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High Performing Greenways Design: A Case Study of Gainesville, GA

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Abstract
Greenways play a significant role in structuring and developing our living environment in urban as well as suburban areas. They provide many recreational, environmental, ecological, social, educational, and economical benefits to cities. This article questions what makes high performing greenways by exploring the concept, history, and development of greenways in the United States. The paper illustrates the concept of linked open spaces and high performing urban greenways in residential communities and suggests a methodological blueprint for their implementation in the planning process. A case study of high performing greenways design in Gainesville, Georgia demonstrates the role of such a greenways system as an open space connector in residential communities. A detailed investigation of the planning process, approaches, and development concept is presented following an overview of the significance of the design method.

Key Words: *High performing greenways; open spaces; case study; Gainesville, GA.*

INTRODUCTION

The roots of the greenway movement are a century and a half old. Since their inception greenways have played significant roles in the development of urban and suburban areas throughout the United States. Today the popularity of greenways has increased because of their recreational, environmental, economic, and social functions, as well as other benefits to the cities in which they were implemented. According to Edward McMahon (1999), thirty of the nation's fifth largest metropolitan areas are involved in (i.e. developed or have been developing) state-wide regional green space planning. As the popularity of greenways increases, urbanization has negatively affected or erased many natural areas, green spaces, and scenic routes by replacing them with concrete and non-porous surfaces. While sidewalks are edged with high-rise towers and noxious, noisy vehicles on streets, rivers are enclosed with concrete beds. In contrast, streets have become traffic conveyors serving mostly vehicles. Bicycle-ways are lacking, though bicycles have been defined as the "great green machine" (Turner, 1995).

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It is obvious that urbanization has slowly but surely erased much of the natural landscape in many important cities over the centuries. Despite people's need to be connected with nature, has contributed to certain recreational, health, and social issues. With the saving or integrative development of greenways can help diminish the negative effects of ills of urbanization such us noise, pollution, crowding, and auto fumes. Offering alternative corridors that provide attractive visual form, greenery and comfort to people may help the human psyche (Searns, 1995). Open-space systems are considered as the essential and necessary counter from the built environment in discussion of models of city form (Lynch, 1981). As Frederick Law Olmstead said "we are genetically programmed to a natural habitat of clean air and a varied green landscape, like any other mammal" (Todd, 1982) and it is humans' "desire to remain connected with nature, to maintain a semblance of natural landscape in the urban settings" (Searns, 1995, p. 79).

Greenways as circulation routes can provide a basic organizing structure to the urban landscape (Gosling & Maitland, 1984; Zakaria El Adli Imam, 2006). As discussed in the next sections, there exist different types of greenways. However, not much attention has been given high performing greenways. The first objective of this paper is to define high performing greenways which are environmentally friendly, provide recreational needs, conserve and support wildlife habitat, and preserve cultural benefits. To do this, functions and benefits of greenways, their evaluation, and types of greenways system were investigated and a matrix was created. The second objective is to propose a methodological design and a model for integrating high performing urban greenways system in residential communities. The second objective is supported by an in-depth case study of urban greenways development of the city of Gainesville, Georgia. The planning process, development of the design, and rationale to develop the high performing urban greenways are demonstrated in the case study.

Definitions, functions, and benefits of greenways

There are almost as many definitions of greenways as there are different forms. Little (1990, p. 2) defines greenways as 1) a linear open space established along either a natural corridor, such as a riverfront, stream, valley, or ridgeline, or overland along a railroad right-of-way converted to recreational use, a canal, scenic road, or other route, 2) any natural or landscaped course for pedestrian or bicycle passage, 3) an open-space connector linking parks, nature reserves, cultural features, or historic sites with each other and with populated areas, and 4) locally, certain strip or linear parks designated as a parkway or greenbelt. Ahern (1995, p. 134) also defines greenways as "networks of land that are planned, designed, and managed for multiple purposes including ecological, recreational, cultural, aesthetic, or other purposes compatible with the concept of sustainable land use."

Greenways are "more than just parks or amenities" (Searns, 1995, p. 65). They serve a number of important functions and provide numerous benefits that enhance the quality of life through the use of land for multiple purposes. Ecological, environmental, social, recreational, aesthetic, educational, and economic benefits are derived from the development, as well as preservation of greenways. Greenways provide wildlife habitat and migration corridors to protect and enhance biological diversity for plants and animals. They improve and sustain hydrological functions, provide a place for significant levels of carbon entrapment and a place for remediation of pollutants by natural processes. Greenways also protect cultural and historic resources, improve the quality of life of neighborhoods and communities, and assist in the planning and shaping of communities. They tie park components together to form a cohesive park, recreation, and open space system. Greenways also allow for uninterrupted and safe pedestrian movement between parks throughout the community providing people with a resource based outdoor recreational opportunity and experience. Greenways enhance the natural beauty and aesthetics of neighborhoods and communities. They provide an "outdoor classroom" to students that let students learn about the natural systems of the rivers and environment. Greenways also protect public infrastructure investment and can enhance property values and purpose (Little, 1990; Mertes & Hall, 1995; Ahern, 1995; Searns, 1995; Fábos, 2004; Bryant, 2006; Giordano & Riedel, 2008).

Given the above potential uses of natural corridors, high performing greenways are natural corridors that provide for a mixture of 1) ecological, 2) recreational, 3) environmental, 4) cultural and social, 5) aesthetics, 6) educational, and 7) economical benefits. In comparison, a low performing greenways only would serve small functions and provide limited benefits that only addresses partial purposes.

Evolution and development of greenways in the USA

Although the first generation of ancestral greenways, which were represented in boulevards along major axes and parkways, go as far back as the 1700s (Searns, 1995), the timelime for greenways in the United States started in 1865 with Frederick Law Olmstead`s plan for the College of California (now UC Berkeley) grounds and the immediate neighborhoods (Little, 1990). Olmstead proposed two greenway element features that aimed to provide pleasure drives and walks ending with a viewpoint at the top of the canyon. He did this by taking the whole valley of Strawberry Creek above the campus for public parkland. An additional proposal by Olmstead which would have been his first road designed mainly for carriages and for scenic experience, was to create a pleasure drive through the hills, linking the campus with Oakland (Little, 1990).

The first complete greenway designed by Olmstead is found in the Boston Park System. Built in 1880s and commonly referred to as the Emerald Necklace is Olmsted's most featured and earliest greenway in the US (Ahern, 2004 ; Fábos, 2004). This park system is referred to as a parkway by Newton (1971). Olmsted's greenways linked Franklin Park through Arnold Arboretum and Jamaica Park to the Boston Garden and Common. The Boston Park System is considered a model of integration of existing protected lands, ecological corridors, and built linear elements (Ahern, 2004). The next historically significant greenway is the Metropolitan Boston Park System, designed by Olmsted's pupil, Charles Eliot, in the 1890s. It was intended to expand Olmstead`s "emerald necklace" by creating a regional open space system, or greenway, structured by five elements: ocean fronts, river estuaries, harbour islands, large forests, and small urban squares (Ahern, 2004; Fábos, 2004).

In 1928, Olmstead and Eliot`s urban park system concepts were expended by Benton MacKaye. For the first time, MacKaye advanced the idea of a metropolitan system of protected lands conceived and designed to control urban expansion (Ahern, 2004). The next significant development towards greenways occurred in the1960s with the environmental planning network. Ian McHarg raised international awareness of the need for an ecological basis for planning with his book *Design with Nature* (1969) and he provided a widely accepted planning method to achieve it (Ahern, 2004). He argued that the major planning issue was not relative to areas of occupied and protected lands, but how one approached their pattern and distribution. In the 1970s, the greenline concept emerged which presented a new idea in land protection and management based on mixed public and private ownership (Ahern, 2004). This concept defined the greenline parks as "mixed mosaics of public and private lands" which was not based on the public ownership definition but rather a "green line" on a map (Ahern, 2004, p. 51). The Adirondack Mountains in New York and the New Jersey Pinelands are examples of greenline parks.

As the greenline concept evolved its emphasis changed from large, park-like reserves to linear corridors including historic canals, railroads, and rivers (Ahern, 2004). During this period, an emphasis on trail-oriented recreation emerged. Searns (1996) defines this period as the second generation of greenway evolution which then further developed into a planning–management entity with National Historic Corridors (NHC). Searns (1996) defines this period as third-generation greenways. The mission was to maintain threatened ecosystems, protect the natural habitat, defend against flood hazards and erosion control, sustain and emphasize cultural resources, and provide opportunities for explanation and education of nature (Zakaria El Adli Imam, 2006). During the 1980s, a significant event took place that helped the spread of the greenway movement. The President's Commission of American Outdoors (1987) recommended

a strong support for greenways. The commission addressed the need for additional open space and recreational land and proposed a national system of greenways.

Types of greenways

As stated, a greenway is a linear open space system established along either a natural corridor or overland, or along a man-made corridor to connect parks, nature preserves, streams, and cultural and historic sites with each other. Like arteries they link vital organs with each other. Greenways can be as narrow as a trail or as wide as a watershed. Some of them are publicly owned while others are established on private land. While some are purely recreational, others may be managed to preserve ecological diversity. Little (1990) defined the following five types of greenways:

1. *Urban riverside (or lakeside) greenways, which are usually created as part of a redevelopment program along neglected and often run-down city waterfronts.*
2. *Recreational greenways, which feature paths and various kinds of trails and are often a relatively long distance, based on natural corridors as well as canals, abandoned railbeds, and public rights of way.*
3. *Ecologically significant natural corridors, which are usually along rivers and streams and sometimes ridgelines, providing for wildlife migration and species interchange, nature study, and hiking.*
4. *Scenic and historic routes, which are usually along a road, highway (or less often a waterway), the most representative of them making an effort to provide pedestrian access along the route or places to alight from the car.*
5. *Comprehensive greenway systems or networks, which are usually based on natural land forms such as valleys and ridges but sometimes simply an opportunistic assemblage of greenways and open spaces creating an alternative municipal or regional green infrastructure* (pp. 4-5).

As the definitions of greenways show, types of greenways are 1) a linear configuration, 2) linkage, 3) multi-functionality, 4) consistency with sustainability, and 5) integration (Ahern, 1995). It is also inferred from definitions that greenways are planned and designed for recreational, ecological, historical, or preservative reasons. Another important feature of greenways is that they are linear systems which link open spaces to one another. Turner (1995) described 6 theoretical alternatives for the distrubution of open spaces that each of them has been adopted in the past century (Figure 1).

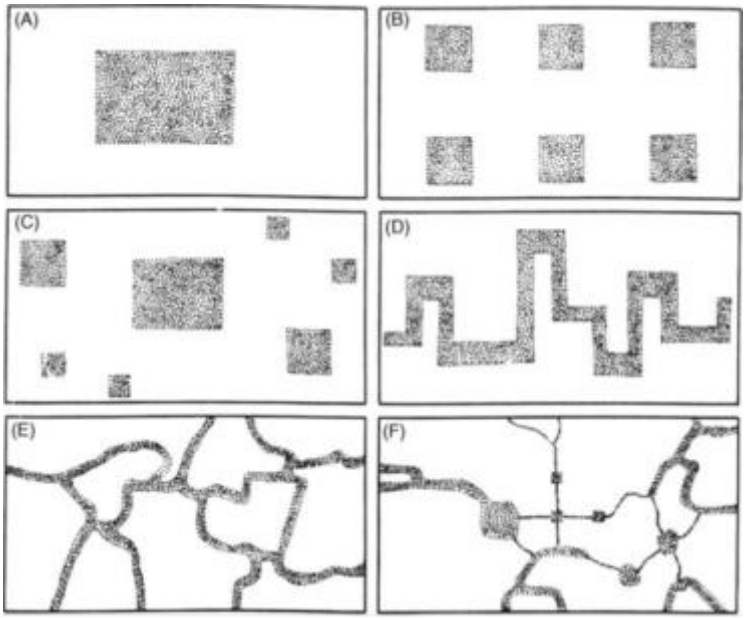

Figure 1. *Six theoretical alternatives for open space planning (from Turner,1995).*

High performing greenways

As it is discussed, greenways provide many benefits and functions with their different types. The important questions here are, how can we create a high performing greenway and what makes a greenway high performing? Greenways consist of different components in different places to serve different functions and benefits. Each component, or we may say each landscape setting, where greenways are applied has certain roles in recreational, ecological, environmental, social, aesthetic, and economic benefits. However, every component serves different functions and provides for different benefits. What is necessary to the development of a high performing greenway is the utilization of each component as much as possible.

Table 1 shows the main components and main benefits of greenways. It is important to note that there might be different components and benefits, however, the ones in the table are derived from the discussion above based on the researchers` works and experts` opinions on greenways. When we rank the components based on their benefits, riverfronts/streams and parks are the most important. They are followed by natural/landscaped courses, nature reserves, valleys, streets, scenic rods/highways, railroads, canals, and ridgelines, respectively. It is well known that greenways provide the connections linking these components to one another. When designing a greenway, taking advantage of as many of these components is an important criterion for that greenway to be identified as high performing. For example, if a greenway uses riverfronts/streams, parks, natural/landscaped courses, scenic roads, railroads, and streets then its effects and benefits to the society would be much more advanced than if it only provided for riverfronts and streams.

Table 1. Greenways main components and benefits/functions.

Main Components \ Main Benefits	Aesthetic	Recreation	Conservation	Connectivity	Biological diversity	Wildlife Migration	Economic benefit	Preservation	Social interaction	Water discharge
Riverfronts/Streams	X	X	X	X	X	X	X	X	X	X
Valleys		X	X	X	X	X		X		X
Ridgelines		X	X			X				
Railroads	X	X		X					X	
Canals	X	X		X						X
Scenic roads/Highways	X	X		X					X	
Streets	X	X		X			X		X	
Natural/Landscaped courses	X	X	X	X	X	X		X	X	X
Parks	X	X	X	X	X	X	X	X	X	X
Nature reserves		X	X	X	X	X		X		X
Cultural features/Historical sites	X	X	X				X	X	X	

Another important point for high performing greenways is that greenways should address society, environment, and wildlife habitat with different assets. For instance, a high performing greenway should not only provide for natural systems but also make places attractive to live, work, play, and socialize, should encourage economic development by improving the environment to create business and tourism opportunities. They could also promote healthy lives by providing places for walking, cycling or sport, should protect and support wildlife habitat, and preserve natural and cultural resources such as scenic areas and historic places. There may not be a golden standard for high performing greenways since each greenway is applied based on different purposes. However, in order to design and develop high performing

greenways, the goal should be to utilize each component as much as possible. By doing this both community, environment, and animals can take advantage of greenways.

In sum, greenways play important roles with their different types of applications in structuring the development of urban and/or suburban areas, shaping and linking open space and landscape, providing corridors for wildlife and places for recreation, enhancing biodiversity, and protecting many assets. Olmstead`s the Emerald Necklace was designed for the purposes of recreational, ecological, environmental and health benefits to the public. MacKaye advanced the idea of greenways system to control urban expansion. Ian McHarg raised awareness of the need for an ecological planning. With the greenline concept, greenways movement added linear corridors including historic canals, railroads, and rivers. The tradition was developed with second and third generation of greenways evaluation. The tradition of greenways movement may be expanded upon by Gainesville, GA high performing greenways. Therefore, designing and integrating high performing greenways system in residential communities seem to be an extension of greenways movement. The following section of this paper elaborates upon the proper application of the high performing greenways.

METHODS

Link corridors from open spaces to greenways: A case study of Gainesville, GA

Gainesville, GA is used to demonstrate a process implemented by the author in planning a linked network of open spaces in residential communities. This case study is an attempt to propose a methodological design and a model for integrating high performing urban greenways system in residential communities while considering environmental conditions as well as other aspect of users in the society.

Background and context

Gainesville, with a population of 34,786, is located in Hall County, GA (U.S. Census Bureau, 2013). The city is situated between Lake Lanier to the west and Interstate 985 to the east. The city has a railroad system coming from Atlanta through the northeast side of the state (Figure 2). According to the U.S. Census Bureau, Gainesville has a growing population, and its economy is ranked as one of the growing Metropolitan and Micropolitan Statistical Areas (MSA) in the United States (Fruth, 2013). Hall County is ranked #27 by U.S. Bureau of Economic Analysis among the wealthiest citizens in the country and ranked #1 for counties whose residents have total incomes of $1 billion or more in Georgia (Mackun, 2005). The growing population and economy contribute to increasing environmental, social, economic, and cultural pressures.

Gainesville and Hall County prepared a Comprehensive Plan in 2005. During the planning process public meetings were held in order to understand citizens` concerns. One of the top three priorities they recognized was the need of parks/green spaces (Gainesville and Hall County Comprehensive Plan, 2005). Although increasing demands exist, the city of Gainesville does not have enough parks, recreational areas, and greenways based on the per capita needs for green space. Lancaster (1983) and the National Recreation and Park Association (NRPA) (1995) published guidelines for recreation, park, open space, and greenways, which provide a framework for recommended park classifications based on service levels. For instance, it calls for 0.25 to 0.5 acres for a mini-park, 1.0 to 2.0 acres for neighborhood parks, and 5.0 to 8.0 acres for community parks per 1000 people. However, Hall County modified the NRPA standards both in acreage and facility type by taking into account local conditions, such as participation and utilization data. The County adopted 6.5 acres per 1,000 persons as its standard. When the county considered current conditions, it found that 1,686 acres of parkland is needed (Gainesville and Hall County Comprehensive Plan, 2005). Therefore, the recommendations to develop more greenways and community parks show that the city of Gainesville needs more green spaces, greenways and recreational areas.

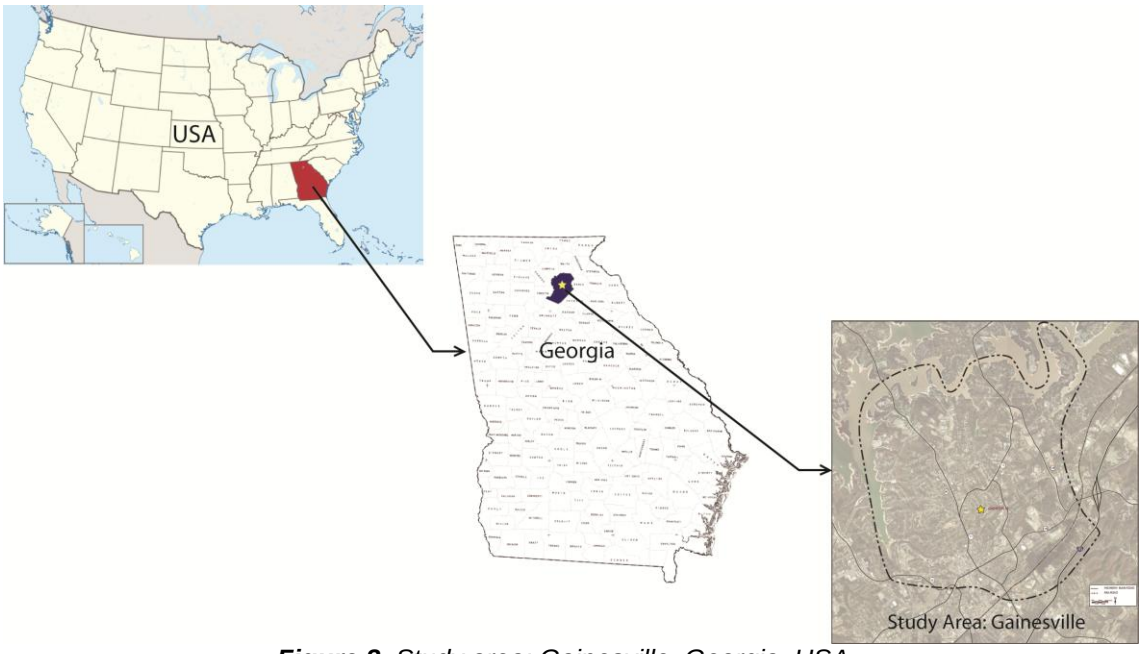

Figure 2. *Study area: Gainesville, Georgia, USA.*

Planning approach

In order to fulfill the community`s needs for greenways and recreational areas the Comprehensive Plan was evaluated with the SWOT technique to find the strengths, weaknesses, opportunities and threats of the proposed scheme to reach high performing greenways. Gainesville has a growing population and economy while it lacks recreational areas and greenways. On the other hand, Gainesville is surrounded by Lake Lanier and has numerous rivers and open spaces, which provide good opportunities for recreational areas and greenways. However, if the demands of citizens are not met, then environmental, recreational, social, and cultural needs will be missing in Gainesville. Outcomes of the SWOT assessment contributed to the development and further refinement of an effective implementation strategy. The approach used in high performing greenways design consists of a multi-level planning process that emphasizes the analysis of natural and cultural resources and urban systems within the development area. The four-phase process was planned to integrate and take advantage of existing natural corridors, rivers, and the lake into the proposed development plan. The four-phase process was:

- Phase 1: Environmental and resources inventory to determine and analyze natural, recreational, cultural, and educational resources, and identification of site opportunities and constraints.
- Phase 2: Formulation of goals, objectives, and strategies.
- Phase 3: Development, modification and evaluation of plan alternatives; and formulation of development concept.
- Phase 4: Implementation of detail plans.

Inventory and analysis phase

This phase identifies, maps, and records recreational, natural, cultural as well as educational resources. Recreational, natural, cultural, and educational resources are key elements and contribute to the quality of life throughout the region. Gainesville was found to have two elementary schools, three middle schools, one high school, three Christian schools, one military academy school, one university, one civic center, one recreation center and one hospital. The nature inventory found eleven rivers/creeks and two watershed areas. The city`s existing parks included Wilshire Trails Park, City Park, Candler Street Park, Wessel Park, Riverside Park, Roper Park, and Academy Park. Besides these parks the city proposed recreation and

conservation parks, which follow the rivers and lakes around the city. The city also has plenty of open space areas which are located along the rivers, lakes and the southeast part of study area. In addition, the railroad system coming from Atlanta through the northeast side of the state is available on the southeast part of the city (Figure 3).

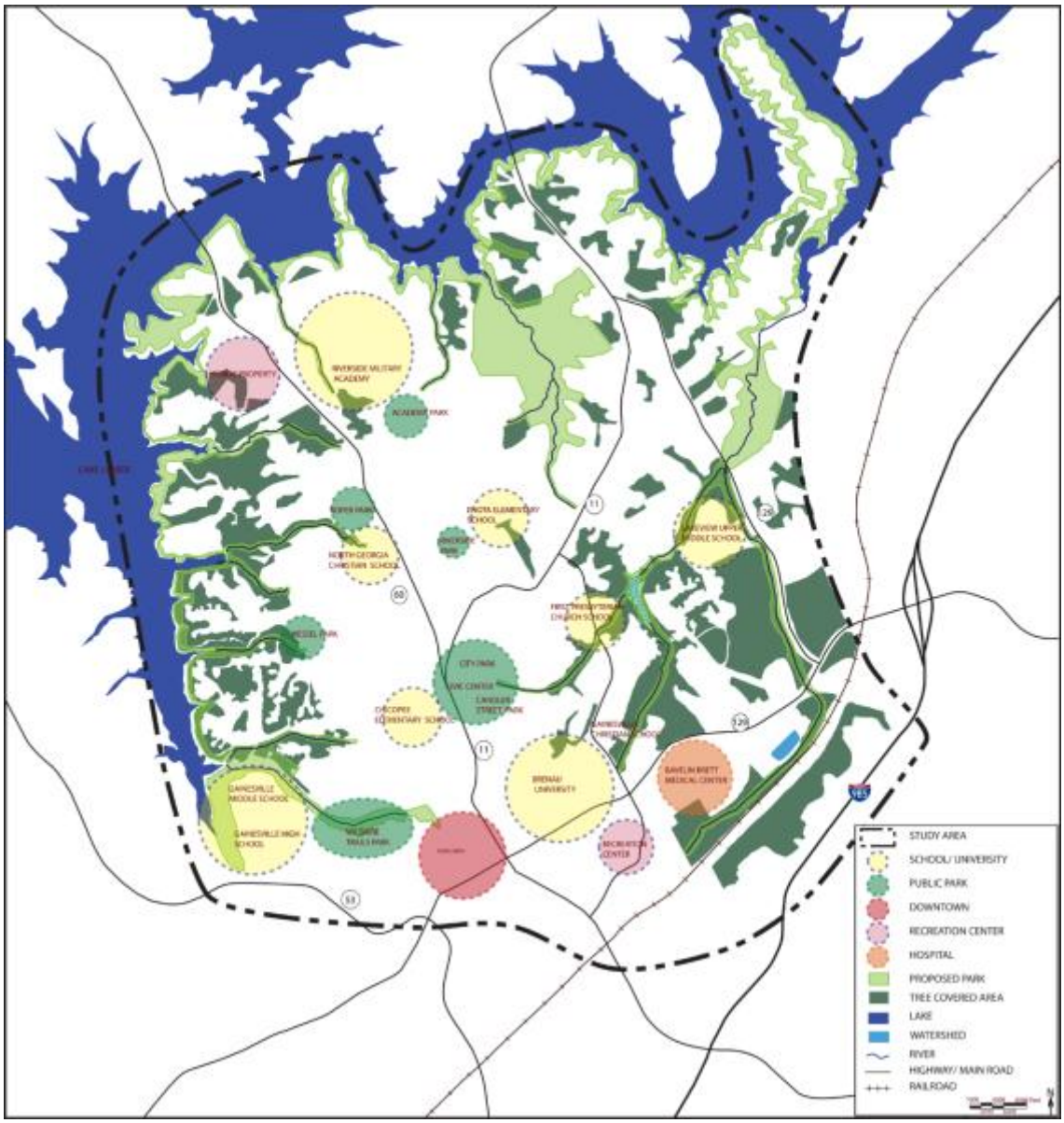

Figure 3. *Inventory analysis of natural, recreational, cultural, and educational resources.*

One of the main roads in Gainesville, Road 60, connects the northwest side of the lake to the city through downtown. Some of the rivers connect the lake to Road 60. Wessel Park, Roper Park, and Wilshire Park are connection downtown and Road 60 to the rivers. The civic center is located next to the City Park, Candler Street Park, and Chicopee Elementary School and is on the connection point from Road 60 to downtown. There is another connection between downtown and Brenau University. The Brenau University which is next to the Gainesville Christian School is close to rivers. Lakeview Upper Middle School is located next to Road 129 and close to rivers and the watershed. This provides another good connection to greenways. Besides this connection, the river next to Gainesville Christian School flows to the northeast

side of the lake into open spaces, which has a good potential for recreation and wildlife (Figure 4).

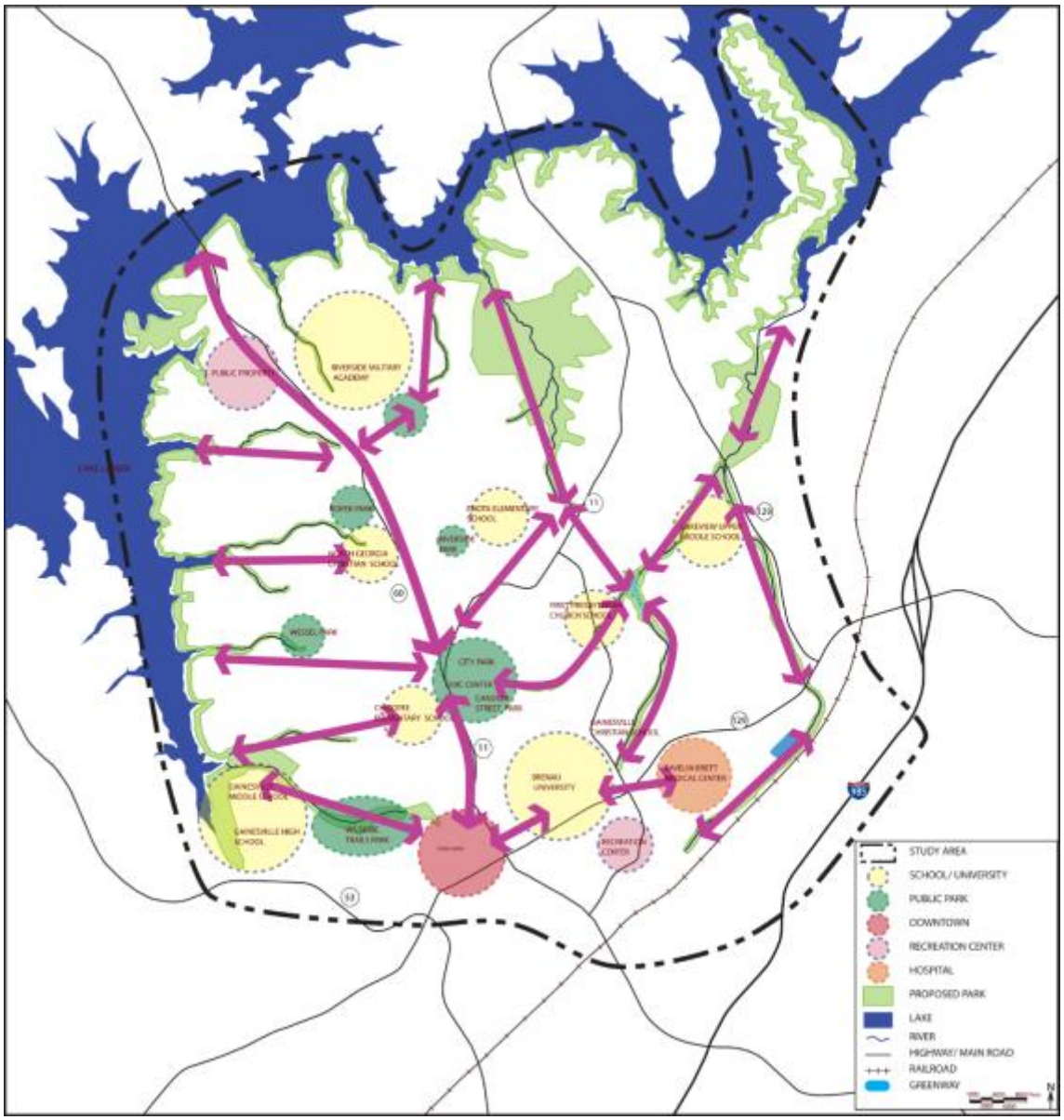

Figure 4. *Analysis of connection routes of natural, recreational, cultural, and educational resources*

After looking at the connective routes, it appears that there are three important connection points that have potential for becoming an attraction point. One of them is in the downtown area connects Lake Lanier, Wilshire Park, downtown, and Brenau University. The corridor continues through Bavelin Brett Medical Center, and Gainesville Christian School. Another important connection point is around the civic center. The center connects Lake Lanier, Chicopee Elementary School, City Park, Candler Street Park and the civic center through Lakeview Upper Middle School and the northeast side of Lake Lanier. The last important connection point is located on Road 60 and next to the Riverside Military Academy. This area connects the north and northwest side of Lake Lanier to Riverside Military Academy (Figure 5).

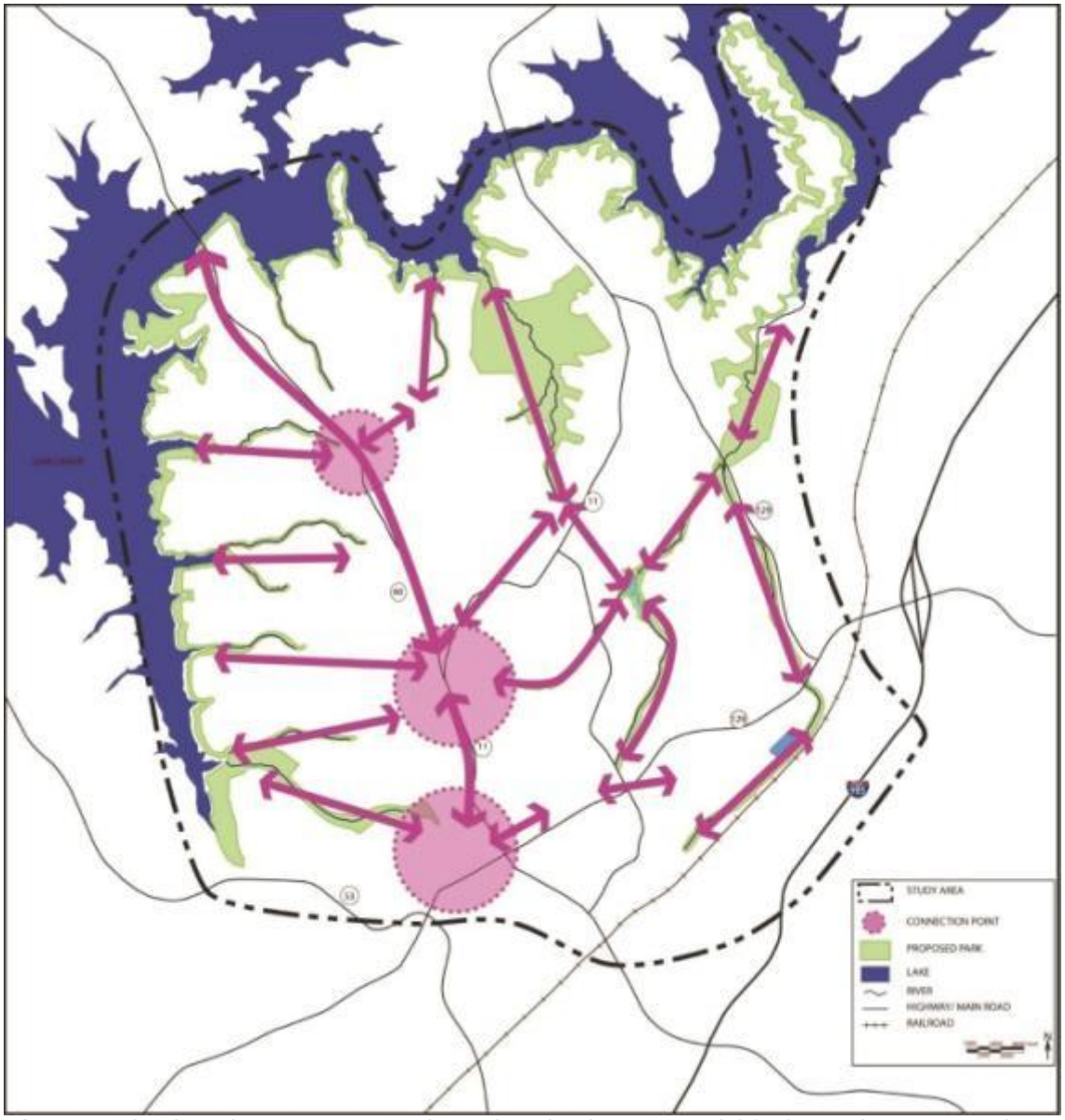

Figure 5. *The three important connection points that have potential for becoming an attraction point.*

In sum, the inventory and analysis provided that Gainesville has plenty of opportunities for high performing greenways such as the lake, rivers and creeks, watersheds, green spaces as natural resources, parks, railroads, open spaces, and recreation centers as recreational resources, civic centers as cultural resources, and schools and universities as educational resources. Using these resources, it is possible to design high performing greenways which can provide for recreational, ecological, environmental, social, aesthetic, and educational benefits to the city.

Developments of goals and strategies phase

Phase 2 of the process includes the formulation of a list of goals, objectives, and strategies to guide development of Gainesville high performing greenways design towards sustaining ecosystems, preserving and highlighting cultures and heritages, and improving link corridors among green spaces. The development goals of the plan are as follows:

- Provide organized, structured, and enjoyable greenways for all ages to be physically active and identify places to encourage recreational activities for a diversity of users.
- Identify available railway, rivers, and lakeside green corridors that contribute to development of trails for strolling, biking, jogging, and other recreational activities.
- Protect, preserve, and enhance the quantity, as well as quality, of current environmental resources to keep existing wildlife habitat safe.
- Encourage exercising, walking, cycling, and casual encounters among residents and lessen automobile dependency for internally generated outings.
- Retain groundwater recharge areas, storm water protection from wetlands, floodplain protection, and natural sound barriers.
- Identify existing connections and create new ones that enhance neighborhoods through open space corridors and pedestrian linkages.

Another important step in this process is the development of strategies aimed at fulfilling the development goals. The strategies are as follows:

- Connect parks, open spaces, and sport centers by utilizing streets, rivers, watersheds, and railroads in order to create a linkage corridor.
- Design a system that utilizes backyards, streets, and parks as one piece of greenway that provides places for adults and children to engage in other types of personally important daily recreational activities on their own land, whether it's a simple short walk, bird watching, fishing, gardening, nature observation, or playing in and near creeks.
- Propose trailheads based on safety, traffic flow, visibility (i.e. nearby businesses, foot traffic, light etc.), topographic availability, walking distance, and availability (i.e. park and ride, neighborhood access, streets/sidewalks access).
- Design of looped walking routes (based on people`s willingness to walk, run, and jog) that address different age groups.
- Propose high performing greenways and trails adjacent to schools to provide "outdoor classrooms," allowing students to learn about the natural systems of the river and become leaders in community environmental education.

Development concept phase

Phase 3 of the design process develops, modifies, and evaluates high performing greenways system alternatives to form an overall development plan. This is accomplished with improving, simplifying, blending and linking different pieces, and adding new elements together. The overall development concept plan for the city of Gainesville was designed according to the formulated goals, objectives, and strategies (Figure 6).

This plan illustrated a concept that concentrated on the connection of open spaces, parks, rivers and lakesides, educational institutes, and community centers. The system looks like a spider web that surrounds the city and interconnects all the components. The greenway system was also created based on loops where people start walking or biking and end up in the same location they started in a short or long distance. This conceptual approach focused on locating facilities in areas of appropriate carrying capacity and special landscape interest. Therefore, different bicycle, trail, and walking networks were provided. In addition, the conceptual plans emphasized a need for balance, so that to separate users and prevent overuse of certain areas. More details are provided in the general development plan section.

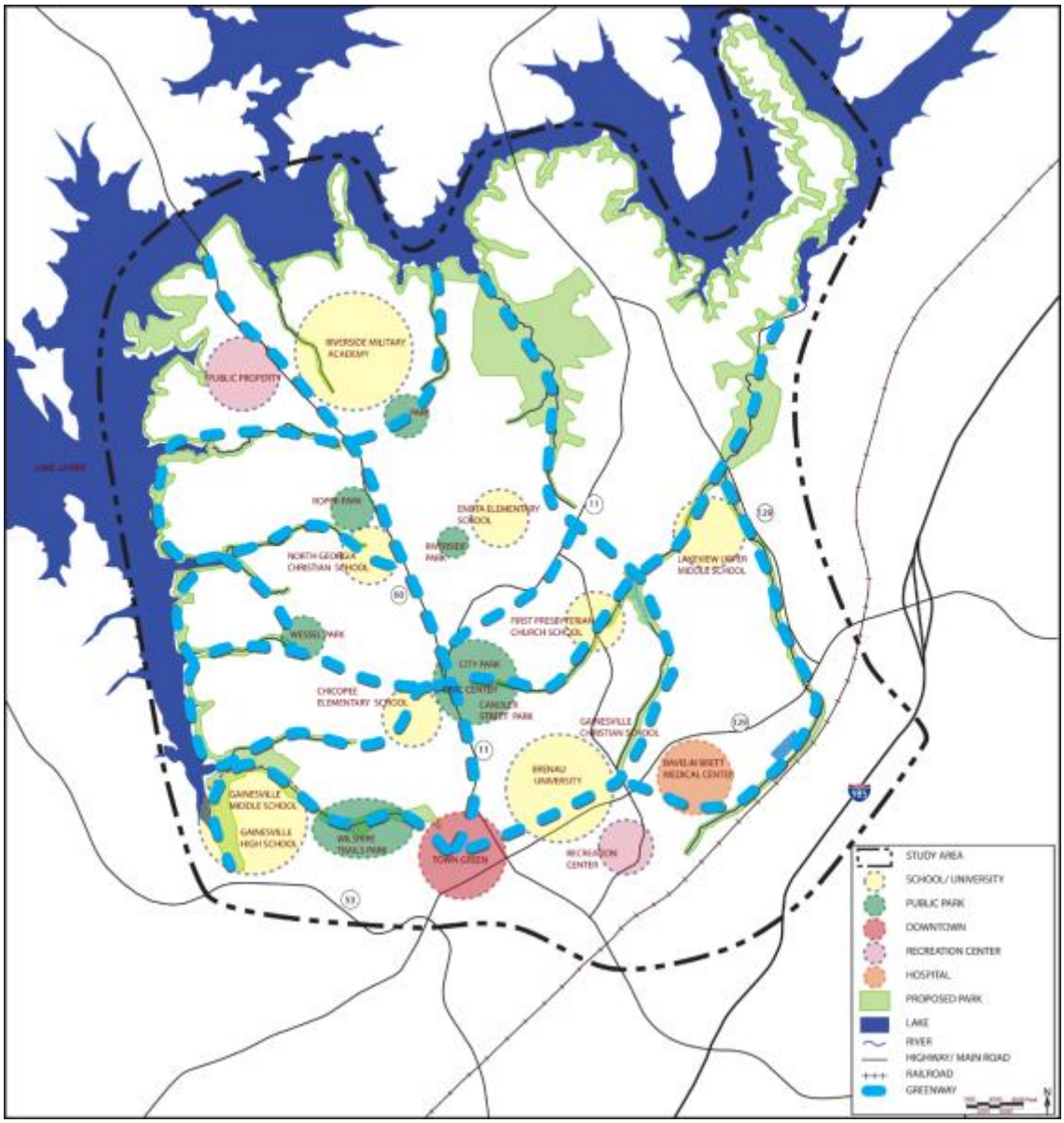

Figure 6. *Concept plan of greenways.*

RESULTS

General development phase

Phase 4 constitutes the development of an action plan to manage implementation. To ensure the development of the high performing greenways plan into a comprehensible and detailed implementation plans, the action plan serves as a vehicle. This phase consists of three implementation plans. They are the bicycle and trail network plan, the trailheads plan, and the walking network plan.

Bicycle and trail network plan

Bicycle and trail networks were designed based on nature and urban area components to decrease automobile dependency for internally generated trips, to encourage residents to be physically active, and for recreational activities: cycling, walking, and exercising (Figure 7). Open and green spaces, parks, sport and civic centers, educational institutes, rivers, and the lake were connected to each other by utilizing main and neighborhood roads, streets, existing

sidewalks, and railroads while considering topographic features of sites. This plan uses different types of trails to address different user groups` needs. One type is a dedicated trail, which is shown as blue dots in the plan, is an off-road trail for the exclusive use of pedestrians, bicyclists, skaters, and people in wheelchairs (Figure 8). The shared-use trail, shown as red dots in the plan, was designed on low-volume streets and designated to be shared by existing vehicular traffic with proposed bicycle and other non-motorized uses (Figure 9). Another trail design is natural trail, which is established along the rivers and Lake Lanier. Natural trails consist of two trail types for advanced bicyclists and basic bicyclists (Figure 10). Advanced bicycle trails are for those who can bike in high slopes and hard conditions. Because of the high slope areas, bridges were designed in order to connect trails (Figure 11).

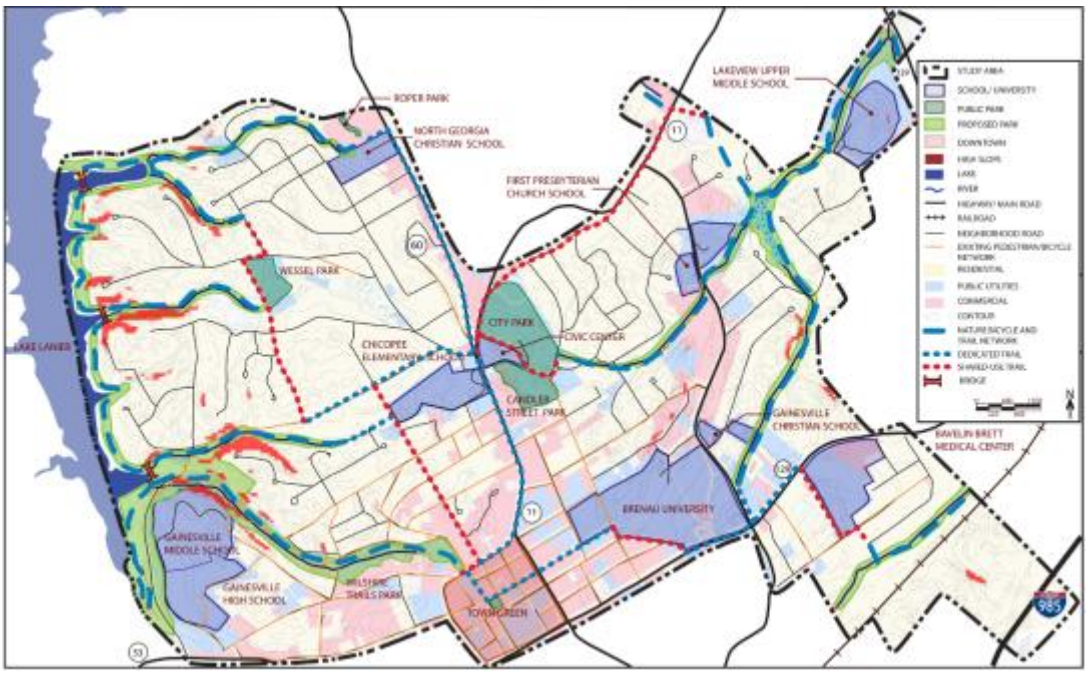

Figure 7. *Bicycle and trail networks conceptual plan*

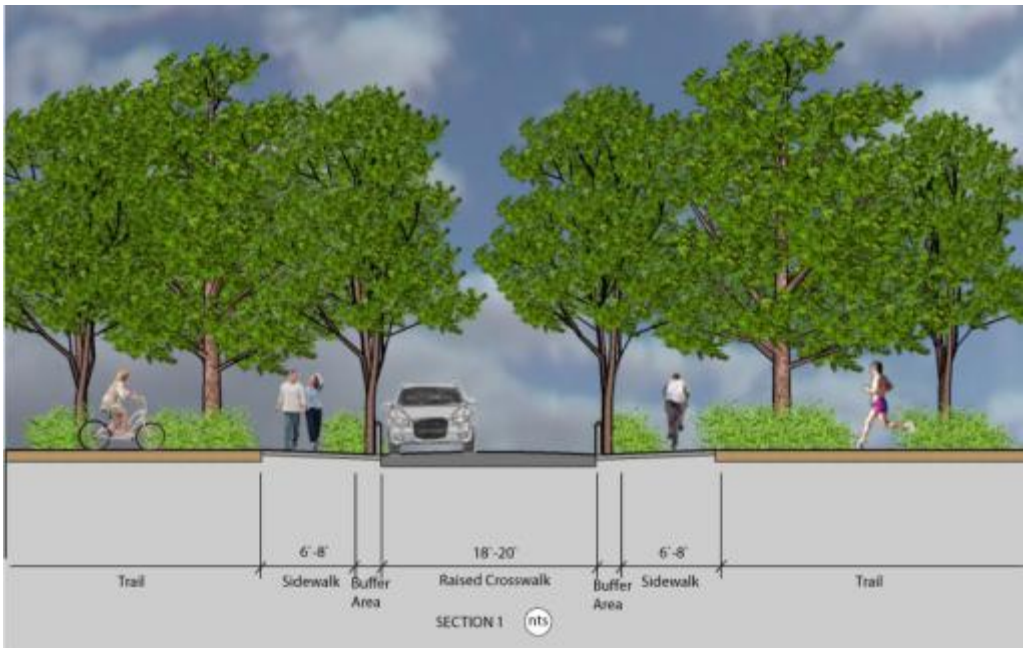

Figure 8. *The off-road trail for the exclusive use of pedestrians, bicyclists, and skaters.*

Figure 9. *The shared-use trail designated to be shared by existing vehicular traffic with proposed bicycle and other non-motorized uses.*

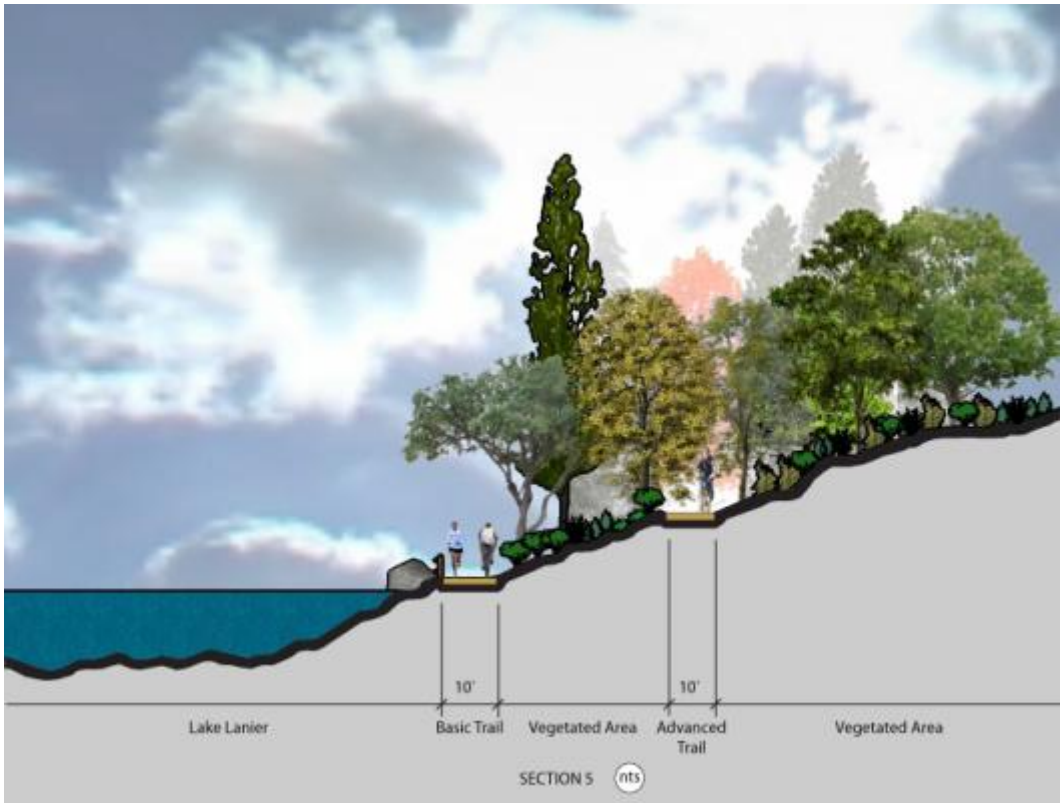

Figure 10. *Natural trails which consist of two trail types for advanced and basic bicyclists.*

Figure 11. *Bridges were designed in order to connect trails in the natural trails.*

Trailheads plan

In order to attract and inform people regarding the trails and improve the access, the trailheads were designed. Trailhead designs considered: safety, traffic flow, visibility, proximity to businesses, schools, and parks/civic centers, foot traffic, walking distance, park and ride, neighborhood access, and street/sidewalk access. Surrounding land uses and topography that allows for ready access were also taken into consideration. Three different trailheads were designed. They are primary trailheads (T1), secondary trailheads (T2), and tertiary trailheads (T3). In order to become an entry point the criteria in the matrix must be met (Figure 12). For instance, having or being located near parking lots, and being close to sport centers were the requirements for the primary trailheads. The secondary trailheads were close to the schools and civic centers. Neighborhood access determined the tertiary trailheads. Site furnishings such as kiosks, bicycle racks, wooden benches, trash receptacles, pedestrian lightings, and decorative banners at the entry points were also planned.

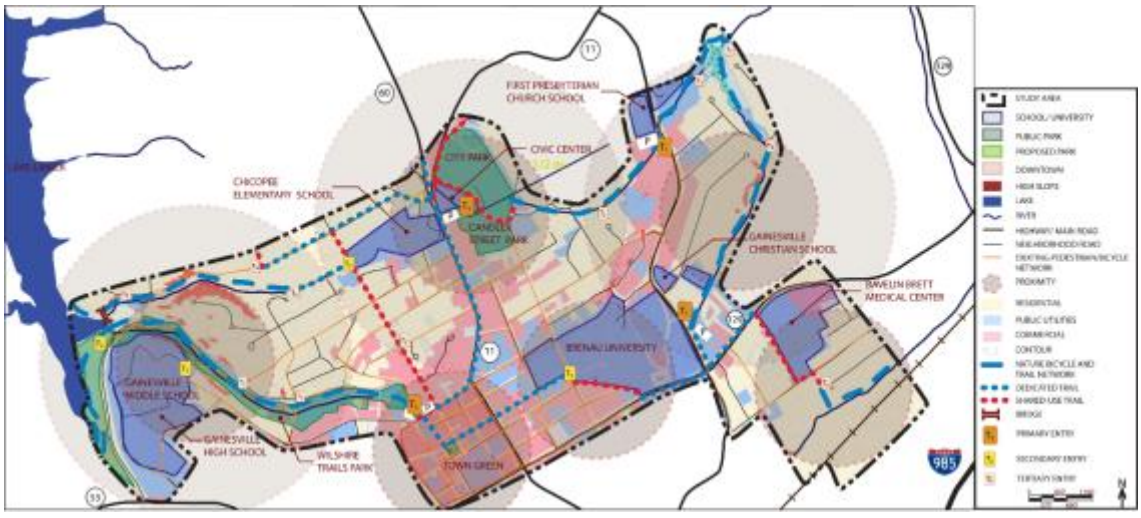

Figure 12. *Trailheads*

Walking network plan

High performing greenways that accommodate multiple functions require sensitive attention be given to how those functions are interrelated. Walking trails were designed to preserve, protect and enhance the quality as well as quantity of existing environmental resources to keep existing

wildlife habitat safe and to retain groundwater recharge areas, stormwater protection from wetlands, floodplain protection, and natural sound barriers (Figure 13). The walking trails accommodated the broadest possible user group that includes the elderly and disable people. Along with the design criteria land use, topographical availability and proximity were also considered in trail networks. In this plan, walking trails were designed along the river and behind backyards with buffer zones (Figure 14). The trails' designs utilized every component such as rivers, backyards, schools, green spaces etc. in ways that made the overall design attractive, useful, and able to accommodate the natural systems. The trail size was designed to be 10 feet with a buffer zone of at least 25 feet between trails and rivers. In urban areas, walking trails were dedicated for the pedestrians, bicyclists, skaters, and people in wheelchairs with 5 feet buffer between roads and walking trails to (Figure 15).

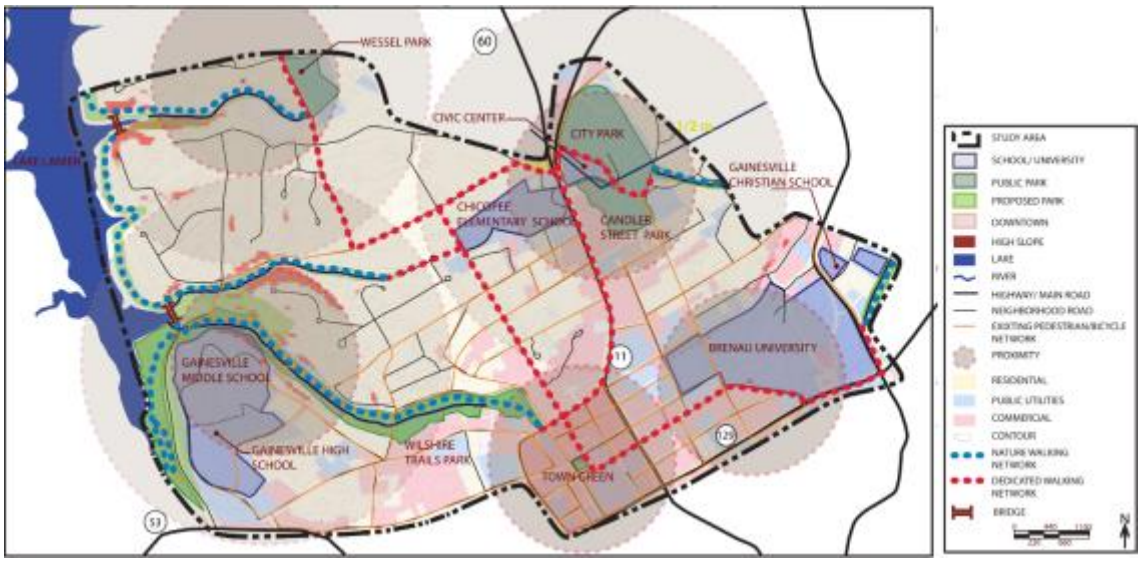

Figure 13. Walking networks conceptual plan.

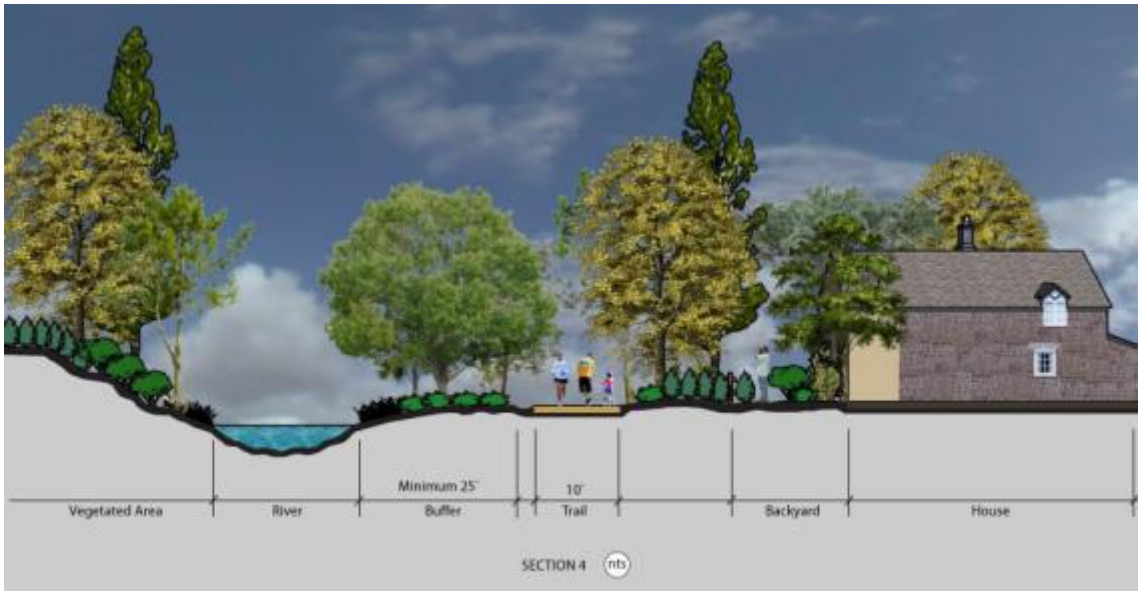

Figure 14. *Natural trail in the walking network conceptual plan.*

Figure 15. *Walking trail in urban areas.*

DISCUSSION

As mentioned earlier, the purpose of this case study is to illustrate the high performing greenways design concept created by the author in planning a link network of open spaces in a residential community in the city of Gainesville, GA. This is an attempt to propose a methodological design and a model for integrating high performing urban greenways system in residential communities. This case study has value in that it demonstrates a detailed procedure applied in Gainesville to integrate natural, recreational, cultural, and educational needs in the city.

One of the important aspects of this greenways design concept is the recreational opportunities it provides. In the high performing greenways design, parks and open spaces are connected one to another by converting unused railway lines, streets with light traffic, and other natural paths. Turner (1995) names this connection as “parkways” that lead from park to park, to create more opportunity for active recreation. Another type of trail used in the high performing greenways design concept is “blueways” that follow watercourses (Turner, 1995). Some waterside routes are for commuting and some are for leisure while other areas of the river and riverside land are closed off to humans to help wildlife habitats develop. Another well-designed greenway with appropriate planting and street furniture which is formed along main pedestrian desire lines trail was “paveway”. It links pedestrian origins to destinations to offer safe enjoyable pedestrian routes in urban areas (Turner, 1995). In this respect, this high performing greenways concept can provide active recreational opportunities such as biking, running, walking, boating, fishing and passive recreational activities such as picnics, lunch breaks and observing nature for residents. Furthermore, easy access to recreational activities may improve the health and quality of life for the community by helping to combat problems of obesity, diabetes and asthma.

High performing greenways provide environmental and ecological benefits. Establishing green networks of ecological space in cities by using urban water courses, public utility corridors, parklands, green spaces, and private gardens provide great opportunities for ecological benefits. Turner (1995) defines this type of network as "ecoway." An ecoway has portions accessible to the public while networks that are for plants, animals, air and water, are closed off to public access. Creating buffer zones along the rivers for riparian corridors are fundamental for greenways to provide connectivity, contain many resources, and support multiple uses and functions (Ahern, 2004). As Forman (1995) argues, for the sustainable functioning of any landscape riparian corridors are indispensable anywhere in the world because any other means or location in a landscape cannot provide the functions they do. Therefore, the buffers around rivers and green networks are provided in blueprints of greenways design. In this respect, this greenways design concept can protect and enhance habitat, provide refuge for many species, such as Bluestripe shiner, Golden seal, Indian olive, etc. in the city and offer a place for remediation of pollutants by natural processes.

This high performing greenways design concept also provides educational benefits to society. Anne Lusk, who is the champion of the Stowe, VT, a trail and greenway activist, recommends that greenways and schools make useful partners. To her, greenways are the ideal outdoor classrooms. She recommends that more schools be developed nearby greenway corridors (Searns, 1995). According to the Pennsylvania Greenways Partnership Commission (2002) greenways that are designed to serve educational purposes provide a lot of opportunities for all ages to learn their natural surroundings and interact with them. Searns (1995) also argues that when schools adopt greenway sections, students become the stewards who provide a source of contributed labor (i.e. wetland plantings and/or other projects) and monitor ecosystems. One of the important aspects of this high performing greenways design concept is that greenways are designed adjacent to schools to provide "outdoor classrooms." Therefore, this concept allows students to learn about the natural systems of the rivers, the lake and the surrounding environments.

Continues of greenways depend on community support since nearby residents tend to use greenways more often (Furuseth & Altman, 1991). Therefore, their support can play a major role in the success of greenways (Gobster, 1995). Integrating backyards into high performing greenways in neighborhoods was one of the strategies in greenways design concept to improve the usage of greenways and its success. This concept also connects civic centers, parks, rivers, and lake so that designing connections create a safer environment for children and pedestrians, and this can facilitate larger events and festivals. Another important aspect in greenways is access issue. In Gobster & Westphal`s (2004) study, access to greenways emerged as a key feature. In the study, an on-site survey and interviews with recreation providers revealed that participants called for better physical access. Therefore, creating trailheads are critically important to access greenways and make it more useable. Having all aspects can help continues of greenways, improvement of greater sense of neighborhood involvement and community pride, and better access to greenways.

In conclusion, various forms of greenways played important roles in shaping cities for more than a century. Since Frederick Law Olmstead`s plan, greenways with all their many forms have been a major component of urban form. Greenways not only play an important role in the shaping and development and growth of cities, but also provide many recreational, environmental, ecological, social, and educational opportunities as they help minimize the negative effects of urbanization. Greenways` popularity has increased because of many benefits they provide to the cities in which they are implemented. Although many greenways projects exist, little attention has been paid high performing greenways. This study suggests that high performing greenways should take advantage of each greenway component to better serve communities in terms of recreational, environmental, ecological, cultural benefits. The Gainesville, GA`s case study aimed to provide a methodological blueprint to integrate the concept of linked open spaces and high performing urban greenway systems in residential communities. It is the author's conviction that this high performing greenways design concept can bring many benefits to the communities in the city. That is why, as Walmsley (1995)

discussed, the historic initiatives of greenways planning and design should therefore be revived and reinvented again in today`s urbanized cities. As mentioned earlier, the purpose of this case study is to illustrate the high performing greenways design concept created by the author in planning a link network of open spaces in a residential community in the city of Gainesville, GA. This is an attempt to propose a methodological design and a model for integrating high performing urban greenways system in residential communities. This case study has value in that it demonstrates a detailed procedure applied in Gainesville to integrate natural, recreational, cultural, and educational needs in the city.

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