

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

***ANNUAL REPORT OF ACTIVITIES FOR
CALENDAR YEAR 2013***

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July 7, 2014



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EXECUTIVE SUMMARY

OEWRI activities in 2013 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 and watershed function and disturbance in Missouri. In addition, OEWRI has supported several thesis projects and additional outreach in the areas environmental management and geotourism in Jamaica.

Research accomplishments include work on 10 externally funded projects totaling about \$204,000 in funds expended by OEWRI in 2013. Two peer-reviewed articles were published, seven final project reports submitted to sponsors, and 21 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 5 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 21 thesis projects with 4 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 2013 OEWRI worked with 8 MSU faculty, 3 MSU centers, and 29 other units including 7 watershed groups.

Two factors slowed OEWRI productivity in 2013 to some degree: (i) our long-time laboratory manager left for another position in September and it took until February to hire a replacement; and (ii) construction of the vivarium interfered with laboratory operations.

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.

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 2013
- (3) Accomplishments in research, education, outreach, partnerships, and Public Affairs
- (4) Budget Expenditures and Income for 2013
- (5) Strategic Plan for 2013
- (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. John Steiert).

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 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 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 2011 OEWRI supported 6 undergraduate hourly workers and 8 undergraduate research projects. Further, the Institute supported 10 graduate assistants and 20 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 2013

OEWRI activities in 2013 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 in partnership with the Bluefields Bay Friendly Fisherman's Society to assess the marine fishery, habitat characteristics, and environmental threats and develop sustainable tourism opportunities in the Bluefields Bay Fish Sanctuary in Jamaica.

RESEARCH ACCOMPLISHMENTS

OEWRI's research accomplishments include work on externally funded projects, publications, and presentations. Specific accomplishments for 2013 are listed below

External Grants

OEWRI worked on 10 externally funded projects in 2013. Five were continuing from previous years and five were new in 2013. The total multi-year value of the active grants in 2013 was approximately \$895,052. The total budget for the three new grants in 2013 was \$322,500. The value of external funds spent by OEWRI in the 2013 single year period totaled \$264,900. This amount included an indirect cost contribution from OEWRI to the university and college of about \$12,600.

The 10 active grants for 2013 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: \$200,000 2013: \$20,000
Period: 08-01-08 to 07-31-13 IC rate: 38.5% DC

James River Urban Stream MS-4 & TMDL Monitoring Program

Sponsor: Greene County and local governments
Budget No. M02025-1520123-021 Total: \$270,000 2013: \$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 2013: \$28,000
Period: 09-01-12 to 08-31-13 IC rate: 20% DC

Springfield Urban Stream MS4 Monitoring (annual continuation)

Sponsor: City of Springfield
Budget No. M02029-152013-021 Total: \$29,000 2013: \$29,000
Period: 09-01-13 to 08-31-14 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 2013: \$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: \$25,000
Period: 05-01-12 to 01-31-14 IC rate: 13% DC

(5) James River-Stone Co 319 Project

Sponsor: James River Basin Partnership, Springfield, MO
Budget No. I02358-152013-021 Total: \$8,399 2013: \$3,400
Period: 05-21-12 to 07-31-13 IC rate: 13% DC

(6) Pearson Creek 319 Project

Sponsor: James River Basin Partnership, Springfield, MO
Budget No. I02356-152013-021 Total: \$60,060 2013: \$35,000
Period: 06-05-12 to 02-28-14 IC rate: 13% DC

(7) Viburnum Trend Stream

Sponsor: U.S. Fish and Wildlife Service, Columbia, MO
Budget No. I02377-152013-021 Total: \$88,113 2013: \$39,000
Period: 09-04-12 to 12-31-14 IC rate: 17.5% DC

(8) James River-Greene County Riparian Easement 319 Project

Sponsor: James River Basin Partnership, Springfield, MO
Budget No. - Contract invoice Total: \$4,300 2013: \$4,300
Period: 02-01-13 to 07-31-13 IC rate: 13% DC

(9) Finley Creek-Christian County Riparian Easement 319 Project

Sponsor: James River Basin Partnership, Springfield, MO
Budget No. - Contract invoice Total: \$2,200 2013: \$2,200
Period: 02-01-13 to 07-31-13 IC rate: 13% DC

(10) Indian Creek Geomorphology Project, Olathe, Kansas

Sponsor: Olsson Associates
Budget No. - Contract invoice Total: \$17,000 2013: \$17,000
Period: 01-15-13 to 09-31-13 IC rate: 38.5% DC

Journal Articles (2)

- (1) Witt III, E.C., D.J. Wronkiewicz, R.T. Pavlowsky, and H. Shi, 2013. Trace metals in fugitive dust from unsurfaced roads in the Viburnum Trend resource mining District of Missouri—Implementation of a direct-suspension sampling methodology. *Chemosphere* 92:1506-1512.
- (2) Pavlowsky, R.T., 2013. Coal-tar pavement sealant use and polycyclic aromatic hydrocarbon contamination in urban stream sediments. *Physical Geography* 34(4-5):392-415.

Project Final Reports (7)

- (1) Owen, M.R. and R.T. Pavlowsky (2013). 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. December 17, 2013.
- (2) Pavlowsky, R.T. and M.R. Owen (2013). Indian Creek Fluvial Geomorphology Study, Olathe, Kansas. Final report to Olsson Associates for the City of Olathe, Kansas. November 11, 2013.
- (3) Pavlowsky, R.T., and M.R. Owen, 2013. *Stream Sediment Contamination in the Viburnum Trend in Crawford, Dent, Iron, Reynolds, and Washington Counties in Southeast Missouri: Channel Sediment Concentrations*. Ozarks Environmental and Water Resources Institute, Missouri State University, Springfield, MO, Report no. OEWRI EDR-13-005A. Draft Report to U.S. Fish and Wildlife Service, Columbia, Missouri.
- (4) Pavlowsky, R.T., 2013. *Source allocation for lead-contaminated sediment in the Big River from two different mining sources in St. Francois and Washington Counties, Missouri*. Ozarks Environmental and Water Resources Institute, Missouri State University, Springfield, MO, Report no. OEWRI EDR-13-004. Draft report to the Department of Justice, contract DJJ-13W-ENR01-0474. November 2, 2013.
- (5) Owen, M.R., R.T. Pavlowsky and E. Kuehn (2013). Nonpoint Source Bank Erosion and Water Quality Impairment Assessment, James River at Rivercut Golf Course, Greene County, Missouri. Prepared for the James River Basin Partnership. September 17, 2013.
- (6) Owen, M.R., R.T. Pavlowsky and E. Kuehn (2013). Nonpoint Source Bank Erosion and Water Quality Assessment, James River at River Bluff Farm, Stone County, Missouri. Prepared for the James River Basin Partnership. August 16, 2013.
- (7) Owen, M.R., R.T. Pavlowsky and E. Kuehn (2013). Historical Water Quality Data Analysis, Pearson Creek, Springfield, Missouri. Ozarks Environmental and Water Resources Institute EDR-13-001. Prepared for the James River Basin Partnership. February 11, 2013.

Presentations (21)

National and International Meetings (10)

- (1) Pavlowsky, R.T., 2013. Mining contamination of alluvial sediments and management implications in the Big River, Old Lead belt, Missouri. Special session on Sediment, Geomorphology, and Society, American Water Resources Association, Annual Water Resources Conference, Portland, OR, November 4-7.
- (2) Pavlowsky, R.T., 2013. Spatial variability of PAHs in stream sediments in an urban karst watershed. On-line presentation, United States Geological Survey Web-Ex Program, December 2
- (3) Pavlowsky, R.T., S.A. Lecce, 2013. Legacy sediment waves in channel and floodplain deposits of an Ozarks river, SE Missouri. Association of American Geographers annual meeting, Los Angeles, CA, March 9-13.
- (4) Lecce, S.A., and R.T. Pavlowsky, 2013. Contamination of floodplain deposits by mining sediment in streams draining the Viburnum Trend mining district of southeast Missouri. Association of American Geographers annual meeting, Los Angeles, CA, March 9-13.
- (5) Wang, C., R.T. Pavlowsky, and L.M. Olson, 2013. Gravel bar detection using object based image analysis for remote sensing, Big River, SE Missouri. Association of American Geographers annual meeting, Los Angeles, CA, March 9-13.
- (6) Mbuh, B.J., P. Hpouser, R.T. Pavlowsky, and J. Lee, 2013. Effects of soil moisture initialization on dust storm forecasting model. Association of American Geographers annual meeting, Los Angeles, CA, March 9-13.
- (7) Foreman, A.T., and R.T. Pavlowsky, 2013. Historical flood regime variability in Missouri rivers. Annual meeting of the Geological Society of America, Denver, CO, October 27-30.
- (8) Kissel, J., A.L. Vaughan, M.R. Owen, and R.T. Pavlowsky, 2013. Magnetic susceptibility profiles in floodplain and terrace deposits along the James River, southwest Missouri. Annual meeting of the Geological Society of America, Denver, CO, October 27-30.
- (9) Pavlowsky, R.T. and A.T. Foreman, 2013. Historical flood variability and geomorphic effectiveness in Ozark Plateau rivers. Annual meeting of the Geological Society of America, Denver, CO, October 27-30.
- (10) Lecce, S.A. and Pavlowsky, R.T. 2013. Hydraulic Geometry in a North Carolina Piedmont Watershed. Annual Meeting of the Southeastern Division of the Association of American Geographers, Roanoke, Virginia, November 17-19.

Regional or State Meetings (11)

- (1) Pavlowsky, R.T., 2013. Urban stream management and water quality monitoring in the Springfield area, Annual conference of the Missouri Chapter of the American Public Works Association, University Plaza Hotel, Springfield, Mo.
- (2) Pavlowsky, R.T., 2013. Sediment PAHs, phosphorus, and metal contamination in urban streams draining Springfield, Missouri. Annual meeting of the Ozarks Chapter of the Institute of Transportation Engineers, Lake Springfield Boathouse, June 6.

- (3) Kuehn, E., M.R. Owen, R.T. Pavlowsky, and J. Pitts, 2013. Reduction of sediment and nutrient loads from riparian land and bank erosion along a southwest Missouri River. Upper Midwest Stream Restoration Symposium, La Crosse, WI, February 24-27.
- (4) Owen, M.R., and R.T. Pavlowsky, 2013. Geomorphic-based urban stream restoration projects in Missouri and Kansas. Upper Midwest Stream Restoration Symposium, La Crosse, WI, February 24-27.
- (5) Breckenridge, K., and R.T. Pavlowsky, 2013. Field-based measurements of bed-load transport in an urban stream in the Missouri Ozarks. Upper Midwest Stream Restoration Symposium, La Crosse, WI, February 24-27.
- (6) Vaughan, A., M.R. Owen, and R.T. Pavlowsky, 2013. Application of urban-source metals for stratigraphic tracers in floodplain deposits along an Ozarks stream. Upper Midwest Stream Restoration Symposium, La Crosse, WI, February 24-27.
- (7) Mayus, A., R.T. Pavlowsky, and M.R. Owen, 2013. Source of mining sediment contamination in historical overbank floodplain deposits along the Big River, Meramec River Basin, MO. Upper Midwest Stream Restoration Symposium, La Crosse, WI, February 24-27.
- (8) Carroll, J.D., and R.T. Pavlowsky, 2013. Physical habitat mapping in Bluefields Bay fish sanctuary, Westmoreland, Jamaica. Annual conference of the Missouri Academy of Science, College of the Ozarks, Branson, MO, April 20.
- (9) Mayus, A.L., R.T. Pavlowsky, and M.R. Owen, 2013. Mining sediment contamination in floodplain deposits along the Big River, Missouri Ozarks. Annual conference of the Missouri Academy of Science, College of the Ozarks, Branson, MO, April 20.
- (10) Vaughan, A.L., M.R. Owen, L.M. Olson, R.T. Pavlowsky, 2013. Geomorphology of a contaminated urban floodplain along Wilsons Creek, Springfield, Missouri. Annual conference of the Missouri Academy of Science, College of the Ozarks, Branson, MO, April 20.
- (11) Kuehn, E.A., M.R. Owen, and R.T. Pavlowsky, 2013. Contributions of stream bank erosion to sediment loads in a southwestern Missouri river. Annual conference of the Missouri Academy of Science, College of the Ozarks, Branson, MO, April 20.

Laboratory Productivity

The OEWRI laboratory in Temple Hall performed the following analytical services external projects and internal projects in 2013.

1,005 = Nutrients in water, total phosphorus and total nitrogen

823 = Physical water chemistry, pH and specific conductance

816 = total suspended solids

353 = Bacteria in stream water

246 = Optical brighteners in water (in partnership with Dr. Doug Gouzie, GGP)

80 = Gamma spectrophotometer analysis of Cs-137 in soil

876 = Chloride in water

221= Textural analysis of sediment/soil by Laser Diffraction

1,002 = Metal analysis of soil by X-ray Fluorescence

329 = Carbon-Nitrogen-Sulfur analysis in soil and sediment

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 2013, 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 (4)

- (1) Jeremy Hines (CHM) Water quality laboratory
- (2) Samantha Marshall (CHM), Water quality laboratory
- (3) Micah Mayle (GGP), Water quality laboratory
- (4) Zach Morris (BIO), Water quality laboratory

Undergraduate Student Research Projects (8)

Research projects in GRY 348-Geomorphology (Fall 2013) (5)

- (1) Felix Corrodi (GRY) Geomorphic characterization of Spring Branch using two different discharge measurement methods, Fall 2013.
- (2) Kim Garland (GLG) Nutrient concentrations and sources in Roark Creek, Branson, MO., Fall 2013.
- (3) Misty Carr (GRY) Land use and soil effects on flooding in eastern Springfield, Fall 2013.

- (4) Dominique Knowles (GRY) House age and paint effects on soil lead concentrations in residential soils, Fall 2013.
- (5) Becka Giboney (GLG) , Presence and implications of Mn-Cr system elements within the Weaubleau structure area, Southwest Missouri, Fall 2013.

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

- (1) Joshua Elson (GLG/GRY) Seasonal variability of rainfall-runoff relationships for Missouri watersheds, April 2013.
- (2) Sara Cheek (GLG/BIO), Temperature variation on Lake Springfield relative to the James River Power Station, April 2013.
- (3) Michael Jahnke (GLG), Effect of slope and flow time on fluvial geomorphology using a stream table, April 2013.

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 Thesis Research (14)

OEWRI supports various levels of graduate student research at Missouri State University. The Institute entirely or partially supported 14 MS thesis projects in two programs: Geospatial Science (11) and MNAS (3) (see below). In addition, external funds for OEWRI projects provided graduate assistantships for 8 students and hourly work positions for 1 graduate student in 2013. These students and their programs are listed below.

<u>Graduated</u>	<u>2nd Year</u>	<u>1st Year</u>
Kyle Kosovich (MNAS)	Virgil Cane (MNAS)	Karen Zelzer (GSS)
Jennifer Carroll (GSS)	Aubree Vaughan (GSS)	Adam Mulling (GSS)
Tylene Coonts (GSS)	Ezekiel Kuehn (GSS)	
	Cora Arnall (GSS)	
	Andrew Foremen (GSS)	
	Loring Bullard (MNAS)	
	Andrea Mayus (GSS)	
	Mellora Hall (GSS)	
	Kris Breckenridge (GSS)	

Graduate Assistantships (8)

- (1) Andrea Mayus (GSS), Urban Springfield 319 project, Spring and Summer
- (2) Mellora Hall (GSS), Pearson Creek 319 project, Spring
- (3) Aubree Vaughan (GSS), Non-Springfield MS-4, Spring, Summer and Fall

- (4) Ezekiel Kuehn (GSS), Viburnum Trend, Spring, Summer and Fall
- (5) Virgil Cane (MNAS), Pearson Creek, Spring, Summer and Fall
- (6) Loring Bullard (MNAS), Pearson Creek, Spring, Summer and Fall
- (7) Karen Zelzer (GSS), Viburnum Trend, Fall
- (8) Adam Mulling (GSS), Urban 319 project, Fall

Graduate Hourly Student Workers (1)

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

Completed MS Theses and Seminar Papers (3)

- 1) Carroll, Jennifer D., May 2013: Physical Habitat Mapping and Assessment in Bluesfield Bay Fish Sanctuary, Westmoreland, Jamaica (Geospatial Science)
- 2) Coonts, Tylene, May 2013: Metal concentrations in soils and sediments in disturbed and restored areas of a historical coal mining site in SW Missouri (Geospatial Science) *(Seminar Paper)*
- 3) Kosovich, Kyle K., Dec 2013: Gravel Sediment Sources and Bar Distribution within the Main Stem of Upper Bull Creek Southwest Missouri (Natural and Applied Science)

National and Regional Student Presentations Awards (1)

- (1) Breckenridge, K., and R.T. Pavlowsky, 2013. Field-based measurements of bed-load transport in an urban stream in the Missouri Ozarks. Upper Midwest Stream Restoration Symposium, La Crosse, WI, February 24-27. First place in graduate student poster competition.

Graduate-level Field Trips (3)

- (1) Field trip for stream walk for river workshop for graduate students in Education, July 2013
- (2) 1 week field trip for GEO 770-summer graduate course on river assessment, June 2013
- (3) Two one-day field trips to local streams for GRY 751-Human Impacts on Watersheds, Spring 2013

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 2013 Missouri Natural Resources Conference, Osage Beach, Missouri, January 30-February 1, 2013.

Teaching Support at MSU (3)

- (1) Staff operated truck-mounted Giddings soil probe for a field trip in GRY 348 *Geomorphology* (Pavlowsky), Fall 2013.
- (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.

Geospatial Technology Support (4)

- (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.
- (4) University Cartographic Support: OEWRI worked with the State Fruit Experiment Station in Mountain Grove to update their Ozarks Arboretum database, brochure map, and poster.

Regional Outreach (2)

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

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 2013, OEWRI worked with the following agencies and groups:

Regional Environmental Groups (7)

- (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
- (6) Ozark Regional Land Trust, Abigail Lambert
- (7) Big River Watershed Group, Michael Andresini

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) Southern Missouri Water Quality Project
- (6) Greene County Soil and Water District
- (7) USGS-Water Resources Program (Rolla, MO)
- (8) U.S. Fish and Wildlife Service

Universities (4)

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

Local Governments (9)

- (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
- (8) City of Bolivar
- (9) City of Ava

Private Companies (1)

- (1) Olsson Associates

Missouri State University Centers (4)

- (1) Center for Resources Planning and Management
- (2) Darr Agricultural Center
- (3) Center for Biomedical and Life Sciences
- (4) Bullshoals Field Station/Project Wet

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) William Wedenoja, Anthropology
- (7) Linnea Iantria, Geotourism

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 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) worked 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. In 2012, Pavlowsky lead one study-away student group and two graduate/undergraduate research trips to address marine conservation, water quality, and geotourism in Jamaica. With the financial support of the Latin American, Caribbean, and Hispanic Studies program and faculty research grants at MSU, OEWRI, GGP, and the Biology Department has been working on a pilot study to determine the baseline condition of the fishery and habitat quality in Bluefields Bay Fish Sanctuary. Two GSS MS theses have previously been completed in support of these efforts in 2010. In December 2012, a thesis on the effects of artificial reefs on fish populations was completed by Joshua Rudolph in Biology. Another thesis in GGP was completed in May 2013 on mapping of habitat including coral reefs in Bluefields Bay. Pavlowsky presently has two graduate student working on thesis projects in Jamaica, one on beach erosion problems and the other on sustainable tourism opportunities.

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 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 2014

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 effectiveness is limited by space limitations. OEWRI will work with CNAS and GGP to find more space.
- (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 grant writing, analysis, and writing is a bottleneck for productivity.
- (7) Expand partnerships with centers and research groups at MSU.

SPACE AND STAFFING NEEDS

Given the level of productivity of OEWRI and its lack of sufficient space to house staff, students, laboratories, and field equipment, four 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) OEWRI office space (10' x 10') to support Director's administration and research time.

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.

THREE EVENTS FOR 2013

1. Tyler Smith hired as new Laboratory Manager in February 2013.



Tyler is originally from Joplin, Missouri where he earned his B.S. in Bioinformatics (dual majors in Biology and Computer Information Science) from Missouri Southern State University. Tyler finished his M.S. degree in Biology at Missouri State University in the summer of 2013. Prior to working at OEWRI, as a graduate student Tyler taught labs within the biology department. Tyler is responsible for managing laboratory activities, training students and staff, and performing maintenance and upkeep on laboratory instruments in Temple 125. Tyler's office is in Temple 328.

2. OEWRI students and staff travel to the Upper Midwest Stream Restoration Symposium in LaCrosse, Wisconsin.

Dr. Pavlowsky, Marc Owen, and four graduate students attended the Upper Midwest Stream Restoration Symposium in LaCrosse, Wisconsin, February 24-27, 2013. Students and staff learned about different strategies from the public and private sector for stream stabilization, aquatic habitat enhancement and water quality improvement in the Midwest. Students participated in a poster competition and Kris Breckenridge won first place for her thesis research entitled, "Field-Based Measurements of Bed-Load Transport in an Urban Stream in the Missouri Ozarks."



3. Fall 2013- OEWRI takes undergraduate students to study soil along Pearson Creek, east Springfield.

Dr. Pavlowsky's GRY 348-Geomorphology class went to a farm along Pearson Creek to study soil-landform associations. OEWRI staff including Marc Owen used the Giddings Coring Rig to pull soil cores for students to study. Tom DeWitt, soil scientist and instructor at the Darr School of Agriculture, also described soil conditions and management practices to the students.

