Title of Proposal: Post-restoration Evaluation of Urban Streams in Central Texas

Statement of Critical Regional Water Problem:

The city of Austin is an example of the many cities recently applying geomorphological methods to restore degraded urban streams (Kondolf et al. 2002). Few studies have investigated what occurs post-restoration, however (Kondolf and Micheli 1995), and whether these urban streams are able to return to a healthier state. The proposed research will address the effects of restoration on stream reaches in urban tributaries of the Colorado River in Austin, Texas. This research is significant because it will be the first comprehensive analysis of restoration efforts on urban streams in Texas, and one of the few in the United States. Results of this research will improve knowledge of stream adjustments to restoration practices. As urbanization continues at a rapid rate in Texas and elsewhere, results of this study will also provide guidance for future urban stream restoration projects. Successful restoration of urban streams will mitigate flood hazards in populated communities as well as enhance aquatic habitats toward healthy and sustainable river systems.

Nature, Scope, and Objectives of the Research

Introduction

Urbanization has altered river channels everywhere. Over the past few decades, research has addressed the causes, appearance, duration, and location of these changes (Chin and Gregory 2005), and application of this knowledge to stream management has increased (Riley 1998). Kondolf et al. (2002) noted that geomorphology is increasingly used as a management tool because geomorphology provides the basis for ecological processes, water quality, and movement of floodwaters. This is also true in Texas, where cities like Austin have restored many stream reaches using principles of fluvial geomorphology (City of Austin 1995a). Restoration of urban streams will likely become increasingly important in Texas because populations are predicted to double over the next 50 years, and many cities, including Austin (City of Austin 1995b), have already encountered negative environmental effects of population growth. In 1995, Austin had identified 947 cases of localized erosion, with 160 stream reaches classified as unstable (City of Austin 1995a). Although nearly 30 of these stream reaches have been restored, they have not been evaluated to determine the extent to which channel conditions may have improved. Post-project evaluations (e.g. Purcell et al. 2002) are valuable tools for adaptive resource management by providing feedback to increase cost-effectiveness and to improve current and future projects (Kondolf et al. 2002). These evaluations should assess a range of morphological variables in order to identify differences that may exist between urban and rural streams, as well as between restored and unrestored conditions (Pizzuto et al. 2000). Despite the benefits of post-project evaluations, few have been administered, thus limiting our knowledge of stream restoration effectiveness (Kondolf and Micheli 1995).

Objective

The objective of the proposed research is to determine the effectiveness of stream restoration efforts in the city of Austin, Texas, by quantifying geomorphic differences between urban-restored, urban-unrestored, and rural watersheds. The working hypothesis is that urban streams will be wider, straighter, and coarser (contain larger sediments) than rural streams

because higher flows from urban watersheds are expected to erode channel banks and remove fine sediments. Because restoration is expected to stabilize stream banks, restored urban streams are hypothesized to be more similar to rural streams. They will likely not be identical to rural streams, however, because the restored reaches are expected to have adjusted to the higher flows from the urban watersheds, and they should accommodate the force of these flows.

Methods

The general approach in this study will be to select six restored urban stream reaches in the Lower Colorado River watershed near Austin, Texas. These will be compared to six comparable un-restored urban stream reaches, and both will be analyzed against a reference standard non-urban or rural stream reaches. Therefore, six groups of stream reaches will be selected based on drainage basin size (ranging from 10 to 80 km^2) and slope, with each group containing a restored urban stream, an unrestored urban stream, and a rural stream for reference (Kondolf et al. 2002).

An urban stream will be defined as a stream with at least 20% of the watershed developed, based on the urban stream classification model by Schueler (2000). The unrestored urban and rural stream reaches will be selected using topographic maps, aerial photographs, and digital elevation models, and then field checked to ensure similarity to the restored reached. The length of the restored portion in a particular group will determine the reach length in each stream.

The following variables will be measured in each stream reach and compared using a non-parametric statistical test, such as the Mann-Whitney test: width, depth, cross-sectional area, velocity, sinuosity, and average grain size. These data provide the information needed to calculate important process-related parameters including Shield's dimensionless shear stress, Manning's roughness coefficient, and bankfull discharge. Comparing stream variables and parameters will allow us to determine how streams react to flows in different settings (urban vs. rural) and reveal how they may have changed after restoration. Channel morphological data will be obtained with a total station and tape. A Marsh-McBirney meter and top-setting rod will provide flow data. The Wolman method, using a caliper, will give measurements of gravel to determine grain size distributions. Sinuosity will be determined by measuring the channel length using a tape and reach length using GPS (Pizzuto et al. 2000). Historical channel changes will be further analyzed using aerial photographs to give a context to current conditions.

Results Expected from this Project

The proposed research is expected to identify differences between restored and un-restored urban stream reaches in Austin, as well as between these and the reference rural reaches. Urban streams are expected to be wider and less sinuous than rural streams, with a coarser sediment matrix reflecting higher flow regimes. Restored reaches are expected to approximate those of rural streams, but may fall in between because channels altered by urbanization will likely not return to pre-urban conditions. Significant differences between the restored and unrestored urban streams should indicate which variables restoration has corrected or needs to correct. This knowledge would allow managers in Austin and elsewhere to improve current and

future stream restoration projects. Successful restoration of urban streams would also improve aquatic habitats and mitigate flooding hazards in populated communities.

Literature Cited

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