MEMORANDUM

TO: COMMISSIONER KELLY GIRTZ, ATHENS-CLARKE COUNTY

FROM: KELLY SIRAGUSA, ENVIRONMENTAL PRACTICUM

SUBJECT: STREAM RESTORATION ON STREAMS DEGRADED BY ILLEGAL DUMPING

DATE: 5/2/2007

CC: LAURIE FOWLER, PROFESSOR, ENVIRONMENTAL PRACTICUM AND ENVIRONMENTAL PRACTICUM STAFF

IMPORTANCE OF URBAN STREAMS

Urban streams are important because of the environmental services they provide, such as water supply, waste assimilation, flood attenuation, greenspace for public enjoyment, and wildlife habitat. For some people, urban streams are the only natural environments they regularly see and enjoy. Urban stream corridors provide opportunities for observing nature in the place people work and live. Individualized experiences with nature help to generate a sense of appreciation for the natural environment amongst citizenry.

Urban stream corridors also represent some of the last relics of wildlife habitat within highly urbanized areas. The wildlife habitat value of streams is provided by the mixture of habitat and food supply that supports both aquatic and terrestrial organisms. The variability of habitat types found within healthy stream systems, including fast-flowing riffles, deep pools, cool water, rocks, snags, and overhanging vegetation, can support a diverse assemblage of species. However, this habitat variation and the availability of suitable habitats can be lost quickly in streams subject to urban impacts, which may scour streambeds and undercut streambanks.

Furthermore, research has shown that small streams remove more nutrients, such as nitrogen, from water than do their larger counterparts. In fact, the smaller the stream, the more quickly nitrogen can be removed and the less distance it will be transported down the stream.[1] Scientists have reported that humans have more than doubled the amount of nitrogen available to systems on Earth over the past century. Nitrogen knocks streams out of balance causing algal blooms and depleted oxygen supply. High levels of nitrogen have cause dead zones off the coast where large rivers, such as the Mississippi, divulge of run-off from land activities.[2] Thus, restoration activities along small streams have larger benefits than what might be immediately inferred.[3]

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[1] Peterson, B.J., W. Wolheim, P.J. Mulholland, I.R. Webster, J.L. Meyer, J.L. Tank, N.B. Grimm, W.B. Bowden, H.M. Vallet, A.E. Hershey, W.B, McDowell, W.K, Dodds, S.K. Hamilton, S. Gregory and D.J. Morrall. 2001. Stream Processes alter the amount and form of Nitrogen exported from small watersheds. Science 292: 86-90.
[2] Mayell, H. 2001, May 4. Streams Reduce Nitrogen Pollution, Scientists Find**.** *National Geographic News* [online]. http://news.nationalgeographic.com/news/2001/05/0504_smallstreams.html.
[3] Peterson, B.J et al. 2001.

PROBLEMS AND IMPACTS ALONG DEGRADED STREAMS

One of the first steps in stream restoration is to identify the source of impairment. Many human-induced disturbances are likely along urban streams. In order to complete a successful and sustainable stream restoration, it may be necessary to address several different impacts.

At first glance, the most noticeable impacts may be illegal dumping of residential or commercial waste. There are many environmental problems associated with illegal dumping such as erosion, leachate, and habitat loss. Perhaps the most important in urban settings is the loss of aesthetics and visual appeal to the public. Illegal dumps take away from the natural beauty of community streams and leave citizens with little motivation to maintain those streams on a daily basis. This can lead to a spiraling negative feedback that is difficult to overcome. The nation's streams are now emerging from a longstanding history of being receptacles for society's trash. Stricter laws such as the Clean Water Act and stricter local codes have reduced the amount of dumping occurring along streams, but the remnants of past offenses have resulted in the growing science of ecological restoration.

Many environmental problems associated with illegal dumping are worth addressing. Streambank vegetation loss is significant because it makes streambanks more susceptible to erosion and reduces cover, food sources, and habitat for wildlife. Streamside vegetation is also important because it maintains cool water temperatures by shading. [4] Vegetation can be lost due to intentional removal or due to degradation from human use. Dumping along streams can reduce streamside vegetation area and quality. Furthermore, vegetation can be reduced due to trampling from humans in frequently used dump sites or frequently visited streamside sites. Loss of streambank and streamside vegetation is the greatest contributing factor to accelerated erosion on small and medium-sized streams. [5]

Chemicals from the trash and debris in illegal dumps can leach out and contaminate rivers and streams. Mixtures of chemicals and debris make illegal dumps a fire risk, because people may set them on fire and because they can spontaneously combust when heated by the sun. Burning can further release the harmful chemicals associated with these sites into the atmosphere. Illegal dumps and their associated chemicals are harmful to wildlife which may consume the harmful chemicals or become trapped among the debris. Furthermore, chemicals may seep into groundwater supplies and contaminate private wells.[6]

Channel constrictions caused by rocks, old tires, cars, oil drums, shopping carts, logs and other debris can cause erosion up and downstream. These constrictions deflect flows off banks, over topping the capacity of the stream, and causing bank erosion. An organized removal of debris obstructions can be a useful community initiative that maintains the capacity of stream channels to carry heavy storm flows and reduce the risk of flooding. [7]

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[4] Georgia Soil and Water Conservation Commission. 1994. "A Few Comments About Streams," *Guidelines for Streambank Restoration.*

[5] Georgia Soil and Water Conservation Commission. 1994. "Streambank Erosion Processes and Types."

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[7] Georgia Soil and Water Conservation Commission. "Streambank Erosion Processes and Types," *Guidelines for Streambank Restoration.* (1994).

Furthermore, dumping and debris buildup at culverts and road crossings can block fish package along stream segments. Research has shown that reduced fish passage through culverts and road crossings leads to reduced genetic diversity and fitness among fish populations.[8,9,10]

Urbanization in general has affected streams considerably. Research has shown that urban watersheds have very different characteristics from streams in forested, rural, or even agricultural watersheds. The main reason for these differences is the amount of impervious surface within the watershed, which also serves as an indicator of the level of impairment. In many studies, total impervious cover in the watershed of more than 10% has been linked to degradation of streams.[11] Impervious cover affects streams by increasing the volume and velocity of storm water runoff. High storm water volumes degrade streams by increasing stream flows and accelerating the natural erosion of stream banks. Most urban and suburban stream channels have become deeper and wider than their natural counterparts. This problem has been exacerbated by streamside vegetation loss, which helps to control bank erosion. [12] Furthermore, increased run off across the land flushes contaminants and sediments into streams. The hydrology of the overall system can be impacted by impervious surface because less rainfall infiltrates into the soil to recharge groundwater, meaning reduced baseflows during droughts in streams with groundwater connections.[13] Changes in flow patterns often pose a challenge to the sustainability of restoration projects because newly planted vegetation and bank stabilization can take years to become fully established. Streams offering a level of control and reduced risk of high flows, such as provided by upstream dams, may offer better opportunities for stream restoration.

DEVELOPING A STREAM RESTORATION PLAN

Appropriate activities for stream restoration are usually site and goal specific. The expectation of restoration is not to return the stream to a pristine or original condition, but rather to a state of self sustaining stream functions. With this in mind, the first step in developing a restoration strategy is to assess the severity of the problem and to develop goals for the project. According to *Stream Corridor Restoration: Principles, Processes, and Practices*, a guidebook produced in 1998 by the United States Department of Agriculture in coordination with several other federal agencies, "One of the most common mistakes made in planning restorations is the failure to characterize the nature of the problems to be solved and when, where, and exactly how they affect the stream corridor." For example, identifying whether an eroding bank needs to be repaired or just protected from additional erosion depends on the type, extent, severity, and location of the erosion. Erosion is a natural process and evaluating the severity of streambank erosion is a subjective task. Some streambank erosion is expected and may not need to be addressed, while erosion that threatens structures, valuable land, wildlife habitat, or that is highly visible may be cause for concern.

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[8] Schaefer, J. F., E. Marsh-Matthews, D. E. Spooner, K. B. Gido, and W. J. Matthews. 2003. Effects of barriers and thermal refugia on local movement of the threatened leopard darter, Percina pantherina. *Environmental Biology of Fishes* 66: 391-400.

[9] Warren, M. L., and M. G. Pardew. 1998. Road crossings as barriers to small-stream fish movement. *Transactions of the American Fisheries Society* 127: 637-644.

[10] Norman, J.R. 2006. Effects of Road-Stream Crossings on Stream Geomorphology and the Movement of Small Bodied Fishes in the Etowah River Basin, USA. *Unpublished.*

[11] Schueler, T. 1995. The importance of imperviousness. *Watershed Protection Techniquies* 1(3):100-11.

[12] Georgia Soil and Water Conservation Commission. 1994 "A Few Comments About Streams."

[13] Simmons, D. and R. Reynolds. 1982. Effects of urbanization on baseflow of selected south shore streams, Long Island, NY. *Water resources bulletin* 18(5) 797-805.

Organizing Restoration Planning

The USDA guidebook on Stream Restoration identifies the first step in restoration planning as "Getting Organized." "Getting organized" consists of setting boundaries for the project. At what geographic scale is the project focused? Factors that should go into this decision are technical assessments, ecological processes and establishing a sense of place for community involvement.

Other components of the initial organization process include forming advisory and technical groups. The size and extent of these groups may vary, but are essential to the project. Advisory groups should consist of experts, as well as, local citizens and groups who are interested stakeholders and who may be impacted by the restoration project. Technical committees should represent the interdisciplinary aspects of stream restoration. Specialists from a variety of disciplines are needed to provide input on scientific, social, political, and economic issues involved in the effort. Certainly, ACC can expect cooperation from UGA faculty in providing technical expertise. Several of the local watershed groups have also developed expertise in stream restoration. Depending on the complexity of parties involved and the levels of participation, it may be beneficial to establish a decision structure.

Public Involvement and dissemination of information related to the status of the project should occur throughout the project. Public buy-in is essential for the overall success of the project. Public buy-in in the beginning will facilitate a sense of public ownership of the stream and a desire amongst citizens to maintain the stream in the long-term. Furthermore, restoration efforts provide an excellent educational opportunity for the entire community.

The City of Philadelphia Water Department has developed partnerships to combat dumping along streams and provides an interesting case study on one government's approach to restoring and cleaning-up streams.

A Case Study in "Protecting and Enhancing Urban Streams"

The Philadelphia Water Department has undertaken a unique partnership with the local park commission, Fairmount Park Commission, to improve the environmental quality of the City's streams and parks. Together, they have initiated the Waterways Restoration Team (WRT), a crew dedicated to the removal of large trash from the 100 miles of stream found within the City. The WRT also undertakes works to restore eroded streambanks and streambeds. The goal of the partnership is to maximize resources and the positive impacts for the community that come from having healthy environmental resources, such as clean streams and ecologically healthy parks.

The WRT Crew is comprised of Water Department staff, Park Commission staff, and volunteers from various Friends of the Parks groups. Furthermore, the WRT contains group leaders, heavy equipment operators (pulled from the Sewer Maintenance Department), Equipment Operators 1s, and semi-skilled laborers. The team works Monday thru Friday on special request from citizens, public officials, partners and other work orders. Volunteer clean ups are often scheduled on Saturdays. [14]

During the first month of operation, the WRT pulled approximately 14.6 tons of debris from several streams within the City. The partnership and operations have continued to strengthen and have resulted in over 100 tons of debris being removed from Philadelphia's waterways since inception in

[14] Philidelphia Water Department. Waterways Restoration Team Operational Procedures. July, 2004. www.phillywater.org/wrt.html.

July of 2003. In addition to the phenomenal amounts of trash being removed, the WRT has undertaken numerous stream and infrastructure restoration projects, some designed to eliminate scour pools and attenuate storm flows in an effort to address the deleterious effects on aquatic life.[15] This successful partnership provides a model to aid municipalities in the development of proactive programs to address the rehabilitation of degraded streams.

Georgia's Rivers Alive

Rivers Alive provides an opportunity for tremendous community involvement in stream clean-ups. Rivers Alive is Georgia's annual volunteer waterway cleanup event that targets all waterways in the State including streams, rivers, lakes, beaches, and wetlands. Rivers Alive is held annually each October and is sponsored by the Georgia Department of Natural Resources Environmental Protection Division's Georgia Adopt-A-Stream Program and the Georgia Department of Community Affairs' Keep Georgia Beautiful Program, in cooperation with Help the Hooch. In 2006, Rivers Alive partnered with over 144 groups and involved 25,020 participants to remove 10,707 bags of garbage, weighing over 708,322 lbs (58 dump trucks), from 2,395 stream miles in Georgia.[16] In September of 2006, Rivers Alive held clean ups on portions of the North Oconee River, Trail Creek, and Lake Chapman. This effort was a partnership between Athens-Clarke County Beautiful, ACC Public Utilities, ACC Leisure Service Natural Resources Division, ACC Transportation and Public Works, and Georgia Outdoor Recreation Program.[17] A similar partnership may be effective at targeting clean-ups at illegal dump sites.

Rivers Alive provides communities with the capacity and tools to make scheduling and recruiting volunteers for clean-ups a breeze. They have created a manual on how to organize a clean-up and provide registration forms online at www.riversalive.org/Registration.htm for registering and advertising your local clean-up as part of their statewide program.[18]

Defining Project Goals

Data collection, analysis, and an understanding of the factors influencing the project area are essential to correctly characterize the problem and solution. Data collection and analysis may be undertaken by the technical committee and should consist of review of baseline data, historical data, social, cultural, and economic data, and reference condition data, in order to identify the source of impairment and feasible project goals. Scoping may prioritize the important data and determine those data that are critical to decision making. Most important in the collection process is the information needed to characterize the stream processes.

Developing a restoration plan also includes developing concise statements on the impetus for the restoration project, similar to a mission statement. These should include a description of the impaired stream corridor conditions in measurable terms and a description of the proper function of the impaired stream and the desired condition of the stream. These statements serve as common ground and a basis from which other restoration objectives can be explored. It is important to remember

[15] Butler, Lance H. *Fish Tales #11: PWD's Waterways Restoration Team 'Protecting and Enhancing Our Urban Ecosystems.'* Waterways Restoration Team Website. www.phillywater.org/wrt/Default.htm. Updated: August, 2004.
[16] Rivers Alive. "River Alive Results" at http://www.riversalive.com/ra_results.htm. Accessed 4/5/07.
[17] Rivers Alive. "Clean-ups" at http://www.riversalive.com/ra_cleanups06.htm. Accessed 4/5/07.
[18] Rivers Alive. 2006, Spring. *How to Organize a Waterway Cleanup Resource Guide.* http://riversalive.com/cleanupguide06.doc.

that the original, pristine state of the stream may not be the most reasonable or feasible expectation for the final outcome of the restoration.

Funding

Funding sources may also influence the restoration planning process and therefore should be identified early. Stream restoration can have many outcomes. The goal of a stream restoration can be flexible to fit the visionary goals of stakeholders. Some restoration projects may focus on creating a sense of community in an urban area, while others may aim at water quality values or wildlife habitat. The source of funding may come in to play in determining the end goal for the project. Funding coming from state and federal sources may have restrictions as to what the money can be used for, such as replacement of certain impacted stream functions or water quality improvement. Philanthropic organizations, local governments, and citizens may have more community based objectives. [19] The River Basin Center is compiling a guide to funding sources for addressing storm water issues that will be available in late summer of this year. This may provide a good starting point for identifying funding sources for stream restoration efforts.

Cost and Ease of Implementation

The cost of restoring a stream is dependent on the type of restoration being performed and the severity of the problems being addressed. One of the easiest and most inexpensive means to begin addressing stream restoration is stream clean-ups. Community involvement can make these efforts especially inexpensive. In some cases, removal of large trash, such as cars, shopping carts and other dumped debris, may be all that is needed to allow natural stream processes to recover beneficial stream functions.

Restoration Techniques

Some erosion problems may require active restoration to return the stream to a self-sustaining state. Live staking, joint planting, and conventional vegetation replacement are some of the cheapest ways to address erosion, but they are only suitable in certain situations and may not be sufficient to stabilize all erosional problems. Live stakes are living, woody plant cuttings capable of rooting with relative ease. They are intended to root and grow into mature shrubs that will stabilize soils and restore riparian zones. A few examples of vegetation suitable for this approach are willow, hawthorn, viburnum, and dogwood. Live stakes are placed at random and should be installed in densities of 2 to 4 cuttings per square yard.

Joint planting also involves planting woody plant cuttings, but instead, these stakes are planted within previously installed conventional riprap rock bank, rock systems, or rocks loosely dumped or hand placed in the soil, no thicker than 2 feet. The rocks control deposition and may result in a more natural look and function over time.

Other streambank restoration methods known as brushmattresses and branchpacking often provide the most environmental benefits among streambank protection measures. However, the relative cost of these activities is moderate and the installation can be moderate to complex in comparison to other methods. Still, they provide advantages over other more technical and costly systems.

The brushmattress system uses a combination of living elements such as live stakes, live fascines (bundles of live cut branches) and a mattress branch cover (long flexible branches placed against the

[19] Federal Interagency Stream Restoration Working Group. 1998. "Getting Organized."

bank surface). One disadvantage of these systems is the large amount of live material that they require. However, they are superior systems in their ability to capture sediments during flooding and ability to rapidly produce wildlife habitat value.

Branchpaking is the process of installing alternating layers of live branches and soil stabilized by poles or timbers installed vertically where streambanks have eroded. Branchpacking is one of the most effective and inexpensive methods for repairing localized washouts along small stream sites.[20]

RESTORATION MANAGEMENT

Long-term monitoring and management is an important part of stream restoration. Monitoring is needed for several reasons. The primary reason is to assure that the restoration measures are leading to the desired outcomes. Because restoration projects rely on natural processes to ultimately return the stream to a sustainable state, attainment of the final condition may happen slowly overtime. Therefore, it is necessary that monitoring be conducted to assure that the restoration measures are leading toward the desired condition and that the desired stream functions are emerging. Monitoring plans should be based on predetermined criteria, such as understory cover and diversity, and should be established during the initial planning.[21] The National Research Council recommends that physical, hydrological, and ecological parameters are included in stream restoration monitoring.[22] Restoration assessments on an annual basis may be sufficient to identify problems and monitoring should include systematic reporting and written documentation.

Monitoring is also needed to assure that impacts have not interfered or reversed the recovery process. Impacts may be unpredictable, natural phenomena, such as floods, fire, or hurricanes. Anthropogenic impacts such as continued dumping at the site should also be a concern.

It may be necessary to actively manage for these impacts. Restoration management plans should include efforts to reduce the frequency of controllable impacts and to lessen the severity of uncontrollable impacts. In the case of impervious surface and storm water, best management practices can be installed upstream to assure the success at the downstream restoration site. Likewise, restoration sites that are subject to frequent illegal dumping may be maintained by enacting community campaigns against dumping as discussed below.

Finally, some unexpected problems may arise following restoration that require adjustments to the original management plan. This characteristic of restoration makes it an excellent practice for adaptive management. Adaptive management involves the development of different hypotheses during the planning process, in order to anticipate potential problems that could arise and to provide mechanisms and flexibility within the management plan to proactively addressing those problems.[23]

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[20] Georgia Soil and Water Conservation Commission. "Protecting Streambanks Against Erosion," *Guidelines for Streambank Restoration.* (1994).

[21] Federal Interagency Stream Restoration Working Group. 1998. "Restoration Monitoring, Evaluation, and Adaptive Management."

[22] National Research Council. 1992. as quoted in Federal Interagency Stream Restoration Working Group. 1998.

[23] Federal Interagency Stream Restoration Working Group. 1998. "Restoration Monitoring, Evaluation, and Adaptive Management."

Combating Illegal Dumping

Dumping is a difficult offense to manage because illegal dumpers are rarely caught and prosecuted. Initiatives to combat illegal dumping through outreach that encourages people not to dump illegally and to report illegal dumping when they see it, may be the most effective approaches. These campaigns can include a variety of approaches, such as paid mass media campaigns or more affordable grassroots approaches. Region 5 of the Environmental Protection Agency has established the Illegal Dumping Prevention Project to exchange information and establish partnerships to develop and implement strategies to combat illegal dumping. Information about this effort can be found online at http://www.epa.gov/region5/illegaldumping/. Successful restoration is community based, and as such, campaigns to combat dumping should also engage community members and collaboration between many groups.[24]

[24] Iowa Department of Natural Resources and Keep Iowa Beautiful. 2006. Take a Stand for Your Land: A Community Guide to Combat Illegal Dumping. www.iowadnr.com/waste/sw/files/cguide.pdf.