Contributions of watercourse-associated greenways to green infrastructure: a comparison between two case studies in Arizona and Maryland, USA.

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Introduction

Greenways have historically played a significant role in the development of green infrastructure design and planning. As one of the many components of greenways, vegetated buffers along urban and suburban watercourses are typically well-suited for recreational uses such as biking, walking trails and wildlife-viewing. However, development pressures in cities and suburban environments can lead to fragmented and redirected watercourses to accommodate other land uses. In some cases, unplanned access increases erosion and loss of vegetation and potential wildlife habitat in these areas. It is critical for future conservation of these natural and restored areas that appropriate access be explored. This paper presents two case studies of watercourse-associated greenway development in two distinctly different regions, arid and temperate, and compares the approaches and contributions to green infrastructure in their respective regions.

Background

Study areas

Case study one: secondary watercourses in Tucson, AZ

The city of Tucson, AZ is located at the northeastern boundary of the Sonoran Desert, which reaches from southeastern California to southwestern Arizona, and south to the state of Sonora, Mexico. This study evaluated the suitability of trail development along smaller, secondary watercourses located throughout Tucson. These semi-natural spaces have become more valuable to city residents for a variety of recreational and urban wildlife uses (Rohde and Kindle, 1994). In addition, they are very accessible to urban dwellers and can effectively highlight some of the biological context of the region. It has been suggested that daily exposure to these types of areas can potentially aid in informing people about their role in conservation of nature (Noss, 2004). Pima County Parks and Recreation (PCPR) officials are responsible for planning buffer areas along many of these watercourses, and partnered with University of Arizona faculty and graduate students to investigate feasibility of future access points and trails along these areas. The study area was composed of thirteen secondary watercourses within Tucson's urban core, each with a water capacity greater than 2,000 cfs and less than 10,000 cfs. These corridors feed into three major watercourses surrounding central Tucson.

Case study two: greenway along the Patuxent River, Prince George's County, MD

Prince George's County, MD, is located in the upper coastal plain physiographic province. This case study research documents the process and products of a service learning studio. The Patuxent River Greenway is a proposed greenway in Prince George's County, MD which will eventually link high ecologically-valuable properties principally owned by the Maryland-National Capital Park & Planning Commission (MNCPPC). The proposed Patuxent River Greenway offers an opportunity to protect vegetation and potential wildlife habitat in these areas while providing appropriate human uses.

Goals

Our overarching goal of the paper emphasizes the similarities and differences in approaches used and contributions in each site, and this is the focus of the discussion and conclusion. Specific goals of these case studies included 1) researching and documenting site inventory, and 2) informing and creating envisioning design and planning products that could be used by public planning agencies (PCPR and MNCPPC). These are discussed in the following methods and results sections.

Methods

Arizona case study

Methods included field evaluation of eighth-mile segments of each watercourse studied and ranking of the corridors based on their suitability for access and trail development. Field data were collected and ranked for different wash attributes: watercourse composition, watercourse vegetation, walkability, path development, and connectivity (road crossing types and linkages).

Data categories:

1. Watercourse composition: a) bank treatment (natural/treated), b) streambed treatment (natural/treated), and c) upland vegetation (natural/graded)
2. Walkability: streambed surface (evenness, geology)
3. Path development: upland presence/absence of buffer available for paths
4. Connectivity: a) road crossings (types and frequency), b) underpass characteristics (height, rise), and c) links (alleys, drainageways, other watercourses)

Preliminary indices were generated to evaluate the accessibility and pedestrian experience categories for each wash within the study area.

Accessibility index: ***2(path development) + (linkages) + (road crossings) + (streambed walkability)***, and
Pedestrian experience index: ***(bank treatment) + (streambed treatment) + (upland vegetation) + (native vegetation).***

Path development was given twice the weight compared to other values in the index, based on the importance of this characteristic for greenway success as emphasized by expert opinions. Underpass height was not included in the index, as it was determined to be uncertain if underpasses could be used for pedestrian crossings, given the liability concerns suggested by Pima County planners at this time. It was restricted to point data within GIS for small scale site analysis and for future use in trail design.

Prior to calculation of a final feasibility index (FFI), census data from Pima County, Arizona was used to determine washes with the greatest adjacent population density and therefore having greater potential for public use. The formula used to calculate the final index for trail feasibility was the following: ***2(population density) + (accessibility index) + (pedestrian experience index).***

The feasibility study identified Alamo Wash as a relatively high-ranking wash relative to public access, and further spatial data analysis was done for planning an urban greenway along this corridor. In addition, an extensive vegetation inventory was done to evaluate wash and upland plants along Alamo Wash, including neighboring planted areas, to reveal opportunities and constraints relative to habitat opportunities. Results from these analyses included a proposed trail route and design strategies for trail and habitat development along Alamo Wash.

Maryland case study

Initial methods included evaluation of GIS data supplied by the MNCPPC. The general approach to understand and envision the greenway was to divide the proposed greenway into eighteen greenway river areas. Each student was assigned a segment and the surrounding area. It was at this level that students conducted inventory, analysis, programming and composite analysis and ultimately envisioning ideas for the greenway. The ABC approach was adopted to document the abiotic, biotic and cultural inventory of each designated area (Ndubisi, et. al., 1995)

A class field trip allowed the students to better familiarize themselves with their individual areas. Students returned to the individual sites later to take photographs of their assigned areas to be used on their photo boards. The class held meetings with representatives from the MNCPPC to gather feedback on the way the project was progressing. Students looked at precedent greenway case studies from around the country and produced a case study graphic poster that included innovative features for ideas. Ideas and readings from relevant greenway literature was also introduced (e.g., Fabos and Ahern, 1995; Flink and Searns, 1993; Hellmund and Smith, 2006) at this time. The students were then asked to develop small ideas for their area and larger overall ideas for the entire greenway.

During the final two weeks before the project was to be formally presented, the students developed planning and design solutions boards for their respective area. Utilizing the inventory and analysis information, master plan and site-scale envisioning documents for each area were created. The master plans refined the original alignment of the trail and also proposed new secondary loops that supported interpretive integration. The site-scale proposals sought to integrate abiotic, biotic and cultural interpretive opportunities and constraints and the dominant programmatic needs of trail users.

Results

Arizona case study

The feasibility results indicated Alamo and Christmas Wash ranked highest in the final feasibility index. Alamo Wash was chosen for the design application portion of this project, as it will likely reach a greater number and variety of people due to its greater length (approx. 5 mi.) compared to Christmas Wash (approx. 1.5 mi.). This process included integration of spatial data with the collected attribute field data to determine trail routes along the Alamo Wash and application of design guidelines. A brief history and previous trail development plans and studies of the Alamo Wash were investigated to determine design implications for trail development. Further site inventory and analysis was done to aid in the planning and design phase of a trail such as defining areas where circulation and destination nodes could occur. Inventory of neighborhood character included analysis of existing neighborhood associations and demographic information for the determination of possible user groups. Design treatments included trailheads, signage and wayfinding, crossing strategies, and interpretive materials focusing on urban wildlife (Figures 1 and 2).

Figure 1. Vacant lot is transformed into a parking lot for easy trail access. Wayfinding elements and trailheads are included to welcome and orientate visitors (Jennifer Balsa).

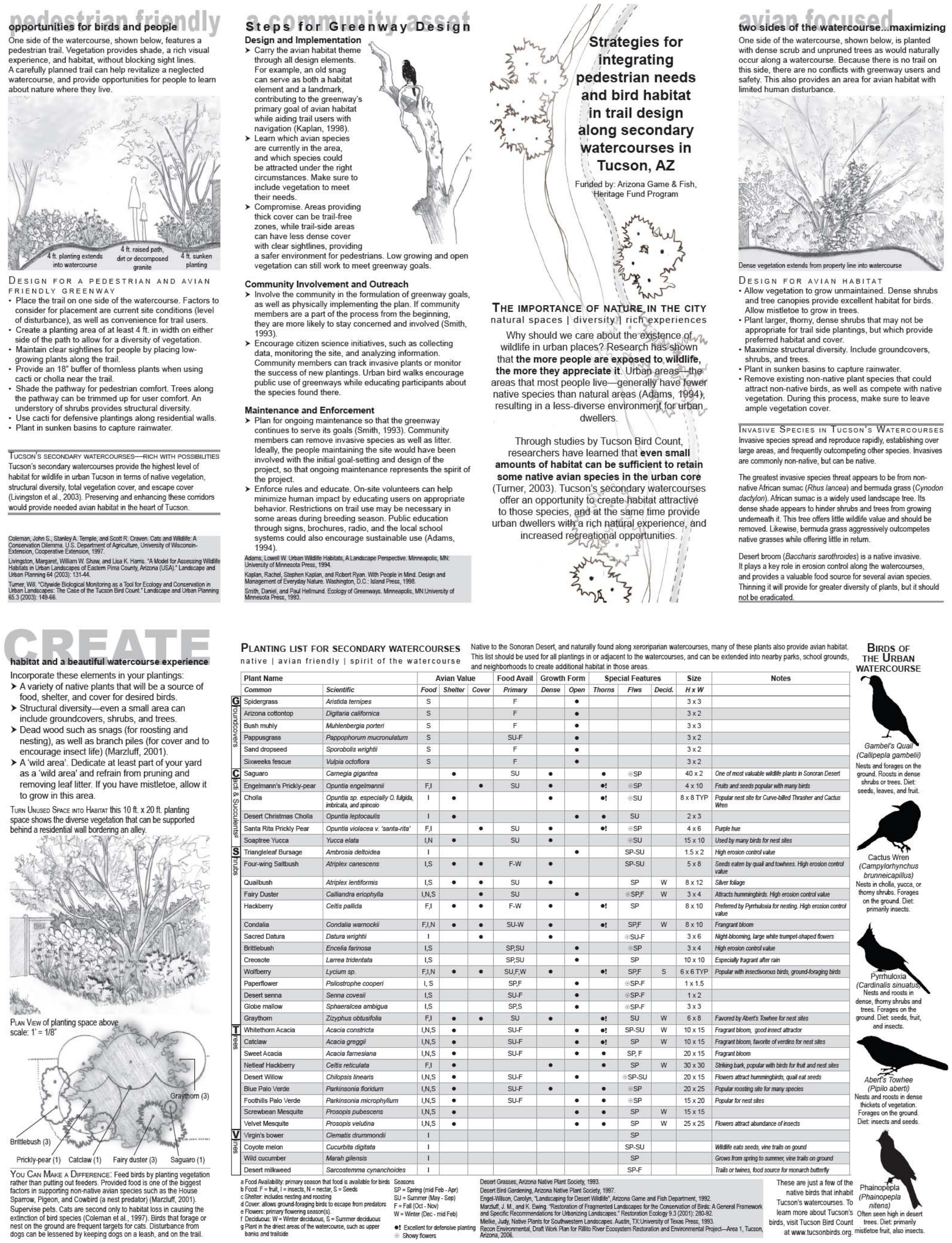


Figure 2. An educational pamphlet (front and back page) was developed for neighborhoods focusing on use of secondary watercourses as habitat and wildlife viewing opportunities (Jennifer Patton).

Maryland case study

The location of existing park land and slope (Figure 3a) were the dominate criteria that guided the alignment of both short term and longer term trail systems in the

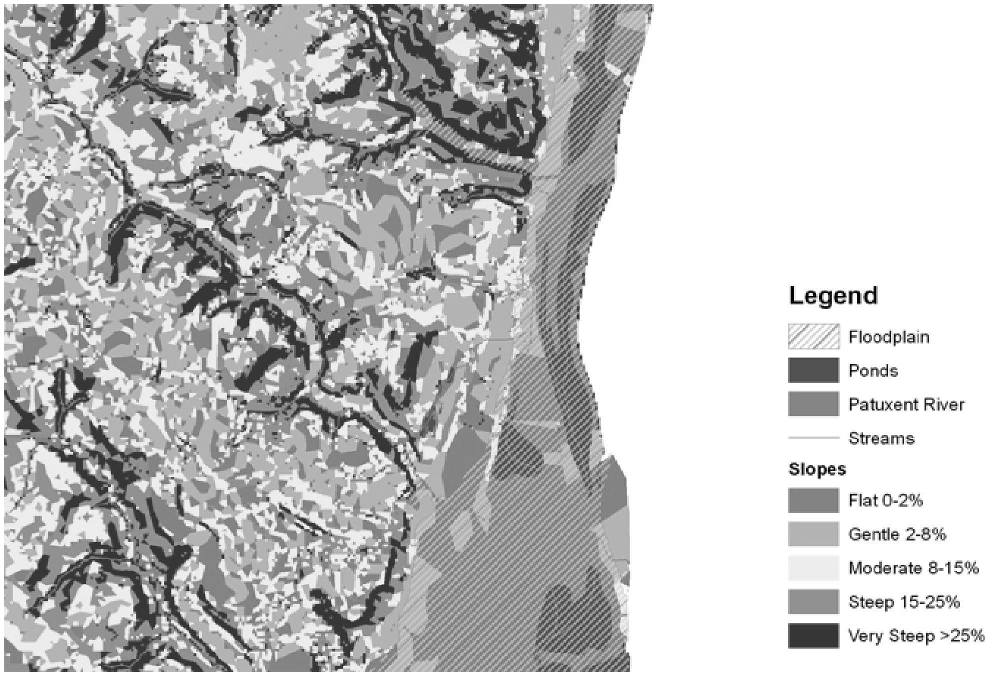
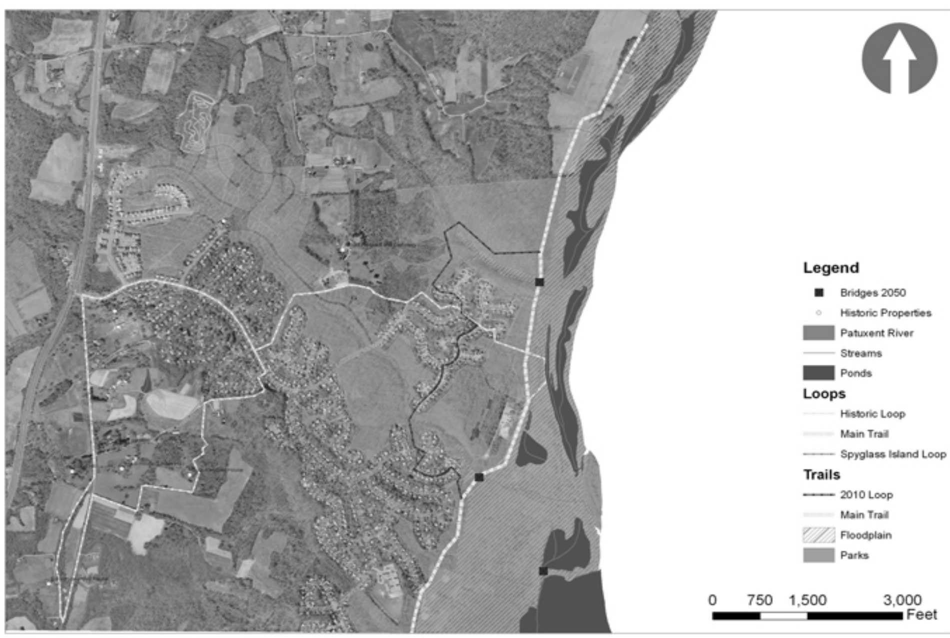


Figure 3a and 3b. Figure 3a (left illustration) is a typical plan (of eighteen) indicating significant abiotic elements (e.g., slopes, floodplains, and waterbodies).



Master Plan of 2010 and 2050 Trail

Figure 3b (right illustration) is a typical master plan (of eighteen) indicating proposed 2010 trail alignment and proposed 2050 trail system alignment and amenities, including focus areas, in the region (Lauren Kovach).

resultant master plans (Figure 3b) and focus areas (Figure 4). While this process used GIS information for opportunities and constraints for trail alignment in all eighteen master plans, students did not execute them in the same manner as the other case study. A more explicit suitability model of each of the alignments would have provided a more accurate feasibility as to the degree that slopes was used in alignment and the percentage that the proposed trails were located in existing park lands. Like the first case study, further site inventory and analysis of primary cultural attributes was done to aid in the planning and design phase of a trail such as defining areas where circulation and destination nodes could occur. Inventory of neighborhood character included analysis of existing neighborhood associations and demographic information for the determination of possible user groups. Design focus areas included both water based focus amenities (e.g. canoe launch, water interpretative center, etc.) and non water based focus amenities (e.g. farm museum, airport memorial, etc.). These reflected the specific opportunities and capabilities of the site area (Figures 3b and 4).

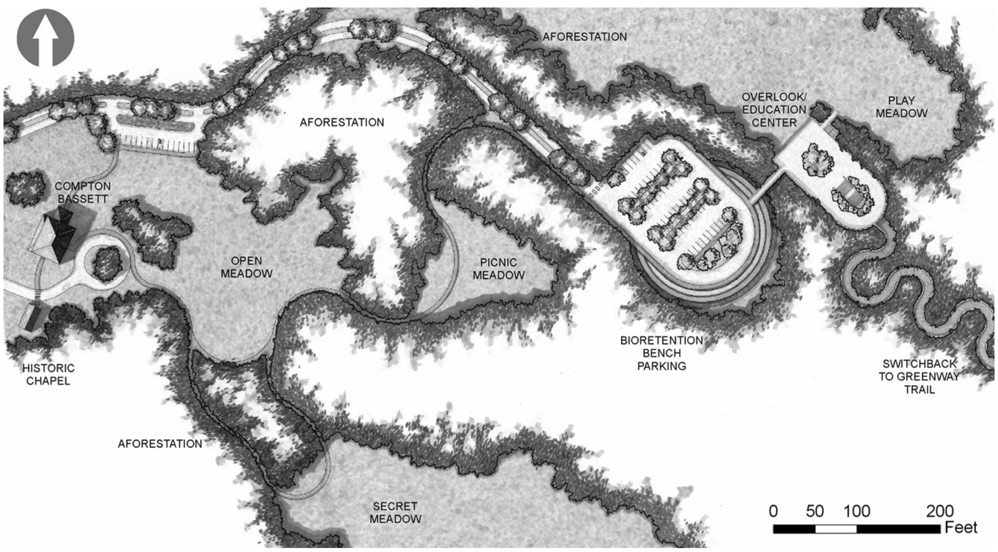


Figure 4. One example of a focus area for the proposed Patuxent River Greenway. This historic oriented proposal also includes reforestation, access to the river and parking as well as secondary trail systems to accommodate mutliple user types (John Lightle).

Discussion and conclusion

Comparison of these case studies demonstrated some of the limitations experienced when evaluating greenways for green infrastructure development. For example, the first case study had minimal existing data to work with to determine suitability of greenway trails, and a majority of the study work focused on creating data layers for analysis at this scale. The second case study had significantly more existing data which allowed for more site-specific information as the focus of the results. Regional limitations of the greenways may partially explain these differences; arid cities such as Tucson are relatively recent in their interest in integrating trail systems along smaller, ephemeral watercourses where stormwater drainage is historically the primary function of these corridors. It can sometimes be difficult for city residents and officials to recognize these areas as valuable corridors for recreational use as well as wildlife opportunities (linkages) compared to greenways in more temperate areas where these corridors tend to have more year-round flows. In addition, the design focus may slightly vary among the regions; in Maryland, emphasis is predominantly on streams and the open-bodied waters that are often the primary focus areas and primarily determine the alignment of the trail and short boardwalk sections. In arid areas, design focus is often related to enhancing connections to surrounding amenities and urban pedestrian and bike paths and to highlighting wildlife viewing opportunities, particularly urban birds (as highlighted in Figure 2). Typically, these dry streambed corridors attract walkers, runners, wildlife watchers, and bicyclists, perhaps a narrower user group than those corridors in temperate areas. In terms of similarities among the research, the case studies share the issue of determining where related elements can be integrated into existing city and suburban sites, retrofitting the design into the urban and suburban matrix. Finally, lessons learned from the comparison, regardless of region, are that the tools of investigation have been developed thoroughly enough to effectively enable students to assess trail suitability in a more explicit manner (i.e. a explicit suitability or constraint model). Such tools allow them to explore the use of ground-truthing and GIS analysis for suitability assessment of greenways under a variety of conditions. Furthermore, these student-based outcomes have provided a valuable foundation for development of greenways in urban and suburban areas where funding for these projects can be limited.

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Acknowledgements

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