

# **Science Impact – Enhancing the Use of USGS Science**

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## **Introduction**

Science Impact represents a focused USGS effort to improve and expand the use of science information to inform and support decisions at all levels of society. To accomplish this, the USGS will develop methods, tools, and techniques to build explicit linkages between science and societal decision makers. In the process, we will be developing new approaches that integrate science and its societal context to address the needs of decision makers.

There is a long history of objective USGS science contributing to critical decisions throughout our nation and society. Whether the issues relate to water quality and quantity; natural hazards such as earthquakes, volcanoes, landslides, or floods; energy, mineral, and biological resources, the USGS has a well-documented record of delivering important scientific information to inform and to support societal decisions.

In recent years, however, three related developments have significantly increased opportunities and needs for USGS science to greatly expand its contribution to critical decisions on managing hazards, the environment, and natural resources. At one level, decisions have become more decentralized with an increased emphasis on local and citizen involvement. Decisions that were uniformly made at the Federal level years ago are now made with explicit local and citizen collaboration.

This decentralization of decision-making has evolved in parallel with an explosion of information accessibility and analytical capability. Information that a few years ago was accessible only to a select few government officials, can now be obtained easily by many through the Internet. In addition, the development and institutionalization of geographic information and decision support systems has greatly expanded the potential use and value of science information integrated with economic, social, and political factors.

Over a year ago, USGS Director Chip Groat instructed the Office of Strategic Planning and Analysis (SPA) to begin developing a Science Impact program to facilitate the enhanced use and value of USGS science information. Dr. Groat directed that a Science Impact program should represent an interdisciplinary effort of natural and social scientists to broaden and expand linkages between USGS science and societal decision makers.

To develop ideas from varied perspectives, SPA convened a workshop at the USGS National Center in Reston, VA, during September 11-13, 2001, to develop, focus, and synthesize ideas and possible strategies for structuring and initiating the Science Impact program. The ideas articulated in this paper represent a synthesis of discussions held before, during, and subsequent to the September workshop.

## **Rationale for a Science Impact Program**

### ***Changing Needs, Capabilities, and Expectations***

The Science Impact program is designed to meet the changing external environment that has significantly increased and changed the demand for USGS science information. This new demand creates both opportunities and challenges for the USGS, as we continue to meet the needs of traditional customers, while also broadening our efforts to serve new types of customers.

As discussed in the Introduction, three related developments have affected the demand for science information and its usefulness in informing decisions. These developments are:

- An increased emphasis on decentralized decisions
- Increased data accessibility through the Internet and other electronic media, and
- A revolution in new analytical and presentation tools such as geographic information and decision support systems.

Each of these developments has changed the demand, opportunity, and expectations for use of USGS science information. The increased emphasis on decentralized decisions and improved data accessibility greatly broadens the potential impact of science. The need for information on the consequences of decisions expands beyond traditional decision-makers. This is manifested by the active participation of citizens in advisory committees and “listening sessions,” and by the proliferation of stakeholder groups and land trusts across the country.

Advanced technology has transformed our ability to obtain and manage data and information. The analytic capabilities of Geographic Information Systems (GIS) and Decision Support Systems (DSS), originally available only to highly trained specialists, are increasingly accessible to a larger audience. These systems make possible evaluations integrating objective science information with economic, social, cultural, and political factors to predict the consequences of alternative decisions. In many ways this information technology has enabled the trend towards decentralized decision-making. A significant challenge is in how scientific information, expertise and insight can be delivered using these new technologies, and how they can be made most useful to non-technical customers for decision making. The Science Impact program needs to build

from this base by developing new integrated products, models, techniques, and tools that will expand the use of science information to a broadened customer base.

### ***Emphasis on Relevance, Performance, and Results***

The emphasis on accountability as exemplified by the Government Performance and Results Act (GPRA), has increased the importance of developing and documenting explicit demonstrations of USGS science information informing important societal decisions. There is a long history of USGS science information contributing to critical decisions throughout our nation and society. The focus of Science Impact is to improve and expand the use of USGS science information to inform and support decisions. The Science Impact program needs to develop measures to evaluate the success and effectiveness of its efforts to link science information with societal decisions.

The Science Impact program directly supports the revised draft Department of the Interior (DOI) Strategic Plan and the USGS Strategic Direction. The draft DOI Strategic Plan highlights the importance of science to inform decision-making both in the mission statement and as a foundation of the Plan.

A commitment to address complex issues and engage more actively with customers is embodied in the USGS Strategic Direction. There, we commit to “combine and enhance USGS’ diverse programs, capabilities, and talents, and increase customer involvement to strengthen our scientific leadership and contribution to the resolution of complex issues.” With the Science Impact program we recognize that our contribution to the resolution of complex issues must be realized through an explicit effort to actively engage with decision makers to ensure that the science that is provided meets their needs. This will be accomplished by developing partnerships with decision makers and developing new understandings of the decision context to link our science more effectively to the decision making process.

The 1998 National Research Council report on “Future Roles and Opportunities for the U.S. Geological Survey,”<sup>1</sup> recommends an increased emphasis “toward the value-added activities of data analysis, problem solving, and information dissemination” and suggests that we “do more to interpret what the data mean and to make the data useful and accessible” to the general public and stakeholders in “critical issues.” The report further urges USGS to diversify its customer base and regularly assess the services it provides to its customers. These recommendations will be implemented in a USGS Science Impact program. Building on our unique capabilities.

As a public agency that encompasses the natural sciences, the USGS is uniquely suited to bringing our science to bear on the resolution of complex issues at multiple levels of

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<sup>1</sup> National Research Council, 1998, Future Roles and Opportunities for the Geological Survey: National Academy Press, Washington, D.C.

decision-making. Moreover, we have the trust of the public because we have built a reputation for excellence and impartiality, and thus credibility. Based on customer surveys, our data, reports, and scientific support meet the needs of other science agencies, research offices of regulatory and natural resource agencies, and science and technology firms in the private sector. This tradition serves us well as we expand our constituency to include a wider range of decision-makers, stakeholders, and citizens who participate in decision-making processes.

There are many excellent examples of us working closely with current customers to ensure the usefulness of our scientific information. Through our district offices we maintain a close connection to the users of water resources information, and our scientists partner with many of them through the Coop Program. Scientists who work on earthquake hazards partner with agencies such as FEMA to provide information that ensures rapid response in the event of an earthquake. The USGS works closely with natural resource managers of the National Park Service and the Fish and Wildlife Service to provide decision support in a variety of management contexts, including working with citizen-stakeholders. The USGS also invested in three months of public “listening sessions” to develop priorities for *The National Map*. These are just a few of many examples in which the USGS has served decision makers by providing credible science results that meet their needs.

The evolving needs, capabilities, and expectations of our customers, renewed emphasis on performance and results, and our unique capabilities justify a new Science Impact program within USGS.

## The Science Impact Program

### **Goals**

The purpose of the Science Impact program is to improve and expand the use of USGS science information to inform and support decisions at all levels of society. To this end, there are three component goals:

- Improving the scientist-decision maker interface
- Developing new integrated products, models, techniques, and tools
- Developing measures to evaluate our success and effectiveness

### **Improving the scientist—decision maker interface**

As the customer base for science information broadens and expands, the USGS needs to develop improved methods of collaborating with and delivering useful science information to customers. This interface includes problem definition, determination of the most effective science products, and timing. The objective is to develop a common language and mutual goals in order to ensure a successful outcome. Improving this

interface can result in better understanding of science information and products better focused to meeting customer needs.

### **Developing new integrated products, models, techniques, and tools**

The technology revolution and the development of advanced geographic information and decision support systems provide significant opportunities to integrate science information with economic, social, cultural, and political factors to determine or predict the consequences of alternative decisions. The objective is to effectively use science information within its societal context to provide decision makers with an understanding of the consequences, implications, and trade-offs of potential decisions.

### **Developing measures to evaluate our success and effectiveness**

Objective measures and evaluations are required to determine whether science is effectively informing societal decisions. The evaluation and documentation of the use of science in informing decisions is a critical factor in the development and the implementation of new methods.

### ***Project characteristics***

Research and development of methodologies for science impact will be largely through projects that permit experimentation to determine the best ways to bring USGS science into the decision making process. A guiding principle of science impact is that we will learn best through projects and case studies—the ‘doing’ teaches us to do it better. The ‘lessons learned’ will be continually transferred and integrated into USGS science programs so that we improve our ability as an agency to work within the decision-making framework. Natural scientists and social scientists will partner with decision makers with the goal of mutual learning and benefit.

Despite some variability in the nature of projects, several characteristics commonly distinguish Science Impact projects:

- ❑ Projects focus on the decision context in which environmental or natural resource considerations are associated with economic or other societal concerns.
- ❑ Decision-makers who can use project results are readily identifiable and are actively engaged in project planning and implementation.
- ❑ Project planning and implementation, including the timely delivery of results, are driven by decision needs which are identified through consultation.
- ❑ Science information focuses on usability, not just availability.

Science Impact projects will typically require partnering with expertise found throughout the USGS and outside the Bureau. For example, many approaches that would be useful in Science Impact projects are being developed at universities and various institutes, with

whom we can partner. Projects could include any combination of natural scientists, social scientists, and the decision-makers who will ultimately use the science products developed.

In some cases, the relevant science information may already exist in a usable format. In other cases, decision-makers may prefer interpretations of science information that is already available, translated into terms they understand, and put into a context of its degree of certainty. Other times, available scientific information may not be sufficient to address the issues, and additional scientific information may be necessary before the needs of the user can be addressed. With the goal of informing and supporting decisions, the Science Impact program will work to acquire the additional information. The boundaries between Science Impact responsibilities and those of other USGS programs will be established in an implementation plan.

### ***Project Scope and Type***

All science impact projects will address the goals of the program. They will also have the characteristics just described. Their scope will vary from a few that will inform nationally-important policy decisions, to others that will require partnerships with sister agencies to address specific land management or regulatory issues, to still others where we work with local agencies and community groups. Some projects may be regarded as decision-related research. These will focus on early development of approaches, tools, and techniques for subsequent use in other Science Impact projects.

Some suggestions of projects that may be considered include:

- ❑ Multi-hazard risk maps developed in collaboration with FEMA and affected communities.
- ❑ Stakeholder analysis techniques that enable managers to anticipate key issues or possible solutions, implemented in collaboration with sister agencies who are engaged in complex stakeholder participation in wildlife, land, or water resource management.
- ❑ Decision support models that cast potential solutions into a range of options for investing in hazard mitigation, developed in collaboration with municipal planners in high-risk areas.
- ❑ Environmental vulnerability maps or decision trees, focused on water or biological resources, developed in collaboration with the private sector, non-governmental organizations, regulatory or legislative staffs, or community-level planning entities.
- ❑ Community-based projects, which may involve local planning boards, other decision makers, stakeholder groups, and citizens. These projects will use

processes such as joint fact-finding or other techniques that will identify and address issues of concern.

### ***Program Planning and Funding***

Science Impact is an integral part of the work that the USGS does, with leadership and guidance from the Director through his review and approval of the 5-Year and Annual Planning documents. The Science Impact program will be located within the Office of Strategic Planning and Analysis. A program coordinator will participate in the Bureau's programmatic activities along with other programs and participate in the 5-year and annual program planning processes.

The Program Coordinator will chair a small "core group" drawn from the disciplines and regions. This group will assist and advise the Program Coordinator on proposal and project reviews, guiding creation of partnerships, identifying training needs, and by ensuring that project successes benefit the Bureau as a whole. The core group will also provide thought and direction for the Science Impact 5-year plan and build relationships by facilitating communication among the program, regional and discipline management, and customers.

The Science Impact program will have its own budget, with the potential for separate funding from Congress, to conduct work cooperatively with other programs and partners. In addition to new projects supported by the Science Impact program, existing programs will be invited to work cooperatively with the program to plan and cost-share specific projects that enhance the impact of the science efforts they conduct. We anticipate that approaches, tools, and products that are developed by the Science Impact Program will significantly benefit the existing customers served by USGS programs, which will provide an incentive to support science impact.

### ***Implementation***

#### **Boundaries and Roles**

By initiating the Science Impact program, the USGS becomes a champion for using science in decision making, without being an advocate for specific decisions. Although this boundary may appear to be less distinct as we attempt to cast our science more in a decision-making framework, the USGS must preserve its non-advocacy policy. We can act neither as advocates nor as consultants in this effort. The high degree of trust that our agency enjoys derives largely from our impartiality and our commitment to providing broad public benefits through our work. Admittedly, the boundary between supplying scientific information for decision making and recommending a course of action sometimes becomes somewhat difficult to delineate. Even when our scientific information seems to lead toward a certain solution or decision, however, we must present the scientific information in such a way as to refrain from making specific policy recommendations.

### **A Sustained Commitment**

Implementation of the Science Impact program will take sustained commitment because it will require a degree of cultural change. Scientists who have worked in isolation or on teams that consist only of their traditional colleagues will find themselves dealing with new partners and the complex arena of decision-making. Products designed for decision-makers may be significantly different from those prepared for a scientific audience, and additional time will be required for collaboration to define project goals and components, and to perform the necessary research or analysis to respond to decision needs. Moreover, the science that is needed to address the issues may require integration of various scientific disciplines. These realities will need to be factored into project plans, and supported in concrete ways.

### **Training**

A 1995 National Research Council report recognized the need to “improve the cross-disciplinary training of natural and social scientists...by creating programs of training for ‘science translators’...[which would] include exposure to the natural and social sciences, policy development and implementation, and conflict management and communication skills.” Such training for USGS scientists would enhance efforts to develop the capacity to work more effectively in a decision-making framework. This training could include 1) seminars to stimulate interest in the science impact approach by covering subjects such as collaborative-problem solving, 2) courses in subjects that relate to working in a decision context, and 3) courses in the theory and application of assessment techniques. These training opportunities and seminars will be particularly valuable for those who are selected to lead Science Impact project teams.

Because of the potential for advocacy concerns, it is likely that guidelines will be needed, and training provided, to ensure the maintenance of appropriate USGS roles and boundaries. The Science Impact program core group, in collaboration with the Office of Communication, will develop guidelines, provide training, and offer support to scientists engaged in Science Impact projects to ensure the maintenance of appropriate USGS roles and boundaries. Case studies can be used from past experience to provide examples to guide scientists.

### **Reward System**

Reward systems within USGS differ; however, existing reward systems tend to favor traditional scientific endeavors. Recognition for demonstrated excellence in conducting Science Impact projects is important to ensure that Science Impact activities are understood to be a service to our constituency and thus of value to the organization. One of several approaches that might be taken is to include in performance reviews elements like the “Factor IV” committee recommendations to the Research Grade and Evaluation Guide process. This committee emphasized “quality and impact” as key factors in evaluating Factor IV. For those not in research positions, specific rewards and incentives must also be created.

## Conclusion

The USGS has a long tradition of meeting the needs of its customers, and an outstanding record of providing credible science information to support critical decisions on managing hazards, the environment, and natural resources. As we continue to serve the needs of our existing customers, however, a combination of factors that include the decentralization of decision making in society creating additional potential audiences for our science information; advances in technology that allow for broad access to and sharing of information; and increased emphasis on accountability, require an increased emphasis on finding ways to better serve a wider range of customers who could benefit from our science information if it were provided in a context useful for decision making.

The successful entry of our scientific information into the decision-making process requires that, as an institution, we learn more about the contexts of decision making, the kinds of scientific information that will truly inform decision-makers, potential new formats that might better serve the emerging needs of customers for our natural science information, and how to communicate the uncertainties associated with our scientific insights.

We plan to develop a Science Impact Program to address these issues. A cornerstone of science impact will be the active engagement of the users of our scientific information in problem definition, and in the planning and implementation stages of science impact projects. To accomplish this, we will need to work directly, in a collaborative manner, with the decision makers and various stakeholder groups to plan both the science that we do and the products that we provide. To facilitate enhanced use of science information by decision makers, we will also develop new approaches, analytical tools, and methods to communicate science information in formats that are useful to decision makers. We will develop these products and tools in collaboration with the decision makers to ensure their usefulness. The goal is to communicate the science clearly and allow users to assess the implications of various decision options, and the potential tradeoffs of various choices. Research and application of methodologies for science impact will be largely through projects that permit experimentation to determine the best ways to bring USGS science into the decision making process.

Implementation of science impact will take sustained commitment because it will require a degree of cultural change. Products designed for a broader range of decision-makers may be significantly different from those prepared for technical audiences; moreover, the science that is needed to address the issues may require greater integration of various scientific disciplines and may need to be combined with economic, social, cultural, and political factors. The USGS is capable of rising to this new challenge. As a public agency that encompasses the natural sciences, the USGS is uniquely suited to bringing our science to bear on the resolution of complex issues at multiple levels of decision-making. Moreover, we have the trust of the public because we have built a reputation for excellence and impartiality, and thus credibility. If we can effectively bring our science

into the framework of decision-making, we will demonstrate more fully the public benefits of our science and our accountability to the tax-payers who invest in what we do.