's EOS data to the USGS (<http://edc.usgs.gov/about/eos.html>).

Planned data management FY 2005 activities in support of Long-Term Data Preservation and Access will focus upon maintaining, preserving, and providing ready public access to historical remote sensing film and digital databases and archives. Work will include data and metadata receipt, coordination and ingest processing, and inventory and storage area management. It also includes data set preservation actions such as copying data from obsolete to new media, performing data sets appraisals and transferring vinegar syndrome-affected historical film to the National Archive and Records Administration to ensure long-term preservation.

Infrastructure will be developed, appropriately sized to product demand, and operated to generate scanned and digitized products from the film-based historical archives. Products from both the historical aerial and satellite archives will be delivered to the public using standard digital media such as CD, DVD, and FTP. Additionally, public access to the historical film archives will be significantly improved by creating and placing browse and digitized photo indexes online and creating single frame coordinate metadata.

Customer demand for digital products has resulted in photographic production equipment and lab spaces being decommissioned. Planned activities include cleanup, disassembly, and removal of all equipment; disposal and cleanup of chemical management and storage areas; and disposal of excess equipment and unused film raw stock and chemical inventories.

Remote Sensing Research and Data Utilization

(Estimate for FY 2004, \$12.9 million; FY 2005, \$13.0 million; FY 2006, \$13.2 million)

Research, Development and Applications — The LRS program conducts research in remotely sensed land data collection, access, distribution, and applications from current and possible future data sources. Scientists and engineers sponsored by the LRS Program are

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investigating new types of satellite systems and sensors, studying promising new data sources, developing new data acquisition programs and sources, and assessing the potential for new data applications. In addition, the program is seeking new ways to make remotely sensed data products more accessible to the land remote sensing user community, as well as ways to expand and enhance the overall use of remotely sensed data (<http://remotesensing.usgs.gov/researchapps.html>). This research is in alignment with not only the goals of the USGS and DOI but also with the coastal mapping needs of the Nation as reported by the National Research Council's Committee on National Needs for Coastal Mapping and Charting. The Committee's 2004 report, *A Geospatial Framework for the Coastal Zone: National Needs for Coastal Mapping and Charting*, specifies as one of their recommendations that "New remote sensing and in situ technologies and techniques should be developed to help fill critical data gaps at the land-water interface," by improving satellite imaging capabilities and integrated bathymetric/topographic LIDAR, multispectral, hyperspectral, and photographic imaging systems. Land Remote Sensing projects will continue scientific research in all these state-of-the-art systems.

National Civil Applications Program (NCAP) — The National Civil Applications Program (NCAP) serves the Federal civil community by providing for the acquisition, dissemination, and exploitation of classified remote sensing systems and data. NCAP provides USGS with a unique ability to conduct synthesis and fusion of all source (classified, commercial, governmental and open source) remotely sensed data in order to provide decisionmakers with the best available information in support of land and resource management, environmental, socioeconomic, hazards, disasters, and other scientific and policy issues. As part of its mission, NCAP also provides informational support for Continuity of Operations/Continuity of Government (COO/COG) and homeland security/defense functions.

The LRS program has refined the strategic direction of the NCAP activity. The focus and emphasis of the NCAP is to maintain and enhance the USGS classified research and applications capabilities. The awareness, utilization, and synthesis of all source (classified, commercial, open source and governmental) information and data provide USGS with a unique ability to provide decisionmakers with the best available, scientifically sound information available. This evolution will result in fundamental changes and enhanced potential for the activity to support the USGS mission. The most dramatic changes in the activity are:

- A shift from an exclusively National Technical Means (NTM) focus to an all source (classified, commercial, governmental) exploitation perspective and functionality,
- A more focused role supporting Department of the Interior requirements,
- A more robust role in hazards-related homeland security (HLS) and emergency planning and response (EPR) activities,
- A greater emphasis on collaborative scientific and technological research with the Intelligence Community, and
- Active engagement as an information provider supporting Homeland Security and Homeland Defense, as well as a consumer of classified assets.

Public Access and Applications of Remote Sensing Data: *AmericaView* — Ensuring public access to remotely sensed and other geospatial data is an important aspect of the USGS mission. To maximize public access to these data, enhance the understanding of the science of

remote sensing, and to encourage development of remote sensing curricula, the USGS has entered into an agreement with *AmericaView*, a national group of State university consortia and other institutions that are seeking improved, affordable access to land remotely sensed data for research, education, and other applications. *AmericaView* is the outgrowth of the successful *OhioView* pilot project, initiated as a prototype for high-speed processing and rapid delivery of remotely sensed data to State and local users (<http://www.americaview.org>).

AmericaView will continue to expand access to remotely sensed data and support development of applications by adding new members to the consortium and by actively engaging in workshops, research, and consortium outreach and education efforts. Support of this interest by the Federal Government will result in significant benefit to the public through the growing number of practical applications of this valuable source of information about the Earth.

AmericaView will significantly enhance the capability of States, counties, cities, other localities, and the private sector to take advantage of the benefits of using remotely sensed information and technology. In addition, many of the member universities have established goals to expand the numbers of students following a course of instruction in remote sensing. In the future, as researchers analyze and add value to the data received through *AmericaView*, enhanced data and information for *The National Map* will be available via Internet connections and accessible to all Americans. By engaging users at the State and local level, *AmericaView* also helps build partnerships that will be useful in activities related to homeland security in both counties and municipalities across the Nation. In addition, the technological infrastructure built through *AmericaView* activities will support the exchange and enhancement of geospatial data and information that can be applied to a wide variety of needs including land use and agricultural analyses, urban growth and planning, environmental and natural hazards studies, and national security applications nationwide at the local level. The Consortium currently consists of the State members listed below.

***AmericaView* Participation – 2004**

Full Members	Affiliate Members	Interested States
Alabama	California	Arizona
Alaska	Kentucky	Colorado
Arkansas	Hawaii	Florida
Georgia	Louisiana	Idaho
Indiana	Montana	Illinois
Kansas	North Dakota	Mississippi
Nebraska		New Mexico
Ohio		Pennsylvania
South Dakota		
Texas		
Virginia		
West Virginia		
Wisconsin		
Wyoming		

FY 2004 Program Performance Accomplishments for Remote Sensing Research and Data Utilization

The program accomplishments for FY 2004 are linked in the performance measure to provide "% of land with temporal and spatial monitoring, research, and assessment to meet land use planning and monitoring requirements."

DOI Science Support

Mapping Noxious Plants with High-Resolution Satellite Imagery — The BLM manages a weed control program to mitigate the effects of noxious plants, especially tamarisk, in San Juan County, UT. The USGS developed methods of mapping tamarisk from readily available, high-resolution satellite imagery. These methods were employed in the Comb Wash area of the county and were successful in providing the BLM with accurate tamarisk locations.

Monitoring Ecological Processes in Alaska — Land remote sensing data are increasingly being used to monitor most of the ecological processes that occur on the surface of the Earth. This is especially true of Alaska, where the vast majority of territory occurs in remote and inaccessible areas. Land remote sensing studies in Alaska during FY 2004 attempted to model land cover classifications in high arctic tundra areas over different temporal periods and using high spatial resolution InSAR/LANDSAT merge data at 2.5-m resolution, small and large scale historical (1955, 1979) and more recent (2002) aerial photography, and 30-m Landsat (circa 1999-2002) data. Working with the BLM, and each of the four science disciplines in the USGS, sample areas of the National Petroleum Reserve-Alaska were assessed for changes in shoreline configuration and habitat. Using a large tundra lake as a prototype area, initial results indicate that there have been some major changes in the size of the lake and the shoreline configuration. These types of studies will continue into FY 2005 and possibly FY 2006, extending to assess coastal shoreline change along the Arctic Ocean. (http://edc.usgs.gov/Geo_Apps/).

Innovative Approaches to Analysis of High-Resolution Light Detection and Ranging (LiDAR) Data — USGS scientists conducted research on "bare earth" processed LiDAR data collected for a nine-quad area surrounding Lincoln, NE, using new tools and methodologies. Building footprints for the Lincoln area were generated using automated feature extraction. (<http://gisdata.usgs.net/topographic/lidar.asp>).

Phenology — Phenology is the study of the timing of biological events, particularly in response to climatic changes to the environment. Phenology has historically been studied as direct observations of the timing of leaf opening, flowering, leaf fall, and such events. To study large areas, remote sensing from satellites has emerged as an essential tool. Regular, repeatable Earth observations from satellites provide a strong, objective basis for terrestrial monitoring. By analyzing time-series greenness data derived from NOAA's AVHRR and NASA's MODIS satellite-based sensors, we can identify patterns of changing vegetation conditions and research their causes. Initial results indicate increasing growing season length (and corresponding increasing production) in the Great Lakes area, while there is decreasing production in the desert southwest. Ongoing research is designed to explain the driving forces of the phenological changes as a result of natural climatic cycles (for example, El Nino-related fluctuations), longer term shifts in climate related to greenhouse gas buildup in the Earth's atmosphere, or the climatic influences of land use and land cover change.

Drought Monitoring — A cooperative project with the National Drought Mitigation Center at the University of Nebraska-Lincoln, has developed techniques to incorporate satellite-derived information with additional data on soils, irrigation, land cover, and daily weather to develop a Vegetation Drought Response Index (VegDRI) for the northern Great Plains (see fig. 7). This product identifies levels of drought severity during the growing season and is updated on a biweekly basis.

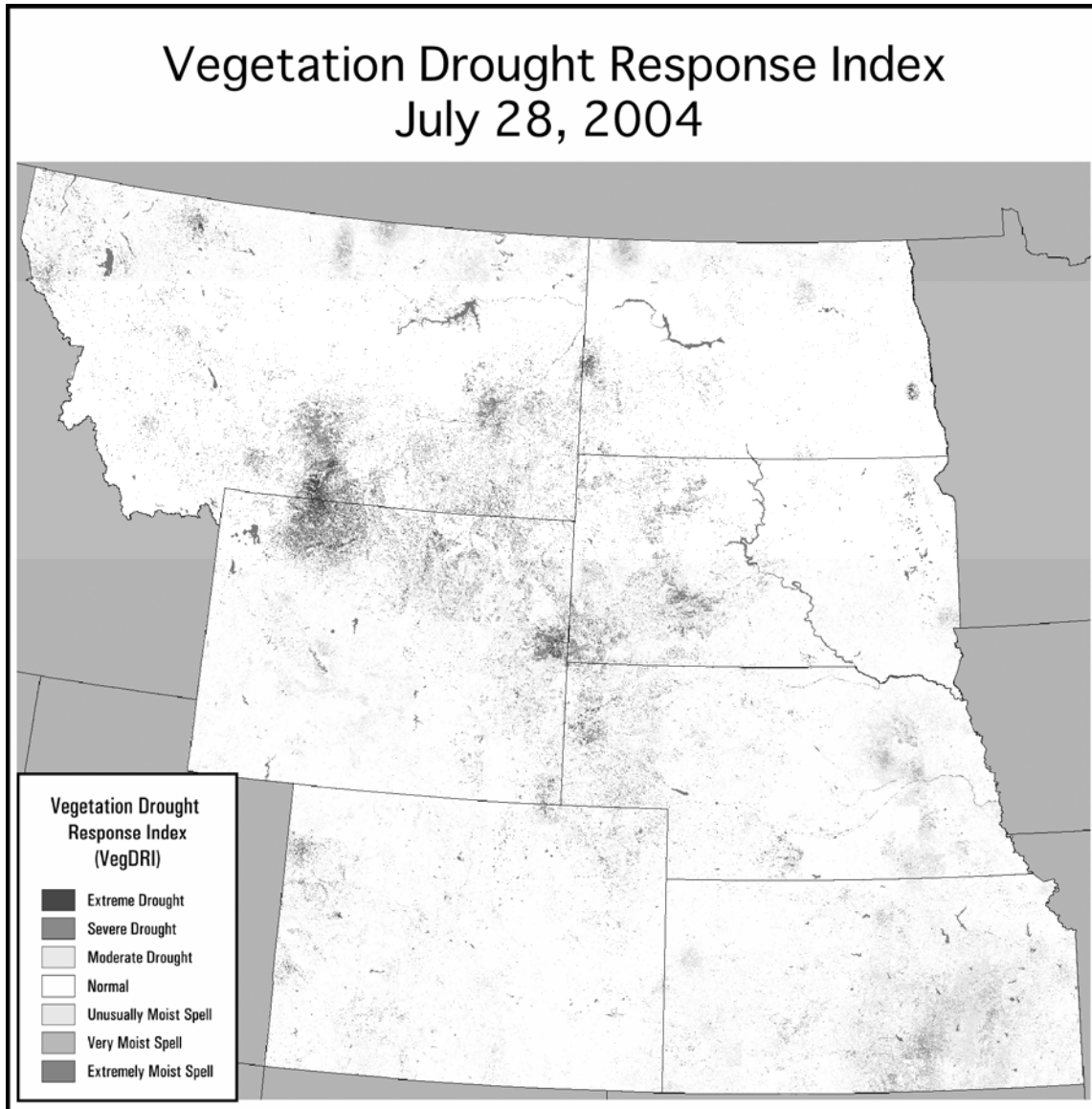


Figure 7. Example of a Vegetative Drought Response Index for the Northern Great Plains.

Sage Grouse — USGS is participating on a project team that involves scientists from the University of Montana, Wyoming State Game and Fish Department, Montana State Department of Fish, Wildlife and Parks, Wyoming and Montana BLM State and field offices, plus several private/industry partners. The focus of the project is conservation planning for sage grouse in the Powder River Basin of southeast Montana and northeast Wyoming. Detailed sage grouse habitat and population data are being linked with landscape-scale vegetation/habitat information derived from satellite imagery and aerial photography to create planning maps that prioritize

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landscapes for sage grouse conservation in the Powder River Basin. A regionwide vegetation classification and attempt at classifying sagebrush canopy cover is in progress. The project documented the first case of West Nile Virus mortality in sage grouse, raising questions about potential mosquito habitat derived from increased surface water produced by coal-bed methane (CBM) activities.

Ridge-to-Reef Assessment of Land-based Pollution Impacts on Pacific Coral Reefs —

The U.S. Coral Reef Task Force identified land-based pollution as one of six priority threats on which to focus efforts to protect coral reefs. The Coral Reef Task Force commissioned regional partnerships to plan Local Action Strategies (LASs) to reduce or eliminate threats to coral reefs. Land-based pollution threats are identified for action in the LASs for Hawaii, American Samoa, Northern Mariana Islands, Guam, and other former territories in Micronesia. Hawaii's LAS partners (including FWS, NPS, USGS, EPA, NRCS, NOAA, Hawaii natural resource, health, and coastal zone management agencies, and local non-governmental organizations including The Nature Conservancy) developed a strategy based on traditional native Hawaiian natural resource management systems that encompass the whole ecosystem from the high island ridges to the near-shore reef. In FY 2004, USGS initiated the "Ridge-to-Reef" Study that provides monitoring and research support for priority ridge-to-reef restoration sites identified by the LAS on Molokai, Kauai, and Maui. USGS began baseline-monitoring activities founded on previous accomplishments and directed at watershed restoration and actions implemented by other LAS partners. The Molokai reef, the longest of the fringing coral reefs in the Hawaiian Islands, is strongly affected by land-based sedimentation. USGS installed the first of a proposed network of streamgages and sediment monitoring devices in critical watersheds (see Real-time Streamflow data for Station #16415600 at <http://hi.water.usgs.gov/>). About 8,000 very high resolution remote sensed images have been collected and analysis to produce high-resolution vegetation maps of watersheds currently designated for feral animal control has begun.

National Civil Applications Program (NCAP) — NCAP provides USGS support to the Civil Applications Committee (CAC). The CAC is a Presidential chartered interagency committee that provides oversight for the collection and use of classified remote sensing data by facilitating image acquisition, coordinating research and policy activities, providing an interface to the military and intelligence communities, and ensuring the proper use of classified information. Interior delegates the Chair of the CAC to the USGS. The Geography Discipline staffs the CAC Secretariat and NCAP provides security, facilities, source management, and other services to CAC members. NCAP priorities are: Infrastructure (Security, Facilities); Hazards (Natural Hazards, Homeland Security, and Homeland Defense); DOI Science Support and Research and Technology Transfer related to the above priorities.

Hazards and Emergency Response — Geospatial Multi-Agency Coordination (GeoMAC): Near-real-time data were continuously integrated and disseminated via the Web-based Geospatial Multi-Agency Coordination (GeoMAC; <http://www.geomac.gov>) to aid firefighters in decisionmaking at strategic levels. During the 2004 Alaska fire season, in which over 6 million acres burned, GeoMAC was used extensively and proved to fill a critical niche for fire operations personnel.

Collaborators:

DOI/Bureau of Land Management
DOI/Bureau of Indian Affairs
DOI/U.S. Fish and Wildlife Service
Geospatial Task Group
USDA/U.S. Forest Service
National Interagency Fire Center
NOAA/National Weather Service

FY 2004 was a slow fire year and yet approximately 50 million users requested information. GeoMAC continues to gain popularity in the firefighting arena. If 2005 becomes as busy a fire season as 2000 or 2002, USGS estimates that GeoMAC requests could approach 250 million.

Transportation Issues and Natural Disasters: CASCADE FURY II, an emergency transportation exercise, simulated a series of natural disasters impacting the transportation network throughout the northwestern United States. This exercise was the first emergency transportation exercise jointly conducted by the Department of Transportation Regions 8 and 10, and included State and Federal transportation professionals and emergency managers from six States in a 2½-day exercise.

The USGS provided technical support from the initial design concept, to the development of the detailed scenario and through the final execution of the exercise. USGS support professionals developed and implemented Web-map services that deployed at specified intervals volcanic ash fall and earthquake shake zones impacting the transportation network in the six-State region. Statewide base maps were also produced by USGS to support the exercise.

Natural Hazards Support System (NHSS): NHSS has been developed by the USGS to aid in monitoring, supporting, and responding to natural hazard events. NHSS provides a one-stop natural hazards approach by combining easy access to current hazard information, geo-spatial data, and direct access to more detailed information from the source agencies. This Web-enabled combination of information, packaged with unique functionality, aids both the Federal and emergency response community in planning for response and recovery activities (see fig. 8). NHSS currently contains dynamic natural hazards information from a wide variety of agencies such as the National Earthquake Information Center (NEIC), NOAA, the National Hurricane Center, and the National Interagency Fire Center (NIFC) (<http://nhss.cr.usgs.gov/viewer.htm>).

"I would like to thank you personally for the dedication and hard work that you displayed as a member of the CASCADE FURY II Exercise Design Team... Comments from both participants and evaluators show that the exercise was a resounding success. Exercise participants lauded the superb lectures and the realism of the exercise play. And most importantly, I believe that our collective ability to respond to and support a natural disaster scenario within this region has been notably enhanced by this effort."

Jeffrey M. Garrett, Rear Admiral,
U.S. Coast Guard
Regional Emergency Transportation Coordinator
June 2004

Collaborators:

USGS Earthquake Hazards Program
NOAA/National Weather Service
NOAA/National Hurricane Center
National Interagency Fire Center

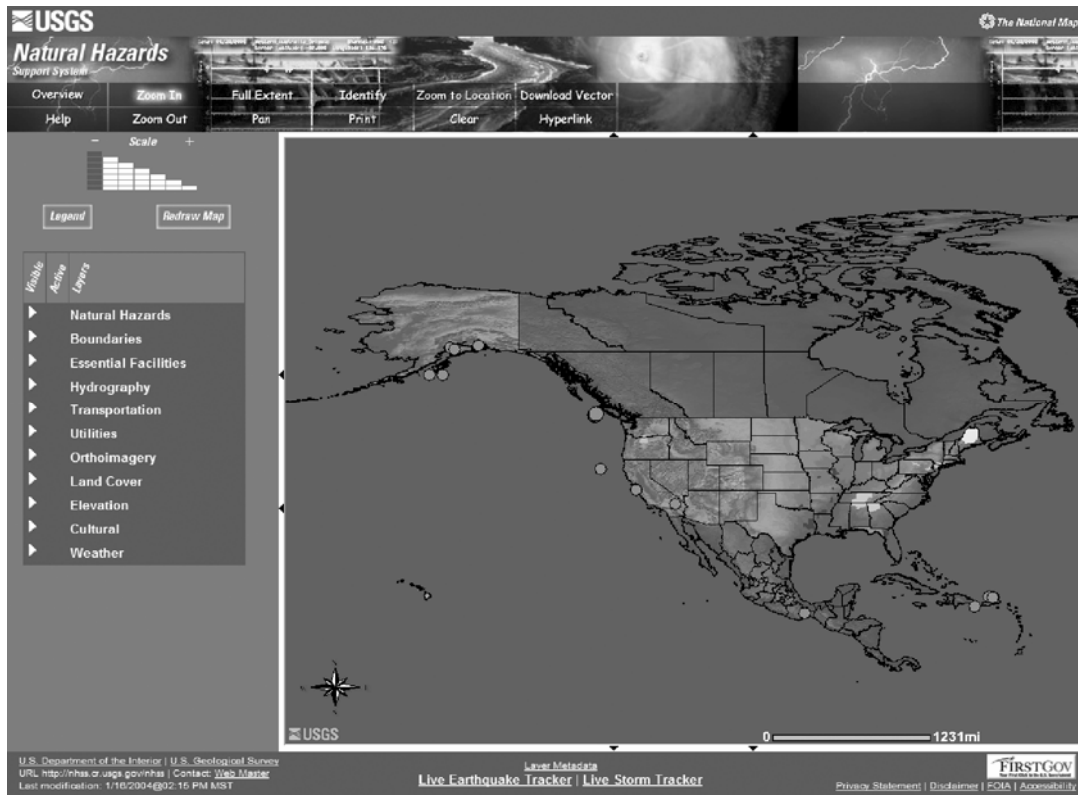


Figure 8. Sample Home Page for the Natural Hazards Support System.

Homeland Security Situational Awareness Applications — A critical component of our Nation's homeland security is the requirement to develop timely, accurate situational awareness (SA) and the capability to share this "awareness" throughout the homeland security and emergency response communities.

Developing the best possible SA requires the integration of geospatial data, situation reports, and other essential information. The USGS has developed two SA tools to support this requirement; The Interagency Operating Picture (IOP) and the Emergency Management (EM) application.

Collaborators:

USGS Geography Discipline, Rocky Mountain Mapping Center
USGS Geology Discipline, Earthquake Hazards Program
Department of Defense/U.S. Northern Command
Department of Homeland Security/FEMA
NOAA/National Weather Service
NOAA/National Hurricane Center
National Interagency Fire Center

IOP was developed for the United States Northern Command's (USNORTHCOM), Interagency Coordination Group (ICG), and allows USNORTHCOM to track the "big picture" of natural and man-made disasters, and also "zoom-in" to understand the geographic implications of a single event. In addition, IOP allows incidents and associated information, including situation reports, to be interactively added in order to provide a real-time visual overview of events. IOP is currently deployed as two separate versions; operational for real-time monitoring, and training to support on-going training requirements. The training version of IOP was one of the key tools used by the Interagency Directorate to monitor and report situational awareness during the spring 2004 Unified Defense (UD04) and fall 2004 Determined Promise (DP04) exercises. This version of IOP was also used in May 2004 for both the Air Force Space Command Colorado

Springs Global Mirror exercise, and the Department of Transportation CASCADE FURY II exercise.

The Emergency Management (EM) Web-mapping application was developed for the Federal Emergency Management Agency - Department of Homeland Security (FEMA-DHS) as a SA and hazards monitoring tool. EM currently occupies a space (screen) in the Homeland Security Operations Center (HSOC) CROP, and is primarily used to track hazards events and identify potentially impacted FEMA assets (facilities and staff). In addition, the EM application is also being used by U.S. Immigration and Customs Enforcement (ICE), U.S. Customs and Border Protection (CBP), and FEMA/National Emergency Operations Center (NEOC).

"This is a fabulous tool. Thank you for sharing it with us. I will distribute it to our Watch Teams. As I have time to work/play with it, I may call on you for assistance and tips. Great to know we're moving ever closer to working effectively together. Please also know you can call on us."

Bruce Price, Watch Officer
Christi Bordeaux, Watch Analyst
Watch Team A
FEMA National Emergency Operations Center
Washington, DC
November 2003

Both IOP and EM combine base geospatial data with dynamic event information to provide an integrated visual overview of events. They pull the dynamic event data from a variety of sources including: NOAA NWS watches and warnings; USGS streamgages; NIFC wild land fire information; USGS NEIC earthquake information; National Hurricane Center hurricane tracking; Remote Access Weather Stations; and United States Coast Guard Commercial Vessel Tracking.

USGS Support to U.S. Northern Command/NORAD through the National Civil Applications Program — During FY 2004, the USGS and USNORTHCOM established an MOA to "... formalize mutually beneficial coordination and information sharing capabilities." As such, USGS science and technology has added value to USNORTHCOM's situational awareness and operations during real world events and exercises. During the 2004 hurricane season and the recent volcanic activity of Mount St. Helens, USGS representatives and support personnel provided critical support to USNORTHCOM's Domestic Warning Center, Interagency Coordination directorate, and the USNORTHCOM Command. USGS occupied a seat in the Domestic Warning Center during the duration of the period of increased volcanic activity. USGS maintained situational awareness and gave USNORTHCOM the information needed for any planning/contingency purposes that would arise from these natural events, as well as from seismic events.

USGS participated in two national-level USNORTHCOM-sponsored exercises as a member of the Interagency Coordination Group. These exercises included participants from all levels of government, DHS, DoD, first responders, NGO's and the private sector. The Interagency Coordination Group utilized the Interagency Operating Picture, a Web-based GIS application developed by USGS for the USNORTHCOM Interagency Coordination directorate that filled an information void that previously existed. Using the application, the Interagency Coordinating Group developed strategic as well as operational level analysis of a situation(s), which was in some cases provided to the USNORTHCOM commander contributing to the command's situational awareness.

As *The National Map* develops and hazards and emergency response requirements are increasing, many Federal agencies are turning to the Hazards-U.S. (HAZUS) database as a source of information. These data have been used for Wildfire support, Hurricane Isabel

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monitoring, and hazards and emergency response training exercises. The need for better spatial accuracy has surfaced as the data are increasingly used for tactical level planning. The USGS has developed procedures to enhance the existing national data and make it usable for a variety of applications. First, local source data from cities, counties, and other local agencies and high-resolution orthoimagery are assembled. Local data points are used to update HAZUS and all points are georegistered to the imagery – creating a product that is accurate to a scale of at least 1:10,000. Ultimately the integrated database is routed back to local entities for quality control and maintenance. When this cycle is complete, local data and HAZUS facilities data share a common baseline.

AmericaView

Program Infrastructure Improvements —

Data Collections Added: Among the improvements made to the AmericaView program infrastructure support system, new Landsat-related and Earth Observing-1 (EO-1) data collections to the GloVis application. The GloVis application is the basis for several State-based data access applications (<http://glovis.usgs.gov>).

StateView Visualization Viewer (StateVis): Related to these USGS infrastructure improvements, StateVis is an implementation of GloVis for a particular StateView archive. StateVis is being developed cooperatively as a prototype by the Alaska and Texas consortia. Any State consortium can now host an instance of StateVis for their archive. Data requests from StateVis are passed to a shopping cart or download facility operated by the archive (the Alaska Shopping Cart, the Texas Automated Archive Responder Gadget (AARG), etc.) Recent work done by AlaskaView has greatly improved the ease of installing and configuring a StateVis instance. Source code, utilities and technical support for implementing a StateView are available from the AmericaView GloVis development team.

AmericaView Visualization Viewer (AV-VIS): AV-Vis is the next phase of GloVis distribution and implementation. Currently under development, AV-Vis differs from StateVis in that each AV-Vis instance will contain browse and metadata for all *AmericaView* state archive holdings. Any State Consortium will be able to host an instance of AV-Vis instead of, or along with their own StateVis if they choose to do so. Data requests from AV-Vis are sent to the archive that houses the requested data. These requests are tailored to meet the needs and requirements of each archive.

Expanding State Information Nodes Through *AmericaView* —

Consortium Growth: Expansion of State imagery archives continued in FY 2004 and 2005 as new member organizations and States were added within the existing AmericaView membership. In response to a May 2004, *AmericaView, Inc.* call for proposals for new affiliate memberships, seven State university groups submitted applications for consideration. Following evaluation of these proposals by the membership committee, five State consortia were admitted to affiliate membership status. Included are groups from California, Hawaii, Kentucky, Louisiana, and North Dakota. This brings the membership total in the national *AmericaView Consortium* to 20 States, which includes 14 full members and 6 affiliate members (see fig. 9). This growth in membership facilitates access to remotely sensed data and promotes increased knowledge of the uses and applications of remotely sensed data. Growth in membership is promoted by adding new member States to the consortium as affiliate members,

accepting affiliate members into the next level as either associate or full members, and by expanding the participation and partnerships within current State members by adding more universities, colleges, and government agencies to the in-State membership. USGS has developed and included growth objectives for the AmericaView Consortium in the statement of work for the FY 2004 and 2005 grants, including these kinds of growth expectations.

Education and Outreach: Workshops were held by several member universities and consortia to enhance the understanding of the science of remote sensing and to communicate information and applications throughout the community. Additionally, the *AmericaView, Inc.* annual conference was held September 20-22, 2004, at the USGS EROS Data Center. The theme for this year's conference was "National and State Partnerships to Enable Remote Sensing Education, Training, and Applications." Workshops were held on the first day, with 58 attendees participating in these training opportunities. Topics of the workshops included Introduction to ArcGIS 9.0, Adapting GloVis for State Use, Introduction to LiDAR, DigitalGlobe and QuickBird's Imagery for Use in Government and Commercial Applications, Introduction to eCognition software, and status reports on the USGS EO-1 and Landsat 7 missions. There were 68 conference participants from 20 states, for the two-day conference, representing several state and local government organizations as well as research faculty and graduate students from nearly 30 universities (<http://www.americaview.org/Conference.html>).

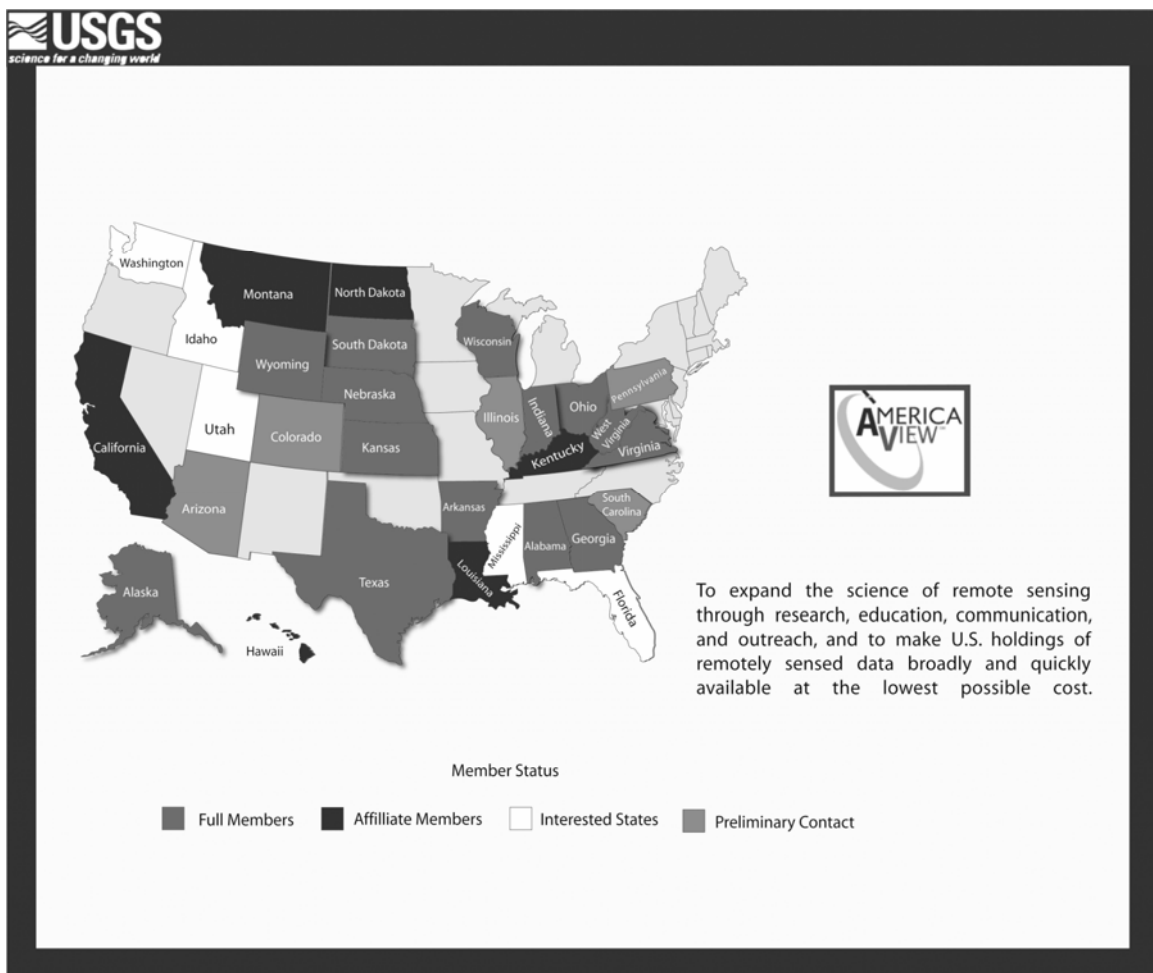


Figure 9. Nationwide map showing State memberships in *AmericaView*.

FY 2005 Planned Program Performance for Remote Sensing Research and Data Utilization

The FY 2005 planned program performance examples listed below are linked to the performance measure to provide "% of land with temporal and spatial monitoring, research, and assessment to meet land use planning and monitoring requirements."

Training — In the area of remote sensing education and training, a comprehensive land remote sensing instructional curriculum covering a broad spectrum of topics ranging from fundamental concepts to advanced multidisciplinary applications of the data will be developed in FY 2005. This instructional curriculum will be presented in remote sensing short courses and workshops designed for the Federal and general user communities and based on their needs as defined during the requirements definition and program promotion process. Remote sensing informational and instructional materials for Web-based presentation will also be developed and presented through a dedicated land remote sensing educational Web site.

Hydrologic Derivatives from Shuttle Radar Topography Mission (SRTM) and LIDAR — SRTM data for the Canadian and Mexican portions of the land surface that drain into the United States, including Alaska, will be processed into hydrologic derivatives. The techniques needed to perform this processing will be prototyped in the Rio Grande watershed. This watershed was selected due to its international nature and the high quality hydrographic data that are available through Mexican colleagues. An enhanced Elevation Derivatives for National Applications (EDNA) database that includes the SRTM derivatives for Canada and Mexico will be produced. This data set is currently available for viewing through several map services and these will be updated to include the enhanced database (<http://srtm.usgs.gov/>).

Innovative Approaches to Analysis of LIDAR Data for *The National Map* — In FY 2005, the completed bare earth surfaces will be input into the National Elevation Dataset (NED) at 3-meter (1/9 arc-second) resolution for the nine-quadrangle area in Lincoln, NE. Three dimensional visualization using volume visualization techniques will be demonstrated to show the potential of visualizing 3-D data interactively on the Web using COTS software. An open-file report has been completed documenting all aspects of the LIDAR collection, processing, and application research, and final edits and publishing will occur in FY 2005. An article is being published in FY 2005 describing aspects of this USGS research and others in Photogrammetric Engineering and Remote Sensing (PE&RS).

Development of RADAR Remote Sensing Technologies — A point target interferometric synthetic aperture radar (InSAR) technique, which utilizes multitemporal InSAR images to identify man-made structures will be developed. This has the potential to monitor movement of these man-made structures with an accuracy of a few millimeters. The point target InSAR technique will be applied to Los Angeles, CA, and a volcano in Alaska. We will investigate the use of SAR imagery (polarimetric, interferometric, and mutliwavelength) on land cover classification and retrieval of surface hydrology variables (flood assessment, soil moisture), produce 1-2 publications on the developed techniques and applications, and provide recommendations on the use of SAR sensors for a variety of land cover related applications.

InSAR Studies of Coastal Regions — Subsidence of coastal regions (southeastern Louisiana and Florida) using InSAR will be studied. Subsidence at a few millimeter accuracy will be mapped using ERS-1, ERS-2, JERS-1, and Radarsat-1 satellite InSAR images. The capability of monitoring three-dimension water-level changes of coastal wetlands using InSAR will be developed. All of these activities will result in one or two publications, will demonstrate the

value of space-based remote sensing technologies for addressing ground subsidence issues in coastal regions, will provide vital information for real-time water flow management of coastal wetlands, and will serve as the basis for understanding water balance and its impact on ecosystem development.

InSAR Monitoring of Earthquake, Volcano, and Landslide Processes — Deformation mapping and modeling to understand processes that lead to earthquakes, volcanic eruptions, and landslides will be pursued in collaborations with the USGS Earthquake Hazards Program, USGS Volcano Hazards Program, and USGS Landslide Program. The goal is to establish observational technologies based on space-borne InSAR analysis of radar imagery to relate surface deformations to subsurface geophysical processes and augment our volcano and earthquake forecasting capabilities.

Phenological Trends — The development of methodology for phenology trend analysis will be completed. The influences of short-term climate change and land use change on land surface phenology for selected ecoregions in the United States will be summarized.

Development of Multisensor Applications for Landscape and Regional Quantification of Climate Change Impacts — Degraded rangelands will be mapped at 1 kilometer for western United States 1989-2004 and an associated manuscript will be published assessing consistency of two methods used with detailed descriptions of the separation of soil and management effects. Simulations will be prepared of the long-term carbon effects of CRP and no-till farming. This process will be repeated for the Flint Hills and Central Oklahoma and Texas Plains, Western High Plains and Central Great Plains. A manuscript will be prepared describing carbon dynamics in the three regions.

Biodiversity Characterization and Dynamics of North and Central America Using MODIS 500m Data — Spatial analysis and modeling of biophysical (e.g., land cover, elevation, climate, and soil etc) and species distribution data will be performed. The main aim will be to refine species distribution and hotspot boundaries that can be used for planning and management of conservation areas. Multiresolution land cover data with a spatial resolution of 1 km, and 500 m will be used for the North and Central America, and Mesoamerica respectively. Individual species distribution data of mammals, birds, and amphibians will be processed to make it consistent with the land cover data.

Program Infrastructure Improvements —

Data Collections Added: New Landsat-related and Earth Observing-1 (EO-1) data collections will be added to the GloVis application and made available to all *AmericaView* members. The GloVis application will serve an increasing number of state based data access applications as more State viewers are adapted to use GloVis (<http://glovis.usgs.gov>).

StateView Visualization Viewer (StateVis): State Viewer capabilities will be added by more members of the *AmericaView* consortium, making data more easily accessible to all members.

AmericaView Visualization Viewer (AV-Vis): AV-Vis will be prototyped and will permit all member states to host an instance of AV-Vis. Data requests from AV-Vis are sent to the archive that houses the requested data.

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Expanding State Information Nodes Through *AmericaView* —

Consortium Growth: In FY 2005, *AmericaView* will continue to expand access to remotely sensed data and support development of applications. Continued growth will be realized in the number of new members added to the consortium, both in the number of new states becoming members, and the number of new partners participating within member states. Within the consortia, significant numbers of in-state members will be added to the State consortia, thereby significantly increasing the numbers of *AmericaView* partners across the country. Increases will be seen in the acquisition and distribution of imagery by *Americaview* Consortium members and within member states as the number of nodes available and viewer capabilities increases.

Enterprise Planning: *AmericaView, Inc.* will publish a strategic plan for continued development, growth and outreach for the Consortium in the spring of 2005. FY 2005 beginning membership in the National consortium totals twenty State organizations, doubling the membership total from last year at this time. FY 2005 will see a conversion of at least three of the affiliate members to full member status, with at least three new affiliate members added in 2005.

Imagery Acquisition: Landsat, ASTER, and MODIS scenes will be added to State and university digital imagery libraries at an increasing pace as *AmericaView* members develop and implement archive and distribution systems. The continued increase in the number of information downloads from these State nodes is attributed to the existence and growth of *AmericaView* consortium archives and distribution systems (<http://americaview.usgs.gov/>).

Education and Outreach: Workshops will be held or contributed to by most members to enhance the understanding of the science of remote sensing and to communicate information and applications throughout the community. Curricula will be expanded in member universities and new courses will be offered, particularly permitting course offerings to students in institutions where a full remote sensing curricula is not currently available. The *AmericaView, Inc.* annual conference will be held in the fall of 2005 with a view toward further educational, outreach and communications results. Workshops will be offered to assist with the development of new consortia and new programs throughout the membership of the national consortium.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Land Remote Sensing (\$000)	\$46,396	+13,407
FTE	104	+2

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006 budget request for Land Remote Sensing Program is \$46,396,000 and 104 FTE, which is a net increase of +\$13,666,000 (includes adjustments for uncontrollable costs) and +2 FTE from the FY 2005 enacted level.

Landsat Operations (+\$6,000,000) — This increase of \$6 million will provide the additional base funds necessary to continue operations of Landsat 7 through the launch of LDCM in 2009. The Landsat data is vital for numerous scientific and operational activities, including many programs within the Department of the Interior. The additional funds will enable USGS to meet requirements under the Land Remote Sensing Policy Act of 1992 (P.L.102-555) and continue to provide moderate resolution data to the Nation at the cost of fulfilling user requests. Since the failure of the scan line corrector aboard the Landsat 7 satellite, the USGS has been unable to

generate sufficient revenue to cover operational costs. Since 2004, the USGS has experienced an annual shortfall of approximately \$6 million in revenue, necessitating the need for a reprogramming of funds. As Landsat data are vital to many programs, for example, wildland fire, global crop assessments, and monitoring of the coastal and near shore environment, it is important to keep the program intact. The \$6 million will allow the Landsat Program to continue providing medium resolution imagery to the Nation.

Landsat Data Continuity Mission (+\$7,450,000) — This increase will enable the USGS to start system development activities that ensure capabilities are in place to ingest, archive, process and distribute LDCM data for a launch on the first NPOESS satellite in 2009. The majority of the work will be done at the USGS National Center for EROS using in-house Technical Support Services Contract (TSSC) staff to provide systems engineering, algorithm development, software development, requirements management, documentation control, testing support, and management needed to modify existing software, as well as to implement new systems and software that support LDCM ground system functions. A portion of the ground system development may be contracted to commercial system builders.

During FY 2006, the development effort will encompass the following activities and deliverables for the NPOESS/LDCM system:

- Documentation of operational concepts for each ground sub-system
- Documentation of sub-system requirements, and formal review
- Preliminary ground system design and formal review
- Documentation and exchange of interface requirements
- Documentation of interface design and data formats
- Documentation of a security plan
- Identification of sub-systems or components for outsourcing
- Initiation of critical design for the ground system
- Acquisition of some hardware components for in-house software development
- Participation with NASA and NOAA in coordination meetings and design reviews
- Coordination with other potential Landsat-continuity partners, including International Cooperators
- Communication and coordination with USGS and DOI management

This project's deliverables directly support USGS strategic objectives by making high-quality remotely sensed data widely and inexpensively available without restrictions to a global community of international, Federal civil, defense, NGO, State, local, academic, commercial, and individual users in both operational and research environments. The project directly supports the DOI's role in Landsat Program Management as outlined in Presidential Decision Directive NSPD-3. The LDCM Project will ensure continuation, post Landsat 7, of a collection of

Land Remote Sensing Subactivity

consistently calibrated imagery of the Earth's land mass, coastal boundaries, and coral reefs. It will also ensure that LDCM data are of maximum utility in supporting the scientific objectives of monitoring changes in the Earth's land surface and associated environment. Image data from satellites, such as the Landsat series, are one of the most efficient, cost-effective sources of essential geospatial information for the scientific and operational land and resource management communities.

Geographic Analysis and Monitoring Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Geographic Analysis and Monitoring	15,238	14,628	+325	+222	15,175	+547
FTE	107	107	0	+1	108	+1
Total Requirements \$000	15,238	14,628	+325	+222	15,175	+547
FTE	107	107	0	+1	108	+1

^{a/} Changes for this subactivity include a reduction of -\$27 for travel and -\$1 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for the Geographic Analysis and Monitoring (GAM) Program is \$15,175,000.

The GAM Program addresses the DOI Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science. Scientific validity of USGS performance is reflected in the end outcome measure for research: soundness of methodology, accuracy, and reliability of science (100 percent of GAM research is validated through appropriate peer review).

To clearly measure progress in achieving the intermediate outcomes of improving information base, information management, and technical assistance, USGS tracks three intermediate outcome measures for exchange of knowledge (cumulative number of National Land Cover data sets completed; cumulative number of ecoregion assessments completed, and the percent of studies validated through appropriate peer review or independent review). Output measures or efficiency measures are also tracked for the GAM Program (number of systematic analyses and investigations delivered to customers, the number of formal workshops or training sessions provided to customers, and the number of new or improved decision support tools produced by the program).

Although not formulated into a performance measure, the GAM Program will produce a topical report series documenting highlights of important research results. The reports will provide resource managers and citizens with reliable reference tools to understand the dynamic nature of the Nation's landscape and the opportunities and consequences of natural processes and human actions. As the Program matures, future reports will reflect a truly national assessment of land surface change and a synthesis of GAM research investigating this change. The first report in the series will be produced in 2005 and will focus on the status and trends of the land surface in the eastern United States. Reports focusing on the central and western portions of the country will be produced in subsequent years.

The GAM Program assesses the Nation's land resources at a range of spatial and temporal scales to understand the rates, causes, and consequences of landscape change over time. Long-term studies of land use and disturbance histories are underway, determining the reasons

Geographic Analysis and Monitoring Subactivity

for change, leading to improved understanding and knowledge about landscape processes. GAM brings focus to the Nation's environmental, natural resource, and economic issues through scientific assessments that provide a national perspective on land-surface change. The program encompasses three fundamental science issues concerning changes to the Earth's surface:

- Understanding change: How and why changes are occurring on the land surface;
- Understanding positive and negative impacts of these changes: Land-surface changes on ecosystem health, climate variability, biogeochemical cycles, hydrology, and human health; and
- Delivering the results of this research: Using the best methods available to incorporate GAM science findings in the decisionmaking processes of natural resource managers and providing information to the public.

GAM research has been organized into several broad themes with goals that encompass the integrative, holistic nature of the research:

(dollars in millions)

Component	Theme	Goals	2004	2005	2006
Landscape Monitoring	Status and Trends Synthesis	Conduct long-term monitoring of status and trends of the Nation's land surface for regional and national policy decisionmaking.	6.6	6.3	6.5
	Landscape Change	Analyze and interpret record of land use dynamics including land use and land cover change to enhance the understanding of physical and social drivers of land surface change.			
		Determine impacts of land use and land cover on climate and biochemistry.			
Impacts of Landscape Change	Ecosystem Dynamics	Analyze, understand, model, and predict the response of land surface and adjacent hydrosphere, biosphere, or atmosphere to natural and human-induced stimuli at regional, continental, or global scales.	8.6	8.3	8.7
	Science Data and Analytical Tools	Develop advanced spatial techniques to monitor land surface change and ecosystem structure and function.			
		Develop and implement methods to understand how management strategies and decisionmaking impact the environment, including Science Impact.			
Total			15.2	14.6	15.2

The Science Impact program supports GAM's Impacts of Landscape Change component. Science Impact is a cross-discipline, focused effort to increase the use and value of USGS science in informing decisionmaking at DOI, at other Federal, State, and local agencies; and by citizens. A more detailed description of Science Impact activities and accomplishments is included in the Regional activities section beginning on page F - 36.

The Science Impact program encompasses three principal activities emphasizing the effective use of scientific data:

- Science Synthesis: Developing, testing, evaluating, and applying methods and processes that facilitate expanded and more effective use of USGS science in informing decision making.
- Science Applications: Developing, testing, and implementing multidisciplinary tools and products that integrate USGS science with other relevant factors including socioeconomic information to enable more effective decisionmaking.
- Science Evaluations: Developing methods and conducting analyses to evaluate and measure the effectiveness of USGS scientific information and programs in informing decisionmaking.

Beginning in FY 2004, USGS created partnership "centers" with five universities to provide specialized research skills needed for the Science Impact program and to develop external centers of innovation to improve linkages between scientific information and societal decisions. The five centers are:

- Science Impact Laboratory for Urban Systems (SILUS) – University of Pennsylvania, Philadelphia, PA,
- Science Impact Center for Visualization and Delivery – Prescott College, Prescott, AZ,
- Science Impact Laboratory for Policy and Economics (SILPE) – University of New Mexico, Albuquerque, NM,
- Indigenous Knowledge Center for Education and Science Impact (IKCE SI) – Sinte Gleska University, Mission, SD, and
- MIT-USGS Science Impact Collaborative (MUSIC) – Massachusetts Institute of Technology (MIT), Cambridge, MA.

The GAM Program also provides support for the USGS Priority Ecosystems Science (PES) program, formerly Place-Based Studies, in the Impacts of Landscape Change component, activities that are described in more detail beginning on page F – 30 in the Regional Activities section.

Through PES, GAM supports research within the Everglades, San Francisco Bay, Chesapeake Bay, and Mojave Desert study areas to evaluate land use changes, ecosystem histories, indices of ecosystem sensitivity to change, and vulnerability to potential stressors in order to devise restoration and adaptive management strategies for land use managers.

Landscape Monitoring

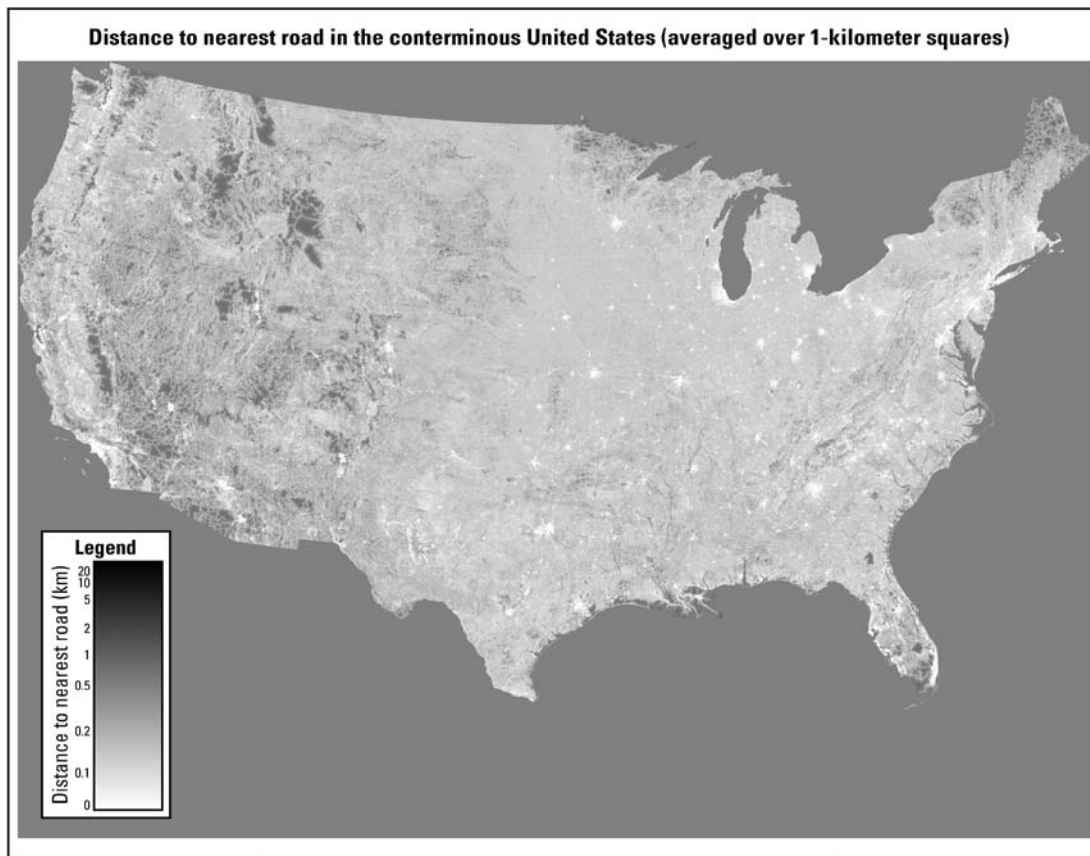
(Estimates for FY 2004, \$6.6 million; FY 2005, \$6.3 million; FY 2006, \$6.5 million),

2004 Program Performance Accomplishments: Landscape Monitoring

GAM program performance accomplishments reflect the sound application of geographic research in response to national needs and issues. These applications represent the program's

Geographic Analysis and Monitoring Subactivity

comprehensive, innovative, and diverse approaches to resolve issues. The FY 2004 program accomplishments listed below demonstrate the utility of USGS research activities that are counted under the following output measures: "land cover assessments tied to mapping units," "eco-region assessments," and "number of systematic analyses and investigations delivered to customers." Specific research results in Landscape Monitoring are described below.

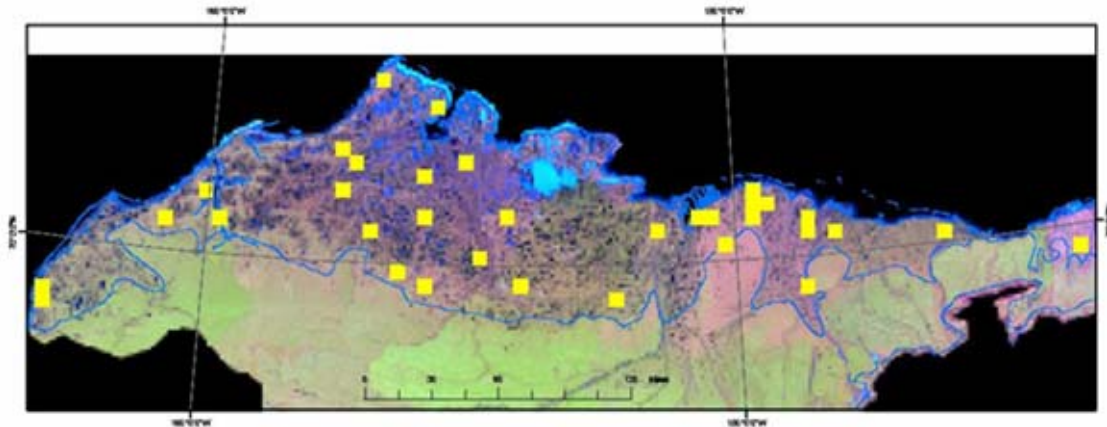


Measuring the Impact of Roads — The National Park Service, U.S. Forest Service (USFS), Environmental Protection Agency, and the H. John Heinz III Center for Science, Economics, and the Environment have increased their efforts to provide the Nation with indicators of environmental conditions that affect ecological resources and human wellbeing. One such indicator is distance to the nearest road. Roads influence habitat integrity, watershed disturbances, and other environmental conditions, thus a distance-to-road indicator provides a relative measure of vulnerability to road- and traffic-induced effects. In 2004, USGS produced a high-resolution (30-meter sampling interval) data set containing values of the distance to the nearest road. Called "NORM-ED" (National Overview Road Metrics – Euclidean Distance), this data set is being used by the USFS in a national comparative assessment of watershed disturbance. A significant fraction of the Nation's drinking water supply is derived from Forest Service watersheds, and this effort will identify areas where water quality is at risk due to the proximity of roads. The data set can be viewed and accessed on *The National Map* Web viewer at <http://nationalmap.usgs.gov>, in the transportation section.

Carbon Stocks in the Conterminous United States — Carbon dioxide in the atmosphere plays an important role in regulating the climate of the Earth system. The continuing increase of atmospheric CO₂ concentration has the potential to significantly alter the living environment and negatively affect the economy at the regional to global scales. However, the magnitude, spatial patterns, mechanisms, and uncertainty of contemporary U.S. carbon sources and sinks of CO₂ exchange with the atmosphere are not well understood and quantified. In 2004, USGS models quantified the dynamic exchange of CO₂ between the land and the atmosphere impacted by land use changes and climate variability for a number of ecoregions. For the first time, dynamic land cover change information derived from Landsat imagery was used for assessing carbon storage change for the conterminous United States. Results for the ecoregions under study indicate that the U.S. landmass has been a significant carbon sink since 1973. However, the carbon sink strength has been decreasing from 1973 to 2000. Climate variability and change was the predominant factor defining the inter-annual variability of the carbon sink strength, however ignoring the dynamic land use change information could lead to significant overestimation of the carbon sink strength.

Carbon Stocks on Department of Interior Lands — The DOI manages large areas of land, and the condition of these lands can influence the exchange of carbon dioxide and other greenhouse gases between biomass, soils, and the atmosphere. Understanding these processes is important for projecting future responses of ecological systems to climate change. In 2004 USGS completed a study that showed that large portions of the Nation's soil organic carbon are in high latitudes on lands managed by the Department of the Interior. A set of 523 soil profiles in Alaska were evaluated to begin establishing a baseline for monitoring future changes in soil carbon.

Alaska Land Cover Trends — Land cover changes are particularly important in Alaska due to the fact that much of the landscape is underlain with permafrost and thus may be extremely susceptible to global change and prone to large fires. This area also contains the vast majority of the Nation's mineral and oil and gas resources. The objective of the Land Characterization project in Alaska is to conduct research and investigations that provide descriptive and quantitative data and information of the Alaskan landscape. In 2004, USGS completed a status and trends project for the Alaskan North Slope where a series of 10-km by 10-km sample blocks were obtained over areas of high change (e.g., villages) and areas of low change (e.g., inaccessible tundra). These areas were assessed for change using Landsat-derived land cover data from the late 1970s and early 2000. Some changes are a natural occurrence across the tundra landscape (e.g., increases in barren areas due to river channels) and others are due to human influence (e.g., small plane landing strips).



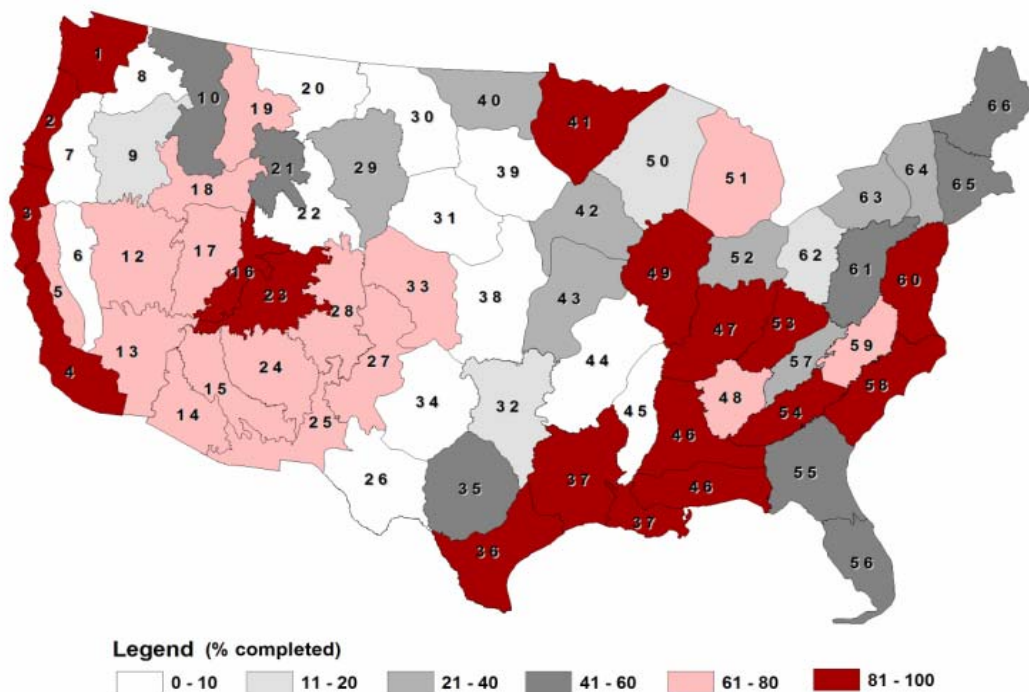
Location of 10-km by 10-km sample blocks over the North Slope of Alaska.

Geographic Analysis and Monitoring Subactivity

Land Cover Trends over the Eastern United States — Since 2002, USGS has conducted a Land Cover Trends project that studies the rates, causes, and consequences of land use and land cover change in the conterminous United States for the 1972 -2000 period. Eighty-four "ecoregions," each containing a geographically distinct assemblage of environmental conditions, provide a geographic framework for the project and serve as separate reporting units. In 2004, USGS completed the interpretation of sample blocks in the Northeastern Coastal Zone ecoregion and the Southern Florida Coastal Plain ecoregion. In addition, USGS completed a draft chapter for the GAM Status and Trends topical report, "Documenting the driving forces of land cover change in the northern Piedmont." USGS also produced the first prototype for Status and Trends Indicators. Indicators provide insight into the dynamics of land cover change by measuring landscape characteristics such as fragmentation, proximity, and adjacency.

The National Land Cover Database (NLCD) — Through the multiagency NLCD project, Federal agencies are compiling land cover information across all 50 States and Puerto Rico, using a partnership of eight Federal agencies and private outsourcing, with the USGS as lead. The NLCD captures the type of land cover, the proportion of urban development, and the proportion of trees for every 1-acre patch across the United States. An improved understanding of land cover is critical to evaluating its impact of ecosystem processes. Land cover information is used in a tremendous variety of applications among Federal, State and private organizations, including pesticide management, fire risk modeling, watershed runoff modeling, wildlife habitat characterization, and economic development. In 2004, the NLCD project completed land cover information for 42 percent of the continental United States and 15 percent of Alaska.

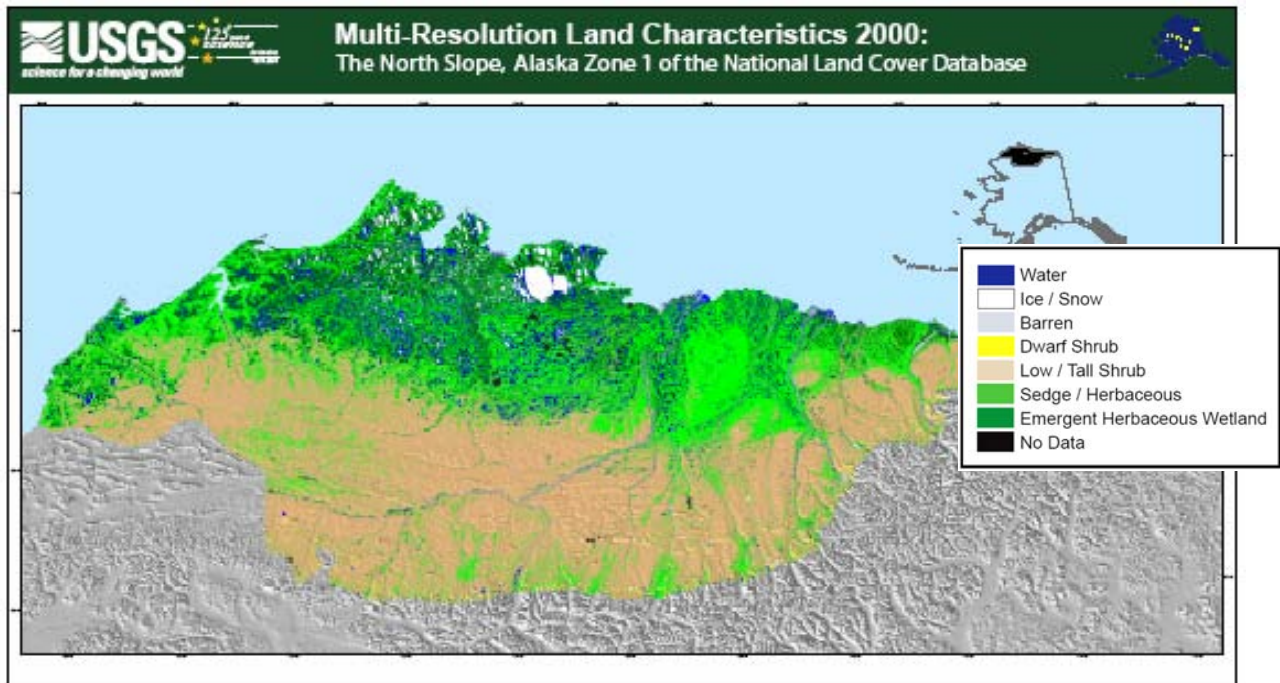
2001 National Land Cover Mapping Status



Consequences of Land Cover Change in South Florida — In 2004 USGS research findings indicated that the conversion of natural wetlands to agriculture may have inadvertently

increased the incidence and severity of damaging freezes in south Florida. Economically important agricultural production in former wetlands areas now includes extensive cultivation of winter season vegetable, citrus, and sugar cane crops. In spite of this shift southward, agricultural crops are still prone to damaging winter freeze events termed "radiation freezes," which typically occur on calm, clear nights with nocturnal cooling. During FY 2004, the USGS and Colorado State University (CSU) used regional climate modeling with historical land cover change datasets to investigate the potential link between land use change and damaging radiation freeze events in south Florida. The model's simulations suggested that the current land use of the 1990s is associated with a tendency for lower minimum temperatures with a longer critical freeze duration as compared to the pre-1900 natural vegetation. In addition to this winter season study, USGS and Colorado State University conducted a warm season study that describes the potential consequences of land cover change on the summer season weather variability in south Florida. The south Florida research has demonstrated the importance of coupled models to quantify the potential effects of land cover change. Furthermore, the research has demonstrated the utility of the Landsat-derived NLCD as an important resource for regional coupled modeling studies.

Alaska Land Cover — Alaska is the center of the Nation's onshore energy development and is the only region in the United States with extensive arctic and boreal ecosystems that are in a nearly pristine state. Energy development coupled with human activities, fires and insect outbreaks, and accelerated global change in the northern latitudes, requires up-to-date land cover data to plan for and to monitor associated impacts over time. The USGS began the Alaskan Multi-Resolution Land Characteristics Consortium (MRLC) land cover activities in 2003 and continued them in FY 2004. Accomplishments in 2004 include completing land cover mapping over three areas: Kodiak Archipelago, which contains the Kodiak National Wildlife Refuge; the Alaska arctic coastal plain to the north, which includes the National Petroleum Reserve and both the Alaska and the Arctic National Wildlife Refuges; and two mapping zones centered over the Yukon Flats National Wildlife Refuge and Selawik National Wildlife Refuge.



USGS land cover map for the arctic coastal plain of Alaska.

FY 2005 Planned Program Performance: Landscape Monitoring

The FY 2004 program accomplishments listed below demonstrate the utility of USGS research activities that are counted under the following output measures: "land cover assessments tied to mapping units," "eco-region assessments," and "number of systematic analyses and investigations delivered to customers." Specific research results in Impacts of Landscape Change include:

Carbon Stocks in the Conterminous United States — In FY 2005, the dynamics of carbon stocks and fluxes in additional eco-regions will be simulated. Emphasis will be on quantifying the impacts of agricultural policy and practices (e.g., the Conservation Reserve Program) on carbon sequestration. The results generated from this project will advance the understanding of the spatial and temporal dimensions of the contemporary U.S. carbon sources and sinks and the underlying mechanisms that determine these dimensions. It will provide a solid scientific basis for societal decisions about CO₂ management and the carbon cycle at regional and national scales.

Carbon Stocks on Department of Interior Lands — In FY 2005, a monitoring system will be designed for soil carbon with sample locations based on the magnitude of carbon stocks, carbon fluxes, and the potential for carbon sequestration. The monitoring will be essential for evaluating programs for carbon sequestration, and for assessing the potential for unintended feedbacks in which climate change may influence the carbon flux rates. The interactions of land use and land cover change with soil characteristics such as soil carbon and agricultural potential will be investigated, especially for the eastern United States. The research will lead to greater understanding of the geographical nature of the interactions between human and natural systems.

Alaska Land Cover Trends — In a further continuation of the 2004 status and trends project for the Alaskan North Slope, the Statewide status and trends will be completed in 2005. A series of 10-km by 10-km sample blocks were obtained over areas of high change (e.g., villages) and areas of low change (e.g., inaccessible tundra). These areas were assessed for change using Landsat derived land cover data from the late 1970s and early 2000 period. Some changes are a natural occurrence across the tundra landscape (e.g., increases in barren areas due to river channels) and others are due to human influence (e.g., small plane landing strips).

Land Cover Trends Over the Eastern Region of the United States — Representing the culmination of a project begun in 2000, 2005 will see the milestone of USGS completing the ecoregions that make up the "forested" portion of the eastern United States. This will enable the project to produce a synthesis of the rates, causes, and consequences of land cover change of in the eastern United States.

National Land Cover Database (NLCD) — The NLCD project is compiling land cover information across all 50 States and Puerto Rico, using a partnership of eight Federal agencies and private outsourcing, with USGS as lead. This database captures the type of land cover, the proportion of urban development, and the proportion of trees for every 1-acre patch across the United States. An improved understanding of land cover is critical to evaluating its impact of ecosystem processes. Land cover information is used in a wide variety of applications among Federal, State and private organizations, including pesticide management, fire risk modeling, watershed runoff modeling, wildlife habitat characterization, and economic development.

In 2005 USGS will complete NLCD evaluations for 75 percent of the conterminous United States and 35 percent of Alaska.

Impacts of Landscape Change

(Estimates for FY 2004, \$8.6 million; FY 2005, \$8.3 million; FY 2006, \$8.7 million)

2004 Program Performance Accomplishments: Impacts of Landscape Change

The FY 2004 program accomplishments listed below demonstrate the utility of USGS research activities that are counted under the following output measures: "land cover assessments tied to mapping units," "eco-region assessments," and "number of systematic analyses and investigations delivered to customers." Specific research results in Impacts of Landscape Change include:

Phenology and Drought Monitoring in Great Lakes Area, Desert Southwest, and Northern Great Plains

— Regular, repeatable Earth observations from satellites provide a strong, objective basis for terrestrial monitoring. By analyzing time-series greenness data derived from the National Oceanic and Atmospheric Administration's Advanced Very High Resolution Radiometer (AVHRR) sensor and the National Aeronautics and Space Administration's Moderate Resolution Imaging Spectroradiometer (MODIS) satellite-based sensors, USGS can identify patterns of changing vegetation conditions and research their causes. In this research, USGS analyzes vegetation dynamics (phenology) for regional trends toward shorter or longer growing seasons, increasing or decreasing production, and earlier or later growing seasons. Results indicate increasing growing season length (and corresponding increasing production) in the Great Lakes area, while there is decreasing production in the desert southwest. In a cooperative project with the National Drought Mitigation Center at the University of Nebraska-Lincoln, USGS has developed techniques to incorporate satellite-derived phenological information with additional geographic information on soils, irrigation, land cover, and daily weather to develop a Vegetation Drought Response Index (VegDRI) for the northern Great Plains. This product identifies levels of drought severity during the growing season and is updated on a biweekly basis.

Land Use Portfolio Model Application in Southern California

— The land use portfolio model is a USGS tool for estimating and comparing the costs and benefits of spatially variable development projects, in order to reduce risks to communities. It provides decisionmakers with the costs and risks for different earthquake-mitigation strategies. During FY 2004, the model was tested in Ventura County, California, and entailed the creation of a geospatial database for assessing multihazard risks as well as formulating methodologies to support multihazard applications. Spatial failure inventory data and susceptibility maps for hazards such as earthquake-triggered soil liquefaction and landslides, fires, and floods were located and assembled from multiple sources. In order to assess future risks, a hedonic model was created that estimates future property values.

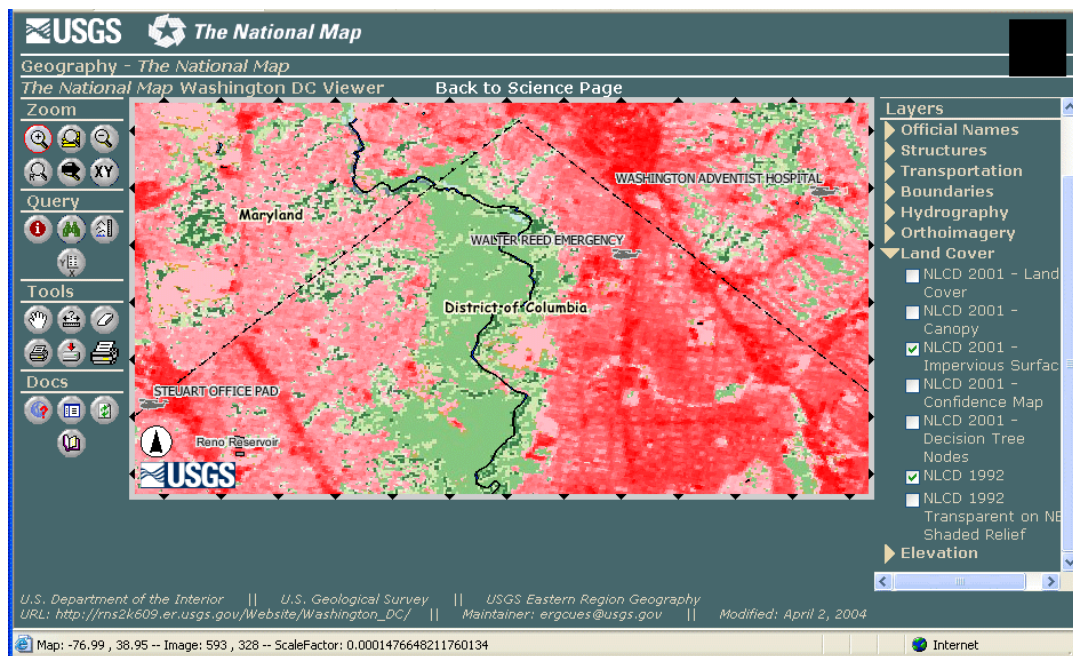
Improving Test Methods for Beach Contamination Indicator *Enterrococci* — The purpose of this project is to provide comprehensive methodologies for assessment of beach management policy impacts upon swimmers. USGS completed a test of available methods on a southern California beach. Local beach visitor and water quality data were compiled and used to calculate probabilities of various management outcomes under the current water quality standard and hypothetical swim closure procedures. Input data parameters were consolidated to make the necessary economic and policy outcome calculations. Refinements included using a different bacteria indicator, *Enterrococci*, adjustment of the method to use a more extensive

Geographic Analysis and Monitoring Subactivity

historic water quality catalog rather than seasonal probabilities, and corrections for visitor behavior in response to closures.

Understanding the Geography and Pathways of West Nile Virus — The USGS and Centers for Disease Control and Prevention began a long-term study in 2001 to understand the geography and transmission pathways of West Nile virus (WNV) in North America. The USGS was able to bring together experts in wildlife biology, field biology and collection, mapping, geographic information systems, remote sensing, and spatial analysis with health professionals to test various spatial hypotheses about the WNV outbreak. In FY 2004 USGS completed field investigations along two avian flyways. More than 13,000 songbirds were captured at 17 study sites along the Atlantic coast and Mississippi River, 2 of the 4 major migration corridors for birds in North America, during both spring and fall, 2001-2003. Blood samples from each bird were tested for WNV. Results indicate that the WNV epizootic that began in eastern North America almost 5 years ago is still growing in that geographic region and that migratory birds are a principal agent involved in the spread of WNV in North America.

Comprehensive Urban Ecosystems Studies (CUES) — The Comprehensive Urban Ecosystems Studies (CUES) project brought USGS science expertise to bear on critical issues in the Nation's urban areas, including homeland security, vulnerability of water resources, natural hazards, urban sprawl, and the conservation and protection of parklands and other natural resources. In 2004 CUES Web sites with integrated map viewers were built for Washington, DC, and Charleston, SC, metropolitan areas and the Shenandoah National Park. All viewers and other site content can be accessed at <http://ms2k609.er.usgs.gov/Website/>.

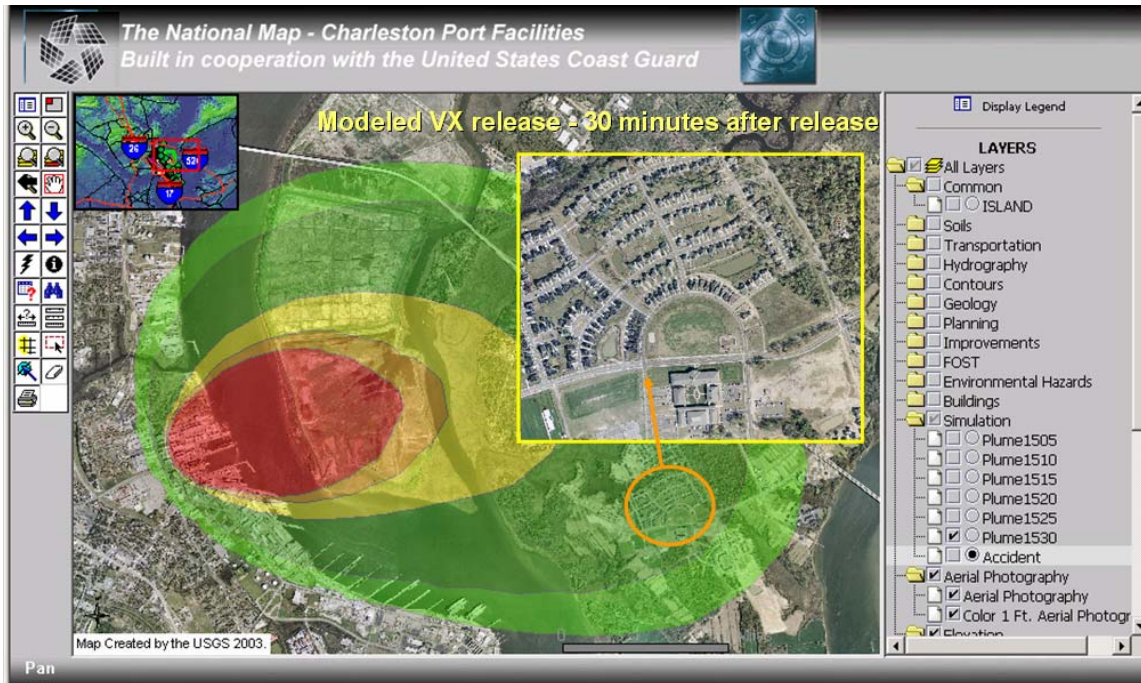


CUES map viewer for Washington, DC, showing a map of impervious surfaces derived from Landsat 7 satellite imagery. Accurate estimates of imperviousness are needed to determine the effect of urbanization on storm water runoff and ground-water flow.

An improved digital elevation model (DEM) was produced for the Charleston area. This DEM, with 1-meter vertical accuracy, was a low-cost alternative to LIDAR data and will significantly

improve models used by the South Carolina Emergency Management Division to predict the degree of flooding due to storm surge from hurricanes.

A prototype port security GIS for the port of Charleston was developed for the U.S. Coast Guard to aid in its development of a port security GIS plan. This product helped the Coast Guard demonstrate how geospatial data can be combined with models to allow contingency planning for various disaster or terrorist attack scenarios.



This graphic shows a simulated nerve gas release, modeled using the Consequence Assessment Toolset (CATS) software. The utility of models like this are vastly improved by high-resolution imagery and other data, which allow planners or emergency responders to quickly determine areas of greatest exposure.

2005 Planned Program Accomplishments: Impacts of Landscape Change

The FY 2005 planned program performance examples listed below provide the linkage between USGS research activities and these output measures: “land cover assessments tied to mapping units,” “eco-region assessments,” and “number of systematic analyses and investigations delivered to customers.”

Phenology and Drought Monitoring in Western United States — Regular, repeatable Earth observations from satellites provide a strong, objective basis for terrestrial monitoring. By analyzing time-series greenness data derived from the National Oceanic and Atmospheric Administration's Advanced Very High Resolution Radiometer (AVHRR) sensor and the National Aeronautics and Space Administration's Moderate Resolution Imaging Spectroradiometer (MODIS) satellite-based sensors, USGS can identify patterns of changing vegetation conditions and research their causes. In this research, USGS analyzes vegetation dynamics (phenology) for regional trends toward shorter or longer growing seasons, increasing or decreasing production, and earlier or later growing seasons. In 2005 USGS will continue to populate the satellite-derived phenology and drought monitoring database, expanding drought monitoring to

Geographic Analysis and Monitoring Subactivity

encompass the western United States, and identify and quantify the driving forces of terrestrial climate change.

Understanding the Geography and Pathways of West Nile Virus — In 2005 laboratory analysis of the collected bird samples is being finalized. More than 13,000 songbirds were captured at 17 study sites along the Atlantic coast and Mississippi River, 2 of the 4 major migration corridors for birds in North America, during both spring and fall, 2001-2003. In 2005 these data will be coupled with information about landscape characteristics and weather conditions, over space and time, to provide the foundation for spatial analytical and forecasting models. Spatial and temporal diffusion modeling may allow USGS scientists to determine the initial focal points of an outbreak but also forecast when and where the next outbreak might occur.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Geographic Analysis and Monitoring (\$000)	\$15,175	+\$222
FTE	108	+1

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006 budget request for the Geographic Analysis and Monitoring Program is \$15,175,000 (includes adjustments for uncontrollable costs) and 108 FTE, a net program increase of +\$547,000 and +1 FTE from the FY 2005 enacted level.

Science Impact (+\$250,000) — A new Science Impact project is proposed in FY 2006, focusing on ways that science can better inform decisionmaking relating to western water issues. The project will complement existing DOI efforts and will build upon the capabilities and capacity developed during FY 2004 and 2005 (see page F - 36). Studies will be conducted in locations where water availability issues have included citizen involvement in deciding difficult water management choices. The first set of studies will address issues associated with the lower Colorado River in California and Arizona.

The proposed project will include structured contact with the institutions, stakeholders, and sources of conflict. Collaborative processes will be applied to examine ways in which science can effectively be linked with the decision making process. Science Impact integrated tools will be developed and implemented to link natural science data with socio-economic and institutional analyses of alternative policy decisions. These integrated products will be evaluated for their effectiveness in addressing implications associated with critical water management decisions and in their acceptance and use in different settings with different sets of stakeholders. Integrated tools will be developed and implemented to link natural science data with socio-economic and institutional analyses of alternative policy decisions.

Geologic Hazards, Resources, and Processes

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes ^{a/}	Program Changes ^{b/}	2006 Budget Request	Change from 2005
Geologic Hazard Assessments	75,283	75,979	+1,076	+5,154	82,209	+6,230
FTE	412	401	0	+20	421	+20
Geologic Landscape and Coastal Assessments	78,351	76,253	+750	+225	77,228	+975
FTE	469	453	0	+3	456	+3
Geologic Resource Assessments	80,549	77,014	+1,559	-29,874	48,699	-28,315
FTE	573	557	0	-240	317	-240
Total Requirements \$000	234,183	229,246	+3,385	-24,495	208,136	-21,110
FTE	1,454	1,411	0	-217	1,194	-217

^{a/} Included in this activity is a one-time technical adjustment of -\$462 that moves all USGS funds associated with the Science on the DOI Landscape initiative to a single location in the Biological Research Activity for ease of administration and accounting.

^{b/} Changes for this program element include a reduction of -\$459 for travel and -\$23 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

Activity Summary

Introduction

Through its programs within the Geologic Hazards, Resources, and Processes Activity, the USGS provides the Earth science information needs for a wide variety of partners and customers, including Federal, State, and local agencies, non-government organizations, industry, and academia. This information is used by the USGS and its partners, cooperators, and customers in evaluating resource potential, defining and mitigating risks associated with natural hazards, and characterizing the potential impact of natural geologic processes on human activity, the economy, and the environment. A comprehensive science strategy, entitled *Geology for a Changing World*, was developed with program partners and customers and sets forth the science goals, objectives, strategic actions, and products expected to result from scientific activities through 2010. These science

Use of Cost and Performance Information

In response to a program review by the National Research Council (NRC) and the OMB PART review, a draft of the new Volcano Hazards Program (VHP) 5-year plan was completed in FY 2004. The new plan emphasizes strengthening volcano monitoring capabilities, adding new technologies such as InSAR, and developing a National Volcano Early Warning System that focuses both effort and budget on the most dangerous volcanoes. A preliminary report that provides a quantitative ranking of the most dangerous volcanoes and guidance on monitoring needs for future prioritization of program resources has been completed and is in review. A final report will be released FY 2005.

Customer feedback on the Atlas of Natural Hazards in the Hawaiian Coastal Zone prompted changes to the atlas Web site. Recipients were asked about their satisfaction with and use of the first comprehensive, multi-hazard coastal atlas produced by the USGS for a section of U.S. coastline. In response to customer requests, ArcView/GIS compatible shape files of the data for each main Hawaiian island were added to the atlas Web site. Other customer suggestions are helping to drive planning efforts for similar hazard assessment products for other areas of the United States.

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goals contribute to the achievement of DOI's strategic goals of providing for responsible use of resources and serving communities by providing information to protect lives, resources, and property and advancing knowledge through scientific leadership. Each year, all ongoing and new project work plans and accomplishments undergo peer and management review for progress toward meeting the science strategy and DOI goals. Also reviewed are the annual performance results of each individual program as they relate to the achievement of long-term goals detailed in the program 5-year plans that directly support the science strategy and DOI strategic goals.

Worldwide and domestically during 2004 and early 2005, the USGS provided information critical to understanding and mitigating a number of highly damaging volcanoes, earthquakes, landslides, and hurricanes. In cases such as the eruption of Mount St. Helens, the landslides in southern California, and the hurricanes that plagued Florida and the Gulf Coast, USGS issued alerts and vulnerability assessments that assisted emergency operations agencies in saving lives and property. In December of 2004, a magnitude 9.0 earthquake off the Coast of Sumatra—the world's largest since 1964—resulted in the Indian Ocean tsunami, causing the loss of over 150,000 lives and untold billions of dollars in damage. USGS is assisting in post-event field and modeling activities using ground-surveys and sampling to improve models of tsunami generation used in the United States and worldwide. Since the disaster, USGS has also worked with the National Oceanic and Atmospheric Administration (NOAA) Pacific Tsunami Warning Center to enhance USGS rapid notifications for the aftershocks of the magnitude 9.0 earthquake and for other large, sub-oceanic earthquakes outside the Pacific. Other areas USGS will pursue as part of new program in FY 2006 to improve the safety of the United States from natural disasters includes (1) increase USGS ability to rapidly determine the location, size, and depth of large earthquakes, (2) discriminate kinds of earthquakes and geologic areas of the Pacific and Caribbean likely to cause tsunamis, (3) improve landslide models, assessments, and alert systems, (4) improve monitoring of the most dangerous volcanoes, and (5) work with Federal, local, and foreign partners to improve coordination, ensure timely warnings can be issued for all geologic hazards, and provide information so that informed community response plans can be developed and put in place.

To consolidate USGS enterprise delivery of information, the oversight for Geographic Information System (GIS) tools for the Geo-Data Explorer (GEODE) project will be transferred from the Energy Resources Program to the Geospatial Information Office (GIO) and will be managed under the GIO structure in FY 2006. GEODE, a free service offered by the USGS on the Internet at <http://geode.usgs.gov>, provides digital geographically referenced data to the desktop computers of any user, including policymakers, land and resource managers, educators, industries, and private citizens. The ultimate goal of GEODE is to provide diverse users a gateway (data portal) that will supply real-time data and analysis over the Internet without the need for special hardware, software, and training. The GEODE project will be integrated with the Enterprise GIS activity and incorporated into the National Geospatial Programs Office (NGPO) within the Enterprise Information Activity. These transfers facilitate implementation of the fundamental responsibilities of the USGS to complete basic geospatial data layers on a national scale, meet customer and stakeholder expectations, and demonstrate management excellence. For more information regarding improved management of geospatial data within the USGS, please see page E - 4 of the Geographic Research and Geospatial Information Transition section.

During FY 2006, the USGS Energy Resources Program will start a 3-year project to produce a new national assessment of geothermal resources capable of producing electric power, with a focus on the western United States, including Alaska and Hawaii. This new assessment effort

will involve partnerships with the Department of Energy (DOE), the Bureau of Land Management (BLM), national laboratories, universities, State agencies and a consortium of the geothermal industry. This assessment effort will highlight geothermal energy resources located on public lands. The western States contain some of the highest potential for geothermal energy, but updated information is needed by the land management agencies, as well as the geothermal and electrical utility industries, to determine the extent to which these resources can contribute to the Nation's electrical needs. The final assessment will include a detailed estimate of electrical power generation potential and an evaluation of the major technological challenges and environmental effects of increased geothermal development.

Hazards — USGS geologic hazards programs conduct basic and applied research, gather long-term data, operate monitoring networks, perform assessments and modeling, and disseminate findings to the public, enabling the Nation's emergency response capabilities to warn of impending disasters, better define risk associated with natural hazards, encourage appropriate response, and mitigate damage and loss. These programs are designed to produce information and understanding that will lead to a reduced impact of natural hazards and disasters on human life and the economy. The United States is subject to a variety of natural hazards (earthquakes, volcanic eruptions, landslides, coastal erosion, and floods) that can result in considerable human suffering and billions of dollars in property and business losses. The occurrence of these hazardous events is inevitable and uncontrollable. However, the extent of damage and loss of life can be reduced through preventative planning; social, economic, and engineering adaptations; provision of real-time warning capabilities; and more effective post-event emergency response. Central to this preplanning is the availability of accurate, scientifically based geologic hazards assessments and real-time warning systems that define the nature and degree of risk or potential damage. The more precisely risks can be defined, the greater the likelihood that appropriate mitigation strategies will be adopted (e.g., building codes for new construction and retrofitting; land-use plans; and design and location/routing of critical infrastructure such as highways, bridges, subways, water, sewer, gas, electric, local zoning regulations, and petroleum-distribution networks). The sooner information reaches emergency response centers, the sooner teams can be dispatched to resolve time sensitive medical, utility, or other infrastructure problems.

Use of Cost and Performance Information

The Coastal & Marine Geology Program (CMGP) is spearheading an effort to rescue and preserve millions of dollars in offshore seismic data collected by industry off the coast of California through a partnership with the American Geological Institute rather than recollect these data. Further the data will be made public over the next 5 years, saving governmental, public, industry, and academic groups valuable dollars.

The National Cooperative Geologic Mapping Program (NCGMP) has implemented a new tracking mechanism for documenting publication efficiency for all three components of its program. Project funding is now linked directly to these productivity measures. For example, funding was increased for FY 2005 for the Pacific Northwest Urban Corridor project based on productivity.

A random survey of users of the NCGMP Web site during FY 2003 produced a detailed report on their satisfaction with and use of the Web site. Responding to customer requests, the NCGMP Web redesign team made numerous enhancements to the Web site in FY 2004. These included increasing the speed of downloads, improving the number, quality, and description of links to related sites, and increasing the level of detail in the map catalog.

In response to the need for information on hurricane impacts from customers, USGS coordinated with NOAA and U.S. Army Corps of Engineers to more effectively prioritize and collect essential pre- and post-storm information, leading an interagency effort with Federal Geographic Data Coordination to assess and address priority needs for coastal geospatial information as part of the President's Action Plan in response to the Ocean Commission Report.

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The Office of Management and Budget (OMB) reviewed the geologic hazards programs using the Program Assessment Rating Tool (PART). The review concluded that these programs are moderately effective in achieving results, as indicated by a score of 82. As a result of the PART review, the hazards programs will work with at-risk jurisdictions to increase the number that have adopted hazard mitigation measures based on USGS geologic hazard information and coordinate with Federal partners to determine the effectiveness of Federal efforts to reduce the loss of life and property due to geologic hazards. The hazards programs' 5-year plans are being revised and will include performance measures developed during the PART process, and opportunities to coordinate hazards investments across landslide, earthquake, and volcano activities will be explored.

These programs support DOI's Serving Communities strategic goal to protect lives, resources, and property, which is aimed at making information available to communities to use in developing hazard mitigation, preparedness, and avoidance plans. These efforts also contribute to the achievement of the following Geology science strategy goals:

- Conduct geologic hazard assessments for mitigation planning, and
- Provide short-term prediction of geologic disasters and rapidly characterize their effects.

Topics of recent emphasis include:

- Continuing the development of the Advanced National Seismic System (ANSS), installing 126 new strong motion sensors in 2003 and 2004 including 10 critical stations as part of the 100-station National Backbone network.
- Developing the Prompt Assessment of Global Earthquakes for Response (PAGER), that rapidly estimates the impact on humans from significant earthquakes worldwide by combining maps of shaking intensity with population density and infrastructure fragility.
- Generating products that address the specific earthquake hazards in high-to-moderate risk urban areas, where the population and risks are greatest, such as the San Francisco Bay area and Los Angeles, CA; Seattle, WA; Salt Lake City, UT; St. Louis, MO; Evanston, IL; Memphis, TN; and Charleston, SC. Large-scale maps showing anticipated earthquake shaking levels are being developed for use by local officials in determining engineering and zoning.
- Intensive and improved monitoring and alerts associated with active volcanoes in the United States including the currently erupting Mount St. Helens, Anatahan, and Kilauea as well as unrest in 2004 at Veniaminoff, Mount Shishaldin, Mount Spurr, AK; Mammoth Mountain, CA; and Yellowstone caldera.
- Forecasting post-fire and seasonally recurrent landslides across the western United States, especially in southern California and Washington State.
- Collaborating with Federal, State, and local governments and regional coalitions to create comprehensive and coordinated alert and response plans in areas of high risk to natural hazards.

Landscape and Coastal Assessments — These programs focus on understanding geologic processes at or near the Earth's surface through research, monitoring, and assessment of the

landscape. Information and modeling derived from these geologic process studies allow scientists to distinguish the effects of human activities from natural changes and enable more effective, adaptive, and efficient resource and environmental management decisions.

Society needs to develop better knowledge of the Earth's natural processes and cycles—their rates, frequencies, magnitudes, and how they affect each other. The USGS provides scientific data to understand issues such as coastal erosion and pollution, sea-level rise, loss of wetlands and marine habitats, the geologic processes controlling the invasion of cheat grass, and the role of dust in desert ecosystem health. Armed with this knowledge, decisionmakers can respond better to both natural and human-induced changes. Extreme changes in the environment are less costly if their likely effects can be mapped, quantified, and anticipated. Resources can be more efficiently used if the impacts of their extraction can be predicted and mitigated. Damaged or endangered ecosystems can be repaired more effectively if the natural processes that form and maintain them are accounted for in remediation and restoration plans. Strategies for conserving and using the Nation's lands and resources are improved when the natural processes at work are incorporated into predictive models and management plans in an adaptive manner.

Overall direction for the programs are established by 5-year plans that are created using internal and external inputs such as USGS and DOI strategic plans, periodic reviews by committees overseen by the National Research Council (NRC) (with 9-12 members representing various sectors of industry, State and local governments, and academia), workshops with stakeholders on specific topics (e.g., Tampa Bay project, national coastal change hazards assessment), and the advice of senior scientists within and outside the USGS. The appropriateness of specific directions of projects designed to meet 5-year plan goals is assured by internal and external management and scientific review of project concepts while still in the formative stages, by project proposals when submitted for initial funding, by periodic review of progress of multiyear projects, and by peer review of the reports of project results at completion. During FY 2006, the National Cooperative Geologic Mapping Program will undergo review by OMB using the PART.

These programs support DOI's Serving Communities strategic goal to advance knowledge through scientific leadership and inform decisions through the applications of science, which is aimed at improving the information base, information management, and technical assistance. These efforts also contribute to the achievement of the following Geology science strategy goals:

- Anticipate the environmental impacts of climate variability,
- Establish the geologic framework for ecosystem structure and function,
- Interpret the links between human health and geologic processes, and
- Determine the geologic controls on ground-water resources and hazardous waste isolation.

Topics of recent emphasis include:

- Collaborative, interdisciplinary scientific studies of the marine and estuarine processes in critical bays and estuaries conducted with regional coalitions, Federal agencies, and local and State governments. Studies such as sediment transport modeling along the southwest Washington, North Carolina, and South Carolina coasts; understanding the

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dynamics of the Tampa Bay ecosystem; and quantifying subsidence and loss of wetlands along the Louisiana coast; are enabling communities and governments to make better decisions for management and restoration.

- Monitoring the changes in permafrost temperature in Alaska and understanding the impacts on fire ecology, boreal forests, local subsistence, and carbon cycling with the Bureau of Land Management (BLM) and U.S. Forest Service (USFS).
- Providing data and models on the timing of past changes in climate and vegetation in ecologically sensitive areas, including southeast Alaska, northern California, and the Appalachians. These studies are being used by land management agencies including the USFS, U.S. Fish and Wildlife Service (FWS), and National Park Service (NPS) to develop management plans for these areas.
- Producing high-quality, multi-purpose digital geologic maps and accompanying databases and reports to solve a diversity of land-use problems in high priority areas such as our national parks, national forests, and heavily populated coasts.
- Working with the Gulf Coastal States, NPS, and FWS to assess hazards and determine the vulnerability of coastlines to sea-level rise and inundation caused by hurricanes. Pre-storm data, in the form of maps showing the "first line of defense" of areas that would be inundated by storm surges associated with various categories of hurricanes, were made available to researchers, local users, and coastal zone managers prior to landfall of Hurricanes Charlie, Frances, Ivan, and Jeanne in FY 2004. These data helped managers prepare for the extent of possible damage. USGS post-damage assessments form the basis for future mitigation and response plans.

Resources — USGS geologic resources programs assess the availability and quality of the Nation's mineral and energy resources, including the economic and environmental effects of resource extraction and use. The availability and cost (both economic and environmental) of energy and mineral resources and their extraction and use are limiting factors to human development. Throughout its history, the Nation has faced important, and often controversial, decisions regarding the competing uses of Federal lands, environmental consequences of resource development, and the supply of energy and mineral resources to sustain development and enable growth. Federal land management agencies are required to develop plans that reconcile competing demands for resource development with other human activities, while recognizing environmental values and providing for the sustainability of resources and natural environments.

The geologic resources programs were reviewed by OMB using the PART. The review concluded that both the Mineral

Use of Cost and Performance Information

The Mineral Resources Program data delivery Web site (<http://mrddata.usgs.gov>) underwent a major upgrade in FY 2004 and will have further improvements based on customer feedback in FY 2005. One key enhancement was providing tools for the user to have more selectivity and control over the types of data downloaded and the ability to choose using a combination of factors. A new database, the National Geochronologic Database, was also launched and brings together data from numerous programs to more effectively serve users.

To better monitor and improve performance, the Energy Resources Program has created a new customer survey and placed it on its Web site to gather feedback. The program has streamlined the three Web sites that serve energy products in response to customer needs and has transferred the GEODE geospatial tool to the GIO to better and more efficiently serve enterprise information needs of the whole organization.

Resources and the Energy Resources programs were moderately effective in achieving results, as indicated by scores of 80 and 83, respectively. As a result of the PART reviews in FY 2003, the geologic resources programs will continue to work with administration officials to refine performance measures drafted during the PART process and develop 5-year program plans that incorporate these measures. The OMB recommended that the Mineral Resources Program (MRP) target funding to activities that support long-term land use and economic policy decisions and improve accessibility and application of MRP information. The OMB recommended that the Energy Resources Program continue to make its reports and data more accessible and user friendly.

Overall direction for these programs is established by a 5-year plan that results from internal and external inputs such as USGS and DOI strategic plans, the results of periodic reviews (every 5 years) by committees overseen by the NRC (with 9-12 members representing various sectors of industry, State and local governments, and academia), workshops with stakeholders on specific topics (such as abandoned mine lands or opportunities for collaboration in materials flow studies), and the advice of senior scientists within and outside the USGS. The appropriateness of the specific directions of projects designed to meet the goals of the 5-year plans are assured by requiring internal and external management and scientific review of project concepts while still in the formative stages and of project proposals when they are submitted for initial funding, by periodic review of progress of multiyear projects, and by peer review of the reports of project results at completion.

Providing unbiased, scientifically valid resource assessments of the potential energy and mineral supply of the United States, and the environmental consequences of developing these resources, are core functions of the USGS. Historically, emphasis within the USGS energy and mineral resource programs on ore genesis and the formation of mineral and energy deposits has provided a foundation for the programs' evolution to modern resource studies and probabilistic assessments. The USGS energy and mineral resource programs currently focus on (1) developing and applying improved quantitative methods for oil, gas, coal, and mineral assessments through the use of advanced computer modeling, (2) assessing resource quality and availability to enable more informed decisions by public and private entities involved in energy and mineral resource extraction and use, and (3) gathering and disseminating periodic, census-style information on the production and use of mineral resources, both domestically and internationally, for use by government agencies such as the Federal Reserve and Department of Defense (DoD) and by the private sector.

These two programs support DOI's Resource Use strategic goal to manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal-value energy and non-energy minerals, which is aimed at ensuring data are available for managers to make informed decisions about use of resources. These efforts also contribute to the achievement of the following Geology science strategy goal:

- Advance the understanding of the Nation's energy and mineral resources in a global geologic, economic, and environmental context.

Topics of recent emphasis include:

- Working with the BLM, Department of Energy (DOE), and USFS to conduct energy resource assessments of all Federal lands in compliance with the Energy Policy and Conservation Act (EPCA) amendments of 2000,

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- Studying the recoverability, production characteristics, and resource potential of permafrost-associated natural gas hydrates and associated free-gas accumulations in the Prudhoe Bay-Kuparuk River area on the North Slope of Alaska with DOE, BLM, and the State of Alaska,
- Mineral and geochemical studies in national parks, national forests, and BLM resource areas that provide mineral resource, geologic, geochemical, and geophysical information for land stewardship, future management plans, and allow rapid response to evolving land management concerns,
- Investigating the potential coalbed methane resources in southernmost Texas, north-central Louisiana, and Wyoming with State and Federal partners, and
- Provide long and short-range statistics and analysis on production and consumption of mineral commodities to DOI, DoD, the Central Intelligence Agency, Department of State, the Federal Reserve, and private sector companies for market analysis, economic forecasting, security policy, and managing the National Defense Stockpile.

Federal Role

The Federal role in conducting science to understand geologic hazards, resources, and processes derives from the U.S. Government's responsibilities to protect the lives and property of its citizens, to support continued economic growth and competitiveness, and to assist society in anticipating and coping with the enormous forces of nature that shape and control the landscape.

Customers and Partners

Hazards — The USGS cooperates and coordinates closely with local, State, and other Federal agencies and the university community to determine and provide for their needs for Earth science information critical for developing mitigation strategies and response plans. For example, the USGS is a major partner of the National Earthquake Hazards Reduction Program, cooperating closely with the Federal Emergency Management Agency (FEMA), the National Science Foundation (NSF), and the National Institute of Standards and Technology (NIST). The USGS also monitors 49 volcanoes in the United States, including 2 in the Commonwealth of the Northern Mariana Islands, for signs of unrest and eruptions and notifies Federal, State, and local emergency agencies. The USGS cooperates with the National Weather Service (NWS) and the Federal Aviation Administration (FAA) to provide warnings to the airline industry on volcanic ash from explosive volcano eruptions and improved alert systems for landslides and tsunamis is being developed with NOAA. Through these and other cooperative arrangements, the USGS helps assure that the needs for risk assessments of hazards are met.

Landscape and Coastal Assessments — The USGS coordinates with a large number of local, State, and Federal agencies on a wide range of geologic, coastal, and marine studies. For example, the USGS cooperates and coordinates with Federal land management agencies, including the BLM, USFS, NPS, FWS, Bureau of Indian Affairs, and others, to provide basic geologic and interpretive information tailored to their issues and management needs. On environmental issues, the USGS coordinates with the U.S. Environmental Protection Agency, DOE, DoD, and State and local environmental agencies to assist in characterizing sites and providing needed information on the nature, magnitude, and source of contamination problems.

In the coastal environment, the USGS cooperates closely with the National Marine Fisheries Service, NOAA, and the U.S. Army Corps of Engineers to provide the marine and coastal geologic information necessary for developing management plans. Locally and regionally, the USGS coordinates with State geological surveys and other State agencies, communities, and universities. The objectives of this close cooperation and coordination are to (1) assure that USGS is addressing priority issues and that the information is prepared and presented in a form that is readily usable, and (2) assure that the appropriate mix of scientific expertise, including personnel from State and local agencies and universities as necessary, is addressing identified problems.

Resources — The Federal Government manages about one-third of the Nation's land area. It also manages the Exclusive Economic Zone, which extends 200 nautical miles from the Nation's coasts and encompasses an area that exceeds the Nation's land area. The USGS is the primary provider of Earth science mineral and energy resource information and assessments for Federal agencies such as BLM and USFS who are responsible for managing these areas. The USGS also works closely with DOE in implementation of the National Energy Policy. The USGS cooperates with many local and State agencies and coal and electric power producers to assess the availability and quality of coal resources. Every 5 years, the USGS publishes an assessment of the Nation's oil and natural-gas resources; land managers, energy producers, utility managers, and policymakers, among others, use the assessment and cooperate on its creation and methodology. The USGS World Petroleum Assessment examines the 76 most productive oil and gas provinces of the world that contain about 95 percent of the world's oil and gas resources. Currently we are working with partners in DOE, and the energy industry, and academic and governmental agencies in Canada, Russia, Norway, and Greenland to assess our Arctic energy resources. The FY 2000 World assessment was the first of its kind to include a rigorous geologic foundation for remaining resource volumes internationally and the first to make those data available to the entire geoscience, business, and research communities. The U.S. Departments of Energy, Defense, and State; U.S. Agency for International Development; Energy Information Administration; International Energy Agency; the intelligence community; and over two dozen industry partners assisted in this effort. The USGS cooperates with State geological surveys in conducting coal-quality studies. Regional consortia are being developed between the USGS and the State geological surveys, electric utilities, coal producers, and the Electric Power Research Institute to assess coal quality in several coal-producing basins. Finally, the USGS cooperates with hundreds of domestic and international producers and users of mineral commodities to compile reports on the supply and utilization of these resources for purposes of economic development and national security.

Funding, Strategic Goals, and Performance Data

Funding for the Geologic Hazards, Resources, and Processes Activity addresses the DOI Strategic Plan's Resource Use and Serving Communities mission themes. The Geologic Resource Assessments subactivity supports the Resource Use strategic goal of managing resources to enhance public benefit, promote responsible use, and ensure optimal value of energy and non-energy minerals. The Geologic Hazard Assessments subactivity supports the Serving Communities strategic goal of protecting lives, resources, and property and the Geologic Landscape and Coastal Assessments subactivity supports the Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science.

FY 2005 and prior year performance targets capture the metrics from the prior GPRA Strategic and Annual Plans (largely in outputs) and where possible, prior year performance actuals were

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also derived for the new metrics. "SP" coded measures relate to specific measures in the DOI Strategic Plan and contribute to the aggregate bureau outcome as shown in the General Statement and the aggregate DOI outcome in the Department's unified plan. Outputs are only included in bureau plans.

The USGS customer satisfaction metrics are developed on the basis of information collected in an ongoing series of customer satisfaction/outcome surveys. Each survey collects information on satisfaction with various aspects of one specific USGS science product. Information is collected from a random sample of the customers of that specific product. The satisfaction ratings for the individual products are extracted or combined to create the cited customer satisfaction metrics. The individual satisfaction ratings used to create the metrics are replaced on a 3-year cycle. The metrics for any 2 consecutive fiscal years, therefore, have about two-thirds of the specific science products in common on average. This has the effect of making the data series more stable than if all products were replaced each year. It also makes the metrics more representative of USGS science products as a whole, since it approximately triples the number of specific products included in each metric.

FY 2004 Actual Plan Compared to FY 2004 Plan/Budget

- Changes in performance targets are predominantly due to the difference in funds received under the FY 2004 Enacted appropriation.
- The Geologic Hazards, Resources, and Processes Program met or exceeded all performance targets for FY 2004, except:
 - Target measure percent of expected responses for which canvass forms have been converted to electronic format did not meet the target of 70 percent. Year end actual reported was 58 percent. Progress in conversion of forms to electronic format was delayed by about 9 months due to difficulties in diagnosing software problems.
 - Soundness of methodology, accuracy, and reliability of science (program evaluation) target of 100 percent was not met. Year end actual reported was 80 percent. External reviews were delayed from original schedule. There is no effect on overall program or activity performance.

FY 2005 Revised Final Plan Compared to FY 2004 Actual

- Changes in performance targets are predominantly due to the difference in funds received under the FY 2005 Enacted appropriation.
- Several target measures in hazards and resources have been revised upward to account for increases and funding restoration in the FY 2005 enacted amount over the FY 2005 Presidents budget. Target measures for # of sensors installed and # of counties or jurisdictions with improved plans have changed due to the creation of accurate and detailed baseline numbers.
- Changes to the output measure "# of real-time ANSS earthquake sensors (reported yearly and cumulative at the end of the year)" — Procedures were changed, resulting in improvements to the scope of this measure. Previous sensor counts focused on seismic stations that measured ground movement and not those that measured buildings and other structures. A new procedure for counting ANSS sensors installed in buildings and other structures (a major element of the ANSS deployment plan) has been developed

and has been incorporated into the estimate. Prior year actuals have been recalculated using the new procedures, which are shown in the performance summary table at the end of this section.

FY 2006 Plan Compared to FY 2005 Revised Plan

- Changes are mostly due to the difference between FY 2005 enacted appropriation and the FY 2006 plan dollars.
- Output measures for hazards have been revised to reflect increases in funding for new tsunami, landslide and volcano monitoring work.
- Output measures for mineral and energy resources have been revised to reflect decreases in mineral resource assessments, geochemical and geophysical surveys, mineral commodity reports, mineral environmental and public health studies, and energy environmental studies.

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2003 to 2006 Performance Summary

Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD = Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Resource Use Goal:

End Outcome Goal: UEO.1. Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value - Energy							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Baseline Information:</i> # of targeted basins with oil and gas resource assessments available to support management decisions (SP) (PART)	7	5	6	6	6	0	5
<i>Quality & Utility of Information:</i> X% of customers satisfied with timeliness of data (BUR)	100%	100%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality & Utility of Information:</i> X% of data is accessible (NK)	95%	95%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality & Utility of Information:</i> X% of customers for which energy data meets their needs (BUR)	93%	93%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality and Utility of Information:</i> X% of energy studies validated through appropriate peer review or independent review (SP) (PART)	100%	100%	100%	100%	100%	0	100%
PART Efficiency and other Output Measures							
# of systematic analyses & investigations delivered to customers (assessments)	7	5	6	6	5	-1	5
# of formal workshops or training provided to customers (instances/issues/events)	9	8	8	8	7	-1	8
X% of targeted analyses/investigations delivered which are cited by identified partners within 3 years of delivery (PART)	UNK	80%	80%	80%	80%	0	80
Average cost of a systematic analysis or investigation (PART Eff. Measure)	\$2.75M	\$2.2M	\$2.75M	\$2.75M	\$2.75M	0	\$2.75M

Activity Summary

# of annual gigabytes collected	UNK	0.745	42.038	42.038	20.038	-22	TBD
# of cumulative gigabytes managed	2.713	211.458	253.496	253.496	273.534	+20.038	TBD

End Outcome Goal: UEO.2. Manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value – Non-Energy Minerals							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Improve information base, information management and technical assistance Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Baseline Information:</i> Average square miles of the United States with non-energy mineral information available to support management decisions (SP) (PART)	2,368,794	2,401,329	2,587,318	2,987,340	2,987,340	0	2,987,340
<i>Quality & Utility of Information:</i> X% of U. S. with geologic, geochemical, geophysical and mineral locality data (BUR)	67%	68%	73%	84%	84%	0	84%
<i>Quality & Utility of Information:</i> X% of customers satisfied with timeliness of data (BUR)	78%	78%	70%	78%	50%	-28%	50%
<i>Quality & Utility of Information:</i> X% of customers for which minerals data meets their needs (BUR)	84%	84%	70%	84%	40%	-44%	40%
<i>Quality & Utility of Information:</i> X% of mineral studies validated through appropriate peer review or independent review (SP) (PART)	100%	100%	100%	100%	100%	0	100%
PART Efficiency and other Output Measures							
# of systematic analyses & investigations delivered to customers (assessments)	4	5	3	3	2	-1	3
# of cumulative gigabytes managed	1.818	15.420	16.021	16.021	16.121	+0.1	16.5
# of formal workshops or training provided to customers (instances/issues/events)	9	8	5	8	2	-6	2
# of mineral commodity reports available for decisions	UNK	733	700	720	700	-20	700

Geologic Hazards, Resources, and Processes

X% of expected responses for which canvass forms have been converted to electronic format	UNK	58%	70%	80%	80%	0	80%
X% of targeted analyses delivered which are cited by identified partners within 3 years after analysis delivered (PART)	80%	80%	80%	80%	80%	0	80%
Average cost of a systematic analysis or investigation (PART Eff. Measure)	\$4.13M	\$4.31M	\$4.18M	\$4.18M	\$11.40M	+7.22M	\$8M

Serving Communities Goal:

End Outcome Goal: SEO.1. Protect Lives, Resources and Property							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
<i>Hazards:</i> X% of communities using DOI science on hazard mitigation, preparedness and avoidance for each hazard management activity (SP)	39.5%	43.2%	44.8%	45.9%	47.5%	+1.6%	49.1%
<i>Decision Maker Satisfaction:</i> Met need for information to help achieve goal of reduced risk (SP)	98%	98%	≥80%	≥80%	≥80%	0	≥80%
Intermediate Outcome: Provide information to assist communities in managing risks from natural hazards							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Use Rate: Earthquakes:</i> X% of communities using DOI science on hazard mitigation, preparedness and avoidance for each hazard management activity (NK)	56.5%	62.7%	63.9%	63.4%	63.9%	+0.5%	63.9%
<i>Use Rate: Landslides:</i> X% of communities using DOI science on hazard mitigation, preparedness, and avoidance for each hazard management activity (NK)	3.3%	3.7%	4.2%	3.9%	4.4%	+0.5%	5.4%
<i>Use Rate: Volcanoes:</i> X% of communities using DOI science on hazard mitigation, preparedness, and avoidance for each hazard management activity (NK)	58.6%	63.3%	66.4%	70.3%	74.2%	+3.9%	78.13%

Activity Summary

<i>Use Rate: Landslide Hazards: # of responses to inquiries from the public, educators, and public officials to the National Landslide Information Center on hazard mitigation, preparedness and avoidance strategies for landslide hazards (BUR)</i>	1,600	1,600	1,600	1,600	1,600	0	1,600 (100%)
<i>Adequacy: X% of sampled stakeholders reporting adequacy of science base to inform decisionmaking for each hazard management activity (volcanoes, earthquakes, etc.) (SP)</i>	97%	98%	≥80%	≥80%	≥80%	0	≥80%
<i>Adequacy: Earthquake Hazards: X% of customers for which earthquake hazards data meets their needs (BUR)</i>	97%	97%	≥80%	≥80%	≥80%	0	≥80%

PART Efficiency and other Output Measures

PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
# of systematic analyses & investigations delivered to customers (risk/hazard assessments)	4	3	6	5	7	+2	32
# of real-time ANSS earthquake sensors (reported yearly and cumulative at the end of the year) (old)	51 (cum 476)	75 (cum 551)	Procedures were changed, resulting in improvements to the scope of this measure. See new data below and explanation of procedures.				
# of real-time ANSS earthquake sensors (reported yearly and cumulative at the end of the year) (new)	46 (cum 428)	95 (cum 523)	11 (cum 534)	40 (cum 563)	21 (cum 563)	+21	Targets set Annually
% of earthquake monitoring global seismic network stations that have telemetry (increase reporting speed from 1 hour to 20 minutes)	UNK	80%	80%	80%	96%*	+16%	Targets set Annually
# of formal workshops or training provided to customers (instances/issues/events)	13	14	14	14	14	0	14
# of sites (mobile or fixed) monitored for ground deformation to identify volcanic activity (VHP)	75	85	85	86	101	+15	130

Geologic Hazards, Resources, and Processes

Adoption of National Seismic Hazard Maps by NEHRP provisions and International Building Codes (PART long-term) (EHP)	1	0	0	0	0	0	Maps revised every 5 years; adopted within 2 years
# of urban areas for which detailed seismic hazard maps are completed (PART) (EHP)	1	2	3	3	3	0	26
# of areas or locations for which geophysical models exist that are used to interpret monitoring data (PART) (LHP)	3	4	4 1/3	4 1/3	4 2/3	+1/3	5
# of metropolitan regions where Shakemap is incorporated into emergency procedures (PART) (EHP)	4	5	5	5	5	0	26
# of volcanoes for which information supports public safety decisions (PART) (VHP)	48	49	50	51	53	+2	57
X% of potentially hazardous volcanoes with published hazard assessments (x number of 70) (PART) (VHP)	61.4%	61.4%	64.3%	62.8%	65.6%	+2.8%	68.6%
X% of potentially active volcanoes monitored (PART) (VHP)	66%	67%	70%	72%	73%	+1%	73%
# of counties, or comparable jurisdictions, that have adopted improved building codes, land-use plans, emergency response plans, or other hazard mitigation measures based on USGS earthquake hazards information (PART) (FY03 Baseline is 891 at risk counties)	503	559	569	565	569	+4	569
# of counties, or comparable jurisdictions, that have adopted improved building codes, land-use plans, emergency response plans, or other hazard mitigation measures based on USGS landslide hazards information (PART) (Baseline is 1,800 counties and parks with moderate to high landslide susceptibility in the U.S. (FY99-FY03, 60 adopted measure)	60	68	76	71	80	+9	98

Activity Summary

# of counties, or comparable jurisdictions, that have adopted improved building codes, land-use plans, emergency response plans, or other hazard mitigation measures based on USGS volcano hazards information (PART) (Baseline is 256 at risk counties)	162	162	170	180	190	+10	200
X% data availability for real-time data from the GSN (PART)	90%	90.5%	90%	90%	90%	0	90%
Data processing and notification costs per unit volume of input data from ANSS earthquake sensors in monitoring networks (in cost per gigabyte) (PART Eff. Measure)	1.007 \$k/Gb	0.90 \$k/Gb (-1%)	0.990 \$k/Gb	0.990 \$k/GB	TBD	0	TBD

End Outcome Goal: SEO.2. Advance knowledge through scientific leadership and inform decisions through the application of science.

End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
<i>Research:</i> Soundness of methodology, accuracy, and reliability of science (program evaluation) (SP)	100%	80%	100%	100%	100%	0	100%
<i>Inform decisions through the application of science:</i> Improved access to needed science information (# score) (SP)	92%	90%	90%	90%	90%	0	90%
<i>Inform decisions through the application of science:</i> Stakeholders reporting that information helped achieve goal (# score) (SP)	94%	93%	90%	90%	90%	0	90%

Intermediate Outcome: Improve information base, information management and technical assistance
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures

<i>Content and expanse of knowledge base:</i> X% of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (SP) (NCGMP)	5.5%	7.9%	9.8%	10.1%	12.2%	+2.1%	16.5%
<i>Quality:</i> X% of studies validated through appropriate peer review or independent review (SP)	100%	100%	100%	100%	100%	0	100%

Geologic Hazards, Resources, and Processes

PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
# of annual gigabytes collected	UNK	407.2	210.8	210.8	212.8	+2	TBD
# of cumulative gigabytes managed	491	898.2	1.109	1.109	1.321.8	+212.8	TBD
# of systematic analyses and investigations delivered to customers		20	23	18	17	-1	30
# of formal workshops or training provided to customers (instances/issues/events)		24	26	25	26	+1	28
# of conceptual or numerical models developed (Puget Sound)	0	2	2	2	2	0	4

* Includes adding 8 new stations with telemetry and upgrading 20 dial-up stations with telemetry.

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Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Earthquake Hazards	47,401	46,898	+694	+3,745	51,337	+4,439
FTE	231	226	0	+20	246	+20
Volcano Hazards	19,785	20,714	+247	+826	21,787	+1,073
FTE	138	133	0	0	133	0
Landslide Hazards	2,620	3,043	+51	-6	3,088	+45
FTE	22	22	0	0	22	0
Global Seismographic Network	3,434	3,335	+42	+595	3,972	+637
FTE	7	7	0	0	7	0
Geomagnetism	2,043	1,989	+42	-6	2,025	+36
FTE	14	14	0	0	14	0
Total Requirements \$000	75,283	75,979	+1,076	+5,154	82,209	+6,230
FTE ^{b/}	412	401	0	+20	421	+20

^{a/} Changes for this program element include a reduction of -\$71 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

^{b/} FTE may not add to total, due to rounding.

Earthquake Hazards

2006 Program Overview

The 2006 budget request for the Earthquake Hazards Program is \$51,337,000.

The USGS Earthquake Hazards Program (EHP) provides the scientific information and knowledge necessary to reduce deaths, injuries, and economic losses from earthquakes and earthquake-induced tsunamis, landslides and liquefaction. Products of this program include timely notifications of earthquake locations, size, and potential damage; regional and national assessments of earthquakes hazards; and increased understanding of the cause of earthquakes and their effects and the degree to which they can be predicted.

Of all natural hazards facing the United States, earthquakes have the greatest potential for inflicting casualties, damage, economic loss, and disruption. Although damaging earthquakes are infrequent, their consequences can be immense. According to recent studies, a major earthquake in an urbanized region of the United States could exceed \$200 billion in losses, cause several thousand deaths, and impact the national economy. Although the risk from earthquakes is famously high in California, many other parts of the country are also at risk, including the Mississippi River valley, Pacific Northwest, Intermountain West, Alaska, Hawaii,

Geologic Hazard Assessments Subactivity

and parts of the eastern seaboard. In fact, 75 million people, including 46 million outside California, live in metropolitan areas with significant earthquake risk.

The coastal communities of the United States, its island territories, and many other countries are vulnerable to damaging tsunamis generated by large earthquakes, submarine landslides, volcanic slope failures and severe tropical storms. Within the United States, key populated areas at risk include the entire west coast, southern Alaska coast, territories in the Pacific and Caribbean, and the eastern seaboard. Increasing the safety of coastal communities requires a broad program of monitoring, warning system development and public education, accompanied by research into earthquake and tsunami sources and processes. The Indian Ocean tsunami starkly illustrates the potential dangers of earthquake-generated tsunamis, and highlights opportunities for increasing the Nation's ability to (1) rapidly determine the location, size and depth of large earthquakes, (2) discriminate those likely to have caused a tsunami, and (3) work with Federal, local and foreign partners to ensure timely warnings can be issued. For example, tsunami warnings issued by the National Oceanic and Atmospheric Administration (NOAA) Pacific and Alaska Tsunami Warning Centers rely on seismic data transmitted from the USGS National Earthquake Information Center.

Worldwide, 2004 delivered several highly damaging earthquakes, including deaths due to earthquake shaking in Japan, Morocco, Indonesia, and Afghanistan, as well as the huge toll from the December's magnitude 9.0 earthquake—the world's largest since 1964—and the resulting tsunami. The United States most recent deadly earthquake was in central California in December of 2003. The magnitude 6.5 earthquake, with epicenter near San Simeon, killed two and caused extensive damage to non-retrofitted buildings in the area. Casualties and damage were mitigated by the quake's location beneath the thinly populated region between Los Angeles and San Francisco. However, it serves as a potent warning of the much greater impact that could await those urban regions.

Earthquakes are inevitable, but earthquake damage and life-loss are not. America's first line of defense against earthquakes is the construction of buildings that withstand strong shaking. The EHP provides the seismic assessments that underlie modern building codes, as well as the scientific information and knowledge necessary to reduce deaths, injuries, and economic losses from earthquakes.

The EHP is the applied Earth science component of the multiagency National Earthquake Hazards Reduction Program (NEHRP), most recently re-authorized by the Earthquake Hazards Reduction Authorization Act of 2004, P.L. 108–360 enacted on October 25, 2004. The National Institute of Standards and Technology (NIST) is the lead agency of the national program, and it coordinates the activities with the three other principal NEHRP agencies: the USGS, the National Science Foundation (NSF), and the Federal Emergency Management Agency (FEMA).

As described in the Office of Management and Budget (OMB) Program Assessment Rating Tool (PART) review of Geologic Hazard Programs, the EHP role is clearly defined and unique from other Federal, State, local, or private entities. The Hazards Programs were reviewed in FY 2003 for the FY 2005 Budget using the PART and were found to be working effectively with partners and fulfilling its mission. As a result, they received a score of 82. An example of responding to a PART recommendation, the program has sought to quantify the use of its products by measuring the number of jurisdictions around the Nation that have adopted building codes using USGS National Seismic Hazard Maps.

Overall direction for the EHP is established by a 5-Year Plan that results from internal and external inputs such as the USGS and the Department of the Interior (DOI) strategic plans, the results of periodic reviews by the Scientific Earthquake Studies Advisory Committee, workshops with stakeholders on specific topics, and the advice of senior scientists both within and outside the USGS. The appropriateness of the specific directions being taken by the EHP to meet the goals of the 5-Year Plan is assured by requiring both management and scientific review of project concepts and of final project proposals when submitted for initial funding. Additionally, periodic reviews are conducted on progress of multiyear projects and peer review of reported project results at the time of completion.

The elements of the EHP 5-Year Plan that were developed in 1997 (Products for Earthquake Loss Reduction, Earthquake Information, and Research on Earthquake Occurrence and Effects) have evolved into the following three program components:

- Assessment and Characterization of Earthquake Hazards,
- Monitoring and Reporting Earthquake Activity and Crustal Deformation, and
- Conducting Research into Earthquake Causes and Effects.

As of January 2005, a final draft 5-Year Plan for 2004–08 is under review at OMB.

This program supports the DOI "Serving Communities" strategic goal to protect lives, resources, and property by making information available to communities to use in developing earthquake hazard mitigation, preparedness, and avoidance plans. Three intermediate outcome measures in support of the intermediate outcome of providing information to assist communities in managing risks from natural hazards are tracked: (1) the use rate of products, (2) the adequacy of information, and (3) the percent of customers for which earthquake hazards data meets their needs. Output measures for which targets are established in support of achieving the intermediate outcome goal include: (1) the maintenance of one hazard monitoring network, (2) the delivery of risk/hazard assessments to customers, (3) the presentation of formal workshops or training to customers, and (4) the number of sensors installed in the Advanced National Seismic System (ANSS).

The three program components are described in detail below. The USGS supports external research and monitoring activities in each of these components. Approximately 25 percent of the total EHP budget is directed toward research grants and cooperative agreements with universities, State agencies, and private technical firms. This external funding is highly leveraged by funds from other Federal agencies, States, and the private sector.

Assessment and Characterization of Earthquake Hazards

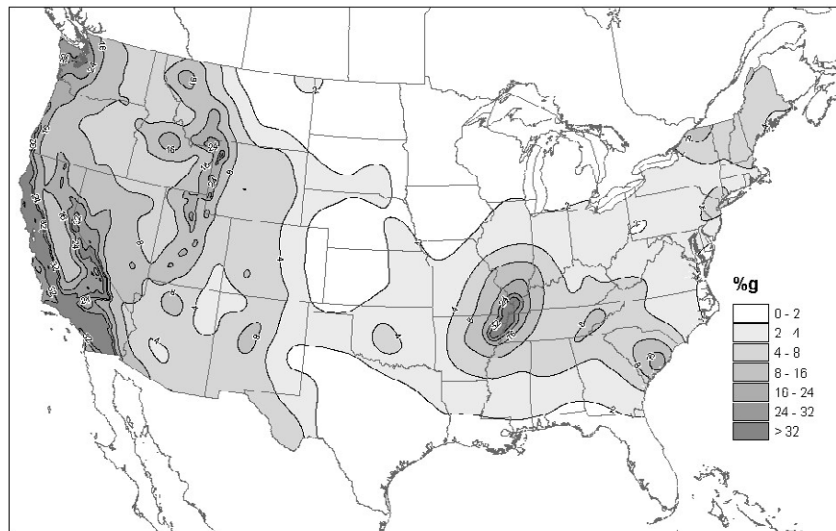
(Estimates for FY 2004, \$19.0 million; FY 2005, \$18.5 million; FY 2006, \$18.5 million)

The USGS contributes to earthquake hazard mitigation strategies by (1) estimating and describing the likelihood of and potential effects of moderate-to-large earthquakes in high-risk regions of the United States, such as southern California and the Pacific Northwest, and (2) making this knowledge available to others so that it can be used to reduce the impact of potentially damaging earthquakes. Federal, State, and local government agencies, architects and engineers, insurance companies and other private businesses, land-use planners, emergency response officials, and the general public rely on the USGS for earthquake hazard information to refine building codes, develop land-use strategies, safeguard lifelines and critical

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facilities, develop emergency response plans, and take other precautionary actions to reduce losses from future earthquakes.

National Seismic Hazard Maps — USGS national-scale seismic hazard maps are used to develop new, unified building codes for the United States. The maps integrate geologic mapping; fault locations, fault slip rates, and earthquake recurrence intervals; and analyses of crustal deformation, ground-motion patterns, and recent seismicity. These maps are prepared in digital format and give, as a function of latitude and longitude, the maximum severity of ground shaking (in terms of horizontal acceleration) that can be expected during exposure periods of 50, 100, and 250 years. As such, they are the basis for applying the seismic design criteria contained in the building codes. The maps and their associated databases are also used to predict earthquake losses and to define insurance risks. Periodic review and updating of the seismic hazard maps to incorporate new information are among the highest priorities for the EHP. The latest generation of maps was released in FY 2003. Maps are scheduled for updating every 5 years, conforming to the schedule for re-issue of national and international building codes. The USGS is also working closely with earthquake researchers, engineers, and State and local government representatives across the Nation to ensure that the base geologic data represent the most current and accurate information available, consistent with the Department's strategic plan end outcome goal to protect lives, resources, and property by providing information to assist communities in managing risks from natural hazards.



Seismic hazard for the conterminous United States, from the USGS National Seismic Hazard Map update released in FY 2003. Map shows peak horizontal acceleration with 10 percent probability of being exceeded in 50 years. These maps form the basis for the seismic design provisions of major building codes in the United States. See <http://earthquake.usgs.gov> for more maps and details.

Maps for Urban Areas — The national-scale earthquake hazards maps cannot take into account variations in the amplitude and duration of seismic shaking caused by local geologic structures and soil conditions. The USGS is generating products that address the specific hazards in high-to-moderate risk urban areas, where the population and risks are greatest, such as the San Francisco Bay area and Los Angeles, CA; Seattle, WA; Salt Lake City, UT; St. Louis, MO; Evanston, IL; Memphis, TN; and Charleston, SC. Large-scale maps showing anticipated earthquake shaking levels are being developed for use by local officials in determining where to allow development, and modeling of ground motion is being provided for

engineering applications. In conjunction with release of these targeted assessments, the USGS conducts workshops to assure the proper transfer of knowledge and to help design effective mitigation.

During FY 2006, the USGS will complete collaborative urban seismic hazard mapping projects in the densely-populated, high-risk St. Louis urban area and the Tri-State (Evansville) area of Indiana, Kentucky, and Illinois, which were begun in FY 2004. In both these efforts we serve primarily as coordinators, with most of the technical work being done by partners more local to each area. Partners in the St. Louis project include the University of Missouri at Rolla, the Missouri Department of Natural Resources, and the Illinois State Geological Survey. Those for the Tri-State (Evansville) project include the State Geological Surveys of Indiana, Kentucky, and Illinois, the Southwest Indiana Disaster Resistant Community Corporation, the Association of Central United States Earthquake Consortium (CUSEC) State Geological Surveys, and Purdue University. In addition, the Kentucky Geological Survey is working with the USGS National Cooperative Geologic Mapping Program on detailed geologic mapping on the Indiana side of the Ohio River.

Monitoring and Reporting Earthquake Activity and Crustal Deformation

(Estimates for FY 2004, \$20.5 million; FY 2005, \$20.5 million; FY 2006, \$24.1 million)

As required under the Disaster Relief Act of 1974 (P.L. 92-288), the USGS has the assigned Federal responsibility for monitoring and notification of seismic activity in the United States. The USGS is the only agency in the United States that routinely and continuously reports on current domestic and worldwide earthquake activity. The USGS fulfills this role by operating the Advanced National Seismic System (ANSS), components of which include the U.S. National Seismograph Network (USNSN), the National Earthquake Information Center (NEIC), and the National Strong Motion Program (NSMP), and by supporting 15 regional networks in areas of moderate-to-high seismic activity.

Reports of potentially damaging earthquakes are provided to the National Command Center; the White House; the Departments of Defense, Homeland Security (including FEMA), Transportation, Energy, and the Interior; State offices of disaster services; numerous public and private infrastructure management centers (e.g., railroads and pipelines); the news media, and the public. Rapid earthquake notifications are delivered by e-mail, pager, fax, and through USGS Web sites. USGS also provides near-real-time data to NOAA's tsunami warning centers, supporting tsunami monitoring in the Pacific Rim and disaster alerting in Alaska, Hawaii, Washington, California, and U.S. territories in the western Pacific.

The Advanced National Seismic System (ANSS) — The ANSS initiative is focused on expanding and improving the performance and integration of national, regional, and urban seismic monitoring networks in the United States. Begun in 2000, ANSS implementation efforts in that year focused on the installation of new urban recording sites in three metropolitan areas: Salt Lake City, UT; San Francisco, CA; and Seattle, WA. Instrumentation continued in these three urban centers in FY 2001, along with new efforts in Memphis, TN; Anchorage, AK; and Reno, NV. Increasing seismic monitoring capability in urban regions has two major benefits. The first is to provide rapid assessments of the distribution and severity of strong ground shaking just after an earthquake. This information can be used by emergency response officials to determine the scope and scale of the crisis they face. The second is to provide detailed and accurate data on the shaking of the ground and structures during a damaging earthquake. These data can be used in the recovery and rebuilding phase for more earthquake-resistant design and construction in the future. In FY 2002, installation of new seismic instrumentation

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continued in these six areas and expanded to Hawaii and the northeastern United States. In FY 2003 and FY 2004, an additional 126 seismic stations were installed across the country. The table below provides the funding history that has supported this instrumentation to date.

Advanced National Seismic System Funding				
(dollars in millions)				
<u>Year</u>	<u>Base</u>	<u>Change</u>	<u>Annual Funding</u>	<u>Cumulative Expenditure</u>
FY 2000	\$0.0	+\$1.6	\$1.6	\$1.6
FY 2001	\$1.6	+\$2.0	\$3.6	\$5.2
FY 2002	\$3.6	+\$0.3	\$3.9	\$9.1
FY 2003	\$3.9	\$0.0	\$3.9	\$13.0
FY 2004	\$3.9	+\$0.5	\$4.4	\$17.4
FY 2005	\$4.4	+\$0.85	\$5.25	\$22.65
FY 2006 (request)	\$5.25	\$2.816	\$8.066	\$30.716

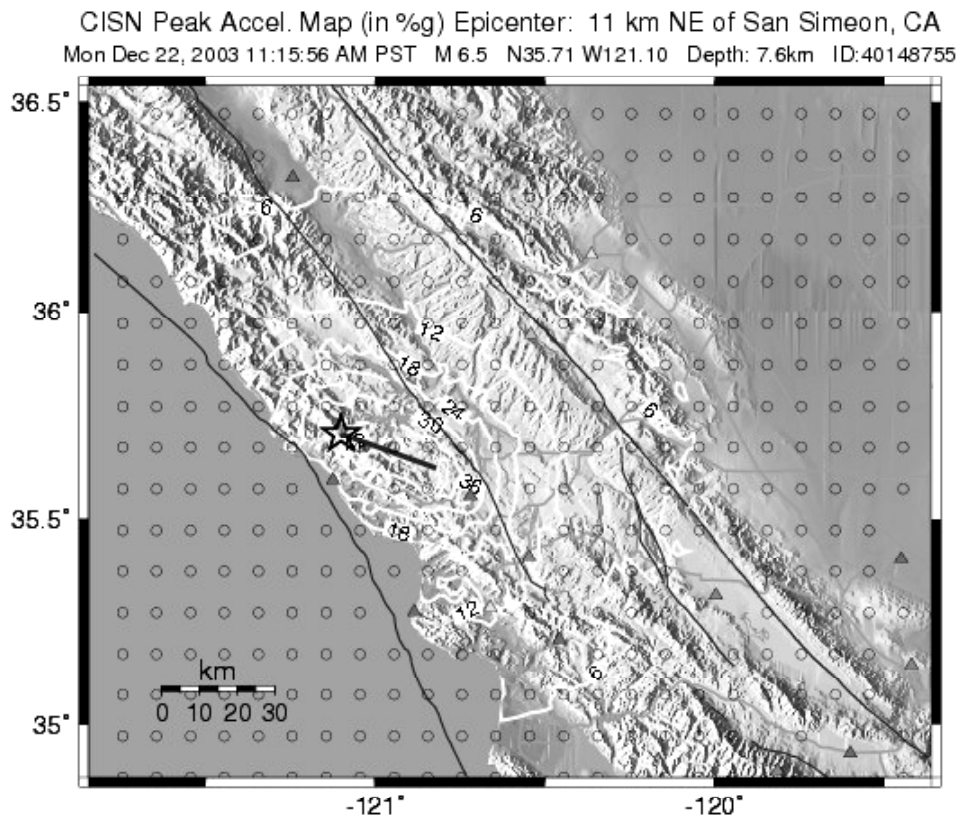
One goal of the ANSS plan is the completion of a 100-station ANSS Backbone national network. In FY 2004, ANSS installed 10 new Backbone stations, a 20 percent increase in the total number of stations. In FY 2005 and FY 2006, USGS expects a significant partner contribution to the Backbone network by the NSF, which will add 17 new stations to the network and upgrade an additional 8 stations. With this partner contribution, no additional funding in FY 2006 is requested for the ANSS Backbone. At existing ANSS funding levels, the USGS hopes to accelerate national seismic network development in support of NSF's *EarthScope* initiative: As part of the *EarthScope* program, a dense network of seismic stations will be sequentially deployed across the continental United States beginning in 2004 and ending in about 2012. In any given region, this "transportable array" will be in place for 18-24 months. Success of this seismic deployment requires uniform stable seismic data collection across the continental United States, information made available by the ANSS Backbone. Inter-agency cooperation is guided by an annex to a Memorandum of Understanding between USGS and the NSF.

Earthquake Notification Innovation, ShakeMap — The ANSS initiative provides comprehensive new data on earthquake ground shaking in urban areas. These data are being used to generate maps of the distribution and severity of ground shaking following an earthquake in or near the urban center. This product, called "ShakeMap," was developed by USGS scientists and is available within about 10 minutes following an earthquake. Using data from newly installed stations and an integrated approach to data processing and products, the ShakeMap capability is now available in the Los Angeles, CA; San Francisco, CA; Seattle, WA; Salt Lake City, UT; and Anchorage, AK, urban areas.

Government officials, emergency managers, and infrastructure and transportation supervisors use ShakeMap for rapid assessment of earthquake situations and in planning their response; the news media and public use it to obtain a quick overview of the local impact of the earthquake. A recent example of ShakeMap use was in rapidly estimating the expected losses from the December 22, 2003, San Simeon magnitude 6.5 earthquake in California. The initial ShakeMap was available 9 minutes after the event, allowing the California Governor's Office of Emergency Services (OES) to quickly gauge the extent of damage, and allowing FEMA to generate a loss estimate within 1 hour. Prior to the development of ShakeMap, OES and FEMA had to await reports from each affected county, and the initial loss estimate took days. In addition, the California Department of Transportation used ShakeMap to determine the number

and location of bridges that needed to be inspected and to establish prioritization for those inspections.

NEIC seismologists have also developed the capability of producing Global ShakeMaps that estimate the extent and distribution of strong shaking from large earthquakes worldwide. Such ShakeMaps lack the benefit of ANSS seismic stations so are highly provisional until other sources of information on shaking and damage become available. However, they Global ShakeMaps be rapidly calculated, and underlie the new USGS product called Prompt Assessment of Global Earthquakes for Response (PAGER), that rapidly estimates the impact on humans from significant earthquakes worldwide by combining maps of shaking intensity with population density and infrastructure fragility. More details on PAGER and an illustration from December's magnitude 9.0 earthquake are presented in the Global Seismographic Network section later in this volume.



ShakeMap, created by USGS in partnership with the California Integrated Seismic Network (CISN), shows shaking intensities during the magnitude 6.5 San Simeon, CA, earthquake in December 2003. The earthquake caused extensive structural damage and two deaths in the nearby city of Paso Robles. ShakeMaps are generated within minutes of large earthquakes in well-instrumented regions of the United States and help greatly in the quick assessment of the scope of an earthquake emergency, in guiding emergency response, and serve as input to the FEMA "HAZUS" software for rapid loss estimation. ShakeMap requires data from modern seismic networks with digital strong-motion recording and real-time telecommunications. Currently a handful of urban areas possess such networks. Full implementation by USGS of the Advanced National Seismic System will allow expansion to all large metropolitan areas with moderate to high seismic risk.

Regional Earthquake Monitoring — As part of ANSS, the USGS and cooperating universities operate regional seismic networks in areas of high seismicity. Data from all U.S. seismic networks are used to monitor active tectonic structures in much greater detail than is possible

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with the national-scale network. Each region has a local data center where the data are processed and regional catalogues of earthquakes are produced. These data centers serve as local distribution points for information about earthquakes to the public, local, and State agencies, and other regional interests. The regional data centers relay earthquake data in real time to the NEIC as well as to other regional networks. They also provide information about regional earthquake hazards and accepted mitigation practices, and those centers located at universities provide training and research facilities for students. To support partner activities in regional earthquake monitoring, \$5.1 million will be provided in FY 2005 through cooperative agreements, \$3.0 million of which comes from base program funds and \$2.1 million of which comes from funds earmarked by Congress for the construction and maintenance of the ANSS.

Regional Earthquake Monitoring Supported by the USGS

ANSS Earthquake Monitoring Region	Cooperating Institutions
Southern California	California Institute of Technology University of California at San Diego USGS – Pasadena
Northern California	University of California at Berkeley USGS – Menlo Park
Pacific Northwest	University of Washington University of Oregon USGS – Seattle and Vancouver, WA
Alaska	University of Alaska, Fairbanks
Inter-mountain West	Montana Geological Survey University of Utah University of Nevada, Reno
Central United States	University of Kentucky University of Memphis St. Louis University Ohio Geological Survey
Eastern United States	Boston College Columbia University University of South Carolina Virginia Polytechnic Institute

Monitoring Strong Motions Caused by Earthquakes — Conventional seismometers used in earthquake monitoring networks cannot accurately record strong ground motions caused by large, nearby earthquakes, yet these technical data are extremely valuable for the design of earthquake resistant buildings and other structures. Like the "black box" that is used to help understand and reconstruct airline accidents, strong motion seismic data, recorded in and adjacent to buildings and other structures, allows engineers to reconstruct both the history of severe earthquake shaking at the site and the structure's response to it. Without these data, it would be impossible to understand how buildings fail (or survive) during large earthquakes. With these data and the models derived from their analysis, engineers and architects are learning how to design safer structures, thereby improving the resilience of communities and lessening the economic impacts of earthquakes. Through the ANSS Strong Motion Program, the USGS maintains about 850 strong motion recorders in 35 States and territories. The strong motion data show the amplitude, frequency content, and duration of strong accelerations caused by an earthquake. These parameters are direct inputs to computer models and scale models of structures to test their performance under realistic earthquake shaking. In FY 2006, this program element will be fully integrated into the ANSS.

Monitoring Changes in the Shape of the Earth's Surface — Geodetic networks provide essential information about the massive, static deformation (strain) of the land surface near

faults. The USGS is working with universities and local agencies to conduct geodetic investigations using Global Positioning System (GPS) and laser-ranging surveys. To address the problem of hazards in the urban Los Angeles region and its environs, the USGS operates and distributes data from a new, state-of-the-art network of continuously operating GPS stations. USGS built this Southern California Integrated GPS Network (SCIGN) in cooperation with the National Aeronautical and Space Administration (NASA) Jet Propulsion Laboratory, the Scripps Institution of Oceanography, and the Southern California Earthquake Center (SCEC). SCIGN measures changes in the shape of the Earth's surface that help reveal the way stress accumulates on earthquake faults in the region, and how those faults are moving at depth. (Beginning in FY 2005 portions of SCIGN will transition to become stations of the Plate Boundary Observatory (PBO), the geodetic component of NSF's *EarthScope* initiative). In addition, the USGS is employing a new satellite technology, Interferometric Synthetic Aperture Radar (InSAR), to quickly and accurately produce large aerial maps of pre- and post-earthquake land deformation. The USGS continues to develop computational tools necessary to efficiently analyze, interpret, and model InSAR data. In southern California, InSAR results will be used to augment, check, and, if necessary, correct the independent GPS measurements.

Conducting Research into Earthquake Causes and Effects

(Estimates for FY 2004, \$8.0 million; FY 2005, \$7.5 million; FY 2006, \$7.7 million)

The USGS conducts research on the causes, characteristics, and effects of earthquakes. This research has direct application in increasing the accuracy and precision of the agency's earthquake hazards assessments, earthquake forecasts, and earthquake mitigation practices. The following paragraphs summarize several noteworthy accomplishments in this broad area.

Studies and Research on Earthquake Processes — A major focus of USGS earthquake research is in understanding earthquake occurrence in space and time. Ongoing USGS investigations seek to understand the physical conditions for earthquake initiation and growth; processes of earthquake triggering; how individual faults in the same region interact; why some faults slip slowly without generating earthquakes while others generate earthquakes; and the factors that control variations in recurrence intervals of earthquakes along the same fault.

Studies and Research on Earthquake Effects — USGS research efforts are also directed at improving the understanding of earthquake-induced strong ground shaking and its effects. Specifically, USGS researchers are investigating how complexities in the earthquake source, Earth's crust, and near-surface soils and deposits influence seismic wave propagation and strong ground motion. Improving current techniques for forecasting the effects of strong ground motion will greatly improve seismic hazard maps for urban regions. These efforts are thus critical for cost-effective earthquake hazard mitigation. Another research priority is the identification and understanding of behavior of weak soils that liquefy and fail when subjected to earthquake shaking. Research on ground failure, carried out in collaboration with structural and geotechnical engineers, will lead to improved design of earthquake-resistant infrastructure and lifelines, such as bridges and airports, commonly built on fill or weak soil.

Improvements and Innovations in Earthquake Forecasting — Forecasts of earthquake occurrence and their effects form the basis of regional earthquake probability forecasts, the national hazard maps, and more specialized products such as aftershock and foreshock predictions. Currently, these products rely extensively on empirical characterizations of earthquake activity. Scientists now stand poised at a critical juncture in the field of earthquake studies. New dense arrays of instrumentation are being deployed across the United States and around the world. These include high precision seismic and geodetic arrays. Satellite-based

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remote sensing systems are now providing exciting new tools for conducting global scale observations of surface deformation, electromagnetic fields and other critical geophysical observations. Paleoseismological work on key faults aided by new high-precision dating techniques has also produced detailed earthquake histories that extend back thousands of years. The well-recorded magnitude 6.0 Parkfield, CA, earthquake (see below) is providing a uniquely detailed view of the processes by which an earthquake prepares, begins, and ruptures, and of the distribution of strong ground shaking nearby. This quantum leap in the quality and variety of geophysical data can be used to improve the precision of earthquake hazards assessments and earthquake forecasting procedures and to broaden the suite of earthquake information products available to emergency managers. This flood of new data also provides the opportunity to test the predictability of earthquake occurrence. Despite earlier optimism, it remains unclear whether intermediate- and short-term earthquake predictions are feasible. However, USGS and other research teams are taking advantage of improved data sets and are evaluating schemes for predicting earthquakes based on, for example, patterns of small earthquakes, patterns of surface strain, and electromagnetic field variations.

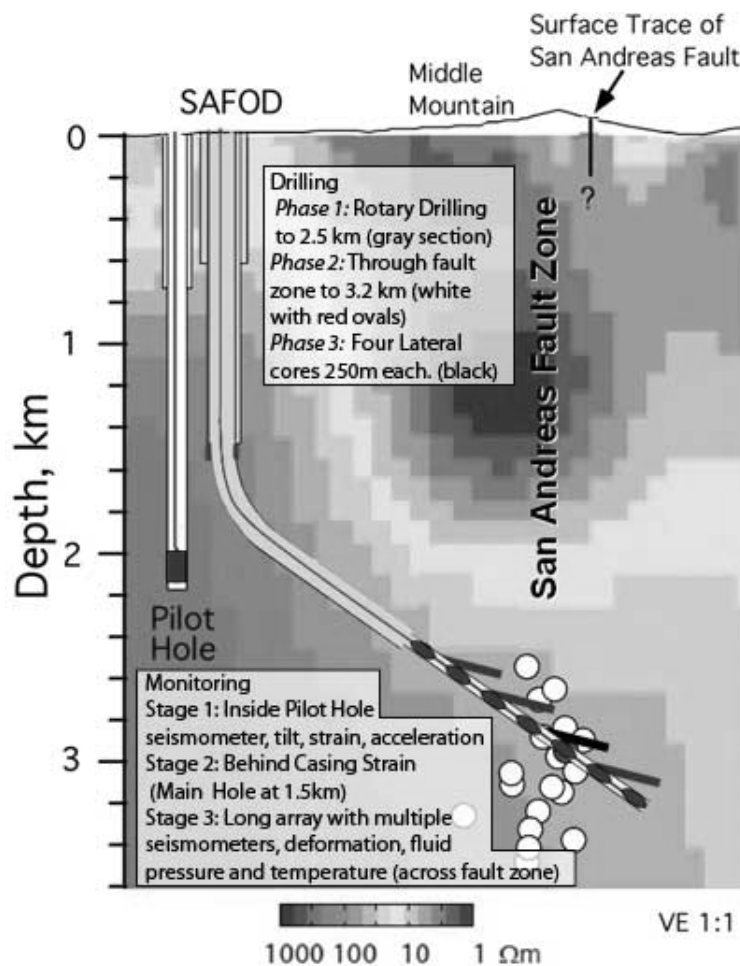
National Earthquake Prediction Evaluation Council to be Re-established — Due to the high level of interest and scrutiny in the field of earthquake prediction and forecasting, it is imperative that the USGS continue to provide scientific and public leadership, by evaluating proposed earthquake prediction methods, providing guidance to the government on appropriate public policy, and managing public expectations when earthquake predictions arise. To this end, USGS will re-establish a National Earthquake Prediction Evaluation Council (NEPEC) to provide the Director and the Nation with authoritative evaluations of proposed earthquake predictions by individuals and organizations within the United States and worldwide. The Council is established pursuant to Earthquake Hazards Reduction Act of 1977 and furthers the objectives of Sec. 202 of the Disaster Relief Act of 1974. The Council is required by Sec. 101 (e)(2) of P.L. 96-472, October 19, 1980. Membership will include USGS and non-USGS scientists. To be effective, the NEPEC will rely on the USGS to maintain the broad internal base of expertise and vibrant research program that is essential to providing authoritative review of the varied prediction schemes now being proposed.

Studies of Prehistoric Earthquakes — The USGS conducts paleoseismology studies at a number of sites across the United States to determine past earthquake chronologies. Studies in the San Francisco Bay Area, performed in collaboration with the California Geological Survey and the Lawrence Livermore National Laboratory, have enabled scientists to piece together, for the first time, a 2,000-year slip history of active faults in the region. The new data suggest that six large earthquakes, including a San Andreas rupture similar to the one in 1906, occurred between about 1600 and 1776. This chronology stands in sharp contrast to relatively low seismicity levels experienced since the great San Francisco earthquake of 1906, thus providing important constraints on the irregularity of earthquake occurrence. Extensive research in both northern and southern California indicates that parts of the San Andreas Fault system are likely to experience a major temblor sooner than previously believed. This would include the fault's section near Palm Springs and the San Bernardino-Riverside areas, and the Hayward fault in the Bay Area. These and other findings are part of a special report on the San Andreas Fault system released in mid-November 2003, in the *Bulletin of the Seismological Society of America*.

Centennial of the Great San Francisco Earthquake — April 18, 2006 will mark the 100th anniversary of the San Francisco earthquake and fire, a seminal event in the scientific study of earthquakes as well as in the cultural and social history of California. The 1906 earthquake is generally regarded as the birth of modern earthquake science. Its upcoming 100th anniversary provides a unique opportunity to increase public awareness of seismic hazard as well as

earthquake preparedness and mitigation. The USGS has joined with partner groups to form the 1906 Earthquake Centennial Alliance to help coordinate efforts and activities between organizations throughout Northern California planning to commemorate the earthquake. The Alliance: (1) brings together policymakers, scientists, engineers, historians, teachers, and emergency responders, (2) will take advantage of this unique "teachable moment" to deliver messages to the California public on what scientists know about earthquakes and where earthquake research is going in the future, and (3) along with engineers and emergency responders, will encourage implementation of policies to minimize the impact of future earthquakes. The USGS and its partners will prepare and release a suite of new research and information products for this occasion, including: (1) a database of active faults, (2) a highly detailed simulation of the ground motion induced by the 1906 earthquake, (3) a modern geologic bedrock map for the greater San Francisco Bay Area, (4) a 45-minute television program highlighting the century of progress in understanding earthquakes and their effects, and (5) printed materials for broad distribution.

Earthquake Research Borehole Drilling — Alongside the San Andreas fault in central California, earthquake researchers directionally drilled a borehole to nearly three kilometers depth and to within a few hundred meters of the fault near Parkfield, California. This completed Stage 1 of the ambitious San Andreas Fault Observatory at Depth (SAFOD) project that is a component of NSF's *EarthScope* initiative. The USGS is a primary contributor to SAFOD and has been a key player in scientific planning, site characterization and drilling operations, and analysis of the abundant observations already begun in the borehole. The location of the borehole was chosen to take advantage of the long-standing USGS research in the Parkfield area (see below). Data are now being analyzed in preparation for the commencement in April 2005 of Stage 2 drilling that will extend the borehole to cross the San Andreas Fault at a depth of approximately 3 kilometers in a zone of the fault where earthquakes frequently nucleate. SAFOD is the first underground observatory to penetrate a seismically active fault zone, giving scientists a unique opportunity to continuously observe a fault during the build-up, occurrence, and aftermath of earthquakes. Observations made during drilling, and by monitoring the instruments placed within the fault zone for years following, will help scientists better understand the origins of earthquakes and better predict the timing and severity of earthquake activity along the 800-mile-long fault.



Cross section diagram of the San Andreas Fault Observatory at Depth (SAFOD) scientific drilling project. The planned path of the fault-crossing borehole is superimposed on the regional electrical resistivity structure. The locations of small earthquakes are also shown as light dots. During summer 2004, the borehole was drilled vertically to a depth of 1.4 km, then deviated 55 degrees toward the fault. Phase 2 begins in summer 2005 and continues the deviated hole through the fault zone. Phase 3 begins in summer of 2007 and will involve taking four cores lateral from the main hole (shown in black). Drilling is accompanied by an extensive measurement program. At the completion of drilling, monitoring of seismicity, deformation, fluid pressure and other parameters will continue for about 20 years. See <http://www.icdp-online.de/sites/sanandreas/index/> for additional information about SAFOD.

Post-Earthquake Investigations — The USGS responds to large domestic earthquakes and to some foreign earthquakes by deploying portable seismic and geodetic instrumentation, conducting detailed geologic field investigations, and evaluating damage patterns in relation to geologic conditions and effects. These investigations provide essential information during and immediately after the emergency and an opportunity to make substantial advances in the understanding of earthquake geology and in the development of earthquake resistant design, construction, and engineering practices. When western Japan was struck by a magnitude 6.9 earthquake on October 23, 2004, USGS earthquake and landslide experts were part of a team sent to evaluate the damage and learn from the quake's effects. Earlier in the year, USGS scientists participated in post-earthquake investigations of Bam, Iran, where 26,000 people died in a magnitude-6.6 quake that devastated the city in December, 2003.

Southern California Earthquake Center (SCEC) — The USGS, along with NSF, fund the SCEC, a 40-institution research consortium headquartered at the University of Southern

California. SCEC was founded in 1991 with a mission to (1) gather new information about earthquakes in southern California, (2) integrate this information into a comprehensive and predictive understanding of earthquake phenomena, and (3) communicate this understanding to end-users and the general public to increase earthquake awareness, reduce economic losses, and save lives. Leading scientists from institutions throughout the country participate in SCEC. To support this community, SCEC also engages in information technology research that will revolutionize methods of doing collaborative research and distributing research products on-line. In addition, the SCEC Communication, Education, and Outreach Program offers student research experiences, Web-based education tools, classroom curricula, museum displays, public information brochures, online newsletters, and technical workshops and publications.

Joint Development of Earthquake-Forecast Models for Southern California — The USGS is cooperating with the Southern California Earthquake Center to develop, test and evaluate the hazard implications of earthquake-forecast models for that region. The Regional Earthquake Likelihood Models (RELM) working group is using a variety of viable models to (1) define existing uncertainties in seismic hazard analysis, (2) identify the research topics needed to reduce these uncertainties, and (3) identify which models are exportable to other regions. A large component of this project is the construction of a community modeling environment, where each RELM participant will be able to plug their forecast model into a distributed computational infrastructure for seismic hazard analysis. This approach provides an opportunity for research seismologists from government, academia and the private sector to test, evaluate, and share models, codes, and ideas for earthquake occurrence.

Supporting External Research Partnerships — EHP provides competitive, peer-reviewed, external research support through cooperative agreements and grants that enlist the talents and expertise of State and local government, the academic community, and the private sector. Investigations and activities supported through the external awards are closely coordinated with and complement the internal USGS program goals. In FY 2005, a total of 100 research grants are planned to be supported, 68 with universities and colleges, 7 with State geological surveys, and 25 with private sector companies. Many of the external projects are co-funded with other agencies and sources, leveraging the effect of USGS support. External program activities include (1) mapping seismic hazards in metropolitan areas, (2) developing credible earthquake planning scenarios including loss estimates, (3) defining the prehistoric record of large earthquakes, (4) investigating the origins of earthquakes, and (5) improving methods for predicting earthquake effects. By involving the external community, the USGS program increases its geographical and institutional impact, promotes earthquake awareness across the Nation, encourages the application of new hazards assessment techniques by State and local governments and the private sector, and increases the level of technical knowledge within State and local government agencies. To support external work, \$4.9 million is provided in FY 2005 for competitively awarded earthquake research grants, \$0.5 million is provided through cooperative agreements for the operation and maintenance of regional geodetic networks and other long-term research efforts, and \$1.1 million is provided to the Southern California Earthquake Center (SCEC). The FY 2006 request maintains this same level of funding and effort. In FY 2006 EHP will support targeted research to improve algorithms used to rapidly and accurately determine the magnitude of large earthquakes. Implementation of such algorithms into NEIC analysis operations will shorten the time needed to report on potentially damaging earthquakes.

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USGS FY 2005 Earthquake Program Cooperative Agreements and Research Grants Cooperative Agreements	
California Geological Survey	University of California - San Diego
Central U.S. Earthquake Consortium	University of Colorado
Central Washington University	University of Memphis
Commonwealth Scientific and Industrial Research Organization	University of Southern California (2 agreements)
Geomatrix	University of Utah
Oregon DOGAMI	University of Washington
San Francisco State University	Utah Geological Survey
University of California - Berkeley (2 agreements)	

Grants	
Auburn University	Stanford University (2 agreements)
Boise State University	State University of New York - Stony Brook
Brown University	Tufts University
California Geological Survey (2 agreements)	Universidad de Granada
California Institute of Technology	University of Arkansas
Carleton University	University of California - Berkeley (8 agreements)
Clemson University	University of California - Los Angeles
College of Charleston	University of California - Riverside
Columbia University	University of California - San Diego (4 agreements)
Earth Scientific Consultants	University of California - Santa Barbara (4 agreements)
Eastern Geodynamics Laboratory, Inc.	University of Colorado (2 agreements)
EQE International, Inc.	University of Kentucky
Harvard University (2 agreements)	University of Massachusetts
Illinois State Geological Survey	University of Memphis (2 agreements)
Independent Consultants (5 agreements)	University of Missouri (2 agreements)
LACHEL & Assoc., Inc.	University of Nevada - Las Vegas
M Tuttle & Assoc	University of Nevada - Reno (2 agreements)
Missouri Department of Natural Resources	University of Oklahoma
Monash University	University of Oregon (2 agreements)
Nevada Division of Mines and Geology	University of Puerto Rico
Oregon State University (2 agreements)	University of Southern California (2 agreements)
Pacific Geoscience Centre	University of Texas - El Paso
Pennsylvania State University	University of Utah (2 agreements)
Piedmont Geosciences Inc	University of Wisconsin (2 agreements)
Purdue University	URS Corporation (7 agreements)
San Diego State University (2 agreements)	Utah Geological Survey
Sanders & Assoc. Engineering, Inc.	Utah State University (2 agreements)
St. Louis University (3 agreements)	William Lettis and Associates (6 agreements)

2004 Program Performance Accomplishments

The accomplishments listed below demonstrate the value of USGS products that are counted under the program performance measures of "hazard monitoring networks maintained," "risk/hazard assessments completed," "ANSS real-time earthquake sensors installed," and "workshops or formal training provided to customers."

San Simeon Earthquake — The magnitude 6.5 San Simeon earthquake occurred in December 2003, with an epicenter near the Pacific coast in central California. While it did not rupture the surface, the quake triggered landslides and caused strong shaking with the worst damage in Paso Robles, 24 miles southeast of the epicenter. Numerous older buildings were damaged and one such building collapsed killing two people. In addition, significant liquefaction damaged housing and buried utilities in Oceano, nearly 50 miles away. In response to the San Simeon earthquake, the USGS produced a ShakeMap (a graphical representation of ground shaking caused by an earthquake) within 9 minutes of the event. The ShakeMap served as the basis for a loss estimation by the California OES using FEMA's earthquake loss estimation software (HAZUS) within an hour. Such estimations used to take 1-2 days with OES calling each county and waiting for estimates based on field visits. California Department of Transportation (CALTRANS) used the ShakeMap information to determine the number and location of bridges that required inspection. USGS data and analysis allowed Pacific Gas and Electric to decide not to defer critical maintenance on the Diablo Canyon nuclear power plant when it was demonstrated that the earthquake had actually reduced stress on the faults near the plant. USGS also provided real-time information on aftershock location and probability of occurrence. The area around San Simeon has experienced significant earthquakes in 1853, 1906, and 1952, the last being the largest at magnitude 6.2 and centered just 6 miles from the San Simeon event. Similar "blind" thrusts caused the magnitude 6.7 Coalinga earthquake in 1983, also in the Central Coast Ranges, as well as the Northridge earthquake that struck the Los Angeles area in 1994 at a cost of 52 lives and \$47 billion.

Learning from the Parkfield Earthquake — The San Andreas Fault generated a long-anticipated magnitude 6.0 earthquake struck Parkfield in central California on September 28, 2004. The 2004 Parkfield earthquake is the sixth in a series of similar earthquakes that have occurred on this segment of the San Andreas Fault since the great magnitude 7.8 Fort Tejon earthquake in 1857. In anticipation of another earthquake, USGS and the California Geological Survey installed a dense network of geophysical sensors in the mid-1980s. Those sensors caught the 2004 Parkfield earthquake in the act, making it the best-recorded major earthquake in history. No precursory changes were observed even though the epicentral region was instrumented to detect a variety of subtle precursors that might be used for short-term earthquake prediction. But during the earthquake, the dense network of seismic sensors recorded surprising near-source variations in the strong shaking that was produced. Moreover, strong shaking decreased more rapidly with distance than predicted by models underlying current building codes. Little structural damage occurred in the rural epicentral region, but what USGS scientists and engineers learn at Parkfield can now be applied to predicting the impacts of future earthquakes in more populated areas.

Collaborative Field Experiment on Seismic Waves — The USGS participated in a project to demonstrate the potential to solve challenging scientific and engineering problems by combining the capabilities of the USGS with the NSF-sponsored Incorporated Research Institutions for Seismology (IRIS) and the George E. Brown Network for Earthquake Engineering Simulation (NEES). A pilot field study was conducted in August 2004 centered around the use of state-of-the-art seismic recording instrumentation in California's Garner Valley. Using a newly developed NEES shaker truck to simulate an earthquake's waves, a tremendous dataset was collected for study of non-linear sediment response, ground motion site and basin shaking effects, basin and fault imaging, and broad-scale deep imaging. USGS funding for the experiment was further leveraged by resources and participants provided by the Mid-America Earthquake Center, the SCEC, the Center for Embedded Network Sensing, and the High Performance Wireless Research and Education Network (all NSF-supported), and the

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Department of Energy's Los Alamos National Laboratory (LANL). Collaborations continue with ongoing analyses and intriguing new results.

Fault Study at Proposed Treatment Site in Washington — The USGS and King County (Washington) signed an Interagency Agreement that funds a detailed investigation of the Southern Whidbey Island fault near the Brightwater Wastewater Treatment plant site, a \$1.8 billion dollar project that is the largest public capital improvement project in Washington State. The USGS identified the probable extension of the fault last summer using a combination of aeromagnetic, Light Detecting and Ranging (LiDAR) imagery, and field studies. Based on these studies and using King County funding, the USGS has opened four research trenches across two distinct strands of the fault. These trenches reveal evidence of young faulting cutting through the Brightwater site and of significant liquefaction that has occurred in past earthquakes. Neither result was initially considered in plant design. The USGS subsequently met with the Brightwater engineering design team to discuss the implication of the findings on seismic and foundation design.

Field Investigations along the Denali Fault — Geologists conducted detailed field investigations along Alaska's Denali Fault, location of the gigantic magnitude 7.9 earthquake in 2002. This work, done in partnership with Alyeska Pipeline Company and Pacific Gas and Electric, concentrated on developing the paleoseismic record and slip rate of the Denali Fault along the 2002 rupture, and on the unruptured parts of the fault to the west and southeast. Trenching studies were undertaken at nine sites where substantial evidence for paleoearthquakes was developed. The Susitna Glacier Fault, whose rupture initiated the great earthquake in 2002, was also trenched for the first time. These investigations are confirming that the Denali Fault ruptures in large-magnitude earthquakes at intervals of several hundred years, and when complete will help geologists quantify the earthquake hazard along the unruptured segments of the fault.

Central U.S. Earthquake Poster Map — Extending back into the 17th century, there is a record of earthquakes striking various locations in the central United States. In FY 2004, the USGS published a new full-color wall poster map of the central United States showing all historic earthquakes recorded or otherwise known to have occurred in the region since 1699. The map area includes the well-known New Madrid seismic zone, a dense, northeast-elongated cluster of earthquakes in northeastern Arkansas, southeastern Missouri, and adjacent Tennessee and Kentucky, which is the most seismically active part of North America east of the Rocky Mountains and the area that produced three large (magnitude 7 to 8) earthquakes within a few months in 1811-1812. The poster map (USGS Geologic Investigations Series I-2812) is an important educational tool for the population in the region and also serves as a planning document for agencies such as the CUSEC and FEMA for use in promoting earthquake preparedness.

National Fault Database — In March 2004, USGS unveiled an up-to-date, comprehensive nationwide compilation of information on known or suspected active faults and associated geologic folds. Accessible via a user-friendly Web interface at <http://Qfaults.cr.usgs.gov/>, the database summarizes geologic, geomorphic, and geographic data for about 2,000 faults in the United States that are believed to be sources of earthquakes greater than magnitude 6 with documented activity during the past 1.6 million years. The database is designed to fulfill the needs of a broad group of users, ranging from the science community to the general public, and will allow these users to identify faults that have likely produced strong ground motion in the past and that may remain hazardous today. Targeted users include the earthquake-engineering community, the insurance industry, and companies managing large infrastructures, such as

pipelines or power-transmission networks. State and local planners can use the database to locate potential earthquake sources on maps. Emergency-response officials can use the database to plan earthquake drills and to identify and fortify critical infrastructure near active faults.

Southern California Outreach Document Updated — To answer the growing concern regarding the implications of the Northridge earthquake and other recent seismic events in southern California, in 1995 the USGS and SCEC, (a USGS- and NSF-sponsored university consortium) developed *Putting Down Roots in Earthquake Country*, a graphically illustrated, 32-page color handbook on earthquake science, mitigation and preparedness. A new version of *Roots* was updated by SCEC and USGS in 2004. It features current scientific understanding of when and where earthquakes will occur in southern California, and how the ground will shake as a result. Updated maps of earthquakes, faults, and potential shaking are included, as well as instructions on how to get information after earthquakes. The reworked preparedness section is now organized according to the "Seven Steps on the Road to Earthquake Safety." These steps provide a simple set of guidelines for preparing and protecting lives and property, and for surviving and recovering from a damaging earthquake. In January 2004, over 200,000 copies were printed, with funding from the California Earthquake Authority (CEA) and FEMA, and another 150,000 copies were printed in September 2004, with funding from the CEA, USGS, Edison, Amgen, Quakehold, and others. Copies of the document are distributed at home improvement centers, via the American Red Cross, and many other avenues. The updated handbook is available at <http://www.earthquakecountry.info>. A northern California version is in development. Both versions will also be translated into Spanish, and versions for other regions may be created using this template.

USGS, University Scientists Unravel History of San Andreas Fault — An accomplishment of far-reaching significance is the documentation of the faulting history on the southern reach of the San Andreas Fault, as revealed in paleoseismic investigations led by USGS and The University of Oregon. The 1857 Fort Tejon earthquake, centered on the northern big bend of the San Andreas fault (at the Tehachapi Mountains) and the 1685 earthquake centered on the southern big bend of the fault (at the San Bernardino Mountains) may be typical of great earthquakes that dominate strain release on the southern San Andreas fault. These earthquakes overlap in the vicinity of the Wrightwood paleoseismic observatory, which appears to record virtually every large earthquake on the southern San Andreas fault. The section that ruptured during the 1685 earthquake, extending from Wrightwood to the Salton Sea, appears to be late in its earthquake cycle. A study of deformation at Wrightwood reveals that the strain level on the fault is at a maximum level, previously reached only twice before during the past 1,500 years. Information on San Andreas recurrence rates is crucial to generating the next generation of seismic hazard assessments for California.

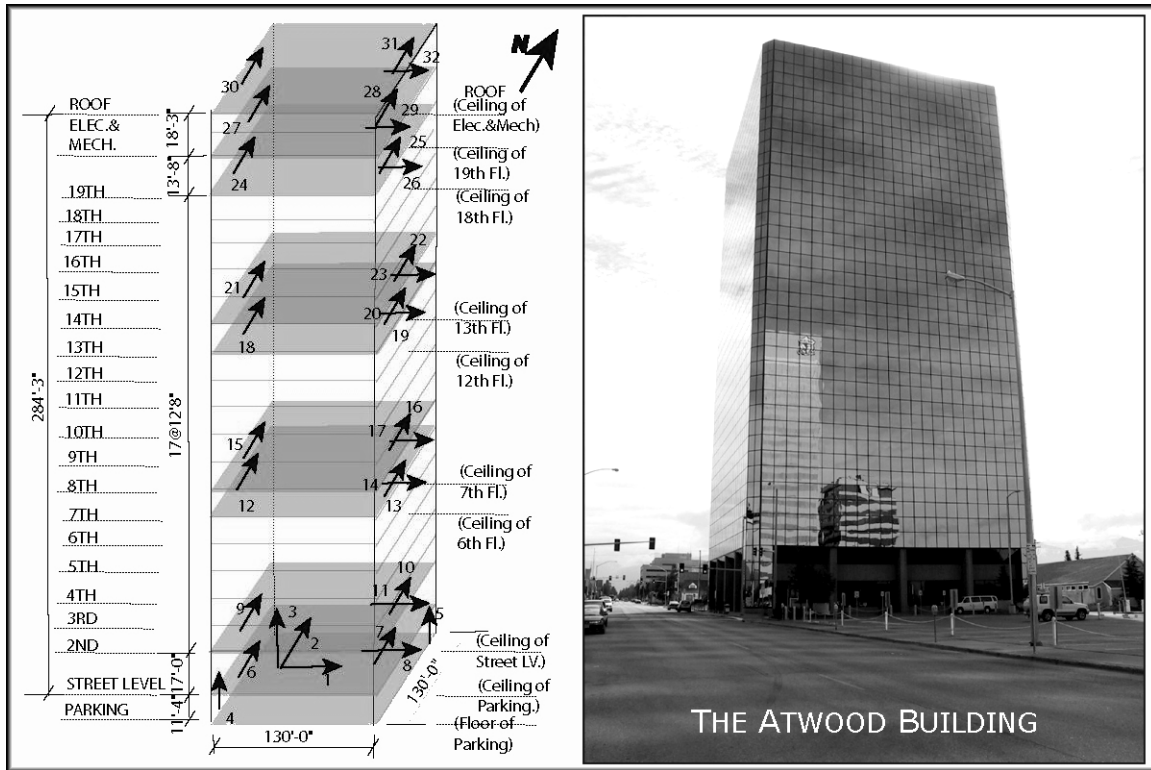
New ANSS Regional Seismic Network Responds to Teton County Concerns and Wyoming State Needs — In FY 2004, the USGS Earthquake Hazards Program installed 11 new, real-time seismograph stations in Wyoming as part of the ANSS. Eight of the stations operate in the vicinity of Jackson Hole and Grand Teton National Park, to monitor seismic activity along the Teton fault and other active faults near the Wyoming-Idaho border, part of the Intermountain Seismic Belt. Three additional stations were installed near Rawlins and Laramie, WY, to provide improved regional earthquake monitoring and notification capabilities in the State. These stations are operated by the USGS in coordination with regional seismic monitoring systems in Utah (University of Utah Seismograph Stations), Montana (Montana Bureau of Mines and Geology) and Idaho (DOE Idaho National Environmental Laboratory). The network of stations near Jackson, Wyoming, replaces antiquated stations operated by the

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Bureau of Reclamation from 1986 to 1993. These new stations provide critical new data on seismic activity and ground motions necessary for improved earthquake hazards assessment and mitigation in seismically active areas of eastern Idaho and western Wyoming.

"Did You Feel It?" Earthquake Shaking Maps — The USGS Community Internet Intensity Map (CIIM) is an automatic Web-based system for rapidly generating seismic intensity maps based on reports collected from Internet users immediately following earthquakes. The vast majority of data are contributed by non-specialists, describing their own experiences of earthquakes. Internet data contributed by the public have profoundly changed the approach, coverage, and usefulness of intensity observation in the United States. The USGS now typically receives thousands of individual questionnaire responses for widely felt earthquakes. Over 6 years, USGS has received over half a million individual responses in the United States, including entries from all 50 States, the District of Columbia, as well as the territories of Guam, the Virgin Islands, and Puerto Rico. In some parts of the United States, CIIM provides constraints on earthquake magnitudes and depths beyond those provided by sparse instrumental data and invokes an enthusiastic response from members of the public who contribute to it. CIIM provides an important opportunity for public education and outreach. This past year, large numbers of citizens responded to widely felt earthquakes near Jackson, WY; Bremerton, WA; Parkfield, CA; and Craig, AK, as well those near Chicago, IL, and along the central Oregon coast. Based on this success, the CIIM system was recently expanded to work in all areas of the world. Users of the international Internet simply pick from over 55,000 cities in order to indicate their location. Their local intensity of shaking gets instantly mapped based on the city location and is available to all via the Internet. This worked well for a recent magnitude 5.9 earthquake in Romania, with reports of shaking coming from 6 different countries the day after the system went online. Further efforts to increase awareness of the global system will be made in FY 2005. CIIM, including the global maps, can be found at <http://earthquake.usgs.gov> under "Did You Feel It?"

Anchorage Gets Major Urban Seismic Monitoring Upgrade — Over the past 2 years, the USGS has worked in conjunction with the University of Alaska-Fairbanks (UAF) to improve seismic monitoring in the Anchorage area. In FY 2003, a dense urban recording network was established and the 20-story, State of Alaska (Atwood) building was instrumented with 32 digital sensor systems located at 10 levels throughout the structure. The USGS Menlo Park office was responsible for installing the structural monitoring system, while UAF personnel installed the interconnecting conduit, cabling, and other ancillary equipment. In FY 2004, ANSS funded the installation of sensors and recording systems for a network of six underground borehole recording stations located adjacent to the building. The combined network represents one of the best instrumented urban areas and soil/structure systems in the country. Data recorded by this network will be invaluable to civil and structural engineers for assessing soil-structure interaction, building response, and building performance during large earthquakes.



Photograph and ANSS instrumentation plan for the Atwood Building in downtown Anchorage, AK. The earthquake monitoring system, which includes a network of 32 accelerometers distributed on 10 floors of the structure, allows the reconstruction of the full range of motions in the building in response to earthquakes.

The Atwood Building installation was unveiled at an event commemorating the 40th anniversary of the 1964 Good Friday earthquake. The event was sponsored by the USGS, the University of Alaska Fairbanks Geophysical Institute (GI), and members of the local engineering community, and attended by Senator Lisa Murkowski and Lt. Gov. Loren Leman. Alaska is the most seismically active state in the United States, and the Good Friday earthquake, at magnitude 9.2, was the second largest ever recorded in the world.

Expansion of ShakeMap and ShakeCast — ShakeMap, a flagship product of the ANSS, is a tool used to rapidly portray the extent of potentially damaging shaking following an earthquake. It is used primarily for emergency response, loss estimation, and public information. ShakeMap is now being generated in Anchorage and the Reno/Las Vegas corridor. Efforts are underway to bring the system online in the Memphis/New Madrid region as instrumentation in these areas increases. In California, much progress has been made to make ShakeMap more robust by adding redundant Statewide map generation. Maps made immediately after the 2003 San Simeon and 2004 Parkfield earthquakes were successfully used by a variety of agencies and responders.

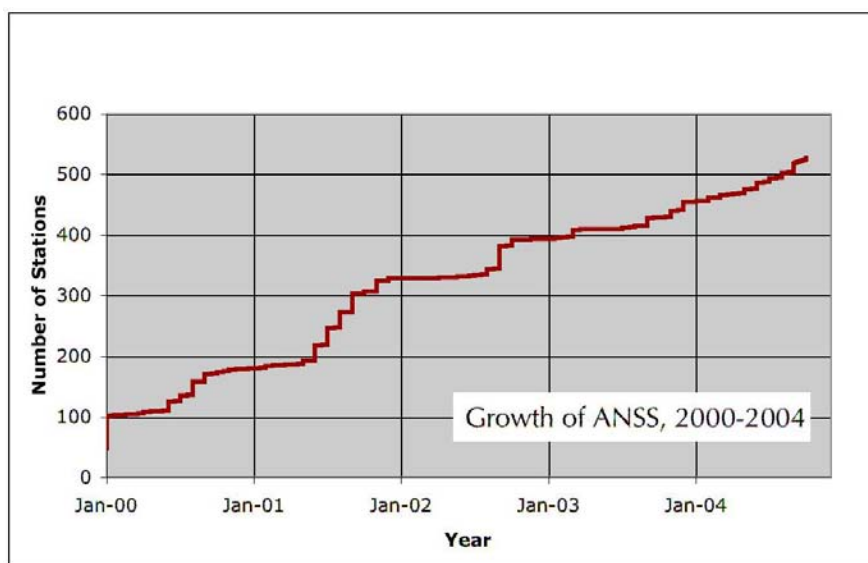
ShakeCast is a fully-automated system designed to deliver specific ShakeMap products to critical users and trigger established post-earthquake response protocols. ShakeCast provides utilities and other large organizations with instantaneous, hierarchical listings of their affected facilities, notifies them (via pager, cell phone, e-mail) when user-set thresholds have been exceeded, and automatically initiates other software systems, e.g., loss estimation, Geographic Information System (GIS). Currently, the CALTRANS Bridge Engineering Division and Pacific

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Gas and Electric is testing the prototype system. CALTRANS has over 25,000 bridges and overpasses under their responsibility in California and will use ShakeCast to construct an instantaneous snapshot of the likely damage to each, thereby allowing them to prioritize traffic rerouting, closures, and inspections following a damaging earthquake.

ANSS Security and Facility Upgrades — Extensive upgrades are completed at the NEIC, including security and satellite communications. In FY 2003, ANSS completed both its Major Application Security Plan and, in FY 2004, received a full security Certification and Accreditation (C&A). Support for C&A came both from the program itself and from Enterprise Information program. Equipment upgrades implemented in FY 2003 and 2004 have facilitated faster reporting of earthquake information, improved coordination with regional networks, and more comprehensive suite of derived products for use by a broad array of customers. While the NEIC enhancement program is a multiyear effort, continuing in FY 2005, significant progress has already been achieved, resulting in noticeable improvements in timeliness and quality of earthquake reporting. There are also extensive, ongoing efforts to upgrade the acquisition and processing systems each of the seven ANSS regions involving replacement of aging computer systems and installations of new modules that allow robust interconnection between regional networks and the NEIC, thereby enhancing the distribution of earthquake information to system-wide Web pages and other outlet mechanisms.

New ANSS Station Installations — In FY 2004, ANSS pushed ahead with 95 new station installations and upgrades in all seven ANSS regions, bringing the total number of ANSS sensors installed to 523. This included expanding the ANSS Backbone national network by 10 stations to a total of 63, and the installation of the 8-station Teton/Jackson Hole regional network mentioned above. New ground-reference, strong-motion sensors were also installed at each of the three buildings that have been instrumented under ANSS. The accompanying figure shows the growth of ANSS seismic stations since the system was established in FY 2000.



2005 Planned Program Performance

In FY 2005, EHP plans several accomplishments in areas related to seismic monitoring and seismic hazard assessments. These include completion of the modernization of the ANSS NEIC, completion of the ANSS guideline for structure monitoring, and further expansion of the

ANSS Backbone network through a partner agreement. Several of these anticipated accomplishments are outlined in the following paragraphs. While it should be noted that these efforts are all interconnected, the primary program component for each is also shown. The activities listed below contribute to USGS products that are counted under the program performance measures of "hazard monitoring networks maintained," "risk/hazard assessments completed," "ANSS real-time earthquake sensors installed," "workshops or formal training provided to customers," and "metropolitan regions where ShakeMap is incorporated into emergency procedures."

USGS Contributions to Improved Global Tsunami Warning and Earthquake Response —

On the morning of December 26, 2004, a giant earthquake initiated off the coast of northern Sumatra and ruptured the Earth's crust for 1,000 km along the boundary where the Indian plate is subducting beneath the Burma plate. The resulting tsunami struck the coast of Sumatra within half an hour, Thailand within 1.5 hours, and India and Sri Lanka within 2 hours. The combination of the great earthquake itself and the resulting tsunami is among the deadliest ever. Even as the devastating toll continues to rise and the world struggles to aid the victims, there is much that can be done to help ensure that such a calamity does not happen again. Living on an active planet, natural hazards are inevitable, but their consequences are not. USGS, in cooperation with NOAA and other domestic and international partners, are undertaking a suite of activities for improvement. These modest investments can rapidly improve our Nation's ability to address combined tsunami and earthquake hazards to the United States, which faces threats to its coastal states and island territories. Both Alaska in 1964 and the Pacific Northwest in 1700 were struck by tsunami-generating earthquakes of similar or greater magnitude, and such events will inevitably happen again.

There is a plethora of USGS efforts underway or accelerated in response to the December disaster. Among the actions being undertaken by the EHP are the following:

- **Interagency coordination:** Tsunami warning involves both the USGS and NOAA. USGS operates the Global Seismographic Network (with NSF), monitors earthquakes globally, and provides rapid earthquake information. NOAA evaluates the likelihood that an earthquake has generated a tsunami, verifies tsunami generation and propagation using ocean buoys in the Pacific, and issues tsunami warnings. Tsunami warnings issued by NOAA's Pacific and Alaska Tsunami Warning Centers rely on USGS seismic data. USGS and NOAA will push forward efforts to improve the speed by which earthquakes can be accurately measured and tsunami generation predicted, including efforts to minimize redundancies in the system. Since the December disaster, USGS has worked with NOAA's Pacific Tsunami Warning Center to enhance USGS rapid notifications for aftershocks of the magnitude 9.0 earthquake and for other large, sub-oceanic earthquakes outside the Pacific, by including a statement warning of potential tsunami generation. NOAA and USGS will also explore options for adding real-time telemetry of seismic data from existing seismic stations operated by other nations in the Caribbean and Indian Oceans as a means for improving the speed and reliability of earthquake notification in those areas.
- **System development:** The Earthquake Hazards Program (EHP) is accelerating completion of the "Hydra" real-time earthquake detection and notification system, which will replace the older legacy system that is presently in operation. After 2 years of development, a beta version of this system is operating in a testing mode but is not yet functional. The new system will dramatically decrease the time needed to determine

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earthquake size and location worldwide and to broadcast notifications. EHP is evaluating the resources needed to greatly accelerate completion and testing of the Hydra system in order to implement it as the primary operational earthquake analysis system. Primary needs to complete the system are additional staff with expertise in computer programming, database development, and computer systems support, plus replacement of outdated computer server systems. When completed, Hydra, associated hardware and software systems and NEIC seismic analysts will form the core of a modern National Operations Center (NOC) for analysis, cataloging and reporting of large earthquakes globally. These improvements will result in more rapid earthquake detection and notification in tsunamagenic source areas that border the United States and its territories.

ANSS Activities — In FY 2005, the ANSS Backbone network will be expanded by 7-10 stations, through a partnership with the USArray element of *EarthScope*, a program of the NSF. Most FY 2006 funding, however, will not go to new station installations but to completion of software development efforts (including the upgrade of the NEIC called *Hydra*), the upgrade to the National Strong Motion Database, and to improvements to the ShakeMap and ShakeCast products), and to the operation and maintenance of the installed station base. Also completed in FY 2005 will be a guideline for structural monitoring under ANSS. Building instrumentation proposals will be solicited according to the guideline and prioritized for implementation in FY 2006, if sufficient funds are available. Note that this effort relates to the Monitoring and Reporting Earthquake Activity program component.

Changes to the Output Measure "# of real-time ANSS earthquake sensors (reported yearly and cumulative at the end of the year)" — Procedures were changed, resulting in improvements to the scope of this measure. Previous sensor counts focused on seismic stations that measured ground movement and not those that measured buildings and other structures. A new procedure for counting ANSS sensors installed in buildings and other structures (a major element of the ANSS deployment plan) has been developed and has been incorporated into the estimate. Prior year actuals have been recalculated using the new procedures, which are shown in the performance summary table in the Activity Summary.

Cost Efficiency Targets Set — EHP has implemented and reported on the PART performance measure of program efficiency: the annual cost of data processing, notification, and product delivery at the NEIC, in dollars per gigabyte of input data. A modest improvement, a decrease of 1 percent is the projected cost measure for FY 2005. This effort relates to the Monitoring and Reporting Earthquake Activity and Crustal Deformation program component.

Workshops and Training Sessions — Several workshops are planned for FY 2005, including those related to hazard mapping, ShakeMap implementation, ANSS structural instrumentation planning and development, and research. The number of workshops or training sessions varies from year to year, depending on the status of studies and requests received. This effort relates to the Assessment and Characterization of Earthquake Hazards program component.

Earthquake Monitoring and Reporting Software Upgrade — The USGS NEIC is completing a substantial upgrade to its software systems. Programming of version 1.0 of Hydra, as the new system is called, is complete. Testing of this new system is now underway with installation planned for the winter/spring of FY 2005. The new software system will allow faster identification and analysis of earthquakes in the United States and worldwide, faster reporting of earthquake locations and magnitudes, and improved integration of ShakeMap real-time shaking

intensity estimation. The system will also incorporate a full suite of modern network security measures.

ShakeCast Partnerships — In 2005, USGS will be coordinating with several other large, critical facility agencies to implement ShakeCast, including the California Department of Water Resources (Division of Dam Safety), Washington Department of Transportation, Washington State and the City of Seattle Emergency Management Divisions, FEMA, and the Los Angeles Department of Public Works. Deployment of ShakeCast to better use USGS ShakeMaps will greatly enhance these agencies ability to respond to and recover from earthquakes.

Five-Year Plan Completed — The EHP 5-Year plan for 2004-2008 was sent to OMB for review and comment in September 2004. Prior to that, the plan had been reviewed and approved by the program's Federal advisory and had completed USGS internal reviews per the requirements of the USGS program planning process. It is expected that the plan will be published as a USGS Circular early in 2005.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-)^{1/}
Earthquake Hazards (\$000)	51,337	+3,745
FTE	246	+20

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006 budget request for Earthquake Hazards Program is \$51,337,000 and 246 FTE, a net program increase of +\$4,439,000 (includes adjustments for uncontrollable costs) and +20 FTE from the 2005 enacted level. The Administration plans to request +\$8.1 million in the 2005 emergency supplemental funding request for tsunami assistance for the USGS to begin procuring and installing additional seismic monitoring stations and to enhance the existing seismic monitoring network. For FY 2006, the budget includes tsunami-related increase requests for the Global Seismographic Network and Coastal and Marine Geology Programs, as well as the increase request described below.

Tsunami Warning (+3,816,000) — Improved seismic monitoring and information delivery is critical to expanding tsunami warning capability globally and in the United States. The NEIC systems are 15-20 years old and in need of upgrade. Similarly, the staffing levels need to be strengthened if NEIC is to provide the best earthquake information possible. Software systems under development will bring a dramatic improvement in the time required to detect large earthquake and accurately determine their location, magnitude, and probable impacts. This will then allow USGS to deliver a suite of timely and authoritative earthquake information products to sister agencies, State and local emergency managers, and decisionmakers.

Information generated by the NEIC is critical to United States and foreign governments, State and Federal response agencies, and the public. This is reflected in the number of e-mailed earthquake alerts sent out (>25,000), hits to the Web site (120 million in the first week alone), and overwhelming request for TV and radio interviews from local, national, and international news agencies following a damaging event such as the December 26, 2004, Sumatra-Andaman 9.0 earthquake.

Increased funds address both system development costs for an enhanced NEIC as well as long-term maintenance needs for the system. These needs are in agreement with existing

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ANSS planning documents, and thus reflect long-standing and broadly recognized needs for a truly robust, reliable earthquake notification and response system. The activities summarized below contribute to the program performance measure of "hazard monitoring networks maintained." Currently USGS has no measure that captures improved timeliness and accuracy of seismic information as an aspect of performance, but is working with other Federal agencies to develop an appropriate, coordinated measure. Elements of the improved system are as follows:

- **NEIC Software Development** — USGS has begun the process of upgrading its 20-year-old legacy system for real-time earthquake detection and notification. The beta version of the new system, *Hydra*, is currently operating in test mode. Additional investments in FY 2005 are speeding the development and implementation of Hydra as the primary operational earthquake analysis system. EHP is also purchasing and completing development of the EDGE server needed to replace antiquated hardware with modern servers that integrate a number of different seismic data sources from USGS and international partners in support of USGS and NOAA monitoring activities. NEIC is the brain center for regional, national, and international monitoring integration and data assimilation but lacks a modern National Operations Center (NOC) software package for cataloging, databasing and reporting functions. The development of such a system is critical to both international and domestic response efforts. It is critical that specialized analysis modules be revamped to integrate seamlessly into the core Hydra system. Moreover, this enhancement is necessary to insure reliable operations, performance, and long term operational cost efficiencies. The principal costs covered by the increased funding are for a software development team. Improvements in this area will result in more rapid earthquake detection and notification in tsunamagenic source areas that border the United States and its territories.
- **Full Implementation of PAGER** — The Prompt Assessment of Global Earthquakes for Response (PAGER) system uses information about an earthquake's source (e.g., ground shaking, rupture length, depth), combined with information regarding population and infrastructure in the affected region, to estimate potential impact (both damage and loss of life) of a major ground shaking event. PAGER is ideal for both domestic and international earthquakes in areas where a dense seismic network is not available, but where a rapid assessment is critical for estimating impact. Funding for PAGER will provide for additional research scientists, technical support and computer programmers needed to fully implement the PAGER program. The outcome of this investment will be improved algorithms for Global ShakeMaps, finite fault modeling, rapid aftershock identification and association, and loss estimation. PAGER will also allow for integration and evaluation of impact of secondary hazards such as liquefaction, landslides, and tsunamis.
- **Establish Robust 24 x 7 Operations** — NEIC optimally requires a full-time, 24 x 7 staff of seismologists to quickly respond to potentially damaging events. To accomplish this, additional FTE will be used to augment the current duty seismologist staff in order to operate on a 24 x 7 schedule versus the current 8 x 5 (work-day) schedule with evening, nights and weekends covered by staff on stand-by status. NEIC also requires a commensurate level of commitment to oversee the computer and network operations to insure continuity of operations 24 x 7. Currently a small group of research scientists volunteer on an ad hoc basis to respond when computer systems fail in the off hours. A significant number of NEIC-supported field sites are critical to NOAA operations as well as NEIC's. Specifically, data from the GSN and the ANSS backbone are primary data

sources for NOAA in their tsunami evaluations and reporting. With the requested increase, NEIC will decrease reporting time for global earthquakes (currently over one hour) and reliably deliver a complete suite of earthquake products including PAGER to 20 minutes.

- **Improved Tsunami Warning Distribution** — Software developed by the California Integrated Seismic Network (a USGS university and State partnership) to speed USGS-generated earthquake information directly to local emergency managers has a dual use capability to also provide NOAA tsunami warnings. This system, designed to provide a mechanism for instantaneous transmission of seismic information, complements existing NOAA delivery mechanisms. Investment in this area will allow emergency managers to respond to earthquakes as well as tsunamis.

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Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Earthquake Hazards	47,401	46,898	+694	+3,745	51,337	+4,439
FTE	231	226	0	+20	246	+20
Volcano Hazards	19,785	20,714	+247	+826	21,787	+1,073
FTE	138	133	0	0	133	0
Landslide Hazards	2,620	3,043	+51	-6	3,088	+45
FTE	22	22	0	0	22	0
Global Seismographic Network	3,434	3,335	+42	+595	3,972	+637
FTE	7	7	0	0	7	0
Geomagnetism	2,043	1,989	+42	-6	2,025	+36
FTE	14	14	0	0	14	0
Total Requirements \$000	75,283	75,979	+1,076	+5,154	82,209	+6,230
FTE ^{b/}	412	401	0	+20	421	+20

^{a/} Changes for this program element include a reduction of -\$38 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

^{b/} FTE may not add to total, due to rounding.

Volcano Hazards

2006 Program Overview

The 2006 budget request for the Volcano Hazards Program (VHP) is \$21,787,000.

Under the Stafford Act (P.L. 93-288), the USGS has the responsibility to issue timely warnings of potential geologic disasters to the affected populace and civil authorities. Accordingly, the mission of the USGS VHP is to provide the Earth science data and information, analyses, and research needed to reduce the loss of life, property, and economic impact of geohazards related to volcanoes.

As described in the Office of Management and Budget (OMB) Program Assessment Rating Tool (PART) review, the VHP role is clearly defined and unique from other Federal, State, local, or private entities. The VHP was reviewed in 2003, as part of the overall Geologic Hazards Program, for the FY 2005 Budget using the PART. The overall Hazards Program was found to be moderately effective and as a result received a score of 82.

The VHP addresses the Department of Interior's (DOI) Serving Communities strategic goal of protecting lives, resources, and property by making information available to communities to use

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in developing volcano hazard mitigation, preparedness, and avoidance plans. Three intermediate outcome measures are tracked in support of the intermediate outcome of providing information to assist communities in managing risks from natural hazards. These outcome measures are: (1) use rate of products, (2) percent of high-risk areas (defined as approximately 70 potentially active volcanoes in Alaska, Hawaii, California, Oregon, Washington, Wyoming, and the Commonwealth of the Northern Mariana Islands) served with DOI science on hazard mitigation, preparedness, and avoidance for volcano hazard management activity, and (3) adequacy of information. Output measures for which targets are established in support of achieving the intermediate outcome goal include: (1) maintenance of one hazard monitoring network, (2) delivery of risk assessments to customers, (3) presentation of formal workshops or training to customers, and (4) expanding the number of sites (mobile or fixed) monitored for ground deformation to identify volcanic activity.

The program activities support the Geology Strategic Plan (2001-2010) goals of conducting geologic hazards assessments for mitigation planning and providing short-term prediction of geologic disasters and rapidly characterize their effects. As a result of the PART review in 2003, other measures were developed to measure the effectiveness of annual and long-term goals of the program.

The VHP has long-term goals of monitoring all the potentially active volcanoes in the United States and studying volcanic processes to improve forecasting of volcanic events. 169 volcanic centers have erupted within the United States within the last 10,000 years – more than any other nation. The USGS considers that approximately 70 of these volcanoes pose significant threats to people, property and infrastructure on the ground, and to jet aircraft in the air. On average each year, 5 to 10 U.S. volcanoes exhibit unrest consisting of some combination of ground deformation, earthquakes, increased emission of volcanic ash or increased hydrothermal activity. Periods of unrest may or may not develop into eruptions; but typically, there is one eruption in Alaska every two years, one eruption in the Northern Mariana Islands every 3 to 5 years, one eruption in the Cascades every decade, and an eruption of Mauna Loa every 5 to 10 years. Kilauea Volcano in Hawaii has been erupting continuously for the last 20 years, Mount St. Helens has been erupting since early October 2004, and Anatahan volcano in the Marianas, began to erupt on January 5, 2005, for the third time in 18 months.

The VHP currently monitors 49 volcanoes in the United States, including two in the Commonwealth of the Northern Mariana Islands, for signs of unrest, and these data are used to provide early warnings and forecasts of eruptions. Maintenance of this monitoring network is an annual performance measure for the VHP and contributes to goals 1 and 2 of the Geologic Strategic Plan (2001-2010). Over the past two decades, the results of the studies of volcanic processes and the monitoring efforts have been applied by the USGS, both domestically and to some international sites, and have resulted in savings of billions of dollars in U.S. assets and tens of thousands of lives. Hazardous volcanic activity will continue to occur, and because of increasing populations, increasing development, and expanding national and international air traffic over volcanic regions, the exposure of human life and enterprise to volcano hazards is increasing. USGS scientists monitor volcanoes, assess their hazards, respond to volcanic crises with experienced scientists and state-of-the-art equipment, and conduct multidisciplinary research on volcanic processes. Key scientific investigations include: mapping high-risk volcanic hazard areas and determining where and in what manner volcanic unrest is occurring; improving eruption forecasting through better monitoring and through studies of what triggers eruptions and volcanic unrest; understanding what controls the explosivity of eruptions and the duration of volcanic unrest; and why some periods of unrest lead to eruptions while others do not.

The VHP activities may be broadly divided into monitoring and assessment categories. Basic volcanologic research is conducted under both of these categories and constitutes the scientific foundation for issuing volcanic hazard assessments and warnings.

The VHP supports activities across the Nation, including five volcano observatories. Monitoring data collected by the VHP observatories are interpreted by USGS scientists, and advisories summarizing conditions at U.S. volcanoes are issued to the public on a regular basis. In a typical year, more than 1,000 such advisories are prepared and distributed by fax, email, and news outlets and were posted on the public Web site of the USGS VHP. The following are significant examples of observatory activities in FY 2004:

- The Cascade Volcano Observatory (CVO) detected the beginning of the new eruptive cycle at Mount St. Helens (MSH), which was heralded by a swarm of tiny earthquakes in the last week of September 2004. CVO issued advisories for the eruptive behavior of the volcano, which began with modest venting of steam and ash and transitioned into dome building in October 2004, which has continued through 2004. Characteristics of the eruption and analogy to eruptions at similar volcanoes suggest that the current eruption of MSH could continue for years. CVO will continue to monitor MSH as well as the other Cascade volcanoes, including the Three Sisters volcanic area of central Oregon, where a swarm of earthquakes occurred in late March 2004, at the center of an area of uplift, which has been inflating for the last seven years, possible as the result of deep subsurface movement of magma.
- In FY 2004, the Alaska Volcano Observatory (AVO) closely watched significant volcanic unrest at Mount Veniaminoff, Mount Shishaldin, and Mount Spurr, while extending the number of monitoring network to a total of 28 Alaskan volcanoes, and continuing to collaborate with the Kamchatkan Volcanic Eruption Response Team to track eruptive activity at volcanoes in the Russian Far East, which frequently caused volcanic-ash advisory statements to be issued to U.S. aviators.
- The Hawaiian Volcano Observatory (HVO) tracked the eruption of Kilauea Volcano on Hawaii Island, and in FY 2004 expanded its monitoring network for the Mauna Loa volcano following detection of inflation in the previous year, which may indicate the onset of a new eruptive cycle.
- The Yellowstone Volcano Observatory (YVO) continued to monitor the Yellowstone caldera for increased hydrothermal activity and other signs of unrest, and to respond to widespread public interest and concern about unrest at the Nation's largest volcanic center.
- The Long Valley Observatory (LVO) watched for signs of renewed volcanic unrest in the vicinity of Mammoth Mountain, a popular recreational area in California, and in the path of heavily traveled air-traffic routes.

The five observatories share resources with one another and cooperate with numerous university and government partners. Only the primary partners with whom there are formal cooperative agreements or shared facilities are listed below.

- Hawaii Volcano Observatory (Estimates for FY 2004, \$3.2 million; FY 2005, \$3.2 million; FY 2006, \$3.4 million) on Hawaii Island. Primary partners are Hawaii Volcanoes

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National Park and the University of Hawaii, which operates the Center for the Study of Active Volcanism.

- Cascades Volcano Observatory (Estimates for FY 2004, \$3.6 million; FY 2005, \$5.0 million; FY 2006, \$5.2 million) in Vancouver, WA, near MSH. Primary partners are the U.S. Forest Service (USFS), which manages volcanic lands, such as the MSH Volcanic National Monument, and the University of Washington, which operates the Pacific Northwest Seismograph Network.
- Alaska Volcano Observatory (Estimates for FY 2004, \$4.3 million; FY 2005, \$4.2 million; FY 2006, \$4.3 million), which is a formal cooperative partnership with the University of Alaska, Fairbanks, and the State of Alaska Division of Geological and Geophysical Surveys.
- Long Valley Observatory (Estimates for FY 2004, \$2.2 million; FY 2005, \$2.2 million; FY 2006, \$2.2 million), which focuses on the large Long Valley caldera in east-central California and partners with the USGS Northern California Seismic Network.
- Yellowstone Volcano Observatory (Estimates for FY 2004, \$0.3 million; FY 2005, \$0.3 million; FY 2006, \$0.4 million) which focuses on the enormous volcanic system encompassed by Yellowstone National Park and is conducted in cooperation with the University of Utah and the Yellowstone National Park.

Allied-projects funding (FY 2004, \$6.2 million; FY 2005, \$6.2 million; FY 2006 \$6.2 million) covers laboratories, topical investigations, geologic-mapping projects, development of monitoring and data-analysis techniques, international crisis response, and hazard-information dissemination that are closely allied with observatory activities but not necessarily located at one of the observatories. Staff and equipment in the program are utilized nationally whenever feasible to leverage resources and avoid duplication, share resources easily, and respond effectively to volcano emergencies.

Monitoring Volcanic Unrest and Eruptions

(Estimates for FY 2004, \$13.3 million; FY 2005, \$15.0 million; FY 2006, \$16.0 million)

The United States repeatedly experiences significant levels of volcanic unrest and eruptive activity that require long-term monitoring, practical explanation, and timely response by the USGS. The USGS currently monitors 49 U.S. volcanoes using a combination of on-site real-time and near-real-time geophysical and geochemical techniques designed to detect the rise of magma toward the surface. Periodic satellite observations are used to complement ground-based monitoring; however, satellite observations do not provide the all-weather, real-time, early warnings that are essential for effective hazard warnings. Principal components of the USGS volcano monitoring system are arrays of sensitive seismometers and permanent Global Positioning System (GPS) stations surrounding volcanoes, with telemetry to central sites for computer processing. Data acquired with the monitoring system are interpreted in conjunction with satellite and other data, and hazard alerts, warnings, and crisis response activities are managed through the USGS volcano observatory structure.

The USGS also responds to selected volcanic crises around the world through a mobile observatory and crisis response program funded jointly with the U.S. Agency for International Development (USAID). Working through USAID and the State Department when requested by

another country, the USGS can rapidly deploy a team of experienced volcanologists to help monitor and interpret volcanic unrest and assess possible consequences of eruptive activity. The core team is located at the CVO but draws on expertise from throughout the USGS. Since the mobile observatory and crisis response program's inception in 1986, USGS volcanologists have helped with volcano crises in 15 countries, most notably the 1991 eruption of Mount Pinatubo in the Philippines, which saved tens of thousands of lives and billions of dollars in U.S. assets. Beyond the main benefit of keeping people out of harm's way and building host-country capacity, the international responses have been consistent with U.S. foreign-policy objectives abroad and have enhanced volcano-risk mitigation domestically by providing opportunities to learn from diverse eruption scenarios and through testing of new monitoring techniques.

Information dissemination is a critical aspect of USGS volcano monitoring. Data obtained from the monitoring networks are interpreted by program scientists and explained to affected communities and Federal, State, and local emergency-management officials. Notices summarizing conditions at U.S. volcanoes are issued to the public on a regular basis (daily, weekly, or monthly, as appropriate) by USGS volcano observatories, consistent with DOI's Serving Communities strategic goal of protecting lives, resources, and property by providing information to assist communities in managing risks from natural hazards. In addition, all the observatories give specialized briefings on episodes of anomalous unrest or heightened activity to appropriate public officials and land managers.

Research on volcanic processes is inherent in USGS volcano-monitoring activities. Monitoring data are used to formulate and test models of volcanic behavior so that patterns of unrest can be interpreted more definitively and forecasts can be improved. Priority research topics include the process of magma movement in relation to seismicity and ground deformation and the role of magmatic gases and fluids in driving eruptions.

The long-term goal of the monitoring component is to acquire, process, interpret and report data from all restless, active, or potentially hazardous U.S. volcanoes at various time-scales so as to optimize detection and characterization of early signs of unrest so that emergency officials and the public can effectively plan and implement appropriate preparedness and mitigation actions. During the past 8 years, monitoring networks have been installed at an additional 28 hazardous volcanoes (primarily in Alaska, with funding from the Federal Aviation Administration), and critical improvements have been made to existing networks. At this time, more than 20 of the potentially hazardous volcanoes of the United States lack the ground sensors necessary for basic monitoring, and at many monitored volcanoes, sensors still are sparse and (or) becoming outdated. Unmonitored volcanoes are in Alaska and the Commonwealth of the Northern Mariana Islands, where the primary purpose of volcano monitoring is to route aircraft around volcanic-ash clouds from recently erupted volcanoes.

Hazard Assessment and Related Process Investigations

(Estimates for FY 2004, \$6.5 million; FY 2005, \$6.4 million; FY 2006, \$6.4 million)

USGS scientists decipher the record of past geological activity at volcanoes and evaluate current conditions to assess the nature and likelihood of future hazardous events. Multidisciplinary findings are combined into geologic and hazard-zonation maps, digital databases, and probabilistic recurrence and inundation models. Assessments, updated periodically as new data become available, are used by the USGS to identify the appropriate level of monitoring and crisis response at specific volcanoes and by other agencies as critical input to emergency preparedness and land-use planning.

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As with monitoring activities, process research is an integral part of assessing hazards. Field, laboratory, and modeling studies are undertaken to understand how surface geologic deposits were emplaced by previous activity and how volcanic systems can change over time. The interaction of magma and eruptive products with snow/ice and ground or surface water is investigated, as are the dynamic hydrologic processes that affect debris avalanches, mudflows, and sediment transport at volcanoes.

Diverse groups seek information about volcano hazards and processes, and USGS staff share their expertise with public-safety officials, land managers, scientists in other institutions, business leaders, the media, land developers and planners, educational institutions, and citizen groups. A variety of methods to disseminate hazard information are used, including maps, scientific publications, pamphlets, briefings, workshops, videos, digital databases, Web sites, newspaper articles, and interviews with media.

Current program emphasis is on preparing hazard-assessment reports for newly monitored Alaskan volcanoes and well-studied volcanic centers in northeastern California and on conducting field studies to more fully characterize eruptive histories and processes at volcanoes in central Oregon. New methods for probabilistic assessment continue to be developed for application along with more traditional means of describing hazard potential.

InSAR Applied to Volcano Studies — USGS researchers from the VHP, the Earthquake Hazards Program, and the USGS National Center for EROS are using a recently developed satellite remote sensing technique called Interferometric Synthetic Aperture Radar (InSAR) to study ground deformation at volcanoes in the United States and around the world. This technique can detect small (centimeter scale) changes in elevation in the Earth's surface by comparing small changes in radar images of the same area collected by satellites at different times. With InSAR, scientists are able to map the areal extent of ground deformation caused by magma accumulation in the crust, strain along earthquake faults, ground water changes, and other processes that are common near active volcanoes. The addition of InSAR to the existing suite of monitoring techniques is providing new insights into how subsurface volcanic reservoirs are resupplied with magma and on how volcanic centers swell and deform prior to eruption. One major result is that InSAR has detected surface deformation at a number of seismically quiet volcanoes, providing an earlier indicator of volcanic unrest than we have had previously. Since the inception of this work in FY 1998, InSAR has been used to study uplift and subsidence cycles at the Yellowstone caldera in Wyoming; inflation or subsidence of several volcanoes in the Aleutian volcanic arc in Alaska; and uplift near the Three Sisters volcanic center in central Oregon.

Determining Effects of Volcanic Gases on Eruption Explosivity — The driving force behind a volcanic eruption comes from the build-up and release of water-, carbon-, and sulfur-rich gases stored in the magmas buried deep beneath restless volcanoes. USGS scientists in Menlo Park, CA, are working to quantify the factors that control eruption explosivity. Using specialized furnaces and pressure vessels, molten rock is subjected to the conditions magma encounters as it travels to the Earth's surface. The entire eruptive process can be examined in a succession of carefully controlled high temperature, high-pressure experiments. Recent results show that degassing of magma is strongly influenced by magma composition such that low-SiO₂ magma release gas easily en route to the surface, with the result that gas pressure does not build up dangerously. In contrast, high-SiO₂ magmas retain gases until they are close to the surface where catastrophic release of the gas leads to an explosive eruption. Other recent results demonstrate that the gas composition of samples of Mt. Rainier magma indicate magma

storage is deeper than previously thought, which is in better agreement with seismic imaging of the magmatic plumbing system and which helps to focus attention for future monitoring.

New Eruptive History of Veniaminoff Volcano, Alaska — Because of its historic activity, large pre-historic eruptions, size, and deep exposure in glacial valleys, Veniaminoff Volcano in the Aleutians was selected for a detailed eruptive history study to improve the understanding of the long-term evolution of Aleutian arc volcanoes and their potential for large explosive eruptions. This effort involves geologic mapping of pyroclastic deposits, lahars, and the volcano itself conducted by a team of scientists from USGS offices in Menlo Park and Anchorage, the Alaska Division of Geological and Geophysical Surveys, and the University of Alaska, Fairbanks. The first results of field work reveal evidence of three major explosive eruptions in the past, each of which probably contributed to formation of the volcano's large caldera. In addition, scientists have determined that the volcano is constructed of hundreds of lava flows spanning a wide range of composition. Much of the lava flowed under or adjacent to glaciers. New data suggest that much of the 8,000 foot high, ice clad edifice is geologically young, an indication that this volcano has been exceptionally active in the past, and will likely continue to erupt frequently in the future. These results suggest that Veniaminoff Volcano poses a greater risk than previously thought. Results will be used to complete a hazard assessment for the volcano.

2004 Program Performance Accomplishments

The accomplishments listed below demonstrate the utility of USGS products that are counted under the output measures of: hazard network maintained, risk/hazard assessments completed, workshops or training provided to customers, number of sites monitored, and amount of information provided to the public to help mitigate risk.

A Year of Unprecedented Volcanic Activity — FY 2004 was a year of unprecedented volcanic activity in the United States that challenged the resources of the VHP. During the year, the VHP responded to volcanic eruptions at Kilauea in Hawaii, Mount St. Helens in Washington, Anatahan in the Commonwealth of the Northern Mariana Islands, and Mount Veniaminoff and Mount Shishaldin in Alaska. The monitoring network was expanded at Mount Spurr in Alaska in response to increased earthquake activity and melting of the summit glacier. Additionally, significant deformation and earthquake activity was carefully monitored at Mauna Loa volcano in Hawaii, and at Three Sisters volcanic center in Oregon.

Response to the 2004 Eruption of Mount St. Helens (MSH) — MSH in southwestern Washington State, the most active and explosive volcano in the Cascade Range, awoke in September 2004, following nearly 18 years of relative quiescence since its previous eruption in October 1986.

- On September 23, the CVO detected a swarm of shallow earthquakes beneath MSH. CVO issued a Notice of Volcanic Unrest on September 26, followed by a Volcano Advisory on September 29.
- During the next several days, earthquakes increased both in rate of occurrence and magnitude, accompanied by fracturing and uplift of glacial ice on the south crater floor. Elevated concentrations of magmatic gas were detected in the crater on October 1.

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- On October 2, a 50-minute episode of strong volcanic tremor prompted CVO to issue a Volcano Alert warning of the possibility of an imminent eruption. Small steam-and-ash eruptions (Volcanic Explosivity Index VEI 1) from vents in the western part of the deforming area sent plumes to 2500-3500 m above sea level (as much as 1000 m above the vent) in early October.
- Beginning in early October 2004 and continuing through January 2005, steady growth of a lava dome continued at rate equal to four football fields covered by 100 feet of new lava each day.

The worst-case hazards from future eruptions of MSH include ash from vertically-directed plinian eruption columns, pyroclastic flows, and lahars (volcanic mudflows). At present, land-use closures have been imposed by Federal (USFS), State, and local agencies to prohibit access to threatened areas by all but essential monitoring personnel.

In response to the eruption, CVO utilized the entire range of available analytical techniques including seismology, GPS, Light Detecting and Ranging (LiDAR), high-resolution photogrammetry, airborne multispectral and infrared remote sensing, airborne and satellite synthetic aperture radar (INSAR), airborne instruments to detect magmatic gases, and electron microbeam analysis of volcanic ash and rock samples. CVO collaborated with the University of Washington's Pacific Northwest Seismograph Network on the seismology of the eruption, and with the University of Oregon on the petrology and chemistry of the new magma. Equipment and personnel were redirected to CVO from Alaska, HI, and Menlo Park, CA. New seismometers and GPS units were installed within and near the crater, and CVO collaborated with the EarthScope Program of the National Science Foundation (NSF) to expand the far-field GPS network in areas well removed from the crater. CVO also partnered with the National Aeronautical and Space Administration (NASA) on remote sensing flights to characterize the evolution of the eruption.

CVO continues to monitor the situation closely at MSH, and will immediately notify the Federal Aviation Administration (FAA), the National Oceanic and Atmospheric Administration (NOAA), and the Washington Emergency Management Directorate of any event at the volcano that could pose such a threat.



Figure 1. Steam and ash emission at Mount St. Helens on October 1, 2004.

Expanded Volcano Monitoring in Alaska — The Alaskan Volcano Observatory (AVO) continued to expand its seismic monitoring network according to plan and on schedule. AVO installed new seismic networks at Korovin Volcano near the village of Atka in the Aleutians and Peulik Volcano on the Alaska Peninsula. AVO augmented existing seismic networks on Akutan, Okmok, and Katmai volcanoes with real-time telemetered broadband seismometers that will aid both monitoring and increase our scientific understanding of volcanoes. The monitoring network provides crucial early warning of eruptions and unrest in support of volcanic ash avoidance by aircraft. An update was made to The Alaska Interagency Operating Plan for Volcanic Ash Episodes, which outlines the collaboration between USGS, National Weather Service (NWS), FAA, U.S. Air Force, U.S. Coast Guard, and the Alaska Division of Homeland Security and Emergency Management.

Unprecedented Unrest at Alaskan Volcanoes — Significant levels of unrest were exhibited in FY 2004 by three Alaskan volcanoes, Spurr, Shishaldin, and Veniaminoff. Scientists at the AVO first noticed the unrest at Mount Spurr volcano about 80 miles west of Anchorage in early July when hundreds of small earthquakes occurred 3 to 4 miles beneath Spurr's summit. Aerial reconnaissance in mid-July and early August documented recent small flows of mud and rock and a newly formed "ice cauldron" in the summit ice cap. The ice cauldron is a collapse feature possibly caused by an increase in heat coming from deep beneath the summit (fig. 2). Using sensitive, airborne instruments, scientists detected on August 7 small amounts of the volcanic gases in a plume from the summit. In response to unrest at Mount Spurr, AVO increased its seismic coverage of the volcano by adding 5 new seismic stations including 3 modern broadband seismometers, 3 telemetered GPS instruments, and a Web camera. Since late July, AVO has been in a heightened state of watchfulness because the activity at Mount Spurr continues to indicate the increased possibility of an eruption, though an eruption is not imminent. Also, two other volcanoes, Shishaldin and Mount Veniaminoff, were active at a low level for several months in FY 2004. Veniaminoff routinely erupted ash to about 10,000 ft. above sea level while Shishaldin showed evidence of small ash emissions confined to the upper flanks of the volcano. Data from seismic networks on the volcanoes enabled AVO to inform the aviation industry and local officials that more energetic activity was unlikely and they could plan accordingly.

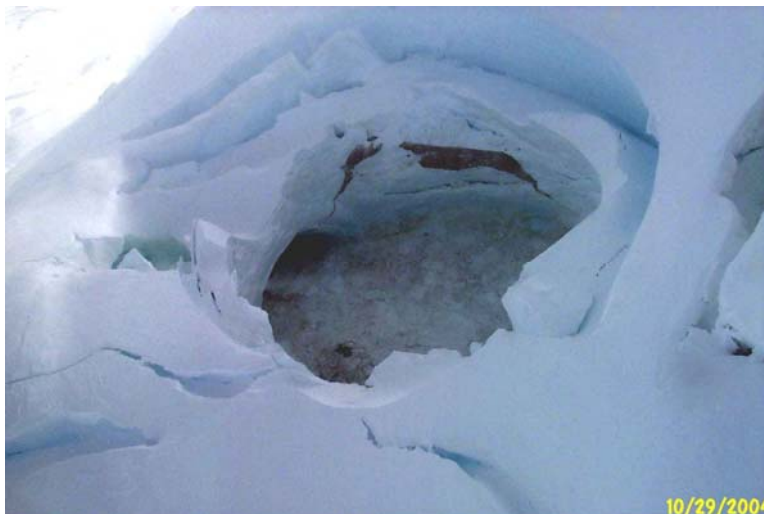


Figure. 2. Collapsed glacier and "ice cauldron" at the summit of Mount Spurr. The "ice cauldron" is approximately 100 m wide and is possibly caused by an increase in heat coming from deep beneath the summit.

Progress on Hazard Assessments for Alaskan Volcanoes — A geologic map of Peulik was published. Geologic field mapping at Okmok and Veniaminoff volcanoes was completed this summer and compiling the data in the form of geologic maps and hazards assessments has begun. Because of its historic activity, large pre-historic eruptions, size, and deep exposure in glacial valleys, Veniaminoff Volcano in the Aleutians was selected for a detailed eruptive history study to improve the understanding of the long-term evolution of Aleutian arc volcanoes and their potential for large explosive eruptions. This effort involves geologic mapping of pyroclastic deposits, lahars, and the volcano itself conducted by a team of scientists from USGS offices in Menlo Park and Anchorage, the Alaska Division of Geological and Geophysical Surveys, and the University of Alaska, Fairbanks. The first results of field work reveal evidence of three major explosive eruptions in the past, each of which probably contributed to formation of the volcano's large caldera. In addition, scientists have determined that the volcano is constructed of hundreds of lava flows spanning a wide range of composition. Much of the lava flowed under or adjacent to glaciers. New data suggest that much of the 8,000 foot high, ice clad edifice is geologically young, an indication that this volcano has been exceptionally active in the past, and will likely continue to erupt frequently in the future. These results suggest that Veniaminoff Volcano poses a greater risk than previously thought. Results will be used to complete a hazard assessment for the volcano.

Expanded InSAR activities in 2004 — Pilot studies in previous years have shown that InSAR data can be used to monitor ground deformation such as that which precedes and accompanies volcanic eruptions, and that which is produced by large earthquakes, and ground-water withdrawals. This technique complements results from ground-based USGS monitoring networks. Because of extensive ground-based monitoring networks and mission responsibilities for the DOI in natural hazards and resources, USGS is the most appropriate Federal agency to validate and apply this technology for monitoring natural hazards and resources. In FY 2004, the USGS broadened and formalized its InSAR related activities by: (1) negotiating with the European Space Agency (ESA) to establish the USGS program as a Category-1 (research) effort, (2) submitting tasking to ESA to produce InSAR coverage for all active U.S. volcanoes in the western United States, Alaska, Hawaii and the Marianas, and (3) establishing contracts to allow scientists to systematically purchase scenes as ESA acquires them. In addition, VHP has

moved to standardize and improve processing techniques for all scientists working with InSAR, acquiring software that permits use of Canadian Radarsat data as well as ESA data for interferometry. The data management and archival systems are being set up to support systematic exploitation of this vital new technique. Among the successful InSAR applications to date, the most important may be the detection of more than seven years of continuous inflation at the Three Sisters volcanic center in central Oregon, consistent with the addition of 30,000 m³ of magma at a depth of about 5 to 7 km. Significantly, a swarm of more than 300 small earthquakes occurred beneath the inflating area on March 23-25, 2004 (fig. 3).

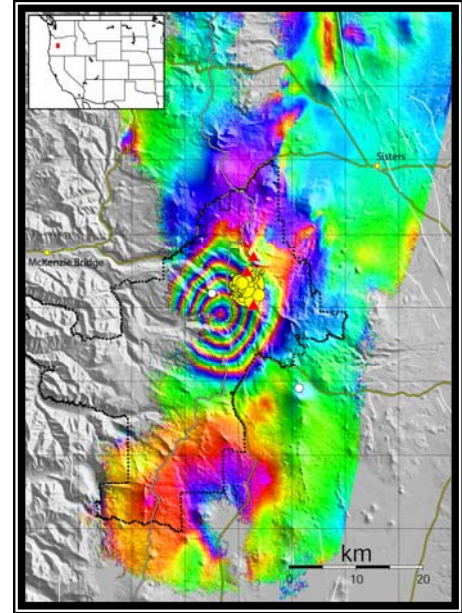


Figure. 3. Interferogram for the Three Sisters volcanic center in central Oregon. Bulls-eye pattern of rings corresponds to area of inflation. Small circles show locations of a swarm of more than 300 small earthquakes, which occurred on 23-25 March, 2004.

Volcanic Eruption in the Commonwealth of the Northern Marianas (CNMI) — Increased seismic activity on March 30, 2004, marked the onset of renewed volcanic activity at the Anatahan Volcano, Commonwealth of the Northern Mariana Islands (CNMI). Lava was noted in the crater in April 2004, and a moderate eruption began producing steam and ash, which reached altitudes of about 2000 feet. Responding to the new eruption, the USGS collaborated with the Emergency Management Office (EMO) of the CNMI to evaluate data from monitoring equipment that had been repaired or installed in response to the 2003 eruption of Anatahan. Seismic data from Anatahan and Sarigan, which are evaluated by USGS scientists, with reports made daily to the EMO and posted regularly for the public on the Web site of the USGS HVO. As necessary, a call down list was activated by the USGS so that immediate warning is directly transmitted to the EMO, the Washington Volcanic Ash Advisory Center (NOAA), the Guam Meteorological Watch Office, the FAA, and the Air Force Weather Agency (AFWA). USGS scientists also visited the CNMI to provide training to EMO staff and to maintain the monitoring network on Anatahan and Sarigan; these efforts were funded in part by the Office in Insular Affairs. Although the March 30 eruption of Anatahan ended in early July, long-period seismic events were recorded on September 27, indicating the continuation of unrest and the underscoring the fact that Anatahan is an active volcano. Responding a request from the EMO, the USGS prepared a plan for hazard assessments and complete monitoring of the nine volcanic islands north of Saipan, which would facilitate safe development and resettlement of the northern islands, provide early detection of explosive eruptions and flank collapse that could generate destructive tsunamis, and provide early warning of conditions precursory to explosive eruptions that would inject volcanic ash to flight altitudes endangering civilian and military aircraft operating in the western Pacific. The plan has been endorsed by the Governor and the Legislature of the CNMI, and by the Mayors and Governing Councils for Rota, Tinian, Saipan, and the Northern Islands.

International Volcanic Hazard Mitigation — Through a joint agreement with the USAID, the USGS maintains a mobile volcano-monitoring capability to respond to selected volcanic crises around the world. At the request of other countries and working through USAID and the State

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Department, USGS scientists provide both training and rapid-response volcano monitoring to determine the nature of volcanic unrest and assess possible consequences of eruptive activity. In Papua New Guinea, USGS scientists provided assistance to local scientists to monitor Pago volcano, which threatens a population of 40 to 50 thousand people and international air traffic in the region. In the eastern Congo, the USGS assisted local staff at the Goma Volcano Observatory with the interpretation of monitoring data for the recent activity at Nyiragongo and Nyamuragira. In Ecuador, the USGS provided eruption- and lahar-hazard monitoring systems for Cotopaxi Volcano, assisted in the response to the November 2002 eruption of El Reventador, and helped local scientists to educate the government and civil defense officials about hazard mitigation. In 2003, the USGS systematically provided improved equipment, training, and volcano hazards assessments in Central America (Nicaragua, Guatemala, El Salvador, and Costa Rica). In addition to contributing directly to the objectives of the State Department, these activities provided VHP scientists opportunities to study the differences in hazards posed by six volcanoes. Such experience is expected to pay dividends in improved understanding of eruptive processes, especially as applied to forecasting the behavior of U.S. volcanoes.

Escalating Unrest at Mauna Loa Volcano — HVO kept watch on the very large, increasingly populated Mauna Loa volcano, which last erupted in 1984, and which began to show signs of renewed activity in the spring of 2002. Geophysical monitoring by HVO indicates that the rate of ground deformation at Mauna Loa has increased by 5 to 10 times and has a predominantly radial pattern likely caused by the movement of magma into a reservoir beneath the summit. Seismicity also increased, starting with a swarm of deep earthquakes beneath the summit in April 2003. Since early July 2004, an increased number of earthquakes were recorded from beneath Mauna Loa. Through mid-October 2004, more than 825 earthquakes related to the ongoing seismic activity were centered beneath Mauna Loa's summit caldera and the adjacent part of the southwest rift zone. Most of these earthquakes are quite deep (35 to 50 km), "long-period" (LP) earthquakes, which means their signals gradually rise out of the background rather than appearing abruptly. Such a concentrated number of deep LP earthquakes from this part of Mauna Loa is unprecedented in our modern earthquake record dating back to the 1960s. The recently expanded GPS network detected continued deformation in FY 2004, consistent with swelling of a magma reservoir within the volcano.

2005 Planned Program Performance

The accomplishments and outcomes listed below demonstrate the utility of USGS products that are counted under the output measures established for this program element.

Networks Maintained — The VHP will continue to maintain one overall monitoring network system. The VHP has been treating five regional networks as one cumulative network. Looking to the future, the VHP plans to formalize the overall monitoring capability as the National Volcano Early Warning System (NVEWS), which would provide coverage for all potentially hazardous volcanoes in the United States at levels commensurate with the risk each poses.

Risk/Hazard Assessments Delivered to Customers — The VHP plans to deliver one hazard assessment to customers in FY 2005, which is a reduction from two previously scheduled. This reduction reflects a necessary shift in Program emphasis to monitoring in response to the current and unprecedented, high levels of volcanic activity and unrest. Hazard assessments are multiyear studies. VHP will continue to make progress on hazard assessments in FY 2005 and plan to deliver three in FY 2006, which will put the Program back on schedule with respect to this performance target.

Formal Workshops or Training Provided to Customers — The VHP will provide four workshops or training sessions to customers in FY 2005. Currently scheduled are the Alaska Coordination Meeting, Anchorage, AK, and a workshop to produce a response plan for eruption of volcanoes in the Northern Mariana Islands.

Counties or Comparable Jurisdictions that have Adopted Improved Building Codes, Land-Use Plans, Emergency Response Plans or Other Hazard Mitigation Measures — The VHP estimates that 256 counties or comparable jurisdictions are threatened by volcano hazards. At present, 162 have adopted response plans based on USGS volcano hazard assessments and (or) work closely with the appropriate USGS volcano observatory to track and respond to volcanic activity. This number will be increased to 180 with completion of response plans for eruption of volcanoes in the Northern Mariana Islands and the central Cascades.

Sites Monitored for Ground Deformation — The VHP presently monitors ground deformation with 86 continuous telemetered GPS and tiltmeter stations in Long Valley, HI, (unified arrays for Mauna Loa and Kilauea); Yellowstone; Three Sisters; Mount St. Helens; and in Alaska. In FY 2006, the number of USGS stations will be increased by 15, primarily reflecting increased instrumentation at Mount St. Helens. In addition, VHP scientists will collaborate with the University of Hawaii and with the EarthScope Program of NSF to install continuously telemetered GPS stations at Hawaiian and the Cascade volcanoes. Continuous GPS and tilt monitoring is supplemented by surveys as warranted of volcanic centers in the Cascades, Yellowstone, and Long Valley, using high-precision leveling and (or) campaign-style GPS. InSAR (Interferometric Synthetic Aperture Radar) using European and Canadian satellites is being used extensively to track on a time scale of months to years the deformation of Alaskan and Cascade volcanoes and Yellowstone caldera. VHP plans to expand the use of this technique to Mauna Loa in FY 2005.

Volcanoes for Which Information Supports Public Safety — During FY 2005, the VHP expects to increase by two the number of monitored U.S. volcanoes for a total of 51. Monitoring upgrades at Mount St. Helens and Mauna Loa, while not expanding the number of volcanoes monitored, will significantly improve the quality and quantity of data available for these volcanic centers.

Percent of Potentially Hazardous Volcanoes with Published Hazard Assessments — Based on 70 potentially active volcanoes (including 8 in CNMI): To date, 61.4 percent of the volcanoes have hazard assessments completed. Hazard assessments are underway in FY 2005 for 4 volcanoes and will be completed and published in FY 2005 (1) and 2006 (3).

Data processing and Notification Costs per Unit Volume of Input Data from Geophysical Sensors in Monitoring Networks — This information was developed as part of the planning exercise to design a National Volcano Early Warning System during the second and third quarters of FY 2004. The cost is currently estimated to be approximately \$12 per gigabyte but is expected to drop significantly with increasing size of the seismic monitoring network as a result of economy of scale.

Five-Year Plan — In response to a program review by the National Research Council (NRC) and the PART review, a draft of the new VHP 5-Year Plan has been completed and reviewed. Emphasis was placed on strengthening research capabilities, adding new technologies such as InSAR, and developing a "National Volcano Early Warning System." The addition of InSAR to the existing suite of monitoring techniques is already providing insight on the movement of

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magma in the subsurface prior to eruption. A supplementary draft document has been completed providing the rationale for improved monitoring system, (National Volcano Early Warning System), which would provide monitoring of all the Nation's volcanoes at levels commensurate with the risk each poses. The document summarizes an analysis and ranking of the threat posed by each of the 169 volcanic centers in the United States, which have erupted or shown significant hydrothermal activity within the last 10,000 years, and presents a "gap analysis" of the monitoring capability for each volcanic center.

Recent and Imminent Volcanic Activity — The additional \$3,242,000 of funding provided by Congress for volcanic research and monitoring will allow significantly enhanced response to those volcanoes currently in eruption or showing signs of possible imminent volcanic activity.

Mount St. Helens (MSH) — Satellite telemetry will be installed to take advantage of increased band width required for expanded monitoring. The MSH seismic network will be augmented with accelerometers and state-of-the-art, telemetered, broadband seismometers. By year's end, the geodetic network will have been augmented by at least 14 telemetered GPS stations to measure ground deformation. Funds will also allow installation of additional telemetered cameras and periodic overflights for visual and infrared imaging, photogrammetry to calculate eruption volumes, and sampling for volcanic gas emissions. These network improvements will significantly increase the Cascade Volcano Observatory's ability to track the subtle changes in seismicity, ground movement, and gas emission, which can precede large explosive eruptions. Seismometers, which were planned for the Three Sisters volcanic center but deployed at MSH in response to the eruption, will be redirected to Three Sisters to track the continuing unrest at that volcanic center.

Hawaii — The Hawaiian Volcano Observatory (HVO), working with the Center for the Study of Active Volcanism of the University of Hawaii, will continue preparations for a possible future eruption of Mauna Loa, where seismicity remains elevated and continued inflation indicates swelling of the magma chamber within the volcano. Urgently needed maintenance will be performed on the backbone of the telemetry system required for monitoring both Mauna Loa and the continuing eruption at Kilauea. Much needed repairs to the short-period seismic network will continue in order to achieve the highest level of functionality of that system. Complete installation and telemetry of at least two borehole instrument packages will be completed on Mauna Loa. The packages consist of seismometers and strain meters, which will provide extremely high quality data on the seismicity and deformation of Mauna Loa. HVO will also assist the University of Hawaii in the installation of 12 new GPS stations, and will make progress on establishing telemetered, ground-based SO₂ and CO₂ sensors and a camera surveillance system at the summit caldera of Mauna Loa.

Commonwealth of the Northern Mariana Islands (CNMI) — Maintenance will be performed on the monitoring system on Anatahan volcano, which began to erupt on January 4, 2005, for the third time in 18 months. Progress will be made toward completion of a hazard assessment for Pagan Island, which appears to be the most dangerous volcanic system in the CNMI. An eruption response plan will be developed for the Northern Mariana Islands in concert with the commonwealth and local governments of the CNMI and Guam, the FAA, NOAA, the Air Force Weather Agency, and Pacific Command.

Aleutian Volcano Monitoring and Hazard Assessment — The additional \$3,242,000 provided by Congress for volcanic research and monitoring will allow continued expansion of the Aleutian volcano monitoring network. Of these funds, approximately, \$1,500,000 will be used to extend the western Aleutian volcano monitoring network and conduct geologic

investigations in support of hazard assessment. Seismic monitoring networks will be installed on Semisopochnoi and Little Sitkin volcanoes and a regional telemetry hub will be established on Amchitka Island. Geologic investigations will be conducted on Semisopochnoi, Little Sitkin, Gareloi and Tanaga volcanoes. Equipment installed in 2003 at the western Aleutian volcanoes, Gareloi and Tanaga, will be maintained. Mount Spurr, located 80 miles west of Anchorage and exhibiting elevated earthquake activity and melting of the summit glacier, will be carefully watched utilizing overflights and a monitoring network augmented in late FY 2004 by three new GPS units and five new seismometers.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Volcano Hazards (\$000)	\$21,787	+\$826
FTE	133	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs

The FY 2006 budget request for Volcano Hazards Program is \$21,787,000 and 133 FTE, a net program increase of +\$1,073,000 (includes adjustments for uncontrollable costs) and 0 FTE from the 2005 enacted level.

Volcano Monitoring (+\$864,000) — The \$864,000 increase for VHP will be used for equipment purchases and deployment costs to complete modernization of the MSH monitoring network, to initialize the improvement of monitoring capability at other Cascade volcanoes, and to expand monitoring capability in the CNMI. Improvements will be implemented without addition of FTE in FY 2006.

The program's recent evaluation of U.S. volcanoes that forms the basis for a National Volcano Early Warning System indicates: (1) large gaps in monitoring capability occur in the Cascades, where together with Hawaii, the volcanoes pose the greatest threat to lives and property within the United States, and (2) volcanoes of the Mariana Islands, which are virtually unmonitored, are capable of generating ash clouds and tsunamis, which could impact Guam, the CNMI, and military deployment and international air traffic in the western Pacific. Among the most threatening of these volcanoes, the greatest deficiencies in monitoring capability exist at Glacier Peak, Mount Rainier, Mount Hood, Three Sisters, Mount Baker, Mount Adams, and Crater Lake in the Cascades, and at Pagan and Agrigan in the Mariana Islands. In FY 2006 and subsequent years, priority will be given to improved monitoring of those volcanoes in eruption or those which have recently erupted, followed by volcanoes showing significant unrest, followed by volcanoes in repose in the order of the level of threat they pose to citizens and property. MSH, Anatahan, and Mauna Loa are priorities in FY 2005. Completion of the network at MSH will continue to be a priority in FY 2006, but upgrades to the monitoring networks at Three Sisters and Mount Rainier will be performed, and progress will be made toward providing monitoring of Pagan and Agrigan.

The recent eruption of MSH demonstrated that, during an eruption, the need for more adequate ground-based networks resulted in increased expenses and increased risk to USGS personnel. At MSH, a sparse GPS network and the lack of modern broadband seismometers resulted in the failure to capture important seismic and geodetic information during the early weeks of the eruption. Looking to the future, the failure to capture adequate information during the onset of unrest could translate into reduced warning time for people on the ground and aircraft in the air. Approximately \$10,000 per week was spent on helicopter and fixed wing support through the

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first two months of FY 2005 because the ground-based monitoring network was not sufficient to fully track the eruptive activity. USGS personnel were placed at risk making these observations and upgrading the monitoring network.

The additional funds will allow the program to increase its performance goals by more rapidly expanding the monitoring network to unmonitored volcanoes. For the past several years, two volcanoes per year have been added to the monitoring network in Alaska. This rate will continue in Alaska and will be augmented by an additional volcano per year in the Mariana Islands. The number of sites (mobile or fixed) monitored for ground deformation to identify volcanic activity will be increased to an addition of 15 sites per year. The program will continue according to plan to increase the percentage of communities using DOI science on hazard mitigation, preparedness, and avoidance. Not adequately captured by this metric will be the increased ability of the VHP to detect volcanic unrest, forecast eruptive behavior as a result of improvements to the monitoring of Cascade volcanoes through addition of seismic and geodetic stations. Communities on both flanks of the Cascades, including the increasingly populated I-5 corridor from Puget Sound to Mount Shasta, will benefit from the improved detection and interpretation of volcanic unrest.

Geologic Hazard Assessments Subactivity

Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Earthquake Hazards	47,401	46,898	+694	+3,745	51,337	+4,439
FTE	231	226	0	+20	246	+20
Volcano Hazards	19,785	20,714	+247	+826	21,787	+1,073
FTE	138	133	0	0	133	0
Landslide Hazards	2,620	3,043	+51	-6	3,088	+45
FTE	22	22	0	0	22	0
Global Seismographic Network	3,434	3,335	+42	+595	3,972	+637
FTE	7	7	0	0	7	0
Geomagnetism	2,043	1,989	+42	-6	2,025	+36
FTE	14	14	0	0	14	0
Total Requirements \$000	75,283	75,979	+1,076	+5,154	82,209	+6,230
FTE ^{b/}	412	401	0	+20	421	+20

^{a/} Changes for this program element include a reduction of -\$6 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

^{b/} FTE may not add to total, due to rounding.

Landslide Hazards

2006 Program Overview

The 2006 budget request for the Landslide Hazards Program (LHP) is \$3,088,000.

The LHP gathers information, conducts research, responds to disasters, and produces scientific reports and other products that can be used by a broadly based user community, including Federal, State, and local governments and the private sector. LHP investigations focus on research to better understand, assess, and monitor the causes and mechanisms of ground failure. Its main goal is to reduce losses from landslides through improved understanding of landslide hazards and application of new strategies for hazard mitigation.

As described in the Office of Management and Budget (OMB) Program Assessment Rating Tool (PART) review, the LHP role is clearly defined and unique from other Federal, State, local, or private entities. The LHP was reviewed in FY 2003 as part of the Geologic Hazard Assessments Program for the FY 2005 Budget using the PART, was found to be moderately effective, and received a score of 82.

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This program supports the Department of the Interior's (DOI) Serving Communities strategic goal to protect lives, resources, and property by making information available to communities to use in developing landslide hazard mitigation, preparedness, and avoidance plans. Three intermediate outcome measures in support of the intermediate outcome of providing information to assist communities in managing risks from natural hazards—the use rate of products, response to inquiries, and adequacy of information—are tracked. Output measures for which targets are established in support of achieving the intermediate outcome goal include the maintenance of one hazard monitoring network, the delivery of risk assessments to customers, and the presentation of formal workshops or training to customers.

Landslide-hazard assessments provide the scientific basis for land-use, emergency management, and loss reduction measures. For example, studies of landslide susceptibility and hazards are providing much needed information to reduce landslide losses in parts of the country that have significant landslide problems including, but not limited to: California, the Pacific Northwest, and the Blue Ridge of the eastern United States. The USGS cooperates with local partners and the Federal Emergency Management Agency (FEMA) in Seattle, WA, and southern California.

Landslide hazard research concentrates on understanding landslide processes, developing and deploying instruments that monitor threatening landslides, and forecasting the onset of catastrophic movement of future landslides. Research into processes and forecasting methodologies is conducted on the types of landslides that produce losses in the United States such as landslides related to steep slopes, heavy rains, and vegetation loss due to wildfires.

The USGS deploys near-real-time monitoring systems at sites along coastal bluffs between Everett and Seattle, WA. This work is in cooperation with the Washington Department of Transportation, the Burlington Northern Santa Fe Railway, its private geotechnical consultant, and a private telecommunications company. These experimental sites will provide continuous rainfall, soil-moisture, and pore-pressure data needed to correctly understand the mechanisms of landslide occurrence on the bluffs. Such understanding can form the scientific underpinnings for early warning of conditions that may trigger landslides. A landslide early-warning system based on such information will be useful in reducing hazards in landslide-prone areas of transportation corridors.

USGS scientists respond to landslide emergencies and disasters nationwide. Federal, State, and local agencies are assisted through landslide site evaluations and recommendations of strategies for reducing ongoing and future damages from landslides. The USGS provided general advisories of potential landslide activity for southern California early January 2005 following intense rainfall. The Director of the USGS has been delegated the responsibility to issue warnings for an earthquake, volcanic eruption, landslide, or other geologic catastrophe (1974 Disaster Relief Act 41 U.S.C. 5201 et seq). When there is sufficient information or knowledge of a particular area, such as in southern California, LHP provides information on potential hazards. Specifically, if rainfall intensity-duration thresholds for landslide activity have been developed for an area or if landslide-hazard maps have been produced, LHP can issue an advisory. LHP works in conjunction with the National Weather Service to issue advisories and press releases regarding the potential for landslide activity. These advisories are provided relatively infrequently.

For foreign disasters, the USGS works with the Agency for International Development's Office of Foreign Disaster Assistance (USAID/OFDA) in responding to appeals for technical assistance from affected countries.

The USGS provides timely information through the National Landslide Information Center (NLIC). The Center communicates with the public and media about ongoing emergency responses and provides information to the external user-community through fact sheets, books, reports, and press releases, consistent with the Department's Serving Communities strategic goal to protect lives, resources, and property by providing information to assist communities in managing risks from natural hazards. The NLIC maintains several databases: the Landslide Bibliography (more than 15,000 entries), the International Landslide Experts Roster of about 2,000 entries, and Major Landslide Events of the U.S. (part of the USGS National Atlas). The NLIC also has real-time measurements from ongoing landslide monitoring projects available for viewing via the Internet. These measurements are used to forecast landslide movement or changes in an individual landslide's behavior.

Monitoring along U.S. Highway 50 (Cleveland Corral landslide and Mission Peak landslide site above Fremont, CA); I-70 in DeBeque Canyon, CO; and at Woodway, WA, (near Seattle) continues to provide key information for dealing with landslide hazards in those areas.

Monitoring can detect early indications of rapid catastrophic movement. Up-to-the-minute or real-time monitoring provides immediate notification of landslide activity, potentially saving lives and property. Continuous information from real-time monitoring also provides a better understanding of landslide behavior for scientists, engineers, and public officials. The USGS conducts these efforts in cooperation with other Federal, State, and local agencies, including the Bureau of Land Management (BLM); the Federal Highway Administration

Karl Gebhardt of BLM says "This report (Assessment of Hazards Associated with the Blue Gill Landslide, South-Central Idaho) has given the BLM a number of recommendations for mitigation and monitoring The BLM greatly appreciates the team assembled by USGS and the world-class expertise the team has provided in the assessment of the Bluegill Landslide."

(FHA); the National Park Service (NPS); the California, Washington, and Colorado State Departments of Transportation; the Colorado Geological Survey; the Colorado School of Mines; and private companies. This cooperation results in technology transfer to other agencies, such as assistance to: (1) the BLM in constructing a remote monitoring system for the Bluegill landslide in Idaho, (2) the NPS in design and implementation of a rock movement monitoring strategy at El Morro National Monument, NM, (3) the California Department of Transportation for monitoring of U.S. Highway 50 landslides, and the (4) Burlington Northern Santa Fe Railway for potential landslides impacting the rail system.

2004 Program Performance Accomplishments

The accomplishments listed below demonstrate the utility of USGS products that are counted under the output measures of: hazard network maintained, risk/hazard assessments completed, hazards mitigation measures adopted, and workshops or training provided to customers.

National Landslide Hazards Mitigation Strategy — The National Research Council (NRC) of the National Academies of Science released its assessment of the National Landslide Hazards Mitigation Strategy entitled *Partnerships for Reducing Landslide Risk*, in which it commended "the USGS for undertaking the important initial steps toward a comprehensive national landslide hazards mitigation strategy." The committee of experts that reviewed the strategy recommended "that the USGS—in close partnership with other relevant agencies—produce the implementation and management plans that will provide the practical basis for an effective national strategy that can be applied at the local level." The LHP began to formulate implementation and management plans recommended by the NRC committee through meetings

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with the planners and leaders of the American Planning Association at its National Conference in Washington, DC, in May 2004 and State geologists and emergency managers at the National Earthquake Conference in St. Louis, MO, in September 2004. At both meetings, LHP program managers sought the support and input from public officials and private sector representatives on how best to form partnerships that would lead to the reduction of losses from landslides in the United States. The report can be found at <http://books.nap.edu/catalog/10946.html>.

Seattle, Washington, Landslide Analyses — The culmination of many years of LHP landslide assessments and analyses conducted in Seattle, WA, were discussed in a paper entitled, "Probabilistic Assessment of Precipitation-Triggered Landslides Using Historic Records of Landslide Occurrence, Seattle, Washington" that was selected by *Environmental & Engineering Geoscience* as the best paper in *Environmental & Engineering Geoscience* for the period from November 2003 through August 2004 issues.

The paper analyzed 90 years of historical landslide data and included maps that show the time interval between historical landslides, as well as the future probability of landslides within Seattle. The maps included in the paper are being used by the City of Seattle for storm preparedness planning, emergency access and response planning, development and redevelopment planning of hillside areas, and municipal facility planning and prioritization. The work was conducted in cooperation with Shannon & Wilson, Inc., the City of Seattle, and FEMA. The paper is posted on the Web at: http://landslides.usgs.gov/html_files/nlic/Coe_eeg_art.pdf. The maps are available at http://landslides.usgs.gov/html_files/nlic/Coe_eeg_maps.pdf.

Debris-flow Hazard Assessments from Areas Burned by Wildfire in Southern California — Debris flows are one of the most dangerous consequences of rainfall on recently burned hillslopes. The occurrence of the catastrophic wildfires that burned more than 750,000 acres in southern California during the fall of 2003 demanded rapid assessments of potential debris-flow hazards over extensive areas. At the request of FEMA, and the U.S. Department of Agriculture Forest Service (USFS) Burned Area Emergency Response Team, Landslide Hazards Program personnel applied a recently-developed approach for assessing debris-flow hazards to basins burned by the Old and Grand Prix Fires in San Bernardino County, the Padua Fire in Los Angeles County, the Simi, Piru and Verdale Fires in Ventura County, and the Cedar and Paradise Fires in San Diego County. The assessments provided a series of maps that show the basin-scale probability of debris-flow production, and potential magnitudes of events for different storm scenarios. For a given basin, the probability and magnitude of debris-flow activity are determined as a function of the extent and severity of the fire, the basin morphology and physical characteristics, and the potential rainfall. The hazard assessments are available on-line at <http://pubs.usgs.gov/of/2003/ofr-03-475/> and <http://pubs.usgs.gov/of/2003/ofr-03-481/>.

These assessments were provided to USFS Burned Area Emergency Response Teams, and through FEMA, were provided to the California State Office of Emergency Services, County Flood Control Districts, and Department of Public Works. Land managers used these maps to focus post-fire mitigation efforts, and emergency response officials used them to identify the most hazardous basins during warnings and to plan for potential evacuations.



Wildfires burning in southern California.

Post-disaster Assessment of Debris-Flow Impacts to a Transportation Corridor in Idaho — Debris-flow activity generated from recently-burned basins crossed by a State highway in Idaho resulted in the repeated destruction of a 6-kilometer length of the road, and damming of the Middle Fork of the Boise River, limiting access to communities and impacting the fish habitat. Following each debris-flow event, the road had been reconstructed, at considerable expense to State and Federal highway departments. At the request of the USFS and the Idaho Department of Transportation, Landslide Hazards Program personnel participated in an assessment of the short- and long-term potential for continued debris-flow activity and evaluation of the potential impacts, and made recommendations for highway reconstruction strategies. The assessment was performed by a team of personnel from USFS, National Weather Service, Federal Highway Administration, and USGS. The team determined that debris flows would be continued to be produced from the burned basins in response to short-recurrence storms, that the volume of material delivered to the Middle Fork of the Boise River would likely decrease with time, but significant hazards still remained to travelers on the road. The recommendations made by this panel formed the basis of the State Highway Department decision to establish a warning system and for the location and frequency of road reconstruction.

Massive Volcano Edifice Failure — Rapid catastrophic landsliding poses an extreme hazard on volcano edifices and other mountains. Scientists used field, experimental, and modeling approaches to understand catastrophic landsliding, including volcano edifice instability. Scientists modeled massive collapse of volcano edifices instigated by transient pressurization of a hydrothermal system. Knowledge gained from this 3-D slope stability modeling can be used to develop hazard maps showing location and size of potential massive collapses and has sparked interest with U.S. and international researchers.

Assessing Landslide Hazard in a Wildlife Refuge — Logan Cave National Wildlife Refuge in northwestern Arkansas is the home of several threatened and endangered species, including the endangered gray bat, the threatened Ozark cave fish, and a cave crayfish. Concern that future landslides might close a main entrance of the cave, which is used by the bats and by cave researchers, prompted the U.S. Fish and Wildlife Service (FWS), to seek USGS assistance in assessing slope stability near the cave entrance. In July 2004, USGS geologists, accompanied by FWS representatives, conducted a detailed field survey and subsurface

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sampling of soils on the unstable slope. The field investigation, supplemented by subsequent laboratory testing and numerical modeling of slope stability enabled the USGS to determine that sediment is accumulating in the entrance as a result of water erosion, foot traffic, and shallow landslides. Continued sediment movement and possible future landslides are likely to block the entrance. The USGS was able to evaluate the effectiveness of various possible remedial actions to prevent blockage. The results of the slope stability investigation at Logan Cave are found in USGS Open-file Report 2004-1357, on-line at <http://pubs.usgs.gov/of/2004/1357/>. The FWS plans to use the results of the study to implement remedial works needed to protect the entrance to Logan Cave.

Hurricane and Storm Response — LHP had a prominent role in the USGS hurricane response efforts to Hurricanes Charlie, Frances, Ivan, and Jeanne during August and September of 2004 in the eastern United States. Scientists compared predicted paths of hurricanes and anticipated rainfall with steepness of topography and antecedent rainfall to evaluate whether the storms would trigger damaging landslides. The path and predicted rainfall amounts for Hurricane Ivan led to the release of a landslide alert to Federal and State government agencies in 11 States in the Appalachian region and a news release to alert the public. Hurricane Ivan triggered a number of costly landslides in the mountainous regions of Tennessee, West Virginia, Ohio, Pennsylvania, and North Carolina, with the most numerous in western North Carolina. The most severe landslide, a rapidly moving debris flow, damaged 12 homes and killed 5 people at Peeks Creek, NC, southwest of Asheville.



Hurricane Ivan triggers 100-foot wide debris flow at Peeks Creek, NC, southwest of Asheville on September 16, 2004. (Scott Eaton, James Madison University).

Landslide Hazard Map for Islands of Chuuk State, Micronesia — Rainfall from Typhoon Chata'an in July 2002 caused about 250 landslides on the islands of Chuuk State, Federated States of Micronesia; the landslides caused 43 fatalities and damaged or destroyed 231 structures, including hospitals, schools, and homes. Following a FEMA and U.S. Army Corps of Engineers (USACE) sponsored field investigation of the landslides to characterize their locations, dimensions, geologic setting and causes; the USGS began preparing a landslide

hazard map for the affected islands. A USGS scientist, Ed Harp, briefed the Governor's office of Chuuk State, and the Vice President's office of the Federated States of Micronesia in September 2003 concerning the uses and limitations of a preliminary version of the landslide hazard map of the Chuuk islands. FEMA regional offices in Honolulu received a similar briefing as they were the responders to the disaster declaration, and partially supported a post-disaster investigation of the landslides. The landslide hazard map and accompanying text was completed at the end of FY 2004 is now published as USGS Open-File Report 2004-1348, and is available on-line at <http://pubs.usgs.gov/of/2004/1348/>. Officials of Chuuk State can use this map to identify relatively safe areas for relocating structures or establishing areas where people could gather for shelter in relative safety during future typhoons or tropical storms similar to Chata'an.

Training on Application of Rainfall Thresholds for Seattle, Washington — Within weeks after issuing warnings of possible landslide activity associated with major storms that battered the Seattle area in October and November 2003; the USGS and the city of Seattle convened a training session for city planners, engineers, and emergency managers on the application of recently developed rainfall thresholds for anticipating landslide activity in Seattle and neighboring areas. USGS scientists described the origins, uses, and limitations of the rainfall thresholds and discussed plans for developing more formal landslide warning protocols based on the thresholds. For the past two wet seasons, Seattle Departments of Public Utilities, Transportation, and Planning and Development have been using a USGS Web site (http://landslides.usgs.gov/html_files/ofr-00-0469/seattlenet.html) to improve their preparedness for landslide emergencies. The Web site relies on rainfall data provided by the city of Seattle from its rain gauge network to show when current conditions are approaching the preliminary rainfall thresholds. Since conducting the training session, USGS scientists have been performing a thorough evaluation of the reliability of the thresholds in order to establish a formal protocol for issuing future landslide warnings. During FY 2005 the USGS plans to prepare reports detailing the final thresholds resulting from the evaluation and documenting the warning protocol.

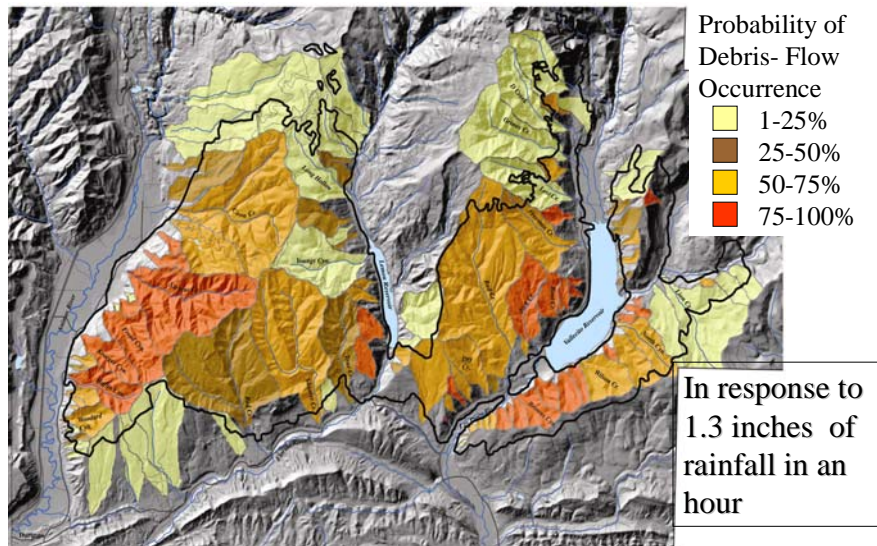
Workshops on Landslide and Earthquake Hazards — In December 2003, the USGS, Washington Division of Earth Resources (WDGER), and Washington State Emergency Management convened a series of four half-day workshops for county and local emergency managers to review results of recent research on landslide and earthquake hazards in the Puget Sound region. The workshops, which were held at Snohomish, King, and Thurston County emergency operations centers and at Washington State Emergency Operations center near Tacoma, drew emergency management personnel from cities and counties throughout the Puget Sound region. USGS scientists from the Landslide Hazards and Earthquake Hazards Programs and WDGER scientists described the latest findings related to landslide, earthquake, and tsunami hazards of the Puget Sound region and their application to emergency preparedness. Landslide presentations focused on precipitation thresholds for landslide activity and landslide hazard mapping in Seattle and how similar work might be extended to surrounding areas. The USGS expects to complete a landslide hazard map for Seattle early in FY 2005. Earthquake presentations focused on studies of recently discovered faults in the region, seismic detection of catastrophic landslides, and the Advanced National Seismic System.

Workshops on Post-wildfire Debris-Flow Hazards — Landslide Hazards personnel organized or participated in a series of workshops designed to inform the public about potential debris-flow hazards from recently-burned basins, and to share methods for assessing debris-flow hazards with other scientists, practitioners, land managers, decisionmakers and

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emergency-response personnel. These include the Geological Society of America Special Workshop on Wildland Fire Impacts on Watersheds, the Southern California Floodplain Managers Association Annual Meeting, the Water Resources Institute Forum on Flood and Debris-Flow Hazards after the California Wildfires, the USDA Forest Service Regional Workshop for Decision-Makers, and the USDA Forest Service, Natural Resources Conservation Service, California Geological Survey and USGS Workshop on Post-fire Runoff and Erosion.

Probability of debris-flow occurrence – Missionary Ridge Fire, Colorado



Rock-Fall Hazard Training in Hawaii — Recent fatalities at Sacred Falls, Manoa Falls, and within the Nuuanu district of Honolulu have caught public attention and heightened the State government's awareness of rock-fall and landslide hazards that are present in Hawaii, even in urban surroundings. This awareness prompted the State of Hawaii to turn to the USGS for training and assistance in assessing rock fall hazards throughout the islands. As a result, USGS Geologists conducted training during March 2004 in rock-fall susceptibility evaluation for 8 technical staff and 12 non-technical staff of the State of Hawaii. Technical staff included the Hawaii State Geologist. Technical training included classroom and field training at various rock outcrops in and around the Honolulu area so that the trainees could practice USGS "rock-mass-quality" evaluation method on real outcrops that are likely to produce rock falls. Awareness of rock-fall hazard issues in Hawaii and the recent training have caught the attention of the office of Senator Inouye, whose staff has contacted the USGS to inquire if further training for State, city and other agency staff can be accommodated. At present, funding is being sought by a group of agencies in Hawaii to have USGS geologists provide training for approximately 30 more employees.

Post-Disaster Assessment of Landslides and Flooding in the Dominican Republic and Haiti — Over 10 inches of rain from May 21-24, 2004, triggered debris flows and flooding within the Río Soliette/Blanco watershed resulting in 1,059 fatalities with over 1,600 missing in the town of Fond Verettes in Haiti and 414 fatalities with 270 missing in the town of Jimaní in the Dominican Republic. In response to a USAID request, two USGS scientists traveled to island of

Hispaniola in June 2004 to assess the hazard from landslides and flooding in the southern part of the island along the border between the Dominican Republic and Haiti. The USGS field investigation determined that the watershed terrain is largely composed of massive limestone with relatively thin soils on extremely steep slopes. This combination of geology and topography resulted in a rapid response in river flow to the rainfall due to the extremely thin soil with little absorptive capacity. The USGS scientists advised the personnel of USAID and several government agencies within the Dominican Republic as to what measures could be employed to reduce the risk to people and property from future disasters of this nature. These measures include excavation within the debris-flow fan at Jimaní to provide diversion of future debris and flood waters in the downstream portion of the watershed and the establishment of an alert system of rain gauges within the upper Soliette/Blanco watershed to provide an early warning of impending threats within the upper watershed.

2005 Planned Program Performance

The accomplishments and outcomes listed below demonstrate the utility of USGS products that are counted under the output measures established for this program element.

New Program Efforts — With additional funds in 2005, LHP has initiated important projects that will assist in the implementation of the National Landslide Hazard Mitigation Strategy. The LHP is working with the National Weather Service on a pilot landslide advisory system for parts of southern California that have experienced wildfires. This pilot will eventually be expanded to a nationwide process. The LHP is also supporting a cooperative project with the Oregon Department of Geology and Mineral Industries and the Oregon Department of Transportation that will lead to the understanding of landslide susceptibility in Oregon and the reduction of losses from landslides, which have historically been very high. Lastly, the additional funds will be used to strengthen hurricane response by the LHP in the East, which raised the level of awareness of landslide hazards after the hurricane season in 2004 when 15 people died as a result of debris flows triggered by Hurricane Ivan in North Carolina.

Networks Maintained — The LHP will continue to maintain its monitoring network. The LHP expects to complete a report during FY 2005 that describes the results of 3 years of monitoring Puget Sound coastal bluffs and how those results define the basis for a landslide early-warning network that could be used to improve the safety of rail transportation in the Puget Sound Region. LHP will continue to maintain the rain-gage network established in areas burned by the fall of 2003 wildfires in southern California. Additional networks will be established as new fires occur in the region.

Risk/Hazard Assessments Delivered to Customers — The LHP will complete hazard assessments in early in FY 2005 entitled *Map of Landslides identified from Light Detecting and Ranging LIDAR imagery, in Seattle Washington*, and *Landslide Hazard Map, Seattle, Washington*.

Workshops or Training Sessions — A workshop and training session for local planners and emergency managers in Seattle is planned to explain how to use the new landslide hazard maps developed by LHP scientists to anticipate locations of future landslides.

A training session for USFS personnel tasked with assessing post-fire effects is planned to explain how to implement and apply the debris-flow hazard assessment technique in a Geographic Information System (GIS) platform. The assessment technique will also be presented at additional workshops designed to inform the public about potential debris-flow

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hazards from recently-burned basins, and to share methods for assessing debris-flow hazards with other scientists, practitioners, land managers, decisionmakers and emergency-response personnel.

Responses to Public Inquiries — The National Landslide Information Center expects to respond to all 1,600 inquiries received from the public, educators, and public officials regarding hazard mitigation, preparedness, and avoidance strategies for landslide hazards.

Locations Using Geophysical Models — The LHP expects to complete detailed evaluation of rainfall threshold models that explain landslide activity that results from rainfall in the Seattle, WA, area. The evaluation will result in a well-defined protocol for alerting local emergency managers about expected levels of landslide activity.

Locations Adopting Improved Codes and Plans — The LHP expects that three counties and (or) parks/refuges in Utah, Arkansas, Puget Sound, or southern California, including counties impacted by wildfires, will adopt new landslide hazard mitigation measures to reduce future losses from landslides bringing the total to 71.

Five-Year Plan Updated — The LHP will complete its new 5-year program plan incorporating, where possible, suggestions of the NRC. The NRC recommended a monumental increase in funding to fully implement elements of the strategy, which precludes adopting many of the recommendations.

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Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Earthquake Hazards	47,401	46,898	+694	+3,745	51,337	+4,439
FTE	231	226	0	+20	246	+20
Volcano Hazards	19,785	20,714	+247	+826	21,787	+1,073
FTE	138	133	0	0	133	0
Landslide Hazards	2,620	3,043	+51	-6	3,088	+45
FTE	22	22	0	0	22	0
Global Seismographic Network	3,434	3,335	+42	+595	3,972	+637
FTE	7	7	0	0	7	0
Geomagnetism	2,043	1,989	+42	-6	2,025	+36
FTE	14	14	0	0	14	0
Total Requirements \$000	75,283	75,979	+1,076	+5,154	82,209	+6,230
FTE ^{b/}	412	401	0	+20	421	+20

^{a/} Changes for this program element include a reduction of -\$5 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

^{b/} FTE may not add to total, due to rounding.

Global Seismographic Network

2006 Program Overview

The 2006 budget request for the Global Seismographic Network is \$3,972,000.

The Global Seismographic Network (GSN) is a worldwide monitoring network providing high-quality seismic data to address problems related to disaster management, hazards assessment, national security, loss reduction, and the structure and dynamics of the Earth. The program is a joint effort involving the USGS, the Institute for Geophysics and Planetary Physics (IGPP) of the University of California, and the Incorporated Research Institutions for Seismology (IRIS), which is a consortium of universities supported by the National Science Foundation (NSF). Currently consisting of 130 modern digital seismographic stations, the GSN has a network completion goal of 140 globally distributed stations. The USGS is responsible for operating and maintaining approximately two-thirds of the network, and the National Science Foundation (NSF) supports the University of California to operate and maintain the other third.

Maintenance of the GSN is accomplished in cooperation with many international partners who, in most cases, provide facilities to shelter the instruments and personnel to oversee the security of each station. The majority of GSN stations are operated within the framework of agreements

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between a host organization (academic institution or foreign government agency) and either the USGS, IRIS, or IGPP.

Data and products derived from this program have multiple and diverse uses. First, the program supports the Department of the Interior's Serving Communities strategic goal to protect lives, resources, and property by making information available to communities to use in developing hazard mitigation, preparedness, and avoidance plans. The information provided to end users supports the intermediate outcome goal of providing information to assist communities in managing risks from natural hazards.

For example, GSN stations provide near-real-time data to NOAA's tsunami warning centers, supporting tsunami monitoring in the Pacific Rim and disaster alerting in Alaska, Hawaii, Washington, California, and U.S. territories in the western Pacific. Automated alerts, generated from GSN stations in the region of the December 26, 2004, great earthquake off northern Sumatra. These were transmitted to the Pacific Tsunami Warning Center within minutes of the earthquake. For the Pacific Ocean basin, NOAA relies on GSN real-time data to trigger analysis of ocean-bottom sensors that are designed to detect tsunami waves.

The program also supports basic and applied research conducted or supported by other agencies; e.g., NSF, Department of Energy, and U.S. Air Force that are aimed at better understanding of the Earth and furthering geophysical sciences. Some of this research and data application supports national security through the seismic monitoring of nuclear explosions and the improved calibration of nuclear explosion monitoring networks. Finally, the network supports the Nation's ability to rapidly respond to foreign earthquake disasters, both in terms of decisionmaking and in targeting relief efforts.

As described in the Office of Management and Budget (OMB) Program Assessment Rating Tool (PART) review, the USGS role is clearly defined and unique from other Federal, State, local, or private entities. The GSN was reviewed in FY 2003 as part of the Geologic Hazard Programs for the FY 2005 Budget using the PART. It was found to be moderately effective and received a score of 82. GSN-specific performance measures were established as part of that process.

Funds for the purchase and installation of new GSN stations are provided to IRIS by NSF; the USGS and IGPP install new GSN stations on behalf of IRIS. Once installed, the USGS is responsible for maintenance, data collection, and quality control of two-thirds of the GSN stations. The minor and routine maintenance at most foreign GSN stations is carried out by host-organization personnel who are trained by the USGS. USGS tasks include training station operators; providing major repairs; conducting routine service visits to network stations; and providing direct financial aid in support of station operations at those sites lacking a host organization (many of these stations reside within the former Soviet Union).

"The Global Seismic Network ... is furnishing unprecedented data on the source processes during major earthquakes in remote areas The GSN data acquired over the last 15 years have facilitated many advances in the study of global Earth structure and earthquake sources ... [and] have also improved the plate-tectonic framework for understanding earthquake hazards Discoveries based on data now being collected by the GSN will undoubtedly continue into the indefinite future With each passing year, GSN [will] add new information to the evolving pattern of global seismicity by the direct observation of large, rare events and the delineation of low-level seismicity that may mark the eventual occurrence of such events.

"Stable support of the GSN from a federal agency that embraces the mission of global seismic monitoring is essential to the long-term health of earthquake science."

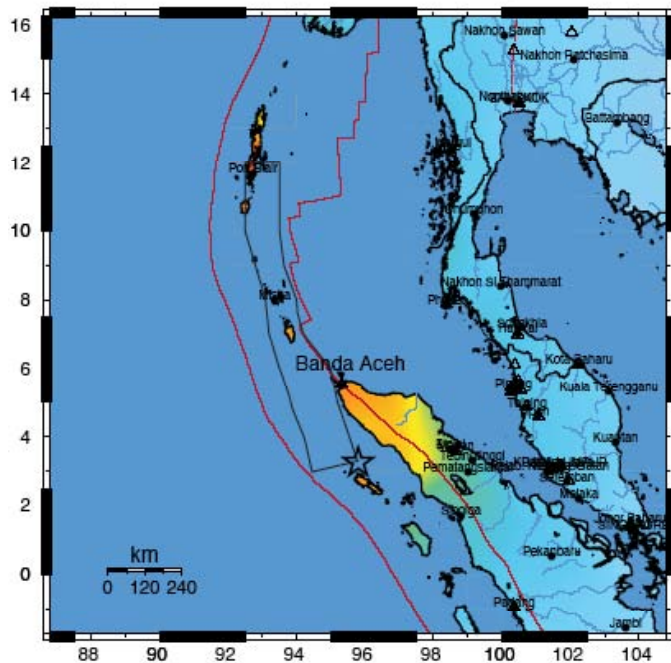
Living on an Active Earth: Perspectives on Earthquake Science, National Academy of Sciences, Board on Earth Sciences and Resources, 2003.

The USGS and IRIS also evaluate, develop, and advance new technologies in data acquisition and management. To improve performance, stations with unusually high background noises are relocated to quieter sites or configurations (e.g., placing sensors in boreholes) so that smaller events (earthquakes or explosions) may be detected. Siting, permitting, and installation of GSN stations will continue through FY 2005 because of extended negotiations with host countries. The planned lifetime of the completed network is 30 years. However, with proper maintenance and gradual upgrades of data system components, GSN can produce data indefinitely, and its performance will improve yearly.

Principal end-users of GSN data include the USGS National Earthquake Information Center (NEIC) in Golden, CO, and a broad range of government agencies and academic researchers both domestic and international. These include the Comprehensive Test Ban Treaty Organization (CTBTO) and the Air Force Technical Applications Center (AFTAC), in their respective nuclear monitoring missions, as well as the NOAA Tsunami Warning Centers in Hawaii and Alaska. Copies of all the data from USGS GSN stations are sent to the IRIS Data

Management Center in Seattle, WA. The IRIS data center is the distribution point for GSN data to users (such as scientists, engineers, and government agencies) throughout the world. Every year it responds to over ten thousand requests for GSN data. In addition, data from over 115 GSN stations are currently available within hours of large earthquakes to the worldwide user community via the USGS Live Internet Seismic Server (LISS), the software for real-time data collection and transfer, i.e., the IDA Near Real Time System (NRTS), and telephone dial-up and (or) Internet connections/satellite links to the stations.

USGS ShakeMap : 158 miles SSE of Banda Aceh, Sumatera, Indonesia
Sun Dec 26, 2004 12:58:50 AM GMT M 9.0 N3.25 E95.80 Depth: 10.0km ID:slav



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<.01	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

PAGER estimate of strong ground shaking during the December 26 Sumatra great earthquake, based on GSN data and model calculations. The USGS estimated that more than 1.3 million persons were exposed to severe shaking during this earthquake, and rapidly delivered that analysis to U.S. Government agencies including the Office of Foreign Disaster Assistance, which is providing support for PAGER development.

GSN data are used daily in the routine operations of the NEIC. Real-time data are transmitted continuously to the NEIC where they are used, with other data, to determine the locations, depths, magnitudes, and other parameters of earthquakes worldwide. As in the example above, GSN data and parametric reports are automatically provided to the Pacific and Alaskan tsunami warning centers, operated by the National Oceanic and Atmospheric Administration (NOAA). A unique feature of the GSN data is that they can be used to determine, within an hour, the geometric orientation of the fault that caused the earthquake, and provide an estimate of the length of the fault that ruptured during the earthquake. A

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damaging earthquake near a populated region generates great demand for such information by government officials and scientists responsible for assessing and responding to an earthquake disaster. Such information about significant domestic earthquakes is immediately sent to Federal and State emergency management and public safety agencies, operators of transportation facilities and public utilities, and national news media.

Information about potentially damaging foreign earthquakes; e.g., the damaging magnitude 6.6 earthquake in southeastern Iran that occurred on December 26, 2003, killing 40,000 people, is immediately sent to the Department of State, embassies and consulates in the affected region, the Office of Foreign Disaster Assistance, the Red Cross, and the United Nations, as well as national and international news media.

A new USGS product that relies on GSN data is the Prompt Assessment of Global Earthquakes for Response (PAGER) system. PAGER rapidly estimates the impact on humans from significant earthquakes worldwide by combining maps of shaking intensity with population density and infrastructure fragility. The above figure displays an example of PAGER map output for the December 26, 2004, Sumatra-Andaman Islands magnitude 9.0 earthquake. This map shows which regions suffered the most intense shaking and when combined with a global population map, it indicates that 1.3 million people were exposed to "severe" shaking during the earthquake. The PAGER results were generated within hours of the event and transmitted to the State Department's Office of Foreign Disaster Assistance (OFDA) and other government agencies. PAGER is in development, with supporting funding from OFDA and other government agencies.

Research Support — Data from the GSN continue to be used extensively in basic and applied research on earthquakes, Earth structure, and seismic monitoring. Research efforts using GSN data that have received recent attention include: secondary earthquake triggering by nearby large earthquakes, the three-dimensional structure of the Earth's mantle, and the structure and seismic properties of the Earth's crust and upper mantle in central Asia, the Middle East, and northern Africa. The latter studies have application in enhancing the ability of the United States to monitor possible nuclear tests in regions of concern.

Education and Outreach — The USGS has worked with IRIS to develop educational museum displays based on data from the GSN. These displays explain the basic concepts of seismology and earthquake occurrence and have proven to be quite popular with the public. Displays are in place at the Smithsonian Institution in Washington, DC, the New Mexico Museum of Natural History in Albuquerque, the American Museum of Natural History in New York, the Carnegie Museum in Pittsburgh, USGS Headquarters in Reston, and as part of the Franklin Institute's traveling "Powers of Nature" exhibit.

FY 2004 Program Performance Accomplishments

The accomplishments listed below pertain to USGS products that are counted under the output measures of "hazard network maintained" and "% data availability for real-time data," and the output efficiency measure of "data processing and notification costs per unit volume of input data from earthquake sensors in monitoring networks."

During FY 2004, the USGS installed two new GSN stations on Funafuti, Tuvalu; and Raoul Island, New Zealand (both in the South Pacific Ocean region), and one station on Tristan da Cunha in the South Atlantic. The Funafuti installation was prepared using only NSF funds through IRIS. The Raoul and Tristan da Cunha installations were prepared in cooperation with

the CTBTO, which also supplied funding and real time telemetry links. The CTBTO also funded telemetry links for Tsumeb, Namibia; Santo Domingo, Venezuela; Afiamalu, Samoa; and Honiara, Solomon Islands. The USGS cooperated in these installations to assure reliable operation. Using IRIS/NSF funding, USGS also conducted station operator training in Albuquerque, NM, for seven key GSN station operators.

The USGS GSN data availability for July 2003 through July 2004 was 91.8 percent, up from 90.1 percent for the previous 1-year period. The increase is attributed to more real-time telemetry (so problems can be recognized and fixed more quickly), more spare parts, and the diligence and efficiency of USGS employees and contractors. The cost of most spare parts was covered by NSF funds through IRIS, while the cost of most of the newest telemetry links was provided by the CTBTO through a cooperative agreement.

2005 Planned Program Performance

The accomplishments listed below pertain to USGS products that are counted under the output measures of "hazard network maintained" and "% data availability for real-time data," and the output efficiency measure of "data processing and notification costs per unit volume of input data from earthquake sensors in monitoring networks."

To complete the full GSN, the following stations remain to be installed: Quetta, Pakistan; Tarawa and Kanton, Kiribati; Tenerife, Canary Islands; Isla Socorro, Mexico; and Trindade Island, Brazil. Of these, USGS expects to install Quetta, Tarawa, and Kanton this year pending memoranda of understanding with these countries that should soon be signed. The Tenerife station is being hindered by permitting delays for the site. The Isla Socorro site has its own diplomatic problems and is likely to be moved to Baja California, while the Trindade Island location may simply be logistically impossible to maintain.

Leveraged by partnership with the CTBTO, additional VSAT (satellite Internet) telemetry will be installed in FY 2005 at a number of CTBTO-supported GSN stations. Specifically, these are the International Monitoring System's "Auxiliary Seismic Network" stations at: Pitinga and Riachuelo, Brazil; Sondre Stromfjord, Greenland; Garni, Armenia; Kowa, Mali; Franceville, Gabon; Davao, Philippines; and Kiritimati Island, Kiribati. These cooperative efforts provide the opportunity to upgrade and maintain these sites, as well as cost-effectively maintaining other GSN stations that can be visited on the same trips. Beyond that, USGS will be maintaining all the network stations while trying to improve upon its already high performance.

In addition, the GSN will also move this year toward incorporation into the Global Earth Observation System of Systems (GEOSS). USGS and IRIS, supported by NSF, have co-funded an international workshop on GSN within GEOSS, designed to explore the feasibility of turning the GSN's 130 seismic stations into expanded Earth Observatories, to monitor multiple geophysical phenomena. This process has already begun at many GSN stations through partnerships. Because the GSN already provides infrastructure, host-country involvement and on-site support, international agreement on data sharing, and in most places real-time communications, the GSN is ideally situated to serve as a global backbone for Earth Observation. The results of the planned workshop will guide system development in the FY 2006.

Geologic Hazard Assessments Subactivity

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Global Seismographic Network (\$000)	\$3,972	+\$595
FTE	7	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The 2006 budget request for Global Seismographic Network is \$3,972,000 and 7 FTE, a net program increase of +\$637,000 (includes adjustments for uncontrollable costs) and 0 FTE from the 2005 enacted level.

Tsunami Work (+\$600,000) — Improved global seismic monitoring and rapid information delivery is critical to expanding earthquake notification and tsunami warning capabilities, including for the United States and its territories. Seismological data generated by the GSN is critical to United States and foreign governments, State and Federal response agencies, and ultimately the public. The importance of the USGS earthquake notification service is reflected in the number of e-mailed earthquake alerts sent out (>25,000), the hits to the Web site (575 million in 4 days), and the overwhelming request for television and radio interviews from local, national, and international news agencies following a damaging event such as the December 26, 2004 Sumatra-Andaman 9.0 earthquake.

With the proposed FY 2006 increase, critically-needed improvements to the GSN are planned in two areas: (1) improved telemetry connections so that all GSN stations provide data in real time and (2) more frequent maintenance for enhanced station uptime. Because the global distribution of GSN stations is used to accurately determine the location and magnitude of the largest earthquakes, telemetry upgrades are required system-wide in order to improve the timeliness and accuracy of earthquake analyses for rapid response. Partnerships will be key to further strengthen seismic coverage using existing networks maintained by other countries. The outcome of this investment will be a state-of-the-art, real time earthquake detection and notification system that is both timely and robust and enables delivery of a suite of value-added earthquake information products that emergency managers want (e.g., products such as PAGER and ShakeMap). The increased network uptime, data quality and availability will enhance rapid earthquake notification, support improved tsunami warning and rapid delivery of disaster impact assessments, by USGS and its Federal and State partners.

Geologic Hazard Assessments Subactivity

Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Earthquake Hazards	47,401	46,898	+694	+3,745	51,337	+4,439
FTE	231	226	0	+20	246	+20
Volcano Hazards	19,785	20,714	+247	+826	21,787	+1,073
FTE	138	133	0	0	133	0
Landslide Hazards	2,620	3,043	+51	-6	3,088	+45
FTE	22	22	0	0	22	0
Global Seismographic Network	3,434	3,335	+42	+595	3,972	+637
FTE	7	7	0	0	7	0
Geomagnetism	2,043	1,989	+42	-6	2,025	+36
FTE	14	14	0	0	14	0
Total Requirements \$000	75,283	75,979	+1,076	+5,154	82,209	+6,230
FTE ^{b/}	412	401	0	+20	421	+20

^{a/} Changes for this program element include a reduction of -\$6 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

^{b/} FTE may not add to total, due to rounding.

Geomagnetism

2006 Program Overview

The 2006 budget request for the Geomagnetism Program is \$2,025,000.

The mission of the USGS Geomagnetism Program is to monitor the Earth's magnetic field through an array of ground-based magnetic observatories; to provide high temporal resolution records of magnetic field variations covering long timescales; to disseminate magnetic data to various governmental, academic, and private institutions; and to conduct research into the nature of geomagnetic variations for purposes of scientific understanding and hazard mitigation. The program consists of three main elements (1) Geomagnetic Observatory Operations, (2) Data Transportation, Management, Processing and Dissemination, and (3) Scientific Research. Short-term variations, in particular those occurring during geomagnetic storms, are hazardous to satellites and electrical power distribution systems and make radio communications, navigation, and geophysical surveys difficult. During magnetic storms, astronauts and high-flying aircraft pilots can be exposed to dangerous levels of radiation. The program's magnetometer data are used for diagnosis of near-Earth space-weather conditions by both the National Oceanic and Atmospheric Administration's (NOAA) Space Environment

Geologic Hazard Assessments Subactivity

Center and the U.S. Air Force, and the program is an integral part of the National Space Weather Program as detailed in its strategic plan.

It is estimated that the annual economic impact of magnetic storms runs into the hundreds of millions of dollars, not to mention the potential impact upon national security. Long-term, secular variation of the field is caused by convection in the Earth's core, resulting in a slow drift in the global-scale structure of the magnetic field. Because many navigational systems use the magnetic field direction as a means of orientation, it is essential to track these long-term changes. Moreover, drilling programs undertaken within the oil industry rely on magnetic orientation, and these can be degraded during magnetic storms, particularly at high latitude. Finally, many historical property boundaries are based on magnetic orientation, and knowledge of the magnetic field is needed to reconstruct or re-establish these boundaries.

This program addresses the Department of the Interior's Serving Communities strategic goal to protect lives, resources, and property by making information available to communities to use in developing hazard mitigation, preparedness, and avoidance plans. Two measures are tracked in support of the intermediate outcome of providing information to assist communities in managing risks from natural hazards: (1) use rate of products, and (2) adequacy of information. Output measures for which targets are established in support of achieving the intermediate outcome goal include the maintenance of one hazard monitoring network and the presentation of formal workshops or training to customers.

"Within DOI, the US Geological Survey (USGS) cooperates with the international scientific organization of *Intermagnet* to support a growing world-wide network of 90 or more geomagnetic observatories, many of which contribute data in real-time to the USAF forecast center for hourly computations of geomagnetic indices. The data are also valuable input for ionospheric and magnetospheric forecasting models. ... The monitoring network contributes to natural disaster mitigation by providing the information needed to quickly and accurately assess significant changes in the Earth's magnetic field (geomagnetic storms)."

National Space Weather Program Strategic Plan
August 1995

As described in the Office of Management and Budget (OMB) Program Assessment Rating Tool (PART) review, the Geomagnetism Program role is clearly defined and unique from other Federal, State, local, or private entities. The Geomagnetism Program was reviewed in FY 2003 as part of the Geologic Hazard Programs for the FY 2005 Budget using the PART. It was found to be moderately effective and as a result received a score of 82. PART measures include the number of jurisdictions adopting improved plans, as well as cost per gigabyte of data from geophysical sensors per year.

The program activities support the USGS Geology Strategic Plan (2001-2010) goals of conducting geologic hazards assessments for mitigation planning and providing short-term prediction of geologic disasters and rapidly characterizing their effects.

Geomagnetic Observatory Operations — The USGS Geomagnetism Program operates a network of 14 geomagnetic observatories, distributed across the United States and its territories. Data are collected continuously from each observatory by a variety of instruments housed in buildings designed to provide environmental stability and to ensure long-term baseline stability. Each site is visited regularly by either program staff or contract employees to conduct calibrations of the instruments. Data are transmitted in real time to program headquarters in Golden, CO, via a set of satellite linkages. The program is currently working to improve the temporal resolution of the measurements, by increasing the sampling frequency from 1 minute to 1 second, and to improve data access by installing Internet links to each

observatory. By necessity, the network and everything associated with handling the data is technologically elaborate. It consists of many finely tuned components, each of which need to be operated in careful synchronization.

Data Processing, Management, and Dissemination — Once the data from the observatories are received in Golden, CO, they are subjected to an initial processing. They are then organized for immediate transmission to both NOAA's Space Environment Center in Boulder, CO, and the U.S. Air Force Weather Agency in Omaha, NE. For longer-term studies, the magnetic data are adjusted using the periodic calibration measurements made at each observatory, making them useful for statistical studies of rapid magnetic field variations and for the purpose of mapping the field on a global scale. These fully calibrated or "definitive" data are published yearly on a CD-ROM in cooperation with foreign national geomagnetism programs working with Intermagnet (<http://www.intermagnet.org>). The USGS Geomagnetism Program also distributes data and maps and models of the magnetic field through its Web site (<http://geomag.usgs.gov>), which receives several hundred to a thousand visits from the public per day.

Scientific and Applications Research — USGS Geomagnetism Program staff conduct geomagnetic research to achieve a better understanding of basic geomagnetic processes and their effects on physical and social environments. Recent projects have included the development of a statistical framework for characterizing the long-term secular variation of the magnetic field and studies of the dynamo generating the field within the Earth's core. The program has recently begun an analysis of the statistics of rapid magnetic field variations with the goal of characterizing them both spatially and temporally so that geomagnetic hazards can be mapped and so that risks can be quantified.

2004 Program Performance Accomplishments

The accomplishments and outcomes listed below demonstrate the utility of USGS products that are counted under the output measures for number of workshops or training provided, number of data collections, and numbers of locations adopting hazard mitigation measures.

Improved Monitoring of the Earth's Magnetic Field — As part of an ongoing effort to expand and upgrade observatory operations, in 2004 the Geomagnetism group staff made operational the new Shumagin Geomagnetic Observatory in the Aleutian Islands, bringing the total number of USGS geomagnetic observatories to 14. The group staff also deployed a new data collection and transmission system at six observatories. When made fully operational, this system will enhance the temporal resolution of the data and will take full advantage of the Internet-based Earthworm data-transportation system developed by USGS seismologists. Program staff began the construction of a coil-calibration facility at Boulder, CO, allowing magnetometer systems to be fully tested and calibrated prior to deployment. Staff have developed an Oracle database to better manage the program's data, which is now being integrated into data collection, management, and dissemination operations. To better present the program's data products and research to the scientific and applied communities, staff unveiled a new Web site at (<http://geomag.usgs.gov>). During 2004 program staff submitted for publication one paper on the statistics of magnetic field variations and one summary of the program. The program currently has a post-doctoral fellow working with staff on the statistical summary of magnetic-field activity for eventual production of a geomagnetic-hazard map.

2005 Planned Program Performance

The Geomagnetism Program expects improved cost performance when the new data-acquisition system becomes fully operational. The usage of the calibration system should make systems more reliable and reduce the burden of data processing.

There will be three workshops held in 2005:

- The annual meeting of the National Space Weather Program Council, in Silver Spring, MD. The USGS represents the Department of the Interior in the National Space Weather Program, which coordinates Federal space weather monitoring and research activities across multiple agencies.
- The IAGA (International Association of Geomagnetism and Aeronomy) operations meeting in Kakioka, Japan.
- The 5-Year Plan and Geomagnetism Program review, to be held in January, in Golden, CO.

Geologic Landscape and Coastal Assessments Subactivity

Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Earth Surface Dynamics	14,022	13,634	-53	-277	13,304	-330
FTE	89	84	0	0	84	0
National Cooperative Geologic Mapping	25,901	25,162	+400	-74	25,488	+326
FTE	144	139	0	0	139	0
Coastal and Marine Geology	38,428	37,457	+403	+576	38,436	+979
FTE	236	231	0	+3	234	+3
Total Requirements \$000	78,351	76,253	+750	+225	77,228	975
FTE ^{c/}	469	453	0	+3	456	+3

^{a/} Included in this program is a one-time technical adjustment of -\$243 that moves all USGS funds associated with the Science on the DOI Landscape initiative to a single location in the Biological Research Activity for ease of administration and accounting.

^{b/} Changes for this program element include a reduction of -\$30 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

^{c/} FTE may not add to total, due to rounding.

Earth Surface Dynamics

2006 Program Overview

The 2006 budget request for the Earth Surface Dynamics Program is \$13,304,000.

The USGS Earth Surface Dynamics Program (ESDP) supports research in three principal Earth processes study areas: impacts of climate change and variability, Great Lakes geologic mapping, and studies of priority ecosystems (PES).

This program supports the Department of the Interior's (DOI) Serving Communities strategic goal to advance knowledge through scientific leadership and inform decisions through the application of science. The goal of the ESDP is to be the primary provider of scientific information on past, present, and future climates and their effects on Earth and human systems to fulfill the mission of the USGS. Understanding of Earth surface processes and climate change impacts is used to provide perspectives for policymakers and support for land and resource managers.

Program goals are achieved via a series of projects in the following main groups that:

- Document the nature of climatic and environmental change and variability on timescales ranging from years to millennia,

Geologic Landscape and Coastal Assessments Subactivity

- Develop fundamental understanding of interactions between climate, Earth surface processes, and marine and terrestrial ecosystems on timescales ranging from years to millennia,
- Seek to understand impacts of climate change and variability on landscapes and marine and terrestrial systems,
- Model and anticipate the effects of climate change and variability on natural and human systems,
- Provide information on the relative sensitivity, adaptability, and vulnerability of ecosystems, resources, and regions to climatic change and variability to support land and resource management and policy decisions, and
- Enhance the quality and relevance of program activities through collaboration with national and international scientific entities.

Projects supported by ESDP support the goals of the U.S. Climate Change Science Program (CCSP) to: (1) improve knowledge of the Earth's past and present climate and environment, including its natural variability, (2) improve quantification of the forces bringing about changes in the Earth's climate and related systems, (3) reduce uncertainty in projections of how the Earth's climate and environmental systems may change in the future, (4) understand the sensitivity and adaptability of different natural and managed ecosystems and human systems to climate and related global changes, and (5) explore the uses and identify the limits of evolving knowledge to manage risks and opportunities related to climate variability and change.

Results of scientific activities supported by ESDP are communicated to customers in academia, resource management agencies, and the general public through project reports and peer-reviewed scientific papers, Web sites, databases, and meetings with stakeholders. Metrics of program success include the number of reports and publications, number of people accessing Web sites, and the frequency of meetings with stakeholders.

End outcome measures for which targets are set relate to the soundness of methodology, accuracy, and reliability of the science, and the accessibility to and satisfaction with products and services. In support of the intermediate outcome to improve the information base, information management, and technical assistance, intermediate outcome measures regarding the content and expanse of the knowledge base and the quality of studies are tracked. Outputs associated with these intermediate outcome measures include the maintenance and update of three long-term data collections, the completion of systematic analyses or investigations for customers, and formal workshops or training provided to customers.

Global Change

(Estimates for FY 2004, \$10.9 million; FY 2005, \$10.4 million, FY 2006, \$10.3 million)

The ESDP supports multidisciplinary studies of past environmental and climatic changes (climate and environmental history), process studies that explore the sensitivity of the Earth-surface and associated ecosystems to climate change and variability, and forecasting of potential future changes and their effects on landscapes, land use, and ecosystems (particularly on public lands). The combination of these studies provides integrated long-term perspectives on the effects of climatic changes and variability and on the interactions through time among

climatic, geologic, biologic, and human systems on regional and landscape scales. These studies provide information to allow policymakers and land and resource managers to gauge the relative sensitivity of particular ecosystems, resources, and regions to climatic change and variability. Understanding the nature and magnitude of past climate and environmental changes is necessary to provide a baseline against which to identify the effects of humans as agents of environmental change and to provide a long-term perspective on climate variability that can be used in developing plans for ecosystem restoration.

The USGS works closely with other participating Federal agencies to coordinate research under the auspices of the U.S. Global Change Research Program (USGCRP) and the CCSP. Scientific support for land stewardship is provided by addressing resource-management issues related to the impacts of climate variability and land use on ecosystems, the landscape, and resources. Priority is given to improving the utility of global change research for natural-resource managers, through a fundamental understanding of the impacts of climate change on landscapes and ecosystems. This knowledge is used to model and forecast how climate change affects landscapes and ecosystems, thereby providing resource managers with information on the possible future state of natural resources.

Emphasis is also placed on understanding the impact of climate change and land use on the carbon cycle and carbon sequestration in soils and sediments as a contribution to the Carbon Cycle Science Program of the USGCRP.

2004 Program Performance Accomplishments

The program accomplishments described below are examples that demonstrate the utility of scientific publications, reports, and other products that are counted under the output measures "systematic analyses and investigations delivered to customers" and "number of long-term data collections maintained."

Effects of Urbanization on River Systems — USGS scientists have recently completed a study of the effects of increasing urbanization on the Las Vegas, NV, wash, which has been transformed from an ephemeral stream receiving water only after a storm to a perennial stream, fed mostly by discharge of effluent from wastewater treatment plants. Population in the Las Vegas, NV, metropolitan area has increased by a factor of six between 1970 and 2000. During this period, runoff in the wash increased four fold and as much as 8.6 million cubic yards of sediment were eroded from the floodplain and deposited in a delta in Lake Mead over a 15-year period. Flood magnitude and frequency also increased, as a result of increased runoff from streets and paved areas. Stream erosion and deposition caused major damage to infrastructure in the area and \$87 to \$99 million of ongoing and planned engineering structures have been required to stabilize the wash. These studies indicate the magnitude of changes in river channels that can take place as a result of human-caused changes in the environment. Data from this study are being used by State and local governments to plan and execute engineering measures to mitigate the effects of these changes.

Studies of Past Vegetation and Climate — Scientists supported by the ESDP continue to provide important data regarding the characteristics and timing of past changes in climate and vegetation in ecologically sensitive areas, including southeast Alaska, northern California, and the Appalachians. These studies are being used by land management agencies including the U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (FWS), and National Park Service (NPS) to develop management plans for these areas, in addition to supporting CCSP goals. For example, recently completed studies in northern California indicate that the redwood forests

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in that area were established around 5,200 years ago. Since 3,500 years ago, rapid changes in effective moisture and seasonal temperatures indicate that El Nino cycles have dominated the climate of this region. In the Shenandoah National Park, studies of past vegetation indicate frequent and rapid changes in species composition in response to global climate changes. Many forest types identified suggest regional climates cooler than the present. These studies are helping the NPS develop plans to manage threatened and endangered species of plants.

Soil Carbon Database for the Mississippi River Basin — In order to better understand the dynamics of the carbon cycle in the United States, USGS scientists have recently completed a site specific database for soil organic carbon for much of the Mississippi River basin. The database includes soil-carbon and related data for 9,215 pedons (soil columns) that were described and sampled by various agencies (e.g., U.S. Department of Agriculture (USDA), National Resources Conservation Service, State soil surveys, and universities) between 1928 and 1995. The database was originally developed for use in USGS terrestrial-carbon cycling studies in the Mississippi River basin as part of the USGCRP, Global Carbon Cycle program element. The USGS studies were designed to characterize systems across spatial scales ranging from hillslopes to small watersheds to the large-river systems that comprise the Mississippi River basin. These studies included (1) measurement of soil organic carbon (SOC) erosion, deposition, and transformation at the field scale, (2) measurement and modeling of SOC and sediment transport at the small-watershed scale, and (3) measurement, modeling, and statistical analysis of environmental controls on the geographic distribution of SOC at the large-basin scale.

This database is a major USGS contribution to the U.S. CCSP and also is being used by FWS and National Oceanic and Atmospheric Administration (NOAA) to plan and execute strategies for carbon sequestration.

Tree Islands in the Florida Everglades — Tree islands are important centers of biodiversity in the Everglades, with two to three times the plant and animal diversity of the surrounding wetlands. They are also considered key indicators of the health of the Everglades ecosystem because of their sensitivity to both flooding and drought conditions. Recently completed studies of fossil pollen in sediments have provided information on the timing and cause of tree island formation, as well as their response to changing water levels in past centuries and recent times. The results of this study will be used by the NPS, FWS, and State agencies to better plan restoration of the Everglades and adjacent areas and manage water levels more effectively.

Impacts of Drought on Stabilized Sand Dunes — Much of the area of the Navajo Nation in northeastern Arizona and adjacent areas of New Mexico, Colorado, and Utah is covered by vegetated sand dunes. These dunes are very sensitive to climate variability and change, including the current period of drought, resulting in remobilization of dune areas and consequent impacts on infrastructure and agriculture. USGS scientists working closely with the Navajo Nation have compiled maps of the sand deposits at a scale of 1:50,000. These maps are combined with information on the spatial variation in rainfall and potential evapotranspiration over the period of record and recent drought years to provide an assessment of landscapes susceptibility to climate change and variability in the region. These products are being used by the Navajo Nation to plan response to and mitigate the effects of the current severe drought; as well as by the Navajo-Hopi lands commission to develop grazing guidelines for the Navajo partition lands.

2005 Planned Program Performance

The planned program activities described below are examples that demonstrate the utility of scientific publications, reports, and other products that are counted under the output measures "systematic analyses and investigations delivered to customers" and "number of long-term data collections maintained."

Satellite Image Atlas of the World — In FY 2005, the program plans to complete the 11 volumes of the Satellite Image Atlas of the World (USGS Professional Paper 1386).

This is the culmination of a long-term international project to use Landsat Multispectral Scanner (MSS) images acquired in the mid-1970s to establish a baseline for the areal distribution of the Earth's glaciers. More than 70 U.S. and foreign scientists, from 25 countries, representing 45 different institutions, have collaborated in the preparation of 10 geographic-area chapters and an introductory chapter on State of the Earth's Cryosphere at the Beginning of the 21st Century: Glaciers, Snow Cover, Floating Ice, and Permafrost, the latter with a 1:50,000,000-scale map of the Earth's Dynamic Cryosphere.

Long-term Data Collection Efforts — The ESDP continues to measure temperatures to monitor changes in Alaskan permafrost and collect and analyze meteorological and wind erosion data from USGS monitoring stations in the Southwest. The program also supports long term paleoenvironmental datasets including the Packrat Midden database on past vegetation composition.

Central Great Lakes Geologic Mapping Coalition Project

(Estimates for FY 2004, \$0.5 million; FY 2005, \$0.5 million; FY 2006, \$0.5 million)

The USGS and the State geological surveys of Illinois, Indiana, Michigan, and Ohio continue a partnership to produce three-dimensional (3-D) geologic maps of the extensive glacial deposits that blanket the upper Midwest. These maps provide a foundation for making economic and environmental decisions related to ground water balances, land, and other natural resources in the Great Lakes. Because of the vast amount of digital database information contained in a 3-D geologic map, there are a large number of derivative map products that can be produced for specific uses by the user. The studies benefit from the integration of a variety of geophysical, remotely sensed, geochemical, and bore hole data and field geologic mapping to produce 3-D geologic maps. These maps, in their greater detail, provide a better product for the customer. This project contributes to ESDP goals of understanding the interrelationships among Earth surface processes, ecological systems, and human activities by documenting, analyzing, and modeling geological and hydrological processes involved in environmental change; as well as providing information on the nature and extent of past climate changes (especially the extent of Pleistocene ice advances in the Midwest).

In Illinois, the Illinois State Geological Survey continues to produce large-scale maps and 3-D stratigraphic and hydrostratigraphic models of the glacial geology for the most densely populated and rapidly growing part of Illinois. With the completion of the Antioch Quadrangle Pilot Phase, work will begin on additional adjacent study areas. These areas are north of Chicago in northwestern Lake County and northeastern McHenry County and straddle the Lake Michigan water allocation boundary and coincide with areas experiencing increasing conflicts concerning the withdrawal of ground water from glacial drift aquifers, aggregate resource extraction, and zoning. Currently, very little geologic information at useful scales is available to State, county, and local agencies who desire to make informative planning decisions. Products

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that were completed in FY 2004 as a part of the Antioch Quadrangle pilot phase include a 3-D model of the surficial geology, a surficial geologic map, a bedrock topography map, and a drift thickness maps. In FY 2005, expected products include a 3-D hydrostratigraphic model of the Antioch Quadrangle, an aquifer sensitivity map for the Antioch Quadrangle, and draft aquifer sensitivity maps for the adjacent quadrangles (Fox Lake, Wauconda, Grayslake, Libertyville, Lake Zurich, Barrington, and Wadsworth).

The Indiana Geological Survey (IGS) is focusing on Indiana's three largest and most rapidly growing metropolitan areas: the greater Indianapolis area (Marion County and parts of adjacent counties), the Southern Lake Michigan Rim counties (Lake, Porter, LaPorte), and the greater Fort Wayne area (Allen County and parts of adjacent counties). Products for each area will include an Atlas of Glacial Geologic Maps that includes bedrock elevation maps, structure contour maps of key glacial boundaries, lithofacies maps, and a map of the glaciated terrain at 1/100,000-scale. For the Allen County area these products will be completed in FY 2005. FY 2004 products include a hydrogeologic framework of Marion County, IN—a digital atlas illustrating hydrogeologic terrain and sequence. In FY 2005 analyses will be completed for the Lake Michigan rim portfolio of maps that will include a raster-based bedrock elevation maps derived from statistical interpretations of subsurface data, 1:100,000 scale; structure contour map(s) of key glacial stratigraphic boundaries; Raster-based lithofacies maps for depth slices for the three-county area and by land form; the nature of glacial and other unconsolidated sedimentary sequences interpreted through downhole gamma-ray logging. Work on products for the Southern Lake Michigan area will begin in the FY 2004–05 project year. Work on products for the Marion County regions will begin in FY 2006 or 2007.

In rapidly growing Wexford and Manistee Counties in west-central Michigan, there is a lack of modern surficial geologic maps to aid city and county planners in their decisionmaking. In FY 2005, reconnaissance scale (1:100,000) surficial geologic maps will be completed for the two counties. The results of this work will provide the basis for making selected, detailed geologic maps (1:24,000) in FY 2006 for priority areas of these two counties.

Work in Ohio is focused on the lower Huron River area in Huron and Erie Counties, which is undergoing significant development pressure in the Lake Erie coastal zone. The prototype 3-D geologic map of the Milan 1:24,000-scale quadrangle will be completed, and the protocols and methods developed for the Milan quadrangle applied to an expanded area that will include the surrounding quadrangles Kimball, Sandusky, Huron, Vermilion West and Berlin Heights. Products will include a prototype detailed 3-D surficial geologic model, maps of surficial geology, bedrock topography, and drift thickness. The digital databases developed from boreholes, water-well and other information to provide the basis for producing the 3-D surficial geologic maps will be made available for other uses. Once the 3-D hydrogeologic models are developed, additional products can be developed in close cooperation with county and local officials.

The utility of the 3-D geologic mapping for ground-water modeling is being tested by developing and comparing two hydrogeologic models. This work is an integrated coalition effort using expertise from the Indiana, Michigan, and USGS. The first hydrogeologic model is geologically derived based on the 3-D geologic map that was developed by the Michigan Geological Survey and the USGS for Berrien County, MI, an area that covers about 12, 1:24,000-scale quadrangles. The second hydrogeologic model will be empirically derived using a spatial, statistically based procedure to classify and represent lithologic information contained in water-well logs from Berrien County. When completed, the results for these two ground-water models will be compared to demonstrate the utility of 3-D geologic mapping to aid the development of

ground-water models. This is a 2-year research effort that began in the summer of 2003. A lithologic model was developed from water-well data in FY 2004. The ground-water model based on 3-D geologic mapping will be completed in FY 2005 and the two models will be compared.

Priority Ecosystems Studies

(Estimates for FY 2004, \$2.6 million; FY 2005, \$2.7 million; FY 2006, \$2.6 million)

In FY 2005 and FY 2006, the ESDP will provide support for Priority Ecosystems Science (PES) studies which are described in more detail in the Regional Activities section beginning on page F - 31. Through PES, ESDP supports interdisciplinary studies of ecosystems, including studies of the Everglades, San Francisco Bay Delta, Chesapeake Bay, Platte River, and the Mojave Desert to evaluate land-use changes, ecosystem histories, indexes of ecosystem sensitivity to change, and vulnerability to potential stressors in order to devise restoration and adaptive management strategies for land use managers.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-)^{1/}
Earth Surface Dynamics (\$000)	\$13,304	-\$277
FTE	84	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs and technical adjustments.

The 2006 budget request for Earth Surface Dynamics Program is \$13,304,000 and 84 FTE, a net program decrease of -\$330,000 (includes adjustments for uncontrollable costs and technical adjustments) and 0 FTE from the 2005 enacted level.

Global Dust Study (-\$247,000) — The decrease of -\$247,000 reduces an unrequested earmark. \$500,000 remains for studies documenting the micro-organisms and chemical contaminants associated with dust in source regions and areas of dust deposition in the United States and territories.

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Geologic Landscape and Coastal Assessments Subactivity

Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Earth Surface Dynamics	14,022	13,634	-53	-277	13,304	-330
FTE	89	84	0	0	84	0
National Cooperative Geologic Mapping	25,901	25,162	+400	-74	25,488	+326
FTE	144	139	0	0	139	0
Coastal and Marine Geology	38,428	37,457	+403	+576	38,436	+979
FTE	236	231	0	+3	234	+3
Total Requirements \$000	78,351	76,253	+750	+225	77,228	975
FTE ^{b/}	469	453	0	+3	456	+3

^{a/} Changes for this program element include a reduction of -\$51 for travel and -\$23 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

^{b/} FTE may not add to total, due to rounding.

National Cooperative Geologic Mapping

2006 Program Overview

The 2006 budget request for the National Cooperative Geologic Mapping Program is \$25,488,000.

The National Cooperative Geologic Mapping Program (NCGMP) was created following the passage of the National Geologic Mapping Act of 1992, which was reauthorized in 1997 and 1999 (Public Laws 105–36 and 106 – 148). The NCGMP is the primary source of multiple-purpose geologic maps that depict the distribution of the Nation's sediment and rocks and the resources they provide. Geologic maps are vital for exploring, developing, and preserving mineral, energy, and water resources; evaluating and planning for land management and environmental protection; reducing losses from natural hazards, including earthquakes, volcanoes, landslides, and other ground failures; mitigating effects of coastal and stream erosion; siting of critical facilities; and planning for basic Earth science research. The NCGMP represents more than a decade of successful cooperation among Federal, State, and university partners in delivering state-of-the-art digital geologic maps to the Nation in a cost-effective, timely manner. Each of these partners has a unique role, yet all work cooperatively to leverage financial resources and to determine the areas of highest priority for new geologic mapping.

This program supports the Department of Interior's Serving Communities strategic goal to advance knowledge through scientific leadership and inform decisions through the application of science. End outcome measures for which targets are established relate to the soundness of methodology, accuracy, and reliability of the science, and to the accessibility and satisfaction with information products and services. In support of the intermediate outcome to improve the information base, information management, and technical assistance, intermediate outcome

Geologic Landscape and Coastal Assessments Subactivity

measures regarding the content and expanse of the knowledge base and the quality of studies are tracked. Outputs associated with these intermediate outcome measures include the maintenance and updating of a long-term data collection, the completion of systematic analyses or investigations for customers, and formal workshops or training provided to customers.

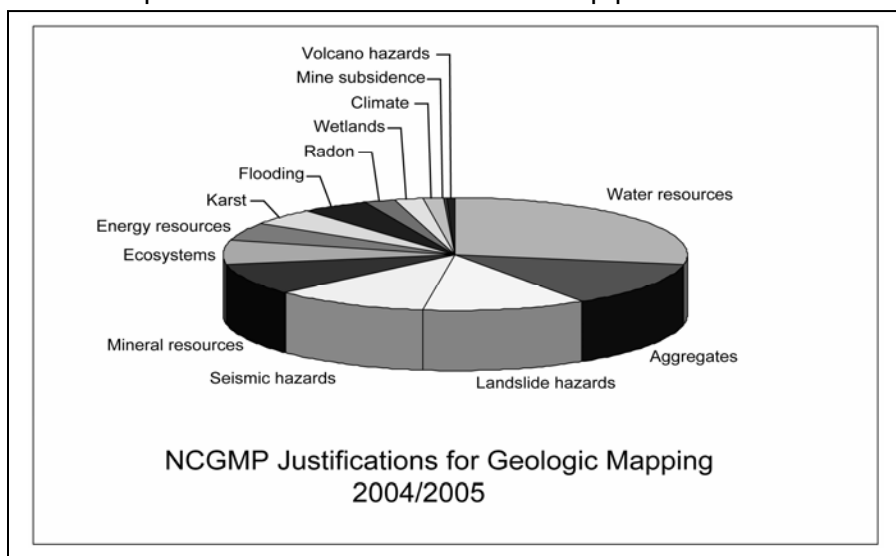
The mission of the NCGMP is to provide accurate geologic maps and three-dimensional frameworks that contribute to sustaining and improving the quality of life and economic vitality of the Nation and mitigating geologic hazardous events and conditions.

Program priorities are outlined in the National Geologic Mapping Reauthorization Act of 1999 (P.L. 106-148) and in the program's 5-Year Plan which, which will be finalized in 2005. The new NCGMP 5-Year Plan has three goals:

- Goal 1 — Produce high-quality, multi-purpose digital geologic maps and accompanying databases and reports to solve a diversity of land-use problems in high priority areas. Develop three-dimensional geologic frameworks that extend into the subsurface and use them in a variety of predictive models, such as ground-water flow, seismic shaking, landslide probabilities, landscape change, and ecosystem health. Measures under this goal deal with production, innovation, and efficiencies.
- Goal 2 — Make geologic map information more accessible to the public. Provide geologic maps, reports, and databases in a variety of digital formats. Work to preserve and make accessible the extensive USGS paleontologic collections and accompanying databases. Measures under this goal document the numbers of maps/reports that are produced and geologic map information provided to our customers through formal workshops and training.
- Goal 3 — Ensure that the NCGMP will have the capabilities/work force to meet the future needs of the Nation. Measures include documenting EDMAP student participation and their use of the EDMAP experience in geoscience careers.

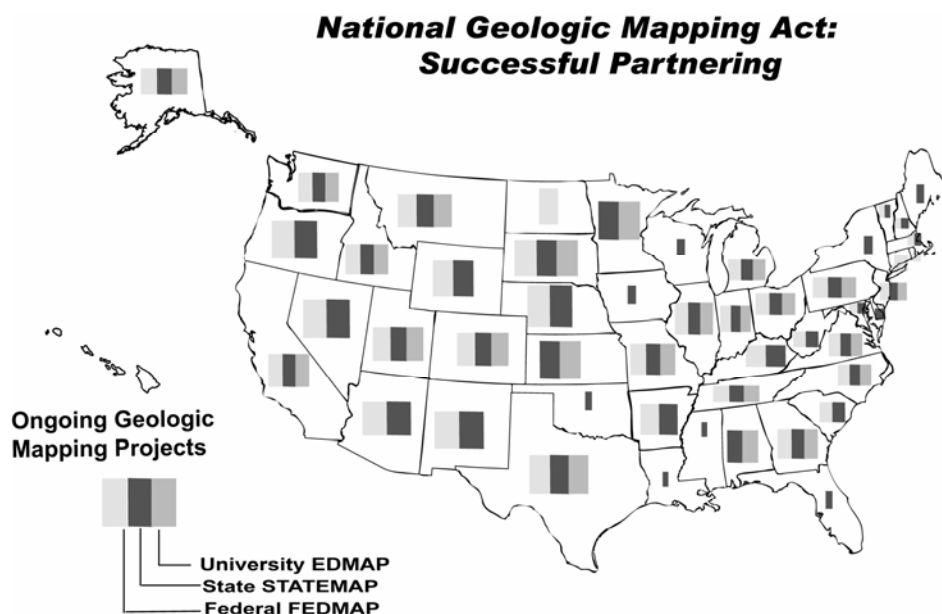
Efficiency Measure — Over the past few years, geologists within the NCGMP have been working to advance and improve the production of geologic maps through the use of new field mapping techniques that streamline the process from data collection to map production.

FEDMAP project members are currently collecting quantitative data on the success of these improvements.



The NCGMP priorities are reviewed annually by a Congressionally mandated Federal Advisory Committee, which includes representatives from the U.S. Department of Energy (DOE), U.S. Department of Agriculture (USDA), the Office of Science and Technology Policy (OSTP), U.S. Environmental Protection Agency (EPA), State geological surveys, academia, and the private sector. In addition, State Mapping Advisory Committees in 47 States meet each year to prioritize local geologic mapping needs and assist USGS managers in modifying and prioritizing long-range plans. These priorities are based upon customer needs for the maps. In 1987, geologic maps had five primary applications: oil and gas, metals, industrial minerals, ground water, and coal, listed in decreasing order. By 2005, this number not only had increased to 14, as can be seen in the figure above, but the emphasis had shifted completely. Progress and status reports on the NCGMP are prepared for the Secretary of the Interior to deliver to the Committee on Resources of the House of Representatives and the Committee on Energy and Natural Resources of the Senate.

The NCGMP carries out the Mapping Act through three main program components: FEDMAP, STATEMAP, and EDMAP. Each year, panels that include scientists from Federal and State governments and academia critically review all proposals that are submitted to the three components.



FEDMAP

(Estimates for FY 2004, \$17.7 million; FY 2005, \$17.4 million; FY 2006, \$17.5 million)

The FEDMAP component currently supports, totally or in part, 31 regional geologic mapping and synthesis projects that address issues with cross-jurisdictional boundaries or involving Federal lands. These projects are located primarily within three regional teams: Western Earth Surface Processes Team, Central Earth Surface Processes Team, and Eastern Earth Surface Processes Team. A significant number of the geologists in these teams work on projects that last approximately 5 years. In FY 2005, studies will be undertaken in 37 States, the District of Columbia, and Canada. These projects also include four geochronology laboratories and the National Geologic Map Database. New and ongoing geologic mapping proposals are evaluated

Geologic Landscape and Coastal Assessments Subactivity

annually by a FEDMAP Review Panel, which includes representatives from State geological surveys, the National Park Service (NPS), the Fish and Wildlife Service (FWS), the USGS Water Resources Discipline (WRD), and USGS scientists with diverse scientific backgrounds.

The National Geologic Map Database project is an ongoing effort with State geological surveys, universities, the Canadian Geological Survey, and the Consejo de Recursos Minerales, Mexico, to present all geologic mapping data from North America on one Web site and with a common set of map standards. Additionally, users can access information on current geologic mapping activities and the proper use of geologic names. The project's Web site serves more than 40,000 users per month. In FY 2005, thousands of new bibliographic map records will continue to be added to the map catalog, and the recently implemented online image library, which serves interactive digital geologic maps, will be significantly expanded.

The Association of American State Geologists passed a resolution on June 15, 2004, "to recognize the outstanding service rendered to the Association by ... David Soller ... and herein extends its gratitude and thanks to ... David ... for enthusiastic and tireless efforts to bring" the National Geologic Map Database "to fruition, an effort for which both the AASG and USGS can be justifiably proud."

Through a Science in the Parks effort, the NCGMP is the principal USGS partner coordinating and prioritizing geologic mapping studies with the NPS. This effort is now an integral component of the FEDMAP program, and the NCGMP is committed to working with NPS well into the future. Projects are developed and selected jointly by the NPS and the USGS to merge the Earth science information needs of individual parks with the geologic mapping mission of the USGS. The resulting geologic data is made available in digital, as well as standard, formats that are needed for NPS land-use management, educational outreach, inventory, and monitoring of natural resources.

The USGS has ongoing geologic mapping efforts in Buffalo National River, Death Valley National Park, Delaware Water Gap National Recreation Area, Devils Tower National Monument, Grand Canyon National Park, Great Smoky Mountains National Park, Joshua Tree National Park, Lake Mead National Recreation Area, Mojave National Preserve, National Capital Region Parks, Ozark National Scenic Riverways, Parashant National Monument, Pipe Spring National Monument, and Shenandoah National Park.

STATEMAP

(Estimates for FY 2004, \$7.6 million; FY 2005, \$7.4 million; FY 2006, \$7.5 million)

The STATEMAP component supports geologic mapping studies by State geological surveys through a competitive grant program that matches every Federal dollar with a State dollar. Mapping priorities are determined with the help of State Mapping Advisory Committees in each State, which include representatives from all levels of government, the private sector, academia, and industry. Currently, more than 500 individuals offer their time on the committees to prioritize geologic mapping needs.

EDMAP

(Estimates for FY 2004, \$0.6 million; FY 2005, \$0.6 million; FY 2006, \$0.6 million)

The EDMAP component supports the training of a new generation of geologic mappers in universities and colleges through a competitive matching-fund grant program. In FY 2004, the NCGMP began a career study of the more than 400 university students that EDMAP has supported since it began in 1995. So far, NCGMP has received responses from approximately 200 EDMAP students, and the results clearly demonstrate that EDMAP students: (1) fall well

above the national average for pursuing advanced academic degrees in the geoscience field, (2) easily obtain geoscience positions due to the knowledge gained through the EDMAP experience, and (3) frequently use the geologic mapping skills gained through the EDMAP. In fact, several of our past EDMAP students, now teachers/professors, are applying for EDMAP grants for their students.

2004 Program Performance Accomplishments

The accomplishments and outcomes listed below demonstrate the utility of USGS products that are counted under GPRA performance measures for (1) long-term data collections maintained/updated, (2) systematic analyses delivered to customers, (3) formal workshops or training provided, and (4) number of square miles of land that are geologically mapped each year. Listed below are the first systematic analyses that were used by NCGMP for FY 2005 GPRA results.

FEDMAP Project – Central Death Valley Region — Through cooperation with the USGS WRD, the NPS at Death Valley National Park, and the DOE, this project addressed three areas of concern in the central Death Valley region: (1) ground-water issues, including stability of quality and quantity in the park's springs, (2) digital geologic map data that the Death Valley National Park is required to obtain, and (3) earthquake and mass wasting hazards in regions of the park near active faults. Project members conducted detailed fault mapping, created various scaled geologic maps, obtained tephrochronology and cosmogenic dating of the sediments, and produced regional synthesis studies of the tectonic evolution of the region.

Based on project earthquake hazard results, the Death Valley National Park significantly modified the construction plan for their administrative facilities and residence accommodations in the park. USGS WRD used project results for developing their regional ground-water flow model. The first domestic water well in the park was drilled using project information. Using project results, four wells were drilled to monitor water quality down gradient from the planned nuclear waste repository site at Yucca Mountain, NV. Inyo County, CA has used project information to construct new site-specific ground-water flow models.

FEDMAP Project – Great Lakes Investigations — Through collaboration with the Geological Surveys of Illinois, Indiana, Ohio, and Michigan (Central Great Lakes Mapping Coalition), this project worked to (1) provide detailed and regional geologic maps and models in high priority areas of the region, (2) improve the scientific understanding of the geologic processes that produce and modify glacial and interglacial deposits, and (3) determine ways to translate geologic information into decision-support systems for land-use decisions, human health and economic issues. Representatives from local, county, and State governments, Federal agencies, private consultants, industry and the business community and private landowners testified at several public forums that there was a need for this information.

Project maps show where highly permeable deposits in the uplands of the region form recharge areas for local aquifers, which in turn feed many of the local streams. Lake County, IL, has written their regional framework plan so it can incorporate geologic information from this project for making planning and zoning decisions. Berrien County Health Department officials used project information to understand contaminated drinking water in one of the county schools for a savings of \$50,000.

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STATEMAP Project – Rio Grande Watershed — Geologic maps from central New Mexico, which were made as part of this project, are being used to solve water-related issues such as riparian habitats, stream erosion, water rights, increased water demand, and safe disposal of waste products, as well as earthquake hazards.

STATEMAP Project – Fall Line Recharge Area — This project in western Georgia has generated geologic maps that are being used to resolve issues such as the impact of the significantly increased ground-water demand on existing aquifers and how to maintain sufficient quality and quantity of this vital resource.

STATEMAP Project – Auburn University — Students participating in this project have been making geologic maps of the Appalachian Mountains in eastern Alabama. The State of Alabama is using these maps for land-use planning in this region of conflicting mineral resource and urban development needs.

Geologic Map and Report Production in FY 2004 — The NCGMP, through the USGS and its partners in 47 State geological surveys, published hundreds of peer-reviewed geologic maps and reports in high priority areas as determined by State Mapping Advisory Committees, DOI and other Federal land management agencies, our Federal Advisory Committee, and customer forums. All geologic maps have multiple uses; however, the most important current uses deal with preserving the quality and quantity of ground-water resources and assisting in the understanding of and prediction of natural hazards, such as landslides, earthquakes, floods, and volcanoes.

FEDMAP

Appalachian Blue Ridge Landscape — By means of geologic mapping and multidiscipline work with USGS biology, water, and geography researchers, this project is determining how geology has influenced the topography, water, soils, and plant and animal communities of the Appalachian Blue Ridge Mountains. Integration of geologic information with ecological data from the region will result in an understanding of the relationship among past climate, geologic processes, and the biota that will be used for a variety of land management applications. Data is now available for climate models of past vegetation and annual temperatures for Shenandoah National Park. Geologic mapping and an interpretive materials map were completed in the Great Smoky Mountains National Park.



Project Chief Scott Southworth was filmed for part of an upcoming PBS documentary on the Appalachians (<http://geology.er.usgs.gov/eespteam/smoky/>).

Big Bend National Park — This park, the eighth largest National Park in the contiguous United States, is faced with a broad variety of issues, including water supply, water and air contamination from mineral deposits and abandoned mines, and ecosystem preservation. At the request of the NPS, the USGS is producing new bedrock and surficial geologic maps of the park that will be used to meet its needs. This process also will result in a clearer understanding of past volcanic events in the park. In FY 2004, through a consortium among universities, the Texas Bureau of Economic Geology, and USGS geologists, geologic mapping was conducted

on large sections of the park. This mapping will continue in FY 2005 (http://minerals.cr.usgs.gov/projects/big_bend/index.html).

Carolina Continental Margin — This project is working to understand how geology affects ground-water availability in North and South Carolina by mapping the subsurface 3-D hydrogeologic framework of the coastal plain portions of the two States. In this region of rapid economic and population growth, there is a need for revised, regional, ground-water flow models that will be used to insure the quality, supply, and protection of coastal plain and offshore aquifers. The project is providing input into these models by improving the understanding of regional ground-water systems, investigating salt-water intrusion, and documenting the timing and magnitude of past sea-level changes.

Morris Balderman of Balderman Consulting, Inc., Environmental and Engineering Geology, wrote on February 10, 2004, that he finds "general geologic mapping to be very important to my work and consider it to be something that only a government agency ... such as the U.S. Geological Survey ... can do properly ... because it requires work over a much larger area than can be addressed in an individual site assessment. I hope the U.S. Geological Survey continues to emphasize areal mapping."

Recent geophysical logging of the Hope Plantation corehole in Bertie County, NC, documented the presence of an untapped freshwater aquifer that is deeper than the one currently being used. This discovery significantly increases the known available ground-water supplies for that region. The coastal plain portion of the Roanoke Rapids, NC, 1:100,000 geologic map was completed, and six 1:24,000 geologic maps were mapped near Elizabethtown, NC (<http://nc.water.usgs.gov/ccp/index.html>).

Central Colorado Assessment — In order to plan for responsible land use in the central Colorado urban corridor and large areas of Federal and private land in the Colorado Front Range, it is essential to understand the mineral and energy resources, geologic hazards, long-term effects of forest fires on erosion, effects of increased recreational land use, and quantity and quality of ground- and surface-water resources of the region. The comprehensive geoscience data and interpretations provided by this project will be used by Federal, State, and local land management entities to make informed land-use decisions. In FY 2004, geologic mapping was completed for the Estes Park and Denver West 1:100,000-scale maps (http://minerals.cr.usgs.gov/projects/colorado_assessment/index.html).

Isotopic/Geochronology Core Operations, Lab Support — These modern USGS laboratories support isotopic tracer and geochronology investigations. The project provides the base level funding to these laboratories that assures their continued availability and operation. The laboratories facilitate interdisciplinary integrated studies in geology, biology-ecology, and hydrology-water resource management. Capabilities include (1) radiogenic isotope studies, (2) K-Ar and $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology of geologic and ore-forming events, (3) stable isotope geochemistry, (4) noble gas geochemistry, and (5) thermal luminescence. The project offers support for age dating of Recent, Holocene, and Quaternary geologic events processes, and landforms with U-series, TL/OSL, cosmogenic exposure dating (TCN), and high precision sensitive argon isotope geochronologic techniques, all essential for ongoing earth surface processes studies.

Mancos Shale Landscapes: Science and Management of Black Shale Terrains — Part of this project is devoted to making detailed geologic maps and stratigraphic studies of the Mancos Shale in the Gunnison Gorge National Conservation Area. Black shales can be both a source of mineral wealth (oil and gas) and a cause of environmental concern (sources of arsenic, selenium, chromium, and mercury). This project is providing scientifically valid information that

Geologic Landscape and Coastal Assessments Subactivity

can be used to make informed land-use decisions for black shale regions. In FY 2004, the initial drafting of six geologic maps was completed in the area (http://minerals.cr.usgs.gov/projects/mancos_shale/index.html).

STATEMAP

In 2004, 123 projects were carried out in 47 States through the STATEMAP component of the Program. More than 450 geologic maps, as pre-publication drafts, were delivered. Some examples of accomplishments include:

- Geologic mapping in the San Pedro River Valley, southeast of Tucson, AZ, is helping to identify water resources in a rapidly urbanizing area and to delineate unique ecological habitats for protection,
- Geologic mapping in south-central Indiana and along the proposed I-69 corridor is being used by geotechnical engineers to design an important transportation corridor linking Canada and Mexico. The maps help in designing drainage systems and locating potential karst hazards,
- Geologic mapping in the Charleston-Summerville area of South Carolina is identifying potential active faults that may impact the proposed water treatment facilities and dam construction for water impoundments,
- Geologic mapping in the Powder River basin of Wyoming is helping the coalbed methane industry in the safe disposal of contaminated waters by delineating aquifers that could be potentially affected, and
- Digital geologic maps for an area of central Utah are being used by Federal and State land managers in their geographic information systems to make informed decisions on mining, ranching, recreation, and ecological protection.

EDMAP

In 2004, 60 students working on 36 projects from 30 universities learned and applied geologic mapping techniques in 18 States through support by EDMAP. All of these student activities were coordinated with projects within the USGS and (or) State geological surveys. The students delivered 102 geologic maps that they used for various university projects, theses, and dissertations.

2005 Planned Program Performance

In FY 2005, there are several planned accomplishments that will be used to satisfy the NCGMP GPRA Performance Measures. These activities will demonstrate the utility of USGS products.

Data Collection and Analysis — Five systematic analyses will be delivered to NCGMP customers. These include the numerous products that have resulted from the three multiyear FEDMAP projects that will be ending in FY 2005: Bedrock Regional Aquifer Systematics Study (BRASS), Southern California Areal Mapping Project (SCAMP), and Surficial Geologic Mapping in the Southwest, and from two multiyear STATEMAP efforts. The NCGMP will provide 10 formal workshops or training to its customers and will continue to maintain 1 long-term data collection: the National Geologic Mapping Database, which at the end of FY 2004 contained

840 gigabytes of information. In FY 2004, 405 gigabytes of information were added, primarily to the newly implemented Image Library. In FY 2005, approximately 200 to 250 gigabytes will be added to the National Geologic Mapping Database.

With the budget change for the NCGMP in FY 2005, the Program has had to reduce the funding money distributed to every FEDMAP, STATEMAP, and EDMAP project. This will reduce their ability to begin new geologic mapping efforts, to acquire essential additional information for ongoing mapping projects, and to publish completed investigations.

Program Planning — In FY 2005, the NCGMP will complete its new 5-Year Program Plan and will be evaluated through the OMB's Performance Assessment Rating Tool (PART).

The NCGMP has implemented a new tracking mechanism for documenting publication efficiency for all three components of its program. Project funding is now linked directly to these productivity measures. For example, funding was increased for FY 2005 for the Pacific Northwest Urban Corridor Project based on productivity.

How California Wildfires Increase the Chances for Debris Flows and Landslides — This new 4-year project, partially funded by NCGMP, will study the distribution, magnitude, and triggering processes for debris flows and landslides that occur in mountainous terrain after major wildfires. Understanding of these physical processes can be used to predict these events and mitigate their effects on people, property, and natural resources. In FY 2005, project members will initiate a field-monitoring program in southern California to identify conditions that can lead to debris flows following wildfires and how these conditions relate to the magnitude of these flows. Sediment transport from rainfall in recently burned areas will be studied in order to develop predictive models for debris-flow hazards.

Landscape Change on Navajo Nation Lands, Southern Colorado Plateau — This new 5-year project, which grew out of an earlier task, incorporates collaborative studies on the Navajo Nation among the USGS, Northern Arizona University, Arizona State University, and Diné College that will produce geologic maps and water-quality reports that (1) differentiate the impacts of climate change versus land-use, (2) determine the extent to which local bedrock geology may contribute uranium, arsenic, and other contaminants to ground-water resources and springs in the region, (3) provide local Navajo Nation governing bodies information for developing land use plans (i.e., urban development, highways, buildings, bridges, and domestic septic and landfill systems), and (4) provide information for grazing management and drought mitigation.

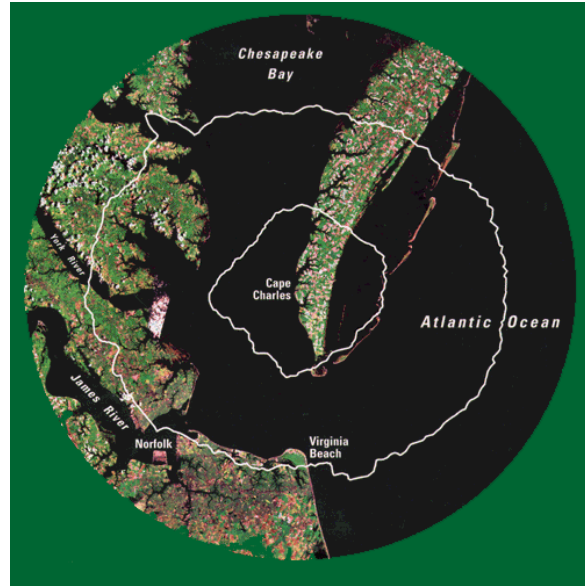
Roman Bitsuie, Executive Director of the Navajo-Hopi Land Commission Office, stated on June 21, 2004, that the Office "would like to express its support for the work of Dr. Margaret Hiza ... in regards to geologic mapping" that "will provide information needed for land use planning by Navajo Nation Chapters."

In FY 2005, as the first phase of the project, detailed (1:24,000) bedrock and surficial geologic mapping will be conducted in the study area. Community outreach to the Navajo Nation is an integral part of the project that will serve to expedite permit processing and provide links for transfer of user-friendly scientific information and educational materials to the community.

Chesapeake Bay Impact Crater — This project is working to understand how a comet/asteroid that crashed into Chesapeake Bay 35 million years ago has influenced modern ground-water supplies in southeast Virginia. The location of the resulting impact crater can be seen in the figure below, as well as an example of the type of equipment used to drill coreholes in the outer portions of the crater. An international scientific workshop developed plans for drilling a 2-kilometer-deep corehole through the center of the crater. This core, which will be drilled in

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2005, will be financed primarily by the International Continental Scientific Drilling Program. The results from this deep core, other cores already drilled nearer the crater margin, and geophysical data will provide an unprecedented amount of information about how craters are formed, and specifically about how this crater led to salty groundwater in the Hampton Roads area of Virginia (<http://geology.er.usgs.gov/eespteam/crater/>).



Geologic Landscape and Coastal Assessments Subactivity

Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes ^{a/}	Program Changes ^{b/}	2006 Budget Request	Change from 2005
Earth Surface Dynamics	14,022	13,634	-53	-277	13,304	-330
FTE	89	84	0	0	84	0
National Cooperative Geologic Mapping	25,901	25,162	+400	-74	25,488	+326
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FTE	236	231	0	+3	234	+3
Total Requirements \$000	78,351	76,253	+750	+225	77,228	975
FTE ^{c/}	469	453	0	+3	456	+3

^{a/} Included in this program is a one-time technical adjustment of -\$194 that moves all USGS funds associated with the Science on the DOI Landscape initiative to a single location in the Biological Research Activity for ease of administration and accounting.

^{b/} Changes for this program element include a reduction of -\$88 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

^{c/} FTE may not add to total, due to rounding.

Coastal and Marine Geology

2006 Program Overview

The 2006 budget request for the Coastal and Marine Geology Program is \$38,436,000.

The USGS Coastal and Marine Geology Program (CMGP) provides geologic information critical to the management of the Nation's coastal and marine environments. National issues, such as coastal erosion and storm impacts, earthquake and tsunami hazards, coastal pollution, loss of coastal and marine habitats, and water, energy, and mineral resource availability require the credible and objective science data, information, and understanding provided by the USGS. CMGP information and products provide Federal, State, and local agencies and the public the authoritative, scientific basis for regulating, managing, and protecting the Nation's coastal and marine resources and communities.

This program supports Department of Interior (DOI) Serving Communities strategic goal to advance knowledge through scientific leadership and inform decisions through the application of science. End outcome measures for which targets are set relate to the soundness of methodology, accuracy and reliability of the science and to the accessibility and satisfaction with products and services. In support of the intermediate outcome to improve the information base, information management, and technical assistance, measures regarding the content and expanse of the knowledge base and the quality of studies are tracked. Outputs associated with these intermediate outcome measures include the maintenance and update of long-term data

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collections, the completion of systematic analyses or investigations for customers, and formal workshops or training provided to customers.

In the long-term CMGP strives to: (1) develop regional and national assessments of coastal change vulnerability, (2) develop understanding of the geological and geochemical requirements for healthy and sustainable ecosystems, including the impact of human activities and natural variability on ecosystem change, (3) characterize the resource potential of coastal and marine regions, (4) provide geologic, geochemical, and oceanographic tools for characterization and modeling coastal sedimentary systems on regional scales, and (5) develop coherent and accessible information resources for broad application by a diversity of end users.

In pursuit of these goals, the CMGP supports a mixture of national- and regional-scale, and process-oriented studies. Individual projects contribute to syntheses that integrate coastal and marine issues or topics into national or regional assessments (e.g., coral reefs, storm and erosion hazards). Regional studies provide high-quality objective scientific information used to address pressing regional problems. Processes studies (coastal earthquake and tsunami hazards, sediment transport modeling, storm impacts) address fundamental issues of national importance while contributing to understanding of pressing regional problems and development of predictive capabilities. Recognizing the complexity of coastal systems, CMGP projects are being coordinated with biological, hydrologic, and geographic research within the Gulf of Mexico (habitat loss, subsidence, contaminated sediments), Chesapeake Bay, Puget Sound, and elsewhere. Project work plans submitted to the CMGP are reviewed annually by internal and external scientists and managers deemed knowledgeable in the relevant area of proposed work. A program panel is convened annually to evaluate these written reviews and to provide guidance to the program. Midway through the projected lifespan of each project, an additional formal review is conducted to evaluate progress and quality of products. The CMGP is reviewed every 5 to 8 years by the National Academy of Science.

The CMGP supports research projects located primarily in science centers in Woods Hole, MA; St. Petersburg, FL; and Menlo Park and Santa Cruz, CA. Additional resources are provided to other USGS science centers and external cooperators (State, academic) to ensure needed capabilities are effectively provided. CMGP program activities address the following themes, with funds distributed to respond to both national issues and critical regional needs.

Environmental Quality and Human Health

(Estimates for FY 2004, \$15.0 million; FY 2005, \$15.6 million, FY 2006, \$16.4 million)

These studies address topics such as pollution and waste disposal, characterization of coastal and offshore biological habitats, understanding of habitat loss, coral reef health, marine sanctuaries and reserves, and environmental change. Results from these efforts provide an understanding of geologic processes needed to predict natural and human-related variability and to evaluate the influence of human activities on coastal, estuarine, and offshore regions. Federal and State agencies and private groups routinely use the regional broad-based and long-term science information produced by this USGS work to make land-management decisions.

National Coastal Efforts: Science for Sustaining and Restoring Coastal Resources — In accordance with the goals of the bureau National Coastal Program Plan, work is planned for several high priority areas around the Nation including the mid-Atlantic Coastal Plain, southern Louisiana, Puget Sound and Tampa Bay:

- In FY 2006, CMGP will provide support to Eastern Region priorities in the mid-Atlantic Coastal Plain by examining the flux of groundwater to the mid-Atlantic Coastal Plain. This effort will allow for informed decisionmaking that balances human use and ecosystem requirements by examining the role groundwater and associated nutrients play in coastal eutrophication in North Carolina estuarine systems. Continued efforts in the Chesapeake Bay will address the impact of sediment input and mobility associated with natural and human processes on water clarity and ecosystem health.
- In partnership with East Carolina University researchers and scientists from the Woods Hole Oceanographic Institution (WHOI), CMGP scientists are applying simultaneous electrical resistivity profiling and a new system for measuring near-continuous dissolved radon in FY 2005. Radon is an excellent tracer of ground water discharge to the coastal ocean; thus, provides a means of tracing the transport of nutrients, primarily nitrates and ammonium ions, which fuel estuarine productivity including harmful algal blooms. The two systems will continue to be used in FY 2006 for mapping fresh and saline water layers below the estuary seafloor in the mid-Atlantic Coastal Plain and Cape Cod, MA. This collaborative effort between USGS geologists, hydrologists, and biologists is resulting in techniques, models, and lessons learned that may be extended to other critical estuarine systems including southern Louisiana and Puget Sound. Efforts in FY 2005–06 will focus on (1) preparing journal publications on 2003–04 work, (2) refining new methods and collecting data on controls on nitrogen removal in submarine ground water prior to discharge, (3) collaboration on a 3-year project, including field and modeling components, beginning in 2005 at Cape Cod National Seashore (CCNS) with USGS Water Resources Discipline colleagues (WRD), and (4) seeking supplemental funds from various sources (e.g., the Massachusetts Environmental Trust and the National Science Foundation (NSF), to apply new tools and techniques to other locations. These successive efforts reflect regional priorities and needs while contributing to the knowledge base required for development of national approaches and solutions.
- Initial CMGP-funded efforts in the Chesapeake Bay are concluding. The most significant finding is that changes caused by humans in the last few centuries, such as increased sedimentation, increased algal blooms, and decreased oxygen in Bay waters, have far surpassed any natural variability of the system. Further, results from CMGP studies of sediment sources (e.g., shoreline erosion, watershed input, sediment resuspension) to the Bay are being used by the Chesapeake Bay Program to develop total minimum daily loads (TMDLs) for sediment and nutrients. As a result, mandates to control sediment input from the watershed are being developed in collaboration with all the watershed States (Pennsylvania, Virginia, Maryland, the District of Columbia, Delaware, New York, and West Virginia). Findings will be used to assess scenarios for the future of the Bay ecosystem and to optimize management strategies of Chesapeake Bay Program partners to reduce negative human impacts to the ecosystem. Efforts in FY 2005 will be devoted to finalizing products of prior work in Chesapeake Bay. Continuing work in FY 2005 and beyond will focus on the fate and transport of sediment within the Bay system and the impact of sediments on water clarity and estuarine habitat.
- In southern Louisiana, the USGS has engaged with partners; e.g., University of New Orleans, Louisiana Department of Natural Resources, and the U.S. Army Corps of Engineers (USACE), to write the Near-Term Louisiana Coastal Area (LCA) plan for restoration activities associated with wetlands loss. The CMGP is supporting science needs of the region by (1) participating in the Shoreline Restoration Team with a focus

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on barrier island restoration and an assessment of available material for beach and island renourishment, and (2) conducting research into the causes of regional subsidence with a focus on both large-scale natural subsidence processes, and more localized subsidence as a result of fault activation by oil and gas withdrawal. Regional subsidence, as a primary driver of habitat loss and increased hazard vulnerability, is the primary focus of future CMGP research in support of restoration goals for the region. CMGP efforts will address the nature and magnitude of subsidence as a critical input to assessing the viability and success of restoration projects. Efforts in FY 2006 will include an expansion of regional subsidence modeling focusing on subsurface processes including natural consolidation processes and faulting induced by anthropogenic activity as well as around naturally occurring, localized salt domes (see also under Natural Hazards and Public Safety, Subsidence and Fault Activation in Louisiana).

- The CMGP is partnering with other Federal, State, and regional agencies in Washington State as part of the Puget Sound Nearshore Ecosystem Restoration (PSNER) group to provide the knowledge and information required to rehabilitate Puget Sound ecosystem health and prevent additional damage as population and human impact in the basin continues to increase. Puget Sound is the second largest estuary in the United States, supporting abundant fish and wildlife populations and a vibrant economy. Increasing human activity, including urbanization and shoreline development (encompassing bluffs, beaches, mudflats, kelp and eelgrass beds, salt marshes, gravel spits, and estuaries), has resulted in significant modifications of many of the natural processes that maintain these ecosystems. In fact, 9 of the 10 species listed as endangered or threatened within the Puget Sound region inhabit the nearshore zone affected by human activities. CMGP efforts to develop science information and tools support natural resource managers in the adaptive management of nearshore habitats of Puget Sound. Specifically, CMGP supports research as part of a USGS multidisciplinary effort (FY 2005 - 2010) designed to evaluate the probable effects of the Elwha dam removal, planned for FY 2008, on nearshore habitats; to understand the physical and ecological interactions within the highly-modified Skagit Delta; and to provide information on beach, cliff, and nearshore sediment dynamics as they relate to critical nearshore habitats. These efforts will provide information required to evaluate changes in Puget Sound habitat and utilization by various species of commercial and forage fish species.
- A major focus in the Gulf of Mexico is Tampa Bay, environmentally threatened by continued growth and development throughout the Bay watershed and by specific activities including construction of an underwater gas pipeline, construction and operation of a major desalinization plant, three expansions of port facilities, and dredging of Tampa Bay to support commercial vessel traffic. The USGS was directed in FY 2001 to develop a pilot program to address critical issues facing the region. The pilot program is designed to continue through FY 2007. Major goals are to (1) assess the geological, ecological, and water quality history of the Bay, (2) develop monitoring programs to assess the current health of the bay, and (3) provide the scientific understanding and tools to evaluate future changes in the Bay ecosystem. Predicting changes in estuarine health that result from natural and anthropogenic changes will allow USGS to provide decision aids to managers planning restoration efforts and balancing multiple uses of Bay resources. To accomplish this, the USGS is modeling the structural setting of the historic Bay to provide the basis for assessing change; identifying, quantifying, and modeling the impacts of urbanization on benthic habitat distribution, health, and restoration; and developing and maintaining a decision support system to facilitate

science information exchange. In FY 2006, scientists will undertake a major effort to integrate hydrodynamic and wetlands models into a Tampa Bay Integrated Coastal Model (TBICM) that will be used to provide managers with information on the impacts of engineering structural changes and urban development on the broad range of water quality, habitat, ecological, public health, and coastal safety issues necessary to develop management strategies for coping with increasing urbanization around the bay.

Coral Ecosystem Research — The USGS serves the Nation by providing reliable scientific information to manage natural resources. In this role the USGS, as the DOI science agency, is uniquely suited to undertake coordinated multidisciplinary research on coral reef issues. Two Executive Orders (EO 13089 and 13158) established a Coral Reef Task Force and a resulting plan to conserve coral reefs; requiring all Federal agencies to protect coral reefs and associated habitats and identifying coordinated action by both National Oceanic and Atmospheric Administration (NOAA) and DOI as essential to meet the Nation's coral reef conservation needs.

A bureauwide plan for coral ecosystem research developed by all four USGS disciplines will be completed in FY 2005 and will guide bureau research over the next 5 years. This plan responds to needs identified by the U.S. Commission on Ocean Policy and the Coral Reef Task Force and has identified four major issues where USGS research can have an impact: land-based pollution, global climate change, ecological integrity, and remote and deep coral ecosystems. Of these major issues, between FY 2005 and FY 2010, CMGP will focus on (1) identifying the sources, transport pathways and biologic and physiologic impacts of land-based pollution on U.S. coral reefs with the objective of providing the science base for management of watershed and land use activities (mitigation) and developing protocols for monitoring land-use impacts on coral reefs, and (2) building models to integrate remote sensing data with experimental results of reef response to various stressors including global climate change. Focus 1 above responds directly to the main issue outlined in the Hawaiian Local Action Strategy (LAS): land-based pollution. The expected output from focus 1 and 2 will be tools for assessing coral reef response to environmental change for application by the primary DOI stewards of the Nation's coral reef resources, the National Park Service (NPS), Fish and Wildlife Service (FWS), and Minerals Management Service (MMS), for parks, refuges, and outer continental shelf (OCS) lands under their respective jurisdictions.

Benthic Habitat Characterization — Improved understanding of seabed character and processes has immediate application to fisheries management, designation of Marine Protected Areas (MPA), assessment of mineral resources, and use of the seabed for pipelines, cables, wind farms, and waste disposal. The USGS is the Federal agency with the mission and competencies required to characterize seafloor resources, using advanced technologies, to meet the myriad of policy, regulatory, and management needs. In particular, geologic and seabed mapping data developed by the CMGP support efforts to characterize benthic habitats (seafloor and lake bottom areas) and link geology and geologic processes to the distribution, abundance, and diversity of marine habitats. The production of interpretive maps showing the distribution of seabed materials, seabed dynamics, and biologic habitats is a major goal of CMGP habitat characterization. Such maps, and related studies, developed in collaboration with NOAA and academic partners, are necessary for the effective management of the Nation's marine lands for diverse uses. Interpretive maps of this nature must organize seabed characteristics into units that describe seabed properties in a coherent manner useful to management agencies—and must be developed collaboratively with those agencies.

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This work is addressing areas identified as high priority by the NPS, MMS, National Marine Fisheries Service (NMFS), National Marine Sanctuaries (NMS), and coastal States including those surrounding the Gulf of Maine region managed jointly by the United States and Canada. The New England Fishery Management Council and NMFS use results to manage the fisheries and habitats of the region and USGS scientists serve as technical advisors to the Council's Habitat Committee. In Alaska, the USGS is cooperating with the NPS and the State through FY 2005 to develop geologic and habitat maps in Glacier Bay National Park. Investigation of shelf-edge habitats on the Atlantic margin and in the Gulf of Mexico, in cooperation with the MMS, Florida State University, and NOAA/NMFS, is revealing the interrelationships between sea floor geology and the benthic biological community. During FY 2005, scientists funded by the benthic habitat projects will work together to provide a coherent plan for future activities in FY 2006 and beyond. It is expected that USGS scientists will continue to work with Federal partners to provide baseline resource characterization in priority locales, while pursuing research aimed at better understanding the physical requirements for healthy and sustainable resources.

Natural Hazards and Public Safety

(Estimates for FY 2004, \$12.3 million; FY 2005, \$11.1 million; FY 2006, \$10.85 million)

These studies provide geologic information for understanding and predicting coastal erosion, sea-level rise, and storm impacts, identifying and evaluating offshore earthquake and tsunami hazard potential, and evaluating submarine and coastal landslide hazards. As the population growth along the Nation's coasts continues, accurate scientific understanding of the dynamics of coastal systems is needed to address issues relating to public safety, recreational and commercial use, and resource management.

Geologic Hazards Impacting Coastal Communities: California — Over 15 million people live in the coastal counties of southern California. The region is highly active seismically, critically dependent upon ground-water pumping for its water supply, and dependent on the quality and ecologic health of its beaches and urban ocean areas. Active faults occur onshore and offshore and pass across the coastline. Developing an understanding of seismic hazards requires improved knowledge of active fault systems. Information on fault-slip history and strain along active faults is needed to evaluate the hazard potential from earthquakes and associated tsunami.

The beaches and adjacent bodies of water, important resources for the area's residents, are stressed by increasing urbanization of the region. Aquifers, a major source of water for the Los Angeles metropolitan area, are experiencing salt-water intrusion. Barriers to such intrusion have been emplaced, but these are only partially successful. A better understanding of both the onshore and offshore structure of the aquifer system is needed so that the barrier systems can be improved and good ground-water use policies can be formulated.

Fires are also impacting the coastal region by leaving slopes vulnerable to landslides and other runoff events. In FY 2004, in response to the Piru and Simi fires, CMGP scientists began monitoring sediment dispersal in the coastal environment immediately offshore of the Santa Clara River mouth and discovered the magnitude of storm-driven sediment supply subsequent to the fires was so great that the monitoring stations were buried by 1-2 meters of sediment and charred vegetation debris. In FY 2005, data will be analyzed in order to understand and predict the magnitude and frequency of such events and their impacts on submerged habitat.

In addition to normal coastal processes that are producing shoreline change in southern California, structures such as river dams, port facilities, and beach retention structures are interacting with natural processes complicating management decisions along the coast. Efforts to understand these societally relevant problems will continue in FY 2005 and beyond although the particular focus areas of study in California may change. During FY 2005, all work to date in southern California will be synthesized and delivered in a major publication, and plans for FY 2006-2011 will be formulated.

Submarine Landslide, Earthquake and Tsunami Hazards — The U.S. Pacific Coast and island territories are threatened by a number of geologic hazards including earthquakes, subsidence, liquefaction, tsunamis and submarine landslides. The CMGP provides critical information for the comprehensive assessment of these hazards. Regional offshore investigations have recently focused on mapping active submarine faults and associated offshore geology in southern California and the Caribbean, near highly populated areas. This information complements previous assessments of offshore geologic hazards in central California and the Pacific Northwest and provides the basis for models to estimate the hazard posed by earthquakes, landslides, and tsunamis. For example, recent studies by the USGS and its local partners have shown the existence of several very large landslide deposits on the floor of the Santa Barbara Channel, directly offshore from the city of Santa Barbara, CA. These historical landslides, almost 10 miles wide, moved about 10 miles downslope into a nearby basin. Spanish records from the early 1800s reported large sea waves or tsunamis following a major earthquake. If similar waves were to occur today, coastal communities and economically critical port facilities would be devastated. The earlier waves may have been caused by submarine landslides resulting from the earthquake shaking. The USGS is collaborating with the Monterey Bay Aquarium Research Institute (MBARI) to determine the probability of submarine landslides occurring in the future. Previous work, including mapping of old landslides and engineering tests, demonstrated that future coastal and submarine landslides are distinctly possible and could induce damaging tsunamis and disrupt nearshore habitats. Probabilistic modeling of tsunami and earthquake hazards will continue as planned into FY 2005 and FY 2006. Partners in these efforts include International, Federal, State and local agencies, for example, JMASTEC (Japan Agency for Marine-Earth Science Technology), the MMS, NOAA, several University of California and Oregon State University researchers, Washington Emergency Management, and numerous others.

The USGS, in response to the December 26, 2004, Sumatra earthquake and tsunami, will support post-event field and modeling activities. Ground-surveys and sampling will provide information to validate models of tsunami generation and to constrain methodologies for interpreting tsunami deposits. These field validation efforts will feed into long-term research efforts to combine geologic and model investigations to assess tsunami hazards within the United States and globally. Ongoing research efforts will result in FY 2005 delivery of research publications related to probabilistic analyses of tsunami hazards for the Pacific Northwest.

In FY 2003, USGS staff began work under a Cooperative Research and Development Agreement (CRADA) funded by SwissRe, a major reinsurance company based in Zurich, to develop and evaluate improved probabilistic earthquake hazard assessments. These activities are closely coordinated with and support the USGS Earthquake Hazards Program (EHP). Test regions are identified globally that have exceptional documented earthquake histories, are densely populated, and have fault systems that pose comparable threat as the San Andreas fault of California and the subduction zone settings of Oregon, Washington, and Alaska. Lessons learned in these regions are being applied to development of earthquake hazard assessments in the United States, where the long-term earthquake record is insufficient to

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properly evaluate hazard calculations. The CRADA has two phases: the initial phase is complete for studies in Istanbul, Turkey, in cooperation with SwissRe and Istanbul Technical University. Results from this phase identified the resolution of input data needed to make meaningful hazard estimates. The current phase of the CRADA, based in Tokyo, Japan, in cooperation with three major Japanese science agencies: the National Research Institute for Earth Science and Disaster Prevention, the Geographical Survey Institute, and the Active Fault Research Center, is developing novel techniques for relocating historic earthquakes using 3-D pattern recognition which will allow better earthquake probability calculations. As a byproduct, expected shaking from scenario earthquakes is predicted empirically.

Analysis of the deep structure of San Francisco Bay strike-slip faults required for earthquake probability estimates were completed in FY 2004. In FY 2005, the focus will be expanded to apply model-based and probabilistic methods to a variety of coastal change hazards. Further research, done under the CRADA with SwissRE and USGS, will develop a new method of locating historic earthquakes from damage descriptions compared to modern instrumental intensity recordings. The methodology developed will be applied to various western U.S. and Puerto Rican coasts in FY 2005 and FY 2006.

Continuing work (FY 2005 and FY 2006) by USGS scientists includes estimating earthquake ground deformation of ports, harbors, and coastal communities to aid State government agencies; e.g., California Department of Transportation (CalTrans) and utilities in assessing and mitigating the hazard earthquakes and landslides pose to infrastructure. Collaborative work among CMGP and EHP scientists has focused on the role that stress transfer plays within the network of faults that extend throughout California and offshore. This information will lead to more accurate earthquake probability estimates.

USGS scientists also are working closely with NOAA to reduce losses from tsunamis through analysis of tsunami deposits and offshore earthquake source characterization to improve real-time warning systems operated by NOAA. Collaborative studies with the USGS EHP, NOAA, CalTrans, and the Southern California Earthquake Consortium in California, Washington, and Oregon contributed to probabilistic earthquake hazard forecasts in FY 2002. Investigations of earthquakes globally demonstrate the importance of past earthquakes on the likelihood of future shocks. Offshore measurements documented new faults and related deformation in southern California. Rapid tsunami simulations demonstrated the viability of quickly determining areas of heaviest damage after a tsunami to guide search and rescue efforts. These simulations have resulted in new approaches for developing tsunami inundation maps for U.S. coastal communities. In FY 2004 through FY 2006, tsunami modeling research will focus on stochastic model development since tsunamis are inherently unpredictable; results will feed into the emerging tsunami warning system for the Caribbean.

Evaluation of both tsunami and earthquake hazards depends critically on identification of fault structure and the recentness of activity along faults. Offshore seismic surveys provide the regional coverage required to identify and map active and dormant faults. The required surveys are prohibitively expensive and environmentally contentious. The USGS is working with the private sector and the American Geological Institute (AGI) to preserve existing offshore seismic data and to ensure that it is available to the research community. Existing data resources are irreplaceable, in danger of being lost, and will provide the basis for future investigations leading to improved understanding of hazard potential across the U.S. marine realm.

National Coastal Change Hazards — The last national compilation of historical shoreline change was completed by the USGS more than 30 years ago. Since that time, methods of

obtaining, analyzing, and displaying shoreline data have substantially improved, and over 30 years of coastal change has occurred. The primary objectives of this study are to (1) determine and quantify the relative vulnerabilities of U.S. coastlines to coastal change hazards, (2) improve understanding of the processes contributing to coastal change hazards, (3) enhance implementation of probabilistic assessments of hazards and vulnerability, and (4) enter into strategic partnerships to facilitate hazard data dissemination. The three themes being emphasized include (1) monitoring hazards using airborne sensors (e.g., Light Detecting and Ranging [LiDAR]), (2) understanding processes, particularly those that facilitate assessment of long-term and storm-induced coastal change hazards, and (3) data integration and dissemination using database and Geographic Information System (GIS) technology. The first objective national baseline of coastal position and topography was completed in FY 2002. In FY 2003, efforts to compare the baseline to historical shoreline measures to quantitatively assess past coastal change were begun and continued through FY 2004. An analysis entitled *Historical Shoreline Change for the Gulf Coast*, was delivered in FY 2004. FY 2005 and FY 2006 efforts will continue for the Atlantic and Pacific coastlines, respectively. The baseline map information being produced provides an outstanding assessment for pre-storm condition throughout the country. For example, subsequent post-storm LiDAR missions (e.g., Hurricanes Charlie, Frances, Ivan and Jeanne in FY 2004) allowed rapid quantification of storm-induced changes. Pre-storm data, some in the form of maps showing the "first line of defense" that would be inundated by storm surges associated with category of hurricane, were made available to researchers, local users, and coastal zone managers prior to landfall. Continuing efforts to maintain up-to-date coastal map products and assess coastal change are being pursued collaboratively with National Aeronautical and Space Administration (NASA), NOAA, and the USACE. These collaborative efforts ensure comprehensive data collection that effectively applies resources to meet multiple agency requirements and future work will address the development of products and tools that support the breadth of applications at all levels.

Regional Coastal Erosion: North Carolina — Numerous hurricanes have impacted North Carolina in recent years, including Hurricane Isabel in September 2003 and Alex in August 2004, resulting in severe coastal and inland flooding, erosion of hundreds of kilometers of shoreline, damage or destruction of thousands of homes, and disruption of transportation arteries. These impacts to the coastal zone occur against a backdrop of continued sea-level rise, chronic erosion, and the likelihood that we are entering a period of higher hurricane risk. The North Carolina coast attracts significant tourism to its parks and beaches, including Cape Hatteras and Cape Lookout National Seashores and Pea Island National Wildlife Refuge. Coastal development continues to increase throughout the region, tourism is a major economic factor, and the coastal ocean supports a local fishing industry; all of which are impacted by coastal change. The USGS, the North Carolina Geological Survey, East Carolina University, and other academic investigators are collaborating to map and understand the regional coastal system of northern North Carolina in an effort to relate the geologic history, setting and physical processes to coastal change. Among the issues being addressed are: shoreline erosion, storm dynamics and coastal system response, location of sand resources for beach nourishment, records of climate and sea-level change, and habitat evolution across the nearshore, barrier islands, and estuaries.

In FY 2004, the project completed its 4-year effort to collect geophysical data for the inner continental shelf from Virginia to Cape Lookout, and the corresponding backbarrier estuarine system. In FY 2004, the project produced its first major publication, on sea-level rise and estuarine dynamics (ISBN 0-9747801-0-3, 153 p.), that represents a synthesis of coastal processes in the North Carolina Outer Banks estuarine system. Drill holes and monitoring wells have been installed in collaboration with the USGS WRD. Work in FY 2005 and FY 2006 will

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measure and model shoreline response to severe storms, thus providing information essential for utilizing and managing this extremely dynamic coastal system, and furnishing a sound scientific basis for policy and regulatory decisions. Findings from this study are being used by the NPS to assess the impacts of proposed coastal mitigation strategies and transportation corridor planning, by the FWS to evaluate the environmental consequences of inlet abandonment, and by the USACE and State Department of Transportation to refine sand resource exploration strategy. The NPS, FWS, USACE, and several State agencies are presently debating a number of issues related to mitigation of coastal erosion and inlet dynamics in the study area; this project provides a critical foundation of objective information and scientific analyses that serves all stakeholders.

Regional Coastal Erosion: South Carolina — Much of the South Carolina coastline is heavily developed, supporting large populations and infrastructure, and robust commercial and tourism industries. The continued success of these coastal economies is closely related to the health of local shorelines, which mitigate the potential for property loss and damage associated with coastal erosion and severe storm events. The USGS, the NOAA Sea Grant Consortium, the State of South Carolina, several university partners, and the USACE, Charleston District are cooperating to provide a sound scientific understanding of the factors that control coastal erosion, sediment availability and transport, habitat distribution, and vulnerability to coastal change along coastal South Carolina. The main objectives of the study are to: (1) evaluate the role that older geologic units, underlying the lower Coastal Plain and inner-shelf, play in the evolution of the coastal system, (2) assess sediment distribution and the mechanisms and pathways by which sediment is transported, and (3) develop a conceptual sediment budget, based upon qualitative observations from geologic mapping and shoreline erosion/accretion rates, that will be tested and supplemented by quantitative measurements of the physical processes that drive inner-shelf circulation and sediment transport.

Between FY 2001 and FY 2003, field programs completed the acquisition of geologic mapping data along the lower Coastal Plain and shallow inner-shelf of Long Bay. Final processing and interpretation of these data have been completed, and preliminary reports were released during FY 2004. Results from high-resolution geophysical mapping within the inner-shelf were immediately useful in identifying new aggregate resources for planned beach nourishment projects, and providing new baseline maps for ongoing biological habitat studies within the region. Integrated interpretation and analysis of onshore and offshore geologic mapping, high-resolution shoreline mapping and Coastal Plain geomorphology has begun, will continue through FY 2005, and be completed during FY 2006. Preliminary results indicate a complex geologic framework in which differential erosion of older, underlying units has heavily influenced the evolution of the region, exerting control over the locations of river systems and tidal inlets, modern depositional patterns, and areas of chronic erosion. Between late FY 2003 and FY 2004, physical oceanographic data were acquired at select sites within Long Bay, with the intent of quantifying the physical processes responsible for driving inner-shelf circulation and sediment transport. Analysis, modeling and interpretation of these data will continue through FY 2005 and into FY 2006. Findings from this phase of the study will be used to test and supplement conceptual sediment budget analyses that were completed in FY 2003, and will ultimately be included in an overall data synthesis that will be completed during FY 2006.

Subsidence and Fault Activation in Louisiana — Nowhere are the impacts of natural and human-induced change on coastal resources more dramatically apparent than in coastal Louisiana. Loss and alteration of barrier islands, bays, and coastal marshes continue to impact public safety as well as the economic, cultural, and environmental health of the region. More than \$150 billion worth of municipal and industrial infrastructure is at risk. Losses to industries

such as commercial fisheries are only estimated (in the case of fisheries, to be up to \$500 million lost by 2050).

Over 900,000 acres of wetlands and protective barrier islands have been lost since the 1930s, with land-loss rates as high as 25,600 acres per year as recently as the 1970s. Natural processes resulting in high rates of sea-level rise and subsidence are exacerbated by human alterations of the Mississippi River and subsidence associated with hydrocarbon and ground water withdrawal. Louisiana's low-lying coastal resources, infrastructure, and population centers are increasingly at risk to increased flooding, land-loss, and storm impacts. USGS programs are providing assessments of risk, documenting historic and ongoing land-loss and subsidence and contributing to the Louisiana Comprehensive Area plan for restoration efforts in cooperation with the University of New Orleans (UNO), Louisiana State University, Tulane University, the Louisiana Department of Natural Resources, and Federal partners including the USACE.

A series of USGS studies in collaboration with the USACE UNO have provided valuable insights into the processes driving subsidence and sea-level rise within the Mississippi River delta plain. Subsidence impacts the socio-economic infrastructure of southeastern Louisiana, contributes to the extensive loss of wetlands, and places communities and infrastructure at risk of inundation. Recent USGS investigations have focused on wetland subsidence and fault activation induced by oil and gas production. Wetlands subsidence is shown to be significantly accelerated in areas of persistent hydrocarbon production. The reductions in elevation are sufficient to cause dramatic changes in the affected wetland ecosystems.

The USGS and UNO are coordinating efforts to develop a comprehensive understanding of coastal vulnerability in this rapidly changing coastal setting to both human-induced and natural subsidence, including plans to place site-specific subsidence investigations into the broader regional context of sea-level rise and storm hazards. In FY 2003, researchers tested the hypothesis that long-term, large-volume oil and gas production in the Gulf Coast Basin has resulted in land-surface subsidence and activation of deep-seated faults around some fields, and investigated the mechanisms and timing of subsidence to determine whether the processes are still active. The resulting data are being examined by the scientific community and Louisiana State and local planning agencies to determine how to incorporate this knowledge into restoration plans for southern Louisiana. During FY 2004 and FY 2005, conceptual and empirical models are being developed to predict subsidence impacts on the basis of production histories and the regional geologic framework. In FY 2004, researchers expanded efforts, in cooperation with the University of New Orleans, to better understand natural subsidence and how it contributes to increased storm vulnerability and wetland loss. In FY 2005 and 2006, modeling efforts are being extended to incorporate the regional effects of natural consolidation and subsurface faulting on subsidence. State and Federal natural resource agencies responsible for flood control, wetland protection, and coastal restoration are using the study's products in their planning and regulatory activities. Study products will aid in identification of critical areas at risk and in assessing the feasibility and effective life of restoration and mitigation efforts. Users will include Federal (FWS, USACE) and State (Louisiana Department of Natural Resources) agencies, as well as joint State/Federal entities developing restoration plans for coastal Louisiana.

Natural Resources

(Estimates for FY 2004, \$3.8 million; FY 2005, \$3.6 million; FY 2006, \$3.7 million)

These studies provide information on the location, distribution, quantity, and quality of fresh water and mineral and energy resources in coastal and marine environments and the potential

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impacts of resource use and extraction. Increasing demands on ground- and surface-water resources require improved understanding of the interaction of hydrologic and geologic systems in coastal regions and the environmental impacts of resource use and modification.

Understanding the distribution of sand and gravel resources is critical to assessing the resource potential and the impact on sedimentary systems and coastal habitats of resource development.

Ground-water Resources are critical to coastal communities and the health of coastal habitats. Overpumping of groundwater has caused saltwater to encroach into and contaminate many coastal aquifers around the Nation. In response to widespread saline encroachment beginning in the early 1950s, water managers in Los Angeles developed costly barriers to protect the storage basin. Leaks in these barriers allow salt-water encroachment to continue to threaten this valuable resource. USGS geologists, geochemists, and hydrologists are cooperating with local water managers as well as other Federal and State agencies to: (1) understand the stratigraphic, geomorphic, and structural controls of saltwater intrusion, (2) model the hydrogeologic character and ground water flow paths of the Los Angeles Basin, and (3) assist local water managers to better maintain the groundwater storage basin. USGS scientists are contributing to efforts to map the geologic structure underlying much of the Los Angeles/Long Beach harbor area and the adjacent continental shelf and mainland slope. Data collected and integrated in FY 2004 with academic and commercial data sets will be used in FY 2005 and 2006 to map the stratigraphy of offshore fault systems and buried channel systems that are potential pathways for saltwater intrusion. A 3-D stratigraphic model is being developed and will incorporate the offshore seismic and geologic data in a unified spatial geodatabase in FY 2005. This information will be used to develop mitigation strategies as well as supporting development of detailed models of aquifer geology and hydrology that will be used to characterize the principal pathways for seawater intrusion.

In the mid-Atlantic region, USGS scientists have been investigating delivery by direct ground-water discharge of excess nutrients from fertilizer and septic systems to coastal bays in the Delaware-Maryland-Virginia (Delmarva) Peninsula. Collaborators and stakeholders include the U.S. Environmental Protection Agency (EPA), Coastal Intensive Site Network (CISNet) consortium, NPS, State agencies, universities, marine laboratories, and citizens' groups. Through development and application of new drilling, sampling, and geophysical surveying techniques, investigators have shown that (1) flowing plumes of fresh ground water underlie significant areas of Delmarva bays and (2) nutrients in the ground water under the bays are commonly broken down before being discharged to the surface water. These results show that ground water may influence much larger areas of the coastal bay systems than previously thought, but that the pre-existing understanding of the particulars of the nutrient chemistry involved needs to be modified. Findings will inform future land and resource use decisions and nutrient management strategies in Delmarva watersheds. In FY 2004 and into FY 2005, CMGP expanded efforts from the Delmarva Peninsula to Pamlico Sound, NC, and to New England, including Cape Cod National Seashore, MA. Future efforts (FY 2006) will be carried out in Chincoteague Bay (DelMarVa) and Florida. These sites were chosen to represent the variability of ground water discharge in settings typical of the Atlantic coast (1) glaciated coasts, (2) coastal plain barriers with wide and narrow lagoons, and (3) carbonate platforms. Preliminary ground-water budgets and nutrient budgets will be prepared and delivered. The multifaceted nature of these problems requires interactions with scientists from the WRD, the Biological Resources Discipline and the NPS. The approaches are planned to yield information necessary to improve hydrologic models, quantify sustainable rates of ground water withdrawal, and determine the importance and biological impacts of nutrient fluxes from ground water into estuaries.

Sand Resources — The Nation's continental margins, products of diverse geologic processes, contain important submerged landforms that serve a variety of purposes: habitats for fisheries, ship navigation and national defense operations, and engineering activities (i.e., oil and gas platforms, pipeline and cable routes, wind farms). Continental shelf margins also contain hard mineral resources such as aggregate sand and gravel. Coastal erosion and land loss, resulting from complex natural processes (i.e., storms, sea-level rise, sediment starvation) and man-made alterations (i.e., dams, dredging, coastal engineering structures), are pervasive along coastal regions. Beach nourishment is increasingly viewed for developed coasts as a cost-effective and environmentally sound method of mitigating coastal erosion, reducing storm and flooding risk, and restoring degraded coastal ecosystems. For beach nourishment to be viable, however, large volumes of high quality sand are necessary and must be located close to the intended project beaches. Offshore marine sand bodies are often the sole sand source alternative for beach nourishment.

Completed studies in Long Island and continuing regional studies in Louisiana, South Carolina, and North Carolina are providing regional-scale assessments of the availability of offshore sand and gravel resources suitable for beach nourishment. Historic data, combined with the results of regional studies, are leading to the development of a consistent national assessment of sand and gravel resources around the United States. USGS scientists will synthesize, disseminate, and map available coastal sediment and geologic framework data from the USGS and cooperating external organizations. Efforts in FY 2005 and 2006 will focus on continued population of a unified relational database for sediments in partnership with MMS, NOAA, USACE, the Institute of Arctic and Alpine Research/Colorado University, the UNO, and several coastal States. FY 2005 activities will emphasize identifying and characterizing potential Louisiana sand resources for barrier island restoration. The long-term goal (FY 2006 and beyond) of this project is to increase scientific understanding of the Quaternary shelf history and sand supply and budgets for coastal-shelf systems leading to assessments of the character and distribution of sand and gravel resources potentially suitable for beach nourishment.

USGS scientists have implemented a scientifically rigorous series of regional assessments of marine sand and gravel resources around the United States. The usSEABED system, initially used to map surficial seabed sediments along the West Coast for correlation with benthic habitats, is providing a new kind of marine information structure, based on information processing including data mining, "fuzzy-logic" processing of qualitative descriptions, with complete temporal and geospatial discrimination of data. The usSEABED is enabling data from the sampling, probing, and imaging of the seabed to be processed into substrate information. As it is being created, usSEABED can accept a wide variety of data types and the outputs can be utilized in virtually any program such as GIS applications, spreadsheets, and relational databases. Data from usSEABED can be mapped, analyzed, interpreted and presented in a number of ways through the use of LAseDs, an interactive Web-based database developed specifically in response to Louisiana resource management needs for sediment and geophysical data.

Gas Hydrates — Since passage of the Methane Hydrate Research and Development Act of 2000, hydrates have been recognized increasingly as both a potential energy resource and a hazard to deep water drilling. The CMGP and the Energy Resources Program (ERP) of the USGS are working with the Department of Energy, NOAA, NSF, and the Naval Research Laboratory to fully implement a comprehensive gas hydrate research program in the United States. In FY 2002, major field programs studying gas hydrates took place on the Mackenzie Delta, AK (in cooperation with Japanese, German, Indian, and Canadian partners), in the Gulf of Mexico (in cooperation with French, Japanese, Russian, academic, and industrial

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partners), and off the Oregon Coast (in cooperation with the Ocean Drilling Program). Samples collected during those field efforts are being analyzed at several USGS labs to understand the physical and dynamic properties that control gas hydrate formation in both permafrost and continental margin settings. These studies are also leading to better strategies for studying these substances and modeling their behavior in natural settings. USGS researchers were invited to participate in several interagency conferences and lead sessions and discussions about hydrates research. In FY 2005 and 2006, the USGS will continue working with the Joint Industry Program, headed by Chevron-Texaco and Maurer Technologies in Alaska and the Gulf of Mexico, to further gas hydrate studies. A new 5-Year Plan for USGS hydrate research has been prepared collaboratively by CMGP and ERP and is now available for external review. In addition to specific energy-related efforts, the CMGP plans to expand its efforts in assessing the role of gas hydrates in sea-floor stability and climate change issues.

Technology and Information

(Estimates for FY 2004, \$7.3 million; FY 2005, \$7.1 million; FY 2006, \$7.1 million)

These studies provide baseline products characterizing the form and composition of the Nation's coasts and seafloor through systematic reconnaissance-level surveys and production of maps of the U.S. coast and offshore Exclusive Economic Zone (EEZ). These scientific maps and information are used for assessment and management of the sea floor and provide a foundation for investigations of environmental, hazard, and resource issues in coastal and offshore areas. The USGS also addresses the management and transfer of marine geologic information and products.

LiDAR (Light Detecting and Ranging) Mapping — The EAARL (Experimental Advanced Airborne Research LiDAR) is an airborne system developed by NASA and applied cooperatively with the USGS that provides unprecedented capabilities to survey coral reefs, nearshore benthic habitats, coastal vegetation, and sandy beaches. A single EAARL overflight allows automatic adaptive acquisition of dramatically different surface types which makes EAARL uniquely suited for mapping features where extreme variations in the laser backscatter complexity and signal strength are caused by different physical and optical characteristics. In FY 2003, the development of this capability focused on developing algorithms and methodology to use this information for improving: (1) fire fuel estimation, (2) discrimination between vegetation community classes, and (3) the combination of airborne bathymetric LiDAR measurement of water column thickness and turbidity with simultaneous hyperspectral scanning to improve the retrieval of benthic reflectance spectra and thereby improve the accuracy of fine scale shallow benthic habitat maps over coral reef and seagrass communities. Those algorithms will be tested in FY 2005. Work with the NPS will continue on mapping coral rugosity (a measure of coral reef degradation) in Florida and the Caribbean. This technology provides an effective method of mapping relevant to a broad range of USGS and other Federal programs. Work in FY 2006 will focus on integrating remotely sensed LiDAR data into a model framework being constructed to extrapolate coral reef response to external stressors over a large geographic region. While focusing on coastal and marine applications, the CMGP will continue to work with other programs and other agencies to expand the range of applications for which these tools are optimally suitable.

Coastal Modeling — The National Community Sediment Transport Model is being promoted by CMGP to further the understanding of sediment resources and the transport of sediments and associated contaminants. This will be an open-source numerical model for sediment transport in coastal regions developed in cooperation with other Federal agencies, academic institutions, and private industry where the development of the sediment transport model architecture and

models will evolve into standards for use in applications by the broader community interested in coastal issues. Ongoing activities in this project include promoting, testing, selecting, developing, improving, and maintaining the community models; advancing instrumentation and data analysis techniques for making measurements to test and improve sediment-transport models; providing software analysis and visualization tools that support model applications; and applying sediment transport models to regional contaminant and erosion issues. In FY 2005, the USGS will work the Office of Naval Research (ONR), and scientists funded by the NSF to ensure that a coordinated effort increases model effectiveness in addressing needs across the entire spectrum of Federal agency needs.

The Coastal Evolution Model — A new modeling project initiated by CMGP in FY 2004 will develop a multiscale numerical modeling system for coastal evolution that incorporates physical processes and empirical knowledge. Newly discovered and newly appreciated processes studied through observational and theoretical investigations in regional investigations, national assessment programs, and by the research community at large will be continually incorporated into a dynamic modeling system. Model components will be calibrated and evaluated with data obtained from regional and other field investigations, coordinated with the above Community Sediment Transport Modeling System, and with program site-specific investigations. Objectives of this project are to (1) predict morphological change (profile and shoreline change), (2) quantify the linkages between antecedent geologic framework, inner shelf and nearshore morphology, watershed sediment delivery, and shoreline change over a continuum of socially relevant scales, (3) examine the relative contribution of cross-shore and alongshore sediment transport processes to morphological changes over a range of time and space scales, and (4) improve sediment transport parameterizations to be used for long-term morphologic modeling. FY 2005 and FY 2006 work will be undertaken in conjunction with ongoing CMGP regional studies (e.g., North and South Carolina Erosion Studies, Puget Sound, and the National Assessment of Coastal Change Hazards).

Law of the Sea/Limits of the Outer Continental Shelf — Should the United States become a signatory to the United Nations Convention on the Law of the Sea (UNCLOS) the Nation will have a 10-year time window to develop and submit evidence for extending the limits of its continental shelf beyond 200 nautical miles. The criteria that a nation can use in its submission require an understanding of the geologic structure, history, and sedimentary extension of the continental shelf. The USGS has collected much of the existing regional data required to assess sediment thickness information and, in FY 2003, undertook two tasks toward determining the adequacy of these data. First, the USGS developed a GIS for eight continental margin regions and trust territories identified as locations where an extension might be proposed. This GIS contains navigation data that have been classified for navigational accuracy and suitability for assessing sediment thickness and is the first step in determining where additional data might be needed should the United States submit a claim. Second, the USGS compiled actual sediment thickness values in the Bering Sea region of Alaska. This is the first attempt to recompile sediment thickness information digitally and to identify potential gas hydrate resources in this priority area extending beyond the 200-nautical mile limit. Further required work to actually map sediment thickness and evaluate geologic formations around the United States will not occur until the United States ratifies UNCLOS.

In 2004, Brazil became the second nation, after Russia, to make a submission to the Commission on the Limits of the Continental Shelf for an extended continental shelf. USGS worked extensively with the Department of State in 2004 to develop technical evaluations of the submission. USGS is working with the Department of State to devise a strategy for evaluating the substantial Australian submission, which is expected in early FY 2005. All work has been

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done collaboratively with NOAA, which is the lead agency for assessing the bathymetric criteria relevant to UNCLOS.

Marine Realms Information Bank (MRIB) and Knowledge Management — The Internet offers quick and convenient service for those who need the best available scientific results as the basis of decisions about disaster response, waste disposal, beach nourishment, and other important issues. Unfortunately, the great volume of miscellaneous information on the Internet presents a daunting prospect to those who need to quickly find reliable scientific information about a particular issue and location. The MRIB is an online library of the USGS CMGP that organizes and provides links to high-quality scientific resources that are maintained online by the USGS, other agencies, and partners in academia and the private sector. Unlike most search engines, MRIB uses maps to allow search for information about particular places, and allows Internet users to browse for information in an organized set of categories that includes environmental issues, natural disasters, geological features, and research methods. MRIB is now being incorporated into a larger Coastal and Marine Knowledge Bank (CMKB) that provides an electronic organization, presentation, and interactive capability to utilize the Nation's Coastal and Marine Geology knowledge assets, i.e., for data, derived products, knowledge, and also human intellectual resources. The CMKB will ensure that CMGP data and knowledge are available to a wide variety of users to address multiple, complex issues and archiving and serving this data should lead to new science by providing links to other system studies. In FY 2004, a demonstration Monterey Bay Portal Demonstration Site (<http://marine.usgs.gov/cmkb/>) was created. In FY 2005 and FY 2006, a parallel site highlighting the results of regional and national hazards assessments will be created.

FY 2004 Program Performance Accomplishments

The accomplishments listed below demonstrate the utility of USGS products that are counted under the output measures of long-term data collections maintained, workshops or training provided to customers, and systematic analyses/investigations delivered to customers. These accomplishments support the goals of the Coastal and Marine Geology Program and support the Activity Based Costing theme of Serving Communities. The program goals support and begin to implement the comprehensive National Coastal Plan submitted to congress by the USGS. The National Coastal Plan describes a program that responds to critical regional needs while addressing national issues associated with coastal change. The overall goals of this program are to: (1) provide the scientific information, knowledge, and tools required to ensure that land and resource use decisions, management practices, and future development in the coastal zone and adjacent watersheds can be evaluated with a complete understanding of the effects on coastal ecosystems and communities, and (2) provide a full assessment of their vulnerability to natural and human-driven changes.

Mapping and Monitoring Activities — The final report of the U.S. Commission on Ocean Policy (USCOP) includes multiple findings and recommendations throughout the report and specifically in Chapter 25 with respect to the coordinated development, provision, and application of geospatial data, information products, tools, and services. In response, the USGS and other agencies (e.g., on the Joint Subcommittee for Oceans) involved in the development and application of geospatial data, products, tools, and services are working collaboratively to enhance coordination of federally-supported mapping and charting programs. The goal of this effort is to develop mechanisms that enhance the development and delivery of geospatial data, products, tools, and services that meet both agency-specific mission requirements and the broad needs of Federal and non-Federal decisionmakers. Among the more focused goals is development of coordinated efforts to provide consistent, up-to-date, and national quantification

of both short-term (storms; e.g., LiDAR surveys in collaboration with NASA) and long-term (erosion, sea-level rise; in collaboration with local groups such as East Carolina University) coastal change. Additional efforts will focus on development of strategies for consistent national and regional provision of information for assessment of offshore resource and hazard potential and baseline characterization. The CMGP has long-term mapping activities crafted to support program goals. Some highlights of these activities and societal relevance are described below.

The rapid growth in population within 50 miles of the Nation's coast results in continuously increasing impacts on natural habitats, living resources, and environmental quality of the coastal ocean. In Massachusetts Bay, CMGP scientists have been refining and verifying a predictive capability for the transport, fate, and environmental effects of wastes discharged to the coastal oceans and make this information readily available to environmental managers and the public. The USGS has collected physical oceanographic measurements from moored instruments in western Massachusetts Bay since 1989 with platform support from the U.S. Coast Guard. This is one of the longest continuous data sets of its type in coastal waters of the United States documenting seasonal and inter-annual changes in currents, hydrography, and suspended-matter concentration and the importance of infrequent catastrophic events, such as major storms or hurricanes in transporting sediment. These data provide a framework for testing numerical models of circulation and sediment transport. Both the observational and modeling capabilities provided are potential USGS contributions to the development of Integrated Ocean Observing Systems.

The USGS work, funded through CMGP, is part of a larger monitoring program being conducted by the Massachusetts Water Resources Authority. At the same time and in collaboration with chemists at the WHOI, the USGS is investigating the degree of remobilization of metals and nutrients from the contaminated sediments of Boston Harbor and Massachusetts Bay. FY 2004 accomplishments include development of sensitive analytical techniques for measuring heavy metals in pore water and successful operation of benthic chambers at locations near the old and new waste-water outfalls. Preliminary results indicate copper, lead, and silver are remobilized from a few centimeters below the water/sediment interface and adsorbed with newly precipitating iron oxides at the water sediment interface. The process is significant because metals thus deposited at the sediment surface are more susceptible to resuspension and transport to other environments. The techniques and new information developed in this project have application to contaminated sediment issues that are common near coastal urban centers around the United States and the world.

Managing the coastal ocean requires an understanding of the geologic framework at high-resolution over large areas. At present, high-resolution geologic maps of the coastal ocean exist only in limited areas of the United States; shallow areas have not been mapped on a regional basis because high-resolution mapping requires substantial time to cover large areas. However, the shallow areas (water depths less than 30 meters) are often heavily used and most affected by human activities. Technologies now exist to obtain 100 percent coverage of bathymetry and bottom character information on a regional basis in water shallower than 20 meters. Regions selected for mapping include areas offshore of major metropolitan centers, key biological habitats, unique topographic features, areas where new maps are needed for research studies, and areas identified by cooperators.

In FY 2004, the South Essex Ocean Sanctuary (between Cape Ann and Boston) was mapped using sidescan sonar (with interferometric bathymetry) and chirp seismic reflection profiling. Sediment samples and photographs of the sea floor were obtained to provide additional information on the sea floor geology and to aid in interpretation of the sidescan and bathymetric

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observations. In the Boston Harbor area, existing sidescan sonar and bathymetry collected by the NOAA were obtained and reprocessed to form the basis of geologic maps of Boston Harbor and Approaches. Sediment samples and photographs of the sea floor were also obtained. In the southern Merrimack Embayment, mapping was carried out using a multibeam sea floor mapping systems in water greater than about 20 meters depth. Products will be published in FY 2006 as a USGS Open-File Report (on DVD-ROM), including digital maps and data presented in a GIS. See "High-resolution geologic mapping of the sea floor offshore of Massachusetts" at http://woodshole.er.usgs.gov/project-pages/coastal_mass/, for summary information on this work.

The New York/New Jersey area is the most populated coastal region of the United States. New York City, with a population of nearly 8 million, is the largest city in the United States, and the NY/NJ metropolitan area is the second largest in the world (behind Tokyo). The harbor estuary and offshore New York area are used for waste disposal, transportation, recreation, and commercial and recreational fishing. The USGS, in cooperation with the USACE, Rutgers University, and NOAA, has been conducting studies offshore New York designed to map and characterize the sea floor. The purpose is to (1) understand the transport and fate of sediments and associated pollutants, (2) map the inner shelf and sand deposits along the southern shore of Long Island, and (3) understand the recent geologic history. A long-term goal of these geological studies is to develop predictive models and geologic information to guide research and sustainable use of the coastal ocean. For a regional synthesis of FY 2004 results and all of the information associated with USGS work offshore New York/New Jersey, see "USGS Studies in the New York Bight" at <http://woodshole.er.usgs.gov/project-pages/newyork/>.

Hudson Canyon, located off the New York metropolitan area, is the largest submarine canyon off the U.S. East Coast. The head of the canyon connects with the Hudson Shelf Valley, which originates on the inner shelf off New York City. The seafloor off New York is a major route for trans-Atlantic cables; has been a site of active dredge disposal; and appears to be a sink for contaminated sediments. Parts of the continental slope and rise appear to be underlain by gas hydrates. Because of the heavy utilization of the seafloor and the potential activity of the underlying gas hydrates, a detailed understanding of the morphology, shallow geology, and geologic processes of the area was deemed essential. The USGS, in cooperation with NOAA, WHOI, Rutgers University, and others have mapped Hudson Canyon and the adjacent continental slope and rise. The area was surveyed in 2002 using a high-resolution multibeam bathymetric mapping system, which provides resolution of sea floor features on the order of 10 meters. The survey provided a framework for defining critical habitat, for mapping areas of polluted sediment accumulation, for selecting pathways for cable routes, and for better understanding sea floor response to gas hydrates. In FY 2004 maps were completed that show the topography and geology of Hudson Canyon and the adjacent slope and rise, and will be published in FY 2005. These maps indicate that submarine landslides are more extensive than had been indicated by previous studies, and sediment waves on the continental rise suggest reworking and movement of sediment by currents associated with Hudson Canyon.

The New York/New Jersey/Connecticut metropolitan region has been an industrial and commercial center for more than 2 centuries. The nearby coastal waters of New York Bight and Long Island Sound consequently have widespread bottom sediment contamination with anthropogenic deposits up to 2 meters thick. Geologic, geochemical, and oceanographic processes act to remobilize and redistribute polluted sediments in this region, creating areas where sediments that are toxic to biota accumulate and other areas where frequent winnowing and biological activity prevent burial of contaminants. CMGP scientists have been assembling and synthesizing data on contaminants in sediments to understand their temporal distribution

and spatial variability. CMGP is providing public access to contaminated sediment data and to assist managers in sustainable use of the ocean. The contaminant data are applicable to a wide range of management issues (e.g., toxicity, dredge disposal, fisheries, eutrophication), and provide fundamental understanding of the sediment dynamics and geochemical processes that control the distribution of contaminants and benthic habitats. In FY 2004 sediment chemistry data collected by the USGS between 1993 and 2001 were assembled. These data have been plotted and assembled into a Web site that will be published as a USGS Open-File Report in FY 2005.

Within the continental United States, Lake Mead and Lake Mohave are two large reservoirs on the Colorado River that provide water for residential, commercial, and recreational users in communities across the southwestern United States. Understanding the volume of sediment in the lakes, its distribution, and the processes of sediment dispersal are of key interest to several agencies responsible for management of these lakes including the Bureau of Reclamation (BOR), NPS, U.S. Environmental Protection Agency (EPA), and Southern Nevada Water Authority. The USGS completed the first geophysical mapping of both of these lakes, and collected cores from Lake Mead. These studies were conducted in collaboration with researchers at University of Nevada, Las Vegas. The results indicate that sedimentation in the two reservoirs is quite different. A thick cover of sediment has accumulated since impoundment on the floor of Lake Mead. This sediment is derived primarily from the Colorado River and is deposited in the lake from density currents. By contrast, much of the floor of Lake Mohave has no post-impoundment sediment cover. Here, debris flow deposits and localized failure of cliffs are the only evidence of sedimentation in this lake. The debris flows result from flash floods and are transported to the lake through tributary washes, some of which are used for recreation. During FY 2004 three reports were completed that summarize the research on these lakes. This project is now complete. For more information on publications and results see "USGS Sediment Studies in Lake Mead" at <http://woodshole.er.usgs.gov/project-pages/LakeMead/index.htm>.

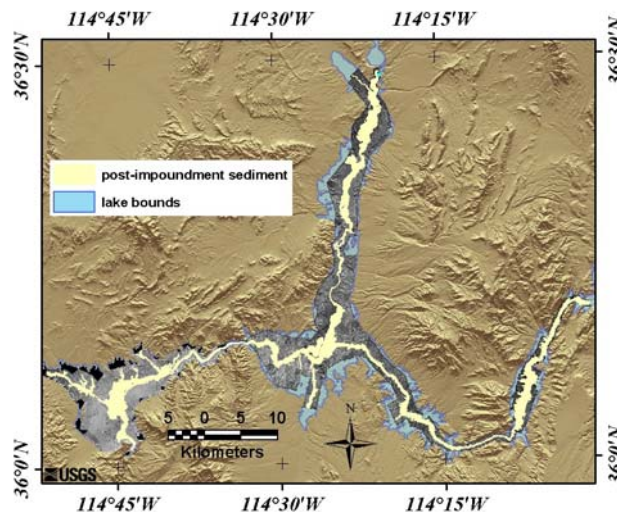


Figure 1. Distribution of post-impoundment sediments in Lake Mead. The post-impoundment sediments are concentrated in the deepest parts of the lake along the valleys cut by rivers that originally flowed through this area. These sediments form a continuous cover along the entire extent of the original Colorado River valley from the eastern extremity of the lake to the Hoover Dam in the West. Sediment filling the original Colorado River valley is thickest to the east at the mouth of the Colorado River. Here sediment is nearly 70 meters thick. It thins to 15-25 meters in the central third of the lake, and then gradually increases in thickness in the western third of the lake. Near the Hoover Dam, sediment reaches 30 meters in thickness.

Environmental Quality

The Coral Ecosystems — The CMGP corals project has made significant progress in understanding how reef organisms respond to various types of natural stress such as light limitation and temperature change, and how reefs respond to sediment deposition from the nearby watershed. Using the Submersible Habitat for Analyzing Reef Quality (SHARQ) habitat, developed and patented by USGS scientists, in numerous locations in the Florida Keys (e.g., in Biscayne Bay in response to requests from the NPS), the Caribbean, and Hawaiian Islands, scientists have quantified the impacts of external drivers such as temperature and light fluctuations on calcification, photosynthesis and respiration. Data from a number of *in situ* experiments in FY 2003 and FY 2004 combined with remotely sensed map data are enabling scientist to model impacts of global climate change, turbidity, nutrients, temperature and grazing on coral reefs.

Many of Hawaii's coral reefs are sparse and poorly developed, and the causes are complex and not well understood. An effort off the Hawaiian Island of Molokai with the Hawaii Institute of Marine Biology at the University of Hawaii measured conditions that lead to high levels of sediment movement on the reef and its impact on the reef habitat. Results showed that conditions leading to elevated amounts of resuspended mud occur several hundred times a year, and even small amounts of sediment introduced from the land significantly influence coral health. The new information, responding to the Hawaiian Local Action Strategy (LAS), has been used by EPA, the State of Hawaii Division of Aquatic Resources, and an ad hoc government and private Watershed Advisory Group to develop management plans for reducing the amount of sediment run-off in two pilot areas on the islands of Molokai and Maui.

In addition to high rates of sediment being shed from the islands, natural processes play a role in determining where reefs evolve. One such factor recently recognized to affect reef development is the pathway of coral larvae during spawning periods. By tracking the travel routes of microscopic coral larvae off the coast of Maui in late June 2003, in cooperation with the University of Hawaii, the State of Hawaii Division of Aquatic Resources, and the Maui Ocean Center, the USGS showed in FY 2004 that the stage of the tide is crucial in determining which areas receive new larvae, and that healthy reefs on Maui are a source of new corals for neighboring islands. Results from this study are helping resource managers at the State and Federal levels better understand the role of tides and local currents in seeding rocky areas with coral larvae, and to make informed judgments about location and size of potential marine protected areas.

Benthic Habitats — Geological features of the sea floor (on a scale of a meter to 100s of meters) are the framework of seabed habitats. In FY 2004, USGS habitat geoscience studies resulted in the development of an automated method to recognize and map such features by analyzing high-resolution digital bathymetric data. The analysis produces a seabed "ruggedness" index and maps that are being used to characterize benthic habitats over large areas of the sea floor. For example, in NOAA's Stellwagen Bank National Marine Sanctuary, the distribution of boulder ridges that provide essential habitat for cod and other species were identified and mapped using this approach. See the USGS Web site at <http://woodshole.er.usgs.gov/project-pages/stellwagen/seabed/index.htm>.

Also in FY 2004, the USGS and NOAA fisheries discovered an invasive colonial tunicate that has infested and covered several square miles of seabed in the famed Georges Bank offshore fishing grounds in the Gulf of Maine region. This European species is spreading rapidly and is smothering commercial sea scallops, as well as clams and worms that live in the seabed and

provide food for commercial fish stocks. The tunicate has no known predators. It also occurs in the coastal waters of New England, the U.S. West Coast, Europe, and New Zealand. USGS research results from Georges Bank and Cape Cod show that the species requires hard substrate (gravel, aquaculture structures, docks) and cannot survive habitats that are characterized by mud or moving sand. It tolerates very cold water temperatures (-2 degrees C, freezing sea water) and will be able to expand its range northward into northern New England and Canadian waters wherever it encounters suitable geological substrates. The species is very aggressive and threatens the commercial shellfish, aquaculture, and groundfish fisheries. Information on its distribution and characteristics is provided to the New England Fishery Management Council. See the USGS Web site <http://woodshole.er.usgs.gov/project-pages/stellwagen/didemnum/index.htm>.

Hazards

California — In response to the Piru and Simi fires in California, CMGP scientists deployed five instrumented marine stations directly offshore of the Santa Clara River mouth to monitor post-fire sediment dispersal processes from the local watershed. The large runoff event of late February 2004 buried the stations under 1-2 meters of sediment and charred vegetation debris. Due to the apparent magnitude of this discharge event, CMGP funded a coring cruise to measure the flood deposit on the shelf offshore of the river mouth. Thirteen box cores and six vibracores sampled the deposits and show a thin (2-3 centimeters) mud deposit centered at about 40 meters depth, and a thicker deposit of mostly sand inshore. The mud deposit had numerous black "charcoal" particles in it. Both organic and inorganic chemists are working on the geochemical nature of this deposit.

A sediment-sampling cruise led by USGS scientists in late July 2003 discovered gas hydrate, an icelike crystalline solid containing trapped molecules of natural gas, in sediment off southern California. This is the first discovery of gas hydrate in the area north of the Gulf of California and south of the Mendocino Triple Junction (in northern California). The cruise was part of the USGS CABRILLO (Southern CALifornia Bight Regional Investigations Life, Land, and Ocean) project, which addresses issues that affect southern California coastal communities. The most heavily populated urban corridor along the U.S. West Coast, the southern California coastal region hosts millions of human inhabitants onshore and countless marine organisms, including marine mammals and commercially important fish, in diverse habitats offshore. Both the human and nonhuman inhabitants are at risk from pollution and toxic waste, degradation of freshwater supplies by saltwater intrusion, and the potential for earthquakes, underwater mass-wasting events (landslides and slumps), and tsunamis. USGS scientists, in partnership with local agencies, including the Water Replenishment District of Southern California, the Los Angeles County Department of Public Works, the Southern California Coastal Water Research Project, the city of Los Angeles, the Orange County Sanitation District, and the Southern California Earthquake Center, are studying these potential threats. To estimate the mass balance of contaminants (chlorinated hydrocarbons and trace metals) associated with sediment deposited on the Los Angeles margin (Point Dume to Huntington Beach, CA), the seafloor was sampled at a site chosen for sampling sea-floor discharge of methylmercury, when gas hydrate was discovered in a short piston core taken from a water depth of 813 meters near the summit of a mud diapir in Santa Monica Basin. Fresh mussel shells recovered from the top of the core indicate the presence of a "cold seep" community supported by methane venting from the diapir.

Infrastructure at Risk — CMGP scientists from Menlo Park compiled regional seismic and geologic information on seismic hazards in the Santa Barbara Channel. The study examines regional seismic and geologic hazards that could affect proposed liquefied natural gas (LNG)

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facilities in coastal Ventura County, CA. The salient information follows: faults throughout this area are thought to be capable of producing earthquakes of magnitude 6.5 to 7.5, which could produce surface fault offsets of as much as 15 feet. Many of these faults are sufficiently well understood to be included in the current generation of the National Seismic Hazard Maps; others may become candidates for inclusion in future revisions as research proceeds. The estimated probability of a magnitude 6.5 or larger earthquake (comparable in size to the 2003 San Simeon quake) occurring in the next 30 years within 30 miles of Platform Grace is 50 to 60 percent; for Cabrillo Port, the estimate is a 35 percent likelihood. Combining these probabilities of earthquake occurrence with relationships that give expected ground motions yields the estimated seismic-shaking hazard. In parts of the project area, the estimated shaking hazard is as high as along the San Andreas Fault. The combination of long-period basin waves and LNG installations with large long-period resonances potentially increases this hazard.

Extreme storms such as hurricanes are an annual threat to our coasts. CMGP scientists respond to all category 3 (and higher) hurricanes by assessing pre- and post-storm impacts with the overall objective to improve the capability to predict coastal change that results from severe tropical and extra-tropical storms. Such a capability will facilitate assessment of the vulnerability of coastal infrastructure and communities to coastal storms. In FY 2004 for the first time, CMGP scientists made available to the public an assessment of potential impact of Hurricanes Frances and Ivan before landfall. For example, on September 14, 2004, as of the 11:00 a.m. National Hurricane Center (NHC) forecast, the barrier islands from Louisiana to the panhandle of Florida were within the cone of uncertainty for the path of Hurricane Ivan. In a cooperative research program between the USGS and NASA, these islands were surveyed using airborne laser mapping (LiDAR) providing, for the first time, detailed elevation maps of the island's "first line of defense," essentially the Gulf-front dune (or in the absence of dunes, the crest of the beach berm or cliff). The maps show where the "first line of defense" would be inundated by worst-case storm surge associated with different category hurricanes. The model storm-surge elevations, obtained from NOAA, represent the maximum simulated surge that will result along the open coast from hurricanes of a given category approaching from different directions and at different speeds. This experimental product is based on research results of the USGS National Assessment of Coastal Change Project and applies to potential changes to the coast (e.g., erosion, inundation, overwash) caused by storm surge, ocean waves, and associated currents. The vulnerability assessment does not directly consider potential property damage or the impacts of high wind speeds and heavy rain. The actual changes that occur to the coast during extreme storms are complex functions of a number of processes and variables.

Numerous hurricanes have impacted North Carolina in recent years—including hurricane Isabel in September 2003 and Alex in August 2004—resulting in severe coastal and inland flooding, erosion of hundreds of kilometers of shoreline, damage or destruction of thousands of homes, and disruption of transportation arteries. These impacts to the coastal zone occur against a backdrop of continued sea-level rise, chronic erosion, and the likelihood that the United States is entering a period of higher hurricane risk. The North Carolina coast attracts significant tourism to its parks and beaches, including Cape Hatteras and Cape Lookout National Seashores, and Pea Island National Wildlife Refuge. A number of coastal communities and local fishing industry are all impacted by coastal change. USGS, the North Carolina Geological Survey, East Carolina University, and other academic investigators are collaborating to map the regional coastal system of northern North Carolina to understand the geologic history and physical processes of the coastal system, especially coastal erosion. Among the issues being addressed are (1) shoreline erosion, (2) storm dynamics and coastal system response, (3) location of sand resources for beach nourishment, (4) quality of crucial water resources, (5) record of climate and sea-level change, and (6) habitat evolution within the

barrier islands and estuaries. In FY 2004, the project completed its 4-year effort to collect geophysical data for the inner continental shelf from Virginia to Cape Lookout, and the corresponding backbarrier estuarine system (see the accompanying figure). Drill holes and monitoring wells have been installed in collaboration with the USGS Water Resources Discipline. Ongoing work is measuring and modeling the shoreline response to severe storms.

In FY 2004, the project published its first major publication, on sea-level rise and estuarine dynamics (ISBN 0-9747801-0-3, 153 p.), that represents a synthesis of coastal processes in the North Carolina Outer Banks estuarine system. This CMGP effort provides information essential for resolving critical questions associated with utilizing and managing this extremely dynamic coastal system, and furnishes a sound scientific basis for policy and regulatory decisions. Findings from this study are being used by (1) NPS to assess the impacts of proposed coastal mitigation strategies and transportation corridor planning, (2) FWS to evaluate the environmental consequences of inlet abandonment, and (3) USACE and State Department of Transportation to refine sand resource exploration strategy. NPS, FWS, USACE, and several State agencies are presently debating a number of issues related to mitigation of coastal erosion and inlet dynamics in the study area. This project provides a critical foundation of objective information and scientific analyses that serves all stakeholders.

Much of the South Carolina coastline is heavily developed, supporting large populations and infrastructure, and robust commercial and tourism industries. The continued success of these coastal economies is closely related to the health of local shorelines, which mitigate the potential for property loss and damage associated with coastal erosion and severe storm events. The USGS, the NOAA Sea Grant Consortium, the State of South Carolina, several university partners, and the USACE, Charleston District are working in cooperation to provide a sound scientific understanding of the factors that control coastal erosion, sediment availability and transport, habitat distribution and vulnerability to coastal change along coastal South Carolina. The main objectives of the study are to (1) evaluate the role that older geologic units, underlying the lower Coastal Plain and inner-shelf, play in the evolution of the coastal system, (2) assess sediment distribution and the mechanisms and pathways by which sediment is transported, and (3) develop a conceptual sediment budget, based upon qualitative observations from geologic mapping and shoreline erosion/accretion rates, that will be tested and supplemented by quantitative measurements of the physical processes that drive inner-shelf circulation and sediment transport.

Between FY 2001 and FY 2003, field programs completed the acquisition of geologic mapping data along the lower Coastal Plain and shallow inner-shelf of Long Bay. Final processing and interpretation of these data have been completed, and preliminary reports were released during FY 2004. Results from high-resolution geophysical mapping within the inner-shelf were immediately useful in identifying new aggregate resources for planned beach nourishment projects, and providing new baseline maps for ongoing biological habitat studies within the region. Integrated interpretation and analysis of onshore and offshore geologic mapping, high-resolution shoreline mapping and Coastal Plain geomorphology has begun and will continue through FY 2005, and be completed during FY 2006. Preliminary results indicate a complex geologic framework in which differential erosion of older, underlying units have heavily influenced the evolution of the region, exerting control over the locations of river systems and tidal inlets, modern depositional patterns, and areas of chronic erosion. Between late FY 2003 and FY 2004, physical oceanographic data were acquired at select sites within Long Bay, with the intent of quantifying the physical processes responsible for driving inner-shelf circulation and sediment transport. Analysis, modeling and interpretation of these data will continue through FY 2005 and into FY 2006. Findings from this phase of the study will be used to test and

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supplement conceptual sediment budget analyses that were completed in FY 2003, and will ultimately be included in an overall data synthesis that will be completed during FY 2006.

In Southern Louisiana, large areas of wetlands are being converted to open water each year. CMGP scientists working to unravel the causes and rates of subsidence in FY 2004 found:

- Rapid wetland loss resulted from widespread delta plain subsidence (confirmed by coring analyses). Cores taken where wetlands were converted to open water show minimum subsidence magnitudes of 50 cm to 150 cm,
- Subsidence rates calculated from National Geodetic Survey releveling data show that subsidence rates increased between the 1970s and 1980s, and highest subsidence rates were located near oil and gas fields and associated faults, and
- Detailed analyses of aerial photographs and satellite images show that recent rates of wetland loss in south Louisiana are substantially lower than previously reported, which is a trend consistent with greatly reduced rates of oil and gas production from the same area. These results will be used in wetlands restoration planning by the USACE, the Louisiana Department of Natural Resources, and local land managers. Partners in this research include investigators from the University of New Orleans and Louisiana State University.

Resources

Discharge of Ground Water to Atlantic Estuaries — In FY 2004, USGS scientists performed field investigations of ground-water discharge to estuaries in North Carolina and Massachusetts, prepared presentations on these efforts for national scientific meetings, and published an overview report on the project (see <http://soundwaves.usgs.gov/2004/06/research4.html>). For an article on North Carolina work, see <http://soundwaves.usgs.gov/2004/06/fieldwork.html>.

The USGS CMGP, Geologic Discipline Venture Capital Fund, Eastern Regional Integrated Science Fund, and Water Resources Discipline (WRD) Programs (North Carolina and Massachusetts/Rhode Island Districts, and National Research Program) primarily supported the research. The work contributes to a larger program seeking to understand the causes of excess algal blooms and general environmental degradation attributed to nutrient over-enrichment in coastal bays along the Atlantic coast. Collaborators and stakeholders include: WHOI, East Carolina University, the National Park Service-Cape Cod National Seashore (CCNS), Waquoit Bay National Estuarine Research Reserve (NOAA), Marine Corps Air Station Cherry Point, Massachusetts Office of Coastal Zone Management and other State agencies, as well as towns and citizens' groups.

Through acquisition, development, and application of new sampling and surveying techniques (reusable piezometers, streaming electrical resistivity, radon and water quality mapping), and execution of time-series experiments, CMG investigators have shown (1) locations of ground-water discharge to estuaries can be mapped rapidly using dissolved radon gas as a tracer, (2) discharge of ground water can be quantified by independent means in enclosed bays, and is generally greatest at low tides, and (3) the lateral and vertical edges of the freshwater-saltwater interface can be very sharp in the subsurface beneath estuaries. These results show that the influence of ground water on coastal bay systems is unpredictable, and can be highly variable in both space and time. Numerical flow models that have been developed in the past using generalized properties of coastal ground-water systems can now be refined to incorporate these

new observations and better inform nutrient management decisions. Three papers describing previous work were scheduled for publication published in Ground Water in December 2004.

USGS Gas Hydrate Studies — USGS continues to work with the Department of Energy, other Federal agencies, industry partners, and academic collaborators to understand gas hydrates in the natural environment, as laid out in the Methane Hydrates Research and Development Act of 2000 (P.L. 106–193). Marine studies are undertaken to understand how drilling through shallow gas hydrate layers might pose a hazard to deep-water hydrocarbon production in the Gulf of Mexico. In June 2004, USGS participated in a collaborative research cruise to obtain electrical soundings and bottom photographs of two sea-floor mounds in the northern Gulf of Mexico where industry sponsored drilling of gas hydrate will occur in spring 2005. Preliminary analysis of these photographs indicates active fluid venting, recent mud flow movements, and unusual concentrations of biota including bacterial mats. In addition, USGS has conducted laboratory experiments on methane hydrate and tetrahydrofuran hydrate to understand how acoustic, strength and thermal properties vary during hydrate formation, melting, and changing environmental conditions. These measurements are used to help constrain interpretations of well-log data during drilling and develop parameters used in modeling hydrate occurrence. A surprising result is how grain size affects behavior, such as velocity of sound through a hydrate-bearing sample. These analyses are on-going and are being used in developing hypotheses of hydrate occurrence in the Gulf of Mexico that will be tested during industry drilling in 2005.

Information and Technology

Coastal Sediment-Transport Model — Coastal ocean models are important tools used for navigation, oil-spill response, search and rescue, naval tactical operations, remediation of contaminated seafloors, management of coastal resources, and prediction of coastal erosion. Community models are collaborative efforts among developers (oceanographers, geologists, ecologists, and computer scientists) and users (researchers, coastal resource managers, and tactical decisionmakers). Participation of a large group of developers and users has resulted in an advanced and complex but well-tested modeling system. In FY 2003, the USGS made significant contributions to a community computer model for simulating coastal currents and sediment transport. In FY 2004, the model was improved and used in a number of key projects. For example, the model has demonstrated that it can simulate realistic changes in bottom sediments caused by severe winter storms that episodically hit Massachusetts Bay. In South Carolina, the model is being used to help determine whether offshore sand ridges are active or relict, and whether they influence nearshore waves and coastline evolution. The model has been used to study estuarine circulation in the Hudson River, and has been used to help explain sediment dynamics in the Adriatic Sea as part of the international EuroSTRATAFORM project. Products from the National Community Sediment-Transport Model Project in FY 2004 include revised model code (available at <http://marine.rutgers.edu/po/index.html>), a USGS Fact Sheet (approved and in publication), several scientific papers, and a general interest magazine article (Sherwood et al., 2004, *Oceanography*, vol. 17).

Analyses of Data from Acoustic Instruments — The USGS uses a wide variety of oceanographic instruments that rely on sound to measure currents, suspended sediments, or bottom features. During FY 2004, significant progress was made developing software to analyze data from pulse-coherent acoustic Doppler profilers (PCADP) and acoustic Doppler velocimeters (ADV). These instruments measure currents and generate data in a proprietary binary format. USGS developed-software performs quality checks on these data, embeds metadata to describe the deployment conditions, and reformats the data in netCDF, a widely

Geologic Landscape and Coastal Assessments Subactivity

used format that is portable, self-describing, and can be read with public domain software. CMGP scientists also developed a laboratory test facility for calibrating the acoustic backscatter sensor (ABS), an instrument for measuring suspended-sediment concentration profiles. Software developed for the ABS allows us to analyze test-facility data and determine calibration coefficients. Finally, software to map data from the imaging sonar and quantify ripple dimensions was written. USGS software is shared internally and with contributing external collaborators via a Lotus Notes Quickplace.

2005 Planned Program Performance

Unless otherwise noted, the program accomplishments listed below demonstrate the utility of scientific publications and other products counted under the output measures for "number of long-term data bases maintained," "systematic analyses delivered to customers," and "number of formal workshops and training provided to customers."

The Coastal and Marine Geology Program will continue to maintain and update the following long-term databases:

- Antarctic Data Library – currently 45 gigabytes, add 5 gigabytes/year, cost to maintain ~\$50,000 per year, and
- Tampa Bay (<http://gulfsci.usgs.gov/tampabay/>) data base now enlarged to include Gulf of Mexico coastal data – currently 5 gigabytes, add 3 gigabytes/year. Cost to maintain ~\$30,000 per year.

The CMGP will deliver the following analyses in FY 2005:

- Sediment Transport: Updated Community Sediment Model (ROMS 2.2; cost ~\$2 million) Louisiana and New York Bight Offshore Sand and Gravel Assessment Report (synthesis of reports, maps and computer visualizations; cost ~\$1 million).
- Gulf of Mexico Gas Hydrate Giant Piston Coring Results (Synthesis publication of all field data and analyses of hydrate occurrence in the GOM; cost ~\$750,000).
- National Assessment of Shoreline Change: Historical Shoreline Changes and Associated Coastal Land Loss Along the California Coast (cost ~\$500,000).
- South Carolina compilation of maps showing the Modern sediment distribution on the inner shelf and shoreface of South Carolina's Long Bay from Little River Inlet to Winyah Bay. September 2005, cost ~\$2.4 million. This work, the South Carolina Coastal Erosion Study Web site and Fact Sheet, are bundled under this product.
- National Benthic Habitat Studies – Atlantic. Valentine, P.C., editor, 2005, Sea floor image maps showing topography, sun-illuminated topography, backscatter intensity, ruggedness, slope, and the distribution of boulder ridges and bedrock outcrops in the Stellwagen Bank National Marine Sanctuary region off Boston, Massachusetts: U.S. Geological Survey Scientific Investigations Maps I-2840-A thru F, 12 sheets, scale 1:60,000, CD-ROM. Cost ~\$2.1 million over 8 years.
- Fate of Contaminants and Sediments in Massachusetts Coastal Waters. Synthesis of Massachusetts Bay and Boston Harbor work, will be Web (CD) based. Cost ~\$1.6 million SIR, \$1.6 million Massachusetts Water Resources Authority.

- Synthesis of Pulley Ridge Sediments and Biota. (Marine Geology publication together with previously published abstracts, posters and presentations synthesizes the results of a 5-year effort.) Cost ~\$2 million.

Workshops (FY 2005)

- Southern California: November 22-24, 2004. Objective: present results to date, develop plans for final synthesis volume. Attendees: USGS scientists.
- Integration of Hydrates Lab and Modeling Efforts, March 2005. Objective: develop long term recommendations for identifying key laboratory and modeling parameters. Participants: representatives from USGS, National Labs, academia and private industry.
- Modeling Workshop: March 2005. Objective: information exchange and assessment of current and future science needs/directions. Participants: USGS and external scientists.
- North Carolina: November 18-19, 2005. Purpose: present work to date and finalize plans for final project years. Attendees: project participants.
- North Carolina: June 2005: Purpose: to examine, log and sample drill cores from the NC coastal zone. Attendees: project participants and cooperators.
- Tobago Lidar Workshop, November 9-11, 2004, Scarborough, Tobago, Trinidad and Tobago. Participants: scientists, NGOs and local land managers.
- Knowledge Bank/Management Workshop: March 2005. Purpose: organize standards for new data types, presentation of Monterey Bay node. Participants: CMG Web masters, data experts and outside experts.
- Deep Coral Ecosystem Workshop, Summer 2005. Purpose: outline direction of coral research within USGS. Participants: USGS and external scientists, selected Coral Reef Task Force and DOI representatives.
- 4th Annual Gulf of Mexico Integrated Science – Tampa Bay Study Conference, January 2005. Purpose: report progress and provide opportunity for USGS managers and external Science Advisory Council to review progress. Participants: USGS scientists and local stakeholders; open to the public.
- Tampa Bay training session for local stakeholders and managers, Spring 2005.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Coastal and Marine Geology (\$000)	\$38,436	+\$576
FTE	234	+3

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs and technical adjustments.

The FY 2006 budget request for Coastal and Marine Geology Program is \$38,436,000 and 234 FTE, a net program increase of +\$979,000 (includes adjustments for uncontrollable costs and technical adjustments) and an increase of +3 FTE from the 2005 enacted level.

Puget Sound (+\$912,000) — The increase will provide funding to expand the USGS participation in the Puget Sound Nearshore Ecosystem Restoration study. Determining the extent of degradation to nearshore environments will require a significant, dedicated effort. The increase will provide the science required by the Puget Sound Nearshore Ecosystem Restoration Partnership (ACOE, other Federal agencies, State resource agencies, local governments, commercial and non-governmental organizations) to evaluate critical habitat restoration and preservation solutions. The increase will support engagement of broad multidisciplinary research expertise in an effort to provide the integrated science needed for local and regional habitat restoration efforts. This represents a further implementation of the comprehensive USGS National Coastal Plan and project activities will be developed collaboratively with regional leadership, local partners, and the USGS Priority Ecosystems Science program. Efforts will build on FY 2005 activities focused on priority ecosystem components in the Skagit Delta, the Elwha River, and throughout the Puget Sound ecosystem. As a result, one additional workshop will be supported in FY 2006.

Tsunami Hazards Investigations (+\$1,000,000) — Efforts will be expanded to develop enhanced geological and geospatial information to improve regional assessments of tsunami hazard potential. FY 2006 activities will focus on tsunami hazards in the Caribbean, particularly Puerto Rico and the U.S. Virgin Islands, through enhancement of coastal and marine mapping activities and application of tsunami models. The USGS will acquire existing high-resolution elevation data for nearshore and coastal regions of Puerto Rico and the U.S. Virgin Islands and begin development of improved elevation models to constrain tsunami inundation models. Coastal mapping in Puerto Rico will assess the potential to identify and characterize past tsunami events in support of probabilistic hazards assessments. Marine geophysical surveys in regions associated with past tsunami events will be undertaken to assess future tsunami source potential. Computer simulations from these potential tsunami sources will help identify coastal regions vulnerable to inundation. Synthesis of this new information with available data, along with characterization of regional seismic activity, will result in improved tsunami hazard assessments and maps for Puerto Rico and the U.S. Virgin Islands. As a result, one additional workshop will be supported in FY 2006.

Coastal Erosion Study (-\$1,248,000) — The South Carolina Coastal Erosion study will be brought to completion with final year efforts exclusively focused on generation of final products by research staff within the USGS and cooperating agencies. No funding will be provided for field work by either the USGS or cooperators and efforts to develop and validate regional models synthesizing previously developed geological and oceanographic information will be eliminated. As a result one fewer analysis will be delivered in FY 2006 and one fewer workshop will be held.

Geologic Resource Assessments Subactivity

Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Mineral Resources	55,481	53,764	+1,140	-29,820	25,084	-28,680
FTE	408	398	0	-240	158	-240
Energy Resources	25,068	23,250	+419	-54	23,615	+365
FTE	165	160	0	0	160	0
Total Requirements \$000	80,549	77,014	+1,559	-29,874	48,699	-28,315
FTE ^{b/}	573	557	0	-240	317	-240

^{a/} Changes for this program element include a reduction of -\$110 for travel. The impact of this change is described in the Program Changes section beginning on page G-1.

^{b/} FTE may not add to total, due to rounding.

Mineral Resources

2006 Program Overview

The 2006 budget request for the Mineral Resources Program is \$25,084,000.

The United States is the world's largest user of mineral commodities. Processed materials of mineral origin accounted for over \$418 billion in the U.S. economy in 2004 (an increase of 13 percent over 2003). U.S. manufacturers and consumers of mineral products depended on other countries for 100 percent of 17 mineral commodities (an increase of 18 percent over 2003) and for more than 50 percent of 42 mineral commodities (an increase of 14 percent over 2003) that are critical to the U.S. economy. Making informed decisions about supply and development of mineral commodities requires current and reliable information about both mineral resources and the consequences of their development.

USGS Mineral Resources Program (MRP) is the sole Federal provider of scientific information for objective resource assessments and unbiased research results on mineral potential, production, consumption, and environmental effects. As described in the Program Assessment Rating Tool (PART) review, the MRP role is clearly defined and unique from other Federal, State, local, or private entities. The MRP was reviewed in FY 2003 for the FY 2005 budget using the PART and was found to be working effectively with partners and fulfilling its missions, and, as a result, received a score of 80.

This program addresses the Department of the Interior (DOI) Resource Use strategic goal of managing resources to enhance public benefit, promote responsible use, and ensure optimal value of non-energy minerals. To clearly measure USGS progress in providing information, four outcome measures (percent of the United States with geochemical and lithologic data coverage; percent of customers satisfied with the timeliness of data; percent of customers who have their minerals data needs met; and percent of studies validated through appropriate peer review or independent review) were identified in partnership with DOI and OMB and designed to roll up

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into the intermediate goal of improving the information base, information management, and technical assistance. Outputs include the number of systematic analyses and investigations delivered to customers, the number of long-term data collections maintained, the number of formal workshops or training provided to customers, and the number of decision support tools.

The MRP comprises two major functions, a research and assessment function that provides information for land planners and decisionmakers about where mineral commodities are known and suspected in the Earth's crust, and a data collection, analysis, and dissemination function that describes current production and consumption of about 100 mineral commodities, both domestically and internationally for approximately 180 countries. Each function supports the other, and each meets the needs of different parts of the diverse community of mineral resource information users. Together these activities provide information ranging from that required for land planning decisions on specific management units to that required for national and international economic decisions.

Overall direction for the MRP is established by a 5-Year Plan that results from internal and external inputs such as USGS and DOI strategic plans, the results of periodic reviews (every 5 years) by committees overseen by the National Research Council (NRC) (with 9-12 members representing various sectors of the minerals industries, State and local governments, and academia), workshops with stakeholders on specific topics (such as abandoned mine lands or opportunities for collaboration in materials flow studies), and the advice of senior scientists within and outside USGS. The appropriateness of the specific directions of projects designed to meet the goals of the 5-Year Plan is assured by requiring internal and external management and scientific review of project concepts in the formative stages and of project proposals submitted for initial funding, by periodic review of progress of multi-year projects, and by peer review of the reports of project results at completion.

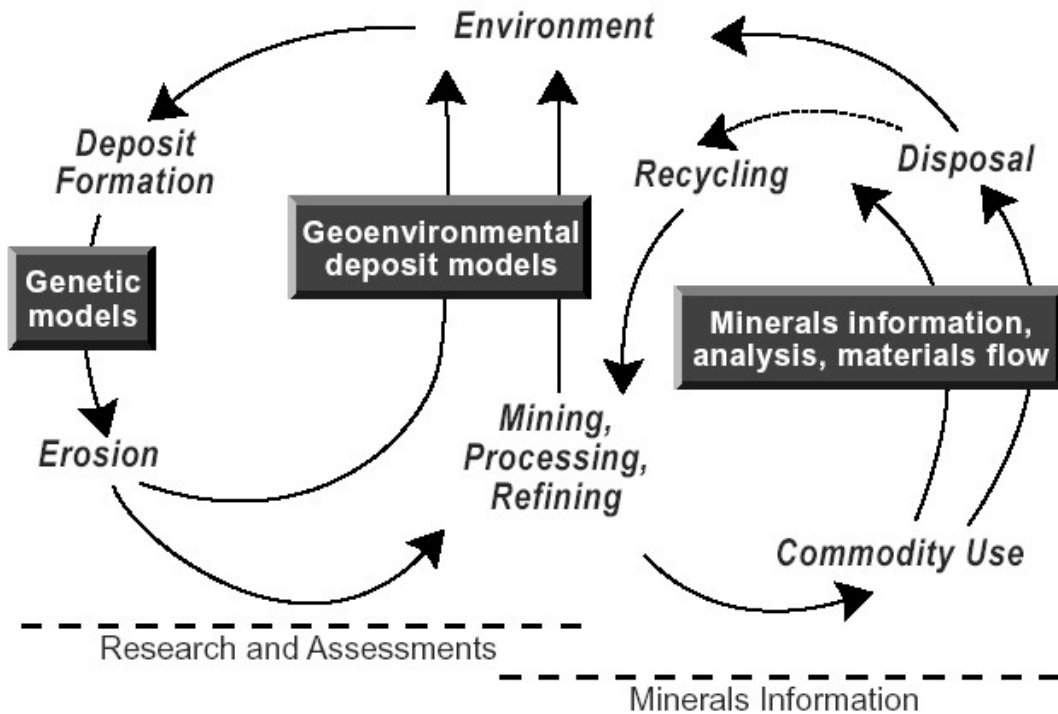
Results of scientific studies conducted under the MRP 5-Year Plan provide:

- Regional-, national-, and global-scale assessments of the potential for undiscovered mineral deposits, which provide the potential supply framework against which national and international decisions can be made with respect to access to land, maintenance of materials stockpiles, focus of research on alternative (substitute) materials, and requirements for recycling of the built environment,
- Public access to reliable methods of geochemical and geophysical analysis of inorganic materials,
- Systems understandings on which to base improved (less costly, less destructive) processes for remediation of abandoned mine sites and other brown fields contaminated with inorganic toxins, and
- Reliable long-term raw and interpreted baseline data at regional- to national-scale against which to measure environmental conditions.

Life cycle analysis of non-fuel mineral systems (see diagram) demonstrates the connections between various natural and anthropogenic processes through which minerals are made available to sustain developed societies. MRP's scientific activities in FY 2005 address the full minerals life-cycle and are managed in two large categories, shown on the diagram as Research and Assessments (left side) and Minerals Information (right side). The research and assessment function provides information for land planners and decisionmakers about where mineral commodities are known and suspected in the Earth's crust; the minerals information

function provides data collection, analysis, and dissemination that describe current production and consumption of about 100 mineral commodities, both domestically and internationally for approximately 180 countries. Each function supports the other, and each meets the needs of different parts of the community of mineral resource information users, including Federal, State, and local land managers; Federal, State, and international departments and agencies concerned with materials availability, defense, security, the economy, trade, environmental management, human health and safety; private sector companies concerned with materials availability, defense, security, the economy, trade, environmental management, human health and safety; academic institutions; policymakers in the U.S. Congress and State legislatures; and the general public.

Life Cycle Analysis of Non-fuel Mineral Systems



MRP's regional, national, and global mineral assessments provide broader context for long-term land use and economic policy planning, rather than from one company's or one country's perspective. The MRP reports on mineral commodity production, consumption, and recycling worldwide facilitate development of macroeconomic policy and provide information, objective resource assessments, and unbiased research results on mineral potential and environmental effects for use by land managers and policymakers to support resource use decisions that enhance public benefit, promote responsible use, and ensure optimal value.

Geologic Resource Assessments Subactivity

The Federal Land Policy and Management Act of 1976 requires USGS to "conduct mineral surveys of public lands to support the designation of Wilderness Areas . . . Prior to BLM making any recommendation for the designation of any area as wilderness, the Secretary of Interior shall cause minerals surveys to be conducted by USGS." In addition, USGS has significant responsibilities deriving from the Minerals Policy Act of 1970 and the National Materials and Minerals Policy, Research, and Development Act of 1980. The MRP responds to these and other economic and public policy needs of the Nation with both the research and data functions of the program. In addition to assessments of the potential for undiscovered mineral deposits, the MRP provides long-term national and regional data on mineral potential, production, use, and recycling to land-management agencies, regulatory agencies, industry, academia, and the public. MRP statistics and information on the global supply of, demand for, and flow of minerals and materials essential to the U.S. economy, national security, and environmental protection are available on the World Wide Web (<http://minerals.usgs.gov/minerals/>). Customer satisfaction surveys of use of data from the national mineral resource assessment, minerals databases, and geochemical data indicate a total satisfaction score of 86 percent.

Results of scientific studies conducted under the MRP research and assessment and minerals information dissemination categories include:

- Regional-, national-, and global-scale assessments of the potential for undiscovered mineral deposits, which provide the potential supply framework against which national and international decisions can be made with respect to access to land, maintenance of materials (mineral) stockpiles, research on alternative (substitute) materials, and requirements for recycling of mineral materials,
- Public access to reliable methods of geochemical and geophysical analysis of inorganic materials,

Coeur d'Alene Basin: Information on Zinc and Lead Contamination Provided to National Research Council

The Coeur d'Alene mining district ranks as one of the world's largest producers of silver and one of our Nation's major producers of lead and zinc. Although today the mining activities in the district are environmentally sound, historic ore processing methods and periodic flooding of rivers have resulted in the dispersion of metal-enriched sediment at least 150 miles downstream of the mining district. Long-term litigation issues, health problems, environmental impacts, and remediation activities in this area require fundamental information about the distribution, mobility, and geoavailability of toxic elements in the basin. In June 2004, MRP scientists presented the results of studies on the Coeur d'Alene Basin (completed in FY 2002) to the NRC's committee on Superfund Site Assessment and Remediation. The committee was charged with independently evaluating the Superfund site in northern Idaho as a case study to examine the EPA's scientific and technical practices in Superfund site area characterization, human and ecological risk assessment, remedial planning, and decisionmaking. USGS presentations were focused on the distributions and behavior of zinc and lead in the water and sediments of the Coeur d'Alene River and Lake Coeur d'Alene. In collaboration with researchers from the University of Western Australia, MRP scientists provided information that will be incorporated into detailed hydrodynamic and ecological models for Lake Coeur d'Alene; these models will be used by the EPA and other agencies to evaluate alternative management scenarios for the lake. A talk and field trip by MRP scientists addressed two additional issues relevant to the NRC review: (1) the size and shape and metal content of metal-enriched sediment deposits in the valley of the South Fork and main stem of the Coeur d'Alene River and (2) the ongoing movement of metal-enriched sediment in the basin including the rate of movement, metal content, and the source of the metal. The NRC report is in preparation and due to be released in mid 2005. This type of mineral resource assessment work supports the MRP 5-Year Plan goal to understand the influence of mineral deposits, mineralizing processes, and mineral-resource development on environmental integrity, ecosystems, public health, and geologic hazards.

- Systems understandings on which to base improved (less costly, less destructive) processes for remediation of abandoned mine sites and other brown fields contaminated with inorganic toxins,
- Reliable long-term raw and interpreted baseline data at regional- to national-scale against which to measure environmental conditions, and
- Long-term statistics and interpreted data on production and consumption of mineral commodities in the United States and in 180 countries.

To clearly measure the progress MRP is making to provide information required by its customers, four intermediate output measures have been identified. Outputs associated with these measures include systematic investigations and analyses delivered to customers, the maintenance and updating of five long-term data collections, providing formal workshops or training to customers, and the continued updating and maintenance of one decisionmaking support system. Outcome measures include a measure of the percentage of the United States covered by basic data for decisionmaking related to minerals issues. In response to the PART process, MRP also reports measures capturing the percentage of targeted analyses/investigations delivered that are cited by identified partners within 3 years of delivery, and a report of progress toward a targeted completion date for conversion of mineral commodity canvass forms to an electronic format.

MRP tracks progress in providing baseline information available to support management decisions as indicated in the DOI strategic goal to manage or influence resource use to enhance public benefit, promote responsible use, and ensure optimal value; this measure is also described in the PART. This intermediate outcome measure is defined as the average square mileage of non-energy mineral areas having adequate information (mineral deposit, geologic map, and geophysical information) available to support management decisions.

During FY 2004, the NRC review of MRP was published. The NRC recommendations are being used in the development of a new 5-Year Plan for the program; the plan is expected to be completed in FY 2005.

The 2003 review of MRP by the National Research Council recommended that "the MRP establish an external documented review procedure in accordance with USGS guidelines that will evaluate program outcomes relative to those planned." In response to this recommendation, a Federal Advisory Committee will be established for the MRP in FY 2005. There will be eight external members, representing the industrial, academic, and governmental mineral communities, and two USGS members. Selection of individuals for the Committee shall be based on established records of distinguished service and expertise in mineral resources. The governmental members will include at least one member each from the Bureau of Land Management and the U.S. Forest Service. The Committee will periodically review the MRP 5-Year Plan and scientific progress of the program, including the goals and objectives within that program, its capabilities and research needs, guidance on achieving major objectives, and establishing and measuring performance goals. The Committee will also review current or future mineral science issues as they relate to the MRP and make recommendations to the program regarding those issues.

In recent reviews of the MRP, the National Research Council has consistently recommended developing an external grants program to assist MRP's basic research function. In March 2004, the Mineral Resources External Research Program (MRERP) was

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introduced and research-based proposals that supported the goals of MRP were solicited. The new MRERP was announced and managed using the Grants.gov system, as mandated by the President's Management Agenda (<http://www.grants.gov>). In June 2004, the USGS announced that 6 of the 34 proposals received would be funded for mineral-resources research; total funding awarded was \$200,000. The grant recipients were researchers at Oregon State University, University of Florida, Colorado School of Mines, University of Alaska at Fairbanks, Southern Illinois University, Washington State University, and the Idaho Geological Survey. The overall quality of the proposals that were reviewed by a panel of six research scientists (five from SUGS and one external to USGS) was high, and USGS has high expectations that grants program will offer opportunities for collaborative research and synergy.

Research and Assessments

(Estimates for FY 2004, \$39.6 million; FY 2005, \$38.3 million; FY 2006, \$11.4 million)

Research and assessments activities of the MRP provide unbiased science in support of the Nation's need for a sustainable supply of mineral commodities, for protection of human and ecosystem health, and for sound public policy decisions. Research and assessments projects include mineral resource and mineral environmental assessments, geo-environmental models of ore deposits and ore-forming systems, regional and national scale assessments of backgrounds and baselines, genetic models of ore deposits and ore forming systems, methods development (geochemistry, geophysics, remote sensing, mineral resource/mineral environmental assessments), and information management and delivery.

USGS assessments of the distribution, economic significance, and environmental impact of development of the Nation's mineral resources are conducted on regional, national, and global scales to meet the needs of land-management agencies and national policymakers. Current projects include (1) a global assessment of potential for undiscovered deposits of copper, platinum, and related metals, zinc, lead, nickel, gold, potash, and phosphate, which is expected to provide information on which to base regional to national land management policy and (2) a study of Federal lands in north central Colorado, which is expected to produce information on which land managers can base decisions at the scale of a land management unit.

Current activities include projects that provide geospatial minerals, geologic, geochemical, and geophysical information for land stewardship and management plans in national parks, national forests, and Bureau of Land Management (BLM) resource areas. Current activities also include enhancement of national geospatial databases that allow rapid response to land management concerns. New collaborations began in FY 2003 (scheduled for completion in FY 2007) in Big Bend National Park, on BLM lands on the western slope of Colorado, and in national forests in north central Colorado. Each of these projects is designed to address the respective land manager's need for specific information about mineral deposits (which may be sources of inorganic toxins in Big Bend National Park), the processes by which they are formed (to minimize release of toxic metals from mineral-rich black shales in western Colorado), and the potential for discovery of new deposits on or near Federal lands (necessary for planning, particularly in areas affected by urban-wildland interface issues, such as north central Colorado).

Environmental effects associated with mineral deposits result from natural processes, mining, and mineral processing, and are key issues in national and global mineral-resource utilization. The abundance, compositions, and environmental availability of minerals or their contained elements in rocks and soils define the geochemical landscape and directly influence nutrient

availability, toxic element concentration, vegetation distribution, and the general health of ecosystems. The MRP conducts geologic, environmental, and public health studies in cooperation with land-management agencies, biologists, medical professionals, States, universities, and industry.

Mineral-deposit research provides the fundamental knowledge used to understand where minerals occur and how they interact with the environment. Understanding the origin of mineral deposits and developing genetic components of mineral-deposit life-cycle models are fundamental requirements for construction of appropriate deposit models and for accurate assessment of the Nation's mineral resources. Concepts of ore genesis evolve over time as the understanding of geologic and ore-forming processes increases, as new deposit types are recognized, and as technology advances.

The MRP supplies objective scientific information, research, and assessments that are used by others for prioritizing mitigation and restoration projects, developing mitigation and restoration strategies, and formulating regulatory policy. Through the use of remote-sensing technologies such as imaging spectroscopy, developed by the MRP with the National Aeronautics and Space Administration (NASA), USGS scientists map environmentally significant characteristics such as mineral alteration, mineral distribution, and vegetation health. Current MRP activities include examining how minerals affect ecosystem health; characterizing the source, transport, and fate of toxic elements, particularly mercury and arsenic; investigating timely and efficient approaches to improving soil geochemical information for the Nation; and developing regional and national geologic, geochemical, and geophysical baselines and background maps and databases.

MRP has placed increased emphasis on electronically disseminating its national and regional databases of geochemistry, geophysics, mineral and mine localities, and lithology. For example, USGS National Geochemical Database is a digital repository of about 70 million analytical determinations made on approximately 2 million samples of geologic material such as rocks, stream sediments, and soils. The data provide information essential to land-use planners and industries across the Nation, including analytical determinations for potentially toxic trace elements. The data are used to produce geochemical maps, determine background values for selected elements, and, in combination with other data, allow investigation of issues ranging from agro-chemical impacts on the environment and human health to forecasting the nature and distribution of mineral resources. Collaborative work with State agencies, USGS scientists, and data managers has led to major improvements in the reliability and accessibility of this critical database. The database project goals were redefined in FY 2003 to emphasize creation of a Web-enabled search and download capability.

Development and upgrading of national databases, and conversion of those databases to standard formats, is an ongoing effort; as data are available or new databases become standardized, they are placed online. This continuous updating allows users to gain direct access to live databases, instead of being limited to a one-time retrieval of data potentially months or years out of date. Evolving online data delivery tools provide information in digital format to any customer with Internet access; this has been of particular interest to land-management agencies and regional-planning groups. Some of the features of this unique online system include sophisticated data set search options, user viewing of data tables, and downloading of page-sized maps with user control of map data layers, legend, title, and other parameters. The system is available at <http://mrdata.usgs.gov/>.

Data and conclusions from USGS minerals research are available to users in easily accessible, accurate, and timely products. Information is disseminated through traditional paper products,

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in digital form, over the Internet (<http://minerals.usgs.gov/>), through interagency collaborations, and in technical and non-technical public presentations. Other methods through which MRP projects provide timely results for all customers include development of new geophysical and geochemical techniques for mineral-resource studies and the application of mineral-resource expertise and techniques to other societally relevant issues such as mapping earthquake and volcanic hazards, location and evaluation of energy resources, characterization of hydrology, or location of buried ordnance.

The Mineral Resources Data System (MRDS) (Estimates for FY 2004, \$0.43 million; FY 2005, \$0.4 million; FY 2006, \$0.4 million) is a critical database for MRP projects and customers. MRDS is a worldwide database of metallic and industrial mineral sites with related geologic, commodity, and deposit information. It currently contains 113,188 records; new records are continually being added and existing records updated or upgraded. About 200 data fields are available for each location, permitting storage of such disparate information as location, geology, description of deposit, exploration and development, description of workings, commodities present, production, reserves and resources, and published and unpublished references. The data can be searched and sorted using any of these fields. The data are available on CD-ROM and as part of the MRP's data delivery Web site (see above).

Minerals Information

(Estimates for FY 2004, \$15.8 million; FY 2005, \$15.4 million; FY 2006, \$13.7 million)

To provide long-range statistics on production and consumption of mineral commodities, USGS scientists collect, analyze, and disseminate timely information and data on worldwide supply and availability for more than 100 mineral commodities, including fuel and fuel by-products, in more than 180 different countries. These mineral materials are essential to the U.S. economy and national security. The information and data cover the extraction, production, and refining of mineral commodities and some of their products. To complement coverage of mineral production, information is also collected, analyzed, and disseminated on individual country mining, environmental, investment, and other laws that affect the minerals industries; trade, with emphasis on the interactions with the United States; structure and ownership within the minerals industries; types of deposits; labor force; official reserves data; and other pertinent information. The Department of the Interior, Department of Defense (DoD), the Central Intelligence Agency, the Department of State, the Federal Reserve, and private sector companies utilize USGS mineral-related policy analysis in their regional and global analyses. Information on strategic minerals is also provided to the DoD for managing the National Defense Stockpile.

USGS mineral commodity specialists provide production and capacity data for the U.S. nonfuel minerals industry to the Federal Reserve Board (FRB). The FRB uses data in USGS minerals information reports to calculate the indexes of industrial production, capacity, and capacity utilization, which are among the most widely followed monthly indicators of the U.S. economy. These capacity indexes and the rates of capacity utilization based upon them are published monthly in FRB's G.17 release, Industrial Production and Capacity Utilization. USGS scientists also provide assistance to FRB economists and policymakers in analyzing mineral industry indicators and trends.

Continuing MRP work related to industrial ecology and the residual and waste flows to the environment includes substance flow studies, efforts to relate materials to monetary input-output tables, studies of the drivers of mineral supply, metal recycling studies, a primer on material flow analysis, and studies of the dispersal of arsenic in pressure-treated wood. Collaborative projects include a joint project with the U.S. Forest Service (USFS) to create a set of indicators

of sustainable development for mineral and energy systems, participation in the Interagency Working Group on Industrial Ecology and Material and Energy Flows, and cooperation with the World Resources Institute on its research on material outputs from industrial economies.

By monitoring the flow of materials through society, the MRP provides information and analyses essential for sustainability indicators, as well as for mineral conservation and recycling, land stewardship, and environmental policy for governments, industry, and the public. Government agencies, financial institutions, and many types of industries use the MRP's monthly metal industry indicators to monitor the health of the U.S. metal industries.

USGS and USFS are the Federal lead agencies in the Sustainable Minerals Roundtable (SMR); the non-Federal lead is the Mining Life-Cycle Center of the Mackay School of Mines at the University of Nevada, Reno. The purpose of the roundtable is to create a suite of indicators for mineral and energy systems that can be used to assess progress toward sustainable development. USGS is developing several indicators for consumption of materials and energy over time, exploration capacity, and stocks of iron and steel in use. The SMR meets two to three times per year to share progress and to provide an opportunity for non-members to participate in indicator development. Results are also disseminated through workshops and presentations at major mining and land use conferences. Indicators were published through the USFS in a 2003 national report and have been applied in a congressionally mandated State of the Land Report due in 2005.

FY 2004 Program Performance Accomplishments

The accomplishments listed below demonstrate the utility of USGS products that are counted under the output measures for number of systematic analyses and investigations, long-term data collections, and training and workshops.

Headwaters Province, Idaho and Montana: Geoscience Data a Hit with Land Managers —

In a project designed to meet the USFS goals of integrating geoscience information into the land-planning process, MRP scientists have provided a wealth of information including geologic maps, databases (mineral locality, geochemical, and geophysical), and assessments for the Headwaters Province in northern Idaho and Montana. The Headwaters Province is known for its world-class deposits of gold, copper, silver, platinum, garnet, and talc; it also provides critical habitat for grizzly bears, salmon, and bull trout. For the first time, regionally consistent, digital data sets that can be used together have been made available to the USFS. The information in the data sets can be tailored to the needs of the USFS to address a wide range of issues related to land-use, forest health, landslide and wildfire hazards, as well as the potential for future mineral exploration and mining. In the words of one USFS manager, the information generated by this project provided the ability to create data sets to "best solve problems of all types." Among other accomplishments, a spatial geologic database was compiled for the Northern Rockies and new geologic maps were produced for parts of central Idaho and western Montana. The locations of active mines and significant minerals deposits were compiled, along with data sets that describe regional variation in geophysical features. Two of the largest undeveloped copper deposits in the United States occur in this environmentally sensitive area, and there is much public controversy surrounding their potential development. MRP scientists conducted in-depth studies on the characteristics of the geologic formation hosting these copper deposits, and provided information critical for understanding the potential for mineral exploration and potential impact to the environment. Six spatial databases containing geoscience information covering the western Montana copper belt were developed as a part of this work.

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Finally, as a result of this project, USGS scientists were able to produce the Salmon National Forest geologic map and provide interpretations of geologic features along the Lewis and Clark expedition route to the Bureau of Land Management. This project was conducted in collaboration with the University of Idaho, University of Montana, Idaho Geological Survey, and Montana Bureau of Mines. This supports the MRP 5-Year Plan goal of providing objective information and analysis related to minerals issues to support those who make decisions regarding national security, land use, resource policy, and environmental or public health and safety by providing new mineral resource, mineral environmental, and geologic information in easily used digital formats at scales appropriate for regional decisions.

New Geologic and Geochemical Data Available for Land Managers — A long-term commitment of the MRP is to provide consistent, accurate geologic, geochemical, geophysical, and mineral locality information that is readily available in digital formats. Among the accomplishments for FY 2004, new geologic and geochemical data have been made available through a cooperative effort with State geological surveys. Digital data sets consisting of geologic information for the States of Colorado, Illinois, Indiana, Michigan, Minnesota, Montana, New Mexico, Wisconsin, and Wyoming, as well as two large blocks of land in Alaska (14 1:250,000-scale quadrangles) have been prepared for release as USGS publications. For the first time, data for each of these States, organized in a consistent format and reviewed for quality, are readily available to land-use managers from Federal and State agencies, researchers in industry and academia, members of Congress, and the general public. These data can be used to evaluate State and regional scale management options with respect to mineral availability, environmental health, and sustainable development. In addition, these data are a critical component of the MRP core function of performing regional mineral-resource and environmental assessments. In January 2004, a Web-based geochemical database of stream sediment (and some soil) sample analyses was released. It includes sample data from approximately 71 percent of the land area of the United States, with sites in all 50 States (<http://pubs.usgs.gov/of/2004/1001/>). Complete access to the geochemical data, descriptions of the project's history and analytical methods, as well as geochemical maps of the United States for each of the analyzed elements is accessible via the Internet. This national data set can be used to provide regional background values for chemical elements that have potential environmental impacts; characterize regional mineral districts; and provide data for studies on the relationships between toxic commodities, mining practices, and human health. Future work includes collaborative efforts with State and private partners to collect and analyze samples from areas where there is currently no data. This supports MRP's 5-Year Plan goal of providing objective information and analysis related to minerals issues to support those who make decisions regarding national security, land use, resource policy, and environmental or public health and safety by providing new geologic, geochemical, geophysical, and mineral locality information for the entire Nation in a single public easy-to-use location.

Alaska's "Slab Window" – New Insight into the Formation of Minerals — Results of recent MRP studies indicate that ore deposits that are sources of gold, tin, nickel, molybdenum, and uranium are linked to the existence of a short-lived feature of the Earth's crust called a slab window. There are six identified slab windows on present-day Earth and hundreds of others likely existed in the past. The tectonic plates that make up Alaska overrode an oceanic spreading center between 50 and 60 million years ago, and in a process known as ridge subduction (where the two oceanic plates were forced under the continent), a gap between the plates known as a *slab window* was created. The slab window, likened to a blowtorch that heated Alaska below the surface of the Earth, had a huge impact on mineral and energy resources. Recent MRP studies indicate that the geologic effects of the slab window are diverse and widespread, stretching 500 to 1,000 km inland from the continental margin. The

most profound effect of the slab window activity was a complete reorganization of the type and location of igneous rock activity throughout Alaska. For example, the tin granite that composes Mount McKinley was found to have formed as a result of the slab window. The slab-window also affected the development of energy resources, leading to the formation of major coal beds along Alaska's Pacific margin, in the interior of Alaska, and as far away as the North Slope. The new understanding of slab windows resulting from this project improves our ability to assess undiscovered mineral and energy resources worldwide and provides extremely useful insights to both the global mineral and energy assessments that are underway in USGS. This project provides process understanding of the origins of mineral deposits in Alaska and other frontier areas, addressing MRP's 5-Year Plan goal of understanding the geologic setting and genesis of the Nation's mineral resources in a global context, to ensure a sustainable supply of minerals for the Nation's future.

How Do Mineral Dusts Affect Human Health? — The links between mineral dusts and human health are the subject of collaborative studies between USGS scientists and human health experts. MRP scientists are providing timely, earth science information to groups in government, industry, and academia who are involved in the development of regulatory policies and remediation strategies and other health issues related to mineral dusts. Cutting edge scientific investigations by MRP scientists have provided new insights into how the diverse geologic sources for mineral dusts and the mineralogical and chemical characteristics of dusts may influence human health. The U.S. Environmental Protection Agency (EPA), National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Occupational Safety and Health Administration, Mine Safety and Health Administration, National Park Service (NPS), Public Health Service, Colorado Department of Public Health and Environment, University of Arizona, and many other government agencies or universities have collaborated with MRP scientists and used the data. MRP scientists measured and collected new data on a mix of asbestos and fibrous amphiboles with unusual compositions and shapes intergrown with vermiculite, from a mine at Libby, MT. Exposure to these amphibole fibers has been linked to high incidences of asbestos-related diseases in miners, workers, and the general population of Libby. MRP research has been critical to ongoing health studies and development of cleanup strategies at Libby, as well as at more than 200 plants nationwide where Libby vermiculite was processed and in approximately 1 million homes with vermiculite insulation from Libby. This project addresses the goal set in the MRP 5-Year Plan to "provide objective information and analysis related to minerals issues to support those who make

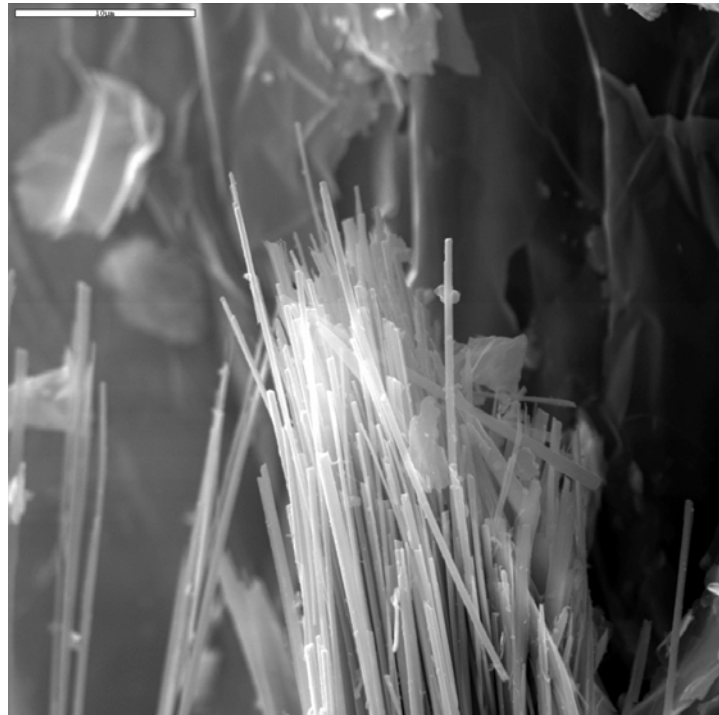


Figure 1. Asbestos from Libby, Montana.

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decisions regarding national security, land use, resource policy, and environmental or public health and safety."

Wildfires Change Geochemistry of Stream Sediments in Central Idaho — As part of recently completed work in the Headwaters Province of Idaho and Montana, MRP scientists demonstrated that the geochemistry of stream sediments in central Idaho changed significantly as a result of numerous wildfires that occurred in 2000. In 1996, MRP scientists collected and analyzed stream sediment and water samples to provide a "geochemical snapshot" of the area. In the summer of 2000, fires swept across most of the large area (>388,000 acres) that had been sampled. Ten months after the fires, the entire area was resampled at the request of the USFS. Pre- and post-wildfire analytical results indicated significant differences in the chemical composition of the sets of stream-sediment samples. Results of the post-fire samples indicated higher concentrations of carbon because of increased ash and char content in the sediments; higher concentrations of rock forming elements (Al, Mg) and selected trace elements (Ba, Co, Cu, Li, Mn, Ni, Sc, V, and Zn) because of the large influx of fine, unsorted sediments into streams; and higher concentrations of cobalt and copper because much of the burned areas were underlain by rocks that host Co-Cu deposits. This information was used by the USFS in environmental studies focused on monitoring changes in drainage basins over long periods of time. This accomplishment reinforces the importance of the MRP core capability to collect and maintain data that in turn are used to monitor change, whether natural or human-induced, in the geochemical landscape and addresses the 5-Year Plan goal of applying mineral-resource expertise and technologies to non-mineral-resource issues.

Customer Use of On-line Minerals Information Continues to Grow — Customer use of the MRP Web site containing information on the global supply of minerals and materials essential to the U.S. economy (<http://minerals.usgs.gov/minerals>) has reached a new high. The Web site had an average of 275,000 publications downloaded each month in 2004. In 2005, downloaded publications are expected to average 333,000 per month. The Web site contains publications on more than 100 minerals and materials as well as the mineral industries of 180 countries. The publications are used by Federal agencies for statistical analysis of U.S. trade and

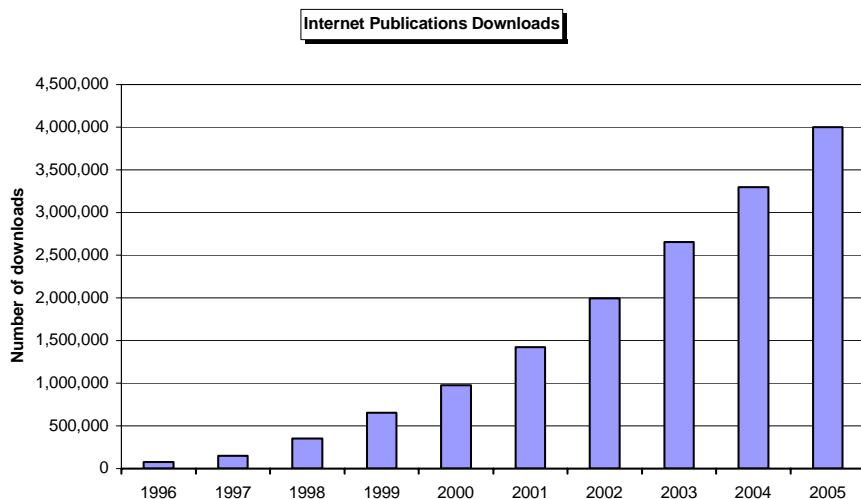


Figure 2. Annual increases in downloads of USGS Minerals Information publications via the Internet are projected to continue with the annual total reaching 4 million by the end of 2005.

production and for making economic forecasts and by industry to estimate market share and evaluate market trends. This work supports the MRP 5-Year Plan goal to collect, compile, analyze, and disseminate data and develop and maintain national and international databases for timely release of information to all users.

Tungsten—The Metal that Makes Drill Bits Durable — In FY 2004, USGS completed a new materials flow study for tungsten, showing that nearly half of U.S. tungsten supply in 2000 was derived from scrap, demonstrating that recycling has reduced U.S. import reliance. Materials flow studies such as this are important for estimating the quantities of scrap generated and recycled, information that was not readily available in the past. According to statistics compiled in the MRP, the United States consumes about 20 percent of world primary tungsten supply on an annual basis. With no domestic production of tungsten in the past decade, the National Defense Stockpile and scrap recycling have become significant sources of tungsten in U.S. industry. China is the major supplier of U.S. imports, although Canada became a significant supplier in 2002 and 2003. In a September 2004 presentation to the International Tungsten Industry Association, which represents nearly 50 companies from 13 countries, including mining companies, processors, consumers, and trading firms, an MRP scientist outlined recent trends in U.S. tungsten supply and demand and highlighted a recently completed study on the worldwide supply and demand for tungsten, a metallic commodity that has numerous important industrial applications, including making drill bits durable. Because the United States is a major processor, consumer, and recycler of tungsten, accurate and timely information about the U.S. market is important to understanding our economy. This work supports the MRP 5-Year Plan goal of providing objective information and analysis related to minerals issues to support those who make decisions regarding national security, land use, resource policy, and environmental or public health and safety.

Map Produced for World Heritage Site, Alaska and Canada — In a collaborative effort with the NPS, Parks Canada, and the British Columbian Park Service, MRP scientists produced a map for the United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Site that consists of the Wrangell-Saint Elias and Glacier Bay National Parks, AK, and the Kluane and Tatshenshini-Alsek Provisional Parks, Yukon Territories and British Columbia, Canada. This USGS publication, completed at the request of the NPS, is the first to show the entire World Heritage Site on a single sheet. The map has a shaded relief base, highlights important cultural features, and is available on the Internet as a poster (<http://pubs.usgs.gov/sim/2004/2819/>). The poster was presented to great acclaim at the NPS-Parks Canada Borderlands Conference; a special feature of this USGS publication is bilingual text (English and French). The poster won second place in the Professional Competition Digital Cartographic Product category at the 2004 Alaska Surveying and Mapping Conference in Anchorage. This work was greatly facilitated by MRP project work designed to provide maps and data sets in geology, geochemistry, geophysical, and mineral locality for the entire United States and addresses the 5-Year Plan goal of applying mineral-resource expertise and technologies to non-mineral-resource issues.

Regional Geophysical Data Provided for Southwestern Alaska — Much of Alaska's economy is based on the development of natural resources. Because basic geologic, geochemical, and geophysical data are lacking in many parts of the State, new data collections have the potential for stimulating exploration activity and economic growth. MRP workshops held with the Alaska Division of Geological and Geophysical Survey, Native Corporations, Bureau of Land Management, industry, academia, and other State agencies in FY 2003 helped to determine which areas in Alaska have the most critical needs for data. In FY 2004, MRP scientists began a project to collect new data that will aid in the understanding of the geology and mineral resources in the central part of southwestern Alaska and the Seward Peninsula, areas identified in the workshops as being among the most critical areas for study. Work completed in FY 2004 focused primarily on the central part of southwestern Alaska, an area thought to have high potential for precious and base metal resources. New geologic mapping in the Taylor Mountains quadrangle, an area in southwest Alaska about which very little is known,

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is required to understand the regional geologic framework. In FY 2004, USGS completed a geophysical (aeromagnetic) survey of the Taylor Mountains quadrangle and an adjacent portion of the Bethel quadrangle, an area key to understanding the underlying geologic structures and processes and the formation of mineral deposits in the entire region. Preliminary data from the geophysical survey have been released on the Web. Field studies focused on geologic investigations, geochemical sampling of stream sediments, and environmental geochemistry were also initiated in FY 2004. Federal, State, and Alaska Native land-planning organizations eagerly await these studies that they identified as critical. In addition, the work supports the MRP 5-Year Plan goal to understand the geologic setting and genesis of the Nation's mineral resources in a global context, in order to ensure a sustainable supply of minerals for the Nation's future.

Department of Commerce Trade Ruling Relies Upon USGS Data — The Department of Commerce's Bureau of Industry and Security (BIS) used USGS data and analyses to make a decision concerning export controls for copper-base scrap. The decision, published on July 22, 2004, rejected a petition by the copper- and brass-producing industry for export controls and export monitoring of copper-base scrap. Based on USGS minerals information, the BIS rejected the industry claims that rising exports of scrap to China had the effect of causing scrap price increases, shortages of domestic materials, and severe economic harm to the brass industry. USGS continues to provide information to the BIS as it works with the Bureau of the Census to refine export classification for copper-base scrap. This work supports the MRP 5-Year Plan goal to provide objective information and analysis related to minerals issues to support those who make decisions regarding national security, land use, resource policy, and environmental or public health and safety.

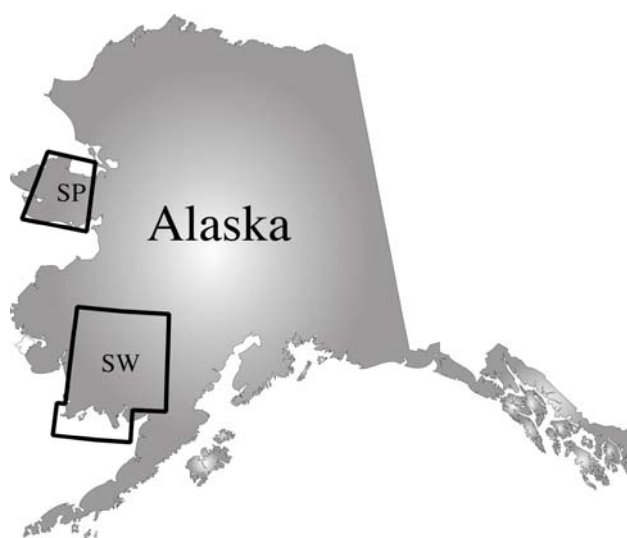


Figure 3. Study areas in southwestern Alaska (SW) and the Seward Peninsula (SP) where new data are being collected to aid in the understanding of the geology and mineral resources.

2005 Planned Program Performance

Analyses to be delivered in FY 2005 (with references to the Mineral Life Cycle Diagram) include:

- Tools for delivery of Mineral Resources Program data via the World Wide Web (Research and Assessments),
- Metals in basinal brines and petroleum (Research and Assessments: Genetic models), and
- Large igneous provinces in Alaska (Research and Assessments: Deposit Formation).

The MRP will conduct eight workshops or formal training sessions. The number of workshops and training sessions will vary from year to year, depending on customer needs.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Mineral Resources (\$000)	\$25,084	-\$29,820
FTE	158	-240

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006 budget request for Mineral Resources Program is \$25,084,000 and 158 FTE, a net program decrease of -\$28,680,000 (includes adjustments for uncontrollable costs) and -240 FTE from the 2005 enacted level.

Mineral Resources (-\$28,478,000) — The reduction will allow for implementation of higher priority projects within the USGS and the Department. The budget request provides MRP with \$25,084,000 in FY 2006. This amount will maintain the core capabilities of data gathering for 100 mineral commodities in the United States and research projects that provide information tailored for Federal land managers. The reduction will result in the elimination of 240 occupied positions.

- **Research and Assessment (-\$26,478,000)** — The reduction of \$26,478,000 in the Research and Assessments function of MRP will discontinue 38 projects including collection of comprehensive basic geologic, geochemical, geophysical, and mineral deposit data for the Nation; the USGS-led, internationally coordinated global mineral resource assessment to provide predictions of worldwide distribution of undiscovered deposits of critical metallic and non-metallic mineral commodities; research on aggregates and industrial minerals; research on inorganic toxins, such as mercury, arsenic, and selenium; and the Mineral Resources External Research Grants Program. Coverage for the United States in geology, geochemistry, geophysics, and mineral deposit information will end and remain at 84 percent complete. USGS will delay delivery of analyses currently underway in Alaska and the Great Basin by 1-2 years and end 28 current projects, resulting in the non-delivery of 28 systematic analyses scheduled for delivery between 2006 and 2010. The reduction will result in the elimination of 220 occupied positions in nine locations across the United States.
- **Minerals Information (-\$2,000,000)** — The reduction of \$2,000,000 in the Minerals Information function of MRP will terminate data collection and analysis for 100 mineral commodities in 180 countries outside the United States. The reduction will eliminate approximately 20 mineral commodity reports each year, end efforts to convert mineral commodity canvass forms to electronic formats, and reduce 20 occupied positions. Employees occupying these positions have expertise in global production and consumption of mineral commodities.

Alaska Mineral Resource Assessment Program (-\$1,134,000) — This is a reduction of an unrequested earmark that will bring to a close cooperative work with Alaska Division of Geologic and Geophysical Survey and academia to accelerate collection of basic geologic, geochemical, and geophysical data to encourage economic development in Alaska.

Alaska Geologic Materials Center (-\$98,000) — This is a reduction of an unrequested earmark that supports a State of Alaska facility that preserves cores, samples, maps, and descriptive materials relating to the energy and mineral resources within the State.

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Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes ^{a/}	Program Changes ^{b/}	2006 Budget Request	Change from 2005
Mineral Resources	55,481	53,764	+1,140	-29,820	25,084	-28,680
FTE	408	398	0	-240	158	-240
Energy Resources	25,068	23,250	+419	-54	23,615	+365
FTE	165	160	0	0	160	0
Total Requirements \$000	80,549	77,014	+1,559	-29,874	48,699	-28,315
FTE ^{c/}	573	557	0	-240	317	-240

^{a/} Included in this program is a one-time technical adjustment of -\$25 that moves all USGS funds associated with the Science on the DOI Landscape initiative to a single location in the Biological Research Activity for ease of administration and accounting.

^{b/} Changes for this program element include a reduction of -\$54 for travel. The impact of this change is described in the Program Changes section beginning on page G-1.

^{c/} FTE may not add to total, due to rounding.

Energy Resources

2006 Program Overview

The 2006 Budget Request for the Energy Resources Program is \$23,615,000.

The Nation faces simultaneous challenges from increasing energy needs, a growing dependence on imported oil from politically unstable parts of the world, and increasing demands to minimize environmental effects associated with energy resource development and utilization. The USGS Energy Resources Program (ERP) addresses these challenges by conducting research to better understand the fundamental processes that lead to the accumulation of energy resources (oil, natural gas, coal, and others such as geothermal) and the environmental and human health effects of energy resource usage. ERP scientists use the results of these geoscientific studies to evaluate energy resource accumulation and distribution and to assess the energy resource potential of the Nation and the world (exclusive of U.S. Federal offshore waters). The ERP conveys results from these studies to land and resource managers and policymakers in support of the Department of the Interior's (DOI) strategic goal of managing resources to enhance public benefit, promote responsible use, and ensure optimal value. Collectively, this information is used to plan for a secure energy future and to allow for the strategic use and evaluation of resources. Major consumers of ERP products are DOI land and resource management bureaus, other land management agencies such as the U.S. Forest Service (USFS), Federal environmental and national security agencies, State geological surveys, the energy industry, the environmental community, and academia.

As described in the Office of Management and Budget (OMB) Program Assessment Rating Tool (PART) review, the ERP role is clearly defined and unique from other Federal, State, local, or private entities. The ERP was reviewed in FY 2003, as an independent, stand-alone program, and received a PART score of 83. The PART findings indicate that the ERP generates and

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provides objective, science-based energy information essential for: shaping policies regarding domestic and foreign energy resources, making sound decisions regarding Federal land use, and maintaining a healthy domestic energy industry. The information ERP produces can be used to determine both current and future resource options.

To clearly measure progress in providing information essential to its customers, ERP tracks four intermediate outcome measures associated with producing baseline information about oil and gas assessments for targeted basins, and the quality, content, and satisfaction with the data provided. Outputs associated with these intermediate outcome measures include the delivery of systematic investigations and analyses to customers, the maintenance and update of 3 long-term data collections, the provision of formal workshops or training to customers, and the update and maintenance of one data delivery/decisionmaking support system. In addition, as indicated in the PART review conducted by OMB, the ERP will gather information regarding the customer citation of select ERP products within a 3-year time period following product delivery, and will expand the number of ERP products released in digital format to the public.

National Oil and Gas Resources

(Estimates for FY 2004, \$14.5 million; FY 2005, \$13.5 million; FY 2006, \$13.0 million)

The 1995 USGS National Oil and Gas Assessment concluded that there was a low probability that many more large oil reservoirs would be discovered in the onshore areas and State waters of the United States. Instead, the Nation's future energy supplies will come from a mix of domestic natural gas deposits, existing domestic oil and gas fields, and from imports. The United States will need about 50 percent more natural gas and one-third more oil to meet the projected demand in 2020, just 16 years from now. The combination of the 1990 Clean Air Act Amendments, concern about greenhouse gas emissions to the atmosphere, and the re-enactment of the Energy Policy and Conservation Act (EPCA) in 2000 have collectively introduced a sense of urgency in the effort to identify the Nation's remaining deposits of natural gas. Methane, the primary constituent of natural gas, is a relatively clean-burning fossil fuel that produces significantly less carbon dioxide (a greenhouse gas) per unit of energy than is produced by coal or oil. Research started in FY 2000 is focusing on regions of the Nation that have high potential for future natural gas production, including coalbed gas and gas hydrates; those areas that have oil and gas resources under public lands; on the economic and environmental impacts of developing and using energy resources; and on the scientific challenge of improving the accuracy of natural gas resource assessments. The USGS will continue to update its oil and gas resource assessments for the United States, and in FY 2006, the USGS will complete its assessments of the Sacramento Basin, Wind River Basin, Cook Inlet, and Paradox Basin, and continue its assessment of North Slope of Alaska unconventional resources, such as coalbed gas.

The USGS ERP is estimating the volume of oil and gas resources that underlie Federal lands. This scientific inventory of oil and gas resources on Federal lands is mandated by the EPCA Amendments of 2000 (P.L. 106-469 §604) and forms the basis for the periodic report to Congress required by the Act. The focus in FY 2006 is to complete the documentation and publication of assessments for the 2005 EPCA regions, including the State and Native lands between the National Petroleum Reserve Alaska (NPR) and the Alaskan National Wildlife Refuge (ANWR) 1002 area, the Eastern Great Basin, San Joaquin Basin, Raton Basin, and Michigan Basin.

Alaska — The North Slope of Alaska is thought to have the greatest remaining petroleum potential of any onshore area in the United States. The USGS is conducting an intensive

examination of its geology and petroleum potential with current research focused on conventional oil and gas resources of the central portion of the North Slope that lies between the NPRA and the ANWR 1002 area, and gathering the geologic information necessary to assess the unconventional resources of the North Slope, including coalbed gas.

Unconventional resources on the North Slope probably occur in great abundance, but relatively little is known about them, and, therefore, an accurate assessment is dependent upon gathering as much geologic information as possible. Work in FY 2006 will focus on developing a methodology for assessing the unconventional resources of northern Alaska. Other work in Alaska includes studies of the petroleum geologic framework of Bristol Bay and Cook Inlet, and coal and coalbed gas studies in various parts of the State. These studies are collaborative efforts with the Alaska Division of Oil and Gas, the Alaska Geological and Geophysical Surveys, and the Bureau of Land Management (BLM).

The USGS ERP continues to support preservation of irreplaceable legacy digital and hardcopy data from the North Slope of Alaska and to provide government, industry, academic, and public institutions the ability to query and download NPRA data directly from the Internet. Similar efforts continue on a national scale to archive approximately 80,000 miles of seismic data and other data sets that currently reside on 9-track and 21-track magnetic tape. These data will be indexed in a geographic information system to allow ease of access and retrieval.

Gas Hydrates-North Slope — Gas hydrate is a crystalline solid formed of water and gas and is potentially one of the most important energy resources for the future. It looks and acts much like ice, but it contains abundant amounts of methane. Gas hydrates exist in huge quantities in marine sediments in a layer several hundred meters thick below the sea floor and it is found in association with large accumulations of permafrost in the Arctic. Gas hydrate's contributions to world energy supplies will depend on the availability, producibility, and cost of extracting methane from the hydrate phase. Yet the overall size and producibility at any one site are still very much in question. Gas hydrate is not stable at normal sea-level pressures and temperatures, which is the primary reason that it is a challenge to study. To date, few dedicated surveys to identify hydrate deposits have been conducted, and better methods to identify and survey gas hydrates need to be developed, particularly to identify the zones of high concentrations. The USGS has a state-of-the-art laboratory studying the nature of gas hydrates and has made important strides in gas hydrate knowledge, yet the understanding of processes that control hydrate accumulation is still in the formative stages.

The USGS ERP is part of an international consortium of research, industry, and academic institutions, known as the Mallik Research Consortium. This group drilled three test wells in the MacKenzie Delta in 2002, the results of which were published in 2005. This work proved that gas hydrates are a producible energy source, but much research yet needs to be done to translate these results into technically recoverable resource assessments for gas hydrates. Results from the Mallik test well support ERP cooperative research efforts on gas hydrate recoverability on the North Slope of Alaska and in other international consortia efforts.

In FY 2005 and FY 2006, efforts will continue to assess the recoverability and production characteristics of permafrost-associated natural gas hydrates and associated free-gas accumulations in the Prudhoe Bay-Kuparuk River area on the North Slope of Alaska. The objective is to examine the resource potential of two known gas hydrate/free-gas accumulations (Eileen and Tarn) in the Prudhoe Bay-Kuparuk River area; and possibly drill and test a viable gas-hydrate/free-gas prospect. This effort is a cost-shared study between the Department of Energy (DOE) and the USGS. Technical support and data access are being supplied by industry and academic cooperators on the North Slope.

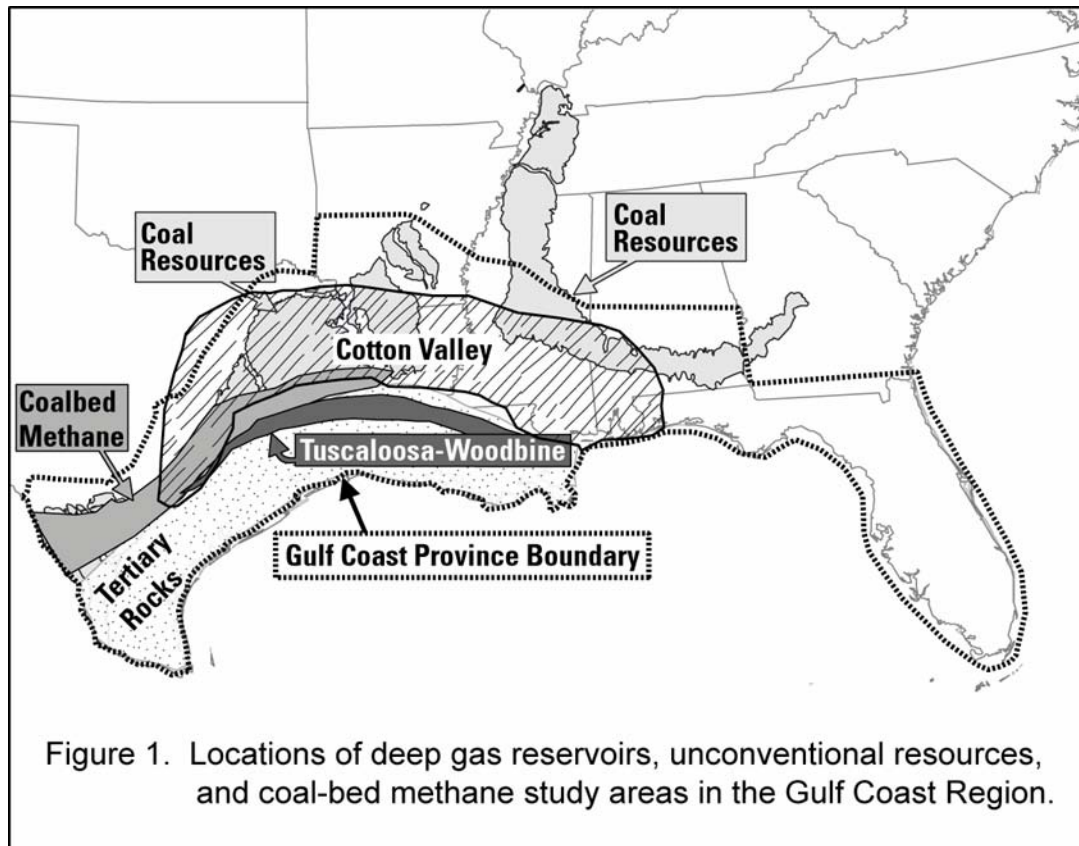
In addition, the USGS ERP is assessing the recoverability, resource potential, environmental effects, and production characteristics of Alaskan permafrost-associated natural gas hydrates in cooperation with BLM and the State of Alaska Department of Natural Resources (DNR) through the Division of Geological and Geophysical Surveys. The primary goal of the research effort is to lay the groundwork for an assessment of the recoverability and potential production characteristics of the onshore natural gas hydrates and associated free-gas accumulations on the Alaska North Slope. Work will include identifying and mapping gas-hydrate/free-gas accumulations, as well as evaluations of well log and seismic studies of existing North Slope developments. The primary goal of this cooperative effort is to assess the resource potential of known and undiscovered gas hydrate and associated conventional gas accumulations on both Federal and State lands in northern Alaska. This work builds on the efforts described above that focus on the known gas hydrate accumulations overlying the Prudhoe Bay and Kuparuk River oil fields. This work will lay the groundwork to assess the occurrence of gas hydrate accumulations on unexplored State and Federal managed lands. USGS cooperators (BLM and Alaska DNR) in this effort are responsible for oil and gas development that takes place on Alaskan public lands, as well as for most pipeline right-of-ways. With the basic and applied research in support of this study provided by the USGS, the BLM and the Alaska DNR will have the knowledge of where potential gas hydrate development will take place.

Gulf Coast Region — The Gulf Coast region is one of the major hydrocarbon producing areas of the world, and as such, the USGS ERP is conducting investigations—using seismic, well, and geochemical data—into the geologic framework of the oil-, gas-, and coal-bearing rocks of Texas, Louisiana, Mississippi, and Alabama that have the greatest potential for future oil, gas, and coalbed gas production. A better understanding of the stratigraphic, structural, and biostratigraphic framework and petroleum systems will enable USGS scientists to better assess the potential for undiscovered petroleum resources and to define potential onshore extensions of plays identified by the Minerals Management Service (MMS) for offshore Federal resources. This project will provide the geologic, geophysical, and geochemical framework studies to facilitate the re-evaluation of the petroleum energy resources in this region.

The USGS ERP has examined the deep gas reservoirs in the Tuscaloosa and Woodbine Formations of Louisiana and Texas. Several major Gulf Coast reservoirs, including the Cotton Valley, Travis Peak, and Olmos Formations, the Bossier Shale, and the large conventional gas reservoirs of the Tertiary rocks, exhibit some of the characteristics of continuous gas accumulations. Continuous gas accumulations generally consist of large, single fields having spatial dimensions equal to or exceeding those of conventional plays, and which, in contrast to conventional gas fields, cannot be represented in terms of discrete, countable units delineated by downdip hydrocarbon-water contacts. Work in FY 2006 will focus on defining the petroleum systems of large conventional Gulf Coast Tertiary reservoirs, as well as defining some of the unconventional (continuous) reservoirs in order to conduct an assessment of these reservoirs in early FY 2007. Current cooperative efforts with the Oil and Gas Boards of Alabama and Mississippi, the Texas Bureau of Economic Geology, and the MMS will continue to improve data quality and availability.

Coalbed Methane — USGS geologists are investigating the potential coalbed methane (CBM) resources in southernmost Texas and north-central Louisiana. To utilize available industry expertise, the USGS currently has Cooperative Research and Development Agreements (CRADAs) with several companies involved in coalbed methane exploration in the Gulf Coast Region. The Louisiana Geological Survey (LGS) has also engaged the USGS in a CRADA effort. Several exploration holes have been drilled by industry with USGS and LGS

participation. The USGS has analyzed core and gas samples from the wells and studied the subsurface geology of the coal basins. The primary goal of this cooperative work is to identify additional resources of domestic gas and to determine the potential for CBM development in the region. Results of these collaborative studies of coalbed methane resource volumes in the Gulf Region show significantly greater resources than were previously recognized (fig. 1). The ERP focus in FY 2006 will take this on-going work and new data and evaluate the coalbed gas potential of the Gulf Coastal Plain.



The USGS and the BLM have an on-going cooperative agreement under which the USGS, in the course of its national geologic studies, produces coal reservoir maps, stratigraphic cross sections, reservoir gas drainage maps, charts of coal reservoir characteristics, graphs of chemical and isotope composition of co-produced water, gas content charts, and CBM resources in the Powder River Basin (PRB). Maps and data are conveyed in digital format; other products include interpretive reports and oral presentations. These data and interpretations will be used directly by BLM land managers, as well as gas operators and pipeline companies who are exploring and developing CBM resources. This information will also enable land managers to moderate disputes between coal miners and gas operators. These data will also be used by BLM and the Bureau of Indian Affairs (BIA) for land use management plans to forecast the minimum number of wells necessary to produce a given volume of gas, and the anticipated effect of water extraction during development of the fields. The information will help BLM and BIA identify areas on Federal and Indian Land leases where the gas resource is being drained by wells on State or private lands, consistent with the DOI strategic goal to manage resources to enhance public benefit, promote responsible use, and ensure optimal value. In addition, effects of co-produced water from gas production on the

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surficial environment can be anticipated and land management agencies can better plan to ameliorate those effects.

Geothermal Resources — In FY 2006, subject to availability of appropriated funds as requested in the President's Budget, the USGS would begin a 3-year project to produce a new national assessment of geothermal resources capable of producing electric power, with a focus on the western United States, including Alaska and Hawaii. This new assessment effort, in partnership with the DOE, BLM, National Laboratories, universities, State agencies, and a consortium of the geothermal industry, will highlight geothermal energy resources located on public lands. Geological, geophysical, and geochemical data from geothermal industry exploration and development studies will be combined with existing information to establish a database for the resource assessment and to investigate the nature and extent of geothermal systems in the western United States. The last national geothermal resource assessment was published in 1979, and advances in the field of geothermal energy and technology indicate that much of the information contained in the earlier assessments is out of date. The proposed assessment will include a detailed estimate of electrical power generation potential and an evaluation of the major technological challenges and environmental effects of increased geothermal development. Support products will include online geospatial databases of regional and system-specific geological, geophysical, geochemical, and hydrological information relevant to geothermal resources. The assessment and associated databases will be augmented with a series of research publications describing scientific advances and improved assessment methodologies.

National Coal Resources

(Estimates for FY 2004, \$2.5 million; FY 2005, \$2.6 million; FY 2006, \$2.5 million)

The USGS ERP is assessing coal resources for use in the first quarter of the 21st century. This intensive, multiyear assessment of the quantity, quality, availability, and recoverability of coal involves the generation of digital databases and use of geographic information systems (GIS) technology to facilitate quantitative estimation of coal resources. While completing the National Coal Resource Assessment, the ERP has been concurrently revising the USGS assessment methodology in order to determine that subset of these coal resources that are available for mining and technically recoverable (i.e., the coal reserve base). The final results of the national coal assessment will be published in FY 2006, and ERP will compare these results with the coal reserve base estimations in particular regions of the country to illustrate how much resource is actually available and technically recoverable. Federal and State land managers use these results to support land-use decisions; environmental regulators use the information to evaluate compliance with regulations stemming from the 1990 Amendments to the Clean Air Act; and economists use the results to forecast economic trends at regional and national scales. Electric utilities, coal producers, and coal consumers also use these results and products for evaluating the availability and quality of coal feedstock to electricity generating power plants and to achieve compliance with emission standards and other environmental regulations. These studies form the basis for addressing the challenge of future changes in the energy mix as the Nation responds to increasing demands for cleaner-burning coal.

With the conclusion of this first digital compilation of coal resource and coal quality data, the USGS will begin to determine how to integrate this new digital resource information with national coal quality inventories. The resulting integrated data will enable the USGS to provide critical information to land and resource managers who must contend with the Nation's ever-increasing need for energy while protecting the environment and human health. As stated previously, ERP is revising its coal assessment methodology to render the results more accessible to a broader

arena of customers and to understand exactly how much useable and recoverable coal is available in the United States. ERP customers include the Securities and Exchange Commission (SEC), BLM, Office of Surface Mining (OSM), Energy Information Administration, and State geological surveys. ERP held a peer review of its revised methodology in 2004 and will have a final review in early FY 2005 to address the resource/reserve needs and concerns of partners, customers, and cooperators. Work in FY 2006 will consist of continuing to assess the technically recoverable resources in the largest coal basins in the country, to determine those coal resources that are technically and (or) economically recoverable.

World Oil and Gas Resources

(Estimates for FY 2004, \$2.0 million; FY 2005, \$2.0 million; FY 2006, \$2.0 million)

In FY 2006, the USGS ERP will continue to assess those oil and gas provinces of the world that were not targeted in previous assessments. The highest priority task is the Arctic Assessment, which will assess Arctic provinces in Canada, United States, Russia, Norway, Greenland, and other countries; these provinces may contain significant petroleum hydrocarbon resources. The USGS 2000 assessment demonstrated that one-quarter of the world's undiscovered resources occur in the Arctic, and focusing on these additional provinces will be critical for understanding not only the full resource potential of the Arctic, but also the world. This task is strongly supported by the DOE, the national security community, a consortium of companies, and most especially by the foreign governments and academic institutions of the assessed countries. Additional tasks include assessment of other provinces, such as those in the Middle East, another area of great petroleum resources, and continuing production of geologic maps and attendant geologic information.

Energy Information and the Environment

(Estimates for FY 2004, \$6.1 million; FY 2005, \$6.3 million; FY 2006, \$ 5.5 million)

The production and use of all energy sources generates some type of environmental impact. Oil and gas production is attended by water production that must be disposed of in some way; mining disrupts the natural equilibrium of the strata, sometimes liberating harmful elements; coal combustion sometimes produces a wide range of potentially hazardous substances, and is one of the leading sources of carbon dioxide emissions in the world.

Environmental and human health challenges addressed by the USGS ERP include safe disposal of hazardous oilfield waters co-produced with oil and gas, disposal of waters produced during coalbed methane recovery, geologic carbon dioxide sequestration, coastal subsidence associated with oil and gas production, and human health impacts of energy usage.

Carbon Dioxide Sequestration — The USGS ERP is conducting unique research to assess the sources and potential geologic sequestration options for carbon dioxide (CO₂), a greenhouse gas emitted during fossil fuel combustion. Outcomes from this research will enable society to limit these emissions to the atmosphere by storing the CO₂ in subsurface geologic units such as depleted oil and gas reservoirs, saline water-bearing formations, and coal beds.

The long-term objective of this ERP research is to develop methods to assess the volume of carbon dioxide that can be safely stored in the subsurface for hundreds to thousands of years or longer. Furthermore, the assessment methods must identify specific locations that can be evaluated for cost-effectiveness, storage integrity, environmental and land-use issues. To provide the scientific foundation for our assessment methods, ERP scientists are conducting research on the solubility of carbon dioxide in natural brines at subsurface temperatures and

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pressures, evaluating the natural occurrences of gas fields with high concentrations of carbon dioxide as analogues to carbon dioxide storage locations, and evaluating some of the environmental issues associated with storing CO₂ in coal beds. This information is critical to realistic, safe, and viable carbon dioxide sequestration.

While other research groups are working on the economic and technologic feasibility of carbon dioxide sequestration in geologic units, the political and regulatory ramifications of this endeavor require objective, scientifically-based geologic assessments of carbon dioxide storage capacity from an unbiased Federal entity. The viability of carbon sequestration is not only a technological issue, but also one dependent upon the geologic characteristics of the various potential reservoirs. Aside from the ERP, no other Federal agency or research organization has the ability and the requisite experience to conduct these geologic framework-based assessments.

In FY 2004, ERP demonstrated that, over a period of 10 to 50 years, capture and storage of annual emissions from a single, large (1,000 megawatt) power station would ultimately require a site with a sequestration capacity equivalent to a billion-barrel oil field and a geographic extent of 2 to 5 square miles. There are about 100 well-described sites of this size (oil and gas fields with known resources of 1 billion barrels oil equivalent or larger) in the United States. With adequate funding, ERP activities for FY 2005 and FY 2006 will study the suitability of these types of large traps for CO₂ sequestration, and develop assessment methods that allow for "storage growth." This storage growth concept, developed by ERP scientists, provides a method by which to accommodate changes in the carbon dioxide storage capacity of individual oil and gas reservoirs resulting from better characterization of subsurface geologic units, for example, the potential for additional carbon dioxide storage in saline-water bearing formations associated with the oil and gas reservoirs. This scientific breakthrough is analogous to the "reserve growth" concept that ERP scientists employ when studying production of oil and gas from geologic formations, and is thus a direct outgrowth of the unique experience that the ERP has developed while conducted it geologically based assessments.

Work started in FY 2005 on testing ERP assessment methods on large geologic sites, such as sedimentary basins in the United States. The CO₂ sequestration assessment methodology will be developed in conjunction with other U.S. Federal agencies including DOE and the Environmental Protection Agency (EPA), which have the technological and regulatory responsibilities of carbon sequestration, and other foreign government agencies that are also developing methods to assess CO₂ storage capacity. The proposed funding reduction in FY 2006 will stop research efforts associated with the geologic sequestration of CO₂ project, and will preclude the development of a consistent, scientifically robust CO₂ sequestration assessment methodology and the efforts to test this assessment methodology on geologic sites.

The USGS ERP entered into a Memorandum of Understanding (MOU) with DOE/Rocky Mountain Oilfield Test Center to perform baseline studies of the oilfield at Teapot Dome in anticipation of the use of that site as a prospective CO₂ storage reservoir.

Coal Quality and Human Health — The USGS ERP conducts research to understand the natural variability of coal quality, and the ramifications of such variability on environmental quality and human health. For example, in many parts of the country and the world, coal deposits may act as natural aquifers and convey large amounts of potable water. Balkan Endemic Nephropathy (BEN), a disease thought to develop from long-term exposure of susceptible individuals to low levels of toxic organic compounds derived from coal in drinking water in many parts of the Balkans, has been extensively studied by the USGS in conjunction

with the human health care sector and international doctors. Study results from BEN research point to other potential connections between human health and toxic organics from energy resources. The ERP continues to build on the expertise developed during the BEN study by evaluating linkages in the United States where the confluence of specific human diseases and toxic organic compounds from coal may occur. In the United States, the water obtained from low-rank coal beds, either by drinking water wells or by coalbed methane production wells, may have leached toxic organic compounds from coal. These compounds may compromise human health and degrade environmental quality. The ERP is characterizing water quality in these settings.

Because more than half of the Nation's electricity demand is met through burning coal, and that demand will continue to increase in the future, an understanding of the connections among coal quality, environmental quality, and human health during aspects of coal resource utilization is essential to resource managers and policymakers alike. The USGS ERP will continue to work with representatives from the human health care sector Center for Disease Control (CDC), National Institutes of Health (NIH), National Institute of Environmental Health Sciences, and other domestic and international groups of doctors, epidemiologists, and health care providers) to investigate health effects that may be associated with energy resource use. In one such project, continuing into FY 2006, the USGS will collaborate with the Navajo Nation to study the relationship of indoor and ambient air quality to respiratory diseases in the Navajo Nation. This work will study the possible linkages between indoor coal burning and human respiratory ailments. This research provides objective scientific information to guide private industry, Federal and State policymakers, foreign government officials, and health care workers.

The USGS ERP is also compiling coal quality data on coals from around the world as part of the **World Coal Quality Inventory**. These data provide information for policymakers to evaluate the environmental impacts of global coal use. On-going work includes coal quality analyses of coal samples from 90 percent of the countries that contain coal. Samples from the former Newly Independent States, Europe, Australia, and other top-coal producing countries are being analyzed, and smaller coal quality data inventories for other countries will be submitted for input to Geo-Data Explorer (GEODE) to make them accessible to the public via the Web as soon as possible. Once the comprehensive coal quality database is created, these data will be added to it and will be part of the data collection effort of international coal quality characteristics. Emphasis in FY 2006 will focus on the major coal-producing countries, rather than collecting samples from all countries, and starting to create a world coal map.

Energy Decisionmaking Support – Geo-Data Explorer (GEODE) — Wise stewardship of Federally managed lands requires detailed knowledge of domestic energy resource availability, quality, and distribution. The ability to integrate resource knowledge with other environmental or land-use information is becoming increasingly important. USGS energy data provide a foundation for the decisions made by energy resource analysts, Federal and State land managers, and environmental policymakers. As the data delivery system of the USGS Geology discipline, GEODE continues to provide unbiased scientific and energy related natural resource data to the public via a Web-accessed GIS map server. This system is a spatially-based, interactive data delivery system of energy, cultural, and environmental information specifically designed to assist land and resource managers and to facilitate integrated energy research within the USGS. Users can access complex energy data sets in a map format, make queries of data details, and superimpose energy and environmental data layers to create their own unique maps, for their specific needs, using just a Web browser. New digital energy-resources data are added to this system as projects are completed. Additionally, the GEODE application continues to expand functionality and increase services to customers. GEODE is moving

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toward providing an integrated spatial data solution for the USGS Geology Discipline by serving data from distributed servers, becoming compatible with a larger variety of data formats and computing platforms, and conforming to widely accepted data format and transfer standards. There has also been a major effort by the GEODE team to form collaborative relationships with other Federal agencies, such as the Federal Emergency Management Agency (FEMA), to serve their data through GEODE and therefore provide customers with a more comprehensive geologic data solution. The system can be accessed at <http://geode.usgs.gov>. In addition, energy databases are maintained and available from the USGS at <http://energy.usgs.gov>.

To improve USGS enterprise delivery of information, the GEODE function will be transferred from ERP and the Geologic Discipline to the Geospatial Information Office (GIO) and will be housed and supported under the GIO structure in FY 2006. The ultimate goal of GEODE is to provide diverse users a gateway (data portal) that will supply real-time data and analysis over the Internet without the need for special hardware, software, and training. The GEODE project will be integrated with the Enterprise GIS activity and incorporated into the National Geospatial Programs Office (NGPO). These transfers facilitate implementation of the fundamental responsibilities of the USGS to complete basic geospatial data layers on a national scale, meet customer and stakeholder expectations, and demonstrate management excellence.

The National Coal Resources Data System (NCRDS) (Estimates for FY 2004, \$0.8 million; FY 2005, \$0.8 million; FY 2006, \$ 0.7 million) — NCRDS provides the world's largest, most comprehensive, publicly available, electronic coal quality and quantity databases. Started more than 25 years ago, the USGS databases contain information on the location, quantity, attributes, stratigraphy, and chemical components of the coal deposits of the United States, including quality analyses of more than 14,000 coal samples and some 200,000 stratigraphic records. At least 136 coal quality parameters are determined, including detailed location information and a wide range of physical and chemical properties. The NCRDS stratigraphic database contains more than 30 parameters describing the geologic section measured from drill holes and surface exposures including specific geo-referenced information. These data are analyzed through USGS analytical tools such as GIS, geologic correlation software, statistical, and cartographic tools to produce a robust variety of coal resource assessment products. The data have been used for many purposes, such as locating coal deposits having desirable characteristics for various uses, assessing environmental impacts of coal use, evaluating coal resources, and describing technological properties of coal from specific areas and beds. A long-term partnership of the USGS and approximately 22 State geological surveys, both contributors to and users of the databases, has been involved in this major effort to collect, correlate, and analyze the basic data, build and verify the databases, and digitally utilize these USGS-maintained data sets. Portions of the coal resource and geochemical databases can be found on the USGS Energy Web site (<http://energy.usgs.gov>) or interested parties may request selected data in several formats.

FY 2004 Program Performance Accomplishments

The accomplishments and outcomes listed below demonstrate the utility of USGS products that are counted for Government Performance and Results Act (GPRA) and Program Assessment Rating Tool (PART) measures including number of targeted basins with oil and gas resource assessments available to support management decisions, percent of formal USGS publications and scientific products receiving appropriate peer review, number of systematic analyses and investigations, long-term data collections, and training and workshops.

Oil and Gas Assessments on Federal Lands – EPCA Inventory — The first phase of the Energy Policy and Conservation Act Amendments of 2000 (EPCA) inventory, "Scientific Inventory of Onshore Federal Lands' Oil and Gas Resources and Reserves and the Extent and Nature of Restrictions or Impediments to their Development," was delivered to Congress and released to the public in January 2003. This document presented a comprehensive review of Federal oil and gas resources in five basins in the interior western United States and constraints on their development. While these five basins comprising Phase I collectively contain a very large proportion of the oil and gas under Federal land, many more basins exist in which oil and gas resources are found. The USGS Energy Resources Program (ERP) continues to assess these basins and work with the Bureau of Land Management (BLM) and others on the EPCA inventory as described in the legislation. Currently under Phase II of the Inventory, the USGS has contributed its assessments of undiscovered, technically recoverable oil and natural gas estimates. Phase II of the EPCA Inventory includes the National Petroleum Reserve – Alaska, Alaska National Wildlife Refuge – 1002 area, Wyoming Thrust Belt, Denver Basin, Appalachian Basin, Florida Peninsula, and Black Warrior Basin.

Gas Hydrate Activities – Mallik Results — The Mallik International Research Consortium is a cooperative research project with numerous research partners, including the USGS ERP, Geological Survey of Canada, the Japan National Oil Corporation, the Japan Petroleum Exploration Company, the GeoForschungsZentrum Potsdam, the DOE, and the India Ministry of Petroleum and Natural Gas. The Research Consortium drilled three dedicated gas hydrate research wells at the Mallik site in the Mackenzie Delta, Canada. The goal was to establish a benchmark contribution by (1) producing hydrates using various production methods, (2) characterizing the engineering properties of gas-hydrate-bearing sediments, (3) determining the geophysical properties of gas hydrates as they apply to surface prospecting techniques, and (4) continuing research in order to improve drilling, coring, and well completion methods. The Mallik International Research Consortium, for the first time, proved that it was technically feasible to produce gas from gas hydrates. Depressurization and thermal heating experiments, with real-time formation monitoring, were successful at the Mallik site. In one test, the results demonstrated that gas could be produced from gas hydrates with different concentrations and characteristics, exclusively through pressure stimulation, which will have implications for the economic viability of hydrate production. The resultant data support the interpretation that the gas-hydrate-bearing sediments are much more permeable and conducive to flow from pressure simulation than previously thought. In another test, the gas production rates were substantially enhanced by artificially fracturing the reservoir. Results of these scientific efforts were released at a meeting in Chiba, Japan, in December 2003 (abstracts can be found at <http://www.mh21japan.gr.jp/english/index.html>) with a volume of all manuscripts due to be published in the spring of 2005. USGS scientists have taken the lead in the Mallik effort in the following areas (1) one of two project co-leaders, (2) management of all production modeling and testing efforts, (3) management of all downhole logging efforts, (4) scientific leadership of the gas geochemistry program, and (5) scientific leadership of the gas hydrate core analysis efforts.

Gas Hydrate Activities – Hedberg Conference — The USGS organized and co-hosted a Hedberg Research Conference entitled "*Gas Hydrates: Energy Resource Potential and Associated Geologic Hazards.*" A Hedberg Conference is a research forum run through the American Association of Petroleum Geologists to critically examine emerging energy resource issues, with the focus of advancing our collective understanding of the issue under consideration. The primary objectives of this particular Hedberg Research Conference on gas hydrates were to (1) critically examine the geologic parameters that control the occurrence and stability of gas hydrates, (2) assess the volume of natural gas stored within known gas hydrate

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accumulations, (3) assess exploration methods for identifying gas hydrate prospects, (4) identify the technologies needed to economically produce gas from hydrate, (5) assess possible marine slope stability hazards that can be attributed the occurrence of gas hydrate, and (6) analyze the effects of gas hydrate on drilling safety. This research conference brought together hundreds of scientists from around the world from government agencies, academia, and industry to critically examine and discuss current gas hydrate research efforts.

Consultation Regarding Alaska Resources — Alaska continues to garner significant attention because it contains the largest endowment of undiscovered oil and gas resources in the United States. Policymakers, State and Federal legislators, Native corporations, industry, and environmental groups have expressed tremendous interest in research activities addressing the distribution, quantity, and quality of these resources. These stakeholders view USGS as an impartial, objective research agency capable of providing scientifically robust estimates of technically recoverable, undiscovered oil and gas resources. As such, all these outreach, data acquisition, and framework assessment activities are important in providing a vehicle for timely and consistent dissemination of information to these stakeholders.

- The ERP continued to facilitate technology transfer related to its geologic research and oil and gas assessment activities in Alaska. For example, other government agencies, nongovernmental organizations, and U.S. independent and Canadian companies have all expressed an interest in acquiring subsurface information stemming from ERP activities on the Alaska North Slope.
- ERP held a non-technical workshop "Petroleum Geology of the National Petroleum Reserve - Alaska." This workshop was attended by representatives from the Department of the Interior (including one Assistant Secretary and two Deputy Assistant Secretaries), BLM, House Science Committee staff members, science/industry media (American geological Institute, Pennwell, Oil and Gas Journal), etc.
- ERP was asked to provide expert testimony before the Alaska State Senate and House Committees on Resources and Ways and Means. The testimony was conducted jointly with the Alaska Division of Oil and Gas, in order to give the State legislature an understanding of how much gas resources occur on the North Slope and whether these would support a natural gas pipeline.
- Numerous media requests continue, as do requests for talks and presentations to academia, nongovernmental organizations such as the Potential Gas Committee, and Congressional staff and committee members.
- ERP completed the acquisition and reprocessing of more than 100 seismic lines in the State and Native lands of northern Alaska. For the first time the USGS has seismic coverage in these areas that is generally comparable in density to those in adjacent NPRA and ANWR - 1002 areas. As a result, the credibility of ERP assessment and ability to document the subsurface geology is greatly enhanced.
- ERP completed the geologic framework for assessment of undiscovered oil and gas resources beneath the State and Native lands in northern Alaska (for assessment in FY 2005).

Remote Alaskan Energy Activities – Coalbed Methane (CBM) — The need for affordable energy sources is acute in remote communities of Alaska where costly diesel fuel must be

delivered by barge or plane. Tank leakage and pollution associated with diesel fuel are significant health concerns. The high cost of energy has two major effects (1) increasing the cost of living and (2) making it expensive for local industry to supply jobs. Rural Alaska contains widespread coal deposits that may contain significant coalbed methane resources. Methane from these coal beds, if found in sufficient quantity, could be produced for local power generation in rural Alaska. A multidisciplinary, multiagency effort (ERP, BLM, DOE, State of Alaska, and University of Alaska) has started a statewide field program to quantify energy sources for rural towns. The USGS is leading coring, logging, hydrologic testing and coal desorption studies as part of this cooperative effort, starting at Fort Yukon. Fort Yukon is a town of about 600 people, composed mostly of Gwich'in Athabascan Native Americans near the center of the Yukon Flats Basin, AK. With cooperation from the U.S. Air Force and the Doyon Native Corporation, a core hole was drilled on an Air Force Radar Site. Together with BLM-Alaska and DOE-Alaska, ERP drilled for coalbed methane in the Fort Yukon area. DOE and BLM funding was used in 2004 to purchase a core drill and transport it to Fort Yukon, AK. The Alaska Rural Energy Program won the Secretary's Four C's award, shared jointly between BLM, USGS, and the State geological survey, for "its broad vision, spirit of cooperation, open communication, and commitment to improving the quality of life in rural Alaskan communities."

USGS Coal Reserve Calculation Methodology Peer Review — The ERP is currently revising its coal assessment methodology to determine those coal resources that are available for mining and technically and economically recoverable (i.e., the coal reserve base). Before conducting studies on the U.S. reserve base, however, the ERP convened a peer review of the USGS's coal reserve calculation methodology and an evaluation of computer mine modeling programs. The peer review group consisted of experts in coal geology, mining, management, economics, and resource evaluations. The peer reviewers were from academia, other Federal agencies, State government agencies, and industry. ERP held the peer review in order to critically evaluate and review methodologies and techniques used, results, and to obtain a report from the group that included a constructive critique and suggestions to modify the methodology and reporting formats where appropriate. Results from the peer review will be published in a USGS Open File Report and made available on the ERP Web site once final edits are completed. When significant new or revised energy resource research projects are initiated, the USGS ERP solicits critical review in order to optimize the relevancy of these programs.

ERP Coal Analytical Laboratory Audit — The data generated and the expertise of the Energy Analytical Laboratory (EAL) personnel is a critical support component of the ERP. The visibility and importance of major, minor, and trace elements results generated by the ERP EAL are underscored by the increased emphasis throughout the coal industry to understand the effects of mercury, arsenic, and other toxic elements on the impacts of coal production and usage. Because of the importance of analytical laboratory analyses to many projects, ERP undertook a laboratory audit to optimize lab performance by evaluating (1) the ability to produce high quality data, (2) approaches to minimize operational costs, and (3) the ability of the working environment to optimize staff involvement in quality improvement. Each analytical capability of the laboratory was analyzed, its performance and work routine evaluated, and suggestions for improvement made. The outcomes of this audit will be used to enhance the EAL position as a recognized, competent practitioner of performance-based testing. This auditing approach is being adopted worldwide by major organizations whose primary function is to compose standard laboratory procedures and accreditation measures.

Resource Assessment Methodology — The USGS provides impartial and objective, scientifically-robust assessments of technically recoverable, undiscovered oil and gas resources

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to a variety of stakeholders. The resource assessment methodology used in this process must continually evolve, by incorporating the latest scientific and technological advances, in order to remain viable, credible, and defensible in the eyes of the broader scientific, customer, and stakeholder community. The following accomplishments maintain the transparency of the USGS assessment methodology by promoting the exchange of information, thus facilitating a general consensus throughout the broader community regarding the assessment methodology.

- The USGS ERP organized and co-hosted the Second Symposium on Resource Assessment Methodologies. The ERP, together with the Potential Committee, hosted a symposium that included formal talks on subjects related to oil and gas resource assessment methodology and four discussion sessions on conceptual plays, the interface of resource assessments with economic modeling, expressing uncertainty, and unconventional resources. This meeting brought together resource assessment experts from the Federal, academia, nongovernmental organizations, and industry.
- The USGS ERP organized and convened the Second USGS Conference on Reserve Growth. This conference focused on reserve growth in international settings. It brought together the world's experts on resource assessments and reserve growth from Federal agencies (USGS, MMS, Energy Information Administration (EIA), DOE, foreign agencies, nongovernmental organizations, and industry.
- The Arctic is an area of high resource potential, low data density, sensitive environmental conditions, and great geologic uncertainty. A large portion of the remaining global endowment of oil and gas resources is known to exist in the high northern latitudes of Russia, Norway, Greenland, United States, and Canada. However, the quantity, distribution, and quality of these resources is poorly understood in many, if not most, areas. Only a relatively small part of the Arctic was included in the USGS World Petroleum Assessment of 2000 and the remaining areas with high resource potential are currently being investigated. Similar methodology will be used for the Arctic Petroleum Assessment; however, special circumstances affect the assessment of Arctic resources. Disparate data density, environmental concerns, high development costs, technological requirements, and the great need for collaborative work require certain modification of existing methodologies or application of additional methodologies. For this reason, the USGS, together with the Geological Survey of Denmark and Greenland (GEUS), convened an international workshop devoted to exploring and discussing the issues surrounding the assessment of oil and gas potential of the Circum-Arctic. Participants in the workshop included geoscientists from the United States, Canada, France, Greenland, Denmark, Norway, and the United Kingdom, including assessment methodologists from various government agencies, industry, and academia.
- USGS ERP scientists participated in the United Nations Framework Classification (UNFC) for oil, gas, and coal resource classification. The UNFC is a universally applicable instrument for classification, based on market criteria of the reserves and resources of energy and mineral commodities. This international effort was designed by the United Nations Economic Commission to accommodate and incorporate all national systems for reserves/resources and to make them comparable and compatible and thus enhance international communications. ERP scientists were an integral part of the United Nations committees developing and reviewing this classification harmonizing effort.

Organic Geochemical Database Available to the Public — The USGS ERP has completed and made public a database with more than 65,000 records containing the chemical analyses of crude oil, natural gas, and rock samples from thousands of locations worldwide (<http://energy.cr.usgs.gov/other/oglab/ogindex.htm>). USGS scientists use the information in the organic geochemistry database to assess domestic and world energy resources, and to develop an understanding of the physical and geochemical processes responsible for hydrocarbon formation, maturation, generation, migration, and accumulation. The public will find the information useful to better understand the geochemistry of many of the world's major oil- and gas-producing regions. The database is also a useful reference for Federal, State, and local agencies involved in land and resource planning, oil and gas production, oil and gas assessments, public safety, and environmental concerns. Information in the database includes rock pyrolysis data, organic mass spectrometry, vitrinite reflectance, gas chromatography, column chromatography, stable carbon isotopes, and a number of other related petroleum geochemical analyses.

2005 Planned Program Performance

The planned accomplishments and outcomes listed below demonstrate the utility of USGS activities that are counted for GPRA and PART measures, including: "number of targeted basins with oil and gas resource assessments available to support management decisions," "percent of formal USGS publications and scientific products receiving appropriate peer review," "number of systematic analyses and investigations," "long-term data collections," and "training and workshops."

The number of long-term data collections maintained remains the same and consists of (1) the National Coal Resources Data System, (2) the National Energy Research Seismic Library, and (3) the Organic Geochemical Database. We are now counting the number of gigabytes in these data bases as a measure of growth. The number of gigabytes is not comparable among databases, as they contain very different types of data. However, the number of gigabytes in each is expected to grow as the databases grow in their utility. In FY 2005, the number of targeted basins with oil and gas resource assessments available to support management decisions is six and includes Hanna Basin, Yukon Flats, Michigan Basin, Eastern Great Basin, North Slope State Lands (between NPRA and ANWR), and an Arctic basin.

Also in FY 2005, the ERP will provide 8 formal workshops or training to customers. ERP training consists of courses that are requested by customers, cooperators, and colleagues, and are therefore not always predictable. Workshops are usually set up by ERP scientists to further a common scientific or research need, to seek outside ideas or validation of ERP work. Examples of ERP training include (1) human health courses outlining the relationships between coal usage and human health and (2) coalbed methane courses where we teach groups about coalbed methane genesis, occurrence, migration, assessment, testing, development, and (3) training of foreign scientists, such as Afghans, the basics of oil and gas assessments. ERP workshops include gatherings of experts to talk about specific oil and gas or coal issues such as reserve growth and resource assessment methodology – two issues that many groups (academic, other government, and industry consortia) struggle with as these issues evolve along with technology and our understanding of geology.

In addition, the ERP will conduct the following research and assessment activities in FY 2005:

- The USGS will continue to update its oil and gas resource assessments for the United States, and in FY 2005, the USGS plans to complete its assessment of the Eastern

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Great Basin, Wind River Basin, Hanna Basin, Michigan Basin, Yukon Flats, and the North Slope State Lands. The ERP will also update its economic analysis of the ANWR 1002 area of the North Slope. Much of this effort is in support of the EPCA amendments of the 2000 and forms the basis for the periodic report to Congress required by the Act.

- The USGS ERP will continue work in FY 2005 to assess the recoverability, resource potential, environmental effects, and production characteristics of Alaskan permafrost-associated natural gas hydrates in the Prudhoe Bay-Kuparuk River area on the North Slope of Alaska. This work will be conducted in cooperation with the BLM, the State of Alaska Department of Natural Resources (DNR), and the cooperative Department of Energy – BP Exploration Alaska project.
- The ERP will continue work in FY 2005 to assess the recoverability, resource potential, environmental effects, and production characteristics of Alaskan permafrost-associated natural gas hydrates in the Prudhoe Bay-Kuparuk River area on the North Slope of Alaska. This work will be conducted in cooperation with the BLM and the State of Alaska DNR through the Division of Geological and Geophysical Surveys.
- ERP work in FY 2005 will continue to define the petroleum systems of large conventional Gulf Coast reservoirs, as well as defining some of the unconventional (continuous) reservoirs. The USGS has also initiated CRADA efforts with several companies involved in coalbed methane exploration in the Gulf Region, and the LGS. The ERP focus in FY 2005 will take this on-going work and new data and for the basis to be able to evaluate the coalbed gas potential of the Gulf Coastal Plain.
- The USGS ERP is revising the USGS methodology for coal resource assessment, in order to determine that subset of these coal resources that are available for mining and are technically recoverable (i.e., the reserve base). This revised reserve base assessment methodology has been peer reviewed and will be published in 2005. Once completed, the ERP then will systematically evaluate the major coal-producing basins in 2006 and beyond and compare the results of the coal reserve base estimates in particular regions of the country to illustrate how much resource is actually available and technically recoverable.
- In FY 2005, the USGS ERP will focus on tasks related to world oil and gas resources, including an ongoing assessment of additional provinces of the world not previously assessed. The highest priority task is the Arctic Assessment, which will assess several Arctic provinces over the next few years. These provinces are in Canada, America, Russia, Norway, Denmark, and other countries that may be significant sources of hydrocarbons. Additional tasks include study of reserve growth in oil and gas pools of Canada that are critical to U.S. supply; study of reserve growth in the North Sea; and continuing production of geologic maps of the world, including a circumpolar geologic map, a draft copy of which has been produced.
- In FY 2005 experimental studies will be conducted to evaluate potential environmental impacts of CO₂ storage in coalbeds, including impacts of the use of CO₂ for enhanced coalbed methane recovery. A preliminary CO₂ sequestration assessment methodology will be created to evaluate the CO₂ storage capacity in geologic reservoirs such as depleted oil and gas reservoirs and saline water-bearing formations.

- In FY 2005, the USGS will collaborate with the Navajo Nation to study the relationship of indoor and ambient air quality to respiratory diseases in the Navajo Nation. The ERP will continue its studies with the human health care sector (Centers for Disease Control and Prevention, National Institutes of Health, National Institute of Environmental Health Sciences, and other domestic and international doctors, epidemiologists, and health care providers) to determine what health effects may be caused by energy occurrence and usage, most particularly Balkan Endemic Nephropathy, a kidney disease hypothesized to relate to lignite aquifers in the Balkans and other parts of Europe.

Also in FY 2005, the ERP will continue activities to follow up on recommended actions from the ERP PART. The two recommended actions and associated activities are as follows:

1. Continue to make reports and data more accessible and user friendly.
 - In response to this recommendation, ERP has generated a customer survey questionnaire and placed it on each of the ERP-supported Web sites. This questionnaire is in its testing phase, but will be monitored to see if usable feedback is gathered, and to use the submitted suggestions in revising Web sites and (or) the way ERP digitally serves information and data. The questionnaire will be revised as necessary in order to gather usable feedback.
 - The ERP has also made a concerted effort to streamline three Web sites in order to make products, information, and other data delivered via the Web seamless to customers. This effort was undertaken to better assist customers, particularly other Federal agencies, in efficiently searching for and successfully obtaining USGS energy-related data and products.
 - The ERP webmasters are also working with the publications groups and others, so that ERP Web sites and bureau Web sites interface in a more user friendly fashion.
 - The ERP IT specialists are working with ERP scientists in order to serve more data sets via the Web and more quickly, as they become available. ERP IT specialists are constantly looking for better ways to serve data and products digitally, and are streamlining the process across all three regions.
2. Refine performance measures drafted during the PART process and develop a 5-year program plan that is consistent with these measures.
 - FY 2004 is the first year of reporting on the new performance measures (all in the DOI MITS system). ERP will refine the process as more data is gathered to make these measures more meaningful.
 - ERP is currently drafting a new program plan that is consistent with PART measures. Refining vision, mission, goals, defining core competencies, and identifying new priority areas of study are all in process as the plan evolves. Procedures for developing this plan are in place at the bureau level, and ERP has engaged a variety of stakeholders, both within and outside the USGS, in the process.

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Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Energy Resources (\$000)	\$23,615	-\$54
FTE	160	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs and technical adjustments.

The 2006 budget request for Energy Resources Program is \$23,615,000 and 160 FTE, a net program increase of +\$365,000 (includes adjustments for uncontrollable costs and technical adjustments) and 0 FTE from the 2005 enacted level.

Geothermal Assessments (+\$500,000) — The increase will provide funding to begin investigating the nature and extent of geothermal systems capable of producing electric power and to produce updated assessments of available geothermal resources in the western United States. The USGS proposes to conduct studies that will advance understanding of the thermal, chemical, and mechanical processes that lead to the co-location of high temperatures and high permeability necessary for the formation of geothermal systems and that will develop improved techniques for locating, characterizing, and exploiting these systems. The available data on the potential geothermal resources of the western United States indicate the presence of substantial undeveloped geothermal energy resources that could be tapped to help provide for the growing energy requirements of the western United States. The National Research Council review of the ERP recommended broadening the Program's energy portfolio to include alternative geologic energy resources, such as geothermal. This will be the first year of a 3-year study.

Energy and Environment Program (-\$500,000) — This activity does not address the highest priority science needs of the USGS and the Department. This decrease will reduce research on potential geologic sequestration options for carbon dioxide (a greenhouse gas emitted to the atmosphere during fossil fuel combustion) and will terminate the development of an assessment methodology for geologic sequestration of carbon dioxide. As a result, one fewer analysis on carbon sequestration will be delivered in FY 2006 and one fewer workshop will be held. The ERP will sustain efforts in CO₂ sequestration by serving in an advisory role to other Federal, State, and international groups. Although this reduction significantly reduces USGS geologic research for carbon sequestration, the USGS is conducting research on carbon sequestration under the Biological Research and Monitoring Program, which starts on page K - 15.

Water Resources Investigations Activity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes ^{a/}	Program Changes ^{b/}	2006 Budget Request	Change from 2005
Hydrologic Monitoring, Assessments, and Research	145,297	142,454	+3,219	-5,272	140,401	-2,053
FTE	1,093	1,035	0	0	1,035	0
Cooperative Water Program	63,995	62,337	+1,711	-278	63,770	+1,433
FTE	860	802	0	0	802	0
Water Resources Research Act Program	6,422	6,409	0	-6,409	0	-6,409
FTE	2	2	0	-2	0	-2
Total Requirements \$000	215,714	211,200	+4,930	-11,959	204,171	-7,029
FTE	1,955	1,839	0	0	1,837	-2

^{a/}Included in this activity is a one-time technical adjustment of -\$366 that moves all USGS funds associated with the Science on the DOI Landscape initiative to a single location in the Biological Research Activity for ease of administration and accounting.

^{b/}Changes for this activity include a reduction of -\$664 for travel and -\$171 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

Activity Summary

Introduction

Since 1879, the USGS has been involved in issues related to water availability, water quality, and flood hazards. This work, conducted by more than 4,000 hydrologists, technicians, and support staff located in every State, includes collection, management, and dissemination of hydrologic data; analysis of hydrologic systems through modeling or statistical methods; and research and development leading to new methods and new understanding. The following is a basic summary of the three broad areas of work:

Water Availability — Competition for water continues to increase throughout the Nation. Demands for water for agriculture, industry, cities, and aquatic habitat all compete for a finite supply of water. The USGS role in this area takes several forms. One of the most visible is the operation of streamgages that measure the flow of rivers. The USGS operates about 7,000 of these streamgages and provides the data in real time over the Internet, along with historical records that are used in resource planning

Use of Cost and Performance Information

Based on a number of factors, including the recommendations of the External Scientific Advisory Committee on Scientific Services (as contained in the March 2004 report, *The Future of Regional and National Scientific Services of the Water Resources Programs*), the USGS decided to close the water-quality laboratory in Ocala, FL, and transfer most of the lab's functions to the National Water Quality Laboratory in Denver. Given the recent budget shortfalls at the Ocala Lab and projected continuing shortfalls, the USGS has determined that consolidation of this function is more cost effective than maintaining two separate laboratories.

In addition, in FY 2004 the USGS Colorado Water District offered a targeted buy-out to accommodate changes in the workforce skill sets needed to keep pace with changes in the technology of water data collection.

Water Resources Investigations

and dispute resolution. The USGS also measures ground-water levels in wells as part of an overall effort to accurately define the Nation's ground-water resources, to make models that predict the impact of proposed ground-water development, and to define the changing status of ground-water resources. In addition, the USGS is the sole source of national-level information on how much water is used for agriculture, industry, commerce, or residences. The maps, models, statistical studies, and historical records of ground water, surface water, and water use are essential to virtually every project aimed at developing water resources or modifying the manner in which these resources are managed. During times of drought, water managers turn to the USGS to determine the status of ground-water and surface-water supplies, as they evaluate their management options.

Water Quality — Since passage of the Clean Water Act in 1972, the Nation has made great strides in improving the quality of surface and ground waters, yet important issues remain. Emerging topics of attention for the USGS include the sources, fate, and transport of nutrients, pesticides, pathogens (bacteria and viruses), and pharmaceuticals in water. The USGS works closely with State and local agencies and Federal agencies such as the U.S. Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and the National Institute of Environmental Health Sciences (NIEHS) on water-quality studies that have a strong connection to human health issues. Topics of recent emphasis include:

- Leadership of interagency studies of the Mississippi River Basin as it relates to Gulf of Mexico hypoxia,
- Analysis of the distribution and fate of methyl tert-butyl ether (MTBE, a gasoline additive) in ground water,
- Comparisons of pesticide contamination of urban and rural stream environments,
- Analysis of natural attenuation as a means of remediating contaminated ground water (natural attenuation refers to a variety of physical, chemical, or biological processes that can act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or ground water),
- Mapping of naturally occurring levels of arsenic and radium in drinking water supplies,
- Assistance to the States in providing the scientific basis for TMDLs (Total Maximum Daily Loads—the Clean Water Act requires States to develop and implement plans to improve the quality of waters that are impaired. TMDLs depend on sound data on water quality, streamflow, and sources of contamination),
- Analysis of water-level management and its role in mercury contamination of fish in the Everglades, and
- Delivery of real-time estimates of pathogens or toxic substances in water, to help regulators and the public avoid dangerous contact with water.

Advisory Committee on Water Information

Water-quality activities at various Federal and non-Federal agencies are coordinated in part through the National Water Quality Monitoring Council, a subcommittee of the Advisory Committee on Water Information (ACWI), which the USGS chairs under the auspices of Office of Management and Budget (OMB) Memorandum 92-01. ACWI is an interagency Federal/non Federal group convened under the auspices of the Federal Advisory Committee Act (FACA), with a broad mandate to represent the interests of water-information users and professionals in advising the Federal Government on activities and plans related to Federal water-information programs and the effectiveness of those programs in meeting the Nation's water-information needs.

Flood Hazards — More lives and property are lost due to flooding than any other type of natural disaster. The U.S. Army Corps of Engineers estimates that flood losses in the United States average more than \$5 billion per year. Hydrologic information from the USGS is needed to help reduce these losses. The information is used in two ways.

First, the long-term hydrologic records from USGS streamgages are used to estimate flood risks (such as the 100 year flood), which are then used to map out areas for flood insurance and flood zoning, and to design flood-resistant infrastructure such as roads, bridges, culverts,

National Weather Service and USGS partnership saved lives and property

The USGS has worked closely with the National Weather Service to establish a flood-warning network and appropriate water-level thresholds for rapid reporting of data.

Heavy rains during the summer of 2004 caused flash flooding in Greensboro, NC, forcing more than 100 people from their homes, trapping many in cars, and forcing the closure of I-40. Once critical water levels were reached, the USGS streamgages transmitted data at 15-minute intervals, enabling the National Weather Service to communicate water levels and approaching floods to the city 911.

According to Jeff Orrock of the National Weather Service, "it was amazing how well the system worked."

Local weathercasters reported to the National Weather Service that they were very impressed with the level of detail and precision of the warnings and statements.

spillways, and floodwalls. Long-term flow records from the streamgages provide important insights into changing land use and long-term climate variations that are necessary for developing risk estimates. Also, these long-term flow records are needed by the National Weather Service (NWS) to properly calibrate their streamflow forecasting models, which are used to produce the flood forecasts that are so vital to public safety and prevention of flood damages.

Second, the data collected at USGS streamgages are delivered rapidly to citizens, communities, businesses, and local emergency response agencies (via satellite and the Internet) so that they can make the best possible decisions about protecting lives and property during a flood. Recent emphasis has been placed on providing

more reliable information delivery, modernizing the existing streamgages to deliver more data in real-time, and adding new streamgages at locations where better flood warnings are needed by flood-prone population centers.

The mission of the USGS Water Programs supports the mission and goals of the USGS as outlined in the USGS Strategic Plan (2000–05), which states: "The USGS serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life." The mission also supports the Serving Communities portion of the DOI Strategic Plan, in particular end outcome goal SEO.2, "Advance knowledge through scientific leadership and inform decisions through the application of science." This is accomplished through activities that contribute to the DOI Intermediate Outcome: "Improve information base, information management, and technical assistance."

All these mission goals are long-term, with no milestone for "completion" of work. Monitoring of water conditions, for example, will continue for as long as resource managers need information on the state of the Nation's water resources. However, the USGS does have long-term (2008) targets for individual performance measures. For example, for the measure "Content and expanse of knowledge base: Percent of land with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (percent of proposed National Streamflow Information Program sites currently in operation)," the

Water Resources Investigations

USGS expects to have attained 58 percent coverage by FY 2008, assuming continued budgets level with the FY 2005 Estimate. Likewise, in FY 2008, the USGS expects to deliver to customers about 397 systematic analyses and investigations and 34 formal workshops/training courses. The USGS also expects to have 4,738 streamgages reporting in real time on the Internet, as well as 656 ground-water sites and 843 water-quality sites.

In addition to budgetary and personnel resources, program performance is affected by (1) advances in technology that can help to gain efficiencies in data collection, research, laboratory techniques, and data storage and dissemination, (2) weather conditions that affect the bureau's ability to perform certain hydrologic analyses that require high-flow or low-flow in water bodies being studied, and (3) support from more than 1,400 State, local, and other Federal agencies that contribute funds, staff time, and expertise to assist in the accomplishment of the program mission.

USGS Water Resources Investigations Programs

The following is a summary of FY 2004 and FY 2005 Water Resources Investigations programs:

- The Ground-Water Resources program evaluates ground water in the Nation's major aquifer systems, assesses the interactions of ground water with surface water, and evaluates the various factors that govern the response of aquifer systems to pumping, droughts, and other stresses. This budget line item includes the funding for the new Water Availability initiative that is beginning in FY 2005.
- The National Water-Quality Assessment (NAWQA) program provides nationally consistent data and information on the quality of the Nation's most important water resources, identifying status and trends, determining cause and effect, and eventually providing forecasting or prediction.
- The Toxic Substances Hydrology program provides scientific information and tools that explain the occurrence, behavior, and effects of toxic substances in the Nation's surface water and ground water. Data and information from the program support sound decisionmaking by resource managers, regulators, industry, and the public, to improve characterization and management of contaminated sites, to protect human and environmental health, and to reduce potential future contamination problems.
- The Hydrologic Research and Development program focuses on long-term investigations that integrate hydrologic, geologic, chemical, climatic, and biological information related to water-resources issues. This program provides the core research capability of the USGS water programs and supports many of the bureau's foremost water research scientists.
- NSIP is the Federal core of the national streamgaging network, which helps to assure the stability of long-term data collection. NSIP reflects that portion of the national streamgaging network that is funded exclusively by the USGS. In addition to NSIP funding, support for the network is supplied by other Federal agencies and by 800 State, local, municipal, and Tribal partners through the Cooperative Water Program. The shared funding and single-agency operation of the USGS network provides high-quality information to all users for a wide variety of uses at low cost to the Federal Government.
- The Hydrologic Networks and Analysis program supports the Federal core of the USGS water-quality monitoring networks, including the National Trends Network, which

monitors atmospheric deposition (acid rain). The program also supports a variety of research and investigations focused on the needs of other DOI bureaus and a portion of the USGS's information storage and dissemination efforts in the area of water resources. In FY 2005, this program is devoting additional resources to work in Upper Klamath Lake in south central Oregon, to help determine the water-quantity and water-quality benefits that can be expected in the Lake in response to various restoration activities.

- The mission of the Cooperative Water Program is to provide reliable, impartial, and timely information needed to understand the Nation's water resources through a program of shared efforts and funding with State, Tribal, and local partners. With States and localities paying at least half the cost of the work that the USGS performs, the Cooperative Program funds about 65 percent of USGS streamgaging activity, as well as a variety of focused water resources investigations in collaboration with State and local water management agencies (including Indian Tribes), with the goal of seeking solutions to water-resources issues of national concern.
- USGS administers grants for 54 State Water Resources Research Institutes designated by the Water Resources Research Act. The program supports academic research to aid in the resolution of State and regional water problems and related land problems, promotes technology transfer, and provides for the training of scientists and engineers.

Congressional Directives

The FY 2004 Appropriations Act for the Department of the Interior and Related Agencies included two directives for the USGS water programs:

- "The Committee requests that the USGS provide a report by January 31, 2004, detailing a five-year plan (2002-2006) for USGS involvement in LEAG [the Long-Term Estuary Assessment Group]. The report should describe the proposed work and show how it relates to the Survey's national program priorities. It should define the resources required to implement the plan through 2006." The report is in the surname process at USGS and will be delivered to the Committee shortly after delivery of the FY 2006 budget.

Federal Role

The USGS Water Resources Investigations Activity is the primary source of scientific information and long-term research on one of the Nation's most important natural resources—water. These water programs fulfill a unique Federal role by providing standardized, objective information for the entire country through long-term hydrologic data, interpretive reports, and new analytical methods. Under the authority of OMB Memorandum 92-01, the USGS has primary responsibility for coordinating water data activities within the Federal Government. Because river basins and aquifers cross many jurisdictional boundaries, there is great efficiency in having one national agency provide standardized regional water information to all interested groups through cost-sharing arrangements.

In addition, because many water issues involve interjurisdictional disputes, it is important that all parties involved view the data and results of studies as credible. This includes adjudication of water rights within a State, among States, or at international boundaries. The USGS is accepted as an impartial source by parties involved in disputes. The USGS provides standardized information to all, making it unnecessary for each State or locality to create its own

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infrastructure for data collection, data handling, interpretation, and dissemination. The basis for this national information program is analogous to the basis for other national information agencies, such as the NWS and the CDC.

Finally, the USGS coordinates with a number of national groups such as the Advisory Committee on Water Information, National Association of Counties, Association of State and Interstate Water Pollution Control Administrators, Association of Floodplain Managers, Interstate Council on Water Policy, Western States Water Council, and Association of American State Geologists. This coordination helps to ensure that the products resulting from USGS studies are relevant to the needs of resource managers across the Nation and that the products are made available in a form that is useful to those managers.

Program Assessment Rating Tool (PART) Evaluation

In FY 2004, the majority of the Water Resources Investigations program underwent PART evaluation. In keeping with the President's Business Reference Model, rather than conducting the PART for eight individual programs, the USGS underwent two PARTs that cover almost 100 percent of its Water programs, divided into two categories (1) research and (2) data collection and dissemination. The USGS received a score of 73 for each of these two PARTs and a rating of "moderately successful." The PART evaluations found that the programs have a clear purpose, do a good job at leveraging resources, work with a wide array of partners, and maintain an effective website for distributing and visualizing water information. The evaluations also concluded that the USGS has effectively used the ACWI and the National Water Quality Monitoring Council for feedback to improve programs and coordinate activities.

Recommendations for improvement included:

- Implement newly developed long-term performance measures to help track progress and scope of program activities,
- Continue to build on the successful effort to develop an integrated water information portal with the EPA to include information from other water programs,
- Work with other Federal agencies on a multi-year plan to coordinate water research and develop shared water research performance measures where possible by August 2005,
- Focus on efforts to work with the EPA and other Federal and State agencies through the ACWI to develop shared water monitoring plans,
- Determine if and how it would be appropriate to contract out streamgaging, and
- Implement regular, independent, and holistic reviews of all information collection and dissemination activities, and independent reviews of the entire water resources research program.

To begin addressing these recommendations, the USGS has drafted an implementation plan, which will be refined over the coming months in collaboration with OMB. The newly developed performance measures resulting from the PART process are included in the performance table below.

Other Program Reviews

In FY 2004, the General Accountability Office (GAO) conducted an investigation around questions on watershed management. The questions Congress asked the GAO to address were (1) who are the key entities that collect water quality and water quantity data, (2) what types of data do they collect, (3) how do they store their data and how can others access the data, and (4) to what extent do these entities coordinate their water quality and water quantity data collection efforts? The USGS provided information and suggestions to the GAO examiners over the life of their investigation, including facilitating their connection with the National Water-Quality Monitoring Council and State agencies. The report resulting from this review is, *Watershed Management: Better Coordination of Data Collection Efforts Needed to Support Key Decisions* (Rept. No. 04-382).

The GAO found that many agencies at all levels of government collect water-quality data, including as many as 16 Federal agencies. Further, the coordination and sharing of water-quality data is not as organized and effective as it could be, especially in contrast to water quantity data. Some of the key barriers to better coordination and sharing identified were (1) data collected for different organizations are geared toward serving different purposes, (2) inconsistent methods are used to obtain samples and interpret their results, (3) data collectors are unaware as to which entities collect what types of data, and (4) low priority for data coordination results in a lack of support for national and State councils that have been established to improve coordination.

To enhance and clearly define authority for coordinating the collection of water data nationwide, the GAO recommended that the Congress consider formally designating a lead organization (either an existing water data coordinating entity or one of the Federal agencies with broad water data collection responsibilities) for this purpose. Among its responsibilities, the organization would:

- Support the development and continued operation of regional and State monitoring councils,
- Coordinate the development of an Internet-based clearinghouse to convey what entities are collecting what types of data. This effort could include the development of a geospatial Internet-based query tool (portal) that would allow users access to information about water data within a given watershed, and
- Coordinate the development of clear guidance on metadata standards so that data users can integrate data from various sources.

National Academy of Sciences Reviews

The USGS assures the quality and relevance of its scientific results and information through a variety of peer review mechanisms, including both internal review by USGS scientists not associated with the program or project being reviewed, and external review by stakeholders (individually or in groups) and by groups such as the National Academy of Sciences, National Research Council (NRC).

During FY 2004, the NRC published one review of USGS programs (*Assessing the National Streamflow Information Program*) and one report on water research across government that included an examination of USGS research (*Confronting the Nation's Water Problems: the Role of Research*).

Other NRC reviews have focused on opportunities to improve the USGS NAWQA Program (2002), the USGS water-use information program (2002), USGS science in the areas of national-scale ground-water investigations (2000), hydrologic hazards (1999), watershed research (1997), and hazardous materials in the hydrologic environment (1996).

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Another review was conducted recently by a task force of external stakeholders, focusing on the Cooperative Water Program. The USGS is implementing the recommendations that resulted from the task force review of this program, and a final report is due to be released to the ACWI in January 2005.

Customers and Partners

A central feature of the USGS water program is that it is heavily leveraged in partnerships with State, Tribal, and local agencies. Out of a total program of \$459.1 million in FY 2004, \$141.3 million (31 percent) came to the USGS through funding agreements with more than 1,400 State, Tribal, and local agencies. This partnership relationship, which has existed for more than 100 years, is instrumental in assuring that USGS data collection and studies are highly relevant to the evolving needs of the States, Tribes, and local governments. An additional \$102.6 million (22 percent) came to the USGS in FY 2004, through reimbursable funding arrangements with more than 20 other Federal agencies.

This effective leveraging of Federal funds is possible because the USGS serves as the primary source of hydrologic information to many other Federal agencies and to American Indian/Alaska Native governments. For example, the USGS:

- Provides to the Department of Energy (DOE) most of the hydrologic and geologic capability for evaluating the suitability of Yucca Mountain, NV, as the site of the Nation's high level nuclear waste repository,
- Collects data for Federal water management agencies such as the U.S. Army Corps of Engineers and the Bureau of Reclamation,
- Conducts studies at the request of many land-management and water-management agencies, including research on optimal management of dams (such as Glen Canyon Dam) and evaluation of aquatic habitat changes due to water regulation and consumption, and
- Characterizes the hydrogeologic settings for use by the DOE, the Department of Defense, and the EPA at many sites where they have responsibility for ground-water contamination cleanup.

USGS participation in activities such as these prevents the need to duplicate a hydrologic staff in these agencies and assures that the collected data will be entered into a standardized national database so the information will be readily available to all potential users. These diverse programs with other Federal agencies result in new techniques and capabilities that are then put to use in the appropriated programs of the USGS.

With respect to partner involvement in the USGS water data collection activities most of the USGS data-collection stations serve multiple purposes and many are funded, wholly or in part, through cooperative agreements. Normally, these stations, though funded by various organizations, are operated as part of an integrated network rather than as stand-alone entities. For this reason, cooperating organizations are billed on the basis of average station cost, rather than actual cost, which rarely can be precisely known. This procedure benefits these organizations and the USGS in at least two ways: administrative costs are reduced because financial transactions are simplified, and definitive cost information is available to all parties for planning purposes at the beginning of the fiscal year. This arrangement also assures that data

collection in remote areas or areas that may be otherwise problematic during a given period of time (due to vandals, extreme flooding, lightning strikes, etc.) do not become so expensive that they must be dropped from the network.

Additional Information

National Research Program

The USGS organized a large portion of its water-resources research activities into a National Research Program (NRP) in the 1950s to promote management efficiency and to facilitate interaction among scientific disciplines. The NRP is designed to encourage pursuit of a diverse agenda of research topics to provide new knowledge and gain insights into hydrologic processes that are not well understood. The techniques and understanding developed by the NRP form the scientific basis for most hydrologic programs carried out by USGS scientists across the Nation. The scientific products of the NRP are used by hydrologists in other agencies, water resource managers, academia, and the private sector worldwide.

NRP scientists conduct research on complex hydrologic problems and develop techniques and methods to help advance the state of the science and assist other USGS programs in carrying out their missions. NRP activities integrate USGS expertise in hydrology, geology, chemistry, climatology, and biology relating to water resources and environmental problems. The research is generally long term; however, the emphasis of research activities changes through time, to reflect the emergence of promising new areas of inquiry and the demand for new tools and techniques with which to address water-resources issues.

In addition to conducting research, scientists in the NRP provide leadership and scientific services, such as (1) teaching formal training courses for USGS and cooperating agency staffs, (2) participating in technology transfer within the USGS, (3) consulting on USGS projects at the State level, (4) participating in reviews of USGS programs, (5) participating in the development of new programs, and (6) serving as scientific advisors for local, State, and other Federal agencies and for the public.

Scientific expertise is provided to the national and international scientific community as well through service on technical panels and committees and participation in activities of professional societies. The focus of the NRP is to conduct research directed toward developing fundamental process knowledge and new models or methods, to resolve difficult hydrologic questions, and to provide service to the USGS and the at large scientific community.

The activities of the NRP are funded at about \$30 million each year, with about 40 percent coming from Hydrologic Research and Development, 20 percent from the National

National Research Program

When the USGS embarks on particularly difficult projects, NRP scientists often take a leading role in the design and conduct of the study, bringing the most advanced scientific thinking and tools to the project. Examples of topical areas where the NRP has provided expertise essential for making science-based decisions include:

- Everglades restoration,
- CALFED and San Francisco Bay/Delta investigations,
- Grand Canyon environmental studies,
- Platte River management for wildlife habitat,
- Selenium poisoning of wildlife refuges from irrigation drainage,
- Emerging contaminants in water supplies, and
- Denitrification of agricultural sources of nitrogen

A significant part of the success of these large undertakings by the USGS comes from the scientific leadership and collaborative role that the NRP plays in planning and conducting these studies.

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Water-Quality Assessment program, 15 percent from the Toxic Substances Hydrology program, and 25 percent from other USGS programs. NRP managers and scientists work closely with the staff of the programs that support it. Descriptions of research activities conducted by NRP scientists are included in the budget justification narratives for the individual programs that support those scientists. More information about the NRP is available on the Web at <http://water.usgs.gov/nrp/>.

Priority Ecosystems Studies

In FY 2005 and FY 2006, two programs in this budget Activity will contribute funds to various interdisciplinary studies of ecosystems, including studies of South Florida, San Francisco Bay Delta, Chesapeake Bay, Platte River, Yellowstone, and Mojave Desert. Some of these studies are described in the Regional Activities section beginning on page F - 1.

Funding, Strategic Goals, and Performance Data

FY 2004 Plan Compared to FY 2004 Actual

- Number of real-time streamgages reporting on the Web exceeded the target by 658: the vast majority of funding for USGS water data collection programs is provided by State, local, Tribal, and Federal partners, and precise funding levels for these activities often are not known until well into the year. Additional reimbursable funds were received, allowing USGS to exceed targets by installing additional real-time sensors that were not originally planned.

FY 2005 Revised Plan Compared to FY 2004 Actual

- For the intermediate outcome "content and expanse of knowledge base" and the output measure "number of real-time streamgages reporting in NWISWeb," the table shows a decrease from FY 2004 to FY 2005. This is due to the decreasing appropriations and increasing costs. The number of streamgages in operation is also affected by changes in the level of funding contributed by partners, who provide most of the financial support for the water data collection networks. As long as appropriations are level or increasing and funding partners are unable to increase their own financial contributions, the number of streamgages in operation will continue to decline every year.
- For the output measure "number of systematic analyses and investigations delivered to customers," the USGS anticipates an increase in FY 2005 due to the increase in the Ground-Water Resources Program for a water availability initiative. In addition, there is some change in the target for the output measure "number of systematic analyses and investigations" every year that has no relationship to funding levels, congressional requirements, new legislation, or other external drivers. This change occurs continually as old projects end and new ones begin, or as projects and products change focus in response to changing customer requirements.

FY 2006 Plan Compared to FY 2005 Revised Plan

- For the intermediate outcome "content and expanse of knowledge base" and the outputs for "number of real-time streamgages reporting in NWISWeb," "number of real-time ground-water sites reporting in NWISWeb," and "number of real-time water-quality sites reporting in NWISWeb," the table shows a decrease from FY 2005 to FY 2006. This is

because the number of streamgages in operation is affected by changes in the level of funding contributed by partners, who provide most of the financial support for the water data collection networks. As long as funding partners are unable to increase their financial contributions, the number of streamgages in operation will continue to decline every year.

- For the output measure "number of systematic analyses and investigations delivered to customers," the USGS anticipates a decrease in FY 2005 due to the decrease in the Toxic Substances Hydrology Program. In addition, there is some change in the target for the output measure "number of systematic analyses and investigations" every year that has no relationship to funding levels, congressional requirements, new legislation, or other external drivers. This change occurs continually as old projects end and new ones begin, or as projects and products change focus in response to changing customer requirements.

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2003 to 2006 Performance Summary

Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD = Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Serving Communities Goal:

End Outcome Goal: SEO.2. Advance knowledge through scientific leadership and inform decisions through the application of science.							
End Outcome Measures	2003 Actual	FY 2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long-term Target (2008)
<i>Research:</i> Soundness of methodology, accuracy, and reliability of science (program evaluation) (SP)	100%	80%	100%	100%	100%	0	100%
<i>Inform decisions through the application of science:</i> Improved access to needed science information (# score) (SP)	92%	90%	90%	90%	90%	0	90%
<i>Inform decisions through the application of science:</i> Stakeholders reporting that information helped achieve goal (# score) (SP)	94%	93%	90%	90%	90%	0	90%
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Content and expanse of knowledge base:</i> % of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (% of proposed NSIP sites currently in operation) (SP)	65%	64%	63%	63%	62%	-1%	58%
<i>Quality:</i> X% of studies validated through appropriate peer review or independent review (SP)	100%	100%	100%	100%	100%	0	100%
<i>Access:</i> For information products surveyed X% of mapping, water, and biology customers are satisfied with ease, timeliness of access (BUR)	92%	90%	≥80%	≥80%	≥80%	0	≥80%

Activity Summary

PART Efficiency and other Output measures							
PART Efficiency Measures or other Outputs	2003 Actual	FY 2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long-term Target (2008)
# of systematic analyses and investigations delivered to customers	421	415	425	425	422	-3	397
# of formal workshops or training provided to customers (instances/issues/events)	UNK	36	36	36	36	-0	34
# real-time streamgages reporting in NWISWeb	5,621	5,978	5,187	5,187	5,120	-197	4,738
# real-time ground-water sites reporting in NWISWeb	697	799	700	700	679	-21	656
# real-time water-quality sites reporting in NWISWeb	891	1,062	900	900	896	-4	843
% of river basins that have streamflow stations (PART)	UNK	77%	79%	79%	81%	+2%	85%
% of streamflow stations with real-time measurement/reporting of water quality (PART)	UNK	6%	7%	7%	8%	+1%	11%
% of daily streamflow measurement sites with data that are converted from provisional to final status within 4 months of day of collection (PART)	UNK	0% (baseline)	10%	10%	20%	+10%	40%
% of proposed streamflow sites currently in operation that meet one or more Federal needs (PART)	65%	64%	63%	63%	60%	-3%	55%
% of WRD streamflow stations with 30 or more years of record (PART)	UNK	60% (baseline)	61%	61%	62%	+1%	65%
% of ground-water stations that have real-time reporting capability in the ground water climate response network (PART)	UNK	57% (baseline)	62%	62%	67%	+5%	77%
% of the Nation's 65 principal aquifers with monitoring wells used to measure responses of water levels to drought and climatic variations to provide information needed for water-supply decisionmaking (PART)	UNK	60%	61%	61%	62%	+1%	65%
% of U.S. with ground water quality status and trends information to support resource management decisions (PART)	UNK	0	12%	12%	18%	+6%	30%

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% of States with web based Streamflow statistics tools to support water management decisions (PART)	UNK	4%	11%	11%	18%	+7%	40%
% of U.S. with ground water availability status and trends information to support resource management decisions (PART)	UNK	5%	7%	7%	8%	+1%	10%
% of targeted contaminants for which methods are developed to assess potential environmental and human health significance (PART)	UNK	10%	20%	20%	30%	+10%	50%
Average cost per analytical result, adjusted for inflation, is stable or declining over a 5-year period (PART)	UNK	\$8.64	\$8.64	\$8.64	\$8.64	+0	\$8.64
% improvement in accuracy of watershed (SPARROW) model prediction for total nitrogen and total phosphorus (measured as reduced error) (PART)	UNK	40%	36%	36%	32%	-4%	25%

Hydrologic Monitoring, Assessments, and Research Subactivity

Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes ^{a/}	Program Changes ^{b/}	2006 Budget Request	Change from 2005
Ground-Water Resources Program	5,967	6,998	+49	+370	7,417	+419
FTE	49	44	0	0	44	0
National Water-Quality Assessment	63,285	61,645	+1,669	-182	63,132	+1,487
FTE	396	381	0	0	381	0
Toxic Substances Hydrology	14,902	14,476	+367	-1,723	13,120	-1,356
FTE	62	62	0	0	62	0
Hydrologic Research and Development	17,112	15,997	+363	-1,932	14,428	-1,569
FTE	305	295	0	0	295	0
National Streamflow Information Program	14,179	13,814	+379	-41	14,152	+338
FTE	41	41	0	0	41	0
Hydrologic Networks and Analysis	29,852	29,524	+392	-1,764	28,152	-1,372
FTE	240	212	0	0	212	0
Total Requirements \$000	145,297	142,454	+3,219	-5,272	140,401	-2,053
FTE	1,093	1,035	0	0	1,035	0

^{a/} Included in this program is a one-time technical adjustment of -\$98 that moves all USGS funds associated with the Science on the DOI Landscape initiative to a single location in the Biological Research Activity for ease of administration and accounting.

^{b/} Changes for this program element include a reduction of -\$25 for travel and -\$5 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

Ground-Water Resources Program

2006 Program Overview

The 2006 budget request for the Ground-Water Resources Program (GWRP) is \$7,417,000.

Ground water is one of the Nation's most important natural resources. It is the source of drinking water for about 130 million U.S. residents (about 50 percent of the population) and growing. The continued availability of ground water is essential for current and future populations and the health of our Nations economy in all 50 States. Much of the water used for irrigation by the Nation's agricultural sector is provided by pumping water from aquifers. Ground water also plays a crucial role in sustaining streamflow and helping to maintain healthy lakes and wetlands, especially during drought periods. The GWRP has four goals that address the ground-water resources of the United States.

Hydrologic Monitoring, Assessments, and Research Subactivity

First, the GWRP seeks to identify, describe, and make available fundamental information essential for the assessment of the availability of ground water in the Nation's major aquifer systems, and evaluates how ground water availability changes over time. By conducting multidisciplinary regional assessments, the GWRP complements the USGS Cooperative Water Program, which evaluates water resources on a more local scale in response to concerns raised by State and local water managers.

A second goal is to characterize and improve scientific understanding of natural and human factors controlling aquifer recharge, storage, and discharge for the Nation's major aquifer systems.

Third, the development and testing of new tools (numerical and geophysical) and field methods for the analysis of ground-water flow systems and their interaction with surface water is necessary to evaluate increasingly complex ground-water availability issues.

Finally, the program provides scientific leadership across all USGS Programs on matters pertaining to the Nation's ground-water resources including research directions, quality control, technology transfer, and information storage and delivery.

The GWRP includes the following activities, which are described in more detail in the 2005 Planned Program Performance section:

- **Focused Studies of Ground Water Sustainability** — including regional evaluation of ground-water availability, natural ground-water recharge, and ground-water issues for karst aquifers. This includes investigations such as the study of ground-water availability in California's Central Valley, where competing interest from the need to supply a rapidly growing population with needed water resources to the demands of one of the most productive agricultural region of the world has created concern for future water supplies. This program component also includes the Water Availability initiative begun in FY 2005. (Estimates for FY 2004, \$2.6 million; FY 2005, \$3.5 million; FY 2006 \$3.9 million)
- **Research and Methods Development** — The USGS has been at the forefront of devising new analytical techniques to solve practical problems in the study of ground-water resources. Predictive models are needed to make informed decisions in many emerging areas related to the effects of ground-water development. New models and methods enhance all USGS water programs, and State and local governments as well as ground-water scientists and engineers in the private sector who use them. (Estimates for FY 2004, \$1.2 million; FY 2005, \$1.2 million; FY 2006, \$1.2 million)
- **Technical Support** — This support provides quality control to assure the technical excellence of ground-water field programs, provides a structured way of transferring new technology to USGS investigative and data activities conducted across the Nation, and provides a formal way of establishing research priorities and making ground-water information available to other agencies, the scientific community, and the public. (Estimates for FY 2004, \$1.1 million; FY 2005, \$1.4 million; FY 2006, \$1.4 million)
- **Ground-Water Level Monitoring** — The USGS operates a national network of about 150 climate-response wells specifically designed for drought monitoring, and supports regional evaluation of ground-water levels in the High Plains aquifer in the central United

States and in Atlantic coastal plain aquifers. (Estimates for FY 2004, \$0.5 million; FY 2005, \$0.3 million; FY 2006, \$0.3 million)

- **Environmental Health in the U.S.-Mexico Border Region** — began in FY 2004, an interdisciplinary study of environmental health issues along the rapidly developing U.S.-Mexico border. The goal of this project is to provide an earth and biological resources database within a geographic framework using an Internet Map Service to further our understanding of the linkages between the condition of the physical environment and public health issues. The study is being conducted in collaboration with the National Institute of Environmental Health Sciences. (Estimates for FY 2004, \$0.5 million; FY 2005, \$0.5 million; FY 2006, \$0.5 million)
- **Science on the DOI Landscape** — The GWRP provides a portion of the funding for the "Science on the DOI Landscape" initiative that began in FY 2004. This initiative allows the USGS to meet regional priorities designated by DOI bureaus such as cooperative hydrologic monitoring studies to track the impacts of coalbed natural gas-produced waters on water quality in streams in development areas; instream flow methods for aquatic systems in the arid West; and studies to expand understanding of arctic hydrology on the North Slope, AK. (Estimates for FY 2004, \$0.1 million; FY 2005, \$0.1 million; FY 2006, \$0 million – funds transferred to Biological Research by a technical adjustment)

2004 Program Performance Accomplishments

Unless otherwise noted, the program accomplishments listed below demonstrate the utility of scientific publications and other products that are counted under the output measures for "systematic analyses and investigations delivered to customers," "number of long-term data collections and large data infrastructures maintained," and "number of formal workshops or training provided to customers."

Focused Studies of Ground-Water Sustainability

Ground-Water Basins in the Southwest — Ground-water resources in the Southwest are among the most stressed in the United States. Natural recharge to aquifers is low and pumping in many areas has resulted in lowering of water tables. The consequences of large-scale removal of water from storage are becoming increasingly evident. These consequences include land subsidence; loss of springs, streams, wetlands, and associated habitat; and degradation of water quality. Water managers are now seeking better ways to manage ground-water resources while looking for supplemental sources of water. New water supplies increasingly rely on conjunctive use of surface water and ground water. The dependence of sensitive ecosystems on ground water creates additional competition for scarce water resources. To address these concerns, the GWRP is completing a 5-year study of the interaction between ground water and surface water in the alluvial basins of the Southwest. More information on the ground-water resources of the Southwest can be found on the Internet at <http://water.usgs.gov/ogw/pubs/fs00086/index.html>.

USGS Works with U.S. Department of Agriculture to Evaluate Various Methods to Estimate Ground-water Recharge — Ground-water recharge is a large component of the water budget of most watersheds in the eastern United States, so it may come as a surprise to learn that ground-water recharge is almost impossible to measure directly. Usually, practicing

hydrologists make the best estimates of recharge possible by the use of indirect methods that are relatively straightforward in their application and require only commonly available hydrologic data. Recognizing this, the National Research Council recommended "it is essential that the USGS continue to develop and test methods that define recharge at scales ranging from local to regional." In response to that recommendation, the USGS, in cooperation with the U.S. Department of Agriculture, compared multiple methods for estimating ground-water recharge and base flow (as a proxy for recharge) at Agricultural Research Service sites in east-central Pennsylvania underlain by fractured bedrock. This study was designed to provide an improved understanding of methods for estimating recharge in the humid eastern United States.

Ground-Water Level Monitoring

Measurement of ground-water levels from wells is used to monitor changes in ground-water conditions due to climate and pumping. During drought conditions, when ground-water-level data are in high demand, real-time ground-water levels are measured at selected wells and transmitted to USGS databases for display on the World Wide Web for water managers. The USGS established a Ground-Water Climate-Response Network of about 150 selected wells to assess the changes in ground-water conditions due to climate stresses, especially drought. The water-level data can be viewed at <http://groundwaterwatch.usgs.gov/>. This accomplishment contributes to the PART measures for the percentage of real-time ground-water sites reporting in the Ground-Water Climate-Response Network.

During FY 2004, the GWRP supported publication of two USGS fact sheets that present water-level monitoring results for the High Plains aquifer. Water-level change maps from predevelopment to 2002 and 2003 were published in FY 2004. More information on the High Plains Water-Leveling Monitoring Project can be found on the Internet at <http://ne.water.usgs.gov/html/hpactivities.htm>.

Research and Methods Development

Geophysical Applications for Ground-Water Studies — The USGS conducts research into new geophysical techniques for water supply and contamination studies. Some areas of research include ground-water flow through fractured rocks, monitoring saltwater intrusion, measuring ground-water recharge, and application of geophysical techniques for geologic and aquifer mapping. New geophysical techniques can be used to characterize these settings in ways not previously possible with standard technology. For example, during FY 2004, work continued on a web-enabled system that will be used to assess and monitor hydrologic processes including aquifer storage and recovery and saltwater intrusion into coastal aquifers. More information on geophysical applications for ground-water studies can be found on the Internet at <http://water.usgs.gov/ogw/bgas/>.

Ground-Water Model Development — Improvements in computer codes for models are needed to keep pace with the changing needs of hydrologists who must evaluate increasingly complex water-resources issues. The USGS has recently completed several updates for MODFLOW, a model that helps scientists and engineers simulate common features in ground-water systems. MODFLOW is the most widely used program in the world for simulating ground-water flow, and the USGS adds new features as the science of ground-water hydrology advances and user needs change. The most recent updates include a new package designed to simulate the interaction of ground water with streams and lakes. Updates also have been made to the SEAWAT package of MODFLOW, which simulates ground-water flow in coastal

settings where the interaction between fresh ground water and seawater is an important factor. In addition, work continued on two new packages that expand MODFLOW's capabilities to better simulate (1) ground-water/surface-water interactions at the basin scale by coupling MODFLOW with a USGS watershed model, and (2) water-resource development and management alternatives.

SUTRA is another USGS model code that is used to simulate both ground-water flow and transport of solutes in ground water. A significantly updated version of SUTRA, which was finalized late in FY 2003, was made available to the public via a USGS Web site early in FY 2004, along with associated utility codes and an online user reference Web site that supplements the formal SUTRA documentation by providing a convenient, interactive source of information about theoretical and practical aspects of SUTRA simulation. This new version of SUTRA continues to be applied in a number of projects within and outside of the USGS. Additional information on ground-water model codes can be found on the Internet at <http://water.usgs.gov/nrp/gwsoftware/>.

Environmental Health in the U.S.-Mexico Border Region

The border region of the United States and Mexico encompasses a diverse array of physical settings and habitats which are unique in terms of their water, mineral, and biological resources. Rapid population growth, economic development, and land-use changes are pushing the limits of environmental sustainability and quality. Lagging infrastructure development has resulted in a shortage of water for municipal, agricultural, and industrial uses. To allow for continued economic growth while protecting the area's natural resources and fostering a high quality of life, the United States and Mexico need an improved understanding of the threats posed by these changes.

Issues of particular concern include (1) contaminants in ground water, surface water, and biota from agricultural, municipal, and industrial activities, (2) airborne pollutants from fossil-fuel combustion and other activities, (3) contaminants from past and present mining activities and mineral deposits, and (4) pathogens, pharmaceuticals, hormones, and other contaminants released in treated and untreated human and animal wastewaters. The goal of this project is to provide an earth and biological resources database within a geographic framework using an Internet Map Service (IMS) to further our understanding of the linkages between the condition of the physical environment and public health issues.

The project is planned to ultimately encompass the entire U.S.-Mexico border. Efforts in FY 2004 focused on the lower Rio Grande basin from Falcon Reservoir to the Gulf of Mexico, and an IMS for that study area is now available via the Internet at <http://borderhealth.cr.usgs.gov/>. Through partnerships with local, State, and Federal agencies in the United States and Mexico, the USGS identified biologic, geologic, hydrologic, environmental, public health, and demographic datasets for incorporation into the binational IMS. Base cartographic data provide a location-based foundation for analyzing the human interaction with the environment. Demographic data and health statistics provide information to study the relation between reportable health incidences and population trends. Geologic maps, soil maps, and geochemical and geophysical data provide information on environmental contamination from naturally occurring toxic materials in soil and underlying rocks. Binational hydrography data and the locations of water quality and quantity monitoring sites facilitate our understanding of linkages between the physical environment and public health issues. Data on the presence of contaminants in ground water, surface water, sediments, and biota, and the presence of development-related stressors such as raw and under-treated sewage have

additional implications to public health concerns. Stakeholder meetings were held in the study area during early FY 2004 to gain support for the project.

2005 Planned Program Performance

Unless otherwise noted, the planned program activities listed below demonstrate the utility of scientific publications and other products that are counted under the output measures for "systematic analyses and investigations delivered to customers," "number of long-term data collections and large data infrastructures maintained," and "number of formal workshops or training provided to customers."

Focused Studies of Ground-Water Sustainability

- **Regional Evaluation of Ground-Water Availability** — The GWRP will continue three studies begun in FY 2004 to evaluate ground-water availability of regional aquifers in the Atlantic Coastal Plain of North and South Carolina, the Denver Basin in Colorado, and California's Central Valley. Information about these aquifers is critically needed to support better management of ground-water resources in these areas with chronic water-supply issues. GWRP scientists are taking advantage of the quantitative work previously conducted about 20 years ago under the USGS Regional Aquifer-System Analysis Program to provide updated quantitative assessments of ground-water availability in areas of critical importance. These assessments will document the effects of human activities on water levels, ground-water storage, and discharge to streams and will evaluate the adequacy of data networks for these regions.
- **Natural Ground-Water Recharge** — Ground-water recharge is a critical part of the overall water budget, and it is one of the hardest components to quantify. Gaining better estimates of the amount of water recharging into regional aquifers is important to the evaluation of regional aquifers, which is a principal part of the GWRP's mission. In 1999, the GWRP began an effort to estimate regional rates of ground-water recharge in the Southwest and extended this effort to more humid parts of the United States in 2002. Projects were conducted in Washington, Minnesota, Wisconsin, Pennsylvania, and North Carolina, as well as a joint project with the National Water-

USGS Water Availability and Use Initiative

The availability and use of freshwater is crucial to the Nation's economy and ecosystems. The goal of the USGS Water Availability and Use Initiative, commencing in 2005 at the request of the Congress, is to help citizens, communities, and natural-resource managers have a clearer knowledge of the status of the Nation's water resources (how much water do we have?), trends over recent decades in its availability and use (how is water availability changing?), and an improved ability to forecast the availability of water for future economic and ecological uses.

In FY 2005, the Initiative is in a pilot phase that will focus its attention on the Great Lakes Region in determining the best ways to evaluate the resource and to deliver the information in a manner that is most helpful to planners and policymakers working at local, regional, and national levels. The Initiative will add other major water-resources regions in the future as funding permits. At full scale, the program would include a national synthesis component to provide an overview of the status and trends of the Nation's water resources in forms useful to policymakers, public officials, and the general public.

Just as a family, a business, or a Nation needs to know its current assets and its history of income and expenses, and needs an ability to forecast the consequences of today's actions on tomorrow's "bottom line" — so too, communities, regions, and the Nation need to know how much water they have now, how its availability and use have been changing over the years, and what its availability will be many years in the future as a result of today's water-management actions and investments.

Quality Assessment Program that covers many locations in the eastern United States. Recharge projects in Pennsylvania and Washington will publish their results in FY 2005. The projects are designed to develop better understanding of recharge processes and new methods to scale up site-specific estimates of recharge to regional values, so that better estimates of ground-water availability can be determined.

- **Ground-Water Issues for Karst Aquifers** — Karst-aquifer systems (limestone and other rocks that can be dissolved by ground water) underlie about 20 percent of the United States. About 40 percent of the ground water used for the Nation's drinking water comes from karst aquifers. In spite of the value of these aquifers for supply, their hydrogeology is not as well understood as other aquifer systems, especially at a regional scale. The USGS began a regional study of the karst aquifers in Alabama, Illinois, Indiana, Kentucky, and Tennessee in 2002, as a prototype for regional studies of karst aquifers. The GWRP is also supporting karst aquifer studies in the Shenandoah Valley of Virginia and West Virginia. These studies will continue in FY 2005.

Research and Methods Development

Research and methods development is an important part of the ongoing studies of regional ground-water availability in the Atlantic Coastal Plain, the Denver Basin, and the Central Valley of California, and also for evaluating karst aquifers in the Shenandoah Valley of Virginia and West Virginia and the south-central United States.

- **Model Development** — In FY 2005, research and code development will continue in the area of coupled ground-water/surface-water interaction, including development and testing of an unsaturated-zone flow package for MODFLOW that will provide for the simulation of water flow from land surface, through the unsaturated zone, to the water table. When completed, the coupled model will be tested using data from two to three basins across the country. In addition, work will be completed on a new MODFLOW process that will provide enhanced capability to evaluate alternative water-resource development and management scenarios posed by local, State, and Federal cooperators.
- **Research in Geophysics** — The USGS Office of Ground Water's Branch of Geophysics and personnel from the Idaho National Environmental and Engineering Laboratory and Stanford University have developed an experimental monitoring system designed to obtain time-lapse images of an aquifer storage and recovery (ASR) experiment planned for spring 2005 in Charleston, SC. The objective of the project is to develop and apply advanced geophysical imaging methods to assess and monitor hydrologic processes including ASR and saltwater intrusion into coastal aquifers. ASR is a method for storing freshwater in an aquifer containing water of poor quality where the freshwater can be withdrawn during an emergency or when demand exceeds the normal or seasonal supply. Although ASR has been in use for decades and is becoming increasingly popular in the United States and around the world, there are many aspects of the method that are poorly understood and that can affect the long-term storage and efficient withdrawal of the freshwater. At the Charleston site, freshwater will be injected into, and withdrawn from, a brackish aquifer. Because there is a large difference between the electrical resistivity of fresh and saline water, the project scientists will be able to see the shape and distribution of the freshwater as it is injected into and withdrawn from the aquifer. Information gleaned from the effort should aid the conceptual understanding of ASR and help improve existing ASR modeling approaches.

Hydrologic Monitoring, Assessments, and Research Subactivity

In addition, project scientists hope that lessons learned from the ASR monitoring experiment can be used to help monitor larger-scale hydrologic behavior including saltwater intrusion in coastal aquifers.

Ground-Water-Level Monitoring

During drought conditions, the ground-water resources managers need to rapidly collect water-level measurements and track trends in ground-water levels. The USGS presently operates a sparse national network of about 150 climate-response wells specifically designed for drought monitoring. This network is augmented by ground-water-level monitoring that is supported by the Cooperative Water Program. Water-level data for these wells can be viewed at <http://groundwaterwatch.usgs.gov/>. The GWRP also supports regional evaluation of ground-water levels in the High Plains aquifer in the central United States and in Atlantic coastal plain aquifers, two areas where ground-water resources have been intensively developed. A ground-water level map of the Atlantic coastal plain aquifer is to be published in FY 2005.

U.S.-Mexico Border Human Health Initiative

An interdisciplinary study of environmental health issues along the rapidly developing U.S.-Mexico border began in FY 2004. The study takes advantage of data and information generated by previous and current USGS studies in water, geology, biology, and geography but focuses on understanding disease-causing agents in the environment and their specific exposure pathways in water, air, and soil. This effort builds on USGS core capabilities in the earth and biological sciences and directly addresses the USGS mission to provide the understanding of the environment and natural resources that will help protect and save lives. The work is a partnership with the National Institute of Environmental Health Sciences, which brings the human health dimension to the study. A fact sheet will be published in FY 2005 that demonstrates the utility of the IMS for the investigation of environmental health in this region. New efforts in FY 2005 will include additional data incorporation, development of real-world applications with local partners, and selection of subsequent study areas along the U.S.-Mexico border.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Ground-Water Resources Program (\$000)	\$7,417	+\$370
FTE	44	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs and technical adjustments.

The FY 2006, budget request for the Ground-Water Resources Program is \$7,417,000 and 44 FTE, a net program increase of +\$419,000 (includes adjustments for uncontrollable costs and technical adjustments) and 0 FTE from the 2005 enacted level.

Water Availability (+\$400,000) — The USGS would begin a broad multi-State effort on assessment of ground-water depletion. During the past 50 years, depletion of ground water has spread from small, isolated pockets to large areas of the country, as ground-water use has intensified. Ground water is currently the source of drinking water for about half the U.S. population and provides much of the irrigation water that supports the Nation's agricultural economy. Despite its importance, information about long-term changes in ground-water reserves remains patchy, and a systematic approach to presenting what is known about

depletion of water available from the Nation's aquifers does not exist. To begin to fill this information gap, the USGS would develop a Web-based system to display and analyze information on long-term changes in ground-water reserves for a multi-State area in the western United States. The system would enable the general public, water-management agencies, policymakers, and others to readily obtain information about the status and trends in ground-water levels, as well as to identify information gaps. A prototype system and analysis would be available for the study area within 2 years, with extension to other areas thereafter.

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Hydrologic Monitoring, Assessments, and Research Subactivity

Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{ai}	2006 Budget Request	Change from 2005
Ground-Water Resources Program	5,967	6,998	+49	+370	7,417	+419
FTE	49	44	0	0	44	0
National Water-Quality Assessment	63,285	61,645	+1,669	-182	63,132	+1,487
FTE	396	381	0	0	381	0
Toxic Substances Hydrology	14,902	14,476	+367	-1,723	13,120	-1,356
FTE	62	62	0	0	62	0
Hydrologic Research and Development	17,112	15,997	+363	-1,932	14,428	-1,569
FTE	305	295	0	0	295	0
National Streamflow Information Program	14,179	13,814	+379	-41	14,152	+338
FTE	41	41	0	0	41	0
Hydrologic Networks and Analysis	29,852	29,524	+392	-1,764	28,152	-1,372
FTE	240	212	0	0	212	0
Total Requirements \$000	145,297	142,454	+3,219	-5,272	140,401	-2,053
FTE	1,093	1,035	0	0	1,035	0

^{ai} Changes for this program element include a reduction of -\$129 for travel and -\$53 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

National Water-Quality Assessment Program

2006 Program Overview

The 2006 budget request for the National Water-Quality Assessment (NAWQA) Program is \$63,132,000.

The USGS NAWQA Program addresses three long-term goals:

- Describe the status and trends in the quality of a large, representative part of the Nation's surface-water and ground-water resources,

"The NAWQA Program is unique in its capability to answer whether the Nation's water quality is improving. This is a fundamental long-term issue that policymakers are seeking to address."

Claudia Copeland
Specialist in Resources and Environmental Policy
Congressional Research Service, October 2004

Hydrologic Monitoring, Assessments, and Research Subactivity

- Provide an improved understanding of the primary natural factors and human activities affecting these conditions, and
- Provide information that supports development and evaluation of management, regulatory, and monitoring decisions by other Federal, State, and local agencies.

The USGS approaches these goals using five major program elements:

- **Study Unit Investigations** of major river basins and aquifer systems (estimates for FY 2004, \$37.6 million; FY 2005, \$36.3 million; FY 2006, \$37.5 million) — Study unit investigations follow consistent practices from data collection through interpretation, to generate comparable findings over time and across the Nation. Study units collaborate with national teams on five water-quality topics selected for study on the basis of an extensive analysis of national and regional water-quality issues and priorities. NAWQA relies on fundamental research accomplished in other water programs like the Toxic Substances Hydrology Program. For example, NAWQA collaborates with other USGS scientists funded by the Toxics Program on the topic of mercury bioaccumulation in aquatic organisms, using appropriate sampling and laboratory analytical techniques for methyl mercury occurrence in the environment and in aquatic organisms.

Study Unit Investigation Topics

Effects of nutrient enrichment on streams

Sources, transport, and fate of agricultural chemicals

Transport of contaminants to water supply wells

Effects of urbanization on stream ecosystems

Bioaccumulation of mercury in aquatic organisms

- **National Syntheses of Key Findings** related to important water-quality topics from investigations in the study units and from other water-quality investigations (estimates for FY 2004, \$7.4 million; FY 2005, \$7.2 million; FY 2006, \$7.4 million) — National synthesis projects compare findings across the country and identify relationships between land use, geology, soils, climate, and water quality conditions. The current national synthesis topics are pesticides, nutrients, volatile organic compounds, trace elements, and aquatic ecology.
- **Supporting Research and Methods Development** (FY 2004, \$6.2 million; FY 2005, \$6.2 million; FY 2006, \$6.2 million) — To ensure NAWQA data collection and analyses are relevant to emerging issues, about 10 percent of program resource is devoted to developing new methods of sample collection and analysis and to continuously improving assessment techniques.
- **Coordination** at local, State, regional, and national levels with environmental and natural resources managers and other users of water-quality information (estimates for FY 2004, \$2.3 million; FY 2005, \$2.2 million; FY 2006, \$2.3 million) — Nationally, over the past several years NAWQA coordination has increased significantly with the U.S. Environmental Protection Agency (EPA). NAWQA provides direct service to the EPA Office of Pesticide Programs; Office of Wetlands, Oceans, and Watersheds; Office of Ground Water and Drinking Water; and Office of Science and Technology, assisting in the timely and relevant application of NAWQA data to those offices' decisionmaking processes. This association has made millions of dollars of field pesticide data available in a useful form for EPA decisionmaking. NAWQA coordination and outreach occurs at

all levels of the program. Liaisons with agencies from national to local have involved over 1,500 organizations and individuals.

- **Technical Support** of USGS water-quality activities (estimates for FY 2004, \$9.8 million; FY 2005, \$9.7 million; FY 2006, \$9.8 million) — The USGS has a long tradition of providing national technical support and training for its geographically distributed water-quality studies. This support provides quality control to assure the technical excellence of water-quality field programs and provides a structured way of transferring new technology to USGS investigative and data activities that are primarily conducted in District offices in each State. Technical support also includes a formal way of establishing priorities for water-quality research by the USGS and provides a mechanism to make water-quality information available to other agencies, the scientific community, and the public.

The program addresses the DOI Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science. Key indications of USGS performance in describing the status and trends in the quality of the Nation's surface-water and ground-water resources and informing decisions are reflected in the end outcome measure for research: soundness of methodology, accuracy, and reliability of science (100 percent of science is validated through appropriate peer review); and the end outcome measure for informing decisions through the application of science: percent of stakeholders reporting that information provided by the USGS helped them achieve their goal. To clearly measure progress in achieving intermediate outcomes of expanding the science knowledge base by assessing water quality conditions and trends, and enhancing the quality and objectivity of science, the USGS tracks outputs including the number of long-term data collections, and the number of systematic analyses and investigations delivered to customers.

"The NAWQA Program provides a critical national focus that helps to quantify the condition of our water resources in a large number of places. Its approach to providing nationally consistent information allows us to make statements that simply could not be made otherwise. Using NAWQA data, we can describe nutrient and contaminant occurrence nationally and among different land uses, and track how those conditions change over time. The Heinz Center depends heavily on NAWQA data to support our periodic report: "The State of the Nation's Ecosystems." We appreciate NAWQA's strong commitment to making its information and data readily accessible to meet our organization's needs and to address the Nation's water-resource information needs."

Robin O'Malley, Senior Fellow and Program Director, H. John Heinz III Center for Science, Economics and the Environment, October 2004

Cycle II – NAWQA's Second Decade

Cycle II studies began in 2001. Cycle II studies focus on water-quality trends over time and expand on the explanation of environmental conditions that influence contaminant distribution. During FY 2005, the first group of 14 Cycle II study units is completing data collection, and NAWQA completed sampling in source water areas in these 14 units. With the FY 2005 budget request level, a second group of 14 Cycle II study units will begin intensive data collection in 2005. These additional study areas will increase investigations of the effects of urbanization in Seattle and Tacoma, WA; San Antonio, TX; Albuquerque, NM; St. Louis, MO; New Jersey; and Sacramento, CA.

As in Cycle I, NAWQA uses a rotational design for its investigations that consists of three groups of 14 study units with staggered intervals of high and low intensity study. About one

Hydrologic Monitoring, Assessments, and Research Subactivity

third of all study units will be under highly intensive investigation at any given time for 4 years, and trends will be assessed about every 10 years for the areas studied.

USGS planning for Cycle II included two major changes from Cycle I emphasis. The changes were twofold:

- Increase emphasis on understanding time trends and processes governing water quality. This change does not eliminate the status assessment, but rather reduces it to bring more balance to the program, particularly given the substantial advances made in assessing the status of water-quality conditions during Cycle I. Strategic planning of the trends component of the NAWQA Program considered streams and aquifers most susceptible to urbanization and agricultural practices for resampling and long-term monitoring to provide land and water-resources managers and policy makers an information base to assess the value of programs such as conservation, farming practices, and planned urban growth.
- Reduce the number of study units to accommodate current NAWQA purchasing power. The USGS decided on a total of 42 study units for Cycle II, with 14 investigations started in 2001, a second group of 14 investigations that started in 2004, and plans for the final group of 14 to start in 2007. The number of study units was determined on an assumption the NAWQA Program would not get funding increases, but would get uncontrollable cost adjustments each year.

The fact that funding has not kept pace with inflation most years is leading to reduced activity within the 42 study units. For example, only one special topical study is being undertaken in each of the 14 study units starting-up in 2005, compared to about 2 special studies per study unit in the first group. Further adjustments in 2004 included a reduction in the number of long-term stream monitoring sites for trend detection from 145 to 84 and to extend the period of data collection and intensive activity from 3 to 4 years for each of the three groups of study units. The extended intensive data-collection and analysis period allows the Program to stretch limited dollars out over time but also extends by 2-3 years the period between the completion of data collection and the publication of findings. The overall effect on the Program has been to extend Cycle II to the year 2013 and to reduce the level of activities in each study unit.

Outreach and Liaison

The USGS has a NAWQA Web site (<http://water.usgs.gov/nawqa/>) to provide rapid access to NAWQA data, reports, and methods documents. Also available is an up to date listing of current developments that allows interested parties to get new information in a timely fashion. By 2004, the Program made publicly available water-quality data for 7,000 wells and 6,400 stream sites. Stream data include 3,000 samples of contaminants in bed sediment and aquatic animal tissues and 1,000 sites with information on biodiversity and abundance of fish and aquatic insects.

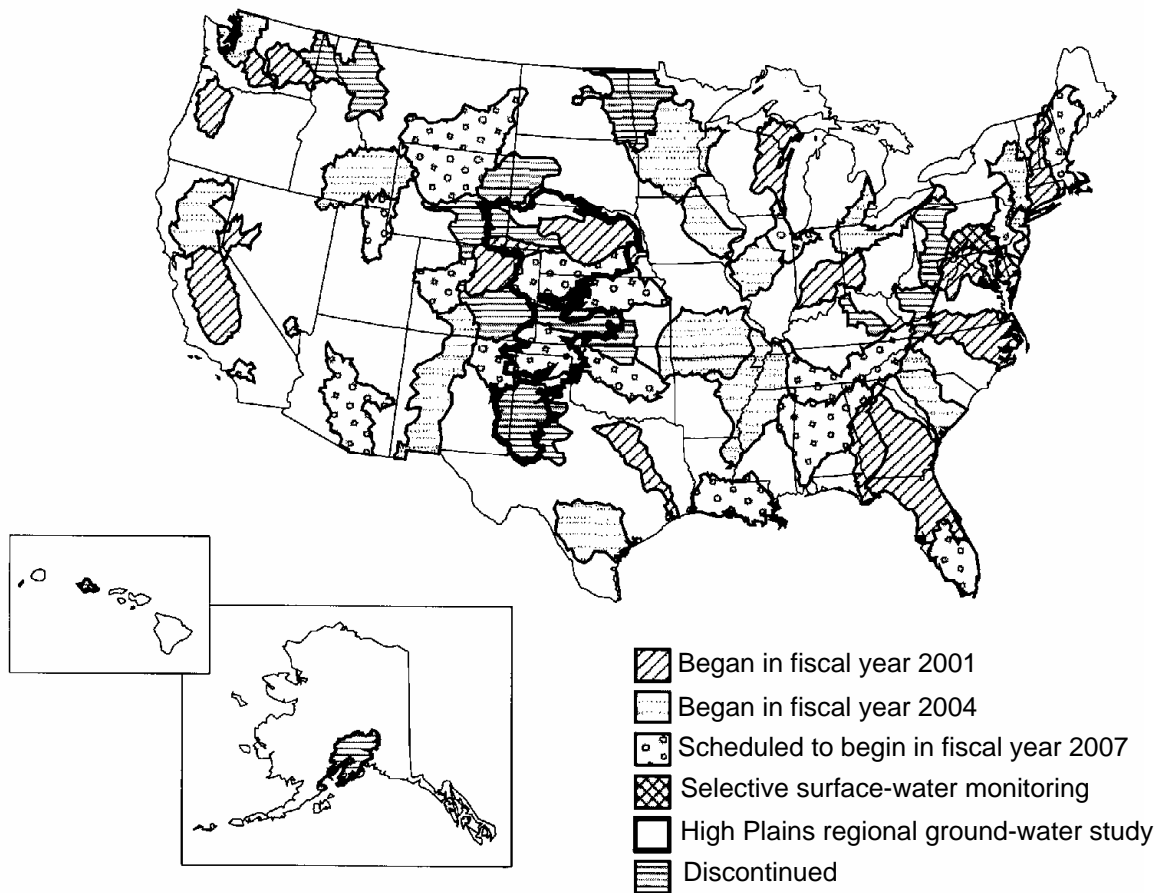
To share program knowledge, NAWQA managers coordinate extensively with Federal agencies such as the EPA, USDA, State and local agencies, non-governmental organizations, and the private

"The NAWQA Program does an excellent job at reporting its high quality, credible, and unbiased information in an understandable way that creates the needed links between science and water-resource policy. Our organization, which is a leader of a nation-wide river movement made up of thousands of river and watershed groups, depends on the water-quality and ecosystem data generated from this Program to help support the protection of our Nation's rivers."

Betsy Otto, American Rivers, October 2004

sector. For example, NAWQA staff share office space in selected EPA offices to ensure that technical information and resources are shared, so that duplication can be avoided and Federal dollars can be saved. Input from these same groups is sought and incorporated in program activities. For example, these groups influence the selection of sampling sites and the selection of chemicals to be analyzed and assist the USGS in gaining access to sampling locations.

**National Water-Quality Assessment
Cycle II Study Units**



2004 Program Performance Accomplishments

The accomplishments and outcomes listed below demonstrate the utility of USGS products that are counted under the output measures for "number of systematic analyses and investigations delivered to customers" and "number of long-term data collections and large data infrastructures maintained." All of these accomplishments and outcomes relate to the "Coordination" program component described above under "FY 2006 Program Overview." Linkages to other program components are shown with each accomplishment below.

The major program accomplishment in FY 2004 was the release of the last 15 of 51 USGS Circulars summarizing water quality in major river basins and aquifers across the Nation.

Hydrologic Monitoring, Assessments, and Research Subactivity

Collectively, these reports characterize the general health of ground- and surface-water resources, address current and emerging water issues and priorities, and describe trends in water quality—a wealth of information that contributes to practical and effective water-resources management. In addition, selected findings of regional and national interest were highlighted in a separate USGS Circular. Overall, these reports provide a foundation to both understand water-quality conditions in NAWQA areas, and to use as a baseline for future trend analysis and comparison to studies done in Cycle II.

Drinking Water and Human Health:

USGS Findings Assist in City of Lincoln, Nebraska Well-field Management — NAWQA findings were used by the City of Lincoln Public Works and Utilities during FY 2004 to develop a well-field management plan. NAWQA results showed elevated concentrations of pesticides, which served as an early warning of possible contamination in the source water used to provide municipal water supplies for Lincoln, NE. The NAWQA study improved the facility's understanding of the transport of pesticides from the Platte River through channel alluvium and into the ground water at the City of Lincoln well-field near the river. This accomplishment is a result of work conducted under the "Study unit investigations" program component described above under "FY 2006 Program Overview."

The USGS Develops Health-based Screening Levels for Application to Ground-water Quality Data in New Jersey — In cooperation with the New Jersey Department of Environmental Protection, the Oregon Health and Science University, and the EPA, the NAWQA Program developed health-based screening levels for selected unregulated contaminants. During FY 2004, the screening levels were used to more comprehensively evaluate NAWQA's ground-water data in New Jersey in a human-health context, particularly for those contaminants with no existing Federal or State drinking-water standard or guidelines. Fourteen unregulated contaminants with new screening levels were detected, 10 of which were detected in ground-water resources used from drinking. Maximum detected concentrations for the contaminants generally were well below the new human-health benchmarks. This accomplishment is a result of work conducted under the "National synthesis" program component described above under "FY 2006 Program Overview."

NAWQA Data Used in Pesticide Exposure and Risk Assessments in Louisiana — Findings on the occurrence of pesticides in ground and surface water in the Acadian-Pontchartrain Drainages in Louisiana, one of the Nation's major rice and sugarcane production areas, are a reliable source of information for the EPA's Office of Pesticide Programs (OPP). The NAWQA study highlighted relations between land use (e.g., agriculture) and the frequency and levels of pesticide detections in water. These findings were useful to OPP during FY 2004 in their pesticide exposure and risk assessments. This accomplishment is a result of work conducted under the "Study unit investigations" program component described above under "FY 2006 Program Overview."

"As a reliable source of comprehensive information, results from the USGS study have been used in [EPA] pesticide exposure and risk assessments."

Sid Abel
U.S. Environmental Protection Agency
Office of Pesticide Programs
October 2004

NAWQA Scientists Assess Influences on Water Supplies within the Potomac River Basin — NAWQA data and expertise on hydrology and water quality are used in the assessment of natural and human influences on water supplies within the Potomac River Basin by the Potomac River Basin Drinking Water Source Protection Partnership. This Partnership is

a voluntary organization of water suppliers and local, State, and Federal agencies. During FY 2004, the findings were used to help assess potential drinking-water issues related to contamination for the 3.6 million people in the Washington, DC, area where the Potomac River provides about 75 percent of the drinking water. This accomplishment is a result of work conducted under the "Study unit investigations" program component described above under "FY 2006 Program Overview."

Modeling and Assessment:

The USGS Models Nutrients in New England Waterways — The USGS, in cooperation with the EPA and New England Interstate Water Pollution Control Commission (NEIWPCC), has developed a statistical model (referred to as SPARROW for Spatially Referenced Regressions On Watershed Attributes) to understand how and where the quality of New England's waterways is affected by nitrogen and phosphorus contamination. The model estimates the levels of total nitrogen and total phosphorus and the sources of these nutrients in 42,000 stream reaches throughout New England. Modeled findings revealed, for example, that half of the nitrogen found in New England streams comes from the atmosphere. The model is used by water-resource managers within the NEIWPCC and EPA to manage excess nutrients, which can stimulate damaging algal blooms downstream. During FY 2004, for example, the findings were incorporated in a regional long-term plan to reduce nitrogen entering Long Island Sound. The EPA Office of Research and Development is using model results to help assess nitrogen inputs to coastal waters and to help explain results in their National Coastal Assessment in New England. This accomplishment is a result of work conducted under the "Study unit investigations" program component described above under "FY 2006 Program Overview."

"The information generated by this [SPARROW] modeling study is enormously valuable, and we're already using it to help us develop a long-term plan to reduce the amount of nitrogen that enters Long Island Sound."

Ronald Poltak
Executive Director
New England Interstate Water
Pollution Control Commission
Summer 2004

NAWQA Develops Models to Predict Pesticide Levels in Sources of Drinking Water for EPA's Pesticide Regulatory Process — NAWQA, in cooperation with EPA and industry

"For many years, EPA has worked closely with the USGS NAWQA Program to advance the scientific tools and data that are used to assess risks posed by pesticides in surface water and ground water. Recently, the two agencies have collaborated in developing an extrapolation model that will statistically relate pesticide concentrations to watershed characteristics. Using national data, this model estimates occurrence and exposure to atrazine for watersheds across the country, with calculated reliability. The model increases EPA's capability to predict potential impacts of pesticide use on water quality, especially in areas where monitoring data are not available and has been used to identify areas where additional monitoring is most needed to evaluate the ecological condition of watersheds."

Elizabeth Behl
Branch Chief, Environmental Risk Branch
U.S. Environmental Protection Agency, October 2004

representatives, has developed statistical models for predicting pesticide concentrations in streams and rivers. The models are based on nationwide NAWQA data. Predicted concentrations were used by EPA in FY 2004 to provide estimates of potential exposure for implementation of the Food Quality Protection Act, which requires estimation of human exposure to pesticides in drinking water. This accomplishment is a result of work conducted under the "National synthesis" program component described above under "FY 2006 Program Overview."

NAWQA Monitors Perchlorate in the Southern High Plains of Texas — Perchlorate, a naturally occurring and man-made chemical, is increasingly being discovered in soil and water throughout the Nation. The chemical is a major ingredient in solid rocket propellant. Monitoring results of perchlorate by the NAWQA Program in the southern High Plains of Texas were used by the Texas Tech University and Texas Commission on Environmental Quality to assess the natural occurrence of perchlorate in the southern High Plains of Texas. This accomplishment is a result of work conducted under the "Study unit investigations" program component described above under "FY 2006 Program Overview."

State Standards and Nutrient Criteria:

NAWQA Data on Algae Support Development of Nutrient Criteria in Indiana — NAWQA scientists, in collaboration with the Indiana Department of Environmental Management, monitor seasonal and annual trends of nutrient and algal concentrations and their potential effects on the biotic community. During FY 2004, the findings were included in the State of Indiana Nutrient Criteria Plan that has been approved by the EPA. This accomplishment is a result of work conducted under the "National synthesis" program component described above under "FY 2006 Program Overview."

"The work that USGS is doing at NAWQA sites in Indiana provides a major contribution to Indiana's plan to develop nutrient criteria for the State. Indiana, like many States, is opting to try to develop nutrient criteria based on "cause and effect" relationships. NAWQA data provide valuable information on seasonal and annual trends, fate and transport of nutrients, and relations between biological, chemical, and physical data—all of which help to define cause-and-effect relationships between nutrients, algal responses, and biological condition."

Denny Clark
Indiana Department of Environmental Management
October 2004

NAWQA Data in Minnesota and Wisconsin Result in an Interagency Protection Strategy for the St. Croix National Scenic Riverway — The St. Croix River Water Resources Planning Team, which is a multi-State-Federal cooperative organization, uses NAWQA data to implement a protection strategy for the St. Croix River in effort to reverse ecological degradation. During FY 2004, the Team announced a goal for a 20 percent reduction in phosphorus loading to the watershed. This recommendation was in large part based on NAWQA findings on nutrient loadings from tributaries. This accomplishment is a result of work conducted under the "Study unit investigations" program component described above under "FY 2006 Program Overview."

"We are very fortunate to have the St. Croix National Scenic Riverway included in the NAWQA Program. The work done through NAWQA has proven to be invaluable and has provided a firm foundation and the momentum for additional studies. We have gained tremendous benefits from our association with NAWQA."

Randy Ferrin
Chair, St. Croix River Water Resources Planning Team, National Park Service
October 2004

State Assessments of Beneficial Uses and Impaired Waters (including TMDLs):

These accomplishments are the result of work conducted under the "Study unit investigations" program component described above under "FY 2006 Program Overview."

NAWQA Program Provides Data to Support Development of a Mercury TMDL in the Willamette Basin, Oregon — Data on atmospheric mercury concentrations and loads to the Willamette Basin in Oregon were incorporated during FY 2004 in the development of an interim basin-wide, mercury TMDL by the Oregon Department of Environmental Quality (ODEQ). These atmospheric data are unique in that they are the first available for the basin. NAWQA sampling efforts in the Willamette Basin continue to provide information to the ODEQ on mercury sources (especially in urban basins), mercury methylation rates, seasonal variability of mercury

concentrations in streams, and bioaccumulation of mercury within the aquatic food web—all of which have been identified as areas needing additional research as ODEQ moves toward development of a final TMDL to be issued in 2009.

Ohio EPA Uses Water-quality Data to Manage Urban Streams — NAWQA findings showed elevated loadings of insecticides, polycyclic aromatic hydrocarbons and heavy metals in urban streams and rivers in the Great and Little Miami River Basins. The study was used by Ohio EPA in FY 2004 to assign with greater confidence the causes and sources of pollution to impaired waters appearing on the EPA 303 (d) list. Results were timely with respect to several on-going Ohio EPA TMDL studies, particularly for Big Darby Creek, which was designated by American Rivers as one of the ten most imperiled rivers in the Nation because of suburban development.

Stream Restoration and Ecosystem Management Strategies:

These accomplishments are the result of work conducted under the "Study unit investigations" program component described above under "FY 2006 Program Overview."

NAWQA Data are Used by the U.S. Fish and Wildlife Service to Re-establish Sturgeon in the Platte River — Continuous water-quality monitoring data by NAWQA at the Platte River near Louisville were used by the U.S. Fish and Wildlife Service in FY 2004 to help determine habitat requirements for re-establishment of the endangered pallid sturgeon fish in the Platte River.

"The NAWQA study of urbanization and stream quality drew comparable conclusions to an Ohio EPA state-wide study of effects from urbanization, confirming the importance of maintaining riparian buffers and stream physical habitat. The finding has clear implications in drawing guidelines for suburban development. The NAWQA study was also able to confirm what Ohio EPA could only conclude inferentially, that a significant part of the cause of poor biological quality in urbanized catchments is due to loadings of contaminants. These findings are important because many researchers focus mainly on the consequences of hydrologic alteration affected by impervious surfaces and ignore water quality. The USGS NAWQA program helps Ohio EPA make informed water-resource management decisions by providing information from independent water-quality studies and advancing the science of water-quality monitoring, and through collaborative studies and sharing of technical expertise for the study of water-quality problems.

Bob Miltner
Ohio Environmental Protection Agency
May 2004

Menominee Tribe of Wisconsin Cooperates in Mercury Sampling — The Menominee Tribe of Wisconsin works with NAWQA personnel in sampling mercury at a relatively pristine, undeveloped site in the Western Lake Michigan Basins in Wisconsin. During FY 2004, the Tribe used the data in their development of water-quality management and monitoring programs.

"Data collected via NAWQA on fish community composition has provided valuable information to the Wyoming Game and Fish Department, assisting in our effort to document native species distributions and their habitat preferences in northeast Wyoming."

Bob McDowell, Regional Fisheries Supervisor, Wyoming Game and Fish Department, Sheridan Region
Summer 2004

NAWQA Protocols Help Guide Monitoring Plan for Aquatic Ecology — Selected NAWQA protocols for aquatic invertebrate and fish communities were adopted in FY 2004 by an interagency working group that includes the State of Wyoming, and Federal and other agencies, and incorporated in an aquatic ecology monitoring plan. This plan was prepared to document ecological conditions and to assess the effects of resource development, including coal-bed natural gas, in the Powder River Basin of northeastern Wyoming.

The USGS Works with South Carolina Department of Health and Environmental Control on Mercury in Fish — NAWQA provided sound data on mercury concentrations to the South

Carolina Department of Health and Environmental Control (SCDHEC) that helped explain elevated mercury in fish and the large number of fish consumption advisories in rivers and streams in and around the Santee River Basin. Comparisons to other NAWQA studies across the Nation showed that this basin has one of the highest rates of conversion of inorganic mercury to its more toxic form, methylmercury, which is the form readily available for uptake by fish and other aquatic communities. During FY 2004, the findings were used by the SCDHEC and the National Park Service, in partnership with the USGS, to assess natural factors controlling the mercury conversion, such as related to sediment microbial communities. The analysis is used to guide the State's continued management of stream health and fish advisories.

"Properly balancing competing water-resource demands while conserving our significant fish and wildlife resources for future generations is one of the most critical environmental management issues facing the Service today. The NAWQA Program provides an objective scientific foundation to assist resource agencies charged with making difficult management decisions. It synthesizes surface-water, ground-water, and biological data in an accessible and understandable way for a wide variety of readers."

Larry E. Goldman, Field Supervisor,
U.S. Fish and Wildlife Service, May 2004

Land-management Practices:

NAWQA Findings Show Impacts of Farmland on Water Resources on the Delmarva Peninsula, Maryland — In FY 2004, results from NAWQA studies were used to understand the impacts of farming on the Delmarva Peninsula in response to the development of a pilot program called the Delmarva Conservation Corridor Program, which was established by the authority of the 2002 U.S. Farm Bill to promote sustainable agriculture. This accomplishment is a result of work conducted under the "Study unit investigations" program component described above under "FY 2006 Program Overview."

Monitoring and Sampling Strategies:

Monitoring Approach Used by the California State Water Resources Control Board — The NAWQA approach, methods, and results have been fully integrated into California's plans to evaluate ground-water quality, and incorporated in their comprehensive monitoring and assessment plan for California's groundwater basins. This accomplishment is a result of work conducted under the "Study unit investigations" program component described above under "FY 2006 Program Overview."

"NAWQA data on benthic invertebrates is a major contribution to the State of Hawaii because the data have never been collected in Hawaiian streams and never before in conjunction with such a wealth of water-quality parameters. The information could provide the basis for an important new component in water-quality monitoring in Hawaii, which would be especially useful for volunteer monitors and educational groups."

Dr. Carl Evenson
University of Hawaii at Manoa
May 2004

NAWQA Data are Used by Pesticide Registrants and EPA to Design Cost-efficient Pesticide Monitoring Programs —

Statistical analyses and models developed from NAWQA pesticide data were used by pesticide registrants and EPA to design and prioritize monitoring for ecological assessment in FY 2004. The new modeling approach supports cost-effective allocation of limited monitoring resources, resulting in improved estimates of risk at lower costs than previously possible. This accomplishment is a

result of work conducted under the "National synthesis" program component described above under "FY 2006 Program Overview."

2005 Planned Program Performance

The activities described below demonstrate the utility of USGS products that are counted under the output measures for "number of systematic analyses and investigations delivered to customers" and "number of long-term data collections and large data infrastructures maintained."

In FY 2005, there are several planned accomplishments related to the national synthesis of Cycle I activities and progress of Cycle II activities. Major products planned in 2005 from the NAWQA national synthesis are two USGS Circulars, one on pesticides and one on volatile organic chemicals (VOCs). While there are many other reports being published by NAWQA in 2005, the pesticide and VOC circulars synthesize the accumulated knowledge from 51 geographic areas together at the national scale. Another set of publications on the results of pilot studies of the effects of urbanization on stream ecosystems that were completed in Cycle 1, are planned for publication in 2005 in a book from the American Fisheries Society. The findings from the urbanization pilot studies indicate that aquatic species in streams respond to the process of urbanization even at very low levels. Results show that species intolerant of nutrient enrichment and other types of land-use stresses associated with urbanization are replaced by more tolerant species. In some cases, nonnative species replace native species as urbanization progresses. An index of urbanization was developed to quantify the progression of the urbanization process at the watershed scale. Cycle II activities will include completion of intensive sampling in the 14 study units where NAWQA began working in 2001 and the start of sampling in the 14 study units where NAWQA began working in 2004. New work includes six studies on the effects of urbanization on stream ecosystems.

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Hydrologic Monitoring, Assessments, and Research Subactivity

Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Ground-Water Resources Program	5,967	6,998	+49	+370	7,417	+419
FTE	49	44	0	0	44	0
National Water-Quality Assessment	63,285	61,645	+1,669	-182	63,132	+1,487
FTE	396	381	0	0	381	0
Toxic Substances Hydrology	14,902	14,476	+367	-1,723	13,120	-1,356
FTE	62	62	0	0	62	0
Hydrologic Research and Development	17,112	15,997	+363	-1,932	14,428	-1,569
FTE	305	295	0	0	295	0
National Streamflow Information Program	14,179	13,814	+379	-41	14,152	+338
FTE	41	41	0	0	41	0
Hydrologic Networks and Analysis	29,852	29,524	+392	-1,764	28,152	-1,372
FTE	240	212	0	0	212	0
Total Requirements \$000	145,297	142,454	+3,219	-5,272	140,401	-2,053
FTE	1,093	1,035	0	0	1,035	0

^{a/} Changes for this program element include a reduction of -\$25 for travel and -\$11 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

Toxic Substances Hydrology Program

2006 Program Overview

The FY 2006 budget request for the Toxic Substances Hydrology (Toxics) Program is \$13,120,000.

The Toxics Program provides unbiased and reliable scientific information and tools that explain the occurrence, behavior, and effects of toxic substances in the Nation's hydrologic environments. These results support sound decisionmaking by resource managers, regulators, industry, and the public at the Federal, State, and local levels. The program addresses DOI's Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science.

The contamination problems investigated by the Toxics Program are widespread and pose significant risk to human health and the environment. Based on input from many agencies and

Hydrologic Monitoring, Assessments, and Research Subactivity

organizations, the USGS identifies high priority problems for intensive, field-based research. These field studies are conducted at representative sites, watersheds, or areas that focus on subsurface, point-source contamination or nonpoint source contamination at the watershed or regional scale. Study results help water managers improve environmental monitoring, characterize and manage contamination, develop best management practices, form regulatory policies and standards, register the use of new chemicals, and guide chemical manufacture and use. The program complements other USGS programs that monitor and assess the quality of the Nation's waters by focusing rapidly on new issues and on new and understudied contaminants, by identifying which issues warrant future attention, and by developing improved and needed methods.

The Toxics Program's strengths are its long-term field-based approach, interdisciplinary research teams, ability to address contamination problems with a wide range of geographic scales and geologic terrain, and ability to bring fundamental scientific knowledge to define the natural environmental response to contamination and natural clean-up capacity. Maintenance of long-term field research laboratories and data collection on extensive regional and national networks, using consistent and reliable methods, makes this contribution particularly unique.

The Toxics Program works in partnership with other Federal agencies to ensure that priorities for science needs are coordinated, including other DOI bureaus, the U.S. Environmental Protection Agency (USEPA), the U.S. Department of Agriculture (USDA), the Departments of Defense and Energy (DOD and DOE), the Nuclear Regulatory Commission, and more recently, public health agencies, such as the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), and the National Institute for Environmental Health Sciences (NIEHS). Because the USGS is an objective science agency, program information and methods often provide a basis for consensus in contentious issues and for achieving cost efficiencies by meeting the needs of numerous management and regulatory agencies. Scientists from universities, other Federal agencies, and industry find significant research opportunities through collaboration in Toxics Program activities and research sites. The Toxics Program complements and coordinates with a range of other USGS programs, by providing new methods and information on new issues to monitoring and assessment programs such as NAWQA and NASQAN, by addressing environmental effects of resource development with programs such as the Energy Resources and Mineral Resources Programs, and by evaluating the connections between environmental contamination of toxicological effects in fish and wildlife with the Contaminant Biology Program. Program results are distributed at briefings for regulatory agencies and industry groups, at workshops, at national scientific meetings, in USGS reports, and in scientific journals and books. More information about the Toxics Program is available on the Web at <http://toxics.usgs.gov/>.

A key indication of USGS performance in characterizing the occurrence, fate, and effects of toxic substances is reflected in the end outcome measure for research: soundness of methodology, accuracy, and reliability of science—100 percent of the science products are validated through appropriate peer review. To clearly measure progress in achieving intermediate outcomes of improving the information base, information management, and technical assistance through Toxics Program studies, the USGS tracks outputs including the number of systematic analyses and investigations delivered to customers and the number of formal workshops or training provided to customers.

A description of major program activities in FY 2006 follows, organized by the program's two major components: investigations of subsurface, point-source contamination and investigations of watershed-scale and regional-scale contamination. These major program activities are

developed and revised through internal and external planning and review processes led by Toxics Program managers.

Investigations of Subsurface, Point-source Contamination

(Estimates for FY 2004, \$4.5 million; FY 2005, \$4.7 million; FY 2006, \$4.7 million)

Interdisciplinary USGS research teams conduct long-term intensive field investigations of common types of subsurface contamination in a variety of hydrogeologic environments. These investigations provide fundamental knowledge of the processes that control contaminant-plume transport and persistence. This knowledge and new methods are applied to similar sites across the Nation. The Toxics Program conducts the only organized research on subsurface contamination from point sources within the USGS and is looked upon by those responsible for contaminated site cleanup as a unique provider of information and methods on issues such as contamination in fractured rock aquifers and long-term performance of monitored natural attenuation. The Toxics Program will organize and initiate a review of this program component in FY 2006. This review will identify research priorities, gaps in existing activities, and actions needed to fill those gaps. Expert scientists and managers representing government partners and the academic community will participate in the review.

Program activities in FY 2006 will focus on the following contamination problems:

- **Hydrocarbons and Petroleum-Related Contamination** — Hydrocarbon contamination occurs in association with petroleum development, transport, storage, and use. The large number of hydrocarbon contamination sites across the Nation makes systematic management and cleanup decisionmaking essential. The introduction of fuel oxygenates such as MTBE to improve air quality have significantly exacerbated subsurface contamination problems from gasoline. Research will focus on the limitations to natural clean-up options, impacts from production, and development and improvement of simulation models.
- **Mixed-Waste Disposal and Contamination in Arid Environments** — Mixed radioactive and organic wastes often are disposed in the shallow subsurface in arid regions. Contamination leaks from disposal facilities result in gaseous and water-borne contamination that violates accepted theories of contaminant transport. As a result, there are concerns for management of existing leaks and plans for future waste disposal. Inadequate knowledge of the behavior of these wastes has deadlocked national decisions about the disposition of low-level radioactive wastes. Delays in resolving these questions are costly (due to the interim solutions used) and can pose a health risk (due to the multitude of temporary waste-storage sites located in highly populated areas of the Nation). Research will focus on quantifying the processes that affect movement of radionuclides and volatile organic chemicals in these unique environments.
- **Contamination in Fractured-Rock Aquifers** — Great uncertainty exists in determining the direction and rate of water and contaminant movement, and the ability of chemical and microbial reactions to mitigate contamination in fractured-rock aquifers. Remediation is delayed or stymied at many such sites by a lack of knowledge of fundamental processes. Researchers will help with design and performance evaluation of new remediation technologies using injections of microbe slurries to degrade subsurface solvents contamination in fractured-rock aquifers.

- **Contaminant Plumes with Complex Chemical Mixtures** — Contaminant plumes with complex mixtures of organic and inorganic contaminants, such as landfill leachate and wastewater discharges, are difficult to characterize, manage, and remediate. Reactions among dissolved chemicals, reactions between dissolved chemicals and the aquifer material, and microbial reactions can significantly accelerate or retard contaminant movement and complicate natural and engineered cleanup. Research will focus on quantifying transport processes and development of simulation modeling capabilities.

Investigations of Watershed-scale and Regional-Scale Contamination (Estimates for FY 2004, \$7.7 million; FY 2005, \$7.1 million; FY 2006, \$5.9 million)

Watershed scale and regional-scale investigations address contamination problems typical of widespread land uses or human activities that may pose a threat to human and environmental health throughout a significant portion of the Nation. These investigations involve characterizing contaminant sources, investigating the mechanisms by which nonpoint-source contamination affects aquatic ecosystems, and investigating the processes that transform contaminants into different and possibly more toxic forms. Program activities in FY 2006 will focus on the following contamination problems:

- **Watershed Contamination from Hard-Rock Mining** — Affected watersheds often have hundreds of abandoned mine sites with little information on their relative significance, making the traditional site by site cleanup approach grossly inefficient. Toxics Program scientists have helped develop and are applying a revolutionary, watershed-based approach to remediation. This research, in conjunction with land managers, has enabled decisionmaking that identifies realistic cleanup goals and targets contamination sources that have the most significant effect on watershed quality. Project activities will focus on publication of significant findings from ongoing activities. A project level review is being implemented and will be completed during FY 2005. This review will identify research priorities, gaps in existing activities, and actions needed to fill those gaps. Expert scientists and managers representing government partners and the academic community will participate in the review.
- **Pesticide Contamination in Hydrologic Environments** — New pesticides are registered continually for use in a wide range of agricultural and other land-use settings. Understanding their long-term environmental persistence and effects is essential to responsible product registration and use. Environmentally safe use of effective pesticides is important to agriculture, public facilities (parks, roadways, and golf courses), and home maintenance (for protection of lawns, gardens, and structures). Research will continue to focus on new and understudied pesticides as well as new methods development and assessments of other chemicals commonly used in pesticide formulations. In some cases, these “inert” and “adjuvant” chemicals may have ecological health concerns equal to, or greater than, the active ingredients. A project level review is underway and will be completed during FY 2005. This review will identify research priorities, gaps in existing activities, and actions needed to fill those gaps. Expert scientists and managers representing government partners and the academic community will participate in the review.
- **Emerging Contaminants** — Many chemicals used in our daily lives such as household products, human and veterinary pharmaceuticals, and commercial chemicals can be concentrated in household, industrial, and livestock wastewaters and can contaminate water resources. The environmental occurrence of these compounds, individually and in

mixtures, has significant implications for drinking water, water re-use, occurrence of bacterial and viral pathogens, endocrine disruption, antibiotic resistance, chemical production, chemical registration and use, management of animal agriculture including aquaculture, and priorities for research and toxicological studies. In FY 2006 the project will continue to expand efforts to integrate environmental chemistry studies with ecological health effects research; in addition a new national reconnaissance is planned that will incorporate additional sites, new compounds, and new understandings gained from previous results. This review will identify research priorities, gaps in existing activities, and actions needed to fill those gaps. Expert scientists and managers representing government partners and the academic community will participate in the review.

- **Mercury in Aquatic Ecosystems** — Trace loadings of atmospheric mercury deposition from natural and man-related sources have resulted in widespread accumulation of methylmercury in fish and wildlife in remote wetlands, lakes, and streams, often at levels that present toxicological concerns. However, a general understanding of the factors that result in some aquatic ecosystems susceptible to mercury loading remains elusive, making protection of human health and the health of fish-eating wildlife a challenge. Research efforts focus on the factors controlling mercury methylation and accumulation among aquatic ecosystem types, factors that control methylmercury contamination locally, regionally and globally, and investigation of whether plans for emissions reductions will result in corresponding reduced levels in bioaccumulation and at what timescales. The results are being used to advance discussions of pending mercury emissions regulation and health standards.
- **Unsaturated Zone Processes and Shallow Ground Water Quality** — The Toxics Program is expanding research on transport processes in the unsaturated zone and the movement of contaminants across the water table. This research addresses fundamental questions about ground-water contamination, mitigation, and remediation such as the design of vapor extraction remediation, the evaluation of the contribution of hydrocarbon degradation and volatilization to natural attenuation at gasoline spill sites, and determining the contribution of atmospheric sources of MTBE to its occurrence in aquifers. Currently project researchers are engaged in several collaborative activities within New Jersey including the determination of effects of unsaturated zone properties on the spatial variability of recharge to better understand nitrate contamination of ground water in agricultural areas and the development of a technique to determine ground water under the direct influence of surface water based on the presence of diatoms in ground water. The objective of this research will be to answer fundamental questions about often overlooked unsaturated zone processes in contaminant fate and transport and ultimately determining practical uses of those answers to solve important environmental problems.
- **Human Stresses on Sensitive Aquatic Ecosystems** — The increasing complexity of human stresses on natural ecosystems requires a sound interdisciplinary scientific basis for decisions to preserve and restore unique and valued ecosystems. Restoration schemes must be developed that do not exacerbate contamination issues in these systems. Effective restoration will depend on a practical understanding of the processes that affect contamination and other human influences on aquatic ecosystems. Interdisciplinary approaches capable of addressing the broad range of controlling factors are employed in ecosystems that are identified to have high DOI and national priorities. Research will focus on the Everglades, Platte River, Chesapeake Bay, Mojave Desert,

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and San Francisco Bay. The Toxics Program supports these activities directly and through contributions to Priority Ecosystems Science (PES) activities, which are described in more detail in the Regional Activities section beginning on page F - 1.

- **Amphibian Research and Monitoring Initiative** —Reports of declining amphibian populations and of populations with excessive occurrence of limb deformities are increasing dramatically. Evidence indicates that stress from human influences is either a direct or a contributing factor. Toxics Program scientists will continue efforts with USGS biologists and scientists from other DOI bureaus to design and implement a national framework for monitoring the status and trends in amphibian populations and for research into factors that affect amphibian declines and deformities.

Technical Support

(Estimates for FY 2004, \$2.7 million; FY 2005, \$2.7 million; FY 2006, 2.7 million)

The USGS has a long tradition of providing national technical support for its geographically distributed water resources studies. This support provides quality control to assure the technical excellence of water resources field programs and provides a structured way of transferring new technology to USGS investigative and data activities that are primarily conducted in District offices in each State. Technical support also includes a formal way of establishing priorities for water research by the USGS and provides a mechanism to make water resources information available to other agencies, the scientific community, and the public. In the case of the Toxics Program, this amount also includes support for various interdisciplinary ecosystem studies, some of which are described in the Regional Activities section beginning on page F - 1.

2004 Program Performance Accomplishments

The program accomplishments listed below demonstrate the utility of products that are counted under the output measures for "systematic analyses and investigations delivered to customers" and "formal workshops or training provided to customers."

Toxics Program Scientists Continue to Develop New Laboratory and Field Methods

- **New Method for Assessing Bed Sediment Contamination** — USGS scientists have developed a method for estimating the contribution of contaminated bed sediments in lakes and reservoirs to the overall levels of contamination in water systems. Resource managers in the Nation's mining-affected areas are faced with difficult challenges, such as what to do about fish contaminated with toxic metals, how to quantify the significance of different sources of metal contamination in watersheds, and how to assess the impacts of remediation and restoration plans. The USGS's new method gives resource managers information on the rate (benthic flux) that nutrients and trace metals, such as methylmercury or nickel, move between the sediments and overlying waters. The method involves collecting bed sediment cores from the bottom of a body of water, collecting water-quality samples, and conducting laboratory test on the cores. The magnitude and variability of the benthic flux determines whether or not contaminants in the bottom of lakes and reservoirs represent a significant source of those biologically reactive solutes to the environment. (http://toxics.usgs.gov/highlights/benthic_flux.html)

- **The USGS has Developed a New Analytical Method for Detecting Toxic Chromium VI (Cr(VI)) in Ground Water in the Field** — This new method enables scientists and resource managers to distinguish between the toxic and carcinogenic chromium VI and the more benign chromium III on site. The method overcomes several obstacles that prevented past methods from being able to accurately determinate the concentration of chromium VI in water. Past methods were not very accurate, the instability of chromium VI was problematic, and expensive laboratory equipment was required for analysis. (http://toxics.usgs.gov/highlights/detecting_crvi.html)
- **New Laboratory Method for Human-Health Pharmaceuticals in Sediment** — Research by Toxics Program scientists is documenting the sources, occurrence, fate, transport, and ecological-health effects of selected human and animal-health pharmaceuticals and other emerging contaminants in the environment. A new USGS method, which is capable of measuring human-health pharmaceuticals in sediment at trace levels, was recently evaluated and published in the *Journal of Chromatography*. The method performed well for the majority of the 22 pharmaceuticals evaluated, with recoveries greater than 60 percent for 12 pharmaceuticals. (http://toxics.usgs.gov/regional/emc/emc_sediment.html)
- **Toxics Program Scientists Contribute to New Scientific Book** — Four Toxics Program scientists were invited to contribute chapters for the second version of the book, *Pharmaceuticals in the Environment*. The chapters include summaries of human and veterinary pharmaceutical occurrence in water-resources of the United States and highlights previous work by the Toxics Program. This unique book, which includes chapters by several researchers from different parts of the world, serves as a needed update to the first version as interest and research in environmental chemistry of pharmaceuticals continues to expand worldwide. (<http://toxics.usgs.gov/highlights/pharmaceuticals.html>)

Over 3,200 Publications and Counting

Since the Toxics Program's inception in 1984, research results have been documented in over 3,200 publications. Over 1,000 of these publications are articles in peer-reviewed professional journals; results also are published in USGS reports, fact sheets, magazine articles, and books that meet the needs of stakeholders. Over 120 of the publications are student theses completed as part of Program activities, and over 450 publications are on the fate of agricultural chemicals. A bibliography of these publications and more is available on the Web (<http://toxics.usgs.gov/bib/>), where users can browse by subject or create custom searches.

Subsurface Point-Source Investigation Accomplishments

- **History and Ecology of Chloroethene Biodegradation—A Review** — A USGS scientist has written a review of the scientific community's current understanding of the biodegradation pathways of chloroethenes, common industrial solvents. This review is based in a large part on the Toxics Program's contributions to the use of microbial degradation to cleanup chloroethene contamination. Program investigations have recently demonstrated the potential for microbial oxidation of dichloroethene and vinyl chloride in anoxic ground-water and surface-water environments. The biodegradation of chloroethene compounds has been investigated extensively since these compounds were first identified in the late 1970s as common contaminants in ground water at hazardous-waste sites. Over time, perspectives on chloroethene biodegradation and on the fate of these compounds in the environment have changed. Before 1980, chloroethene contaminants were considered to be recalcitrant (not readily

biodegradable). Today, biodegradation is viewed as an essential component of remediation of chloroethene plumes, and several microbial mechanisms for biodegradation of chloroethenes have been identified.

(http://toxics.usgs.gov/highlights/chloroethene_biodeg_hist.html)

- **The Changing Face of Microbial Communities in Contaminant Plumes** — Use of monitored natural attenuation as a cleanup option for hazardous waste sites often relies on estimates of the effectiveness of indigenous microbial communities to degrade the contaminant. Typically, samples collected from the contaminated ground water are tested to quantify degradation rates. The degradation rates are used in models to assess the effectiveness of natural attenuation and to design monitoring strategies. USGS scientists and their colleagues, however, have shown that the composition of the microbial community in a contaminant plume continually changes, suggesting that the accuracy of estimates of microbiological degradation depends on when and where test samples are collected. This variability could impact the effectiveness of monitored natural attenuation and engineering systems that enhance biodegradation processes to clean up sites. Failure to account for the variability could result in remediation plans that are less effective because of changes or shifts in the makeup of microbial communities in contaminant plumes. This research provides insights into how representative samples could be collected to give reliable estimates of degradation potential.
(http://toxics.usgs.gov/highlights/plume_microbiology.html)

- **Using Oxygen to Enhance Biodegradation of Contaminants** — Adding oxygen to ground water contaminated by gasoline spills or leaking underground storage tanks is a common approach for site remediation. Since the late 1980s, it has been known that adding oxygen to contaminant plumes promotes the aerobic biodegradation of petroleum contaminants such as gasoline. On the other hand, the addition of oxygen to anoxic ground water does not always result in increased aerobic biodegradation. For example, the Toxics Program's investigation of oxygen-based remediation at a leaking underground storage tank located in Laurel Bay, SC, revealed distinctly different results for contaminant cleanup in different locations. In one area near the site of the tank (source area), an oxygen-release compound injected into the subsurface did not increase the low levels of dissolved oxygen (DO); therefore, concentrations of BTEX and methyl tert-butyl ether (MTBE) remained relatively unchanged. Conversely, the same oxygen-release compound injected less than 200 meters downgradient rapidly increased DO levels, and BTEX and MTBE concentrations rapidly decreased. Results of this research can provide necessary scientific rationale for decisions on the use of oxygen for site remediation in various hydrogeologic environments.
(http://toxics.usgs.gov/highlights/o2_biodeg_lessons.html)

Watershed- and Regional-Scale Investigation Accomplishments

- **New Report on Science for Hypoxia in Gulf of Mexico** — The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force coordinates activities to reduce hypoxia in the northern Gulf of Mexico, to improve water quality conditions in the Mississippi River Basin, and to improve communities and economic conditions. The Task Force has released a new report that describes a framework for science activities to support management decisionmaking. The report describes the scientific information needed to answer key management questions and support management actions, and defines the scope, interrelation, and framework of the activities needed to provide that information. It describes existing programs and activities that contribute to the framework, identifies

gaps and limitations, and includes information on environmental monitoring and modeling, as well as on social and economic research for the northern Gulf of Mexico and the Mississippi River Basin. The USGS supports DOI participation in the Task Force and co-chairs the Task Force Monitoring, Modeling, and Research Workgroup (http://toxics.usgs.gov/highlights/new_hypoxia.html).

- **New Technology and Capability for the USGS in atmospheric mercury studies** — The USGS Mercury Research Lab has developed and put into operation a mobile mercury laboratory capable of executing real-time measurements of mercury concentrations and all the related ancillary measurements that aid interpretive studies of atmospheric mercury studies. In the past year, the mobile mercury lab has been deployed to the Four Corners Area of Colorado; Yellowstone National Park; St. Louis, MO; Mt. Horeb, WI; Lostwood National Wildlife Refuge in northwestern North Dakota, and Milwaukee, WI. At each of these locations, the purpose of the mobile mercury lab is ascertaining the relative importance of local, regional, and global sources of atmospheric mercury. One of the greatest challenges in environmental mercury research is to determine how large a “halo” mercury emission sources create. Growing need for the mobile mercury lab is expected based on interest expressed by many Federal agencies, States, and interest groups.

- **OSTP Report on Methylmercury in the Gulf of Mexico** — The USGS participated in the Interagency Working Group on Methylmercury, which was recently reactivated by the Office of Science and Technology Policy’s National Science and Technology Council. The Working Group published a report titled *Methylmercury in the Gulf of Mexico: State of Knowledge and Research Needs*. In 2002, public concern was raised over reported high levels of methylmercury in commercial fisheries in the Gulf of Mexico, and attention was drawn toward the operation of oil and gas rigs as a possible mercury source. Although a great deal as been learned about the sources and fate of methylmercury in freshwater systems, comparatively little is known about estuarine and marine systems. The report provides policymakers with critically needed information on what is currently known and not known about the sources and fate of methylmercury in the Gulf of Mexico as it relates to human health. This issue is particularly important for this region because fish consumption rates are higher than the consumption rates for average Americans. The report will help policymakers make better decisions concerning this sensitive issue (http://toxics.usgs.gov/highlights/ostp_report.html).

Limnology and Oceanography Feature Article

The editors of the journal *Limnology and Oceanography* named "Reach-scale isotope tracer experiment to quantify denitrification and related processes in a nitrate-rich stream, midcontinent United States" (Böhlke and others, 2004) one of two feature articles for their May 2004 issue.

“To gain a better understanding of the role that small streams play in removing N (nitrogen) from water and preventing it from polluting downstream ecosystems, investigators are developing and refining techniques for whole-stream stable isotope additions. ... The two articles featured here represent the state-of-the-art in this line of research.”

Hamilton, Stephen, and Canuel, Elizabeth, 2004, L&O Featured Article: *Limnology and Oceanography Bulletin*, v. 13, no. 2 http://aslo.org/bulletin/04_v13_i2.pdf, pageS 41, 43.

(http://toxics.usgs.gov/highlights/nitrogen_isotope.html)

- **USGS Studies the Natural Recovery of an Organotin Spill** — In 2000 the largest known spill of highly toxic organotin compounds occurred in South Carolina. The spill

caused the shutdown of a municipal wastewater treatment plant and the closure of the City of Cayce's only drinking water intake. The organotin compounds spilled make up a suite of chemicals used in the manufacture of plastics. The compounds are also used in antifouling marine paint where their toxicity prevents the growth of nuisance organisms on the hulls of ships. The USGS partnered with the USEPA to study the fate of the compounds in the freshwater ecosystem of Red Bank Creek, SC. The study partially filled the void of information on the fate of organotin compounds in freshwater ecosystems. Very little had been known about the fate and toxicity of organotins in fresh water when compared to the information on organotin compounds in marine environments. Based on methods developed by the Toxic Substances Hydrology Program, the USGS and USEPA scientists found that by 2003, the organotin compounds in the creek's ecosystem had naturally degraded to levels that were thousands of times less than the levels found just after the spill and consequently were below levels of concern. The USEPA used the results of this study as one of the deciding factors to select monitored natural attenuation as the remedial solution for the stream—a decision that saved millions of dollars. Removing the stream's contaminated sediments would have cost in excess of \$10 million (http://toxics.usgs.gov/highlights/organotin_spill.html).

- **Land-Use Activities can Release Naturally Occurring Arsenic into Sources of Drinking Water** — USGS scientists studying a subsurface plume of wastewater from a sewage treatment plant on Cape Cod, MA, measured high concentrations of arsenic in the plume even though the wastewater from the treatment plant did not contain high concentrations of arsenic. The contamination was above the drinking water standard for arsenic of 10 micrograms per liter in many places. Further investigations showed the source of the arsenic to be from mineral coatings on the sediments of the sand and gravel aquifer that the wastewater plume was moving through. The wastewater plume changed the chemistry of the aquifer, creating conditions where the arsenic bound to the sediments could be released into the water. Sand and gravel aquifers are sought after across the country as sources of drinking-water. The finding is significant because naturally occurring arsenic, adsorbed to coatings on the surfaces of mineral grains, can be mobilized by changing chemical conditions. Shallow aquifers like the one on Cape Cod are now considered susceptible to arsenic contamination resulting from changing chemical conditions induced by human activities on the land surface. Local land-use planners can use the results of this investigation to design better protection strategies for underground drinking-water sources (http://toxics.usgs.gov/highlights/arsenic_desorption.html).
- **Focus on Environmental Degradates of Pesticides** — The USGS is partnering with scientists in the United Kingdom and Switzerland to address the importance of pesticide degradation products in the environment. Toxics Program scientists participated in an international workshop sponsored by the American Water Works Association in June 2004 focused on the current state of knowledge on fate, effects and treatability of degradates and adjuvants from a drinking water perspective. An overview of what happens when pesticides degrade in the environment was reported as the feature article in the October 1, 2004, issue of *Environmental Science & Technology*.
- **Understudied Fungicide Used on Peanut and Potato Fields** — Chlorothalonil is a fungicide that has been used in large quantities for peanut and potato agriculture in the United States. Although chlorothalonil has been used for more than 30 years, there are few studies on its fate in the environment. The USGS measured this fungicide and its

degradation products in surface waters draining peanut-growing regions of Alabama, Florida, Georgia, and Oklahoma. Because chlorothalonil is not very soluble in water it was only detected in environmental waters when samples were collected immediately after storms transporting runoff from the fields. In contrast, the major degradate, 4 hydroxy chlorothalonil, is more water soluble and was detected in most of the samples at low concentrations (less than one part per billion). The USEPA lists the degradate as slightly toxic to aquatic organisms and moderately toxic to birds and mammals; therefore the ecological implications of these findings will be explored. In addition, because chlorothalonil is likely strongly adsorbed to soil particles, this project will analyze sediment samples for the fungicide and its degradation products.

2005 Planned Program Performance

A brief description of major program accomplishments planned for FY 2005 follows, organized by the program's two major components and the associated investigations as described above. These activities demonstrate the utility of products that are counted under the output measures for "systematic analyses and investigations delivered to customers" and "formal workshops or training provided to customers."

Investigations of Subsurface, Point-Source Contamination

- **Hydrocarbons and Petroleum-Related Contamination** — Scientific contributions planned for FY 2005 include (1) quantifying the natural processes that control removal of residual oil product in the subsurface at the plume source (this residuum is a major determinant of the duration and ultimate success of natural cleanup alternatives) (2) developing efficient methods for characterizing and cleaning up contamination associated with oil and gas production, and (3) defining the efficiency of cleanup alternatives for fuel oxygenates, including oxygen enrichment and bioremediation at the streambed interface.
- **Mixed-waste Disposal and Contamination in Arid Environments** — Scientific contributions planned for FY 2005 include definition and understanding of the processes that control subsurface transport of radionuclides and volatile organic chemicals commonly found in mixed wastes, development and testing of methods to characterize subsurface contamination in arid environments, and development of improved simulation modeling techniques for waste management and cleanup.
- **Contamination in Fractured-Rock Aquifers** — Research will focus on defining contaminant processes unique to fractured rock and understanding the effects of dense non aqueous phase liquids (liquids that sink because they are denser than water, forming a long-term source of contamination) on contaminant transport and persistence. The work will focus on development of tools to characterize the processes that control the biodegradation of contaminants in fractured rock aquifers.
- **Contaminant Plumes with Complex Chemical Mixtures** — Research will focus on identifying processes that control contaminant transport in representative contaminant plumes with complex chemical mixtures and developing tools to predict contaminant movement as it is affected by natural processes. Results from previous long-term observations of restoration efforts at a wastewater effluent plume in Cape Cod, MA, will guide laboratory and field studies of the geochemical processes controlling the natural restorative processes in aquifers contaminated with wastewater effluent. In addition,

field instrumentation designed to measure changes over very small distances will be tested at the landfill research site in Norman, OK. This new instrumentation enables scientists to measure the products of reduction and oxidation reactions in the field at the appropriate scale, thereby providing indications of the efficiency of natural biodegradation processes that occur in landfill leachate plumes. This work will result in additional outputs under the "systematic analyses and investigations" output measure.

Investigations of Watershed- and Regional-Scale Contamination

- **Watershed Contamination from Hard-Rock Mining** — The focus of this research in 2005 will be two-fold. First, it will characterize hydrologic and biogeochemical processes that affect dispersal of metals and associated contaminants. Second, it will detail contaminant pathways to organisms. Results will support science-based decisions that will be cost-effective and lasting, and could lead to new methods of remediation.
- **Pesticide Contamination in Hydrologic Environments** — Scientific contributions planned for FY 2005 include (1) continued development and improvement of lab methods to make environmental measurements of new and understudied pesticides, their degradates and other chemicals (byproducts) used in their formulations to enhance application and effectiveness, (2) definition of the environmental occurrence and persistence of the combinations of pesticides and their byproducts used in common cropping and land-use settings, including completion of a preliminary assessment of the environmental occurrence of a common organic fungicide in peanut agriculture and a fate and transport study of glyphosate applied to a Roundup Ready® soybean field, (3) identification of potential implications for environmental and ecological health. The project review process will be completed.
- **Emerging Contaminants** — Efforts in FY 2005 will focus on publication, dissemination, and stakeholder briefings of a wide variety of research activities including additional and revised laboratory methods for hormones and human and veterinary antibiotics, pathogens in water, determination of antibiotics in swine waste, characterization of organic matter in swine waste, examining the effects of drinking water and wastewater treatment on contaminant concentrations, examining the estrogenicity of municipal wastewater effluent, and determining the occurrence of antibiotics in aquaculture. Investigations will include an in-depth analytical measurement of liquid or solid waste samples from a wide variety of human and livestock sources, antibiotic degradation experiments in waste and water, continued research on contaminant migration in waste-dominated streams, and the ecologic effects from exposure to emerging contaminants. A project level review is underway and will be completed during FY 2005. This work will result in additional outputs under the "systematic analyses and investigations" output measure.
- **Mercury in Aquatic Ecosystems** — In FY 2005, project activities will focus on linking food web mercury contamination to atmospheric deposition through national-scale data compilation and construction of mercury vulnerability maps. Maps will rely upon ecological factors known to influence post-depositional toxicity of mercury in aquatic ecosystems (such as water quality factors, wetland occurrence, soil types). The overall goal is to determine if national-scale trends in sensitivity to mercury loading exist, and to explain what controls those trends.

- **Human Stresses on Sensitive Aquatic Ecosystems** — Scientific contributions planned for FY 2005 will focus on critical ecosystem issues in the Everglades, Chesapeake Bay, the Mojave Desert, and San Francisco Bay. More information on these activities is available in the description of Priority Ecosystems Science (PES), which is included in the Regional Activities section beginning on page F - 1.
- **Amphibian Research and Monitoring Initiative** — Research will focus on continued monitoring of water quantity and quality factors that affect amphibian health, identification of critical hydrologic and water-quality habitat characteristics, and exploration of hydrologic, climatic, and contaminant stressors that may affect amphibian declines and deformities.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Toxic Substances Hydrology Program (\$000)	\$13,120	-\$1,723
FTE	62	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006 budget request for Toxic Substances Hydrology is \$13,120,000 and 62 FTE, a net program decrease of -\$1,356,000 (includes adjustments for uncontrollable costs) and 0 FTE from the 2005 enacted level.

Roubidoux Aquifer (-\$1,460,000) — This is a reduction of an unrequested earmark that will bring to a close a study with the University of Oklahoma to characterize the Tar Creek Superfund site in Oklahoma, including characterization of mine drainage discharges, characterization of waste pile and pond drainage runoff, assessment of in-stream contaminant loading, characterization of asphalt road runoff, assessment of surface water impacts, and air quality and meteorological monitoring.

Study of Petroleum-Related Contamination (-\$227,000) — The USGS will end a study of petroleum-related contamination at Skiatook Lake in the southeastern part of the Osage Indian Reservation in northeastern Oklahoma.

The decrease of -\$227,000 for the Skiatook Lake study will result in the loss of 1 systematic analyses and investigations in FY 2006, compared to the FY 2005 level. There is no change in FTE or other resources associated with either of the decreases described above.

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Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Ground-Water Resources Program	5,967	6,998	+49	+370	7,417	+419
FTE	49	44	0	0	44	0
National Water-Quality Assessment	63,285	61,645	+1,669	-182	63,132	+1,487
FTE	396	381	0	0	381	0
Toxic Substances Hydrology	14,902	14,476	+367	-1,723	13,120	-1,356
FTE	62	62	0	0	62	0
Hydrologic Research and Development	17,112	15,997	+363	-1,932	14,428	-1,569
FTE	305	295	0	0	295	0
National Streamflow Information Program	14,179	13,814	+379	-41	14,152	+338
FTE	41	41	0	0	41	0
Hydrologic Networks and Analysis	29,852	29,524	+392	-1,764	28,152	-1,372
FTE	240	212	0	0	212	0
Total Requirements \$000	145,297	142,454	+3,219	-5,272	140,401	-2,053
FTE	1,093	1,035	0	0	1,035	0

^{a/} Changes for this program element include a reduction of -\$95 for travel and -\$14 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

Hydrologic Research and Development Program

2006 Program Overview

The 2006 budget request for the Hydrologic Research and Development (HR&D) Program is \$14,428,000.

The HR&D program conducts long-term sustained research on complex problems in the hydrologic sciences and supports the research and development needs of other water resource and USGS programs. HR&D Program investigations integrate hydrological, geological, chemical, climatic, and biological science in addressing water resources issues. The Program seeks to maintain an appropriate balance between high-risk high-reward research that leads to major scientific breakthroughs and future applications, and more applied research that helps keep the program relevant and focused on today's water resource issues. The research and development efforts of the HR&D program are typically multi-disciplinary in nature and require

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strong collaborative relations, both among scientists funded by the program and with scientists in other parts of the USGS, in Federal and State agencies, universities, and foreign countries.

To fulfill their critical role in support of other USGS programs, scientists funded by the HR&D program:

- Provide training, workshops, reviews, and advice on water resource issues to respond to national, regional, and local needs,
- Provide specialized laboratory services, such as chemical and isotopic analyses and methods to characterize microbes,
- Develop new geophysical and geochemical techniques and numerical modeling tools, and
- Provide advice to USGS leadership on future program directions.

The long-term goals of the HR&D program are:

- To understand ecological and biogeochemical processes in the context of the hydrologic cycle and of process responses to system perturbations, to enable discrimination between natural and human-induced changes, and to ensure effective water-availability, water-quality, and ecosystem management,
- To understand chemical and biochemical processes affecting organic and inorganic solutes and gases in aquatic systems to enable evaluation of water quality, helping managers make informed water-management decisions,
- To understand the physical processes controlling the distribution and quality of the Nation's surface-water resources to improve flood and drought hazard mitigation,
- To understand the movement, availability, and transport of subsurface water in order to minimize further contamination of the Nation's ground waters, optimize aquifer remediation efforts, and ensure effective ground-water management,
- To understand stream-channel morphology and erosional processes governing the source, mobility, and deposition of sediment to ensure scientifically based management of rivers, dams, and reservoirs, and
- To understand long-term processes in small watersheds, including the effect of atmospheric and climatic variables, and provide water and land managers with information needed for water resources management.

The HR&D line item provides the core funding for the National Research Program (NRP) and the smaller Water, Energy, and Biogeochemical Budgets (WEBB) Program. Both the NRP and the WEBB programs are also dependent on funding from other USGS programs, and they leverage their core funds with funds from other Federal and State agencies. These linkages ensure that research efforts are focused on developing new concepts and future techniques and remain relevant to current USGS programs and DOI management responsibilities.

Several forms of internal and external reviews are used to evaluate progress in the HR&D program. Each scientific project funded by the HR&D program is internally reviewed for its accomplishments and plans on a yearly basis. In FY 2004, 76 NRP projects and 5 WEBB projects were reviewed. In addition, in-depth reviews of projects and associated personnel were conducted for 27 NRP projects. These in-depth reviews examine: the relationship of project work to the USGS mission and its disciplinary and regional needs; the productivity, relevance, and scientific impact of the project; the project plans and goals for the next 5 years; and the expertise and responsibilities of project personnel. The Research Grade Evaluation (RGE) Process, a double-tiered peer/research-manager review system, ensures that the progress of each research scientist funded by HR&D funds is thoroughly reviewed by other scientists and program managers at least once every 4 years. During FY 2004, 45 NRP and WEBB scientists were reviewed through the RGE process for their scientific contributions and for the relevance and impact of their work. Publications in the externally reviewed scientific literature are considered primary products of work conducted under the HR&D program. The National Academy of Sciences also conducts reviews through its Committee on USGS Water Resources Research, parts of which apply to research funded under the HR&D program.

Long-term Interdisciplinary Research

(Estimates for FY 2004, \$12.9 million; FY 2005, \$12.7 million; FY 2006, \$12.9 million)

The HR&D program funds focused research studies, large-scale research investigations, and the development of tools and methods for hydrologic studies. Examples of activities planned for 2006 under the long-term goals of the HR&D program are described below.

- **Nutrient Cycling, Biotic Response, and Mercury Contamination in the Lower Mississippi** — The lower Mississippi receives considerable inputs of nutrients, especially nitrate. Studies will be conducted to monitor and assess the complex coupling between nutrient transport and removal mechanisms, biotic responses to excess nutrients, the consequent build-up of highly reactive carbon from decaying algal blooms, and its impact on mercury methylation. Improved understanding of these processes will allow better management of water and sediment resources, and scientifically based responses to nutrient and mercury issues.
- **Drought** — During the past several decades, the United States as a whole has been wetter than the long-term average, and although short-term (1-3 years) droughts have affected some parts of the Nation, prolonged droughts of the magnitude experienced during the 1930s and 1950s have not occurred. A new research effort will be carried out in collaboration with scientists from the Midwestern Regional Climate Center, NOAA, State water agencies, and universities to characterize the development and persistence of drought in the conterminous United States. This study will be done in cooperation with the USGS Hydrologic Networks and Analysis and National Streamflow Information Programs. The study objective is to provide a scientific basis that will allow improved, longer-term management of water resources across the Nation during both wet and dry periods.
- **New Techniques Related to Streamflow** — Emerging and traditional technologies for the estimation of streamflow to assist in forecasting flood magnitudes will be evaluated and new methods will be developed. Studies will focus on flood data from the Southeast. In a pilot study in the Arkansas-White-Red River Basin, mass balance principles will be incorporated into traditional statistical methods in order to correct regression estimates of mean monthly and mean annual flows for each reach on a river

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network and thus improve the accuracy of calculated streamflow characteristics. The study will lead to improved forecasting of flood magnitudes and travel times.

- **Development of a General Surface Flow and Sedimentation Model** — In cooperation with the National Streamflow Information Program, a two-dimensional surface water computer model will be developed as a precursor to increasingly complex models that will include features such as sediment transport, flow over dry areas, and dam-break flows. This work has a wide range of potential applications, ranging from the improved management of sediment transport in the Lower Mississippi to slow land loss and seawater encroachment in the wetlands, to the management or restoration of ecological environments in river systems.
- **Integrated Modeling of Ground-Water / Surface-Water Interactions** — Traditionally, numerical models of ground-water and surface-water flow and transport have been conducted in isolation, at the expense of a proper description of their significant interactions and feedback effects. Models that integrate ground-water/surface-water interactions will be constructed and will be applied to a diversity of water resource management problems, including “whole-system” management of watersheds, and assessments of the potential impacts of ground-water pumping on streamflow. This effort will extend the capabilities and impact of current USGS-developed numerical models, such as MODFLOW and the Modular Modeling System, which already have worldwide renown and use.
- **Coalbed Methane Hydrology** — Hydrological properties of fractured coal aquifers will be investigated and evaluated through a variety of geophysical logging techniques and observations. This effort will provide a better assessment of water storage and transport in areas of coalbed methane exploitation, and will be coupled with geochemical investigations of the solutes and nutrients associated with waters produced during extraction of coalbed methane. The results of the study should help guide best management practices and will provide fundamental improvements in our use of geophysical techniques and in our understanding of fractured-coal aquifers and of nutrient reactions and transformations.
- **Climate, Location and Topography Effects on Mercury and Methyl-Mercury Fluxes and Occurrence** — This effort will complement and extend knowledge gained to date in comparing and understanding the effects of climate, location, and topography on the overall fluxes of water, major solutes, and nutrients through small watersheds. The idea is to determine the sources of mercury input in up to five small watersheds and examine the processes that affect the transport of mercury and its transformation into toxic methyl-mercury. Given the diversity of settings for the watersheds involved, the study is expected to have high transfer value in understanding the overall distribution and transformation of mercury across the Nation.

Short-term Research to Meet Congressional Priorities

(Estimates for FY 2004, \$3.5 million; FY 2005, \$2.7 million; FY 2006, \$0.9 million)

The HR&D Program also performs short-term research to meet local needs in several areas, including a multi-year collaboration with the Long-Term Estuary Assessment Group (LEAG), a consortium of universities dedicated to increasing scientific understanding of water-quality conditions in the lower Mississippi River basin.

Technical Support

(Estimates for FY 2004, \$0.6 million; FY 2005, \$0.6 million; FY 2006, \$0.6 million)

The USGS has a long tradition of providing national technical support for its geographically distributed studies. This support provides quality control to assure the technical excellence of field programs and provides a structured way of transferring new technology to USGS investigative and data activities that are primarily conducted in District offices in each State. Technical support also includes a formal way of establishing priorities for water research by the USGS and provides a mechanism to make water resources information available to other agencies, the scientific community, and the public.

2004 Program Performance Accomplishments

The program accomplishments listed below demonstrate the utility of products that are counted under the output measures for "systematic analyses and investigations delivered to customers" and "formal workshops or training provided to customers." These accomplishments are all related to the "Long-term Interdisciplinary Research" component of the HR&D Program.

Development of a 3-Dimensional Ground-Water Model for Density/Heat-Driven Flow and Transport — Ground-water models are used to make important predictions, such as predicting the response of an aquifer to future ground-water pumping or the transport of a contaminant from its source. The density of the materials through which the ground-water moves can affect the flow of the water and transport of solutes. The USGS has developed a model that can account for the effect of these density differences, an ability which is increasingly important in managing water resources in coastal areas. These areas are commonly threatened by seawater intrusion driven by excessive pumping and by other problems, such as nutrient contamination of ground and surface waters. The ability to simulate the coupled flow of heat and water will also be useful in developing geothermal energy resources, and in understanding volcanic processes and eruptions.

Effect of Permafrost on Dissolved Organic Carbon Transport to Streams — Permafrost in the northern latitudes is melting in response to climate change. Landscapes underlain by permafrost contain a potential large pool of sequestered organic carbon. Dissolved organic carbon (DOC) export during spring snowmelt was compared in two watersheds: one underlain by permafrost (American Creek watershed in the Yukon River Basin, AK) and one without frozen soil (Sleepers River watershed in northeast Vermont). Many factors contribute to the export of DOC from a watershed, but the results obtained in this study suggest that the presence of permafrost enhances the export of DOC relative to a watershed without permafrost. Determining carbon fluxes as a function of changing climate conditions is essential to predicting the significant hydrological and ecological changes that will occur if current warming trends continue in the highly sensitive northern latitudes and elsewhere.

Geochemical Characterization of Ground-Water Flow in the Middle Rio Grande Basin — Chemical and isotopic analyses on ground waters from the Middle Rio Grande Basin were used to characterize, identify origins, and determine ground-water flow directions from 12 different sources of recharge to the basin. The data were also used to evaluate radiocarbon ages, which were found to range from modern to more than 30,000 years old. Information on the chemically and isotopically distinct sources of recharge and on ground-water ages was used to calibrate a ground-water flow model for the basin. The model indicates a recharge rate of about 3 cm per year for recharge along the eastern mountain front and for infiltration from the Rio Grande near

Albuquerque, with appreciably less recharge along the mountain fronts north and south of Albuquerque. This knowledge will assist managers in Albuquerque in their continuing efforts to balance limited water resources with a growing population and industrial base.

Field Experiment Quantifies Denitrification and Related Processes — Understanding denitrification rates in farming areas of the U.S. Midcontinent is essential in finding solutions to nutrient contamination problems across the country, including the Gulf Hypoxia or “dead zone” that develops each year at the mouth of the Mississippi River. In-stream tracer experiments were conducted to determine the rates of denitrification and related processes in an agricultural watershed in the Upper Mississippi basin in Indiana. The rates of denitrification and other nitrogen losses were large but were more than offset by nitrification and ground-water inputs to the stream. The tracer experiment provided a sensitive and direct measurement of denitrification and related processes where other, more traditional, techniques were not suitable. Results from this experiment will help to inform the continually evolving process of managing nitrogen in the Midcontinent.

Snowpack Loss as a Function of Elevation – Potential Effects on Water Supply and Ecosystem Health in the San Francisco Estuary and Upstream Watersheds — California's primary hydrologic system, the San Francisco Estuary and its upstream watershed, is vulnerable to the regional hydrologic consequences of projected global climate change. Previous work has shown that a projected warming would result in a reduction of snowpack storage leading to higher winter streamflows, lower spring-summer streamflows, and increased spring-summer salinities in the estuary. Present work shows that these hydrologic changes exhibit a strong dependence on elevation, with the greatest loss of snowpack volume expected to be in the 1,300 - 2,700 m elevation range. Hydrologic and estuarine modeling reveals that the shift of water in mid-elevations of the Sacramento River basin from snowmelt to rainfall runoff is the dominant cause of projected changes in estuarine inflows and salinity. Although spring-summer losses of estuarine inflows are balanced by winter gains, losses have a stronger influence on salinity since longer spring-summer residence times allow the inflow changes to accumulate in the estuary. Changes in inflows from the Sacramento River basin in the 1,300 - 2,200 m elevation range are expected to lead to a net increase in estuarine salinity. Such changes would impact ecosystems throughout the watershed and threaten to contaminate much of California's freshwater supply.

Climatic Factors Associated with Extended Multi-Decadal Droughts — Understanding the factors responsible for prolonged drought periods (extending decades) is critical to improving water resource management in the United States. More than half of the spatial and temporal variance in multi-decadal drought frequency over the conterminous United States is attributable to the Pacific Decadal Oscillation and the Atlantic Multi-decadal Oscillation in sea-surface temperatures. An additional quarter of the variance is related to a complex spatial pattern of positive and negative trends in drought occurrence, possibly related to increasing Northern Hemisphere temperatures or some other unidirectional climate trend. Recent droughts with broad impacts over the conterminous United States (1996, 1999, 2002) were associated with North Atlantic warming and northeastern and tropical Pacific cooling. Much of the long-term predictability of drought frequency may reside in the multi-decadal behavior of the North Atlantic Ocean. The persistence of current warm North Atlantic conditions into the upcoming decade could lead to either of two possible drought scenarios. These would resemble the continental-scale patterns associated with the historic droughts of either the 1930s or of the 1950s.

2005 Planned Program Performance

The activities listed below demonstrate the utility of products that are counted under the output measures for "systematic analyses and investigations delivered to customers" and "formal workshops or training provided to customers." They are all related to the "Long-term Interdisciplinary Research" component of the HR&D Program.

- Microbiological research — Studies are being undertaken in aquatic and subsurface environments to understand the transport of bacteria, viruses, and the transformations of organic contaminants and metals between toxic to non-toxic forms by microbial processes. Water resource managers use such information to make decisions about restoration efforts.
- Nutrient transformations — Studies are in progress to understand the transformation, storage, and transport of nutrients such as nitrogen and carbon in fluvial, wetland, and estuarine environments, including in the Mississippi River Basin, at NAWQA sites, and in the Yukon River Basin.
- Stable isotopes — Methods for a variety of stable isotopes are being developed and applied throughout the United States. These investigations provide water-resource managers with information needed to separate point-source and non-point-source contamination and improved understanding of hydrological and ecological systems.
- Organic compounds in aquatic systems — Methods are being developed and evaluated for the measurement of emerging organic contaminants, for processes associated with naturally occurring dissolved organic carbon, and for biogeochemical reactions of organic compounds in contaminated aquifers. Studies are being conducted to understand human impacts on the environment and to help design the most cost-effective remediation strategies for impaired waters.
- Surface-water flow — Studies include developing improved techniques for estimating regional flood probabilities and the magnitude of extreme flood events, examining hydrodynamic processes in estuarine systems, and evaluating interactions of surface water with ground water. These studies help in regional planning and management of water resources.
- Linkage of hydrology and climate change — Studies are investigating the effect of climate on hydrologic variability. Information from such studies is critical to long-term water resources planning and management.
- Geomorphology and sediment transport — Studies are examining how river channels respond to changes in water discharge, sediment size, and sediment load and how these changes influence aquatic and riparian habitat. This research provides the scientific foundation necessary for predicting effects of changes in water releases from dams and for evaluating the hazards due to large floods.
- Wildfire and floods — Studies are investigating the effects of wildfires on floods, erosion, and debris flows. Because devastating floods and accompanying erosion damage often occur well after a wildfire, this information is critical to managing burned areas.
- Unsaturated zone hydrology — Studies are examining transport and flow in the unsaturated zone. Information from unsaturated zone studies is important in evaluating

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the potential for ground-water contamination from various sources, including from landfills, from nuclear waste repositories, and from the application of agricultural chemicals.

- Fractured-rock hydrology — Investigations are continuing to examine fluid movement, contaminant migration, and energy transport in fractured-rock formations. Understanding how water and contaminants flow in and between fractures is important because fractured rock aquifers are significant sources of water and are susceptible to human impacts.
- Small watershed research — Long-term data are being collected and studies of hydrologic processes are being carried out in five small watersheds. Similarities and differences in their response to disturbances (from changes in climate, atmospheric chemistry, or land use practices) can help scientists and managers (1) assess changes at various spatial and temporal scales, (2) differentiate between natural and anthropogenic impacts, and (3) evaluate watershed sensitivity to these impacts. The studies are being carried out in collaboration with scientists from universities and from other Federal and State agencies, including the National Park Service, U.S. Forest Service, and the National Science Foundation.

In 2005, areas of research that will receive less funding include the theory of how to incorporate geochemical reactions into physically-based models, the study of biotransformation processes affecting organic chemical in the subsurface, and understanding of the geochemistry of arid-regions and the evaluation of ground-water resources in the Middle Rio Grande Basin.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Hydrologic Research and Development (\$000)	\$14,428	-\$1,932
FTE	295	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006, budget request for Hydrologic Research and Development is \$14,428,000 and 295 FTE, a net program decrease of -\$1,569,000 (includes adjustments for uncontrollable costs) and 0 FTE from the 2005 enacted level, which eliminates congressional earmarks, as they were not identified as priorities in the President's budget and do not address the highest priority science needs of the USGS and the Department. This will keep the core program intact while allowing the Survey and the Department to make the best use of limited resources and ensure that the highest priority programs are funded.

Berkeley Pit Lake (-\$195,000) — A pass-through grant to Montana Tech at the University of Montana, for the study of extremophilic life at Berkeley Pit Lake. The University is conducting this work independently, without USGS oversight or collaboration.

Potomac River Basin (-\$296,000) — Funding of a joint effort with the Interstate Commission on the Potomac River Basin to study ground water in the Potomac River basin. Project funds to date have been used to install and operate ground-water monitoring wells, and to begin development of more detailed water supply simulation tools for two interstate watersheds in the basin where demand on water resources is increasing most rapidly.

Spokane Valley / Rathdrum Prairie Aquifer Study (-\$493,000) — A study with the States of Washington and Oregon of the Rathdrum Prairie / Spokane Valley aquifer system. The USGS would cease data collection and stop development of a flow model that would be used by water managers in Washington and Oregon.

Chesapeake Bay (-\$247,000) — A portion of the work in the Chesapeake Bay Program, which was augmented in FY 2005 by the addition of funds by the Congress, will stop. Work in the Chesapeake Bay that is part of the USGS long-term program planning, will continue through the interdisciplinary Priority Ecosystems Studies program, which is described in the Regional Activities section, which begins on page F - 1.

Hood Canal (-\$345,000) — Research to help determine the causes of low dissolved oxygen levels and fish mortality study in Hood Canal, WA.

San Pedro Partnership (-\$247,000) — USGS participation in the interagency Upper San Pedro Partnership and the reporting requirements of P.L. 108-136, Section 321, will not be funded.

The discontinuation of these activities in FY 2006 will not affect performance targets, except by making slightly less data available in the databases that are counted under the output measure, "number of long-term data collections and large data infrastructures maintained."

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Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Ground-Water Resources Program	5,967	6,998	+49	+370	7,417	+419
FTE	49	44	0	0	44	0
National Water-Quality Assessment	63,285	61,645	+1,669	-182	63,132	+1,487
FTE	396	381	0	0	381	0
Toxic Substances Hydrology	14,902	14,476	+367	-1,723	13,120	-1,356
FTE	62	62	0	0	62	0
Hydrologic Research and Development	17,112	15,997	+363	-1,932	14,428	-1,569
FTE	305	295	0	0	295	0
National Streamflow Information Program	14,179	13,814	+379	-41	14,152	+338
FTE	41	41	0	0	41	0
Hydrologic Networks and Analysis	29,852	29,524	+392	-1,764	28,152	-1,372
FTE	240	212	0	0	212	0
Total Requirements \$000	145,297	142,454	+3,219	-5,272	140,401	-2,053
FTE	1,093	1,035	0	0	1,035	0

^{a/} Changes for this program element include a reduction of -\$30 for travel and -\$11 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

National Streamflow Information Program

2006 Program Overview

The FY 2006 budget request for the National Streamflow Information Program (NSIP) is \$14,152,000.

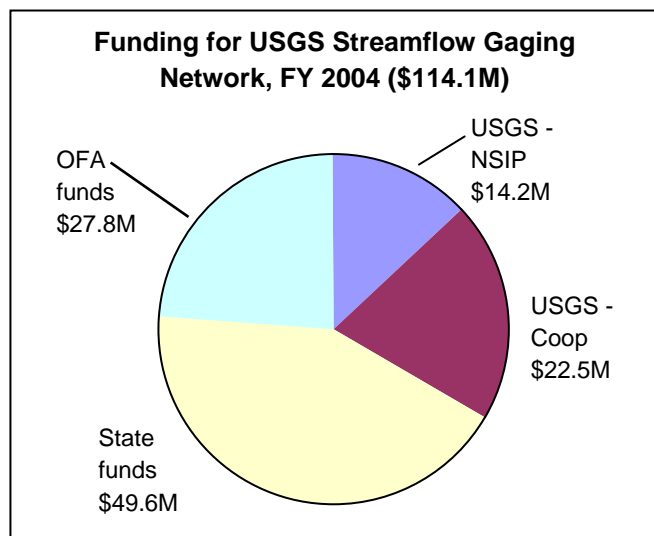
The USGS has the responsibility within the Federal Government for collecting and disseminating information about flow in the Nation's rivers and streams. This information is used for (1) providing for national and local needs for water availability planning and management, (2) managing water quality and habitat, (3) engineering design, (4) understanding the changing characteristics of the hydrologic system in response to water use, land use, and climate variations, and (5) recreation safety. The USGS also provides the streamflow and related hydrologic information needed by the National Weather Service (NWS) to predict and monitor floods and for general streamflow forecasting. USGS flood hazard experts work closely with local, State, and Federal partners, in pursuit of the national goals of reducing the toll of

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natural disasters and building disaster resilient communities. The streamflow information produced by the USGS is crucial to the success of the NWS's Advanced Hydrologic Prediction Services, a major initiative in recent years. Similarly, the streamflow information provided by NSIP is also crucial to the success of the Federal Emergency Management Agency's (FEMA) \$200 million per year flood plain map modernization initiative that was started in FY 2003. Neither of these major programs designed to save lives and property from flooding can be successful without the streamflow information provided by the USGS's NSIP.

The Streamgaging Taskforce under the interagency Advisory Committee for Water Information (ACWI) reviewed the NSIP plan, with the assistance of the Interstate Council on Water Policy. Their review included four workshops held around the country and included stakeholders in the streamgaging program from all levels of government, universities, and private entities. From this review, two reports were submitted to the USGS for consideration.

The National Research Council also completed a review in 2004 of the NSIP plan. The NRC NSIP review was very positive regarding the details of the NSIP plan. In addition, many of the features of NSIP are consistent with recommendations made by the National Research Council in 1992 and 1999.



The NSIP addresses the DOI's Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science. The USGS has chosen to classify the entirety of NSIP under this goal even though the NWS, the FEMA, and local emergency managers use data from some USGS streamgages in their efforts to address hazardous or potentially hazardous flood situations. The streamgaging network is a multi-purpose network, and the same data from a single streamgage may be used for flood forecasting, engineering design for bridges and culverts, evaluating water availability for habitat requirements, evaluating the impacts of land use change, and a host of other purposes. Splitting performance metrics and funding for the streamgaging network between hazards and non-hazards goals is problematic at best. The expenditures cannot be tied to individual purposes because they all contribute to the creation of the multipurpose information. Therefore, the USGS has chosen to

classify the entire streamgaging network under the "Advance knowledge through scientific leadership" goal, which is more appropriate to multipurpose information.

Key indicators of USGS performance in monitoring and assessing flow in the Nation's rivers and streams are (1) soundness of methodology, accuracy, and reliability of science as determined through the various USGS peer review processes, and (2) number of stakeholders reporting that information provided by the USGS helped them achieve their goal.

Year	Annual Funding
FY 2000	\$ 5,839
FY 2001	\$14,127
FY 2002	\$14,310
FY 2003	\$14,217
FY 2004	\$14,179
FY 2005	\$13,814
FY 2006 request	\$14,152

To clearly measure USGS progress in monitoring and assessing streamflow and transferring the knowledge gained through those analyses to water managers, one intermediate outcome measure (63 percent of proposed NSIP streamgages in operation in FY 2005, although only approximately 13 percent are funded by NSIP) and one output measure (formal workshops or training provided to customers in FY 2005) roll up into the intermediate outcome goal of improving the information base, information management, and technical assistance. Outputs include the number of real-time streamgages reporting on the Internet through the USGS's National Water Information System's Web interface (NWISWeb), the number of long-term data collection streamgages, the number of new systematic analyses and investigations delivered to customers, and the number of formal workshops or training provided to customers. For FY 2006, the USGS anticipates that 62 percent of proposed NSIP streamgages will be in operation.

Because of relatively level funding, the NSIP has been operating in a "steady state" since FY 2001. Thus, activities in FY 2005 and FY 2006 will be geared toward maintaining the network.

Funding NSIP at \$14,152,000 in FY 2006 will allow the USGS to maintain operations at most of the streamgages that are currently operating under this Program. This funding level would help maintain the core network of streamgages needed to ensure the USGS can provide the data needed by various government, industry, and private organizations that rely on streamflow information to assure public safety during floods, conduct business, provide appropriate engineering design for bridges and culverts, and ensure efficient and effective allocation of the water resources among competing needs. Some streamgages that funding partners consider to be a lower priority may be shut down to ensure higher priority streamgaging needs.

The following description of program activities reflects the work that would take place in each of NSIP's major program goals in FY 2005 and in FY 2006 with the anticipated funding level. These goals were first laid out in the NSIP plan published in 1999: *Streamflow Information for the Next Century – A Plan for the National Streamflow Information Program of the U.S. Geological Survey*. These goals are also consistent with recommendations provided by the National Research Council in 1992 and 1999.

Goal 1 — A nationwide Federal-interest streamgaging network for measuring streamflow and related environmental variables (precipitation, temperature) reliably and continuously in time. In FY 2005 and FY 2006, no additional streamgages will be added to this Federal network. When the last network inventory was taken, at the end of FY 2003, NSIP was fully funding 359 streamgages, and providing partial funding for an additional 324 streamgages. Under current plans, a fully implemented NSIP would fully fund a core network of 4,425 Federal-interest streamgages, and approximately the same number of streamgages would be cooperatively funded to meet joint Federal, State, and local needs through the USGS Cooperative Water Program; together, these would constitute the USGS national streamgaging network. This goal also includes activities to reduce infrastructure costs and upgrade equipment, though those activities will not be possible in FY 2004 and FY 2005. (Estimates for FY 2004, \$9.1 million; FY 2005, \$8.7 million; FY 2006, \$9.1 million)

Goal 2 — Provide a better understanding of hydrologic extremes (floods and droughts) by more intensive data collection during and immediately following the event and analyses of the information collected. As major floods or droughts occur, funds are allocated each year to assist in additional data collection and analyses to better define the event by measuring flow

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more often and at a greater number of locations. This practice will continue during FY 2005 and FY 2006. (Estimates for FY 2004, \$0.1 million; FY 2005, \$0.1 million; FY 2006, \$0.1 million)

Goal 3 — Provide periodic assessments and interpretation of streamflow information on a regional scale to better define streamflow statistics and trends, to estimate flow at ungaged sites, and as an evaluation of the network to provide needed streamflow information to perform such analyses. Planning for the regional assessments was completed in FY 2003, and a pilot regional assessment was started. The pilot assessment will continue in FY 2004 and FY 2005. Another effort that will continue under this goal in FY 2005 is an evaluation of extremely high flood values in the USGS database to verify their accuracy. (Estimates for FY 2004, \$0.1 million; FY 2005, \$0.1 million; FY 2006, \$0.1 million)

Goal 4 — Develop, implement, and maintain a highly reliable system for real-time streamflow information delivery to customers that includes data processing, quality assurance, storage, and easy access. Some progress has been made toward this goal over the past few years, but there are many functions that still need to be developed. In FY 2004, the USGS completed NATWEB, a system of backup redundant data servers to help ensure reliability of data delivery during times of crisis such as floods and hurricanes. In FY 2005 and FY 2006, NSIP will invest about \$800,000 in additional improvements to help meet this goal, so users can be assured of being able to get the information when they most need it. This program component also includes funding for continuous database development and maintenance. (Estimates for FY 2004, \$0.8 million; FY 2005, \$0.8 million; FY 2006, \$0.8 million)

Goal 5 — Investigate, develop, and implement new methodologies and equipment to more accurately, safely, and inexpensively obtain and deliver streamflow information. Many streamflow measurements are being made today by the same methods used when the USGS started its first streamgauge in 1889. The USGS continues to invest in research and investigations of new technologies and development of new methods of information delivery. Even small advances made in this area can help assure a more efficient, more cost-effective program and greater safety for the technicians who must go into the field to make measurements. (Estimates for FY 2004, \$1.4 million; FY 2005, \$1.4 million; FY 2006, \$1.2 million)

In addition, \$400,000 will be used for program coordination, support, planning, and management. (Estimates for FY 2004, \$0.3 million; FY 2005, \$0.4 million; FY 2006, \$0.4 million)

Finally, the USGS will continue to invest funds in technical support and quality assurance of equipment and procedures. The USGS has a long tradition of providing national technical support for its geographically distributed water resources studies and data collection activities. This support provides quality control to assure the technical excellence of water resources field programs and provides a structured way of transferring new technology to USGS investigative and data activities that are primarily conducted in District offices in each State. Technical support also includes a formal way of establishing priorities for water resources research by the USGS and provides a mechanism to make water resources information available to other agencies, the scientific community, and the public. (Estimates for FY 2004, \$2.4 million; FY 2005, \$2.3 million; FY 2006, \$2.4 million)

NSIP Federal interest streamgages reflect that portion of the national streamgaging network that is funded exclusively by the USGS and, therefore, that part of the network over which the USGS maintains maximum control. As planned, NSIP would be the Federal core of the national streamgaging program that helps to assure stability of long-term data collection. In addition to NSIP funding, support for the network is supplied by other Federal agencies and by 800 State, local, municipal, and Tribal partners through the Cooperative Water Program. The shared funding and single-agency operation of the USGS network provides high-quality information to all potential users, for a wide variety of uses, at low cost to the Federal Government. Because a single agency operates this network, data are collected using nationally consistent methods, which enables comparability of data across jurisdictional boundaries and acceptance of results by water management agencies and courts at all levels of government. Operation of the national network by a single agency also helps to minimize the costs of providing the needed streamflow information by consolidating the data collection and information management infrastructure required. The table on page J - 67 shows the number of data collection stations operated in FY 2004, including type and funding source.

National Academy of Sciences – Evaluation of NSIP Plans

The National Research Council's Committee on Water Resources Research has just completed an assessment of the USGS plans for NSIP. The Committee's report said, "Overall, the Committee concludes that the National Streamflow Information Program is a sound, well-conceived program that meets the Nation's needs for streamflow measurement, interpretation, and information delivery."

The following are recommendations and comments about NSIP from the Committee's report.

- Federal support of a base streamgaging network is recommended to assure long-term viability of the network for national needs.
- The goals of the NSIP are an appropriate foundation for the program.
- The set of minimum national streamflow information needs that underlie the goals are reasonable and appropriate.
- Designing the base streamgaging network by establishing national goals and then using GIS-based methods to select sites to provide the required national coverage is reasonable.
- Intense data collection and interpretation during floods and droughts is a strength of the USGS and should be continued.
- Periodic regional and national assessments of streamflow characteristics are fundamental to NSIP and should be continued.
- Enhanced data delivery is an important and highly valued component of NSIP.

2004 Program Performance Accomplishments

The program accomplishments listed below contribute to the intermediate outcome measure "content and expanse of knowledge base" through its support for the national streamgaging network. In addition, the Program contributes to the output measures for "number of real-time streamgages reporting in NWISWeb," and "number of long-term data collections and large data infrastructures maintained."

Enhanced Streamflow Information for the Nation — Streamflow information is required for the protection of life and property and for the appropriate management of the Nation's water resources. In response to a decline in critical streamgages and increased demand for real-time streamflow information, the USGS, in 2000, began to implement network enhancements to provide real-time data at more sites and to ensure more reliable data delivery to emergency response officials, the NWS, and the general public. These improvements continued into FY 2004. During FY 2004, the USGS completed the following improvements:

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- Under Goal 1, maintained operation of existing streamgages to provide streamflow information to meet national needs, in spite of level funding and rising costs,
- Under Goal 1, upgraded about 25 existing streamgages, including equipment modernization,
- Under Goal 4, invested in data systems, including completion of NATWEB, a system of backup redundant data servers to ensure reliability of data delivery during times of crisis such as floods and hurricanes, and
- Under Goal 5, invested in new technology and techniques, allowing completion of a proof of concept study for real-time non contact streamflow measurements.

2005 Planned Program Performance

In FY 2005, under goal 4, NSIP will continue to support improvements and maintenance of the database to ensure that the information is available when required. In addition, under goals 3 and 5, efforts will continue to develop regional streamflow assessment techniques and procedures to estimate streamflow characteristics at ungaged locations and to develop new technologies and tools to measure streamflow more accurately, safer, and at less cost. These program accomplishments contribute to the intermediate outcome measure "content and expanse of knowledge base" through its support for the national streamgaging network. In addition, the Program contributes to the output measures for "number of real-time streamgages reporting in NWISWeb," and "number of long-term data collections and large data infrastructures maintained."

USGS WATER DATA COLLECTION ACTIVITIES

Types of Stations

Continuous record: Hydrologic information is collected continuously over a long period to detect trends, and in many instances, the station is instrumented to transmit data in near real time.

Partial record: Hydrologic information is collected only during selected periods, for example, during floods.

Periodic record: Ground-water levels and ground-water quality are measured manually according to a schedule.

Number of Stations

Column A – Stations totally supported by funds appropriated to the Hydrologic Monitoring, Assessments and Research subactivity.

Column B – Stations partially supported by funds appropriated to the Cooperative Water Program subactivity.

Column C – Stations totally supported by reimbursement from other Federal agencies.

Column D – Stations supported by a combination of two or more of the above.

Types of Stations	Number of Stations as of October 2004				
	A Federal Program	B Coop Water Program	C Other Federal Agencies	D Combined Support	Total
SURFACE WATER					
Discharge					
Continuous record	694	4,685	1,307	936	7,622
Partial record	23	1,891	239	44	2,197
Stage Only—Streams					
Continuous record	28	371	262	30	691
Partial record	0	136	24	0	160
Stage Only—Lakes/Reservoirs					
Continuous record	16	333	207	15	571
Partial record	0	55	0	1	56
Quality					
Continuous record	62	628	207	28	925
Periodic record	161	1,921	211	132	2,425
GROUND WATER					
Water Levels					
Continuous record	171	1,959	401	252	2,783
Periodic record	3,999	8,772	1,506	509	14,786
Quality					
Continuous record	4	17	39	10	70
Periodic record	702	2,635	627	28	3,992

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Program	2004 Actual	2005 Enacted	Uncontroll. & Related Changes ^{a/}	Program Changes ^{b/}	2006 Budget Request	Change from 2005
Ground-Water Resources Program	5,967	6,998	+49	+370	7,417	+419
FTE	49	44	0	0	44	0
National Water-Quality Assessment	63,285	61,645	+1,669	-182	63,132	+1,487
FTE	396	381	0	0	381	0
Toxic Substances Hydrology	14,902	14,476	+367	-1,723	13,120	-1,356
FTE	62	62	0	0	62	0
Hydrologic Research and Development	17,112	15,997	+363	-1,932	14,428	-1,569
FTE	305	295	0	0	295	0
National Streamflow Information Program	14,179	13,814	+379	-41	14,152	+338
FTE	41	41	0	0	41	0
Hydrologic Networks and Analysis	29,852	29,524	+392	-1,764	28,152	-1,372
FTE	240	212	0	0	212	0
Total Requirements \$000	145,297	142,454	+3,219	-5,272	140,401	-2,053
FTE	1,093	1,035	0	0	1,035	0

^{a/} Included in this program is a one-time technical adjustment of -\$268 that moves all USGS funds associated with the Science on the DOI Landscape initiative to a single location in the Biological Research Activity for ease of administration and accounting.

^{b/} Changes for this program element include a reduction of -\$135 for travel and -\$24 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

Hydrologic Networks and Analysis Program

2006 Program Overview

The 2006 budget request for the Hydrologic Networks and Analysis (HNA) Program is \$28,152,000.

Data on the quantity and quality of water in the Nation's streams, lakes, and aquifers, as well as analytical studies, are necessary for the wise planning, development, utilization, and protection of the Nation's water resources. As the Federal Government's primary agency for water quantity and quality information, the USGS maintains national networks for collecting long term, comprehensive data on water quantity and quality and atmospheric deposition (such as the chemical quality of rain and snow). The Federal funds appropriated through the HNA Program support three distinct water-quality networks, one for large rivers, one for relatively pristine

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streams, and one, in collaboration with many other agencies and organizations, for atmospheric deposition. The HNA Program also supports selected hydrologic analysis and modeling activities, and a small but vital portion of the overall information delivery activity of the USGS water resources programs.

The program addresses the DOI's Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science. A key indication of the USGS's performance in collection of water-quality and atmospheric deposition data and in hydrologic analysis is reflected in the end outcome measure for research: soundness of methodology, accuracy, and reliability of science (100 percent of science is validated through appropriate peer review). To clearly measure progress in achieving the intermediate outcome of improving the information base, information management and technical assistance, the USGS tracks outputs including real-time streamgages reporting in the National Water Information System-Web (NWISWeb), real-time ground-water sites reporting in NWISWeb, real-time water-quality sites reporting in NWISWeb, long-term data collections, and new systematic analyses and investigations delivered to customers.

The sub-programs under HNA have the following objectives:

- Monitor the chemical quality of rain and snowfall,
- Monitor streamflow and the water quality of streams and ground water to fulfill USGS obligations for specific river basin compacts and treaties,
- Provide direct technical support to DOI bureaus for hydrologic concerns,
- Understand the impacts of global climate change; monitor long-term changes in streamflow and stream quality at sites relatively unaffected by human activities,
- Provide direct technical support to the National Park Service for water-quality concerns,
- Monitor the water quality and trends of selected major rivers,
- Maintain and enhance USGS data delivery systems to process and disseminate water data and study results, and
- Develop decision-support systems for specific river basins in the western United States.

Some of the HNA sub-programs are fairly fixed and will not change for a number of years. Others have some flexibility in planning and implementation.

Because of the vast range of activities funded by HNA, the water-quality data and analytical information that the USGS provides through this program are used by a wide variety of stakeholders, including other DOI bureaus (through the National Park Service water quality partnership and the DOI Cost-Share), U.S. Environmental Protection Agency and Department of Agriculture (both customers for baseline water-quality information), Department of Commerce (for real-time flood level information provided through the National Water Information System, which this program supports), State and local governments (for both water-quality and flood level information), academia, consulting and advocacy organizations, industry, and private citizens. Stakeholders use program information to:

- Describe short-term or severe changes in water resources, such as changes in water quality caused by flooding, droughts, and widespread contamination,
- Monitor long-term changes in the quality of selected rivers, lakes, reservoirs, and ground water to document the current conditions and changes in these hydrologic systems over time, and
- Measure the quality of small streams in pristine environments to document current conditions and changes over time in natural watersheds.

The following describes activities underway in FY 2005 and planned for FY 2006.

Hydrologic Networks

The Hydrologic Networks component of the HNA Program includes the National Stream Quality Accounting Network, the Hydrologic Benchmark Network, and the National Atmospheric Deposition Program / National Trends Network, which are described below. (Estimates for FY 2004, \$4.5 million; FY 2005, \$4.4 million; FY 2006, \$4.5 million)

National Stream Quality Accounting Network (NASQAN) —

(Estimates for FY 2004, \$2.3 million; FY 2005, \$2.2 million; FY 2006, \$2.2 million)

NASQAN operates 32 fixed stations to measure water quality and to calculate the loading (pounds per year) and time trends of sediments and chemicals in five of the Nation's largest rivers (Mississippi, Columbia, Colorado, Rio Grande, and Yukon) and their major tributaries. Data from these stations aid in the planning, utilization, and protection of these major rivers that flow across interstate and international boundaries and are the subject of complex regulatory requirements. Fixed station monitoring includes 17 Mississippi basin sites, 1 Columbia basin site, 2 Colorado basin sites, 7 Rio Grande basin sites, and 5 Yukon basin sites. Monitoring of the Yukon River began in FY 2001 and is planned to continue through 2005; operations in the Columbia and Colorado were reduced to provide the resources for this activity in Alaska.

The Yukon River Basin (330,000 square miles) is one of the largest and most diverse ecosystems in North America. Much of the permafrost south of the Yukon River is anticipated to melt in the next 20 to 30 years if present warming trends (0.75 degrees C per decade) continue at these latitudes. In addition to causing an increase in glacial runoff, predicted arctic/subarctic warming has the potential of (1) making vast amounts of organic carbon and nutrients available for decomposition and release to wetlands, lakes, and streams, (2) having global effects on concentrations of greenhouse gases such as carbon dioxide and methane, (3) having regional effects on all levels of stream productivity (including salmon populations), and (4) increasing fire frequency and soil erosion. The objective of the Yukon River effort is to establish baseline water-quality conditions for comparison with anticipated conditions 2 to 3 decades in the future. These observations will be important in terms of understanding the release of carbon due to the expected partial melting of permafrost in the Yukon basin.

A broad range of chemicals—including nutrients, mercury, natural and manmade organic chemicals, and trace elements—are being measured at five fixed stations from the Canadian border to the mouth of the river. In addition to the five fixed stations being monitored, intensive sampling runs supplement this monitoring during the summer. Two sampling runs—one under high flow conditions and the other under low flow conditions—were made during 2002, from the

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Canadian border to the Dalton Highway crossing. Two more runs were made in 2003, farther downstream, and these sample runs will be supplemented by additional sample collection in 2004. A final summer sampling run covering the entire study reach of the Yukon, from the Canadian Border to the river mouth will occur in FY 2005. These expeditions will characterize the contributions of sub basins within this area to the overall river loadings and will include more detailed measurements in the Yukon Flats. During FY 2006, Yukon data and information publication will begin.

Hydrologic Benchmark Program (HBN) —

(Estimates for FY 2004, \$0.7 million; FY 2005, \$0.7 million; FY 2006, \$0.7 million)

The HBN supports monitoring sites and assesses streamflow and water quality in a national network of undeveloped watersheds which serve as benchmarks against which to measure man's direct impacts on water quantity and quality. These watersheds are also useful to monitor the more subtle effects of inputs from atmospheric deposition and changes in geochemical cycling resulting from climate change. Chemical and hydrologic monitoring provides basic, yet critical, data needed as part of any ecosystem monitoring effort. Stream chemistry integrates the chemical and hydrologic processes in basins. HBN monitoring and assessments can objectively gage the effectiveness of control measures intended to mitigate impacts of sulfur and nitrogen deposition to sensitive ecosystems. A major redesign of the network was completed and implemented in FY 2004 and FY 2005. A revised network of 36 sites is now operational with intensive water-quality sampling underway at 16 of the 36 sites. Annual interpretive products on HBN monitoring results will be supported and produced in FY 2005 and FY 2006, along with more comprehensive assessments at 5-year intervals. All data and major reports from HBN sites dating back to the 1960s has been loaded to a new public Web site and the program is developing partnerships with DOI and other land management agencies to restart water-quality sampling at additional Benchmark sites.

National Atmospheric Deposition Program (NADP) —

(Estimates for FY 2004, \$1.5 million; FY 2005, \$1.5 million; FY 2006, \$1.5 million)

As the lead Federal agency for monitoring wet atmospheric deposition (chemical constituents deposited to the Earth's surface from the atmosphere via rain, sleet, and snow) in the United States, the USGS supports 87 sites in the interagency NADP. Under this program, the USGS pools resources with over 100 other Federal, State, and local organizations to provide scientists and policymakers with a national-scale, long-term network measuring atmospheric deposition. In FY 2006, the program will update assessments to detect the latest trends in mercury and nitrogen deposition since the mid-1990s at NADP deposition monitoring sites, and begin the installation of next-generation deposition sampling instruments needed to modernize aging field equipment at NADP sites.

DOI Support for Acid Rain Monitoring

Participation in the National Atmospheric Deposition Program (NADP) by USGS disciplines and other DOI bureaus continued in FY 2004 and 2005. In addition to longstanding support from the USGS Atmospheric Deposition Program, participation continued by the NAWQA and Cooperative Water Programs, the Energy Resources Program, and the Cooperative Research Unit and Ecosystem Dynamics Programs to provide monitoring and assessment through the NADP in both the National Trends and Mercury Deposition Networks. Collectively, the DOI now supports nearly one-half of NADP sites with coordinated participation by the USGS, National Park Service, Fish and Wildlife Service, Bureau of Land Management, Bureau of Reclamation, and eight Tribal Nations.

Hydrologic Analysis

The Hydrologic Analysis component of the HNA Program includes Studies of Climate Variability and Change, Watershed Modeling, USGS Science for the National Park Service, DOI Cost-Share activities, Special Studies, and Integrated, Interdisciplinary Science. These activities are described below. (Estimates for FY 2004, \$10.3 million; FY 2005, \$11.4 million; FY 2006, \$9.9 million)

Studies of Climate Variability and Change —

(Estimates for FY 2004, \$0.9 million; FY 2005, \$0.9 million; FY 2006, \$0.9 million)

The USGS is identifying which atmospheric and oceanic circulation patterns are most responsible for variations in hydrologic conditions such as streamflow, lake levels, snow pack, and glacier mass. Work focuses particularly on extreme events (such as the flooding that affected the eastern seaboard after Hurricane Floyd and the drought that has affected the Southeastern and Mid-Atlantic States following Hurricane Ivan and the drought that has been affecting the Western States since 2000), at time scales ranging from weeks to decades. These investigations depend upon the primary surface-water (streamflow) databases collected by the USGS, specialized data on glacier-mass, and proxy data on hydrologic conditions that existed prior to hydrologic record keeping. These studies are leading to a better understanding of the causes, intensity, duration, and timing of droughts, floods, ice ages, and other hydroclimatic phenomena. The studies are developing improved planning and management information for water-resource system operators and land-management agencies.

In FY 2005 and 2006, the Global Change Hydroclimatology program will continue (1) monitoring climate-sensitive glaciers, (2) identifying past hydrologic variations by examination of sediment and mineral deposits, biotic material, and historical and instrumental records, (3) determining relations between hydrologic variations and large-scale atmospheric circulations and other climatic indices, and (4) determining effects of climate variation and change on streamflow, erosion, sedimentation, water quality, and vegetation. Studies will include simulation of conditions that lead to high wildfire potential, with the expectation of achieving a better understanding of climate-fire relationships in the West and perhaps the opportunity to develop new fire indices based on a broader set of atmospheric, surface hydrologic, and vegetation parameters. Studies also will include investigation of regional relations among glaciers in the North Cascades with the objective of determining the annual storage or release of water by glaciers in a watershed, and studies of the timing of snowmelt and spring runoff. Data collection and studies supported by the Global Change Hydroclimatology program help sustain scientific efforts to improve the understanding of drought and water resources in the western United States, where a severe multi-year drought has affected most of the States west of the Mississippi.

Watershed Modeling —

(Estimates for FY 2004, \$0.4 million; FY 2005, \$0.3 million; FY 2006, \$0.3 million)

Increasing competition among water-resource users in many basins in the West, coupled with a drought that is currently in its fifth year, has significantly increased the need for near-real-time assessments of water availability and use. Given recent advancements in computer hardware and modeling software, coupled hydrologic and water-management models are now capable of providing these assessments, with substantial benefits for water-resources planning and operations. Since 1995, the USGS and the Bureau of Reclamation have collaborated on a project called the Watershed and River Systems Management Program. The program has two

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goals: (1) coupling of watershed and river-reach models that simulate the physical hydrologic setting, with routing and reservoir management models that account for water availability and use, and (2) application of these coupled models to Reclamation projects in the western United States. Starting in FY 2004, the program began focusing on model support for improved water planning and management operations during the current drought. Activities have centered on Reclamation operations in the Upper Columbia, Yakima, and Upper Rio Grande basins and, to a lesser extent, the Truckee basin.

USGS Science for the National Park Service —

(Estimates for FY 2004, \$1.9 million; FY 2005, \$1.9 million; FY 2006, \$1.9 million)

In 1998, the USGS began a water-quality assessment and monitoring partnership with the National Park Service (NPS) to address a range of water-quality issues in national parks. The USGS/NPS partnership program provides a unique and seamless mechanism for sister bureau collaboration within DOI and assures appropriate science is made available to park managers for defensible decisionmaking. Since its inception, data and information from 112 partnership projects are being, or will be, used to address water-quality issues in 87 national park units across the United States.

In FY 2005, there are 7 new and 33 continuing projects in the partnership. Projects for FY 2006 will be selected when the USGS has completed its consultation process with NPS to identify new NPS needs. The scope of individual projects varies in accordance with the objectives of individual park managers, and all new projects are selected annually by a panel of USGS and NPS personnel through a competitive proposal process. Activities range from basic data collection of targeted baseline water-quality constituents to longer term intensive investigations of potential anthropogenic impacts on water quality and associated aquatic resources.

The partnership also supports direct local technical support by USGS scientists for NPS resource managers and decisionmakers at participating parks. Results of the first completed projects are already being used to make decisions on a variety of issues, such as when and where background water quality is degraded by anthropogenic sources of contamination and determination of the best management practices within and outside park boundaries that can affect the biological health of water resources within park units. More information about the USGS-NPS partnership is available at http://water.usgs.gov/nps_partnership/.

DOI Cost-Share —

(Estimates for FY 2004, \$1.4 million; FY 2005, \$1.5 million; FY 2006, \$1.5 million)

Starting in January 2003, in recognition of its role as the science bureau of the DOI, the USGS instituted a standard 15 percent charge to fund indirect costs for all the work the USGS performs on a reimbursable basis for other DOI bureaus. The charge is substantially lower than the average charge to other reimbursable customers. Because this special rate will not fully cover the indirect costs associated with the reimbursable projects performed for the DOI bureaus, the remaining indirect costs are paid by the USGS, using appropriated funds. Through the DOI cost-share program, a part of the HNA Program, the USGS provided \$1,450,000 in FY 2004 to cover those indirect costs not recovered from these DOI customers. In FY 2005, additional funds of \$50,000 will be redirected from other activities in the HNA Program to more fully cover the indirect costs of the reimbursable projects for DOI customers.

Special Studies —

(Estimates for FY 2004, \$0.9 million; FY 2005, \$1.8 million; FY 2006, \$0.2 million)

The HNA Program funds a number of special studies that the USGS has undertaken to help State and local officials in evaluating their local water resources, in terms of both quality and availability for sustained future development. In FY 2004 and FY 2005, the USGS is continuing its baseline streamflow and water-quality monitoring program in the Lake Champlain basin and water-quantity monitoring in Hawaii.

Integrated, Interdisciplinary Science —

(Estimates for FY 2004, \$2.9 million; FY 2005, \$2.9 million; FY 2006, \$2.9 million)

The HNA Program also provides support for interdisciplinary work and the Priority Ecosystems Science (PES) activities that are described in more detail in the Regional Activities Section section beginning on page F - 1. Through PES, HNA supports studies within the Everglades, San Francisco Bay, Chesapeake Bay, the Platte River, and the Mojave Desert to integrate hydrological, geological, chemical, climatological, and biological information related to water resources and environmental hazards in support of land managers needs.

National Research Program —

(Estimates for FY 2004, \$1.7 million; FY 2005, \$2.0 million; FY 2006, \$2.0 million)

As described in the Activity Summary on page J - 9, all of the Water Resources Investigations programs contribute funding to the National Research Program, which encourages pursuit of a diverse agenda of research topics to provide new knowledge and gain insights into hydrologic processes that are not well understood, at the same time promoting management efficiency and facilitating interaction among scientific disciplines.

Water Information Delivery

The USGS funds the delivery of basic hydrologic data directly as a part of the overall cost of the data collection activity (for example, data delivery funding is also provided by the National Streamflow Information Program, the Cooperative Water Program, and by reimbursements from Federal and non-Federal partners). Publication of project specific findings is funded within the cost of each project. The HNA Program provides for the delivery of results and water information beyond the immediate needs of funding agencies or programs. This activity has two pieces: publications and the computer-based National Water Information System. (Estimates for FY 2004, \$5.9 million; FY 2005, \$5.9 million; FY 2006, \$6.0 million)

Publications —

(Estimates for FY 2004, \$2.0 million; FY 2005, \$1.9 million; FY 2006, \$1.9 million)

The HNA Program funds the extra costs (beyond the costs of producing a product required for immediate local needs) of preparing, printing, and disseminating selected USGS professional papers, special information products, and circulars. Scientific data and interpretations from USGS water-resources programs are synthesized to create products that address significant regional and national water-resources topics and describe the current thinking on specific and relevant water-resources issues. In addition, the Water Information Delivery Program continues to develop processes to employ critical new technologies for scientific information preparation, presentation, and delivery. For example, implementing new work processes to more efficiently use scientific author-prepared materials and to effectively support the use of the World Wide

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Web to make data and reports more readily available, to meet increased demands, expectations, and goals of E-Government. This includes conversion of historic, seminal scientific publications from paper to electronic format for serving through the Web. The Water Information Delivery Program maintains a comprehensive Web site for consistent access to all water-resources information products (<http://water.usgs.gov/pubs/>).

National Water Information System (NWIS) —

(Estimates for FY 2004, \$3.8 million; FY 2005, \$3.9 million; FY 2006, \$3.9 million. This includes only the portion of NWIS funding that the HNA Program pays. Other programs also contribute funding, for a total funding level of \$7.1 million each year for FY 2004, FY 2005, and FY 2006 \$7.1 million.)

The USGS maintains a distributed network of computers and file servers for the acquisition, storage, and retrieval of the water data collected at approximately 1.5 million sites around the country. This system is called NWIS. Many types of data are stored in this NWIS network, including site information, time-series (flow, stage, precipitation, and chemical), flood streamflow, ground water, water use, and water quality. The NWIS contains the data the USGS has collected, compiled, and archived on the water resources of the United States for more than a century.

NWISWeb is the World Wide Web application that allows users, both internal and external, to retrieve information from the NWIS

(<http://waterdata.usgs.gov/nwis>). Data are retrieved by category (surface water, ground water, or water quality) and by geographic area. Of the 1.5 million sites with NWIS data, over 9,300 report their data in real time. The NWISWeb provides the public access to: 201 million daily values (mostly streamflow), 7.6 million ground-water levels, 4.3 million water-quality samples resulting in more than 68 million water-quality analyses, and 650,000 peak discharges (floods). The NWISWeb makes data that are collected in real time available to all within a few minutes or hours. During times of crisis, managers and emergency management agencies can now make critical decisions for saving lives and property based on up to date information. Because some users require an uninterrupted source of real-time data in critical situations, the USGS implemented a system of backup servers to improve the reliability of delivering real-time data to the World Wide Web. For FY 2006 improvements will be made to facilitate the entry of field-data, and additional data “collections” and metadata will be available from NWISWeb.

Information Technology Improvements

Water resources mission-critical information systems submitted Capital Asset Plans (Exhibit 300) to DOI and have received certification and accreditation. NWIS is undertaking process improvements to improve productivity. As a cost avoidance measure, NWIS is developing failover and recovery capabilities to minimize costly disruption and recovery of lost data. The USGS water resources programs are gaining efficiencies in timeliness and cost by serving digital data and analysis tools through common Web portals.

The USGS is achieving efficiencies in water data collection and dissemination through software advances. In FY 2003 the USGS developed a new tool to detect probable erroneous real-time water-level data that are publicly available on the Internet through the NWISWeb interface. The use of this software, combined with increased vigilance by data maintainers, has dramatically reduced the number of real-time water-level gages with large data spikes on NWISWeb. Because of this success, a new real-time data quality assurance tool was developed during FY 2004 to check for possible erroneous data in other types of real-time data, including selected water-quality parameters. Results of the modified tool are sent by electronic mail daily to the USGS Water District Offices whenever a publicly-available spike is detected for that District. This tool allows staff to focus their attention on identified problem areas, thereby reducing the time needed to quality assure the vast amounts of water data that the USGS collects daily.

Science on the DOI Landscape

In FY 2005, the HNA Program includes \$0.3 million to continue an effort begun in FY 2004, to provide support for the Science on the DOI Landscape Initiative to meet regional priorities designated by the DOI bureaus, such as in-stream flow methods for aquatic systems in the arid West, hydrologic processes related to ecosystem sustainability in the Great Basin, and restoration ecology and coalbed methane production in the Central Region. In FY 2006, a technical adjustment is requested to transfer all funding for Science on the DOI Landscape to a single line item in the Biological Research Activity, for ease of accounting and program management. The Science on the DOI Landscape initiative is more fully described beginning on page K - 53 in the Biological Research and Monitoring Section. (Estimates for FY 2004, \$0.3 million; FY 2005, \$0.3 million; FY 2006, \$0.3 million transferred to Biological Research and Monitoring)

Upper Klamath Lake Studies

In FY 2005 and FY 2006, the HNA Program includes \$0.5 million for work at Klamath Lake in south central Oregon, to help determine the water-quantity and water-quality benefits that can be expected in the Lake in response to various restoration activities. These activities span two States—Oregon and California—and focus on environmental, economic, and statutory concerns. The USGS is working closely with the Bureau of Reclamation, Bureau of Land Management, Fish and Wildlife Service, NOAA Fisheries, Natural Resources Conservation Service, several Tribes, the Oregon Departments of Water Resources, Fish and Wildlife, and Environmental Quality, California Department of Water Resources, and Siskiyou and Modoc Counties in California to address basin issues. This work is in collaboration with work being conducted under the Biological Research Activity and is described in more detail in the Regional Activities section beginning on page F - 1. (Estimates for FY 2005, \$0.5 million; FY 2006, \$0.5 million)

Technical Support

The USGS has a long tradition of providing national technical support for its geographically distributed water-resources studies. This support provides quality control to assure the technical excellence of water resources programs and provides a structured way of transferring new technology to USGS investigative and data activities that are primarily conducted in District offices in each State. Technical support also includes a formal way of establishing priorities for water-resources research by the USGS and provides a mechanism to make water resources information available to other agencies, the scientific community, and the public. (Estimates for FY 2004, \$8.9 million; FY 2005, \$7.1 million; FY 2006, \$7.3 million)

2004 Program Performance Accomplishments

The FY 2004 program accomplishments listed below demonstrate the utility of USGS products that are counted under the following output measures: "number of systematic analyses and investigations delivered to customers," "number of long-term data collections and large data infrastructures maintained," "number of real-time streamgages reporting in NWISWeb," "number of real-time ground-water sites reporting in NWISWeb," and "number of real-time water-quality sites reporting in NWISWeb."

Improved Understanding of Drought Occurrence — USGS researchers analyzed rainfall data to identify spatial and temporal variation of drought occurrence in the conterminous

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United States during the 20th Century. They found that these variations were largely (74 percent) explained by multi-decadal fluctuations in sea-surface temperatures in the North Atlantic and North Pacific Oceans and by the long-term trend in Northern Hemisphere temperatures. The results suggest that persistence of the present warm conditions in the North Atlantic into the next decade may lead to continuation of the present western drought pattern, which is similar to that of the 1950s, or to development of a drought pattern similar to that of the 1930s.

Potential Effects of Climate Change on the Hydrology of California Sierra Nevada — USGS researchers have simulated the streamflow and water-balance response of river basins in the California Sierra Nevada to historical (20th century) and potential future (21st century) climate variations and changes. The historical records and the historical-period simulation both showed stationary climate and hydrologic variations until about 1975, when temperatures began to rise and streamflow and snowmelt began to occur progressively earlier in the seasonal cycle. A simulation with greenhouse-gas concentrations held constant at 1995 levels showed climate and streamflow timing conditions similar to those in 1980s and 1990s. A simulation with "business-as-usual" increases in greenhouse gas concentrations showed a continuation of recent trends, with 2.5-degrees-C warming and hastening of snowmelt and runoff by almost a month, and with the trends becoming readily visible after about 2025 against a realistic background of natural year-to-year variability. Despite the changes in timing, the annual total streamflows remained similar to the historical values. Controlled experiments such as these promises to improve the quality and usability of future climate-change impact assessments.

Changes in the Timing of Seasonal Runoff in New England — USGS researchers have identified significant changes in the timing of seasonal winter-spring runoff in New England. They found that the date by which half of the runoff volume has been discharged now occurs 1 to 2 weeks earlier than it did in the past at sites where snowmelt runoff has the most effect on spring river flows. These changes are consistent with results of studies of New England lake ice-out dates, last-frost dates, lilac-bloom dates, and spring air temperatures, and also with runoff-timing changes found in the western United States. The New England studies are being extended to the other northern-tier States east of the Rockies.

Reliable Water Supplies in the Red River of the North Basin — The USGS is using USGS-DOI cost-share to assist the Bureau of Reclamation in a comprehensive study for the future water-quantity and quality needs for the Red River of the North Basin in North Dakota and the possible options to meet those water needs. Several projects have been completed, technical assistance is being provided, and several other projects are being conducted to assist Reclamation to complete their comprehensive study. Regression equations for estimating concentrations of selected water-quality constituents for selected gaging stations in the Red River have been developed. Streamflow gain and loss information has been developed to account for available streamflow within the basin. Water withdrawal and return flow data have been compiled to support evaluation of water-supply options.

Hydrological Understanding of the Obed Wild and Scenic River System — The USGS, in partnership with the National Park Service and the USGS-DOI Cost-Share Program, continued studies to aid in the protection of the Obed Wild and Scenic River (WSR) in Tennessee, one of the few Wild and Scenic Rivers authorized in the southeastern United States. The Obed WSR, including reaches of the Obed and Emory Rivers, Clear Creek, and Daddys Creek, was established in 1976 to protect the free-flowing conditions of the streams and the environmental resources of an important and unique habitat for a number of threatened and endangered species. The Obed WSR is impacted by increased water use, mineral and hydrocarbon

extraction, road construction, and residential and industrial development. One of the fastest growing communities in Tennessee is in the upper reaches of the watershed. The increased development, increased water use, and the presence of more than 3,000 impoundments in the Obed River basin have affected the flow regimes, water quality, and aquatic and riparian habitats of the river. Studies are being conducted to evaluate the effect of impoundments on the flow regimes, to begin to assess the effects of development and land-use changes on geomorphic and ecological stability of flood plains and channel habitat, and to evaluate and identify water-quality conditions and changes in the Obed WSR.

Streamflow Characterization on Charles M. Russell National Wildlife Refuge — During FY 2000-04, the USGS collected streamflow data at 5 gaging stations on the Charles M. Russell National Wildlife Refuge (CMRNWR) using USGS DOI cost-share and U.S. Fish and Wildlife Service (FWS) funds. This data collection was the first part of a study to characterize streamflows on the refuge. The CMRNWR encompasses Fort Peck Reservoir on the Missouri River in northeastern Montana, including parts of the rugged country called the Missouri River Breaks. The Missouri River Breaks provide varied habitat, including riparian corridors along Missouri River tributary streams, for numerous animals and plants on the refuge. During FY 2005 and FY 2006, the USGS plans to use the 5 years of streamflow data previously collected to estimate long-term streamflows on gaged and ungaged streams in the CMRNWR. This information is needed by the FWS to ensure that sufficient streamflow remains in the tributary streams to maintain the riparian corridors. The FWS is negotiating with the Reserved Water Rights Compact Commission of Montana and these negotiations require accurate information about current and long-term streamflow characteristics for Missouri River tributary streams crossing the CMRNWR.

Monitoring of Hydrothermal Activity in Tantalus Creek, Yellowstone National Park — The USGS installed new monitoring equipment and re-established operation at a streamflow-gaging station on Tantalus Creek in Yellowstone National Park using USGS DOI cost-share funds. Tantalus Creek drains the Norris Geyser Basin, in which hydrothermal changes have occurred in the past year. Continuous measurement of streamflow, water temperature, and precipitation at the station and public presentation of the information in real time through the USGS NWIS helps scientists to evaluate the significance of the hydrothermal changes. The hydrologic monitoring compliments other monitoring efforts of the Yellowstone Volcano Observatory, which is a partnership between the USGS, Yellowstone National Park, and the University of Utah.

Reliably Serving Real-Time Water Information for the Nation — In FY 2003, the NWIS completed the first release of the backup services to provide reliable and redundant processing and delivery of real-time data on streamflow, water quality, and ground water levels to the World Wide Web. Additional improvements were made in FY 2004 to ensure that real-time data served via the National Water Information System Web (NWISWeb) will remain available during natural disasters such as floods, storms, or information technology-related outages. Despite the office evacuations and subsequent power outages that occurred during the hurricanes and flooding that severely impacted Florida, the USGS Florida offices continued to provide vital real-time streamflow information to NWISWeb by utilizing the backup in California. This accomplishment demonstrates the utility of USGS products that are counted under the following output measures: "number of real-time streamgages reporting in NWISWeb," "number of real-time ground-water sites reporting in NWISWeb," and "number of real-time water-quality sites reporting in NWISWeb." This activity was conducted under the "Water Information Delivery" component of the program described above.

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State Water Use Data System Improvements — Significant improvements were made to the Site-specific Water Use Data System, a component of NWIS which is used to compile and store measurements and estimates of water use by individual user, aggregate user, or user-defined geographic area. The improvements consisted of changes to both the database architecture and the user software applications to allow for more efficient use and storage of water-use information.

Acid Rain Data Across the Nation — NADP networks provide a primary national scorecard with which to (1) evaluate the effectiveness of ongoing regulations such as Phase II reductions under the Clean Air Act Amendments and (2) set a benchmark to measure the effectiveness of potential future regulations of sulfur dioxide, nitrogen oxides, and mercury such as those recently proposed in the Interstate Air Quality and Utility Mercury Emissions Rule. All data from NADP is online, and in the past 12 months 69,000 unique registered users downloaded 16,000 numerical data sets and 114,000 maps in support of research on air quality, water quality, forest productivity, materials effects, ecosystem studies, watershed studies, and human health. In FY 2004, NADP data was identified as being cited in over 100 scientific publications including 88 journal articles and 37 publications with USGS authorship.

2005 Planned Program Performance

The activities listed below demonstrate the utility of USGS products that are counted under the following output measures: "number of systematic analyses and investigations delivered to customers," "number of long-term data collections and large data infrastructures maintained," "number of real-time streamgages reporting in NWISWeb," "number of real-time ground-water sites reporting in NWISWeb," and "number of real-time water-quality sites reporting in NWISWeb."

Planned program performance in FY 2005 will focus on several key scientific and basic data collection/management areas, including the continuation of the following:

- Under the "Hydrologic Analysis" component of the program, studies that enhance knowledge of the hydrologic and other components of sensitive ecosystems in the arid West, large lake and estuary systems, river and flood plain environments, among others,
- Under the "Hydrologic Networks" component of the program, long-term data collection networks such as the Hydrologic Benchmark Network, NASQAN, NADP, which have become increasingly necessary because of intensive land-use change in the country,
- Under the "Hydrologic Analysis" component of the program, hydroclimatic studies plus water availability and use,
- Under the "Hydrologic Analysis" component of the program, watershed modeling, including increased focus on ground-water-surface-water interactions,
- Under the "Hydrologic Analysis" component of the program, expanded collaborative efforts to solve scientific problems faced by DOI bureaus through the USGS DOI cost-share program,
- Under the "Water Information Delivery" component of the program, delivery of reliable hydrologic data to the public and other governmental agencies,

Hydrologic Networks and Analysis

- Under the reimbursable component of the program (not described above), Department of Defense Environmental Contamination programs, to help DOD resolve ongoing land management issues at military facilities, and
- With funding provided through an FY 2005 supplemental appropriation (\$707,000), the USGS repaired and replaced streamgages and field other instruments that were damaged or destroyed in the series of hurricanes and storms that struck the East Coast and the Gulf Coast in late FY 2004.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Hydrologic Networks and Analysis (\$000)	\$28,152	-\$1,764
FTE	212	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs and technical adjustments.

The FY 2006, budget request for Hydrologic Networks and Analysis is \$28,152,000 and 212 FTE, a net program decrease of -\$1,372,000 (includes adjustments for uncontrollable costs and technical adjustments) and 0 FTE from the 2005 enacted level, which will end some congressionally earmarked projects. These projects were not identified as priorities in the President's budget and do not address the highest priority science needs of the USGS and the Department. This will keep the core program intact while allowing the Survey and the Department to make the best use of limited resources and ensure that the highest priority programs are funded.

Lake Champlain Monitoring (-\$291,000) — Expanded water-quality monitoring for mercury and other toxic substances in Lake Champlain.

Monitoring Water in Hawaii (-\$437,000) — Expanded monitoring of water resources (especially ground water) in Hawaii, in cooperation with the State Department of Natural Resources.

Tongue River Coalbed Methane study (-\$877,000) — The USGS would stop the collection of hydrologic data that was begun in FY 2004 to document and establish a baseline for current conditions in the streams in the Tongue River watershed.

The discontinuation of these activities in FY 2005 will not affect performance targets, except by making slightly less data available in the databases that are counted under the output measure, "number of long-term data collections and large data infrastructures maintained."

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Cooperative Water Program Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Cooperative Water Program Subactivity	63,995	62,337	+1,711	-278	63,770	+1,433
FTE	860	802	0	0	802	0
Total Requirements \$000	63,995	62,337	+1,711	-278	63,770	+1,433
FTE	860	802	0	0	802	0

^{a/} Changes for this subactivity include a reduction of -\$225 for travel and -\$53 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for the Cooperative Water (Coop) Program is \$63,770,000.

As the primary Federal science agency for water-resource information, the USGS monitors the quantity and quality of water in the Nation's rivers and aquifers, assesses the sources and fate of contaminants in aquatic systems, develops tools to improve the application of hydrologic information, and ensures that its information and tools are available to all potential users. This broad, diverse mission cannot be accomplished effectively without the contributions of the Cooperative Water (Coop) Program. For 109 years, the Coop Program has been a highly successful cost-sharing partnership between the USGS and water-resource agencies at the State, local, and Tribal levels. Throughout its history, the program has made important contributions to meeting USGS mission requirements, developing meaningful partnerships, sharing Federal and non-Federal financial resources, and keeping the agency focused on everyday challenges facing water users across the country.

In FY 2004, more than 1,400 State, regional, local, and municipal agencies, and Native American Tribes participated in the Coop Program. These cooperators matched the \$64 million appropriated to the USGS, and contributed an additional \$74 million, for total program funding of \$202 million. The Coop Program has been highly successful because it:

- Combines Federal and non-Federal resources in addressing many of the Nation's most pressing water resource issues, resulting in great cost savings to both the Federal Government and the States,
- Conducts studies across the country in each of the 50 States, Puerto Rico, and U.S. Trust Territories, allowing the USGS to form a national picture of important water-resources issues and potential solutions,
- Uses standardized methods of data collection and analysis across the country, so that information and results of studies are comparable from one State to another, and so that knowledge gained from one study contributes significantly to understanding the hydrology in other parts of the country,

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- Helps resolve inter jurisdictional disputes by assessing conditions at State boundaries and by assuring all parties that the data and results of investigations are objective and are equally available to all parties, and
- Combines the utilization of USGS offices within the State with the much larger national infrastructure of the USGS. This infrastructure includes the National Water Quality Laboratory, the National Water Information System, the National Research Program (which provides new methods and consultation on difficult scientific issues), instrumentation testing facilities, and a national system of quality assurance.

Within the Coop Program, about half the funds are used to support data collection activities; the remaining funds are used for interpretive studies. To maximize the usefulness of hydrologic data and the results of interpretive studies, the USGS compiles and analyzes information resulting from these activities into regional and national synthesis products using modest amounts of funding from other USGS programs.

The Program addresses the DOI's Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science. Key indication of the USGS's performance is reflected in the end outcome measure for research: soundness of methodology, accuracy, and reliability of science (100 percent of USGS science is validated through appropriate peer review). To clearly measure progress in achieving the intermediate outcome of improving the information base, information management, and technical assistance by providing information responsive to State or local needs, by water managers, the USGS tracks outputs including real-time streamgages reporting in NWISWeb (see <http://waterdata.usgs.gov>), real-time water-quality sites reporting in NWISWeb, long-term data collections, and the number of systematic analyses and investigations delivered to customers.

In addition to providing information responsive to State or local needs, the Coop Program provides information that satisfies the needs of many Federal agencies. Some of these needs are:

- Forecasting floods,
- Managing surface-water supplies,
- Monitoring hydroelectric power production,
- Setting waste disposal limitations,
- Regulating industrial discharges,
- Designing highway structures,
- Measuring the downstream transport of pollutants or nutrients,
- Determining total maximum daily loads,
- Evaluating mine permits,
- Planning and evaluating land reclamation,
- Evaluating fish habitat,
- Quantifying Indian water rights, and
- Quantifying Federal reserved water rights.

The following describes activities underway in FY 2005 and planned for FY 2006.

Data Collection Activities

(Estimates for FY 2004, \$32.4 million; FY 2005, \$31.2 million; FY 2006, \$31.9 million)

Cooperatively funded hydrologic data collection activities are underway in every State, Guam, Puerto Rico, and the U.S. Virgin Islands. Over the past few years, the Coop Program has provided sole support or partial support for well over half of the sites where the USGS collects data on surface-water levels and flow, ground-water levels, and ground-water quality. In addition, the Coop Program supports collection of data on surface-water quality, which is becoming increasingly important to the States as they monitor total maximum daily loads (TMDLs), to comply with the requirements of the Clean Water Act.

All these data provide resource managers with the information they need to determine the suitability of water for various uses, identify trends in water quality, and evaluate the effects of various stresses on the Nation's ground water and surface water resources. Much of the data collected at USGS monitoring sites is provided free of charge on the Internet. This includes historical data, as well as real-time data, which are generally less than 4 hours old. The real-time data are used routinely by emergency management agencies, State and municipal agencies, businesses, irrigators, and recreational boaters and fishers.

Most of the USGS data-collection stations serve multiple purposes and many are funded, wholly or in part, through joint-funding agreements. Normally, these stations, though funded by various organizations, are operated as part of an integrated network rather than as stand-alone entities. For this reason, cooperating organizations are billed on the basis of average station cost, rather than actual cost, which rarely can be precisely known. This procedure benefits these organizations and the USGS in at least two ways: administrative costs are reduced because financial transactions are simplified, and definitive cost information is available to all parties for planning purposes at the beginning of the fiscal year. This arrangement also assures that data collection in remote areas or areas which may be otherwise problematic during a given period of time (due to vandals, extreme flooding, lightning strikes) do not become so expensive that they must be dropped from the network.

Interpretive Studies

(Estimates for FY 2004, \$24.9 million; FY 2005, \$24.9 million; FY 2006, \$25.5 million)

In addition to data collection activities, the Coop Program currently supports about 750 hydrologic studies each year. Water resource studies define, characterize, and evaluate the extent, quality, and availability of water resources. Since the early 1970s, these investigations have increasingly emphasized water quality issues, such as aquifer contamination, land application and injection of reclaimed water, river quality, storm runoff quality, and the effects of acid rain, urbanization, mining, and agricultural chemicals and practices on water resources. The results of these investigations are published and provided to State agencies, which use them as the basis for managing the water resources for which they are responsible. Also, these investigations provide information that can be synthesized and applied to a variety of hydrogeologic and climatic settings across the Nation, greatly expanding the usefulness and transferability of USGS study results nationwide.

High-Priority Issues for Coop Program Involvement

In consultation with local and regional managers, external cooperators, and the interagency Advisory Committee on Water Information, the USGS has identified seven water-related issues that closely align with USGS mission goals that most require USGS involvement at State and local levels.

The USGS water-resources senior water-discipline leaders, in consultation with district and regional managers, external organizations, and cooperators have identified seven water-related issues that closely align with USGS mission goals that most require USGS involvement at State and local levels.

- **Hydrologic Hazards** — Economic losses from floods, debris flows, and droughts amount to hundreds of millions of dollars annually. Monitoring the occurrence and magnitude of these extreme events and studying the basic processes underlying these

hazards will lead to improving the ability to forecast probability of occurrence and likely magnitudes, and help prepare for and prevent disasters. Needs in this category also include development and public dissemination of near-real time and forecast inundation maps for specific floods, studies of increased flood potential following large-scale forest fires, and studies of the effects of changes in dam operations, including decommissioning of dams and studies of the impact of urbanization. Revision of flood insurance rate maps is becoming a significant national priority, which will likely provide an opportunity to develop improved information on regional flood characteristics and more efficient methods of flood-plain mapping.

- **Water Quality** — The need to provide information to better define and protect the quality of the Nation's water resources remains among the highest Coop Program priorities. Water-quality activities that support Federal, State, or local efforts to improve water quality and stream ecosystems in degraded watersheds across the country and to improve the availability and dissemination of water-quality information to all potential users are of vital interest. Through partnerships with State and local agencies, the Coop Program can assist efforts by addressing issues that include (1) determining linkages between agricultural practices and contaminants in ground water and surface water, (2) providing a more quantitative understanding of the sources of chemicals entering streams, including atmospheric deposition of potential pollutants such as mercury, (3) determining the effects of land use practices on surface and ground water quality, (4) understanding and simulating the relations between water quality and the health of stream ecosystems, (5) assisting States in setting Total Maximum Daily Load (TMDL) requirements of the Clean Water Act, (6) addressing the potential effects of energy development, including coal bed methane extraction, on water resources, (7) better quantifying the effects of active and abandoned mines on streams and aquifers, (8) evaluating effectiveness of non-point source pollution management practices (9) improving strategies to identify and protect drinking water sources, and (10) increasing the availability of water-quality information, including real-time data, for rivers and coastal waters throughout the Nation.
- **Hydrologic Data Networks** — The hydrologic-data networks constitute the foundation for watershed and aquifer management and for many other USGS programs. They continue to be a high priority item. Present and future USGS initiatives will require access to a comprehensive, uniform, and accurate foundation of surface-water, ground-water, water-quality, and water-use data of national scope. Emphasis will be placed on biological monitoring to assess conditions that affect human health and aquatic health. Large amounts of water data and specialized interpretation often are required for management of the resource and for water-rights determination by State and Federal agencies, as well as for development and operation of models to simulate and forecast hydrologic events. Enhancement of the hydrologic-data networks; improved accessibility and presentation of available information, such as an increase in the availability of real-time data for surface water and ground water and presenting regional summaries of current conditions, and coordination of program activities with those of other agencies continue to be high-priority activities.
- **Water Availability and Use** — The future health and economic welfare of the Nation's population is dependent upon a continuing supply of uncontaminated freshwater. Many existing sources of water are being stressed by increasing withdrawals and instream-flow requirements. More comprehensive water-use data and analysis of water-use information are needed to quantify the stress on existing supplies and to

better model and evaluate possible demand management options to supplement the traditional supply approaches. Improved watershed characterization and flow-system definition and simulation also are needed for the management of aquifers and streams that serve as important local or regional sources of water supply and for the management and support of watershed ecosystems. Because aquifers and streams often are highly interdependent, improved tools for simulating interactions between ground and surface water that account quantitatively for effects of withdrawals and climate variations also are needed so that watersheds can be managed more readily as systems. Hydrologic systems models that are capable of showing the consequences of various decisions over a wide range of hydrologic and climatic conditions will be very helpful to local water managers. Additionally, one of most pressing questions to aquatic ecologists, hydrologists, and water resource and wildlife managers is understanding the hydrologic flow regime that must be maintained in order to sustain a healthy aquatic community. The Coop Program is in a strong position to develop and test tools and techniques that can be used nationwide to help resource managers understand water use and ecosystem function. Specifically, studies are needed to understand the ecological requirements of the affected aquatic communities and how they can be safeguarded from the potentially detrimental effects of ground-water depletion, altered water levels and flows of our Nation's lakes, rivers, streams, wetlands, and estuaries.

- **Wetlands, Lakes, Reservoirs, And Estuaries** — These valuable ecosystems merit special attention from the USGS because of their importance as fish and wildlife habitats, recreational areas, and sources of water supply for which the DOI has substantial mission responsibility. Wetlands, in particular, are areas where important water treatment and purification processes can occur naturally. In many areas wetlands are being restored or constructed without pre- or post-scientific evaluations. Studies that integrate and contribute to a better understanding of the physical, chemical, and biological processes of these ecosystems and their watersheds are needed to evaluate development and management alternatives.
- **Water Resources Issues in the Coastal Zone** — Effects of land use and population increases on the water resources in the coastal zone are major national concerns. Hydrologic monitoring and studies are needed to address issues of erosion, loss of wetlands, subsidence, saltwater intrusion, and problems associated with excessive nutrients, disease-causing micro-organisms, and toxic chemicals, originating upstream from industrial activities and agricultural practices. These pollutants can degrade habitat and health of fish and other wildlife and make beaches and other areas unsuitable for recreational use. The 2004 recommendation of the Ocean Policy Commission that the United States establish an integrated monitoring network for marine and freshwater resources gives added weight to the issue of monitoring fluxes of water and materials from rivers to oceans.
- **Environmental Effects on Human Health** — Major gaps exist with regard to understanding the processes and activities leading to the exposure of human disease-causing contaminants. Issues include (1) waterborne microbiological threats to human health, including bacteria, viruses, protozoa, and potentially toxic algae, and tracking their sources in watersheds, (2) bioaccumulation of trace elements in plants and fish that humans eat, (3) naturally-occurring contaminants, such as arsenic, radium, and trace elements, (4) occurrence and persistence of harmful organic compounds in ground waters, rivers, and reservoirs, and (5) so-called “emerging contaminants” such as antibiotics, hormones, and the metabolites of pesticides.

National Synthesis

One of the major strengths of Coop Program is its ability to provide data and assessments on varied topics from across the country, which, when synthesized, can be useful in addressing broad, national USGS mission goals. As recommended by the External Task Force that reviewed the Coop Program, we plan to expand these efforts by pre-planning selected synthesis products. The memorandum describes four topics for possible future national synthesis over the next few years. We encourage districts to explore the needs of cooperating agencies for addressing these issues and, to the extent that is mutually agreeable, follow the guidance that will be provided by the contact for each synthesis topic. The USGS believes that including this guidance in project planning will help enhance district capabilities, promote use of valid, standard approaches, and enhance future synthesis products. The topics for National Synthesis are:

- **Recharge to Ground-Water Systems** — Recharge is one of the most important components of water budgets, yet estimating recharge accurately remains problematic, requiring a variety of techniques in different parts of the country and at different scales. Enhancing our ability to evaluate different techniques in various settings would enable us to provide better guidance on matching the appropriate technique to a specific need for recharge information.
- **Fluvial Sediment** — The EPA has declared fluvial sediment the most prevalent impairment to the Nation's surface waters; as such, sediment is playing a major role in river restoration efforts and TMDL evaluations. The Offices of Water Quality and Surface Water, and the National Research Program continue their collaboration to identify methods, tools, and capabilities for sediment data collection and analysis that the USGS can bring to bear in support of stream restoration and TMDL projects. A variety of new technologies are creating opportunities for producing more accurate and (or) more efficient estimates of sediment flux.
- **Changes in Flood Frequency** — Many urban areas are concerned about changes in flood frequencies resulting from land use changes, and FEMA recently issued revised regulations for its Flood Insurance Rate Maps. For example, under the new regulations, communities may now include a delineation of the floodplain based on anticipated "future conditions." The USGS Office of Surface Water has prepared a Fact Sheet summarizing this issue and describing USGS capabilities and data needs for future projects. The fact sheet is available at <http://water.usgs.gov/pubs/fs/fs07603/>.
- **Synthesis of Water Quality Information** — As the NAWQA Program begins a redesign of its surface-water quality data network, there are opportunities to combine water-quality data from networks established in the Cooperative Water Program with NAWQA data to develop a more integrated approach to water-quality monitoring nationwide within the USGS. Ground-water data could also be included in such a comprehensive nationwide approach. The information from integrated monitoring networks could be used to more fully answer important questions about the Nation's water quality and trends.
- **Determination of Water Needs for Ecological Functions** — Several valuable collaborations of hydrologists and biologists have arisen in the Coop Program in recent years to help determine water needs, in terms of water levels, flows, and varying

hydrographs, to support healthy ecosystems. These studies pertain to both ground water and surface water, and sometimes to interconnected systems of both. Results include data, research results, and tools such as models that can provide a scientific basis for critical decisions on allocation or reallocation of precious water resources. As this issue takes on greater importance nationally, the USGS will seek opportunities to synthesize geographically varied examples into a national summary.

Technical Support

(Estimates for FY 2004, \$6.7 million; FY 2005, \$6.2 million; FY 2006, \$6.4 million.)

The USGS has a long tradition of providing national and regional technical support for its geographically distributed water resources studies. This support provides quality control to assure the technical excellence of water resources field programs and provides a structured way of transferring new technology to USGS investigative and data activities that are primarily conducted in District offices in each State. Technical support also includes a formal way of establishing priorities for water resources research by the USGS and provides a mechanism to make water resources information available to other agencies, the scientific community, and the public.

2004 Program Performance Accomplishments

The program accomplishments listed below demonstrate the utility of USGS products that are counted under the "systematic analyses and investigations delivered to customers" output measure. The Program also contributes to the intermediate outcome measure "content and expanse of knowledge base" through its support for the national streamgaging network; however, accomplishments associated with the streamgaging network are shown in the write-up for the National Streamflow Information Program. In addition, the Program contributes to the output measures for "number of real-time streamgages reporting in NWISWeb," "number of ground-water sites reporting in NWISWeb," and "number of water-quality sites reporting in NWISWeb."

Assessing Firm Yield for Drinking-Water Supply Reservoirs in Massachusetts — Growing demands on drinking-water supplies in Massachusetts have increased the likelihood that withdrawals could deplete available storage capacity in surface-water reservoirs, resulting in supply shortfalls. As demands increase, water suppliers and regulators have recognized the need to establish upper limits on the amount of water a reservoir can consistently supply, particularly if the reservoir were to experience a period of severe drought. This upper limit on reservoir yield is termed the firm yield. To estimate this firm yield for drinking-water supply reservoirs in Massachusetts, the USGS, in cooperation with the Massachusetts Department of Environmental Protection and local drinking-water suppliers, developed a model using a relational database and a convenient user interface. Firm yields were calculated for 47 streamflow-dominated reservoirs representing 15 Massachusetts drinking-water supplies. Detailed firm yield estimates were completed for reservoirs in the Ipswich River Basin. To enhance the applicability of the model to include both ground-water and surface-water dominated reservoirs, a method to estimate the contribution of ground water to surface-water reservoirs is currently being developed and validated.

Barton Springs Ground-water Characterization Project, Texas — The Barton Springs segment of the Edwards Aquifer, a karst ground-water system located in southern Travis and northern Hays counties, provides vital water resources to the people of Austin and to endemic

Cooperative Water Program Subactivity

species, including the Barton Springs salamander (*Eurycea sosorum*, a federally-listed endangered species). Austin is one of the most rapidly urbanizing cities in the United States, and the impact of urbanization in the Barton Springs watershed is beginning to be seen, particularly following rain events. This investigation is improving the resolution of water quality data for the Barton Springs portion of the Edwards Aquifer, and will interpret the data to expand our general understanding of the aquifer's response to natural and anthropogenic phenomena. Using stream discharge, spring discharge, and chemical data obtained, USGS scientists will estimate quantitative balances of water, ions, and contaminants in the aquifer. The balances will be used to evaluate to what extent the water balance has changed since 1986 as a result of urbanization; where loading of different contaminants is occurring; and to what extent contaminants are being stored or attenuated within the aquifer.

Coastal Georgia Sound Science Initiative — Rapid population growth in coastal Georgia, increased tourism, and sustained industrial activity have adversely affected coastal Georgia's water resources and limited the available water supply. Pumpage from the productive Upper Floridan limestone aquifer has resulted in several problems including:

- Substantial water-level declines,
- Migration of seawater into the aquifer at the northern end of Hilton Head Island, SC,
- Contamination of the aquifer from underlying brine-filled strata at Brunswick, GA, and
- Decreased ground-water inflow to springs, freshwater ponds, marshes, and wetlands, which could impact the balance of freshwater and saltwater in tidal rivers and estuaries.

Saltwater contamination has constrained further development of the Upper Floridan aquifer in coastal Georgia and created fierce competing demands for the limited fresh water supply. The Georgia Environmental Protection Division (GaEPD), the Georgia Water Resources Research Institute, and the USGS have been collaborating on a program of scientific and feasibility studies (Coastal Sound Science Initiative) to support development a final water-management strategy. The USGS is evaluating ground-water flow, saltwater contamination, and alternative water sources of ground water in the coastal area of Georgia and adjacent parts of South Carolina and Florida. Project activities include offshore drilling near Savannah and Hilton Head Island, drilling of deep test wells onshore, evaluation of alternative water supplies in man-made seepage ponds, ground-water monitoring, and simulation of saltwater intrusion using digital ground-water models. GaEPD is using the results to formulate the final strategy, which is scheduled for January 2006.

Methyl-tert-Butyl Ether (MTBE) Contamination Involves Deep Public-Supply Wells in Southeast New Hampshire — Contamination of ground water in New Hampshire with MTBE has occurred since its initial use, first as a substitute for tetraethyl lead in 1979, and then as an oxygenate in reformulated fuel in the 1990. The potential risk of exposure to MTBE through drinking water in New Hampshire may be greatest in Rockingham County, where reformulated gasoline usage is mandated. This County has the second largest population in the State (280,500) and has the largest population served by ground water (50 percent on private wells and another 25 percent on public wells). The USGS conducted a study of the occurrence of MTBE in public and private water-supply wells in Rockingham County, with the New Hampshire Department of Environmental Services (NHDES), under the Cooperative Water Program. Using a detection level of 0.2 micrograms per liter, MTBE was found in 40 percent of the public wells and 21 percent of the private wells sampled. Further, 67 percent of public wells serving

residential properties had MTBE concentrations above the detection level. MTBE concentrations were strongly related to urban factors. Surprisingly, the presence and concentration of MTBE increased with well depth in public-supply wells. Since deep bedrock wells are often low yielding in New Hampshire, this finding may indicate that there is little opportunity for dilution of MTBE in deep, low-yielding wells that are being used for public water supply.

Evaluation of streamflow requirements for habitat protection in Southern New England —

Widespread development and increasing water withdrawals threaten to reduce streamflows in many river systems. This creates a need to estimate flows required to sustain aquatic life, particularly during summer low-flow periods. Streamflow requirements for habitat protection were determined for riffle habitats near selected index streamflow-gaging stations in southern New England. These flow requirements were compared to streamflow statistics describing the natural flow regime and streamflow variability for the index stations. Differences in streamflow regimes were also identified between different regions of southern New England and between streams with different basin characteristics. The Massachusetts Department of Conservation and Recreation and the Massachusetts Department of Environmental Protection are using the information to develop instream-flow standards for Massachusetts.

Ground-Water Ambient Monitoring and Assessment (GAMA) in California — In response to a need for consistent, statewide data on the quality of ground-water in California, the USGS has teamed up with State and Regional Water Boards, Department of Water Resources, Department of Health Services, Lawrence Livermore National Laboratory, regional water management entities, and county and local water agencies to improve statewide ground-water monitoring and facilitate the availability of information about groundwater quality to the public. A key aspect of the GAMA program is interagency collaboration and cooperation with local water agencies and well owners. The data collected during the study include analyses for chemical constituents that are not normally available; these data will be especially useful for providing an early indication of potential water-quality problems. The data also will be used to identify the natural and human factors affecting ground-water quality. An understanding of these factors is important for the long term management and protection of California's ground-water resources. To organize the assessment, the 476 ground-water basins in the State were ranked by priority, and 116 high-priority basins were selected for monitoring, and were combined into 50 study units. These units represent more than 75 percent of the public-supply wells in California. In each unit, 60 120 public-supply wells will be sampled. Three types of water-quality assessments will be conducted for each study unit (1) Status: the assessment of current ground-water quality, (2) Trends: the detection of changes in water quality, and (3) Understanding: the assessment of natural and human factors that affect ground-water quality.

2005 Planned Program Performance

The program activities listed below will demonstrate the utility of USGS products that are counted under the "systematic analyses and investigations delivered to customers" output measure. These activities also contribute to the intermediate outcome measure "content and expanse of knowledge base" through support for the national streamgaging network; however, performance associated with the streamgaging network is shown in the write-up for the National Streamflow Information Program. In addition, the Coop Program contributes to the output measures for "number of real-time streamgages reporting in NWISWeb," "number of ground-water sites reporting in NWISWeb," and "number of water-quality sites reporting in NWISWeb."

Cooperative Water Program Subactivity

Planned program performance in FY 2005 will focus on:

- Hydrologic Hazards: floods and droughts cause losses of hundreds of millions of dollars annually,
- Water Quality: information to better define and protect the quality of the Nation's water resources remains among the highest Coop Program priorities,
- Hydrologic Data Networks: hydrologic-data networks constitute the foundation for watershed and aquifer management and for many USGS programs and continue to be a high priority,
- Water Availability and Use: the future health and economic welfare of the Nation's population is dependent upon a continuing supply of uncontaminated freshwater, and
- National Synthesis effort for Recharge to Ground-Water Systems, Fluvial Sediment, Changes in Flood Frequency, Synthesis of Water Quality Information, and Water Needs for Ecological Functions.

Cooperative Water Program Subactivity

Cooperative Water Program Funding by State, FY 2004

State	USGS Funds	Cooperator Funds
Alabama	899,755	1,415,706
Alaska	1,061,023	1,566,014
Arizona	1,208,887	2,389,238
Arkansas	826,505	1,686,576
California	4,402,306	16,733,734
Colorado	2,093,592	4,143,047
Connecticut	552,853	929,916
Florida	5,145,604	11,717,099
Georgia	1,590,977	6,700,077
Hawaii & Trust Territories	1,152,584	2,714,563
Idaho	1,235,815	1,890,302
Illinois	1,010,097	1,587,942
Indiana	901,862	1,562,354
Iowa	840,136	1,081,645
Kansas	1,225,541	2,288,021
Kentucky	857,121	1,389,061
Louisiana	1,168,165	1,873,554
Maine	391,155	582,735
Maryland/Delaware/D.C.	1,138,208	2,438,340
Massachusetts/Rhode Island	1,156,040	3,467,384
Michigan	872,846	3,319,998
Minnesota	1,047,823	1,267,221
Mississippi	903,901	1,385,261
Missouri	913,034	2,991,340
Montana	1,024,974	1,410,866
Nebraska	785,747	1,344,052
Nevada	1,746,085	2,277,984
New Hampshire/Vermont	602,296	941,402
New Jersey	1,952,776	5,698,093
New Mexico	1,590,806	2,876,958
New York	2,207,399	7,774,706
North Carolina	1,661,222	3,073,532
North Dakota	689,147	931,581
Ohio	1,063,155	2,379,915
Oklahoma	1,044,064	1,504,790
Oregon	1,346,006	1,860,220
Pennsylvania	1,622,866	3,936,150
South Carolina	1,300,291	1,877,609
South Dakota	1,116,181	1,206,058
Tennessee	1,128,633	1,496,200
Texas	2,887,023	6,235,923
Utah	1,267,651	1,692,712
Virginia	826,807	2,104,454
Washington	1,371,868	2,074,149
West Virginia	602,911	707,530
Wisconsin	1,494,933	3,306,789
Wyoming	733,399	1,215,224
Puerto Rico & Caribbean	1,333,462	2,972,538
Total	63,995,531	138,020,563

The statutory required match for this program is 50:50. In 2004, State, local, and Tribal cooperators exceeded this match by 116 percent.

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Water Resources Research Act Program Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes	2006 Budget Request	Change from 2005
Water Resources Research Act Program	6,422	6,409	0	-6,409	0	-6,409
FTE	2	2	0	-2	0	-2
Total Requirements \$000	6,422	6,409	0	-6,409	0	-6,409
FTE	2	2	0	-2	0	-2

2006 Program Overview

The FY 2006 budget request for the Water Resources Research Act Program is \$0.

Section 104 of the Water Resources Research Act of 1984 (P.L. 98-242), as amended by P.L. 101-397, P.L. 104-147, and P.L. 106-374, establishes a Federal-State partnership in water resources research, education, and information transfer through a matching grant program that authorizes State Water Resources Research Institutes at land grant universities across the Nation. There are currently 54 Institutes: one in each State, the District of Columbia, Puerto Rico, the Virgin Islands, and Guam, which also serves the Federated States of Micronesia and the Commonwealth of the Northern Mariana Islands.

This Program addresses the DOI's Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science. A key indication of the USGS's performance in administering this Program is reflected in the end outcome measure for research: soundness of methodology, accuracy, and reliability of science (most of the research proposals are funded only after a competitive, peer review, selection process). Although the Water Resources Research Act does not give the USGS either the authority or the resources to peer review every project funded by this Program at the participating universities, review of these projects is conducted as part of each Institute's own peer review process. The Act requires each Institute to have a State advisory panel to recommend research priorities for the Institute, thus ensuring the relevance of its research. For the competitive grants, the USGS receives many more proposals each year than budget levels can support, so the proposals receive rigorous peer review before any funds are awarded. In addition, the Institutes are evaluated on a 5-year cycle, to determine their eligibility to continue receiving grants under the Program. One such evaluation occurred during FY 2004.

The Water Resources Research Act Program provides an institutional mechanism for promoting State, regional, and national coordination of water resources research and training and a network of Institutes to facilitate research coordination and information and technology transfer. With its matching requirements, it is also a key mechanism for promoting State investments in such research and training. In fact, the Institutes have developed a constituency and a Program that far exceeds that supported by their direct Federal appropriation. According to the results of a 2004 survey conducted by the National Institutes for Water Resources, in FY 2004, the

Water Resources Research Act Program Subactivity

Institutes collectively generated an additional \$16 in support for each dollar appropriated to them under the USGS Program, with \$8 coming from other Federal sources and \$8 coming from non-Federal sources.

Each Institute operates a program of multi-year research, education, and information transfer projects focused on State and regional water resource priorities. In FY 2004, total Institute funding from all sources (USGS grant, plus 2:1 non-Federal matching funds, plus other sources of funding) supported more than 1,100 research projects involving researchers from at least 137 universities and colleges nationwide. Though the emphasis varies across the Nation, depending upon State and regional priorities, the most common topics were concerned with surface-water and ground-water quality, toxic substances, and non-point source pollution. The Institutes collaborated with over 500 Federal, State, and local agency offices and private sector organizations.

In FY 2004, the Institutes used their USGS grant and the required matching funds to support 234 research and information transfer projects. The programmatic priorities of the individual Institutes are developed in consultation with their State Advisory Committees and the individual research projects are selected through standard peer review and selection processes. It is expected that in FY 2005, the Institutes will support over 230 research and information transfer projects with their USGS grants. Descriptions of the projects conducted by the Institutes under the Water Resource Research Act Program are provided at <http://water.usgs.gov/wrri/projects.html>.

The Institute Program is a primary source of training for water scientists and engineers. In FY 2004, more than 1,400 students received training by participation in Institute-supported research and information transfer projects. More than 500 of these students were supported by the USGS grants and matching funds. Students trained under this Program provide the talent needed to meet the mandates of the many new programs for water resources protection that have come into existence in recent years and to support the water management initiatives of Federal, State, and local agencies.

The Institutes make the results of their research available through workshops, conferences, seminars, publications, and communication with State and local agencies. Each year, the Institutes publish about 1,000 reports, nearly one-fourth of which are in refereed scientific journals. In FY 2004, the Institutes conducted 160 conferences, seminars, and workshops for more than 18,000 participants. All of the Institutes maintain an Internet site through which they keep the public informed of their activities.

Institute Evaluations — The Water Resources Research Act requires that each Institute be evaluated at least every 5 years to determine its eligibility to receive grants. Detailed evaluations of all 54 Institutes were conducted in 2004. The independent panel which conducted the evaluations concluded that: "the Institute program, with its Federal-State matching requirements, is an important and significant part of the Nation's water resources research infrastructure" and that "the program garners significant funding leverage for the modest Federal appropriation that supports it." The panel noted that the program "does well in attracting young scientists to the water resources fields," which it considered to be "very important as we enter a period in which there will be a disproportionate number of retirements in all fields." The panel found that the program "embodies an effective information clearinghouse and fosters significant opportunities for multi-disciplinary research on all aspects of water resources and water management." The panel recommended that future funding of three of the

Institutes be contingent upon those Institutes developing and implementing strategic plans to improve their programs.

2004 Program Performance Accomplishments

The Institutes support several hundred projects each year, involving over 1,400 students. The results of this work appear initially in Institute reports and scientific journals. Much of this work results eventually in changes in water management practices. The following are examples of some recent accomplishments that have had, or may soon have, management applications. These accomplishments do not appear as outcome or output measures in the strategic plan, as the work is not performed by the USGS and the products of the research are not USGS products. However, the work performed by the Institutes does indirectly contribute to the end outcome goal, "Advance knowledge through scientific leadership and inform decisions through the application of science."

- The Utah Water Research Laboratory, working in collaboration with the U.S. Bureau of Reclamation, is developing real-time reservoir operation models for more efficient water management using methods from statistical learning theory. The models help provide real-time management information for determining releases from Piute Reservoir and diversions in the Sevier Valley/Piute Canal. They can be run over the Internet by reservoir and canal operators of the Sevier River Water Users Association. If the models perform well in tests using data from the 2004 irrigation season, they will be programmed to take direct control of the outlet gates from Piute Reservoir and manage the hour-to-hour releases from the reservoir during the 2005 irrigation season.
- The New Mexico Water Resources Research Institute has provided technical and organizational assistance to the US Bureau of Reclamation and Sandia National Laboratories in the development of the Tularosa Basin National Desalination Research Facility, which is scheduled to be completed in the fall of 2005. The facility will focus on inland desalination research with the goal of improving water quality and quantity. It will test desalination concepts designed and assembled elsewhere. The first project will be the testing of a U.S. Navy expeditionary force system developing small-scale mobile desalination units for use in emergency situations.
- Research conducted by the Montana Water Center resulted in practical hatchery management strategies to control outbreaks of bacterial coldwater disease, which has caused significant salmonid mortality in hatcheries throughout the West. The researchers developed control strategies to address a variety of transmission routes of the bacterial pathogen *Flavobacterium psychrophilum*. The principal beneficiaries will be hatchery-reared cutthroat trout, essential to native fish reintroduction/restoration programs of several States. This work was part of a research initiative supporting the Partners in Fish and Wildlife program of the U.S. Fish and Wildlife Service.
- The North Carolina Water Resources Research Institute has provided research-based information on effective best management practices to control stormwater runoff from construction sites and urban communities in rapidly developing regions of North Carolina. Designers and government agencies are using this information for planning, designing, constructing, and monitoring new developments to protect water quality. Specific practices being investigated include modified sediment basins, erosion control technologies, bioretention areas, stormwater wetlands, permeable pavement systems,

Water Resources Research Act Program Subactivity

and green roofs. Data from these studies are being used to develop guidance for low impact development approaches.

- The Upper Susquehanna River Basin, as headwaters of the Chesapeake Bay Watershed, must achieve very substantial reductions in the loading of nitrogen, phosphorous, and sediment to meet the targets established by the Chesapeake Bay Program. The Upper Susquehanna Coalition has adopted the multiple barrier approach to identify options for the management of these nonpoint source pollutants. The multiple barrier approach was substantially developed and demonstrated in the New York City Watershed with funding provided through the New York Water Resources Institute.
- The Arizona Water Resources Research Center co-issued with the University of Arizona Office of Economic Development the report, *Arizona's Water Future: Challenges and Opportunities*, which served as the background report for the 85th Arizona Town Hall. Included among the State and regional issues discussed in the report were climate variability and water planning, Indian water rights, Colorado River issues including operation of the Yuma Desalting Plant, water sustainability for rural communities, and environmental issues. The findings and recommendations of the Town Hall forum are already serving as the foundation for water policy development, legislative proposals, and water management deliberations.
- The Michigan Institute of Water Research is collaborating with the National Park Service to develop an integrated, Web-accessible, natural resource information system that provides spatial environmental data for the nine National Park Service Units in the Great Lakes Network. The purpose of this project is to build the underlying architecture and framework for making monitoring data and other ecological information available to managers and partners of these National Park Service Units.

2005 Planned Program Performance

Grants will be awarded to the 54 State Water Resources Research Institutes. Research project abstracts and completion reports will be placed on the Internet at <http://water.usgs.gov/wrri/projects.html>.

Under the National Competitive Grant Program, research proposals will be solicited on the topic of water availability. Proposals will be subjected to a competitive peer review and selection process with the assistance of a lead Institute. It is expected that about 60 proposals will be received and that about 10 matching grants will be awarded with the approximately \$1 million available.

The strategic plans to be developed by the three Institutes placed on probation as a result of the FY 2004 evaluation will be reviewed and the performance of those institutes in implementing the plans will be monitored.

Water Resources Research Act Program Subactivity

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-)
Water Resources Research Act Program (\$000)	\$0	-\$6,409
FTE	0	-2

The FY 2006 budget request for the Water Resources Research Act Program is \$0 and 0 FTE, a net program decrease of -\$6,409,000 and -2 FTE from the FY 2005 enacted level.

Grants to the State Water Resources Research Institutes (-\$6,409,000) — The decrease eliminates USGS funding for each of the 54 State Water Resources Research Institutes. The decrease also eliminates USGS support for research projects under the national competitive grant program authorized by section 104 (g) of the Water Resources Research Act. This USGS support amounts to less than 6 percent of their total funding. Most of the Institutes have been very successful in generating funding from non-USGS sources and no longer need USGS funding to continue operating.

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Biological Research

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes ^{a/}	Program Changes ^{b/}	2006 Budget Request	Change from 2005
Biological Research and Monitoring	135,110	133,130	+3,393	-2,175	134,348	+1,218
FTE	1,046	1,007	0	+4	1,011	+4
Biological Information Management and Delivery	24,662	23,999	+217	-67	24,149	+150
FTE	85	80	0	0	80	0
Cooperative Research Units	14,757	14,570	+343	-485	14,428	-142
FTE	138	133	0	0	133	0
Total Requirements \$000	174,529	171,699	+3,953	-2,727	172,925	+1,226
FTE	1,269	1,220	0	+4	1,224	+4

^{a/} Included in this amount is a one-time technical adjustment of \$828 that moves all USGS funds associated with the Science on the DOI Landscape initiative to a single location in the Biological Research Activity for ease of administration and accounting.

^{b/} Changes for this activity include a reduction of -\$470 for travel and -\$52 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

Activity Summary

Introduction

The U.S. Geological Survey (USGS) Biological Research Activity generates and distributes information needed in the conservation and management of the Nation's biological resources. This program serves as the Department of the Interior's (DOI) biological research arm and continues the strong traditions for management-oriented research developed within the Department's land management bureaus. Core biological research capability at 17 research centers and associated field stations, one technology center, and 40 Cooperative Research Units supports research on fish, wildlife, and habitats that is used by Federal and State government and non-governmental organizations.

Use of Cost and Performance Information

Promoting Collaborative Science in the USGS Global Change Program:

A 2004 survey of principal investigators involved in USGS global change research revealed both a strong desire to expand cross-disciplinary work and significant communication/information barriers to such work. In response, steps have been taken to overcome existing barriers to collaborative science. Activities of the U.S. Global Change program have been made available to assist biology global change projects. Joint technical/project review meetings across all USGS disciplines and other agencies are planned. The Biology discipline's global change Web site now has links to other key sites.

A list of science centers and field stations appears at the end of the discussion of the information subactivity. A list of cooperative research units appears in the discussion of that subactivity.

Information generated by the Biological Research program also contributes to achieving improved management of the Nation's water resources, availability of maps and map data, and

Biological Research

improved decisionmaking regarding land and water use. These goals are supported by the efforts conducted in three subactivities: Research and Monitoring, Information Management and Delivery, and Cooperative Research Units.

Research and Monitoring — The USGS serves the biological research needs of DOI bureaus and others by providing scientific information through research, inventory, and monitoring investigations. Biological studies develop new methods and techniques to identify, observe, and manage fish and wildlife, including invasive species, and their habitats; inventory populations of animals, plants, and their habitats; and monitor changes in abundance, distribution, and health of biological resources through time. DOI land and resource managers use USGS biological science to maintain the health, diversity, and ecological balances of biological resources while meeting public needs, such as game harvests and the use of public lands and waters, all of which enable the managers to address the DOI strategic goals of improving the health of watersheds, landscapes, and marine resources and of sustaining biological communities.

Use of Cost and Performance Information

Assessing Reorganization Effectiveness at the Grand Canyon Monitoring and Research Center (GCMRC):

The GCMRC underwent a major reorganization in October 2003. Six months later the GCMRC conducted an Organizational Assessment Survey to ascertain the effectiveness of the organizational change. The assessment highlighted staffing shortages in the new integrated science program and concerns about administrative support. Staffing changes taken in response to these problems include recruiting a Biology Program Coordinator, an Administrative Officer, and a dedicated Budget Analyst. A GCMRC Intranet site has been developed for employee assistance. A follow-up assessment survey is planned to measure the impact of these changes.

This subactivity supports the DOI Resource Protection strategic goal by providing the natural resource management community with scientific information to improve the health of watersheds and landscapes. This subactivity also supports the DOI Resource Protection strategic goal by providing the natural resource management community with scientific information to implement sound resource management to sustain biological communities on DOI lands and influenced land and waters.

USGS biologists work toward program goals in collaboration with other scientists, customers, and partners. Biologists combine their expertise with that of the other USGS disciplines in interagency ecosystem initiatives across the United States, from South Florida to the Pacific Northwest, where scientists are working together to understand, evaluate, and provide options for restoring fish and wildlife habitats and for better resource-management decisions.

USGS specialists also provide technical assistance to DOI bureaus and other customers in applying the information, methodologies, and tools developed by the USGS in addressing resource management problems. In a collaborative process, the USGS involves the users of scientific results by engaging them in the identification and prioritization of their information needs as research is planned. DOI bureaus and other customers and partners are involved in this process, and where appropriate, are involved in an adaptive process to find solutions and develop new methods by testing research results in the field.

Information Management and Delivery — Science-based decisionmaking is a Department of the Interior priority, particularly as it pertains to the conservation, management, and use of the Nation's natural resources. To facilitate this, the USGS is committed to making available the data and information that are critical to scientific discovery and application. Data sets, maps, and other information on products are vital to achieve this goal. This subactivity supports DOI's Serving Communities strategic goal of advancing knowledge through scientific leadership and

informing decisions through the applications of science by increasing the quantity of biological information available by improving access to and interactions with biological data.

The USGS works in cooperation with many organizations across the country to provide critical information to partners, stakeholders, customers, and the general public. Through electronic infrastructures, the USGS delivers relevant data and information faster and in more usable formats than in the past, leading to better stewardship of our natural resources.

Congress included language in their FY 2003 appropriations report accompanying the Department of the Interior and Related Agencies Appropriations Bill that directs the USGS to prepare a strategic plan for the National Biological Information Infrastructure (NBII) outlining the prioritized vision for the network including details and a time line on all new nodes, expansions of existing nodes, the costs associated with each node, and all other projects that are part of the NBII program. The USGS is preparing the report in its final form. The report will be sent to the Committees shortly.

Cooperative Research Units — This cooperative program allows government and nongovernmental entities with common interests and responsibilities for natural resource management to address biological resources issues. Through this unique program, biologists from Federal and State governments and academia are able to work as a team and focus their expertise and creativity on the resolution of biological resources issues. This subactivity supports the DOI Resource Protection strategic goal of sustaining biological communities on DOI managed and influenced lands and waters by providing the natural-resource management community with scientific information and trained personnel to implement sound resource management to sustain biological communities on DOI lands and influenced lands and waters.

Federal support of the Cooperative Research Units program is matched with State and university contributions of expertise, equipment, facilities, and project funding. Through university affiliations, Federal scientists train future natural resource professionals.

The Senate included language in their FY 2003 appropriations report accompanying the Department of the Interior and Related Agencies Appropriations Bill that directs the USGS Cooperative Research Units program to develop a priority system for expanding the current program. The report has been submitted to the Department for signature.

Federal Role

Changes in living resources, from individual species to overall ecosystem health, can only be detected and evaluated through careful, long-term monitoring and a continuing research commitment that come together to form the baseline of the environmental and ecological health of the Nation. Without such a baseline, subtle and even obvious changes in natural resource conditions may go unnoticed, whether they are caused by human population growth, bioterrorism, increases in ultraviolet radiation, or some other source. The USGS research and information activities are integral to the Nation's long-term research and monitoring capabilities and critical to sound resources management decisionmaking.

Because resources and species cross many jurisdictional boundaries and often have little short-term commercial appeal, no other entity has the capability or interest to ensure continuity of these long-term research and information management priorities. In fact, the Federal Government is the only entity engaged in such long-term, non-profit-driven research and monitoring, such as the Breeding Bird Survey and amphibian research and monitoring. The

Biological Research

USGS represents the Nation's most comprehensive collection of expertise about the Earth, its resources, and its processes.

USGS biologists and information scientists, in partnership with many others, provide the scientific understanding and technologies necessary to support sound management and conservation of the Nation's biological resources. USGS research is conducted according to the highest standards of scientific objectivity to ensure credibility. The USGS also ensures that the information from scientific research is appropriately managed to provide broad access to all interested parties, thus maximizing the Nation's return on its biological science investment.

Customers and Partners

The USGS national-level approach to managing biological and resource data and information ensures the application of standards that foster opportunities for collaboration and cooperation. The USGS places a premium on partnerships at all levels of government and with nongovernmental entities, including the private sector. These partners both use USGS-generated data and information, as well as add credible scientific data and information to the knowledge base, which then becomes available to DOI land and resource managers, as well as all others.

The USGS works closely with its partners and customers in defining priorities, developing science plans, and carrying out its biological research to support the needs of research management organizations. Key partners in many of these endeavors include Interior bureaus, other Federal agencies, States, and private organizations with regional and ecosystem-specific interests.

An example of such a partnership is the Science Support Partnership (SSP) program that addresses the priority science needs of the U.S. Fish and Wildlife Service (FWS). Since 2001, the USGS has undertaken more than 260 projects in support of FWS local, regional, and National programs such as:

- Migratory bird management,
- Endangered species recovery,
- Freshwater fisheries restoration,
- Ecosystem-based management,
- Coastal habitat conservation,
- Fish and wildlife law enforcement, and
- National Wildlife Refuge System management.

The SSP program has provided tremendous benefits to FWS efforts in conserving the Nation's fish and wildlife resources.

Another example is the Vegetation Mapping Program, a cooperative effort by the USGS and the National Park Service (NPS) to classify, describe, and map vegetation communities in more than 250 national park units across the United States. The vegetation mapping program is an

important part of the NPS Inventory and Monitoring Program, a long-term effort to develop baseline data for all national park units that have a natural resource component.

Each node of the National Biological Information Infrastructure (NBII) is developed through the collaboration of the partners and customers involved with that node. All together, NBII has over 250 partner organizations and agencies that help define the direction both of individual nodes and of the NBII as a whole.

The USGS considers its customers as close partners in research. This focus on knowing and meeting partners' needs, establishing a goal for partner satisfaction, and measuring performance toward reaching that goal has improved the quality of USGS products and services.

Funding, Strategic Goals, and Performance Data

Funding for the Biological Research Activity addresses the DOI Strategic Plan's Resource Protection and Serving Communities mission themes.

- Biological Research and Monitoring subactivity supports end outcome strategic goals of Improving Health of Watersheds, Landscapes, and Marine Resources and Sustain Biological Communities.
- Cooperative Research Units subactivity also supports Sustain Biological Communities.
- Biological Information Management and Delivery subactivity joins other USGS multi-purpose information activities in supporting the Serving Communities end outcome goal of advancing knowledge through scientific leadership and informing decisions through the application of science.

FY 2003, and prior year, performance and targets capture the metrics from the prior GPRA Strategic and Annual Plans (largely in outputs) and, where possible, prior year performance actuals were also derived for the new metrics. These "SP" coded measures relate to specific measures in the DOI Strategic Plan and contribute to the aggregate bureau outcome as shown in the General Statement and the aggregate DOI outcome in the Department's strategic plan. Outputs are only included in bureau plans.

The USGS customer satisfaction metrics are developed on the basis of information collected in an ongoing series of customer satisfaction/outcome surveys. Each survey collects information on satisfaction with various aspects of one specific USGS science product. Information is collected from a random sample of the customers of that specific product. The satisfaction ratings for the individual products are extracted or combined to create the cited customer satisfaction metrics. The individual satisfaction ratings used to create the metrics are replaced on a 3-year cycle. The metrics for any two consecutive fiscal years, therefore, have about two-thirds of the specific science products in common on average. This has the effect of making the data series more stable than if all products were replaced each year. It also makes the metrics more representative of USGS science products as a whole, since it approximately triples the number of specific products included in each metric.

Biological Research

FY 2004 Actual Compared to FY 2004 Plan/Budget

- In many cases, targets were met or exceeded.
- Under the Resource Protection strategic goal, systematic analyses are funded by multiple sources for multiple purposes. This results in difficulty ensuring that a product is counted only once and deciding which goal it supports. This is further complicated in that the actual products are customer driven, which also influences the goal to which they are associated, compared against a target set well before requirements and customers are identified. There is no effect on overall program or activity performance.
- Under the Resource Protection strategic goal, workshops/training are funded by multiple sources for multiple purposes resulting in difficulty ensuring that a product is counted only once and deciding which goal it supports. This is further complicated by the actual products being customer driven, which also influences the goal to which they are associated, compared against a target set well before requirements and customers are identified. There is no effect on overall program or activity performance.
- Under the Serving Communities strategic goal, target was exceeded—NBII successfully expanded partnership contributions to the knowledge base beyond original expectations for FY 2004. Because metadata records are created for each dataset or information product registered by an NBII partner, this expansion resulted in a greater than target increase in the number of metadata records in the NBII Clearinghouse.
- Under the Serving Communities strategic goal, target was not met for efficiency—during FY 2004 NBII changed its method of organizing and storing data, resulting in a one-time decrease in the count of gigabytes of data in servers under biology management. The knowledge base under NBII stewardship, however, did not decrease.

FY 2005 Revised Final Plan Compared to FY 2004 Actual

- Under the Resource Protection strategic goal, changes result from projects initiated in FY 2003. There is a 2-year lag between initiating research and obtaining results. Additional funds provided in FY 2003 will increase the number of systematic analyses or investigations delivered to customers in FY 2005 by 7.
- Under the Resource Protection strategic goal, estimate is based on history, adjusted for expected funding levels regarding the number of formal workshops and training.
- Under the Serving Communities strategic goal, the plan is a cumulative number of clearinghouse records. Previous records will be maintained; an estimated 500 additional records will be added. Estimate is based on history, adjusted for expected funding levels.

FY 2005 Revised Final Plan Compared to FY 2005 Plan/Budget

- Under the Serving Communities strategic goal, partnerships resulted in greater-than-expected increases in the number of metadata records submitted to the NBII Clearinghouse and the number of biological partnership links, matching or exceeding by the end of FY 2004 the estimated targets originally in the FY 2005 plan/budget. The FY 2005 revised final plan anticipates the normal annual increase in number of metadata records (500) and links (2,500) over FY 2004 actuals.

FY 2006 Plan Compared to FY 2005 Revised Final Plan

- Changes result from additional funding provided in FY 2004. There is a 2-year lag between initiating research and obtaining results. Additional funds provided in FY 2004 will increase the number of systematic analyses or investigations delivered to customers in FY 2006 by 9.
- The outcome measures for invasive species relate to changing the predominant focus of research from control and management to prevention, early detection, and rapid response to support the needs of the National Invasive Species Council
- Under the Serving Communities strategic goal, the plan for links to relevant biological informatics resources, number of NBII nodes, number of NBII Clearinghouse metadata records, and number of gigabytes of data managed are cumulative numbers. Given a slightly decreasing budget, the plan for FY 2006 is identical to the FY 2005 revised final plan.

Biological Research

2003 to 2006 Performance Summary

Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD = Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Resource Protection Goal:

End Outcome Goal: PEO.1. Improve health of watersheds, landscapes and marine resources that are DOI managed or influenced in a manner consistent with the obligations regarding the allocation and use of water.							
End Outcome Measures	2003 Actual	FY 2004 Actual	2005 President's Budget	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Restore and maintain proper functions to watersheds and landscapes							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Restored Fire Adapted Ecosystem:</i> X% satisfaction with scientific and technical products and assistance (SP)	97%	100%	≥80%	≥80%	≥80%	0	≥80%
PART Efficiency Measures or other Outputs							
# of systematic analyses & investigations delivered to customers	11	4	11	8	8	0	8
# of formal workshops or training provided to customers (instances/issues/events)	1	1	1	1	1	0	1
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Forge Effective Partnerships:</i> Satisfaction score (# score) on resource protection partnerships (SP)	97%	97%	≥80%	≥80%	≥80%	0	≥80%
<i>Customer Satisfaction:</i> X% satisfaction with scientific and technical products and assistance (NK)	97%	97%	≥80%	≥80%	≥80%	0	≥80%
<i>Customer Satisfaction:</i> Timeliness of scientific and technical products (BUR)	93%	93%	≥80%	≥80%	≥80%	0	≥80%
<i>Customer Satisfaction:</i> Usefulness of scientific and technical products (BUR)	97%	97%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality:</i> X% of watershed and landscape-related research studies validated through appropriate peer review or independent review (SP)	100%	100%	100%	100%	100%	0	100%

Activity Summary

PART Efficiency Measures or other Outputs	2003 Actual	FY 2004 Actual	2005 President's Budget	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long-term Target (2008)
Intermediate Outcome: Improve information base, information management and technical assistance Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Facilities Condition:</i> Conservation and biological research facilities are in fair to good condition as measured by the Facilities Condition Index (lower FCI is good) (NK)	UNK	0.24	0.24	0.24	0.24 ¹	0	0.24
PART Efficiency Measures or other Outputs							
# of systematic analyses & investigations delivered to customers	151	107	155	177	189	+12 ²	189
# of formal workshops or training provided to customers (instances/issues/events)	63	**	63	23	27	+4 ³	27

¹For all buildings owned and operated by USGS, FCI equals the total deferred maintenance for all buildings, divided by the current replacement values of the buildings.

²Represents increased outputs as a result of research initiated in FY 2004 and a technical adjustment in FY 2006. There is a 2-year lag between initiating research and obtaining results. Research initiated with additional FY 2006 funding for ecological systems mapping and science on the DOI landscape initiatives will produce 4 systematic analyses in FY 2008. Results will also include 4 less systematic analyses and investigations in FY 2008 due to the proposed decreases in funding for the Mark Twain National Forest lead mining study.

³This change represents additional funds for science on the DOI Landscape initiative and a technical adjustment in FY 2006.

** See total in PEO.2.

Resource Protection Goal:

End Outcome Goal: PEO.2. Sustain biological communities on DOI managed or influenced lands and waters in a manner consistent with the obligations regarding the allocation and use of water.							
End Outcome Measures	2003 Actual	FY 2004 Actual	2005 President's Budget	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Create habitat conditions for desired biological communities to flourish Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Invasive Species:</i> Prevention: % of invasive species research focused on pathways and prevention methods (BUR)	8%	7%	6%	6%	6%	0%	10%
<i>Invasive Species: Early Detection:</i> % of invasive species research focused on detection and assessments of new invasions (BUR)	3%	8%	5%	5%	5%	0%	10%

Biological Research

End Outcome Measures	2003 Actual	FY 2004 Actual	2005 President's Budget	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long-term Target (2008)
Intermediate Outcome: Create habitat conditions for desired biological communities to flourish							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Invasive Species: Rapid Response:</i> % of invasive species research focused on rapid management response to new invaders (BUR)	<1%	1%	2%	2%	2%	0%	6%
<i>Invasive Species: Control & Management:</i> % invasive species research focused on providing information and methods for control and management of established invasive species (BUR)	89%	84%	87%	87%	87%	0%	74%
<i>Invasive Species: Forge Effective Partnerships:</i> Satisfaction score (# score) on biological research partnerships (BUR)	97%	99%	≥80%	≥80%	≥80%	0	≥80%
PART Efficiency Measures or other Outputs							
# of systematic analyses & investigations delivered to customers	20	51	24	24	30	+6 ⁴	34
# of formal workshops or training provided to customers (instances/issues/events)	1	1	1	1	1	0	3
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Forge Effective Partnerships:</i> Satisfaction score (# score) on biological research partnerships (SP)	97%	98%	≥80%	≥80%	≥80%	0	≥80%
<i>Shared Data:</i> X% of DOI databases with species information that is available throughout DOI and other partners (NK)	100%	100%	100%	100%	100%	0	100%
<i>Customer Satisfaction:</i> X% satisfaction with DOI scientific and technical information (NK)	99%	98%	≥80%	≥80%	≥80%	0	≥80%
<i>Customer Satisfaction:</i> timeliness of scientific and technical information (BUR)	97%	97%	≥80%	≥80%	≥80%	0	≥80%

⁴ This change represents the results of research initiated in FY 2004. There is a 2-year lag between initiating research and obtaining results. Research initiated with additional FY 2006 funding for the Invasive Species Initiative will produce 2 systematic analyses in FY 2008.

Activity Summary

End Outcome Measures	2003 Actual	FY 2004 Actual	2005 President's Budget	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long- term Target (2008)
Intermediate Outcome: Improve information base, information management and technical assistance Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Customer Satisfaction:</i> Usefulness of scientific and technical information (BUR)	98%	98%	≥80%	≥80%	≥80%	0	≥80%
<i>Quality:</i> X% of biological research studies validated through appropriate peer review or independent review (SP)	100%	100%	100%	100%	100%	0	100%
<i>Facilities Condition:</i> Conservation and biological research facilities are in fair to good condition as measured by the Facilities Condition Index (lower FCI is good) (SP)	UNK	0.19	0.19	0.19	0.19 ⁵	0	0.19
PART Efficiency Measures or other Outputs							
# of systematic analyses & investigations delivered to customers	796	797	838	838	846	+8 ⁶	898
# of formal workshops or training provided to customers (instances/issues/events)	97	70**	125	55	55	0	58

⁵ For all buildings owned and operated by USGS, FCI equals the total deferred maintenance for all buildings, divided by the current replacement values of the buildings.

⁶ Represents increased outputs as a result of research initiated in FY 2004. Also, there is a 2-year lag between initiating research and obtaining results. Research initiated with additional FY 2006 funding for the Glen Canyon adaptive management plan and Great Lakes deepwater fisheries will produce 5 systematic analyses in FY 2008. Results also include 16 less systematic analyses and investigations in FY 2008 due to the proposed decreases in funding for pallid sturgeon research, a multidisciplinary water study at Leetown, manatee research, diamondback terrapin research, molecular biology at Leetown, Delaware River basin water project, and grizzly bear DNA assessment would have been delivered in FY 2008.

** See total in PEO.2.

Biological Research

Serving Communities Goal:

End Outcome Goal: SEO.2. Advance knowledge through scientific leadership and inform decisions through the application of science.							
End Outcome Measures	2003 Actual	FY 2004 Actual	2005 President's Budget	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long-term Target (2008)
<i>Research:</i> Soundness of methodology, accuracy, and reliability of science (program evaluation) (BUR)	100%	80%	100%	100%	100%	0	100%
<i>Inform decisions through the application of science:</i> Improved access to needed science information (# score) (SP)	92%	90%	90%	90%	90%	0	90%
<i>Inform decisions through the application of science:</i> Stakeholders reporting that information helped achieve goal (# score) (SP)	94%	93%	90%	90%	90%	0	90%
<i>Inform decisions through the application of science:</i> Improve access to needed science information (# of biological partnership links) (BUR)	32,500	36,000	36,000	38,500	41,000	+2,500	46,000
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Content and expanse of knowledge base:</i> % of surface area with temporal and spatial monitoring, research, and assessment/data coverage to meet land use planning and monitoring requirements (SP) (# of square miles assessed by Gap analysis)	UNK	82%	83%	83%	83%	0	85%
<i>Quality:</i> X% of studies validated through appropriate peer review or independent review (SP)	100%	100%	100%	100%	100%	0	100%

Activity Summary

End Outcome Measures	2003 Actual	FY 2004 Actual	2005 President's Budget	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long- term Target (2008)
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
Access: For information products surveyed X% of mapping, water, and biology customers are satisfied with ease, timeliness of access (BUR)	92%	90%	≥80%	≥80%	≥80%	0	≥80%
PART Efficiency Measures or other Outputs							
# of systematic analyses and investigations delivered to customers	35	46	37	36	36	0	37
# of formal workshops or training provided to customers (instances/issues/events)	22	27	22	22	22	0	25
# of NBII nodes	10	14	14	14	14	0	18
# of NBII Clearinghouse metadata records	6,600	7,500	7,300	8,000	8,500	+500	9,500
# of cumulative gigabytes managed	400	360	440	380	400	+20	440

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Biological Research and Monitoring Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes ^{a/}	Program Changes ^{b/}	2006 Budget Request	Change from 2005
Biological Research and Monitoring	135,110	133,130	+3,393	-2,175	134,348	+1,218
FTE	1,046	1,007	0	+4	1,011	+4
Total Requirements \$000	135,110	133,130	+3,393	-2,175	134,348	+1,218
FTE	1,046	1,007	0	+4	1,011	+4

^{a/} Included in this amount is a one-time technical adjustment of \$828 that moves all USGS funds associated with the Science on the DOI Landscape initiative to a single location in the Biological Research Activity for ease of administration and accounting.

^{b/} Changes for this subactivity include a reduction of -\$389 for travel and -\$31 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for Biological Research and Monitoring is \$134,348,000.

The Biological Research and Monitoring subactivity generates specialized biological research and monitoring information needed to effectively manage and conserve biological resources. This program addresses the Department of the Interior (DOI) Resource Protection strategic goal of improving the health of watersheds, landscapes, and marine resources that are DOI managed or influenced in a manner consistent with obligations regarding the allocation and use of water. The USGS conducts research and monitoring that focuses on understanding how ecosystems (diverse communities of living organisms interacting with one another and with the physical environment) are structured, function, and provide “ecosystem services.” The DOI manages vast Federal lands and the biological resources that inhabit them. DOI land- and resource-management bureaus need the scientific understanding and the technical tools to wisely manage these lands and resources on a sustainable basis. The Biological Research and Monitoring subactivity provides science information needs for resource managers.

To clearly measure USGS progress in supporting the intermediate outcome of restoring and maintaining proper function to watersheds and landscapes, the USGS tracks an intermediate outcome measure related to restoring ecosystems (≥80 percent customer satisfaction with scientific and technical products and assistance related to restoring fire ecosystems). To measure progress in achieving the intermediate outcome of improving the information base, information management, and technical assistance, the USGS tracks six intermediate outcome measures related to forging effective partnerships (≥80 percent satisfaction on resource protection partnerships); customer satisfaction (≥80 percent satisfaction with scientific and technical products and assistance, ≥80 percent satisfaction with usefulness of scientific and technical information, and ≥80 percent satisfaction with timeliness of scientific and technical projects); quality (100 percent of watershed and landscape-related research studies validated through appropriate peer review); and facilities condition (0.24 conservation and biological facility in fair or better condition as measured by the Facilities Condition Index). The USGS also tracks outputs including the number of systematic analyses and investigations delivered to

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customers and the number of workshops/training with USGS sponsorship or participation to transfer results to customers and partners.

This program also addresses the DOI Resource Protection strategic goal of sustaining biological communities on DOI managed and influenced lands and waters in a manner consistent with obligations regarding the allocation and use of water. The USGS provides the natural resource management community with scientific information to implement sound resource management to sustain biological communities.

To clearly measure USGS progress in supporting the intermediate outcome of creating habitat conditions for biological communities to flourish, the USGS tracks five intermediate outcome measures for invasive species related to changing the predominant focus of research from control and management to prevention, early detection, and rapid response to support the needs of the National Invasive Species Council and forging effective partnerships (≥ 80 percent satisfaction on biological research partnerships). The relative levels of effort for USGS invasive species research for FY 2006 are prevention (6 percent of invasive species research focused on pathways and prevention methods); early detection (5 percent of invasive species research focused on detection and assessments of new invasions); rapid response (2 percent of invasive species research focused on rapid management response to new invaders); control and management (87 percent of invasive species research focused on providing information and methods for control and management of established invasive species). The USGS also tracks outputs including the number of systematic analyses and investigations delivered to customers and the number of workshops/training with USGS sponsorship or participation to transfer results to customers and partners.

To clearly measure USGS progress in supporting the intermediate outcome of improving the information base, information management, and technical assistance, the USGS tracks seven intermediate outcome measures related to forging effective partnerships (≥ 80 percent satisfaction on biological research partnerships); shared data (100 percent of DOI databases with species information are available throughout DOI and other bureaus); customer satisfaction (≥ 80 percent satisfaction with DOI scientific and technical information, ≥ 80 percent satisfaction with usefulness of scientific and technical information, and ≥ 80 percent satisfaction with timeliness of scientific and technical projects); quality (100 percent of research studies validated through appropriate peer review); and facilities condition (0.19 conservation and biological facility in fair or better condition as measured by the Facilities Condition Index). The USGS also tracks outputs including the number of systematic analyses and investigations delivered to customers and the number of workshops/training with USGS sponsorship or participation to transfer results to customers and partners.

Biological resources are an invaluable and increasingly vulnerable part of the Nation's heritage and economy. These resources are varied, widely distributed, and complex. They extend from the polar bear habitats of the Arctic to the sea grass beds of the Florida coast and encompass the aquatic treasures of the Great Lakes and the beauty and extreme conditions of the Southwest deserts. These resources include isolated islands of incredible diversity such as Hawaii and large interconnected waters like the Mississippi River. The types of habitats that people live alongside include mountains, forests, rangelands, wetlands, coasts, and open waters. The products of these habitats provide food, energy, medicine, transportation, and enjoyment. These habitats are vulnerable to the adverse effects of many natural and human-induced changes.

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Research is needed to reduce and avoid the costs of controlling and eradicating the rapidly growing number of invasive species being introduced into and spreading within the United States as a result of increasing global travel and commerce and increasing human impacts on lands and water. For example, the damage to wildlife, livestock, and public health from invasive fire ants, plus the cost of control, is estimated at \$500 million annually in Texas alone.

Over the past decade, more than two-thirds of emerging diseases have animal origins and diseases among wildlife can have profound impacts on both humans and wildlife. Diseases can devastate regional wildlife populations, threaten the last remaining individuals of an endangered species, or spread from animals to humans, creating a public health hazard. Single outbreaks of a disease have killed more than 300,000 waterfowl. The spread of chronic wasting disease in deer and elk has alarmed the public and threatened State-hunting activities. Moreover, the rapid spread of West Nile virus across the United States, resulting in both avian and human mortality, has demonstrated the need for better wildlife disease surveillance and management programs. USGS biological research seeks to understand the underlying causes of wildlife disease and disease emergence and to provide resource managers and decisionmakers with the tools needed to manage and prevent diseases that impact the Nation's natural resources.

All Biological Research and Monitoring programs have completed or are in the process of completing 5-year plans. The USGS also conducts periodic program reviews to evaluate the relevance, significance, effectiveness, and productivity of ongoing scientific activities and to set goals, objectives, and priorities for future work. Program reviews are conducted every five years. In FY 2005, the Biological Research and Monitoring subactivity will undergo a Program Assessment Rating Tool, or PART review by OMB.

The following table displays program-funding estimates for three fiscal years for the Biological Research and Monitoring subactivity:

Biological Research and Monitoring Program Areas (dollars in millions)			
Program	2004 Enacted	2005 Enacted	2006 Request
Status and Trends	21.0	20.5	21.2
Contaminant Biology	10.7	10.5	9.9
Fisheries: Aquatic and Endangered Resources	26.7	26.6	25.5
Wildlife: Terrestrial and Endangered Resources	37.0	36.0	35.4
Terrestrial, Freshwater, & Marine Ecosystems	30.5	30.0	32.3
Invasive Species	9.2	9.5	10.0
Total Biological Research & Monitoring	135.1	133.1	134.3

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The following sections describe the Biological Research and Monitoring subactivity by program area:

Status and Trends of Biological Resources

(Estimates for FY 2004, \$21.0 million, 169 FTE; FY 2005, \$20.5 million, 162 FTE; FY 2006, \$21.2 million, 162 FTE)

To protect and conserve the living resources entrusted to their care, Federal land and resource managers must first understand the condition, or status, of those resources: what they are (inventory), where they are located (distribution), how many there are (abundance), and how they change over time (trend)—information only long-term, scientifically sound monitoring can produce. Long-term monitoring of the environment is fundamental to:

- Detecting changes that may signal degradation of natural systems,
- Assessing the effectiveness of management actions,
- Identifying new or emerging problems,
- Validating research results and models, and
- Promoting increased public understanding and appreciation of our living resources.

The USGS Status and Trends of Biological Resources program measures, predicts, assesses, and reports the status and trends of the Nation's biological resources to advance research, facilitate resource management and stewardship, and promote public understanding and appreciation of the Nation's living resources, with emphasis on Federal lands. This program supports DOI's Resource Protection strategic goal of sustaining biological communities.

Program goals, as outlined in the program's five-year plan, are to:

- Facilitate integrated monitoring from a variety of sources at multiple spatial and temporal scales to describe and track the abundance, distribution, productivity, and health of the Nation's plants, animals, and landscapes,
- Develop and evaluate inventory and monitoring methods, protocols, experimental designs, analytic tools, models, and technologies to measure biological status and trends,
- Collect, archive, and share critical, high-quality monitoring data in cooperation with partners to determine the status and trends of biological resources, and
- Produce and provide analyses and reports that synthesize information on the status and trends of the Nation's flora, fauna, and ecosystems and be responsive to the needs of the scientific community, land and resource managers, policymakers, and the public.

National Park Monitoring (estimates for FY 2004, \$0.9 million; FY 2005, \$0.9 million; FY 2006, \$0.9 million) — USGS scientists assist National Parks with inventory and monitoring protocol development and other monitoring-related research needs such as assistance with monitoring planning and design, statistical data analysis, and review/revision of existing protocols. USGS

scientists and technical specialists address priority issues identified by the NPS that typically involve and benefit several parks and require multiyear efforts.

Park-Oriented Biological Support — The USGS and the NPS, through the Natural Resource Preservation Program, jointly support biological projects that provide exploratory research and technical assistance to National Parks. The effort is an attempt to encourage USGS biologists to critically assess research needs on lands administered by the NPS, and to develop creative proposals to meet these needs, adapting their experience and scientific interests to construct imaginative solutions. The main objective is to provide seed funding for new research on emerging issues that may become significant to the parks and to develop products useful to the parks.

Bird Monitoring — Monitoring bird populations is particularly important because of the Federal role in conservation of migratory birds. Migratory bird population surveys provide data for establishing State waterfowl hunting limits and understanding songbird and seabird population fluctuations. In support of this monitoring activity, the USGS maintains the National Bird Banding Laboratory and the Breeding Bird Survey, a bird-monitoring database, and conducts research to improve the accuracy and efficiency of monitoring methods.

Mammal Monitoring — USGS scientists play a major role in monitoring the status of mammal populations that extend from the Arctic to Yellowstone to the Florida Everglades. Research is focused on certain species of marine mammals such as polar bears and sea lions, threatened and endangered mammals such as manatees, sea otters, and various bat species, and moose, elk, bison and other large mammals residing on Federal lands.

Fish Monitoring — States, Tribes, other Federal agencies, and the USGS partner to collect, analyze, and interpret data on fishery resources, anadromous (migrating up rivers from the sea) fishes, and other species on the Atlantic, Pacific, and Gulf coasts and in the Great Lakes. Partnering efforts in delivering this information is essential in enforcing Tribal and international agreements and providing effective regulation of fisheries harvests.

Biomonitoring of Environmental Status and Trends (BEST) Project (estimates for FY 2004, \$1.9 million; FY 2005, \$1.8 million; FY 2006, \$1.8 million) — Working through USGS science centers, the BEST project monitors and assesses impacts on fish due to environmental contaminants at over 120 sites within the Columbia, Colorado, Yukon, Rio Grande, Mississippi, Colorado, Mobile, Apalachicola, Savannah, and Pee Dee River basins. The project disseminates all study findings via the Web and in peer-reviewed outlets. In addition to its active monitoring efforts, BEST also supports the development of the Contaminant Exposure and Effects -Terrestrial Vertebrates (CEE-TV) database that contains 16,696 contaminant data records on free-ranging amphibians, reptiles, birds, and mammals residing in estuarine and coastal habitats of the Atlantic, Gulf, and Pacific coasts, Alaska, Hawaii and the Great Lakes. The database is used to identify spatial data gaps that help DOI land managers prioritize data collection efforts. The BEST project works with the FWS to develop an on-line module known as the Contaminant Assessment Process used to assess contaminant threats to over 300 National Wildlife Refuges across the country.

Great Lakes (estimates for FY 2004, \$3.1 million; FY 2005, \$3.0 million; FY 2006, \$3.0 million) — USGS scientists conduct a regional deepwater science, large vessel program that complements other DOI activities with large-scale multiyear strategic investigations. The program provides long-term, consistent, lakewide assessment of forage fish stocks that support sport and commercial fish species, monitor invasive species for protection and restoration of the

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Great Lakes, and provide scientific and technological monitoring tools for aquatic species assessment and conservation in the Great Lakes. This research program includes studies of the biology and dynamics of important sport and commercial food and forage fish populations. The deepwater science program is unique in its ability to sample the deep, offshore waters of the Great Lakes and is relied upon by State, Tribal, and provincial agencies across the Great Lakes basin. Program surveys have documented population cycles in native and invasive species and displacement of resident fishes by invading zebra mussels. Commercial fish species have been affected by declines in deepwater invertebrates. USGS science, in support of State and provincial efforts, facilitates information transfer across jurisdictional boundaries to promote ecosystem level management, conservation, and restoration of Great Lakes aquatic resources.

Standards and Protocols — The use of compatible standards and protocols is needed to compare and aggregate results among studies, agencies, and regions. USGS scientists develop statistically valid, efficient, and feasible protocols that are relevant to the needs of resource managers for monitoring the abundance, distribution, productivity, and health of the Nation's plants, animals, and ecosystems.

Taxonomy, Systematics, and Museum Studies — The National Museum of Natural History is a major repository of scientific information used by USGS scientists to study natural variation in many groups of animals. Curation of North American vertebrate collections at the Smithsonian Institution provides stewardship of an important scientific database available to scientists from around the world.

Predictive Population Modeling — Through development of predictive population models, the Status and Trends program assists resource managers in making difficult decisions by reducing the uncertainty associated with population responses to habitat and environmental change. In essence, these models allow managers to project the likely outcome of various management alternatives on populations of plants and animals.

Science for Decision-Support Systems — Land and other natural resource managers require strong scientific, social, and economic information to make justifiable management decisions. However, the gap between quality information and management decisionmaking is often pronounced. Decision-support systems are computer-based tools that bridge that gap by bringing the best scientific and human dimensions information to bear on specific natural resource issues. The Status and Trends program develops and advances the science associated with decision-support systems, thereby ensuring that results from scientific research are directly funneled back into the decisionmaking process of natural resources agencies.

Adaptive Management — The use of monitoring data to assess the effectiveness of management actions is an essential component of adaptive resource management. It is a sequential decisionmaking process for continually improving management policies and practices by learning from the outcomes of previous decisions. The role of long-term monitoring at regular intervals is important in this process for detecting change that may require further investigative research and (or) special management approaches. In addition, long-term monitoring can span those changes that are driven by natural forces, such as unusual weather patterns, disease events, changes in predator densities, or other factors so that managers can recognize trends, anticipate outcomes, and adapt management actions to respond to them. The aim is to close the gap between scientific knowledge and application of that knowledge through strong, on-the-ground collaboration between scientists and State, Federal, and private natural resource managers.

Human Dimensions and Socio-Economics — Natural resources management requires a firm understanding of biological, economic, and social issues and processes. Interaction between human communities and their natural surroundings can introduce various changes to ecosystems. Human dimensions studies are used to better understand those human-induced changes, determine the environmental conditions desired by local communities and users of natural resources, and develop information that assists decisionmakers in sustaining or restoring healthy ecosystems.

Vegetation Mapping (estimates for FY 2004, \$1.2 million; FY 2005, \$1.2 million; FY 2006, \$1.2 million) — The Vegetation Mapping program is a cooperative effort by the USGS and the NPS to classify, describe, and map vegetation communities in more than 270 National Park units across the Nation. This landmark program is both the first to provide national-scale descriptions of vegetation for a Federal agency and the first to create national vegetation standards for its data products. Its goal is to meet specific information needs identified by NPS, with additional cooperative projects for the FWS at Ouray and Lacreek National Wildlife Refuges, and with the BLM at Gunnison Gorge National Conservation Area. Current efforts include dovetailing protocols for invasive species inventory and fire fuels mapping related to vegetation to achieve efficient and integrated field data collection protocols. Current ongoing projects include continuing work at Rocky Mountain National Park, Glacier National Park, Joshua Tree National Monument, Effigy Mounds National Monument, Wapatki National Monument, Sunset Crater National Monument, Walnut Canyon National Monument, Zion National Park, and Grand Teton National Park. The program status includes 13 parks complete with data served and available via the Web, 6 park projects complete or in contract review, and over 60 additional parks working on vegetation mapping projects in cooperation with the Vegetation Mapping program.

Contaminant Biology

(Estimates for FY 2004, \$10.7 million, 72 FTE; FY 2005, \$10.5 million, 69 FTE; FY 2006, \$9.9 million, 69 FTE)

The Contaminant Biology program provides high quality, objective scientific information on exposure to and effects of environmental contaminants for managing, protecting and restoring the Nation's biotic resources and, in particular, for the trust resources of the Department of the Interior. Toxicology and chemistry expertise, research, information, scientific interpretations, monitoring tools, and models are used by DOI and other agencies to prevent contamination, restore contaminated DOI lands and trust resources, and fulfill recreational, statutory, and regulatory responsibilities. This program supports DOI's Resource Protection strategic goal of improving the health of watersheds and landscapes that are DOI managed or influenced.

Program goals, as outlined in the program's 5-year plan, are:

- Toxicology and Chemistry — Determine the causes, fate, exposure and effects of environmental contaminants. Develop and standardize biomarkers, molecular biology methods and techniques and other analytical and toxicological methods,
- Contaminated Habitats — Develop the scientific basis for assessment, restoration, and monitoring of habitats that are contaminated by mining, agriculture, urban wastewater, industry, and chemical control agents. Develop the toxicological basis to remediate and prevent contamination effects of chemical controls for invasive species, fire, and other hazards, and

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- Integration of Ecological Stressors — Improve the scientific basis for evaluating the effect of multiple stressors, at all levels of biological organization and at multiple temporal or spatial scales.

Environmental Toxicology Research — Research determines the sources, fate, exposure, and effects of environmental contaminants; develops standardized biomarkers, molecular biology methods, and other analytical and toxicological assays; develops the scientific basis for assessment, restoration, and monitoring of contaminated habitats; develops toxicological criteria to remediate or prevent contamination effects; and evaluates the effects of multiple stressors. Research frequently pairs controlled laboratory investigations with field studies of trust species and their habitat in contaminated sites. USGS scientists identify causative agents such as contaminants, diseases, nutrient enrichment, and other habitat factors; measure responses to toxic agents; and evaluate the ecological risk posed by contaminants. Research on endocrine disruptors, flame-retardants, mercury, other metals, and other emerging contaminants are important emphases within the program. Research on chemical degradation reveals pathways that modify contaminant toxicity. Studies describe the variation in toxicity among species. Evaluation of fish and bird kills link contaminant stressors to mortality. Research clarifies the physiological mechanisms, such as endocrine disruption, by which contaminants affect growth, reproduction, immunity, and other life processes.

Biological Assistance to the National Water-Quality Assessment Program (NAWQA) (estimates for FY 2004, \$0.6 million; FY 2005, \$0.6 million; FY 2006, \$0.6 million) — The Contaminant Biology program provides toxicological expertise and enhancements to the NAWQA program at the national, regional, and field levels. Biologists supply toxicological testing in urbanizing environments, study effects of mercury bioaccumulation in fish and agriculturally derived nutrients in streams, and provide other expertise to compliment NAWQA activities. Biologists assist NAWQA by improving methods to assess fish health, training field personnel, and reviewing NAWQA products.

Fisheries: Aquatic and Endangered Resources

(Estimates for FY 2004, \$ 26.7 million, 224 FTE; FY 2005, \$26.6 million, 216 FTE; FY 2006, \$25.5 million, 218 FTE)

Research conducted in the "Fisheries: Aquatic and Endangered Resources (FAER) program" centers on the determination of factors affecting the health and survival of fish and other native aquatic fauna, and aquatic community structure and function. Based on the genetics, life history, behavior, and habitat requirements of aquatic organisms, USGS scientists provide the scientific information needed by aquatic resource managers to develop and evaluate methods for restoring and managing aquatic populations. High quality scientific information about the distribution of species of concern and their habitats, and the biological integrity of multijurisdictional aquatic systems are provided to resource managers to support adaptive management of the Nation's aquatic species and habitats. High priority is given to studies that directly assist other DOI agencies and national, international, State, and Tribal efforts to manage inter-jurisdictional fishery and aquatic resources. USGS expertise in genetics, fish health and diseases, aquaculture drug research, native and endangered fishes, other freshwater organisms and aquatic habitats provides long-term research support, quick response, and technical assistance in support of the DOI's Resource Protection strategic goal of sustaining biological communities.

The FAER 5-year plan has been developed through an extensive collaborative effort to predict and identify the aquatic biological information needs of our partners and customers, and to posture USGS science to respond to ongoing and future challenges. The plan describes the current and future roles of the FAER program and projected coordinated research with USGS disciplines, DOI partners, and other natural resource managers.

Program goals, as outlined in the program's 5-year plan, are to:

- Provide scientific information about the diversity, life history and species interactions that affect the condition and dynamics of aquatic communities,
- Provide scientific information about factors and processes that affect aquatic organism health in support of survival, protection, conservation and recovery,
- Quantify and describe functional relationships among aquatic species and habitats to provide information to conserve or restore aquatic community structure and function,
- Provide science support for natural resource managers by investigating the factors that contribute to the conservation and recovery of aquatic species at risk,
- Develop research and technology tools to provide the scientific basis for developing adaptive management strategies and evaluating their effectiveness for restoration efforts to sustain aquatic resources, and
- Provide research support and technical assistance to DOI bureaus, other Federal and State government agencies, Tribes, and non-governmental organizations to support natural resource management problem solving and decisionmaking.

Reasons for aquatic species decline include health effects such as disease, changes in the amount and quality of water, habitat loss, invasive species, and contaminants. Restoration of declining populations depends on critical science information provided by an integrated program of research to determine the biology of individual aquatic species and the ecological relationships between those species and their habitats. Through improved systematic analyses, data collection, analysis and modeling focused on linking biological, physical, and chemical factors with others contributing to alterations in species composition and health, the USGS is providing resource managers with science-based tools for addressing these issues. Most USGS endangered species research supports recovery of species already having legal status under the Endangered Species Act of 1973, as amended. To help managers achieve the goals of recovery plans, USGS scientists investigate the life history requirements of listed species and factors limiting their populations. Better knowledge of both critical requirements and limiting factors is needed for managers to act effectively to promote restoration of populations.

USGS scientists investigate fish species and aquatic organism diversity in large freshwater lakes, large rivers and major tributaries, estuaries and nearshore areas. Important sport and commercial species such as salmon, steelhead, and sturgeon, as well as forage and prey species are studied to provide fishery managers with information to help mitigate the impact of aquatic diseases, barriers, and habitat loss. USGS scientists operate a Bio-Level III aquatics laboratory to investigate the heritability and spread of aquatic pathogens and diseases. This unique capability allows scientists to study, develop, and use advanced genetic and molecular tools to detect and identify introduced or invasive aquatic diseases, fishes, or other aquatic organisms that imperil the Nation's aquatic resources. USGS scientists develop and adapt

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advanced research tools such as remote sensing, hydroacoustics and geospatial technologies to characterize aquatic populations and the community dynamics of large lakes, reservoirs, impounded and free-flowing stretches of major rivers, estuaries, and coastal areas.

Klamath Basin (estimates for FY 2004, \$0.7 million; FY 2005, \$1.2 million; FY 2006, \$1.2 million) — Water availability is of primary concern to the DOI, State, and Tribal natural resources agencies that manage fishery and aquatic resources, national wildlife refuges, and agriculture in the Klamath Basin. Interdisciplinary research of the USGS Biological Research and Water Resources disciplines in the Upper Klamath Basin focuses on the effects of lake water conditions on endangered fishes such as the Lost River and Shortnose Suckers. Researchers investigate habitat used by juvenile and adult fish, movement, behavior, and survival in response to water availability, water quality, sediment, wetland, and watershed contributions to the ecological status of the Upper Klamath River basin and Klamath Lake. Investigations are being conducted to determine population dynamics and ecological response under different water, weather, or climate conditions that influence precipitation and recirculation in the lake. Results support development of risk assessments to improve restoration technologies for the basin, the imperiled species, and critical aquatic habitats. See Regional Section beginning on page F - 1 for more information on Klamath Basin research.

High Priority Fisheries Research for the FWS (estimates for FY 2004, \$2.0 million; FY 2005, \$2.0 million; FY 2006, \$2.0 million) — The USGS continues to address critical research needs of the FWS in support of imperiled and at-risk species, inventory and monitoring programs, and fisheries and aquatic resources management. The FWS looks to the USGS for scientific information to make science-based decisions and develops science-based approaches to address its resource management needs. The USGS is developing priority research and assessment tools and technologies, including risk assessment protocols, to assist wildlife refuges, molecular tools to measure the genetic diversity of imperiled native fishes and other at-risk aquatic species (mussels), deepwater science research and technology tools, and decision support and predictive modeling tools to measure the effects of water and land management practices on declining and at-risk species and their critical habitats. Research support and rapid response technical assistance help to provide the scientific information needed for aquatic species and habitat conservation and restoration planning throughout the United States.

Endangered Fish and Aquatic Species (estimates for FY 2004, \$6.9 million; FY 2005, \$6.6 million; FY 2006, \$5.8 million) — USGS aquatic endangered species research provides biological information needed to support de-listing, to preclude future listings by clarifying species' status or suggesting timely preventive actions, and to aid in the restoration of currently listed populations. Ongoing research support on genetic diversity and health, aquatic species and habitat interactions, at-risk species and restoration technology for imperiled fishes, and other research on aquatic species and aquatic habitats provides Federal, State, and private-sector managers more effective science-based tools to restore populations. The key to multispecies adaptive management for both protecting species and preventing the listing of additional species occupying the same habitats is science-based habitat restoration science and conservation planning. In partnership with DOI resource management bureaus and with State and local governments, USGS scientists are providing quality scientific and technical knowledge required to develop and implement effective species and habitat conservation and restoration plans.

Fish and Aquatic Species at Risk (estimates for FY 2004, \$0.4 million; FY 2005, \$0.4 million; FY 2006, \$0.4 million) — USGS scientists are involved in efforts to provide scientific information to managers to develop strategies to conserve species before they become listed, thereby

avoiding associated constraints and conflicts. Species-at-risk projects support conservation science options and actions that reduce the need for listing species as threatened or endangered. Projects focus on species for which there is concern over possible endangerment or additional scientific information is needed to assess the level of risk. Projects involving population viability analyses and investigations of factors causing the decline of aquatic species generate new information to support imperiled species protection, conservation and restoration.

Fish Passage (estimates for FY 2004, \$2.1 million; FY 2005, \$2.0 million; FY 2006, \$2.0 million) — The USGS conducts research on fish and other aquatic species in impounded rivers across the United States. The USGS maintains a unique facility, the S.O. Conte Anadromous Fish Research Laboratory in Turner Falls, MA, designed to develop, adapt, and test structures that allow fish to bypass dams or other obstructions that limit access to spawning grounds and migration routes, and affect the long-term survival of at-risk resident and migratory aquatic species. Information is developed on physiological, behavioral, and hydraulic phenomena that determine the successful navigation of barriers by fish and other at-risk aquatic species and the efficiency of artificial structures designed to allow passage through or around obstacles.

Great Lakes (estimates for FY2004, \$4.0 million; FY 2005, \$4.4 million; FY 2006, \$4.7 million) — USGS scientists focus research investigations on the genetics, life history, trophic interactions, health, habitat requirements, and ecology of deepwater and near shore fisheries and aquatic resources in the Great Lakes and tributaries. The Fisheries: Aquatic and Endangered Resources program research investigations coordinate with the Status and Trends program monitoring activities in the Great Lakes Deep Water Science - Large Vessels program. Long-term, large-scaled multiyear strategic investigations support coordinated, inter-jurisdictional adaptive management of the aquatic resources of the five Great Lakes. Interdisciplinary research is conducted with other USGS programs, the surrounding States, Canadian natural resource agencies, Tribes and First Nations, and non-governmental agencies in response to research needs identified by the regional cooperators and the Great Lakes Fishery Commission. The goal is to provide scientific research and technological assessment tools that further the conservation and restoration goals of the Great Lakes basin fisheries and aquatic resources management agencies. The Deep Water Science - Large Vessels program is unique in its ability to sample the deep, offshore areas of the Great Lakes, and to offer coordinated research and monitoring opportunities to regional natural resource managers. Program investigations have documented population cycles in native and invasive species, and displacement of native species by introduced and exotic species. USGS scientific research in support of inter-jurisdictional management of the Great Lakes fish and aquatic resources facilitates information transfer across jurisdictional boundaries to promote ecosystem level adaptive management, conservation, and restoration in the Great Lakes basin.

Chemical and Drug Approval and Registration (estimates for FY 2004, \$0.8 million; FY 2005, \$0.8 million; FY 2006, \$0.8 million) — The USGS collaborates with the FWS, the USDA Agriculture Research Service, the International Association of Fish and Wildlife Agencies, and participating drug sponsors in a major national effort to conduct the research necessary to develop the data required for broad aquaculture drug approvals. The highly leveraged nature of the project ensures that both Federal and State public fish hatcheries and the private aquaculture industry make drugs available for use on the numerous fish species cultured. Concurrent use of aquaculture facilities at all three agencies enables testing and research of cold, cool, and warm water fish species to occur simultaneously. USGS scientists complete research components, technical sections, and data delivery required by the Federal Food and Drug Administration, Center for Veterinary Medicine for fish drug and chemical approvals.

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Coastal Fisheries — USGS scientists are studying how coastal and estuarine fish and other aquatic species are affected by changes in their habitat and interactions with other resident and migratory species. Genetics, health, population densities, size and age distributions, and the recruitment dynamics of commercially important species including Pacific halibut, Dungeness crabs, white abalone, and red sea urchins are investigated in relation to the distribution and abundance of critical habitat, such as crab spawning areas. The USGS is developing unique systems for aquatic habitat mapping using a combination of advanced sonar techniques, hydroacoustics, remote sensing, and advanced tagging techniques. Models of coastal and estuarine benthic biohabitats and coastal and estuarine community dynamics provide aquatic resource managers with information to conserve and restore important aquatic resources.

Quick Response Program – Fisheries Issues (estimates for FY 2004, \$0.3 million; FY 2005, \$0.3 million; FY 2006, \$0.3 million) — This program was established in FY 1994, to provide quick-turn-around research or technical assistance requested by the FWS. Studies undertaken by this program involve scientific research that is short-term and provides critical scientific information about aquatic species and aquatic habitats required for making credible and effective adaptive management decisions. The research addresses many priority issues including anadromous fish and aquatic invasive species, threatened and endangered species, management of public waters and lands, and environmental contaminants.

Fish Biology — The USGS fishery research program examines the biology, genetic diversity, and health, all phases of the life cycles of fish and other aquatic organisms, and their habitat requirements. The goal is to develop research to answer the science information needs of fishery managers to aid the development of techniques to restore fish populations. USGS research on imperiled and at-risk fishes and other aquatic organisms focuses on species and habitat interactions, competition with non-native species, and changes in water availability and water quality associated with watershed characteristics, land use, and the diversion and impoundment of rivers and streams.

Fish Genetics — Studies in fish genetics characterize the diversity, variability and taxonomic status of individuals, stocks, races, and populations. Genetic information is used to help manage conservation, restoration, and harvest strategies to sustain populations. USGS efforts include identifying genetic traits to aid restoration program for Atlantic and Pacific salmon, lake trout, and native mussels, among others.

Fish Disease — Fish disease research focuses on development of new techniques for the detection and identification of emerging pathogens and causative agents, disease resistance and immunology, and understanding the role of stress and environmental factors upon disease outbreaks, severity, and cycles. Improved diagnosis of disease and the identification of new and invasive aquatic pathogens are used to recommend and develop methods that control the distribution and transmission of diseases of aquatic organisms and affect aquatic species restoration efforts.

Native Mussels — The USGS is a nationwide leader in research and monitoring of native freshwater mussel populations. Freshwater mussels are an important but threatened component of aquatic ecosystems. The factors that make freshwater mussels excellent indicators of water quality also make them vulnerable to habitat destruction, changes in hydrological conditions, sedimentation from upland sources, and water pollution. USGS research activities determine their life histories, hosts, distribution and abundance, and identify how invasive species and environmental degradation of streams, rivers, and lakes are affecting

mussel populations. Techniques developed by USGS biologists are used by the FWS to hold, propagate, relocate, and reintroduce native mussels.

Large Rivers — USGS research related to water availability and the unique aquatic resources and conditions found in America's large rivers, such as the Colorado, Missouri, Mississippi, and Columbia, is providing vital information on fish community structure and function, critical habitat, hydrology and hydraulics of the rivers, sediments, and water quality. Water managers use this information to respond to increasing demands and legal mandates for water allocations, high-quality water, and reliable and integrated scientific information on aquatic systems for science-based decisionmaking and adaptive management to sustain biological communities.

Wildlife: Terrestrial and Endangered Resources

(Estimates for FY 2004, \$37.0 million, 286 FTE; FY 2005, \$36.0 million, 274 FTE; FY 2006, \$35.4 million, 274 FTE)

Research conducted in the Wildlife: Terrestrial and Endangered Resources (WTER) program focuses on meeting the wildlife-related information needs of DOI's natural resource management bureaus and other partners as authorized by law. This program supports investigations to determine factors influencing the distribution, abundance, and condition of wildlife populations and communities. Studies also focus on developing the tools and methods needed to prevent and manage disease in free-ranging wildlife populations and evaluate the effects of disease on wildlife populations. This program supports DOI's Resource Protection strategic goal of sustaining biological communities.

Program goals, as outlined in the program's 5-year plan, are to:

- Provide the scientific foundation for the conservation of terrestrial plants, wildlife, and habitats by developing the basic biological information that partners need to formulate adaptive management strategies,
- Provide tools and techniques for effective science-based management, such as predictive models, decision support systems, and expert systems,
- Identify the factors that contribute to and (or) limit the conservation and recovery efforts for terrestrial plant and wildlife species-at-risk,
- Institute an adaptive science approach to support the adaptive management of terrestrial plants and wildlife and provide technical assistance to natural resource managers, and
- Continue to build additional research capabilities, expertise, and to meet the emerging needs of USGS partners as wildlife issues take on new importance in today's society.

Reversing the rapid loss of biological diversity remains one of the greatest challenges to natural resource managers. The reasons for species decline are numerous and include habitat loss, habitat degradation, competition with invasive species, environmental contaminants, and disease, among others. Restoring declining wildlife populations thus depends on an integrated program of research to develop critical information on the biology of individual species and the ecological relationships among those species, their communities, and their habitats. Through investigations that link physical, chemical, and biological factors impacting species composition and health, the USGS provides land and resource managers with the tools needed to address these issues.

Biological Research and Monitoring Subactivity

Imperiled species research focuses on identifying factors responsible for the decline of threatened and endangered species populations, and assisting in the development of management plans and methods to restore depleted populations and to prevent further declines. USGS imperiled species research supports recovery of species already having legal status under the Endangered Species Act of 1973, as amended, as well as those in long-term population decline but not yet listed. To help managers achieve the goals of recovery plans, USGS scientists investigate the life requirements of imperiled species and factors limiting their populations. Better knowledge of both requirements and limitations is needed for managers to act effectively to promote restoration of populations.

Cooperative studies among the USGS National Wildlife Health Center, other USGS science centers, the Southeastern Cooperative Wildlife Disease Study, State natural resource agencies, and the International Association of Fish and Wildlife Agencies are now underway to determine causes and impacts of wildlife diseases such as West Nile Virus and chronic wasting disease. In addition, efforts have begun to examine interactions between wildlife and human diseases. This work is being conducted in partnership with other Federal agencies, such as the Department of Health and Human Services and the U.S. Department of Agriculture.

High Priority Wildlife Research for the FWS (estimates for FY 2004, \$2.0 million; FY 2005, \$2.0 million; FY 2006, \$2.0 million) — The FWS looks to the USGS for science-based decisionmaking approaches to address its resource management needs in fields such as habitat management, species at risk, invasive species, and wildlife population monitoring. The USGS is developing tools and technology such as inventory and monitoring protocols to assist wildlife refuges, tools to measure the effects of land management practices on habitats of declining and at-risk species, and technical assistance to help determine the needs for habitat conservation planning.

Endangered Wildlife and Terrestrial Species (estimates for FY 2004, \$7.7 million; FY 2005, \$7.6 million; FY 2006, \$6.6 million) — USGS endangered species research provides biological information needed to restore currently listed populations, support delisting wherever possible, or preclude future listings by clarifying species' status or suggesting timely preventive actions. The key to both protecting species and preventing the listing of additional species that occupy the same habitats is habitat conservation planning. In partnership with DOI resource management bureaus and with State and local governments, USGS scientists are providing the sophisticated technical knowledge required to develop and implement effective habitat conservation plans.

Wildlife and Terrestrial Species at Risk (estimates for FY 2004, \$0.5 million; FY 2005, \$0.5 million; FY 2006, \$0.3 million) — USGS scientists are also involved in efforts to conserve species before they become listed, thereby avoiding associated constraints and conflicts. Species-at-Risk activities lead to conservation options and actions that reduce the need for listing species as threatened or endangered. Projects focus on species for which there is concern over possible endangerment or additional field evidence is needed to assess the risk. Projects involving population viability analyses and investigations of factors causing the decline of species generate new information to support species protection and restoration efforts.

Migratory Birds (estimates for FY 2004, \$1.0 million; FY 2005, \$1.0 million; FY 2006, \$1.0 million) — USGS research efforts on migratory birds are international in scope and are coordinated with the FWS, and State fish and wildlife agencies, and the Canadian and Mexican wildlife agencies. Migratory bird research includes projects on individual species, communities,

habitat relationships, and applied work on increasing the number and diversity of birds. These research efforts support the Interior Department's stewardship responsibilities in the broadest sense. The USGS helps to provide the scientific support to achieve the objectives of the North American Bird Conservation initiative. This initiative focuses on managing the populations and habitats of birds that are protected, restored, or enhanced through coordinated efforts at the national, regional, State, and local level, guided by sound science and effective management. For example, USGS bird research data are crucial to the FWS and the States in the management of migratory waterfowl populations. The USGS also conducts scientific research necessary in conservation planning for endangered bird species such as whooping cranes, native Hawaiian birds, declining grassland birds, neotropical migrant songbirds, shorebirds, and many others. Research into threats such as wildlife disease (e.g., West Nile Virus and avian influenza), habitat loss, and contaminants is an important part of the program.

Quick Response Program – Wildlife Issues (estimates for FY 2004, \$0.3 million; FY 2005, \$0.3 million; FY 2006, \$0.3 million) — This program was established in FY 1994 to provide unforeseeable research or technical assistance support requested by the FWS. Studies undertaken by this program involve scientific research that is short-term and provides critical information required for making credible and effective resource management decisions. The research addresses many issues, including the management of public lands, environmental contaminants, threatened and endangered species, and terrestrial invasives.

Natural Resource Preservation Program (NRPP) (estimates for FY 2004, \$2.8 million; FY 2005, \$2.7 million; FY 2006, \$2.7 million) — USGS biologists also conduct short-term, tactical research to meet the natural resource management needs of the NPS. NRPP funds help fill gaps in applied biological research in the Nation's National Parks and allow the USGS to address research needs significant to park resource managers. USGS investigators deliver NPS park superintendents timely results that analyze the issue, evaluate management options, and provide a variety of possible solutions. The NPS provides comparable funding that enables them to implement management actions recommended by the USGS.

Wildlife Disease (estimates for FY 2004, \$5.9 million; FY 2005, \$5.8 million; FY 2006, \$5.8 million) — Each year, Federal and State wildlife managers across the United States are confronted with sick and dying animals, often on a large scale. Managing such wildlife losses and minimizing disease outbreaks depends on effective diagnostic and technical support, knowledgeable guidance, and timely intervention. The USGS National Wildlife Health Center (NWHC) has a unique mission to provide information, technical assistance, and research on State, national, and international wildlife health issues. The NWHC monitors wildlife disease and assesses the impact on wildlife populations, defines ecological relationships leading to the occurrence of disease, transfers technology for disease prevention and control, and provides guidance, training, and onsite assistance to State and Federal wildlife managers when disease outbreaks occur. Due to the mobility of wildlife and the potential for the spread of disease, timely and accurate determination of the causes of wildlife illness and death is a prerequisite to achieving effective disease control and prevention. Other USGS science centers aid in determining the impacts of wildlife disease on populations. Expertise on modeling, population dynamics, behavior, genetics, and wildlife movements contribute to the overall understanding of disease ecology and the development of control and prevention strategies.

West Nile Virus (estimates for FY 2004, \$1.0 million; FY 2005, \$1.0 million; FY 2006, \$1.0 million) — The USGS assists the Centers for Disease Control and Prevention (CDC) and State and Federal agencies in the national West Nile Virus Surveillance program through viral testing of wildlife specimens, primarily birds, at diagnostic

Biological Research and Monitoring Subactivity

laboratories such as the NWHC. The USGS also collaborates with these agencies to document the geographic spread of the virus across the United States and to increase the understanding of the U.S. epidemic since it was first discovered in New York City in 1999. Concurrently, the USGS is working cooperatively with State and Federal natural resource and wildlife agencies to investigate regional wildlife mortality events (die-offs) potentially associated with West Nile Virus (WNV).

By the end of the 2004 season, WNV was active in 47 States and the District of Columbia. Over 2,230 human cases of WNV infection were reported to CDC in 2004 and the number of human deaths attributed to WNV numbered 73. The rapid spread of this virus across the Nation has brought it into contact with a large number of susceptible animal species.

The USGS, in collaboration with several State and Federal agencies and organizations, is investigating the impact the virus has had on wildlife populations in those areas already affected and the impact the virus may have in areas not yet affected such as Hawaii. In January 2004, the USGS co-sponsored a WNV workshop for Hawaiian organizations that are preparing for the disease. This included partner organizations in the Federal, State, and private sectors that deal with public health and wildlife conservation issues.

Chronic Wasting Disease (estimates for FY 2004, \$2.7 million; FY 2005, \$2.6 million; FY 2006, \$2.6 million) — The USGS, along with the U.S. Department of Agriculture and a number of State and Federal agencies, is involved in critical research and information sharing on chronic wasting disease (CWD). CWD is a fatal disease affecting elk and deer and belongs to the same family as mad cow disease in cattle and scrapie in sheep. Originally observed in only captive animals, it has recently been discovered in wild deer populations in Wisconsin, Colorado, Wyoming, Illinois, Nebraska, Utah, South Dakota, and New Mexico. State wildlife agencies, governors, and members of Congress have great concern about the possible spread of the disease, both geographically and to livestock and humans. States are looking to USGS to provide research, technical assistance, and other forms of support to combat CWD.

To help meet the need, USGS scientists are investigating how CWD is transmitted, what conditions lead to disease outbreaks, and how to manage outbreaks once they occur. In addition, the Disease Information Node of National Biological Information Infrastructure has developed a CWD Data Clearinghouse that provides a means for State and Federal agencies to share CWD-related data quickly and securely. The USGS also continues to fund cooperative State proposals from State wildlife agencies and universities to further enhance the research effort. Together, the USGS and its State partners are creating geospatial models to analyze patterns of disease occurrence and to develop new hypotheses and research plans to assist managers.

Amphibian Research and Monitoring (estimates for FY 2004, \$3.0 million; FY 2005, \$2.9 million; FY 2006, \$2.9 million) — In response to alarming declines in amphibian populations in the United States and throughout the world, several DOI bureaus have undertaken a national Amphibian Research and Monitoring Initiative (ARMI). The USGS, as the science bureau for DOI, leads a coordinated effort extending beyond DOI to include other Federal, State, and academic partners, to determine the status of amphibian populations nationwide and investigate potential causative factors for their decline. A steering committee, with members representing Federal land management agencies and other amphibian

conservation organizations, provides guidance and recommendations to the ARMI program. ARMI coordinators in seven regions throughout the country conduct amphibian population status and trend surveys on Federal lands, develop and test new monitoring protocols, and evaluate habitat conditions. Interdisciplinary science teams conduct research on the potential causes of amphibian declines and malformations in the United States such as contaminants, habitat alteration, predation, invasive species, and disease.

Alaska Research (estimates for FY2004, \$2.5 million; FY 2005, \$2.4 million; FY 2006, \$2.4 million) — The USGS plays a pivotal role in conducting research on wildlife and their vast habitats in Alaska. Federal public lands in the State represent an overwhelming landscape (equivalent in size to the entire Eastern Seaboard from Maine through Florida). Nearly 88 percent of all national wildlife refuge lands and 65 percent of all National Park lands are in Alaska. The Biological Science Office of the Alaska Science Center is responsible for research in support of trust lands and waters (including those of the NPS, FWS, BLM, and Minerals Management Service (MMS)) and DOI trust species (including migratory birds, marine mammals, and anadromous fish) in Alaska, providing scientific information essential for resource management decisions.

Terrestrial, Freshwater, and Marine Ecosystems

(Estimates for FY 2004, \$30.5 million, 238 FTE; FY 2005, \$30.0 million, 229 FTE FY 2006, \$32.3 million, 231 FTE)

The USGS ecosystems research program focuses on understanding how ecosystems (diverse communities of living organisms interacting with one another and with the physical environment) are structured, function, and provide “ecosystem services.” The health of ecosystems and ecosystem processes strongly influences environmental conditions and services of major concern to humans, such as the productivity of animals and plants, aquatic community health, local and global biodiversity within landscapes, air and water quality, and response to natural and human-induced events such as fires, floods, and mudslides. Studies of ecosystem productivity, food-web relationships and energy flow, the cycling of nutrients and other biogeochemical processes, and the diversity of biological communities are examples of such research. Investigations seek to identify, explain, and predict the consequences of short- and long-term changes in the environment. Activities include assessing the effects of environmental change on ecosystems and ecosystem processes and providing the information resource managers need to manage natural systems and mitigate adverse effects. Topical areas for ecosystems research include the ecology of wetland, lake and river, forest, arid land, arctic, and grassland ecosystems, disturbances and landscape ecology, modeling ecological systems and quantifying ecosystem services, systems restoration ecology; fire ecology, and global change. This program supports DOI’s Resource Protection strategic goal of improving health of watersheds and landscapes that are DOI managed or influenced. The program’s five-year plan will be completed in FY 2005.

Science on the DOI Landscape — This initiative supports USGS performance in meeting the DOI Resource Protection outcome goal of improve health of watersheds, landscapes, and marine resources that are DOI managed or influenced to meet the increased needs for requested research and tactical science to DOI bureaus. DOI bureaus rely on the USGS as the Department’s science bureau to provide science information and technical assistance to enhance the information base, information management, and technical assistance for the bureaus to meet the goals of Resource Protection on DOI lands.

Biological Research and Monitoring Subactivity

The USGS proposes a technical adjustment to funding for DOI Science on the Landscape efforts, transferring \$828,000 from the Geology and Water activities to the Biological Research and Monitoring (BRM) subactivity. The nature of this program is to fund DOI bureau priorities current at the time of appropriation. The priorities of the DOI bureaus can change dramatically from the time of original budget planning to allocation, which can be as much as 2 years later. In FY 2004, reallocation requirements resulted in unnecessary complexity in tracking dollars and performance data. Appropriating all funding to BRM, which already receives the largest share of funding, provides more flexibility in allocating funds appropriately to meet current and future priority requests for DOI science at the time of appropriation. All projects are interdisciplinary, and funds will continue to flow to appropriate USGS programs to meet changing priorities.

This technical adjustment furthers the Management Excellence DOI Strategic Goal, specifically “Strategy 2. Improved Financial Management” under “End Outcome Goal 2. Accountability.”

In FY 2006, the USGS proposes an increase of \$750,000 for Science on the DOI Landscape to increase support to meet regional priorities designated by the DOI bureaus. Criteria for funding definitive study sites and research objectives in FY 2006 will be based primarily on DOI bureaus’ needs, as well as on funding availability, partnership opportunities, and urgency (tactical science). Based on current knowledge of priority needs, USGS will focus on integrated studies that address regional issues such as ecosystem restoration and sustainability in eastern coastal areas and the Mojave Desert (BLM, FWS, NPS, MMS, OSM), landscape and ecological changes in the Lower Colorado River, Great Basin and Columbia Plateau ecoregions, and National Petroleum Reserve - Alaska (BIA, BLM, BOR, FWS, NPS), and rapid response on technical assistance (BIA, BLM, BOR, FWS, NPS). Detailed information on this initiative is available in the Regional Section on page F - 7.

Coastal Habitats, Wetlands, and Adjacent Uplands — Coastal wetlands and adjacent freshwater habitats have suffered significant losses this last century. USGS biologists investigate wetland structure and function (including Great Lakes habitats) to assess the effects of human activities, predict environmental changes, determine restoration actions required for these systems, and measure the effectiveness of management actions. Studies examine the ecological responses of coastal wetlands to multiple stressors such as sea-level rise and nutrient inputs. Locations of major ongoing or planned research include the Gulf of Mexico, Chesapeake Bay, South Florida, San Francisco Bay, the North Atlantic coast, the Great Lakes, and the Puget Sound watershed. Effects of sea level change and coastal systems are being studied and monitored along the Atlantic and Gulf coasts. Research into non-native species impacts and the effects of disturbances, such as canal dredging, hurricanes, shoreline modifications, and floods are ongoing. Methods and standards for restoring coastal wetlands and habitats are under development, adaptive management evaluations are being conducted, and monitoring and modeling are underway to design restoration and management tools.

Fire Ecology (estimates for FY 2004, \$2.7 million; FY 2005, \$2.7 million; FY 2006, \$2.7 million) — The USGS conducts fire ecology research to understand the effects of wildland fire on wildlife habitat and ecosystem structure, function, sustainability, and restoration. Emphasis is on the role of fire in the restoration of rangelands and the effectiveness of fire/vegetation treatments in the control of invasive plants. Several studies are being conducted including projects to evaluate post-fire restoration in Pinyon-juniper habitats in northern Arizona, fire behavior and effectiveness of fuel treatments in blackbrush shrublands, and effectiveness of post-fire seeding to reduce invasive cheatgrass growth and reproduction in sagebrush steppe. USGS is participating in a national study with the BLM, USFS, and several universities to evaluate the effectiveness and appropriate balance among mechanical fuel treatments and

prescribed fire in sequoia-dominated ecosystems. Studies are conducted to determine how the frequency, intensity, and geographic scope of fires influence the distribution and abundance of key wildlife species. USGS conducts studies funded by the Joint Interior-Agriculture Fire Science Program to address fuels management and fire hazard reduction.

The USGS has recently been invited to join the Wildland Fire Leadership Council (WFLC). The WFLC is a senior level fire policy group composed of the DOI bureau directors, the Chief of the USFS, FEMA, and other agencies and organizations.

Outer Continental Shelf Marine Environmental Studies (estimates for FY 2004, \$2.4 million; FY 2005, \$2.4 million; FY 2006, \$2.4 million) — The Minerals Management Service (MMS) needs information on the long-term effects of offshore oil and gas exploration and production, including the effects of production platforms on fish and deep sea corals, and changes to existing biological conditions in areas of potential or new production. USGS scientists collaborate with the MMS to determine the health and appraise the vulnerability of marine biological communities that could be affected by offshore oil and gas exploration and production.

Coral Reefs (estimates for FY 2004, \$0.5 million; FY 2005, \$0.5 million; FY 2006, \$0.5 million) — Coral reefs and associated sea grass beds, mangroves, and estuarine ecosystems are declining worldwide. Near shore and deep reef ecosystems under DOI jurisdiction in Hawaii, Florida, the U.S. Trust Territories in the Pacific, and the Caribbean are among the most productive systems on Earth, but many are experiencing poorly understood decline. Causes of decline likely include increased sedimentation, declining water quality, disease, and over-fishing. USGS research on issues facing land and water managers include: understanding conditions needed for productive and healthy reef communities, understanding terrestrial contributions to reef health in support of U.S. Coral Reef Task Force resolutions, and assessing abiotic and biotic factors contributing to coral disease and decline. USGS scientists are also evaluating human activities and management options in marine parks and refuges and their influence on reef integrity and biodiversity.

Rangelands and Grasslands — The USGS conducts studies on native grasslands and managed rangelands to quantify ecosystem condition, determine rare plant patterns, appraise species richness, and identify areas of native plant diversity. Such studies provide baseline information for managers and underpin measures of human-induced stress in natural biological communities and the development of management actions for restoring and maintaining the productivity of managed public rangelands.

Deserts and Arid Lands — In the Southwest, USGS scientists are investigating soils and the effects of disturbance on different soils units. Drought, high winds and low precipitation, and soil disturbance result in severe dust events. The effects of these events on highway operations have caused severe accidents and highway shutdowns. These studies have provided a scientific basis for recommendations by management agencies on the use of these lands during different environmental conditions, such as high winds or drought.

Prairie Wetlands — Prairie pothole wetlands serve as the principal breeding ground for water birds in the Great Plains and the principal staging area for migratory sandhill cranes, shorebirds, and arctic-nesting waterfowl. Restored prairie potholes may play an important role in sequestering carbon within the landscape. USGS researchers are investigating factors influencing the use of restored wetlands by birds, amphibians, macroinvertebrates, and quantifying the recovery of non-wildlife functions such as carbon sequestration.

Biological Research and Monitoring Subactivity

Landscape-scale studies focus on the interactions of wetland biota with hydrology, geochemistry, and sedimentation in this fragmented mix of grassland and wetland habitats.

Forested Wetlands — Forested wetlands are one of the most rapidly declining wetland types in North America. USGS research focuses on wetland regeneration and restoration in the southeastern United States, including site selection and preparation; seeds, seedlings, seedbanks, forest mix, and biodiversity enhancements; planting and management procedures; and monitoring. Research is providing information for managing forested wetland flora and fauna, including economically valuable species and species at risk. Scientists are quantifying the role forested wetlands play in nutrient cycling, the retention of nutrients, and the regulation of nutrients entering waterways.

Pacific Northwest Forest Program (estimates for FY 2004, \$3.0 million; FY 2005, \$2.9 million; FY 2006, \$2.9 million) — Pacific Northwest forest planning calls for major changes in the management of forests on Federal lands to ensure that species associated with old-growth forest and riparian ecosystems have suitable habitat throughout their ranges. USGS biologists identify the essential habitats and life history requirements of key sensitive species and develop resource management options and tools so land managers can maintain biodiversity through sound ecosystem and resource management practices.

Global Change (estimates for FY 2004, \$5.6 million; FY 2005, \$6.3 million; FY 2006, \$6.3 million) — This research program began a new 5-year research program that is based on the new Strategic Plan for the U.S. Climate Change Science Program. This work specifically addresses goals and products in the Chapter 8, Ecosystems of the Strategic Plan. Global change research goals are to (1) determine sensitivity and response of natural systems to climate change and environmental factors at local, landscape, and regional levels, (2) predict future global change impacts on the structure, function, and viability of natural systems, (3) describe and quantify the role of natural and restored ecosystems in the global carbon cycle, and (4) develop and test management options for adapting to the effects of global change and reducing undesired effects of global change.

New areas of emphasis are: sequestration of carbon in prairie potholes, forested wetlands, and temperate forests, effects of changing climate on coastal forests, and effects of sea-level rise on coastal areas. This includes expansion of an ongoing study of the response to climate variability and change of fire adapted mountain ecosystems in several National Parks in the West. Studies in the Arctic address the effect of vanishing sea ice on polar bear survival and the influence of broad scale climate effects on salmon growth and survival. Pacific island studies address sensitivity of tropical mountain cloud forests to climate change and the resilience of corals to climate change.

Invasive Species

(Estimates for FY 2004, \$9.2 million, 57 FTE; FY 2005, \$9.5 million, 57 FTE; FY 2006, \$10.0 million, 57 FTE)

Non-indigenous invasive plants, animals, and disease organisms cause increasing harm to native species and significant economic losses by reducing productivity and diminishing opportunities for beneficial uses of forests, croplands, rangelands, and aquatic resources. Many species introduced decades ago have begun to spread rapidly in U.S. ecosystems and pose increasing threats to lands and waters managed by the Department of the Interior. They harm native ecosystems and contribute to the predicament of 40 percent of threatened and endangered species. The economic costs associated with invasive species exceed

\$100 billion per year. This program supports DOI's Resource Protection strategic goal of sustaining biological communities.

The goals of the Invasive Species Program address:

- Prevention,
- Early Detection and Rapid Assessment of New Invaders,
- Monitoring and Forecasting of Established Invaders,
- Effects of Invasive Species,
- Control and Management, and
- Information Systems (in cooperation with Biological Information Management and Delivery subactivity).

Program goals, as outlined in the program's 5-year plan, are to:

- Conduct research on priority pathways,
- Develop innovative control methods,
- Develop a national forecasting system for invasive species, and
- Maintain a National Invasive Species Information Network.

For FY 2006, the Department has developed an inter-bureau budget request for invasive plants. This integrated budget effort focuses on specific species in three geographic areas, leafy spurge in the Northern Great Plains, Brazilian pepper tree in South Florida, and tamarisk in the Rio Grande Basin.

The Department is also continuing its participation in an interagency performance budget on invasive species that is coordinated through the National Invasive Species Council (NISC). The Department's bureaus work in partnership with other Federal agencies, State, local, and Tribal governments, and private sources to perform the seven functions of invasive species management: prevention, early detection and rapid response, control and management, restoration, research, education and public awareness, and leadership and international cooperation.

The USGS plays an important role in Federal efforts to combat invasive species in natural and semi-natural areas through early detection and assessment of newly established invaders, monitoring of invading populations, improving understanding of the ecology of invaders and factors in the resistance of habitats to invasion, and development and testing of prevention and alternative management and control approaches. USGS research on invasive species includes all significant groups of invasive organisms in terrestrial and aquatic ecosystems.

In FY 2005, Congress appropriated an additional \$500,000 to address critical research needs in two areas: working with partners to conduct research, detect and control the brown tree snake on Guam, and conduct research on strategies to prevent and control Asian carp and other

Biological Research and Monitoring Subactivity

aquatic invaders in the Mississippi River Basin, the southeastern United States and the Great Lakes Region. These research activities will continue in FY 2006.

The USGS plays a significant role in implementing the National Invasive Species Management Plan (Plan), developed by the NISC, as called for in the Presidential Executive Order on invasive species. To meet the goals of the Plan, the USGS Invasive Species program provides management-oriented research and delivers information needed to prevent, detect, control, and eradicate invasive species and to restore impaired ecosystems. Facilitating these efforts is the National Institute for Invasive Species Science, a growing consortium of partnerships between government and non-governmental organizations that is administratively housed in the USGS Fort Collins Science Center in Colorado. USGS researchers are leading or cooperating in efforts to integrate the capabilities of the USGS and partners, including Federal and State resource agencies, to help provide the information, methods, technologies, and technical assistance needed for effective responses to terrestrial and aquatic invaders threatening U.S. ecosystems and native species. An important focus is on developing models for predicting the probable spread and impacts of invaders, in cooperation with NASA Goddard Space Flight Center, the USGS EROS Data Center, and others.
(<http://www.nrel.colostate.edu/projects/niiss/niiss.html>)

To ensure the strategic allocation of resources to combat invasive species, the NISC, co-chaired by the Secretary of the Interior, the Department of Agriculture, and the Department of Commerce, developed the first interagency example of a performance-based budget. Based on common goal statements, strategies, actions, and performance measures, the NISC selected priority topical and geographical areas of focus, and member agencies developed coordinated budget requests to address these. The Department participates in the development of this interagency performance budget on invasive species which links spending levels with levels of performance.

Hawaiian Invaders — Hawaii's flora and fauna, which evolved in a high degree of isolation, are unusually susceptible to selective pressures from invasive species. Hawaii has the largest proportion of non-indigenous species of any State. Its ecosystems are especially vulnerable to the introduction and spread of invasive species due to increasing human travel and trade. USGS research focuses on the ecology and control of highly invasive plants (e.g., miconia, faya tree, strawberry guava, Kahili ginger), including exploration and testing for biological control agents; animals (e.g., Argentine ant, yellow jackets, brown tree snake on Guam); wildlife disease organisms; and methods for reducing the impacts of invasive species on the region's unique native flora and fauna.

Weeds in the West — The USGS is conducting a multiscale, integrative program for mapping infestations and accurately monitoring the spread of invasive plants (i.e., weeds) in western forests and rangelands, improving methods for predicting areas most vulnerable to invasions, and assessing the effects of management practices and natural disturbances on invasions. The USGS is assessing the effects of invasions on ecosystems and native species (e.g., fire ecologists are determining how invasive species alter the frequency and intensity of wild fires) and providing improved methods for reducing the adverse impacts of invasive weeds and for restoring public range lands affected by weed invasions.

Invasives in the East — The USGS conducts research on invasive species that threaten ecosystems and native species in the eastern United States. These efforts include terrestrial and aquatic surveys of non-indigenous species in eastern parks and wildlife refuges, studies of pathways for establishment and spread of invasive species, research on the impacts of invasive

species and factors in invasions (e.g., management history, natural and human caused disturbances), and development of methods to control or eliminate invasive species to promote healthy native communities that are resistant to invasion.

Great Lakes Invaders — USGS research supports cooperative efforts in the Great Lakes region to prevent and control the spread of invasive fish, such as the round goby and sea lamprey, reduce the pervasive impacts of zebra mussels on U.S. waterways, and manage or mitigate the adverse ecological and economic impacts of the invaders.

2004 Program Performance Accomplishments

Unless otherwise noted, the program accomplishments listed below demonstrate the utility of scientific publications and other products that are counted under the output measures for "systematic analyses and investigations delivered to customers" and "number of formal workshops or training provided to customers."

Program: Status and Trends of Biological Resources

Project Name: Ecotoxicological Data Gaps for Terrestrial Vertebrates Residing in National Wildlife Refuges and National Parks in Coastal Areas of the United States

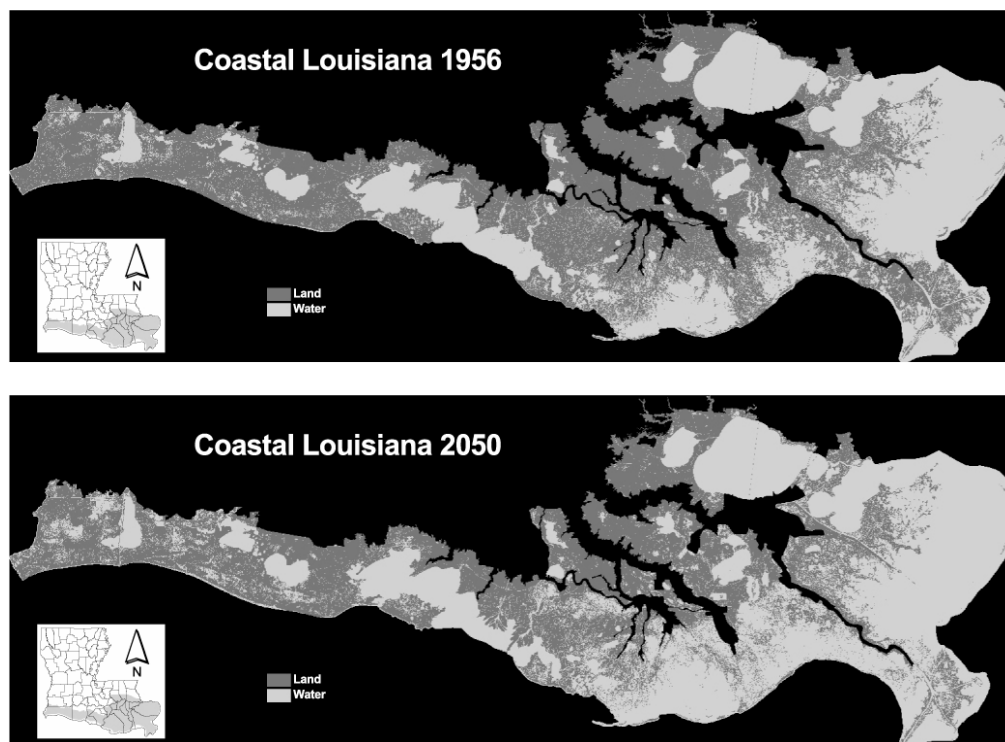
Project Description: The Contaminant Exposure and Effects -Terrestrial Vertebrates (CEE-TV) database has been updated in 2004 and now contains 16,696 data records on free-ranging amphibians, reptiles, birds, and mammals residing in estuarine and coastal habitats of the Atlantic, Gulf, and Pacific coasts, Alaska, Hawaii and the Great Lakes. An analysis of this database was performed in 2004 to identify spatial data gaps. More than 11,300 database records with specific sampling locations were combined with the boundaries of coastal watersheds, National Wildlife Refuges, and National Park units. Terrestrial vertebrate ecotoxicological data were lacking in 41.9 percent of 464 coastal watersheds in the continental United States. Recent (1990 through 2003) terrestrial vertebrate contaminant exposure or effects data were available for only about half of the National Wildlife Refuges and National Park units in the geographic area encompassed by the database. When these data gaps were overlaid on watersheds exhibiting serious water quality problems and (or) high vulnerability to pollution, 72 coastal watersheds, 76 National Wildlife Refuges, and 62 National Park units in the continental United States were found to lack recent terrestrial vertebrate ecotoxicology data. Delineation of data gaps in watersheds of concern helps Department of Interior land managers prioritize monitoring in areas with impaired water quality, and emphasize the need for comprehensive monitoring to gain a more complete understanding of coastal ecosystem health.

Biological Research and Monitoring Subactivity

Program: Status and Trends of Biological Resources

Project Name: Louisiana Coastal Area (LCA) Ecosystem Study

Project Description: Scientists from the USGS and other Federal and State agencies report that Louisiana lost approximately 1,900 square miles of coastal land, primarily coastal marshes, during the 20th century. To address this national issue, the U.S. Army Corps of Engineers and the State of Louisiana initiated the \$2.0 billion LCA ecosystem study. An important component of the LCA study is the projection of a “future condition” for the Louisiana coast if no further restoration measures are adopted. USGS scientists worked with the LCA land change study group to develop new land loss projections. The research effort concluded the projected magnitude of change by 2050 is the net loss of 513 square miles, however, loss could reach 674 square miles if gains from existing restoration efforts fail. In addition to projecting a “future condition” for coastal Louisiana, the current and projected land loss data has been incorporated into the LCA ecosystem model. The model was developed to establish a process to evaluate the various projects proposed to rehabilitate coastal Louisiana utilizing the concepts of restoration science.



Program: Status and Trends of Biological Resources

Project Name: SAGEMAP: a Web-Based Information Portal for Issues in Sagebrush Ecosystems in Western North America

Project Description: The USGS SAGEMAP project is the primary Internet source of spatial data and information important to shrub-steppe habitats and wildlife in western North America. Transferring this information is critical to management and research on species such as greater sage-grouse which now are considered for listing under the Endangered Species Act. In 2004, SAGEMAP was a key component in developing the Rangewide Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats sponsored by the Western Association of Fish and Wildlife Agencies. The authors, representing USGS and 14 agencies, depended on SAGEMAP resources to obtain and analyze more than 200 datasets representing sage-grouse

population trends, habitat characteristics, and influences such as fires, livestock grazing, oil/gas development, exotic plant species, and human development. Since completion of the assessment, the SAGEMAP site has been the primary platform to deliver the final document, datasets, and compliant metadata. Approximately 3,000 spatial data sets are now documented and available on the SAGEMAP site, which has been developed in collaboration with 9 Federal bureaus, 14 State and local agencies, 8 universities, and multiple non-government sources. In addition, research documents and data, management plans, guidelines, and bibliographies important for management and research in shrub-steppe regions are available. The site also provides updates on issues such as West Nile Virus and status of petitions for listing Endangered Species.



Greater Sage Grouse.

Program: Contaminant Biology

Project Name: California Mercury Clean-up

Project Description: The widespread historical use of mercury for processing gold resulted in mercury contamination of many Central Valley Rivers, the Sacramento-San Joaquin Delta, and the San Francisco Bay Estuary. Mercury continues to flow into the Bay and Delta from the Coast Range and Sierra Nevada. Using USGS evaluations of mercury in stream biota, and water and sediment, the USFS and the BLM were able to prioritize rivers and sites for remediation of contamination; selecting the Bear River, Deer Creek, and South Fork Yuba River watersheds as their highest priority.

Program: Contaminant Biology

Project Name: Making Restoration Possible

Project Description: The USGS works in partnership with the DOI including major trustee bureaus, on the Natural Resource Damage Assessment and Restoration (NRDAR) program. The DOI's NRDAR program funds the restoration of contaminated sites by assessing resource injuries to air, water, soil, sediment, and biological resources from exposure to oil or other hazardous substances. During 2004, USGS provided scientific technical support and scientific guidance to the DOI for 20 on-going NRDAR assessment cases across the country addressing injuries caused by both mining and industrial wastes. The assessment process uses many of the tools and technologies developed by the USGS. The preliminary remediation goals for contaminated sediments, developed by the USGS, are being used by FWS and the National Oceanic and Atmospheric Administration (NOAA) to make restoration decisions at Calcasieu estuary in Louisiana and from the Grand Calumet River NRDAR site in Indiana. At the Grand Calumet River site, USGS sediment injury studies and expert witness testimony supported a major restoration claim for DOI in August 2004, resulting in a restoration settlement

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of almost \$60.0 million and permanent protection of 233 acres of globally rare dune and swale habitats.

Program: Fisheries: Aquatic and Endangered Resources

Project Name: Science for Cost-Effective River Restoration

Project Description: The Upper Mississippi River System is undergoing one of the largest river restoration efforts in the Nation. The U.S. Army Corps of Engineers has invested more than \$100 million in restoration of habitat for fish, waterfowl, and plants, and has proposed integrated navigation improvement and ecosystem restoration that may cost as much as \$7.7 billion. These massive habitat restoration efforts are predicated on the assumption that “habitat” limits the production of fish and wildlife. In order to base restoration efforts on sound science, the Corps asked the USGS to investigate, monitor, and evaluate the potential connection between river habitat limitations on the abundance of specified economically important fishes. USGS scientists’ research findings determined that largemouth bass and other valuable fish populations were limited on reaches of the Upper Mississippi River with scarce amounts of ‘backwater’ areas (areas characterized as shallow and with low flow velocity). These research results are very important because 19 of 41 Corps proposed habitat restoration projects in the Upper Mississippi River System include features to enhance backwaters. USGS research indicates that restoration of backwater areas will produce the largest increases in abundance of fishes and demonstrates the high value of science to habitat restoration planning. Major partners are the FWS, U.S. Army Corps of Engineers, and the water resources and conservation agencies of the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The report: Challenging the assumption of habitat limitation: an example from centrarchid fishes over an intermediate spatial scale (Gutreuter, S., 2004, *River Research and Applications* 20:413-425) was the focus of the Upper Mississippi River Conservation Committee Fish Technical Section and will be used in selecting and planning restoration projects on the Upper Mississippi River.



Upper Mississippi River: Large rivers and their floodplains are among the most productive ecosystems in the world.

Program: Fisheries: Aquatic and Endangered Resources

Project Name: Relationships of Land Management to Imperiled Fishes in Aquatic Habitats

Project Description: The USGS, in collaboration with the BLM, Oregon State University, and Oregon Department of Forestry, has developed a probability-based sampling model that determines the effects of land-management activities on aquatic organisms and aquatic habitats. The relationship between land management and aquatic habitat is especially relevant for non-migratory species, such as the coastal cutthroat trout, now under consideration for

listing under the U.S. Endangered Species Act. USGS scientists developed the model that uses the watershed as the sample unit and measures variables at each level of the spatial hierarchy within each watershed. Researchers collected spatially continuous data throughout each of 40 watersheds in Oregon. The model illustrated the need to view fish habitat as a matrix of physical sites critical to the fitness and persistence of fish populations that are linked by movement. Results from the model studies are providing insight for BLM managers regarding land-use impacts and helping the BLM make better science-based land management decisions.

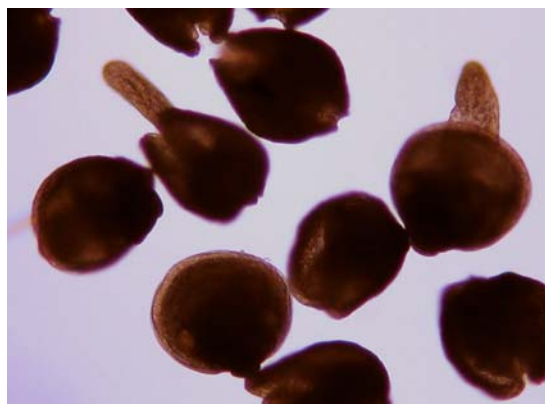


Coastal cutthroat trout from an Olympic Peninsula, WA, stream.

Program: Fisheries: Aquatic and Endangered Resources

Project Name: Missing Link Found for Endangered Native Mussels

Project Description: Freshwater mussels are the most imperiled group of animals in North America. The winged mapleleaf mussel (*Quadrula fragosa*), a federally-listed endangered species since 1991, exists only as a remnant population of 100 individuals in a 20-kilometer reach of the lower St. Croix River bordering Minnesota and Wisconsin. One critical data gap identified by the FWS's Winged Mapleleaf Recovery Team was a lack of knowledge of the fish hosts needed to transform mussel larvae into juveniles. Scientists from the USGS, the FWS, and the University of Minnesota collaborated in successfully transforming winged mapleleaf larvae on two fish species (blue catfish and channel catfish). Twenty-five thousand juveniles were produced and reintroduced to the St. Croix River. The newly identified fish hosts are now being used by the FWS's Genoa National Fish Hatchery to artificially propagate mussels to re-establish winged mapleleaf populations within its historic range.



Winged mapleleaf mussel (*Quadrula fragosa*).

Program: Wildlife: Terrestrial and Endangered Resources

Project Name: Sylvatic Plague Vaccine for Endangered Ferrets

Project Description: Through efforts at the National Wildlife Health Center, significant progress has been made toward developing sylvatic plague vaccines for both prairie dogs and the federally-endangered black-footed ferret. Sylvatic plague is a disease of wild rodents that was introduced into the United States in the early 1900s and has since spread throughout the

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western States. Prairie dogs are particularly susceptible, and mortality rates from the disease have been nearly 100 percent in some colonies. Black-footed ferrets, which prey exclusively on prairie dogs, are also highly susceptible to plague. This has hampered efforts of the FWS and others to re-establish these ferrets to their historic range. Tests on two different vaccines, one for ferrets and one for prairie dogs, have had successful results. Ferrets given the test vaccine via injection were able to resist contracting plague after being exposed to the bacteria. Over half of the prairie dogs immunized with an oral vaccine demonstrated resistance to plague, indicating future potential for mass immunization of wild prairie dogs. Resistance levels may still be improved through additional work on the oral vaccine.



The endangered black-footed ferret.

Program: Wildlife: Terrestrial and Endangered Resources

Project Name: Mountain Lion Research and Monitoring Effort Established in Colorado's the Front Range

Project Description: The USGS Fort Collins Research Center, in cooperation with the NPS and the Colorado Division of Wildlife, has established and completed the first stages of a monitoring and research project on mountain lions (*Felis concolor*) in the Front Range of the Rocky Mountains. As urbanization has increased throughout the region, information on mountain lions and management approaches that allow humans and mountain lions to co-exist are a top priority for Rocky Mountain National Park (RMNP) and for parks and natural resource agencies throughout the western United States. The project was designed to provide information on the life history, population characteristics, recruitment, mortality, home range, and habitat preferences of mountain lions in RMNP and adjacent lands. In addition, the project provides information on the effects of chronic wasting among prey species such as deer on mountain lion predation behavior. The project's interdisciplinary approach involved the use of new technologies for tracking the movement and activities of mountain lions. In 2004, two individual mountain lions were captured and outfitted with state-of-the-science radio collars to provide real-time GPS data to researchers so that the precise data on the movements and predatory activities of the individual mountain lions under study could be determined. In addition to the use of radio collars, non-invasive automated photographic techniques have also been used to track mountain lions in the park. The information gathered using these innovative techniques has assisted managers in RMNP and elsewhere to more safely manage human-mountain lion interactions and to sustain viable mountain lion populations in the face of growing habitat change. The project has also helped in establishing Federal, State and local agencies to form the Colorado Mountain Lion Research Group, which will establish long-term studies of mountain lions in the Front Range to facilitate their successful management and conservation.



Mountain Lion photographed in RMNP -- note camera on right (courtesy Rocky Mountain Lion Research Group).

Program: Terrestrial, Freshwater, & Marine Ecosystems

Project Name: Vegetation in the Central Mojave Desert

Project Description: Long-term management of natural vegetation in arid environments requires information on the vegetation types that are present and their location. Scientists from the USGS Southwest Biological Science Center collaborated with State and university partners to synthesize data from over 1,200 field plots to classify vegetation types in the eastern California Mojave and to map their distribution. The information was developed at the request of the Desert Managers Group, a consortium of Federal and State Mojave Desert land managers, to help guide actions on habitat protection, invasive species management, and fire planning. Vegetation alliances (101) are currently known to occur in the Mojave Desert; over 70 were described and 31 mapping units developed. The map and ancillary databases were completed in previous years. In FY 2004, the final report was completed. The report describes the mapping methods and alliances and provides a field key to the alliances. These maps are available to agencies and the public on the Mojave Desert Ecosystem program Web site (<http://www.mojavedata.gov/>). The Department of Defense Legacy project funded the study, which covers land managed by the BLM, two National Park units (Death Valley National Park and the Mojave National Preserve), and several Department of Defense facilities (Fort Irwin, China Lake, 29 Palms). The maps and associated data are already being used by agencies for fire modeling and management to design vegetation monitoring programs and to make measures of vegetation recovery after disturbances.



Vegetation in the Central Mojave Desert.

Biological Research and Monitoring Subactivity

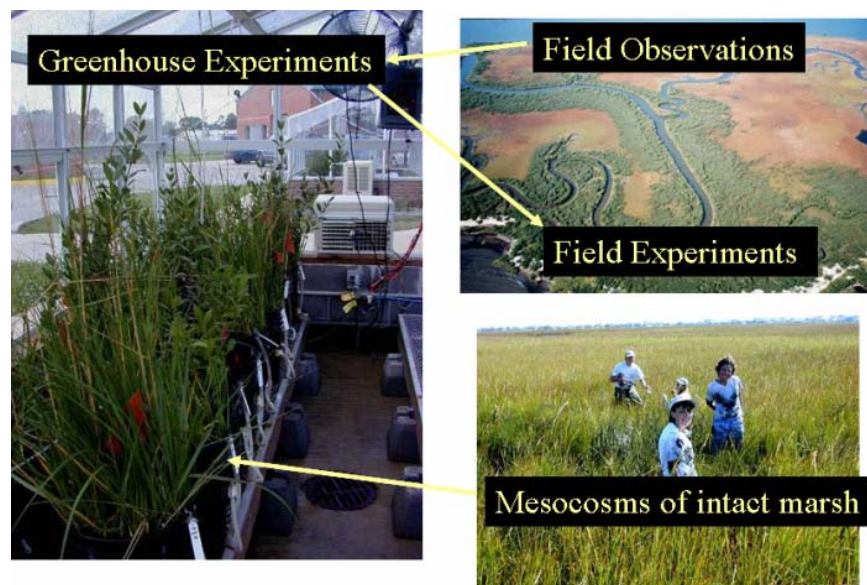
Program: Terrestrial, Freshwater, & Marine Ecosystems

Project Name: How Does CO₂ Effect Wetland Vegetation

Project Description: Increasing carbon dioxide (CO₂) concentrations that contribute to global warming and climate change can also have a direct impact on wetland plant growth by stimulating photosynthesis or improving water use efficiency. USGS scientists at the National Wetlands Research Center in Lafayette, LA, completed a multiyear study on the response of wetland plants to CO₂ and interactions with other factors. Three wetland plant community types were examined: a freshwater marsh, a brackish marsh, and a mangrove-salt marsh. Samples of these marsh types were established in the laboratory at ambient and elevated ambient CO₂ concentrations. The results of these experiments provide insights into biological and physical factors that modify the response of wetland plants to CO₂ and consequences for ecosystem functioning:

- Elevated CO₂ enhanced below-ground production of a brackish marsh community, but only at lower salinity levels, indicating that marshes additionally affected by sea-level rise and increased salinity may not respond to increases in atmospheric CO₂, and
- Increased below-ground production by black mangrove under elevated CO₂ treatment led to organic matter accumulation and increased soil elevation indicating the potential for elevated CO₂ to offset effects of sea-level rise on increased flooding.

These findings can be used to develop models to predict vegetation change in response to increases in atmospheric CO₂. Further, these results help understand influence of CO₂ on production-decomposition processes, nutrient cycling, carbon storage, and other factors important to wetland function. This information will also provide a better understanding of the ability of wetland plants to keep pace with sea-level rise and respond to future changes in global factors. Resource managers in the FWS, NPS, and State natural resource management agencies are using this information to develop better wetland management plans that can minimize adverse impacts of these future environmental changes on wetlands.



A combined field and greenhouse approach was developed and tested for assessing interactive effects of CO₂ with factors difficult to manipulate in the field.

Program: Invasive Species

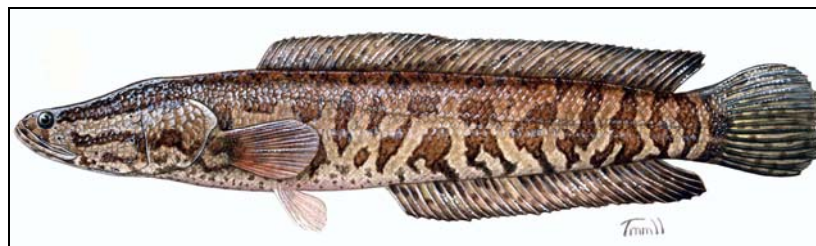
Project Name: Synthesis of invasion patterns in the United States

Project Description: The USGS National Institute of Invasive Species Science at the Fort Collins Science Center completed a synthesis on the patterns of invasion of plants, birds, and fishes in the United States, based on the first national-scale database linking data on different groups of terrestrial and aquatic invasive species from many agencies and organizations. The synthesis revealed clear patterns of invasion where areas close to coasts, at low elevations, and high in productivity were particularly impacted by invasive species. This synthesis will help Federal agencies, States, and non-government organizations set priorities for prevention, early detection, monitoring, research, and control of invasions. The synthesis is scheduled for publication as a special issue of *Biological Invasions*. The USGS also completed a survey of invasive species in the National Wildlife Refuge System. Managers, administrators, and biologists responded to an electronic survey providing detailed information on 430 fish and wildlife refuges. More than 80 percent of the refuges recognized problems involving more than 790 invasive organisms. The report, submitted to the FWS, provided the basis for launching a cooperative effort of USGS scientists, volunteers and refuge staff to document and map invasive plants in refuges. It is available on the Internet at <http://www.niiss.org/cwis438/niiss/DownloadFiles/NWRInvasiveSpeciesSurvey04.pdf>.

Program: Invasive Species

Project Name: Tools and Techniques for Assessing the Risk of Aquatic Invaders

Project Description: Recent introductions of Asian fishes into the United States have caused concern among government agencies, natural resource managers, economic interests, and the public. These invaders pose risks to the native species and threaten economically important recreational and commercial fishing. In 2004, working cooperatively with the FWS, the USGS published a risk assessment on snakehead fishes (USGS Circular 1251) that was used by the FWS to support a ban on importation into the United States of individuals of the entire snakehead family (Channidae). The USGS also maintains the Non-indigenous Aquatic Species (NAS) database, which collects and tracks information on the distribution of exotic aquatic species, many of which are invasive. Real-time information in the geographically referenced database can be accessed over the Internet at <http://nas.er.usgs.gov>. The USGS initiated a new NAS alert system to track the spread of invasive species nationwide. Early detection and response are critical in reducing the damage caused when non-indigenous species become invasive. Users can now report non-indigenous and invasive aquatic species they sight, automatically receive email alerts, or perform searches on aquatic species – such as Asian carp in Colorado or snakehead fishes in Virginia – either by geographic area or species. The alert system is tailored to provide Federal, State, and local natural resource managers the information they require to help them plan and manage the impact of invasives on native species and habitats in their States, parks, or conservation areas.



Northern Snakehead.

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Program: Invasive Species

Project Name: Wheat Seeding after Fire Found to Negatively Effect Forest Communities

Project Description: The Highway Fire burned 1,680 hectares of mixed ponderosa pine-oak-chaparral in the newly created Giant Sequoia National Monument and the adjacent Sequoia National Forest of Fresno County, CA, in August 2001. The USFS Burned Area Emergency Rehabilitation (BAER) program recommended that portions of the burned forest be seeded with a sterile variety of wheat. The USGS study funded in part through the Invasive Species program and Joint Fire Science program compared plant diversity and cover in seeded versus unseeded parts of this burn to evaluate the ecological impact of seeding an alien grass. Wheat seeding was found to disrupt the natural ecological structure of these communities. On sites seeded with wheat, wheat dominated over all other species and there was a significant decrease in species richness. Native species most strongly inhibited were post-fire endemics whose lifecycle is restricted to immediate post-fire environments. Seeding was also associated with an order of magnitude drop in *Pinus ponderosa* seedling recruitment and, coupled with the massive thatch still remaining on site, it is likely that recruitment will be inhibited in subsequent years. Other potential effects of wheat seeding are the increased fire hazard in subsequent post-fire years and potential for alien invasion to fill the ecological vacuum created when the sterile wheat fails to reestablish after the first post-fire year. As a result of this study and other similar studies, the USFS is reevaluating the use of sterile wheat in post-fire remediation.



Post-fire seeding with wheat.

2005 Planned Program Performance

Unless otherwise noted, the program accomplishments listed below demonstrate the utility of scientific publications and other products that are counted under the output measures for "systematic analyses and investigations delivered to customers" and "number of formal workshops or training provided to customers."

Program: Status and Trends of Biological Resources

Project Name: Refuge Cooperative Research Program

Project Description: The National Wildlife Refuge System Improvement Act, signed into law in 1997, states that, "The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats" In 1999, the FWS published Fulfilling the Promise, a report defining the vision for wildlife, habitat, people and leadership, needed by the National Wildlife Refuge System (NWRS) to address its mission. In FY 2004, the USGS entered into a partnership, the Refuge Cooperative Research Program (RCRP), with the NWRS to provide the science needed to achieve its mission and advance the

vision and recommendations outlined in the Fulfilling the Promise report. Specifically, the USGS will provide refuge staffs and managers with more and better tools for establishing management objectives, implementing management decisions, and evaluating the effectiveness of management actions at various geographic (individual refuge, FWS region, and throughout the NWRS) scales. Products will include workshops on biological monitoring design and implementation, analytical and synthesis tools, published reports, technical support, maps, monitoring protocols, and data management (collection, analysis, storing and distributing) recommendations. The RCRP was initiated with three research projects that will take three years to complete. The information will be used to promote systematic monitoring on refuges enabling refuge managers to make better informed, science-based decisions on their refuge in the context of how these decisions/actions affect, support, and (or) contribute to desirable resource goals at larger geographic scales.

Program: Status and Trends of Biological Resources

Project Name: SAGEMAP: a Web-Based Information Portal for Issues in Sagebrush Ecosystems in Western North America

Project Description: In FY 2005, the SAGEMAP project will launch the Science Locator page, a map of completed, ongoing, and proposed research and management activities in shrub-steppe habitats. This page provides the locations and background information describing hundreds of projects in the western United States. In FY 2004 and FY 2005, the Geology, Geography, Water and Biological disciplines are contributing spatial data to develop the interdisciplinary foundation for understanding natural resource issues in the Great Basin as part of the Western Region Integrated Science Project.

Program: Status and Trends of Biological Resources

Project Name: Making Sense of Censuses

Project Description: Population surveys are fundamental tools of wildlife management. Unfortunately, virtually all surveys are imperfect, in that they inevitably miss many of the animals present in the survey area. Given this fact, how confident can we be in survey counts? Can we reliably estimate true populations from survey data? Do repeated surveys always detect the same proportion of animals that are present? The answers lie in the survey methodology itself. The USGS Status and Trends program is supporting efforts to evaluate methods of measuring detection probability that are simple enough to be adopted by volunteer-based survey programs, like the North American Breeding Bird Survey, without unacceptable increases in cost. Researchers at the North Carolina Cooperative Wildlife and Fisheries Research Unit and the USGS Patuxent Wildlife Research Center are conducting experiments using sophisticated computer programs that simulate natural bird populations by broadcasting bird sounds of many species at different distances through a complex array of speakers. The system allows the researchers to vary a range of factors that affect detection probabilities and evaluate the performance of observers. In FY 2004, the software was developed and perfected and preliminary tests of experimental procedures conducted. In FY 2005, experienced birders, such as those that participate in the Breeding Bird Survey, will be enlisted to take part in a series of trials. The performance of the listeners will be evaluated using various field and analytical methods. These experiments will establish not only how well the different techniques perform, but also which are the most feasible for broad-scale implementation. The truly unique and exciting nature of this work is that, because the experimenter controls the bird populations, the exact number of birds of each species in the population is known. This is a feature that could never be duplicated in the wild. When implemented, these new methods will significantly improve the quality of bird census data in the Breeding Bird Survey and other surveys commonly used in more localized applications. These surveys have been providing the framework for landbird conservation planning efforts by the FWS for decades. With the

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improvements, FWS conservation management actions will be much more strongly grounded in sound science. State and Tribal natural resource agencies will similarly benefit as they carry out new conservation mandates through State Wildlife Conservation Grant appropriations.



North American Breeding Bird Survey field crew.

Program: Fisheries: Aquatic and Endangered Resources

Project Name: Control of Exotic Organisms in Ship Ballast Water with Gas Recovery and Reuse Methods

Project Description: There is a pressing need for safe and economical methods to control exotic aquatic organisms that are often introduced through ship ballast water. Release of ballast water from international transport ships is a major introduction mechanism for non-indigenous aquatic organisms, which pose a serious threat to native species. In an average year, the U.S. waters alone receive about 50,000,000 metric tons of ballast water from foreign ports. Many invasive organisms, including zebra mussels, Asian clams, bloom forming dinoflagellates, bacteria, fish and crustaceans are capable of passing through coarse ballast water intake screens currently used for control methods. USGS scientists at the Leetown Science Center are developing new control methods based on findings that most aquatic species are intolerant of increases in dissolved carbon dioxide concentrations and are sensitive to elevated total dissolved gas pressures. By manipulating dissolved gas concentrations in ballast water tanks to cause supersaturation of blood and tissues followed by an induced (short-term) pressure release, a gas bubble disease develops that causes mortality in organisms. Tests to date have been completed using replicate bench scale hyperbaric chambers and results indicate carbon dioxide and power plant exhaust are effective at controlling a wide range of target species, including mollusks, crustaceans and fish. Gas recovery and reuse methods have reduced gas requirements by about 85 percent making the method attractive in ballast tank applications as well as water conduits susceptible to fouling with exotics such as the Zebra Mussel. Further refinement of the method is underway to model the effect of ballast tank geometry on gas transfer and mixing, and using a ballast tank model that simulates tanks of up to 50 feet in height, evaluate the potential for use of diesel (ship) engine exhaust gas and demonstrate method effectiveness in water conduit applications. Additional tests have also demonstrated the ability of the new method to control an important fish pathogen (*A. salmonicida*). Replicated tests with other representative microorganisms are planned. A U.S. Patent application submitted to the Commerce Department has been granted.

Program: Fisheries: Aquatic and Endangered Resources

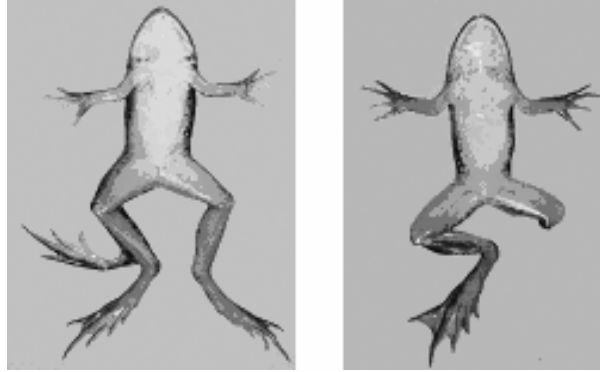
Project Name: USGS Scientists Help Bring Shad Back to New England Anglers

Project Description: USGS scientists at the Conte Anadromous Fisheries Laboratory of the Leetown Science Center collaborated with State, Federal, and commercial partners in the design and evaluation of a mock fish passage entrance structure at a power canal at Turners Falls, MA. Poor fish passage through Northeast Generation's power canal has resulted in lost sport fishing opportunity for American shad in the New Hampshire and Vermont sections of the Connecticut River. The State and Federal fishery agencies, acting through the Fish Passage subcommittee of the Connecticut River Atlantic Salmon Commission's Technical Committee, sought USGS research to investigate potential solutions to the power canal fish passage bottleneck. Fewer than 20 percent of the shad entering the power canal from another fish ladder successfully entered the gatehouse fish ladder at the top end of the canal. Experiments demonstrated that once fish enter the last fish ladder at Turners Falls, over 70 percent will continue through the ladder allowing them to proceed to the New Hampshire and Vermont sections of the river. The evaluation looked at the impact of various flow conditions and successful entrance rates of tagged shad. Data from the research showed that fish entrance rates through the modified mock fish passage entrance were four times higher than the existing entrance rates. Fishery agency and utility company staff have been briefed on the results. Based on these data, all parties concluded that a second year of evaluation was warranted, and would likely lead to the construction of a new fish entrance the following year resulting in a much higher proportion of power canal shad migrating to New Hampshire and Vermont waters and thus supporting a significant new sport fishery in those two States. The agencies seeking this research were New Hampshire Fish and Game Department, Vermont Department of Fisheries and Wildlife, the FWS and National Marine Fisheries Service. The Connecticut Department of Environmental Protection, and Massachusetts Division of Fisheries and Wildlife also support the research as members of the Connecticut Atlantic Salmon Commission.

Program: Wildlife: Terrestrial and Endangered Resources

Project Name: Amphibian Research and Monitoring Activities

Project Description: For the past seven years, scientists at the USGS National Wildlife Health Center have worked to identify the causes of amphibian deformities, diseases, and population declines across the Nation. With the cooperation and assistance of the FWS, NPS, USFS, private landowners, State and Tribal wildlife management agencies and universities, USGS scientists have examined over 100 species of amphibians (predominantly frogs). This work has resulted in the discovery of at least four disease-causing agents that either deform or kill amphibians. There are species of viruses, fungi, parasites, and a newly discovered virus-like organism that all kill frogs and tadpoles. A planned study in 2005 will identify and evaluate several species of water molds that are believed to kill amphibian egg masses. New diseases are discovered each year, and new locations of well known diseases are identified as well. This work is time consuming as several thousands of adult frogs and tadpoles are examined each year. In order to streamline disease investigations, USGS scientists have developed improved testing techniques based upon advanced molecular tests commonly used in human medicine. This information will assist State, Federal, and Tribal wildlife managers in evaluating the status of wetlands communities that support amphibians. Management strategies based upon disease information can be developed that will prevent spread of diseases and potentially control diseases. These studies support the USGS Wildlife and Terrestrial Resources Program.



Amphibian deformities.

Program: Terrestrial, Freshwater, and Marine Ecosystems

Project Name: Understanding Ongoing Changes in the Mountains of the Western United States

Project Description: A study was launched by the USGS Fort Collins Science Center, Northern Rocky Science Center, Western Ecological Science Center, and USFS Pacific Northwest Research Station to better understand ongoing changes in the mountains of the western United States. Aims of the study include understanding the causes of sudden, often unwanted changes in mountainous areas, such as the recent die-off of trees on millions of acres in New Mexico, Arizona, and southern California. Since 2002, in the Jemez Mountains, mortality of overstory piñon has exceeded 95 percent (by spring 2004), and most piñon seedlings have died. Local piñon-juniper woodlands are being rapidly and massively transformed in the southwestern United States by the current combination of warm, dry climate conditions. These results highlight the potential for rapid, drought-induced changes in woody vegetation due to extreme climate events. The risk of massive forest dieback, along with associated changes in carbon pools, is an increasing concern with predicted global climate changes. Primary clients for the information include NPS managers of western mountain parks, including Bandelier, Rocky Mountain Glacier, Olympic, North Cascades, Mt. Rainier, Yosemite, and Sequoia/Kings Canyon National Parks. The information will be useful to State and local resource officials in increasing their understanding of the vulnerability of mountain resources to climate change and variability, and for planning ameliorative or interpretive actions.



Dying piñon, Jemez Mountains, NM, October 2002.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-)^{1/}
Biological Research and Monitoring (\$000)	\$134,348	-\$2,175
FTE	1,011	+4

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs and technical adjustments.

The FY 2006 budget request for the Biological Research and Monitoring is \$134,348,000 and 1,011 FTE, a net program increase of +\$1,218,000 (includes adjustments for uncontrollable costs and technical adjustments) and +4 FTE from the 2005 enacted level.

Great Lakes Deepwater Fisheries (+\$252,000) — This initiative focuses on deepwater fisheries research to assist USGS partners in understanding the mechanisms that drive the wide fluctuations in the Great Lakes prey fish communities. Specifically, the prey fish studies would be enhanced to provide more accurate abundance estimates and to allow better predictions of recruitment, growth, and survival. Sampling designs and models would be developed and enhanced to improve the accuracy of biomass and abundance estimates and to allow statistical comparisons of data through time within and between the lakes. Efforts would focus on remote sensing technology, particularly hydro-acoustics (scaled echo soundings through water to assess fish assemblages), to complement bottom trawl information and provide more information about pelagic (open water) fish.

The proposed increase supports the DOI Resource Protection strategic goal of sustaining biological communities on DOI managed and influenced lands and waters in a manner consistent with obligations regarding the allocation and use of water. While there is a 2-year lag between initiating research and obtaining results, research initiated with FY 2006 funding would produce two systematic analyses (a Vessel Replacement Capital Improvement Plan and a Vessel Safety Management Plan would be developed for the Great Lakes Research Center and the region) in FY 2008.

This initiative would require two additional FTE in FY 2006 to support additional work related to the Deepwater Fisheries program.

This initiative relates to the Secretary's priorities in that it requests funding for an activity that directly addresses the needs of the DOI land management bureaus, particularly the FWS, the NPS, and the Bureau of Indian Affairs.

Glen Canyon Dam Adaptive Management Program (GCDAMP) (+\$750,000) — The GCDAMP is largely supported by power revenues from the operation of Glen Canyon Dam. Statutorily, these funds are capped, although the workload of research and monitoring mandated by the Adaptive Management Work Group increases. Among the new requirements for this program are (1) implementing recommendations from the Humpback Chub Ad Hoc committee of the Adaptive Management Work Group, charged with arresting the decline of this federally-endangered fish in the Grand Canyon, and (2) developing a long-term core monitoring plan that would assess the effects of dam operations on natural and cultural resources for the next 10 years.

The increased funding requested will be used to support biological and geological research activities designed to better understand the Colorado River ecosystem within Grand Canyon National Park and to provide input related to decisionmaking regarding Glen Canyon Dam

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operations. Experimental flow regimes are key to understanding the future operations of this important western dam. The outputs will provide a decision support framework for 25 stakeholders in the GCDAMP, including 6 Federal bureaus, 5 Indian Tribes, 7 western States, and several non-government organizations.

The funding would allow the USGS to develop and refine fisheries stock assessment models, particularly as applied to endangered large river fishes. These funds would also provide information on critical habitat for the endangered humpback chub and support experiments on non-native fish removal on a 17-mile reach in Grand Canyon National Park near the confluence with the Little Colorado River. Predation by non-native fishes is thought to be a major cause of the continued decline in the humpback chub within Grand Canyon National Park.

The proposed increase supports the DOI Resource Protection strategic goal of sustaining biological communities on DOI managed and influenced lands and waters in a manner consistent with obligations regarding the allocation and use of water. Outputs include the number of systematic analyses and investigations delivered to customers. While there is a 2-year lag between initiating research and obtaining results, research initiated with FY 2006 funding will produce three completed systematic analyses in FY 2008.

For this initiative, no additional FTE are needed because work will be accomplished with existing FTE.

Ecological Systems Mapping (+\$250,000) — Under this initiative, the USGS would support Federal, regional, State, and local partnerships by leading development and synthesis of ecological information at a new level. It would build on the foundation of existing partnerships represented by the Gap Analysis program, National Biological Information Infrastructure, and *The National Map*. Partners would provide the requisite species and ecological community data needed to achieve ecological systems mapping. Representative examples of partners in the new synthesis include all DOI bureaus, State natural resource agencies, the Multi-Resolution Land Characterization Consortium, NatureServe, the Biodiversity Conservation Information System, the Heinz Center for Science, Economics, and the Environment, the Missouri Botanical Garden, the Smithsonian Institution, The Nature Conservancy, the American Bird Conservancy, the Ecological Society of America, and universities. The support from NatureServe and other NGOs would be access to their databases and the contribution of some staff time during the initial phase of completing a comprehensive assessment of current activities and developing a plan.

Ecological Systems Mapping would entail the spatial integration of information on biodiversity and ecological information at different organizational scales (species, assemblage, and ecosystem characteristics) and would be coupled with information on landscapes and resources to generate maps of terrestrial, fresh water, and coastal ecological systems for the Nation. Dynamic and interactive maps would, for the first time, represent biological data in the holistic context needed by resource managers, policymakers, and research scientists. Such products would build on, and integrate, the traditional skills for which the USGS is widely known in the fields of biology, geography, geology, and hydrology. The mapping of critical biological assemblages in the context of their geologic and hydrologic underpinnings can portray what is known and understood about their distribution, importance, magnitude, and other key characteristics at local, regional, and national scales, with the ability to manipulate the base layers in real time for making management decisions. These map products would directly support decisionmakers implementing Administration priorities on managing wild land fire, managing invasive species, restoring healthy forests, improving monitoring, restoring

landscapes, and coordinating spatial data. The Multi-Resolution Land Characterization Consortium (USGS, EPA, NOAA, USFS, NRCS, BLM, NPS, and NASA) is coordinating Federal land cover mapping activities. NOAA's Coastal Change Analysis program, the USGS Gap Analysis program, and the Land Cover Mapping Project have pooled resources and are producing the National Land Cover Database. Ecological Systems Mapping would build on and integrate these efforts, add significant information content to the multiagency land cover databases, and incorporate State and local mapping databases. The initiative would benefit DOI land managers by providing access to quality biological and ecological information for improving resource management decisionmaking.

In FY 2006, the USGS requests \$250,000 to initiate a comprehensive assessment of current ecological systems mapping activities across the Nation. This assessment would provide the framework for the development of strategic Science and Business Models/Plans to implement mapping and would establish priorities for the new mapping information needed. As soon as feasible but before full implementation, pilot activities will be required at regional and national scales. The regional pilot would focus on management application needs for biological data of high interest to DOI, such as sage grouse habitat, and should take advantage of data-rich regions or focus on a region identified by resource managers and partners as having high levels of concern over specific issues. A national pilot will be needed to demonstrate and test the ability to synthesize and use ecological data, in conjunction with remote sensing, physical, and thematic map data, to map across multiple scales: ecoregions, ecosystems, species assemblages, and species. This would build on a largely untapped strength of the USGS to manage a rich national and global spatial database, and our ability to analyze these data to support ecological mapping at scales ranging from local to national. Partners would be full participants in deciding what to map (species, habitats, or other environmental indicators), how to map it (approaches to display data most effectively), and where to conduct the pilot effort.

Beneficiaries of Ecological Systems Mapping would include DOI land and resource management bureaus, and many partners such as State natural resource agencies, the Multi-Resolution Land Characterization Consortium, NatureServe, the Biodiversity Conservation Information System, the Heinz Center for Science, Economics, and the Environment, the Missouri Botanical Garden, the Smithsonian Institution, The Nature Conservancy, the American Bird Conservancy, the Ecological Society of America, and universities.

This initiative supports the DOI Resource Protection strategy to improve health of watersheds, landscapes and marine resources that are DOI managed or influenced in a manner consistent with the obligations regarding the allocation and use of water. To clearly measure USGS progress in supporting the intermediate outcome goal of improving the information base, information management, and technical assistance, the USGS supports Federal, State, and local partnerships by providing resource managers with information on landscapes and resources to generate maps of terrestrial, fresh water, and coastal ecosystems for the Nation. Outputs would be one additional systematic analysis. This includes a report on the comprehensive assessment of current ecological systems mapping activities across the Nation and a draft strategic science and business plan and implementation strategy for Ecological Systems Mapping.

Science on the DOI Landscape (+\$750,000) — An increase in FY 2006 of \$750,000 for Science on the DOI Landscape will provide funds to enhance science support to meet regional priorities identified by DOI bureaus. Criteria for initiating or continuing specific studies in FY 2006 will be based on DOI bureau needs, as well as on funding availability, leveraging and partnership opportunities, and urgency as determined nearer the time of the appropriation.

Biological Research and Monitoring Subactivity

Based on current knowledge of priority needs, the USGS will focus on studies that address the following regional issues.

Eastern Region will conduct studies for the BLM, FWS, NPS, MMS, and OSM on understanding the threats to ecosystem sustainability and solutions for restoring degraded habitats, water quantity and quality for both human and ecological needs, and biological and physical influences on emerging diseases.

Central Region will conduct studies for the BIA, BLM, NPS, BOR, and FWS, in cooperation with the U.S. Army Corps of Engineers and other agencies, on sustainable ecosystems in the sage habitats and riparian areas that are impacted by development, invasive species, and fire in the northern Front Range. Other focus areas will include rapid response to short-term science needs, such as synthesis of existing scientific knowledge and data or consultation, and continued work on coal bed methane and Mancos shale landscapes.

Western Region will conduct studies for the BIA, BLM, BOR, FWS, and NPS on landscape and biological issues related to the ecological condition of natural systems in the Great Basin and Columbia Plateau ecoregions, history and rates of landscape and ecologic change, and links to geologic and hydrologic processes, in the Lower Colorado River basin, and ridge-to-reef habitats in the Hawaiian islands. Alaska, as a component of the Western Region, will conduct work under the North Slope Science Plan to expand landscape forecasting work initiated in 2004 and 2005 and will expand energy assessment, hydrologic network analysis, surficial geologic mapping, permafrost studies, and aquatic populations and habitat assessment for the entire North Slope region.

These regional projects address the outcome goal of improve health of watersheds, landscapes and marine resources that are DOI managed or influenced in a manner consistent with the obligations regarding the allocation and use of water under Resource Protection in the DOI Strategic Plan. Products will include three systematic analyses and investigations delivered in FY 2008 and two workshops in FY 2006. The FY 2006 request will allow the USGS to collect more data and conduct additional assessments and research to address the science issues of the DOI bureaus. To achieve this, two additional FTE will be required.

This initiative has successfully leveraged funding and in-kind support from DOI bureaus in FY 2004; this sharing of resources indicates the interest of the bureaus to partner with USGS in the planning and development of work that addresses their important issues. Collaboration between USGS and DOI bureaus begins with discussions of management challenges and the scientific information needed to inform land and resource decisions. Collaboration continues through setting priorities for work, planning and implementing projects, conducting field work to collect data and share information, and disseminating the results of work through jointly-hosted workshops, stakeholder meetings, and other venues. Collaboration results in sharing monetary resources and in-kind support, such as personnel and equipment to promote efficient use of resources and reduce duplication of effort, field data and site information to assist USGS scientists in data gathering and analysis, and shared office and laboratory space to facilitate analysis and dissemination of results. From priority setting to products that help meet performance goals, DOI bureaus are partnering with USGS and with each other to share resources and results, and to make a difference in managing resources. This initiative relates to the Secretary's priorities in that it requests funding for an activity that directly addresses the needs of DOI bureaus.

Biological Research and Monitoring Subactivity

Invasive Species (+\$300,000) — With additional funds, the USGS would address critical research needs for specific invasive species identified in three geographic areas: tamarisk research in the Rio Grande Basin, Brazilian pepper tree research in South Florida, and leafy spurge research in the Northern Great Plains. Efforts in these three geographic areas are part of a Departmentwide initiative to collaboratively address invasive species issues in specific geographic regions across all DOI agencies.

The proposed change will enhance USGS performance in meeting the DOI Resource Protection outcome goal of sustained biological communities on DOI managed and influenced lands and waters, in a manner consistent with obligations regarding the allotment and use of water, and will support interagency implementation of the National Invasive Species Management Plan, approved by the interagency National Invasive Species Council. While there is a 2-year lag between initiating research and obtaining results, research initiated with FY 2006 funding will produce two systematic analyses in FY 2008.

General Reduction (-\$50,000) — Of a \$247,000 general increase received in FY 2005, the USGS requests a decrease of \$50,000 to maintain higher priority funding elsewhere in the USGS.

Other Decreases — The following activities are projects funded through Congressional earmarks and are not identified as priorities in the President's budget. These activities are decreased to focus funding on higher priority needs elsewhere in the USGS.

As a result of the following proposed decreases, the number of systematic analyses and investigations delivered to customers would decrease by 16. These systematic analyses and investigations would have been delivered in FY 2008. The proposed decreases do not impact FTE totals.

Mark Twain National Forest Lead Mining (-\$731,000) — A study to determine potential impacts of lead mining in the Mark Twain National Forest in Missouri in cooperation with the USFS will end in FY 2005.

Pallid Sturgeon Research (-\$296,000) — The decrease would discontinue scientific investigations to locate and monitor pallid sturgeon in the Missouri River Basin and document their habitat relationships and requirements for all life stages for population growth.

Diamondback Terrapins Research (-\$195,000) — The budget discontinues funding to study the decline of diamondback terrapins in the Chesapeake Bay. The decrease would discontinue research on the Chesapeake Bay populations that is coordinated with the Maryland Department of Natural Resources and the University of Maryland Cooperative Research Unit.

Bear DNA Sampling Study (-\$974,000) — The proposed reduction would end an assessment of the grizzly bear population using genetic technology to identify species, sex, and individuals from DNA extracted from bear hair to address bear conservation issues.

Multidisciplinary Water Study at Leetown (-\$292,000) — The proposed reduction would eliminate funds that would be used to study the quantity and quality of the Leetown Science Center's ground water supply.

Biological Research and Monitoring Subactivity

Molecular Biology at Leetown (-\$779,000) — The decrease reduces funding to conduct fishery genetics research projects along the Northeast and Mid-Atlantic coast, in the Great Lakes and Finger Lakes, and in northern Appalachia. These projects include systematics in support of percid and salmonid fisheries restoration, systematics of mussel (bivalve) species, and identification of disease agents.

Manatee Research (-\$493,000) — The budget reduces funding for research that addresses science needs identified by the FWS Manatee Recovery Team. The change being proposed would reduce efforts to develop improved methods of estimating manatee numbers using aerial surveys.

Delaware River Basin Water Project (-\$247,000) — The proposed reduction would stop current field work, discontinue modeling efforts to determine ecologically-based flow relationships for the Upper Delaware River main stem and tributaries, and eliminate development of a decision support system to analyze and interpret water management and reservoir operations alternatives.

Biological Information Management and Delivery Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{al}	2006 Budget Request	Change from 2005
Biological Information Management and Delivery	24,662	23,999	+217	-67	24,149	+150
FTE	85	80	0	0	80	0
Total Requirements \$000	24,662	23,999	+217	-67	24,149	+150
FTE	85	80	0	0	80	0

^{al} Changes for this subactivity include a reduction of -\$67 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for Biological Information Management and Delivery is \$24,149,000.

Providing credible, applicable, unbiased information for science-based decisionmaking is a USGS priority, particularly as it pertains to the conservation, management, and use of the Nation's natural resources. To facilitate this, the USGS is committed to making available the data and information that are critical to scientific discovery and application. Databases, maps, and publications are examples of the vital mechanisms used to convey this information to users. In addition, the USGS is committed to the development and easy accessibility of tools, models, visualizations, and applications to aid policymakers and resource managers in the analysis and synthesis of scientific data to support decisionmaking. The USGS works in cooperation with many organizations across the United States to provide critical information to partners, stakeholders, customers, and the general public. Through electronic infrastructures, the USGS delivers relevant data and information faster and in more interoperable formats than in the past, leading to better stewardship of the Nation's natural resources.

This program addresses DOI's Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science. The USGS plays a vital role in making biological data and information more accessible and useable. Key indications of USGS performance are reflected in the end outcome measure for research: soundness of methodology, accuracy, and reliability of science (100 percent of science is validated through appropriate peer review); and the end outcome measure for informing decisions through the application of science (41,000 partnership links to USGS Web site, 90 percent improved access to needed information, and 90 percent of stakeholders reporting that information provided by the USGS helped them achieve their goal). To clearly progress in achieving intermediate outcomes of improving the information base, information management, and technical assistance, the USGS tracks content and expanse of knowledge base (83 percent of total square miles assessed by Gap Analysis); quality (100 percent studies validated through appropriated peer review or independent review); and access (≥80 percent of biology customers are satisfied with ease, timeliness of access to information products).

Biological Information Management and Delivery Subactivity

To measure progress in improving the information base, information management and technical assistance, the USGS tracks outputs including the number of NBII nodes, number of cumulative gigabytes managed, number of NBII Clearinghouse metadata records, number of systematic analyses delivered to customers, and number of workshops/training with USGS sponsorship or participation to transfer results to customers and partners.

The Biological Information Management and Delivery subactivity provides researchers, resource managers, decisionmakers, educators, and others with access to relevant knowledge to support the understanding and stewardship of our Nation's biological resources. The goal of this program is to provide a high quality knowledge base relevant to biological resources to encourage scientific advancement and inform decisionmaking.

The goals of this program are to:

- Increase the availability and usefulness of biological resources data and information (content),
- Implement technologies and tools to integrate, analyze, visualize, and apply biological information to natural resource issues (tools),
- Develop, apply, and promote the adoption of standard practices, protocols, and techniques to enhance knowledge discovery and retrieval from various resources (infrastructure),
- Facilitate information science research that supports the advancement of biological informatics capabilities (research), and
- Apply innovative technologies and best practices to improve the development, description, and dissemination of biological information to customers (advancement).

In FY 2005, the Biological Information Management and Delivery subactivity will undergo a Program Assessment Rating Tool, or PART review by OMB.

National Biological Information Infrastructure (NBII) (estimates for FY 2004, \$8.6 million; FY 2005, \$8.5 million; FY 2006, \$8.5 million) — The NBII is the premier national infrastructure for making biological data, information, and associated tools and technologies more accessible for customers and partners to use in making cost-effective, informed decisions regarding resource management, environmental considerations, disease vectors, control of invasive species, and other issues.

The NBII uses the capabilities of the World Wide Web and other advanced technologies to establish a distributed "federation" of biological data and information sources through which users can find biological information, retrieve it, and apply it to resource management questions. Partners and customers that take part in this effort include government agencies at all levels, private sector organizations, natural history museums, libraries, academic institutions, international scientific organizations, and the public.

The USGS works with many public and private partners in implementing the NBII to:

- Develop a nationwide network of advanced NBII "nodes" in selected regions around the United States,

Biological Information Management and Delivery Subactivity

- Expand the overall content of the NBII, and
- Develop and apply new information tools and technologies.

The NBII achieved certification and accreditation (C&A) in FY 2003 and was re-certified in July 2004. Support for C&A of specific science program information technology comes from the NBII program and from the Enterprise Information program.

In FY 2004 and FY 2005, the USGS continues to develop the 10 NBII nodes that were initiated in FY 2001 around the United States, 2 new regional nodes initiated in FY 2004, and thematic nodes originally begun as prototype efforts. Each node is developed and operated by a consortium of public and private partners working together in the region. The nodes supply a national, integrated network for biological information. Node projects are active at the following locations:

- The Pacific Basin Information Node (Hawaii) brings local, educational, State, and Federal partners together to address current and future biodiversity information needs. Partners are making capacity and legacy data available as a baseline. Collaboration at all levels of the invasive species effort is leading to a Statewide information system for invasive species reporting. Innovative products created by the node represent the next generation in technology (\$850,000).
- The Central Southwest/Gulf Coast Node (Texas) focuses on creating a standardized, digital information resource relevant to critical issues concerning sustainable development within the Central Southwest and the Gulf Coast. Activities include development, implementation, and application of new spatial digital data analysis and visualization techniques including remote sensing and digital field data collection and verification (\$1,000,000).
- The Southern Appalachian Node (Tennessee) provides information on the dynamics of biodiversity in a rapidly changing environment, including productivity and distribution of forest species, shifts in the abundance and distribution of wildlife, and changes in ecosystems. This node also proactively involves communities and schools (elementary through university) in documenting information and data sets, and helps to focus node resources in ways that best assist the community and region (\$2,000,000).
- The Northwest Node (Idaho) provides information to evaluate strategies and to understand forest resource management issues; to facilitate the application of information to land management activities, including invasive species and wildlife disease; and to provide the natural resource content to the infrastructure that aggregates the most up-to-date information and tools relevant for wildland fires and fuels management, and research. This node has developed partnerships with Federal, State, and academic communities throughout the Northwest (\$200,000).
- The Knowledge Integration Node (Ohio) provides technology and information science capabilities, including knowledge integration and engineering; information gateway expertise; and access to high-quality scientific literature to meet the needs of targeted constituencies. The purpose of knowledge integration activities is to select, develop, and implement network-wide methods and techniques for organizing content to enhance the discovery, retrieval, and use of information. These methods include the use of standards, tools, controlled vocabularies, and authorities (\$250,000).

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- The Bird Conservation Node (Maryland) helps to implement the North American Bird Conservation (NABC) Act by coordinating, managing, and disseminating bird habitat and population data and information for all of North America. This node has emerged as an important partnership between the USGS and the U.S. Fish and Wildlife Service. It serves as an electronic gateway to data and information supporting bird conservation activities in North America and provides a framework for collaboration among organizations concerned with bird conservation (\$200,000).
- The Network Standards and Technology Node (Colorado) provides an integrating function for the NBII, offering a mechanism to address user accessibility, promote understanding of the nature of online interactions, and develop tools for evaluating activities in terms of their ability to meet user needs (\$250,000). The node also provides infrastructure to support USGS collaboration with researchers and scientists throughout the Nation.
- The Fisheries and Aquatic Resources Node (Pennsylvania) is an integrated, comprehensive, Web-based resource that serves and accesses databases, links to information resources, and coordinates standards relevant to fisheries and aquatic resources. By providing information critical to conservation and restoration efforts, this node supports community activities to address habitat alternation, degrading water quality, invasive species, water availability, and over-harvest that are factors in the decline of aquatic resources (\$400,000).
- The California Information Node (California) supports information systems addressing interagency conservation planning efforts, biodiversity and watershed assessments, invasive species, and water quality and quantity issues in California. It provides access to biological scientific data and information and other natural resource information on public lands in the region in the context of natural forces and changing land use patterns (\$200,000).
- The Mountain-Prairie Information Node (Montana), previously called the Northern Rocky Mountains Information Node, was renamed to better reflect the ecosystems of the entire region—which includes Montana, Wyoming, North and South Dakota, Kansas, and Missouri—and their associated biological issues and challenges. The node supports natural resource management decisions in the Greater Yellowstone ecosystem and other locations by providing scientific information about wildlife and its relationship to habitat, human activities, and ecosystem processes in the northern Rockies and prairie areas (\$150,000).
- The Mid-Atlantic Information Node (Virginia) works with partners throughout the region to provide data and information critical to the Chesapeake Bay and its tributaries, land use, land cover, and wildlife habitat. The availability of such data and information is critical to resource management in a region unique in its ecological span, range of biological resource challenges, and large and rapidly growing human population (\$500,000).
- The Northeast Information Node (New York) is focusing initial efforts on aspects of urban biodiversity and conservation of natural landscapes critical to wildlife habitat and important to the long-term environmental health of the region. It will provide information about urban impacts on the environment and health strengthening local support for making sound decisions to retain both the region's environmental quality and the unique character of the landscape (\$500,000).

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- The Invasive Species Information Node (Colorado) is a central repository for data and information pertaining to the identification, description, management, and control of invasive species. The node coordinates regional invasive species information management efforts at a national level (\$1,000,000).
- The Wildlife Disease Information Node (Wisconsin) is a Web-based monitoring and information system providing State and Federal resource managers, animal disease specialists, veterinary diagnostic laboratories, physicians, public health workers, educators, and the public access to near-real-time data related to animal mortality events and other critical related information. Most recently, this node engaged States and the USGS National Wildlife Health Center in producing a national chronic wasting disease clearinghouse prototype (\$250,000).

In addition, the USGS routinely invests approximately \$1.0 million of base funding that provides prototype activities designed as startup nodes in regions not yet covered and funds opportunities to respond to special information needs of partners and customers. In FY 2004, for example, the USGS continued efforts in the Southwest (Colorado, New Mexico and Arizona), focusing on fire science and drought issues related to this part of the country and producing a GIS-based application showing critical habitats for threatened and endangered species in relation to fire location information from 2002 to the present.

These activities provide increased access to and integration of biological data and information related to specific biological issues (such as invasive species or migratory birds) and/or specific ecosystems or geographic regions, and support integrated landscape monitoring and other science priorities. Stakeholders using the NBII have stated that there is no question that issues of data—their access, comparability, synthesis, and application—are "the" issues of the next decade for the environmental science community and that the NBII is clearly the world leader in this newly emerging area of environmental cyberinfrastructure. Stakeholders state that growth of the NBII will provide unprecedented access to scientific information in quantities and ways not possible before this time due to limitations in technology.

Gap Analysis (estimates for FY 2004, \$6.8 million; FY 2005, \$6.7 million; FY 2006, \$6.7 million) — The Gap Analysis Program (GAP) provides broad geographic information on the status of species and their habitats and identifies the degree to which native animal and plant species are represented in the present-day mix of conservation lands (those species not adequately represented constitute conservation "gaps"). Currently, GAP products are available for most of the country. These products include digital databases describing Statewide land-cover assemblages, distributions of mammals, birds, reptiles, and amphibians, and characterizations of land stewardship. The current emphasis of the program is on completing GAP projects in the few States where data are not available, updating selected regions of the country with state-of-the-art methods and technologies, organizing new aquatic projects, and developing partnerships with data users to facilitate use of GAP information in land-management decisions.

GAP is currently involved in a five-State (Nevada, Utah, Colorado, New Mexico, and Arizona) project to update land cover data, animal distribution models, and other GAP-related data in the southwestern United States. This is the most extensive update of GAP data currently underway with land cover data now available. In areas of the country where recent data sets have been developed, such as the Midwest and the Southeast, GAP has initiated projects to take existing products and data and consolidate them into regional databases. This makes data and

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information more accessible and useful to Federal and State resource managers and other users when analyzing data across State boundaries. Furthermore, State and local planners use decision-support systems and other technologies developed by the GAP to protect and manage resources.

Aquatic projects are underway in Hawaii, the Great Lakes region, the southeastern United States, and in most of the Missouri River drainage. The initial phase of most of these projects, including consolidation of existing data and classification of riverine habitats, is nearly completed.

The USGS continues to emphasize GAP research where needed and the development of applications to better serve the needs of Interior's land management bureaus, including the U.S. Fish and Wildlife Service, the Bureau of Land Management, and other agencies such as the U.S. Forest Service. New mechanisms being implemented to facilitate access to GAP products include regional views, species information at regional and national scales, and user-defined online mapping.

Integrated Taxonomic Information System (ITIS) — The USGS leads and works with other Federal agencies (including the Environmental Protection Agency, USDA Agricultural Research Service, USDA Natural Resources Conservation Service, National Oceanic and Atmospheric Administration, Smithsonian Institution, National Science Foundation, and the National Park Service) organizations, institutions, and taxonomic specialists across the United States and internationally to operate the largest taxonomic thesaurus and database of its kind in the world. ITIS provides an accepted scientific name (with a unique Taxonomic Serial Number) as the "common denominator" for accessing information on such topics as biodiversity, invasive species, declining amphibians, migratory birds, fishery stocks, pollinators, agricultural pests, and emerging diseases. ITIS is also the source of biological names for the NBII. ITIS supports the only comprehensive national taxonomic database that provides free access (directly over the Internet) to standard scientific names for all U.S. plant and animal species. Currently, ITIS is coordinating efforts with the NBII Invasive Species Information Node in development of an early detection and rapid response system, building taxonomies for invasive species as a key component of that system.

State Partnerships — The USGS works with State fish and wildlife agencies around the United States through major partnerships with the International Association of Fish and Wildlife Agencies (IAFWA); the Natural Heritage programs through their partnership with NatureServe; and other groups such as The Nature Conservancy. In addition, individual State partnerships have been developed that focus on building the capacity to increase access to biological data they collect and maintain. Data from these partnerships are important to major USGS programs, such as GAP and NBII, and will be used to develop more effectively the State comprehensive wildlife strategic plans required to receive Federal funding. These data are also integrated into broader management initiatives such as the Eastern Brook Trout and the Sage Grouse assessments.

Technology Development and Transfer — The USGS identifies, adapts, develops, and distributes technologies to enhance the access, collection, and use of biological data and information. These technologies include geographic information systems, information technology applications, remote sensing, global positioning systems, decision-support systems, scientific visualization, and computer modeling and simulation tools. Technologies and applications developed by NBII, GAP, and other projects are also shared with international

partners through USGS participation in regional and international initiatives such as the Inter-American Biodiversity Information Network and the Global Biodiversity Information Facility.

2004 Program Performance Accomplishments

Unless otherwise noted, the program accomplishments listed below demonstrate products that are counted under the output measures for "systematic analyses and investigations delivered to customers," "NBII Clearinghouse metadata records," "cumulative gigabytes managed," and "number of formal workshops or training provided to customers (instances/issues/events)."

Inter-Organizational Partnerships Permit Access to Broader Data Sources for Improved Science-Based Decisionmaking — Collaboration across a broad range of communities is essential to the success of DOI's goal of Serving Communities, and the Secretary's "4 C's," *Communication, Cooperation, and Consultation – all in the service of Conservation*. The USGS National Biological Information Infrastructure (NBII) works with more than 250 partners from Federal, State, local, and Tribal governments; universities; non-government organizations; and the private sector. Since no single organization can provide all of the biological data and information necessary to inform decisions regarding natural resources and land management, such collaboration enables managers and others to access a more complete picture of the status of, challenges to, and goals for environmental stewardship.

To that end, in 2004, the NBII created several important new partnerships and hosted multiple forums in which producers, holders, and users of biological resource data came together with the result of enhanced communication and collaboration:

- Through its Fisheries and Aquatic Resources Node, the USGS took on a leadership role with 4 Federal, 16 State, and 4 non-governmental organizations to integrate data on Eastern Brook Trout to be used as part of a larger brook trout joint venture project to protect and restore the species throughout its eastern range.
- With the Cornell Lab of Ornithology, Bird Studies Canada, Point Reyes Bird Observatory Conservation Science, and the Canadian Information System for Environment, through the NBII Bird Conservation Node, the USGS coordinated the 2nd Meeting of Experts during which they finalized a data exchange schema for the bird conservation community. This marks the first step in linking together bird monitoring data sets from all over North America promoting the ability to combine data sets from different sources to gain new insights.
- Through the NBII Invasive Species Information Node, the USGS hosted an experts meeting attended by 76 representatives from the United States, international agencies, universities, and non-government organizations. Concepts for a Global Invasive Species Information Network were discussed.

Bringing Museum Collections Data to Scientists' Fingertips Enhances Taxonomic Knowledge Base — Natural history museum specimen and plant records and cultures of living microorganisms provide scientists with pertinent details about the organism including the locality where the organism was found. These records document collections that serve as strong representations of their species. Such information can be used to generate maps of the distribution of occurrences of particular species and can help provide insight into the status and

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general health of the species. Historically, these records were available only to researchers who visited natural history collections.

In support of its objective to provide easy access to all types of biological information, in 2004 the National Biological Information Infrastructure (NBII) undertook an effort to improve access to museum collection records online. This project required establishing partnerships with natural history collections (including the Smithsonian Institution, Missouri Botanical Garden, and others); the National Science Collections Alliance, which represents more than 130 museums around the world; the National Science Foundation; and the Department of Energy's Oak Ridge National Laboratory. Through workshops, tools development, and general systems support, NBII made accessible over 9 million museum collection records in 2004. The NBII Museum portal includes collections from Harvard University's Museum of Comparative Zoology, the New York Botanical Garden, Ohio State's Insect Collection, and other collections from across the Nation. Users of this database can search all collections simultaneously by specimen type and/or geographic location. Through its partnership with the Global Biodiversity Information Facility, the NBII makes available these records throughout the world.

2005 Planned Program Performance

Unless otherwise noted, the program accomplishments listed below demonstrate products that are counted under the output measures for "NBII Clearinghouse metadata records," "cumulative gigabytes managed," and "NBII nodes."

Activities that will continue into FY 2005 in which NBII is engaged with partners include:

- Managing the Biology Channel for the Geospatial One-Stop E-Government initiative,
- Serving on National Science Foundation-sponsored panels and committees to assist in the development of the National Ecological Observatory Network,
- Developing an Environmental Grid Computing Network with the Environmental Protection Agency, the National Science Foundation, and the European Environmental Agency,
- Coordinating the Invasive Species Thematic Network of the Inter-American Biodiversity information Network (IABIN) working with IABIN to develop tools for managing information on protected areas, and
- Representing the United States with the Global Biodiversity Information Facility to develop a worldwide species information bank to support taxonomic research.

Support to the existing NBII nodes will continue in FY 2005 at essentially the same level as in FY 2004. The USGS will continue expanding two regional NBII nodes, the Mid-Atlantic (Virginia) and the Northeast (New York), and two thematic nodes, the Invasive Species and Wildlife Disease (particularly chronic wasting disease) that will result in new partnerships and additional data. The Southern Appalachian Information Node (Tennessee), coupled with the new Mid-Atlantic and Northeast nodes, will continue to address biological information requirements of the eastern United States.

The USGS will continue its work with current partnerships in FY 2005 and seek additional partners, particularly with State, local, and Tribal entities resulting in additional metadata records

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incorporated into the NBII Clearinghouse and additional information available through NBII. The USGS anticipates that the number of metadata records, and the number of links to partner data and information will continue to grow at a rate of about 10 percent in FY 2005. Consultation with stakeholders, partners, and customers will continue and planning for additional thematic and regional nodes, as needed, will proceed.

Gigabytes of data under Biological Information Management and Delivery subactivity will increase not only through the continued development of current NBII nodes but also through increased access to biological data created, managed, and made available by USGS science centers.

In FY 2005, the GAP will continue to focus on advancing regional analyses, integrating State level analyses already completed.

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Science Centers and Field Stations Summary

Center Name	Location	FY2004 ¹⁷ Estimate (\$000)	FY2005 ¹⁷ Estimate (\$000)	FY2006 ¹⁷ Estimate (\$000)
Center for Biological Informatics	Lakewood, CO	6,725	6,542	6,607
Program Description: The Center facilitates access to and use of biological data and information through leadership in establishing standards, developing information products, and using information technologies. The Center supports such programs as GAP Analysis, the USGS/National Park Service Vegetation Mapping, and the National Biological Information Infrastructure.				
Upper Midwest Environmental Science Center	LaCrosse, WI	3,699	3,591	3,627
Program Description: The Center provides natural resource managers with scientific information needed to address issues such as environmental contaminants, declining and endangered species, and fishery drug research and development. The following field stations are State-run stations that are funded through a reimbursable cooperative agreement to facilitate the Army Corps of Engineer's funded Long Term Resource Monitoring Program: Great Rivers Field Station, Brighton, IL; Lake City Field Station, Lake City, MN; Open River Field Station, Jackson, MO; Havana Field Station, Havana, IL; Bellevue Field Station, Bellevue, IA; and Onalaska Field Station, Onalaska, WI				
Leetown Science Center	Leetown, WV	8,190	7,945	6,952
Program Description: The Center conducts research to provide land and resource managers information needed to restore, enhance, maintain, and protect biological resources and their supporting systems.				
Field Stations:				
Aquatic Ecology Laboratory	Leetown, WV	1,463	1,435	1,435
Fish Health Research Laboratory	Leetown, WV	1,238	1,214	1,214
Southern Appalachian Field Laboratory	Knoxville, TN	387	381	381
Great Smoky Mountain Field Station	Gatlinburg, TN	35	35	35
Northern Appalachian Research Laboratory	Wellsboro, PA	820	804	804
Conte Anadromous Fish Research Laboratory	Turners Falls, MA	1,824	1,788	1,788
Orono Field Station	Orono, ME	172	170	170
Columbus Field Station	Columbus, OH	87	87	87
Restoration Technology Laboratory	Leetown, WV	282	278	278
National Wildlife Health Center	Madison, WI	6,301	6,117	6,177
Program Description: The Center provides national and international leadership for addressing health issues involving wildlife resources under Interior's stewardship and to foster partnerships with others to address wildlife health as a component of ecosystem health.				
Field Stations:				
Honolulu Field Station	Honolulu, HI	183	181	181

Biological Research

Center Name	Location	FY2004 ^{1/} Estimate (\$000)	FY2005 ^{1/} Estimate (\$000)	FY2006 ^{1/} Estimate (\$000)
Patuxent Wildlife Research Center	Laurel, MD	13,556	13,159	13,094
Program Description: The Center focuses on wildlife research and management, specializing in wildlife conservation, especially in such areas as waterfowl harvest management, wildlife habitat improvement, the effects of environmental contaminants, endangered species conservation, migratory bird management, and wildlife population analysis.				
Field Stations:				
Orono	Orono, ME	262	258	258
Athens	Athens, GA	646	634	634
Vicksburg	Vicksburg, MS	324	318	318
Narragansett	Narragansett, RI	625	613	613
Smithsonian	Washington, DC	1,014	994	994
Syracuse	Syracuse, NY	94	94	94
Blacksburg	Blacksburg, VA	111	110	110
Biological Science Office of the Florida Integrated Science Center (formerly the Florida Caribbean Science Center)	Gainesville, FL	5,073	4,925	4,481
Program Description: The Center provides natural resource managers with scientific information needed for effective conservation with emphasis on biological resources of the Florida peninsula, the Southeastern States, and the Caribbean region. The Center focuses on coastal and marine ecology, ecosystems restoration ecology, invasive species, and biological diversity.				
Field Stations:				
Northeast Laboratory	Gainesville, FL	490	482	482
South Florida Field Stations	Miami/Homestead/ Ochopee, FL	1,034	1,014	1,014
Virgin Islands Field Station	St. John, U.S. Virgin Islands	132	130	130
Center for Coastal Geology and Regional Marine Studies	St. Petersburg, FL	238	234	234
Great Lakes Science Center	Ann Arbor, MI	7,195	7,477	7,803
Program Description: The USGS Great Lakes Science Center meets the Nation's need for scientific information for restoring, enhancing, managing, and protecting the living resources and their habitats in the Great Lakes Basin Ecosystem. This mission is accomplished with scientific knowledge gained through quality research, inventory and monitoring, and information transfer.				
Field Stations:				
Lake Superior Biological Station	Ashland, WI	687	675	675
Lake Ontario Biological Station	Oswego, NY	403	395	395
Lake Erie Biological Station	Sandusky, OH	322	316	316
Cheboygan Vessel Base	Cheboygan, MI	273	269	269
Munising Biological Station	Munising, MI	90	90	90
Lake Michigan Ecological Research Station	Porter, IN	411	403	403
Hammond Bay Biological Station	Hammond Bay, MI	38	38	38
Tunison Lab. of Aquatic Science	Cortland, NY	614	602	602

Science Centers and Field Stations

Center Name	Location	FY2004 ¹ Estimate (\$000)	FY2005 ¹ Estimate (\$000)	FY2006 ¹ Estimate (\$000)
Fort Collins Science Center (formerly the Midcontinent Ecological Science Center)	Fort Collins, CO	9,131	9,601	9,748
Program Description: Program description: The Fort Collins Science Center (FORT) conducts research and develops technical applications to assist land managers in understanding and managing biological resources, habitats and ecosystems. FORT is home to the National Institute of Invasive Species Science. FORT conducts research related to species & habitats, aquatic systems, riparian ecology, global change, fire ecology, and herbivore ecosystems in support of DOI bureaus and the International Center for Applied Ecology.				
Field Stations:				
Arid Lands Field Station	Albuquerque, NM	212	208	208
Jemez Mountain Field Station	Los Alamos, NM	318	312	312
Northern Prairie Wildlife Research Center	Jamestown, ND	4,069	4,690	4,737
Program Description: The Center develops research information on the quantitative ecological requirements for sustainable wildlife populations primarily in grasslands and wetlands, determines the distribution of flora and fauna, and identifies consequences of habitat loss, management, and restoration.				
Field Stations:				
Central Plains/Ozark Plateau Ecology	Columbia, MO	248	244	244
Arkansas Project Office	Fayetteville, AR	0	0	0
Project Office-Wolf – U. of Minn.	St. Paul, MN	282	278	278
Minnesota Project Office	St. Paul, MN	185	183	183
Columbia Environmental Research Center	Columbia, MO	7,645	7,229	6,273
Program Description: The Center provides scientific information and data needed to address national and international environmental contaminant issues, and effects of habitat alterations on aquatic and terrestrial ecosystems.				
Field Stations:				
Texas Gulf Coast	Corpus Christi, TX	305	299	299
Texas Gulf Coast	College Station, TX	104	102	102
Padre Island Field Station	Padre Island, TX	72	72	72
International Falls Field Station	International Falls, MN	84	84	84
Yankton Field Station	Yankton, SD	199	195	195
Jackson Field Station	Jackson, WY	76	76	76
National Wetlands Research Center	Lafayette, LA	5,583	5,419	5,473
Program Description: The Center conducts research activity to address loss of wetlands in coastal systems, the changes in fresh and estuarine systems because of changes in water quality, and the resulting effects on birds.				
Field Stations:				
Corpus Christi Field Station	Corpus Christi, TX	152	150	150
Baton Rouge Field Station	Baton Rouge, LA	94	94	94

Biological Research

Center Name	Location	FY2004 ¹ Estimate (\$000)	FY2005 ¹ Estimate (\$000)	FY2006 ¹ Estimate (\$000)
Northern Rocky Mountain Science Center	Bozeman, MT	3,001	2,913	1,968
Program Description: The Center conducts research to provide land and resource managers information needed to restore, enhance, maintain, and protect natural resources of the Rocky Mountain ecosystems.				
Field Stations:				
Glacier Field Station	West Glacier, MT	339	333	333
Missoula Field Station	Missoula, MT	96	96	96
Western Fisheries Research Center	Seattle, WA	3,184	3,190	3,221
Program Description: The Center conducts research and provides fisheries managers and land and resource managers technical assistance to support the stewardship of the Nation's natural resources, emphasizing fish populations and aquatic ecosystems of the West. The Center focuses on fish health, fish, ecology, and aquatic systems.				
Field Stations:				
Marrowstone Field Station	Norland, WA	268	264	264
Columbia River Research Lab	Cook, WA	493	485	485
Reno Field Station	Reno, NV	178	176	176
Dixon Duty Station	Dixon, CA	371	365	365
Klamath Falls Duty Station	Klamath Falls, OR	151	149	149
Biological Science Office of the Alaska Science Center	Anchorage, AK	7,314	7,100	7,171
Program Description: The Center provides biological information and research findings to resource managers, policymakers, and the public to support sound management of biological resources and ecosystems in Alaska. The Center's research focuses on arctic and subarctic ecosystems, marine mammal ecology, migratory birds, and terrestrial mammal ecology. The Center has duty stations in various locations that do not have independent budgets.				
Pacific Islands Ecosystem Research Center	Honolulu, HI	3,099	3,008	3,038
Program Description: The Center conducts research to provide land and resource managers information needed to restore, enhance, maintain, and protect biological resources and their supporting ecosystems in the Pacific Basin.				
Field Stations:				
Kilauea Field Station	Hawaii National Park, Hawaii, HI	1,536	1,506	1,506
Haleakala Field Station	Makawao, Maui, HI	252	248	248
Manoa Field Station	Honolulu, Oahu, HI	265	261	261
Western Ecological Research Center	Davis, CA	7,322	7,108	7,173
Program Description: The Center provides biological information and research findings to resource managers, policymakers, and the public to support sound management of biological resources and ecosystems in California, Nevada, Arizona, and Utah. The Center's research focuses on work related to endangered species, waterfowl, amphibians, fire ecology, global change, and other ecological issues.				
Field Stations:				
Santa Cruz Field Station	Santa Cruz, CA	743	729	729
Piedras Blancas Field Station	San Simeon, CA	0	0	0
Dixon Field Station	Dixon, CA	749	735	735
Davis Station	Davis, CA	338	332	332

Science Centers and Field Stations

Center Name	Location	FY2004 ^{1/} Estimate (\$000)	FY2005 ^{1/} Estimate (\$000)	FY2006 ^{1/} Estimate (\$000)
Western Ecological Research Center Field Stations (continued):				
San Diego Field Station	San Diego, CA	673	661	661
Kern Field Station	Delano, CA	0	0	0
Channel Island Field Station	Ventura, CA	245	241	241
Point Reyes Field Station	Point Reyes, CA	164	162	162
Redwood Field Station	Arcata, CA	108	106	106
Sequoia-Kings Station	Tree Rivers, CA	376	370	370
Yosemite Field Station	Portal, CA	289	285	285
Golden Gate Field Station	Sausalito, CA	198	196	196
San Francisco Bay Field Station	Vallejo, CA	287	283	283
Nevada Field Station	Las Vegas, NV	0	0	0
Box Springs Field Station	Riverside, CA	172	170	170
Canyon Crest Field Station	Riverside, CA	0	0	0
Las Vegas Field Station	Las Vegas, NV	590	580	580
Forest and Rangeland Ecosystem Science Center				
	Corvallis, OR	6,419	6,231	6,293
Program Description: The Center provides scientific understanding and technology to support sound management and conservation of forest and rangeland ecosystems in the Pacific Northwest and Intermountain West.				
Field Stations:				
Regional Ecosystem Office	Portland, OR	122	120	120
Olympic Field Station	Port Angeles, WA	232	228	228
Snake River Field Station	Boise, ID	1,028	1,008	1,008
University of Washington Field Station	Seattle, WA	261	257	257
Southwest Biological Science Center				
	Flagstaff, AZ	1,634	1,587	2,353
Program Description: The Center studies the effects of the operation of Glen Canyon Dam on downstream resources within the Glen Canyon National Recreation Area and Grand Canyon National Park.				
Grand Canyon Monitoring and Research Center	Flagstaff, AZ	263 (remainder funded by receipts from power revenue)	259 (remainder funded by receipts from power revenue)	259 (remainder funded by receipts from power revenue)
Sonoran Field Station	Tucson, AZ	432	424	424
Colorado Plateau Field Station	Flagstaff, AZ	836	820	820
Canyonlands Field Station	Moab, UT	338	332	332

^{1/} Science Center and Field Station funding are estimates and do not include cyclical funds.

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Cooperative Research Units Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{ai}	2006 Budget Request	Change from 2005
Cooperative Research Units	14,757	14,570	+343	-485	14,428	-142
FTE	138	133	0	0	133	0
Total Requirements \$000	14,757	14,570	+343	-485	14,428	-142
FTE	138	133	0	0	133	0

^{ai} Changes for this subactivity include a reduction of -\$14 for travel and -\$21 for vehicle fleet savings. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for the Cooperative Research Units program is \$14,428,000.

The Cooperative Research Units program is a unique cooperative partnership among Federal and State governments and academia, and provides one of the strongest partnership links between USGS and Federal and State management agencies.

This program addresses the DOI Resource Protection strategic goal of sustaining biological communities on DOI managed and influenced lands and waters in a manner consistent with obligations regarding the allocation and use of water by providing the natural resource management community with scientific information and trained personnel to implement sound resource management policies and practices. To clearly measure USGS progress in achieving the intermediate outcome of improving the information base, information management, and technical assistance, the USGS tracks two intermediate outcome measures related to forging effective partnerships (≥ 80 percent satisfaction on biological research partnerships) and quality (100 percent research studies and products validated through appropriate peer review processes). The USGS also tracks outputs including the number of systematic analyses and investigations delivered to customers and the number of workshops/training with USGS sponsorship or participation to transfer results to customers and partners.

Federal scientists stationed at universities (1) help identify and respond to natural resource information needs through the pooling of resources among agencies, (2) provide access to scientific expertise among Unit scientists, university faculty, and other Unit cooperators, especially where the required expertise is not readily available within Federal resource agencies, and (3) provide Federal and other natural resource managers access to a geographically dispersed science organization of Units to meet information needs that transcend State and regional boundaries. Federal support of the Cooperative Research Units is multiplied by State and university cooperator contributions of expertise, equipment, facilities, and project funding, thereby enhancing the program's cost-effectiveness. Local guidance of activities by Unit cooperators ensures that projects addressed by the Units are high priority. Through university affiliations, Unit scientists train future natural resource professionals and provide opportunities through graduate education to diversify the Federal workforce.

Cooperative Research Units Subactivity

The USGS Cooperative Research Unit program is comprised of 40 Cooperative Fish and Wildlife Research Units located at leading universities in 38 States, with a headquarters office in Reston, VA. The overall goal of the program is to maintain cooperative partnerships with State and Federal agencies to address mutual needs of all partners in a cost effective manner. Currently, science positions in 14 States remain vacant.

Funds appropriated to the Cooperative Research Unit program are used to staff, support, and manage USGS participation in this important Federal partnership with States and universities. The research and technical assistance activities of individual Units are supported by reimbursable funds from State, Federal, and local governments and non-government organizations. Each Cooperative Research Unit is directed by a Coordinating Committee of Federal, State, university, and non-government representatives. Each Coordinating Committee establishes the goals and expectations for each Unit within the program's mission of research, education, and technical assistance. The mix of priorities is established locally and changes annually based on the local needs of the cooperators and funding available from cooperators and program partners including DOI.

The following table lists current cooperative research units by State:

Cooperative Research Units Locations

Alabama	Auburn University
Alaska	University of Alaska
Arizona	University of Arizona
Arkansas*	University of Arkansas, Fayetteville
California	Humboldt State University
Colorado*	Colorado State University
Florida	University of Florida
Georgia	University of Georgia
Hawaii	University of Hawaii
Idaho*	University of Idaho
Iowa	Iowa State University
Kansas	Kansas State University
Louisiana*	Louisiana State University
Maine	University of Maine
Maryland*	University of Maryland, Eastern Shore
Massachusetts	University of Massachusetts
Minnesota	University of Minnesota
Mississippi	Mississippi State University
Missouri*	University of Missouri
Montana	Montana State University (Fish Unit) University of Montana (Wildlife Unit)
Nebraska*	University of Nebraska
New Mexico*	New Mexico State University
New York*	Cornell University
North Carolina	North Carolina University
Oklahoma*	Okalahoma State University
Oregon	Oregon State University

Cooperative Research Units Subactivity

Pennsylvania*	Pennsylvania State University
South Carolina*	Clemson University
South Dakota	South Dakota State University
Tennessee	Tennessee Tech University
Texas*	Texas Tech University
Utah	Utah State University
Vermont*	University of Vermont
Virginia	Virginia Polytechnic University
Washington	University of Washington
West Virginia	West Virginia University
Wisconsin	University of Wisconsin, Stevens Point (Fish Unit) University of Wisconsin, Madison (Wildlife Unit)
Wyoming	University of Wyoming

*States with one or more unfunded unit scientist vacancies

The Unit program is highly productive in scientific, academic, and outreach activities. Through affiliations with host universities, Unit scientists advise and mentor over 600 graduate students annually. Approximately 100 of these students received graduate degrees in FY 2004. Activities also involve Unit sponsorship of undergraduate and graduate education programs for minorities that are underrepresented in the Federal workforce. These efforts focus on minority student recruitment and career training in natural resources and include USGS programs for minority students at the University of Arizona and a national scholars in fisheries program at the University of Arkansas-Pine Bluff.

In FY 2006, Unit scientists will continue to work directly with resource managers to identify and address information needs through research and technical assistance.

Every year, CRU cooperators review each of the 40 Units through an annual meeting of Unit cooperators.

The following are the program goals of the Cooperative Research Units:

- Sustain a national network of State/university/Federal partnerships pursuant to the Cooperative Research Units Act, with a legislated mission of research, education, and technical assistance on issues related to fish, wildlife, ecology, and natural resources.
- Sustain a quality-driven, results-oriented, network of expertise for research, teaching, and technical assistance that is responsive to the resource information needs of State resource agencies and host universities participating in the Cooperative Research Units program.
- Maintain science capabilities that are responsive to the resource management information needs of bureaus in the Department of the Interior and provide Department bureaus with access to these capabilities.
- Enhance and support science programs in the USGS by providing coordination and access to research capabilities at 40 host universities.

2004 Program Performance Accomplishments

Unless otherwise noted, the program accomplishments listed below demonstrate the utility of scientific publications and other products that are counted under the output measures for "systematic analyses and investigations delivered to customers" and "number of formal workshops or training provided to customers (instances/issues/events)."

All FY 2004 planned program goals as specified in the FY 2005 Budget Justifications were met as follows:

Meetings were held with State, Federal, university, and other cooperators from all 40 of the Cooperative Research Units (CRU) to review Unit finances, performance, local program direction, and contributions of each cooperator to the operations of each Unit. A national meeting of program cooperators was held in March 2004.

The USGS reviewed, renegotiated, and became signatories to four cooperative agreements for the operation of Cooperative Fish and Wildlife Research Units.

Implemented a streamlined invoicing and payment process for reimbursing universities for funds expended on behalf of USGS supported research.

Working with States, universities, the U.S. Fish and Wildlife Service, and the Wildlife Management Institute, the USGS agreed to play a supportive role in a new coalition of program cooperators. The CRU national office provided information as requested by cooperators. Meetings of the Coalition will replace the annual, national meetings of Unit cooperators.

In FY 2004, the program staffed the Unit leader position at Nebraska and filled two assistant Unit Leader positions, one in Alaska and the other in Maine. In addition, the program filled one of its Unit supervisor positions following the retirement of the incumbent.

During FY 2004, Unit scientists, affiliates, and students published approximately 290 scientific papers, submitted more than 100 reports to management agencies, and presented more than 1,100 papers and workshops to natural resource professional societies and agencies. In total, approximately 880 research projects were active in FY 2004, with more than 150 projects completed and over 100 new projects initiated in response to Federal and State agency needs. Unit projects covered a wide range of disciplines, including biodiversity, invasive species, anadromous fish and migratory bird management, habitat management and restoration, wildlife diseases, fire ecology, environmental contaminants, assessment of imperiled species, and population modeling and genetics.

Cooperative Research Units are available to assist organizations with research needs related to fish, wildlife, and natural resources. Special emphasis is placed on assisting bureaus within the Department of the Interior and State agency cooperators. During FY 2004, Unit scientists conducted research projects for the following bureaus/agencies/States: U.S. Fish and Wildlife Service (126), Bureau of Land Management (14), Bureau of Reclamation (8), National Park Service (43), U.S. Department of Agriculture (49), Environmental Protection Agency (8), Department of Defense (25), and State agencies (349). The following research projects, completed during FY 2004, are representative of the work of the program in support of the information needs of natural resource management agencies and are listed by program partner:

U.S. Fish and Wildlife Service (FWS)

Georgia Cooperative Fish and Wildlife Research Unit — Developed and evaluated models for adaptive harvest management (AHM) of American black ducks. The FWS, USGS, and Canadian Wildlife Service will use the information for developing an Integrated AHM protocol for black ducks.

Tennessee Cooperative Fishery Research Unit — Investigated the life history of the endangered bluemask darter. Spawning habitat differed significantly from habitats occupied by darters during the non-spawning season. Spawning occurred in shallow runs with moderate currents and gravel substrate. Although some age 1 individuals spawned, the majority of the spawning population was comprised of older individuals. This information will be used by State and Federal agencies for developing recovery plans for the species.

Florida Cooperative Fish and Wildlife Research Unit — Evaluated the impact of Savannah River harbor expansion activities on the wetlands and freshwater/brackish marshes of the Savannah National Wildlife Refuge, which is adjacent to the harbor. The FWS will use this information to forecast impacts of harbor development and evaluate the success of restoration efforts to mitigate past impacts.

Maine Cooperative Fish and Wildlife Research Unit — Mapped vegetation in 52 impoundments at Moosehorn National Wildlife Refuge managed for waterbird use, and assessed changes in impoundment condition for waterbirds in relation to age and water management practices. Information will be incorporated into refuge management plans for impoundment vegetation.

Arizona Cooperative Fish and Wildlife Research Unit — Examined the impacts of recreation visitation on wildlife locations in Misty Fjords National Monument. This is the first study in southeast Alaska to use computer simulation to aid in evaluating impacts of recreation visitation on wildlife populations. This information is being used to support efforts to monitor and manage human-wildlife interactions.

Vermont Cooperative Fish and Wildlife Research Unit — Developed a population viability model for the Lake Champlain sea lamprey population to determine which life stages of sea lamprey are most sensitive to control, and to examine optimal combinations of control methods. These results are being evaluated by management agencies for use in sea lamprey control efforts.

Bureau of Reclamation (BOR) and Bureau of Land Management (BLM)

Arizona Cooperative Fish and Wildlife Research Unit — Evaluated the validity of using prescribed fire as a possible management tool to help improve habitat conditions for two species of endangered birds on the lower Colorado River. The FWS, BOR, BLM, and Arizona Game and Fish Department use this information to plan the location and timing of prescribed fires in the region.

Arizona Cooperative Fish and Wildlife Research Unit — Documented nesting success, annual fidelity, rate of nest destruction, and other parameters associated with burrowing owls in eastern Washington. This information is being used by the Washington Department of Fish and Wildlife in cooperation with the BLM and FWS, to make decisions on a listing category for this species.

National Park Service (NPS)

Pennsylvania Cooperative Fish and Wildlife Research Unit — Developed a sampling design for the Long Term Ecological Monitoring program at Shenandoah National Park. This sampling design was a revision to a previous sampling design and provides more precise estimates of tree and shrub species.

South Dakota Cooperative Fish and Wildlife Research Unit — Working with South Dakota State University experts, we determined that fawn mortality was a significant factor limiting population growth of pronghorn antelope within Wind Cave National Park. The NPS is incorporating this information into management plans for the park.

Iowa Cooperative Fish and Wildlife Research Unit — Conducted population and angler exploitation assessments of the genetically unique Shoepack Lake muskellunge population, and evaluated potential natural and anthropogenic threats to the long-term viability of the population using simulation modeling. A 50 percent reduction in habitat (observed during the study) posed the greatest threat to long-term population. The NPS is using this information for evaluating management options for Shoepack Lake.

Maine Cooperative Fish and Wildlife Research Unit — Conducted mercury analyses on tadpoles, water, and sediment samples from wetlands distributed across Acadia National Park, ME. This information is being used by NPS personnel to evaluate mercury contamination at the park in relation to nearby areas outside the park boundaries.

Arizona Cooperative Fish and Wildlife Research Unit — Documented the number of nesting burrowing owls on Casa Grande Ruins National Monument, and the importance of the area to this species of national conservation concern. This information is being used by park management to educate visitors to the park and the park staff is using the information to adjust their management plans to protect nest burrows.

Environmental Protection Agency (EPA)

South Dakota Cooperative Fish and Wildlife Research Unit — Determined biotic community composition at 123 stream reaches in South Dakota. Data will be included in the western EMAP study.

Arizona Cooperative Fish and Wildlife Research Unit — Compiled and reported biotic and abiotic factors associated with the distribution and relative abundance of non-native fishes across 12 western States. Data were from approximately 900 sites across the West, one of the largest standardized sampling efforts of western fish to date. This information is being used by managers to identify the most prevalent introduced fishes across the West, factors associated with the presence of these species, and characteristics that might be used to manage these fishes.

West Virginia Cooperative Fish and Wildlife Research Unit — Determined that landscape changes from mountaintop removal mining decreased salamander abundance and increased reptile abundance. Salamanders were slow to re-colonize reclaimed habitats, and stream salamander abundance in mining-impacted streams was lower than in un-impacted streams. This information was incorporated in the Environmental Impact Statement on mountaintop removal mining.

National Marine Fisheries Service (NMFS) and National Oceanic and Atmospheric Administration (NOAA)

California Cooperative Fishery Research Unit — Investigated population demographics of coho salmon in undisturbed and recently disturbed streams and determined that adult spawning numbers and juvenile survival were higher in undisturbed habitats. The NOAA and the California Department of Fish and Game use this information in recovery planning for coho salmon.

U.S. Forest Service (USFS)

Alabama Cooperative Fish and Wildlife Research Unit — Determined the relationships among vegetative cover, stream proximity, goose nest density, and bald eagle abundance in relation to nest success of dusky Canada geese breeding on the Copper River Delta, AK. This information is being used by the USFS to guide management actions to improve the productivity of this declining population of dusky Canada geese.

Utah Cooperative Fish and Wildlife Research Unit — As part of the Survey and Manage program, Pacific Northwest Forest Plan, the Utah Unit developed and implemented a research design for sampling rare bryophytes (plants such as mosses, liverworts, and hornworts) to determine distributions and associations with old forest. Results indicated that for a majority of the targeted Survey and Manage species defensible estimates of abundance, and distribution maps, were unachievable given logistical constraints and species detection problems.

Arizona Cooperative Fish and Wildlife Research Unit — Examined the influence of species, size class, environment, and season on introduced fish predation on native fishes in the Verde River System, AZ. This information is being used by State and Federal agencies to understand the importance of non-native fish predation as a factor in the declines of imperiled southwestern native fishes, and to prioritize where programs to control non-native fishes can best be focused.

West Virginia Cooperative Fish and Wildlife Research Unit — Determined raccoon habitat preferences and limiting factors in forested areas so as to determine preferred areas for rabies vaccination bait-drop. Pinpointing such areas will reduce the areas covered by bait drop by 36 percent, while maintaining greater than 70 percent contact with all animals. This information will be used by the U.S. Department of Agriculture in their rabies vaccination program.

Arizona Cooperative Fish and Wildlife Research Unit — Estimated demographic parameters and documented habitat correlates for montane forest birds in the unique Sky Island Mountain Ranges of southeastern Arizona. The Arizona Game and Fish Department uses this information to document distribution and abundance of birds in these environments to complement their Statewide Breeding Bird Atlas program. USFS will be able to use this information to help assess the effects of recent wildfires on biological resources within Coronado National Forest.

U.S. Department of Defense (DOD)

Texas Cooperative Fish and Wildlife Research Unit — Examined the efficacy of prairie dog control as a means of reducing aircraft-raptor strike risk in areas of prairie dog colonies, and the feasibility of using visual barriers as a means of non-lethal prairie dog control. The value of

Cooperative Research Units Subactivity

prairie dog control can be related to abundance of a given raptor species at the site in question, the general strike risk of that species, and the relationship of that species to prairie dog colonies. Visual barriers did not hinder prairie dog colony expansion. This information will be used by the DOD to formulate management plans to reduce bird-aircraft strikes.

Florida Cooperative Fish and Wildlife Research Unit — Documented the use of coastal waters by both juvenile and adult sea turtles and the interesting movements of adult loggerhead turtles along the northwestern coast of Florida. The DOD, FWS, NOAA, and Florida Fish and Wildlife Commission uses this information for resource management in conservation planning for marine turtles in Florida.

Texas Cooperative Fish and Wildlife Research Unit — Developed new biomarker ("Colloidal T4 ring") of exposure to environmental perchlorate in fishes and assessed its sensitivity in relation to currently available biomarkers. The utility of this new biomarker is now being evaluated for amphibians and has potential widespread field use by resource management agencies.

U.S. Army Corps of Engineers (COE)

Mississippi Cooperative Fish and Wildlife Research Unit — Developed a bioenergetic model to provide insight into the potential for fishes to impact zebra mussel populations by predation across river and lake systems in eastern North America. This study generally supports the premise that fishes in more southern (including central) U.S. waters have inherently greater potential to impact zebra mussels because of community composition and bioenergetics. Our simulations provide a partial explanation of why zebra mussel invasions have not been as rapid and widespread in southern U.S. waters compared to the Great Lakes region.

Florida Cooperative Fish and Wildlife Research Unit — Determined the relationship of wading bird reproduction to hydrological manipulations in the Florida Everglades. The project was funded by the US Army COE and is being used by the multiple agencies responsible for Everglades restoration.

State Agencies

Virginia Cooperative Fish and Wildlife Research Unit — Investigated various aspects of the demographics of Virginia's black bear population. Bait station visitation rates were low and likely did not reflect population trends. Adult females had the highest annual survival rate and yearling males had the lowest. Adult female survival was the most important factor affecting population growth rates. This data will be used by the Virginia Department of Game and Inland Fisheries to develop management strategies for bears in Virginia.

Oklahoma Cooperative Fish and Wildlife Research Unit — Assessed differential recruitment of striped bass from the Red and Washita rivers that flow into Lake Texoma. Recruitment varied depending on timing and magnitude of river flows, and growth of juvenile striped bass was density-dependent. Microchemistry successfully differentiated striped bass spawned from the Red and Washita rivers. This information will be used by the Oklahoma Department of Wildlife Conservation to better manage striped bass populations.

Montana Cooperative Fishery Research Unit — Characterized seasonal movement patterns, habitat use, and aggregation of sauger and estimated their movement, exploitation, and

irrigation canal entrainment rates to test hypotheses explaining the failure of Yellowstone River sauger to return to historical abundances following drought. Entrainment in irrigation diversions may have accounted for more than half of non-fishing mortality. Migratory barriers, habitat loss, and overexploitation of adult sauger did not prevent sauger recovery. This information is being used to formulate fishing regulations and develop irrigation canal screening programs.

Louisiana Cooperative Fish and Wildlife Research Unit — Working with the Louisiana Department of Wildlife and Fisheries, the Unit found that small created oyster reefs could be used in low energy sites for reducing shoreline erosion. This information is used by parish governments, State, and Federal agencies are evaluating strategies to reduce shoreline erosion along the entire coast.

Oklahoma Cooperative Fish and Wildlife Research Unit — Compiled and analyzed demographic data from a large sample of radio-collared bobwhite quail to examine survival and cause-specific mortality of quail. Assessed demographic variables associated with breeding behavior, mobility, and home ranges of bobwhites in western Oklahoma. Information will be used by Oklahoma Department of Wildlife Conservation to make management decisions regarding bobwhite quail harvest and habitat management.

North Carolina Cooperative Fish and Wildlife Research Unit — Developed an ecosystem simulation model, based on empirical data collected from North Carolina coastal rivers, to evaluate the impact of introduced flathead catfish on the native fish community. Model results suggest that flathead catfish suppress native fish community biomass by 5-50 percent through both predatory and competitive interactions. These findings and others associated with this project will provide the basis for managing this fish in its introduced range.

Wisconsin Cooperative Fishery Research Unit — Developed a bioenergetics consumption model to look at mechanisms of interaction between walleye and smallmouth bass, which typically do not coexist in large numbers in north temperate lakes. When applied to data from Big Crooked Lake, a system where walleye are abundant and smallmouth bass are uncommon, the model predicted that young-of-year walleye consume nearly all young-of-year smallmouth bass before their first winter. The results suggest that establishing high populations of smallmouth bass in percid (perch) lakes may be impractical. This information will be used to guide stocking programs in the State.

Tennessee Cooperative Fishery Research Unit — Tested several methods of propagating and culturing the endangered pink mucket mussel. Successful long-term (greater than 2 years) culture was accomplished by initially culturing juveniles indoors for 6 to 12 weeks, and then transferring them to a hatchery raceway. Between-year survival was about 85 percent. This information will be used by State and Federal agencies to restore native mussel populations.

South Dakota Cooperative Fish and Wildlife Research Unit — Determined the number, surface area, and kinds of wetlands in western South Dakota. The information will be used to complete the wetland atlas for South Dakota.

Wyoming Cooperative Fish and Wildlife Research Unit — Assessed Hungarian partridge use of habitats and food resources in the State of Wyoming and determined that population fluctuations were highly related to food sources. The State will use this information in their management and stewardship of this resource.

Cooperative Research Units Subactivity

Montana Cooperative Fishery Research Unit — Documented the spatial, temporal, and discharge-mediated dynamics of whirling disease organism concentrations directly using packed-bed filtration at five mainstem sites on the upper Madison River and at Willow Creek, MT. Packed-bed filtration proved to be a rapid, efficient, and effective method for assessing whirling disease infection risk among wild trout. The Whirling Disease Initiative of the National Partnership on the Management of Wild and Native Cold Water Fisheries will use the results of this work.

Hawaii Cooperative Fishery Research Unit — Conducted a comparative study of the diets of an introduced, invasive snapper and important native fish species in Hawaiian coastal waters. The State of Hawaii will use this information to evaluate the need for control measures for introduced snappers.

Missouri Cooperative Fish and Wildlife Research Unit — Identified characteristics related to white-tailed deer abundance and harvest vulnerability in Deer Management Units of Missouri, and deer abundance in Missouri State parks. The Unit recommended that habitat and land use patterns on adjacent areas be monitored and incorporated into herd management plans on parklands.

Non-governmental Conservation Organizations and other Private Entities

Virginia Cooperative Fish and Wildlife Research Unit — Developed techniques to propagate two federally endangered mussel species residing in the Big South Fork Cumberland River to augment natural reproduction. In 2003-2004, a total of 55,000 endangered juveniles of the Cumberland combshell, tan riffleshell, Cumberland bean, and little-wing pearl mussel were released into the river. NPS personnel will monitor release sites in subsequent years.

California Cooperative Fishery Research Unit — Evaluated the response of tidal wetlands to ecological restoration activities. Response measurements included hydrology, sedimentation, water quality, and community level metrics of vegetation, invertebrates, fish, birds and mammals. The Ducks Unlimited and the California Department of Fish and Game use this information to develop management plans for a newly acquired waterfowl refuge.

Vermont Cooperative Fish and Wildlife Research Unit — Conducted surveys of birds, amphibians, and selected carnivores in the Southern Lake Champlain Ecoregion. The data are being used by The Nature Conservancy to aid in large-scale conservation planning.

Alabama Cooperative Fish and Wildlife Research Unit — Developed an Integrated Rapid Assessment Technique (IRAT) to detect and prioritize streams that are impacted by acid mine drainage (AMD). The IRAT used an extensive data set of water chemistry and invertebrate metrics and allowed ranking of AMD impacts in 51 stream reaches in north Alabama. The Alabama Department of Environmental Management and Alabama Water Watch will use the technique to determine impact of AMD on stream ecosystems.

2005 Planned Program Performance

Unless otherwise noted, the program accomplishments listed below demonstrate the utility of scientific publications and other products that are counted under the output measures for "systematic analyses and investigations delivered to customers" and "number of formal workshops or training provided to customers (instances/issues/events)."

Cooperative Research Units Subactivity

The USGS will actively work to maintain the Federal-State-University partnerships that support 40 Cooperative Fish and Wildlife Research Units. These Units will continue to provide cost-effective approaches to natural resource issues of mutual interest to participating organizations. Through these partnerships, the Federal Government will maintain access to the expertise and facilities of 40 leading universities distributed across 38 States.

Meetings with State, Federal, university, and other cooperators from each of the Cooperative Research Units will be held to review Unit finances, performance, local program direction, and contributions of each cooperator to the operations of each Unit.

Based on funding available, prioritize and initiate recruitment actions for one to two scientists to be stationed at cooperating universities, to replace scientific staff lost through attrition.

The program will review and as appropriate, renegotiate 10 percent of the cooperative agreements for the operation of Cooperative Research Units.

Within 6 months after the end of the fiscal year, the USGS plans to make available to all program cooperators, an annual report of program accomplishments placed within a historical timeframe that facilitates recognition of trends in resources, productivity, and partnership outcomes.

The program will complete development of a centralized CRU project database and incorporate it into office practices to increase efficiency and responsiveness to information needs of USGS and other program cooperators.

In consultation with program cooperators, the program will complete its 5-year strategic plan for the national program.

The program will increase training opportunities for demographic groups underrepresented in the conservation community.

The program will develop a workforce planning strategy to further its current efforts to address the anticipated large number of retirements from scientific and management positions.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Cooperative Research Units (\$000)	14,428	-485
FTE	133	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006 budget request for the Cooperative Research Units is \$14,428,000 and 133 FTE, a net program decrease of -\$142,000 (includes adjustments for uncontrollable costs) and 0 FTE from the 2005 enacted level.

Nebraska Cooperative Research Unit (-\$395,000) — This reduces a Congressional earmark for a new cooperative research unit in Nebraska. The reduction eliminates implementation of this Unit.

Cooperative Research Units Subactivity

General Reduction (-\$55,000) — Of a \$247,000 general increase received in FY 2005, the USGS requests a decrease of \$55,000 to maintain higher priority funding elsewhere in the USGS.

Enterprise Information

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Enterprise Information Security and Technology	0	22,714	+256	+2,267	25,237	+2,523
FTE	0	155	0	0	155	0
Enterprise Information Resources	0	16,989	+185	-21	17,153	+164
FTE	0	109	0	0	109	0
Federal Geographic Data Coordination	0	4,670	+34	+673	5,377	+707
FTE	0	17	0	0	17	0
Total Requirements \$000	0	44,373	+475	+2,919	47,767	+3,394
FTE	0	281	0	0	281	0

^{a/} Changes for this activity include a reduction of -\$55 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

Activity Summary

Introduction

In FY 2005, the USGS consolidated funding of all bureauwide (enterprisewide) IT (information technology), management, and service functions that were previously distributed among several different USGS offices and budget subactivities under the authority of the Geospatial Information Officer as a single Enterprise Information Activity. The USGS enterprise information program supports bureau-level activities and investments in the areas of information technology, information security, information management, information policy and standards, and information science. As the primary vehicle for planning and pursuing the broad information goals and objectives of the USGS, the program provides effective and efficient bureau-level information policies, infrastructure, and services needed to support the bureau's scientific mission, to create

Use of Cost and Performance Information

In FY 2004, the USGS made substantial progress beyond planned performance in several key information technology areas.

Narrowband Radio Conversion — In FY 2004, the USGS converted its remaining VHF radio equipment to narrowband channels and met the December 31, 2004, governmentwide deadline ahead of schedule. The USGS also completed conversion of UHF wide-band radio equipment during FY 2004 significantly in advance of the governmentwide deadline (end of 2008).

Access to Science Information — The Electronic Publications Warehouse (<http://pubs.usgs.gov>) for locating USGS reports and other publications was launched in January 2004 and expanded to more than 66,000 titles in the data base and almost 26,000 electronic publication products by the end of FY 2004. USGS installed new, faster scanning equipment and implemented efficiencies for the conversion and quality control of paper reports and publications to digital form. As the existing staff gains experience with implementing the Electronic Publications Warehouse, USGS continues to implement process improvements.

Enhanced Web Site Security — As part of a continuing emphasis on enhanced network security, USGS migrated six times the planned amount of Web sites into the secure National Web Server infrastructure.

Enterprise Information

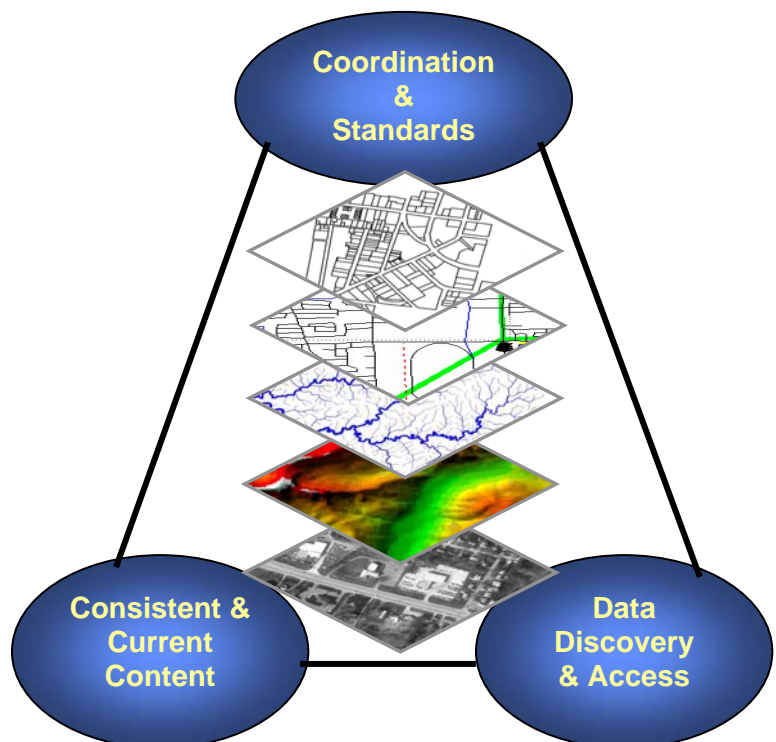
a more integrated information environment at the USGS, and to ensure that the bureau meets legislative and administrative mandates. The resulting integrated information environment fosters easier discovery, access, acquisition, and use of USGS geospatial and other data and information by scientists, academia, partners, and the interested public. The activity also provides management oversight and staff support for DOI-led interagency geographic data coordination including the Federal Geographic Data Committee (FGDC) and the Geospatial One-Stop (GOS) E-Government project.

Therefore, informed by the National Research Council recommendations and by discussions with constituent groups on how to best serve their geospatial data needs, USGS geospatial data programs have been organized under a new National Geospatial Programs Office (NGPO). This realignment brings *The National Map*, GOS, and the FGDC into a single program office. Related activities under the NGPO umbrella include The National Atlas, Department of the Interior Enterprise Geographic Information Management, and GEODE (Geologic Data Explorer). In FY 2005 and FY 2006, the Survey will work with Congress to make budget structure adjustments to align funding with program management. Specifically, most of the Cooperative Topographic Mapping Subactivity funding will be moved from the Mapping, Remote Sensing, and Geographic Investigations Activity to the Enterprise Information Activity. In addition performance measures for NGPO activities will be evaluated and integrated to reflect program and organizational realignment.

Leadership — The USGS Geospatial Information Officer (GIO) serves as the bureau's Chief Information Officer and is responsible for overall policy direction, management, and oversight for bureau-level systems and activities in IT, information security, information services, information resources management, and capital asset planning activities.

Enterprise Information Security and Technology — The Enterprise Information Security and Technology Subactivity supports bureau-level management and operation of USGS telecommunications networks, computing infrastructure, electronic mail, computer help desks, and enterprise-level hardware and software acquisition. It also supports the bureau's overall information security program, including responsibility for IT security operations and for the confidentiality, integrity, and availability of USGS data and information assets.

Enterprise Information Resources — The Enterprise Information Resources Subactivity provides for overall policy direction, management, and oversight for bureau-level systems and activities in information services (Web-Internet services, science publishing, libraries, and science information centers);



information resources management (compliance with Federal mandates for records archiving and management, privacy, Freedom of Information Act (FOIA), Section 508 accessibility, Office of Management and Budget (OMB) Data Quality Guidelines, and others); and science information coordination (IT capital asset planning, strategic planning, and enterprise-level coordination of geographic information systems).

Federal Geographic Data Coordination — The Federal Geographic Data Coordination Subactivity provides for operational support and overall executive management for the Federal Geographic Data Committee (FGDC). This leadership role is specified as a DOI responsibility under OMB Circular A-16. The FGDC is an interagency and intergovernmental committee that encourages Federal, State, local, and Tribal governments, academia, the private sector, and nonprofit organizations to work together within a geographic area to make geospatial data available to all through the National Spatial Data Infrastructure (NSDI), Geospatial One Stop (GOS), and The National Map. The GOS is a focused set of collaborative activities designed to accelerate the development and advance the use of the NSDI as a fundamental building block for Electronic Government. The Department serves as the managing partner of the GOS E-Government Quicksilver Project. The USGS provides the operational support and overall executive management for the GOS project on behalf of the Department. FGDC participates actively in related international activities including the Global Spatial Data Infrastructure, Group on Earth Observation (GEO) comprised of United Nations and European Commission members, and in the development of a 10-year implementation plan for the Global Earth Observation System of Systems (GEOSS). New partnerships with National Geospatial-Intelligence Agency and the Department of Homeland Security will be implemented to support national security requirements.

Customers and Partners

National Geospatial Programs Office — During FY 2005 USGS will develop strategies to align national geospatial activities and responsibilities including the FGDC, GOS, and *The National Map* into a National Geospatial Programs Office (NGPO). The NGPO merges the essential components of delivering the NSDI into a unified management structure. The USGS will engage partners throughout the geospatial community in its planning for an NGPO to ensure that a more unified portfolio benefits the entire community. Study teams that include USGS partners have been chartered to provide feedback and direction on:

- A Unified Geospatial Enterprise Architecture,
- Geospatial Technology Integration,
- Partnerships,
- Web Presence,
- Measuring Geospatial Investments, and
- USGS Geospatial Products and Services.

Compliance with Federal Mandates and DOI Initiatives — Emphasis in FY 2006 will continue on implementation of Federal and Departmental Information Technology initiatives. High priority efforts include achieving full utilization of the President's E-Government Initiatives, institutionalizing effective IT management practices such as Federal Information Security

Enterprise Information

Management Act (FISMA), Certification and Accreditation, Project Management, and IT Capital Planning and Portfolio Management, and advancing the development and use of the Federal Enterprise Architecture and the USGS component of the DOI Enterprise Architecture. Further implementation of Federal policy regarding E-Authentication will also continue in FY 2006.

USGS will focus resources on high priority, cost saving DOI IT Transformation investments. During FY 2006, the USGS will transition to a centrally managed DOI-wide electronic mail platform, Enterprise Messaging System (EMS). USGS will continue the phased implementation of integrated bureau directory services to provide a consistent technical architecture, security controls and common software tools to USGS local office environments nationwide. The USGS Enterprise Web will be improved with management controls and an enhanced customer focus. USGS will continue our leadership role in the implementation of the DOI Enterprise Services Network (ESN). Benefits of centralization from the ESN include enhanced network standardization, efficient network operations, and a uniformly high level of security.

USGS Natural Science Network — The bureau is undertaking a new approach to providing more efficient access to USGS data, information and knowledge through a Natural Science Network (NSN). This network will depend on automated tools, a knowledge base of USGS science, and a core group of information professionals to bring the full breadth of USGS data and information to users when, where, and how they need it.

The NSN will have three primary components (1) the Science Information and Library Services Center created by melding together the Earth Science Information Centers and the USGS Library System to provide an integrated network of both physical and virtual information offices that will make data, information, and knowledge available to anyone, anywhere at anytime, (2) a Knowledge Management component that will provide the software and electronic tools to ensure that USGS data, information and scientific knowledge are linked to the NSN, and (3) an Information Delivery component that will make the transition from a paper-based warehouse to electronic delivery of USGS products and information.

As part of the strategy for the NSN, the USGS analyzed financial structure and the need for new skills needed to meet future requirements. To achieve appropriate workforce realignment, USGS is seeking Voluntary Separation Incentive Payments (buyout) and Voluntary Early Retirement Program (earlyout) authority in FY 2005 for selected library functions.

By working toward this desired future state, the USGS will continue to serve as the Nation's primary integrated natural science and information agency. This knowledge and information network will enable the USGS to serve our customers more efficiently and effectively. Diverse users across the Nation and around the world will be able to access USGS scientific information at the USGS quickly and easily.

Funding, Strategic Goals, and Performance Data

All funding for the Enterprise Information Activity addresses the DOI Strategic Plan's Serving Communities strategic goal of advance knowledge through scientific leadership and inform decisions through the application of science, and the Management Excellence theme. Funding from Science Support and science discipline budget activities supported accomplishments shown for FY 2003 and FY 2004. "SP" coded measures relate to specific measures in the DOI Strategic Plan and contribute to the aggregate bureau outcome as shown in the General Statement and the aggregate DOI outcome in the Department's unified plan. Outputs are only

included in bureau plans. Where possible, prior year performance actuals were also derived for the new metrics.

FY 2004 Actual Compared to FY 2004 Plan/Budget

- For the end outcome measure, "# of USGS science publications cataloged in master USGS publications databases", the target was exceeded by 3,626 publications. Additional focus was placed on adding citations for historical and previously retired scientific publication report series. Adding these older references enables the USGS to be more comprehensive in completing its citation lists.
- For the end outcome measure "# of associated USGS science publications accessible on-line", the target was exceeded by 10,909. USGS has installed a new, faster scanner and implemented efficiencies for the conversion and quality control of paper reports and publications to digital form.
- For the intermediate outcome measure "% of time that all WAN (wide area network) and Internet access locations are up and running", USGS exceeded the planned target by 1.2 percent as the outage restoration time was shorter than prior experience.
- For the intermediate outcome measure, "Increase on-line transactions to X% relative to a baseline inventory of all USGS transactional services", the FY 2004 target was not met due to technical problems and subsequent delays relating to data base software.
- For the output measure, "# of new NSDI Clearinghouse nodes established for serving data", the target was exceeded by 40 percent due in large part to the collaboration between the FGDC and the Canada GeoConnections program that yielded additional metadata collections.
- For the output measure, "# of informal NSDI conference outreach exhibits", the target was exceeded by 9 conferences as additional conference opportunities were available as a result of NSDI collaboration with Geospatial One-Stop.
- For the output measure, "# of new NSDI standards developed", the target was not met. The FGDC has assumed leadership for the Framework data standards initially developed through Geospatial One-Stop. As a result, several new NSDI standards are undergoing public review through the formal American National Standards Institute (ANSI) standards approval process. USGS anticipates that these new standards will be endorsed as NSDI standards in FY 2005.
- For the output measure "# of new NSDI partnership agreements", the target was not met due to the natural variation from year-to-year in the number of projects awarded through the NSDI Cooperative Agreements Program (CAP). Number of project awards made each year varies due to quality of project proposals and size of proposed project budgets, category of awards, and total amount of funding available.
- For the output measure "# of significant Web sites co-located on consolidated, hardened, secure, and redundant Internet servers," the USGS migrated 87 more Web sites into the secure National Web Server (NatWeb) infrastructure than had been planned. This was due to re-alignment of existing staff resources in this area and as a response to emphasis of USGS management on enhancing network security and due to the DOI directive to plan and consolidate servers.

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- For the output measure "% of total legislatively mandated narrowband radio transition achieved," the USGS completed conversion of 2 percent more of its total wideband radio equipment than had been planned for a total of 100 percent completed. This was the result of coordination with DOI-wide wideband radio procurement, which resulted in increased efficiencies in the procurement process.
- For the output measure "# of IT help desks operational in major USGS offices," the USGS consolidated 1 less help desk than had been planned. This was the result of unanticipated delays in the acquisition of a new bureauwide help desk tracking software suite.

FY 2005 Revised Final Plan Compared to FY 2004 Actual

- Decrease of 1.7 percent shown for intermediate outcome measure "% of time that all WAN and Internet access locations are up, running and accessible" is due to anticipated transition issues during the FY 2005 conversion from USGS WAN to DOI Enterprise Services Network (ESN)
- Change of 1 less help desk shown for output measure "# of IT help desks operational in major USGS offices" is due to USGS plans to acquire a bureauwide help desk tracking software suite in FY 2005, which will facilitate further consolidation of major USGS IT Help Desks.

FY 2005 Revised Final Plan Compared to FY 2005 Plan/Budget

- For the end outcome measure, "# of USGS science publications cataloged in master USGS publications databases," historical documents previously not included as official USGS publications are being cataloged. These include mainly publications from organizational units recently brought into the USGS. The FY 2005 plan has been increased by 2,000 publications.
- The increase 1 percent in the intermediate outcome measure "% of time that all WAN and Internet access locations are up, running and accessible" is due to outage restoration time proving to be shorter than prior experience.
- For the output measure "# of significant Web sites co-located on consolidated, hardened, secure, and redundant Internet servers," the FY 2005 plan has been increased by 100 Web sites. This increase was because the USGS migrated 87 more Web sites into the secure National Web Server (NatWeb) infrastructure than had been planned for FY 2004 so the FY 2005 plan has increased.

FY 2006 Plan Compared to FY 2005 Revised Final Plan

- For the end outcome measure "improved access to needed science information, # of USGS science publications cataloged in master USGS publications database," the FY 2006 plan has been adjusted upward by 500 science publications catalogued. The collecting of these additional citations is performed by existing staff, and familiarity with issues and available sources continues to expand.
- For the end outcome measure "improved access to needed science information, # of associated USGS science publications accessible on-line," the FY 2006 plan has been

adjusted upward to account for growth of 10,000 in the number of on-line science publications. USGS has installed a new, faster scanner and implemented efficiencies for the conversion and quality control of paper reports and publications to digital form.

- For the intermediate outcome measure "% of time that all WAN and Internet access locations are up, running and accessible," the USGS anticipates a decrease due to the expectation that DOI's Enterprise Services Network will be in Phase 2 with over 200 USGS field locations and there may be more downtime experienced during this transition.
- For the intermediate outcome measure "increase on-line transactions to X% relative to a baseline inventory of all USGS transactional services," the FY 2006 plan has been increased by 8 percent to show yearly progress toward a long term goal of 100 percent of transactions on-line.
- For the output measure "# of significant Web sites co-located on consolidated, hardened, secure, and redundant Internet servers," the FY 2006 plan has been adjusted upward to account for increased migration of Web sites into the secure National Web Server (NatWeb) infrastructure in FY 2004.

Enterprise Information

2003 to 2006 Performance Summary

Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD = Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Serving Communities Goal:

End Outcome Goal: SEO.2. Advance knowledge through scientific leadership and inform decisions through the application of science							
End Outcome Measures	2003 Actual	FY 2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long-term Target (2008)
<i>Inform decisions through the application of science:</i> Improved access to needed science information, # of USGS science publications cataloged in master USGS publications database (BUR)	56,086	66,626	65,000	67,000	67,500	+500	72,500
<i>Inform decisions through the application of science:</i> Improved access to needed science information, # of associated USGS science publications accessible on-line (BUR)	3,533	25,909	35,000	35,000	45,000	+10,000	65,000
<i>Inform decisions through the application of science:</i> X% of IT customers reporting that information helped achieve goal (BUR)	91%	86%	≥70%	≥70%	≥70%	0	≥70%
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures (Key and Non-Key) and bureau and PART Outcome Measures							
% of time that all WAN and Internet access locations are up and running and accessible (BUR)	99.8%	99.7%	98%	99%	98%	-1%	99%
IT Investment: X% of major IT investment projects for which cost estimates, established in project or contract agreement, meet actual costs with a variance of X% (established in Exhibit 300 business case meet actual costs within a variance of 5%) (BUR)	100%	100%	100%	100%	100%	0	100%

Activity Summary

On-line transactions: Increase on-line transactions to X% relative to a baseline inventory of all USGS transactional services (BUR)	51%	58%	80%	80%	88%	+8%	100%
PART Efficiency and other Output measures							
PART Efficiency Measures or other Outputs	2003 Actual	FY 2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long-term Target (2008)
# of bureauwide data integration practices and/or policies adopted	UNK	1	3	3	3	0	5
# of new NSDI Clearinghouse nodes established for serving data	41	82	50	50	50	0	25
# of informal NSDI conference outreach exhibits	52	52	50	50	50	0	50
# of new NSDI standards developed (cumulative)	2 (cum 20)	0 (cum 20)	5 (cum 25)	5 (cum 25)	5 (cum 30)	0	2 (cum 34)
# of new NSDI partnership agreements	51	52	60	60	60	0	150
# of significant Web sites co-located on consolidated hardened, secure, and redundant Internet servers	61	167	100	200	225	+25	280
% of total legislatively mandated narrowband radio transition achieved	34%	100%	100%	100%	100%	0	100%
# of IT help desks operational in major USGS offices	8	5	4	4	4	0	3
X% of Internet hosts potentially vulnerable to unauthorized access	UNK	5%	<1%	<1%	<1%	0	<1%

Enterprise Information

Management Excellence Goal:

End Outcome Goal: Modernization							
End Outcome Measures	2003 Actual	FY 2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance from 2005 to Proposed 2006	Long-term Target (2008)
X% of mission critical IT systems completing the IT security certification and accreditation process (SP)	25%	100%	100%	100%	100%	0	100%
Strategy 4: Citizen-Centered E-Government and Information Technology Management							
<i>IT Investment Management: X% of IT investments reviewed/approved through the CPIC process (SP)</i>	100%	100%	100%	100%	100%	0	100%
<i>IT Investments meet business/program needs: Business cases established for X% of USGS IT Investments (BUR) (NK)</i>	100%	100%	100%	100%	100%	0	100%

Enterprise Information Security and Technology Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Enterprise Information Security and Technology	0	22,714	+256	+2,267	25,237	+2,523
FTE	0	155	0	0	155	0
Enterprise Information Resources	0	16,989	+185	-21	17,153	+164
FTE	0	109	0	0	109	0
Federal Geographic Data Coordination	0	4,670	+34	+673	5,377	+707
FTE	0	17	0	0	17	0
Total Requirements \$000	0	44,373	+475	+2,919	47,767	+3,394
FTE	0	281	0	0	281	0

^{a/} Changes for this subactivity include a reduction of -\$27 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for the Enterprise Information Security and Technology Subactivity is \$25,237,000.

This subactivity supports the bureau's overall information security program, including Federal Information Security Management Act (FISMA) compliance and responsibility for information technology (IT) security operations, as well as for the confidentiality, integrity, and availability of USGS data and information assets. Other program components include bureau-level management and operation of USGS telecommunications, including wide area networks (WAN) and telecommunications services, and management and operation of the bureau's computing infrastructure (including electronic mail, computer help desks, and enterprise-level hardware and software acquisition).

Information Security

(Estimates for FY 2005, \$5.4 million; FY 2006, \$6.4 million)

The DOI and the individual bureaus have made the improvement of IT security the highest IT priority for the Department. The USGS approach to improving the overall security posture of the bureau focuses on two components: achieving and maintaining certification and accreditation of critical information systems and strengthening the overall security program of the bureau.

Security Operations — The USGS is engaged in completing a significant enhancement of its underlying IT security operations infrastructure (including extensive network perimeter controls, vulnerability scanning and intrusion detection, and training) and in providing program oversight necessary to maintain this secure infrastructure on a continuing basis, in compliance with Federal laws and regulations and with DOI policies. Security operations focus on providing the necessary standards, guidelines, procedures, and training to ensure that effective information

Enterprise Information Security and Technology Subactivity

security practices are carried out throughout the entire bureau. This component also is responsible for maintaining the bureau's existing security systems, which includes continual monitoring and scanning of systems and networks to identify potential vulnerabilities, quickly detect intrusions, and respond effectively to incidents.

Security for the USGS WAN infrastructure is being strengthened by installing security firewalls on connections between the USGS network and the Internet. Firewalls provide for containment of unauthorized access and intrusions into the USGS network and result in "defense in depth." The "defense-in-depth" strategy provides a high degree of security enforcement by requiring all network traffic to pass through multiple security layers. The strategy also permits network security controls to be tailored to the security needs of the individual USGS science centers.

Establishing an independent security zone or "demilitarized zone" (DMZ) to separate publicly available information systems from those that are used only by USGS personnel and USGS partners helps ensure that sensitive USGS information is protected in the event of a system compromise or breach of security. Network traffic in these public security zones is restricted from accessing computer systems and resources located within the USGS internal networks. This strategy also means that a compromised computer cannot be used as a staging area for attacks against other USGS IT systems or against the entire public Internet.

Security Certification and Accreditation — The DOI directed USGS to ensure that all high-risk information technology systems receive full security certification and accreditation, in compliance with OMB Circular A-130, by the end of FY 2004, and that all remaining information systems are certified and accredited by the end of FY 2005. For the USGS, this includes major application information systems (i.e., science and business/administration) and general support systems (i.e., infrastructure systems). Support for certification and accreditation of program-specific IT systems comes both from the program itself and from the Enterprise Information Program. In addition to achieving the initial certification and accreditation for USGS systems, it is necessary to continually monitor and maintain certification and accreditation status for operational information systems and to support the re-certification of systems on a regular and continuing basis, as required by OMB and the National Institute of Standards and Technology (NIST).

Telecommunications

(Estimates for FY 2005, \$6.4 million; FY 2006, \$7.6 million)

This component funds the management and operation of the USGS wide area network infrastructure and bureauwide telecommunications services (for voice, data, and video), and is also responsible for overseeing conversion of mobile radio equipment to meet new Federal requirements.

Telecommunications Networks — The USGS is transitioning from an older WAN technology to an enhanced and more secure very high-speed network that will better support USGS science activities. This network architecture includes a primary "backbone" connecting eight major "Tier 1" USGS sites; high-speed connections from this backbone to smaller individual "Tier 2" USGS sites across the country; maintaining secure and highly reliable connections from the USGS WAN to the public Internet; and maintaining connections from selected USGS sites to the ultra-high speed "research" Internet (Internet-2) to enable USGS scientists to collaborate with the external scientific research community. The USGS is also implementing an improved system to track and manage costs under the governmentwide telecommunications services contract. These improvements will enable individual USGS field centers to have greater

accountability and management of costs for telephone usage, calling card usage, and other telecommunications services.

Computing Infrastructure

(Estimates for FY 2005, \$10.9 million; FY 2006, \$11.2 million)

This component supports the bureau-level management and operation of computing infrastructure that includes electronic mail, computer help desks and IT technical support services, and enterprise-level hardware and software acquisition. Implementation of more integrated and cost-efficient IT management practices at the bureauwide level is a key element of the bureau's commitment to continually improving business and management practices and to supporting more integrated science. Key objectives are to implement more cost-effective enterprisewide strategies (i.e., for help desk operations, software site licenses) for commonly used IT software, hardware, and support services.

Help Desk Consolidation — Responsibility for IT help desks and IT technical support currently is distributed among various individual disciplines and offices in USGS, resulting in inconsistencies and inefficiencies in how these services are provided to USGS employees. Consolidation of these support functions at the bureau level will provide improvements and efficiencies in response time, problem resolution, and quality of technical support, while also relieving the individual science disciplines and offices from having to support and perform these functions independently. Under this strategy, a unified USGS IT help desk system will serve as a single point of contact for all IT customer support. The system will utilize some specialized hardware and software (i.e., for call tracking), but will primarily consist of IT support personnel across the bureau who will be formally linked together through organizational and matrix relationships to provide more consistent help desk and computer technical support services. Three call centers will be established: one in each USGS region to provide extended time zone coverage. Call centers will have primary responsibility for call resolution, call tracking, and customer satisfaction. The call centers will be linked with each other and with local computer technical support units to form a more integrated bureauwide operation.

2004 Program Performance Accomplishments

The FY 2004 program accomplishments listed below relate directly to successful completion of the following end outcome, intermediate outcome, and output measures:

- Security Operations: "% of Internet hosts potentially vulnerable to unauthorized access,"
- Security Certification and Accreditation: "% of mission critical IT systems completing the IT security certification and accreditation process,"
- Telecommunications Network: "% of time that all WAN and Internet access locations are up and running and accessible," and
- Narrowband Radios Conversion: "% of total legislatively mandated narrowband radio transition achieved."

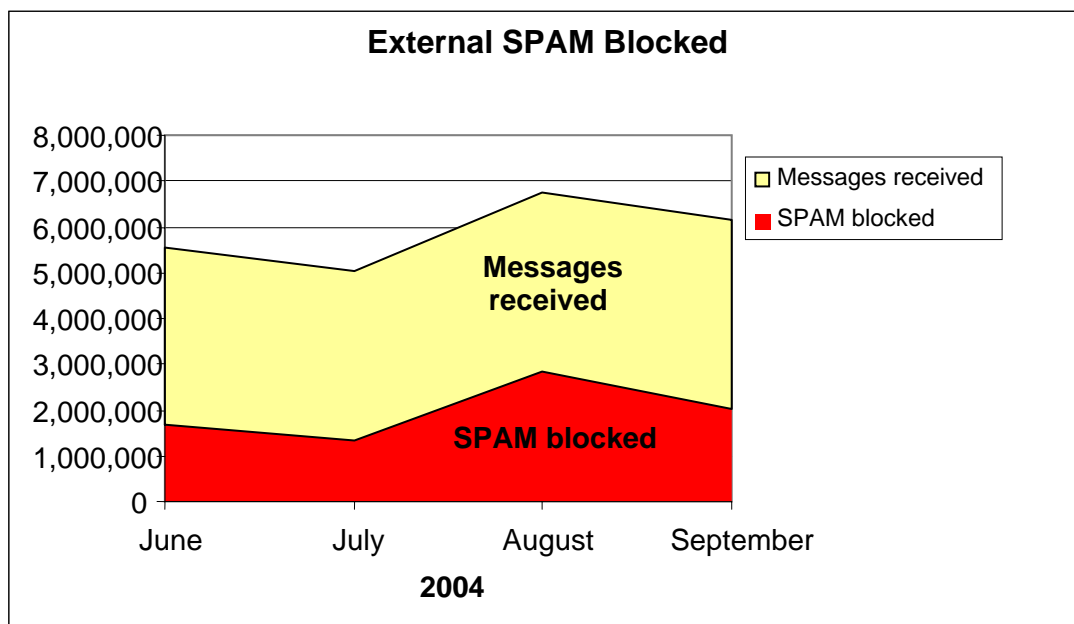
Security Operations — As part of the USGS Information Technology (IT) Security Program, a permanent IT security operations team was fully established in FY 2004. The team is responsible for development of security standards and guidelines; deployment and day-to-day operations of the bureau's IT security architecture; ongoing assessment of IT vulnerability; and

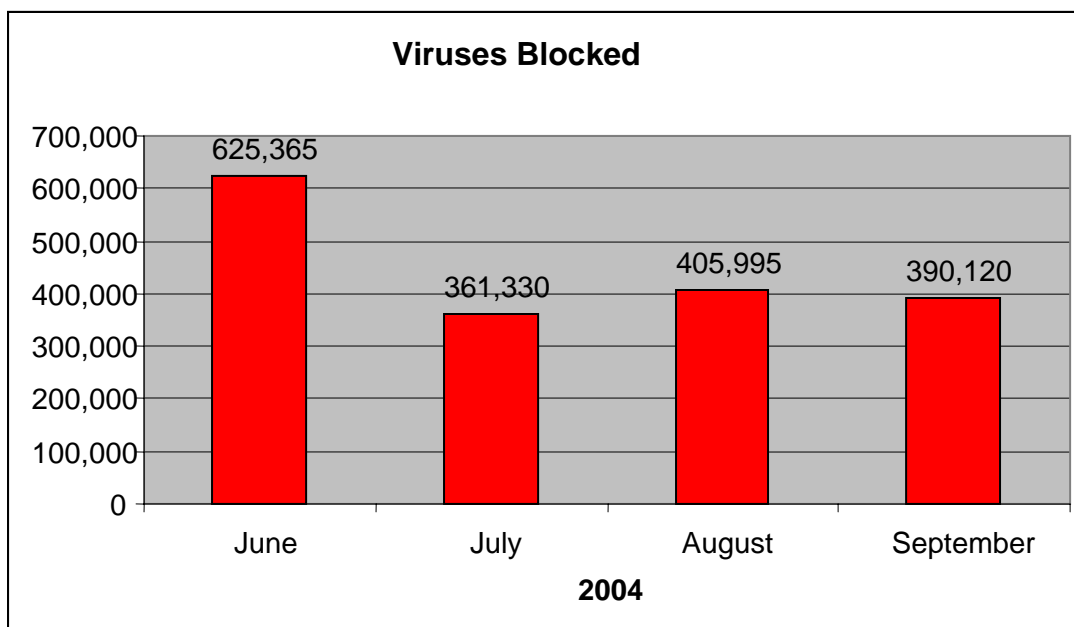
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correction of identified security weaknesses. The team ensures that appropriate IT security controls are implemented consistent with bureau, Department, and Federal policies, standards, and guidelines. The USGS Computer Security Incident Response Team (CSIRT) was expanded in FY 2004 to include wide- and local-area IT security and networking specialists with established roles and responsibilities.

In FY 2004, USGS identified security points of contact at the widely distributed science centers to collaborate with the security operations and computer security incident response teams. The bureau initiated a program for assessment and identification of vulnerability in the local area network. High-risk vulnerabilities are reported to the system owner and system manager for correction. This internal assessment is an extension of the external vulnerability assessment conducted monthly by the Department for Internet facing systems. The USGS has maintained a zero-detected score on this Department measure on vulnerability since October 1, 2003.

In response to significant increases in delivery of unsolicited commercial e-mail and SPAM, the USGS improved its automatic response capabilities for detection and quarantine of unwanted e-mail. Along with these enhancements, the USGS incorporated an additional layer of anti-virus protection at the Internet gateways for detection and mitigation of potentially malicious e-mail. These enhancements have significantly contributed to the interception of infected and unwanted messages at the Internet gateway, as shown in the diagrams below.





Security Certification and Accreditation (C&A) — During FY 2004, as a major requirement of the Federal Information Security Management Act (FISMA), the USGS completed C&A on 100 percent of all 12 system categories that include major applications (science and business/administration) and general support systems (infrastructure systems). A Plan of Action and Milestones (POA&M) report is used to identify and address weaknesses discovered by the C&A process and other auditing functions that are monitored through completion.

Telecommunications Networks — While maintaining the existing USGS WAN infrastructure and focusing on upholding reliable and secure operations across this network to support USGS science activities (including those for earthquakes, streamgaging, and other natural hazards monitoring and reporting systems), the USGS helped lead the Department's Enterprise Services Network (ESN) initiative. The Enterprise Services Network is a DOI initiative that will consolidate 13 DOI bureauwide area networks onto 1 (logical) infrastructure under central DOI management with the objective of lowering overall network costs throughout the system life. The USGS represents over one-half of the ESN Design Team that is laying the groundwork for both ESN Phase 1 (Internet 1 services) and Phase 2 (full Intranet throughout DOI). Further, in mid-FY 2004, the USGS authored and signed an agreement with DOI, which transferred the entire USGS WAN to DOI as the foundational element for ESN Phase 1. Other priorities completed in FY 2004 included the security certification and accreditation of the USGS WAN backbone, and the conversion of several maintenance contracts for WAN equipment maintenance to one umbrella contract, thereby decreasing maintenance costs by about 15 percent per year across the USGS.

Narrowband Radio Conversion — Under Federal law (Title 47, U.S.C. 903 (d)(1)), all Federal agencies have been ordered to migrate from the use of wideband radio channels (26 KHz) to narrowband channels (12.5 KHz) for VHF radio equipment by December 31, 2004. In FY 2004, the USGS converted its remaining VHF radio equipment to narrowband channels and has therefore met the December 31, 2004, governmentwide deadline ahead of schedule. The USGS has also completed conversion of UHF wideband radio equipment during FY 2004. This

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accomplishment is significantly in advance of the governmentwide deadline (end of 2008) for conversion of UHF equipment.

Help Desk Consolidation — In FY 2004, the USGS completed the consolidation of five IT help desks operated at the USGS National Center in Reston, VA, and their realignment into a cost-effective, integrated IT support organization, providing consistent service levels. USGS National Center IT help desk and desktop support functions and personnel were realigned into two separate but integrated units within the USGS Information Technology Office. The Reston Call Center unit (RCC) is a single point of contact for IT support in Reston and serves as the pilot for the Enterprise Call Center component of the bureauwide IT help desk system. The Office Automation Technical Support Team (TST) now provides local desktop support for all 2000+ staff at the National Center.

2005 Planned Program Performance

Progress toward completion of the FY 2005 planned program accomplishments listed below will be monitored by the following end outcome, intermediate outcome and output measures:

- Security Operations: "% of Internet hosts potentially vulnerable to unauthorized access,"
- Security Certification and Accreditation: "% of mission critical IT systems completing the IT security certification and accreditation process,"
- Telecommunications Network: "% of time that all WAN and Internet access locations are up and running and accessible," and
- Help Desk Consolidation: "# of IT help desks operational in major USGS offices."

Security Operations — The USGS continues to emphasize the improvement of the information security program as one of the bureau's highest overall priorities. The primary objective for FY 2005 is to improve bureau performance with regard to full compliance with Federal laws and regulations, including FISMA. The USGS will continue to work on the deployment of a highly secure perimeter network, including the physical separation of publicly accessible systems and information content from systems that are only accessible to the USGS and its partners.

The USGS plans to strengthen its security posture through deployment of automatic IT security patch management for all systems. USGS plans deployment of intrusion prevention security systems to identify, log, alert and automatically mitigate potentially malicious Internet and local-area activities. This state-of-the-art detection and mitigation strategy will move USGS from a reactive to pro-active strategy in response to potential network threats. In a continuing effort to improve overall security through a strategy of a defense-in-depth, the bureau will undertake identification of systems operating in the general network that operate at a different security level and move these assets into separate security zones.

Security Certification and Accreditation — The USGS intends to use FY 2005 funding to remediate weaknesses identified in the Management Control Review and Certification and Accreditation processes. Activities include testing contingency plans and improving the quality of security documentation. In addition, security documents for some systems (ANSS, NBII, and NWIS) require updates to comply with new DOI format guidance. Employees with IT security responsibilities and program managers will require additional training in the areas of IT security, project management and life-cycle management.

Telecommunications Networks — The single largest USGS WAN initiative in FY 2005 will be the transition of 300+ USGS locations to the Department's Enterprise Services Network (ESN) Phase 1 and the conversion of existing USGS locations on Alaska's ARTNet to the newly advanced ESN-AK by mid-FY 2005. The USGS telecommunications team will continue to be involved in all aspects of the strategic planning, ordering of facilities and equipment, and deploying of the Enterprise Services Network. Pending the FY 2005 decision as to the full deployment of ESN Phase 2, the USGS may be required to "rehome" all locations from the existing connectivity, as the departmentwide ESN will support more secure and efficient connections between the USGS and other DOI bureaus. This major change would begin during the later part of FY 2005 with plans for completion in early FY 2006. Furthermore, the USGS will complete the field site certification and accreditation in accordance with the recent FISMA POA&M report. And, in keeping with the technology move of Voice Over IP (VOIP), the USGS will begin deployment of some VOIP systems at field locations and within selected areas within the USGS National Center in Reston, VA.

Help Desk Consolidation — In FY 2005, the USGS will expand the USGS National Center Reston Information Technology (IT) Help Desk pilot to support the USGS Eastern and Central Regions, thus further consolidating the overall number of IT help desks within the bureau. Requirements for the full software suite necessary to support the bureau IT Help Desk System (including call tracking, knowledge management, and automated call distribution) will be finalized and the new system will be acquired.

Bureau Directory Services — In FY 2005, the USGS will continue to transition the distributed and highly disparate local computing environments of offices to an integrated USGS-wide infrastructure, based on Microsoft Active Directory (AD), with consistent technical architecture, security controls and common software tools. In addition, AD will become the authoritative Directory Service and will be used to enhance collaboration between offices, disciplines and researchers. Furthermore, AD will be used to protect the USGS computing environment by establishing the baseline levels of security in Microsoft Windows systems. By the close of FY 2005, the USGS will have migrated approximately 6,000 users and computers to the DOI enterprise architecture. Other priorities associated with this migration include a bureauwide anti-virus architecture with consistent software updates and reporting and a comprehensive patch management configuration for all USGS computer systems.

Electronic Messaging — The USGS is participating in the design and development of a departmentwide Enterprise Messaging System (EMS) that will place all DOI bureaus on one electronic mail (e-mail) platform. In FY 2005, USGS will implement a lab to test reliable and time sensitive message delivery that meets the requirements of the USGS science activities, including communication during emergency situations. The USGS will work with the other DOI bureaus to jointly design and implement the new messaging system throughout the Department. The USGS will also explore the migration of current collaborative tools including Web conferencing, on-line project/document management, wireless e-mail, and calendaring/scheduling to the new Department system.

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Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Enterprise Information Security and Technology (\$000)	25,237	+2,267
FTE	155	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006, budget request for Enterprise Information Security and Technology is \$25,237,000 and 155 FTE, a net program increase of +\$2,523,000 (includes adjustments for uncontrollable costs) and 0 FTE from the 2005 enacted level.

The 2006 budget includes a net program change of \$2,294,000 for enterprise information technology investments for IT certification and accreditation of legacy systems and implementation of the enterprise services network.

Certification and Accreditation of Systems (+\$1,059,000) — In 2006, the Department will continue to focus on improving IT security. The 2006 budget includes \$12.8 million DOI-wide for coordinated certification and accreditation (C&A) activities, including \$2.9 million collected through the Department's working capital fund. The USGS share of this funding in 2006 includes a total of \$1,059,000, of which \$432,700 will be collected through the DOI working capital fund to support centralized activities to enhance efficiencies; reduce overall costs; enhance the quality, consistency, and documentation supporting accreditations; and prioritize remediation activities.

In 2004, Interior strengthened its IT security program by accelerating the timeframes for completing C&A using government-wide standard processes. As of November 15, 2005, Interior had significantly improved its security posture, having certified and accredited 161 of its 165 production systems, or 98 percent. Now that a preponderance of systems are formally managed with regard to security, challenges remain to schedule and remediate weaknesses discovered through C&A, Inspector General, or annual reviews. Furthermore, once established, accreditation status must be maintained through system functional releases and infrastructure modernization. During 2005 and 2006, the Department and its bureaus are completing third party reviews of completed certification and accreditations; remediating identified risks; and establishing the necessary security program infrastructure to allow ongoing maintenance of accreditation status in an efficient and effective manner. These activities include:

- Establish or update C&A package contents including risk assessments, planned controls, and testing of controls,
- Where controls are deficient, institute new or upgraded management, operational, or technical controls,
- With adequate rigor, test controls for effectiveness,
- Establish prioritized inventory of items to resolve (plan of action & milestones - POA&M) and resolve in a prioritized manner such that residual risk is acceptable for Authority To Operate,

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- Establish standards, procedures, tools, and training to enable the cost effective maintenance of accreditation packages, and
- Improve security activates involving contracted/outsourced IT operations.

In 2004, USGS completed Certification and Accreditation (C&A) of its remaining 8 system categories, resulting in a greatly improved security posture. All 12 system categories have completed the C&A process and follow DOI/NIST requirements. In 2005, USGS is working through resolution of outstanding residual risks identified in the C&A process, and other internal risk assessment processes, based on priority. These items are documented in Plan of Actions and Milestones reports that are managed, monitored, and submitted to DOI on a quarterly basis. In addition, C&A security documentation is maintained and updated as appropriate, Information Technology (IT) Standards are being developed as needed, and C&A related training is being conducted. In 2005, USGS has implemented acquisition guidance, assigning security activities directly to contracts and outsourced operations.

Enterprise Services Network (+\$1,235,000) — Interior is deploying the Enterprise Services Network to provide secure, state-of-the-art internet and intranet connections and a fully functional operational center for data communications that will be used by the entire Department. In addition to providing better services for many Interior offices, the system will provide a uniformly secure environment, standardized and efficient 24-hour/7-day operations, and improved technical support. The USGS budget includes \$3,521,000 for ESN of which \$986,000 was new funding in FY 2005 and \$1,300,000 is an estimated amount that will be redirected from legacy network systems to the ESN project. The Department is working with its bureaus to finalize the amounts that will be redirected, and will provide the subcommittees updates to the amounts in the spring.

In 2004, Interior began to implement Phase I of ESN, which will be completed in December 2005, with deployment of a modern, integrated network backbone that supports telecommunications within the Department. This includes access to the internet, a Departmentwide Intranet, and a fully operational technical support center. Phase I also transitions management of the National Park Service's wide area network to managed services and thereby simplifies and modernizes a geographically dispersed and outdated architecture.

The return on investment for this system is high. Up-front investments, including the redirection of bureau telecommunication savings, will, in the long term, result in reduced costs with elimination of duplicative networks, improved performance of data services with less "down time" for many offices, skilled and knowledgeable staff trained to operate standardized and centralized operations, and better support for E-Government initiatives.

Phase I of ESN reduces the Department's current 13 wide area networks to one and 33 Internet access points to 5. For NPS, Lotus Notes maintenance sites were reduced from 253 to 7.

During 2005, the Department will also plan Phase II to expand secure connections to approximately 150 sites located primarily in large cities and approximately 1,500 hubs at other Interior locations.

Enterprise Information Security and Technology Subactivity

ESN will also facilitate efforts to consolidate directory services, web hosting, messaging, data warehousing, and other applications and systems.

Over the past 2 years, USGS has actively supported the transition to the DOI Enterprise Services Network (ESN). To date, USGS has

- Ordered and deployed the four enterprise high-speed Internet 1 nodes that will serve as the consolidated DOI Internet access points. This action moves the Department toward its goal of consolidating 33 access points to 4 (operational December 9, 2004),
- Ordered and is deploying Metropolitan Area Network service (i.e., Yipes) for connecting all bureaus in the Washington, DC, area to the Internet access point and is positioning MAN services in other large sites to the same end,
- Developed the strategy and applied the technical expertise to the ESN Alaska (aka, "ESN-AK") transition, which offers consolidated high-speed service in Alaska and gateways to the lower 48 with access to the ESN Intranet, and
- Worked with DOI and several bureaus in Denver for the planning and deployment of the ESN Intranet (operational December 18, 2004). USGS has benefited directly from the Internet 1 high-speed access with three-times more bandwidth than was previously available.

Enterprise Information Resources Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Enterprise Information Security and Technology	0	22,714	+256	+2,267	25,237	+2,523
FTE	0	155	0	0	155	0
Enterprise Information Resources	0	16,989	+185	-21	17,153	+164
FTE	0	109	0	0	109	0
Federal Geographic Data Coordination	0	4,670	+34	+673	5,377	+707
FTE	0	17	0	0	17	0
Total Requirements \$000	0	44,373	+475	+2,919	47,767	+3,394
FTE	0	281	0	0	281	0

^{a/} Changes for this subactivity include a reduction of -\$21 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for the Enterprise Information Resources Subactivity is \$17,153,000.

The USGS is committed to increasing efficiency and effectiveness of its scientific information integration and dissemination services by creating a "Natural Science Network" of integrated information, science, and knowledge to ensure that the latest USGS science data are readily available to diverse customers in accessible formats. The objective is to optimize each individual customer's ability to seek, obtain, and use USGS information and products tailored to their specific requirements.

The USGS is committed to fulfilling its statutory and regulatory requirements across the spectrum of information resource management directives especially in the areas of records management, privacy protection and IT acquisition. The USGS continues to focus on maturing its procedures and processes for both capital planning and investment control (CPIC) of information technology (IT) capital investments, following the IT Investment Management Maturity Model from the Government Accountability Office. The objectives are to maintain compliance with CPIC requirements from Office of Management and Budget (OMB) and the Department, to ensure the bureau's overall IT investment portfolio supports USGS and DOI strategic goals and priorities, and to ensure the Investment Review Board (IRB) follows established, repeatable processes for major IT investment selection, control and evaluation.

The Enterprise Information Resources Subactivity provides for overall direction, management, and oversight for bureau-level systems and activities in information policy and information integration and delivery. The information integration and delivery component provides direction, coordination, and strategic planning of scientific data integration and management: Web-Internet services, science publishing, libraries, information centers, and enterprise-level

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coordination of geographic information systems. The information resource management component includes the oversight for the following activities: compliance with Federal mandates for records archiving and management, privacy, Freedom of Information Act (FOIA), Section 508 of the Rehabilitation Act, E-Government Act, OMB Data Quality Guidelines, Paperwork Reduction Act, and investment technology capital asset planning.

Information Integration and Delivery

(Estimates for FY 2005, \$14.0 million; FY 2006, \$14.1 million)

Information Integration and Delivery activities focus on transforming existing functions and services to reflect the changing nature of USGS science and science products, achieve efficiencies in the accessibility, delivery and integration of USGS information through enterprise-level approaches, employ innovative and cost-effective technologies, and utilize alternative sourcing and partnerships for a flexible and balanced workforce.

Information Centers and Library — The USGS information offices and library provide scientific and product information and technical assistance to a wide range of customers. These offices use a variety of tools and capabilities to provide access to USGS science and serve as a conduit for feedback between customers of USGS data and information and the USGS scientific and technical community.

Enterprise Publishing — Accurate reporting of our science must be delivered in an efficient and timely manner for the USGS to fulfill the vision to be a world leader in the natural sciences through scientific excellence and responsiveness to societal needs. Enterprise Publishing focuses on developing bureau-level policies and procedures to maintain the USGS reputation for quality and unbiased published science.

Enterprise Web — The USGS maintains approximately 300 public Web sites providing science information to a variety of customers. The Enterprise Web project is developing more efficient and consistent bureau-level tools and practices to ensure that these public Web sites are (1) secure, reliable, and easy to maintain and update and (2) carefully organized, designed, and equipped to allow customers to find, get, and use the vast array of USGS natural science data and information products quickly, efficiently, and in a manner that meets their needs.

Enterprise Geographic Information Systems — The USGS is providing leadership in developing a new enterprisewide focus on managing Geographic Information Systems (GIS) technology and geospatial data across DOI. The DOI Enterprise Geographic Information Management (E-GIM) initiative will enhance geospatial data sharing, increase operating efficiencies, and provide overall cost-savings across the Department.

Information Resource Management

(Estimates for FY 2005, \$2.9 million; FY 2006, \$3.0 million)

Information Resource Management activities focus on establishing, monitoring, and directing policy that enables the USGS to fulfill statutory and regulatory information resource requirements.

Complying with Government Mandates — Effective bureau compliance with Federal information mandates, particularly in the areas of: records management, privacy, information accessibility, IT acquisition, and capital planning has been hampered by having these responsibilities fall to individual science disciplines, programs, and offices to address on an ad

hoc basis. Providing a single bureau-level point of coordination and oversight will allow the bureau to develop an integrated, comprehensive, and more pro-active compliance program.

Capital Asset Planning and Investment Control — The USGS continues to mature its CPIC processes and procedures for planning and managing IT projects. This effort is in compliance with the Clinger-Cohen Act of 1996, OMB Circulars A-11 and A-130, and establishes compliance with Level 2 of the GAO IT Investment Management maturity model. The USGS Associate Director for Geospatial Information is responsible for developing bureauwide policies and procedures to mature the IT CPIC process toward Level 2 IT Investment Management compliance. Capital asset IT investment business cases analysis is completed for all major proposed and existing information system projects. The CPIC program ensures that the Investment Review Board follows established, repeatable processes for major IT investment selection, control, and evaluation, which includes a regular cost, schedule and performance review of all major information technology projects and annual reviews of all non-major projects. Approved major IT investment business cases and approved non-major IT investments are submitted to the USGS budget office to provide information necessary for preparation of the Exhibit 53. The Exhibit 53 is the USGS portfolio that provides summary information for all of the bureau's IT investments.

2004 Program Performance Accomplishments

The FY 2004 program accomplishments listed below relate directly to the successful completion of the following end outcome and output measures:

- Enterprise Publishing: "# of USGS science publications cataloged in master USGS publications database" and "number of associated USGS science publications accessible on-line,"
- Enterprise Web: "# of significant Website collocated on consolidated, hardened, secure and redundant Internet servers," and
- Capital Asset Planning and Investment Control: "% of major IT investment projects for which cost estimates established in project or contract agreement meet actual costs with a variance of %" and "% of IT investments reviewed/approved through the CPIC process" and "business cases established for % of USGS IT investments."

Information Centers and Library — Activities defining the Natural Science Network (NSN) continued through FY 2004. An Information Services Strategy Team was established to investigate policy, functionality, staffing, space, and finance components of the NSN. A business plan was completed identifying three major functional areas (1) the Science Information and Library Services Center, (2) Knowledge Management, and (3) Information Delivery. A budget plan, including a staffing transition strategy, was also completed. A Request For Information was conducted to identify interest in modernizing, and new technologies available for, USGS product inventory and dissemination activities. The 1-888-ASKUSGS phone tree was revised to provide customers with more direct access to information sources across the USGS. Several USGS question and answer data bases were consolidated into a Frequently Asked Questions data base, accessible from the USGS Home Page (<http://www.usgs.gov>), which provides instant answers to a wide variety of customer inquiries. A Web application called Contact USGS was implemented that provides individual e-mail responses to customer inquiries. Both of these activities were accomplished in coordination with Enterprise Web. Initial implementation of the NSN Business Plan will begin in FY 2005.

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As part of a strategy for enabling USGS science projects to acquire needed electronic resources, the library staff acquired more electronic journals and reference sources to provide better desktop access to science information for USGS staff in all locations. During the year, the libraries added 2,634 books, 6,670 maps, 22,862 paper journal issues, and 142 electronic titles. Response time for delivery of library materials still in paper format was significantly reduced by using overnight mail and e-mail delivery of scanned articles. To reduce duplication in USGS library collections in different locations, the library continued to scan its collections for dissemination in the Electronic Publications Warehouse. In addition, the library acquisitions staff established a decision table to review multiple copies of long journal runs in four libraries against the availability of electronic archives of these journals to save shelf space while retaining at least one paper copy. The library expanded its partnership network with other government agencies to share resources and expertise. The library staff worked with the Smithsonian Natural History Museum to bring back a large collection of valuable paleontology books loaned to the Museum 40 years ago. These volumes are now being repaired and cataloged into the online catalog for increased availability to researchers. The USGS library in Denver, CO, has cooperated with the U.S. National Archives and Records Administration (NARA) to ensure preservation of the rare photographs in their historical photograph collection and continued an extensive program of scanning photographs for electronic access.

Enterprise Publishing — In FY 2004, the USGS built on the recently completed vision and strategy for enhancing scientific publishing capabilities. A USGS business case for publishing was created that gave particular attention to denoting publishing's long-standing relation to the USGS science mission and direction, potential business process changes, and workforce planning. This analysis included the current state of distribution, demographics, workload, and personnel expenditures. Management issues associated with the Visual Information Competitive Sourcing effort were detailed in preparation for implementing either a strategic restructuring approach to USGS publishing or a full A-76 study.

In the fall a national workshop for approximately 260 publishing personnel was conducted, and individual training classes were held throughout the year. Common business processes and guidelines, with standard tools and templates from authoring to publishing, were piloted. The total number of USGS publishing series was reduced from 35 to 10. An Enterprise Publishing Office was established that immediately took the lead for reviewing and updating USGS publishing policies and handbooks. In FY 2004, four publishing policies were approved and entered in the Survey Manual. New policy and guidance for USGS fundamental science practices that details peer review and approval processes were developed and released for extensive review.

The Electronic Publications Warehouse (<http://pubs.usgs.gov>) for locating USGS reports and other publications was launched in January 2004, and by the end of FY 2004 included more than 66,000 titles in the data base. In addition, almost 26,000 electronic publication products are now accessible on line. The Electronic Publications Warehouse was developed to interface with Enterprise Web activities.

Enterprise Web — In FY 2004 Enterprise Web completed the Certification and Accreditation Process for an enclave of 25 systems, including those supporting the USGS Home Pages. Security and reliability was strengthened further by the expansion of the National Web Server System, a reliable, consolidated, and failure-resistant Web server infrastructure to ensure that critical USGS public Web sites will remain available during emergency situations. Approximately 87 more USGS Web sites were incorporated into this system.

The USGS Home Page was analyzed and redesigned to improve its capacity to provide access to USGS science for all customers. Corresponding Web page templates and guidelines for bureauwide use were developed. Enterprise Web released several enhanced tools to integrate USGS Web-based information resources. A USGS Thesaurus was established as the basis for the new "Our Science" Web site and other categorizing of Web pages, publications, and records. More than 1,300 USGS Web pages have been catalogued to 673 scientific and technical terms and 863 common terms. More than 741 frequently asked questions located on 200 distinct USGS Web sites were integrated into a central Frequently Asked Questions data base. Service for visitors to the USGS Home Page was improved. Immediate replies are provided to 750 users per month. Several of these Web site improvements were coordinated with the Information Centers and Library projects.

In FY 2004 processes were instituted to improve Web collaboration and governance, both within the USGS and the DOI. Enterprise Web technical staff was expanded to include regional and science program liaisons. Coordination with USGS science programs was strengthened by holding listening sessions with science program coordinators. A Web of the Future Forum was held to identify USGS Web priorities. Participants included USGS science project leads and other Federal organization representatives. A priority action from this forum was to create a USGS Web Advisory Group. In addition, the USGS actively participated in the newly established DOI Web Advisory Council. One of the responsibilities of this Council is to create a plan to address the June 2003 DOI Inspector General report, "Moving to a Customer-Centered Web Presence." The Enterprise Web Exhibit 300 was updated to reflect impacts of the Inspector General's Report and new security requirements

Enterprise Geographic Information Systems — During FY 2004, the USGS continued to provide leadership for departmentwide efforts in the use of geospatial data technologies and GIS. As part of its leadership of this initiative, USGS was responsible in FY 2003 for the establishment of a departmentwide license agreement for procurement of GIS software products from Environmental Systems Research Institute (ESRI). It is conservatively estimated that this agreement will save the participating DOI bureaus and offices hundreds of thousands of dollars each year in comparison to their pre-agreement costs. The administrative costs and time that each DOI bureau and office spends on acquisition of ESRI products have also been significantly reduced through use of the common procurement vehicle. The common procurement also offers significant cost savings and efficiencies across the Department in GIS training, technical support, and help desk operations. The USGS also provided leadership to ensure that the departmentwide license agreement can be used to provide Tribal Governments with ready access to GIS technology. USGS led implementation of the ESRI SmartBuy agreement with DOI that was signed in February of 2004. Among other provisions, this agreement included providing free access to standard ESRI Virtual Campus courses to DOI. The USGS created a GIS-enabled data base of DOI-owned and managed facilities. This "facilities locator" system is used to help DOI managers identify potential opportunities for cost-sharing in facilities use and operation. In FY 2004, the Enterprise Geographic Information Management initiative successfully completed efforts addressing GIS requirements for training, software deployment, Knowledge Base, Help Desk, data base support, spatially enabled DOI business, Communications Planning, and System architecture. In March 2004, the USGS coordinated and hosted the Fifth Biennial Geographic Information Science (GIS) Workshop in Denver, CO, to conduct high quality, diverse GIS training provided by industry, academic, and USGS experts.

Enterprise Information Resources Subactivity

Complying with Government Mandates — The USGS is committed to fulfilling its statutory and regulatory requirements in information resources management (IRM). Strategic planning of USGS IRM programs continued in concert with DOI IRM program leads. In FY 2004, the USGS implemented enterprise software (procured in FY 2003) that will validate, repair, and caption multimedia for all USGS Web sites to comply with Section 508 requirements of The Rehabilitation Act of 1973. Extensive training sessions were held in headquarters and in all three regions to ensure employee understanding of both the desktop and server tools. The USGS continued to share its extensive knowledge of Section 508 requirements with other Federal agencies and military organizations. The IT investment program strengthened its relation to the Section 508 Program by requiring a Section 508 compliance form for all appropriate IT procurements.

The Records Management staff continued to work closely with the NARA on planning for an electronic record-keeping system, on testing records transfer requirements, and on the review of USGS scientific, mission-specific records disposition schedules. The Records Management staff conducted training sessions in all of the USGS regions emphasizing employee records management responsibilities. Staff continued to respond to DOI data calls for Indian Trust related documents, including requirements for e-mail backups. Compliance with the Privacy Act of 1974, specifically in electronic records and systems, was a high priority for the USGS in FY 2004. Privacy impact assessments were prepared for all major system Exhibit 300's in compliance with OMB's CPIC process and Section 208 of the E-Government Act of 2002. All USGS employees are benefiting from the increased coordination of IRM activities at the USGS, which will help ensure that USGS programs are in compliance with all government mandates.

Capital Asset Planning and Investment Control — During FY 2004, the USGS matured its Capital Asset Planning and Investment Control (CPIC) processes by ensuring the Investment Review Board (IRB) followed established, repeatable processes to review and select major IT investments as part of the FY 2006 budget formulation process and for development of the overall USGS IT investment portfolio. The IRB conducted quarterly reviews (cost, schedule, performance, participation and risk) of all major IT projects. The USGS successfully submitted eight major IT investment business cases (Exhibit 300) to OMB for the FY 2006 Budget Submission. Prior to submission, these business cases were evaluated and scored by both bureau- and Department-level subject matter experts in IT Security, IT Procurement, Enterprise Architecture, Budget, Acquisition, Planning and Performance Management, and Capital Planning. Special emphasis was placed on IT Security, Project Management and performance measure results, factors that place business cases on OMB's at-risk list. Business cases were also aligned with the Federal Enterprise Architecture Performance Reference Model, Business Reference Model, Service Reference Model and Technical Reference Model. The USGS continues to identify and complete activities for GAO IT Investment Management Level 2 compliance.

2005 Planned Program Performance

Progress toward completion of the FY 2005 planned program accomplishments listed below will be monitored by the following end outcome and output measures:

- Enterprise Publishing: "number of USGS science publications cataloged in master USGS publications database" and "number of associated USGS science publications accessible on-line,"

- Enterprise Web: "# of significant Web site collocated on consolidated, hardened, secure and redundant Internet servers," and
- Capital Asset Planning and Investment Control: "% of major IT investment projects for which cost estimates established in project or contract agreement meet actual costs with a variance of %" and "% of IT investments reviewed/approved through the CPIC process" and "business cases established for % of USGS IT investments."

Science Information and Library Services Center — In continuing efforts to provide more efficient access to USGS data, information and knowledge, the bureau is reorganizing and melding the primary information offices—the Earth Science Information Center and the Library—into a new entity: the Science Information and Library Services Center (SILSC). Merging these two functions will provide an integrated network of physical and virtual information offices that will enhance our ability to make USGS data, information, and knowledge available to anyone, anywhere, at anytime. The SILSC will house a network of people, tools, and processes to assist anyone who wants to find, get, and use data, information, and knowledge from the USGS. An integrated library and information services staff will assist the public and scientists to gain access to the physical and electronic holdings of the bureau. Use of a call center operation will be investigated to determine the applicability and effectiveness of this process to the access and distribution of USGS products and services. As new electronic retrieval tools are developed, the SILSC will transition to electronic library services. Legacy collections will continue to be maintained. The SILSC will continue to provide library services that follow internationally recognized library standards, including collection management and balancing, electronic subscription and licensing, and online cataloging. The SILSC will maintain excellence in customer service as the front door to USGS science.

Knowledge Management — An implementation plan will be developed for the Knowledge Management function by (1) electronically organizing scientific information, including metadata development, (2) making digital information useful and easy to locate and link, (3) ensuring appropriate archive of the information, and (4) coordinating with Enterprise Web (EWeb) and the new National Geospatial Programs Office (NGPO). Activities that will be performed in conjunction with EWeb include Web server and application development, software development and maintenance for the USGS Store (an electronic virtual store), expansion of the Frequently Asked Questions data base, and enhancement of utilization of the USGS Thesaurus. The Knowledge Management function will interact with the NGPO and other USGS science programs by (1) partnering with science centers to address software needed for improved public/partner access to NSN holdings, (2) assisting in designing the structure of metadata for new research, and (3) coordinating with science center information representatives to assist scientists in the field.

Information Delivery — The Information Delivery function will continue to ensure that existing USGS publications and maps are available and delivered to customers in a timely and responsive manner. Digital and print-on-demand capabilities will be increasingly used as technology improves, creating greater efficiencies and the opportunity for better customer service. This includes maximizing the USGS Store (an electronic virtual store) for product delivery through the transition to electronic inventory management. Establishing partnerships with interpretive associations to provide product (counter) sales and mission-related interpretive activities will continue. The USGS Business Partner Program will be maintained and will continue to serve as a valuable network to access USGS products and information.

Enterprise Information Resources Subactivity

Enterprise Publishing — In FY 2005 publishing functions will be restructured either through implementation of a USGS directed business process reengineering supporting the science mission or through an A-76 study. Using one of these approaches, publishing activities will be linked to USGS strategic changes to promote further integration of science and publishing, expanded enterprise publishing practices, common business practices, process re-engineering, and workforce realignment.

The USGS will continue to expand the realignment of existing science discipline publication resources, moving toward common publishing business practices and technical procedures. The USGS will expand the role of the Enterprise Publishing Office that will direct development and coordination of bureau publishing policies and procedures. This realignment will maintain the link between science authors and publishing staffs. A 2-year phased transition will minimize disruptions to science delivery. Changes in publishing will link to other USGS strategic changes, promoting further integration of science and publishing, expanded enterprise approaches, common business practices, process re-engineering, and workforce planning. The USGS fundamental science practices policy and guidance will be approved and implemented, creating a consistent approach to peer review and approval of USGS scientific publications.

The USGS will expand the Electronic Publications Warehouse (<http://pubs.usgs.gov>) to beyond the more than 66,000 current bibliographic citations for USGS reports and thematic maps by adding additional outside citations of reports authored by USGS scientists. Work will also include scanning and linking to the full publications. The Electronic Publications Warehouse will provide a single point of service with a citation search tool, full on-line content (if available), and links to those reports currently in stock and available for ordering. The Electronic Publications Warehouse will continue to be integrated with other Enterprise Web data base development efforts. Throughout FY 2005, reports will be converted from paper to digital at the average rate of 1,000 per month.

Enterprise Web — In FY 2005, USGS Enterprise Web will focus on responding to DOI's Web directives on governance, server and content consolidation, infrastructure baseline, and quarterly reporting. Implementing these directives will enable the USGS to address the findings of the DOI Inspector General. This will facilitate the improvement of management controls of the DOI and USGS Web presence, with an increased focus on our customers. In addition, USGS will work with DOI to update Web policies and best practices to reflect new guidance and requirements from OMB, NARA, and other Federal content initiatives.

USGS Enterprise Web will make progress on several fronts. Collaboration and governance processes will be established in coordination with DOI. USGS Web content clean-up and categorization pilots will lay the groundwork for content management and portal implementation, and also improve the effectiveness of the USGS search engine. The USGS Web sites, including the Our Science Web site and the State templates, will become more robust and representative of the diversity of USGS science and geospatial and educational resources. Web content delivery and customer service will be enhanced to support the NSN. Demonstration projects to model how Enterprise Web supports USGS science programs will reach completion. Enterprise Web will redesign training modules and introduce them to the USGS community in the spring. Tools to integrate USGS Web-based information resources (the Thesaurus and Frequently Asked Questions data base) will continue development in coordination with Knowledge Management activities.

The USGS will increase its effort to inventory, secure, and manage future development of the USGS Web infrastructure. The Enterprise Web enclave will continue its work to maintain its

Certification and Accreditation and implement its recommendations. Security and reliability will be strengthened by the expansion of National Web Server System, the consolidated and failure-resistant Web server infrastructure to ensure that critical USGS public Web sites will remain available during emergency situations.

Complying with Government Mandates — In FY 2005 the USGS will release a computer-based course titled "Introduction to Information Resources Management" that will be required training for USGS managers. All USGS employees will be encouraged to take the course. The USGS information policies that relate to government mandates will be reviewed, and revised as necessary, to ensure accurate integration with USGS science polices. The Section 508 Program will continue to monitor USGS Web sites for Section 508 compliance using enterprise software and will form a partnership with the USGS contracts office to provide training on Section 508 procurement requirements.

Records Management staff will initiate an inventory of USGS data holdings in preparation for the conversion to an electronic record-keeping system under the direction of DOI and NARA. The USGS Record Liaison Team (composed of representatives from USGS offices and regions) will assist in this effort. Records Management training for all employees will continue to be a high priority for the USGS as part of the plan for the conversion to an electronic record-keeping system. Privacy impact assessments and systems of records will be prepared for all USGS systems to fully comply with the Privacy Act and E-Government Act. Records Management and Privacy components of USGS Exhibit 300's will continue to be monitored. The USGS is participating in the DOI E-Forms Management efforts that will design an enterprise solution to Federal forms creation and use. The USGS is committed to complying with government mandates and ensuring that these requirements are fully integrated in USGS science programs.

Capital Asset Planning and Investment Control — In FY 2005, the USGS will achieve Level 2 compliance with the GAO IT Investment Management maturity model. The CPIC program will begin monthly reviews of major IT investments and annual reviews of non-major IT investments. Policies, procedures and tools will be developed to identify all levels of IT spending for the Exhibit 53, as required by OMB Circular A-11. The USGS subject matter experts will continue to review major IT investments to ensure compliance with emerging IT policies and OMB business case criteria. The CPIC office will continue to provide guidance and technical support to USGS science and administrative programs to assist them in preparing sound and effective business case analyses for their program-specific information systems. In preparation for Level 3 maturity, the CPIC office will develop portfolio management procedures to be reviewed and approved through the IRB.

Enterprise Geographic Information Systems — In FY 2005, the USGS Enterprise GIS (EGIS) effort will focus on collaboration with other DOI bureaus to review business goals, technical requirements, and current status and capabilities with regard to use of GIS. The USGS will also continue to provide leadership for the Department in administering the departmentwide license agreement for procurement of GIS software products from ESRI. The EGIS will continue to lead the USGS implementation of an updated suite of GIS software, as well as lead a research effort to determine the feasibility of software and data distribution using external hard drives to replace other distribution media. Through collaboration with other DOI bureaus and GIS agencies, the EGIM initiative will develop a GIS Training Plan and clearinghouse, develop common software deployment scripts and policies for enterprise license deployment, establish a GIS knowledge base clearinghouse, provide GIS data management and tools, institute GIS participation in Federal enterprise activities, implement the GIS communications plan, and develop a systems architecture white paper.

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Federal Geographic Data Coordination Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Enterprise Information Security and Technology	0	22,714	+256	+2,267	25,237	+2,523
FTE	0	155	0	0	155	0
Enterprise Information Resources	0	16,989	+185	-21	17,153	+164
FTE	0	109	0	0	109	0
Federal Geographic Data Coordination	0	4,670	+34	+673	5,377	+707
FTE		17	0	0	17	0
Total Requirements \$000	0	44,373	+475	+2,919	47,767	+3,394
FTE	0	281	0	0	281	0

^{a/} Changes for this subactivity include a reduction of -\$7 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for the Federal Geographic Data Coordination (FGDC) subactivity is \$5,377,000.

This subactivity provides operational support and overall executive management for the FGDC and its attendant activities. This leadership role is specified as a Department of the Interior (DOI) responsibility under the Office of Management and Budget (OMB) Circular A-16. The FGDC is an interagency and intergovernmental committee that encourages Federal, State, local, and Tribal Governments, academia, the private sector, and nonprofit organizations to work together within a geographic area to make geospatial data available to all through the National Spatial Data Infrastructure (NSDI). In addition, the FGDC provides operational support to Geospatial One-Stop (GOS), one of the Administration's 24 E-Government initiatives.

Future Directions — The FGDC is collaborating on streamlining business processes, reducing program overlap, and developing a unified geospatial enterprise architecture and management portfolio due to an organizational realignment of related spatial data activities and programs into the National Geospatial Programs Office. The major goals are (1) forging partnerships with a purpose and creating a governance structure, (2) making framework real by expediting the framework data standards approval process, and (3) communicating the NSDI message through creation of a business plan, communications strategy, and standardized training materials and courses.

NSDI Cooperative Agreements Program (CAP) (estimates for FY 2005, \$1 million; FY 2006, \$1 million) — This program provides grants to all sectors of the geospatial community involved in implementing the NSDI. The program provides seed money to stimulate collaboration and cost sharing among participants, as well as assistance in their efforts to provide more timely access to geospatial resources for critical applications. Major funding categories include

Federal Geographic Data Coordination Subactivity

(1) metadata standard implementation training: assistance to organizations in acquiring the skill and experience to document their geospatial data holdings on the NSDI Clearinghouse so that they can be discovered for use by other organizations, (2) metadata standard train the trainers: support to experienced metadata trainers to train other organizations in the use of the NSDI metadata standard, (3) support to organizations with successful NSDI metadata development and Clearinghouse programs to assist other organizations in applying innovative approaches in these areas, (4) Web mapping service implementation: support to organizations to enhance their existing NSDI Clearinghouse nodes by adding on-line Web mapping services, and (5) capacity building: support for collaborative projects among organizations in the Americas (United States, Canada, and Mexico) to maintain, and share geospatial data within regions or topics of common interest.

Homeland Security and Critical Infrastructure Data Needs — The FGDC Homeland Security Working Group advances the development and use of the NSDI to support Homeland Security data needs. Major focus is on establishing a consistent and common set of "national" symbols for features that are commonly portrayed for homeland security applications, and identifying common, minimum information content and a releasability policy that supports homeland security activities, especially for critical infrastructure protection.

Geospatial One-Stop — The GOS is a focused set of collaborative activities designed to accelerate the development and advance the use of the NSDI as a fundamental building block for Electronic Government and to make geospatial information access and sharing, easier, faster, and less expensive. The DOI serves as the managing partner of the GOS E-Government Quicksilver Project. The USGS provides the operational support and overall executive management for the GOS Project on behalf of the Department. Two major focus areas are (1) the development of a GOS Web portal to make it easier for citizens to find and integrate the Nation's spatial data assets and geographic data services over the Internet and (2) the establishment and implementation of national data standards for the fundamental "Framework" data themes of the NSDI. Efforts in FY 2006 will continue to focus on facilitating the work of Federal agencies in describing and documenting their existing and planned Framework data collection activities to the GOS Web portal.

Supporting Electronic Government — In addition to providing the key technical and funding support for DOI as the governmentwide managing partner of GOS, the USGS geography and water disciplines are responsible for the development of standards and data content for three of the national Framework geospatial data themes for GOS (elevation, hydrography, digital orthoimagery). The USGS also contributes (with in-kind technical expertise and scientific data) to two other E-Government initiatives: Disaster.Gov and Recreation One-Stop. The USGS also participates in governmentwide initiatives for Science.gov and Volunteer.gov.

International Cooperation — At the direction of the OMB Circular A-16, the FGDC participates in international-level efforts, such as the Global Spatial Data Infrastructure, to develop common and consistent policies, protocols, and standards for more effective use of geospatial data, spatial data infrastructure, and geographic information system technologies in Nations throughout the world.

2004 Program Performance Accomplishments

The FY 2004 program accomplishments for the NSDI Cooperative Agreement Program and Geospatial One-Stop (GOS) described below demonstrate the utility of the following output

measures: "# of informal NSDI conference outreach exhibits" and "# of new NSDI clearinghouse nodes established for serving data" for helping to integrate GOS and the FGDC.

NSDI Cooperative Agreements Program (CAP) — In FY 2004, the FGDC provided more than \$1,000,000 in funding through the CAP to 51 organizations. Funded projects include:

- Ten metadata training sessions have been conducted to assist 15 organizations and 40 individuals in gaining skill in application of the NSDI metadata standard,
- Over 400 metadata files were created to document 24 organizations geospatial data holdings,
- Seven existing NSDI Clearinghouse nodes (online catalogs of geographic data) were enhanced so that they can allow their users based on OpenGIS interoperability standards to graphically integrate geospatial data from multiple clearinghouse sites over the Internet,
- Thirteen agencies and organizations with existing and effective successful NSDI metadata development and clearinghouse programs provided technical support and assistance to a total of more than 40 other collaborating organizations in how to successfully implement these services, and
- Joint geospatial data collaboration was established among 10 multisector Canadian and U.S. organizations for the Gulf of Maine.

Homeland Security and Critical Infrastructure Data Needs — In FY 2004, the FGDC Homeland Security Working Group completed an interoperability test bed for emergency map symbology. This draft emergency map symbology standard is endorsed by the National Fire Protection Association and is going through a nationally recognized standards accreditation process for broad review and formal American National Standards Institute approval. In addition, the Working Group developed draft FGDC policy to reduce or eliminate public access to specific geospatial data for Homeland Security reasons. This policy is in the final FGDC approval stage.

Geospatial One-Stop — In FY 2004, over 150 planned geospatial data acquisitions were identified and documented among Federal, State and local governments, as required in OMB Circular A-11. This service allows government agencies to identify where needed data may already exist or to collaborate and share costs on acquisition of data that are of mutual interest. Over 35,000 existing geospatial data sets were identified and posted on the GOS Portal. During FY 2004, the Version 1 operational prototype portal was used by more than 300,000 users to discover and access geospatial data resources. A suite of more advanced services and tools were made available to other E-Government initiatives and agencies building upon those E-Government initiatives in FY 2004. These included modules for inclusion in those initiatives for address finding, weather, and routing. The primary user of these services was the Recreation One-Stop portal. Channel Stewards, data theme experts responsible for managing the "two clicks to content" data channels, were identified based on agencies' framework data responsibilities during this fiscal year. A suite of channel management tools was developed for Channel Stewards to easily keep data category channels populated with featured data resources that users can access without the need to do searches of the entire GOS catalog. Automated harvesting copies of metadata from NSDI Clearinghouse nodes also became operational this year.

International Cooperation — The FGDC continues to support the Global Spatial Data Infrastructure (GSDI) both administratively and programmatically by providing the infrastructure for the operation of the secretariat as well as chairmanship of the technical working group and the conference planning committee and participation in the sponsored projects committee. It also developed and published version 2.0 of the Spatial Data Infrastructure (SDI) "Cookbook," which can be found on the GSDI Web site (<http://www.gsdi.org/>). The cookbook is a well-recognized how-to handbook that can be used as a guide for SDI creation in any organization, domestically as well as globally. In collaboration with the GSDI, for the second year the FGDC successfully distributed 12 grants to emerging Nations supporting some component SDI development and managed a \$40,000 grant provided by the U.S. State Department for training in Afghanistan. The regional electronic newsletter program was expanded from the monthly edition published initially in Africa only to two additional regions: the Americas and Asia/Pacific regions. Actions were also seeded to move the secretariat to a formally established mechanism. A highly successful seventh GSDI meeting was conducted in Bangalore, India, with approximately 400 attendees representing 36 Nations.

2005 Planned Program Performance

Planned program priorities for the FGDC in FY 2005 include:

- The FGDC will work to integrate the GOS initiative and the USGS *The National Map* into pilot implementation and testing of 5 NSDI Framework data standards, with the ultimate goal of creating one portal for national geospatial information and data. Cooperative data construction and maintenance of NSDI Framework geospatial data across the Nation will continue and another set of 5 Framework data themes will begin the standard approval process.
- The NSDI Clearinghouse will continue to coordinate the publication of metadata describing geographic data and services at over 250 distributed Clearinghouse nodes. All domestic NSDI Clearinghouse metadata collections will be made accessible through the GOS Web portal as the primary governmentwide search interface.
- The FGDC will evaluate and further integrate the following output measures: "# of informal NSDI conference outreach exhibits," "# of new NSDI clearinghouse nodes established for serving data," "# of new NSDI standards developed," and "# of new NSDI partnership agreements" with the GOS initiative and the USGS *The National Map*.
- The NSDI Cooperative Agreements Program (CAP) — This program will work cooperatively with GOS and with *The National Map* initiative of the USGS to further the adoption and implementation of NSDI data standards by more Federal, State, and local government agencies and non-government organizations. By providing \$1,500,000, the CAP expects to establish 60 new partnership agreements in FY 2005. Highlights of these partnerships are:
 - Thirteen organizations begin sustained implementation of data documentation (metadata creation),
 - Ten organizations with metadata expertise assist up to 30 other organizations in metadata training, creation and service,

Federal Geographic Data Coordination Subactivity

- Thirteen projects to enhance multijurisdictional organizational and institutional capacity to collaborate and share geographic data resources across organizational and jurisdictional boundaries by reaching agreement on technical, political and financial factors,
 - Two existing NSDI Clearinghouse nodes are enhanced so they can allow their users based on OpenGIS interoperability standards to graphically integrate geospatial data from multiple clearinghouse sites over the Internet,
 - Six projects to begin serving and using Framework data over the bureau using OpenGIS Web Feature Service specifications. Projects involving collaboration between a data provider and software provider will quickly prototype and disseminate emerging Framework base data standards, and
 - Eight organizations that maintain, update, and serve geospatial data will enhance or begin participation in providing data to *The National Map*. These data will provide a base for applications nationally.
- The FGDC will implement a national NSDI Education and Training Strategy with standard curricula and materials for several NSDI components. This will increase the understanding and adoption of NSDI standards and practices among all sectors of the geospatial data community. The strategy will address the broad national need for training, while also continuing to address local and regional needs.
 - The FGDC will implement the new "Future Directions" action plan through core and study teams that work on identified first year goals and specific steps needed for the FGDC to continue to expand the NSDI, GOS and *The National Map* as a shared geospatial data resource for the Nation. Each team will complete a charter, develop communications materials, and focus on implementing short-term goals.
 - The FGDC will continue its participation with other countries in development of the GSDI, as a key way to foster use of common and consistent policies, protocols, and standards for more effective use and exchange of geospatial data both within Nations and across political boundaries. In FY 2005, FGDC will also support the Group on Earth Observation (GEO) comprised of UN and European Commission members, and the Global Earth Observation System of Systems (GEOSS), a 10-year implementation plan to build the infrastructure for global sustainable development. The FGDC is providing leadership and support for the eighth GSDI international conference in Egypt, and the groundwork will be laid for a tenth GSDI meeting in Santiago, Chile, in 2006. The FGDC will continue to provide technical support for publication of the GSDI regional electronic newsletters and potentially expand to an additional region such as the Caribbean region. The FGDC will again provide a total of about \$25,000 to implement a small number of geospatial data infrastructure projects in developing Nations. A formal agreement will be created to move the business administration of both the newsletter and grant programs to the formal GSDI secretariat in order to increase efficiency and improve effectiveness. A Memorandum of Understanding between FGDC and the Mexican Mapping Institute will be developed to facilitate collaboration on cross border projects for 2005–10, similar to the cross-border projects conducted with Canada under the FGDC CAP grant program. The business components of the GSDI secretariat will be moved to a formal secretariat.

Federal Geographic Data Coordination Subactivity

- The FGDC will formalize agreements with several new partners. Urban and Regional Information Systems Association and the Federal Communications Commission are important new partners because of their substantial national level commitments for managing and mapping infrastructure and communications respectively and their ability to promulgate standards to a large user base. The FGDC will work with the National Geospatial-Intelligence Agency and the Department of Homeland Security to leverage FGDC activities and products for national security requirements, which include development of data standards, data models, and data sharing partnerships with State and local governments, Canada, and Mexico.

Homeland Security and Critical Infrastructure Data Needs — The working group will draft a symbol standard for emergency response, provide educational materials on the "Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns," and begin to implement the National Grid for a test bed in the Washington, DC, area.

Geospatial One-Stop — In FY 2005, the lessons learned from operating the Version 1 prototype of the portal will be used to finalize and issue a statement of work as part of the competitive procurement for the Version 2 Operational Portal for GOS. The portal contract will be awarded during the second quarter of FY 2005 and deployed during the third quarter of FY 2005. The registration and harvesting of all NSDI nodes will be followed by registration of new non-NSDI geospatial data resource servers as a way to include even more resources available for Federal, State and local government agencies to share and build partnerships. The integration of *The National Map* with the GOS catalog will be optimized and integrated with the National States Geographic Information Council's Random Access Metadata Tool for Online National Assessment (RAMONA) metadata catalog. RAMONA will be a single inventory system that can be shared across Federal, State and local governments and with the private sector. The GOS is expected to surpass 200,000 geospatial data resources in its catalog, and usage will grow to 500,000.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Federal Geographic Data Coordination (\$000)	5,377	+673
FTE	17	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006 budget request for Federal Geographic Data Coordination is \$5,377,000 and 17 FTE, a net program increase of +\$707,000 (includes adjustments for uncontrollable costs) and 0 FTE from the FY 2005 enacted level.

The 2006 budget includes a net program change of \$680,000 enterprise information technology investments in E-Government.

Disaster Management (+\$680,000) — Interior is an active participant in many E-Government initiatives, providing leadership, funding, and in-kind technical and staffing support. These initiatives strive to eliminate redundant systems and significantly improve the government's quality of customer service for citizens and businesses. The budget includes an increase of \$680,000 to support Disaster Management.

Federal Geographic Data Coordination Subactivity

The Disaster Management Initiative will improve the delivery of disaster assistance information and services to government agencies and the private sector by creating a single Internet-based portal. The public side of the portal will be a single location where the public and businesses can access disaster information and services provided by government agencies and non-governmental organizations. The Government side of the portal will provide a layered, secure environment providing access to disaster information and the means to exchange information on disaster preparedness, response, mitigation, and recovery.

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Science Support

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{a/}	2006 Budget Request	Change from 2005
Bureau Operations	89,849	64,636	+582	+6,171	71,389	+6,753
FTE	584	461	0	0	461	0
Payments to the National Business Center	962	948	0	0	948	0
Total Requirements \$000	90,811	65,584	+582	+6,171	72,337	+6,753
FTE	584	461	0	0	461	0

^{a/} Changes for this activity include -\$200 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

Activity Summary

Introduction

Science Support funds the executive and managerial direction of the bureau, as well as bureau sustaining support services. Science Support has two budgetary components: Bureau Operations and Payments to the National Business Center.

Leadership — The Director serves as Chief Executive of the USGS with ultimate authority for all strategy, policy, and program decisions. This includes direct involvement in program, budget, finance, and communications development. The Deputy Director serves as Chief Operating Officer supporting the Director in implementing policy decisions, with a focus on operational issues.

The Executive Leadership Team is composed of 15 senior policy-level leaders of the bureau including the Director and Deputy Director. It identifies issues of interest and concern to the USGS enterprise and functions as a senior advisory body to the Director and as the principal mechanism for building a bureau-centered culture.

Use of Cost and Performance Information

In accordance with Departmental guidelines, USGS implemented Activity Based Costing/Management in FY 2004. Cost and performance data were presented in the FY 2004 Performance and Accountability report where the Statement of Net Cost was presented aligned to the Department's revised Strategic Goals.

During FY 2003 and FY 2004, USGS's quest for excellence in its business and financial arena worked through a comprehensive corrective action plan resulting in an unqualified opinion on the bureau's Consolidated Balance Sheet as of September 30, 2003, and an unqualified audit opinion with no material weaknesses and 2 reportable conditions for FY 2004. The USGS received \$1 million in FY 2005 for additional financial management improvements in its financial, accounting, and business practices to improve accountability for its management excellence performance measures.

Associate Directors have oversight of national programs, establish program direction and goals, and serve as science advisors to the Director for their respective program areas. Regional Directors are responsible for meeting regional science and operational needs through integrated science centers and other means. The bureau uses regional science programs and integrated

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science centers as tools to effectively coordinate program activities in addressing regional issues.

The Office of Budget and Performance and the Office of Communications report to the Director and provide bureau-level advice and staff assistance to the Director and executive leadership. This advice includes bureauwide policy, guidance, and direction for:

- Budget formulation, execution, presentation, and advocacy with the Department, Office of Management and Budget, and Congressional Appropriations Committees,
- Strategic planning and performance management, and
- Communicating information about USGS research, programs, activities and products, and liaison and close coordination between USGS and the Congress, the Department, and other bureaus for congressional and public affairs matters.

The **Office of Administrative Policy and Services** provides bureau-level policy, program direction, and leadership for science support. These support services include accounting and fiscal management; general services and office support; security; safety, environmental protection, and occupational health; contract negotiation and administration; grant administration; facilities and property management; and business information systems management. The Chief, Office of Administrative Policy and Services, also serves as the USGS Chief Financial Officer (CFO).

The **Office of Human Resources** provides bureau-level leadership, program direction, and staff support for human resources programs, including equal employment opportunity, diversity, affirmative employment, employee development, personnel management, and supervisory, managerial and leadership training development.

Bureauwide Costs — Bureau sustaining costs are budgeted centrally. The budget for these costs is formulated annually based on past actual expenses and an estimate of future need. Certain essential program support costs are relatively uncontrollable by the USGS and, because of the nature of organization and billing arrangements, are more effectively and efficiently managed centrally (e.g., payments to the Department of the Interior (DOI) for services provided through the Departmental Working Capital Fund and other departmental charges, such as the Performance and Accountability Report, Federal Lab Consortium, and Property Management Disposal System). Other bureau-level costs include payments to the Department of Labor for unemployment compensation and on-going injury compensation, administrative computer systems (such as the Federal Financial System [FFS] and the Federal Personnel and Payroll System [FPPS]), and human resources initiatives. The Science Support Activity also partners with other Interior bureaus and offices to provide shuttle service to and from the DOI to the Reston area. Bureauwide (enterprisewide) information technology, management, and service functions that were previously distributed among several different USGS offices and budget sub-activities have been consolidated under the authority of the Geospatial Information Officer (GIO) as a single Enterprise Information Activity.

The Payments to the National Business Center Component funds management and support services related to the FFS, Fixed Assets and Inventory Subsystem, Interior Department Electronic Acquisition System (IDEAS), and the Procurement Data Reporting System.

Funding, Strategic Goals, and Performance Data

All funding for the Science Support Activity addresses the DOI Strategic Plan's Serving Communities mission theme strategic goal of advance knowledge through scientific leadership and inform decisions through the application of science and the Management Excellence theme.

FY 2003 and prior year performance and targets capture the metrics from the prior GPRA Strategic and Annual Plans (largely in outputs) and where possible, prior year performance actuals were also derived for the new metrics. "SP" coded measures relate to specific measures in the DOI Strategic Plan and contribute to the aggregate bureau outcome as shown in the General Statement and the aggregate DOI outcome in the Department's unified plan. Outputs are only included in bureau plans. FY 2004 is the first year the Department's unified strategic plan was implemented and therefore the first year for which actual performance is provided in that context.

The USGS customer satisfaction metrics are developed on the basis of information collected in an ongoing series of customer satisfaction/outcome surveys. Each survey collects information on satisfaction with various aspects of one specific USGS science product. Information is collected from a random sample of the customers of that specific product. The satisfaction ratings for the individual products are extracted or combined to create the cited customer satisfaction metrics. The individual satisfaction ratings used to create the metrics are replaced on a 3-year cycle. The metrics for any two consecutive fiscal years, therefore, have about two-thirds of the specific science products in common on average. This has the effect of making the data series more stable than if all products were replaced each year. It also makes the metrics more representative of USGS science products as a whole, since it approximately triples the number of specific products included in each metric.

FY 2004 Actual compared to FY 2004 Revised Final Plan

- For the output “# of summer workshops provided to TCU instructors,” the target was exceeded by 2 workshops due to additional opportunities.
- For the output “Number of academic year internships,” the target was not met. The performance goal was set at an approximate target level was 4, and the actual performance is under the target by 1 due to budget constraints. There is no effect on overall program or activity performance.
- For the intermediate outcome measures “Diversity: people with disabilities is X% over baseline levels,” the target was not met as there was a decline from 7.91 to 6.8 percent due to geography discipline buyouts in 2004. Thirty-three (20.4 percent) of those who took the buyouts were employees with disabilities.
- For the intermediate outcome measure “Human Resources: Reduce Office of Workers' Compensation Programs (OWCP) cases by 3 percent per year (FY 1999 baseline was 536),” the target was not met because the USGS goals for FY 2000–04 were based on FY 1999 baseline data. Although the USGS did not meet the FY 2004 OWCP Case and Cost goals when benchmarked against the baseline data, there were significant cost reductions as compared to FY 2003 actual expense (i.e., a reduction of 11.44 percent in OWCP Cases and a 1 percent reduction in OWCP costs). This is a positive trend, and the first time a cost reduction has been achieved over previous year's costs since the USGS began tracking these measures. Note: These reductions do not include inflationary medical and increased compensation costs.

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- The intermediate outcome measure “Competition: Number of commercial type FTE involved in competitive studies” was not met. In consultation with DOI, USGS revised its FY 2003–04 Competitive Sourcing Plan to allow additional pre-planning activities (defined by Circular A–76) to be conducted on the Visual Information function, accounting for the bulk of the FTE not studied. The remaining 11 FTE were to be studied separately but due to the Geography reorganization, those 11 FTE were reduced to 2 FTE and, in consultation with DOI, a study was not deemed appropriate. Note that the new inventory will show only 2 or fewer FTE remain but the numbers here remain consistent with the 2003 FAIR Inventory, the last approved inventory in use.

FY 2005 Revised Final Plan Compared to FY 2004 Actual

- For the output “# of summer workshops provided to Tribal Colleges and Universities (TCUs) and Instructors,” the decrease to half the number of workshops (2) reflects the greater emphases on development and delivery of structured activities through distance learning technology. At the most recent Tribal Colleges Forum, held at the USGS EROS Data Center, instructors from TCU’s expressed a need to have GIS and related science information available in an instructionally ready format. All of the TCUs now have high level, broadband capability that makes this mode of delivering more efficient and useful.
- For the output “# of academic year internships,” the modest increase in numbers reflects recent discussions between the National Science Foundation (NSF) and the Bureau. The Division of Geoscience at NSF is interested in supporting geoscience student interns from under-represented groups, such as Native Americans, African Americans, and other minorities, and placing these students with USGS scientists at our various research centers. NSF presently has a program where students in the atmospheric sciences are provided summer internships at the National Center for Atmospheric Research. It is anticipated that approximately 12 interns, drawn from all under-represented groups, would have summer internships. The additional internship in the FY 2005 plan represents the Native American demographic-based percentage of under represented populations.
- For the end outcome measure “X% of managers who indicate that their workforce has the job-relevant knowledge and skills necessary to accomplish organization goals,” the USGS projects an increase from 65 percent in FY 2004 to 70 percent in FY 2005, because of USGS focus on workforce planning, skills assessment, and skills development.
- For the intermediate outcome measure “Human Capital Plan Implementation: Enhanced Management Skills,” the number of all managerial/supervisory positions (SES/non-SES) with training involving the Secretary’s 4 C’s increased to 360 in FY 2004. USGS plans to include an additional 100 managers and supervisors in sessions of our Supervisory Challenge Training Course conducted during FY 2005 that includes information concerning the Secretary’s 4 C’s.
- For the intermediate outcome measures that relate to “Diversity – women and minorities is X% over baseline levels” and “people with disabilities is X% over baseline levels,” there is an increase of workforce participation over the baseline each year for each measure because USGS is focusing on increasing its diversity for women, minorities and people with disabilities. In FY 2005, USGS will develop a new Affirmative Employment Plan (AEP) based on the Equal Employment Opportunity Commission’s (EEOC) new guidelines, Management Directive 715 (MD-715). The focus of MD-715 is on identifying

and removing barriers to equal access for all employees and applicants. This will assist us in meeting our goal of increasing our workforce diversity by 0.5 percent for women and minorities and by 0.1 percent for people with disabilities.

- For the intermediate outcome measure “Safety: Reduce Occupational Safety and Health Administration (OSHA) total injury/illness Case Rate by 3 percent per year from FY 2003 base year (3.57),” in FY 2004, OSHA established governmentwide goals to reduce injury/illness rates by 3 percent per year over a 3-year period. The USGS goal for FY 2004 was 3.46. The actual rate was 3.19. The USGS met their FY 2004 annual reduction goal by 7.80 percent. Safety, Health and Environment, Return-to-Employment (SHARE) Initiative goals for FY 2005–07 are as follows: FY 2005, 3.35; FY 2006, 3.25; FY 2007, 3.16.
- For the intermediate outcome measure “Safety: Reduce Occupational Safety and Health Administration (OSHA) total lost time injury/illness Case Rate by 3 percent per year from FY 2003 base year (0.82).” in FY 2004, OSHA established governmentwide goals to reduce injury/illness rates by 3 percent per year over a 3-year period. The USGS goal for FY 2004 was 0.79. The actual rate was 0.97. The USGS did not meet their FY 2004 annual reduction goal. SHARE Initiative goals for FY 2005–2007 are as follows: FY 2005, 0.77; FY 2006, 0.74; FY 2007, 0.72.
- For the intermediate outcome measure “Account Delinquency: Refer X% of eligible delinquent debt to Treasury for cross-servicing,” 94 percent compliance rate is a governmentwide objective. The bureau exceeded governmentwide objectives and referred 100 percent of all eligible debt to Treasury at year-end.
- The intermediate outcome measure “Competition: Number of commercial type FTE involved in competitive studies” is not comparable because each year has a standalone target.

FY 2005 Revised Final Plan Compared to FY 2005 Plan/Budget

- For the intermediate outcome measure “Safety: Reduce Occupational Safety and Health Administration (OSHA) total injury/illness Case Rate by 3 percent per year from FY 2003 base year (3.57),” new data changes are based on the establishment of new SHARE goals with a baseline year of 2003. The 2005 actual plan called for an initial injury/illness case rate of 3.11. The FY 2005 plan should now be 3.35 due to additional SMIS data input and new SHARE goals established by the Department of Labor.
- For the intermediate outcome measure “Safety: Reduce OSHA total lost time injury/illness Case Rate by 3 percent per year from FY 2003 base year (0.82),” new data changes are based on the establishment of new SHARE goals with a baseline year of 2003. The 2005 actual plan called for an initial injury/illness case rate of 0.58. The FY 2005 plan should now be 0.77 due to additional SMIS data input and new SHARE goals established by the Department of Labor.
- For the intermediate outcome measure “Human Resources: Reduce the rate of lost production days due to injury by 1 percent each year (per 100 employees),” in FY 2004, the Department of Labor established the governmentwide SHARE Initiative to reduce the lost work-day rate as a result of injury by 1 percent each year over a 5-year period. We used FY 2003 as our baseline year rather than FY 2004. The USGS’s lost production

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day rate in the FY 2003 base year was 10.57. The actual goal for FY 2004 lost production day rate was 10.46. We met our goal in FY 2004. The revised goal for USGS in FY 2005 is 10.35.

- For the intermediate outcome measure “Human Resources: Increase the timeliness for OWCP claims by 5 percent per year. In FY 2004, the Department of Labor established the governmentwide SHARE Initiative to increase the timeliness of claim filing. We used FY 2003 as our baseline rather FY 2004. During FY 2003, the baseline year, 31.10 percent of claims were filed to the Department of Labor within 10 working days after receipt of notice from the employee. During FY 2004, we established a goal of 32.65 percent of our claims being filed in a timely manner. The USGS met our FY 2004 compliance goal. The revised goal for USGS in FY 2005 is 34.28 percent.
- For the intermediate outcome measure “Improved Financial Management: Complete implementation of X% of OIG and GAO recommendations by their original target date as reported in the Performance and Accountability Report,” the FY 2005 Plan is revised to reflect 100 percent implementation by their target dates of recommendations reported in the Annual Accountability Report. As reported in the FY 2004 audit report on the bureau’s Annual Performance and Accountability report, all previous material weaknesses were cleared. The bureau expects to clear two reporting reportable conditions during FY 2005 and not incur any additional findings
- For the intermediate outcome measure “Complete X% of corrective action plans for Federal Managers' Financial Integrity Act (FMFIA) of 1982 and audited financial statement material weaknesses by their original target date as reported in the Performance and Accountability Report,” the FY 2005 Plan is revised to reflect 100 percent correction of FMFIA and audit financial statement material weaknesses. As noted above, the bureau cleared previous material weaknesses and does not anticipate the FY 2005 audit report to reflect any material weaknesses.
- For the intermediate outcome measure “Account Delinquency Refer X% of eligible delinquent debt to Treasury for cross-servicing,” the FY 2005 Plan is revised to reflect 100 percent of eligible debt referred to Treasury. The bureau referred 100 percent of eligible debt in FY 2003 and FY 2004 and does not foresee any reason why this will not continue.
- For the intermediate outcome measure “Percent of Timeliness: X% of invoices (subject to Prompt Payment Action) paid on-time,” the FY 2005 Plan is revised to reflect 98.8 percent in accordance with the DOI Strategic Plan.
- For the intermediate outcome measure “Core Competencies Training for Fiscal Community: X% of fiscal community personnel trained in core competencies,” the FY 2005 Plan is revised from 50 to 25 percent due to the reduction in the amounts appropriated in FY 2005 for this activity.
- The intermediate outcome measure “Competition: Number of commercial type FTE involved in competitive studies” changed from 278 to 0. In consultation with DOI, USGS revised its Competitive Sourcing Green Plan to restructure the Visual Information function (278 FTE) and initiate a review of its science technician and science support positions (477 FTE) and begin a study of its geospatial data production functions of 266 FTE.

FY 2006 Plan Compared to FY 2005 Revised Final Plan

- For the intermediate outcome measure “Human Capital Plan Implementation Enhanced Management Skills,” the USGS plans to train an additional 100 managers and supervisor in the FY 2006 sessions of our Supervisory Challenge Training Course that includes information concerning the Secretary’s 4 C’s.
- For the intermediate outcome measure “Safety: Reduce Occupational Safety and Health Administration (OSHA) total injury/illness Case Rate by 3 percent per year from FY 2003 base year (3.57),” in FY 2004, OSHA established governmentwide goals to reduce injury/illness rates by 3 percent per year over a 3-year period. The USGS goal for FY 2004 was 3.46. The actual rate was 3.19. The goal for USGS in FY 2005 is 3.35. USGS plans to continue this improvement in FY 2006 with a goal of 3.25.
- For the intermediate outcome measure “Safety: Reduce Occupational Safety and Health Administration (OSHA) total lost time injury/illness Case Rate by 3 percent per year from FY 2003 base year (0.82),” in FY 2004, OSHA established governmentwide goals to reduce injury/illness rates by 3 percent per year over a 3-year period. The USGS goal for FY 2004 was 0.79. The actual rate was 0.97. The goal for USGS in FY 2005 is 0.77. USGS plan to continue this improvement in FY 2006 with a goal of 0.74.
- For intermediate outcome measure “Human Resources: Reduce the rate of lost production days due to injury by 1 percent each year (per 100 employees),” in FY 2004, the Department of Labor established the governmentwide SHARE Initiative to reduce the lost workday rate as a result of injury by 1 percent each year over a 5-year period. USGS’s lost production day rate in the FY 2003 base year was 10.57. The actual FY 2004 lost production day rate was 6.73. The revised goal for USGS in FY 2005 is 10.35. The USGS plans to continue this improvement in FY 2006 with a goal of 10.25.
- For intermediate outcome measure “Human Resources: Increase the timeliness for OWCP claims by 5 percent per year,” in FY 2004, the Department of Labor established the governmentwide SHARE Initiative to increase the timeliness of claim filing. During FY 2003, the baseline year, 31.10 percent of claims were filed to the Department of Labor within 10 working days after receipt of notice from the employee. During FY 2004, 34.80 percent of the claims were filed in a timely manner. The goal for USGS in FY 2005 is 34.28 percent. The USGS plans to continue this improvement in FY 2006 with a goal of 35.99 percent.
- For intermediate outcome measure “Core Competencies Training for Fiscal Community”: X% of fiscal community personnel trained in core competencies,” in FY 2005 the Bureau will begin to deliver core competencies training developed by the Chief Financial Officers Council and the Joint Financial Management Improvement Program. The goal for USGS in FY 2005 and FY 2006 is 25 percent per year to complete 100 percent of the Fiscal Community by FY 2008.
- The intermediate outcome measure “Competition: Number of commercial type FTE involved in competitive studies” as compared to FY 2005 revised final plan changed from 0 to 743. In consultation with DOI, USGS revised its Competitive Sourcing Green Plan to not begin any studies in FY 2006.

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2003 to 2006 Performance Summary

Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD = Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Serving Communities Goal:

End Outcome Goal: SEO.2. Advance knowledge through scientific leadership and inform decisions through the application of science.							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Access:</i> Customer satisfaction (# score) with ease, timeliness of delivery of science support services (BUR)	81%	82%	≥70%	≥70%	≥70%	0	≥70%
<i>Ease of use:</i> Customer satisfaction (# score) with documentation and ease of usability of science support services (BUR)	81%	74%	≥70%	≥70%	≥70%	0	≥70%
<i>Learning Approach:</i> X% of instructor proficiencies in select subject areas GIS, earth science) (BUR)	20%	30%	30%	30%	30%	0	30%
PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
# of summer workshop provided to Tribal Colleges & Universities (TCUs) instructors	2	4	2	2	2	0	2
# of academic year short courses and mini-workshops provided to TCUs	9	8	8	8	8	0	8
# of summer internships	4	5	5	5	5	0	5
# of academic year internships	3	3	4	4	4	0	4

Management Excellence:

End Outcome Goal: Workforce Has Job-related Knowledge and Skills Necessary to Accomplish Organizational Goals							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
X% of managers who indicate that their workforce has the job-relevant knowledge and skills necessary to accomplish organizational goals (SP)	65%	65%	70%	70%	70%	0	70%
Strategy 1: Human Capital Management							
<i>Human Capital Plan Implementation: Performance-based management</i> – Percent of SES executives and direct reports that have performance agreements containing GPRA performance-based elements (SP)	SES Members 100% Direct Reports NA	100%	100%	100%	100%	0	100%
<i>Human Capital Plan Implementation: Enhanced Management Skills</i> – Percent of all managerial/supervisory positions (SES/non-SES) with training involving the Secretary's 4C's (including use of volunteers) (SP)	260 cum	360 cum	460 cum	460 cum	560 cum	+100	760 cum
<i>Diversity: women & minorities</i> is X% over baseline levels (BUR)	42.0%	42.2%	43%	43%	43%	0	43.5%
<i>Diversity: people with disabilities</i> is X% over baseline levels (BUR)	7.2%	6.8%	7.92%	7.92%	7.92%	0	7.93%
<i>Safety: Number of fatalities and serious injuries</i> per 10,000 employees at DOI (lower number is good) (SP)	0	0	0	0	0	0	0
<i>Safety: Reduce OSHA total injury/illness Case Rate</i> by 3% per year from base year (3.57) (NK)	3.57%	3.19%	3.11%	3.35%	3.25%	-0.10 (-3%)	3.08%
<i>Safety: Reduce OSHA lost time injury/illness case rate</i> by 3% per year from base year (Initial FY 2004 baseline is .06) (BUR)	0.82%	0.97%	0.58%	0.77%	0.74%	-0.03 (-4%)	0.70%
<i>Human Resources: Reduce the rate of lost production days</i> due to injury by 1% each year (per 100 employees) (BUR)	10.75%	6.73%	5.98%	10.35%	10.25%	-0.10 (-1%)	10.05%

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<i>Human Resources:</i> Increase the timely filling of OWCP claims by 5% per year (higher number is good) (BUR)	31.10%	34.80 %	44.1%	34.28%	35.99%	+1.71 (+1%)	38.16%
End Outcome Goal: Accountability							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
Obtain unqualified audit (SP)	Unqualified Opinion on Consolidate Balance Sheet	Unqualified Opinion	Unqualified Opinion	Unqualified Opinion	Unqualified Opinion	0	Unqualified Opinion
Strategy 2: Improved Financial Management							
<i>Corrective Actions:</i> Complete implementation of X% of OIG and GAO recommendations by their original target date as reported in the Annual Accountability Report (NK)	80%	97%	90%	100%	100%	0	100%
<i>Corrective Actions:</i> Complete X% of corrective action plans for FMFIA and audited financial statement material weaknesses by their original target data as reported in the Annual Accountability Report (NK)	80%	100%	95%	100%	100%	0	100%
<i>Account Delinquency:</i> Refer X% of eligible delinquent debt to Treasury for cross-servicing (SP-NK)	93%	94%	95%	100%	100%	0	99.5%
<i>Payment Timeliness:</i> X% of invoices (subject to Prompt Payment Action) paid on-time (NK)	97%	97%	97%	98.8%	98.8%	0	98%
<i>Core Competencies Training for Fiscal Community:</i> X% of fiscal community personnel trained in core competencies. (BUR)	N/A	N/A	50%	25%	25%	0	100%
Strategy 3: Performance-Budget Integration							
<i>Cost Management:</i> X% fully implementing accurate, activity-based cost accounting systems in compliance with departmental guidelines (SP)	Awaiting DOI System Implementation	100%	100%	Implement Interim System 100%	Implement Interim System 100%	0	Implement FBMS
End Outcome Goal: Modernization							
Strategy 5: Competitive Reviews and Contract Management							
<i>Competition # of commercial-type FTE involved in competitive sourcing studies completed during the fiscal year (SP)</i>	42 FTE	0 FTE	278 FTE	0 FTE	743 FTE	0	571 FTE

Bureau Operations Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes ^{al}	2006 Budget Request	Change from 2005
Bureau Operations	89,849	64,636	+582	+6,171	71,389	+6,753
FTE	584	461	0	0	461	0
Total Requirements \$000	89,849	64,636	+582	+6,171	71,389	+6,753
FTE	584	461	0	0	461	0

^{al} Changes for this subactivity include -\$200 for travel. The impact of this change is described in the Program Changes section beginning on page G - 1.

2006 Program Overview

The FY 2006 budget request for the Bureau Operations subactivity is \$71,389,000.

The Bureau Operations subactivity promotes the orderly and efficient conduct of USGS programs through organizational leadership, shared administrative support services, and promotion of common business practices. This program addresses DOI's Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the applications of science, and DOI's Management Excellence strategic goal. Key indications of the USGS's performance are reflected in the end outcome goals for informing decisions through the application of science; workforce knowledge and skills; accountability; and modernization. To clearly measure progress in achieving the intermediate outcome of improving information base, information management and technical assistance, the USGS tracks intermediate outcome measures for access (customers' satisfaction with the ease and timeliness of delivery of science support services) and ease of use (customers' satisfaction with documentation and ease of usability of science support services). To measure progress in achieving the intermediate outcome measure of obtaining an unqualified opinion, USGS tracks the percent of corrective actions completed from the OIG/GAO annual accountability report and audited financial statement for weaknesses identified in the Federal Manager's Financial Integrity Act (FMFIA) corrective action plan.

The President's Management Agenda — Offices within the Bureau Operations subactivity manage and oversee bureauwide implementation of the President's Management Agenda initiatives that are part of ongoing departmentwide and governmentwide efforts to implement innovative Federal programs that promote improved financial management, competitive sourcing, strategic management of human capital, expanded electronic government, and budget and performance integration. Highlights of USGS progress on specific initiatives follow:

- **Financial Management Improvements** — The USGS continues to enhance performance against measures identified under the President's Management Agenda. The bureau's most recent self-assessment reflected a "green" under Improving Financial Management. The bureau will continue to pursue obtaining a best practice level by improving management of accounts receivable, initiating action to raise the level of Electronic Funds Transfer compliance by vendors and student employees, and

Bureau Operations Subactivity

improving internal controls. The bureau created an Internal Control and Quality Assurance Office that reports to the Deputy CFO and began in FY 2004 performing internal audit reviews of headquarters functions. During FY 2005 and FY 2006, these types of activities will be expanded to incorporate regional and field financial management functions. The USGS will also continue participation and implementation plans for transition to the Department's Financial and Business Management System (FBMS).

- **Budget and Performance Integration** — Relating planned performance with budget requests and financial reports is a critical element in forging a comprehensive understanding of what is being achieved in relation to what is being spent. To fully realize the integration of budget and performance, DOI revised its strategic plan to produce a single unified stratagem for all bureaus. Science provides the foundation for the Department's four mission areas of Resource Protection, Resource Use, Recreation, and Serving Communities. USGS data collection, monitoring, research, assessment, and support activities are also linked to outcomes and outputs for departmental mission areas, and changes in USGS funding are described in terms of changes in program performance. Simultaneously, the USGS is fully engaged with other bureaus in improving cost reporting for activities, outputs, and outcomes through Activity Based Cost Management (ABC/M), implemented in FY 2004. USGS will continue to monitor results and work with the Department to refine performance and activity definitions to enhance consistency in application and accountability for results.
- **Competitive Sourcing** — Based on results of a planning team convened in FY 2004, USGS prepared a Competitive Sourcing Green Plan that has been coordinated and approved by the Department. The USGS will use \$500,000 of base funds to contract for support services to obtain necessary external expertise, to develop effective Performance Work Statements and Agency Tenders, and to provide employee training in support of the President's Management Agenda for Competitive Sourcing. In FY 2005, the USGS is scheduled to begin the review of its science technician and science support functions, and initiate a study of geospatial data production functions. Based on the outcome of these reviews, funds will be required for the next phase of this review. In accordance with the USGS competitive Sourcing Green Plan, in FY 2006 the USGS will perform reviews on Library and Information Services and Information Technology positions. Funds will be required for external expertise for these reviews. FTE resources are required to implement and manage the USGS Competitive Sourcing Initiative, including the oversight of contractor support, development of Competitive Sourcing Plans and management of the FAIR Act inventory collection process. Under the Competitive Sourcing mandate, implemented through the OMB Circular A-76, Federal agencies are required to review commercial functions performed by Federal employees.
- **Strategic Management of Human Capital** — In FY 2006, the USGS will expand its workforce planning efforts to address the impacts of restructuring of the USGS organizations and resulting balance of the workforce on achieving the bureau level strategic goals of integrated science. In addition, the USGS will continue to develop workforce plans for science centers in each region and discipline. Science center managers will use the automated skills tool to assess the skills of the current workforce and compare current skills to future skill needs based on their science plans. Regional managers will aggregate science center plans at the regional level to identify regional strategies for acquiring critical skills, and the USGS will prepare a bureau workforce plan

that identifies critical skill needs at the bureau level and strategies for meeting those needs.

The USGS will continue to extend the capabilities of the automated desktop workforce planning tools for managers and the integration of workforce data into the DOI Learning Management System. In FY 2006, the USGS will focus on extending the coverage of critical and emerging skills included in the skills assessment, refining the information reports capabilities, and developing tools to link identified skill needs to course listings and (or) other developmental opportunities.

The USGS will implement the Core Competencies for Managers Model with the goal of improving managerial performance at all organizational levels of the USGS. During FY 2006, this effort will be integrally linked with the succession-planning component of the FY 2005 USGS Workforce Plan and with the long-term Leadership-Centered Culture goals of the USGS.

The FY 2006 Rewarding Environment Program goal will be extended to develop applications and actions that connect Rewarding Environment initiatives with employee perceptions on science vitality and customer satisfaction with USGS products. A further outcome in FY 2006 will be the identification of behaviors and best practices that will be used to provide managers and supervisors with ideas they can adapt for their own use to effect and monitor statistically-based measures of organizational effectiveness.

As a key measure of Human Capital Management progress and success, the USGS will administer the third iteration of the bureau OAS to all employees in FY 2005. During FY 2006, the OAS will be used to report findings and information about employee perceptions of USGS management policies and approaches with a focus on indicators of organizational effectiveness in achieving the USGS goals of science excellence, impact and leadership. The human resources staff will lead the analysis of the survey and compare the results to information gathered in FY 2000 and FY 2003.

The USGS will be approximately halfway toward the goal of creating and training a critical mass of leaders at all levels of the organization by the end of FY 2006. The Leadership Centered Culture Program will provide an intensive focus on supervisory and managerial development that will serve as a core element of the bureau's implementation strategy for succession planning efforts as part of the FY 2006 USGS Workforce Plan.

The USGS will fully implement the automated safety management information system (SMIS). The goals of this system include the timely submission of workers' compensation claims and improved compensation case management in an effort to reduce overall workers' compensation costs to the bureau.

Improving workforce diversity is a priority for the USGS and a significant workforce planning issue. A major initiative in FY 2006 will be implementation strategies to comply with the requirements of the EEOC MD-715, particularly with regard to the identification of barriers that prevent the accomplishment of diversity and affirmative employment goals. The USGS will implement new, real-time reporting tools that will assist HR and line managers identify demographic trends and recruitment opportunities. The USGS will continue to use the Special Emphasis Program Advisory Committee to help identify

Bureau Operations Subactivity

barriers to diversity and recommend solutions to management. The USGS will direct its recruitment efforts to provide our regions with additional fiscal resources to establish relationships with local colleges and universities with majors in the USGS programs and with high enrollments of minority students. The USGS will implement the DOI Workforce Diversity Plan that will focus on goals that will be measured by outcomes in recruitment, retention, zero tolerance and accountability.

Energy Management — The USGS Facilities Energy Management Program supports the USGS mission by providing leadership, information, support, data analysis, and access to resources to assist in the economical and environmentally sound purchase, use, storage, and control of energy and water resources at our installations. The USGS reports energy cost and consumption data to DOI annually for all facilities that directly pay for their utility costs. These installations include owned space, leased space, and gauging stations. The data from approximately 40 percent of these sites are currently being collected through a utility bill analysis contract. This contract improves the validity of the data and enhances our reporting and tracking capabilities.

Core Competencies Initiative in Support of Strategic Management of Human Capital Goal

The USGS is developing safety, health, and environmental core competencies required by professionals and collateral-duty personnel at all grade levels. This initiative includes identification of the basic tasks of the positions, development of reference manuals that provide guidance on safety, health, and environmental roles and responsibilities, template position documents, individual development plan guidance, and a professional certification program. Implementation will integrate these products into USGS policy and guidance documents, on the safety and human resource internal Web sites, and in automated systems such as the Online Automated Recruitment System (OARS), Fast Class, and the Skills Inventory Data Warehouse during FY 2005–06.

Electronic Government, and Budget and Performance Integration Strategy Goals

Web-Based Safety and Environmental Training — In concert with the Department of the Interior and National Business Center-DOI University, the USGS has developed online initial safety and health orientation curricula for executives, supervisors, employees, and collateral duty safety program coordinators. In addition, the USGS has developed hazard communication and radiation safety courses. These courses are in the current stages of implementation departmentwide. The USGS has also developed the online materials for an OSHA equivalent Collateral Duty Safety Course (over 24 technical curricula modules) to meet the initial training requirements for safety professionals. This course is expected to be released in FY 2006 for all DOI bureaus, and will potentially be available on the OPM “Gov Online Learning Center” Web site for all Federal agencies. The USGS has published a “Supervisors Safety Guidebook” and is in the process of developing similar reference materials for employees, executives, and collateral duty safety program coordinators as a desk supplement for this training detailing individual program responsibilities.

Environmental Auditing and Management System (EMS) Pilot Projects for GAP

Analysis — The USGS conducted EMS pilots at the National Center, Leetown Science Center; and Menlo Park, CA (including Redwood City, CA). Site locations underwent a GAP analysis to establish a management baseline and identify programmatic shortfalls or “gaps” in program implementation. The pilot project effort has resulted in development of Web-based tools

necessary for the remaining sites to use for EMS implementation at their locations by December 2005.

2004 Program Performance Accomplishments

Unless otherwise noted, the FY 2004 Program Performance Accomplishments listed below demonstrate the utility of USGS products that are counted under the mission goal Management Excellence. The outcomes that contribute fall under the strategies "Human Capital Management," "Improved Financial Management," "Performance-Budget Integration," and "Competitive Reviews and Contract Management." In addition, the customer service accomplishments listed below demonstrate the utility of USGS products that are counted under the mission goal Serving Communities. The outcomes include "access: Customer satisfaction with ease, timeliness of delivery of science support services" and "ease of use: Customer satisfaction with documentation and ease of usability of science support services."

Financial Management — The USGS achieved an unqualified opinion on the FY 2004 annual Performance and Accountability Report and successfully cleared its FY 2003 material weakness. This success is due to improved policies and procedures, enhanced staff capability, and continued focus on training for administrative staffs. The bureau developed and used as a guide an annual operating schedule that highlights due dates for all financial activity for the fiscal year. This schedule was used to monitor compliance. Additionally, the bureau successfully performed a "hard-close" of accounts at the end of the 3rd quarter, allowing program managers and administrative staff the opportunity to clean accounts before the year-end rush of activity.

Budget and Performance Integration — In support of integrated budget planning, the USGS has consolidated within a single office the planning/evaluation, budget, and program staff work to create plans and budgets and to monitor and evaluate their implementation. A comprehensive system of program evaluations executed through a 5-year program review schedule, National Research Council reviews, OMB Program Assessment Rating Tool (PART), Organizational Assessments are all fundamental to this integrated program- and budget-planning process that ensures that the management of programs and funding is handled appropriately and uniformly at local, regional, and national levels. The USGS Director's Assurance Statement, Management Control Reviews and Audit Follow-Up, continue to lead the Department in scope, thoroughness, and documentation. The evaluations not only improve the accountability and quality of programs, but also identify and address gaps in programs; redirect or reaffirm program directions; identify and provide guidance for development of new programs; and review and (or) motivate managers and scientists. In addition, management control automated surveys were sent to employees of 3 science centers (Alaska Science Center, Great Lakes Science Center, and Grand Canyon Monitoring and Research Center), 2 programs (Global Change Program and Safety, Health, and Environmental Program), and 1 team (Business Leaders Team). The employees were asked to evaluate various aspects of management control at their center, program, or team. The USGS implemented the Department's strategic plan that has enabled integration of budget and performance for FY 2004, and will provide a meaningful measure of departmental accountability. Specific measures tied to departmental priorities have been used in SES performance plans. In concert with ABC objectives, the USGS enhanced a distributed planning and budgeting system that uses ABC/M data and interfaces with the financial system to provide budget and program managers financial information to support the development of annual budgets.

Bureau Operations Subactivity

Strategic Management of Human Capital – Workforce Planning — The USGS developed a bureau FY 2004 Workforce Plan that identified major workforce initiatives and contributed to the DOI Strategic Human Capital goals. In addition, the Human Resources Office provided managers at the science center, regional, and discipline levels demographic information about their current workforce, an automated skills assessment tool to assist them in identifying the skills of their current workforce, assistance in identifying critical skills needs based on their science plans and future science directions, and assistance in identifying the gap (or surplus) between the current skills and future skill needs. Using this information, managers are developing strategies for recruiting and hiring new employees, training and developing current employees, and outsourcing to meet current and future skill needs. One successful outcome of the workforce analysis and planning was the approval of the Voluntary Separation Incentive Payment and Voluntary Early Retirement Authority that was elected by 162 employees in the Geography organization in early FY 2004.

Diversity — Improving workforce diversity continues to be a priority for the USGS. The Special Emphasis Program Advisory Committee (SEPAC) is actively engaged with management in identifying barriers to diversity and in recommending solutions to management. The SEPAC group at headquarters and each region conducted an analysis of USGS employee recruitment, retention, career development, and advancement. A summary report with recommendations to enhance diversity within USGS was presented to the Executive Leadership Team. Diversity Days were held in Headquarters and the Regions to provide training in a variety of diversity and equal opportunity areas.

An accomplishment reflective of the affirmative employment goals of the USGS was the collaboration between the Central Region Human Resources and Water Resources staffs to enhance the relationship between USGS and Gateway Community College in Phoenix, AZ. Efforts during FY 2004 resulted in seven job offers, and five new SCEP appointments, two of which were from under-represented groups. The Gateway Team is providing avenues of hydrologic training, state-of-the-art equipment and professional advice and input to Gateway staff on their curricula and other subjects of interests.

Activity Based Costing (ABC) — For FY 2004, the Department began simultaneously implementing the Unified Strategic Plan and activity based costing. The efforts that USGS has undertaken in evolving common business practices such as reducing the number of accounts in FFS served us well in implementing this new performance and accounting approach. The common project planning tool, BASIS+ (Budget and Science Information System), that we implemented in FY 2003, associating work processes with projects, helped us transition in FY 2004 to linking work activities to outputs and associating these with costs. Cyber seminars were used to train employees in DOI-shared categories of work and coding to ensure they had the appropriate information and tools to integrate performance, budget, and accounting on October 1, 2003. The standard set of ABC work activities that USGS implemented in FY 2004 included:

- 15 indirect work activities,
- 42 direct science activities (6 per USGS/DOI shared goals), and
- 6 indirect science program management activities (1 per USGS/DOI shared goal).

Several years of implementation will be needed to standardize processes, ensure consistency of interpretation and application of work activity definitions across the organization and across

the scientific disciplines, and to identify trends in the data that can lead to programmatic decisions.

In FY 2004, USGS participated in the Department's ABC oversight efforts to "get the work activities right," by reviewing 326 DOI work activities for commonality/distinctions, challenging models and assumptions to define common ground, defining outputs, and realigning bureau work activities with a revised set of DOI activities. In FY 2005, USGS will collect the same work activities as FY 2004 but with improved definitions.

In FY 2004, USGS conducted internal processes to standardize ABC and Strategic Plan outputs so that a single set will be used for both. This effort led to a substantial refinement in the distinctions among work activities and products, and a new approach to analyzing work fashioned after the OMB's Business Reference Model for Knowledge Creation and Management. Analysis of program outputs against the new standards will result in some target revisions being developed. Integrating the two management processes with more descriptive definition templates will result in a more meaningful and reliable cost and performance tool for project managers.

Competitive Sourcing — USGS successfully completed a Competitive Sourcing planning effort, resulting in a strategy and timetable for conducting business strategy reviews (BSRs) on all commercial full time equivalents (FTE) by the end of FY 2008. A detailed outline of the plan is documented in the Competitive Sourcing Green Plan for FY 2005–08. The BSR will link bureau mission, strategic change initiatives, current and future science directions, and workforce planning activities into a comprehensive coordinated vision. In FY 2005, USGS will complete the first BSR on the Visual Information function, totaling approximately 278 FTE.

Energy Management — In FY 2004, the USGS completed energy audits at three of its owned sites and the National Center. One low cost project implemented by the facility staff at the National Wetlands Research Laboratory, adding automatic controls on their boilers, resulted in a 44 percent reduction in usage and a 45 percent reduction in cost as compared with the prior year.

Safety and Security — Via contract services the USGS is finalizing internal Continuity of Operations plans to address compatibility with field Mission Essential Site plans and the DOI plan, and to develop toolkits, guidelines, training and exercises to ensure viability of our program.

2005 Planned Program Performance

Unless otherwise noted, the planned program activities listed below demonstrate the utility of USGS products that are counted under the mission goal Management Excellence. The outcomes that contribute fall under the strategies "Human Capital Management," "Improved Financial Management," "Performance-Budget Integration," and "Competitive Reviews and Contract Management."

Financial Management — The USGS achieved an unqualified opinion on the FY 2004 annual Performance and Accountability Report and successfully cleared all FY 2003 material weaknesses. This success is due to improved policies and procedures over accounts receivables, undelivered orders and continued focus on training for administrative staffs. The bureau developed and used as a guide an annual operating schedule that highlights due-dates for all financial activity for the fiscal year. This schedule was used to monitor compliance.

Bureau Operations Subactivity

Additionally, the bureau successfully performed a “hard-close” of accounts at the end of the 3rd quarter, allowing program managers and administrative staff the opportunity to clean accounts before the year-end rush of activity.

Activity Based Costing (ABC) — USGS implemented ABC/M in FY 2004, and is working with USGS managers to interpret the information for use in planning and formulation processes to realize the full benefit of budget and performance integration. USGS continues to work with USGS scientists and managers, and the Department, to refine Activity definitions and linkages to the Strategic Plan.

Strategic Management of Human Capital — In FY 2005, the USGS will expand its workforce planning efforts to include the implementation of a succession planning model and workforce plans to address the bureau level strategic goals of integrated science. In addition, workforce plans will be developed and implemented for science centers in each region and discipline. Science center managers will use the automated skills tool to assess the skills of the current workforce and compare current skills to future skill needs based on their science plans. Regional managers will aggregate science center plans at the regional level to identify regional strategies for acquiring critical skills, and the USGS will prepare a bureau workforce plan that identifies critical skill needs at the bureau level and strategies for meeting those needs.

The USGS will expand the features of the automated Skills Assessment System, an online tool that allows managers to assess the current skills of their employees for workforce planning and developmental purposes. In FY 2005, the USGS will focus on extending the coverage of critical and emerging skills included in the skills assessment, refining the information reports capabilities, and developing tools to link identified skill needs to course listings and (or) other developmental opportunities.

The USGS will implement the Core Competencies for Managers Model with the goal of improving managerial performance at all organizational levels of the USGS. This effort will be integrally linked with the succession-planning component of the FY 2005 USGS Workforce Plan and with the long-term Leadership-Centered Culture goals of the USGS.

The FY 2005 Rewarding Environment Program goal is to push this effort out to science centers throughout the USGS. The USGS completed a study to assess the impact of the Rewarding Environment that resulted in the development of measures that connect Rewarding Environment initiatives with employee perceptions on science vitality and customer satisfaction with USGS products. An outcome in FY 2005 will be the identification of behaviors and best practices that will be used to implement the actions to be taken to effect and sustain this culture change and to provide managers and supervisors with ideas they can adapt for their own use.

As a key measure of Human Capital Management progress and success, the USGS will administer the third iteration of the bureau Organizational Assessment Survey (OAS) to all employees in FY 2005. The OAS will be used to gather information about employee perceptions of USGS management policies and approaches with a focus on organizational effectiveness indicators toward the USGS goals of science excellence, impact and leadership. The human resources staff will lead the analysis of the survey and compare the results to information gathered in FY 2000 and FY 2003.

The USGS will be approximately halfway toward the goal of creating and training a critical mass of leaders at all levels of the organization by FY 2005. The Leadership Centered Culture Program will implement an intensive focus on supervisory and managerial development that will

serve as a core element of the bureau's succession-planning efforts as part of the FY 2005 USGS Workforce Plan.

The USGS will fully implement the automated Safety Management Information System (SMIS). The goals of this system include the timely submission of workers' compensation claims and improved compensation case management in an effort to reduce overall workers' compensation costs to the bureau.

Improving workforce diversity is a priority for the USGS and a significant workforce planning issue. A major initiative in FY 2005 will be activities to comply with the requirements of the EEOC MD-715, particularly with regard to the identification of barriers that prevent the accomplishment of diversity and affirmative employment goals. The USGS will implement new, real-time reporting tools that will assist HR and line managers to identify demographic trends and recruitment opportunities. The USGS will continue to use the Special Emphasis Program Advisory Committee to help identify barriers to diversity and recommend solutions to management. The USGS will direct its recruitment efforts to provide our regions with additional fiscal resources to establish relationships with local colleges and universities with majors in the USGS programs and with high enrollments of minority students. The USGS will implement the DOI Workforce Diversity Plan that will focus on goals that will be measured by outcomes in recruitment, retention, zero tolerance and accountability.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Bureau Operations (\$000)	71,389	+6,171
FTE	461	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006 budget request for Bureau Operations is \$71,389,000 and 461 FTE, a net program increase of +\$6,171,000 (includes adjustments for uncontrollable costs) and 0 FTE from the FY 2005 enacted level.

E-Government (+\$371,000) — Interior is an active participant in many E-Government initiatives, providing leadership, funding, and in-kind technical and staffing support. These initiatives strive to eliminate redundant systems and significantly improve the Government's quality of customer service for citizens and businesses. The Department is the managing partner for two E-Government projects – Recreation One-Stop and Geospatial One-Stop. Interior is serving as one of the Governmentwide service providers for the E-Payroll initiative and is a leader in the E-Authentication project.

Departmentwide spending for E-Government activities that will benefit the USGS (excluding fee for service payments) reflected in the 2006 President's budget follow. In addition, the Department is also implementing E-Travel in an integrated fashion with the FBMS. Funds to support E-Travel are included in the FBMS budget under Departmental Management. The 2006 USGS budget includes \$371,000 to support these E-Government initiatives.

Bureau Operations Subactivity

(Dollars in Thousands)

	Billing Method	2006 Estimate
Integrated Acquisition	C-WCF	397
Grants.gov	C-WCF	453
E-Authentication	C-WCF	450
E-Rulemaking	C-WCF	825
E-Training	C-WCF	185
Business Gateway	C-WCF	322

Billing Method Notes. The billing and payment methods of the E-Government projects vary as follows:

C-WCF. The Department has established a centralized WCF account for purposes of billing bureaus and paying managing partners for certain E-Government payments. The Departmental management budget justification includes a description of this account.

D-WCF. Indicates a dedicated WCF account has been established for a single E-Government project. The only current project that falls in this category is Recreation One-Stop.

TBD. The billing methodology for two E-Government projects, SAFECOM and Disaster has yet to be determined. Funding to support SAFECOM and Disaster are included in bureau budgets as noted below.

Direct. Direct means that a bureau makes direct payments to managing partners. In 2006, both recreation one stop and geospatial one stop have a direct component.

The Departmental Management budget justification includes justifications of the programs funded through the working capital fund.

Capital Costs Deferred from FY 2005 (+\$6,000,000) — As part of the budget proposal to provide a long-term solution to the funding shortfall problem with Landsat 7, the USGS will propose a reprogramming in FY 2005 to cover the anticipated shortfall in revenue due to the failure of Landsat 7's scan line correction. This funding will ensure that Landsat 7 data continues to be received, processed, and archived. The USGS reprogramming request will redirect proposed working capital fund contributions in FY 2005 to the Land Remote Sensing program to cover up to \$6.0 million. The budget requests a one-time increase in FY 2006 of \$6.0 million to replace the working capital fund contributions that are redirected in 2005. The replacement of these deferred contributions is critical to ensuring that the USGS is able to remain on track to replace aging mission-critical equipment. The Bureau Operations program will distribute the \$6.0 million increase among the working capital fund investments that were originally scheduled for FY 2005.

Payments to the National Business Center Subactivity

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes	2006 Budget Request	Change from 2005
Payments to the National Business Center	962	948	0	0	948	0
FTE	0	0	0	0	0	0
Total Requirements \$000	962	948	0	0	948	0
FTE	0	0	0	0	0	0

2006 Program Overview

The Department's National Business Center provides efficient and cost effective, standardized, electronic-based administrative systems and automated data processing services to the USGS. These funds provide management and support services related to the Federal Financial System, the Fixed Assets and Inventory Subsystem, the Interior Department Electronic Acquisition System, and the Procurement Data Reporting System.

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Facilities

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes	2006 Budget Request	Change from 2005
Rental Payments	68,899	71,368	+1,509	-1,471	71,406	+38
FTE	1	1	0	0	1	0
Operations and Maintenance	19,959	19,820	+77	0	19,897	+77
FTE	57	57	0	0	57	0
Deferred Maintenance & Capital Improvement	4,131	3,423	0	0	3,423	0
FTE	2	2	0	0	2	0
Total Requirements \$000	92,989	94,611	+1,586	-1,471	94,726	+115
FTE	60	60	0	0	60	0

Activity Summary

Introduction

Funds for this activity provide safe and functional workspace and facilities for accomplishing the bureau's scientific mission. The appropriated funds included in this activity cover approximately 72 percent of recurring USGS facilities costs. Customers, through reimbursable funding provide approximately 21 percent, and USGS science programs provide the remaining funds.

This activity supports the Department of the Interior's (DOI) Serving Communities goals, "protect lives, resources and property and advance knowledge through scientific leadership and Inform decisions through the application of science." This activity also tracks outputs including "number of bureau condition assessments completed" (within a 5-year cycle) and "number of deferred maintenance and capital improvements."

The **Rental Payments** subactivity provides for rental payments to the General Services Administration (GSA), to other Federal agencies, to private lessors, and to cooperators for space holdings nationwide. The USGS occupies a total of 4.4 million square feet of rentable space in about 220 GSA buildings nationwide, making

Use of Cost and Performance Information

The Strategic Facilities Management Plan has been a tool used to achieve the facilities program goal to provide quality space to further science programs while optimizing facilities location, distribution, and use.

USGS has used the Strategic Facilities Management Plan to identify opportunities to reduce space holdings. In FY 2004, USGS rearranged space at the Rocky Mountain Mapping Center in Denver, returning nearly 10,000 square feet to GSA and reducing rent by over \$185,000.

Condition assessments for seven of the eight USGS's largest research vessels were completed. The second round of condition assessments will begin at six science installations in FY 2005. Initial condition reports will establish a baseline of the most critical maintenance deficiencies and help determine future priorities.

Cableways at many of the 113 sites nationwide are being replaced or renovated.

Facilities

USGS one of the largest users of GSA space within the Department. The USGS acquires space directly at over 100 other sites.

The **Operations and Maintenance** subactivity includes the recurring costs of providing for the basic operations and upkeep of facilities and ensuring that they are maintained in compliance with applicable safety and other standards. The USGS has 34 owned installations (280 buildings) on approximately 2,100 acres. This includes biological science centers (9), biological field and research stations (8), the National Center for EROS; geomagnetic, seismic, and volcano observatories (10), a Water Resources district office, and other miscellaneous owned property such as gaging stations, storage annex, and warehouses (7). The USGS also owns nine large research vessels.

The **Deferred Maintenance and Capital Improvement** subactivity funds are used to address the highest priority USGS facility and equipment needs to conform to safety and environmental standards. The current funding level provides for approximately 2.5 percent of the total backlog. The condition assessment program includes annual surveys and a cyclic process for comprehensive onsite inspections to document deferred maintenance.

The USGS defines facilities as separate and individual buildings, structures, or other constructed real property improvements. The USGS further defines facilities to include all locations where USGS activities are housed in the performance of bureau work, including office space, laboratory space, warehouse space, and related parking and common space. The USGS has classified large (greater than 45 feet in length) research vessels as facilities and has transferred oversight, maintenance, and management responsibilities from the science programs to the Facilities Activity. Associated costs and funding for these vessels have also been transferred.

The goal for the facilities program is to meet bureau science needs while optimizing facilities location, distribution, and use to control or reduce costs. Objectives for meeting this goal include:

- Coordinate facility planning with science planning to provide safe, high-quality workspace aligned with science needs,
- Meet performance targets by improving space utilization, controlling rent and operating costs, and releasing unneeded space,
- Eliminate the deferred maintenance backlog,
- Establish an effective maintenance program at each owned facility to meet industry best practices, and
- Increase co-location consistent with science program objectives.

Use of Cost and Performance

USGS awarded a contract to develop a bureau Strategic Facilities Master Plan (SFMP). This effort is focused on strengthening the facilities related planning and investment decisionmaking process. In whole, it will:

- Determine the adequacy of USGS facilities,
- Review the current mix of facilities sources (e.g., owned, rented, and cooperator space) to determine the mix is balanced properly to meet USGS science needs,
- Recommend performance metrics and tracking processes,
- Develop a new business case model for the USGS to apply to decisions about facilities investments, and
- Apply the business case model to identify priority opportunities for reducing current USGS facilities cost with due consideration of science program impact.

Five-Year Facility Plan — The bureau initiated national and regional 5-year facility plans to ensure that facilities meet science mission requirements and that facilities costs are reasonable

and adequately funded. These plans will be amended to include specific action plans that target facility cost reductions.

Lafayette Expansion — In September 2003, USGS completed the Louisiana Science and Facility Expansion Study identifying current and future science growth areas in the Lower Mississippi Valley (LMV)-Gulf Coast focus area. The study recommended multidisciplinary opportunities and integrated science activities to address programmatic and client agency science needs through the synergies of co-located scientific staff. The expansion study recommends that an integrated science facility be constructed adjacent to the existing National Wetlands Research Center (NWRC). The target square footage for the new facility is 75,000 to 80,000 square feet in office space and laboratories with an estimated construction cost of \$22 million. Through the cooperation with the University of Louisiana at Lafayette, USGS is currently conducting a \$1.4-million programming and design project for the new facility funded with grants received from the Department of Energy and the U.S. Department of Housing and Urban Development. The design project began in June 2004 and is anticipated to be completed in July 2005. Construction also funded through grants is anticipated to begin in March 2006.

Bureau Systems — Initiatives such as a Web-based facilities information system are streamlining budget data collection processes for facilities and are increasing the availability of much-needed management information on bureau real property holdings. Comprehensive facility condition assessments are identifying deficiencies that need priority attention and creating an information base that promotes effective stewardship and a more informed asset investment process. The implementation of DOI's standard facilities maintenance management system begins the process of standardizing facility operations and maintenance practices at the largest owned installations.

Maintaining America's Heritage — The DOI is committed to preserving and maintaining operational facilities and major equipment investments as well as to responsible stewardship of DOI-managed natural and cultural treasures. The FY 2006 USGS budget request includes \$33,284,000 for facilities and equipment maintenance and deferred maintenance under the Maintaining America's Heritage initiative. The Operations and Maintenance and Deferred Maintenance and Capital Improvements Subactivity descriptions provide details on the immediate and long-term maintenance projects underway and planned for the next 5 years to ensure that facilities and equipment are functional, safe, and useful to the fullest extent of their lifecycle.

Federal Role

The Facilities function provides for safe, functional, and high-quality workspace for accomplishing the bureaus science mission and ensuring that workspaces are maintained in compliance with applicable safety and other standards set by GSA and Occupational Safety and Health Administration. The USGS has key science facilities that are mission critical including those that are fundamental to providing timely warnings and scientific understanding and technologies needed to support the sound management and conservation of the Nation's biological, energy, water, and mineral resources.

Facilities

Funding, Strategic Goals, and Performance Data

All funding for the Facilities Activity addresses the DOI Strategic Plan's Serving Communities mission theme strategic goals of "protect lives, resources, and property" and "advancing knowledge through scientific leadership and inform decisions through application of science."

FY 2003 and prior year performance and targets capture the metrics from the prior Government Performance and Reform Act Strategic and Annual Plans (largely in outputs) and where possible, prior year performance actuals were also derived for the new metrics. "SP" coded measures relate to specific measures in the DOI Strategic Plan and contribute to the aggregate bureau outcome as shown in the General Statement and the aggregate DOI outcome in the Department's unified plan. Outputs are only included in bureau plans.

FY 2004 Actual Compared to FY 2004 Budget

- For the output measure "# of deferred maintenance and capital improvements" the FY 2004 target results in 12 project completions for FY 2004. 25 percent of the deferred maintenance funding was reprogrammed to address the Landsat 7 malfunction. The loss of funds coupled with the normal variability of project cost and reprioritization resulted in 4 less projects being completed.

FY 2005 Revised Final Plan Compared to FY 2004 Actual

- For the output measure "# of deferred maintenance and capital improvements" completion of deferred maintenance projects include an additional 18 projects for a cumulative total of 54.

FY 2005 Revised Final Plan Compared to FY 2005 Plan/Budget

- For the output measure "# of deferred maintenance and capital improvements" completion of 8 additional deferred maintenance projects are anticipated for FY 2005 due to scheduling changes and relative costs of projects rescheduled.

FY 2006 Plan Compared to FY 2005 Revised Final Plan

- For the output measure "# of deferred maintenance and capital improvements," an additional 10 projects are planned for completion due to reprioritization, scheduling changes and cost of projects.

2003 to 2006 Performance Summary

Target Codes:

SP = Key Strategic Plan measures

NK = Non-Key measures

TBD = Targets have not yet been developed

NA = Long-term targets are inappropriate to determine at this time

PART = PART measures

UNK = Prior year data unavailable

BUR = Bureau specific measures

Serving Communities Goal:

End Outcome Goal: SEO.1. Protect Lives, Resources and Property							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Improve public safety and security and protect public resources from damage							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Facilities Condition -- Hazards: Buildings (administrative, employee housing) are in fair to good condition as measured by the Facilities Condition Index (FCI) (SP)</i>	UNK	0.20	0.20	0.20	0.20	0	0.20

End Outcome Goal: SEO.2. Advance knowledge through scientific leadership and inform decisions through the application of science.							
End Outcome Measures	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
NA							
Intermediate Outcome: Improve information base, information management and technical assistance							
Intermediate Outcome Measures: (Key and Non-Key) and Bureau and PART Outcome Measures							
<i>Facilities Condition: Facilities are in fair to good condition as measured by the Facilities Condition Index (FCI) (SP)</i>	NA	0.17	0.17	0.17	0.17	0	0.17
PART Efficiency and other Output Measures							
PART Efficiency Measures or other Outputs	2003 Actual	2004 Actual	2005 President's Request	2005 Revised Plan	2006 Plan	Change in Performance – 2005 Plan to 2006	Long-term Target (2008)
# of bureau condition assessments in progress or completed (within a 5-year cycle)	39	41	41	41	41	0	41
# of deferred maintenance and capital improvements (cumulative)	24	36	46	54	64	+10	88

Management Excellence:

Strategy 6: Performance/Process Improvement							
<i>Facilities Management: X% of facilities that have a calculated Facilities Condition (SP)</i>	50%	95%	95%	95%	95%	0	100%

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Rental Payments

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes	2006 Budget Request	Change from 2005
Rental Payments	68,899	71,368	+1,509	-1,471	71,406	+38
FTE	1	1	0	0	1	0
Total Requirements \$000	68,899	71,368	+1,509	-1,471	71,406	+38
FTE	1	1	0	0	1	0

2006 Program Overview

The 2006 budget request for the Rental Payments Program is \$71,406,000.

The Rental Payments component of the Facilities Activity funds payments to General Services Administration (GSA) and other Federal sources, private lessors, and cooperators for space occupied by the USGS nationwide. This component funds 72 percent of the appropriated portion of the rental payments. Remaining costs are funded from reimbursable funding and USGS programs. Although the USGS has unique facility requirements necessary to support its science, it relies heavily on GSA to meet these needs. GSA has been an active partner in providing modern laboratory and other support space, which are key to the efficient and effective performance of USGS research and analysis on a host of critical environmental, natural resources, and hazards concerns. Approximately 90 percent of USGS rent costs are for space holdings provided through GSA, 6 percent for cooperative space arrangements, and the remaining rent costs are for other Federal agencies and private lessors. This program addresses the DOI Serving Communities strategic goal of advancing knowledge through scientific leadership and informing decisions through the application of science.

Effective FY 2005, the Office of Management and Budget (OMB) and the Department of Homeland Security (DHS) agreed that basic building specific security charges would be separate from the GSA monthly rent bill although USGS will still fund out of the Rental Payment component.

FY 2005 Planned Program Performance

The activities described below are counted under the mission goal "Serving Communities."

Facility Planning and Management. A contract was awarded to produce a bureau Strategic Facilities Master Plan (SFMP). The SFMP will focus on improving the decisionmaking process for facilities investments, identifying cost control opportunities, and strengthen the USGS budgeting process. In particular, the contractor will:

- Determine the adequacy of USGS facilities, individually and in the aggregate, in meeting USGS current and planned mission needs,
- Review the current mix of facilities sources (e.g., owned, rented, and cooperator space) to determine if the mix is balanced properly to meet USGS science needs,

Rental Payments

- Recommend mechanisms for improving the integration of science/facilities planning,
- Recommend performance metrics and tracking processes for use in measuring the effectiveness, economy, and efficiency of USGS facilities and supporting programs,
- Develop a business case model for the USGS to apply to decisions about facilities investments, and
- Apply the business case model to identify priority opportunities for reducing current USGS facilities costs with due consideration of science program impact.

John W. Powell Federal Building Renovations. Phase B of the laboratory renovation project is in the final stages of completion. Moving into the new space began in November 2004. The new laboratories are reconfigured using a modular concept to standardize the layouts, incorporate adequate fume removal, hazardous material storage, and proper exiting from high hazardous materials and create hazard zones and secondary exits within the laboratories. The final phase, which is Phase C, is scheduled to end October 8, 2005. The total dollar amount of the project is estimated to be \$35 million.

The GSA is in the design phase of renovating the John W. Powell Federal Building Cafeteria Serving Area. This \$1.5-million project will address accessibility as well as environmental compliance and efficiency upgrades. Construction is tentatively scheduled to begin in February 2005.

Space Management. The USGS has completed its initial implementation of the Aperture Software Program at the John W. Powell Federal Building to aid in the management of space allocation, design, and facilities planning. The software will be purchased and implemented at the USGS Denver, CO, and Menlo Park, CA, sites, and will continue to be reviewed for potential space management capabilities bureauwide. In addition, the software will be Web-based and housed on the USGS Headquarters servers accessible to all regions.

2004 Program Performance Accomplishments

The activities described below are counted under the mission goal "Serving Communities."

John W. Powell Federal Building Renovations

Replace Underground Steam and Condensate Line — This General Services Administration project provided for the replacement of underground steam and condensate return piping routing between the John W. Powell Federal Building and the Power Plant (building E). This \$1.5-million project was a critical need necessary to maintain indoor air at acceptable conditions for employee comfort and critical laboratory operations as well domestic hot-water and cafeteria operations.

Refurbished Power Plant Cooling Towers — This \$269,000-project funded with monies delegated from the GSA provided for the replacement of media within the four power plant cooling towers. This project was needed to maintain chilled water production within the power plant which is used to maintain indoor air at acceptable temperatures.

Plate Frame Heat Exchanger — This \$52,000-project funded with monies delegated from the GSA provided for the installation of a Plate Frame Heat-Exchanger installed in the Power Plant, Building E. This heat-exchanger uses ambient temperatures during the winter months to maintain chilled water production eliminating our need for mechanical cooling to meet our heating season cooling loads.

Use of the USGS Investment Review Board (IRB)

The USGS chartered an Investment Review Board to review major information technology investments. The IRB is chaired by the Deputy Director and is composed of senior managers, including a science discipline Associate Director, a Regional Director, the Geographic Information Officer, Budget Officer, and Chief Financial Officer. It meets quarterly. USGS has now expanded the role of the IRB to include facility investments to ensure that costs are contained and long-term space commitments are justified. In addition to proposed construction investments with a life cycle cost of \$2 million or more, the Board will review all space transactions (occupancy agreements, leases, etc.) with a life cycle cost of \$5 million or more. Regional boards will review transactions below this threshold. Business case analysis will be the bureau's primary review mechanism.

Justification of 2006 Program Changes

	2006 Budget Request	Program Changes (+/-) ^{1/}
Rental Payments (\$000)	\$71,406	-\$1,471
FTE	1	0

^{1/} "Program Change(s)" do not reflect FY 2006 adjustments for uncontrollable costs.

The FY 2006 President's budget request for the Rental Payments is \$71,406,000 and 1 FTE, a net program increase of +\$38,000 (includes adjustments for uncontrollable costs) and 0 FTE from the 2005 enacted level.

Rental Payments (-\$1,471,000) — The FY 2006 President's budget request for the USGS includes \$1,471,000 in space cost reduction. The proposed decrease supports the Department's efforts to reduce space costs across the bureaus through consolidations and increased management efforts. The reduction of the Mineral Resources Program includes a reduction of 240 FTE, and with the elimination of this many positions, the USGS will close selected offices in Spokane, WA; Reno, NV; Seattle, WA; Mounds View, MN; and Reston, VA.

In addition to the reduction in rental payments described above, the USGS is also undertaking facilities management actions intended to result in space cost savings over the long term. The USGS is reducing space utilization in several locations through consolidations of existing facilities and closure of unneeded space. Additionally, the USGS expects that its contract for a Strategic Facilities Master Plan and the assignment to the Investment Review Board of the review of all space-related actions, including lease renewals, will generate additional opportunities for reducing USGS space requirements over time. The USGS expects that actions taken during FY 2005 and FY 2006 will generate savings in FY 2006 from reduced space costs, with more significant savings beginning in FY 2007. Between program reductions and management actions regarding space management, the USGS expects to reduce space costs in FY 2006 by \$1,471,000.

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Operations and Maintenance

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes	2006 Budget Request	Change from 2005
Operations and Maintenance	19,959	19,820	+77	0	19,897	+77
FTE	57	57	0	0	57	0
Total Requirements \$000	19,959	19,820	+77	0	19,897	+77
FTE	57	57	0	0	57	0

2006 Program Overview

The FY 2006 budget request for the Operations and Maintenance Program is \$19,897,000.

The Facilities Operations and Maintenance subactivity, funds the routine, daily work necessary for the basic operation and upkeep of USGS-owned facilities to ensure that facilities are in compliance with Federal, State, and local standards and to ensure that facilities remain safe for USGS employees working at the facilities, as well as partners and customers visiting the facilities. This subactivity funds the operations and maintenance costs associated with appropriated work. The cost related to reimbursable activities is recovered from reimbursable customers and a small portion is paid by USGS programs. Operations and maintenance functions include ongoing facility support that sustains day-to-day USGS scientific activities at 34 owned installations ranging from major science centers with complex facilities such as laboratories and chemical storage buildings to smaller facilities such as research stations, research vessels, geomagnetic and seismological observatories, and warehouses.

Facilities Operations and Maintenance addresses the DOI Serving Communities strategic goal of “protect lives, resources, and property.” Key indications of USGS performance are reflected in the end outcome measure for Homeland Security: Facility Risk Reduction (percent of DOI facilities and designated critical assets meet national physical security guidelines). To clearly measure progress in achieving the intermediate outcome of improving public safety and security and protecting public resources from damage, the USGS tracks intermediate outcomes for Homeland Security (percent of facilities with security surveys) and Facilities Condition (facilities in fair or better condition as measured by the Facilities Condition Index).

This subactivity also provides routine operation and maintenance of large vessels. Large research vessels have characteristics, costs, and operations and maintenance features that coincide with those of USGS facilities. These vessels are mobile installations, meeting the criteria for the Comprehensive Condition Assessment. Vessels must exceed 45 feet in length and perform overnight field research to be classified as facilities. There are currently nine large vessels that support biology research, water resources investigations, and marine geology research; six on the Great Lakes and two in California and one in Alaska.

Operations of facilities include activities related to costs such as utilities for owned facilities, as well as all utility costs not included in rent:

Operations and Maintenance

- Electricity, water, and sewage,
- Fuel: gasoline, propane (vehicles, vessels, and heating), natural gas, diesel, and oil (heating),
- Janitorial services: window cleaning and carpet cleaning,
- Upkeep of grounds: grass mowing, snowplowing, and grounds irrigation,
- Waste management/disposal: refuse collection and sewage effluent pumping,
- Vehicles: tractors and trucks solely operated in direct support of operating the facility (includes rented vehicles, vehicles and owned and leased from GSA),
- Vessels: safe and effective operations and maintenance, apply upkeep standards necessary to realize the anticipated useful life of the fixed asset, provide for salaries and benefits of marine professionals operating the vessel, fuel, docking fees, inspections, minor repairs, cyclic maintenance, and at least one vessel haulout a year, and
- Annual certification for facility systems, such as: fire systems, fire extinguishers, back flow preventers, and fume hoods.

Maintenance of facilities involves the upkeep of constructed USGS-owned facilities and structures and capitalized equipment necessary to maintain the useful life of the asset, including preventive maintenance; cyclic maintenance; repairs; rehabilitation; replacement of parts, components, or items of equipment associated with the facility; adjustment, lubrication, and cleaning (non-janitorial) of equipment associated with the facility; periodic inspection; painting; re-roofing; resurfacing; special safety inspections and other actions to assure continuing service and to prevent breakdown; scheduled servicing (such as heating, ventilation, and air conditioning equipment); and maintenance for owned facility-related vehicles.

Salary costs associated with staff that performs operations and maintenance activities are included. USGS staff that perform operations and maintenance are located at the facility they are operating and maintaining. These are primarily USGS-owned facilities, but also include GSA-owned facilities for which GSA has delegated operations and maintenance authority to the USGS (e.g., the National Center) and facilities owned by other agencies or organizations for which the USGS has agreed to cover operations and maintenance expenses in exchange for use of the space (e.g., Patuxent). Staff at these facilities are responsible for the day-to-day operations of the facility and for maintaining it in operating order. This includes such operations as janitorial services, landscaping, snow removal, operation of the heating and air conditioning system, plumbing, electrical, elevator operations, fire alarm systems, fume hood operations, storage, and removal of hazardous materials, etc. Depending upon the location, some of these functions are carried out by government employees and some via contract.

Staff associated with operations and maintenance program management at the regions and headquarters are funded by the Science Support Activity. Bureau policy for facilities operation and maintenance is established at headquarters. Staff at the regional and headquarters level who perform operations and maintenance program management establish standards for operations and maintenance, develop and implement plans for bureauwide systems (e.g., MAXIMO), develop deferred maintenance plans, develop contracts for Operation and

Maintenance services, formulate regional and bureauwide Operation and Maintenance budgets, respond to departmental and Office of Management and Budget reporting requirements, etc.

Effective FY 2005, the Office of Management and Budget (OMB) and the Department of Homeland Security (DHS) agreed that basic and building specific security charges would be separate from the General Services Administration (GSA) monthly rent bill, rates, and collections go directly to Homeland Security.

2004 Program Performance Accomplishments

Unless otherwise noted, the FY 2004 program performance accomplishments listed below demonstrate the utility of facilities condition, facilities management, and deferred maintenance and capital improvements counted under the output measures for "buildings (administrative, employee housing) are in fair to good condition as measured by the Facilities Condition Index," "number of bureau condition assessments in progress or completed (within a 5-year cycle)," "number of deferred maintenance and capital improvements (cumulative)," and "percentage of facilities that have a calculated Facilities Condition."

Facilities Maintenance Management System — The Facilities Maintenance Management System (FMMS) implementation included completing building and equipment inventory at 13 owned USGS installations and the Headquarters facility. Through the inventory process, USGS identified over 22,000 pieces of equipment. The identification included using a standard naming convention, a standard template, and bar coding. In addition, most equipment was linked to a standard job plan and building system. This data has been captured in one of the FMMS environments and will be used as the foundation for a Preventative Maintenance program and tracking work orders for day-to-day operations. The FMMS utilized a commercial off-the-shelf software common to other DOI bureaus and fully supports the key business principles guiding Interior's operations: customer value, accountability, modernization, and integration. Through the use of standard business practices, standard nomenclature, specification templates, and building system definitions, USGS will be able to report our operations and maintenance consistently across the bureau. Once FMMS is implemented at the initial 14 installations, it will continue to expand to the remainder of the USGS-owned installations, including vessels. In addition to expanding to new sites, additional functionality will be added as funding permits.

2005 Program Performance Accomplishments

Unless otherwise noted, the planned program performance for FY 2005 listed below demonstrate the utility of facilities condition, facilities management, and deferred maintenance and capital improvements counted under the output measures for "buildings (administrative, employee housing) are in fair to good condition as measured by the Facilities Condition Index," "number of bureau condition assessments in progress or completed (within a 5-year cycle)," "number of deferred maintenance and capital improvements (cumulative)," and "percentage of facilities that have a calculated Facilities Condition."

Facilities Maintenance Management System — USGS plans to upgrade our Facility Maintenance Management System (FMMS) to MAXIMO v5.2 prior to deploying the system. Deployment will include several modules within the application (Equipment, Locations, Work Order Tracking, Failure Codes, Job Plan and Preventive Maintenance) as well as handheld technology. The handheld technology will be used for work order tracking in addition to the main FMMS application.

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Deferred Maintenance and Capital Improvement

Subactivity	2004 Actual	2005 Enacted	Uncontroll. & Related Changes	Program Changes	2006 Budget Request	Change from 2005
Deferred Maintenance & Capital Improvement	4,131	3,423	0	0	3,423	0
FTE	2	2	0	0	2	0
Total Requirements \$000	4,131	3,423	0	0	3,423	0
FTE	2	2	0	0	2	0

2006 Program Overview

The FY 2006 budget request for the Deferred Maintenance and Capital Improvement Program is \$3,423,000.

The USGS is committed to improving the maintenance of existing facilities and equipment to ensure the health and safety of the public and employees, protection of cultural and natural resources, and compliance with building codes and standards. This program addresses DOI's Serving Communities strategic goals of "advance knowledge through scientific leadership" and "inform decisions through the application of science." To clearly measure progress in achieving the intermediate outcome of improving information base, information management, and technical assistance, the USGS tracks intermediate outcomes for Facilities Condition (facilities are in fair to good condition as measured by the Facilities Condition Index) and outputs for number of bureau condition assessments in progress or completed, and number of deferred maintenance projects and capital improvements.

The USGS backlog of deferred maintenance is approximately \$41 million. The USGS addresses the most critical maintenance and capital improvement needs on the basis of Department of the Interior guidelines. The FY 2006 budget request includes a Maintenance and Construction Plan for FY 2006–10 that lists the priority USGS deferred maintenance and capital improvement projects. This plan is subject to adjustments in outyears due to funding changes and revised priorities based on comprehensive facility condition assessments, annual condition surveys, and emergency needs.

For facilities, projects may reflect the results of comprehensive evaluations conducted by independent architect/engineer firms. These installationwide, building-specific assessments are the linchpin of the DOI program to establish core data on the condition of the Department's constructed assets.

The USGS has stewardship responsibility for unique mission equipment assets such as hazard-warning networks, river cableways, and streamgaging stations. They require effective maintenance and capital investments to preserve functionality. These projects are included under the Equipment Section of the 5-year Maintenance and Capital Improvement Plans and Health. Safety criteria are applied to determine priorities in the same manner as for facility assets.

Deferred Maintenance and Capital Improvement

For FY 2006, remediation of the most critical health, safety, and resource-protection deficiencies is again the focus of the priority facility projects. Of the \$3.48 million budget request for FY 2006, \$2.34 million is for facility projects, \$0.43 million is for equipment projects, and the remaining \$0.71 million is for condition assessments and implementation of the DOI standard facilities maintenance management system.

Facility and Equipment Projects for FY 2006

Eastern Region — Upgrade fire alarm system and replace transom glass with fire-proof glass material in maintenance research and development building at the Florida Integrated Science Center, fire suppression system re-design and correct fire deficiencies at the Fredericksburg Observatory, replace fume hood controls and exhaust fans at the S.O. Conte Anadromous Research Center, and install emergency and general alarms, internal communication and automatic identification systems, repair bulkhead, and replace HVAC at the Great Lakes Science Center.

Central Region — Replace biology west building (C-5) fume hood air delivery systems at the Columbia Environmental Research Center, replace biology east building (D-13) fume hood air delivery systems at the Columbia Environmental Research Center, replace pollution abatement building fume hood air systems at the Columbia Environmental Research Center, replace main building fume hood air systems at the Columbia Environmental Research Center, and replace analytical building fume hood air system at the Columbia Environmental Research Center.

Western Region — Install fire alarm systems, emergency lighting, and exit signs and an automatic fire sprinkler system at the Idaho District Office, correct fire-safety deficiencies at the Hawaii Volcano Observatory (HVO), replace building #3 fume hood air systems at the Idaho District Office, and fume hood replacement at the Columbia River Research Lab.

Headquarters — Correct fire-safety deficiencies at the Solid States Physics Lab.

Mission Critical Equipment — Replacement of outmoded earthquake data collection equipment in the Northern California Seismic Network and replacement or renovation of unsafe river cableways.

FY 2005 funded projects that are in design and construction phases will continue into FY 2006.

During FY 2006, funding is proposed to complete condition assessments for the identification of maintenance and capital improvement needs and to provide engineering services support for funded facility projects.

Facility Maintenance Management System — During FY 2006, the USGS will implement the Facility Maintenance Management System (FMMS) at five additional sites during FY 2006. Planning for these sites will begin in July 2005 with implementation occurring in FY 2006. Additional functionality within FMMS will be deployed that includes the ability to track and plan for Condition Assessments of USGS facilities.

2004 Program Performance Accomplishments

Unless otherwise noted, the FY 2004 program performance accomplishments listed below demonstrate the utility of facilities condition, facilities management, and deferred maintenance

Deferred Maintenance and Capital Improvement

and capital improvements counted under the output measures for "buildings (administrative, employee housing) are in fair to good condition as measured by the Facilities Condition Index," "number of bureau condition assessments in progress or completed (within a 5-year cycle)," "number of deferred maintenance and capital improvements (cumulative)," and "percentage of facilities that have a calculated Facilities Condition."

During FY 2004, the USGS reprogrammed \$530,000 from the Deferred Maintenance and Capital Improvement (DMCI) program to fund the Landsat 7 shortfall. The funds for this reprogramming came from two Western Region DMCI Projects: fume hood replacement at the Western Fisheries Research Center and roof replacement at the HVO.

Close to year's end, \$250,000 was returned to the DMCI program. This funding was reallocated to the fume hood replacement project at the Western Fisheries Research Center. The remaining funds required for this project, as well as for the HVO roof replacement, are provided in the FY 2005–06 DMCI allocation.

Since the program began in FY 2000, the number of projects reached 84, of which 36 have been completed using deferred maintenance funding, and other funding. Accomplishments during FY 2004 follow:

- Replacement of outmoded earthquake data collection equipment in the Northern California Seismic Network remained a priority. Investment in this project, which is a long-term effort to stem increased failure rates and assure adequate responses in emergency situations, was \$200,000. Additional investments totaling an estimated \$8.89 million are required to replace the balance of the network.
- Another bureau priority is the repair, renovation, and replacement of unsafe river cableways. With nearly \$1.38 million invested so far in this multiyear project, approximately \$2.44 million in additional investments are required.
- **Condition Assessments** — The condition assessments for eight of the nine USGS's largest research vessels, the Alaskan Gyre, Grayling, Kaho, Kiyi, Musky II, Polaris, Siscowet and Turning Tide were completed. The ninth vessel, the Sturgeon, was commissioned in the fourth quarter of FY 2004, and will have a condition assessment performed in FY 2005. A condition assessment was also completed at the Barrow Environmental Observatory in Alaska. The second round of condition assessments began at seven science installations in FY 2004. These initial condition reports will establish a baseline of the most critical maintenance deficiencies and help determine future priorities.
- **Facility Maintenance Management System** — The Facilities Maintenance Management System (FMMS) implementation included completing building and equipment inventory at 13 USGS-owned installations and the Headquarters facility. Through the inventory process, USGS identified over 22,000 pieces of equipment. The identification included using a standard naming convention, a standard template, and bar coding. In addition, most equipment was linked to a standard job plan and building system. These data have been captured in one of the FMMS environments and will be used as the foundation for a Preventative Maintenance program and tracking work orders for day-to-day operations. The FMMS utilized a commercial off-the-shelf software common to other DOI bureaus and fully supports the key business principles guiding Interior's operations: customer value, accountability, modernization, and integration.

Deferred Maintenance and Capital Improvement

Through the use of standard business practices, standard nomenclature, specification templates, and building system definitions, USGS will be able to report its operations and maintenance consistently across the bureau. Once FMMS is implemented at the initial 14 installations, it will continue to expand to the remainder of the USGS-owned installations, including vessels. In addition to expanding to new sites, additional functionality will be added as funding permits.

2005 Planned Program Performance

Unless otherwise noted, the planned program performance for FY 2005 listed below demonstrate the utility of facilities condition, facilities management, and deferred maintenance and capital improvements counted under the output measures for "buildings (administrative, employee housing) are in fair to good condition as measured by the Facilities Condition Index," "number of bureau condition assessments in progress or completed (within a 5-year cycle)," "number of deferred maintenance and capital improvements (cumulative)," and "percentage of facilities that have a calculated Facilities Condition."

Replacement or renovation of cableways at many of the 113 sites nationwide continues. Many cableways at these sites do not meet modern design and load-testing criteria to ensure the safe collection of essential scientific data. All 113 sites are scheduled for replacement or renovation.

The USGS will begin its second round of condition assessments for owned facilities. The cycle for completing all USGS condition assessments is 5 years. The Columbia Environmental Research Center, Northern Prairie Science Center, Woodworth Field Station, Northern Appalachian Research Laboratory, Upper Midwest Environmental Sciences Center, Reston Solid State Physics Lab, Boise District Office and the RV Sturgeon are scheduled to have condition assessments performed by FY 2005.

Northern California earthquake network analog and microwave stations that have exceeded their expected life and cannot be expected to operate continuously will be replaced to avoid failure during an emergency. These stations provide monitoring and (or) warnings for large metropolitan areas.

FY 2005 Deferred Maintenance and Construction Plan

FY 2006 Facility Projects

The following table lists, in priority order, the proposed projects to be addressed with FY 2006 funding in USGS:

<p>Idaho District Office</p> <p>\$27,000</p>	<p>Correct Fire-Safety Deficiencies — ID7000136, Bldg. #5 Electronic Shop has approximately 1,344 square feet in the main level with 560 square feet of storage loft for a total of 1,904. This building does not contain a fire management system including pull stations, audio-visual devices or a sprinkler system. GSA requires all occupied buildings to be equipped with automatic sprinkler systems. These deficiencies were identified in the facility condition assessment.</p>
<p>Hawaii Volcano Observatory</p> <p>\$116,000</p>	<p>Correct Fire-Safety Deficiencies — The current fire alarm system is in poor condition and it is not in compliance with NFPA 72, PBS-PQ 100.1, and ADA, (visual devices do not exist, existing system is obsolete, difficult to locate replacement parts) according to a Conditions Assessment and Building Engineering Report submitted May 16, 2003, by CTA Architects Engineers. The report recommends that the system must be replaced with an approved fire alarm system. The computer room at the HVO does not currently have an operational fire suppression/protection system. The Halon gas system in the room discharged a few years ago, but the National Park Service will not permit the system to be recharged with Halon. The computer room with a drop ceiling and raised floor require a NFPA 75 compliant system in order to protect the mission critical computer systems and servers.</p>
<p>Florida Integrated Science Center</p> <p>\$83,000</p>	<p>Correct Fire-Safety Deficiencies — Many of the existing components of the fire alarm for the main building are 18 years old and the smoke and duct detectors are failing, resulting in a large number of "false" alarms and subsequent unnecessary evacuations of the building. Replacement of existing 60 smoke detectors, pull stations, wiring, and possibly the control panel is necessary to correct this problem. Also, all points of egress require updating of signaling and lighting devices to meet life safety codes. In addition, install firewalls as identified in the condition assessment to meet fire codes and provide safety to persons in buildings. The transom glass will be replaced with code-compliant firewall materials.</p>
<p>Fredericksburg Observatory</p> <p>\$50,000</p>	<p>Correct Fire-Safety Deficiencies — The existing fire alarm and suppression systems do not function properly. The existing system is also not compliant with current building codes and standards. There are also other life safety deficiencies at this property. The project will include repair or replacement of the existing fire alarm and suppression systems in accordance with current building codes and standards, correcting egress deficiencies that include panic hardware, door replacement, and installation of exit signs and emergency lighting.</p>
<p>Solid States Physics Lab</p> <p>\$225,000</p>	<p>Correct Fire-Safety Deficiencies — The Solid State Physics Laboratory Buildings fire alarm system, fire sprinkler system fire wall separation and egress routes are deficient. The existing fire alarm system is approximately 30 years old. It currently functions but has had several failures in recent years. Repairs are difficult because parts are obsolete. This requires using parts not designed for the system, decreasing the reliability of the system. In addition, the fire alarm system does not meet current life safety code requirements. Sprinkler coverage in corridors and lobbies does not exist in most locations and existing sprinklers do not provide proper coverage. Firewall separation at the lobby, stairwell, and mechanical spaces is insufficient. The first floor corridor does not provide a second exit route creating a dead end corridor. These deficiencies are identified in the Building Assessment Report prepared by Network Professional Engineering Inc., dated October 2001.</p>
<p>S. O. Conte Anadromous Research Center</p> <p>\$128,000</p>	<p>Replace Fume Hood System — Existing system cannot be adequately controlled to ensure operator safety or maintain negative air pressure in the lab. Replace entire system, including hood controllers and six air valves, exhaust fan on the roof, 150 feet of acid-resistant ductwork, and the pressure control and monitoring system. A recent Condition Assessment recommended priority action to remediate this critical health & safety deficiency.</p>

Deferred Maintenance and Capital Improvement

<p>Columbia Environmental Research Center</p> <p>\$35,000</p>	<p>Replace Biology West Building (C-5) Fume Hood Air Systems — Labs containing fume hoods cannot maintain or verify negative pressure with regard to adjacent spaces. The air systems for these hoods should be modified to correlate with the room air delivery systems to maintain a negative pressure within the fume hood and laboratory. Fans and exhaust system are no longer able to sustain proper CFM to exhaust vapors and odors outside of building.</p>
<p>Columbia Environmental Research Center</p> <p>\$131,000</p>	<p>Replace Biology East Building (D-13) Fume Hood Air Systems — Labs containing fume hoods cannot maintain or verify negative pressure with regard to adjacent spaces. The air systems for these hoods should be modified to correlate with the room air delivery systems to maintain a negative pressure within the fume hood and laboratory. Fans and exhaust system are no longer able to sustain proper CFM to exhaust vapors and odors outside of building.</p>
<p>Columbia Environmental Research Center</p> <p>\$209,000</p>	<p>Replace Pollution Abatement Building Fume Hood Air Systems — Labs containing fume hoods cannot maintain or verify negative pressure with regard to adjacent spaces. The air systems for these hoods should be modified to correlate with the room air delivery systems to maintain a negative pressure within the fume hood and laboratory. Fans and exhaust system are no longer able to sustain proper CFM to exhaust vapors and odors outside of building.</p>
<p>Columbia Environmental Research Center</p> <p>\$682,000</p>	<p>Replace Main Building Fume Hood Air Systems — Labs containing fume hoods cannot maintain or verify negative pressure with regard to adjacent spaces. The air systems for these hoods should be modified to correlate with the room air delivery systems to maintain a negative pressure within the fume hood and laboratory. Fans and exhaust system are no longer able to sustain proper CFM to exhaust vapors and odors outside of building.</p>
<p>Idaho District Office</p> <p>\$33,000</p>	<p>Replace Fume Hood System — Laboratory spaces must be kept at a negative pressure with regard to the adjacent spaces. Current fume hood cannot maintain or verify negative pressure with regard to adjacent spaces. The air system for this hood should be replaced with a modern fume hood and accessories to monitor velocity and pressure. The deficiency was identified in the condition assessment of December 2000.</p>
<p>Columbia Environmental Research Center</p> <p>\$146,000</p>	<p>Replace Analytical Laboratory Building Fume Hood Air System — Labs containing fume hoods cannot maintain or verify negative pressure with regard to adjacent spaces. The air systems for these hoods should be modified to correlate with the room air delivery systems to maintain a negative pressure within the fume hood and laboratory. Fans and exhaust system are no longer able to sustain proper CFM to exhaust vapors and odors outside of building.</p>
<p>Great Lakes Science Center</p> <p>\$463,000</p>	<p>Correct Fire-Safety Deficiencies — Condition assessment revealed fire-safety code violations at the research laboratory, which houses all of the Center's science operations. Install panic hardware, add fire-rated corridor to library, reverse and (or) replace incorrectly swinging doors, add required second egress to labs, upgrade ceilings to proper fire ratings, and install needed fire inclination in wall penetrations. Replace frames that comply with Ann Arbor building and fire codes. If a fire were to break out, staff may not have enough time to evacuate. This project combines remediation of the most critical fire-safety problems from five related projects, which have been superseded.</p>

Deferred Maintenance and Capital Improvement

FY 2006 Equipment Projects

<p>600 sites nationwide</p> <p>\$234,000</p>	<p>Repair or Replace Cablecars — Revised load tests reveal that the 600 cablecars in active use nationwide could fail under adverse field conditions such as snagged cables during flood conditions. Depending on their design and condition, remediation will require partial or total replacement of the cablecars. Interim actions have begun where risk is the highest, but all 600 cars will require either retrofit or replacement. The total needed for this project is \$530,000; of this amount, \$300,000 was funded in prior years.</p>
<p>Northern California Seismic Network</p> <p>\$200,000</p>	<p>Replace Network Analog and Microwave Stations — Replace earthquake network stations that provide seismic monitoring and (or) warning for large metropolitan areas. The requested funds would be used to replace existing equipment that has exceeded its expected life and that cannot be expected to operate continuously without increased failure rates. The current equipment, which supports the network, may fail during an emergency, which would limit or possibly prevent adequate response to other Federal agencies, local governments, the private sector, and public needs. The total needed for this project is \$10.0 million; of this amount, \$1.157 million was funded in prior years, with the balance to be funded in the outyears.</p>
<p>Condition Assessments</p> <p>\$210,000</p>	<p>Condition Assessments/Engineering Support — Funding is proposed to complete condition assessments for the identification of maintenance and capital improvement needs and to provide engineering services support for funded facility projects.</p>
<p>Maintenance Management System</p> <p>\$500,000</p>	<p>Maintenance Management System — Funding is proposed to implement and maintain a maintenance management system that meets bureau reporting and oversight requirements.</p>

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Summary of Requirements by Object Class

Summary of Requirements by Object Class

(dollars in millions)

Appropriation: Surveys, Investigations, and Research		2005 Estimate		Uncontrollable & Related Changes		Program Changes		2006 Request	
		FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
Object Class									
	Personnel compensation								
11.1	Full-time permanent		415		9		-16		408
11.3	Other than full-time permanent		30		1		-2		29
11.5	Other personnel compensation		9		0		0		9
	Total personnel compensation	6,007	454	0	10	-212	-18	5,795	446
12.1	Civilian personnel benefits		113		6		-5		114
13.0	Benefits for former personnel		1		0		0		1
21.0	Travel and transportation of persons		24		0		-2		22
22.0	Transportation of things		5		0		0		5
23.1	Rental payment to GSA		63		2		-1		64
23.2	Rental payments to others		4		0		0		4
23.3	Comm., utilities and misc. charges		19		0		0		19
24.0	Printing and reproduction		2		0		0		2
25.1	Advisory and assistance services		5		0		-1		4
25.2	Other services		85		-1		16		100
25.3	Other purchases of goods and services from Government accounts		21		0		-2		19
25.4	Operation and maintenance of facilities		5		0		0		5
25.7	Operation and maintenance of equipment		10		0		0		10
26.0	Supplies and materials		24		0		-1		23
31.0	Equipment		29		0		-1		28
32.0	Land and structures		1		0		0		1
41.0	Grants, subsidies, and contributions		70		0		-4		66
	Total requirements		935*		17		-19		933

Note: This information is displayed in budget authority (not obligations) by object class.

* Does not include the FY 2005 Hurricane Supplemental funding of \$1 million.

Surveys, Investigations, and Research – Exhibits

Summary of Requirements by Object Class

(dollars in millions)

Appropriation: Surveys, Investigations, and Research

Reimbursable Obligations	2005 Estimate		2006 Request		Increase or Decrease	
	FTE	Amount	FTE	Amount	FTE	Amount
Personnel compensation						
11.1 Full-time permanent		144		153		9
11.3 Other than full-time permanent		17		18		1
11.5 Other personnel compensation		4		4		0
Total personnel compensation	2,736	165	2,821	175	85	10
12.1 Civilian personnel benefits		39		42		3
21.0 Travel and transportation of persons		9		9		0
22.0 Transportation of things		4		4		0
23.1 Rental payments to GSA		17		17		0
23.2 Rental payments to others		2		2		0
23.3 Communications, utilities and miscellaneous charges		6		6		0
25.1 Advisory and assistance services		4		4		0
25.2 Other services		53		47		-6
25.3 Other purchases of goods and services from Government accounts		41		36		-5
25.4 Operation and maintenance of facilities		2		2		0
25.7 Operation and maintenance of equipment		3		3		0
26.0 Supplies and materials		11		11		0
31.0 Equipment		13		13		0
41.0 Grants, subsidies, and contributions		30		24		-6
Total requirements		399		395		-4

United States Geological Survey

Federal Funds

General and special funds:

SURVEYS, INVESTIGATIONS, AND RESEARCH

Program and Financing

(dollars in millions)

Identification Code		2004 Actual	2005 Estimate	2006 Estimate
14-0804-0-1-306				
Obligations by program activity:				
Direct program:				
00.01	Mapping, Remote Sensing, and Geographic Investigations	130	119	139
00.02	Geologic Hazards, Resources, and Processes	235	233	208
00.03	Water Resources Investigations	215	212	204
00.04	Biological Research	185	170	173
00.05	Enterprise Information	0	44	48
00.06	Science Support	92	66	66
00.07	Facilities	93	95	95
09.01	Reimbursable program	404	399	395
10.00	Total new obligations	1,354	1,338	1,328
Budgetary resources available for obligation:				
21.40	Unobligated balance carried forward, start of year	34	21	18
22.00	New budget authority (gross)	1,340	1,335	1,329
22.10	Resources available from recoveries of prior year obligations	2	0	0
23.90	Total budgetary resources available for obligation	1,376	1,356	1,347
23.95	Total new obligations	-1,354	-1,338	-1,328
23.98	Unobligated balance expiring or withdrawn	-1	0	0
24.40	Unobligated balance carried forward, end of year	21	18	19
New budget authority (gross), detail:				
Discretionary:				
40.00	Appropriation	950	948	934
40.00	Appropriation – Hurricane supplemental	0	1	0
40.35	Appropriation permanently reduced	-12	-13	0
43.00	Appropriation (total discretionary)	938	936	934
Spending authority from offsetting collections:				
Discretionary:				
68.00	Offsetting collections (cash)	275	399	395
68.10	Change in uncollected customer payments from Federal sources (unexpired)	127	0	0
68.90	Spending authority from offsetting collections (total discretionary)	402	399	395
70.00	Total new budget authority (gross)	1,340	1,335	1,329

Surveys, Investigations, and Research - Exhibits

United States Geological Survey

Federal Funds

General and special funds:

SURVEYS, INVESTIGATIONS, AND RESEARCH

Program and Financing

(dollars in millions)

Identification Code		2004	2005	2006
14-0804-0-1-306		Actual	Estimate	Estimate
	Change in obligated balances:			
72.40	Obligated balance, start of year	28	91	169
73.10	Total new obligations	1,354	1,338	1,328
73.20	Total outlays (gross)	-1,340	-1,260	-1,317
73.40	Adjustments in expired accounts (net)	4	0	0
73.45	Recoveries of prior year obligations	-2	0	0
74.00	Change in uncollected customer payments from Federal sources (unexpired)	-127	0	0
74.10	Change in uncollected customer payments from Federal Sources (expired)	176	0	0
74.40	Obligated balance, end of year	91	169	180
	Outlays (gross), detail:			
86.90	Outlays from new discretionary authority	1,107	1,175	1,170
86.93	Outlays from discretionary balances	233	85	147
87.00	Total outlays (gross)	1,340	1,260	1,317
	Offsets:			
	Against gross budget authority and outlays:			
	Offsetting collections (cash) from:			
88.00	Federal sources	-246	-223	-221
88.40	Non-Federal sources	-191	-176	-174
88.90	Total, offsetting collections (cash)	-437	-399	-395
	Against gross budget authority only:			
88.95	Change in uncollected customer payments from Federal sources (unexpired)	-127	0	0
88.96	Portion of offsetting collections (cash) credited to expired account	+162	0	0
	Net budget authority and outlays:			
89.00	Budget authority	938	936	934
90.00	Outlays	903	861	922

Object Classification

(dollars in millions)

Identification Code	2004	2005	2006
14-0804-0-1-306	Actual	Estimate	Estimate
Direct obligations:			
Personnel compensation:			
11.1	410	415	408
11.3	30	30	29
11.5	9	9	9
11.9	449	454	446
12.1	109	113	114
13.0	4	1	1
21.0	24	24	22
22.0	5	5	5
23.1	60	63	64
23.2	4	4	4
23.3	19	19	19
24.0	2	2	2
25.1	6	5	4
25.2	103	89	100
25.3	22	21	19
25.4	5	5	5
25.7	10	10	10
26.0	24	24	23
31.0	30	29	28
32.0	1	1	1
41.0	76	70	66
44.0	-3	0	0
99.0	950	939	933

Object Classification

(dollars in millions)

Identification Code		2004	2005	2006
14-0804-0-1-306		Actual	Estimate	Estimate
	Reimbursable obligations:			
	Personnel compensation:			
11.1	Full-time permanent	135	144	153
11.3	Other than full-time permanent	16	17	18
11.5	Other personnel compensation	3	4	4
11.9	Total personnel compensation	154	165	175
12.1	Civilian personnel benefits	37	39	42
21.0	Travel and transportation of persons	10	9	9
22.0	Transportation of things	4	4	4
23.1	Rental payments to GSA	17	17	17
23.2	Rental payments to others	2	2	2
23.3	Comm., utilities, and miscellaneous charges	6	6	6
25.1	Advisory and assistance services	5	4	4
25.2	Other services	61	53	47
25.3	Other purchases of goods and services from Government accounts	44	41	36
25.4	Operation and maintenance of facilities	2	2	2
25.7	Operation and maintenance of equipment	3	3	3
26.0	Supplies and materials	12	11	11
31.0	Equipment	14	13	13
41.0	Grants, subsidies, and contributions	34	30	24
44.0	Refunds	-1	0	0
99.0	Reimbursable obligations	404	399	395
99.9	Total new obligations	1,354	1,338	1,328

Personnel Summary

Identification Code		2004 Actual	2005 Estimate	2006 Estimate
14-0804-0-1-306				
	Direct:			
1001	Total compensable work years: Full-time equivalent employment	6,144	6,007	5,795
	Reimbursable:			
2001	Total compensable work years: Full-time equivalent employment	2,653	2,736	2,821

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Working Capital Fund Overview

The USGS Working Capital Fund (WCF) was established to allow for the efficient financial management of the components listed below. The WCF was made available for expenses necessary for furnishing materials, supplies, equipment, work, and services in support of USGS programs, and as authorized by law, to agencies of the Federal Government and others. The WCF consists of both investment components and fee-for-service components, as follows:

Investment Components

- **Telecommunications Investment** — This component is used for telecommunication hardware, software, facilities, and services. Examples include replacement or expansion of automatic exchange systems and computerized network equipment such as switches, routers, and monitoring systems.
- **Equipment Investment** — This component is used for the acquisition, replacement, and expansion of equipment for USGS programs. Equipment may include, but is not limited to, hydrologic, geologic, and cartographic instruments; laboratory equipment; and computer hardware and software.
- **Facilities Investment** — This component supports facility and space management investment expenses for USGS real property, including owned and leased space. Authorized investment expenses include nonrecurring and emergency repair, relocation of a facility, and facility modernization. The component does not include annual expenses such as rent, day-to-day operating expenses, recurring maintenance, or utilities. The investment component is not used to fund construction of buildings.
- **Publications Investment** — This component is used for the preparation and production of technical publications reporting on the results of scientific data and research. Research projects typically are 3 to 5 years in duration, and planning the medium in which to report results occurs over the life of the project. The Publications Investment Component provides a mechanism for establishing an efficient, effective, and economical means of funding publications costs over the long term.

Fee-for-Service Components

- **National Water Quality Laboratory (NWQL)** — The NWQL is a Fee-for-Service component, conducting chemical analysis of water, sediments, and aquatic tissue for all USGS water district offices and other customers, including other USGS disciplines, DOI bureaus, and Government agencies. The NWQL also does biological classification for these customers. NWQL analyses services are provided on a reimbursable basis, with the price of services calculated to cover direct and indirect costs.
- **USGS Hydrologic Instrumentation Facility (HIF)** — The HIF provides hydrologic instrumentation on a fee-for-service basis. The facility provides its customers with hydrologic instruments that can be rented or purchased, maintains a technical expertise on instrumentation, and tests and evaluates instruments as they become available in the marketplace.
- **Publications** — This component provides a fee-for-service mechanism for funding the production of publications, which often spans fiscal years. It is used by internal and

Working Capital Fund

external customers to pay costs for publishing technical and scientific reports, as well as general interest and other publications deemed to be for the public good.

- **Bureau Laboratories** — This component currently includes three laboratories. There are two Eastern Region Water Research Laboratories that perform gaseous dissolved chlorofluorocarbon measurements and isotope-ratio measurements of water, sediments, rocks, and gases for all WRD district offices, other USGS disciplines, and other Federal agencies. The Vancouver Project Office/Cascades Volcano Observatory Sediment Laboratory analyzes suspended sediment, bedload, and bed material collected as part of routine surveillance and special project sampling in the Cascades, routinely processes sediment samples for several WRD offices, and provides analyses for other volcano observatories in Alaska and Hawaii, as well as international projects.
- **National Training Center** — This component conducts fee-for-service USGS training programs. These programs include, but are not limited to, specialized training for USGS employees, cooperators, and international participants in many facets of hydrology, hydraulics, and water resources investigations, as well as computer applications, management seminars, and various workshops.
- **Drilling** — This component provides drilling services to conduct exploratory drilling for obtaining geologic samples and cores in difficult hydrogeologic environments and the emplacement of sampling devices and sub-surface sensors for hydrologic investigations.
- **GSA Delegated Buildings** — This component is used to manage funds received under the delegated authority for the J.W. Powell Building and Advanced Systems Center in Reston, VA, as provided by section 205(d) of the Federal Property and Administrative Services Act of 1949, as amended. Delegated functions include building operations, maintenance, recurring repairs, minor alterations, historic preservation, concessions, and energy management. Because of the size of the Reston buildings and the need to expend the facility funds in a manner corresponding to GSA's no-year funding (Federal Buildings Fund) mechanisms and the GSA National Capital Region long-range capital improvement plan, no-year funding is a prerequisite to administering the delegation. Public Law 104–208, Section 611, provides that, for the fiscal year ending September 30, 1997, and thereafter, any department or agency that has delegated authority shall retain that portion of the GSA rental payment available for operation, maintenance, and repair of the building, and the funds shall remain available until expended. This WCF component was established to provide us with this no-year flexibility.

The WCF Investment Components provide a mechanism to assist USGS managers in planning for and acquiring goods and services that are too costly to acquire in a single fiscal year or that, due to the nature of services provided, must operate in a multi- as opposed to a single-year basis of funding. Investments are supported by documented investment plans that include estimated acquisition/replacement costs, a schedule of deposits, and approval of the plans, deposits and expenditures by designated USGS officials. WCF Fee-for-Service Components provide a continuous cycle of client services for fees established in a rate-setting process and, in some cases, with funding provided by appropriated funds. Fees are predicated upon both direct and indirect costs associated with providing the services, including amortization of equipment required to provide the services.

Appropriation Language and Citations

Permanent authority:

1. Provided further, That in fiscal year 1986, and thereafter, all amortization fees resulting from the Geological Survey providing telecommunications services shall be deposited in a special fund to be established on the books of the Treasury and be immediately available for payment of replacement or expansion of telecommunications services, to remain available until expended.
 - **43 U.S.C.50a** This authority established the Telecommunications Amortization Fund, which was displayed as part of the Surveys, Investigations and Research appropriation from FY 1986 through FY 1990. Beginning in FY 1991, the Telecommunications Amortization Fund was merged into the Working Capital Fund (WCF) described in the next citation.
2. There is hereby established in the Treasury of the United States a working capital fund to assist in the management of certain support activities of the United States Geological Survey (hereafter referred to as the "Survey"), Department of the Interior. The fund shall be available on and after November 5, 1990, without fiscal year limitation for expenses necessary for furnishing materials, supplies, equipment, work, facilities, and services in support of Survey programs, and, as authorized by law, to agencies of the Federal Government and others. Such expenses may include laboratory modernization and equipment replacement, computer operations, maintenance, and telecommunications services; requirements definition, systems analysis, and design services; acquisition or development of software; systems support services such as implementation assistance, training, and maintenance; acquisition and replacement of computer, publications and scientific instrumentation, telecommunications, and related automatic data processing equipment; and, such other activities as may be approved by the Secretary of the Interior.

There are authorized to be transferred to the fund, at fair and reasonable values at the time of transfer, inventories, equipment, receivables, and other assets, less liabilities, related to the functions to be financed by the fund as determined by the Secretary of the Interior. Provided, That the fund shall be credited with appropriations and other funds of the Survey, and other agencies of the Department of the Interior, other Federal agencies, and other sources, for providing materials, supplies, equipment, work, and other services as authorized by law and such payments may be made in advance or upon performance: Provided further, That charges to users will be at rates approximately equal to the costs of furnishing the materials, supplies, equipment, facilities, and services, including such items as depreciation of equipment and facilities, and accrued annual leave: Provided further, That all existing balances as of November 5, 1990, from amortization fees resulting from the Survey providing telecommunications services and deposited in a special fund established on the books of the Treasury and available for payment of replacement or expansion of telecommunications services as authorized by Public Law 99-190, are hereby transferred to and merged with the working capital fund, to be used for the same purposes as originally authorized. Provided further, That funds that are not necessary to carry out the activities to be financed by the fund, as determined by the Secretary, shall be covered into miscellaneous receipts of the Treasury.

Working Capital Fund

P.L. 101-512 Department of the Interior and Related Agencies Appropriations Act, 1991 This authority established a Working Capital Fund account in FY 1991. The Telecommunications Amortization Fund was included as part of the WCF and all balances of the Telecommunications Amortization Fund existing at the end of FY 1990 were transferred to the WCF. These balances were to be used for the same purposes as originally authorized.

P.L. 103-332 Department of the Interior and Related Agencies Appropriations Act, 1995 The amendments that were made in this appropriations act are shown in underline in the second citation shown above. This authority expanded the use of the Working Capital Fund to partially fund laboratory operations and facilities improvements and to acquire and replace publication and scientific instrumentation and laboratory equipment.

United States Geological Survey

Federal Funds

General and special funds:

WORKING CAPITAL FUND

Program and Financing

(dollars in millions)

Identification Code 14-4556-0-4-306		2004 Actual	2005 Estimate	2006 Estimate
	Obligations by program activity:			
09.01	Working Capital Fund	56	56	54
10.00	Total new obligations	56	56	54
	Budgetary resources available for obligation:			
21.40	Unobligated balance carried forward, start of year	75	73	64
22.00	New budget authority (gross)	54	47	44
23.90	Total budgetary resources available for obligation	129	120	108
23.95	Total new obligations	-56	-56	-54
24.40	Unobligated balance carried forward, end of year	73	64	54
	New budget authority (gross), detail			
	Mandatory:			
69.00	Offsetting collections (cash)	54	47	44
	Change in obligated balances:			
72.40	Obligated balance, start of year	9	12	8
73.10	Total new obligations	56	56	54
73.20	Total outlays (gross)	-53	-60	-55
74.40	Obligated balance, end of year	12	8	7

Working Capital Fund

United States Geological Survey

Federal Funds

General and special funds:

WORKING CAPITAL FUND

Program and Financing

(dollars in millions)

Identification Code		2004	2005	2006
14-4556-0-4-306		Actual	Estimate	Estimate
	Outlays (gross), detail:			
86.97	Outlays from new mandatory authority	16	21	20
86.98	Outlays from mandatory balances	37	39	35
87.00	Total outlays (gross)	53	60	55
	Offsets:			
	Against gross budget authority and outlays:			
88.00	Offsetting collections (cash) from:			
	Federal sources	54	47	44
	Net budget authority and outlays:			
89.00	Budget authority	0	0	0
90.00	Outlays	-1	13	11

United States Geological Survey

Federal Funds

General and special funds:

WORKING CAPITAL FUND

Balance Sheet

(dollars in millions)

Identification Code 14-4556-0-4-306		2003 Actual	2004 Actual
	ASSETS:		
	Federal assets:		
1101	Fund balances with Treasury	84	85
	Investments in U.S. securities:		
1106	Receivables, net		
1803	Other Federal assets: Property, plant and equipment, net	3	8
1999	Total assets	87	93
	LIABILITIES:		
2101	Federal liabilities: Accounts payable		
2201	Non-Federal liabilities: Accounts payable	1	5
2999	Total liabilities	1	5
	NET POSITION:		
3300	Cumulative results of operations	86	88
3999	Total net position	86	88
4999	Total liabilities and net position	87	93

Working Capital Fund

Object Classification

(dollars in millions)

Identification Code		2004	2005	2006
14-4556-0-4-306		Actual	Estimate	Estimate
Reimbursable obligations:				
Personnel compensation:				
11.1	Full-time permanent	12	13	13
11.3	Other than full-time permanent	1	1	1
11.9	Total personnel compensation	13	14	14
12.1	Civilian personnel benefits	3	3	3
21.0	Travel and transportation of persons	1	1	1
23.3	Communications, utilities, and miscellaneous charges	2	2	2
24.0	Printing and reproduction	1	1	1
25.1	Advisory and assistance services	1	0	0
25.2	Other services	10	7	7
25.3	Other purchases of goods and services from Government Accounts	1	2	2
25.4	Operation and maintenance of facilities	5	6	5
25.7	Operation and maintenance of equipment	1	1	1
26.0	Supplies and materials	4	4	4
31.0	Equipment	13	14	14
41.0	Grants, subsidies, and contributions	1	1	0
99.0	Reimbursable obligations	56	56	54
99.9	Total new obligations	56	56	54

Personnel Summary

Identification Code		2004	2005	2006
14-4556-0-4-306		Actual	Estimate	Estimate
Reimbursable:				
2001	Civilian full-time equivalent employment	205	207	208

Funding of U.S. Geological Survey Programs (Obligations)

**Funding of U.S. Geological Survey Programs
(Obligations)**

(dollars in thousands)

	2004 Actual	2005 Estimate	2006 Estimate
Surveys, Investigations, and Research (SIR)			
Mapping, Remote Sensing, and Geographic Investigations			
Annual appropriation	121,621	110,960	131,662
Multi-Year appropriation	280	0	0
No-Year appropriation	7,863	7,878	7,791
Subtotal (appropriation)	129,764	118,838	139,453
<i>Non-Federal (Domestic) sources</i>			
Map receipts	4,920	0	0
Sale of photos, reproductions, and digital products	8,692	6,219	6,219
Sale of personal property	9	0	0
Miscellaneous	187	238	238
Subtotal (non-Federal domestic sources)	13,808	6,457	6,457
<i>Non-Federal (Foreign) sources</i>			
Miscellaneous	1,771	1,771	1,771
Subtotal (non-Federal foreign sources)	1,771	1,771	1,771
<i>State and local sources</i>			
Matched	4,998	2,668	1,635
Unmatched	882	916	920
Subtotal (State and local sources)	5,880	3,584	2,555
<i>Federal sources</i>			
Agency for International Development	3,843	3,724	3,724
Department of Agriculture	1,877	511	123
Department of Commerce			
National Oceanic and Atmospheric Administration	1,310	6	6
Other	164	0	0
Department of Defense			
Corps of Engineers	926	240	240
National Geospatial-Intelligence Agency	7	0	0
Other	2,515	1,189	1,145
Department of Homeland Security			
Federal Emergency Management Agency	270	623	474
Other	96	0	0
Department of the Interior			
Bureau of Land Management	1,879	2,435	2,437
Bureau of Reclamation	629	449	449
Fish and Wildlife Service	375	453	25
National Park Service	1,274	1,969	2,770
Office of Secretary	1,747	2,230	530
Department of State	448	0	0
Department of Transportation	155	0	0
Environmental Protection Agency	1,180	683	508

Sundry Exhibits

	2004 Actual	2005 Estimate	2006 Estimate
General Services Administration	4	4	4
Health and Human Services	144	89	89
Housing and Urban Development	130	162	165
National Aeronautics and Space Administration	10,883	9,725	9,725
National Science Foundation	144	149	149
Sale of maps, photos, reproductions, and digital products	2,937	1,434	1,434
LANDSAT Affil (EOSAT/SPOT)	0	300	300
Miscellaneous agencies	223	176	176
Subtotal (Federal sources)	33,160	26,551	24,473
Total: Mapping, Remote Sensing, and Geographic Investigations	184,383	157,201	174,709

Funding of U.S. Geological Survey Programs (Obligations)

	2004 Actual	2005 Estimate	2006 Estimate
Surveys, Investigations, and Research (SIR)			
Geologic Hazards, Resources, and Processes:			
Annual appropriation	218,704	229,246	208,135
No-Year appropriation	16,535	4,158	0
Subtotal (appropriation)	235,239	233,404	208,135
<i>Non-Federal (Domestic) sources</i>			
Technology transfer			
Miscellaneous	1,079	1,079	1,079
Subtotal (non-Federal domestic sources)	1,079	1,079	1,079
<i>Non-Federal (Foreign) sources</i>			
Saudi Arabia	12	0	0
Other	1,123	1,057	1,074
Subtotal (non-Federal foreign sources)	1,135	1,057	1,074
<i>State and local sources</i>			
Matched	37	37	37
Unmatched	5,312	5,469	5,540
Subtotal (State and local sources)	5,349	5,506	5,577
<i>Federal sources</i>			
Agency for International Development	472	807	123
Central Intelligence Agency	231	270	270
Department of Agriculture	92	92	92
Department of Commerce			
National Oceanic and Atmospheric Administration	4,429	5,051	5,368
Other	415	632	632
Department of Defense			
Corps of Engineers	732	828	828
National Geospatial-Intelligence Agency	37	37	37
Other	2,608	3,296	3,323
Department of Energy	1,581	1,733	1,748
Department of Homeland Security			
Federal Emergency Management Agency	25	25	25
Department of the Interior			
Bureau of Indian Affairs	9	9	9
Bureau of Land Management	1,235	1,555	1,559
Bureau of Reclamation	233	266	269
Fish and Wildlife Service	35	35	36
Minerals Management Service	129	163	166
National Park Service	1,055	1,206	1,216
Office of Secretary	59	0	0
Department of State	667	762	768
Department of Veterans Affairs	368	438	446
Environmental Protection Agency	645	739	744
General Services Administration	85	88	89
National Aeronautics and Space Administration	6,669	7,668	7,813
National Science Foundation	1,345	1,147	1,150

Sundry Exhibits

	2004 Actual	2005 Estimate	2006 Estimate
Nuclear Regulatory Commission	707	958	962
Miscellaneous agencies	75	78	78
Subtotal (Federal sources)	23,938	27,883	27,751
Total: Geologic Hazards, Resources, and Processes	266,740	268,929	243,616

Funding of U.S. Geological Survey Programs (Obligations)

	2004 Actual	2005 Estimate	2006 Estimate
Surveys, Investigations, and Research (SIR)			
Water Resources Investigations:			
Annual appropriation	215,193	211,200	204,172
No-Year appropriation	47	820	0
Subtotal (appropriation)	215,240	212,020	204,172
<i>Non-Federal (Domestic) sources</i>			
Permittees & licensees of the Federal Energy Regulatory Commission	1,683	1,735	1,735
Miscellaneous	641	512	293
Subtotal (non-Federal domestic sources)	2,324	2,247	2,028
<i>Non-Federal (Foreign) sources</i>			
Miscellaneous	930	828	675
Subtotal (non-Federal foreign sources)	930	828	675
<i>State and local sources</i>			
Matched	63,995	63,067	63,327
Matched (In-Kind Services – NON ADD)	458	458	458
Unmatched	74,995	76,880	77,241
Subtotal (State and local sources)	138,990	139,947	140,568
<i>Federal sources</i>			
Agency for International Development	139	532	489
Central Intelligence Agency	150	161	165
Department of Agriculture	2,122	2,125	2,137
Department of Commerce			
National Oceanic and Atmospheric Administration	810	798	801
Department of Defense			
Corps of Engineers	31,455	30,458	30,511
Other	13,238	12,858	12,828
Department of Energy			
Bonneville Power Administration	57	57	57
Other	18,756	17,263	16,780
Department of Homeland Security			
Federal Emergency Management Agency	1,204	1,227	1,213
Department of the Interior			
Bureau of Indian Affairs	538	510	515
Bureau of Land Management	2,349	2,291	2,321
Bureau of Reclamation	10,942	10,146	10,286
Fish and Wildlife Service	1,324	1,330	1,290
National Park Service	3,079	3,036	3,050
Department of Justice	185	190	191
Department of State	2,650	1,968	1,835
Department of Transportation	1,223	1,225	1,246
Department of Veterans Affairs	292	304	304
Environmental Protection Agency	9,966	9,669	9,569
Health and Human Services	392	407	407
National Aeronautics and Space Administration	331	325	366

Sundry Exhibits

	2004 Actual	2005 Estimate	2006 Estimate
National Science Foundation	20	0	0
Nuclear Regulatory Commission	222	193	193
Tennessee Valley Authority	210	218	218
Miscellaneous agencies	0	518	572
Subtotal (Federal sources)	101,654	97,809	97,344
Total: Water Resources Investigations	459,138	452,851	444,787

Funding of U.S. Geological Survey Programs (Obligations)

	2004 Actual	2005 Estimate	2006 Estimate
Surveys, Investigations, and Research (SIR)			
Biological Research:			
Annual appropriation	473	0	0
Multi-Year appropriation	184,474	169,803	172,926
No-Year appropriation	0	379	0
Subtotal (appropriation)	184,947	170,182	172,926
<i>Non-Federal (Domestic) sources</i>			
Permittees & licensees of the Federal Energy Regulatory Commission	10	10	10
Miscellaneous	385	515	400
Subtotal (non-Federal domestic sources)	395	525	410
<i>Non-Federal (Foreign) sources</i>			
Miscellaneous	19	19	19
Subtotal (non-Federal foreign sources)	19	19	19
<i>State and local sources</i>			
Matched	748	778	778
Unmatched	7,103	7,350	7,414
Subtotal (State and local sources)	7,851	8,128	8,192
<i>Federal sources</i>			
Department of Agriculture	1,670	1,807	1,812
Department of Commerce			
National Oceanic and Atmospheric Administration	395	402	402
Other	104	108	108
Department of Defense			
Corps of Engineers	17,032	18,860	19,004
Other	5,990	5,131	5,246
Department of Energy			
Bonneville Power Administration	1,757	1,831	1,867
Other	107	110	112
Department of the Interior			
Bureau of Land Management	2,345	2,837	2,312
Bureau of Reclamation	9,244	9,623	9,795
Fish & Wildlife Service	6,875	7,538	7,332
National Park Service	4,309	4,744	5,109
Office of the Secretary	1,977	2,075	1,998
Department of State	19	145	20
Department of Transportation	2,447	2,543	2,589
Environmental Protection Agency	3,238	3,326	3,331
Health and Human Services	269	279	259
National Aeronautics and Space Administration	82	82	82
National Science Foundation	61	182	62
Miscellaneous agencies	188	66	66
Subtotal (Federal sources)	58,109	61,689	61,506
Total: Biological Research	251,321	240,543	243,053

Sundry Exhibits

	2004 Actual	2005 Estimate	2006 Estimate
Surveys, Investigations, and Research (SIR)			
Enterprise Information:			
Annual appropriation	0	44,373	47,767
Subtotal (appropriation)	0	44,373	47,767
<i>Non-Federal (Domestic) sources</i>			
Map receipts	0	4,737	4,741
Sale of photos, reproductions, and digital products	0	546	642
Subtotal (non-Federal domestic sources)	0	5,283	5,383
<i>Federal sources</i>			
Department of Agriculture	0	135	135
Department of Commerce			
National Oceanic and Atmospheric Administration	0	200	200
Other	0	100	100
Department of Defense	0		
Corps of Engineers	0	100	100
National Geospatial-Intelligence Agency	0	525	525
Department of Homeland Security			
Federal Emergency Management Agency	0	500	500
Department of the Interior			
Bureau of Indian Affairs	0	357	357
Bureau of Land Management	0	2,040	2,040
Bureau of Reclamation	0	166	166
Fish and Wildlife Service	0	561	561
Minerals Management Service	0	80	80
National Park Service	0	536	536
Office of Secretary	0	777	777
Office of Surface Mining	0	80	80
Department of the Transportation	0	200	200
Environmental Protection Agency	0	160	160
General Services Administration	0	2	2
National Aeronautics and Space Administration	0	720	720
Sale of maps, photos, reproductions, and digital products	0	96	0
Miscellaneous agencies	0	5	5
Subtotal (Federal sources)	0	7,340	7,244
Total: Enterprise Information	0	56,996	60,394

Funding of U.S. Geological Survey Programs (Obligations)

	2004 Actual	2005 Estimate	2006 Estimate
Surveys, Investigations, and Research (SIR)			
Science Support:			
Annual appropriation	91,116	65,584	66,337
No-Year appropriation	565	22	0
Subtotal (appropriation)	91,681	65,606	66,337
<i>Non-Federal (Domestic) sources</i>			
Technology Transfer	0	26	28
Subtotal (non-Federal domestic sources)	0	26	28
<i>Federal sources</i>			
Department of Interior			
Bureau of Indian Affairs	459	88	96
Bureau of Land Management	2,225	15	20
Bureau of Reclamation	276	268	274
Fish and Wildlife Service	591	0	0
Minerals Management Service	154	73	82
National Park Service	566	0	0
Office of Secretary			
National Business Center	84	92	99
Other	1,409	47	57
Office of Surface Mining	84	0	0
General Services Administration	769	80	41
National Aeronautics and Space Administration	555	0	0
Miscellaneous agencies	88	81	81
Subtotal (Federal sources)	7,260	744	750
Total: Science Support	98,941	66,376	67,115

Sundry Exhibits

	2004 Actual	2005 Estimate	2006 Estimate
Surveys, Investigations, and Research (SIR)			
Facilities:			
Annual appropriation	68,549	71,368	71,406
Multi-Year appropriation	24,504	22,052	21,719
No-Year appropriation	0	1,577	1,600
Subtotal (appropriation)	93,053	94,997	94,725
<i>Federal sources</i>			
Central Intelligence Agency	262	268	379
Subtotal (Federal sources)	262	268	379
Total: Facilities	93,315	95,265	95,104
SIR Summary:			
Annual appropriation	715,656	732,731	729,479
Multi-Year appropriation	209,258	191,855	194,645
No-Year appropriation	25,010	14,834	9,391
Non-Federal sources			
Map receipts	4,920	4,737	4,741
Domestic	12,686	10,880	10,644
Foreign	3,855	3,675	3,539
State and local sources	158,070	157,165	156,892
Federal sources	224,383	222,284	219,447
Total: SIR	1,353,838	1,338,161	1,328,778

Funding of U.S. Geological Survey Programs (Obligations)

	2004 Actual	2005 Estimate	2006 Estimate
Surveys, Investigations, and Research (SIR)			
Contributed Funds:			
Permanent, indefinite appropriation:			
Mapping, Remote Sensing, and Geographic Investigations	39	15	0
Geologic Hazards, Resources, and Processes	55	99	74
Water Resources Investigations	81	278	186
Biological Research	882	351	205
Science Support	785	0	0
Total: Contributed Funds	1,842	743	465
Operation and Maintenance of Quarters:			
Permanent, indefinite appropriation:			
Geologic Hazards, Resources, and Processes	19	15	18
Biological Research	42	32	31
Total: Operation & Maintenance of Quarters	61	47	49
Working Capital Fund:			
National Water Quality Lab	16,304	16,189	16,541
Hydrologic Instrumentation Facility	11,992	11,183	11,625
Other	28,021	28,619	25,807
Total: Working Capital Fund	56,317	55,991	53,973
Allocations from other Federal Agencies: *			
Department of the Interior: Departmental Offices			
Natural Resource Damage Assessment	1,577	1,528	1,500
Total: Allocations	1,577	1,528	1,500

* Allocations are shown in the year they are received, not when they are obligated.

Sundry Exhibits

Trust Funds

DONATIONS AND CONTRIBUTED FUNDS

Program and Financing
(dollars in millions)

Identification Code 14-8562-0-7-306		2004 Actual	2005 Estimate	2006 Estimate
	Obligations by program activity:			
09.01	Donations and Contributed Funds	2	1	1
10.00	Total new obligations	2	1	1
	Budgetary resources available for obligation:			
21.40	Unobligated balance carried forward, start of year	1	1	1
22.00	New budget authority (gross)	2	1	1
23.90	Total budgetary resources available for Obligation	3	2	2
23.95	Total new obligations	-2	-1	-1
24.40	Unobligated balance carried forward, end of year	1	1	1
	New budget authority (gross), detail:			
	Mandatory:			
60.26	Appropriation (trust fund)	2	1	1
	Change in obligated balances:			
72.40	Obligated balance, start of year	0	1	1
73.10	Total new obligations	2	1	1
73.20	Total outlays (gross)	-1	-1	-1
74.40	Obligated balance, end of year	1	1	1
	Outlays (gross), detail:			
86.97	Outlays from new mandatory authority	1	1	1
	Net budget authority and outlays:			
89.00	Budget authority	2	1	1
90.00	Outlays	1	1	1

Object Classification
(dollars in millions)

Identification Code 14-8562-0-7-306		2004 Actual	2005 Estimate	2006 Estimate
	Direct obligations:			
12.52	Other services	1	1	1
99.95	Below reporting threshold	1	0	0
99.99	Total new obligations	2	1	1

ADMINISTRATIVE PROVISIONS

The amount appropriated for the United States Geological Survey shall be available for the purchase and replacement of passenger motor vehicles; reimbursement to the General Services Administration for security guard services; contracting for the furnishing of topographic maps and for the making of geophysical or other specialized surveys when it is administratively determined that such procedures are in the public interest; construction and maintenance of necessary buildings and appurtenant facilities; acquisition of lands for gauging stations and observation wells; expenses of the United States National Committee on Geology; and payment of compensation and expenses of persons on the rolls of the Survey duly appointed to represent the United States in the negotiation and administration of interstate compacts: *Provided*, That activities funded by appropriations herein made may be accomplished through the use of contracts, grants, or cooperative agreements as defined in 31 U.S.C. 6302 et seq.: *Provided further*, That the United States Geological Survey may enter into contracts or cooperative agreements directly with individuals or indirectly with institutions or nonprofit organizations, without regard to 41 U.S.C. 5, for temporary or intermittent services of students or recent graduates, who shall be considered employees for the purpose of chapters 57 and 81 of title 5, United States Code, relating to compensation for travel and work injuries, and chapter 171 of title 28, United States Code, relating to tort claims, but shall not be considered to be Federal employees for any other purposes. (*Department of the Interior and Related Agencies Appropriations Act, 2005.*)

Appropriation Language and Citations

1. The amount appropriated for the Geological Survey shall be available for purchase and replacement of passenger motor vehicles;
 - **31 U.S.C. 638a(a)** provides that, "Unless specifically authorized by the appropriation concerned or other law, no appropriation shall be expended to purchase or hire passenger motor vehicles for any branch of the Government"
 - **31 U.S.C. 638a(b)** provides that, "Excepting appropriations for the military and Naval Establishments, no appropriation shall be available for the purchase, maintenance, or operation of any aircraft unless specific authority for the purchase, maintenance, or operation thereof has been or is provided in such appropriation."
2. reimbursement to the General Services Administration for security guard services; contracting for the furnishing of topographic maps and for the making of geophysical or other specialized surveys when it is administratively determined that such procedures are in the public interest;
 - **No specific authority.** These provisions are required by reason of rulings of the Comptroller General that specific authority is required for reimbursing the General Services Administration for guard services (B-87255); and for contracting with private persons for the performance of duties with which the agency is specifically charged (15 Comp. Gen. 951).
3. construction and maintenance of necessary buildings and appurtenant facilities;
 - **No specific authority.** The Organic Act of 1879, establishing the Geological Survey and providing for "... examination of the geological structure, mineral resources, and products of the national domain" (43 U.S.C. 31) is general authorization for construction of special-purpose laboratory buildings. Specific authorization by the Congressional committees on public works is not needed because of the highly specialized purposes of the building. 40 U.S.C. 612: "The term 'public building' means any building ... which is generally suitable for office or storage space ... but shall not include any such buildings and construction projects: ... (E) on or used in connection with ... or for nuclear production, research, or development projects." 41 U.S.C. 12: "No contract shall be entered into for the erection, repair, or furnishing of any public building ... which shall bind the government to pay a larger sum of money than the amount in the Treasury appropriated for the specific purpose."
4. acquisition of lands for gauging stations and observation wells;
 - **43 U.S.C. 36(b)** provides that, "The Secretary of the Interior may, on behalf of the United States and for the use by the Geological Survey in gaging streams and underground water resources, acquire lands by donation or when funds have been appropriated by Congress by purchase or condemnation"

5. expenses of the U.S. National Committee on Geology;
 - **43 U.S.C. 31** participation in and payment of expenses of the U.S. National Committee on Geology is a proper and necessary function of the Geological Survey, and so is authorized by the Survey's Organic Act of March 3, 1879, 43 U.S.C. 31. This Act provides that, "...The Director of the Geological Survey, which office is established, under the Interior Department, shall be appointed by the President by and with the advice and consent of the Senate. This officer shall have the direction of the Geological Survey, and the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain"
6. and payment of compensation and expenses of persons on the rolls of the Survey duly appointed to represent the United States in the negotiation and administration of interstate compacts:
 - **66 Stat. 453.** The above language first appeared in the Appropriation Act for FY 1953, P.L. 82-470 (66 Stat. 453), and has been repeated in each Act since that date. Article I, Section 10, paragraph 3, of the United States Constitution provides that, No State shall, without the consent of Congress, lay any duty on tonnage, keep troops, or ships of war in time of peace, enter into any agreement or compact with another State, or with a foreign power, or engage in war, unless actually invaded, or in such imminent danger as will not admit or delay." (emphasis supplied)

Thus each interstate compact must be approved by the Congress and signed by the President. The Public Law approving each interstate compact represents the authorizing legislation.

7. *Provided*, That activities funded by appropriations herein may be accomplished through the use of contracts, grants, or cooperative agreements as defined in 31 U.S.C. 6302, et seq.
 - The above language appears in the Department of the Interior and Related Agencies Appropriations Act, 1988, as included in Public Law 100-202.
8. *Provided further*, That the United States Geological Survey may enter into contracts or cooperative agreements directly with individuals or indirectly with institutions or nonprofit organizations, without regard to 41 U.S.C. 5, for temporary or intermittent services of students or recent graduates, who shall be considered employees for the purpose of chapters 57 and 81 of title 5, United States Code, relating to compensation for travel and work injuries, and chapter 171 of title 28, United States Code, relating to tort claims, but shall not be considered to be Federal employees for any other purposes.
 - The above language appears in the Consolidated Appropriations Act, 2005 (Interior and Related Agencies portion), as included in Public Law 108-447.

Sundry Exhibits

Permanent Authority:

1. *Provided*, That appropriations herein and hereafter made shall be available for paying costs incidental to the utilization of services contributed by individuals who serve without compensation as volunteers in aid of work of the Geological Survey, and that within appropriations herein and hereafter provided, Geological Survey officials may authorize either direct procurement of or reimbursement for expenses incidental to the effective use of volunteers such as, but not limited to, training, transportation, lodging, subsistence, equipment, and supplies.
 - **43 U.S.C. 50c**
2. *Provided further*, That provision for such expenses or services is in accord with volunteer or cooperative agreements made with such individuals, private organizations, educational institutions, or State or local government.
 - **43 U.S.C 31(a)**
3. *Provided further*, That the Geological Survey (43 U.S.C. 31(a)) shall hereafter be designated the United States Geological Survey.
 - **Department of the Interior and Related Agencies Appropriations Act, 1992, as included in Public Law 102-154.**
4. *Provided further*, That the United States Geological Survey may hereafter contract directly with individuals or indirectly with institutions or nonprofit organizations, without regard to 41 U.S.C. 5, for the temporary or intermittent services of students or recent graduates, who shall be considered employees for the purposes of chapters 57 and 81 of title 5, United States Code, relating to compensation for travel and work injuries, and Chapter 171 of Title 28, United States Code, relating to tort claims, but shall not be considered to be a Federal employees for any other purposes.
 - **Department of the Interior and Related Agencies Appropriations Act, 2000, as included in Public Law 106-113.**
5. *Provided further*, That notwithstanding the provisions of the Federal Grant and Cooperative Agreement Act of 1977 (31 U.S.C. 6301–6308), the may be United States Geological Survey is authorized to continue existing, and hereafter, to enter into new cooperative agreements directed towards a particular cooperator, in support of joint research and data collection activities with Federal, State, and academic partners funded by appropriations herein, including those that provide for space in cooperator facilities.
 - **Department of the Interior and Related Agencies Appropriations Act, 2004, as included in Public Law 108-108.**

Employee Count by Grade (Total Employment)

	2004 Actual	2005 Estimate	2006 Estimate
Executive Level V	1	1	1
ES	29	32	34
Subtotal	30	33	35
GS/GM-15	602	609	601
GS/GM-14	806	812	785
GS/GM-13	1,397	1,405	1,382
GS/GM-12	1,662	1,668	1,648
GS/GM-11	1,513	1,526	1,493
GS/GM-10	18	21	17
GS/GM-9	1,076	1,083	1,075
GS/GM-8	310	321	311
GS/GM-7	706	714	702
GS/GM-6	249	255	241
GS/GM-5	318	327	310
GS/GM-4	218	230	213
GS/GM-3	95	98	92
GS/GM-2	41	46	39
GS/GM-1	15	19	13
Subtotal	9,026	9,134	8,922
Other Pay Schedule Systems	324	318	318
Total employment (actual/estimate)	9,380	9,485	9,275

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