Fifth Annual River Center Conference
2007

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Schedule

Thursday, September 20, 2007

07:00 Registration University Center South End
We will travel to the Blackfoot River Basin, north of Missoula. Lunch is included.
Bring waders or shorts and wading shoes, because we will be wading in Dunham Creek.

07:30 Fieldtrip
Field Trip registration is still open. Busses leave at 7:30 a.m. from the lot between the University Center and Library. Parking permits ($2.50/day) are available at the registration table.

~17:30 Fieldtrip returns University Center

Friday, September 21, 2007

07:30-09:00 On-site Registration, University Center Theater, third floor.

07:30-08:00 Posters in the South Ball Room, third floor of the University Center

08:00-08:15 Welcome comments and speaker introductions

08:15-09:30 Keynote presentation by Craig Fischenich

09:30-09:45 Break

09:45-11:00 Keynote presentation by Bill Trush

11:00-13:00 Lunch and Poster Presentations (lunch provided) in the South Ballroom

13:00-14:15 Keynote presentation by Frank Ligon

14:15-14:30 Break

14:30-15:45 Keynote presentation by Peter Goodwin

15:45-16:00 Wrap up and final comments
Meeting adjourns

Key Note Speakers

Craig J. Fischenich

The Role of Conceptual Models in Stream Restoration

Army Corps of Engineers
Engineer Research and Development Center
Vicksburg, Mississippi

Craig's areas of expertise include river engineering, habitat restoration, streambank stabilization, and watershed management. He has conducted investigations of channel degradation, streambank erosion, reservoir aggradation, and mitigation for threatened and endangered species. He has analyzed, designed and constructed stream restoration, streambank stabilization, habitat enhancement and flood control projects in several countries and more than 30 states. His research includes: New techniques for stream restoration, flood management, environmental characterization, and fluvial assessment; Criteria for the evaluation and enhancement of aquatic habitat in channels; Techniques for assessing resistance in vegetated floodways. Craig has organized numerous workshops and short courses in river restoration and evaluated many restoration projects, including the Milltown Reservoir project in Montana.

William J. Trush

The Challenge and Necessity of Making Alluvial River Ecosystems Alluvial Again

McBain & Trush, Inc.
Arcata, California

Bill is co-founder and principal of **MCBAIN & TRUSH,** which was formed in January, 1995 as a professional consultancy applying fluvial geomorphic and ecological research to river preservation, management, and restoration. The company's primary interests are: 1) improving river ecosystem health in regulated rivers; 2) assessing impacts of land use and water development activities on stream ecosystems, and; 3) developing mutually beneficial management strategies that improve those ecosystems. Bill has a wide range of experience as a practitioner in river and ecologic restoration in watersheds throughout the Pacific Northwest, including, salmonid habitat evaluation and restoration, large river management and ecosystem restoration, sediment transport and channel morphology and the ecological roles of floods. He has also advised on the Milltown Reservoir channel restoration project.

Frank K. Ligon

Restoring Stream Ecosystems versus Enhancing High Profile Species: the Role of Ecology in Attempting to Reconcile two Competing Visions

Stillwater Sciences, Inc.
Berkeley, California

Frank has over 20 years experience examining the role of fluvial processes on the ecology of stream fish, invertebrates, and plant communities in California, Oregon, Georgia, and New Zealand. He has developed a geomorphologically-based approach to protecting and preserving stream biodiversity below dams and has applied the approach in streams throughout Northern California and Oregon. Frank currently manages a restoration study on the Tuolumne River investigating the ecology of Chinook salmon and developing a cost-effective salmon enhancement program. He has been involved with this project for over 10 years. He is working with California and Federal agencies to develop rapid assessment protocols to evaluate ecosystem function for Central Valley streams and to prioritize restoration actions for the greatest possible ecosystem benefit. He is also one of the lead authors of a CALFED White Paper on the effects of water diversion on fish in the Sacramento-San Joaquin Delta.

Peter Goodwin

Assessing Performance of River Restoration: Expectations, Modeling and Monitoring

Center for Ecohydraulic Research
University of Idaho, Boise
Boise, Idaho

Peter's research covers a broad spectrum of river science related to ecohydraulics, including ecological restoration and enhancement of river, wetland and estuarine systems, simulation models for flood management, sediment management, geomorphic evolution and environmental management. Peter's current projects include: The Red River Restoration Demonstration Project; Simulation of flows and sediment transport in headwater systems; Simulation of flow and water quality in the Tijuana Estuary; Tidal Wetland Restoration; Interaction between physical and biological processes. Peter has served on a large number of oversight and review panels assessing the proficiency of river and ecosystem restoration projects around the world. His most recent work involves developing river management and science approaches in Chile.

Poster Presentations

Remedial Investigation of Polychlorinated Biphenyl (PCB) Contamination and Feasibility Study for Restoration; Big Spring Creek, Fergus County, Montana--Chase Barton, Peter Jowise, Chris Brummer, Matt Brennan, and Karen Williams

Comparing Least Squares and Robust Methods in Linear Regression Analysis of the Discharge of the Flathead River, Northwestern Montana--Angie Bell, and Johnnie Moore

Impacts of Pre-Dam Removal Reservoir Drawdowns on Linked Aquifer Water Levels, Milltown, Western Montana--Antony Berthelote, Anthony Farinacci, Meryl Storb, and William Woessner

Preserving highways and fish along an aggrading river system, White River, Washington--Chris Brummer, Karen Williams, Jennifer Goldsmith, Ian Mostrenko, and Christina Avolio

Channel-Morphology Data Collection and Analysis Activities of the U.S. Geological Survey in Montana and Colorado--Katherine J. Chase and Sean M. Lawlor

Revelations from a Milan Project: Measured Channel Wood Production Rates, in Small, Steep Stream Channels, Columbia River Basin--Charles Chesney

Delineation of a Channel Migration Zone and Comparison with 100-Year Hydraulic Floodplain: Upper Yellowstone River between Pine Creek and Carters Bridge--Chuck Dalby

Restoration Plan for the Clark Fork River and Blackfoot River Near Milltown Dam--Gary Decker, Matt Daniels, Tom Parker, Doug Martin, and Pat Saffel

The Role of Open-Framework Gravels in the Creation of Preferential Flow Paths in Hyporheic Braided River Sediments--Dale Engstrom, William W. Woessner, and James E. Gannon

Off-Channel Habitat Enhancement in an Urban Environment--Willamette River/Stephens Creek, Portland, Oregon--Matt Klara

Mining-Related contaminants in whole blood of osprey along the Upper Clark Fork River--Heiko Langner, Rob Domenech, Johnnie Moore, and Erick Greene

Arsenic speciation in surface and groundwater related to the Clark Fork River, the Missoula Aquifer and organic rich substrates--Donna Lee Smith

Surface Water Groundwater Exchange in a Leveed Section of the Clark Fork River Floodplain above Milltown Dam, Western Montana--Meryl Storb, Antony Berthelote, Anthony Farinacci, and William Woessner

Physical Model Study of Cross Vanes and Ice--Carrie M. Vuyovich, Andrew M. Tuthill, P.E. and John J. Gagnon

GIS Database Establishment of Rainfall and Snow Cover for Upper Rio Grande River Basin from Remotely Sensed Spatial Data--Xiaobing Zhou and Hongjie Xie

Poster Presentation Abstracts

Remedial Investigation of Polychlorinated Biphenyl (PCB) Contamination and Feasibility Study for Restoration; Big Spring Creek, Fergus County, Montana

Chase Barton, cbarton@herrerainc.com, Peter Jowise, Chris Brummer, Matt Brennan, and Karen Williams -- Herrera Environmental Consultants

The upper reaches of Big Spring Creek, Fergus County, Montana are recognized by the state of Montana to be impaired due to the presence of polychlorinated biphenyls (PCBs) and have been placed on the state's Clean Water Act Section 303(d) list. PCBs were introduced into the stream through the sloughing and maintenance removal of PCB-laden paint applied to fish raceways of the upper and lower Big Spring Creek trout hatcheries from the 1960s through the early 1980s. Although source remediation is complete, PCB-laden paint flakes persist within streambed sediment several miles from these sources and will for some time to come without remedial action. A remedial investigation was conducted to characterize the vertical and longitudinal distribution of PCB contamination, develop a conceptual model of contaminant distribution and migration, and provide a framework for remedial and restorative actions. Field sampling was conducted following a plan dividing the stream system into three geographic reaches, two geomorphic regimes, and four depth intervals. Statistical evaluation of the analytical results from the field sampling yielded several significant results: PCB concentrations are significantly lower in the study reach most distant from the sources, concentrations are significantly higher within the depositional geomorphic regime relative to the transport geomorphic regime, and concentrations show a gradual decreasing trend with increasing sampling depth. These results guided a feasibility study that evaluated alternative removal technologies based on U.S. EPA screening criteria. This study identified a preferred remedial approach for removing PCBs from streambed sediments using suction and mechanical dredging technologies.

Comparing Least Squares and Robust Methods in Linear Regression Analysis of the Discharge of the Flathead River, Northwestern Montana

Angie Bell, angie.bell@umontana.edu, and Johnnie Moore, johnnie.moore@umontana.edu -- The University of Montana, Geosciences Department

The Flathead River is located in Northwestern Montana. The North Fork and Middle Fork of the Flathead River are relatively unmodified by humans. The South Fork of the Flathead River is regulated by the Hungary Horse Dam. USGS stream gage data for the North Fork and the Middle Fork from 1940 to 2006 will be analyzed for significant trends in the timing of quantiles of flow. Any trends will then be compared to the trends in the South Fork timing of quantiles of flow, for 1940 to 2006, that are a result of the dam operation. The analysis of trends in timing will employ two linear regression methods, the least squares estimation and a robust estimation.

Least squares estimation, with significance tested using the t-distribution, is a familiar method employed when performing regression analysis. The power of this method is sensitive to the violation of the assumptions of normal distribution and a constant variance (homoscedasticity). Considering that violations of these assumptions are common in hydrologic data, other methods should be investigated to ensure the desired statistical power is preserved. Robust estimation, with significance tested by bootstrapping, is a method whose power is not significantly affected by non-normality or heteroscedastic variance. The results of the two estimations used in linear regression analysis will be compared and presented.

Impacts of Pre-Dam Removal Reservoir Drawdowns on Linked Aquifer Water Levels, Milltown, Western Montana

Antony Berthelote, aberthelote@yahoo.com, Anthony Farinacci, anthony.farinacci@umontana.edu, Meryl Storb, meryl.storb@umontana.edu, and William Woessner, william.woessner@umontana.edu -- The University of Montana, Geosciences Department

The U.S.A.C.E. National Inventory of Dams lists roughly 75,000 dams over 1.8 m tall that have been built on our rivers. As ecological impacts of these structures are realized fewer than 500 have been removed. Restoration strategies increasingly incorporate dam removals; therefore, predicting how riverine and groundwater systems are likely to react is becoming critical. Milltown Dam, built in 1907, blocks the Clark Fork and Blackfoot rivers just east of Missoula in western Montana. The reservoir contains at least 6.6 mcy of metal-contaminated sediment derived from a century of upstream mining operations. Site remediation efforts are scheduled to excavate portions of the sediment and restore the river channels by removing the 28 ft Milltown Dam in 2008. This multi-year, $100-million construction project includes two ~ 10 ft pre-dam removal drawdowns. Previous and new hydrogeologic data were used to construct and calibrate a three-dimensional numerical groundwater model of the site to forecast declines in groundwater levels for each drawdown period. Field and modeling results suggest a complex pattern of water level change will occur and that the highly transmissive system responds to changes within weeks. The locations of water level changes are directly influenced by non-linear leakage from the reservoir and rivers, and spatial variations in the aquifer saturated thickness. Managers are using model predictions to identify likely production problems at over 400 domestic wells. Future field data collection will be used to perform an audit on the predictions and allow for further model calibration prior to forecasting dam-out conditions.

Preserving highways and fish along an aggrading river system, White River, Washington

Chris Brummer, cbrummer@herrerainc.com, Karen Williams, kwilliams@herrerainc.com, Jennifer Goldsmith, jgoldsmith@herrerainc.com, Ian Mostrenko, imostrenko@herrerainc.com, and Christina Avolio, cavolio@herrerainc.com, -- Herrera Environmental Consultants

Washington State Route 410 provides access to Mount Rainier National Park and Crystal Mountain Ski Resort. The highway was constructed on a former riverbed nearly a century ago and, in some places, is lower than the elevation of the riverbed. Old-growth forests flanking the White River generally disperse erosive flows and protect the highway; however, in some places this forested buffer is gone or the only feasible location for the highway is immediately adjacent to the active channel. Flooding and erosion of the highway embankment require temporary and frequent closure of SR 410. Long-term river aggradation from retreating glaciers on Mount Rainier will increase these hazards if the highway is left untreated. Emergency repairs by the

Washington State Department of Transportation (WSDOT) to keep the highway open impair habitat of ESA-listed Chinook salmon, bull trout, and winter steelhead. Herrera conducted a geomorphic reach analysis and prioritized the problem sites identified under WSDOT's Chronic Environmental Deficiencies program as causing habitat degradation due to repeated emergency maintenance. Herrera evaluated sustainable solutions for preservation of both the highway and threatened fish species at each problem site. The preferred alternatives incorporate self-mitigating logjam structures and forested floodplain buffers into the new highway design. Results from extensive floodplain mapping, hydrodynamic modeling of the 25-mile river corridor, and sediment-transport analyses show that raising the roadway and installing the proposed habitat structures will effectively reduce erosive forces, protect the highway embankment from flooding, accommodate anticipated aggradation, and rehabilitate aquatic habitat.

Channel-Morphology Data Collection and Analysis Activities of the U.S. Geological Survey in Montana and Colorado

Katherine J. Chase, kchase@usgs.gov and Sean M. Lawlor, slawlor@usgs.gov -- U.S. Geological Survey, Helena, Montana

Stream channels throughout the United States are changing in response to stream renaturalization projects and watershed land-use modifications. To understand and document these stream-channel changes and to aid in renaturalization design, the U.S. Geological Survey (USGS) has collected and analyzed channel-morphology data at several sites in Montana and Colorado. This work has been performed using consistent techniques, and results are available through published reports.

In western Montana, the USGS determined channel-morphology characteristics at 41 sites that were relatively undisturbed by structures or diversions. Regression equations relating channel-morphology characteristics to bankfull discharge were developed, as well as regional curves relating channel-morphology characteristics to drainage area and bankfull discharge to drainage area. These regional curves can be used on a reconnaissance level to estimate channel-morphology characteristics and bankfull discharge for ungaged sites in western Montana.
In eastern Montana, the USGS determined channel-morphology characteristics for the Tongue River and several tributaries. These data represent channel characteristics prior to extensive coal-bed methane development in the Tongue River watershed that might discharge large volumes of produced water to streams, which might result in channel changes.

In Colorado, the USGS monitors and assesses stream reaches that have undergone restoration as part of the Reconfigured-Channel Monitoring and Assessment Program (RCMAP). Long-term channel monitoring can be used to determine the effectiveness of a particular reconfiguration design. Data and photographs from RCMAP are accessible at the USGS Web site http://co.water.usgs.gov/projects/rcmap/rcmap.html. Data collection and monitoring programs similar to RCMAP could be beneficial for stream renaturalization projects throughout Montana.

Revelations from a Milan Project: Measured Channel Wood Production Rates, in Small, Steep Stream Channels, Columbia River Basin

Charles Chesney, CRSNWISSP@aol.com -- CRSN WISSP

Long term ecological monitoring is underway to describe the functional roles of wood in small, steep stream channels, and to document the relationship between channel corridor vegetation, tree fall, channel wood, and sediment storage. Results from repeat measurements of 5800 trees, 2500 channel wood pieces, and 300 sediment wedges are presented for three ecological processes: rates of tree fall, and production rates of fallen trees making fluvial (channel) wood or terrestrial wood.

Over six years of monitoring (2000-2006) at eighteen sites, 33% of fallen trees became fluvial (channel) wood, and 67% of fallen trees became terrestrial (down) wood. About a third of fluvial wood was hydraulically active (within the channel bankful perimeter). The tree fall rate is about 0.5% per year. Most channel wood was above and near the channel, and not hydraulically active channel wood. The conversion rate (over 6 years) of fluvial wood into hydraulically and habi-tactically active forms (zones 1 and 2) is about 8% per year.

Of the 52 trees creating fluvial wood in channel zones 1 and 2:
- 12 trees fell from 0-8m from the channel edge (23%)
- 20 trees fell from 8-15m from the channel edge (38%)
- 19 trees fell from 15-23m from the channel edge (37%)

Delineation of a Channel Migration Zone and Comparison with 100-Year Hydraulic Floodplain: Upper Yellowstone River between Pine Creek and Carters Bridge

Chuck Dalby, cdalby@mt.gov -- Montana Department of Natural Resources and Conservation, Water Management Bureau

Fixed-bed hydraulic model (e.g. HEC-RAS) studies of floodplain inundation provide the basis for FEMA's Flood Insurance Rate Maps which are used to assess flood risk for an extended period of time. Fixed-bed maps ignore dynamic aspects of alluvial river channels (e.g. avulsion, lateral migration). Using geomorphic methods, a Channel Migration Zone (CMZ or area where the river floodplain is susceptible to erosion and lateral migration over a designated length of time) was delineated for the Upper Yellowstone River between Pine Creek and Carters Bridge. The composite 100-Year CMZ was mapped in a GIS and consists of three zones: 1) historic migration, 2) avulsion hazard, and 3) erosion hazard area (projected future lateral erosion and mass wasting over 100-year period)--all adjusted for the disconnected migration area where man-made structures (e.g. riprap, levees, roads) physically moderate or eliminate channel migration. The CMZ boundary was compared with three other boundaries: 1) geologic floodplain (lateral extent of recent and Holocene/Pleistocene fluvio-glacial alluvium) representing maximum possible extent of erodible material in the valley; 2) recent alluvium reworked over the past ~1,500 years; and 3) boundaries of the 100 to 500-year floodplain (based on HEC-RAS) -- map features that are nearly equivalent, due to valley/ floodplain configuration and relatively flat slope of the flood frequency curve. Surprisingly, in many areas the 100-Year CMZ was roughly equivalent to the hydraulic 100 or 500-year floodplain; this agreement is due to valley/floodplain architecture in different geomorphic channel types. The CMZ occupies about 54% of the geologic floodplain and 89% of the recent (~1500 year) floodplain; approximately 43% of the CMZ consists of disconnected areas due to bank revetment and other flood plain development. CMZ width increases along a gradient of declining channel stability (e.g. plane-bed, pool-riffle, and anabranching channel types). The CMZ provides supplemental information for more complete assessment of flood and erosion risks, and a basis for evaluating long-term effects of channel and floodplain modification on geomorphic processes and channel stability.

Restoration Plan for the Clark Fork River and Blackfoot River Near Milltown Dam

Gary Decker, westwater@rkymtn.net, -- WestWater Consulting
Matt Daniels, mdaniels@riverdesigngroup.net-- River Design Group,
Tom Parker, tparker@geumconsulting.com -- Geum Environmental Consulting,
Doug Martin, dougmartin@mt.gov -- Natural Resource Damage Program,
Pat Saffel, psaffel@mt.gov -- Montana Department of Fish, Wildlife and Parks

The State of Montana will restore the confluence of Clark Fork and Blackfoot rivers following the removal of the Milltown Dam and some of the contaminated sediments deposited upstream of the Dam. In 2003 a Phase I Conceptual Restoration Plan was developed and used in negotiations to integrate the restoration plan with the EPA Superfund Action at the Milltown site. Using site specific data a Phase II Restoration Plan was completed in 2005 and this plan was presented to a peer review panel consisting of four nationally recognized experts. The Phase III Final Restoration Plan incorporates the comments from the peer review panel and input provided by the public, Missoula County, Army Corp of Engineers (Craig Fischenich, Jock Conyngham), Dave Rosgen, and numerous other experts. The restoration design is based on the goals and objectives developed by the Site Natural Resource Trustees – State of Montana, US Fish and Wildlife Service, and the Confederated Salish and Kootenai Tribes - focusing on restoring natural river and floodplain function. The final design includes goals and objectives and associated performance criteria; floodplain and channel grading plans; revegetation plans; structure designs and layouts; and the supporting analyses used in the restoration design development. Restoration strategies are designed to be adaptable to dynamic conditions, and a monitoring program will provide data to support management of the restoration project. The design team consists of stream restoration and revegetation experts with experience in a wide array of scientific and engineering fields.

The Role of Open-Framework Gravels in the Creation of Preferential Flow Paths in Hyporheic Braided River Sediments

Dale Engstrom, dale.engstrom@umontana.edu, William W. Woessner, william.woessner@umontana.edu, The University of Montana, Geosciences Department and James E. Gannon, Jim.Gannon@umontana.edu -- The University of Montana, Division of Biological Sciences

Preserved networks of interconnected, clast-supported, large diameter pore spaces that provide conduits for rapid water transport are found within near-horizontal beds of coarse open-framework sediments naturally deposited and modified by braided rivers. These pore networks provide highly conductive pathways that dominate water flux in fluvial bars and bar complexes and become interconnected at scales of 10's to 100's of meters. They are here hypothesized to provide rapid flow through extensive hyporheic exchange networks in the braided river-flood plain setting. However, these thin open-framework gravel beds have not been tested by other workers to determine their importance in the hyporheic flow scheme.

At two field sites in the Nyack floodplain in Montana, coarse, open-framework layers have been geologically located within braided river bar sediments, duplicating what others have found in other braided river settings. To hydrologically detect these coarse-grained layers, a number of small vertical-interval techniques are used to detect ground water velocities and hydraulic conductivities developed in closely-spaced wells along a flow-line. Geophysical techniques, including GPR and electrical resistivity tomography, were used to detect braided bar architecture in comparison with the geologic and hydrologic findings, and to extend the geology of the sediments beyond the wells. The demonstrated comparison of the geologic, geophysical and hydrologic results allows the detection of the link between sedimentological conditions and hyporheic exchange mechanisms in the braided river setting.

Off-Channel Habitat Enhancement in an Urban Environment: Willamette River/Stephens Creek, Portland, Oregon

Matt Klara, mklara@herrerainc.com -- Herrera Environmental Consultants, Inc.

Herrera Environmental Consultants developed and assessed three conceptual design alternatives for the enhancement of off-channel habitat at the confluence of the Willamette River and Stephens Creek for the City of Portland, OR. Off-channel habitat areas (many of which have been eliminated in the lower Willamette River) are critical habitats used for foraging and refuge by juvenile fish, including Chinook salmon, steelhead (both listed as threatened under the Endangered Species Act), coho and lamprey. Recent research suggests that beach habitat (sandy substrate, low velocity water, overhanging vegetation, and structural complexity) is also important to juvenile salmonids. This project represents a unique opportunity to restore and enhance off-channel and beach habitat in an urban setting. The primary project objectives were to: 1) provide off-channel habitat and hydrologic connectivity to the Willamette River by creating channels subject to frequent inundation; 2) enhance habitat quality via construction of wood debris structures to promote preferential scour and habitat complexity in off-channel areas; and 3) stabilize Willamette River bank/beach habitat in the Stephens Creek area through construction of sustainable, low-maintenance features to mitigate bank erosion and enhance habitat complexity. Designs focused on maximizing off-channel habitat improvements while minimizing impacts to existing high-quality floodplain habitat on the site. Design alternatives were assessed based on amount of new habitat creation, construction cost, ease of construction, potential methods of staging construction, durability, and aesthetics. Alternative #3, which includes woody debris structures, bank stabilization, revegetation, regrading of floodplain areas, and removal of an obsolete CSO pipe, was recommended.

Mining-Related contaminants in whole blood of osprey along the Upper Clark Fork River

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Rob Domenech, rob.domenech@raptorview.org --Raptor View Research Inst., Missoula,
Johnnie Moore, johnnie.moore@umontana.edu -- The University of Montana, Geosciences Dept.
Erick Greene, erick.greene@umontana.edu -- The University of Montana, Div. of Biological Sci.

Ospreys are top-of-the-food-chain predators that integrate environmental health parameters in riverine ecosystems. The correlation between bird and ecosystem health should be particularly close in Osprey chicks before fledging that have been fed exclusively from local fish populations, suggesting these birds as a convenient indicator for environmental problems or for the success of remediation/restoration activities. We used bucket trucks to access 22 Osprey nest platforms along a 200 km section of the Upper Clark Fork River and several control sites, where we logged reproductive success and obtained blood and feather samples from large nestlings shortly before fledging.

Blood samples did not exhibit elevated concentrations of priority pollutants such as arsenic, cadmium, lead, copper or zinc; however, concentration of mercury and selenium were highly elevated. Interestingly, mercury and selenium concentrations were highest in some downstream locations, in contrast to total contaminant levels in the river that generally decrease in downstream direction. We speculate that these toxic elements are converted into more bioavailable forms within anaerobic wetland sediments that are more abundant downstream, resulting in higher exposure of fish populations and finally accumulate in the predators feeding on these fish. The final goal of this study is to identify hotspots for bioavailable mercury and selenium that may be addressed in the design and realization of river restoration projects.

Arsenic speciation in surface and groundwater related to the Clark Fork River, the Missoula Aquifer and organic rich substrates.

Donna Lee Smith, donna.smith@umontana.edu -- The University of Montana, Geosciences Department

Arsenic transport was evaluated at an area with high levels of organic carbon and nutrients located on the floodplain of the Clark Fork River in the Missoula Valley, Montana, USA. The Clark Fork River contains low levels of arsenic in this reach (1-5 ug/l), and the Missoula Aquifer receives more than 80% of its recharge from the Clark Fork River. Eko Compost is located on a bend in the river that temporally shows a direct connection to the aquifer, which lies 6 to 20 feet below the ground surface at this location. The physical mechanisms of exchange of surface and groundwater were examined as well as the effect of the current and historic surface activities, composting activity and the nearby water treatment plant on arsenic chemistry in the groundwater.

This site was evaluated over the course of two years for hydrological and chemical characteristics. A series of equipotential maps over time were created using measurements of groundwater elevations, and nearby surface water elevations were plotted with respect to these elevations. A significant local flow pattern is described that is seasonally quite different from the regional pattern. This pattern is heavily influenced by a human altered landscape. Hydraulic conductivities are estimated for sections of the uppermost layer of the aquifer.

Water samples were also collected approximately monthly and chemical characteristics of the waters were contoured with respect to the site to evaluate transport. These contours provide information about in situ chemistry in the context of hydrogeologic information.

Surface Water Groundwater Exchange in a Leveed Section of the Clark Fork River Floodplain above Milltown Dam, Western Montana

Meryl Storb, Merytime@gmail.com, Antony Berthelote, Anthony Farinacci and William Woessner -- The University of Montana

In 1908 construction of the Old Milwaukee Railroad tacks along the Clark Fork River north of the Milltown Dam resulted in the straightening sections of the river. Channel modification shortened the river channel and altered the floodplain, creating a series of lakes and wetland areas. In an attempt to evaluate how downstream river restoration associated with Milltown Dam removal may impact hydrologic conditions in this portion of the valley, a hydrogeologic investigation was initiated. The research was designed to establish pre-restoration exchange rates and the linkages between floodplain features and the channel. The study area includes the floodplain from Turah Bridge to the top of the Milltown Superfund Restoration site (approximately 3 miles). A network of ten staff gauges and eleven domestic wells, along with four continuous water level recorders were established to monitor the water table position. A series of piezometers have been set up along the leveed areas, in the lakes, and in the river to examine vertical gradients and exchange rates. Based on these data sets the direction of groundwater flow and gaining and losing sections of streams will be identified. Data sets are being evaluated to determine baseline temporal and spatial variations in groundwater river connections.

Physical Model Study of Cross Vanes and Ice

Carrie M. Vuyovich, Carrie.M.Vuyovich@erdc.usace.army.mil, Andrew M. Tuthill, P.E. and John J. Gagnon -- Engineering Research and Design Center\Cold Regions Research and Engineering Laboratory (ERDC\CRREL)

In recent years, channel restoration and streambank stabilization projects have been turning away from traditional methods such as riprap and concrete and towards more ‘natural’ alternatives. To date, little is known about their performance on rivers with ice. Channel stabilization structures such as rock vanes, cross vanes and rock weirs decrease the effective flow area. They are often constructed in populated areas to reduce the stream degradation caused by urbanization. The potential for these structures to increase the risk of ice jams is investigated in order to minimize future damages that could result. This study addresses the impact of ice in the form of break-up ice jams or major ice runs on in-stream structures as well as how that structure might change the ice regime in the reach.

Three cross vane structures were built in a straight flume assuming a 1:50 scale. Ice was released during various flows to determine whether the structure increased the risk of ice jams. While the cross vane structure did delay the ice run, this experiment did not find a greater risk of break-up ice jams occurring. The cross vane caused velocity to increase through the center of the channel, which increased the ice conveyance even though the effective area is reduced. There was some damage done to the structures which indicates that rock size should be designed for ice loads in northern rivers.

GIS Database Establishment of Rainfall and Snow Cover for Upper Rio Grande River Basin from Remotely Sensed Spatial Data

Xiaobing Zhou, xzhou@mtech.edu, Montana Tech of The University of Montana and
Hongjie Xie, hongjie.xie@utsa.edu, University of Texas at San Antonio, Department of Earth and Environmental Science

Snowmelt and rainfall are the main driving forces for hydrological and ecological processes in a mountain watershed such as Upper Rio Grade basin of Colorado and New Mexico, USA. A long-term database of rainfall and snow cover derived from remotely sensed spatial data from either ground-based observing network or satellite sensors should be an important infrastructure for the ecological analysis of any river ecosystem. In this study, we developed a geographical information system (GIS)-based automated processing of the Next Generation Weather Radar (NEXRAD) Stage III hourly precipitation data and MODIS snow cover daily and eight-day products. The automated processing system, implemented by using commercial GIS and a number of Perl scripts and C/C++ programs, allows for rapid data display, requires less storage capacity, and provides the analytical and data visualization tools inherent in GIS as compared to traditional methods. Here we demonstrate the development of automatic techniques to preprocess raw NEXRAD Stage III hourly data and MODIS daily and eight-day snow cover products, convert the rainfall data from binary format and the snow cover data from Geo-HDF format into a GIS format so that data interoperability is realized, data clip for regions of interest, and data retrieval for statistical rainfall and snow cover analysis over user-defined spatial and temporal scales. Hydrological analysis using these databases as an example is performed to study the impact of rainfall on the snowmelt. ArcIMS-based web visualization and web data-dissemination is also discussed.