

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

***ANNUAL REPORT OF ACTIVITIES FOR
CALENDAR YEAR 2014***

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July 2, 2015



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EXECUTIVE SUMMARY

OEWRI activities in 2014 focused primarily on attracting external funds, developing and sustaining 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, stream and lake conditions, and watershed function and disturbance in Missouri and other areas including Kansas and Jamaica.

Research accomplishments include work on 9 externally funded projects totaling about \$150,000 in funds expended by OEWRI in 2014. Three new grants totaling 31,000 were obtained. Two peer-reviewed articles were published, three final project reports submitted to sponsors, and 19 conference and invited presentations were delivered.

Undergraduate education accomplishments include the hiring of 3 hourly workers, research project support and mentoring for 9 students, and field trip experiences for about 50 students. Graduate education accomplishments include the hiring of 13 graduate assistants and varying levels of support for 14 thesis projects with 5 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. In 2014 OEWRI worked with 7 MSU faculty, 3 MSU centers, and 26 other units including 5 watershed groups. 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.

OEWRI contributes to the Public Affairs mission of MSU through: (i) research, outreach, and student trips in Jamaica to address community and environmental problems, (ii) involvement of students in high profile environmental projects that challenge them to examine leadership style and ethical dimensions, and (iii) strong connections with community leaders and stakeholders in the area of environmental issues and water resources management.

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 to be the director of OEWRI in March 2005. OEWRI is administered within the College of Natural and Applied Science through the Department of Geography, Geology, and Planning (GGP). Additional information about OEWRI can be found at: <http://www.owri.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 2014
- (3) Accomplishments in research, education, outreach, partnerships, and Public Affairs
- (4) Budget Expenditures and Income for 2014
- (5) Strategic Plan for 2014
- (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), Assistant Director and project manager, Soil Quality, Geomorphology, and Field Monitoring;
- (3) Tyler Smith (M.S. Biology), Research specialist I, Manager of the Water and Soil Quality Laboratory; and
- (4) 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 GGP 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- T328, T343, and T307;
Geomorphology Laboratory & GA office- T125 (supervised by Pavlowsky); and
Sample Preparation Laboratory, T129 (shared use area).
Field Equipment Storage and GA office, T103

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. Paul Schweiger).

Outdoor Storage

Three trucks in SW parking deck, including one truck-mounted Giddings soil coring rig.
John boat/motor and canoes in back lot of Kemper Hall.
Box trailer in Cherry Street fenced area

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; gamma spectrophotometer to measure radioisotope activity (Cs-137, Pb-210); MS2 magnetic susceptibility system; 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 Ozark 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 Watershed Committee of the Ozarks, 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 the past, 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. In 2014 OEWRI supported 3 undergraduate hourly workers and 8 undergraduate research projects. Further, the Institute supported 9 graduate assistants and 13 master thesis projects. In addition, OEWRI staff provided 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” Projects

From 2006 to 2010, the primary objective of OEWRI was to implement a start-up plan supported by two federal grants from the USEPA.-Region 7 totaling \$984,000. 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. These four projects were: (i) Water quality assessment of the Pearson Creek Watershed; (ii) Measurement of suspended sediment, inorganic and organic carbon, nutrient, and dissolved chemical loads in the James River Basin; (iii) Historical and present-day channel stability and gravel bar occurrence within Finley Creek; and (iv) History of mining sediment contamination and channel/floodplain sedimentation in the Middle James River Valley.

INSTITUTE ACTIVITIES FOR 2014

OEWRI activities in 2014 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, OEWRI has been working with three partners in Jamaica environmental monitoring and planning projects.

RESEARCH ACCOMPLISHMENTS

OEWRI's research accomplishments include work on externally funded projects, publications, and presentations. Specific accomplishments for 2014 are listed below

External Grants

OEWRI worked on 9 externally funded projects in 2014. Six were continuing from previous years and three were new in 2014. The total multi-year value of the active grants in 2014 was approximately \$666,000. The total budget for the three new grants in 2014 was \$31,000. The value of external funds spent by OEWRI in the 2014 single year period totaled \$149,000. This amount included an indirect cost contribution from OEWRI to the university and college of about \$10,000.

The 9 active grants for 2014 are briefly described below:

(1) James River Urban Stream MS-4 & TMDL Monitoring Program

Sponsor: Greene County and local governments
Budget No. M02025-1520123-021 Total: \$270,000 2014: \$27,000
Period: 08-01-13 to 07-31-18 IC rate: 20% DC

(2) Springfield Urban Stream MS4 Monitoring (annual continuation)

Sponsor: City of Springfield
Budget No. M02029-152013-021 Total: \$28,000 2014: \$14,000
Period: 09-01-13 to 08-31-14 IC rate: 20% DC

Springfield Urban Stream MS4 Monitoring (annual continuation)

Sponsor: City of Springfield
Budget No. M02029-152013-021 Total: \$29,000 2014: \$15,000
Period: 09-01-14 to 08-31-15 IC rate: 20% DC

(3) Urban Watershed Stewardship 319 Project

Sponsor: Watershed Committee of the Ozarks (through MoDNR and USEPA)
Budget No. O02244-152013-021 Total: \$150,240 2014: \$35,000
Period: 04-30-11 to 03-01-15 IC rate: 13% DC

(4) Asher Creek 319 Project

Sponsor: Greene County Soil and Water District, Springfield, MO
Budget No. I02364-152013-021 Total: \$37,740 2013: \$3,000
Period: 05-01-12 to 01-31-14 IC rate: 13% DC

(5) Pearson Creek 319 Project

Sponsor: James River Basin Partnership, Springfield, MO

Budget No. I02356-152013-021 Total: \$60,060 2014: \$5,000

Period: 06-05-12 to 02-28-14 IC rate: 13% DC

(6) Viburnum Trend Stream

Sponsor: U.S. Fish and Wildlife Service, Columbia, MO

Budget No. I02377-152013-021 Total: \$88,113 2014: \$25,000

Period: 09-04-12 to 12-31-14 IC rate: 17.5% DC

NEW in 2014

(7) Big River Sediment Assessment

Sponsor: Department of Justice, Washington, D.C.

Budget No. I02450-152-013-021 Total: \$19,897 2014: \$16,000

Period: 03-20-14 to 03-21-18 IC rate: 40.5%

(8) South Creek 319 Pre-monitoring

Sponsor: City of Springfield

Budget No. M02046-152013-021 Total: \$7,232 2014: \$5,000

Period: 03-01-14 to 03-31-15 IC Rate: 13% (319 rate)

(9) South Creek Fluvial Geomorphology Study, Springfield MO

Sponsor: Olsson and Associates

Budget No. ??? Total: \$4,000 2014: \$4,000

Period: 08-01-2014 to 11-30-14 IC rate: 40.5%

Journal Articles (2)

(1) Lecce, S.A., and R.T. Pavlowsky, 2014. Floodplain storage of sediment contaminated by mercury and copper from historic gold mining at Gold Hill, North Carolina, USA. *Geomorphology* 206: 122-132.

(2) Witt III, E.C., H. Shi, D.J. Wronkiewicz, and R.T. Pavlowsky, 2014. Phase partitioning and bioaccessibility of Pb in suspended dust from unsurfaced roads in Missouri—A potential tool for determining mitigation response. *Atmospheric Environment* 88:90-98.

Project Final Reports (3)

(1) Owen, M.R. and R.T. Pavlowsky (2014). Water Quality Assessment and Load Reductions for Pearson Creek, Springfield, Missouri. Final Report, Completed for: James River Basin Partnership, Show-Me Yards Neighbors, Farms and Ranches 319 Project, February 24, 2014.

- (2) Owen, M.R. and R.T. Pavlowsky (2014). Asher Creek Water Quality Assessment, Greene and Polk Counties, Missouri. Final Report, Completed for: Greene County Soil and Water Conservation District, Asher Creek Watershed 319 Project, G12-NPS-02, May 6, 2014.
- (3) Pavlowsky, R.T. and M.R. Owen (2014). Geomorphic Assessment of South Creek between National and Campbell Avenue, Springfield, Missouri. Completed for: Olsson Associates, August 6, 2014.

Presentations (19)

National and International Meetings (6)

- (1) Lecce, S.A., and R.T. Pavlowsky, 2014. *Floodplain contamination in the Viburnum Trend Mining District, Missouri*. Annual Conference of the Association of American Geographers, Tampa,FL, April 8-12.
- (2) Mulling, A., M.R. Owen, and R.T. Pavlowsky, 2014. *Lake sediment geochemistry, distribution, and point source phosphorus reduction in Table Rock Lake, southwestern Missouri*. Annual Conference of the Association of American Geographers, Tampa,FL, April 8-12.
- (3) Pavlowsky, R.T., and S.A. Lecce, 2014. *Downstream changes in alluvial sediment storage and mining-metal contamination in Viburnum Trend streams, southeast Missouri*. Annual Conference of the Association of American Geographers, Tampa,FL, April 8-12.
- (4) Zelzer, K., and R.T. Pavlowsky, 2014. *Recent shoreline erosion rates along the south coast of Jamaica*. Annual Conference of the Association of American Geographers, Tampa,FL, April 8-12.
- (5) Meyer, J.L., L. Quinn, A.T. Pavlowsky, R.T. Pavlowsky, 2014. *The Howard Eaton Trail: preserving the past with digital mapping and spatial narratives*. 12th Biennial Scientific Conference on the Greater Yellowstone Ecosystem, Mammoth Hot Springs Hotel, Yellowstone National Park, Wyoming, October 6-8.
- (6) Martin, D.J., C. Harden, and R.T. Pavlowsky, 2014. *Geospatial characterization of fluvial wood arrangement in a semi-confined alluvial river*. American Geophysical Union Fall Meeting, San Francisco, December 15-19.

Regional or State Meetings (7)

- (1) Arnall, C., V. Cane, J. Witt, and R.T. Pavlowsky, 2014. *Reach-scale variability of contaminated channel sediments in Big River, St. Francois County, Missouri*. Missouri Natural Resources Conference, Tan-Tar-A Resort, Osage Beach, MO, February 5-7.

- (2) Cane, V., and R.T. Pavlowsky, 2014. *Recovery of macroinvertebrate communities in a restored urban stream in Springfield, Missouri*. Missouri Natural Resources Conference, Tan-Tar-A Resort, Osage Beach, MO, February 5-7. Missouri Natural Resources Conference, Tan-Tar-A Resort, Osage Beach, MO, February 5-7.
- (3) Foreman, A.T., and R.T. Pavlowsky, 2014. *Historical flood variability in Missouri Rivers*. Missouri Natural Resources Conference, Tan-Tar-A Resort, Osage Beach, MO, February 5-7.
- (4) Kuehn, E.A., and R.T. Pavlowsky, 2014. *Contributions of stream bank erosion to sediment loads in a southwestern Missouri River*. Missouri Natural Resources Conference, Tan-Tar-A Resort, Osage Beach, MO, February 5-7.
- (5) Witt, J., R.T. Pavlowsky, V. Cane, and C. Arnall, 2014. *Mining chat contributions to the Big River in St. Francois County, Missouri*. Missouri Natural Resources Conference, Tan-Tar-A Resort, Osage Beach, MO, February 5-7.
- (6) Pavlowsky, R.T., M.R. Owen, and S.A. Lecce, 2014. *Geomorphic controls on alluvial sediment storage and mining-metal contamination in Viburnum Trend streams, SE, Missouri*. 69th annual meeting of the South-Eastern Division of the Association of American Geographers, Athens, Georgia, November 23-25.
- (7) Mulling, A., and R.T. Pavlowsky, 2014. *Spatial distribution of phosphorus in lake bottom sediments before and after improvements in wastewater treatment*. 69th annual meeting of the South-Eastern Division of the Association of American Geographers, Athens, Georgia, November 23-25.

Invited Presentations (6)

- (1) Pavlowsky, R.T., 2014. *Management challenges due to geomorphic instability and climate change in Ozark River systems*. Missouri Natural Resources Conference, Special session on Multidisciplinary assessment and planning to meet future Missouri water needs in a changing climate. Tan-Tar-A Resort, Osage Beach, MO, February 5-7.
- (2) Pavlowsky, R.T., 2014. *Management challenges due to geomorphic instability and climate change in Ozark river systems*. Geotechnical Engineering Seminar Series, Department of Civil and Environmental Engineering, University of Missouri-Columbia.
- (3) Pitts, J., R.T. Pavlowsky, and T. Whaley, 2014. *Riparian protection and restoration: 4 years of progress*. Water Quality Coordinating Committee Meeting, Missouri Department of Natural Resources, Jefferson City, July 15.

- (4) Pavlowsky, R.T., 2014. Overview of Big River sediment contamination problems. Big River Task Force Meeting for the Big River, USEPA and USACE Meramec River Basin Urban Water Partnership, Saint Louis University, St. Louis, Missouri. September 26, 2014.
- (5) Pavlowsky, R.T., 2014. Geomorphic disturbance, mining contamination, and restoration of the Big River, Southeastern Missouri. Dept. Seminar Presentation to the Department of Earth and Atmospheric Sciences, Saint Louis University, St. Louis, Missouri. September 26, 2014.
- (6) Owen, M.R. and R.T. Pavlowsky, 2014. Decade of Watershed Science and Applications in Southwest Missouri. Water Challenges and Opportunities, A symposium in Celebration of 50th Anniversary of Missouri Water Resources Research Center. University of Missouri, Columbia. Sponsored by Mizzou Advantage & the Chancellor's Distinguished Speakers Program, October 7-8, 2014.

Laboratory Productivity

The OEWRI laboratory in Temple Hall performed the following analytical services external projects and internal projects in 2014.

Water Analysis

Nutrients (TP & TN) = 436
Chloride by probe = 495
Total Suspended Solids by filtration = 436
Water pH = 495
Specific Conductance by probe = 495

Sediment/Soil Analysis

Carbon-Nitrogen-Sulfur Analysis = 397
Laser Diffraction particle size analysis = 182
Magnetic Susceptibility = 297
Gamma Spectrometry for Cs-137 = 154
XRF sediment analyses = 658
Soil pH = 24

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 2014, OEWRI staff and facilities provided technical and educational resources for undergraduate and graduate students in several CNAS departments including GGP, BIO, and CHM. A list of student training and education accomplishments supported by OEWRI follows below.

Undergraduate Hourly Student Workers (3)

- (1) Ali Keppel (GGP) Sediment quality laboratory
- (2) Beau Brummel (CHM), Water quality laboratory
- (3) Tyler Beeman (CHM), Water quality laboratory

Undergraduate Student Research Projects (9)

Research projects in GRY 348-Geomorphology (Fall 2014) (4)

- (1) Randal Grace, Fall 2014: “Shoal Creek Water Quality and Effect of Chicken Houses on Nutrient levels”
- (2) Jaime Isham, Fall 2014: “Septic System Care and Effects on Water Quality in the James River Watershed”
- (3) Chris Watson, Fall 2014: “Riparian Forest Composition along the James River: Relationship to Bank Stability.”
- (4) Joe Nash, Fall 2014: “Bank Erosion History along the James River”

Intern Research Projects (CNAS undergrad research showcase participants) (5)

- (1) Jennifer Witt (GLG), “Mining chat contributions to the Big River in St. Francois Co.”
- (2) Liesel Benecke (BIO), “Floodplain contamination caused by historical lead mining, Big River, SE Missouri”
- (3) Michael Jahnke (GLG), “Physical and Geochemical Characteristics of Agricultural Soils from Southern Jamaica”
- (4) Felix Corrodi (GRY), “Bank Erosion Assessment of Wilson Creek in Springfield, Missouri”
- (5) Alex Olive (GLG), “Soil residuum geochemistry and variability formed from Burlington Limestone, Greene County, Missouri”

Undergraduate Field Trips (2)

- (1) GRY 348- Fall: Ward Branch channel assessment (1/2 day x 18 students)
- (2) GRY 348-Fall: Soil Coring at Pearson Creek (1/2 day x 18)

Graduate Student Support

OEWRI supported research and training for 14 graduate student at Missouri State University in 2014. The Institute entirely or partially supported 13 MS thesis projects in three programs: Geospatial Science (8), MNAS (2), and BIO (3) (see below). In addition, external funds for OEWRI projects provided graduate assistantships for 9 students and hourly work positions for 1 graduate student in 2014. These students and their programs are listed below.

Graduate Assistantships (9)

- (1) Aubree Vaughan (GSS), Non-Springfield MS-4, Spring
- (2) Ezekiel Kuehn (GSS), Viburnum Trend, Spring, Summer
- (3) Virgil Cane (MNAS), Pearson Creek, Spring, Summer
- (4) Loring Bullard (MNAS), Pearson Creek, Spring, Summer
- (5) Karen Zelzer (GSS), Viburnum Trend, Spring, Summer, & Fall
- (6) Adam Mulling (GSS), Urban 319 project, Spring, Summer, & Fall
- (7) Kathryn Martin (BIO), Springfield Urban 319 and lab manager, Fall
- (8) Jennifer Witt (GSS), Big River project, Summer
- (9) Kris Breckenridge (GSS), Big River project, Summer

Graduate Hourly Student Workers (1)

- (1) Cora Arnall (GSS), Water quality monitoring technician

Laboratory and Field Study Assistance (13)

- (1) Makala Exner (BIO), nutrients and flow metering (Advisor: Beckman)
- (2) Bryce Maynard (BIO), field sampling procedures (Advisor: Barnhart)
- (3) Kathryn Martin (BIO), laboratory space and supplies (Advisor: Barnhart)
- (4) Ralph Hill (GSS), field sampling and channel studies (Advisor: Pavlowsky)
- (5) David Huggins (GSS), field sampling and channel studies (Advisor: Pavlowsky)
- (6) Aubree Vaughan (GSS), field sampling and channel studies (Advisor: Pavlowsky)
- (7) Ezekiel Kuehn (GSS), field sampling and channel studies (Advisor: Pavlowsky)
- (8) Virgil Cane (MNAS), macroinvertebrate analysis (Advisor: Pavlowsky)
- (9) Loring Bullard (MNAS), field sampling and water analyses (Advisor: Pavlowsky)
- (10) Karen Zelzer (GSS), imagery for analysis (Advisor: Pavlowsky)
- (11) Adam Mulling (GSS), field sampling, sediment analyses (Advisor: Pavlowsky)
- (12) Jennifer Witt (GSS), field sampling, sediment analyses (Advisor: Pavlowsky)
- (13) Kris Breckenridge (GSS), field sampling, channel studies (Advisor: Pavlowsky)

Completed MS Theses and Seminar Papers (4)

- 1) Lamb, C., May 2014. Barriers to low impact development in the city code of Springfield, Missouri. (natural and applied science) (Thesis)
- 2) Bullard, L., Aug 2014. Water quality snapshot survey in the James River Watershed, Missouri (natural and applied science) (Thesis)
- 3) Foreman, A., Aug 2014. Climate change influence on historical flood variability in Ozark Highlands rivers (geospatial science) (Thesis)
- 4) Vaughan, A., Aug 2014. Geomorphology of a contaminated urban floodplain along Wilson Creek, Springfield Missouri (GSS) (Thesis)
- 5) Arnall, C., Aug 2014. Trend analysis of contaminated channel bar sediment storage in Big River, St. Francois County, Missouri (geospatial science) (seminar paper)

Completed PhD Dissertations (Adjunct status)

- (1) Martin, D.J., May 2014. Large woody debris distribution and geomorphic effects in Big River, Missouri. Department of Geography, University of Tennessee, Knoxville, TN. (Adjunct faculty member)

Graduate-level Field Trips (3)

- (1) 2 week field trip for GEO 770-summer graduate course to Yellowstone National Park, June 2014
- (2) 3-day Field trip for channel and floodplain mapping and sediment sampling on the Big River near Bonne Terre MO, December 2014
- (3) Two one-day field trips to local streams for GRY 751-Human Impacts on Watersheds, Spring 2014 to study newly acquired university property “The Woodlands.”
- (4) Field study to Jamaica, 10 days, Jan 2014, 3 undergraduate and 3 graduate students

SERVICE AND OUTREACH ACCOMPLISHMENTS

Service and community outreach is an important component of OEWRI's mission. The Institute is an "on call" campus resources 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: (i) loaning equipment to CNAS faculty for laboratory, classroom, and student use; (ii) giving guest lecture's in research courses; and (iii) providing free expertise and analytical services for faculty and students. Specific examples of service activities are listed below:

Environmental Events (3)

- (1) Director- Gave presentation and conducted field trip featuring geomorphology and physical stream assessments to the Watershed Committee of the Ozarks Watershed Academy, July 15, 2013.
- (2) Assistant Director- Gave presentation over water quality in the Springfield area to the Watershed Committee of the Ozarks Watershed Academy, July 13, 2013.
- (3) Attended 2014 Missouri Natural Resources Conference, Osage Beach, Missouri, January 30-February 1, 2013.

Teaching Support and other Service at MSU (11)

- (1) Staff operated truck-mounted Giddings soil probe for a field trip in GRY 348 *Geomorpholgy* (Pavlowsky), Fall 2014.
- (2) Staff trained students on surveying streams in BIO 509 Stream Ecology (Havel) for field trip to Fassnight Creek, February 8, 2013.
- (3) Recorded and reported mileage records and coordinated maintenance on OEWRI and GGP vehicles.
- (4) Staff taught GRY 348 (Pavlowsky) soil profile description laboratory, November 4, 2014.
- (5) Staff operated OEWRI coring machine for GRY 348 (Pavlowsky) field trip to Pearson Creek, October 30, 2014.
- (6) Staff provided stream surveying training for GRY 348 (Pavlowsky) field trip to Ward Branch, September 23, 2014.
- (7) Staff gave a presentation about OEWRI's involvement with sustainability focused projects in Springfield for GRY 108 Principles of Sustainability (Meyer) January 21, 2014.
- (8) Staff organized and lead a stream field trip for the 6th grade science class at Springfield Lutheran School, May 15, 2014.
- (9) Met with University of Central Missouri McNair Scholars about graduate school opportunities in GGP and OEWRI, April 8, 2014.
- (10) Staff served as a judge at the 2014 Ozarks Science and Engineering Fair, April 1, 2014
- (11) Staff piloted OEWRI boat at Truman Lake for Dr. Evans video shoot, September 11, 2014.

Geospatial Technology Support (3)

- (1) Geospatial database access: OEWRI provides access to geospatial data stored on OEWRI servers to GGP graduate students and faculty to support class projects and research
- (2) GGP GIS Support: OEWRI provides GPS receivers and related equipment for several courses offered by the department.
- (3) 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.

Regional Outreach (8)

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

- (1) Director is a member of the Future of Water Committee, a subcommittee of the Good Community Committee for the City of Springfield
- (2) Assistant Director attends Springfield/Greene County Urban 319 Steering Committee Meetings
- (3) Director is a member of the Ad-Hoc advisory committee for the Coal Ash Disposal Site Evaluation convened by City Utilities.
- (4) Provided technical assistance to Parkboard and James River Basin Partnership on riparian corridor improvements at Rivercut Golf Course along James River.
- (5) Provided Christian County with a map of MS4 sites, May 20, 2014.
- (6) Participated in the quarterly Springfield/Greene County Urban 319 Steering Committee Meetings
- (7) Participated on the technical committee reviewing detention basin retrofit designs for the Springfield/Greene County Urban Storm Water 319 Project.
- (8) Participated in the Local Government Integrated Planning meeting on Sustainable Return on Investment (SROI) for future environmental programs in Springfield/Greene County. February 13, 2014.

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. In 2014, OEWRI worked with the following agencies and groups:

Regional Environmental Groups (5)

- (1) Watershed Committee of the Ozarks, Stacey Armstrong
- (2) James River Basin Partnership, Joseph Pitts

- (3) Upper White River Basin Foundation, David Casaletto
- (4) Table Rock Lake Water Quality, Inc., Gopala Borchelt
- (5) The Nature Conservancy, Steven Herrington

Government Agencies (8)

- (1) Environmental Protection Agency, Region 7
- (2) Missouri Department of Natural Resources
- (3) Missouri Department of Conservation
- (4) National Resources Conservation Service
- (5) Greene County Soil and Water District
- (6) USGS-Water Resources Program (Rolla, MO)
- (7) U.S. Fish and Wildlife Service
- (8) U.S. Army Corp of Engineers, Kansas City District

Universities (5)

- (1) University of Missouri-Columbia
- (2) Missouri University of Science and Technology
- (3) East Carolina University
- (4) Drury University
- (5) St. Louis University

Local Governments (7)

- (1) Greene County
- (2) Christian County
- (3) City of Springfield
- (4) City of Nixa
- (5) City of Ozark
- (6) City of Battlefield
- (7) City Utilities of Springfield

Private Companies (1)

- (1) Olsson Associates

Missouri State University Centers (3)

- (1) Center for Resources Planning and Management
- (2) Darr Agricultural Center
- (3) Center for Biomedical and Life Sciences

Faculty Collaborators at MSU (7)

- (1) Tom Dewitt, Agriculture
- (2) Chris Barnhart, Biology
- (3) Dan Beckman, Biology
- (4) Paul Durham, Biology
- (5) Doug Gouzie, Geology
- (6) Linnea Iantria, Geotourism
- (7) Paul Schweiger, Biology

PUBLIC AFFAIRS ACTIVITIES

OEWRI supports the Public Affairs Mission of MSU. Below are several examples of Public Affairs accomplishments for 2012.

Cultural Competence. OEWRI has extended its outreach and research program to the southwest coast of Jamaica to Bluefields Bay near Belmont and Black River Bay near Treasure Beach. 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. Of significance to this effort is a focus on two marine protected areas or national fish sanctuaries aimed at improving both fish stocks and local economy. 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.

OEWRI has previously teamed up with MSU faculty Bill Wedenoja (ANT), Dan Beckman (BIO), and Linnea Iantria (GGP) 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. To date, OEWRI has supported the completion of seven MS thesis projects in Jamaica including five in GGP and two in BIO. Two GGP theses were completed in 2014 including one on beach erosion along Black River Bay by Karen Zelzer and the other on geotourism opportunities centered in the marine protected area in Bluefields Bay by Emma Clegg.

OEWRI has worked with three partners in Jamaica. First, we worked with the Bluefields Bay Friendly Fisherman's Society to assess the marine fishery and habitat characteristics, including coral reef conditions, in a "no take" fish sanctuary in Bluefields Bay, Westmoreland, Jamaica. Second, we worked with BREDS-the Treasure Beach Foundation to evaluate beach erosion

problems in Black River Bay and Galleon Fish Sanctuary. Thirdly, we visited a local farm in St. Elizabeth Parish to collect soil data to understand fertility and soil-water holding capacity in agricultural soils for a project headed by the UNC-Wilmington, Department of Geography.

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 26 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 and Viburnum Trend sediment contamination studies address questions about the degree and spatial extent of lead contamination in river sediments in eastern Missouri due to past and ongoing mine tailings inputs from mining operations. 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. This work was expanded to include the Viburnum Trend mining area in SE Missouri in 2013.

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 INCOME

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. OEWRI generates from 3 to 4 times the university budget annually included grants and fund leveraging for education and service benefits. 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 generate 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. Typically, annual credit hour support generates about 15k to 20k in benefit for CNAS.

GOALS AND STRATEGIC PLAN FOR 2015

Meeting Previous Goals Set for 2014

The following six goals for 2014 were listed in the 2013 annual report. The progress made toward meeting each of these goals is described below:

(1) Continue to attract externally-funded projects. While only 31K in new 2014 grants was generated by OEWRI in 2014, external funding spending for the year totaled about 150K. Looking ahead, about 100K of new grants have already been obtained by summer 2015.

(2) Continue to support and mentor undergraduate and graduate research. OEWRI supported research projects for 9 undergraduate students and 14 graduate students.

(3) OEWRI effectiveness is limited by space limitations. OEWRI will work with CNAS and GGP to find more space. Renovations to Temple Hall over summer 2015 will result in OEWRI losing office space, but gaining a vented hood laboratory for its water laboratory.

(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. Given the many hats that OEWRI staff must wear, it is hard to make time to write publications for which funding agencies do not fund. Our goal is to publish at least three articles per year in peer reviewed journals. In 2014 we only put out two, but we were busy with several ongoing projects in 2014.

(5) Maintain and regularly update the OEWRI website as a major communication and data outlet. We update the website each semester with pointed updates for current news on a monthly basis (usually, but not always).

(6) Try to find ways to get more faculty into principal investigator roles in OEWRI. Research grant writing, analysis, and writing is a bottleneck for productivity. We have worked to develop partnerships with faculty at MSU and other universities. We have been successful in working with other universities in co-authorship on publications.

(7) Expand partnerships with centers and research groups at MSU. In late 2014, OEWRI started a "self-funded" pilot project with Paul Schweiger in Biology and Paul Durham in the Center for Biomedical and Life Sciences at MSU to monitor local streams and springs for bacteria, nutrients, and other chemicals of environmental concern including pharmaceuticals, endocrine disruptors, and biocides. This partnership is working and we have some preliminary data from three sample runs. However, more time is needed to complete this study.

New Goals for 2015

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. This is important since our capacity to support graduate students will be tested since we have the largest incoming group of new graduate students (7-8) and graduate assistants (6) in our history;
- 3) Continue to focus on peer-reviewed publication as an outlet for research project results;
- 4) Expand partnerships with MSU faculty, centers, and research groups and other universities, agencies, and groups; and
- 5) Complete a self-assessment of OEWRI space and reorganize to try and utilize existing space more effectively.

SPACE, EQUIPMENT, AND STAFFING NEEDS

These are the resources needed by OEWRI to improve productivity, security, 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) Field equipment and supplies space (20' x 20') is needed from where to store and access routine field equipment and to process and provide maintenance for equipment upon return from field operations. It would be helpful, but not required, to have access to trucks for loading purposes. Presently, water quality laboratory, sediment quality laboratory, and field activities are run out of one laboratory and previous field equipment space had to be changed over to provide graduate assistant office space.
- (4) OEWRI office space was cut in half in the summer renovation plans. We need office space to make up for this loss. This loss has come at our period of most need in trying to provide office space for a record number of incoming graduate students.

- 5) Equipment: OEWRI instrumentation is getting old and some of it will need to be replaced or undergo major overhaul over the next few years. Further, OEWRI would like to purchase a high resolution bench XRF system which will run around 60-80K. Given the start of recent projects in areas 3+ hours away from campus, OEWRI also needs another vehicle.
- 6) OEWRI needs more technical faculty in the environmental field of hydrology and water quality to increase its productivity over present levels. This position needs to be full- or half-time faculty position (PhD) with expertise in hydrology and water quality modeling with 50% time supporting OEWRI research and education. This expertise is particularly needed to address water quality needs in the region and attract more external funds. Further this line could help support physical geography faculty load for undergrad major and thesis advisement. There is a market for this expertise in this region and an investment by the university would benefit our research funding success, student training, and research in this area.

SELECTED EVENTS FOR 2014

OEWRI took the lead role in preparing, submitting and ultimately receiving Missouri State University's application for NWK-14-0001: Cooperative Agreement for Research and Program Assistance at DoD Installations Supported by the USACE Kansas City District. OEWRI has been successful in bringing 800K too MSU as the leader of this program at MSU in 2015.

Marc Owen, assistant director of OEWRI, was selected for the 2014-2015 University Staff Ambassadors (USA) program that began in July. The USA program is a 1-year long staff development program offered by the University for 25 staff members annually who must apply and be accepted to participate.

By invitation, Marc presented "Decade of Watershed Science and Applications in Southwest Missouri" at: Water Challenges and Opportunities, A symposium in Celebration of 50th Anniversary of Missouri Water Resources Research Center on the campus of the University of Missouri, Columbia, October 7-8, 2014.

Two out-of-state trips were sponsored by OEWRI. In January 2014, a MSU research team composed of both graduate and undergraduate students traveled to Jamaica to map coral reefs, formulate tourism business options, measure beach erosion, and study agricultural soil characteristics. In June 2014, eight graduate students travelled by van out west to study: (i) Pleistocene history of the Great Salt Lake, (ii) river changes and management in Pocatello, Idaho, (iii) geo-cultural history of Yellowstone National Park, and (iv) natural and cultural landscapes of the Missouri River Basin including the Sand Hills of Nebraska. We toured Pocatello area and the Yellowstone National Park with faculty and student from the Department of History at Idaho State University.