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# Utah Science Activities Update 2010

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

# Our Mission and Vision

The U.S. Geological Survey (USGS), a bureau of the U.S. Department of the Interior, 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 USGS has become a world leader in the natural sciences thanks to our scientific excellence and responsiveness to society's needs.

This newsletter describes some of the current and recently completed USGS earth-science activities in Utah. Please contact us for additional information.

## Active USGS projects in Utah

As an unbiased, multi-disciplinary science organization that focuses on biology, geography, geology, and water, we are dedicated to the timely, relevant, and impartial study of the landscape, our natural resources, and the natural hazards that threaten us. Learn more about our goals and priorities for the coming decade in the USGS Science Strategy at http://www.usgs.gov/science_strategy/. To see what projects are currently active in Utah please visit our websites below.

Utah Water Science Center Active Projects
http://ut.water.usgs.gov/projects/.

Photograph courtesy of Moab Area Travel Council

Canyonlands Field Station Active Projects
http://sbsc.wr.usgs.gov/crs/research/projects/.

# Spotlight on USGS Scientists in Utah

## Dr. Jayne Belnap, Canyonlands Research Station

Research Ecologist
USGS Biological Resources Division

Dr. Jayne Belnap has been a scientist with the Department of the Interior since 1987 and is currently with the USGS in Moab, Utah. She is a past Chair for the Soil Ecology section of the Ecological Society of America and is currently President-Elect of the International Soil Ecology Society. She is also an assigning editor for Ecological Applications and participates in a number of other professional functions.

Dr. Belnap leads the interesting, accomplished, and well-traveled life many of us dream about. She studies how different land uses, including some of our favorite recreational activities such as hiking and biking, and activities that support our society such as livestock grazing and energy exploration, affect the fertility and stability of desert soils. Applying that knowledge, she then studies the factors that make some desert communities susceptible to invasion by exotic plants, while others remain uninvaded, despite similar use patterns.

Her studies have taken her to a number of exotic places, including South Africa, Kenya, Tanzania, Ethiopia, Zimbabwe, Mongolia, China, Siberia, Australia, and Iceland, where she advises scientists and managers on how to maintain soil fertility and stability while still using the land. She also travels extensively within the United States interacting with and training federal, state, and private land managers on how to best manage dryland ecosystems.

# Preventing Highway Deaths

## USGS maps areas of severe dust production in southeast Utah

Dust storms in the past 2 years have resulted in more frequent highway closures and multiple car accidents along Interstate 70 and State Route 191 in southeast Utah. The Bureau of Land Management (BLM), at the request of the local county, Utah Department of Transportation, and the Utah Highway Patrol, asked the U.S. Geological Survey Canyonlands Research Station for assistance in identifying the sources of the dust and determining what management actions could be taken to avoid excessive dust production from these areas.

Using a portable wind tunnel, the USGS characterized and mapped the dominant soil units in the vicinity of these highways, and determined the susceptibility of each unit to wind erosion before and after disturbance of the soil surface. These soil units were classified into categories of soils that would produce low, moderate, high, and extremely high levels of dust and then mapped.

Results of this investigation showed that most soils did not produce high levels of dust unless the soil surface was disturbed. When disturbed, several problematic soil units produced high or extremely high levels of dust until rainfall was sufficient to re-stabilize the surface. Unfortunately, most of these units were either adjacent to the highways or upwind of these highways during times of high winds or low precipitation (March-October). Study results are helping BLM make informed land-management decisions to minimize disturbance of these soil units during times of drought and during times of high winds and low precipitation. More information can be found at http://sbsc.wr.usgs.gov/crs/research/projects/crs.aspx

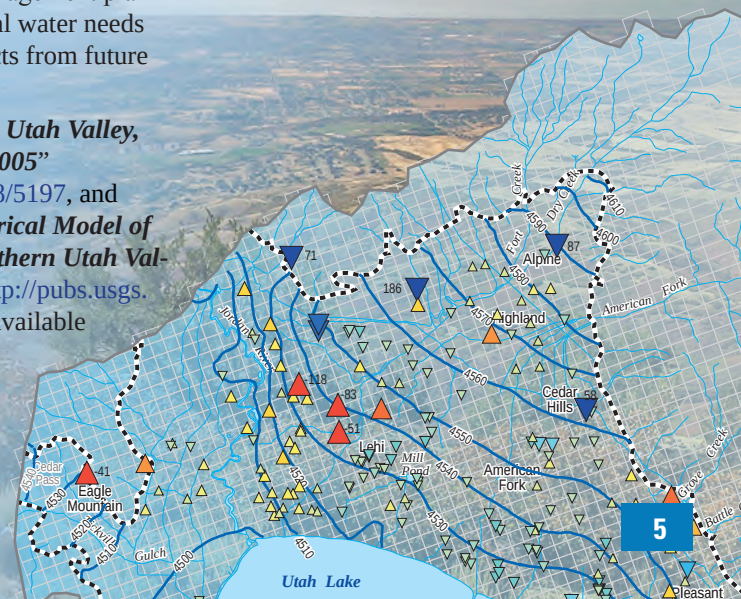
# Use of Groundwater Models

## New computer model aids groundwater management in Northern Utah Valley

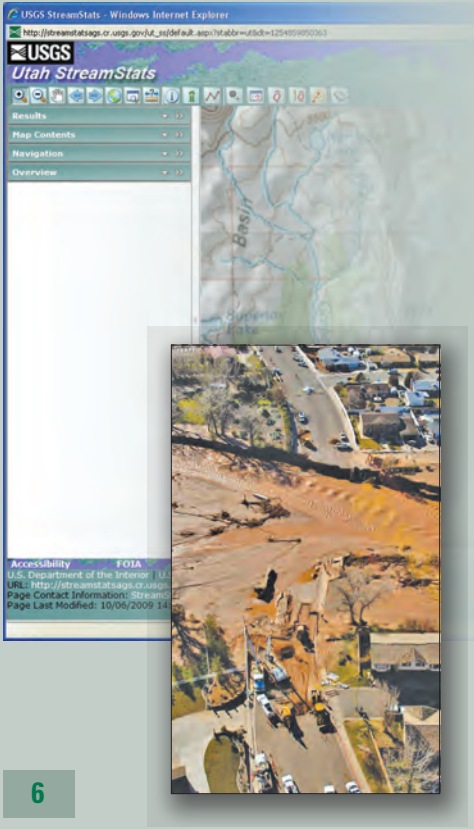
Utah Valley is experiencing a period of rapid population growth that includes a change from agricultural to commercial and residential land and water uses. Much of the recent growth is occurring on the west side of the valley, in previously undeveloped areas, requiring additional groundwater development. The USGS, in cooperation with valley municipalities and water users, has recently completed a new assessment of groundwater resources in Northern Utah Valley and has produced new modeling tools to help water managers.

New USGS models of groundwater conditions and flow include updated estimates of recharge to and discharge from the valley's aquifer system. Scientists have incorporated these refined estimates into a three-dimensional computer model of the Northern Utah Valley aquifer system capable of simulating the potential effects of increases in groundwater use and a changing land-use pattern on the valley's water resources. The USGS will be working with study cooperators to use the new groundwater computer model to help water managers define a management plan that will meet their municipal water needs and minimize adverse impacts from future groundwater development.

"***Hydrology of Northern Utah Valley, Utah County, Utah, 1975–2005***" http://pubs.usgs.gov/sir/2008/5197, and "***Three-Dimensional Numerical Model of Ground-Water Flow in Northern Utah Valley, Utah County, Utah***," http://pubs.usgs.gov/sir/2008/5049 are now available and are free to the public.



# USGS StreamStats Web Application




## Utah Water Science Center releases a new web-based application for estimating streamflow characteristics for Utah streams

Reliable estimates of a wide range of streamflow statistics are needed by water-resource managers, land-use planners, and structural designers. Obtaining this information has just been made much easier with the recent release of the Utah StreamStats tool. StreamStats is a web-based Geographic Information System (GIS) developed by the USGS that provides users with access to an assortment of analytical tools that are useful for water-resources planning and management, and for engineering design applications. For example, flood-flow estimates, that can now be quickly obtained from the StreamStats application, are used in the design of highway and railroad stream crossings, delineation of floodplains and flood-prone areas, management of water-control structures, and water-supply management.

StreamStats allows users to easily obtain streamflow statistics, drainage-basin characteristics, and other information for user-selected sites on streams via an interactive web-mapping application. Currently, StreamStats for Utah can be used to estimate the magnitude of peak flows under natural streamflow conditions at the 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year recurrence intervals.

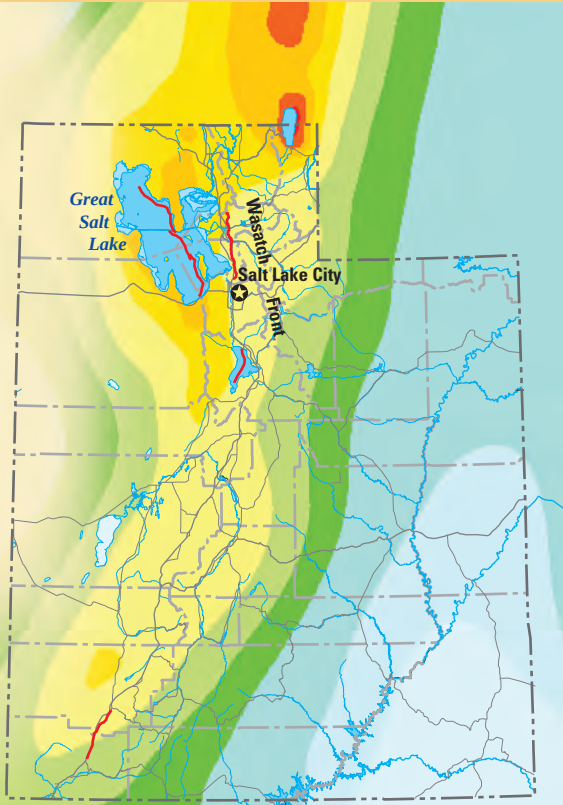
The StreamStats application for Utah incorporates new statistical models for streamflow statistics developed by the USGS Utah Water Science Center on the basis of historic streamflow data from the USGS National Water Information System (NWIS). More information can be found at http://water.usgs.gov/osw/streamstats/.

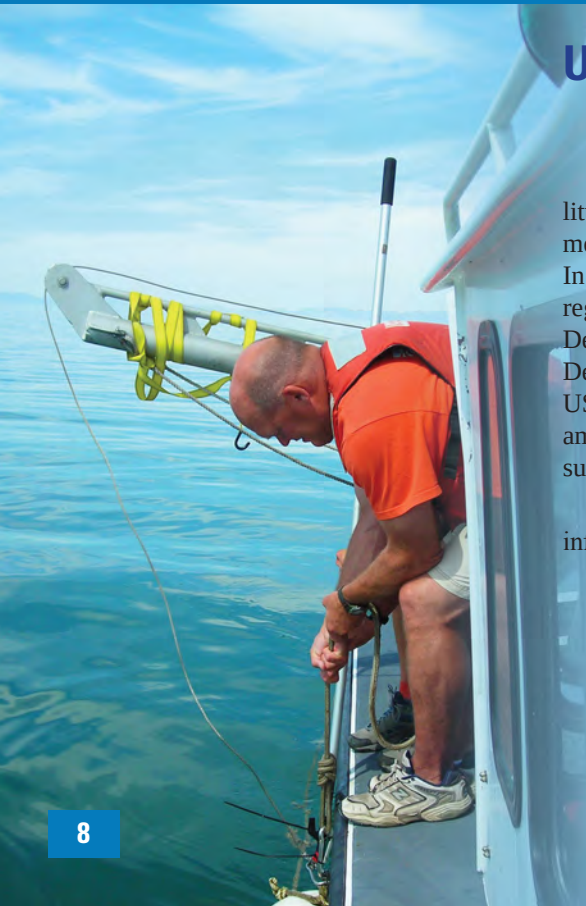
# USGS Seismic Hazard Maps

## Hazard maps play an important role in Utah earthquake preparedness

Utah is one of many states where faults and earthquake hazards play an important role in the lives of its citizens. The largest concentration of major faults in Utah lies along the Wasatch Front, home to the largest population centers. Preparing for the eventual earthquake is stressed through civic and religious organizations and generally includes an assessment of the risk to you and your home based on location. Because a large earthquake can be felt over a large area, you can be affected by movement along a fault miles away from where you are.

Faults, both near and far, provide a source for hazards from surface ruptures and ground shaking. The USGS, as part of its Hazards Reduction Program, has compiled probability maps for shaking hazards for the entire United States. These maps integrate available faulting and seismicity information into an indication of shaking hazard and were created to provide the most accurate and detailed information possible to assist engineers in designing buildings, bridges, highways, and utilities that will withstand shaking from earthquakes. These maps are used to create and update the building codes that are now used by more than 20,000 cities, counties, and local governments to help establish construction requirements necessary to preserve public safety. The National Hazard maps for Utah, as well as other states, are available at http://earthquake.usgs.gov/research/hazmaps/.

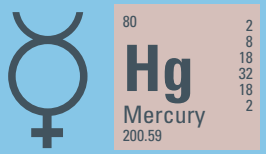




## USGS scientists look at mercury in Great Salt Lake

Despite the ecological and economic importance of Great Salt Lake, little is known about current and historic mercury input and biogeochemical cycling. In response to increasing public concern regarding mercury in the lake, the Utah Department of Environmental Quality, Utah Department of Natural Resources, and the USGS initiated studies to investigate the amount of mercury entering the lake from surface and atmospheric sources.

USGS scientists have quantified stream inflows and mercury concentration at all major inflow sites and determined daily and annual mercury contributions to the lake. The effort also has included utilizing sediment cores retrieved from the lake bottom to help define a record of riverine and atmospheric mercury input to the lake over the last 100 years. Study results indicate that the majority of mercury input to Great Salt Lake is from the atmosphere and the more toxic form of mercury is removed from wetland water bodies during daylight hours and replenished during non-daylight hours. You can learn more about Great Salt Lake and its unique ecosystems at http://ut.water.usgs.gov/greatsaltlake/.



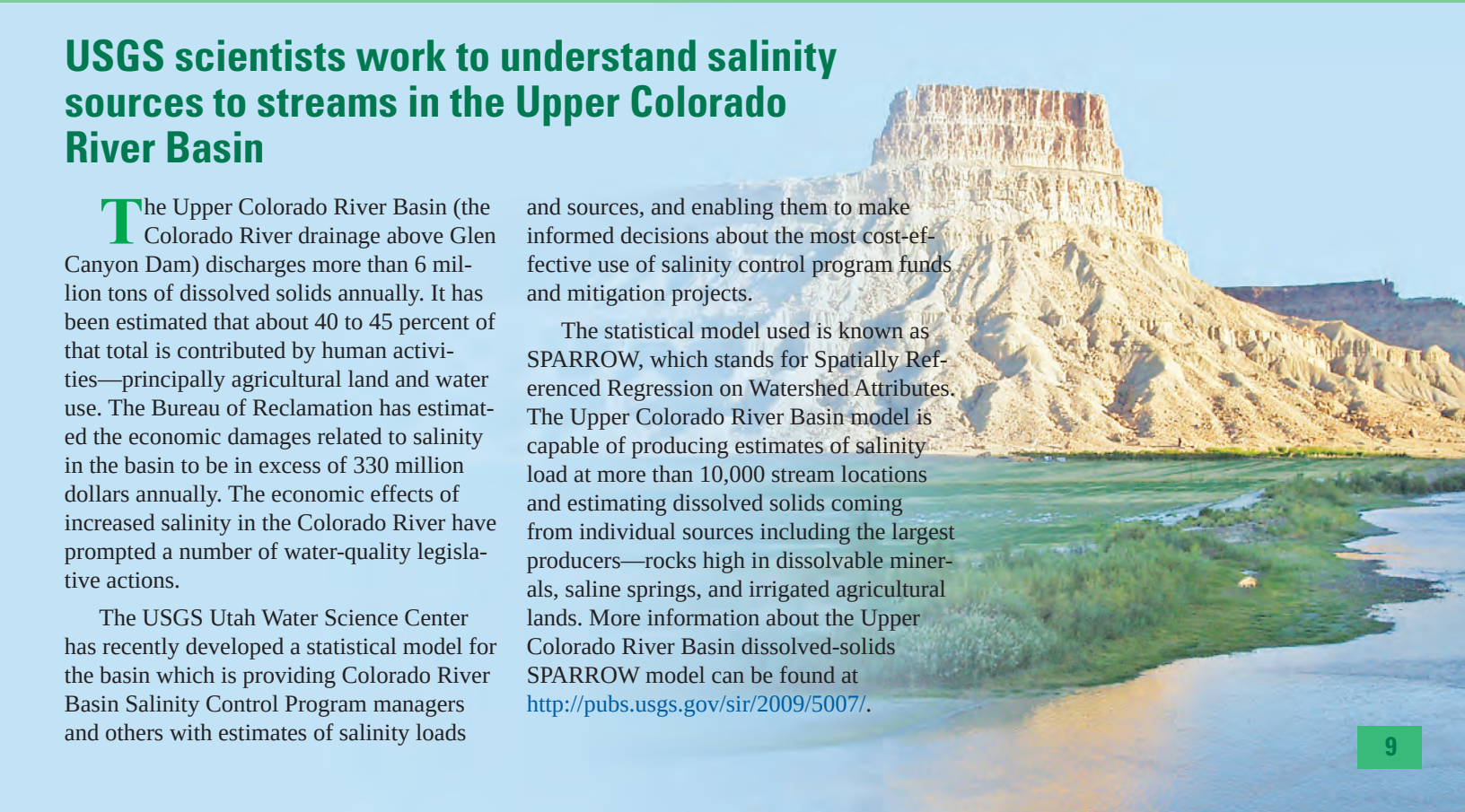
# Pass the Salt

## USGS scientists work to understand salinity sources to streams in the Upper Colorado River Basin

The Upper Colorado River Basin (the Colorado River drainage above Glen Canyon Dam) discharges more than 6 million tons of dissolved solids annually. It has been estimated that about 40 to 45 percent of that total is contributed by human activities—principally agricultural land and water use. The Bureau of Reclamation has estimated the economic damages related to salinity in the basin to be in excess of 330 million dollars annually. The economic effects of increased salinity in the Colorado River have prompted a number of water-quality legislative actions.

The USGS Utah Water Science Center has recently developed a statistical model for the basin which is providing Colorado River Basin Salinity Control Program managers and others with estimates of salinity loads and sources, and enabling them to make informed decisions about the most cost-effective use of salinity control program funds and mitigation projects.

The statistical model used is known as SPARROW, which stands for Spatially Referenced Regression on Watershed Attributes. The Upper Colorado River Basin model is capable of producing estimates of salinity load at more than 10,000 stream locations and estimating dissolved solids coming from individual sources including the largest producers—rocks high in dissolvable minerals, saline springs, and irrigated agricultural lands. More information about the Upper Colorado River Basin dissolved-solids SPARROW model can be found at http://pubs.usgs.gov/sir/2009/5007/.



# Indirect Effects of Pest Control

## Understanding the effects of grasshopper and cricket control in Utah's West Desert

In rangeland ecosystems of the United States, such as Utah's West Desert, rangeland grasshopper and Mormon cricket (Orthoptera) populations periodically build to extremely high numbers and can cause significant economic damage in rangelands and agricultural fields. A variety of insecticides have been applied to control population outbreaks, with recent efforts directed at minimizing impacts to nontarget fauna in treated ecosystems.

The U.S. Geological Survey, in cooperation with the U.S. Department of Agriculture Animal and Plant Health Inspection Service and the Bureau of Land Management are investigating whether applications of pesticides for grasshopper and cricket control may affect other biota including aquatic and terrestial invertebrates living in the pest control areas, and the birds that eat them. USGS scientists are assessing both immediate and long-term effects of pesticide application, focusing on the area in and around the West Desert of Utah. More than 300,000 specimens of land and aquatic arthropods and other invertebrates have been collected during this study.

A link to the report documenting study results to date can be found at http://pubs.usgs.gov/of/2008/1305/.

# Water in the Great Basin

## USGS National Water Availability Program targets the eastern Great Basin of Nevada and Utah

The eastern Great Basin Carbonate Province, located primarily in western Utah and eastern Nevada is undergoing unprecedented population growth in one of the nation's most arid areas. This is placing increasing demands on the area's groundwater resources for meeting public supply, agricultural, and ecosystem demands. As part of the USGS National Water Availability Program, the Great Basin Carbonate and Alluvial Aquifer System (GBCAAS) study is quantifying current groundwater resources, evaluating how those resources have changed over time, and developing tools to assess system responses to stresses from future human uses and climate variability.

Researchers are currently gathering and interpreting information related to the region's geology and hydrology to develop a conceptual understanding of water movement within this complex system. USGS hydrologists will be using this knowledge to construct a computer simulation model to help better understand how the system responds to natural and human stresses. More information on this study is available at the USGS Utah Water Science project web page at http://ut.water.usgs.gov/projects/greatbasin/.

# Navajo Sandstone Aquifer

## USGS scientists look at the Navajo Sandstone as a groundwater source and storage reservoir

As populations in arid areas continue to expand, permeable bedrock aquifers are increasingly targeted for groundwater development. Understanding both natural recharge and the potential for managed artificial recharge is becoming increasingly important for sustainable water-resources management.

To address this increased reliance on bedrock aquifers, the Navajo Sandstone Recharge Project, conducted by the USGS in cooperation with the Washington County Water Conservancy District and the Bureau of Reclamation, has been quantifying both natural and artificial recharge to the Navajo Sandstone aquifer.

Important advances have been made during this study in understanding how recharge from precipitation moves through the subsurface and enters the aquifer, as well as evaluations of the effectiveness of various techniques for enhancing groundwater resources through artificial recharge. Such artificial recharge methods can be used to offset groundwater depletion caused by increased pumping. More information on both natural and artificial recharge to the Navajo Sandstone can be found at http://ut.water.usgs.gov/projects/navajosandstone/.

# Stream Gaging in Utah

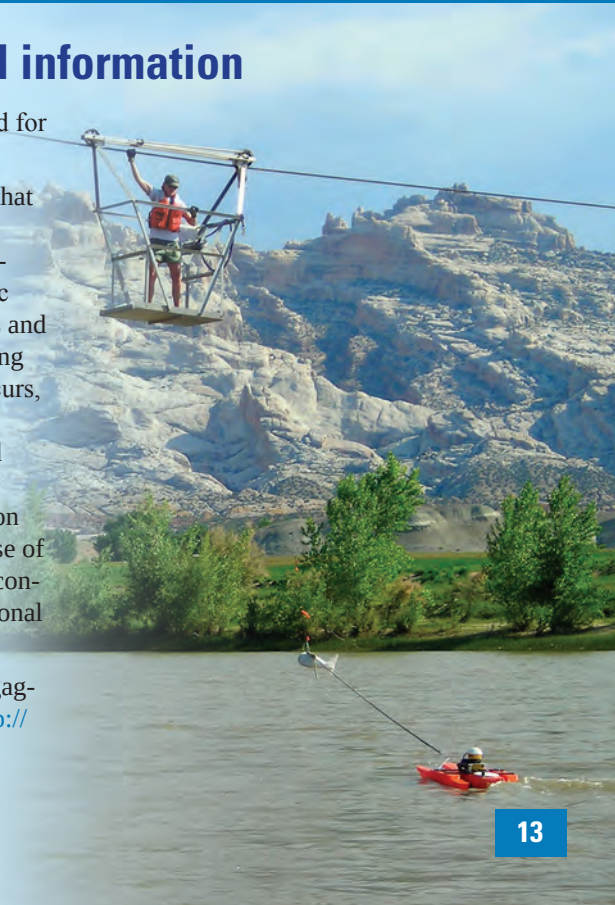
## Gages provide long-term, accurate, and impartial information

Since the late 1800s, the U.S. Geological Survey has been installing and operating stream gages throughout the United States. Currently, the USGS operates and maintains over 140 real-time stream gages in Utah. These gages provide long-term, accurate, and impartial information that meets the needs of many diverse users.

Stream gages measure stage, or the height of the river, which is then used to determine the amount of water flowing in the river. Streamflow measurements are made several times a year to ensure that the relation between the recorded stage values and streamflow is accurate. The stage is recorded every 15 minutes and temporarily stored at the gage. In most cases the recorded values are transmitted, via radios and satellites, on an hourly basis to the National Water Information System (NWIS) database where the information is permanently stored, used in scientific investigations, and displayed for the public on the internet.

Free access over the internet means that the streamflow information these gages provide can be used in a variety of applications from recreational use to scientific investigations. Water-resource managers and engineers use the information for planning and design purposes. When flooding occurs, emergency-response teams and managers use the information for warnings and flood forecasting. Rafters and fishermen throughout the Nation use the information to determine ideal conditions for their use of the river. Information from these gages continues to be a critical component in National and local water-related decisions.

More information about the stream gaging program in Utah can be found at http://ut.water.usgs.gov/.



# USGS Utah Recent Publications

***Assessment of Managed Aquifer Recharge at Sand Hollow Reservoir, Washington County, Utah, Updated to Conditions through 2007***, by V.M. Heilweil, G. Ortiz, and D.D. Susong: U.S. Geological Survey Scientific Investigations Report 2009-5050. Available online at http://pubs.usgs.gov/sir/2009/5050/.

***Evaluation of the Effects of Precipitation on Ground-Water Levels from Wells in Selected Alluvial Aquifers in Utah and Arizona, 1936–2005***, by P.M. Gardner and V.M. Heilweil: U.S. Geological Survey Scientific Investigations Report 2008-5242. Available online at http://pubs.usgs.gov/sir/2008/5242/.

***Federal Guidelines, Requirements, and Procedures for the National Watershed Boundary Dataset***, by U.S. Geological Survey and U.S. Department of Agriculture, Natural Resources Conservation Service: Chapter 3 of Section A, Federal Standards Book 11, Collection and Delineation of Spatial Data. Available online at http://pubs.usgs.gov/tm/tm11a3/.

***Geospatial Data to Support Analysis of Water-Quality Conditions in Basin-Fill Aquifers in the Southwestern United States***, by T.S. McKinney and D.W. Anning: U.S. Geological Survey Scientific Investigations Report 2008-5239. Available online at http://pubs.usgs.gov/sir/2008/5239/.

***Hydrology of Northern Utah Valley, Utah County, Utah, 1975-2005***, by J.R. Cederberg, P.M. Gardner, and S.A. Thiros: U.S. Geological Survey Scientific Investigations Report 2008-5197. Available online at http://pubs.usgs.gov/sir/2008/5197/.

***Southwest Principal Aquifers Regional Ground-Water Quality Assessment***, by D.W. Anning, S.A. Thiros, L.M. Bexfield, T.S. McKinney, and J.M. Green: U.S. Geological Survey Fact Sheet 2009-3015. Available online at http://pubs.usgs.gov/fs/2009/3015/.

S***ummary of Fluvial Sediment Collected at Selected Sites on the Gunnison River in Colorado and the Green and Duchesne Rivers in Utah, Water Years 2005–2008***, by C.A. Williams, S.J. Gerner, and J.G. Elliott: U.S. Geological Survey Data Series 409. Available online at http://pubs.usgs.gov/ds/409/.

***Three-Dimensional Numerical Model of Ground-Water Flow in Northern Utah Valley, Utah County, Utah***, by P.M. Gardner: U.S. Geological Survey Scientific Investigations Report 2008-5049. Available online at http://pubs.usgs.gov/sir/2008/5049/.

***Assessment of Nonpoint Source Chemical Loading Potential to Watersheds Containing Uranium Waste Dumps Associated with Uranium Exploration and Mining, San Rafael Swell, Utah***, by M.L. Freeman, D.L. Naftz, T. Snyder, and G. Johnson: U.S. Geological Survey Scientific Investigations Report 2008-5110. Available online at http://pubs.usgs.gov/sir/2008/5110/.

***Dissolved-Solids Transport in Surface Water of the Muddy Creek Basin, Utah***, by S.J. Gerner: U.S. Geological Survey Scientific Investigations Report 2008-5001. Available online at http://pubs.usgs.gov/sir/2008/5001/.

***Flood Plain Delineation for the Fremont River and Bull Creek, Hanksville, Utah***, by T.A. Kenney and S.G. Buto: U.S. Geological Survey Scientific Investigations Report 2008-5233. Available online at http://pubs.usgs.gov/sir/2008/5233/.

***Estimation of Selenium Loads Entering the South Arm of Great Salt Lake, Utah, from May 2006 through March 2008***, by D.L. Naftz, W.P. Johnson, M.L. Freeman, K. Beisner, X. Diaz, and V.A. Cross: U.S. Geological Survey Scientific Investigations Report 2008-5069. Available online at http://pubs.usgs.gov/sir/2008/5069/.

***Methods for Estimating Monthly and Annual Streamflow Statistics at Ungaged Sites in Utah***, by C.D. Wilkowske, T.A. Kenney, and S.J. Wright: U.S. Geological Survey Scientific Investigations Report 2008-5230. Available online at http://pubs.usgs.gov/sir/2008/5230/.

***Mormon Cricket Control in Utah's West Desert—Evaluation of Impacts of the Pesticide Diflubenzuron on Nontarget Arthropod Communities***, by T.B. Graham, A.M.D. Brasher, and R.N. Close: U.S. Geological Survey Open-File Report 2008-1305. Available online at http://pubs.usgs.gov/of/2008/1305/.

***Principal Locations of Major-Ion, Trace-Element, Nitrate, and Escherichia coli Loading to Emigration Creek, Salt Lake County, Utah, October 2005***, by B.A. Kimball, R.L. Runkel, and K. Walton-Day: U.S. Geological Survey Scientific Investigations Report 2008-5043. Available online at http://pubs.usgs.gov/sir/2008/5043/.

***Methods and Basic Data from Mass-Loading Studies in American Fork, October 1999, and Mary Ellen Gulch, Utah, September 2000***, by B.A. Kimball, R.L. Runkel, and L.J. Gerner: U.S. Geological Survey Data Series 443. Available online at http://pubs.usgs.gov/ds/443/.

***Spatially Referenced Statistical Assessment of Dissolved-Solids Load Sources and Transport in Streams of the Upper Colorado River Basin***, by T.A. Kenney, S.J. Gerner, S.G. Buto, and L.E. Spangler: U.S. Geological Survey Scientific Investigations Report 2009-5007. Available online at http://pubs.usgs.gov/sir/2009/5007/.

***Principal Locations of Metal Loading from Flood-Plain Tailings, Lower Silver Creek, Utah, April 2004***, by B.A. Kimball, R.L. Runkel, and K. Walton-Day: U.S. Geological Survey Scientific Investigations Report 2007–5248. Available online at http://pubs.usgs.gov/sir/2007/5248/.

**More online reports are available at http://ut.water.usgs.gov/publications/ or http://sbsc.wr.usgs.gov/crs/products/.**

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