RECLAMATION Apr - June 2008
Managing Water in the West

Science & Technology Highlights

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U.S. Department of the Interior
Bureau of Reclamation
Science and Technology

Improving Infrastructure Reliability

Reclamation measures how iron reducing bacteria affect water and nutrient transports in subsurface tile drains.—Drain tiles underlie farmers' fields to lower the groundwater level for crops. Iron reducing bacteria, common in the western U.S., plug these tile drains. Irrigation districts spend thousands of dollars cleaning out these drains. Reclamation, as a partner with irrigation districts, directly and indirectly helps bear these increased maintenance costs. However, iron reducing bacteria reduce the nutrients in agricultural drains and can actually improve the drain water quality. We need to find the best schedule to clean these drains to maximize the water quality from the drains and minimize maintenance costs.

Reclamation, the University of North Dakota, North Dakota State University, and state agencies are measuring these effects with several tracer tests to measure nutrient uptake in drain tiles have been conducted, and a drain tile section was cleaned to replicate the experiment as a control. Another major step in measuring nutrient uptake in the area got underway as we installed In-Situ Mesocosms, large stainless steel cylinders, in the project area to measure background uptake of nutrients.

The project is also measuring and documenting changes in hydraulic efficiency of the drain tiles from the biofilms that iron reducing bacteria produce. We are collecting water level data and developing a DRAINMOD hydraulic model for the tile system. We currently have an operational model calibrated to historic conditions that will help calculate changes in hydraulic efficiency. (Allen J. Schlag, 701-221-1277)

Improving Decision Support

Reclamation improves HydroGeoSphere.—Managing water resources at a basin-wide level requires understanding complex, and closely connected, subsurface and surface hydrologic systems. To provide this information, Reclamation is adding groundwater information to HydroGeoSphere, a model that evaluates hydrological and ecological processes. Core researchers and developers of HydroGeoSphere (HGS) and Groundwater Modeling System (GMS) identified ways to collaborate and integrate these systems to:

- Reduce the need for multiple software packages to support the model input and output
- Directly integrate HGS into widely used, easily available software packages in a comprehensive and open delivery to all potential users —Federal, state, local, private, educational, etc.
- Integrate the ongoing research efforts into nationally supported efforts for database standards and modeling integration

- Compare model results from various modeling packages to provide a toolbox of models to modelers

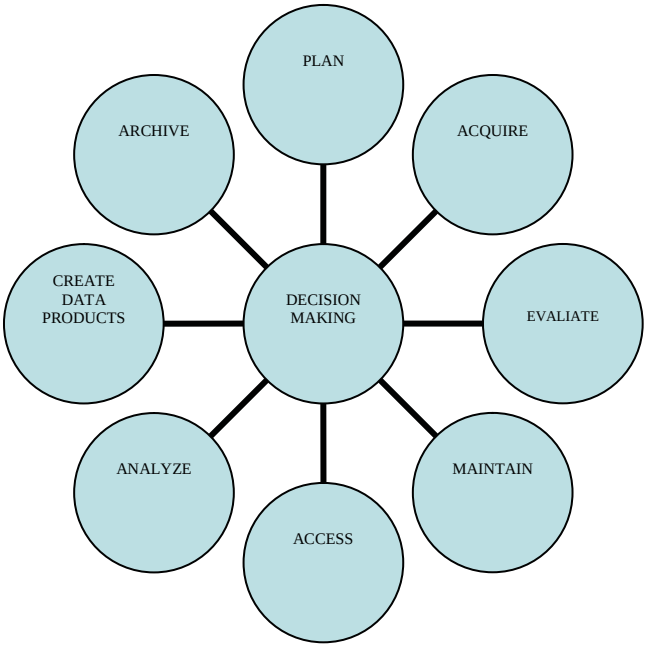
Participants determined that the best way to proceed was to convert HGS input and output to a database format similar to ArcHydro Groundwater stored in the Hierarchical Data Format (HDF5) to support rapid access and display. This effort will require some enhancement of the HGS code but no significant changes. The advantages of this approach include:

- Allowing HGS to take advantage of all of the developments within the other database models.
- Enabling on-the-fly definition of materials and boundary conditions—this spreadsheet-like interface will enable the modeler to extend the model.
- High compression of model results using HDF5—reducing storage requirements.
- Direct integration with GMS and other display/visualization technologies using the HDF5 standard.
- Reducing long-term maintenance and allowing for integration of future improvements that support ongoing research.
- Collaborative modeling environment supporting model comparisons

GMS has numerous other models integrated currently, and adding HGS will provide direct comparisons and enlarge the toolbox for all modelers. (Lorri Peltz-Lewis, 916-978-5271)

Reclamation R&D Office sponsors a workshop on biological data stewardship.—Reclamation regularly uses and produces biological resources data in meeting its mission to manage, develop, and protect water and related resources in an environmentally and economically sound manner. By some estimates, Reclamation annually invests more than $200 million to restore river, reservoir, and riparian habitat. Biological data from these and other programs provide information we use to manage our reservoirs and lands. Biological data are an asset that must be planned for and maintained during the entire data life-cycle to support sound decision-making and obtain the full value from our investment. The nature of this information is growing rapidly in complexity, scope, and importance to Reclamation.

The Research and Development Office, together with the Chief Information Office, hosted a workshop in Denver on June 24-26, 2008, with representatives from each of the Regions, the Technical Service Center, and other Interior agencies.



Data life cycle

The participants:

- Shared approaches to data management from each of Reclamation's Regions
- Heard how data stewardship is practiced in the U.S. Fish and Wildlife Service, the Bureau of Land Management, the U.S. Geological Survey, National Biological Information Infrastructure, the National Park Service, and NatureServe
- Identified areas where Reclamation can improvement its data stewardship

Some of the workshop's conclusions were:

- A Reclamation data stewardship community of practice is needed.
- Data stewardship must extend beyond the boundary or timeline of a project or projects.
- Data stewardship must be a normal business expense.
- While stewardship should be built from the ground up, focusing upon the needs of project managers, support from upper management is also critical to success.

The workshop participants recommended these steps:

- Establish a Reclamation-wide working group
- Detail problems and opportunities related to biological resources data management
- Draft data stewardship goals
- Evaluate solutions for costs and benefits and propose these to the leadership
- Initiate pilot tests of methods

Efforts are underway to establish this working group. If you are interested in these activities, please contact the Research and Development Office. (Curt Brown, 303-445-2098)

Improving Water Delivery Reliability

Reclamation automates surface water irrigation systems to improve water use efficiency.—Agriculture is still by far the major water user in Reclamation's Lower Colorado Region, with over 80 percent of the total water consumption. About 95 percent of this water is applied using surface irrigation methods Decisions on when water to a field should be cut off should be made based upon the extent of water advance across the field.

Water advancing across a field with a typical graded border surface irrigation

In practical terms, this is very difficult to do at night or even in the daytime with tall, dense crops. Therefore, the irrigator often over-compensates by over-irrigating. Furthermore, finding and keeping trained labor to irrigate properly is becoming more difficult. Automating ways to determine irrigation cut-off time for these surface irrigation systems can overcome these difficulties and enable more efficient use of water.

Reclamation is constructing and operating automation systems on two types of surface irrigation—level basins and graded borders— in cooperation with the Universities of California and Arizona.

Mechanical apparatus for operating a farm gate

A sensor at the flume where water flows into the field measures how much water comes in and another sensor on the ground signals when water has reached a predetermined point in the field. A computer uses this information to determines the optimal time to shut off the gate and open the next gate. Initial design of the systems has been completed, and equipment and supplies procured. Mechanical apparatus for opening and shutting farm gates have been fabricated. Installation is scheduled for August-October 2008, and shake-down and de-bugging is scheduled for October-December 2008. (Mark Niblack, 928-343-8253)

Reclamation tags green sturgeon at the Red Bluff Diversion Dam.—Improved operation of Red Bluff Diversion Dam (RBBD) could help green sturgeon survive. Reclamation is monitoring their movements and habitat preferences with acoustic-tags. This information will benefit Reclamation's RBDD operations and the continued survival of the threatened Southern Distinct Population Segment of the green sturgeon. In May and June of 2008, ten adult green sturgeons were captured, tagged, and released within the Sacramento River approximately 13 kilometers downstream of the RBDD. Five of the tagged green sturgeon were captured and released before the gates closed on May 15, 2008, and the other five after the gates were lowered at the RBDD.

Monitoring the sturgeon's movements using stationary receivers less than one kilometer downstream of the RBDD mobile tracking receiver indicated that three of the ten tagged green sturgeon moved upstream of the release site and were detected at the RBDD. One other tagged green sturgeon detected at the RBDD had been previously tagged in Willapa Bay, Washington.

Biologist taking genetic tissue sample

The information gained by monitoring and tracking the movements of acoustic-tagged green sturgeon in the vicinity of RBDD will increase our knowledge of the movements and habitat preferences of this long-living marine species. (Richard Corwin, 530-528-0512)

Reclamation biologists reduce fish stress.—Fish entrained in water diversions need to be moved to a safe location. However, capturing and handling these fish could inadvertently cause them stress. Developing ways to lower this potential stress also lowers the operation and management costs for these fish. Reclamation biologists are researching these effects to lessen the impact on fish and wildlife resources, while allowing the agency to provide water for agriculture and municipalities.

We are currently examining the impacts associated with holding durations on green sturgeon in holding tanks at South Delta fish collection facilities. Collecting blood samples can in itself be stressful to fish, which can affect study results. We have found a viable alternative to handling, netting, and anesthetizing fish for blood sampling. We successfully implanted a catheter in their veins (caudal blood vessel cannulation) to get repeated blood samples. We also concluded that serial blood sampling is an acceptable technique to determine physiological stress responses in fish over time if the fish is large enough to accommodate the blood loss without becoming anemic.

Results will be presented at the International Congress of the Biology of Fishes in Portland, Oregon in the last week of July. The experiment itself was very popular with the public and sent a great message that Reclamation is making strides with cutting edge research and that we are doing our best to conserve natural resources while maintaining the flow of water in the West. (Donald Portz, 303-445-2220)

Implanting a catheter in a green sturgeon.

Serially sampling blood from green sturgeon.

Reclamation curbs urban water waste with efficient turf irrigation.—Irrigating turf grass is one of the largest areas of water use—and water waste—in urban areas. Optimizing turf irrigation can provide significant water savings, especially in the Reclamation West with frequent droughts and rapidly growing cities.

Reclamation's Efficient Turf Irrigation study aims to define improved irrigation schedules for turf grass species or mixes based upon their seasonal growth cycle. The study uses high-tech soil moisture sensors to determine volumetric soil moisture. If this approach proves accurate, it will significantly advance our ability to determine turf grass water requirements cost-effectively. Measurements will be taken for the remainder of this year and two more growing seasons.

This reearch is conducted in partnership with the Northern Colorado Water Conservancy District, which is setting the standard for research on water use efficiency and turf management. This year, a group of 30 college professors toured the District's research facility and were very impressed with the studies and the professional way the work was organized. The study area is open to the public and interested professionals. Tours can be arranged by calling the Northern Colorado Water Conservancy District in Berthoud, Colorado at (970) 532 7700. (Fred Liljegren 801-524-3765)

National Academy of Science releases Reclamation-funded report on desalination technologies.—The National Academy of Science has released their report, "Desalination: A National Perspective." The two-year study, funded by Reclamation's Research and Development Office and the Policy Program Services Office, along with the U.S. Environmental Protection Agency, examined the state-of-the-art in advanced water treatment technologies and recommend priorities for Federal research.

The report summarizes findings that: "Recent technological advances have made removing salt from seawater and groundwater a realistic option for increasing water supplies in some parts of the U.S., and desalination will likely have a niche in the nation's future water management portfolio. However, the potential of desali

nation is constrained by financial, social, and environmental factors. Substantial uncertainties remain about its environmental impacts, which have led to costly permitting delays. A coordinated, strategic research effort with steady funding is needed to better understand and minimize desalination's environmental impacts—and to find ways to further lower its costs and energy use."

The review panel recommended that Federal research be focused to:

1. Assess environmental impacts of desalination intake and concentrate management approaches
    a. Conduct field studies to assess environmental impacts of seawater intakes
    b. Conduct field studies to assess environmental impacts of brackish groundwater development
    c. Develop protocols and conduct field studies to assess the impacts of concentrate management approaches in inland and coastal settings
    d. Develop laboratory protocols for long-term toxicity testing of whole effluent to assess long-term impacts of concentrate on aquatic life
    e. Assess the environmental fate and bioaccumulation potential of desalination related contaminants
2. Detail problems and opportunities related to biological resources data management
3. Assess the quantity and distribution of brackish water resources nationwide
4. Analyze the human health impacts of boron, considering other sources of boron exposure, to expedite water-quality guidance for desalination process design
5. Research configurations and applications for desalination to use waste heat
6. Understand the impact of energy pricing on desalination technology over time
7. Investigate approaches for integrating renewable energy with desalination

Reclamation will use the report findings to help guide future investments in desalination research and development. The summary brochure is at: <http://dels.nas.edu/dels/rpt_briefs/desal_final.pdf> and the full report is at <http://books.nap.edu/openbook.php?record_id=12184>. (Curt Brown, 303-445-2098)