Kansas-based Research Regarding the Importance of Riparian Forests

Balch, P. 2003. Evaluation of Streambank Erosion in the Little Blue Watershed, Kansas. State Conservation Commission.

Based on an analysis of U.S. Department of Agriculture crop slides and aerial photography for a study period from 1977 to 2001 in the Little Blue River Watershed, the most common hotspots of streambank erosion were cropland sites where riparian vegetation had been removed.

A total of 12,679,909 tons of soil was lost from 1977 to 2001 to the Little Blue River system, which eventually flows into Tuttle Creek Reservoir. The total soil loss per linear foot of streambank for the 31 sites was 298 tons, or an average of 13 tons per year.

Geyer, Wayne A.; Neppl, To; and Brooks, K. 1999. Protect Streambanks with Trees. Kansas Agricultural Experiment Station Research Reports: Vol. O: Issa 120

Forest collected soil on streambanks, while grassland riparian areas lost an average of 78 ft of streambank, and cropland riparian areas lost an average of 150 ft. The study estimated that 9.4 acres of grassland and 18.2 acres of cultivated land were lost per stream mile during the flood due to lack of adequate riparian forest. The latter is equivalent to more than a quarter section of land for every 10 miles of stream distance in the study.

Sass, C. KÖ and TDD. Keane 2011. Evaluation and development of predictive streambank erosion curves for Northeast Kansas using Rosgen's "BANCS" Methodology. PhD Dissertation: Dr. Christopher Sasso PhD Major Professor: Dro Timothy Keane. Department of Environmental Planning and Design. College of Architecture, Planning and Design. Kansas State Universityø Manhattan, Kansas.
Sass, C. K., and T.D. Keaneø 20120 Application of Rosgen's BANCS model for NE Kansas and the development of predictive streambank erosion curves. Journal of the American Water Resources Association, 48(4), 774487.

Sass and Keane conducted a streambank erosion study of eighteen study banks at nine sites located mostly along unstable reaches of the upper, middle and lower Black Vermillion Watershed (tributary to Tuttle Creek Reservoir) from 2007 to 2010. Results indicated that streambanks without woody vegetation had at least three times higher erosion rates than those with riparian woody vegetation.

Woody riparian vegetation in the Black Vermillion watershed plays a vital role regarding streambank erosion and lateral migration rates, ranging from a low of 0.2 feet of bank retreat per year for woody vegetated banks to a high value exceeding 3 feet of bank retreat per year for those without woody vegetation.

Sass, co Kn and T.D. Keane. 20080 Inventory and Analysis of the Black Vermillion River System Riparian Corridors. MLA Thesis: Christopher Sass. MLA Major Professor: Dr.

Timothy Keane. Department of Landscape Architecture / Regional and Community Planning, College of Architecture, Planning and Design, Kansas State University. Manhattan, Kansas.

Within the Black Vermillion Watershed, changes in riparian vegetation from the fibrous root structure of trees compared to the finer roots of grasses and shallow roots of crops has made riparian areas and streambanks more susceptible to erosion

Dodd, WOK and R.M. Oakes. 2008, Headwater influences on downstream water quality. Environmental Management 41:367-377. DOI 10.1007/s00267-007-9033-v.

In a study of 68 watersheds in four ecoregions of Eastern Kansas, Dodds and Oakes found that nonpoint pollution control strategies should consider protection and restoration of riparian areas associated with small upland streams as important, integrated components of water quality conservation programs.

Meade B.K, and R.A. Marston. 2009. Spatial Extent, Timing and Causes of Channel Incision, Black
Vermillion Watershed, Northeastern, Kansas. MA Thesis: Benjamin Meade. MA Major Professor: Dr. Richard Marston. Department of Geography. College of Arts and Sciences, Kansas State University. Manhattan, Kansas.

Riparian trees and the stabilizing and cohesive effects of their fibrous rooting systems were noted for holding streambanks in place during flood events and reducing mass wasting of streambanks in the watershed. The impacts of land use conversion from tallgrass prairie to cropland and impacts to the hydrology and stream power generated through increased runoff from the altered drainage area were also identified as having deleterious effects on the stability of the stream systems in the watershed.

Fox, G. Aa, Sheshukov, Aø, Cruse, Re, Kolar, Ra Guertault, La, Gesch, KO R., & Dutnell, R, C.a 2016, Reservoir sedimentation and upstream sediment sources: Perspectives and future research needs on streambank and gully erosion. Environmental Management, 57, 1—11.

Fox et al. noted the sediment and nutrient loads from streambanks were responsible for 30%-83% of total soil erosion occurring in agricultural watersheds across the world. They also reported that riparian forests reduces the sediment and total phosphorus load from streambanks by three to four times compared to banks without riparian forests.

Grudzinski, BOP. and M.D. Daniels. Influence of Watershed Management on Stream Geomorphology in Grassland Headwater Streams. PhD Dissertation: Dr. Bartosv Grudzinski. PhD Major Professor: Dr. Melinda Daniels. Department of Geography. College of Arts and Sciences, Kansas State University. Manhattan, Kansas.

Grudzinski and Daniels concluded that cattle grazing at both moderate and high densities is damaging to grassland stream water quality, stream structure and surrounding riparian habitats.

Hargrove, WeL., D. Johnson, D. Snethen and JO Middendorfo 2010. From Dust Bowl to Mud Bowl: Sedimentation, conservation measures, and the future of reservoirs. Journal of Soil and Water Consentation, 65(1): 14A-17A.

In a literature review and synthesis of research needs regarding sedimentation of reservoirs in the U.S., Hargrove et al. identified that 60-80% of stream reaches in areas of the Midwest were experiencing significant streambank failures and that channel erosion processes were primary contributors to sediment loading in streams and sedimentation of reservoirs, carrying with them nutrients and pesticides from agricultural sources. Streambank stabilization, riparian area protection practices and sediment trapping above reservoirs as accomplished with properly functioning riparian forests.

Juracek, KOE, and A.CO Ziegler. 2009. Estimation of sediment sources using selected chemical tracers in the Perry lake basin, Kansas, USA. International Journal of Sediment Research, 24: 108-125.

In a study of sediment sources using chemical tracers in the Perry Lake Basin, Juracek and Ziegler concluded that the dominant sources of sediment to Perry Lake were from channel-bank sources and the channel-bank contribution increased in importance with distance downstream in the basin.

Burke, and T.DO Keane. 2015. Understanding Gully Process in Two Kansas Landscapes. PhD Dissertation: Dr, Katherine Burke. PhD Major Professor: Dr. Timothy Keane. Department of Environmental Planning and Design. College of Architecture, Planning and Design. Kansas State University. Manhattan, Kansas.

In a study of gully formation and factors affecting agricultural fields, Burke and Keane identified lack of vegetation and associated surface roughness and cohesive forces of roots as being a major contributor to erosion and delivery of sediment from agricultural fields to streams.

Larson, D.M,, WøK, Dodds, and A.M. Veacho 2017 (In Review, Personal Communication with W.K,
Dodds)a Whole•atchment Riparian Removal Substantially Altered Streams in an Otherwise Undisturbed Grassland

This study underscores the concept that protection of riparian zones is particularly important to uphold water quality, quantity and ecosystem functions and suggests that protection of riparian zones should be a high priority since they may represent the most sensitive areas in watersheds to disturbance and impart relatively greater influence on stream ecosystems than upslope landscapes.

Winders, K. and W.K. Dodds. 2010. Ecosystem Processes of Prairie Streams and the Impact of Anthropogenic Alteration of Stream Ecological Integrity. MS Thesis: Christopher Sass. MS Major Professor: Dr. Walter Dodds. Division of Biology. College of Arts and Sciences. Kansas State University. Manhattan, Kansas.

On 23 Kansas and Missouri streams Winders and Dodds found that streams buffered by riparian forest required higher discharge rates to mobilize solid particles and generally had lesser total suspended solid concentrations relative to unbuffered streams during high discharge events. Streams with forested buffers also had less frequent floods, leading to less transport of total suspended solids downstream.

Banner, E.B.K, A.J. Stahl and W.K Dodds, 2009. Stream Discharge and Riparian Land Use Influence In-Stream Concentrations and Loads of Phosphorus from Central Plains Watersheds. Environmental Management, 44:552-565. DOI 10.1007/s00267-009-9332-6.
Results of the study suggested that a proportional reduction in total phosphorus concentration should occur as cropland in the near-stream area is replaced with more permanent riparian vegetation, especially in large watersheds.

Kansas Center for Agricultural Research and the Environment 2014. Understanding Sedimentation of Kansas Lakes.

Lack of cohesive riparian forest vegetation was implicated as a factor leading to greater incidences of streambank mass wasting and potentially sediment mobilization,

Williams, J. and C. Smith. 2008. Economic Issues of Watershed Protection and Reservoir Rehabilitation. In: Sedimentation in Our Reservoirs: Causes and Solutions. Kansas Center for Agricultural Research and the Environment

Using Tuttle Creek Reservoir as a case study, Williams and Smith estimated that implementing streambank stabilization with plantings of 100 feet riparian forest buffers on 10,448 miles of streambanks in the Tuttle Creek Watershed would result in $42,051,296 of savings in the avoided costs to dredge sediment contributed from these sources to the lake. Compared to other best management practices such as no-till farming, vegetative buffers, and terraces, streambank stabilization with riparian forest plantings was 0.8 to 3 times more effective at providing cost savings compared to dredging sediment (assuming $5/ cubic yard dredging cost) transported to the lake from these sources after the fact. Compared to doing nothing, streambank stabilization with riparian forest plantings was 10 times more cost-effective than dredging.

Kansas Water Authority. 2010. Reservoir Roadmap. Presentation to the Kansas Legislature by the Kansas Water Authority.

Based on studies of landscape erosion (Kansas State University), sediment yield studies (Kansas Water Office) and evaluation of active streambank erosion sites (The Watershed Institute and Kansas Water Office) on the Neosho and Cottonwood Rivers above John Redmond Reservoir, streambank erosion (which includes gully erosion) was identified as the primary source of excessive sediment loads delivered to John Redmond Reservoir. Based on an economic

analysis of costs to implement streambank stabilization with 100 feet riparian forest buffers compared to the cost of dredging the sediment that would end up in the reservoir (using a conservative $10/cu yard estimate), each Sl spent in prevention yielded $10 savings in avoided dredging costs.

Kansas Forest Service and Kansas Alliance for Wetlands and Sfreams, 2017. Remote Assessment of Riparian Forest Best Management Practice Opportunities in Ten Kansas Basins. Final Report (Pending) to Natural Resource Conservation Service Regional Conservation Partnership Program, Kansas Forest Service, Manhattan, Kansas.

In a remote assessment of riparian buffers in 57 HUC-12 watersheds in 10 Kansas basins, predominantly above federal reservoirs, the Kansas Forest Service and the Kansas Alliance for Wetlands and Streams identified 51.5%/0 of the riparian areas as in need of riparian forest establishment (currently in cropland, pasture and grassland) and 30.2% in need of riparian forest management, out of total of 160,627 acres assessed for two active channel widths along the streams and rivers. Only 2.3% of the riparian area was assessed as in need of conservation (higher quality forest with adequate cover), with the remainder of the riparian area in development. The predominance of the riparian areas in the ten basins were in need of attention to ensure adequate functioning condition, health and biodiversity, which could include a suite of best management practices ranging from tree and shrub establishment, timber stand improvement, natural channel design to address head-cut migration upstream and bank instability and floodplain connectivity.

Mikesell, F.L. and J. Zimmerman. 1988. Avian Habitat Selection in the Attenuated Riparian Forest on the Tallgrass Prairie. MS Thesis: Fred Mitchell. MS Major Professor: Dr. John Zimmerman. Division of Biology. College of Arts and Sciences. Kansas State University. Manhattan, Kansas.

Regional forests with adequate interior spaces would likely support higher avian species diversity and a larger species pool for colonization of headwater riparian forests.

Johnson, TN. and B.K. Sandercock. 2006. Ecological Restoration of Tallgrass Prairie: Grazing Management Benefits Plant and Bird Communities in Upland and Riparian Habitats. MS Thesis: Tracey Johnson. M.S. Major Professor: Dr. Brett Sandercock. Division of Biology. College of Arts and Sciences. Kansas State University. Manhattan, Kansas.

Riparian zones are particularly important as breeding and wintering sites for bird communities and as stopover sites used during migration.

Eitzman, J.L. and C. Paukert. 2008. Spatial Habitat Variation in a Great Plains River: Effects on the Fish Assemblages and Food Web Structure. MS Thesis: Jeffrey Eitzman. M.S. Major Professor: Dr. Craig Paukert. Division of Biology. College of Arts and Sciences. Kansas State University. Manhattan, Kansas.

In a study of fish assemblages and food web structure along the Kansas River, Eitzman and Paukert found that heterogenous in-stream reaches with more riparian forests supported more complex food webs and intolerant fluvial specialist fish species compared to more macrohabitat generalist fish species in urbanized and channelized homongenous reaches with less riparian habitat.

Two intolerant species (blue sucker and shovelnose sturgeon) captured in high abundance in the river were captured in the upper river reaches that were less impacted by urbanization and channelization and had more riparian forest. Maintaining suitable habitat for fluvial specialist species and restoration of impacted areas of the river and riparian areas downstream to create more heterogeneity were recommended as strategies for conserving intolerant, native species in the Kansas River.

Schumm, S.A. and R.W. Lichty. 1963. Channel Widening and Flood-Plain Construction Along Cimarron River in Southwestern Kansas. Geological Survey Professional Paper 352-D. U.S. Government Printing Office. Washington, DC.

In a historical study of changes in stream channel geomorphology and the effects of floodplain vegetation along the Cimarron River in southwestern Kansas (semi-arid, sand-based stream), Schumm and Lichty found that the channel of the Cimarron River in southwestern Kansas had changed significantly during historic times. The average width of the river was 50 feet in 1874.The floodplain and banks of the river were vegetated and relatively stable from 1874 to 1914. Bank vegetation was apparently destroyed by the 1914 flood. During and after the major flood of 1914, the river widened until an average width of 1,200 feet was reached in 1942. In summary, the trees that bordered the channel offered considerable protection to the banks, and channel widening was minimal under these conditions.

Kansas Water Office. 2017. John Redmond Watershed Streambank Erosion Assessment. Topeka, Kansas.

The purpose of this Kansas Water Office project was to reduce the amount of sediment entering John Redmond Reservoir by rehabilitating and stabilizing portions of the Cottonwood and Neosho Rivers and their tributaries, which are known to contribute significant sediment loads and pollutants to the watershed and John Redmond Reservoir, as well as restoring riparian forest adjacent to the stream rehabilitation sites. The Kansas Water Office 2017 assessment quantified annual tons of sedimentation from streambank erosion between 1991 and 2015 in the John Redmond watershed. A total of 366 streambank erosion sites, covering 197,470 feet of unstable streambank were identified. Eighty percent of the identified streambank erosion sites were identified as having a poor riparian condition (riparian area identified as having cropland or grass/crop streamside vegetation rather than riparian forest). Sediment transport from identified streambank erosion sites accounts for 525,447 tons (426 acre-feet) of sediment per year transported from the John Redmond watershed streams to John Redmond Reservoir annually, accounting for roughly 55 percent of the total load estimated from the most recent bathymetric survey in 2014. Based on the average stabilization costs of $71.50 per linear foot, conducting streambank stabilization practices for the entire watershed would cost approximately $14.1 million.

Assimilated by the Kansas Alliance for Wetland and Streams

Summarized by Larry Biles, Kansas Forest Service