2014 UMSRS Poster Abstract Guide

P-01: Estimating temperature means and trends from stream temperatures measured at haphazard times and dates

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The attainment of water temperature goals for stream restorations will best be evaluated using stream temperature time series data. However, obtaining such regularly-spaced data from multiple river or stream sites may occasionally be challenging (e.g., legal, cost or logistic considerations may preclude the placement of multiple automated samplers in a riverine environment). In such cases, measurements at a sampling location may occur haphazardly in time, may occur only once at each of multiple locations within a stream or river segment, and will typically occur during daylight hours. Further, daily sample sizes may vary from one to many. We propose that such data may yield a nearly unbiased index of daily temperature means when temperature variation within days is small relative to variation among days, and that consistent changes in time of sampling may yield trends with ignorable bias if trends are estimated over sufficient numbers of days or years. Also, concerns with bias induced by consistent change in time of sampling will diminish as the within-day sampling period decreases (e.g., decreases from 0800 to 1600 hr to 1000 to 1400 hr) and when the center of that period approaches a stationary point (e.g., late afternoon). In the absence of relatively low within-day variation or of a relatively long sampling period, an unbiased conditional index may be obtained by regressing observed temperatures against time of sampling. When time of sampling is correlated with longitude or other source of monotonic spatial variation, then the regression equation will need to incorporate that monotonic spatial variation. Many of these findings for time of sampling will also apply to haphazard date of sampling—at least when sampling occurs over relatively short date periods (e.g., less than three months). These findings presume trends in temperature within the portions of each day sampled match those of entire days, and have not yet been elaborated to include seasonal variation in temperature.

P-02: Baseflow Restoration in Minnehaha Creek Watershed with Stormwater Infiltration

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Minnehaha Creek is among the most valued surface water features in the Minneapolis, MN metro area. Flow in Minnehaha Creek is heavily dependent on discharge from the stream's origin, Lake Minnetonka, the outlet of which is closed during drought periods to maintain water elevations in the lake resulting in low- (or no-) flow conditions in the creek. Stormwater runoff entering directly to the creek from the creek's largely urbanized watershed exacerbates extremes in flow conditions. As a result, there is great interest in enhancing the cultural and ecosystem services provided by Minnehaha Creek through improvements in streamflow regime by reducing flashiness and sustaining increased low-flows. Determining the potential for achieving improvements in flow requires first that the current sources of water contributing to low-flows in the creek be identified and quantified. Work on this source identification has involved a number of different approaches, including analyses of the streamflow record using a hydrologic system model framework, examination of the underlying geology of the region, estimation of groundwater-surface water exchange rates within the channel and riparian corridor using temperature probe, seepage meter, and piezometer measurements, and analyses of the stable isotopes of oxygen and hydrogen in samples of stream water, groundwater, and rainfall.

Analysis of baseflow recessions using the method of Brutsaert and Nieber (1977) indicates that only a small portion of the catchment, probably the riparian zone, contributes to baseflows. This result appears to be supported by the observation that the limestone/shale bedrock layer underlying the surficial aquifer has a non-zero permeability, and in a significant portion of the watershed the layer has been eroded away leaving the surficial aquifer 'bottomless' and highly susceptible to vertical (down) water loss. In addition, the analysis of the stable isotopes indicates that much of the low flow volume originates from surface storages including wetlands and small lakes within the watershed, rather than a groundwater source. The groundwater-surface water exchange measurements along the main channel throughout the watershed show a trend that groundwater enters into the creek in the upper reaches, while the flux exchange is from the creek to groundwater in the lower reaches. To address the issue of low groundwater contribution to low-flows in the

creek it is proposed to divert stormwater to key locations within the riparian zone along the creek, and to infiltrate that water and store it for slow release to the creek during non-rain periods.

P-03: Laboratory Based Testing of Culvert Designs for Aquatic Organism Passage

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We evaluated the performance of recessed culverts across a range of geomorphic characteristics representative of Minnesota streams. Recessed culverts are often installed in Minnesota to facilitate aquatic organism passage by providing a natural streambed through the culvert. The least expensive option when installing a recessed culvert is to allow the culvert to fill in with sediment naturally over time; however evidence suggests that although sediment is transported through the control volume, it fails to deposit within the culvert. Hydraulic characteristics responsible for this phenomenon are not fully understood and the inability to maintain a sediment substrate within the culvert could be due to a lack of roughness in the pipe, characteristics of the flood hydrograph, or sediment supply. The objective of this research was to understand the function of a culvert set below the streambed elevation under various sediment transport conditions. Laboratory experiments explored the functionality of a culvert that is prefilled with sediment representative of the stream as a part of the installation process against one that is empty after installation and assessed the need for riprap weirs that protect against headcutting and downstream degradation. The experiments evaluated the development of natural bed roughness structures (steps, pools, ribs, etc.) or the need for artificial roughness installations within the culvert. Research presented will include findings from three sets of experiments: 1) the effect of sediment grain size, slope, and flow hydrograph on sediment transport through a single recessed box culvert, 2) the effect of bed roughness structures on sediment stability in a single recessed box culvert in high-gradient streams, and 3) the effect of culvert offset and skew on sedimentation in multi-barrel culverts.

P-04: Effect of freeze/thaw on bluff erosion in South Central Minnesota

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Studies have indicated that erosion rates in Minnesota River watershed have increased significantly in last 150 years and the source of sediments in the rivers has shifted from agricultural farmland to river bluffs. As a result bluff erosion is a leading cause of high sediment loads in the Le Sueur River watershed in south central Minnesota. High erosion rates threaten existing infrastructure and the resulting turbidity can lead to loss of biodiversity. It is believed there are primarily three processes that influence bluff erosion: under-cutting, sapping, and freeze/thaw. For this study we investigate the process of freeze/thaw and how it affects the bluff erosion rates in the Le Sueur River watershed. Freeze/thaw processes have been shown to disrupt soil structure making soils more easily eroded. To study this effect on bluffs in south central Minnesota, four sites have been selected, based on their aspect and degree of consolidation. The temperature of the bluff face is measured at varying depths, one closer to surface (approx. 6 inches) and another deeper (approx. 12 inches). The east and west facing bluffs, which are over consolidated, have four sensors on them two measuring temperature, one measuring soil moisture, and one measuring relative humidity and air temperature. The north-east and south-west facing bluffs that are normally consolidated have eight sensors on them four measuring soil temperature, two measuring soil moisture, one measuring relative humidity and air temperature and one measuring radiation. The sensors were deployed in the middle of October 2013 and will be out in the field until at least the middle of May 2014. The selected sites were scanned using Terrestrial Laser Scanning (TLS) initially and will be scanned at four additional times during this period. Partial data obtained from the sensors on January 18th 2014 show that this area experienced at least 38 freeze/thaw cycles. TLS data collected at this time reveal the erosion that has resulted from these temperature changes.

P-05: The Multifaceted Nature of Dam Removals: Navigating Challenges and Achieving Success through Partnerships

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Dam removal projects involve a myriad of disciplines and partners. The process is often lengthy due to the variety of factors that need to be considered and addressed. In the Great Lakes, issues vary by watershed but general topics include: 1) invasive species, 2) contaminants, 3) threatened and endangered species, 4) social and aesthetic 5) historic resources and 6) obtaining funds. The U.S. Fish and Wildlife Service through its' National Fish Passage Program, Great Lakes Basin Fish Habitat Partnership, Great Lakes Fish and Wildlife Restoration Act and Partners for Fish Wildlife Program has been partnering with Federal and State agencies, local governments, non-government organizations, and public and private organizations on dam removal and modification projects in the Great Lakes for over 20 years. The number of dams identified for removal has gradually increased as these structures age and they need to be removed or repaired. This poster will provide an overview of why and how these topics are addressed for a typically dam removal project in the Great Lakes because the days of dynamite are long gone.

P-06: Restoring Fish Habitiat in an Historically Urban/Industrial Environment

Geoffrey Parish, *GRAEF;* Steve Fisco, P.E.

The Menomonee River, located in southeastern Wisconsin, is one of three rivers that drain the urban and rural areas around Milwaukee, Wisconsin. An 1,100 foot reach of the Menomonee River was identified as a major impediment to fish passage between Lake Michigan and the spawning areas in the upstream river reaches. Historical alterations of the river included filling, dredging, channel relocations, and in the project area, confining the channel within stone block walls built by the Works Progress Administration (WPA) in 1935. In 1965 the channel was deepened and lined with concrete to improve flood conveyance. These modifications resulted in high velocities, and diminished the biological connection between Lake Michigan and the upper Menomonee River watershed and the hydrologic connection between the river and local groundwater. The Milwaukee Metropolitan Sewerage District (MMSD) contracted with GRAEF to develop designs to remove the concrete lining, to restore a more natural channel, to prepare plans and specifications, to coordinate with public and private agencies and to provide engineering services during construction.

Establishing the hydrological and hydraulic conditions necessary for passage of Northern Pike was considered the benchmark for the system, because of the relatively poor swimming abilities of Northern Pike compared to other fish in the system. Two channel alternative configurations were evaluated and a blended alternative was developed for the final design that allowed for Northern Pike fish passage and also limited the change in flood flow water surface elevation to less than one percent.

Soil samples obtained during the environmental assessment had levels of polycyclic aromatic hydrocarbons (PAHs), arsenic and lead above WDNR generic Residual Contaminant Levels (RCLs), likely reflective of the historical urban/industrial land use. Higher levels of these organic compounds were encountered in the uplands adjacent to the river than in the sediment beneath the concrete lining. Rather than expend district fees to landfill approximately 10,000 cubic yards of material excavated from the channel and channel access, soils which were known to have industrial contaminant impacts, GRAEF identified two former industrial parcels owned by MMSD as disposal locations, and worked with the Wisconsin Department of natural Resources (WDNR) and MMSD to obtain regulatory approval to dispose of the soils at these nearby parcels.

GRAEF finished plans and specifications in 2012 and the project was bid in early 2013. Construction began in summer of 2013 and is anticipated to be complete in 2014.

P-07: What happens when nature, history, and people collide? Cove Spring- A case study.

Suzanne Hoehne, *Biohabitats, Inc;* Vince Sortman, *Biohabitats, Inc.*

Cove Spring drains an approximately 6 square mile groundwater drainage area and surfaces at the upper end of a box canyon. The creek flows through old reservoir sediments for 5000 linear feet until it drains into Penitentiary Branch, a remnant stream within an old oxbow of the Kentucky River. Penitentiary Branch is prime habitat for beaver, and, at one point, a large wetland/pond was formed on the site. In the past decade, the city of Frankfort had to remove the Beaver from Penitentiary Branch due to residents' concerns over flooding and to maintain the flood control capacity of the area. Removal of the beaver resulted in the degradation and eventual loss of the wetland habitat that the beaver impoundment had formed. The city of Frankfort undertook a restoration project working with Kentucky Department of Fish and Wildlife Resources to restore over 7000 linear feet of stream, preservation of 6 acres of wetland and 14 acres of wetland rehabilitation. Biohabitats, working with Ecotech, Inc., was hired to perform the design, construction oversight, and monitoring.

Design of the project was undertaken by considering the impacts of the surrounding watershed upon the project area. Project goals included beaver-friendly design of the lower reach, preservation of the historical aspects and existing tree canopy of the park, reduction of sediment and nutrient loading to the Kentucky River, and expansion of educational opportunities for the park. To reach these goals, the stream design involves two different methodologies, natural channel design and regenerative stream design. Both methodologies were used in areas of the park that would receive the maximum benefit in terms of preservation of existing features. Also included in the design were opportunities to replace existing storm water facilities with better management practices and augment existing native species and wetland habitat.

P-08: Biotic Comparisons of Restored and Non-Restored Reaches of Rush Creek, Southeastern Minnesota

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Rush Creek in southeastern Minnesota (Winona and Fillmore counties) historically was impacted by poor agricultural land use, and the stream experienced a catastrophic, 1,000-year flood event in 2007. Fish habitat has been restored in a severely degraded, >2-mile reach within the upper half of the stream, but most of the stream remains unrestored. The objectives of this study were to assess fish and benthic invertebrate assemblages, fish habitats, and trout angling capture rates at restored (2) and non-restored (4) sites within the stream. Fish assemblages were sampled during summer 2011 and 2012 using a backpack electrofisher, and communities were compared among sites using the Coldwater Index of Biotic Integrity (CIBI). Kick samples of invertebrates were collected during both years, and communities were compared among sites using the Benthic Invertebrate Index of Biotic Integrity (BIBI). Fish habitat was rated with both qualitative (7 features) and quantitative (27 habitat variables) approaches. Nearly 40 hours (three visits per site, 119-188 minutes per visit) were spent fishing (typical spinning tackle) restored and non-restored sections of Rush Creek during summer-fall 2011. Fish CIBIs rated stream sites as fair to good, with no difference in CIBIs, diversities, or species richness between restored and non-restored sites. However, CIBI scores declined and species richness and diversity increased from upstream to downstream sites. Invertebrate BIBIs rated all stream sites as poor, with no difference between restored and non-restored sites. BIBI scores and diversities increased from upstream to downstream sites. Restored sites had higher fish habitat ratings, with greater abundances of pools and riffles, slower current velocities, shallower water, coarser substrates, less bare soil on banks, and wider riparian buffers than non-restored stream sites. After angling nearly 400 trout during the study period, non-restored stream sections tended to have marginally higher brown trout angling catch rates (site averages of 9.86-11.25 fish/hour) than restored sites (7.45-9.54 fish/hour). Average sizes (length and weight) of angled trout did not differ between restored and non-restored sites, but maximum fish lengths and weights were significantly greater in non-restored stream sections than in restored habitat sections. Restored habitat sections of Rush Creek support abundant populations of trout and diverse invertebrate assemblages typical of the remainder of the stream. Heavy fishing pressure in the restored reach may be suppressing catch rates of individual anglers.