GREEN INFRASTRUCTURE FOR SUSTAINABLE LOCAL ECONOMIC DEVELOPMENT:

Green Space, Green Water Systems and Green Transportation Systems

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http://www.centralmidlands.org/greeninfrastructure.asp
Introduction

Green infrastructure is an idea that the natural environment should be preserved in order to enhance quality of life, limit human impacts on the environment, create opportunities for local sustainable development, and work to prevent climate change. Green infrastructure can include independent green space or systems made of interconnected green space as well as conventional infrastructure with environmentally beneficial design, such as permeable pavement roads or storm water runoff controls. Much like hard infrastructure connects human populations by providing services, green infrastructure involves viewing the natural environment as a series of connected systems. While this systematic view of protecting and preserving the local environment has merit, green infrastructure projects must also provide tangible economic benefits to gain the support of local economic developers, planners, and local government officials. Such economic benefits range from cost savings in energy use and insulation needs to storm water easement and property value increases. While individual practice of water conservation techniques and other green design principles can help a local community, a systematic/governmental approach to the built environment, (e.g., transit systems, water systems, habitat preservation, and green space creation), can create greater economic gains on the local level.

This paper will examine green infrastructure, explaining common practices and how these efforts promote environmental sustainability as well as create real economic benefits. The paper will also evaluate academic, non-profit, and think-tank research on green infrastructure, focusing on habitat preservation and green space creation as well as water and transportation systems. Finally, having examined common green infrastructure techniques and practices, the paper will present three case studies that will provide in-depth analysis of different issues found in the literature review. The case studies will also be helpful in providing examples or approaches that can be used by local economic developers.

Green space and Habitat
Green Infrastructure: Habitat Preservation

Habitat preservation is the most logical starting point because preserving natural habitat protects existing areas of green space. This school of thought in green infrastructure for economic development is that green infrastructure is “an interconnected network of protected land and water that supports native species, maintains natural ecological processes, sustains air and water resources and contributes to the health and quality of life for America’s communities and people” (Williamson 2003). A green infrastructure approach to habitat preservation will seek to create local, sustainable economic development by capitalizing on the preserved green space.

Green infrastructure as an idea has many organizations promoting it as a necessary part of public infrastructure funding (McMahon 2000). The Conservation Fund is a major group, which has outlined the major components of habitat based, green infrastructure as hubs and corridors. Hubs can be reserves, managed native landscapes, agricultural preservation districts, regional parks and preserves, cultural, historic, and recreational sites, and trail
heads. Corridors are comprised of landscape linkages, conservation corridors, greenbelts, trail corridors, and utilitarian corridors (McMahon 2000). All of these elements are important for conservationists when implementing a green infrastructure program.

Green infrastructure is contextual. It takes different forms along the continuum from urban to rural. In urban settings “large numbers of linkages are only feasible by enhancing the matrix of backyard habitat, planted boulevards, and utility rights-of-way found in a city” (Rudd et al. 2002). In the urban setting, large parcels of land are unavailable and large bodied animals are rare or non-existent, which makes backyards and planted sidewalks capable of supporting species like birds and small mammals. Rural green infrastructure is different from urban or suburban green infrastructure because the impact of human development is less, but there is greater ability to harm the existing natural habitat. Many rural areas are facing pressure from expanding metropolitan areas, where suburban development is clearing and building on many acres of former farmland and forests. An important part of developing green infrastructure is developing a coherent network of preserved habitat to combat landscape modification and habitat fragmentation (Fisher and Lindenmayer 2007). Therefore, green infrastructure in rural areas typically involves conservation of critical habitat areas from future development.

**Figure 1:** City of Milwaukee, WI Green Infrastructure

**Figure 2:** Birmingham, UK Green Infrastructure

There is little consensus in the academic literature on the effectiveness of green infrastructure, which has given many pro-conservation organizations and think-tanks the ability to better influence policy and shape the debate than their academic counterparts who “appear to be incapable of reaching consensus on anything” (Beier and Noss 2000). The debate over green infrastructure’s effectiveness “has been shaped by a number of reviews that typically are either strongly skeptical (Cox et al. 1992) or strongly supportive (Beier and Noss 1998) …recent experiments support an intermediate position” (Haddad et al. 2000). The intermediate position is that corridors can be effective when following proven principles for corridor design found through experimentation. “Well-designed experiments, in

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1 Source: [http://www.city.milwaukee.gov/MilwaukeeGreenTour14139.htm](http://www.city.milwaukee.gov/MilwaukeeGreenTour14139.htm)

conjunction with observational studies, will provide the greatest insights into corridor use by plants and animals and will be crucial in the assessment of corridors relative to other land-management strategies” (Haddad et al. 2000). The balance of the academic debate over the effectiveness of corridors is largely a debate over using statistical models, typically on the pessimistic side, and observational studies, which are typically more optimistic (Beier and Noss 2000).

This most typical concept of green infrastructure involves maintaining a certain portion of the habitat undeveloped in a network of reserves and corridors. The reserves are blocks of undeveloped habitat which provide enough area to maintain species diversity. The corridors are meant to provide connections between the reserves to allow species to move between them. Different habitat types and groups of species require different sizes of reserves and corridors. For example, long-distance migration is one of the most threatened biological phenomena because of the requirements over large areas. (Berger 2002) The issue is difficult to study because of the many variables involved, the most important may be whether corridors are able to counter the damage done by habitat fragmentation (Bruna and Harrison 1999). Most of the debate centers around the effectiveness of corridors, as the debate over the value of habitat preservation in reserves or hubs is largely settled. Some authors argue that enlarging habitat patches is more effective in maintaining populations (Estades and Falcy 2007). Estades and Falcy’s study bases its results entirely from computer models derived from statistical data, a method disputed by many other authors (Fahrig and Tischendorf 2000). Some new work is being done on plant populations to evaluate the effect of corridors at maintaining native species (Damschen et al. 2006). This work may show that even if corridors are not necessary for maintaining animal populations, they may offer benefits to plant populations.

A body of literature views green infrastructure as a series of interconnected, preserved habitat hubs and corridors. A substantial body of the literature conducts observational studies of a single or very few species and how they fare in connected or fragmented habitat areas. One study evaluates black bear populations in Florida which are separated into two distinct populations and are in danger of losing genetic diversity (Dixon et al. 2004). The black bears reside primarily in large blocks of connected habitat that are conservation lands, but the corridors between the species are not protected. Some of the activities necessary for protecting corridors can include “easements, purchasing conservation lands, fostering agreements with private landowners, and reducing human activity (Beier 1995). The Florida black bear study focuses on how a regional corridor can connect two distant populations of the endangered large mammals, which are the most susceptible to human encroachment and require a more specialized approach (Beier and Noss 1998).

Other studies in the same school of thought provide observational studies, criticized as anecdotal and contradictory by some, on many species ranging from birds to turtles (Carter et al. 2005; Bowers et al. 2006). These differing results point to the need for more studies of species specific results when analyzing a corridor project (Cox et al. 1992), but point to the usefulness of corridors for maintaining a population’s viability.
Some authors criticize the ability of corridors to maintain biodiversity, because the wide range and unclear definition of corridors limits the effectiveness of corridors in an environment of limited funding for conservation. These authors largely criticize corridors for taking funding emphasis away from preserving large areas of habitat to excessive focus on corridors (Cox et al. 1992). These authors rightly point out that groups promoting corridors often promote ineffective “corridors”, such as road and rail right-of-ways that do not follow the typical migration patterns of the targeted species. Other examples include the arguments that the limited effectiveness of small, contrived corridors such as hedgerows may have limited ability to preserve species and should not receive support from limited funding (Davies and Pullin 2007). Cox et al. agree with other critics that acquiring larger blocks of protected habitat will be more effective for conservation efforts (Estades and Foley 2007). The particularly harsh indictment of corridor proponents does not claim that corridors are useless, but that priorities are misplaced, even though corridors and stepping stones may be useful in some regional land-management conservation plans (Cox et al. 1992).

The ecological school of thought concerning green infrastructure is a young science and consensus has not been reached on how to best implement a web of habitat. The most reasonable course comes from the article “Habitat Restoration-Do We Know What We’re Doing”, which creates a process of “setting appropriate goals, linking these to target species, and taking into account the ecological, financial, and social constraints that are in place” (Hobbs and Miller 2007). These goals are similar to comprehensive planning, but with an ecological focus.

**Green Infrastructure: Green Space**

While habitat preservation has both environmental and economic benefits that can affect urban and rural areas, green space creation usually centers on urban areas. Traditionally, green space and parks have been viewed as recreational areas that improve quality of life and foster community spirit (Walker 2004, 1). These areas are also cited for their environmental benefits such as storm water runoff control and pollution abatement. In his white paper on parks in America, Paul Sherer cites a study of New York City trees as removing over 1,800 metric tons of pollution in the year 1994 (Sherer 2006, 19). However, while community green space has such social and environmental advantages, these benefits are often ignored in light of development concerns (Mahon 2003, 1). Communities and developers do a poor job of planning for green space areas, oftentimes developing unused land that would be more effectively used as community green space (Mahon 2003, 1).

![Figure 3: Tanyard Creek Park. Acworth, Georgia](http://www.acworth.org/departments/pnrecreation/parks/tanyardCreek.php)
benefit of green space is the connection between property values and proximity to green space. Studies have found that the closer land is to green space, the higher the property value of that parcel of land. In Boulder, Colorado researchers found that property value decreased by an astounding $4.20 for every foot away from the greenbelt park space (Walker 2004, 1). In Chicago, city officials estimated that the newly renovated Millennium Park will generate $1.4 billion dollars in property tax revenue and $2.6 billion dollars in additional tax revenue (Millennium Park 2005, 4). While such economic benefits require investment and planning from both the public and private sector, this significant economic gains centered around green space should not be ignored (Ulhir 2006).

Further, such economic benefits are not limited to high or middle class developments. Increases in property values due to the presence of green space has also been observed in low income areas (Sherer 2006, 14). Sherer cites a University of Southern California study, noting “an 11 percent increase in the amount of green space within a radius of 200 to 500 feet from a house leads to an approximate increase of 1.5 percent in the expected sales price of the house, or an additional $3,440 in the median price” (Sherer 2006, 15). Thus, officials in any type of community should be proactive in identifying land that can be used for green space in new development projects. Mahon and Miller even suggest a methodology for locating high-valued green space encompassing aesthetic, recreational, and ecological worth of a parcel of land (Mahon 2003, 4). This type of forethought and methodological approach to planning for green space would help ensure that communities do not simply focus on developing the built environment. As private actors and public officials continue to create economic development projects, they need to recognize the economic benefits of green spaces and ensure that parcels of land for green space are identified prior to development.

Greening the Gray Infrastructure Systems

Green Infrastructure: A Systems Approach

In contrast to Benedict and McMahon’s model of large scale green infrastructure with hubs and links, the idea of green infrastructure also encompasses new approaches to the redesign, planning, and unburdening of existing gray infrastructure such as water and transportation systems. These systems will become the center of green infrastructure efforts in the future as they connect all homes and buildings within a community. Richard Little of the Board on Infrastructure and the Constructed Environment notes the vital importance of these systems by stating that, “we may have state-of-the-art building systems but they are often connected to a 19th century distribution system about which we have little capability to predict what [part of it] will fail” (Knecht 2002). Barbara Knecht (2002) further explains that the aging distribution system causes nearly 95% of the power outages throughout the United States costing the national economy an estimated $30 billion every year. Also, in order to resolve the problems of aging infrastructure systems, local governments will incur costs for their updating and repair. As the repair, or, redesign process occurs, city planners and government officials should use foresight through innovative techniques to plan for future infrastructure. For example, when planning a building project or a new infrastructure system government officials should allow architects to design these necessary support systems that we call infrastructure (Knecht 2002). In response to the challenges and costs of
the old system, local economic development agencies and planners should view green infrastructure, not simply as an alternative, but as the standard to combating overuse and mitigating energy and maintenance costs. While proactive citizens may use environmentally friendly practices that conserve water, ease storm water runoff, and create small economic savings, these individual efforts do not have the same impact that new approaches to design within the built environment of infrastructure have. Therefore, government actors need to also be heavily involved in promoting green water and transportation systems through policy, governance, and funding (Gandy 2004). While the role of transport systems in green infrastructure will be discussed later, the first focus will be the importance of water systems.

**Green Water Systems**

While a green infrastructure approach to water systems promotes the protection of natural sources of water such as rivers, streams, lakes, wetlands, and reservoirs, green water systems also include conservation practices and design. A green infrastructure water system at the local level “consists of site-specific management practices… that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls” (EPA; 2007). Such practices promote the conservation of waste, reduce waste water, and ease the effects of storm water runoff on local sewer systems. To be effective for local economic development, water systems planning must involve a thorough examination of the long term economic benefits, as well as offer incentives to businesses, developers, and citizens to offset some of the high initial costs. Two of the most pertinent examples of green infrastructure water systems innovations which can impact local economic development are xeriscaping and green roofing.

**Figure 4: Chicago Green Roof Design**

Xeriscaping involves the use of low water plants specific to the local climate as well as mulches, soil amendments and practical lawn plans that require little irrigation other than typical rainfall (Strub 1999, 4). Xeriscaping practices can be used to protect local water reserves during times of drought as well as promote general water conservation throughout the year. State and local governments are leading efforts to promote xeriscaping within their jurisdictions. In Austin, Texas, city officials conducted a study that found that landscapes that use xeriscaping techniques save nearly 214 gallons of water a day (Strub 1999, 4). Also, during a four year period, Austin had a xeriscape rebate program that gave citizens rebates for buying climate specific grass, shrubs, and other xeriscape materials (Strub 1999, 36). In a retroactive cost/benefit analysis the program was determined to save 34 million gallons of water over the course of the program (Strub 1999, 38). In addition to active research and rebate program government,
officials can also engage citizens through education about xeriscaping. For example, the ColoradoWise Water Council provides demonstrations, workshops, and planning seminars to help local communities and homeowners understand and incorporate the best xeriscaping practices (Xeriscape 2007). Such efforts could lead to a wider acceptance and greater use of xeriscaping practices within a given community resulting in substantial water savings.

**Figure 5: Green Roof**

Fukuoka, Japan

Another feature of green infrastructure that has gained attention in recent years is green roofing. As Wachtel explains “green roof infrastructure involves the use of technologies that incorporate drainage/filtering systems, quality water-proofing, root repellency, and engineered growing media and plants” (Wachtel 2007). Green roofing can help the local environment, as well as provide cost savings to both the public and private sectors. For the public sector, green roofs can provide cost savings in the form of increased storm water retention, decreased need to expand or rebuild related infrastructure, and decreased need for interior building insulation (GreenRoofs.org 2007). For the private sector projects, green roofs have the potential to reduce the size requirements of HVAC equipment, eliminate roof drains, and incorporate cooling or water treatment functions (GreenRoofs.org 2007). Also, as a secondary benefit, green roofing can improve the local environment by mitigating the flow of storm water runoff into local sewer systems as well reducing the urban heat island effects (EPA 2007). Some developers and designers might be wary of the wide variance in the cost of green roofs due to differences in accessibility and the nature of plants and membranes used in the structure (Green Roofs 2007). However, while initial costs can be high, green roofing lasts longer than traditional roofing which would cover the higher installation fees (EPA 2007). A study performed by Dr. Karen Liu of the British Columbia Institute of Technology found that a six inch deep garden rooftop reduced the average daily demand of energy by 75% when compared to a typical non-green rooftop (Liu 2002, 4). Therefore, green roofs could be another environmentally friendly and cost effective green infrastructure project for local communities to use when constructing new buildings.

**Green Transportation Systems**

As mentioned before gray infrastructure is term used to describe transportation, water, sewer, electricity, and telecommunications systems (Benedict and McMahon 2006, 43). The systems approach to engineering planning stresses the interconnectedness of not only the infrastructure, but the environment as well. Although this concept is indirectly related to green infrastructure, it warrants attention because techniques used in constructing, operating, and maintaining gray infrastructure directly affect the availability and quality of

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green infrastructure. This is especially true since gray infrastructure is increasingly strained with growing demand due to the growing population.

In order to accommodate growing demands, along with the need to preserve and enhance our green infrastructure, careful gray infrastructure planning is necessary. The planning and engineering of gray infrastructure and how it relates to green infrastructure can be examined in three different ways, which are automobile based solutions, non-automobile based solutions, and direct environmental solutions (Jeon 2005).

**Green Infrastructure: Automobile-based Solutions**

A review of the literature suggests that approaches to green infrastructure have different philosophies for greening transportation infrastructure that is dedicated to automobiles. One school of thought seeks to conserve natural resources and minimize impact to the environment by reducing the number of automobiles in the transportation system. The primary methods used to achieve this goal are to provide driver incentives for carpooling and to improve the overall functioning of the transportation system.

One method of controlling the number of users in a system is to control demand on that system. This concept has many different names, which includes value pricing, managed lanes, high occupancy toll lanes, or congestion pricing, which “charges motorists to use highways during peak periods” (DeCorla and Souza 2007, 2). This method helps offset gasoline consumption through improved traffic flow and reducing the number of automobiles on the road. This idea relates to earlier thoughts on improving green infrastructure by reducing carbon emissions, as well as contradicting the traditional method used to solve capacity problems, building more traffic lanes. Taking an alternative approach preserves and helps to enhance the quality of green space.

Another automobile based solution that combines the use of technology and traffic analysis is an Intelligent Transportation System (ITS). Georgia Navigator defines ITS as “the integration of technology, information processing and communication that leads to easier travel, increased safety and saved time and money” (Georgia Navigator 2007). ITS technology, such as the Georgia Navigator system, provides users with information to allow them to make better decisions before, and during the use of the network. ITS helps manage congestion and provides all the benefits associated with greater information and awareness, which include decreased fuel consumption and improved traffic flow. Once again, this concept takes an alternative approach. Instead of physically building more capacity, users are given the ability to make better decisions, which, in effect, does build more capacity.

**Green Infrastructure: Non-Automobile based Solutions**

Another view of gray infrastructure and how it relates to green infrastructure supports alternatives to the automobile as a means of transportation. These alternatives can include mass transit and pedestrian infrastructure, such as sidewalks and bike lanes. This approach also conserves resources and minimizes impact to the environment by reducing the
number of vehicles in the system as well as the amount of green space that is consumed. However, it does so by making other forms of transportation more attractive.

One form this approach takes is increasing the amount of pedestrian infrastructure including bicycle lanes and sidewalks. The idea behind this approach is that if people have pedestrian travel options that are safe and efficient, they are more likely to use them instead of motorized transportation for short distance travel. Some municipalities do not treat bike lanes and sidewalks as transportation infrastructure and do not receive the funding necessary to maintain an efficient pedestrian transportation network. In many American cities, pedestrians find that sidewalks are not maintained by the respective departments of transportation. This approach to greening transportation infrastructure seeks to change the disparity between automobile and pedestrian infrastructure funding and incorporate pedestrian infrastructure into the overall transportation system.

Transit oriented design (TOD) and development is another method of promoting green infrastructure by increasing non-automobile transportation alternatives. In a Transit Cooperative Research Program report in 1995, TOD is defined as “higher density development, with pedestrian priority, located within easy walking distance of a major public transit station or stop” (TCRP Report 1995, 1). Transit oriented development should encourage people to walk and utilize transit. With this approach, land is preserved because development occurs in a denser pattern reducing green space clearing, petroleum is conserved due to fewer vehicles on the road, and emissions are reduced because of a decrease in vehicle-miles-traveled. Transit-oriented design accomplishes many goals of green infrastructure simultaneously by increasing density and population inside cities. In order for this design to work as a holistic system, proper mass transit, as well as pedestrian infrastructure, must be in place to encourage its effectiveness.

Green Infrastructure: Transportation Underpasses

Figure 6: Trans Canada Highway
Wolverine Underpass

Green infrastructure can be applied to transportation systems by allowing connections of animal populations across highways and other transportation structures. Unnatural overpasses and underpasses are structures planted with natural vegetation that are often used in connection with fences or other barriers to funnel the animals into the unnatural corridor. “Wildlife crossings are not a panacea but they can go a long way toward reconnecting fragmented habitat” (Ernst and White 2004). These road-crossing corridors are often used where large animals, such as elk, bison, and deer, cause large numbers of vehicle accidents and must travel long distances, but can also be used for smaller

6 Source: http://www.wildlifeandroads.org/decisionguide/2_1_6.cfm
species. A study of three native rodent species in Banff, Canada concluded, “ideal crossing structure characteristics will often be species-specific [and] more generally, need to offer sufficient cover and be placed with a frequency that corresponds to the spatial scale over which targeted species move” (McDonald and St Clair 2004). The study concluded that, in general, species were more prone to utilize the crossing if it was scaled to the targeted species and planted with ground plants or provided with natural cover, such as brush piles.

Most of this body of the literature is focused on individual areas, species, or methods, but could be applied in a comprehensive, systems approach to species conservation. A systems approach to road construction and maintenance can be made part of green infrastructure management by growing native species on the right-of-way, which involves 12 million acres nationwide (Ernst and White 2004). Invasive species are a serious problem: “nearly 50 percent of species on the endangered or threatened species lists are at risk because of non-indigenous species” (Ernst and White 2004). Some of the literature contends that wildlife crossings should be considered part of best practices for road construction, rather than allowing funding to come from budgets for habitat land acquisition funding (Cox et al. 1992). Wildlife road crossings act as microcosms of the larger idea of green infrastructure as a network of interconnected natural habitat areas.

Green Infrastructure: Environmental Solutions

Another approach to green infrastructure seeks to conserve natural resources and reduce the impact of human development. This approach focuses on using land more wisely, cleaning up industrial waste, and incorporating the natural environment into the human infrastructure system.

The need for transportation is derived from the need of a population to reach certain destinations since the location and nature of the destination determines the transportation choices an individual will make. Land-use management in green infrastructure seeks to coordinate transportation and development planning, and the conservation of green space by purposefully limiting development in certain areas. Just as mass transit and roads are strategically placed, land that is not developed or used for infrastructure improvements is strategically planned as well. In order to be effective, land-use management must be paired with effective zoning laws to control the type of developments that can enter an area (TRB 2005, 23). This partnership is the true heart of land-use management in transportation planning and its relationship to green infrastructure. Controlling the type and the structure of development through strict zoning laws can significantly reduce the amount of green space consumed.

Wetlands perform many functions in our environment, all of which are important to human and animal quality of life. The most important of these functions is the natural processing of water. As Zheng notes, combined wetlands and infiltration ponds are cost-effective ‘end-pipe’ drainage solutions that can be applied for local source control as part of urban development and regeneration” (Zheng 2006, 40 ). Having a network of wetland green infrastructure relieves the strain on sewer systems by reducing the need for centralized wastewater facilities and the amount of pollution and runoff control capacity during storms.
Furthermore, the construction of new wetlands helps balance out their destruction due to new development and growth (Ernst and White 2004).

Proper erosion control guidelines are another measure which can lessen the burden on the water infrastructure system. Silt and sediment present a burden on sewer systems which complicate the purification process. Stopping silt and sediment from entering the system through the planting of vegetation and the construction of silt fences improves the functioning and durability of the infrastructure. Also, vegetation can be used in lessening the impact of sediment on storm water systems. As Jones notes, “environmentally beneficial landscape development entails utilizing techniques that complement and enhance the local environment while minimizing the adverse effects of development” (Jones 2007, 1-2). Thus, proper vegetation will prevent sediment from entering the system and keep the human infrastructure green.

Increases in development have caused a subsequent increase in the amount of non-porous surface area. The increase in paved area has in turn resulted in increased storm water runoff which further results in widespread pollution as storm water pools and collects contaminants found on the road surface. Porous pavement is an alternative that allows water to infiltrate the subsurface of the road and never enter the sewer system. Much of this water is filtered by the earth’s soil and it recharges underground aquifers that provide large supplies of drinking water (Boving 2006, 3).

Though a review of the literature reveals different ideas on what green infrastructure means and avenues for creating green infrastructure, it is generally agreed that a combination of approaches should be used. The consensus seems to be that efforts that combine automobile, non-automobile, and direct environmental approaches should be implemented. Since the focus on green infrastructure development is mainly concerned with physical transportation and water infrastructure, engineers, planners, and decision-makers play important roles in achieving green, or, sustainable infrastructure.

Conclusion

The literature on green infrastructure provides many examples of how different approaches to developing green infrastructure can create lasting and sustainable local economic development. Green infrastructure can improve local economic development opportunities for existing residents of a local community by increasing property values, providing green space for healthy recreation, improving quality of life, allowing green space for local food production and creating opportunities to develop local enterprises that respond sustainably to the green infrastructure resources. Green space may also attract other residents or businesses to the local area because of the quality of life benefits provided by green infrastructure. Green infrastructure when expressed as water or transportation systems can also lead to sustainable local economic development, by creating necessary basic utility systems that are sustainable and have lower environmental impacts.

It should be clear that there are many approaches to developing green infrastructure and their potential impacts on sustainable local economic development can vary widely.
With this base of knowledge about green infrastructure approaches, the next task is to evaluate how effectively differing locations have applied various approaches to green infrastructure through a case study analysis. Several areas have emerged as positive examples of how communities and regions can use the principles of green infrastructure to create new foundations for their local economic development. On the state level, Florida has worked to preserve the environment, and is still growing at a very fast pace. Florida’s transportation network has been tied to green infrastructure preservation, which is a promising strategy, because transportation infrastructure will be created to drive local economic development, but with a lesser impact on the natural environment. At the metropolitan level, the Millennium Park project, with green infrastructure linkages throughout the city of Chicago will be explored. The effects of the new green space creation’s ability to create new jobs, improve property values, attract housing development, and stimulate business start-up and/or retention will be explored. In the non-metropolitan case study example, Banff, Canada and its vast network of national parks will be evaluated, because of the increased pressures on the local environment from tourism to develop hotels and housing in green space. Understanding how these very different areas have used green infrastructure to further local, sustainable economic development impacts can inform other areas efforts to develop their own green infrastructure.
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Case Studies: Green Infrastructure for Local Economic Development - Introduction

The literature review of green infrastructure identified common methods and practices that can be applied to local economic development. The following case studies provide a further in-depth analysis of specific examples of green infrastructure use. These case studies include a greater discussion of the background, funding avenues, and possible benefits that governments have encountered in green infrastructure creation. Each case study also connects the practical lessons learned from each project to the possible implementation strategies for local economic developers and planners. The case studies chosen were selected in order to provide a broad scope of projects.
Case Study 1: Green Infrastructure for Local Economic Development Planning – Millennium Park and Property Values

Introduction

One focus of the literature review of green space as infrastructure was on the connection between green space and higher property values. The design of the Millennium Park in Chicago, Illinois, provides a good example of how green infrastructure, such as green space, can foster other types of development and raise property values. This case study explores the issues surrounding green space creation including financing, key stakeholders, and economic benefits for the local community. Lessons or key findings about property values and green space will also be discussed with application possibilities for other local economic development officials in mind. Information and data about Millennium Park were collected through internet searches of academic articles, magazine interviews, and studies issued by the city of Chicago.

About the Project

In 1998, Mayor Richard Daley partnered with Chicago area philanthropic groups and a wide variety of other private and public designers, planners, artists, and financiers to construct what is now Millennium Park (Uhlir 2006, 20). The project was initiated to redesign the unsightly parking lots and train tracks that covered lakefront property in Grant Park (Uhlir 2007). The 24.5 acre park is located near the central business district and officially opened on 16 July 2004 (Uhlir 2006, 20). The new park is a combination of park space, interactive art, and attractive architecture. Rather than being a park of one specific person’s vision, the park’s design arose from the efforts of landscape architects, architects, and artists. The park provides a large scale music venue, several different plazas and pavilions, a 925 foot winding bridge, a natural garden inspired by the history of the city; and even a cycle parking and

Millennium Park serves as a place where Chicago residents can relax, play, and be entertained. While the park landscape, design, and architecture design director believes that

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7 Source: http://www.aia.org/aiarchitect/thisweek06/0113/0113ha_urban.cfm
the park has raised the self esteem of Chicago residents due to the international renown of the park, the park provides measurable economic benefits to the community as well (Uhlir 2006, 22). As an economic engine, the park has increased property values, tourism, building occupancy, and business attraction (Uhlir 2006, 22).

**Financing and Stakeholders**

To fund the park, a strong public-private partnership was formed and a variety of creative finance techniques were used. The city of Chicago committed $270 million, $175 million of which came from “construction bonds that will be retired by the fees paid by people who park in the 2,200-space Millennium Garage built beneath the park” (Uhlir 2006, 21). Another $95 million will be generated through a tax increment finance district as well as $160 million from a mixture of individuals, corporations, and foundations (Uhlir 2006, 21). By using a variety of methods to fund the project, the financial burden of the project has been spread throughout the community. The parking fees simulate a user fee for driving to the park while the private donations for local business and the tax increment finance district generate monies from those whose property and business stand to gain the most from the success of the project. Therefore, the park has been and will continue to be funded by citizens who drive to the park, citizens that live near the park and expect property value gains, and foundations and businesses that stand to gain media attention and new business from all of the commercial activities surrounding the park.

**Property values and Other Benefits**

While nearly 3,700 housing units have been completed in the three year period after the park opening, ten year projections attribute the construction of 2,500 housing units directly to creation of Millennium Park (Millennium Park Economic Impact Study 2005, 2). With an average unit size of 1,400 square feet and an average price per square foot of $400 dollars, Millennium Park is projected to create nearly $1.4 billion dollars of new property taxes over the course of ten years (Millennium Park Economic Impact Study 2005, 2).

While future projections are nice, properties have already seen increase in value due to the presence of the park. As the park was opened in a piece-meal fashion in order to generate interest before the grand opening in 2004, the director of the project, noted that condominium sales near the park became a popular commodity and that “a Michigan Avenue commercial building was sold for $90 a square foot, more than double what the seller purchased it for six years before” (Uhlir 2006, 22).Thus, the project has already generated substantial increases in the market for property near the park.

**Lessons for Local Economic Development**

While smaller communities may not have the same resources that Chicago had, including a vibrant private sector and philanthropic community, large tracts of land, and an already existing tourism industry, there are still lessons that can be applied on a smaller scale. As the Economic Impact Study of Millennium Park and other literature suggests, communities can help increase property values through the creation of green space
(Millennium Park Economic Impact Study 2005; Walker 2004; Sherer 2006). Even low income communities can increase property values by increasing green space within a given neighborhood (Sherer 2006, 14). However, local economic developers can use green space creation and raising property taxes to jumpstart other economic development efforts such as business attraction and building occupancy. Coupled with the increase in community self-esteem, economic development officials can use green space creation and the subsequent rise in property values to improve the local economy as well as the quality of life. While not on the scale of Chicago’s Millennium Park, these small gains could aid a smaller community in their economic development efforts.
References


Case Study 2: Florida Greenways and Statewide Ecological Network

Overview

Florida’s green infrastructure initiative started in 1991 when several organizations and concerned citizens began to worry about the loss of Florida’s wildlife and biodiversity due to increased development. It was important to them to protect Florida’s native ecosystems and provide wildlife and plants corridors within which they can migrate and thrive. Their efforts acquired the attention of decision-makers and led to the creation of the Florida Greenways Commission to study such an initiative and subsequently the Florida Greenways and Trails Council to operate it. The result was the Florida Greenways and Ecological Network, a network of ecologically important hubs linked by corridors and trails and further connected to recreational green space. It has been a success for Florida, offering both environmental and economic benefits.

Figure 8: Map of Florida Ecological Network

Conditions Leading to Strategy

The Florida Greenways and Statewide Ecological Network came into being after researchers at the University of Florida began studying the effects of fragmentation due to development on wildlife during the 1970’s. The results showed that it had a detrimental effect on their ability to survive. Key stakeholders that contributed to this were the 1000 Friends of Florida, the Conservation Fund, the University of Florida, and Florida State University. As academics, ecologists, environmentalists, and citizens who recognized the importance of these natural spaces began to voice their concern decision makers began to

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8 Source: GeoPlan Center, University of Florida. http://ogt.geoplan.ufl.edu/index.html
take notice. Due to substantial amount of community involvement, then governor Lawton Chiles created the Florida Greenways Commission, which was charged with assessing Florida’s greenways, developing a vision for a statewide system of linked green spaces and greenways, drafting recommendations for state agency leadership of the program, and collecting public input on proposed plans for the future of the statewide system of greenways. It is important to note that a motivated constituency was the key catalyst for action as it is with alleviating most political inertia. As this case study continues, its importance will be continually reinforced.

Leadership/ Organization

Local leaders who contributed much to the success of the Florida Greenways Program include the 1000 Friends of Florida who serve as a growth management “watchdog” for the State of Florida. Although they are a national organization, the Conservation Fund had a strong local presence in the development of the Florida Greenways Program. They are a “nonprofit dedicated to protecting America’s most important landscapes and waterways for future generations.” Other important groups include the Florida Department of Environmental Protection and the University of Florida which were responsible for the physical design of the greenway system.

The Florida Greenways program started out as a private/ academic venture and the operation was later transitioned to state government. For this reason, there are two important lead organizations that must be mentioned, the Florida Greenways Commission and the Office of Greenways and Trails. The Florida Greenways Commission laid the foundation for the operating organization and set the initial tone and scope of the project. In the undertaking of this endeavor, the Commission formed four committees. These committees and their responsibilities are as follows (Benedict, McMahon, p.91):

- Greenways Identification and Mapping Committee- This committee first defined a greenway and then proceeded to create a map of existing and proposed greenways throughout the state.
- Program Integration Committee- They integrated the greenways initiative into the state’s existing environmental and recreational programs.
- Community Action Committee- This committee ensured involvement on the local level by educating and incorporating local projects into the larger plan.
- Partners, Awareness and Involvement Committee- They were responsible for identifying groups and individuals who would be of assistance in initiating the Florida Greenways Program as well as marketing and public relations.

Once the Florida Greenways Commission was dissolved, the Office of Greenways and Trails, which is housed in the Florida Department of Environmental Protection assumed authority over the Florida Greenways Program. The rational for this was that the Department of Environmental protection already had oversight over many of these lands and had expertise in the area.
Operational Practice

The Office of Greenways and Trails is the lead organization for operating the Florida Greenways Program. Its structure consists of a director, an assistant director, various field and support staff (Budget and Contracts, Administrative, etc.), Land Administration/Construction, Recreational Trails Coordinators, and three Greenways and Trails Coordinators each responsible for a portion of the state. In addition to maintaining and operating the greenway system, they also acquire land to be included in the system, work with local communities in developing greenways, and teach children about greenway planning through the educational outreach group-Team Green.

Through lessons from Florida’s implementation of their green infrastructure program, certain key principles were identified as being critical in the practice of any initiative. These principles and a short description are listed below.

1. Connectivity is essential for the proper functioning of natural systems and the survival of wildlife.
2. The context in which ecosystems exist are important. In order to truly understand natural systems, their interaction with the outside environment must be examined too.
3. Green infrastructure should be grounded in sound science and land-use planning theory and practice.
4. Green infrastructure should function as the framework for conservation and development by prioritizing systems that maintain essential ecological functions. It complements smart growth initiatives while ensuring the preservation of resources for future generations.
5. Green infrastructure should be planned and protected before development.
6. Green infrastructure is a critical public investment that should be funded up front.
7. Green infrastructure affords benefits to nature and people.
8. Green infrastructure respects the needs and desires of landowners and other stakeholders. All land does not need to be under public ownership, particularly farms. Also, green infrastructure does not seek to stop development, but to plan it responsibly.
9. Green infrastructure requires making connections to activities within and beyond the community.

Outcomes/Results

Important, but unforeseen, outcomes to the Florida Greenways Program were the economic benefits provided by the ecological and green space network. The original intent was to preserve these resources for their ecological importance, but in the process, the State of Florida improved its already strong tourist industry. According to the Office of Greenways and Trails, the preserved networks and trails attract many visitors each year as
part of a tourist industry that generates about $3 billion in revenue. Also, they report that Florida has experienced an increase in property values and tax base due to the network.

In addition to these benefits, jobs were created as part of the Florida Greenways Program. Approximately 90 people are employed in the Office of Greenways and Trails throughout the State of Florida. Besides job creation, it is important to note that the Florida Greenways Program offers relief to agricultural businesses that participate in the program, which surely helps with retention. Incentives, in the form of easements, are given to those with working lands (produce and livestock farms, timber, etc.) as long as biodiversity is preserved and no urban development is allowed. Easements especially help landowners in rapidly urbanizing areas where property taxes are increasing along with development. Designated lands must fit the criteria and objectives of the program and owners must sign a consent and management form.

The success of the program achieved intended outcomes as well, including the protection of native biodiversity, wildlife corridors, protects against erosion, purifies the air, and protects the supply of drinking water. The supply of drinking water is particularly notable since municipalities are starting to learn the value of protecting of this resource. Impervious surfaces greatly diminish the supply of drinking water. Adopting green infrastructure techniques help to prevent this.

Lessons Learned

Florida’s plan for enhancing and preserving their infrastructure works very well and is a model that can be implemented elsewhere. The ten principles stated earlier are critical should be implemented in any green infrastructure initiative. In addition to these key principles, there are key strategies that are essential for the success of a green infrastructure program and can be replicated in any green infrastructure initiative. A listing of these strategies is included below:

- Create a leadership group to guide the green infrastructure initiative.
- Design a green infrastructure network to link green space components across scales and political boundaries.
- Develop an implementation plan to make the network design a reality.
- Prepare a management and stewardship plan that meets the restoration and maintenance needs of all green infrastructure network components.
- Inform and seek input from the public on the green infrastructure network design and plan.
- Integrate green infrastructure into the planning process of local, state, and federal agencies and other community and regional planning efforts.
- Sell the public on benefits of green infrastructure and the need for a green infrastructure network design.
- Build partnerships with the people and organizations that can help support and sustain the green infrastructure initiative (Benedict, McMahon, p. 86).
Perhaps the greatest lesson to learn from Florida is that community involvement and leadership is critical. The Florida Greenways Program started at the community level, with environmental, conservation, and academic groups that realized the importance of green infrastructure and were willing to step forward. Once decision-makers were made aware of the importance of green infrastructure through the motivation of their constituency, they began prioritize its preservation and enhancement.

A fundamental principal of any green infrastructure program is to use the resources already available. This helps to make more efficient the process and ensure the involvement of the local community. For example, Florida requested that the Department of Environmental Protection and the University of Florida be responsible for the physical design of the infrastructure. Most states have research universities capable of providing services to them. Using available resources prevents the need to look for them elsewhere and improves the chances of success for any green infrastructure initiative.

One suggestion to improve Florida’s plan is to better incorporate the Department of Transportation and relevant Metropolitan Planning Organizations (MPO) into their goals and objectives. In reality, both infrastructures, gray and green, interact together so they should be planned for appropriately. Although the DOT is responsible for a completely different type of infrastructure and MPOs are concerned with the economic vitality and development of a metropolitan area, often times they are the largest consumers of green space and ecologically sensitive areas. It is best to build a cooperative relationship with these organizations and show them that providing economic growth, an efficient transportation infrastructure, and preserving and enhancing green infrastructure can and must happen complementary to each other.

The Florida Greenways Program does not stress enough the economic benefits associated with green infrastructure. Florida approached their green infrastructure plan first from a conservation perspective and later realized the economic benefits of it. In order for efforts to be successful more consistently, the economic benefits must be stressed early in the process. Wetlands sustain and enhance our available supply of drinking water and trees remove many tons of carbon dioxide from the atmosphere each year. Both of these processes have real, not just intrinsic, economic benefit. In addition to that, many businesses cite quality of life as a significant determining factor in choosing a location. This further increases a region’s tax base and amount of employment available to its citizens.
References


Florida Office of Greenways and Trails, “Florida Greenways and Statewide Ecological Network.” www.dep.state.fl.us/gwt/about/

1000 Friends of Florida, “Transportation.” www.1000fof.org/Transportation/
Case Study 3: Green Infrastructure for Local Economic Development Planning – Preserving Habitat and Species for Rural Economic Development

Introduction:

Eco-tourism has emerged as a hot topic in economic development, particularly among individuals who support sustainable economic development. Banff National Park in Canada which covers 2,563 square miles, is one of the premier eco-tourism sites in the world as it has been designated a UNESCO World Heritage Site (National Geographic website). Protecting the natural resources that make Banff unique is critical for preserving its economic base, which is highly reliant on tourism. Without tourism, the area would be limited to marginal agriculture, logging and limited commercial activity. This case study will examine how Banff, Canada was able to use green infrastructure to preserve habitat and create sustainable local economic development benefits. The Banff National Park and Banff, Canada Township are closely connected and have taken different green infrastructure approaches to economic development.

Location:

National Park and surrounding localities are situated in the Alberta province of Canada. This area is in the middle of the Canadian Rockies, which are famous for their natural beauty, ruggedness and recreation opportunities. “The town of Banff was originally settled in 1883 when the trans-continental railway was built through the Bow River valley. The town is the centre of recreation, tourism, and dining in the Canadian Rockies and Banff National Park. (Microsoft Case Study, 11/18/2007)” Banff, a town with only 6,000 residents, receives approximately 4.5 million visitors per year (Microsoft Case Study, 11/18/2007). The large volume of visitors has benefited the regions economy tremendously, but also threatens to harm the natural resources and innate beauty that draws visitors.

Leadership:

Canada has a stronger central government with greater powers to create and implement planning activities than the United States, which may be difficult to believe given the US’ status as de facto world superpower, but often the US has difficulty enacting plans from the federal level (Richter, 162). Leadership in the Banff green infrastructure projects is divided among the Canadian Department of Transportation, Infrastructure Canada, the Banff

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9 Source: http://www.banff.ca/business/banff-lake-louise-tourism.htm
Green Infrastructure Planning and Implementation:

Banff National Park’s main attractions are its stunning scenery and wildlife viewing opportunities, but the large number of visitors, most of whom arrive by automobile on the Trans-Canada Highway, means that many vehicle/animal collisions will occur each year. The large size of some species native to Banff; elk, moose, black bear, grizzly bear, and mule deer cause many accidents to be very dangerous for humans and animals, which are often controlled through fences furthering habitat loss (Benedict and McMahon, p 258). The large animal species are one of the main attractions at Banff National Park, so it is crucial for local officials to preserve the species and ensure continued tourism traffic.

In the park, “wildlife crossing structures were installed under and over the Trans-Canada Highway as part of an ongoing attempt to mitigate habitat fragmentation. (Benedict and McMahon, p 258)” The highway crossing structures were also installed to “improve public safety, to reduce wildlife mortality and habitat fragmentation, and increase transportation service and effectiveness. (Golder Associates, p 2)” “The first 45 kilometers of the TCH (Trans-Canada Highway) from the eastern park boundary (phase 1, 2, and 3A) is four lanes and bordered on both sides by a wildlife exclusion fence 2.4 meters high (phase 1 completed in 1986, phase 2 in 1988, and phase 3A late 1997). (Clevenger and Waltho, p 48)” The green infrastructure improvement plan involves widening the road from two to four lanes, and installing wildlife fences and underpasses along 9 kilometers of roadway (Banff National Park of Canada, p 1). The initial study of the site used three cases; doing nothing, only constructing the 9 kilometers of improved roadway, and extending the improvements into British Columbia and fencing Lake Louise, a town inside the park and found that given the current funding restraints constructing the Phase IIIB is the best option. (Golder Associates, p 25)” The study concluded that the additional traffic would occur with or without the additional lanes, and that widening the roads while adding safe wildlife crossings would improve human quality of life and reduce animal mortality (Golder Associates, p 23). Empirical studies of the effectiveness of wildlife corridors found that wildlife overpasses and underpasses are most effective when designed for multiple species and human interaction is limited (Clevenger and Waltho, pp 52-53).

Anticipated Economic Development Effects:

Preserving species through green transportation infrastructure can preserve species with wildlife underpasses and fences. These systems can be critical for keeping large mammal species safe from automobile traffic. Areas like Banff Canada are famous for their natural beauty and animal life. If large mammal species such as grizzly bears, black bears, Canadian lynx, moose, elk, and others have reduced numbers due to vehicle accidents there will be fewer reasons for people to visit Banff National Park. Wildlife crossings and habitat connections are important because they reduce human and vehicle interactions, or wrecks, which can involve the injury or death of animals and humans, damage to property and loss
of time in a trip. Also, areas that are known to have a high number of animal crashes may be avoided by some, which can have a negative effect on local economic development. The public and/or private investment in the green infrastructure of wildlife corridors can be a catalyst to other sustainable economic development strategies.

Tourism is one of the largest and fastest growing industries today. With its rapid growth, a diversification of tourism products and destinations is taking place, consequently, demanding new alternative types of tourism, e.g. small-scale nature-related and rural ‘experience’ tourism. (Backman et al, p 788)” In some cases, such as Banff, the economic development of a locality is not limited to small-scale effects. The economy of Alberta, Canada, the province where Banff is located, has been growing quickly due to the commercialization of oil shale, but the main metropolitan area, Calgary, has average retail rental rates of 30 $/square foot in 2007 (Colliers Inc., p 1) while Banff, which does not have the industrial base of Calgary has average retail rental rates over 75 $/square foot in 2004 (Connery, p 2). The Banff area’s commitment to smart growth and green infrastructure has helped to assure its continued economic health.

Areas such as Banff can seek to develop their existing local residents’ entrepreneurial talents to take advantage of eco-tourism caused by green infrastructure development.

“Nature-based entrepreneurship can be divided into following categories:

1) Responsible tourism and other experience services based on opportunities offered by nature

2) Sustainable exploitation of wild berries, mushrooms, herbs and other products gathered from nature and utilization of wild plants in landscaping

3) Small-scale and sustainable processing of wood and products obtained from wood, stone and other minerals

4) Sustainable exploitation of water resources (e.g. spring water), snow and ice

5) Other services based on nature (e.g. photography of nature, implementation of recreation services, also renewable energy services, EMS services, green purchase, education, and etc.).” (Backman et al, p 791)

The growing popularity of organic farming methods and foods, the slow food movement, and sustainable agriculture all create opportunity for local farmers, vendors, restaurateurs and caterers to create local enterprises that complement environmentally sustainable, green infrastructure plans.

“Development of small-scale tourism entrepreneurship can contribute to the sustainable regional development by strengthening the local culture and identity, by diversifying rural tourism activities and by keeping the rural
population in the region as well as by minimizing environmental impacts due to the small-scale character of rural tourism enterprises.” (Backman et al, p 794)

Strengthening local culture and identity can extend eco-tourism into cultural tourism and/or give a locality a positive energy that is attractive to tourists.

Lessons Learned:

Preserving habitat to protect species is an important goal in its own right, but will be more accepted and successful if it can be sold for its benefits to humans. The case study evaluation of Banff National Park and Banff Township show that green infrastructure planning can be implemented in the rural context to create long term, local economic development. Tourism brings its own challenges, traffic, resource depletion, and energy consumption that can be harmful to the environment, but protecting environmental resources can help develop eco-tourism incomes. Local entrepreneurs are often well suited to take advantage of eco-tourism, which keeps the public benefits of tourist trade in the local economy.

Conclusions and Applications:

Preserving habitat in a system of connected hubs and links should be critical for any locality, particularly rural areas that are rapidly developing as many areas outside of major cities are experiencing. Often, rural areas on the urban fringe initially enjoy the influx of economic vitality that suburbanization and growth bring, but most lose their enthusiasm after several years and resent the changes new residents have caused to the past, undeveloped environment. Areas, like Banff, can that implement green infrastructure plans for local economic development can serve as positive examples on the regional scale, as after Banff initiated many of its green infrastructure programs nearby Calgary has created a large effort to construct wetlands for natural storm water remediation and flow controls (Johnson, p 59). Many of these areas do not have the commitment to preserving green infrastructure because leaders and citizens do not understand the value that undeveloped habitat can provide for providing sustainable local economic development.

The downside to analyzing Banff, Canada as a model of green infrastructure approaches for sustainable, local economic development in the rural context is that Banff has natural resources that are difficult to match, has a history of environmental conservation, and has a strong commitment to limited and sustainable development.

Rural areas can seek to develop indigenous entrepreneurs to capture the benefits of sustainable, local economic development created when implementing green infrastructure plans. “The role of tourism entrepreneurs can be vital for the development of rural areas; therefore, it is essential to find new means of livelihood and alternatives for entrepreneurs. (Backman et al, p 791)” As eco-tourism grows in popularity, new market niches will arise in different areas of the world. New trends in eco-tourism are agri-tourism, slow food, green technology and others. The important lessons for local economic development is to
evaluate what natural resources exist, how should they be protected, how can transportation and other infrastructure be renovated to eliminate the negative effects of habitat fragmentation, how can these efforts be transformed into a sustainable tourism industry, and finally how local entrepreneurs can be positioned to take advantages of the new opportunities.
References


Glossary

*Corridor*- passageway or guided way*

*Biodiversity*- biological diversity in an environment indicated by number of different species of plants and animals*

*Habitat preservation*- protection of natural system functions in order to maintain and support animal, plant and human populations**

*Gray infrastructure*- built environment**

*Xeriscaping*- landscaping that minimizes water usage**

*Green roofing*- A green roof consists of vegetation and soil, or a growing medium, planted over a waterproofing membrane. Additional layers, such as a root barrier and drainage and irrigation systems may also be included***

*Slow food*- movement against fast food started in Italy in 1986, now has organizations in over 100 countries****

* Source: Merriam Webster Dictionary
** Source: American Planning Association
*** Source: United States Environmental Protection Agency
**** Source: British Broadcast Service
Annotated Works Cited


Abstract: Entrepreneurship is considered a central force of economic development, as it generates growth and serves as a vehicle for innovation and change. Tourism is one of the economic sectors in which a great degree of involvement is needed by the entrepreneurial sector: diversification of tourism products and services is needed to cope with increased demand for new types of tourism needs. These include opportunities for more sustainable tourism. The So¨dersla¨tt region of Sweden, which is used as a case study, is a newborn tourist destination with lots of natural and cultural characteristics. It is also one of the most agriculture intensive areas in Sweden where a potential for rural entrepreneurship development can be identified. However, the entrepreneurial culture and climate was poor in the region. This is due to the social pressure that is characteristic for this rural community. This paper shows the results of a SWOT analysis of So¨dersla¨tt tourism entrepreneurship development, which gives an overview of their current entrepreneurial situation. The case of a family-based enterprise, ‘‘Healthy Pig Farm’’ is presented as an example of a successful, innovative entrepreneur in farm tourism. Moreover, based on the findings and analyses, several recommendations are proposed to overcome obstacles for sustainable entrepreneurship development in rural tourist areas. 2004 Elsevier Ltd. All rights reserved.


The announcement of an additional 37 million dollars in funding through the Asia Pacific Gateway and Corridor Initiative was welcome news for the twinning project in October 2006. This brings the project budget up to 87 million dollars. Escalating construction costs and an in-demand labor market had whittled the original 10 km twinning project down to 6 km. Additional funding now allows 9 km of highway to be upgraded from two to four lanes. Project goals are to improve motorist safety; to reduce highway wildlife mortality and habitat fragmentation; and to improve the flow of goods and services on Canada’s national highway.


Abstract: "Green infrastructure" refers to the network of wildlife habitat, open space, woodlands, parks and other areas of nature that sustains clean water, air and natural resources and enhances quality of life. This paper discusses green infrastructure as a strategic method of conserving land that is significant to smart growth success. The paper expands on the concept of green infrastructure and details seven principles and strategies for achieving it successfully.

Bertaud, Alain; Robert W. Poole, Jr. Density in Atlanta: Implications for Traffic and Transit. Reason Foundation.

Abstract: This paper discusses the impact that population density in Atlanta (Georgia) has on Atlanta's policies for reducing traffic congestion in that city. It notes that the population density in Atlanta is significantly smaller than in other cities, both in the United States and around the world; and that public transit seems to work best in those areas of the world that have high population densities. The paper indicates that the best solutions for Atlanta's burgeoning traffic congestion and pollution involve increasing highway capacity through road construction, and utilizing road pricing schemes.


Abstract: A non-polymer modified porous pavement parking lot on the University of Rhode Island campus was recently constructed in an environmentally sensitive area, i.e., in close proximity to a drinking water well field. The objective of this study was to investigate possible impacts of organic and inorganic pollutants (including bacteria) originating from a permeable asphalt parking lot on the water quality immediately beneath it. Another aspect of this study was to evaluate the functioning of the permeable pavement, including clogging and restricted vertical percolation. Four nested sample ports (shallow and deep) were installed below low and high traffic areas, including one port outside the parking lot. At least initially there was a good hydraulic connection between the parking surface and the shallow sample ports. The percolation to the deeper ports, however, was hampered for two reasons: over-compaction of material covering the deep sample ports and the presence of a geotextile layer at the base of the parking lot structure that may have acted as a hydraulic barrier. Clogging of the permeable surface was most pronounced in heavy traffic areas and below snow pile storage areas. Sand brought in by cars during winter was identified as the principal cause for clogging, but at the same time may have provided sorption sites for metal contaminants. Cars also brought up to 65.23 g/m² yr road salt (as chloride) into the parking lot. No bacteria, biological oxygen demand (BOD), and lead were found in percolating water. Polycyclic aromatic hydrocarbons (PAH) were present at concentrations near detection limit. Nutrients (nitrate and phosphate) were being leached into the ground via the permeable parking lot surface at annual flux rates of 0.45 g/m² yr to 0.84 g/m² yr. A multi-species tracer test demonstrated a retention capacity of the permeable parking lot structure >90% for metals. About 27% and 52% of the released nutrients and salicylate were not recovered. Bio-consumption of these compounds of was identified as a possible explanation for the low tracer recoveries.


The authors created a study to evaluate the effectiveness of highway crossing structures on improving the populations of many different species in Banff National Park, Canada. The study found that well designed wildlife corridors can be effective if human activity on the corridors is limited.

Collier’s Inc. is a real estate brokerage and management company that produces newsletters of different real estate markets in areas of operation.


This website provides a newsletter of real estate market conditions in Western Canada.

http://www.greeninfrastructure.net/who_we_are 18 October 2007.


Abstract: This conference was organized around the following five questions: Why is smart growth a transportation issue? What does a smart growth transportation system look like? How does smart growth differ with location (urban infill, suburban redevelopment, and fringe growth) and how do institutional arrangements vary by location? Who must be involved to achieve a smart growth transportation system and what institutional obstacles exist? How can transportation agencies support smart growth and what are the available tools? The conference planning committee, speakers, and attendees represented a broad range of agencies, views, and geographic locations. Included were smart growth advocates and skeptics; transit agencies and highway agencies; national, state, regional, and local agencies; those advocating change in the transportation system and those struggling to accomplish the change; and so forth. While there were no overarching conclusions from such a diverse group, two conclusions appeared to pervade the conference, although they were not voted on or endorsed. First, transportation is inextricably linked to land use and, therefore, to programs such as smart growth. Second, transportation systems that support smart growth are much more nuanced than is typically discussed. The conference proceedings include opening remarks by Charles Howard, Washington State Department of Transportation; presentations addressing the above questions; a keynote presentation by Parris N. Glendenning, Governor, State of Maryland; results of a conference wrap-up session; reports from two breakout sessions; and a list of participants.


Abstract: Congestion pricing may be one solution to managing traffic congestion while financing future infrastructure. This article describes a congestion pricing concept known as the high-performance highway and examines its implementation, costs, benefits and potential public acceptance. The concept of high-performance highways involves applying variable tolls on all lanes of existing tollways and toll-free facilities to manage traffic flow. Tolls would vary by level of demand, either on a fixed schedule or in real time, and would be charged only on congested highway segments to manage traffic flow. Applying pricing to entire segments of roadways during congested periods in effect turns all lanes into premium service lanes. This not only allows more motorists to reach their destination during rush hours, but they also get there faster. High-performance highways maximize capacity, eliminate the need to separate priced lanes from toll-free lanes, could be implemented quickly, and should ensure that all lanes remain congestion-free and relatively affordable. To achieve maximum benefits, high-performance highways should be coupled with travel alternatives such as park-and-ride facilities and transit services. To encourage projects to reduce traffic congestion, the U.S. Department of Transportation has introduced an Urban Partnership Agreement initiative that will grant aid to states and metropolitan areas to test and demonstrate congestion pricing concepts such as the high-performance highways.


Environmental Protection Agency, Green Infrastructure. 18 October 2007.

Website provides background information, resources, and various links to types of green infrastructure projects promoted and encouraged by the EPA.

Environmental Protection Agency, Green Roofs. 9 April 2007.

Website provides background information, effectiveness, types, costs, economic benefits, and limitations of green roofs. Website also provides an overview of the 2002 EPA Clean Water and Drinking Water Gap Analysis Report. The website covers the range, purpose, findings, and other questions about the report as well as pdf full versions of the report.


Abstract: This chapter focuses on the transit oriented development (TOD) land use strategy and its transportation impacts, organized along three dimensions that significantly...
characterize TODs: regional context, land use mix, and primary transit mode. New as well as synthesized research is presented, including suggested "TOD Index" indicators to describe development project "TOD-ness." This chapter is complementary with Chapter 15, "Land Use and Site Design," and Chapter 16, "Pedestrian and Bicycle Facilities." This chapter will be of interest to transit, transportation, and land use planning practitioners; educators and researchers; and professionals across a broad spectrum of transportation and planning agencies, metropolitan planning organizations, and local, state, and federal government agencies. Several case studies are presented.


Florida Office of Greenways and Trails, “Florida Greenways and Statewide Ecological Network.” www.dep.state.fl.us/gwt/about/


Water is a brutal delineator of social power which has at various times worked to either foster greater urban cohesion or generate new forms of political conflict'. In the paper which follows, Matthew Gandy explores this statement by looking at the expansion of urban water systems since the chaos of the nineteenth-century industrial city. In this early period, the relationship between water and urban space can be understood by the emergence of what he calls the 'bacteriological city', defined by features such as new moral geographies and modes of social discipline based upon ideologies of cleanliness, a move away from laissez-faire policies towards a technocratic and rational model of municipal managerialism, and a connection between urban infrastructures and citizenship rights. Gandy goes on to discuss that while many cities never ultimately conformed to this model, the last thirty years has seen a fundamental move away from the bacteriological city to a more diffuse, fragmentary and polarized urban technological landscape. Characteristics here include declining investment in urban infrastructures, a desire to meet shareholder rather than wider public needs, oligopolistic structures amongst providers, the marketisation of goods such as water, increased health scares and mistrust from consumers, and polarisation of the quality of service provision. For Gandy, these shifts are better understood by more relational, hybridised, rather than functional-linear, notions of urban metabolic systems. Abstract from author.

Georgia Department of Transportation. “Georgia Navigator”. www.georgia-navigator.com
This website is maintained by the Georgia Department of Transportation and allows users access to Georgia Navigator, GDOT’s Intelligent Transportation System (ITS). ITS provides drivers with real-time information on traffic conditions and allows users to make better decisions. This was included because it shows how ideal road system capacity can be reached without roadway expansion. It reinforces the idea that smarter engineering practices must be incorporated with green infrastructure.


This website provides extensive information about green roof benefits, costs, design, and forums.


The Banff National Park Management Plan acknowledges this in its strategic goals related to transportation: “to provide a safe and efficient vehicle and rail corridor through the park that supports the national transportation system and is compatible with Parks Canada’s commitment to ecological integrity” (Parks Canada 1997). Herein lies the challenge – to upgrade the TCH to fulfill its role in the nation’s transportation system while at the same time maintaining and restoring ecological integrity in Canada’s first national park.


This article discusses the idea of sustainability and how although it is highly discussed in academic settings, there has been little effort in incorporating it into corporate and governmental structures. It suggests that the *Journal of Infrastructure Systems* be the scholarly publication of choice for issues of sustainability and take a lead role in its study.


Abstract: Addressing the sustainability of transportation systems is an important activity as evidenced by a growing number of initiatives around the world to define and measure sustainability in transportation planning and infrastructure provision. This paper reviews major initiatives in North America, Europe, and Oceania. The purpose is to characterize the
emergent thinking on what constitutes transportation sustainability and how to measure it. While there is no standard definition for transportation system sustainability, it is largely being defined through impacts of the system on the economy, environment, and general social well-being; and measured by system effectiveness and efficiency, and the impacts of the system on the natural environment. Frameworks based on important causal relationships between infrastructure and the broader environment, infrastructure impacts on the economy, environment, and social well-being; and the relative influence of agencies over causal factors, are largely being used to develop and determine indicator systems for measuring sustainability in transportation systems. Process-based approaches involve community representatives and other stakeholders in planning and present opportunities to educate the public and influence collective behaviors. These frameworks can be used collectively to help agencies refine their visions as well as develop policies, planning procedures, and measurement and monitoring systems for achieving sustainable transportation systems.


Evergreen's collection of case studies that examines the myriad of ways that municipalities, community groups, institutions and corporations have embraced nature and incorporated it into innovative projects. Learn how diverse initiatives such as hydro corridor greening, urban agriculture, rooftop gardens and heritage seed preservation are improving the social, ecological and economic health of our cities.

Jones, Kim; Joseph Sai; Debbie Jasek; Beverley Storey. “Synthesis of New Methods and Techniques for Developing Sustainable Roadside Landscapes.”
Texas Transportation Institute. 2006.

Abstract: Several Texas Department of Transportation (TxDOT) districts have developed innovative landscape efforts specifically seeking to establish sustainable landscapes that require little if any supplemental water and utilize no chemical fertilizers. The concept behind this approach is that as land use intensifies, surface water runoff increases and the soil’s ability to absorb runoff diminishes. TxDOT needs creative alternatives that can help soil retain moisture and recycle nutrients to reduce the energy expended in the maintenance of right-of-way landscape development. Techniques that utilize the environmental processes found in natural, self-sustaining, and self-sufficient plant communities have been clearly demonstrated to minimize and restore development impacts on soil, reduce peak storm flows, and increase infiltration. These techniques include major soil modifications as part of large-scale highway plantings. This project identifies many of the common non-chemical soil amendments and additives that can be used to create an environment that simulates a naturally occurring sustainable system found in undisturbed landscapes. Alternative management practices used by the public and private sectors were investigated for possible application to urban roadside landscapes for TxDOT and included cost and benefit evaluations, and the analysis of traditional and more sustainable landscaping comparisons of maintenance, water use, erosion control, and pollutant runoff mitigation. As these sustainable landscape development methods evolve, improved maintenance cost savings and public acceptance is anticipated.

Focuses on the importance of urban infrastructure in the quality of urban environment in the U.S. Effects of the historical lack of planning on the cost of contemporary underground works; Integration of the architecture art with infrastructure planning; Identification of the infrastructure solutions. Abstract from database.


This study presents the experiment background, methodology, and results of a rooftop garden in comparison with a non-green roof.


Community green space provides ecologic, social, and economic benefits, but these benefits are often overlooked in the land development process. As growth pressures intensify, undeveloped land is converted to other uses, often with little regard for parcels that are better suited for green space preservation. This paper provides a methodology for locating high-valued green space. Using Stevens Point, Wisconsin, U.S., as a case study, significant green spaces were identified by assessing the size, composition, and location of forests, wetlands, and grasslands in and around the urbanized area. The ecologic, recreational, and aesthetic value of each parcel was rated and the following four-part process for prioritization was developed: (1) project scope definition, (2) data collection and GIS map development, (3) data analysis and parcel ranking, and (4) protected lands overlay. Geographic information systems (GIS) technology was used as a tool to collect, store, and spatially analyze the project’s data. Abstract from Author.


Site gives information on the number of visitors to Banff, Canada as of 2002. It also has key information on number of residents and size of municipal staff.


This document presents the economic costs and benefits resulting from the Millennium Park redesign and concurrent developments.


Website provides brief history of park as well as detailed information about park events, attractions, and amenities.


This is a site by National Geographic which gives background information on Banff National Park.


Tourism politics in the USA can only be understood by examining it in the context of federalism. Each governmental level has its own tourism dynamics, interests, and problems. By examining the evolution and structure of tourism in the USA, one can understand why city and state governments are increasingly involved and why the national government fails to accord more scarce resources to national tourism efforts. Through the use of questionnaires and interview data, it becomes clear, however, that in the process of continuing tourism politics as usual, the national and even local public interest may be sadly neglected.


Abstract: The growing level of international competition in the tourism marketplace, and the length of lead times for developing the major facilities necessary to meet this competition,
have made strategic level planning increasingly imperative. A critical early stage in the strategic planning process is the formulation of a destination vision a statement that provides an inspirational portrait of a desired future for the destination. Typically, such visions are market-driven. For certain destinations however those having a very special meaning for stakeholders the vision formulation process may be driven, not by market forces, but by the values (the deeply held, enduring beliefs) of those elected. One example of such a vision is presented in this paper. It concerns a vision developed for a unique national treasure and a global tourism icon. The treasure/icon in question is Banff National Park, located in the province of Alberta, Canada. 1999 Elsevier Science Ltd. All rights reserved.


Abstract: Elected officials in Montgomery County, Maryland are implementing a variety of initiatives designed to encourage residents to walk and bicycle more. This article describes some of these initiatives and the larger implications of the county's strategy. The county has created an award that recognizes individuals who help others clear ice and snow from county sidewalks, is committed to building and maintaining sidewalks, has built pedestrian bridges and trails, and has provided traffic calming measures to create a more walking-friendly environment. The county is now considering changes to road design to better serve pedestrians. Land-use policies that have led to the creation of transit-friendly, pedestrian-oriented projects have also been adopted. This multi-faceted emphasis on policy, infrastructure and program development is consistent with a broader message that supports active lifestyles. Montgomery County has been successful in establishing 3 important mechanisms for linking planning with health: (1) the ability to coordinate across departments through mandatory referrals and coordinated project reviews; (2) elected officials and county staff that are increasingly aware of the importance of using residents' health status as a barometer of quality of life; and (3) a solid institutional base upon which to negotiate emerging challenges.


This is a white paper from the Trust for Public Land. The paper discusses the history, importance, and economic benefits of green space in the United States.

This report quantifies the savings and costs of performing xeriscaping techniques and implementing xeriscaping programs in the city of Austin, Texas.


Abstract: Traffic congestion in the United States has soared largely because road building has been outpaced by population growth, as well as because consumer behavior has changed, including increases in both car ownership and distances between home and workplace. In 2003 alone, Americans spent 3.7 billion hours in traffic. Congestion costs the average commuter 47 hours each year, and free flowing travel is less than half of what it was in the 1980s. Rising numbers of "extreme commuters" travel 90 minutes or more to work every day. Commuting may result in reduced community involvement and leisure pursuits, as well as medical and psychological malaise. In order for congestion to be alleviated, government cooperation and support is necessary, including interaction between federal, state, and local governments. The author discusses congestion mitigation, including expansion of both roads and public transportation, and high-tech traffic management systems, as well as congestion pricing, including tolls and highway leasing to private enterprises. Technological innovations, including sensors and cameras, are highlighted. One system is the Automated Traffic Surveillance and Control system in use in Los Angeles. The author discusses congestion crises and mitigation efforts in a number of cities, as well as congestion's predicted future. Although Los Angeles congestion is among the worst in the nation today, it is estimated that by 2030, conditions will be even worse than present day Los Angeles in eleven urban areas, including Minneapolis and Atlanta. Boxes describe the worst commuter cities and counties nationwide; innovative congestion pricing (known as "cordon tolls") underway in London; and traffic operations in the Houston, Texas, area.

http://www.planningreport.com/tpr/?module=displaystory&story_id=1248&format=html

Millennium Park has dazzled visitors and natives to Chicago alike for its seamless integration of interactive open space into an inviting, attractive, and boldly planned urban environment. With ongoing plans for a major Downtown park to be built in conjunction with the Grand Avenue Project, Los Angeles would do well to learn from the design and programming successes of Chicago’s Millennium Park. In order to gain insight from the creation of Millennium Park, TPR was pleased to speak with Ed Ulhir, the director of design, architecture, and landscape for Millennium Park. Abstract from website


Article discusses the projected and actual economic benefits created by Millennium Park and subsequent development.

The article presents a traditional and new view of parks and green space. Author discusses economic and community benefits of having green space.


The article reports on the development of green roof systems by Charlie Miller, founder and president of Roofscapes Inc. in Philadelphia, intended to regulate storm water runoff. The green roof system has been pioneered in Germany in the middle of 1960. Joachim Tourbier, a landscape architect, as well as Miller's friend has sent him German technical books about green roofs which he translated and studied. According to Miller, green roof systems are impressive since it is a large industry in Germany with several competitors and different developments. The survey conducted by Green Roofs for Healthy Cities in 2005-2006 shows a growth rate of more than 25% compared from the 2004-2005 survey. Abstract from database.


Article discusses basic applications of graywater use in rural and urban areas as well as applications specific to the Colorado area. Also, the author discusses benefits and possible health hazards of graywater reuse.


Website serves as the Colorado Water Wise Council avenue to disseminate information about the practice of xeriscaping. The website discusses the benefits of xeriscaping and also offers several examples. Website also serves as a resource tool for those interested in learning more about xeriscaping or xeriscaping seminars.

Zhang, Ming; Chang Yi. “Can Transit Oriented Developments Reduce Austin’s Traffic Congestion?” Texas Transportation Institute. 2006.

Abstract: Transit-Oriented Development (TOD) is expected to generate a long list of benefits, of which reducing car use and relieving traffic congestion are among the top. To what extent can TOD contribute to reduce regional congestion? This paper presents an
empirical study of Austin, Texas where a new commuter rail line is under construction and TOD proposals are being developed. The study applied the four-step travel demand modeling to estimate regional travel outcome in one base scenario (No TOD) and two TOD scenarios for the year 2030. Scenario design considers Austin’s TOD ordinance and the All-System-Go Long-Range Transit Plan. Results of the study confirm that TOD would have a great potential to improve regional travel, should it be fully implemented. The improvement is indicated by several measures. First, TOD is estimated to reduce daily person miles of travel (PMT) by 10-12 million in the region as a whole, or by 3.5-4.5 PMT per person. Second, vehicle miles of travel (VMT) by the driving modes [single occupant vehicle (SOV) and shared ride (SR)] would drop by over 20% while travel by transit and walk/bike increases. The net VMT reduction ranges from 21-27% under the two TOD scenarios. Finally, resulting from TOD practice, the portion of congested roadway in the Austin region is estimated to reduce by 2.2 percentage points, or nearly 700 lane miles. These results provide strong evidence to support TOD practice.


Abstract: Combined wetlands and infiltration ponds are cost-effective end of pipe drainage solutions that can be applied for local source control as part of urban development and regeneration. The aims of this case study were to assess constraints associated with the planning, design, and operation of these ponds, the influence of aquatic plants on infiltration rates, and the water treatment potential. Storm runoff was first stored and treated in a constructed wetland before it overflowed into parallel infiltration ponds of which one was planted and the other one was unplanted. Three international best management practice design guidelines failed in practice. The presence of macrophytes in one infiltration pond had no significant influence on the drainage properties. The water quality of both ponds was not acceptable for water reuse directly after the system setup. Filamentous green algae within the unplanted pond were blooming in spring and summer creating an aesthetically unpleasing pond surface area. After 1 year of operation, barley straw and Carassius auratus (common goldfish) were introduced successfully to control the growth of algae.

1000 Friends of Florida, “Transportation.” www.1000fof.org/Transportation/