

**Ozarks Environmental and Water Resources Institute
Missouri State University**

***ANNUAL REPORT OF ACTIVITIES FOR
CALENDAR YEAR 2010***

Prepared by:

Robert Pavlowsky, Ph.D., Director
Ozarks Environmental and Water Resources Institute
Temple 321
Missouri State University
901 South National Avenue
Springfield, MO 65897
417-836-8473
bobpavlowsky@missouristate.edu

Presented to:

Tamera Jahnke, Ph.D., Dean
College of Natural and Applied Sciences
Temple 142

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EXECUTIVE SUMMARY

OEWRI activities in 2010 focused primarily on attracting external funds, formation of partnerships, student mentoring and training, and implementing applied and basic research projects to support science-based monitoring and analysis of water and sediment quality trends, watershed function and disturbance, and land use/land cover change in southwestern Missouri. In addition, our recent activities have also taken OEWRI out of Missouri to Kansas, North Carolina, and Jamaica.

Research accomplishments include work on 11 externally funded projects totaling about \$204,000 in funds expended by OEWRI in 2010. Two peer-reviewed articles were published, five final project reports submitted to sponsors, and twenty six conference and invited presentations were delivered.

Activity records typically indicate that OEWRI staff spend about 5 to 15 percent of their time per week working on education, service, and outreach activities for the campus community and Springfield area.

Undergraduate education accomplishments include the hiring of 6 hourly workers, research project support and mentoring for 22 students, and field trip experiences for about 80 students.

Graduate education accomplishments include the hiring of 7 graduate assistants and 3 hourly workers, varying levels of support for 19 thesis projects, and 3 MS graduates.

OEWRI provides extensive service and outreach to the community and is involved in many planning committees, environmental events, and conferences. The number of partners involved with the Institute is extensive at all levels.

OEWRI contributes to the Public Affairs mission of MSU through research, outreach, and student trips in Jamaica to address community problems, by involving students in high profile environmental projects that challenge them to examine leadership and ethical dimensions, and

maintaining strong connections with community leaders and stakeholders in the area of environmental issues and water resources management.

A benefit:cost ratio can be computed by summing the income from external grant \$ generation (204K) and base leverage benefits (57K), and then dividing the income by the university contribution of 75K. This yields a value of return on university funding for OEWRI of 3.5 times.

INTRODUCTION

Missouri State University's Board of Governors established the Ozarks Environmental and Water Resources Institute (OEWRI) in January 2004 to address water resource problems within the Ozarks through research, education, and outreach. Funding to start the institute included a one million dollar grant through the U.S. Environmental Protection Agency-Region 7 beginning in 2006-07 and base support by the University of \$75,000 annually. Federal funding was targeted to develop the infrastructure and capacity for research in three areas identified as important to meet the needs of both environmental managers and Ozark communities: water quality and quantity, sedimentation and soil/sediment quality, and geospatial analysis of land use and natural resources. Dr. Pavlowsky was selected through a university search process to be the director of OEWRI in March 2005. OEWRI is administered through the College of Natural and Applied Science. Additional information about OEWRI can be found at: <http://www.oewri.missouristate.edu/>.

This is the annual report of activities for the Ozarks Environmental and Water Resources Institute (OEWRI) in the College of Natural and Applied Sciences (CNAS) at Missouri State University (MSU). The report is organized in the following manner:

- (1) Description of the mission statement and facilities;
- (2) Description of activities for 2010
- (3) Accomplishments in research, education, outreach, partnerships, and Public Affairs
- (4) Budget Expenditures and Income for 2010
- (5) Strategic Plan for 2011
- (6) Resource Needs

MISSION STATEMENT AND FACILITIES

The mission statement for OEWRI was initially approved by the MSU Board of Governors in 2004. It was later revised and expanded to include program areas of emphasis by a committee of 14 CNAS faculty in 2007.

OEWRI's mission is to advance our scientific understanding of water resource quantity, quality, and distribution in Ozarks watersheds. Centrally located in Springfield, Missouri, OEWRI provides technical expertise, analytical capability, and student training to support environmental research, watershed monitoring programs, and watershed group activities in the Ozarks and beyond. OEWRI's mission has four major goals:

- (1) Conduct applied and basic research focusing on understanding the influence of natural processes and human activities on watershed conditions and water resources;
- (2) Establish regional partnerships, disseminate information, and provide educational and training opportunities related to scientific monitoring and management of water resources;
- (3) Provide policy alternatives to address water resource questions raised by decision-makers based on scientific sampling and analytical protocols; and
- (4) Serve as a clearinghouse for research results and publications pertaining to water supply and quality in the Ozarks.

OEWRI supports Missouri State University's mission in [public affairs](#) and its three components in ethical leadership, cultural competence, and community engagement. In addition, OEWRI programs are central to the public affairs theme in science and the environment for research and education. It directs and collaborates on basic and applied research projects aimed at solving environmental problems by working in partnership with university researchers, environmental groups, local communities, and government agencies. It involves students in all levels of its activities.

Staffing

OEWRI is staffed on campus in Temple Hall as follows:

- (1) Robert Pavlowsky, PhD., Director, half-time;
- (2) Marc Owen (M.S. Resource Planning), Research specialist II and project supervisor, Soil Quality, Geomorphology, and Field Monitoring;

(3) Heather Hoggard (M.S. Resource Planning), Research specialist II and project supervisor, Water Quality and Laboratory Director;

(4) Jennifer Duzan (M.S. Biology), Research Specialist I, Field monitoring and Laboratory Analyst (left OEWRI during Summer 2010);

(5) Jennifer Andrews (M.S. Agriculture/GIS), Research Specialist I, Geospatial Technology and Conservation (NEW-Nov 2010); and

(6) Deana Gibson, secretary and project accounts (shared with Geography, Geology, and Planning)

Facilities

OEWRI facilities are presently located in Temple Hall within office and laboratory space that is under departmental control. OEWRI space is allocated in partnership with other units as follows:

Department of Geography, Geology, and Planning

Director's office- T321;

Staff & GA offices- T326, T343, and T307;

Geomorphology Laboratory & GA office- T125 (supervised by Pavlowsky); and
Sample Preparation Laboratory, T129 (shared use area).

Department of Chemistry

Lachat Nutrient laboratory, T470 (supervised by Dr. R. Biagioni); and

Metals/ICP-AES laboratory, T437 (supervised by Dr. R. Biagioni).

Department of Biology

Microbiology laboratory- T239 (supervised by Dr. John Steiert).

CNAS

Field Equipment Storage and GA office, T103 (temporary use)

Outdoor Storage

Three trucks in SW parking deck

John boat and canoes in back lot of Kemper Hall.

Box trailer in Cherry Street fenced area

INSTITUTE ACTIVITIES FOR 2010

OEWRI activities in 2010 focused on attracting external funds, formation of partnerships, student mentoring and training, and implementing applied and basic research projects to support science-based monitoring and analysis of water and sediment quality trends, watershed function and disturbance, and land use/land cover change in southwestern Missouri. In addition, our recent activities have also taken OEWRI out of Missouri to Kansas, North Carolina, and Jamaica.

Program Areas

OEWRI activities at the Institute primarily focus on the following six program areas:

(1) Water and Sediment Quality Laboratory

Laboratory instrumentation and facilities to study water and sediment quality indicators of most concern to researchers, government agencies, and watershed groups in the region. The laboratory has a full-time director and training protocol and follows USEPA-approved standard methods and strict QA/QC procedures. The laboratory can analyze the following water constituents: water chemistry (temperature, pH, DO, SC, turbidity); total suspended solids and settleable solids; nutrients (N, P); metals (Cu, Pb, Zn, etc.); IDEXX bacteria counts; bacterial DNA fingerprinting and tracking using Bacteroides PCR assays; metals (Pb, Zn, Cu); total/organic carbon; suspended and benthic chlorophyll/algae; and dissolved ions by ion chromatography. The OEWRI laboratory offers the following soil/sediment analyses: particle size distribution by laser diffraction, hydrometer, and dry/wet sieving; sediment particle density; two sonic sifters; soil pH; total and inorganic carbon; available, extractable, and total trace metals, major elements, mercury, and phosphorus; radioisotope activity (Cs-137, Pb-210); and other standard soils tests.

(2) Geospatial Sciences Laboratory

The Geospatial Sciences Laboratory provides both investigative and analytical assistance to water and sediment quality related projects within the institute. The laboratory houses both field and desktop geospatial analysis equipment. Desktop instrumentation includes seven computer workstations running geospatial software including ArcGIS Desktop 9.2 suite with multiple ArcGIS Desktop extensions including Spatial Analyst, 3D Analyst, Survey Analyst, Geostatistical Analyst, Feature Analyst, and others. Workstations are also equipped with the latest version of the image processing software ENVI, as well as all of the software necessary to communicate with and integrate numerous pieces of geospatial field equipment. Field instrumentation includes three auto level with tripods and stadia rods; two Topcon electronic Total Stations; two Trimble GeoXH mapping grade GPS receivers; two Trimble Zephyr

antennas; and three Garmin GPS Map 76 GPS units. In addition, OEWRI partially supports a continuous-logging GPS base station and offers on-line access to correction data. With this combination of field and desktop tools OEWRI can provide a range of cartographic products and geospatial analyses including (i) thematic map production; (ii) database development with on-line access; (iii) watershed assessments of geology, soils, stream networks, riparian lands, land use, and point and nonpoint pollution sources; (iv) topographic stream channel and floodplain surveying and mapping, (v) image interpretation and classification using aerial photography and satellite imagery, and (vi) GPS surveying and ground point control.

(3) Water Quality Monitoring

The Institute is a leader in stream sampling, trend analysis, and water quality data interpretation in southwest Missouri. Through collaboration, contracts, and grants, OEWRI provides expert advice and technical support to watershed groups, local communities, and private businesses to help plan and implement baseline and regulatory water quality monitoring programs. It is equipped to cover a wide range of monitoring services such as 319 watershed projects, TMDL monitoring programs, and catchment runoff studies. In addition, the institute supports an on-line accessible data base for publications and water quality data for the region. Data generated by monitoring efforts are used to develop rating curves to evaluate load-based pollution trends, evaluate the influence of land use on water quality, and support compliance monitoring requirements by state and federal agencies. OEWRI is equipped with three autosamplers, two propeller-type velocity meters, two acoustic velocity meters, four depth-integrated field samplers, and other field sampling supplies.

(4) Stream Stability and Sedimentation

Research on the physical characteristics of streams of all sizes is needed to develop models of channel form and behavior that can be used for management purposes to address bank erosion and sedimentation problems in the Ozarks. OEWRI focuses its physical river research efforts in three areas: channel morphology, long-term channel dynamics, and sediment contaminant dispersal. *Channel morphology* research involves the collection and evaluation of field measurements of the cross-section, longitudinal profile, and planform pattern to understand the present condition of the channel and floodplain and predict future changes. OEWRI uses a combination of quantitative and rapid assessment procedures that have been scientifically tested and developed for use in Ozarks streams. The geomorphic data collected is used to model channel form, determine causes of channel instability, and support channel restoration plans. Investigations of *long-term channel dynamics* involves the detection of changes in channel form, bank erosion, and floodplain sedimentation over periods of 10 to 1,000 years or more. Subsurface investigations and remote sensing methods are used in these studies to understand the response of watersheds and river systems to climate change and historical human disturbances.

Finally, for pollution control purposes, it is important to understand processes affecting the spatial trends of *sediment contamination* in rivers. Sediment particles can bind metals and nutrients to high concentrations and often become important contributors to water quality problems. Thus, it is important to understand the role played by active channel and floodplain sediments during the storage, transformation, and remobilization of contaminants in Ozarks rivers. OEWRI is equipped with a truck-mounted Giddings coring rig, field surveying equipment, and sediment/soil sampling tools.

(5) Collaborative Environmental Programs

OEWRI collaborates with governments, consultants, agencies, environmental groups, and other universities to address water resources problem associated with urban and agricultural land management, biomonitoring, and water supply. OEWRI is involved with efforts to develop effective *soil and water conservation practices* for both urban and agricultural areas in the Ozarks. Urban projects include the evaluation of soil conditions and runoff characteristics for low impact developments, identifying causes of bed and bank erosion in urban streams, and understanding nutrient mobility in residential lawns. Local collaborators on these projects include the James River Basin Partnership, City of Springfield, and Greene County, Missouri. Agricultural conservation initiatives include a pilot study on the mobility of potential contaminants after field treatments with biosolids. Collaborators on these projects include the Department of Agriculture at MSU and the City of Springfield.

OEWRI also collaborates with aquatic biologists, limnologists, and microbiologists to use *biomonitoring methods* to evaluate the impacts of natural disturbance and human activities on river and lake biota. The projects involve surveys of macroinvertebrates, mussels, plankton, chlorophyll, and algae in streams and lakes. Biomonitoring surveys are used to compliment water quality studies if information on ecological impacts is required. In addition, OEWRI supports total-coliform and *E. coli* monitoring activities and microbial source tracking using a Bacteroides PCR assays in Ozark watersheds.

OEWRI is involved with regional committees and research initiatives to better understand *water supply vulnerability* in the Ozarks. Population growth and land use change in the region are straining water resources due to water shortages, nonpoint pollution, waste water and septic field releases, and water rights issues. OEWRI is presently involved with several community and regional initiatives to evaluate water supply problems in the southwest Missouri including the role that new infrastructure, conservation, and climate change may play on future supplies and economic growth. In addition, OEWRI has been included on emergency evaluation teams for sinkhole collapse and flood damage in Greene and Christian Counties, Missouri.

(6) Student Training and Research

An important outcome of OEWRI activities is the training and research experience provided to undergraduates and graduate students at MSU. Last year OEWRI supported 6 undergraduate hourly workers and undergraduate research projects for 22 students. Also last year, the Institute supported 7 graduate assistants and 19 master thesis projects. In addition, OEWRI staff provide an important “on call” educational resource to the University because they are accessible to students, have applicable technical expertise, and overlap project involvement with student activities. All students that work on OEWRI projects must complete a structured training program and monitored field or laboratory probationary period prior to the collection or analysis of data for OEWRI projects. Several OEWRI graduate assistants have gone on to jobs in the environmental management field in the Ozarks after graduation.

OEWRI “Start-Up” Project Plan

From 2006 to 2010, a primary objective of OEWRI was to implement a start-up plan supported by federal funding administered by the U.S.E.P.A.-Region 7. While not strictly a program area of the Institute, the objectives of this grant have guided OEWRI activities to a large degree for the past four years. In October 2010, U.S.E.P.A.-Region 7 notified MSU that OEWRI had fulfilled its contract obligations for the start-up grant in full and closed the project.

The Start-up Plan had the following objectives:

- (i) Provide infrastructure and develop office and laboratory space;
- (ii) Develop facilities, instrumentation, and capacity for scientific water and soil/sediment monitoring and analysis including acquisition of equipment and supplies for water and sediment quality activities;
- (iii) Develop EPA-approved Quality Assurance Program Plans (QAPPs) and Standard Operating Procedures (SOPs) for all laboratory/analytical, field monitoring, and geospatial techniques;
- (iv) Inventory and network university-wide resources to provide water and soil/sediment quality monitoring and analytical services for contract work and to support collaborative efforts or matching funds for grants;
- (v) Develop and support environmental and water resource website services including data delivery and communication systems;

(vi) Develop active partnerships with environmental groups, government agencies, or other universities to develop and implement monitoring activities, research projects, or management plans aimed at improving watersheds in the Ozarks;

(vii) Host and sponsor water research and resources conferences for the Ozarks; and

(viii) Plan and implement four water and sediment quality research projects that address regional water quality concerns as determined by government agencies, watershed stakeholders, and published TMDLs. The description and status of each report follows:

(a) Pearson Creek Watershed Water Quality Assessment. A watershed-scale water and sediment study of Pearson Creek addresses questions about “unknown” toxicity and nonpoint pollution sources including bacteria, metals, and nutrients to support Total Maximum Daily Load (TMDL) efforts. Pearson Creek drains a unique watershed area that contains Jones Spring, urban and rural areas, and urbanizing areas. Water from Pearson Creek flows only a short distance down the James River until it reach the Blackmon water works and Springfield Lake. This report is presently in draft form and will be reviewed and posted on the website by June 15, 2011.

(b) Seasonal and Land Use Variations of Suspended Sediment and Chemical Loads in the James River Basin. This study quantifies the suspended sediment and dissolved loads in the James River by sampling at weekly intervals during dry and wet weather at active USGS gaging stations. Suspended sediment is ranked by USEPA as the number one nonpoint pollutant nationally, yet we have no understanding of the seasonal variations in loads and their relationship to land use in the southwestern Ozarks. Other total forms and dissolved constituents of nutrients and other ions will also be evaluated. This study has been completed in the form of a MS thesis by Erin Hutchinson (GSS, 2010). It is presently available on the OEWRI website.

(c) Historical and Present-day Channel Stability of the Finley Creek. This project involves a watershed-scale study of stream bed and bank stability in the Finley Creek. Recent meetings with stakeholders and managers during the development of the management plan for the watershed have identified channel instability and sedimentation as one of the primary problems affecting their watershed. This project will examine channel morphology, riparian vegetation, bank erosion, and gravel bar distribution using historical aerial photography, GIS/remote sensing, field assessments, and subsurface floodplain mapping. The results of this study are presently in review for publication in a peer-reviewed journal. After review, the manuscript will be posted on the OEWRI website; and

(d) Alluvial Chronology, Geomorphology, and Contamination of Floodplains in the Middle James River Valley. This study involves the geospatial and subsurface investigation of the properties, distribution, and metal contamination of alluvial deposits in the Middle James River Valley from the Pearson Creek Confluence, through Lake Springfield, past the Wilson Creek

confluence, and ending at the Finley Creek confluence. Floodplains act as both a source and sink of sediment and sediment-bound pollutants in river systems. Previous research has identified high levels of metals including lead, zinc, and mercury in floodplain deposits below the historical mining areas on Pearson Creek and in active sediments and floodplains along Wilson Creek. Understanding the landform distribution, age, sediment budget, and contamination distribution will offer insights into the geography and timescales of sedimentation and floodplain erosion and the role that bank erosion plays in supplying sediment and other nonpoint pollutants to Ozark rivers. One product of this project is in the form of a MS thesis on mining-Pb contamination in Pearson Creek by Patrick Womble (GSS, 2009). Another product of this study is a manuscript presently in review for publication in a peer-review journal which focuses on the James River.

RESEARCH ACCOMPLISHMENTS

OEWRI's research accomplishments include work on externally funded projects, publications, and presentations. Specific accomplishments for 2010 are listed below

External Grants

OEWRI worked on 11 externally funded projects in 2010. Eight were continuing from previous years and three were new in 2010. The total multi-year value of the active grants in 2010 was approximately \$1,650,000. The value of external funds provided to OEWRI in the 2010 single year period totaled \$204,000. This amount included an indirect cost contribution from OEWRI to the university and college of about \$20,000.

OEWRI submitted two proposals in 2010 that were not funded: (i) Environmental Federation of Jamaica, Baseline Fish and Habitat Survey for Bluefields Bay. Co-PI Dan Beckman (BIO), \$50,000 (declined); and (ii) AmerenUE, Evaluation of Shoreline Erosion Rates along Lake of the Ozarks, \$35,000 (may be funded in 2011).

The 11 active grants for 2010 are briefly described below:

(1) OEWRI Start-up Project

Sponsor: United States Environmental Protection Agency-Region 7, Kansas City.
Budget No. I02040-152013-021 Total: \$988,600 2010: \$30,000
Period: 02-01-06 to 07-31-10 IC rate: 42.5% S&F

(2) Stormwater Runoff Quality to the James River (319)

Sponsor: James River Basin Partnership (through MoDNR and USEPA)
Budget No. I02060-152013-022 Total: \$69,916 2010: \$15,000
Period: 08-01-06 to -01-31-11 IC rate: 13% S&F

- (3) James River Urban Stream MS-4 & TMDL Monitoring Program
 Sponsor: Greene County and local governments
 Budget No. M02025-1520123-021 Total: \$200,000 2010: \$40,000
 Period: 08-01-08 to 07-31-13 IC rate: 38.5% DC
- (4) Biosolids Runoff Study
 Sponsor: City of Springfield
 Budget No. K02192-152013 Total: \$128,408 2010: \$42,000
 Period: 08-15-08 to 12-15-11 IC rate: 38.5% DC
- (5) Longterm Monitoring Program for the UWRB
 Sponsor: Upper White River Basin Foundation
 Budget No. O02162-152013-021 Total: \$9,740 2010: \$3,000
 Period: 08-15-09 to 01-31-10 IC rate: \$42.5 S&F
- (6) Big River Mining Sediment Storage Assessment
 Sponsor: U.S. Fish and Wildlife Service, Columbia, MO
 Budget No. I02172-152013-021 Total: \$151,279 2010: \$50,000
 Period: 01-09-09 to 09-30-13 IC rate: \$17.5% DC
- (7) Analysis and Indexing of Biomonitoring Samples
 Sponsor: URSCorp (through MoDNR/USEPA)
 Budget No. I02187-152013-021 Total: \$35,774 2010: \$10,000
 Period: 03-31-09 to 02-1-10 IC rate: 42.5% S&F
- (8) Lackman Branch Assessment
 Sponsor: Olsson Associates, Springfield, MO
 Budget No. O02194-152013-021 Total: \$8,000 2010: \$6,000
 Period: 08-15-09 to 01-15-10 IC rate: 42.5% S&F
- (9) Upper Ward Branch Assessment (NEW)
 Sponsor: Olsson Associates, Springfield, MO
 Budget No. O02207-152013-021 Total: \$5,000 2010: \$5,000
 Period: 04-01-10 to 10-30-10 IC rate: 38.5% DC
- (10) Springfield Urban Stream MS4 Monitoring (NEW)
 Sponsor: City of Springfield
 Budget No. M02029-152013-021 Total: \$22,000 2010: \$22,000
 Period: 08-31-10 to 08-31-11 IC rate: 38.5% DC
- (11) Baseline Study of PAH Sources in Springfield (NEW)
 Sponsor: City of Springfield
 Budget No. M02029-152013-021 Total: \$2,000 2010: \$30,846
 Period: 11-01-10 to 10-31-11 IC rate: 38.5% DC

Journal Articles (2)

Marc R. Owen and R.T. Pavlowsky, 2010. *Base flow hydrology and water quality of an Ozarks spring and associated recharge area, southern Missouri, USA*. Environmental Earth Sciences <http://www.springerlink.com/content/e484132694nk0505/>.

Robert T. Pavlowsky, Scott A. Lecce, Gwenda Bassett, Derek J. Martin, 2010. Legacy Hg-Cu Contamination of Active Stream Sediments in the Gold Hill Mining District, North Carolina. *Southeastern Geographer* 50(4) 503-522

Project Final Reports (5)

Pavlowsky, R.T., and D.J. Martin, 2010. *River sediment quality of the upper White River Basin*. Ozarks Environmental and Water Resources Institute, Missouri State University, Springfield, MO, Report no. OEWRI EDR-10-001. Final Report to Upper White River Basin Foundation, Branson, Missouri.

Pavlowsky, R.T., M.R. Owen, and D.J. Martin, 2010. *Distribution, geochemistry, and storage of mining sediment in channel and floodplain deposits of the Big River system in St. Francois, Washington, and Jefferson Counties, Missouri*. Ozarks Environmental and Water Resources Institute, Missouri State University, Springfield, MO, Report no. OEWRI EDR-10-002. Final Report to U.S. Fish and Wildlife Service, Columbia, Missouri

Mickus, K.L., R.T. Pavlowsky, M.R. Owen, and P.J. Womble, 2010. *DC-resistivity and ground penetrating radar investigation of the floodplain and gravel bars of the Big River, eastern Missouri*. Ozarks Environmental and Water Resources Institute, Missouri State University, Springfield, MO, Report no. OEWRI EDR-10-004. Final Report to U.S. Fish and Wildlife Service, Columbia, Missouri.

Pavlowsky, R.T., and M.R. Owen, 2010. Geomorphic assessment of upper Wards Branch, Springfield, Missouri. Ozarks Environmental and Water Resources Institute, Missouri State University, Springfield, MO, Report no. OEWRI EDR-10-006. Final Report to Olsson Associates, Springfield, Missouri (August).

Owen, M.R., A. DeWitt, and R.T. Pavlowsky, 2010. *Nutrient transport and fate from municipal biosolids land application (Year 2 annual report)*. Ozarks Environmental and Water Resources Institute, Missouri State University, Springfield, MO, Report no. OEWRI EDR-10-007. Final Report to City of Springfield, Missouri (December).

Presentations (26)

Pavlowsky, R.T., S.A. Lecce, D.J. Martin, and M.R. Owen, 2010. *Preliminary report on contaminated sediment concentrations, distribution, and volume in channel and floodplain deposits of the Big River in St. Francois, Washington, and Jefferson Counties, Missouri*: Workshop on Ecotoxicology and sediment transport of the Big River and other toxicological investigations in Missouri's Lead Mining Districts, Missouri Natural Resources Conference 2010, Tan-Tar-A, Osage Beach, Missouri, February 3-5, 2010.

Martin, D.J., R.T. Pavlowsky, and W.P. Dryer, 2010. *Short-term variations in channel transport and bed and bar storage of mining sediment in the Big River*: Workshop on Ecotoxicology and sediment transport of the Big River and other toxicological investigations in Missouri's Lead Mining Districts, Missouri Natural Resources Conference 2010, Tan-Tar-A, Osage Beach, Missouri, February 3-5, 2010.

Pavlowsky, R.T., S.A. Lecce, D.J. Martin, M.R. Owen, and P.J. Womble, 2010. *Floodplain storage of mining sediment in the Big River, Old Lead Belt, SE Missouri*: GSA North-Central/South-Central Conference, Branson, Missouri, April 10-13.

Austin, E.C., K. Mickus, R.T. Pavlowsky, D.J., Martin, M.R. Owen, S.A. Lecce, and P.J. Womble, 2010. DC-Resistivity and GPR studies along the floodplains of the Big River, Missouri for mining sediment studies: GSA North-Central/South-Central Conference, Branson, Missouri, April 10-13.

Dryer, W.P., and R.T. Pavlowsky, 2010. *Catastrophic valley entrenchment and debris fan formation in the Bluefields River, Westmoreland, Jamaica*: GSA North-Central/South-Central Conference, Branson, Missouri, April 10-13.

Duzan, J., and R.T. Pavlowsky, 2010. *MS4 stormwater monitoring program and year 1 results for the Springfield, Missouri metropolitan region*: GSA North-Central/South-Central Conference, Branson, Missouri, April 10-13.

Ebert, J.E., and R.T. Pavlowsky, 2010. *Water quality trends in the Bluefields Bay Watershed, Jamaica*: GSA North-Central/South-Central Conference, Branson, Missouri, April 10-13.

Hoggard, H.L., and R.T. Pavlowsky, 2010. *Nonpoint source and water quality trends in the Pearson Creek Watershed*: GSA North-Central/South-Central Conference, Branson, Missouri, April 10-13.

Owen, M.R., R.T. Pavlowsky, and P.J. Womble, 2010. *Historical floodplain deposition and disturbance zone evolution in the middle James River, SW Missouri*: GSA North-Central/South-Central Conference, Branson, Missouri, April 10-13.

Sturnfield, E., and R.T. Pavlowsky, 2010. *Influence of urban and rural land use on water quality in a karst watershed, Springfield, Missouri*: GSA North-Central/South-Central Conference, Branson, Missouri, April 10-13.

Womble, P.J., M.R. Owen, and R.T. Pavlowsky, 2010. *Lead and zinc storage within alluvial deposits along lower Pearson Creek, SW Missouri*: GSA North-Central/South-Central Conference, Branson, Missouri, April 10-13.

Young, B.M., and R.T. Pavlowsky, 2010. *Disturbance zones and mining sediment remobilization in the lower Big river, southeast Missouri*: GSA North-Central/South-Central Conference, Branson, Missouri, April 10-13.

Pavlowsky, R.T., and S.A. Lecce, M.R. Owen, and D.J. Martin, 2010. *Channel dispersal and storage of mining sediment in the Big River, Old Lead Belt, SE Missouri*: Association of American Geographers Annual Meeting, Washington, D.C., April 14-18.

Dryer, W.P., and R.T. Pavlowsky, 2010. *Catastrophic valley entrenchment and debris fan formation in the Bluefields River, Westmorland, Jamaica*: Association of American Geographers Annual Meeting, Washington, D.C., April 14-18. Dryer won best oral paper by a MS student for the Geomorphology Specialty Group

Ebert, J., and R.T. Pavlowsky, 2010. *Watershed-based environmental planning in Bluefields Bay, Jamaica*: Association of American Geographers Annual Meeting, Washington, D.C., April 14-18.

Young, B.M., and R.T. Pavlowsky, 2010. *Floodplain storage and release of historical mining contaminated sediment in the lower Big River, SE Missouri*: Association of American Geographers Annual Meeting, Washington, D.C., April 14-18. Young won best oral paper by a MS student for the Water resources Specialty Group

Pavlowsky, R.T., and W.P. Dryer, 2010. *Catastrophic incision and debris fan formation of the Bluefields River due to extreme rainfall in Southwestern Jamaica*. Association of American Geographers Great Plains/Rocky Mountain Division Annual Meeting, Lawrence, Kansas, October 8-9.

Young, B., and R.T. Pavlowsky, 2010. *Historical channel changes along the lower Big River, eastern Missouri*. Association of American Geographers Great Plains/Rocky Mountain Division Annual Meeting, Lawrence, Kansas, October 8-9.

Casey, S., and R.T. Pavlowsky, 2010. Large woody debris in Ozark Highlands rivers. Association of American Geographers Great Plains/Rocky Mountain Division Annual Meeting, Lawrence, Kansas, October 8-9.

Pavlowsky, R.T., D.J. Martin, M.R. Owen, and S.A. Lecce, 2010. *Historical disturbance and geomorphic recovery of Big River, eastern Missouri*. Geological Society of America Annual Meeting, Denver, CO, October 31-November 2010.

Lecce, S.A., R.T. Pavlowsky, M.R. Owen, and D.J. Martin, 2010. *Storage of mining sediment in floodplain deposits of the Big River, Missouri*. Southeast Division of the Association of American Geographers Annual Meeting, Birmingham, AL. November 21-23.

Pavlowsky, R.T., D.J. Martin, and M.R. Owen, 2010. *Channel morphology and sediment characteristics of Ozark rivers*. Southeast Division of the Association of American Geographers Annual Meeting, Birmingham, AL. November 21-23.

Owen, M.R., R.T. Pavlowsky, and D.J. Martin, 2010. *Geomorphic evaluation of channel dredging to control contaminated sediment transport in Big River, Old Lead Belt, eastern Missouri*. Southeast Division of the Association of American Geographers Annual Meeting, Birmingham, AL. November 21-23.

Pavlowsky, R.T., 2010. Lead mining and sediment contamination in the Big River. Ozarks Mountain Paddlers, monthly meeting, July.

Pavlowsky, R.T., 2010. Mining sediment deposited behind low head dams and within gravel bars in the Big River. Trustee Councils of TriState, Missouri Southern University, Joplin, MO, September 14-15.

Pavlowsky, R.T., 2010. Ground and surface water quality in the Ozarks: Conference on “Water: a finite resource in a growing region” Hosted by the TriState Water Resource Coalition and Missouri State University. DoubleTree Inn, Springfield, MO, November 19.

EDUCATION ACCOMPLISHMENTS

OEWRI dedicates a significant amount of effort to training and research support for undergraduate and graduate students. Since staff offices are located on the third floor of Temple Hall in close proximity to CNAS departments, it is only reasonable to expect that OEWRI supports curriculum and teaching activities through technical assistance, research methodologies, and environmental database access. Activity logs show that OEWRI staff spend from 5 to 15 percent of their time per week training and mentoring students and assisting faculty in CNAS and other colleges at MSU. In 2010, OEWRI staff and facilities provided technical and educational resources for undergraduate and graduate students in several CNAS departments including GGP, BIO, CHM, and AGR (now its own “school” unit) and the Department of Sociology, Anthropology, and Criminology in the College of Humanities and Public Affairs. A list of student training and education accomplishments supported by OEWRI follows below.

Undergraduate Hourly Workers (6 students)

Daniel Williams (GRY), GIS analysis

Susan Helwig (GLG), Sediment analysis, Big River mining contamination project

Sarah Morris (BIO), Soil analysis, laboratory worker

Kevin McKee (CHM), Laboratory worker in Water and Sediment Laboratory

Stephanie Prevedel (CHM), Urban stream quality & carbon transport, laboratory worker

Terry Phillips (CHM), Urban stream quality & carbon transport, laboratory worker

Undergraduate Student Research Projects (22 students)

(1) Summer Independent Study- B. Freeman, Channel Assessments of Ozark Streams

(2) Research projects in GRY 348-Geomorphology (Fall 2010)

(a) D. Williams, A. Stueve, M. Gant- Influence of Valley water mill on nutrient and bacteria concentrations in flow from Sanders Spring

(b) R. Culver, C. Arnall- Analysis of sediment cores from Lake Springfield

(c) D. Fouts, K. Newbold- Influence of slope and land use on soil carbon content

(d) R. Jaspering, T. Penner, S. Helwig- Table Rock Lake shoreline erosion rates

(e) Z. Wilkinson, E. Freeman- Gravel bar texture variations along the James River

(f) B. Kinworthy, J. Thomas, B. Kennedy- Difference between urban and rural streams

(3) Intern Research Projects (*CNAS undergrad research showcase participants*)

(a) Daniel Williams (GRY), PAH sources in Springfield (2nd place)

(b) Caroline Pavlowsky (GGP), Sustainability & Energy Use

(c) Susan Helwig (GLG), Big River sediment contamination

(d) Sarah Morris (BIO), Soil analysis (1st place)

(e) Stephanie Prevedel (CHM), Urban stream quality & carbon transport

(f) Terry Phillips (CHM), Urban stream quality & carbon transport

Undergraduate Field Trips

GRY 348- Fall: Ward Branch channel assessment (1/2 day x 15 students)

GRY 348-Fall: Soil Coring at Pearson Creek (1/2 day x 15)

GRY 348-Fall: Lake Springfield bottom sediment coring (1/2 day x 3)

AGA 345-Fall: Soil Judging, use of coring truck and crew (1/2 day x 8)

AGA 545- Spring: Soil Appraisal, use of coring truck and crew (1/2 day x 10)

Graduate Thesis Research (19)

OEWRI supports various levels of graduate student research at Missouri State University. The Institute entirely or partially supported 19 MS thesis projects in three programs: Geospatial Science (16), MNAS (2), and Biology (1) (see below). In addition, external funds for OEWRI projects provided graduate assistantships for 7 students and hourly work positions for 3 students in 2010. These students and their programs are listed below.

<u>Graduated</u>	<u>2nd Year</u>	<u>1st Year</u>
Jackie Ebert (GSS)	Ben Young (GSS)	Jennifer Carroll (GSS)
W. Patrick Dryer (GSS)	Joseph Mbongowo (GSS)	Heather Grootens (GSS)
Erin Hutchison (GSS)	Tyler Suda (GSS)	Matt Grootens (GSS)
Sarah Davis (BIO)	Emily Sturnfield (GSS)	Megan Harrington (GSS)
Doug Giesselbeck (MNAS)		Anna Larkin (GSS)
Katie Tomlin (GSS)		Nicole Daugherty (GSS)
		Andrew DeWitt (GSS)
		Andrew Schiller (GSS)
		Kyle Kosovich (MNAS)

Graduate Assistantships (7)

Patrick Dryer (GSS) Biosolids Runoff Project, Spring
Jackie Ebert (GSS) Big River Project, Spring
Ben Young (GSS) Big River Project, Spring, Summer, & Fall
Ellie Sturnfield (GSS) Urban Stream MS-4 (partial), Spring & Summer
Anna Larkin (GSS) Urban Stream MS-4, Fall
Andrew DeWitt (GSS) James River Runoff-319, Fall
Erin Hutchison (GSS) EPA start-up, Spring

Graduate Workers-Hourly (3)

Joseph Mbongowo (GSS)
Sarah Davis (BIO)
Patrick Womble (GSS)

Completed MS Theses (3)

Patrick Dryer, May 2010, *Catastrophic valley entrenchment and debris fan formation in the Bluefields River, Westmorland, Jamaica*, Geospatial Science MS Program (Pavlowsky)

Jackie Ebert, May 2010, *Integrated watershed management in Bluefields Bay, Jamaica*, Geospatial Science MS Program (Pavlowsky)

Erin Hutchison, December 2010, *Mass transport of suspended sediment sediment, dissolved solids, nutrients, and anions in the James River, sw Missouri*, Geospatial Science MS Program (Pavlowsky)

National Student Awards (2)

Dryer, W.P., and R.T. Pavlowsky, 2010. *Catastrophic valley entrenchment and debris fan formation in the Bluefields River, Westmorland, Jamaica*: Association of American Geographers Annual Meeting, Washington, D.C., April 14-18. Dryer won best oral paper by a MS student for the Geomorphology Specialty Group

Young, B.M., and R.T. Pavlowsky, 2010. *Floodplain storage and release of historical mining contaminated sediment in the lower Big River, SE Missouri*: Association of American Geographers Annual Meeting, Washington, D.C., April 14-18. Young won best oral paper by a MS student for the Water resources Specialty Group

Graduate Field Trips

BIO 609- Spring: Measurement of channel properties and flow (1/2 day x 8)

GEO 770-Summer: Big River Field Trip- channel assessment (5 days x 10)

GEO 770-Summer: Old Lead Belt mining history (1 day x 10)

SERVICE AND OUTREACH ACCOMPLISHMENTS

Service and community outreach is an important component of OEWRI's mission. The Institute is an "on-call" campus resource for technical advice and support and overall this type of service accounts for about 10% of staff workload. Examples of these types of activities include OEWRI loaning field equipment to Drs. Black (GGP) and Barnhart (BIO), providing research topic presentations in Dr. Pavlowsky's GRY 348 and Dr. Meyer's GEO 700 courses, and generating water analyses to support Dr. Biagioni's laboratory projects. Examples of other types of service and outreach activities by OEWRI are described below:

Environmental Events

Sponsored a booth at the annual Missouri Natural Resources Conference at Tan-Tar-A.

Sponsored a special session on Human Impacts on Fluvial Systems at the joint meeting of the North-Central/South-Central Sections of the Geological Society of America, Branson, Missouri, April 11-13.

Represented MSU at the Regional Water Summit hosted by Congressman Roy Blunt at Crowder College, Neosho, Missouri, April 19.

Sponsored a booth at the 2010 Sustainability Conference at MSU, October 27 with five posters.

Organized and presented “Soil Chemistry” practicum at Science Olympiad, MSU, February 20. Also help to staff Expanding Your Horizons (MSU) and Envirothon (Lake Springfield Park).

Geospatial Technology Support

GPS base station data access: OEWRI provides server space and public access through our website for Global Positioning Systems (GPS) differential correction data generated from the GGP base station receiver on top of Sunvilla Towers.

Geospaital database access: OEWRI provides access to geospatial data stored on OEWRI servers to GGP graduate students and faculty to support class projects and research

GGP GIS Support: OEWRI provides GPS receivers and related equipment for several courses offered by the department.

Student and Faculty Help: OEWRI provides “walk-in” assistance to students and faculty on a daily basis to help with GIS/GPS/Remote Sensing related tasks and environmental research needs.

Environmental Group Assistance

Watershed Committee of the Ozarks, Loring Bullard: OEWRI staff regularly attend monthly Watershed Committee meetings to participate and give updates on OEWRI projects and website postings. OEWRI is working with the Watershed Committee on a new urban water quality 319 grant with the City of Springfield. In addition, OEWRI is providing water and channel monitoring data for the South Dry Sac River and pond in the area around the Watershed Center at Valley Water Mill. Both undergraduate and graduate students are working on this.

James River Basin Partnership, Joseph Pitts: OEWRI is working with the JRBP to develop a comprehensive watershed management plan for the James River Basin and complete a study on the effect of storm water from residential subdivision on water quality.

Southwest Missouri Resource Conservation and Development Council, Rita Mueller: OEWRI is providing technical assistance upon which to apply for a federal Conservation Innovation Grant totaling almost 800K over three years. The grant, if successful, will attempt to determine the soil improvements and water quality effects associated with different grazing and biosolids application treatments. MSU’s School of Agriculture is also a partner on the project.

Regional Outreach

Examples of community outreach and related committee work include the following:

Member, Midwest Science Advisory Network; U.S. Fish and Wildlife Service , National Fish Habitat Action Plan

Panel presentation, Water Quality in the Ozarks and its Intersection with water supply, , Conference on “Water:a finite resource in a growing region” Springfield, November 19, 2010.

Member of the Future of Water Committee, a subcommittee of the Good Community Committee for the City of Springfield

Member, Conservation Planning Advisory group for the upper Meramec River watershed. Sponsored by The Nature Conservancy.

PARTNERSHIPS

One of the major goals for OEWRI is to develop and sustain partnerships across a wide range of environmental interests in the Ozarks and beyond through communication, resource sharing, and projects.

OEWRI’s comprehensive list of partners since 2005 is provided below. Each listing is annotated with the letter code (s) representing the nature of the partnership. Those partners marked with an asterisk (*) indicate an activity for 2010.

- A: submission of grant proposal, unfunded or pending
- B: collaboration on a funded project
- C: funding source for OEWRI
- D: shared membership on ad hoc environmental issue committee
- E: technical support or expertise supplied by OEWRI
- F: OEWRI attends monthly meetings and/or gave a presentation
- G: shared education and outreach activities
- H: OEWRI advisory board member (2007)

Regional Environmental Groups (9)

- Watershed Committee of the Ozarks, Loring Bullard (A, D, E, F, G)*
- James River Basin Partnership, Holly Neill/Joseph Pitts (B, C, D, E, F, G)*
- Upper White River Basin Foundation, John Moore/David Casaletto (B, C, D, E, G)*
- Table Rock Lake Water Quality, Inc., David Casaletto (D, E)
- Environmental Resource Coalition, Betty Wyse (B, C, F)

Southwest Missouri Resource C & D Council, Rita Mueller (A, E)*
Elk River Watershed Improvement Association, Drew Holt (D, E, G)
The Nature Conservancy, Kristen Blann (E,F)*
Ozark Regional Land Trust, Abigail Lambert (E,G)*

Government Agencies (9)

Environmental Protection Agency, Region 7 (C, D, E)*
Missouri Department of Natural Resources (C)*
Missouri Department of Conservation (E)*
National Park Service, Heartland Network (C)
National Resources Conservation Service (D, E, G)*
Southern Missouri Water Quality Project (G)*
Christian County Soil and Water District (E, F)
USGS-Mid Continent Geographic Science Center (C, E, G)
U.S. Fish and Wildlife Service (C)*

Universities (7)

University of Missouri-Columbia (A)
Missouri University of Science and Technology (A, G)*
Northwest Missouri University*
University of Arkansas (D, E, G)
East Carolina University (A, B, G)*
Drury University (B, G)*
Southern Illinois-Carbondale (A)*

Local Governments (7)

Greene County (B, D, E, G)*
Christian County (D, E)*
City of Springfield (C, D, E)*
City of Nixa (D, E)*
City of Ozark (D, E)*
City of Battlefield (D, E)*
City Utilities of Springfield (E, F)

Private Companies (3)

MEC Water Resources (B, C, F)
Olsson Associates (A, B, C, E)*
Missouri Partners Inc. (E)

Missouri State University Centers (4)

Center for Archaeological Research (A, B, E)
Center for Resources Planning and Management (B)*
Bull Shoals Field Station (A, D, E, G)
Darr Agricultural Center (A, D, E)*
Center for Biomedical and Life Sciences (A, E)*

Faculty at MSU (28)

Anson Elliot, Head Agriculture (A, E)*
Tom Dewitt, Agriculture/NRCS (D, E, G)*
Ben Fuqua, Agriculture (A, E, H)
Gary Webb, Agriculture (A, E, H)*
Chris Barnhart, Biology (C)*
Dan Beckman, Biology (A, B)*
Paul Durham, Biology (C)*
Janice Greene, Biology (C, E, H)
John Havel, Biology (B)*
Russ Rhodes, Biology (B)
Jack Steiert, Biology (B, C)*
Rich Biagioni, Chemistry (B, E, G)*
Gary Meints, Chemistry (A, B, E, G)
Lloyd Smith, Head Computer Science (H)
Tom Plymate, Head Geography, Geology, and Planning (H)*
Jill Black, Geography (A)*
Jun Luo, Geography (G)
Xin Miao, Geography (A, G)*
Kevin Evans, Geology (E, G)
Melida Gutierrez, Geology (A)
Doug Gouzie, Geology (B, D, G)
Kevin Mickus, Geology (A, B)*
Diane May, Planning (B)
George Mathew, Mathematics (H)
Lifeng Dong, Physics and Material Science (H)
Tammy Jahnke, Dean CNAS (H)
Inno Onwueme, Associate Dean CNAS (H)
William Wedenoja, Anthropology (A, B)*
David Byers, Anthropology (E)*
Adam Coulter, Geography (E)*

PUBLIC AFFAIRS ACTIVITIES

OEWRI supports the Public Affairs Mission of MSU. Below are several examples of Public Affairs accomplishments for 2010.

Cultural Competence. OEWRI has extended its outreach and research program to the southwest coast of Jamaica on Bluefields Bay. MSU faculty, graduate students, and undergraduate students are working within local communities alongside citizen groups to address economic and environmental problems. The goal is to develop a sustainable economy that combines natural resource use with conservation activities including environmental education. Critical to the sustainable goal is the development of geotourism opportunities, better water treatment facilities, improved marine fishery stocks, and soil and water conservation practices that result in both sufficient crop production and reduced soil erosion and runoff problems.

MSU faculty Bill Wedenoja (ANT), Dan Beckman (BIO), and Linnea Iantria (GGP) are working with OEWRI to assist Bluefields Bay community groups in their goal of developing a better future for their community and children. OEWRI is providing water quality, soil management, and mapping expertise to the partnership. Pavlowsky has lead two study-away student groups (one graduate-level and one undergrad) to address water quality problems and geotourism opportunities. In addition, we will begin a pilot study this summer to determine the baseline condition of the fishery and habitat quality in the bay. The Jamaican government, with the support of local fisherman, recently declared Bluefields Bay as a protected sanctuary off limits to fishing. We will also train local fisherman and wardens in the use of proper assessment methods. Two GSS MS theses have been completed in support of these efforts in 2010 (Ebert and Dryer, see above). The plan is for two or three more MS thesis projects to begin this summer in the GSS and BIO MS degree programs.

Ethical Leadership. OEWRI gives students a chance to work in the field of environmental management and research along side of faculty and government managers. They get to work on projects in support of environmental leadership goals and ethical decision-making. There are two projects that showcase this element in the Institute's accomplishments.

First, the MS-4 urban stream water quality monitoring program allows OEWRI to take a leadership role in addressing water management regulations for the City of Springfield and other urban areas in Greene County. We operate and report on a 32 site water quality monitoring network aimed at sampling nutrient, sediment, and chloride concentrations in storm runoff. The results of student run field monitoring and laboratory analyses are used to guide water quality management plans where students get to interact with state and local environmental managers. In addition, the data collected is being stored and evaluated by OEWRI to get as much scientific knowledge from the data as possible, rather than let it become buried in regulatory agency files.

The collaborative aspect of this project helps our students to get hands-on experience in water quality monitoring, reduces the cost for regulatory compliance to the communities, and expands the utility of the data with research for the public good.

Second, the Big River sediment contamination study addresses questions about the degree and spatial extent of lead contamination in sediments from the Big River in eastern Missouri due to mine tailings inputs from the Old Lead Belt mining area which closed in 1972. OEWRI has become the leader on mining contamination problems in association within one of the largest Superfund sites in nation. Our students get opportunities to attend meetings with Federal environmental officials and managers where the results of our studies are being showcased to affect the decision-making process involved with management plans for the Big River. These plans address the toxic risks of contaminated sediment and water to aquatic life and human health.

Community Engagement. OEWRI is constantly out in the community working with partners and responding to new environmental challenges. Recall the long list of partners involved with OEWRI described above. Due to training and networking on projects, several OEWRI graduates have been hired by local watershed groups and local and state environmental agencies.

UNIVERSITY BUDGET EXPENDITURES AND INCOMES

In addition to external grant funding, OEWRI is allocated about \$75,000 annually by the University to support staff and operations. The university dedicated these funds to OEWRI to provide match support for federal start-up funding and to add long-term stability to the operation of the Institute. The budgeting of these funds is generally distributed as follows: (i) full-time staff person, 67%; (ii) supplemental salary for the director, 13%; (iii) administrative and laboratory supplies, 15%; and (iv) emergency reserve, vehicle maintenance, and instrumentation operations, 5%.

The university budget allocation to OEWRI is leveraged to produce benefits beyond base funding in three ways: (i) salary match for federal grants; (ii) additional service time; and (iii) equivalent credit hour generation. An approximate accounting of additional cost benefits is provided below.

Match. State funds can be used to provide salary match on some environmental grants, the Federal 319 nonpoint source grants in particular require a 40% match in the total budget. OEWRI matches at least 25K annually to these types of grants.

Service Time. Activity logs for OEWRI staff indicate that 10% of the weekly workload is related to service to MSU. If a 10% return on staff time and annual staff salary of 34K is assumed, then three full-time staff generates about 13K in service benefits beyond project funding.

Credit Hour Generation. OEWRI staff are precluded from teaching courses at MSU under present funding line conditions. However, they contribute significantly to credit hour generation through mentoring, research projects, and field trips for undergraduate and graduate students. Given the educational accomplishments described above, the dollar value of these benefits can be estimated. Thesis research support is valued at 0.5 to 2 credits per year on a 3 graduate credit base, variable upon the level of support involved (e.g., 8 students x 2 credits; 6 x 1; 5 x 0.5). At \$224 per graduate credit and 24.5 credits, the value is 5.5K for thesis mentoring and support. Graduate field trip contributions are valued at 0.5 credits per student trip day at 64 students per day for a benefit of 32 graduate credits or 7.2K per year. Undergraduate credit generation is valued the same way, but at \$186 per credit. If undergraduate research support is valued at 1 credit per student x 22 students, then the benefit is 4K. Field trip generation is 26 students per day x 0.5 credits each totaling a benefit of 2.4K.

Benefit:Cost Comparison for 2010. A benefit:cost ratio can be computed by summing the income from external grant \$ generation (204K) and base leverage benefits (57K), and then dividing the income by the university contribution of 75K. This yields a value of return on university funding of 3.5 times.

GOALS AND STRATEGIC PLAN FOR 2011

OEWRI plan's is to continue on its present course of action and schedule of activities. The following six goals will help further support the mission of OEWRI:

- (1) Continue to attract externally-funded projects.
- (2) Continue to support and mentor undergraduate and graduate research.
- (3) OEWRI will lose its space in Temple 103 this summer. New space needs to be found to replace this loss and continue operations on funded projects.
- (4) Continue to focus on peer-reviewed publication as an outlet for research project results. Through publication, OEWRI's reputation in the field can grow and it can be more competitive for basic research grant funding in the future.
- (5) Maintain and regularly update the OEWRI website as a major communication and data outlet.

(6) Try to find ways to get more faculty into principal investigator roles in OEWRI. Research analysis and writing is a bottleneck for productivity.

SPACE AND STAFFING NEEDS

Given the extensive productivity of OEWRI and its lack of sufficient space to house staff, students, laboratories, and field equipment, three additional types of spaces are needed by OEWRI to improve productivity, working conditions, and safety:

(1) Sediment laboratory space (15' x 20') is needed for sediment sample preparation and analysis to support recent instrumentation acquisitions and funded research activities. It does not need a hood, but a running hot and cold sink would be very useful ("dirty lab").

(2) Water quality laboratory space (15' x 20') is needed that has a fume hood and sink. Present facilities are not adequately ventilated for the number of staff and students working in the present laboratory. In addition, presently there is not enough space to house the activities required to adequately support the instrumentation and externally funded research projects for OEWRI ("clean lab").

(3) Field equipment and supplies space (20' x 20') is needed to have access to the outside so that field monitoring activities effectively organized and outfitted. Presently, water quality laboratory, sediment quality laboratory, and field activities are run out of one laboratory. Ideally, this space may be part of a larger double-bay garage so that the truck mounted coring rig for which OEWRI presently operates can be shielded from the weather and vandalism ("Field monitoring garage").

(4) Full- or half-time faculty position (PhD) with expertise in hydrology and water quality modeling. This position is justified based on: (1) contract statement by the university to provide a replacement to GGP for the time Pavlowsky is directing the Institute (presently unfilled); (2) In the establishment proposal approved by the MSU Board of Governors, a full-time research position was planned to be included in OEWRI; (3) President's Futures Task Force identified the hiring of a hydrologist to be a high priority in order to support the environmental research goals of the university; (4) The Dean of CNAS has supported and filled similar requests for staffing resources in other centers; (5) this expertise is particularly needed to address water quality needs in the region and attract more external funds; and (6) a recent external review of GGP and OEWRI recognized that OEWRI is understaffed relative to its productivity.