SD1 Testimony for Senate Subcommittee Hearing

Environment and Public Works Committee – Chairman: Senator Boxer; Ranking Member: Senator Vitter

Water and Wildlife Subcommittee – Chairman: Senator Cardin; Ranking Member: Senator Boozman

Scheduled for 5/13/14

Witness: James P. Gibson, Jr., Director of Integrated Watershed Management for Sanitation District No. 1 (SD1) of Northern Kentucky

> Mr. Gibson joined SD1 in 2000 and was appointed Director of Water Resources in 2007, which was reorganized into the Integrated Watershed Management Department in 2013. The Integrated Watershed Management Department, which consists of a multidisciplinary staff of biologists, engineers and scientists, implements Northern Kentucky's regional storm water management program, including compliance with EPA's MS4 Phase II storm water regulations. Additionally, the department conducts comprehensive watershed assessments (i.e., water quality, biological and flow monitoring) and manages watershed model development throughout Northern Kentucky.
>
> Prior to joining SD1, Mr. Gibson was employed for six years with the Ohio River Valley Water Sanitation Commission (ORSANCO – an interstate regulatory agency representing eight states and the Federal Government concerning water pollution control, primarily for the Ohio River) located in Cincinnati, Ohio. While at ORSANCO, Mr. Gibson was primarily involved in the development and management of ORSANCO's national demonstration studies to identify the impacts of wet weather on the water quality of the Ohio River.

As the second largest public sewer utility in Kentucky, SD1 of Northern Kentucky provides regional wastewater and storm water services to approximately 300,000 residents and 35 municipal jurisdictions in the three-county area of Boone, Campbell and Kenton. Storm water management is an essential service to Northern Kentucky—it offers protection to limit property damage from runoff, as well as the preservation of the integrity of approximately 1,500 miles of streams that drain watersheds within the 3-county area. In order to be effective, storm water management must be comprehensively implemented throughout an entire watershed in a coordinated effort that integrates all storm water management initiatives, including both public and private entities.

The value of effective storm water management is most apparent in catchment areas that do not currently have adequate measures for managing storm water runoff. Absent or otherwise ineffective storm water management causes substantial impacts to the quality of our local waterways—impacts that clearly do not meet the intent of the Clean Water Act. Beyond water quality (i.e., the physical, chemical, and biological integrity of waterways), inadequate storm water management can directly impact SD1 customers with property damage (e.g., flooding and erosion), and indirectly through increased rates required to repair damaged infrastructure, as well as additional regulatory compliance burdens associated with impaired waterways.

Water Quality/Stream Health: Stream integrity is rooted in the natural flow regime, the hydrology, of a watershed (Poff et al., 1997). Alteration of the landscape in any way, but particularly the addition of impervious surface, drastically changes the hydrology of a watershed, and therefore impacts the overall integrity of the stream, as demonstrated by The Stream Function Pyramid below (Harmon et al., 2012) (Figure 1). For this reason, storm water management is crucial for protecting the physical, chemical, and biological integrity of our nation's waterways—the three central objectives of the Clean Water Act. Inadequate storm water management strategies can lead to excess pollutants carried from impervious surfaces to waterways, such as oils, road salts, and metals and can also create excessively erosive flows that degrade habitat (Fitzpatrick and Peppler, 2010) and erode stream banks. This accelerated erosion has been identified as a dominant source of excess sediment in streams (Simon and Klimetz, 2008)—one of the nation's most widely documented water quality impairments (e.g., KDOW, 2008; OEPA, 2010). The aggregate effect of all of these impacts is degraded biological communities in watersheds with moderate and high levels of impervious cover such as pavement and roofs (Walsh et al., 2005).

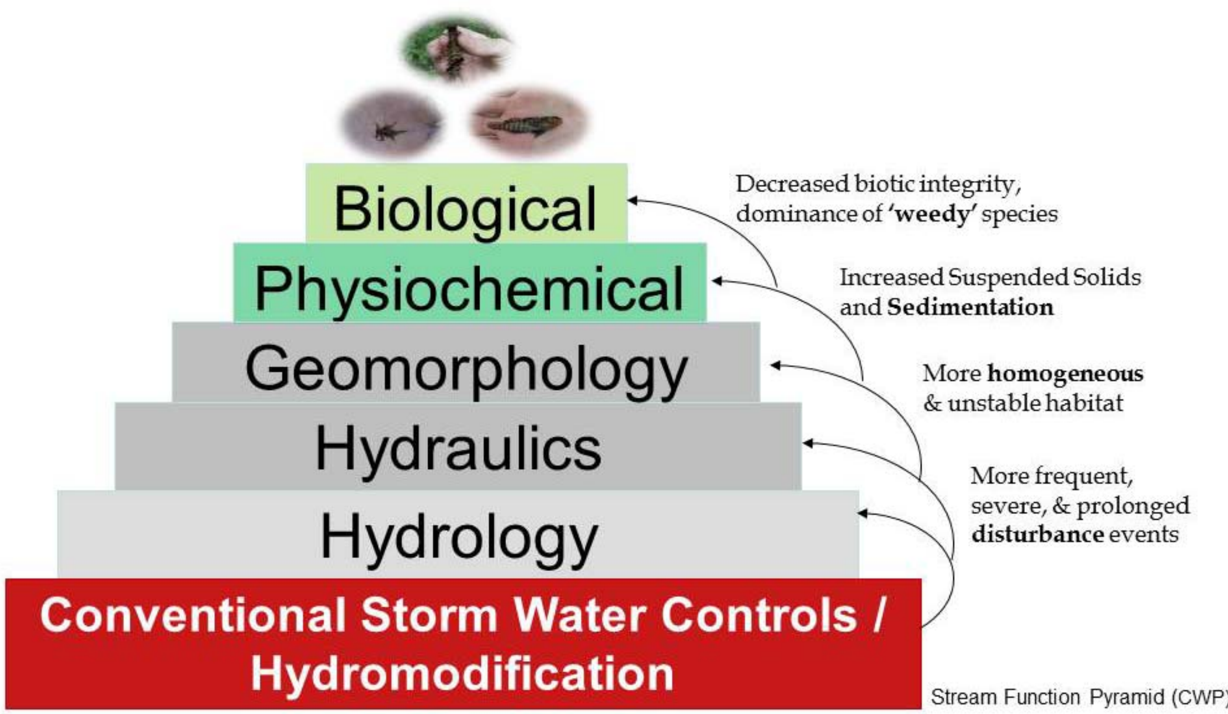

Figure 1. The Stream Function Pyramid (adapted from Harmon et al., 2012) demonstrates the cumulative nature that changes to a watershed's hydrology can have. Conventional and/or no storm water controls can exacerbate impacts, whereas storm water management techniques that seek to mimic natural hydrology and/or disturbance could reduce these same impacts.

Flooding: Storm water management impacts public and private property (Figure 2) because excess runoff from impervious surfaces upstream can increase flooding downstream (e.g., Sauer *et al.,* 1983). This is evident even with conventional storm water flood controls, such as detention basins designed only to control peak flow rates, which extend durations of flood peaks and aggregate downstream flood peaks (Atlanta, 2001). This is also supported with numerous complaints of property owners in Northern Kentucky who have expressed concern over local flooding. Several property owners can attest that the stream on their property rarely, if ever, flooded out of its banks for several decades, but now that the watershed has been developed, flood waters frequently inundate their property.

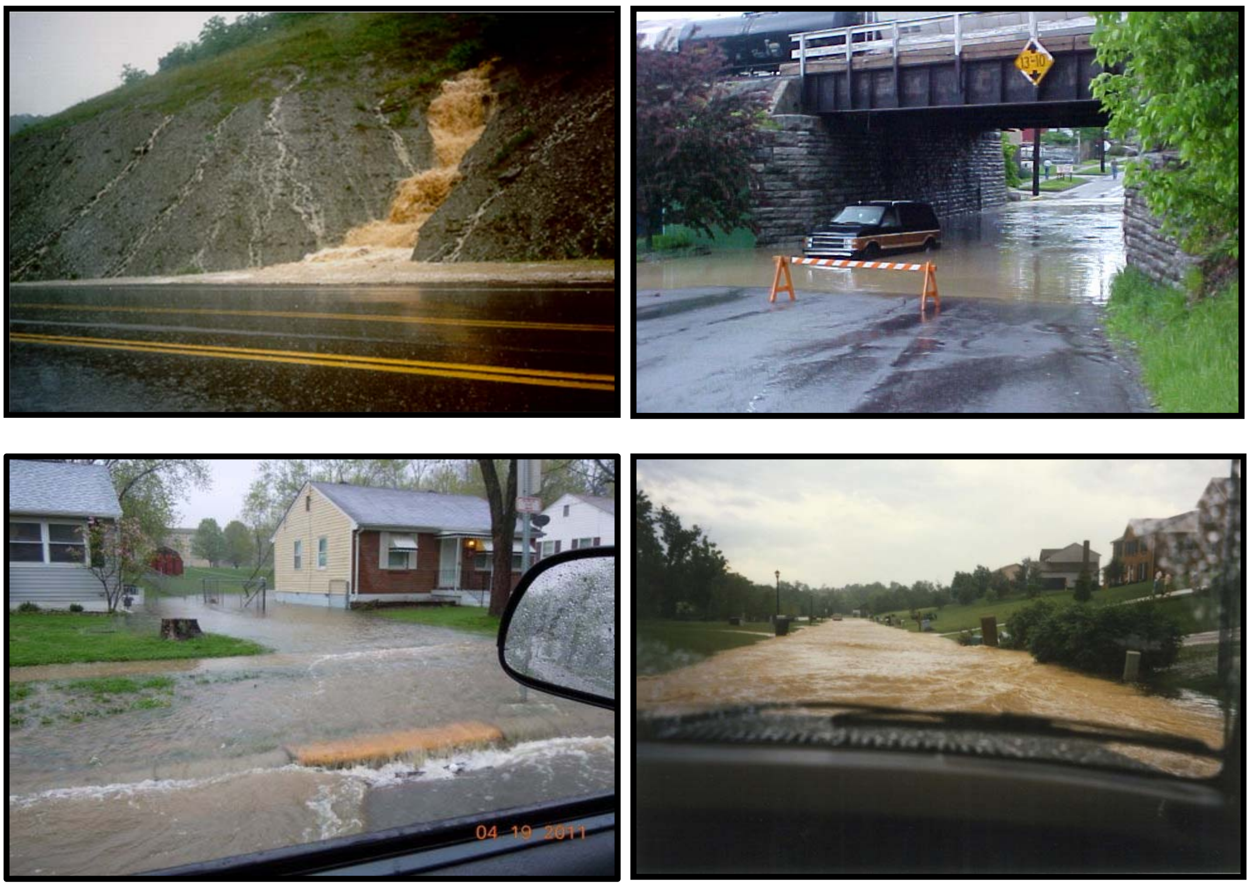

Figure 2. Various roadway and property flooding from absent or inadequate storm water management practices.

Erosion: Absent or inadequate storm water management has been documented across the U.S. to exacerbate stream instability, bank erosion, and channel enlargement downstream (e.g., Bledsoe and Watson, 2001; Booth, 1990; Hammer, 1972; Hawley and Bledsoe, 2013; Hawley *et al*., 2013a). This is apparent in Northern Kentucky based on several accounts offered by property owners that describe dramatic changes in stream morphology after a watershed has been developed. For example, one property owner noted drastic increases in stream width and depth following the construction of the four-lane AA Highway. These anecdotal observations are supported by SD1's extensive hydromodification monitoring program, which has documented that channel area, width, and depth of streams draining developed watersheds are significantly larger than those draining undeveloped watersheds of similar size (Figure 3) (Hawley *et al*., 2013a).

Owl Creek

Middle Creek

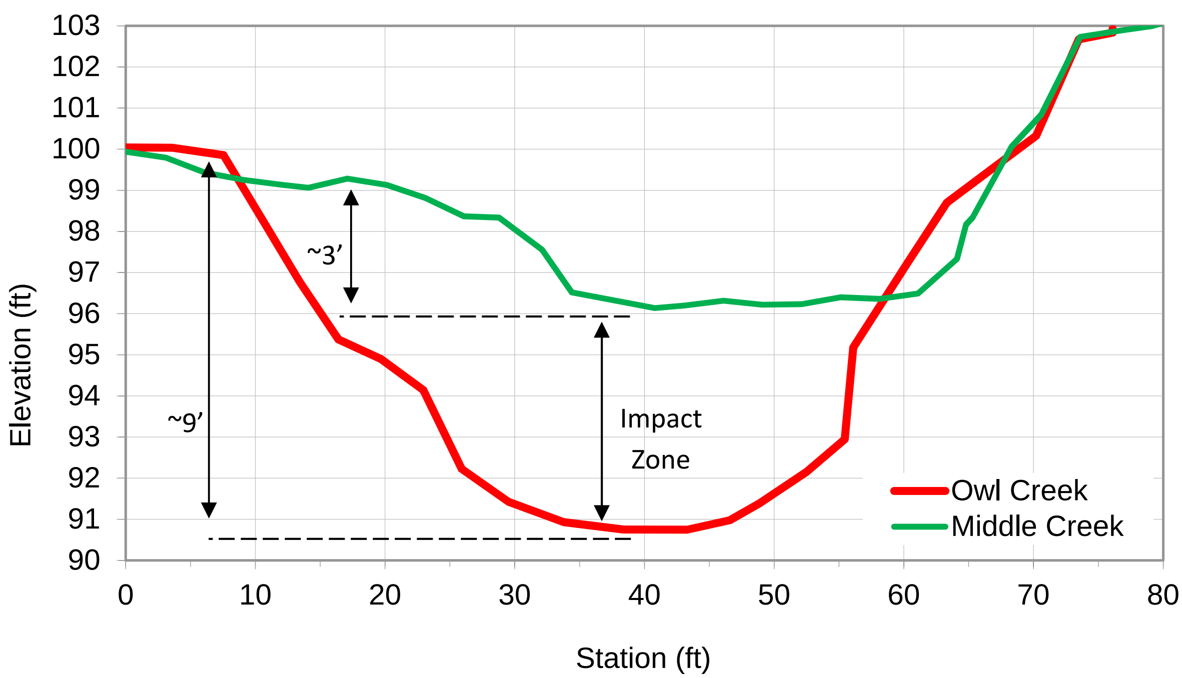

Figure 3. Photographs and cross sectional diagrams of Owl Creek (left-the enlarging stream mentioned above) and Middle Creek (right). Both streams drain approximately 3.5 square miles, but Owl Creek has nearly 10% impervious surface, as opposed to Middle Creek at 2%.

Impacts to Infrastructure: Impacts of unstable streams to adjacent infrastructure and property have been documented for over 30 years, if not longer (e.g., Richey, 1982). As unstable streams become wider and deeper (Figure 3), they often expose and damage infrastructure in the adjacent riparian zone, floodplain, and at stream crossings (Figure 4). An ongoing review of available figures from recent projects in the region estimate the following order of magnitude damages to infrastructure draining developed areas in Northern Kentucky (Hawley *et al.,* 2013b):

- ~$25,000 per square mile per year in estimated damages to state-funded roads,
- ~$2,500 per square mile per year in estimated damages to sewers, and
- ~$1,000 per square mile per year in estimated damages to gas and electric utilities.

(a)

(b)

(c)

(d)

Figure 4. Various forms of infrastructure damage from excessive stream bank erosion and bed incision. Photo (a) stream incision endangers a bridge pier/abutment on a local road; (b) extreme bank failure, repair, and continued failure due to both excessive erosion and incision along a state road; (c) sanitary sewer line and manhole "bullet" is now in creek due to extreme bank erosion; (d) manhole structure exposure from extreme bank erosion.

Regulatory obligations associated with impaired waterways: When streams become impaired, the Clean Water Act requires that pollutant loads be assigned to bring the waterway back into compliance with water quality standards. This can obligate municipal separate storm sewer system (MS4) permitted dischargers, such as cities, counties and special utility districts, to invest in controls to reduce pollutant loads to the allowable levels. It is generally accepted that retrofitting and installing new controls in watersheds with existing problems is more expensive than implementing effective storm water management during initial development, primarily due to limited access and available space to install cost-effective controls in already developed watersheds.

One of the central components of effective storm water management is managing storm water from all substantial sources of runoff prior to discharging into waterways. Impervious areas have been globally documented as one of the most significant sources of excess runoff associated with both water quality and water quantity impacts in receiving streams (e.g., Walsh et al., 2005). Based on this overwhelming evidence, in areas undergoing new development, all new impervious areas should be managed in the most appropriate, cost effective ways to reduce impacts to receiving waters. In areas with existing development and degraded water quality, storm water retrofits and new controls may be implemented to cost effectively manage impervious surfaces in order to obtain reasonable and appropriate water quality goals.

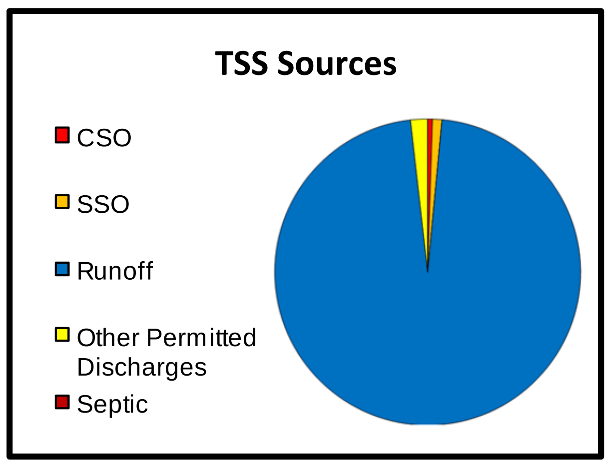

Figure 5. Photo of a tributary to Banklick Creek which is listed as impaired by the Kentucky Division of Water and a figure that displays the relative sources of total suspended solids (TSS) within the Banklick Watershed. When streams are listed as impaired, pollutant loadings are allocated to permitted entities by state regulatory agencies to achieve compliance with water quality standards.

Project coordination among agencies: One of the largest contributors of impervious area in the U.S. is transportation infrastructure. In Northern Kentucky, pavement (i.e., driveways, roads, highways, airport runways and parking lots) accounts for approximately 63% of the total impervious area, and state roads are one of the largest single-entity sources of this impervious area. State roads comprise approximately 24% of the paved surfaces in the three-county area and approximately 15% of all impervious surfaces in the three-county area. Given the contribution of state roadways to the total impervious area of Northern Kentucky, without effective storm water management, it is highly unlikely that even the best storm water management practices applied to the remaining impervious areas would adequately protect the integrity of Northern Kentucky streams.

At times, Kentucky's state transportation agency has been a valued partner on storm water-related projects. On one project alone, a cooperative approach to storm water management allowed for the retrofitting of a detention facility in SD1's largest combined sewer overflow sewershed. In the same area, the state transportation agency allowed use of right of way for innovative storm water practices that reduced combined sewer overflows at lower costs than would have been possible without the use of the state's right of way (note: this project, Terraced Reforestation, recently received the American Council of Engineering Companies Honor Award for exceptional engineering achievement). SD1 has also begun cooperative planning associated with major highway expansions that might have otherwise increase combined sewer overflows with more highway runoff. These projects provide unique partnering opportunities for both agencies to reduce sewer overflows through coordination and cost-sharing so runoff from the highway projects may be addressed through a dedicated storm water system rather than the combined sewer system.

Unfortunately, there are numerous examples where a lack of storm water controls on state transportation infrastructure has caused SD1 to invest more of its resources to achieve water quality benefits than would have been necessary if the roadway infrastructure had adequate storm water controls. For example, on a recent sewer project in the Vernon Lane neighborhood, SD1 included a goal to reduce stream erosion and improve biotic integrity (Hawley *et al*., 2012). During construction efforts to reduce point source pollution from sanitary sewer overflows, it was logical to cost effectively attempt to address nonpoint source pollution and associated storm water issues at the same time. The state road in this catchment amounted to 11% of the impervious area but lacked any storm water treatment or detention; and therefore, SD1's investments had to overcompensate for the impervious area in the neighborhood, costing more money to achieve the desired objectives.

Moreover, SD1 has detailed inventories of how absent or inadequate storm water management directly impacts transportation infrastructure. For example, in one of the three counties in Northern Kentucky, impacts to state-funded roads in 2011 that were attributed to flooding and erosion were estimated at $3.1 million (Hawley *et al*., 2013b). That is, in this one county, in one year alone, approximately $3 million in new highways or scheduled maintenance could **not** be completed because this money needed to be spent on the repairs to address damages that were attributable in part to ineffective storm water management (Figure 6).

Pre-bank failure

Post-bank failure

Bank and roadway repair

Figure 6. Time series of bank failure and subsequent repair that damaged KY State Route 8; an engineer's estimate for this repair was approximately $250,000.

Given the expense associated with these repairs, effective storm water management is clearly in the best interest of both State and Federal Transportation Departments. Effective storm water management is also in the best interest of SD1 customers because ineffective storm water management not only impacts roads and bridges, it also damages sewer, gas, electric, and other utility lines leading to higher user rates.

Regionally-calibrated Storm Water Management: SD1's experience shows that effective storm water management is not necessarily one size fits all. Although national standards can play an important role, SD1 encourages the promotion of regionally-calibrated approaches that are as protective of local streams but are more appropriate and feasible for the setting. For example, a 1-inch retention policy that may be relatively economical in soils that are conducive for infiltration could have unintended consequences in the clay soils of Northern Kentucky. With infiltration rates less than 0.01 inches per hour, the 1-inch retention policy (currently used in West Virginia and Tennessee) would result in excessively large storm water management facilities that come at a high cost to developers and transportation agencies. This could have unintended consequences, because rather than constructing storm water management facilities, entities may elect to pay a fee into a mitigation bank. Such an approach would essentially ensure the degradation of the receiving stream reach, with the hope of implementing commensurate storm water controls (restoration or protection) on a nearby stream segment.

Alternatively, if such storm water controls were constructed in areas with poor infiltration capacities, the 1-inch policy could have undesirable effects in receiving streams by unnaturally decreasing rates of disturbance. Similar to a forest setting, natural rates of disturbance (i.e., stream bed erosion) are important for stream ecosystems just as natural frequencies of forest fires are important for maintaining healthy forests. SD1's extensive data collection and modeling efforts are consistent with international literature (e.g., Holomuzki and Biggs, 2000; Poff, 1992; Suren and Jowett, 2006; Townsend et al., 1997) that indicates managing storm water to match the natural disturbance regime is a key design goal to promoting ecological and geomorphic integrity.

In Northern Kentucky, SD1 has developed a methodology to determine watershed specific discharge rates (Hawley *et al*., 2012) that do not exacerbate erosion for the majority of storm events but avoids the unnatural requirement of trying to infiltrate 1 inch of precipitation through clay soils. Such a regionally-calibrated approach is not only better for local stream integrity but also ensures that storm water management investments are not unnecessarily burdensome to land developers and/or transportation agencies.

Conclusions: In conclusion, the objective of this testimony is to document the direct link between improperly managed impervious surfaces and impaired waterways. Storm water runoff does not respect political or geographical boundaries, nor the agency responsible for the impervious surface. Impervious surfaces that are exempt from adequate storm water management, such as Federal/State roadways, comes at the expense of other entities, such as downstream property owners who lose land from accelerated stream erosion or regulated storm water utilities who might be burdened with future regulatory obligations associated with impaired/degraded waterways.

Inadequate storm water management from any impervious surface can exacerbate stream erosion that, in turn, impacts adjacent infrastructure. Consequently, the apparent savings to one agency's resources which avoids appropriate storm water management investments on a current project can negatively impact future resources of that agency, as well as neighboring agencies. Therefore, adequate storm water management of all impervious surfaces is not only in the best interest of storm water utilities, but also in the interest of Federal/State Transportation Departments for a more sustainable approach to managing transportation infrastructure. Ensuring that adequate storm water management is implemented on all substantial paved surfaces is certainly consistent with the goals of the Clean Water Act, but it goes beyond our nation's water quality. Adequate storm water management is in the best interest of anyone who pays a storm water bill, power bill, or gas tax; because the case is clear that ineffective storm water management causes and/or exacerbates impacts to those utilities that require repairs that are ultimately funded by rate payers.

References:

Atlanta, 2001. Georgia stormwater management manual, Atlanta Regional Commission, Atlanta, GA.

Bledsoe, B.P. and Watson, C.C., 2001. Effects of urbanization on channel instability. Journal of the American Water Resources Association, 37(2): 255-270.

Booth, D.B., 1990. Stream-channel incision following drainage-basin urbanization. Water Resources Bulletin, 26(3): 407-417.

Fitzpatrick, F.A., Peppler, M.C., 2010. Relation of Urbanization to Stream Habitat and Geomorphic Characteristics in Nine Metropolitan Areas of the United States. Scientific Investigations Report 2010-5056. U.S. Geological Survey, Reston, VA.

Hammer, T.R., 1972. Stream channel enlargement due to urbanization. Water Resources Research, 8: 139-167.

Harmon, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs, C. Miller. 2012. A Function-Based Framework for Stream Assessment and Restoration Projects. US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC EPA 843-K-12-006.

Hawley, R.J. and B.P. Bledsoe. 2013. Channel enlargement in semi-arid suburbanizing watersheds: A Southern California case study. Journal of Hydrology, 496: 17-30.

Hawley, R.J., Wooten, M.S., Vatter, B.C., Onderak, E., Lachniet, M .J., Schade, T., Grant, G., Groh, B., and J. DelVerne. 2012. Integrating stormwater controls designed for channel protection, water quality, and inflow/infiltration mitigation in two pilot watersheds to restore a more natural flow regime in urban streams. Watershed Science Bulletin. 3(1), 25-37.

Hawley, R.J., MacMannis, K.R. and Wooten, M.S., 2013a. Bed coarsening, riffle shortening, and channel enlargement in urbanizing watersheds, northern Kentucky, U.S.A. Geomorphology, 201: 111-126.

Hawley, R.J., MacMannis, K.R. and Wooten, M.S., 2013b. How Poor Stormwater Practices Are Shortening the Life of Our Nation's Infrastructure--Recalibrating Stormwater Management for Stream Channel Stability and Infrastructure Sustainability, World Environmental and Water Resources Congress. American Society of Civil Engineers, Environmental and Water Resources Institute, Cincinnati, OH, May 19-23.

Holomuzki, J.R. and Biggs, B.J.F., 2000. Taxon-specific responses to high-flow disturbance in streams: implications for population persistence. Journal of the North American Benthological Society, 19(4): 670-679.

KDOW, 2008. 2008 Integrated Report to Congress on Water Quality in Kentucky. Volume I. 305(b) Report. Kentucky Energy and Environment Cabinet, Department for Environmental Protection, Division of Water, Frankfort, KY.

OEPA, 2010. Ohio 2010 Integrated Water Quality Monitoring and Assessment Report. State of Ohio, Environmental Protection Agency, Columbus, OH.

Poff, N.L., 1992. Why disturbances can be predictable: a perspective on the definition of disturbance in streams. Journal of the North American Benthological Society 11, 86–92.

Poff, N.L., Allan, J. D., Bain, M. B., Karr, J. R., Prestegaard, K. L., Richter, B. D., Sparks, R. E., Stromberg, J. C., 1997. The natural flow regime: A paradigm for conservation and restoration of river ecosystems. BioScience, 47: 769-784.

Richey, J.S., 1982. Effects of urbanization on a lowland stream in urban Washington. Ph.D. Dissertation, University of Washington, Seattle, WA, 248 pp.

Sauer, V.B., Thomas, W.O.J., Stricker, V.A. and Wilson, K.V., 1983. Flood characteristics of urban watersheds in the United States, U. S. Geological Survey.

Simon, A., Klimetz, L., 2008. Relative magnitudes and sources of sediment in benchmark watersheds of the Conservation Effects Assessment Project. Journal of Soil and Water Conservation 63 (6), 504–522.

Suren, A.M. and Jowett, I.G., 2006. Effects of floods versus low flows on invertebrates in a New Zealand gravel-bed river. Freshwater Biology, 51(12): 2207-2227.

Townsend, C.R., Scarsbrook, M.R., Doledec, S., 1997. Quantifying disturbance in streams: alternative measures of disturbance in relation to macroinvertebrate species traits and species richness. Journal of the North American Benthological Society 16 (3), 531–544.

Walsh, C.J., Roy, A.H., Feminella, J.W., Cottingham, P.D., Groffman, P.M., Morgan II, R.P., 2005. The urban stream syndrome: current knowledge and the search for a cure. Journal of the North American Benthologic Society 24 (3), 706–723.