USGS
science for a changing world

USGS Science

Addressing Our Nation's Challenges

General Information Product 93

U.S. Department of the Interior
U.S. Geological Survey

With 6.6 billion people already living on Earth, and that number increasing every day, human influence on our planet is ever more apparent. Changes to the natural world combined with increasing human demands threaten our health and safety, our national security, our economy, and our quality of life. As a planet and a Nation, we face unprecedented challenges: loss of critical and unique ecosystems, the effects of climate change, increasing demand for limited energy and mineral resources, increasing vulnerability to natural hazards, the effects of emerging diseases on wildlife and human health, and growing needs for clean water. The time to respond to these challenges is now, but policymakers and decisionmakers face difficult choices. With competing priorities to balance, and potentially serious—perhaps irreversible—consequences at stake, our leaders need reliable scientific information to guide their decisions. As the Nation's earth and natural science agency, the USGS monitors and conducts scientific research on natural hazards and resources and how these elements and human activities influence our environment.

Because the challenges we face are complex, the science needed to better understand and deal with these challenges must reflect the complex interplay among natural and human systems. With world-class expertise in biology, geology, geography, hydrology, geospatial information, and remote sensing, the USGS is uniquely capable of conducting the comprehensive scientific research needed to better understand the interdependent interactions of Earth's systems. Given the complexity of Earth's systems and competing demands and values of society, decisionmakers need information they can trust. Because the USGS has no management or regulatory responsibilities, it can be relied on to provide unbiased and policy-neutral information. Because the USGS has established a high set of standards for conducting science and requires a rigorous peer review of its results, it can be relied on to provide accurate and dependable scientific information. In order to address the challenges we face, decisionmakers need more than comprehensive and reliable data—they need information they can use. The USGS brings the results of its many research programs together to create knowledge that is understandable, useable, and accessible in many forms—including statistics, reports, analyses, maps, models, and tools that forecast the consequences of various choices. These products, often created in partnership with other governmental, academic, and private organizations, provide the basis for evaluating the effectiveness of specific policies and management actions, and they are essential to the success of policymakers and decisionmakers at local, State, Federal, tribal, and international levels.

Every day, the USGS helps decisionmakers to minimize loss of life and property, manage our natural resources, and protect and enhance our quality of life. Here are just a few examples.

Protecting Our Water Supply

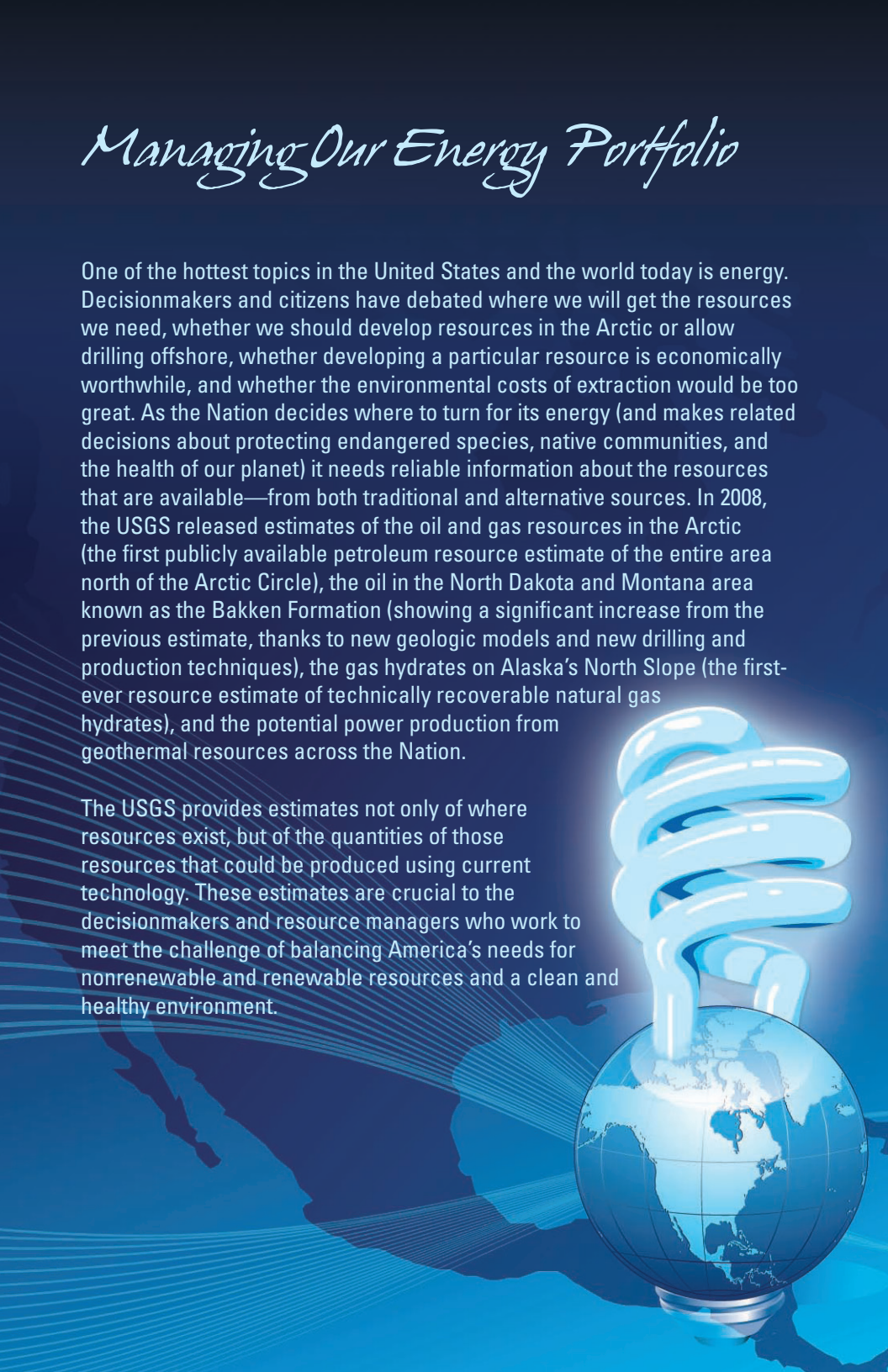
In Montana, USGS water-quality studies revealed that for decades, billions of barrels of a brine byproduct seven times saltier than ocean water had been seeping from an oil field into the ground—contaminating the Poplar River, nearby aquifers, and privately owned wells. Decisionmakers turned to the USGS for the information they needed to understand the potential extent and sources of the contamination. USGS scientists measured the groundwater's salinity, identified its direction and rate of movement, and determined that the contamination—found within 3 miles of the city of Poplar's wells—threatened the area's public water supply. With technical support from a multiagency remediation team (including USGS scientists), an oil producer plugged an abandoned oil well that the USGS had identified as a major source of contamination and built a remediation system that pumps the contaminated groundwater to a deep disposal well. Guided by science, these remediation efforts have improved the water quality of the aquifer and reduced the threat to human health.

Water contamination, water shortages, and conflicts over how to use limited water resources have become more common in the United States. With water science offices in every State, the USGS has a unique ability to conduct comprehensive studies of both the quality and quantity of our Nation's water resources, giving decisionmakers the information they need to address water issues at not only the local but also the regional and national level.

Managing Our Energy Portfolio

One of the hottest topics in the United States and the world today is energy. Decisionmakers and citizens have debated where we will get the resources we need, whether we should develop resources in the Arctic or allow drilling offshore, whether developing a particular resource is economically worthwhile, and whether the environmental costs of extraction would be too great. As the Nation decides where to turn for its energy (and makes related decisions about protecting endangered species, native communities, and the health of our planet) it needs reliable information about the resources that are available—from both traditional and alternative sources. In 2008, the USGS released estimates of the oil and gas resources in the Arctic (the first publicly available petroleum resource estimate of the entire area north of the Arctic Circle), the oil in the North Dakota and Montana area known as the Bakken Formation (showing a significant increase from the previous estimate, thanks to new geologic models and new drilling and production techniques), the gas hydrates on Alaska's North Slope (the first-ever resource estimate of technically recoverable natural gas hydrates), and the potential power production from geothermal resources across the Nation.

The USGS provides estimates not only of where resources exist, but of the quantities of those resources that could be produced using current technology. These estimates are crucial to the decisionmakers and resource managers who work to meet the challenge of balancing America's needs for nonrenewable and renewable resources and a clean and healthy environment.



Assessing America's Cropland

Every year, during the growing season, the U.S. Department of Agriculture (USDA) builds a model of the agricultural landscape called the Cropland Data Layer. This model helps set the official acreage estimates for major agricultural commodities at State and county levels. To help identify types of land and land use, the USDA uses the USGS National Land Cover Database—a massive, detailed database derived from satellite imagery that classifies the land cover across the United States. This census of U.S. lands is so precise (describing sections 98 feet long and wide) that an area the size of a football field would contain nearly six separately classified sections. By integrating USGS methods and data into their model, the USDA has not only comprehensively improved their overall product accuracy and customer satisfaction, they have also made the process more efficient, allowing them to expand into additional States and deliver crop-specific land-cover information and acreage estimates to even more stakeholders. Stakeholders, in turn, use this information to monitor watersheds and water quality; analyze crop-rotation patterns; monitor wildlife habitat; identify resources, such as catfish ponds; and plan for agribusiness needs such as seed, fertilizer, pesticide, fungicide, crop insurance, and the transportation and storage of grain.

By providing both the big picture and specific local information, USGS earth observations and geographic information meet an astounding array of needs for knowledge about our landscape: from tracking changes in land use and human development to documenting the devastation caused by storms and wildfires.

Listing Endangered Species

When the U.S. Fish and Wildlife Service began the process of determining whether the polar bear should be listed as a threatened species under the Endangered Species Act, the Secretary of the Interior turned to the USGS to ensure that the best available science informed the deliberations. The USGS formed a team to interpret existing information and conduct new analyses. USGS scientists improved our understanding of polar bear populations, projected numbers of polar bears in relation to sea-ice habitat, and predicted how polar bear numbers are likely to respond to projections of climate change. Observations of sea-ice decline over the past 20 years and scientific projections of additional sea-ice declines in future decades demonstrated that two-thirds of the world's polar bear population is likely to be lost by the middle of the 21st century. Armed with scientific evidence that the survival of the polar bear could be in jeopardy, the Department of the Interior had the information it needed to list the polar bear as a threatened species.

USGS scientists are currently conducting research on other species petitioned for listing, including the greater sage grouse and walrus. The USGS is also studying the impacts of climate change across the United States, helping resource managers to understand how global warming is affecting our Nation's ecosystems and wildlife and helping them to prepare for the changes we will see in the future.

Living with Wildland Fires

In 2008, the Nation watched as California residents fled their communities and lost their homes. As these fires moved across the land, decisionmakers needed to know the location of the fires, their sizes, their perimeters, and the resources that were in the fires' paths. The USGS provided this information in real time over the Internet, helping firefighters and incident commanders to do their jobs. It also allowed residents, media, tourists, and other decisionmakers to monitor where the fires were and where they were headed. After the fires, scientists determined which areas were at risk for debris flows and identified locations where either invasive species or soil erosion would be likely to cause problems in the future. The USGS supports residents and decisionmakers not only during and after a fire but before the fire starts. USGS satellite imagery can show us not only the locations of current wildfires, but also trends in wildfires through time. By studying the cover of vegetation across the Nation and identifying particular fuel types, such as chaparral plants, that are particularly prone to fire, USGS scientists help to predict fire risks to communities.

Wildland fires are a natural process, but climate change has significantly altered the fire regime, making wildland fires more severe, more widespread, and more frequent. USGS science is continuing to improve our understanding of this natural hazard and to help our communities to identify and reduce their risks.

Forecasting Floods

After a particularly wet spring in central and southern Indiana, on June 6–7, 2008, heavy rainfall of 2 to more than 10 inches fell on ground that was already saturated, adding significantly to the streamflow of rivers that were already running at or near flood levels. This heavy rainfall resulted in severe flooding on many streams within the White River Basin. As the rain fell and waters rose, USGS streamgages transmitted real-time data about the speed of the currents and height of the rivers to the National Weather Service and other agencies, helping them to monitor, predict, and plan for the approaching floods. The flood forecasts and warnings allowed responders to evacuate thousands of residents, prepare for disaster aid, and protect and save lives. The floods caused three deaths and hundreds of millions of dollars of damage to residences, businesses, infrastructure, and agricultural lands. In all, 39 Indiana counties were declared Federal disaster areas. The USGS used data collected before, during, and after the event to put these floods in a historical context, to map the areas that were inundated at the peak of the flooding, and to create profiles of how floodwaters flow through selected streams.

By combining the historical record, data from ongoing streamgage monitoring, and data on new events, the USGS is able to develop the expertise and tools that help Federal, State, and local community leaders not only to enhance short-term preparation, aid, and recovery efforts, but to better understand how their flood risk may be changing over time and how they can reduce their risk in future events.

Preparing for the Big One

It's not a matter of if another large earthquake will hit Southern California; it's a matter of when it does, will we be prepared for it? To help California's home and business owners, city planners, government agencies, emergency and medical facilities, first responders, and residents understand and prepare for the inevitable large earthquake, the USGS joined with numerous partners to hold the Great Southern California ShakeOut—the largest earthquake drill in U.S. history. When emergency responders needed a scenario to practice for the large earthquake they know will come, they didn't want just any scenario—they wanted one that was robust and realistic, one that would help them best prepare for the actual impacts that Southern California will face when a big earthquake strikes. To develop this detailed picture, they turned to the USGS. Using its extensive earthquake data and expertise, the USGS helped them develop a detailed scenario of a magnitude-7.8 earthquake on the San Andreas Fault, modeling and predicting what would happen both during and after the quake. Scientific analysis of the shaking showed that with current structures, this earthquake would kill 1,800 people, injure 53,000, and cause $213 billion in damage. On November 13, 2008, nearly 5.5 million people came together to participate in the ShakeOut drill and work to reduce their risk. By helping Southern Californians to understand the earthquake risks they face and to plan and prepare for the inevitable, the USGS and its partners are working to keep this natural hazard from turning into a national catastrophe.

USGS scientists monitor and study earthquakes not just in California, but all over the world, monitoring faults and gathering data that help them to better understand these geological phenomena and the risks they pose to our lives and communities.

Standing Up to the Storms

During the 2008 hurricane season, as Hurricanes Gustav and Ike approached, the communities in the potential paths of the storms needed to understand the impacts that these storms might have on their area. As the hurricanes bore down on the Gulf Coast, the USGS helped residents and decisionmakers to prepare for the storms by creating and posting targeted maps showing the likelihood that an area would be submerged or would suffer extreme coastal change. After the storms, they needed to understand not only the extent of the damage, but their vulnerability to the next storm. After each hurricane, scientists quickly mobilized to document the coastal changes. Just 3 days after Gustav, the USGS created new vulnerability maps, helping residents to prepare for Hurricane Ike, which threatened the same region 2 weeks later. Immediately after Ike, scientists collected aerial video and still photography of post-storm beach conditions and gathered airborne surveys of post-storm topography. With these data, scientists determined the actual storm surge heights and which parts of the barrier islands remained. They worked quickly to make the information available online to government agencies and others that needed the information to support their disaster-recovery efforts. Residents used the information to plan their return home. USGS Web sites allowed them to look at conditions of bridges, roads, and their properties.

From homeowners desperate to know if their homes still stand to decisionmakers working to improve the safety of their citizens and neighborhoods—our Nation's coastal communities turn to the USGS. Reliable, timely information helps them prepare for the impacts of storms on coastal residents, plan future development, and protect treasured landscapes and habitats.

Understanding Emerging Contaminants

In Boulder Creek, Colorado, male fish are developing female characteristics, and the ratio of male to female fish is going down—changes that could be precursors of more severe impacts, including the ultimate elimination of the local population of the fish species. To help local and national decisionmakers to better understand these changes, their causes, and their implications for the future, USGS scientists conducted a study that demonstrated that exposure to endocrine disruptors (specifically, chemicals that behave like the hormone estrogen) found in wastewater is causing the feminization of local fish. These results are guiding future research on endocrine disruption, industry decisions on waste handling and treatment, and evaluations of appropriate actions to respond to endocrine disruption.

Studies on endocrine disruption are part of a larger USGS research focus on emerging contaminants—chemicals ranging from detergents to disinfectants, fragrances to fire retardants, and plastics to prescription drugs that are entering our environment. In recent years, the USGS has published more than 160 reports on emerging contaminants, helping the Nation to better understand the mixtures and levels of these chemicals, where they are originating, and the impacts that they are having on communities, ecosystems, and human health.

The USGS has

- more than 130 years of data and experience
- nearly 9,000 science and science-support staff
- more than 400 science centers across the United States
- locally, regionally, and nationally scaled studies
- hundreds of research projects
- tens of thousands of sampling and monitoring sites

These unique attributes and capabilities allow the USGS to provide tools for understanding and forecasting Earth processes that no other organization can provide.

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