P-01: Bank Erosion Assessment of Wilson Creek in Springfield, MO

Felix Corrodi, *Missouri State University*

Wilson Creek watershed has been affected by both urbanization and grazing agriculture which has destabilized the channel in several segments as indicated by eroding banks and incised channels. To address this problem, the City of Springfield and local watershed groups have partnered to rehabilitate riparian forest areas and stabilize eroding banks by fencing out cattle and planting trees. This study reports on a long-term study of bank stability along a segment of Wilson Creek where riparian improvements have occurred in order to monitor improvements in channel stability. Bank stability and channel form was assessed at 17 sites along a 1 km segment of Wilson Creek about 3 km downstream of the city limit. Geomorphic assessment and monitoring of the Wilson Creek was conducted to estimate the rate and extent of current channel erosion and to track future bank erosion using erosion pin arrays. Data obtained from the erosion pins over the past 8 months was analyzed to reveal the rate of erosion during that time period. The results were then compared with the geomorphic assessment results to determine the accuracy of the assessment method. Continued erosion monitoring will identify and explain patterns of bank erosion along Wilsons Creek and this information will be used to evaluate the chances for stream bank recovery in the future.

P-02: Historical Channel Change and Disturbance Zone Formation in the Big River, SE Missouri

Marc Owen, Robert Pavlowsky*, Ozarks Environmental and Water Resources Institute, Missouri State University*

Historical mining in the Old Lead Belt of St. Francois County, Missouri resulted in widespread contamination of fluvial sediment with lead (Pb) in the Big River since the late 1800s. Contamination occurs in channel sediments from fine-medium gravel processing waste known as “chat” and sand-size “tailings” released prior to the construction of containment dams in the 1930s. Over time, this material has been transported downstream and can be found in bed, bar and floodplain deposits along the lower 171 km of the river with concentrations of Pb at levels known to be toxic to aquatic organisms. Management plans to monitor and mitigate mining-related contamination need to contain elements that address geomorphic processes involved in the transport, deposition, and long-term storage of contaminated sediment. However, the present understanding of the geomorphic history and sedimentation trends for the Big River is insufficient. This project uses a series of historical aerial photographs from 1937-2007 to identify and classify disturbance zones, or areas of excessive channel change, between photograph years. Results show that: (1) four types of disturbance zones were identified along the Big River; translations, extensions, cutoffs, and mega bars; (2) disturbance zones make up about 30% of the main channel and 78% of all disturbance zones are mega bar formation, which suggests variations in downstream sediment transport or breaks in the sediment transport pathways where legacy bed sediment deposits are being reworked and transported downstream; (3) disturbance zones tend to be larger below the confluence of Mineral Fork, a major tributary, highlighting the importance of sediment and water supply from increased drainage area; (4) valley width appears to be an important control on the type of disturbance zone with a majority of the extensions, translations and cutoffs located in the area of the river with the widest valley; (5) the majority (75%) of disturbance zones were observed in the 1937 photo indicting the Big River has been adjusting to human impacts of land use change and sediment inputs from mining activities for a long time. Flood records at gaging stations in the Big River show a significant increase in flood frequency and magnitude over the past 30 years. If these trends continue, the Big River may respond to increases in flood power, bank erosion, and sediment transport by the expansion of existing disturbance zones or the formation of new ones.

P-03: Sediment budgets for the Greater Blue Earth River Basin: Pleistocene base-level fall drives near-channel erosion

Martin Bevis, Karen Gran*, University of Minnesota-Duluth*

Minnesota River (MNR) tributaries are some of the most turbid in the state; many are impaired for turbidity under the Clean Water Act. Suspended sediment affects ecology and economics from headwater streams to Lake Pepin, where much of it is deposited. This project created sediment budgets for the greater Blue Earth River basin (GBERB), a group of MNR tributaries with some of the highest sediment loads. A sediment budget is a way to understand the movement of sediment though a watershed that can help landowners, land managers and other interested parties allocate resources to effectively reduce sediment loads.

Our budgets use historic aerial photos and lidar-derived digital elevation models to delineate source extents and measure bluff and channel erosion rates in ArcGIS; these data were combined with upland and ravine erosion rates measured in the Le Sueur watershed. We explored sediment budget sensitivity to adjustments for sediment storage, bluff vegetation state, sedimentology, erosion rate extrapolation methods and higher-precision bluff extent delineations.

Tributaries of the Minnesota River are adjusting to a profound (70m) base-level fall at the end of the Pleistocene. About half of the GBERB sediment load comes from reaches below knickpoints where response to base-level fall drives erosion of near-channel features like bluffs. Budgets are not sensitive to bluff erosion rate extrapolation techniques and we found no statistically significant correlations between decadal bluff retreat rates and parameters such as bluff vegetative cover, slope, size, aspect, sediment texture or stream power. There is little in-stream sediment storage in the GBERB: Accommodation space primarily occurs on floodplains and in lakes, but these features are scarce due to base-level fall and agricultural practices. Surficial sediment in the GBERB is composed primarily of homogeneous glacial tills and load estimates have little sensitivity to adjustments for the different bulk density and texture of glaciolacustrine and glaciofluvial sediments. It is important to construct an accurate inventory of bluff extents: A poorly-managed but plausible inventory increased the sediment budget by about 15%. These results will be useful in constructing sediment budgets for other MNR tributaries and in managing the GBERB.

P-04: Spatial and Seasonal Trends in Urban Runoff Water Quality in the Springfield, Missouri Metropolitan Area

Karen Zelzer, Robert Pavlowsky, Marc Owen, *Ozark's Environmental and Water Resource Institiute, Missouri State University*

Municipalities within the Springfield Missouri Metro Area have implemented storm water discharge monitoring programs to address water quality problems specific to urban watersheds as required by the United States Environmental Protection Agency and Missouri Department of Natural Resources. Urban municipalities must participate in the National Pollutant Discharge Elimination System storm water program to reduce adverse impacts from storm water discharges on water quality and aquatic habitat. The Municipal Separate Storm Sewer System (MS4) monitoring program addresses pollutants of concern including total phosphorus, total nitrogen, total suspended solids, and chloride. The Ozarks Environmental and Water Resource Institute at Missouri State University implements the MS4 monitoring program for the Springfield area. Thirty-three sampling sites within 6 municipalities were chosen based on accessibility for sampling, suitability for the project, basin location, and urban land distribution. Upstream drainage areas at each site ranges from 0.8 km^2 to 629 km^2. Percent urban area in the upstream watershed ranges from 2.2% to 86.3%. When available, one base flow and four seasonal first flush samples were collected from each site annually since 2008. The study reports the results of urban runoff monitoring for over 500 samples for the period from 2008 to 2014. Spatial analysis using drainage area characteristics and land use will be used to evaluate water quality variability and quantify trends for different seasons. This information will be used to plan management strategies to reduce water pollution from urban areas.

P-05: Data Management in the Stream

Dean Mattoon, *City of Dubuque,* Eric Schmechel, *Dubuque Soil and Water Conservation District.*

This presentation would be to highlight the use of web based software through an ArcGIS app with an iPad. The focus will be how I have taken traditional stream assessments and other inspections, modified them, and created an electronic database to track all MS4 activities in the field, with a focus on stream assessment and water quality monitoring. This data can then be turned into reports, shared with others, etc.

P-06: Modeling Stream Management through Spatially Distributed Water Control Structures in the Le Sueur Watershed with SWAT

Nathaniel Mitchell, *University of Minnesota-Duluth;* Se Jong Cho*, Johns Hopkins University;* Brent Dalzell*, University of Minnesota,* Karthik Kumarasamy, *Utah State University,* Karen Gran*, University of Minnesota-Duluth*

Documented increases in stream flows, near-channel erosion rates, and turbidity levels within the agricultural Le Sueur Watershed (LSW) in Minnesota have motivated the discussion of potential hydrologic management options to reduce peak flows including increasing water storage in the watershed. Water retention sites (WRS) may be able to increase the residence time of water on the landscape, increase evapotranspiration and seepage, reduce water input to the channel network, and reduce peak flows. This study uses the Soil and Water Assessment Tool (SWAT) to evaluate the extent to which peak flows entering the lower, incised reaches of the LSW can be reduced through WRS scenarios with different extents and placements. The projected peak flows are then used to estimate sediment loading rates through an empirical equation for sediment loading between gauges in the watershed. Sites were selected based on their topography, agricultural productivity, and land use. The restoration scenarios considered placed sites throughout the watershed, far upstream in the watershed, and close to the watershed outlet. Different WRS extents were obtained by prioritizing sites with either small or large surface areas. Utilizing a range of hydraulic conductivity (K) values ($1E^{-9}$ to $1E^{-6}$ m/s) that are possible within the study area produces large changes in WRS behavior, with higher flow reductions occurring with higher K values. Hydraulic conductivity is often the limiting factor in the flow reductions offered by WRS scenarios. WRS placements farther upstream in the watershed generally offer higher water and sediment loading rate reductions. Peak flows and sediment loading rates can be reduced by up to 60 to 80% with all WRS used and high K values (e.g., $5E^{-7}$ to $1E^{-6}$ m/s), but such high values may require tile drainage systems. Even scenarios with lower extents (e.g., 20-25%) can offer sediment loading reductions of 40-50% with high K values. These reductions, however, will not bring erosion rates close to those existing before European settlement and a complete restoration of the rivers to their natural state is unlikely. Any reductions in both sediment loading rates and turbidity levels, however, will likely improve the habitat quality of the Le Sueur Watershed's streams. This study's findings can aid in the comparison of management options like bluff toe protection and water control structures.

P-07: Water treatment plant improvements and the reduction of sediment phosphorus in Table Rock Lake, Southwest Missouri

Adam Mulling, Robert Pavlowsky, Marc Owen, *Missouri State University*

Water quality problems in the James River Arm (JRA) of Table Rock Lake, Missouri led to a TMDL for the James River aimed at reducing excess nutrient loads. In response to the TMDL, upgrades at a major sewage treatment plant (STP) occurred in 2001 that reduced phosphorus (P) loads in the effluent by about 90%. This study aims to quantify the effect of the STP improvements on sediment P in the 65 km long JRA. There are three objectives: (1) analyze the longitudinal and lateral distribution of sediment P; (2) examine sedimentological and geochemical relationships in bottom sediments of the JRA to evaluate nutrient sources and transport processes; and (3) determine the effects of STP controls on P reductions in the JRA. Grab samples of the upper 20 cm of lake bottom sediment were collected along one longitudinal and six lateral transects. River sediment samples were collected on Wilson's Creek near the STP and downstream along the James River to evaluate source-to-sink pathways. Sediment samples were analyzed in the lab for geochemistry, organic carbon, and sediment size. Physical and chemical characteristics of the sediment within the JRA were used to identify lake sedimentation zones. The lake sedimentation zone characteristics allow further investigation into how the distribution of sediment P has changed in response to the STP upgrades. Within the upper zones, P to Al and percent clay ratios suggest sediment P distribution is controlled by fine-grain sedimentation. In the lower zone of the JRA, P to Al and Fe ratios suggest redox reactions influence sediment P distribution. The average decrease in sediment P concentrations between 2001 and 2013 are about 30%, with a maximum of 36% in the middle zone. The original TMDL allocates 27% of the P entering the JRA to the STP. The observed P decrease of 30% in the JRA is primarily related to the STP P load reductions, however sediment P concentrations in the James River, below the STP and above the JRA, do not appear to be affected by reduced P loading upstream.

P-08: Impacts of low light levels in culverts on Topeka shiner and other prairie stream fish movement

Britney Mosey, Jessica Kozarek, Jay Hatch, *University of Minnesota*

The Topeka shiner Notropis topeka is a federally endangered fish species inhabiting the rapidly declining headwater prairie streams of the central US. When these streams intersect roadways, culverts create potential barriers to fish movement by physically impeding swimming (e.g. because of insufficient depth or excess velocity) or by behaviorally deterring movement (e.g. by reducing light levels). Barriers can limit fish migration to key seasonal habitats, such as spawning or nursery areas and off-channel pools and oxbows. They may also isolate small populations of fish further endangering their long-term survival. While some work has been done on swimming abilities and barriers of warm water fish species such as the Topeka shiner, little has been done to evaluate the effects of low light levels in culverts. We evaluated light levels and fish movement in two long box culverts in critical Topeka shiner habitat in Southwestern Minnesota. Through a tag and recapture method using visible elastomer tags, we found a small number of fish passed through the two separate culverts under experimental circumstances. Extensive fieldwork will be done in the upcoming season to increase our overall tag and recapture rates, especially those of Topeka shiners. We also will run control experiments at each culvert site to determine if fish are more likely to swim through natural stream reaches in comparison to those with dark culverts impeding the waterway. The two culverts previously sampled will be monitored throughout the spring, summer, and fall months to account for different spawning events and subsequent flooding seasons. Other culverts in the area with a history of Topeka shiner will also be monitored to encompass a variety of light levels into the study. In addition, future plans include a laboratory study using surrogate species and pond-reared Topeka shiner to evaluate fish response to varying light levels in a controlled environment. Our research will determine if low light levels pose a barrier to fish movement and if light mitigation needs to be considered in long culverts.

P-09: Fish and habitat response to removal of the Rockford Dam on the Shell Rock River, Iowa

Megan Thul, Greg Simmons, Gregory Gelwicks, *Iowa Department of Natural Resources*

Low-head dams can negatively affect fish assemblages in Iowa's interior rivers by impacting habitat and sediment transport, and interfering with seasonal fish movements between critical habitats. One solution to restoring critical fish habitat and improving connectivity between these habitats is complete dam removal. A project to remove a low-head dam on the Shell Rock River at Rockford, IA was initiated to address concerns about the structural integrity of the dam and the public hazard and liability associated with the aging structure. This project also provided an opportunity to quantify changes to fish habitat and fish assemblages in the Shell Rock River associated with the removal. Physical habitat and fish community data was collected at two sites upstream of the dam and one site downstream of the dam on the Shell Rock River, and at one control site on the Winnebago River during 2012 and 2013. After the dam was removed during winter 2014, fish community sampling was conducted at all four sites and physical habitat was measured at sites immediately above and below the former dam. Preliminary results indicate a decrease in water depth and increase in water velocities both upstream and downstream of the former dam. Percent fine substrate was reduced at the site above the former dam, but increased at the site below the dam. We documented an increase in fish species in the former impoundment and sampled two fish species at both sites upstream of the dam that were not present prior to dam removal. Continued monitoring at this site will help determine the long term effects of dam removal on the habitat and fish community in the Shell Rock River and help guide future river restoration projects.

P-10: Analysis of the resilience and future effectiveness of a habitat improvement project following a high magnitude flood: Sucker River, Duluth, MN

Virginia Batts, Gerrit Bass, Nate Mitchell, Courtney Targos, Antoinette Abeyta, Karen Gran*, University of Minnesota-Duluth*

North Shore streams are popular recreational trout fishing destinations, but the loss of large wood from historic logging and naturally low summer flows have detrimentally affected trout habitat. In 2009, Trout Unlimited financed a project on the Sucker River in NE Minnesota to increase pool habitat by installing cross-vanes and large wood (LW) jams. While initial results were promising, the project site was drastically modified by the 500-year flood event in June 2012. In this study, we analyzed 5 years of post-project monitoring data to a) describe the effects of the flood event, b) determine whether steps should be taken to repair the damage to the project site, and c) estimate future watershed responses to changes in climate and land use.

Data collected include pool area measurements, large wood (LW) counts, Wolman pebble counts, and cross-sectional profiles at 16 transects. We compiled our data with previously collected data from 2009 to 2013 and determined sediment transport rates using Parker's (1990) surface-based model. Results show that following the 500-year flood, pools that had been increasing in size and density filled with gravels and cobbles. Our analysis indicates that bankfull flow conditions are not sufficient to mobilize these grains. However, some LW jams and cross-vanes remain and continue to scour pools, suggesting continued deep pool habitat recovery over time. We recommend no further habitat improvement efforts at this time, but continued monitoring of the reach will provide a unique opportunity to observe the resilience of habitat improvement structures through high-magnitude flood events, which have been predicted to increase in frequency in the future.

To assess future trajectories for this reach of the Sucker, we quantified the increase in discharge and its affect on sediment mobility based on future projections of changes in climate and land use (runoff coefficient). Results suggest that the coarsest grains will be mobile during the projected 1- to 2- year flood event within the next century. We do not have an estimation of sediment volume which is required to determine the time to remove the sediment within the reach. Continued monitoring will provide the information needed to determine the time necessary for the deposited grains to move through the system and provide valuable insight into a stream's recovery from rare, high magnitude flood events.

P-11: Mission Creek: Fish Passage Design Performance Evaluation

Andrew McCoy*, HDR*

Mission Creek originates at the crest of the Santa Ynez Mountains and flows south about 7.8 stream miles, entering the Pacific Ocean at the Santa Barbara Harbor in the City of Santa Barbara, California. The stream is characterized by flashy hydraulic patterns typical of southern California which contribute to significant sediment transport and large sediment size gradations during flood events. Flood flows are conveyed through two trapezoidal concrete –lined channel reaches, which represent passage barriers to migrating adult steelhead. The City of Santa Barbara (the City), with support from the Environmental Defense Center (EDC) and others, desired to modify the two concrete-lined reaches of the Mission Creek channel to restore fish passage through the creek's lower reaches. The general fish passage concept included a fishway inset into the floor of the flood control channel, a series of fishway side pockets providing resting opportunities for fish, and a series of ogee crest weirs in the fishway to provide slower moving pools, all facilitating fish movement.

With the ultimate goal of adding fish passage to a supercritical trapezoidal concrete flood control channel, the HDR design team (San Diego and Santa Rosa CA, Gig Harbor WA, Des Moines IA) used coupled 2D hydraulic and biological modeling to evaluate a previously selected design alternative as well as other design revisions against the following three goals: 1)Modify channel and sill geometry to improve hydraulic conditions favorable for sediment transport, 2) Reduce the level of effort associated with anticipated channel maintenance activities, and 3) Integrate the above objectives while maintaining fish passage effectiveness, to the extent possible.

The biological model was based on receiving hydraulic information from the two-dimensional hydraulic model (depths and velocities) at 15 minute intervals, applied over the full range of natural hydrographs, during wet and dry years, and resulted in estimated fish travel times through the project. It was used to determine differences in fish travel time between design alternatives. The design modifications tested included increasing the depth of the fishway channel, modifying the sill shape, including a slotted sill, notching the sill crest, modifying the sill location, lengthening distance between side pockets, and modifying side pocket floor slope.

P-12: Mussel Community Habitat Preferences in the Upper Mississippi River, Pool 12 (Frentress Lake Area)

Michael Malon, *American Public University;* Daniel Call, *Environmental Research & Information Analysts, LLC*.

A Level I survey of the mussel community was performed in September 2013, in side channel habitat of the Upper Mississippi River (Pool 12) near Frentress Lake, East Dubuque, Illinois as a permitting requirement for a proposed dredging project. The survey area was divided into 20 plots of 2,000 m^2 each, and 20-minute collection dives were made starting within each plot. A sediment core sample was collected at each site for characterization of particle size and organic matter, and measurements were made of current velocity, temperature, dissolved oxygen and pH near the sediment-water interface. Data from pairwise plot-by-plot comparisons of species composition (presence or absence) and the Sorensen-Dice coefficient of similarity were used to help characterize the nature of the mussel community and habitat variability. Results from this survey were used to develop a conservation plan approved by the Illinois Department of Natural Resources to relocate any threatened or endangered mussels and provide follow-up monitoring and research over the next ten years.

P-13: A Great Rivers Ecological Observatory Network (GREON) for real-time continuous water quality monitoring in the Mississippi River

John Sloan, *National Great Rivers Research & Education Center;* John H. Chick, Lori Gittinger *Illinois Natural History Survey;* Ted Kratschmer, Michael Brennan, *National Great Rivers Research & Education Center*

The National Great Rivers Research and Education Center (NGRREC) is strategically located on the banks of the Mississippi River between its confluences with the Illinois and Missouri Rivers and immediately below the Melvin Price Lock & Dam. NGRREC is in the process of creating a Great Rivers Ecological Observatory Network (GREON) for continuous, real-time monitoring of water quality conditions on the Mississippi River and its major tributaries. The mission of GREON is to advance the understanding of large-floodplain river ecology by collecting and sharing high resolution data on key water quality parameters with scientists, managers, and the general public. The data collected through this network is relevant to local ecological and aquatic habitat conditions along individual reaches of the river, as well as to regional issues such as the annual Gulf of Mexico hypoxia problem. The GREON system uses existing sensor technology for monitoring a suite of water quality parameters that include temperature, conductivity, pH, DO, turbidity, total algae, blue-green algae, dissolved organic matter, and nitrate. The original GREON unit used a UV spectroscopic sensor to measure nitrate concentrations, but subsequent units used a less expensive ion specific electrode. The first GREON unit was deployed in Ellis Bay below Melvin Price Lock & Dam during summer 2013 and covered a period that included the fifth highest flood level recorded for that location. Data from that deployment showed the value of collecting continuous water quality data during major hydrological events. Additional GREON units were acquired in 2014. In order to assess the relative agreement among sensor data collected by multiple units from a relatively homogenous river stratum, four units were co-deployed as a group in Ellis Bay on the Mississippi River during October 2014. The data showed relatively consistent sensor performance from each of the four units with the exception of the nitrate ion specific electrodes which proved to be unreliable. Therefore, the existing GREON units are being retrofitted to use the UV spectroscopic nitrate sensors for future deployments. Starting in spring 2015, a total of seven units will be deployed on the main stem of the Upper Mississippi River and one tributary. GREON data will be available through the Great Lakes to Gulf Virtual Observatory (GLTG℠) which is being developed with collaboration from the Illinois Sea Grant Program and the University of Illinois National Center for Supercomputing Applications (NCSA).

P-14: Development of hyporheic exchange and subsurface processes following stream restoration

Stuart Baker, Anne Jefferson, Elizabeth Herndon, Lauren Kinsman-Costello, *Kent State University*

Stream restoration is a billion dollar industry with major goals of improving water quality and degraded habitat, yet restoration often falls short of significant improvements toward these objectives. At present, there are limited data and understanding of the physical and biogeochemical responses to restoration that constrain the potential for water quality and ecological improvements. Hyporheic exchange, the flow of water into and out of the streambed, is an important stream process that serves a critical role in naturally functioning streams, allowing for stream water to interact with the substrate in various processes. Hyporheic flowpaths can be altered by the transport of fine sediment through the stream bed and are thus susceptible to changes in sediment regime and hydraulics, as well as the changes wrought by construction of a restoration project. The goal of this research is to determine the effect of restoration on hyporheic exchange and associated biogeochemical processes. Preliminary results from Kelsey Creek, OH, a second-order stream restored in August 2013, show a slight decrease in average hydraulic conductivity but an increase in heterogeneity from pre-restoration (geometric mean 8.47×10^{-5} m/s, range 2.67x10-5-3.05×10^{-4}) to four months post-restoration (geometric mean 4.40×10^{-5} m/s, range 1.18x10-6-1.19×10^{-3}) to ten months post-restoration (geometric mean 1.41×10^{-5} m/s, range

1.11x10-6-6.40x10-4) in piezometer nests through large constructed riffle structures. These piezometers also indicate dominance of downwelling throughout riffle structures with only isolated locations of upwelling. A stream in Holden Arboretum, OH restored in April 2014 had no significant change in average hydraulic conductivity between 1 and 2 months post-restoration, but many individual piezometers had increases of over 100% or decreases of over 50%. The greater variation in hydraulic conductivities in both restored streams may be adjustment from disturbance to a new dynamic equilibrium. Transient storage and hyporheic exchange were also measured with resazurin injections pre-restoration and post-restoration, and nutrient injections of NH_4Cl will compare the nitrogen uptake rates of the restored reach to an unrestored reach downstream. Ongoing research includes analysis of hyporheic water samples for common anions and cations, and sediment analysis of freeze cores collected adjacent to piezometers.

P-15: Watershed Education Program: Assisting communities with watershed education and planning

Karen Terry, Eleanor Burkett, Doug Malchow, Shahram Missaghi, John Bilotta, Mary Blickenderfer, Gary Sands, *University of Minnesota Extension*

The University of Minnesota Extension's Watershed Education Program, which began in 2013, provides community leaders, citizens, and natural resource professionals with knowledge and tools to make informed water and land use decisions to protect and restore the integrity of Minnesota's lakes, rivers, and wetlands. Watershed Education Program staff work with partners to develop coordinated education and outreach plans to reach watershed citizens and stakeholders while simultaneously meeting the goals and obligations of the statewide watershed approach framework. Having a greater understanding of local water resource planning, protection, and improvement empowers communities to meet their clean water goals.

P-16: Stream Restoration Science and Engineering graduate program at the University of Minnesota expands

Karen Gran, *University of Minnesota-Duluth,* Antoinette Abeyta, *University of Minnesota-Duluth* and *University of Minnesota*, Chris Paola and Vaughan Voller, *University of Minnesota*

Stream restoration requires trans-disciplinary training in hydrology, ecology, water quality, geomorphology, and engineering. Since the fall of 2006, the University of Minnesota has offered a post-baccalaureate graduate certificate in Stream Restoration Science and Engineering. The degree program emphasizes an analytical, as opposed to analog-based, approach to restoration and centers around two core courses: an introduction to stream restoration course and a capstone, with students taking an additional 11 credit hours of electives. In 2014, the program was expanded to the Duluth campus, allowing students in residence in Duluth to complete all required courses for the SRSE degree. To better integrate the two campuses, we held a joint weekend field trip for students taking Introduction to Stream Restoration on both campuses and broadcast guest lecturers between campuses. UMD had 12 students enrolled in its inaugural run of the introductory course with 5 students continuing on to the capstone course this spring. These students are addressing a site on the Little Stewart River where Trout Unlimited is planning habitat improvement work. Students in the introductory class collected field data in the fall, and the capstone class this spring will analyze field and watershed data analyses, meet with stakeholders, and develop a restoration plan for the site. We plan to continue offering the core courses at both campuses for years to come, expanding the reach of the SRSE program to meet student needs.

P-17: EPA's NNPM Project finds a 24 percent nitrate reduction and more diverse fishery population in a restored prairie slough *(supplemental material from oral presentation)*

Donald Rosebloom, *Illinois U.S. Geological Survey*

The prairie stream/slough restoration is located at the Grove housing development near Bloomington, Illinois. The City of Bloomington desired alteration of the agricultural ditches to a more natural state by incorporating green infrastructure - specifically floodplain reconnection, riparian wetlands, meanders, and rock riffles within a 90 acre floodwater detention basin. Restoration criteria require the mitigation of development runoff and the agricultural runoff from 9,000 acres of farmland.

A team of State and Federal agencies collected environmental data to determine the effectiveness of stream restoration to improve water quality and stream fisheries under the precipitation extremes of flood and drought over the last 7 years.

The placement of fixed nitrate probes at three U.S. Geological Survey (USGS) stream gaging stations and a portable nitrate probe allowed the determination of agricultural watershed processes that create the largest nitrate loading during major floods. Water quality improvements from nutrient reduction during normal stream flows are demonstrated by a 24 percent reduction in nitrate concentration and nitrate load in 2013. Stream fisheries also increased by ~30 percent per year through the extreme Midwest drought of 2012 and record flooding of 2013.

The Grove watershed lies in the Illinois River Basin which underwent record flooding in the last two weeks of April, 2013. This record flooding is typical of the agricultural floods which creates hypoxia in the Gulf of Mexico near New Orleans. The peak nitrate loading of that Illinois River flood occurred with the peak flood flow, which had a nitrate concentration of @6 mg/l.

Grove stream design criteria allowed large flood peak flows and sediment to overflow into wetlands during the rising limb but the smaller channel forming flood discharges passes much of the sediment load downstream. This approach maintains water detention capacity, nutrient uptake capacity in base flows, and increased stream fishery populations in the Grove Park.

P-18: Making the Connection: Stream Restoration and Watershed Planning

Cecily Cunz, *Applied Ecological Services*

Stream restorations can be a complicated, involved, and expensive process. Much of the current emphasis on Natural Channel Design and enhancements of in-stream habitat and acute erosion tends to be reach-scale. The benefits to these projects are typically short-term fixes in dynamic riverine systems; however, they can be greatly enhanced by taking a watershed approach and prioritizing them for water quality benefits. Applied Ecological Services has proven itself a leader in watershed planning throughout the Midwest.

The USEPA Environmental Protection Agency (EPA) encourages states to develop watershed plans that follow their Nine-Element planning process in order to protect and restore watershed health. The process is designed to create collaboration among stakeholders, identify potential causes and sources of nonpoint source pollution, prioritize projects that can be implemented to protect and restore watershed health, and identify potential funding sources for those projects. The holistic nature of the Nine Element planning process paves the way for future water quality improvements including prioritizing potential stream restoration projects.

The collaborative and iterative planning process is designed to create partnerships and collaboration across the watershed and educate stakeholders about water quality issues. A physical inventory of the watershed, including an assessment of the streams and tributaries, identifies problematic areas and where potential restoration work is needed. The inventory will identify where problems are occurring in the watershed, such as erosion, channelization, and habitat degradation. Later in the process, a pollutant loading model is used to estimate where pollutants are potentially stemming from, and critical areas in the watershed are identified. By overlaying the problem areas identified in the inventory, the results of the pollutant loading model, and critical areas in the watershed, a watershed plan will help prioritize the locations and types of stream restorations that would create the most benefit to the health of the system.

The planning process then examines each potential stream restoration project to estimate the potential pollutant loading reduction to be gained, a rough cost estimate, potential funding sources, and which partners are needed for successful implementation. Once a potential stream restoration is identified in a 319-approved watershed plan -

particularly if it is identified as a critical or high priority project - it is typically prioritized for funding opportunities, not just through 319 funding, but often through other federal and state programs. Watershed planning sets the regulatory stage for successful stream restoration projects and improving water quality holistically.