TANYARD BRANCH: DEMONSTRATING AN INTERDISCIPLINARY APPROACH TO THE DESIGN PHASE OF AN URBAN STREAM RESTORATION

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Abstract. An interdisciplinary group of university students, faculty and staff participating in a summer design studio took on the challenge of designing a restoration proposal for Tanyard Branch, a severely degraded stream that flows through the University of Georgia (UGA) campus. The main problems targeted for restoration in this urban stream were channel erosion and instability, caused by a predominance of impervious surface in the watershed, and poor water quality (particularly fecal coliform contamination) that has prompted health concerns for students who monitor the stream. Data were collected pertaining to utilities, soils, hydrology, geomorphology, county stormwater plans, and the university master plan. A hydrologic model was used to predict water surface profiles for design storms and determine appropriate floodplain width for the design of a new channel. As a product of the studio, students presented two detailed design options for a highly impacted reach of the stream in the middle of campus with conceptual designs for the larger stream network. The detailed designs show two options for this reach of stream: one with a formalized riparian zone including a designated walk to be used in pre-game football ceremonies, and one option with a less formalized park atmosphere surrounding the stream. In the subsequent academic year, classes concerned with ecological and hydrological monitoring, as well as stormwater modeling, landscape management and urban design are continuing work on this stream restoration.

BACKGROUND

Urban streams deserve the attention of researchers and community members for a number of reasons. Impervious surfaces in urban watersheds cause severe hydrologic and geomorphic changes to streams, creating unstable channels and degrading instream habitat (Schueler 1994). Incised urban streams can not access their floodplains, which would slow and store floodwaters reducing erosive power within the channel. Surface water runoff and stormwater inputs piped directly to streams result in an influx of contaminants causing poor water quality (see review in Paul and Meyer 2001).

Restoration of urban streams is particularly challenging due to the many constraints associated with highly developed watersheds. Oftentimes, utilities need to be relocated, parking lots torn up, and the cooperation of many diverse stakeholders is necessary (e.g. Rocky Branch restoration at North Carolina State University).

Urban stream restoration on university campuses creates an opportunity to bring faculty, students, and the community together to improve their environment and perform a service. University communities are starting to undertake stream restorations across the United States (e.g. Strawberry Creek at University of California – Berkeley, Charbonneau and Resh 1992; Rocky Branch at North Carolina State University, Villanova University, and University of Virginia). National Wildlife Federation's Campus Ecology program encourages these types of projects and is helping to transform college campuses into living models of an ecologically sustainable society, and training a new generation of environmental leaders at college campuses (NWF).

STREAM DESCRIPTION

Tanyard Branch bisects the UGA campus and is listed on Georgia's 303(d) List of Impaired Waters for failure to meet its designated use of fishing as a result of its violation of the fecal coliform standards (Georgia EPD 2001a). Seventy-five percent of 45 samples taken over a three-year period by (2001b)

undergraduate classes and interest groups exceeded Georgia EPD (2001b) water quality standards for total coliforms (Meyer 2002, UOWN 2002, Rasmussen 2002). *Escherichia coli* (*E. coli*), which is a better indicator for freshwater recreation because it provides direct evidence of fecal contamination by warm-blooded animals, also exceeded USEPA recommended levels in 95% of 38 samples over a two-year period (Figure 1). Macroinvertebrate sampling of the stream for the last several years indicates very poor water quality with only a few tolerant organisms such as oligochaetes and chironomids present in most samples (Meyer 2002). Turbidity ranged from 2 to 220 NTU and often exceeded the USEPA recommended levels of 25 NTU, while conductivity ranged from 3 to 1,150 S/cm, exceeding its recommended levels over a three year time period (Meyer 2002, Rasmussen 2002).

Tanyard Branch drains a 2.02 square kilometer watershed that is covered with 74% impervious surfaces with 50% of the stream length piped. The stream is an eyesore and a health hazard. Student groups and undergraduate and graduate classes in hydrology, ecology, and engineering use the stream as an outdoor laboratory and monitor the stream for water quality. One student group, S.E.E.D.S. (Students and Educators for Ecological Design and Sustainability), whose members include both undergraduate and graduate students and faculty from Ecology and Environmental Design, have been monitoring the stream and saw the potential to rehabilitate the stream and incorporate it back into the campus and community environment.

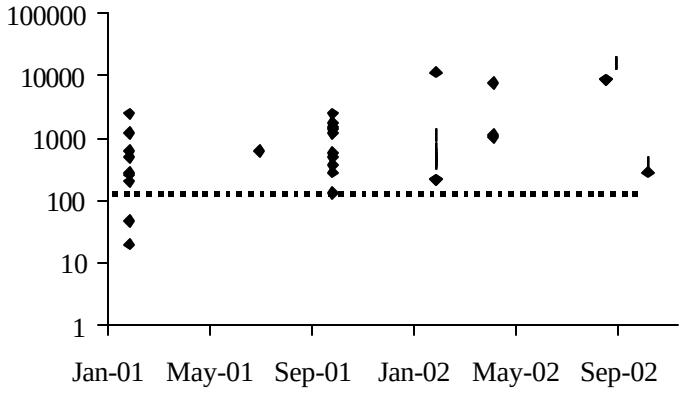

Figure 1. *Escherichia coli* levels (most probable number per 100 ml) from August 1999 to November 2002 in Tanyard Branch and (‐ ‐ ‐) is the USEPA recommended level of 125 *E. coli* /100 ml.

OBJECTIVES

S.E.E.D.S. saw the opportunity to change Tanyard Branch from a liability to an amenity, a goal that is aligned with the guiding principles of the UGA master plan, which includes "protect and enhance natural resources" (University of Georgia 2002). Support for the restoration project was obtained from University administration, and S.E.E.D.S. designed and planned a summer studio design course to address the following objectives: 1) develop a plan to transform Tanyard Branch into a clean and stable water resource that offers recreational and educational opportunities; 2) propose ways to incorporate the stream into the UGA campus master plan; 3) identify sources that contribute to the degradation of the stream and offer solutions; 4) educate the community on the current problems with the stream and how further degradation can be prevented.

RESTORATION COURSE & DESIGN PROPOSAL

During the summer of 2002, students, faculty, and university staff from ecology, environmental design, engineering, biology, geography, and campus planning worked on a restoration proposal for Tanyard Branch. The ultimate goal was to produce a focused, detailed design on a reach of stream through central campus with a conceptual design for the larger watershed.

The class visited the Stream Restoration Institute at North Carolina State University (NCSU SRI) to attend lectures by stream restoration practitioners and observe in-progress restoration sites including Rocky Branch. Rocky Branch is a stream on the NCSU campus that is similar to Tanyard because it runs through the middle of main campus and is subject to numerous urban obstacles such as utility lines, existing parking lots, and the interests of many diverse stakeholders.

The class returned to UGA and began the inventory and data collection phase. In this phase, committees conducted research on stormwater management, greenway design, education and monitoring, historical perspectives, watershed assessment, and hydrologic and geomorphic reference conditions. Groups of students from different backgrounds gathered information on historical conditions of the watershed and how Tanyard became so impaired. Maps and aerial photographs from as early as 1874 show modifications of the stream channel and watershed, including relocation of the channel prior to 1924 for construction of the UGA baseball stadium. The

watershed assessment group performed a stream channel survey including a longitudinal profile and cross-sections. Comparison of historical maps and photographs with current survey data show that the existing channel is not in its historical location, rather it is located 30 m south of where the historical channel was, which is now a central campus parking lot.

Current watershed conditions were assessed with a 1993 United States Geological Survey (USGS) digital orthophotograph quarter-quadrangle for Clarke County (Georgia GIS Data Clearinghouse). Watershed boundaries were delineated and land cover types were classified into impervious cover (pavement, concrete, and roof surfaces) and forest cover using GIS software. The university master plan was used to overlay existing and proposed buildings, roads, and open space in the watershed.

Public education and support is essential to the success of an urban stream restoration. A system of signs was proposed by the education and monitoring committee to explain reasons for stream restoration, how it works, and the stages of restoration. The greenway design committee devised ways to connect a Tanyard greenway corridor to existing greenways, major pedestrian routes, and urban centers in the city of Athens.

Geomorphic reference conditions were obtained for North Carolina Piedmont streams from NCSU SRI and used with permission to approximate meander wavelength and sinuousity appropriate for a new channel. Identification of a local reference stream will be necessary to refine these approximations for a final restoration design. A list of common native riparian plant species in the Georgia Piedmont was compiled.

Stormwater and water quantity issues are causing severe erosion and water quality problems in Tanyard. High amounts of impervious surfaces in the watershed lead to high, flashy flows in the stream. The city of Athens is planning major modifications to the stormwater system in the Tanyard watershed, and since stormwater is a major determinant of the health of this stream, the class targeted areas for infiltration of rain water and stormwater wherever possible.

We used HEC-RAS, (Hydrologic Engineering Center - River Analysis System), a hydrologic model developed by the U.S. Army Corps of Engineers to predict water surface profiles based on water discharges at the 2-yr and 100-yr recurrence interval floods (Giaquinto). We calculated these discharges by using a USGS rainfall-runoff regression model, which was calibrated for urban streams in Georgia, and is based on drainage area and percent impervious

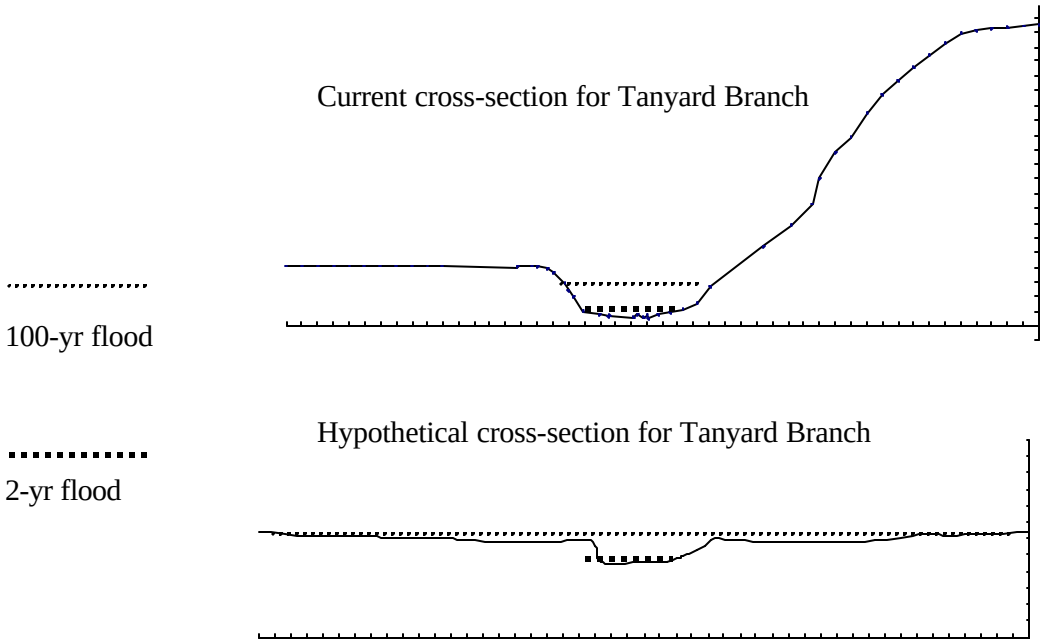

Figure 2. Comparison of current cross-section morphology in Tanyard Branch to morphology of a restored cross-section. The restored design includes a 2-year bankfull channel and a 100-year floodplain. Indicated flood stages were modeled using HEC-RAS. Cross-sections are presented in the same scale with no vertical exaggeration; each tick mark represents 1 m. The restored channel will be located 30-m north of the current channel location.

Georgia, and is based on drainage area and percent impervious surfaces (Inman 1995). Input parameters to HEC-RAS include cross-section survey data, sinuous thalweg slope, and Manning's *n* roughness coefficient for channel and floodplain. Cross-section data were hypothetical, but based on a Georgia Piedmont stream of similar watershed size, and adjusted so that we could account for a larger floodplain.

Using the modeling results, reference stream data, historical analyses, and geographic evidence, a new channel was designed (Figure 2). The class decided that there was a very low potential of being able to restore the channel in its present location because of a steep bluff on the south bank, and a deeply incised channel. The designs reflect a consensus that restoring Tanyard Branch would require constructing a new channel that approximates the stream's historic location.

At the end of the inventory phase, individual committees gave presentations summarizing their findings. In the first design phase, the class divided up into three design teams. Each team used the information gathered by committees to sketch the new channel, modify the master plan where acceptable, and formulate ideas for the channel and watershed. Teams worked closely with the University Architect's office during this time and presented their design ideas to representatives from the scientific community and landscape design faculty for feedback. Common themes in the three designs were to modify the buildings closest to the stream to try to minimize runoff by implementing ideas such as green roofs and cisterns to collect rainwater. These can be seen in Figure 3 in the proposed eco-dorm, education center, and parking deck along the north branch of Tanyard. Through the inclusion of a "football walk" near the stream, the class acknowledged the importance of football to the UGA community while still raising awareness of the stream and natural features on campus.

The best ideas from the three original design proposals were combined in the second design phase. The detailed designs developed in this phase show two options for the stream: one with a more formalized riparian zone including a designated walk to be used in pre-game football ceremonies, and one option with a less formalized park atmosphere where the stream is a destination (Figure 3) (CED 2002). Final presentations were given to representatives from the city and university newspapers, the scientific community, landscape design practitioners and faculty, and UGA administration. Our work was compiled into a report and publicized to generate support for the project.

FUTURE DIRECTIONS

In the subsequent academic year, classes concerned with ecological and hydrological monitoring, stormwater modeling, an economic analysis, and landscape management and urban design are continuing work on this proposed stream restoration. S.E.E.D.S. will continue to work with UGA and Athens–Clarke County to address impending stormwater modifications. Funding sources will be sought once University support and approval is secured for this project.

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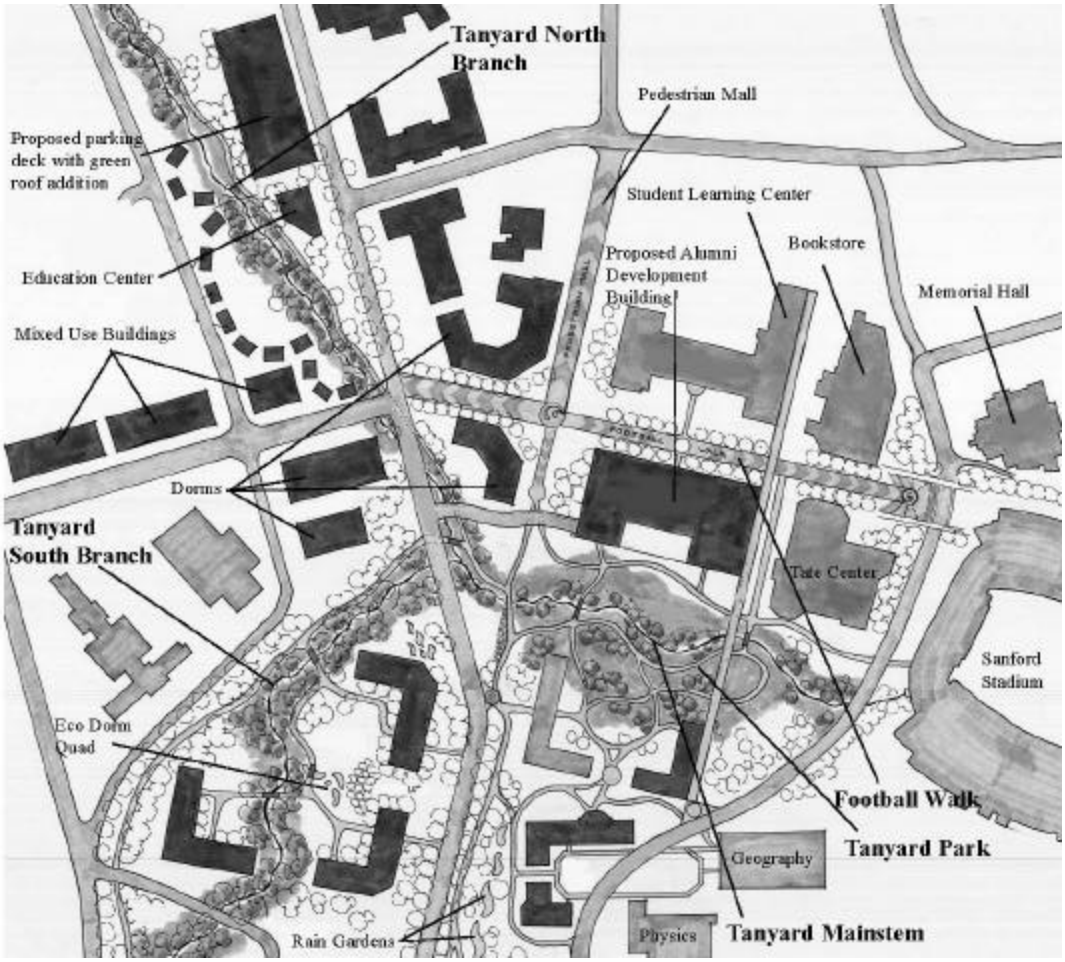

Figure 3. Final conceptual design of Tanyard Branch through the University of Georgia campus.

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