

# Science & Technology Highlights

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### **Improving Water Supply Technologies**

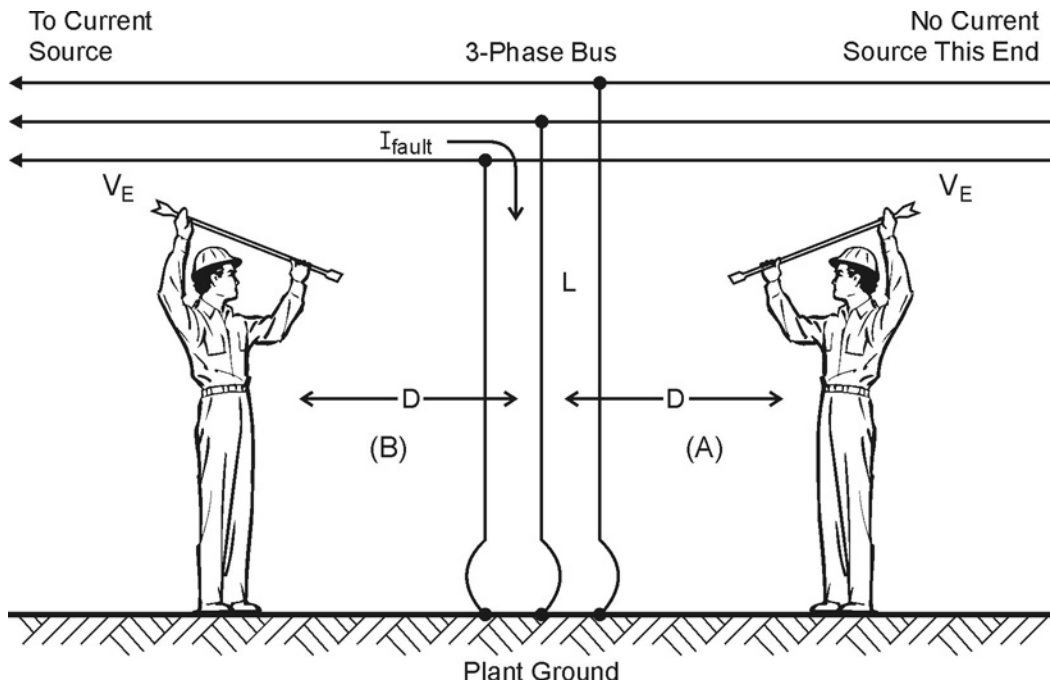
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## Improving Infrastructure Reliability

**Bureau of Reclamation researchers help revise industry high voltage safety standards.**—Workers at high-voltage switchyards must be extremely careful to follow safety standards. Bureau of Reclamation (Reclamation) research in personal protective electrical grounding is culminating in a revision to a national safety grounding standard published by the Institute of Electrical and Electronics Engineers (IEEE). IEEE 1246TM, *Guide for Temporary Protective Grounding Systems Used in Substations*, is currently under revision by a work group of power industry representatives and Reclamation researchers. A major addition to the guide will incorporate the results of Reclamation's grounding safety research.

This research will help users to more accurately quantify worker exposure voltage by accounting for the physical location of the worker with respect to the placement of protective grounds on high-voltage equipment in a switchyard. This will improve safety throughout the electric power industry by reducing the likelihood of electrocution during maintenance work. (Jim DeHaan, 303-445-2305)



The distance ( $D$ ) between a worker and personal protective grounds significantly affects worker exposure voltage.

*Light detection and ranging (LiDAR) technology being used to document and protect pictographs at Cedar Bluff Reservoir.*—The Nebraska-Kansas Area Office is utilizing the expertise of the **Remote Sensing and Survey Group** out of the **Mid-Pacific Region** and the project management skills of the **Land Resources Office in the Office of Program and Policy Services** to document rock art—both petroglyph and pictograph panels. The rock art, located at **Cedar Bluff Reservoir in Kansas**, dates from the mid-19th century and is subject to natural erosion and vandalism. The LiDAR technology will provide highly detailed three-dimensional imagery of the petroglyphs and pictographs so managers can document baseline conditions of the rock art at a very fine scale and pinpoint those panels that need intervention to retard erosion or reduce vandalism. Application of LiDAR technology should create significant cost savings over traditional rock art recording methods as well as provide data that will be used in resource protection and preservation. (Thomas R. Lincoln, 303-445-3311)

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## Improving Decision Support

*Reclamation is integrating HydroGeoSphere (HGS) and the Groundwater Modeling System (GMS).*—Research has started on the integration of geospatial tools to support HydroGeoSphere. The numerous software tools currently used to develop HGS input and visualize HGS output are cumbersome.

HydroGeoSphere is a computer model used to guide management of water resources and protection of complex ecosystems. The development of HydroGeoSphere has been a joint effort involving Reclamation, the University of Waterloo, Laval University, and HydroGeoLogic, Inc. It accounts for water flow and solute migration in two-dimensional surface water, one-dimensional irrigation systems, wells and tile drains, and three-dimensional variably saturated subsurface water.

The integration research is a result of the review of numerous commercial, off-the-shelf software packages that could provide integration support for HGS. The most likely integration candidate for this effort was the Groundwater Modeling System (GMS) from Aquaveo. Reclamation, Aquaveo, the University of Waterloo and Laval University have agreed on a time frame to plan the HGS and GMS research paths and determine the best path for integration. (Lorri Peltz-Lewis, 916-978-5271)

*Reclamation personnel exchange state-of-the-art developments at the American Water Resources Association (AWRA) Spring Specialty Conference.*—At the recent AWRA Spring Specialty Conference, *Geographic Information Systems (GIS) and Water Resources V*, held in **San Mateo, California**, over 200 presentations were given to almost 350 attendees over 3 days. The Science and Technology Program provided support to this conference.

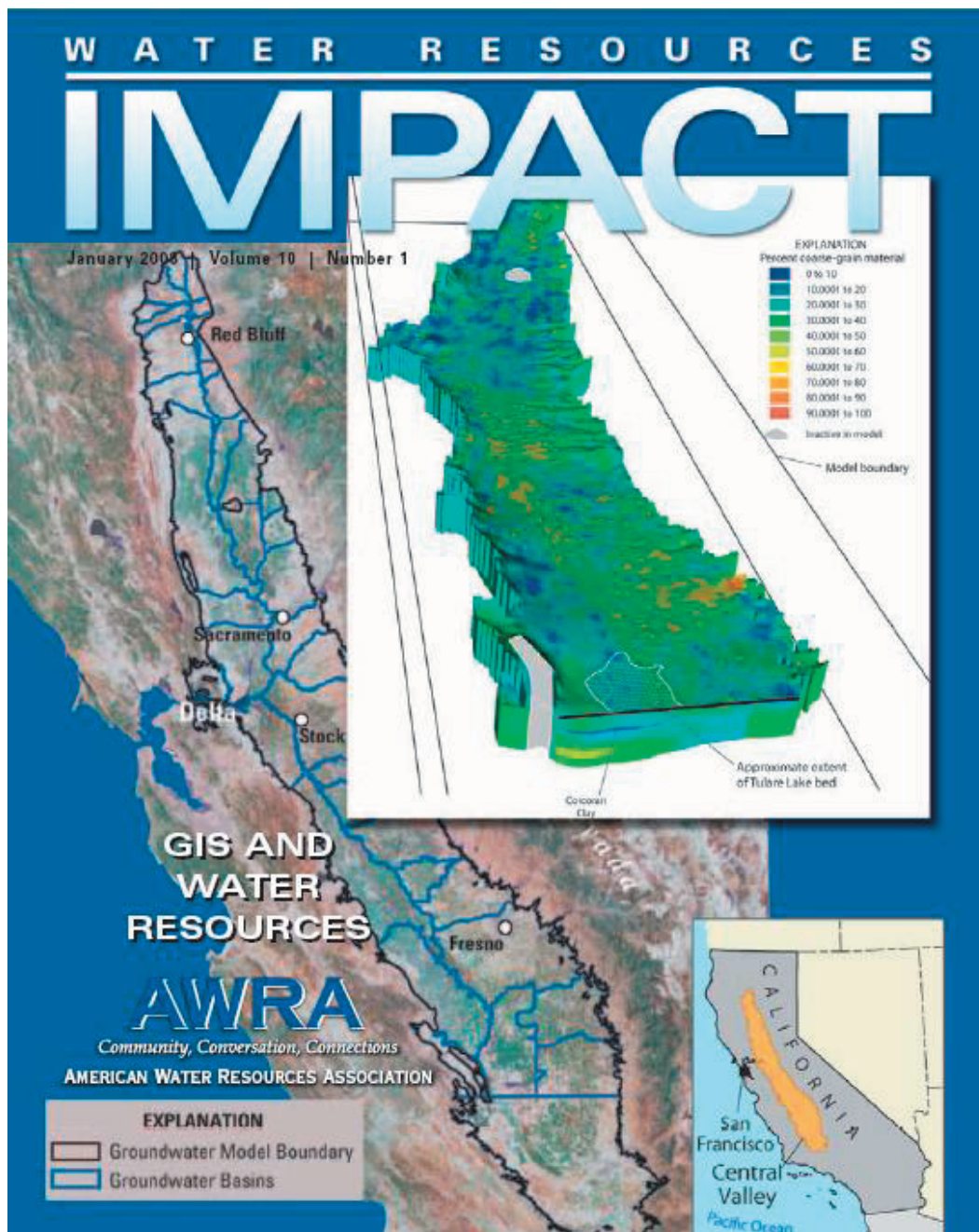
Preconference training sessions included training for deriving input for the Soil and Water Assessment Tool (SWAT) using *ArcSWAT—A Tool for Total Maximum Daily Load (TMDL) Development/Assessment* and the *Consortium of Universities for the Advancement of Hydrologic Science (CUAHSI) Hydrologic Information System*. The keynote presenter, Dr. Robert Twiss, Professor Emeritus, University of California, Berkley, discussed *A Vision for the Future of California's Delta: The Role of GIS in Visualization and Communication*, which demonstrated the use of GIS in the State of California's Delta Vision collaborative efforts. This year's conference saw numerous papers on LiDAR uses, LiDAR applications, CUAHSI efforts, hydrologic information systems (HIS), the National Hydrographic Dataset (NHD), NHDPlus, floodplains, and watersheds. Notable this year were numerous papers on biological and habitat applications based on NHD.

The January 2008 issue of the AWRA's *IMPACT* magazine highlighted the conference. This issue is the largest that the AWRA has ever published and distributed. A digital copy of the January 2008 issue of *IMPACT* magazine is available upon request to the guest editor, Lorri Peltz-Lewis, [lpeltzlewis@mp.usbr.gov](mailto:lpeltzlewis@mp.usbr.gov).

A significant portion of the attendees at the conference were non-AWRA members; while many came from local areas, attendees also came from Europe, Iran, and many Pacific islands. The attendees represented consulting companies, federal/State/local agencies, and educational institutions predominately. During the conference, attendees rated student presenters for the AWRA Outstanding Student Presenter Award. Also during the conference, about one third of the presentations were recorded for release as podcasts, along with Dr. Twiss' presentation, many papers, and a special session lead by Dr. David Maidment discussing the future of hydrology and geospatial technologies.

While topics varied widely, it was apparent that the use of geospatial technologies continues to grow and be a significant contributor to all of the lines of business within all participating organizations.

The excitement at this conference also resulted in volunteers stepping up to take on the coordination of future conferences including the 2010 *GIS and Water Resources VI* being scheduled for Florida, and the 2012 conference being scheduled for New Mexico. (Lorri Peltz-Lewis, 916-978-5271)



Cover of the January 2008 issue of *IMPACT* magazine highlighting the AWRA Spring Specialty Conference: *GIS and Water Resources V*.

***Reclamation is refining streamflow forecasts.***—Methods to determine flood risk depend on the reliable representation of basin hydrology. Most often, historic natural streamflows are used to forecast streamflows, but in basins with significant groundwater storage, historical streamflows may not be representative of present or near future conditions.

Researchers in the **Pacific Northwest Regional Office** have developed daily streamflows for the Upper Snake River Basin adjusted for the combined influence of historical infiltration and historical groundwater pumping. The streamflow adjustments were determined using response functions developed by the University of Idaho by the application of the MODFLOW groundwater model jointly developed by the Idaho Water Resources Research Institute, University of Idaho, the State of Idaho, and Reclamation.

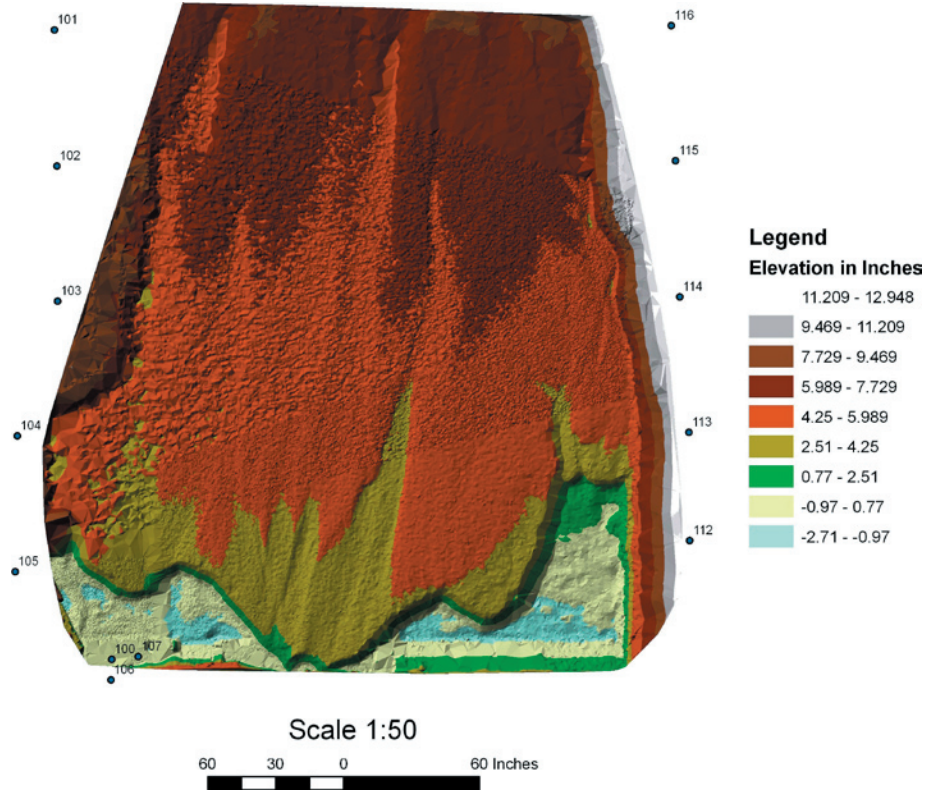
The eastern **Snake River Plain** is primarily basalt and extends 200 miles across southeastern Idaho. In the late 1800s, irrigators began to divert up to twice the amount of water necessary to meet crop requirements. The remainder of the water returned to the Snake River or infiltrated to the aquifer, resulting in higher groundwater levels and delayed discharge to the Snake River. The delay in response can be as long as 50 years. Starting in the mid-1950s, new water storage facilities and water conservation programs resulted in increased water use efficiency, reduced diversions, and less return flow contributing to aquifer recharge. In the 1970s, groundwater pumping for irrigation increased dramatically. The combined effects of surface water irrigation and groundwater pumping have a major influence on measured river streamflows.

The methods used to adjust the hydrologic data for historical infiltration and groundwater pumping are widely applicable. The researchers anticipate the approach will provide improved reliability in streamflow predictions.

This work completes the first phase of this research project. The next phase is to vary the groundwater-adjusted streamflows for historic climate change influences. (Leslie Stillwater, 208-378-5202)

***The Technical Service Center (TSC) creates new hydraulic models to guide sediment management in reservoirs.***—In the past, researchers evaluating the effect of water flows on simulated streambeds in laboratory flumes used manual, labor-intensive methods involving strings and tape measures to measure for changes in the streambed. Such methods are time consuming, and some measurements lack sufficient accuracy for detailed analysis.

The Reclamation Remote Sensing and GIS Team has been investigating the use of close-range photogrammetric techniques to document and analyze sediment distribution and volume for the Robles sediment model in the laboratory. In cooperation with the Hydraulic Investigations and Laboratory Services Group, researchers have photographed seven different Robles model water flows/sediment studies. Hand-held and tripod-mounted digital cameras are being used to capture the digital photographs. Control point coordinate data were collected via traditional surveying methods, and close-range photogrammetric software is being used to process and analyze the digital photos and control data. The end result is the production of digital terrain models and volumetric measurements for each of the seven water flows/sediment runs. (Alan Bell, 303-445-2268)



A color-contoured surface generated from a digital terrain model produced photo-grammetrically.

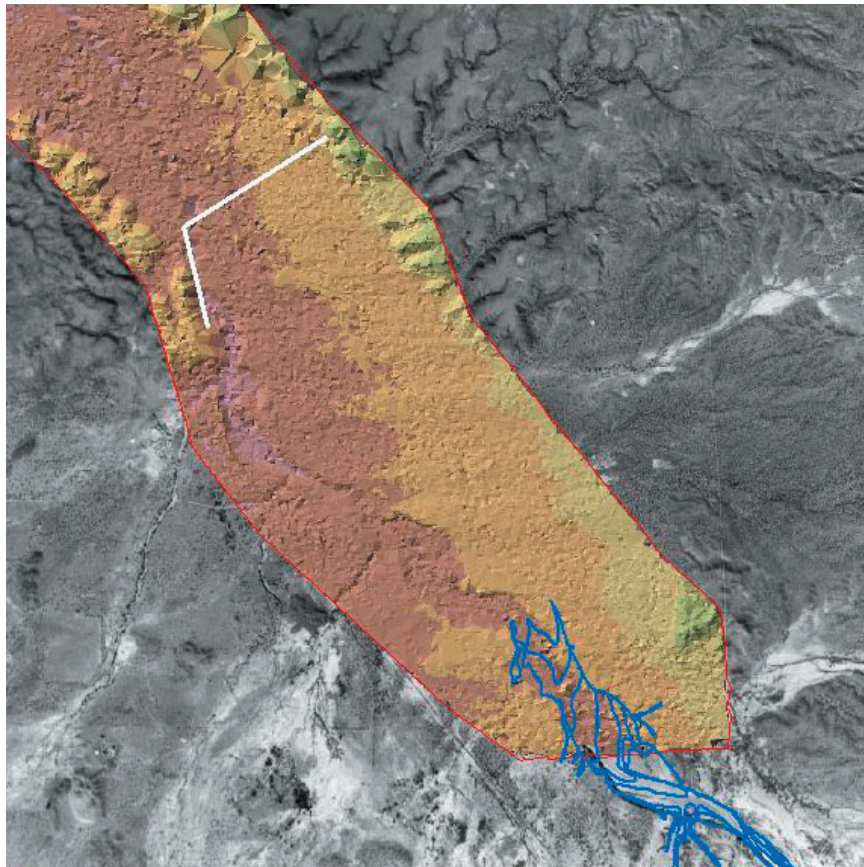


The Robles sediment model.

*The TSC uses remote sensing to measure river changes.*—Sedimentation is a key component of water quality in rivers, and predicting river sedimentation depends on predicting changes in rivers. This research uses remote sensing, including both aerial photography and modern techniques to identify and measure volumetric, spatial, and temporal changes in river systems.

Photogrammetric models representing the confluence of the **Gila** and **San Simon Rivers** in **Arizona** were built using aerial photographs from 1935 supplemented by digital terrain model (DTM) points from 2001. Statistical surface analysis will be performed when the models are completed.

The DTM for a barrier dam near the confluence is shown below (not complete). The dam location is in white, and the 1935 topography is in blue. Models further upstream will be used to complete aggregation and degradation analyses. The layers will be available on a geomorphic research database website for evaluation by Reclamation and the Bureau of Land Management.



In order to evaluate the effectiveness of the barrier dam for blocking sediment, predam channel conditions are needed upstream and downstream of the dam. The 1935 topography ended short of the dam, creating a topographic information gap that needed to be filled. The graphic illustrates that topography in color coding.



This research will allow engineers and scientists to better predict and manage river system changes to provide optimum water quality and delivery. Stream change evaluation along control structures will provide feedback in erosion control effectiveness for this site. The research will also provide supplemental data and tools to better document stream conditions at other sites. (Ron Miller, 303-445-2279)

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## Improving Water Delivery Reliability

*Reclamation tracks green sturgeon at Red Bluff Diversion Dam.*—Improved operation of **Red Bluff Diversion Dam** (RBDD) could help green sturgeon survive. To that end, Reclamation is monitoring the movements and habitat preferences of hydroacoustically tagged green sturgeon. So far in 2008, approximately 15 river miles of the upper **Sacramento River** have been surveyed for possible green sturgeon holding habitat that has depths of 5 meters or more. Three known holding areas have also been surveyed that were identified in 2007 by multiple detections of hydroacoustically tagged green sturgeon using a portable receiver with a directional hydrophone. The average depth within these known holding areas ranges from 5.3 to 6.5 meters, indicating that green sturgeon prefer holding habitats that have depths greater than 5 meters.

Also, four stationary receivers have been deployed within the Sacramento River with two deployed downstream of the RBDD and two upstream of the dam. To date, no hydroacoustically tagged green sturgeons have been located in the vicinity of the RBDD. However, fish biologists from the University of California, Davis, who maintain an extensive stationary receiver array within the Sacramento River, have indicated that two previously tagged green sturgeons have entered the lower river on their way upstream. By downloading data from the stationary receivers at the RBDD weekly and conducting tracking using the mobile receiver, the location and time of detection of any hydroacoustically tagged green sturgeon will be identified.

Information gained from monitoring green sturgeon at RBDD will benefit Reclamation's operations of the dam and the continued survival of the threatened Southern District Population Segment of green sturgeon. (Richard Corwin, 530-528-0512)



A portable receiver with a directional hydrophone detects hydroacoustically tagged green sturgeon.

## Improving Water Supply Technologies

***Reclamation tests programmable logic control of automated surface irrigation systems.***—Despite urbanization, agriculture is still by far the major water user in the Lower Colorado Region with over 80 percent of total water consumption. Within the agricultural sector, about 95 percent is surface irrigation. Surface irrigation systems in Lower Colorado valleys can be efficiently managed using improved methods of determining irrigation cutoff time. Proper decisions on when water should be cut off often must be made based upon determining the extent of water advance across the field. In practical terms, this is very difficult to do at night or even in the daytime with tall, dense crops. Therefore, the irrigator must overcompensate by overirrigating. Finding and keeping trained labor to irrigate properly is becoming more difficult.

This research project will construct and operate automated systems for two types of surface irrigation—level basins and graded borders—on existing farms in cooperation with the Universities of California and Arizona. Design of the systems is complete. Construction is scheduled for the third quarter of fiscal year 2008.

Automated surface irrigation would enable more efficient use of water by overcoming some of the shortcomings of manual irrigation. (Mark Niblack, 928-343-8253)

*Reclamation collaborates on a new water supply planning model for the Boise Valley.*—Increasing demand for water in southwest **Idaho** is forcing Reclamation to consider new ways to stretch existing supplies. Alternatives being considered fall generally into one of two categories. Supply management alternatives, such as building new reservoirs, focus on increasing water supply. Demand management alternatives concentrate on reducing demand for water by conservation, by regulation, or through market pricing.

A spatial water allocation computer model, which Reclamation is developing in collaboration with the University of Idaho, describes the allocation of water based on its (surface and subsurface) hydrologic distribution, and on the economics of supply and demand. Reclamation managers reviewed a report describing the development and initial application of a the model for the **Boise Valley** in February and March. The report is now being revised prior to publication.

The model will assist Reclamation managers in evaluating the cost/benefit associated with various supply management and demand management alternatives. The economic impacts of these alternatives are also critical to Reclamation planning and are represented in the model by economic/hydrologic externalities. (Allyn Meuleman, 208-383-2258)