

Idaho Water Resources Research Institute

Annual Technical Report

FY 2005

Introduction

The Idaho Water Resources Research Institute (IWRRI) is housed at the University of Idaho. IWRRI is dedicated to supporting and promoting water and water-related research, education, and information transfer throughout Idaho. IWRRI collaborates with researchers and educators from all Idaho state universities; staff of local, state, and federal agencies; and private water interests.

The IWRRI is the only mechanism in the state that provides an autonomous statewide source of support for water research and training without regard to specific topic or discipline area. This is important because Idaho's water problems cross multiple topics and disciplines and compartmental approaches to these problems are less effective. IWRRI is relied upon by state and federal agencies and private water interests to provide the objective expertise to address the needs of the state and region. The Institute has been a strong proponent of education and outreach for both youth and adult audiences. It is through education that the public can make informed public policy decisions concerning water. It is also through education that individual citizens become engaged in the process through adjustments of their own attitudes and lifestyles.

Research Program

The Idaho Water Resources Research Institute's research program is comprised of the following objectives:

- (1) To work with state and federal agencies and non-government organizations to identify water research needs of the state and region;
- (2) To promote water-related research relevant to state and regional needs;
- (3) To stimulate, coordinate, and provide leadership for water resources research within Idaho universities and collaborate with sister institutions in adjoining states;
- (4) To cooperate with and assist state and federal agencies and non-governmental organizations for the benefit of the citizens of Idaho and the region;
- (5) To encourage and facilitate public involvement in water resource programs within the state;
- (6) To promote water education within the state at the K-12, undergraduate and graduate levels; and
- (7) To develop funding for needed research and encourage cooperation with other research organizations.

Seasonal variation in anthropogenic nutrient additions and food web response in a large deep lake (Lake Crescent, Olympic National Park)

Basic Information

Title:	Seasonal variation in anthropogenic nutrient additions and food web response in a large deep lake (Lake Crescent, Olympic National Park)
Project Number:	2005ID50B
Start Date:	3/1/2005
End Date:	2/28/2006
Funding Source:	104B
Congressional District:	01
Research Category:	Biological Sciences
Focus Category:	Water Quality, Surface Water, Non Point Pollution
Descriptors:	None
Principal Investigators:	Stephanie Hampton, Stephanie Hampton

Publication

Synopsis
Idaho Water Resources Research Institute 104b Project
March 1 2005 - February 28 2006

1. Title: Seasonal Variation in Anthropogenic Nutrient Additions and Food Web Response in a Large Deep Lake (Lake Crescent, Olympic National Park)
2. Project Number: 2005ID50B
3. Start Date: March 2005
4. End Date: February 2006
5. Funding Source: USGS 104b
6. Research Category: Biological Sciences
7. Focus Categories: Water Quality
Surface Water
Non Point Source Pollution
8. Descriptors:
9. Primary PI: Stephanie Hampton, Assistant Professor, University of Idaho, shampton@uidaho.edu
10. Other PI:
11. Project Class: Research

Project Summary

Shoreline development is known to degrade water quality and nearshore habitat for lake biota. Deep nutrient-poor lakes – particularly prized for their fisheries and beauty in the Pacific Northwest – may be especially sensitive to shoreline development that affects nearshore habitat. Shallow nearshore water in a steep-sided basin comprises relatively little of the total volume and surface area, but may provide the most crucial breeding habitat for fishes and, potentially, the primary feeding habitat. Even if pollutants entering at the shore are not sufficient to change open water conditions, nearshore communities may exhibit biomass and compositional changes that have disproportionately large impacts on food webs dependent on these shallow waters. In Olympic National Park, Washington, Lake Crescent has modest

residential development, and nuisance filamentous algal mats are now regularly observed at developed sites.

In May 2005, I brought on Elizabeth Seminet-Reneau as a M.S. student in the Fish & Wildlife department at UI to work on localized effects of nutrient pollution in Lake Crescent. Seminet-Reneau has a strong work and educational background in limnology, fisheries, and quantitative ecology. In her first year, she collected field samples of lake organisms to complete our stable isotope data set characterizing the food web structure of Lake Crescent. The data strongly suggest substantial dependence of the animal community on nearshore resources, as hypothesized. I am presently preparing a manuscript for submission to a peer-reviewed journal, with Seminet-Reneau as second author.

For her own distinct M.S. thesis research, Seminet-Reneau is currently involved in the collection and analysis of periphyton (attached algae) and macroinvertebrate samples, to determine how community composition shifts in response to localized nutrient pollution. As part of this work, she has begun collecting samples at Lake Pend Oreille and Coeur d'Alene Lake in Idaho so that she may make generalizations about periphyton and macroinvertebrate responses to localized pollution from septic systems. In the fall she will also set up experiments designed to determine electivity of macroinvertebrates for different types of periphyton – i.e., those commonly associated with sewage pollution vs. those associated with unpolluted shorelines in oligotrophic lakes. She has formalized her periphyton counting methods but has not yet begun enumeration of samples.

Importantly, we have found that in Lake Crescent, nutrient content of the water column is generally below detectable limits, and therefore differences in nutrient pollution among sites can not be discerned using standard methods. In a lake that is still oligotrophic such as Lake Crescent, but receiving nutrient inputs, monitoring the biota in the area where pollution enters is likely to give the first detectable “early warning” of ecosystem change. We had hoped to discern an anthropogenic nitrogen signal in the algae from polluted sites, but the signature of algae may be too variable for this distinction; there is some indication that macroinvertebrates may carry the signal with more fidelity. Seminet-Reneau’s 2006 summer sampling will increase our power to detect anthropogenic signal among the macroinvertebrates. She plans to present her work at the annual meeting of the Washington Lake Protection Association in the fall, and for the American Society of Limnology & Oceanography in 2007.

- A. **PUBLICATIONS:** No manuscripts are published yet.
- B. **INFORMATION TRANSFER PROGRAM:** No activities to report yet.

C. **STUDENT SUPPORT:**

Elizabeth Seminet-Reneau

	Section 104 Awards		NIWR-USGS Internship	Supplemental Awards	Total
	Base Grants	Competitive Awards			
Undergrad.					
Masters		1			1
PhD.					
Post-Doc.					
Total		1			1

D. **NIWR-USGS STUDENT INTERNSHIP PROGRAM:** No internships on this project.

E. **NOTABLE ACHIEVEMENTS AND AWARDS:** No activities to report yet.

A Reconnaissance Study of Arsenic Distribution in the Shallow Aquifer of the Treasure Valley

Basic Information

Title:	A Reconnaissance Study of Arsenic Distribution in the Shallow Aquifer of the Treasure Valley
Project Number:	2005ID51B
Start Date:	3/1/2005
End Date:	2/28/2006
Funding Source:	104B
Congressional District:	1
Research Category:	Water Quality
Focus Category:	Water Quality, Toxic Substances, Hydrogeochemistry
Descriptors:	None
Principal Investigators:	Shawn Benner, Shawn Benner

Publication

1. Donato, M. M., K. W. Neely, B. Hoffman, S. Benner, 2005. Geochemical Processes and Mechanisms of Arsenic Contamination in Southwestern Idaho Ground Water, in Proceedings Geological Society of America Annual Meeting, October 16-19, Salt Lake City.

Synopsis
Idaho Water Resources Research Institute 104b Project
March 1 2005 - February 28 2006

1. Title: A Reconnaissance Study of Arsenic Distribution in the Shallow Aquifer of the Treasure Valley
2. Project Number: 2005ID51B
3. Start Date: March 2005
4. End Date: February 2006
5. Funding Source: USGS 104b.
6. Research Category: Water Quality
7. Focus Categories: Water Quality
Toxic Substances
Hydrogeochemistry
8. Descriptors:
9. Primary PI: Shawn Benner, Assistant Professor, Boise State University,
sbenner@boisestate.edu
10. Other PI:
11. Project Class: Research

Project Summary

Perhaps the greatest emerging threat to water quality in Idaho is naturally occurring elevated arsenic in our groundwater-based drinking water supplies. In the most populated region of the state, the Treasure Valley, more than 40% of all tested drinking water wells exceed the new arsenic standard. The distribution of arsenic in the groundwaters of southwest Idaho is complex and not well understood and the mechanism of release has not been identified. This project is examining existing hydrologic and geochemical datasets to better understand arsenic release mechanisms in a research effort coordinated with state agencies.

Our work is ongoing but we are able to make a number of important observations. There are clear spatial trends in the distribution of arsenic in the Treasure Valley Aquifer with dissolved arsenic concentrations primarily elevated in two areas within the Treasure

Valley; the first is in Canyon County and extends from Lake Lowell north and west and the second is located in Ada County north of the Boise River. We have also conducted a comprehensive assessment of the well log data to reconstruct the previously observed redoximorphic boundary for the entire Treasure Valley as a continuation of work started by Donato et al. (2004). The most notable trend in this geologic dataset is the close correlation between the redoximorphic transition and both land surface and groundwater elevation, suggesting that the boundary may be a post depositional feature reflecting the historical water table across the Treasure Valley. The implications of this boundary diagenesis for arsenic release remain unclear. Our initial evaluation of this correlation does suggest that arsenic concentrations may be elevated *proximal* to the boundary.

Future, funded, work will include additional groundwater sampling analysis to better constrain the spatial distribution of groundwater with an emphasis on the shallow (<250 ft depth) aquifer within the region of high arsenic concentrations near Lake Lowell in Canyon County.

Publications:

Donato, M. M., K. W. Neely, B. Hoffman, S. Benner, 2005. Geochemical Processes And Mechanisms Of Arsenic Contamination In Southwestern Idaho Ground Water, in Proceedings Geological Society Of America Annual Meeting, October 16-19, Salt Lake City.

Students Supported:

M.S. Graduate Student: Bernadette Hoffman
M.S. Graduate Student: Monty Busbee

Evaluation of remote sensing of leaf area index for estimating evapotranspiration on irrigated lands

Basic Information

Title:	Evaluation of remote sensing of leaf area index for estimating evapotranspiration on irrigated lands
Project Number:	2005ID54B
Start Date:	3/1/2005
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	01
Research Category:	Climate and Hydrologic Processes
Focus Category:	Irrigation, Management and Planning, Water Quantity
Descriptors:	None
Principal Investigators:	Bryce Contor, Richard Allen

Publication

Synopsis
Idaho Water Resources Research Institute 104b Project
March 1 2005 - February 28 2006

1. Title: Evaluation of remote sensing of leaf area index for estimating evapotranspiration on irrigated lands
2. Project Number: 2005ID54B
3. Start Date: April 2005
4. End Date: March 2007
5. Funding Source: USGS 104b grant # 01HQGR0147, in-kind support from University of Idaho.
6. Research Category: Climate and Hydrologic Processes
7. Focus Categories: Agriculture AG
Climatological Processes CP
Irrigation IG
Water Use WU
Methods MET
8. Descriptors: Evapotranspiration, remote sensing, irrigation, leaf area index
9. Primary PI: Bryce Contor, Research Hydrologist, University of Idaho, bcontor@if.uidaho.edu
10. Other PI: Richard Allen, Professor, University of Idaho, rallen@kimberly.uidaho.edu
11. Project Class: Research

Project Summary

Various vegetative indices have been prepared using Digital Number ("raw") and Reflectance ("processed") data from LANDSAT 5 and LANDSAT 7 satellites, and compared with ETrF (evaporative fraction of energy balance for surface radiant energy; equivalent to Kc or crop coefficient) from METRIC methodology. From this work it appears that only Reflectance data are appropriate for developing vegetative indices that are consistent from date-to-date and path-to-path. A

tentative selection has been made to use the NDVI vegetative index for further work.

A single-predictor linear regression equation has been developed to use NDVI to predict ETrF. This equation was developed using training data from LANDSAT path 40. We are currently in the process of testing this equation on data from the adjacent LANDSAT path 39 and exploring other prediction equations.

This project is at approximately the mid point. It is our expectation that a useful prediction equation will result, allowing publication of a refereed journal article. We expect this work to be valuable to the state water management agency by allowing estimation of evapotranspiration using lower-cost data, reduced reliance on subjective evaluation of "hot" and "cold" pixels, and reduced labor, when compared to the METRIC and SEBAL energy-balance methods. We also expect this work to prompt further research into remote sensing of Kc and ETrF without reliance upon thermal satellite data.

Publications: None to date

Students supported: 1 student, MS Hydrology, U of Idaho, 2005
 1 student, BS Geology, BYU Idaho, 2005
 1 student, MS Geography, Idaho State University 2006

Evaluation of temporal variations of the nitrate concentrations in ground-water of the Ashton, Idaho area and potential causative factors.

Basic Information

Title:	Evaluation of temporal variations of the nitrate concentrations in ground-water of the Ashton, Idaho area and potential causative factors.
Project Number:	2005ID55B
Start Date:	3/1/2005
End Date:	2/28/2006
Funding Source:	104B
Congressional District:	01
Research Category:	Water Quality
Focus Category:	Nitrate Contamination, Water Quality, Non Point Pollution
Descriptors:	None
Principal Investigators:	Gary Steven Johnson, Mark Lovell, Robert Smith

Publication

Synopsis
Idaho Water Resources Research Institute 104b Project
March 1 2005 - February 28 2006

1. Title: Evaluation of Temporal Variations in the Nitrate Concentrations in Ground Water of the Ashton, Idaho Area and Potential Causative Factors
2. Project Number: 2005ID55B
3. Start Date: March 2005
4. End Date: February 2006
5. Funding Source: USGS 104b grant.
6. Research Category: Water Quality
7. Focus Categories: Nitrate Contamination
Water Quality
Non Point Pollution
8. Descriptors:
9. Primary PI: Gary Johnson, :Professor, University of Idaho,
johnson@if.uidaho.edu
10. Other PI: Mark Lovell, Assistant Professor, BYU-Idaho,
lovellm@byui.edu.
11. Project Class: Research

Project Summary:

Existing aquifer water quality and water level data from the Ashton Idaho area have been collected and interpreted. There is a high degree of variation in nitrate concentrations in the area, with numerous samples exceeding drinking water standards. In the few wells where several samples have been evaluated over time, the nitrate appears highest in the early summer and lowest during fall. There does not appear to be a strong relationship between nitrate concentrations and estimated aquifer flow lines.

Two down-hole nitrate probes have been acquired. One has been deployed in a well near Ashton and is indicating dramatic temporal variation in nitrate

concentration. The concentration appears to vary with pumping events in the well, but is also showing variations to unknown causes. The second probe is temporarily being deployed in the same well to verify the dramatic changes. Ultimately, the second probe will be placed in another selected well.

The research on this project is in its initial stages. The activities funded by the 104b support has stimulated interest of state agencies and others. A continuation of the 104b project has been funded and the work will continue into the future.

Award No. 04HQAG0205 Initial Model Development of the Spokane Valley Rathdrum Prairie Aquifer Project

Basic Information

Title:	Award No. 04HQAG0205 Initial Model Development of the Spokane Valley Rathdrum Prairie Aquifer Project
Project Number:	2005ID71S
Start Date:	7/20/2004
End Date:	8/31/2006
Funding Source:	Supplemental
Congressional District:	
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	
Principal Investigators:	

Publication

Synopsis
Idaho Water Resources Research Institute 104b Project
March 1 2005 - February 28 2006

1. Title: INITIAL MODEL DEVELOPMENT FOR THE SPOKANE VALLEY –RATHDRUM PRAIRIE AQUIFER PROJECT
2. Project Number: 2005ID71S
3. Start Date: March 2005
4. End Date: September 2006
5. Funding Source: Supplemental.
6. Research Category: Ground Water Flow and Transport
7. Focus Categories: Groundwater
Models
Water Quantity
8. Descriptors:
9. Primary PI: Gary Johnson, :Professor, University of Idaho,
johnson@if.uidaho.edu
10. Other PI:
11. Project Class: Research

Project Summary:

This Cooperative Agreement was established to provide the Idaho Water Resources Research Institute with funding to become involved in initial efforts on the Spokane Valley – Rathdrum Prairie Modeling Project. This project is a collaborative effort of the USGS, the states of Idaho and Washington, and others. This initial stage was comprised of largely a planning effort, and the overall project is not scheduled for completion until 2008.

There were three specified tasks in the Cooperative Agreement. The following discussion provides a summary of how these tasks were addressed and potentially evolved in the project period. These tasks are intimately connected,

so a complete separation of activities is not possible. Also provided are estimates of the funding expended on each of the tasks.

TASK A

Compile and review existing ground water/surface water models for the study area: conduct preliminary model runs using existing ground water/surface water models to evaluate model conceptual elements (boundary conditions, recharge and discharge, etc.); and identify additional data requirements.

A complete set of documents describing existing models in the Spokane Valley and Rathdrum Prairie has been assembled and reviewed. The Buchanan (1999) model has been the focus of our work because the model extent is similar to the scale of the present investigation. The Buchanan model has been run by all partners in the effort including IWRRI. This model has been selected as the basis from which the new model will evolve. Several steps in that evolution have already occurred in the partnership. Those steps include: a) conversion to operate in MODFLOW 2000, b) extension of the model domain to cover all areas of interest, c) refinement of the model grid, d) distribution of Buchanan aquifer properties and recharge and discharge to the new grid, e) conversion of lakes from fixed head to "river" cells, f) adjustment of aquifer thickness to represent present estimates. In the process of performing initial model runs, the modeling team (including IWRRI) has made assessments and recommendations of additional data requirements.

This task was also amended to include initiation of a review of the interconnection and flux between the aquifer and 9 lakes along the perimeter. A graduate student has been assigned to conduct the evaluation. Pressure transducers have been deployed in most of the lakes and in nearby wells. The program procedures have been reviewed by the Modeling Team and some existing data analysis is underway.

Estimated Expenditures on Task: \$27000

TASK B

Work with project partners to help to determine data requirements for numerical model development. Data requirements will include the collection of historical data and the collection of new field data. These data requirements will be meant to serve the needs of the ground water modeling task as well as more general project needs.

The IWRRI researchers have been working with the rest of the modeling team to identify future data requirements. Part of this effort is associated with performing preliminary model runs to gain an improved understanding of data deficiencies, consequently there is overlap between this task and the first task. Data deficiencies have been discussed in video and phone meetings with the rest of the Modeling Team and have been transmitted to the Program Technical

Leadership Team(PTLT) in writing. The PTLT has been responsive and has also requested Modeling Team input on other data collection suggestions. The Modeling Team (including IWRRI) has responded.

Estimated Expenditures on Task: \$7840

TASK C

Work with project partners to develop an FY05-07 work plan for developing a ground water/surface water model for the SVRP study area. This task will include meeting with project partners and interested constituents to determine modeling requirements and to determine what questions are to be addressed via ground water modeling so that the planned ground water/surface water modeling effort addresses project needs to the fullest extent possible. The SVRP Modeling Team will select the modeling code(s) to be used, and the modeling work plan will address both steady state and transient versions of the ground water/surface water model.

There have been multiple iterations on a modeling work plan within the modeling team. Within the process the roles of team members has become more refined. A draft work plan was submitted to the PTLT for comment. Those comments were subsequently addressed by the Modeling Team. The work plan continues to evolve as the project progresses. It has been developed such that modeling efforts will be complete in December 2006. It has been determined within the Modeling Team that MODFLOW 2000 will be used and that PEST will be applied to parameterize the model. The steady state model is under active development, efforts on the transient model (1995-2005 calibration period) will follow.

Estimated Expenditures on Task: \$7839

Information Transfer Program

The Idaho Water Resources Research Institute at the University of Idaho has endeavored to promote and coordinate education and information transfer related to water resources research throughout the State. These efforts are coordinated with the State of Idaho's water resource agencies (Idaho Department of Water Resources, Idaho Department of Environmental Quality, Idaho Department of Fish and Game), federal agencies involved in water resources activities within the state of Idaho (The United States Geological Survey, the US Bureau of Reclamation, the Environmental Protection Agency, and the Army Corps of Engineers), numerous local water resource planning and management entities, and non-governmental organizations. The following are brief summaries of the water education, outreach and information transfer programs that were partially supported using USGS 104B funds.

Project WET (Water Education for Teachers) Idaho, an interdisciplinary, supplementary water education program of Idaho educators, whose goal is to facilitate and promote awareness, appreciation, and understanding of Idaho's water resources through development and dissemination of classroom-ready teaching aids. Project WET emphasizes teaching students how to think, not what to think. In this past year, there were 12 workshops, that resulted in the training of approximately 220 teachers, who will then take this knowledge to their class room to teach Idaho youth.

The Idaho Water Resources Research Institute also participated in Water Awareness Week, Idaho Salmon and Steelhead Days, geothermal education programs, the Ground Water Awareness Projects and other ad-hoc watershed programs.

In addition, the Idaho Water Resources Research Institute worked with a bi-state committee (Washington and Idaho) to develop the Palouse Basin Water Summit in the Fall of 2005. The purpose of this summit was two fold. First, to provide an overview of what was known about the Palouse Basin aquifer and its management. Second, to provide a forum for citizens within the Palouse Basin (which includes the cities of Colfax, WA, Pullman, WA and Moscow, ID, the counties of Latah, ID and Whitman, WA, and the States of Idaho and Washington) to discuss approaches to developing sustainable water resource planning policies for the Palouse Basin. The forum attracted over 200 participants, and helped initiate a new water resources planning effort within the Palouse Basin.

In addition to these activities, many of the Idaho Water Resources Research Institute Projects also have resulted in information transfer activities. In particular, a number of project investigators have presented their results in the Idaho Hydrology Seminar Series. This seminar series is sponsored by IWRRI, and broadcast via compressed video format to Moscow, ID, Boise, ID, Idaho Falls, ID and Pocatello, ID every week during the fall semester and every other week during the spring semester. At the Boise and Idaho Falls sites, the attendees are a mix of personnel from state agencies, federal agencies, university and private companies.

Finally, the Idaho Water Resources Research Institute undertook an effort during this project period to upgrade its web-site to allow for the downloading of IWRRI project reports, and powerpoint presentations associated with the IWRRI seminar series. This improvement in the web-site has allowed for the more rapid dissemination of research results, as well as provided the State of Idaho with a mechanism to widely disseminate water resources information to its citizens.

Student Support

Student Support					
Category	Section 104 Base Grant	Section 104 NCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	1	0	0	0	1
Masters	5	0	0	1	6
Ph.D.	0	0	0	0	0
Post-Doc.	0	0	0	0	0
Total	6	0	0	1	7

Notable Awards and Achievements

The supplemental grant (Project 2005ID71S) was a key part of the bi-state collaborative project to develop an understanding of water resources availability in the Rathrdum Prairie-Spokane Valley aquifer system. Researchers from the University of Idaho are participating in joint studies with researchers from the USGS (Idaho, Washington and Menlo Park) and Washington State University to develop models that can predict how the future development of the regions ground water resources will affect surface flows in the Spokane River. These models will play a key role in helping water resource and environmental agencies in Idaho and Washington to develop water resource management plans that are sustainable for both human and environmental systems within the region.

Publications from Prior Projects

None