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Mark S Lindhult

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Editors: Julius Gy. Fábos, Mark S. Lindhult, Robert L. Ryan, Madeline Jacknin

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Effects of Detention for Flooding Mitigation under Climate Change Scenarios—Implication for Landscape Planning in the Charles River Watershed, Massachusetts, USA

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Introduction

Climate change has posed increased risks to environmental hazards (e.g., flooding, droughts, hurricanes) in addition to new challenges under climate change impacts (e.g., early snow melt, sea level rises, heat waves). Floods are omnipresent in almost every city in the United States and account for the most economic losses than any other single geophysical hazard (White and Haas 1975). Previous climate change studies have suggested promising trends of increasing temperature and changing precipitation patterns as well as increased intensity and duration of storm events that are likely to result in more flooding events in the Northeast region. Flooding mitigation strategies have been focusing on structured engineering solutions such as dams and dikes along streams and rivers since the late 1910s. In recent decades, in lieu of conventionally engineered infrastructure, scholars have called for "soft" strategies such as green infrastructure (Thomas and Littlewood 2010) and land use planning (Burby 1998; Godschalk 2004) for comprehensive hazard mitigation and stormwater management integrated into planning and design interventions for flooding mitigation.

Stormwater detention is among the most prevalent stormwater management practices for flooding mitigation; however, the perceived benefits could be overestimated without empirical study (Beecham et al. 2005). In addition, planners are now facing challenges to cope with uncertainties from climate change impacts under a paradox between making room for water while managing growth in land use planning. For local planners and stakeholders to make adaptive land use decisions for climate change, this paper aims to answer two key questions: (1) to what degree and in what way does climate change have impacts on long-term flooding hazards? (2) how much detention area in the watershed would be needed for mitigating flooding hazards induced by climate change? And what do the results imply for innovations in landscape planning?

Climate Change and Urbanization Impacts on Flooding and Stormwater Management

Climate change is likely to increase intensity of precipitation pattern in its magnitude and duration and affects the global hydrologic cycle (Frederick and Major 1997; IPCC 2007). The effects of climate change intensify the intensity and frequency of storm events and therefore magnify the urban hydrological impacts (Wood, Lettenmaier, and Palmer 1997). More frequent and intense storm events are likely to occur in some areas such as the New England region (Rock et al. 2001). The consequences of irregular and intensified flooding and drought events have significant impacts on populated urban regions where current water infrastructure is designed based on past climate trend and conventional knowledge. In addition, more frequent flooding and intensified storm events will cause more damage in populated urban regions. Therefore, alternative flooding mitigation and stormwater management are needed for accommodating climate change effects.

Man-made land cover changes derived from urbanization process contribute to climate change that has altered natural hydrological cycle and led to more frequent and intense floods. The increased impervious land cover is the leading cause for excessive runoff, lack of infiltration, and insufficient aquifer recharge (Booth and Jackson 1997; Brabec, Schulte, and Richards 2002). Consequently, human-induced flooding at various scales remains a problem in urbanized areas. Under climate change impacts, climate-induced flooding as a result of increased intensity and duration of storm events are likely to affect the New England region (IPCC 2007; Rock et al. 2001). Compounded by population growth in the Boston Metropolitan Area, more people are likely to be exposed to climate-induced disasters. As a result, landscape planning for enhancing capacity of absorbing urban flooding hazards has become a top national priority in cities (Godschalk, 2003; Beatley, 2009).

Green Infrastructure for Climate Change

Green infrastructure has been widely accepted as alternative stormwater management for restoring or enhancing ecological services. It is defined as a system that "uses natural systems—or engineered systems that mimic natural processes—to enhance overall environmental quality and provide utility services" by the United States Environmental Protection Agency (EPA). The enhanced ecological functions consequently help to increase resilience of ecosystems to absorb environmental impacts from climate change.

Green infrastructure includes both structural and non-structural stormwater best management practices (BMPs). Structural BMPs emphasize ecological engineering design such as bioswales or rain gardens, porous pavements, and green roofs. Non-structural BMPs emphasize policy and regulations that help to alleviate the root of the problem—urbanization—and engage the public (Urbonas, 1994). Non-structural BMPs include a wide range of strategies, including but not limited to land use planning, natural resources management, streams and wetlands restoration (Ellis and Marsalek, 1996), and smart growth. Recent research suggests that the integrated structural and non-structural approach in green infrastructure plays an important role in mitigating impacts from urbanization and climate change impacts as well as an adaptive planning strategy for climate change adaptation strategy in spatial planning (Gill et al, 2007). Finally, adaptive green infrastructure planning and design serves as a critical path toward urban sustainability and resilience (Ahern, 2011; Wise, 2008)

Study Area

The Charles River watershed was one of the nine watersheds in the Boston Metropolitan Area. The entire 778 km^2 watershed is predominately within the Boston Metropolitan Area with minimal coastal lines so that the influence from costal flooding was minimum in this study. In addition, the watershed is comprised of 35 municipalities, including the City of Boston, and is the most densely populated. The watershed consists of the most environmental justice populations defined by the Massachusetts Office of Geographic Information (MassGIS)—implying potential higher social vulnerability to climate change impacts; therefore, research for climate change impacts in this watershed is particularly timely and critical for further social-economic impact studies.

Methods

Soil and Water Assessment Tool (SWAT) is a hydrological model for simulating baseflow and estimating hydrologic budgets in the watersheds (Arnold et al. 1998). It has been successfully employed for evaluating impacts of land use change on hydrology (Bormann et al., 2007), stormwater BMPs effectiveness on water quality improvement (Hunt et al. 2009) as well as climate change impacts on hydrology (Bekele and Knapp, 2010). Therefore, SWAT is suitable for evaluating stormwater BMPs under land use and climate change impacts in the urbanized watershed.

Key inputs for SWAT modeling were land use and weather data. The land use baseline was based on 2005 data from MassGIS. The temperature and precipitation used to build climate change scenarios were generated from weather program using historical data from 1990 to 2011. Climate change sensitivity assessment (Ficklin et al. 2009) from a combination of three weather variables were examined—mean temperature (0, +1, +2, +3˚C), mean precipitation (0, +10, +20%), and variation of precipitation(0, +10, +20%)—resulting a total of 36 climate change scenarios, include the baseline climate (0,0,0). The SWAT run was based on a calibrated watershed model from the previous study (Cheng, in preparation). The output was stream outflow used for building long-term flooding Hazard Index (HI) (Figure 2). HI was defined as the probability of number of days in a study period of 45 years when the stream outflow (Q_i) would exceed the baseline bankfull discharge volume (Q_0) under baseline climate.

$$HI = P\,(Q_i > Q_0) = \frac{\text{Days when } Q_i > Q_0}{\text{365 days a year * 45 years}} \tag{1}$$

P: Probability
Q_i: Stream outflow (mm) under climate change scenario
Q_0: Baseline stream bankfull discharge volume (mm)

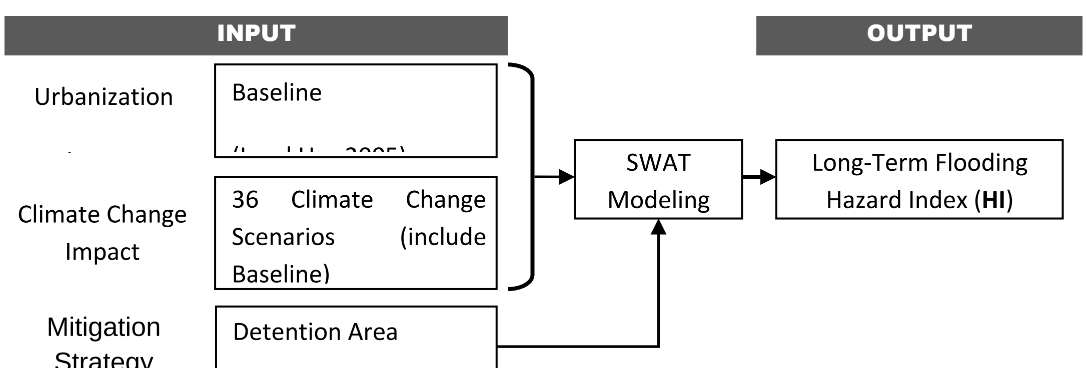

Figure 1. SWAT modeling inputs and outputs. Diagram by the first author.

Assessing detention area for flooding mitigation strategy was conducted an impoundment water routing function in SWAT for modeling water that was temporary stored for water supply or flooding control and mitigation. Besides reservoirs, wetlands, and ponds, which were controlled by land use in this study, the function of depressions/potholes was employed to simulate the function of stormwater detention areas. Potholes are closed depression areas in the watershed functioning as temporary water storage areas. Surfacewater and precipitation are the main source of the inflow and when storage exceeds the maximum volume assigned for each pothole, the excessive volume then becomes surfacewater and contributes to stream baseflow. In addition to water overflow, potholes loose water through evaporation and seepage during the day. In SWAT, only one pothole in each subbasin was created through assigning one hydrologic response unit (HRU). To optimize water storage function in the model, HRUs with the largest AGRL SWAT land use category (i.e., agricultural and recreational land uses) were selected as potholes. In addition, 100% of the selected HRU area was assigned as the drainage area for each respective pothole (POT_FR=1). Furthermore, for the consistency of the long-term flooding hazard defined in this study, the maximum storage for each pothole was the volume of bankfull discharge volume in respective subbasin. Finally, linear regression method was employed for analyzing the relationship between the percentage of detention areas in the subbasin drainage areas and HI under each climate change condition. Two main independent variables were land use and detention areas in the drainage areas of the respective subbasins; dependent variable was HI under 36 climate change conditions; control variable was baseline land use.

$$Y = aX + b \tag{2}$$

Y: HI of each drainage subbasin area under climate change scenario
X: Fraction of detention (pothole) area in the drainage subbasin area
a: X variable coefficient
b: Intercept constant

Results

A total area of 3.2% of the Charles River watershed area was modeled as detention in this study. In average, each of the 54 drainage subbasins had 2.9% of detention area ranging from 0.9 to 8.7% with a standard deviation of 1.5%. The regression results indicated that detention area had significant effects—10 out of 36 climate change scenarios—reducing HI value at a range between 0.0006 and 0.0028 when 1% of detention area increases in the drainage basin, without consideration of land use impacts on the watershed.

In general, the effects of detention were most effective when precipitation variation was controlled at zero percent increase; somewhat effective when temperature were controlled at 1 or 2˚C increase or a 10% increase at precipitation mean; the least effective when mean temperature increased 3˚C or at any level of precipitation variation change (Table 1). In addition, increasing mean precipitation resulted in a trend with a greater slope; increasing mean temperature had a general trend of a smaller slope. When mean temperature increased 3˚C with no mean precipitation increase and precipitation variation increased 10% and 20%, the coefficient became positive.

In order to use the results sensibly for planning, two hazard mitigation policy goals for reducing HI to zero and baseline level were examined respectively by using regression models. The value of 0.01was the HI score for the entire Charles River watershed basin under baseline land use

(2005 data) with no climate change scenario. The results indicated a wide range between 12 to 79% of detention area would be needed for reaching zero long-term flooding hazards in the watershed; a range between 0 to 22% of detention areas would be needed for reaching baseline HI under all possible climate change scenarios (Table 1). However, examining from the selected ten climate change scenarios with significant coefficients, the results illustrated an average of 14% detention area for zero HI and an average of 5% detention area for mitigating HI to baseline level (Figure 2). Among selected climate change scenarios, a steeper slope tend to result in a smaller percentage for detention area to reach zero hazards; on the other hand, a larger detention area for reaching baseline level HI would be needed.

Table 1. Regression coefficients and projected percentage of detention area required for achieving HI=0 and HI=0.01 under climate change scenarios.

Climate Change Scenarios			Regression Coefficients		Detention Area Required	
Tmp (˚C)	Pmean	Pvar	a	b	HI=0	HI=0.01
1	20%	0	-0.2806*	0.0337**	12%	9%
1	20%	20%	-0.2467*	0.0312**	13%	9%
0	10%	0	-0.1620**	0.0205**	13%	7%
1	10%	0	-0.1457**	0.0180**	13%	6%
2	10%	10%	-0.1188*	0.0166**	14%	6%
2	10%	0	-0.1092*	0.0151**	14%	5%
0	0	0	-0.1014**	0.0132**	14%	4%
1	0	0	-0.0835**	0.0111**	14%	2%
3	10%	0	-0.0763*	0.0130**	18%	4%
2	0	0	-0.0573*	0.0091**	16%	-1%
0	20%	0	-0.2361	0.0363**	16%	12%
0	20%	10%	-0.2303	0.0373**	17%	12%
0	20%	20%	-0.2299	0.0385**	17%	13%
1	20%	10%	-0.1876	0.0322**	18%	12%
2	20%	0	-0.1577	0.0277**	18%	12%
2	20%	20%	-0.1509	0.0303**	21%	14%
2	20%	10%	-0.1466	0.0286**	20%	13%
0	10%	20%	-0.1248	0.0248**	20%	12%
0	10%	10%	-0.1216	0.0233**	20%	11%
1	10%	20%	-0.1138	0.0225**	20%	11%
1	10%	10%	-0.1087	0.0196**	19%	9%
3	20%	0	-0.0844	0.0242**	29%	17%
3	20%	10%	-0.0797	0.0255**	32%	20%
2	10%	20%	-0.0795	0.0201**	26%	13%
3	20%	20%	-0.0783	0.0268**	35%	22%
0	0	20%	-0.0640	0.0162**	26%	10%
0	0	10%	-0.0618	0.0147**	24%	8%
1	0	20%	-0.0506	0.0142**	29%	9%
1	0	10%	-0.0456	0.0127**	28%	6%
3	0	0	-0.0408	0.0080**	20%	-4%
3	10%	20%	-0.0353	0.0176**	50%	22%
3	10%	10%	-0.0287	0.0158**	56%	21%

2	0	20%	-0.0178	0.0125**	71%	14%
2	0	10%	-0.0139	0.0109**	79%	7%
3	0	10%	0.0071	0.0094**	-134%	7%
3	0	20%	0.0073	0.0108**	-149%	-132%

tmp: temperature mean; pcp: precipitation mean; pvar: precipitation variation; *p<0.05 **p<0.01

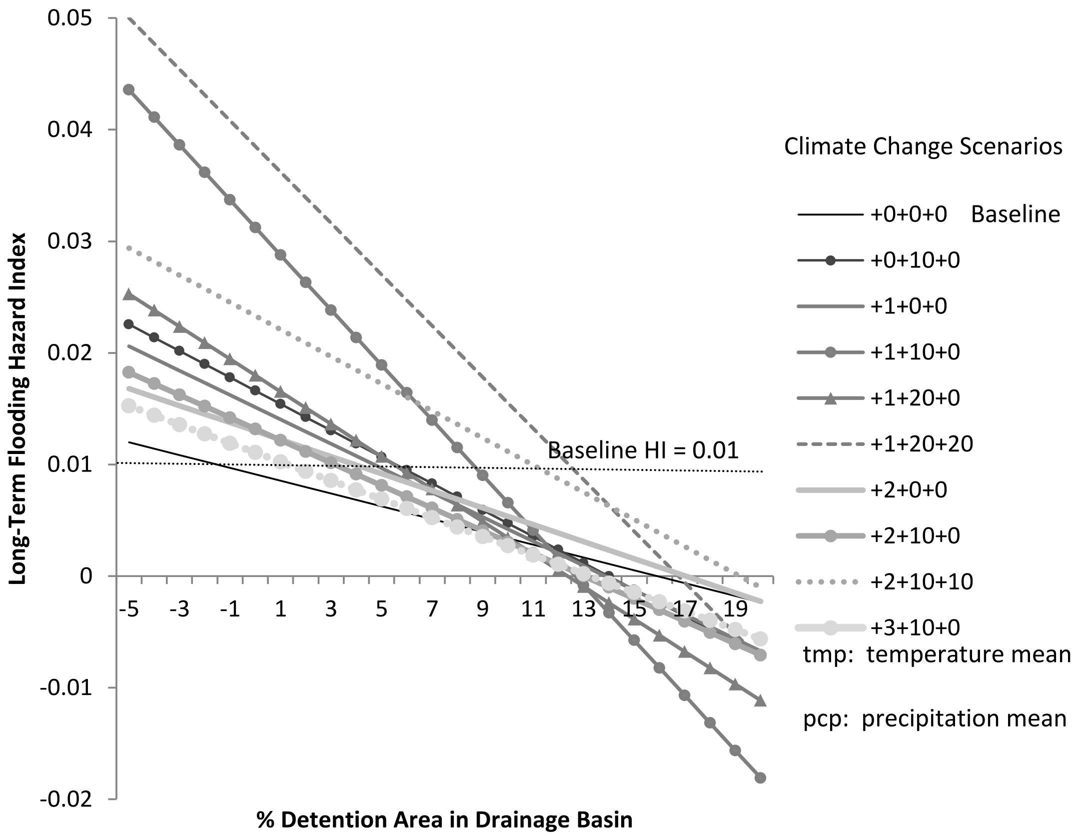

Figure 2. A range between 12 to 16 % of land area for detention function is required for mitigating long-term flooding Hazard Index to 0 under selected climate change scenarios. Comparing to current condition, a range of 2 to 9% of land area for detention function is needed to mitigate climate change impacts. Diagram by the first author.

Discussion

There was no clear threshold point for the effects of detention areas revealed under climate change scenarios due to the fact that climate change impacts on hydrology was complex and varied from watershed to watershed (Praskievicz and Chang 2009). From the results of the climate sensitivity assessment on HI under the baseline land use for the Charles River watershed, in overall, increasing temperature would result in lower HI due to higher evaporation; increasing precipitation in mean and variation would result in higher HI (Cheng et al. in preparation). Since higher temperature resulting in lower HI to begin with, it explained the insignificant effects of applying mitigation strategy. For example, detention coefficient became positive values and detention requirement became negative when the mean temperature increased 3˚C indicating that the HI was already lower than the baseline HI. In addition, it implied that evaporation played a greater role in reducing HI than applying detention area for mitigation strategy.

This study focused on detention stormwater management technique for flooding hazards mitigation. Detention area requires depressional land areas that can be inundated with water for a period of time. Applying this concept for landscape planning and design, those detention areas could possibly be applied on public recreational land use areas such as athletic fields and parks. Currently (based on land use 2005 data) Charles River watershed has 3.6% recreational land uses, including cemetery, golf courses, passive and active recreation, marina and beaches. Excluding privately owned golf courses and cemetery, only 1.7% land areas that are probable for using as detention areas, which is 2% to 7% short for reaching baseline level HI under selected climate change scenarios. Based on land use and land cover analysis, Charles River watershed has 43% of urban land uses (e.g., commercial, residential, utilities). Most of the impervious areas are derived from streets, building footprints, parking lots, and staging areas that are mainly under urban land uses and comprised 21% of total watershed area. With limited natural open space and recreational land use areas that could possibly allowed for detention area in urbanized watershed, in order to reach policy goals for reducing long-term flooding hazards, more innovative and aggressive land use planning and design would be necessary on both impervious and other pervious areas. For example, detention techniques could be implemented on residential lots for site scale detention. In addition, a recent project in Chicago has successfully implemented detention technique underneath impervious road surfaces. Therefore, retrofit BMPs to provide holistic green infrastructure network through urban systems (Ellis 2012) plays a critical role in mitigating climate-induced flooding hazards.

Conclusion

This study has demonstrated a range of potential climate change impacts on long-term flooding hazards and the effectiveness of using detention area for mitigating flooding hazards. Since climate change has implications in long-term environmental hazards associated with water resources and management, the findings were particularly timely for landscape planning for climate change. We examined two hazard mitigation policy goals for achieving zero and baseline level long-term flooding Hazard Index. Even though the zero percent chance of long-term flooding hazard was an extreme policy goal, it provides an upper boundary for developing policy frameworks with intermediate feasible goals. In addition, It is worth noting that detention area alone is limited for flooding mitigation and is no substitution for integrated land use and watershed management strategies such as open space and floodplain protection (Brody and Highfield 2013) as well as engaging the stakeholders and the public to “Make room for River” (Wolsink 2006) for both long-term and short term flooding hazards mitigation. Moreover, an innovation in planning and design to provide multiple-uses in recreation and public lands as well as detention and infiltration under impervious surfaces in urbanized areas plays a criticatl role in integrating stormwater management into green infrastructure system network for climate change adaptation.

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The Role of Landscape in Achieving Water Sensitive Cities: the importance and potential of landscape architecture in influencing change towards sustainable water use in Australia's urban environments

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Highlights

- The existence of desensitised relationship to water in Australian cities is examined for causes and its impacts on sustainable water use are discussed
- The gap between achieving the vision of a water sensitive city and current research efforts in the field is identified
- The application of design research from the discipline of landscape architecture is identified as necessary for understanding relationship to water in urban environments
- Greater engagement of urban design processes is shown as necessary in order to achieve the vision of a water sensitive city
- How the engagement of urban design processes, specifically through landscape architecture, is outlined

1. Introduction

This paper discusses research related to generating water sensitive cities in Australia, using Perth, Western Australia, as a site for testing potential applications of landscape architectural design research to do so. The concept of water sensitive cities has newly emerged and its full ramifications have yet to be explored. There is a need particularly to better engage with how cities are designed in order to readdress the relationships to water within them, with a view to realigning them as water sensitive. The research discussed in this paper has been conducted as part of a Doctorate of Philosophy at the University of Western Australia that has yet to be completed.

The idea of a 'water sensitive city' is now seen as the ultimate goal of water sensitive urban design. Without addressing the entirety of urban water systems, it is questionable that the change required to realise a water sensitive city is achievable. There needs to be exploration into what it means for an urban environment and its inhabitants to be 'water sensitive.' This paper discusses how this might be done through design based research in landscape architecture. It outlines the research findings to date generated through a critical enquiry study, which identified the key issues that are proposed as the focus for a responding design phase.

2. Background and Literature Review

The complexity of the relationship between water and its users are essential issues for consideration if we are to achieve more sustainable relationships with water through water sensitive cities. In the book *City of Flows: modernity, nature, and the city*, author Maria Kaika explains the breadth of these issues in western urban environments. Kaika tracks the path to complete separation of water from the individual by the modernist period of urban design, by which time all water systems were rendered invisible beneath the surface of an idealised relationship with 'nature'. Nowhere is this separation greater than in what she describes as "the private sphere... of newly created private suburban paradises" (Kaika 2005 p 48). In this consequent "new" realm, the individual "would have no reference (aesthetic or functional) whatsoever to the production relations underneath... complet[ing] the severing of ties between surface appearance and the underground flows and networks." The importance of this disconnected relationship as a consequence of the design of the urban realm is especially pertinent to water sensitive cities. The need to consider how a desensitised relationship to water is embedded in the design of the urban realm is missing and is therefore a focus of this study.

The role of urban design in shaping relationships to water systems in Australian cities is discussed by Patrick Troy in *Troubled Waters: confronting the water crisis in Australia's cities*, for which he is both editor and a contributor. Troy explains the relationship between the design of cities and of water systems as a reciprocal one that has occurred for the last one hundred and fifty years, based primarily on Edwin Chadwick's water-based sanitation solutions first appearing in the UK in the 1840s. He advocates reviewing this relationship with the aim of identifying and breaking down dependency on potable water for all water uses (Troy 2008 p 197). Troy's argument is that it is necessary to break down the relationship between urban design and urban water systems, especially with regard to their inbuilt, large-scale, consumption-based, supply and waste removal processes.

The document *blueprint2012: Stormwater Management in a Water Sensitive City* from the Centre for Water Sensitive Cities in Australia, also discusses the need to move away from existing water management processes:

"*The Water Sensitive City requires the transformation of urban water systems from a focus on water supply and wastewater disposal (the 'taps and toilets' water utilities) to more complex, flexible systems that integrate various sources of water, operate through a combination of centralised and decentralised systems, deliver a wider range of services to communities (e.g. ecosystem services, urban heat mitigation) and integration into urban design*" (Wong et al. 2012 p 3).

The *blueprint 2012* is primarily focused on stormwater systems and specifically their transformation as the means to achieve a water sensitive city. While the described 'transformation' addresses points that align with Troy's proposed changes, it misses the reciprocal nature of the relationship between how cities are designed and how water is managed. There is an acknowledgement "...that other parts of the urban water network such as water supply catchments, sewage management, demand management etc., are also important in progressing the objectives for a [sic] water sensitive cities" (2012 p 1). It must be acknowledged that stormwater is only a *part* of this transition and that the benefits linked to it, such as the protection of waterways, would potentially grow exponentially if the water sensitive city first sought to break down inbuilt, reciprocal relationships between the way we manage water and the way we build our cities.

The "form" of urban environments is described by Troy as both created by and a creator of demand for water in contemporary Australian cities (2008 p 191). Stephen Dovers, a contributor to *Troubled Waters*, explains the relationship between water and cities as essentially about the individuals *using* the water, as well as the institutions and systems that harness and deliver it to them (Dovers 2008 p 84). Dovers says "[w]e talk of 'water management' but really it is about managing people, whether individually or collectively in households, firms, communities and cities." Within this context Dovers explains that institutional change is a central issue to be addressed in achieving more sustainable use of water and this must be achieved through governance including "state, private sector, civil society and public" interactions (2008 p 85). Dover distils this down further, saying that reform and policy – the tools of governance – should be directed at "how human behaviours are managed." The difference between this sort of approach to sustainable water use in cities and *blueprint2012'*s focus on stormwater as the key to the water sensitive city is striking and demonstrates the need for further consideration on how to achieve 'sensitivity'.

A key question for research in the field of water sensitivity is therefore to what degree the design of the city can engage with the processes that drive water use. Human behavioural change or the harnessing of an underutilised, problematic resource like stormwater may both only go part way to generating more sustainable water use. It is clear that the use of water and the design of the city occupy a reciprocal relationship. This research explores how landscape architecture can assist in finding mutually beneficial process of designing urban environments and re-designing the management of water systems by focusing first on relationships to water.

3. Methods

This research uses a mixed methodology of written work and design work. Both written and design work follow a Subjectivist research paradigm, as defined by Deming and Swaffield in the text *Landscape Architecture Research* (Deming and Swaffield 2011). The written component is defined as a process of critical enquiry, building a theoretical perspective in which the origin, history, practice and proposed future of the water sensitive city are examined. The design phase of the research responds to this examination using a projective design research strategy. In doing this the limitations as well as the possibilities of what landscape architectural design tools can do must be considered. As discussed by Deming and Swaffield, design is not a "science" (2011 p 221). It is instead "a mediated way of engaging the world based on situated knowing and *imaging.*" Both the written work and design components work towards the research goal of asking the essential questions associated with Subjectivist research of "how might things be done differently?" and "what are the consequences?" of an existing condition (2011 p 36). The findings generated in seeking to achieve this goal then inform the aim of the research project. This is to test the ability of landscape architectural design research to generate a response to the challenge of achieving the vision of a water sensitive city.

The paradigm of Subjectivity lists projective design as a research strategy. In projective design the act of design itself is the creator of new knowledge. For this to be done successfully design processes and outcomes must be transferrable as knowledge to more than just the specific problem or question explored. Deming and Swaffield explain this by saying "[d]esign only becomes an autonomous research strategy when it produces new generalisable knowledge about the world through its purposes, protocols and outcomes" (2011 p 206). They characterise projective design as "systematic" and concerned with the "enhance[ing] our understanding of the relationships between the world as it is... [and] what it might become" (2011 p 209). Under this definition, projective design in landscape research has the ability to re-imagine the urban realm and water systems within it.

The written component of this research is presented as a series of three essays, each answering a question that collectively equate to a scoping out of the issues, challenges and future vision of the water sensitive city in the context of Australia. The discussion arising within these essays is proposed to constitute the first half of the thesis' findings.

The second phase of the research is being undertaken as a series of design processes, following the strategy of projective design. The design phase responses to the written component of the research, first in the form of a brief, prepared as a design manifesto for achieving water sensitive cities. The next and current component of design work explores relationships to water in the study site of Perth, Western Australia. This begins with a series of 'evidence walks' in which the presence of water in key locations related to the form of the city and its hydrology is documented. Proposed further design processes include representation of water and its relationship to other systems, intended to also communicate conceptual scenarios and proposals for a more 'sensitive' relationship to water in Perth**.**

4. Results

The results achieved in this research so far are the outcome of the written phase of critical enquiry. The written work represents, through discussion and argument in essay style, the scope of the task required to achieve a water sensitive city in line with the vision and theories it is based on. As this begins with an examination of the use of water in the cities of western societies from the time of industrial revolution, it is not possible in this paper to provide a full presentation of the outcomes. Instead this paper will discuss in summary three of issues that were identified as critical for design research to address.

The first of these is the mismatch between the vision of a water sensitive city as it is currently written about and promoted in Australia, and its targeted focus on stormwater in practice. Instead it is proposed that the relationships with water on behalf of individuals in urban environments must be the primary focus of the water sensitive city in both.

Water sensitive urban design in Australia to date promotes a tenuous and problematic 'naturalistic' aesthetic. The *blueprint2012* proposes a relationship between stormwater management and landscape systems to generate a new infrastructure in urban environments. This infrastructure is described as "a network of green and blue corridors of open spaces and productive landscapes that also detain flood water..." (2012 p 11). The development of a new infrastructure that hybridises water management and landscape systems holds great potential, but it must be acknowledged that there are potentially intrinsic negative outcomes for water in this approach, the most potent being representations of nature. Kaika proposes a re-framing of relationships to water by redefining the concept of 'nature'. She uses the example of drought to demonstrate a redefinition of 'nature' as "socially produced" and no longer "external to society (or indeed to the socio-natural hybrids called modern cities)" (2005 p 163). In the case of drought, Kaika explains that breaking down the myth of the natural as separate or external to cities could mean "water shortages would no longer feature only as the direct outcome of a prolonged dry period; rather, they could be understood as the outcome of long periods of interaction between available resources, human labour, and the economics, politics, and culture of urbanisation and water use." To date there has been little critique of the aesthetic of water sensitive urban design and consequently the proposed water sensitive city. This alone points to a need for a much greater engagement with the design disciplines, and especially landscape architecture. The enquiry process found that a major missing element from the vision of the water sensitive city is a discourse about how it uses aesthetics, and what this means with regard to its ultimate aim of a sensitive relationship to water within urban environments.

The second outcome of the written work is the identification of barriers to change embedded within the urban realm and a discussion on their impacts. These barriers are complex and are the result of interaction between many factors, including cultural and historical relationships to water, the position of political institutions as controllers and providers of water, water based sanitation for human health and the dominance of engineering in shaping large scale water infrastructure across Australia. At their worst these barriers result in an 'out of sight, out of mind' attitude to systems of water, representing one of the greatest challenges to the notion of water sensitivity and all it seeks to achieve. These barriers are also the result of the legibility of water in urban design processes, pointing to the need for design research.

In the introductory essay of the text *Water Urbanisms*, titled "Water and the City," Kelly Shannon demonstrates urban design's disconnection with water over the nineteenth and twentieth century. Shannon scans the "classic handbooks of urbanism – Raymond Unwin [1909], Werner Hegemann [1922], Harold Maclean Lewis [1949]" and concludes that "one does not find a single substantive component that attends to the relation between water and urbanity" (Shannon 2008 p 5). This is in opposition to what Shannon describes as a previously-existing "tradition of more than 2000 years in which the water structure – artificial or natural – was a keystone of the constructed urban structure... [T]he definition of the city (structure) was unconceivable without river(s) or canal(s) as cornerstones" (2008 p 5 - 6). The loss of water systems as the 'conceptual' origin for the structure of the city is explained by Shannon as the result of the characterisation of water as the agent of sanitation. The perceived primary role of water as the method for achieving sanitation changed our relationship to it with vast consequences for the design of the city:

"*...water became an absent presence in modern urbanism, an engineering trick – out of sight and, consequently, out of mind. Sanitised, canalised, covered, cleaned, piped – hidden. Urban water was absent*" (2008 p 6).

This was not the only cause of a disconnected relationship to water within urban environments and therefore a barrier to change. Further to the 'engineering trick' of making water disappear through pipes and drains, engineered systems were built on a scale never seen before to capture, redirect, and discharge the volumes of water that cities began to demand. In his research titled "Down the gurgler: historical influences on Australian domestic water consumption," Professor Graeme Davison of Monash University outlines that "[o]ur present ways of using water are a product, not or primal needs, but of history" (Davison 2008 p 38). As water has been made readily available through feats of engineering our reliance on supply has grown in volume and in function. Water is still the agent of sanitation, but its meanings and uses have compounded into a position where its use is now unconsciously incorporated into much of daily urban life. Davison summarises this position, describing our relationships to water in Australian cities as "shaped both by culture (tastes, fashions, perceptions of health, virtue and comfort) and by path dependency (the particular array of technologies, governmental and pricing regimes we have created to supply and use water" (Davison 2008 p 38). In creating a situation of path dependency Australian urban societies have reached a point where they are seemingly locked into the processes of control, supply and disposal that the design of the city has steadily relied on as given over the course of the last century. How design might address barriers to change, particularly through processes of revelation, has therefore become a focus of the design phase.

The third and final finding from critical enquiry included in this paper is the scope of change required. The scale of this is potentially colossal and must at least encompass cultural, social, political, economic, infrastructural and environmental systems that relate to water. Within this discussion the landscape architectural design research processes that may assist in this are outlined. Landscape architectural design, and in particular theories of landscape urbanism, are highlighted as capable of generating synthesised responses that can tackle a range of issues with respect to their individual complexity, as well as their combined impacts. Ultimately the written phase of the research proposed that landscape architectural design research using landscape urbanist theories is the best method for exploring how to achieve sensitive relationships to water in Australian cities.

Much of the most recent discussion in landscape architectural theory has been about a move away from being the 'exterior decorators' of the built environment towards an engagement with the systems of landscape and by extension all that connects to it, from politics to ecology to economics. The text *Recovering Landscape: essays in contemporary landscape architecture* is an important example of the examination of landscape architectural theory with regard to its more recent developments and possible future. Editor and contributor James Corner in his essay "Eidetic Operations and New Landscapes" proposes what he describes as "[a] move away from ameliorative and scenographic *designs* towards more productive, engendering *strategies."* By undertaking this repositioning of landscape towards a strategic, interventionist focus, Corner outlines a "necess[ary] parallel shift from appearances and meanings to more prosaic concerns for how things work, what they do, how they interact, and what agency of effects they might exercise over time" (Corner 1999 p 159 - 160). Corner advocates "[a] return to complex and instrumental landscape issues." In this context landscape's position "involves more organisational and strategic skills than those of formal composition per se, more programmatic and metrical practices than solely representational." This positioning of landscape architecture as concerned with "how things work, what they do, how they interact" and their "effects... over time" was found to demonstrate the real potential of landscape architecture in imaging, developing and eventually achieving the water sensitive city.

The water sensitive city is meant to be a realisation of integrated water management (IWM) processes, usually referring to urban environments specifically rather than the broader context of IWM theory, much of which is concerned with water resources outside of cities. The *blueprint2012* clarifies the function of a water sensitive city as an environment "in which urban water cycles are designed and managed as integrated systems enmeshed with urban design and communities..." (2012 p 3). The concept of integrating water systems is a central issue for the future development of a vision for a water sensitive city. A finding of this research has been the identification of a parallel with integration theories, most importantly its strategic, systems-based processes which mirror similar conversations in landscape architecture. An example of this is the theory of landscape urbanism, which explores systems-based, synthesised design responses.

Charles Waldheim, who named the theory, describes landscape urbanism as "a new language" in which landscape becomes central to all other processes (Waldheim 2006a p 19). Waldheim credits landscape as the "most relevant disciplinary locus for discussions historically housed in architecture, urban design or planning" (Waldheim 2006b p 37). In landscape urbanism landscape architecture becomes the discipline most able to realise the whole-of-system approach it has always claimed but not necessarily achieved. Very significantly, landscape urbanism has the capacity to support change through strategic interventions that address systems other than water, an essential component of achieving sustainable water management within integrated water management theory (Lenton and Muller 2009).

Integration is used in integrated water management to mean the coordination of specialised systems in water (Lenton and Muller 2009 p 8). It also recognises that all systems are interconnected. Landscape urbanism is the realisation of a discipline breakdown and therefore the coming together of previously disparate disciplines. The presence in both fields of trans-discipline processes demonstrates another example of an existing alliance between them. Integrated water resource management and landscape urbanism both understand the world as dynamic, shifting and evolutionary. They do not seek a fixed end point but rather work to facilitate adaptive design. There is no end point in achieving integrated water resource management but rather the intention is to achieve continual, responsive and adaptive change (2009 p 13). Similarly landscape urbanism is described by Corner as "a kind of urbanism that anticipates change, open-endedness, and negotiation" (2006 p 31).

What this demonstrates is the potential of a synthesis between theories of landscape urbanism and integrated water management to break down and reconstruct our relationships to water and rebuild them as 'water sensitive' over time.

5. Discussion and Conclusion

This research has yet to be concluded and as such its findings are incomplete. What is does represent thus far is a complete examination of what it means to be water sensitive and, specifically, the gap between current research and this outcome. It shows that there is a great need to engage the design disciplines in research that explores the relationships between individuals in urban environments and the water systems they rely on. It begins to explore ways in which this may be done using landscape architectural design processes, and in particular a synthesis between landscape urbanism and integrated water management.

Efforts to find more sustainable ways of using water in Australia have the potential to benefit urban environments globally. Australia's interests in developing water sensitive cities, especially if better aligned to urban design processes, would set a global precedent that is greatly needed. The International Water Association (IWA) have called for a greater partnership between designers of cities and designers of urban water systems. They explain that this is "key to realising the aspiration of Cities of the Future" and should involve "the expansion of collaboration of the water sector to include those responsible for all facets of city planning, infrastructure and service delivery" (Binney et al. 2010 p 1). A reciprocal broadening of urban design processes to better engage with water management has been identified as missing in the discourse of water sensitivity in Australia. This research represents an example of working towards achieving this through landscape architectural design research.

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Finding Our Way: Urban Waterway Restoration and Participatory Processes

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In this paper, we explore some of the challenges encountered in organizing multiple stakeholders for purposes of revitalizing an urban waterway. Drawing primarily from positive experiences with a creek revitalization project in Syracuse, New York, we identify several factors concerning the context and challenges -- both material and social -- that have helped to shape the outcomes. Several of the popular models for engaging stakeholders in waterways projects are discussed, especially as they have been used communities in other parts of the U.S. that have faced related challenges. We seek to identify key points and lessons that can help inform others about participatory processes in communities coping with water-related environmental justice issues.

Introduction

Some of us remember growing up and playing near small creeks, streams and bayous near our backyards or just down the street, but today few of us rarely experience that kind of connection with a natural water resource. Yet it is these creeks, streams and bayous that are historically connected with development of our town's villages and cities. As a result of decades of development activity and mismanagement –many of these same water resources are extremely degraded from many perspectives. Yet as some authors (Platt, 2006, Spirn 1998) point out – restoring such water features can lead to more sustainable urban places.

As Platt points out" Dozens (and possibly hundreds) of small urban watersheds in the United States and around the world…are the focus of multifarious 'restoration' strategies under complex institutional arrangements" (Platt 2006. p. 29). We know that negative impacts from urbanization accumulate within watersheds as small tributary streams contribute higher peak flows and lower base flows to waterways downstream. In many instances, like our own Onondaga Creek in Syracuse, New York –the main channel has been straightened and 'hardened' moving higher flows faster through the settled areas without flooding. These same channels in many cases are lined with sanitary sewer overflows (SSO's) and combines sewer overflows (CSO's), which may dump raw sewage plus street drainage during storm events thus severely degrading the urban waterway.

As we move to restore and/or revitalize such urban creeks, streams and sloughs – we often are within poor neighborhoods of highly diverse populations and across multiple jurisdictions. Such examples are Wildcat Creek in North Richmond/San Pablo, California (Riley 1989) and Onondaga Creek in Tully, Lafayette, Onondaga Nation, Nedrow and Syracuse, NY (OEI 2008).

[1] This is in fact, one of the key issues facing state environmental review of non-conventional permits.

In such areas we may not have agreement as to what should be done and then we have different agencies and priorities, e.g., flood control vs. water quality improvement vs. habitat restoration.

There has been an incredible amount of research and demonstration projects (Bernhardt et al 2005), which have attempted to restore segments and functions of small creeks, streams and bayous, but we maintain that a major challenge for the urban waterway restoration/revitalization is gaining consensus about what to do and how to do it. We have discovered this during the three years of working on the Onondaga Creek Conceptual Revitalization Plan (OCCRP) in Syracuse, NY and others have found this to be a major challenge as well (Platt 2006, Riley 1998).

When we say restoration we are speaking mainly from a biophysical restorative functional capacity, e.g. hydrology, water quality, aquatic and riparian habitat. When we use the term revitalization we mean that in a social and economic sense or revitalized creek neighborhoods and economically sustainable land use patterns as well as some level of biophysical restoration of the water body.

Given the different waterway objectives for both restoration and /or revitalization – there is a need for a collaborative social process for developing such projects and plans. For urban waterways such as rivers, creeks, sloughs, bayous that fall within multiple jurisdictions and affect divers stakeholders- this is especially challenging as pointed out by Platt (2006), Riley (1998) and Smardon et al (1996). So the question is where are the social process models for either urban waterway restoration and/or revitalization? We maintain there is very little guidance in this regard if one looks at the most accessible sources. So the dilemma is that we have much technical information about urban waterway restoration/revitalization, but not much social guidance if we are serious about involving multiple stakeholders in the process with varying levels of knowledge about waterway restoration/revitalization.

As we have found from our experience with the Onondaga Creek Revitalization Planning effort in central New York – watershed wide planning process transcends political and economic stratification of a metropolitan region, including both rural and urban stakeholders, and even a sovereign nation. We also found that building public awareness of rehabilitating a long neglected urban creek – can foster sense of place and community as found by others (Hopkins 2005,McGinnis 1999, Otto et al 2004). For us the Onondaga Nation, in the middle of the Onondaga Creek watershed, certainly had a deep symbolic and spiritual relationship to the Onondaga Creek and Onondaga Lake watershed.

Given these social participatory process challenges, there is little work in Europe or North America, which provides practical or theoretical process guidance. When we first started the Onondaga Creek outreach process we ‘flew by the seat of our pants’. In the latter stages of the conceptual revitalization planning process, we discovered work in Europe (Eden & Turnstall 2006, Eden et al 2000, McDonald et al 2004, Petts 2006, 2007, Tunstall et al 2000) and North

America (Carrol and Hendrix 1992, Daniels and Walker 1996, Kondolf 1998, Lubell et al 2002, McGinnis 1999, McGinnis et al 1999, Walker et al 1999).

Environmental Justice and Urban Waterways

To date much of the emphasis on stream restoration has been targeted toward rural streams, including those where specific fisheries are amenable to restoration. However, this can sometimes mean that certain streams will be simply being 'written off' and not even considered for improvement (Moran 2010). No community deserves to be discarded, and this is likely to happen to the same places that have already been subject to other forms of marginalization and injustice. The phenomenon of erasure is even more poignant in cases where public monies are used to fund projects, as it constitutes yet another transfer out of community resources.

The project, in Syracuse, was informed by perspectives from political ecology, helping to shape the process in important ways. It was acknowledged that the various dimensions of the problems in the waterscape were inter-linked, and project specialists were aware of the need to establish the project accordingly (Perreault, Wraight, and Perreault 2012). Environmental injustice signifies "compounded disadvantage at the community level," (Wakefield and Baxter 2010, 95), and part of the challenge in the project in Syracuse a matter of balance, requiring participants to stay alert to it without being overwhelmed by its scope.

The project in Syracuse illustrates how stream restoration projects can be carried out differently, bringing important ecological and social benefits to urban, nonwhite, and low-income communities. Overall, projects seeking to restore or re-naturalize waterways (or other degraded environments) have a special appeal in that they resonate with themes of 'recovery' and 'redemption,' (Light and Higgs 1996; Moran 2007).

These projects might: (a) provide amenities, including open space, green space, fishing, clean water, healthier ecosystems, and increased property values; (b) advance socio-ecological relationships by helping engage people in understanding their own community's environment, both built and natural; and (c) advance justice issues through continued interrogation of disparities in outcome and in process.

Despite the efforts of governmental grant programs, many barriers still limit the achievement of environmental equity (Riley 1989). One factor is the limited institutional capacity of many community organizations. The grant programs that typically fund stream restoration projects solicit proposals from these community groups, and while that seems positive in terms of stimulating creative initiatives and stretching limited funds, the approach also has some inherent problems. First, it usually requires a multi-partner, teaming strategy, which makes accountability for overall outcomes much more diffuse, and this dilutes and confounds efforts to achieve environmental justice. And second, since paying staff through grant-based projects requires unique skills and experience, it favors groups that have already had considerable organizational capacity. For this reason, one environmental justice scholar (Sylvia Washington) has advocated the creation of alternative institutions that allow full integration of several kinds of specialists (environmental and otherwise); she advocates "…the creation of US EPA [Environmental Protection Agency] funded Sustainable Justice Institutes at land grant universities,''(Washington 2010).

Although the need to expand public participation around environmental justice is widely acknowledged (Bullard 2002), there continues to be a dearth of support for such initiatives and few models to follow. A recent study of EPA's environmental justice small grant program evaluated 736 awards made over a seven-year period, exploring the types of projects that received support (Abel and Stephan 2008). The authors found that only 7% of the funded projects were seeking to expand public participation and deliver on the democratic and communitarian goals of remedying environmental injustice with engaged communities (ibid.); much more typical were projects with a managerial orientation and using an information transfer approach (ibid.). Thus the need for meaningful participation is clear.

The project planners were concerned about the structural factors that tend to shut out local residents. These factors include processes where public input is obtained after a plan is developed, public meetings held during daytime hours, and elevating various kinds of professional expertise over experiential, local knowledge. These things mediate against meaningful participation narrowing options and reducing quality of environmental decision making for the public good. As one theorist has observed, "the regulatory ideal of formal expertise promotes exclusion of those whose lives are most affected by environmental hazards," (Guana 1998, p. 72).

Background: Onondaga Lake and Creek

Syracuse New York is in the middle of a massive cleanup of the Onondaga Lake Watershed including a half billion dollar effort to upgrade to tertiary treatment of the main sewage treatment plant emptying into Onondaga Lake, but also another half billion dollars to remediate mercury contaminated sediment in the bottom of the same lake. As part of the water quality cleanup there is the issue of combined sewerage overflows (CSO) along Onondaga creek that dump raw sewage plus street drainage any time there is a major rainstorm. This is typical of many northeastern and Great lakes urbanized areas. EPA has called CSOs "…remnants of the country's early infrastructure," (U.S. EPA 2001). Combined sewer systems serve upwards of 772 communities, which are home to more than 40 million people (ibid.). For example, in Massachusetts, there are two-dozen communities that have CSOs, including all of the older urban area (Boston, New Bedford, Worcester, and Springfield).

In addition in the Syracuse city area there has been a history of "redlining" for the lower income residents living along the creek on the City's south side that are subjected to both the CSO's plus a history of major floods. As a result of this flooding the perceived solution along the creeks length within the city was channelization, which results in massive flow rates during major storm events. The creek within the city limits is fenced off because of safety reasons due to storm events thus limiting greenway access.

In the upper middle portion of the Onondaga creek flows through the Onondaga Nation and the whole watershed is part of their original territory and is sacred to them. Both the south side and the Onondaga Nation historical significance constitute environmental justice issues, which are described in detail by Perreault, Wraight, and Perreault (2012).

Learning From Other Urban Waterway Examples

We have examined a number of urban creek revitalization projects across the county, as part of this project and found highly varied organizational models with lesser and greater participation in decision-making (see Table 1). On one end we have large amounts of participatory efforts in the Bronx River, Onondaga Creek, and Wildcat-San Pablo Creeks. For the South Platte, Guadalupe River and Tennessee River Greenway we have periods of participatory activity, but much is done by strong leaders/facilitators. The Milwaukee River greenway is just starting so it is difficult to evaluate at this point.

We also have differences in focus, e.g., restoration vs. revitalization goals. Clearly the Guadalupe River in San Jose, the South Platt River in Denver and the Tennessee River in Chattanooga has economic development as the major driver. Whereas the Wildcat –San Pablo Creek, Milwaukee River greenway and to some degree Onondaga creek are more habitat preservation/natural river focused. Social equity is a major issue for the communities involved with the Bronx River, the Milwaukee River and the Wildcat/San Pablo creeks in the way that all creek communities receive benefits and none are disadvantaged.

Finally we have different organizational schemas throughout all these projects. We have many public-private partnerships, not-for-profits that bridge over time with different city or county administrations; urban land trusts or such organizations that raise, acquire land and/or easements and pass them on to public agencies, and organizations that organize events and activities leading to more consciousness raising and use of urban waterways. We have organizations that perform many functions and some organizational schema that separate functions among many organizations.

Methods & Results: The Process for Developing the Onondaga Creek Plan

We think it is worthwhile to describe the OCRP process to illustrate how participatory planning was used to provide 'voice' and inclusion of the diverse communities along the creek throughout the process. The Onondaga Environmental Institute (OEI) was responsible for compiling stakeholder goals and issues relevant to the revitalization of the Onondaga Creek watershed, under the advisement of the Working Group (See Figures 1-3). Public input is essential in any community development project, of course, but for us, a couple of practical concerns shaped our approach. First, we wanted to be realistic about public participation in what was bound to be a lengthy process: few citizens would be willing or able to fully participate in years of meetings for plan development. However, many more people could be reached in one-time meetings in formats designed for larger groups. Therefore, we organized meetings in ways that would be least burdensome for community members, and still allow many opportunities for developing visions and priorities (Innes and Booher 2004). Second, as in many plans to revitalize waterways, implementation of this one would be voluntary. Voluntary plans need support and involvement of stakeholders throughout the process, both to develop a sense of ownership and to increase the chance of implementation (Scholz et al. 2002, Smolko et al. 2002).

The OCRP Project Team, included four other organizations plus OEI, devised ways to gather concerns from both individual citizens and also organized groups; these two approaches, "community forums" and "stakeholder organization meetings" are detailed in the sections below. The overall goal was to assess the larger watershed community's visions and concerns for Onondaga Creek, which in turn would assist the Working Group in their development of the revitalization plan. Gathering public input prior to the development of the plan allowed themes and goals important to the community to be incorporated into the plan (Firehock et al. 2002). Figure 2 was used at the community forums and stakeholder organization meetings to explain what would happen to the input of meeting participants.

The core leadership, for the project was provided by the Working Group. The Working Group participants were recruited to represent a variety of interests and geographic areas of the Onondaga Creek watershed, and they met monthly from February 2005 to 2008. Meeting minutes document extensive detail about forming the Working Group, interaction between the Working Group and scientists and practitioners specializing in Onondaga Creek, and each step of the OCRP development process. All of the Working Group meetings were open to the public; outreach efforts were extensive and included several avenues of notification, digital and otherwise. Types of notifications included: monthly emails sent to a 300-person list (based on sign-up sheets from the community meetings described above), flyers posted in public libraries in the watershed, and newspaper announcements. The website of the local newspaper (Syracuse.com) included announcements, as did the website of several organizations including the Center for Nature Education, Onondaga Lake Partnership (OLP), and the WRVO (radio station) on-line community calendar. Informal methods of notification about Working Group meetings were used on occasion, particularly handouts and posters at local environmental events and meetings. SUNY-ESF sponsored a website which served as an additional source of information to the public.

As preparation to development of the revitalization plan components, the Working Group engaged in a learning process about the Onondaga Creek watershed; members informed each other as they shared information and experience. Additionally, the Working Group added to their existing knowledge by learning from guest speakers at Working Group meetings, selecting and participating in creek-themed field trips, participating in the goals and issues solicitation process and reviewing the Onondaga Creek 'fact sheets.'

Technical information and mapping process

Before the public input was solicited, several kinds of technical background information were developed (Figure 1 illustrates the components that make up the OCRP project.). One element, called the 'fact sheets' was produced to summarize the current situation and to be used as an interactive planning tool. These fact sheets, prepared by OEI staff, described the current state of Onondaga Creek, primarily in descriptive, technical terms. To develop the fact sheets, the OEI staff did literature searches and compiled relevant information, organized into several topical headings. Once in draft form, the fact sheets were revised following consultation with the Working Group, and they were made available for use starting in January 2007.

Another element of background information was a report, "The Case Studies Guide: Conceptual Alternatives to Onondaga Creek." This document (also prepared by OEI staff and reviewed Atlantic States Legal Foundation) was developed to help provide the community and decision makers learn from various examples of stream revitalization around the country. With details and specifics from a total of twelve cases, the guide described salient points for consideration in the Onondaga Creek planning process. This work was done concurrently as the citizen participation process was occurring.

After the fact sheet review, the Working Group developed the components of the OCRP. First, the Working Group developed and refined *drivers*, the driving forces or motivators, for revitalization. The Project Team invited local scientists and practitioners as resource experts in each topic area to advise the Working Group on possible directions for change. Next, revitalization options for Onondaga Creek were developed through a series of meetings devoted to specific topics: hydrology, biology, and land use/access/recreation. With options complete, the Working Group completed a *design charrette*, a planning exercise where ideas for revitalization were placed on a series of maps over two intense sessions.

The mapping process made the groups learning, discussion of options, and the technical information into a more tangible product. To facilitate the Onondaga Creek Working Group's design charrette, OEI created a set of planning maps, 8-10 feet in length, from aerial images of the Onondaga Creek corridor and its tributaries. OEI also developed a set of 40 cards with graphic representations (symbols) of creek revitalization options. The symbol cards were based on options discussed by the Working Group, gleaned from community input, local experts, and the literature on stream restoration practice (Center for Watershed Protection 2004, FISRWG 1998, Kloss et al. 2006, Pinkham 2000). In addition to the symbol cards, the Working Group used blank cards and markers to customize maps.

The Working Group worked on the maps over two meetings. They split into three teams: urban, rural, and 'mixed' or transitional. The urban team placed their ideas on maps of the creek corridor from the Inner Harbor to Ballantyne Avenue. The transitional team placed ideas on two planning maps that represented the residential outer edge of the city and near suburbs. The rural team covered the remaining segments. Three team facilitators with community design experience were invited to facilitate each mapmaking team. The resource experts that assisted earlier in the project were invited to return and advise the teams. For the planning map representing the Onondaga Nation territory area, the Director of the Onondaga Communications office facilitated input from citizens of the Onondaga Nation.

Once developed, the large planning maps were converted into digital representations by OEI. Symbols, notes, and additional drawings were reproduced on the digital versions as placed by the Working Group on the original planning maps. Working Group members each received a tabloid-sized set of the planning maps, to verify and review. The Project Team grouped revitalization map ideas into project areas. The bundles represent future potential project areas for potential implementation of revitalization projects. OEI developed themes for each project area based on symbol groupings. To establish priorities the Working Group reviewed and voted on their preferred potential project areas. The revitalization maps are the final products, illustrating the Working Group's symbols, bundled into potential project areas.

The Onondaga Creek Community Forums: Generating Goals

The Forums were designed to draw goals and issues from watershed residents and other interested individuals. The meetings were open to the public, and outreach strategies were inspired by the US. EPA's *Getting in Step: A Guide to Watershed Outreach Campaigns* (U.S. EPA 2003) and tailored to the needs of our local community. A communications plan was prepared for the OCRP project in 2005, outlining procedures for communicating with the media and the public. The community outreach efforts included public service announcements, newspaper stories, flyer distribution in targeted neighborhoods, via community groups and libraries, notifications to local organizations, and media kits to the local press. Several Project Team members visited the editorial board of the local newspaper, presented the project, and requested coverage and support for the project. Project Team members also gave several television and radio interviews in order to publicize the project and the community forums.

Forum locations were distributed within the watershed geographically and according to population density. Five forums were held in the City of Syracuse, two were outside of the city. Multiple types of verbal and written input were collected from participants at the forums and scribed to flip charts collected on question cards, and then entered into a Microsoft Access database.

Topics most frequently mentioned in aggregate for the community forums were obtained from written cards completed by participants at each meeting. All written input, catalogued according to goals or concerns, was analyzed and assigned a one or two word code, identified as a key word that captured the contextual meaning. Key words were generated based on review of the data, rather than created beforehand. The input was grouped by key word for each forum and sorted by frequency. Frequencies were aggregated across forums. Input was then graphed by most frequently occurring key word. This process was influenced by two primary methodologies for analyzing qualitative data: content analysis and grounded theory (U.S. EPA 2002, Silverman 2003, Strauss 1987).

The Stakeholder Organization meetings for Inclusion

The Stakeholder Organization meetings were intended to draw goals and issues from members of organizations, institutions, and businesses. A total of eight meetings were held to help learn from specific groups and organizations that would have an interest in Onondaga Creek revitalization. To determine meeting format and groups to approach, OEI staff gathered advice from several community leaders, in government, non-profit and business roles.

Most of the meetings took place in the first half of 2007. To help encourage participation, we sought to coordinate with existing meeting schedules to the extent possible. More than 120 individuals attended the largest meeting, representing over 60 organizations; the Working Group was satisfied with the turnout, given that they had invited over 600 diverse organizations to attend. Another one of the larger stakeholder organizations was the Onondaga Creek Government Workshop, which targeted elected officials and government agency employees for their revitalization goals and concerns.

At the stakeholder meetings, written responses on questionnaires provided the primary form of input. In addition, verbal comments (scribed to flip charts) were collected to the extent practical at each meeting. Treatment of the data followed the same methods described under the Community Forums process. Finally, the input from both kinds of meetings was pulled together and integrated by the staff of OEI. Together with the Working Group, the data was categorized into themes. The majority of Working Group members gained first-hand experience with community's goals and concerns by attending both types of meetings. Subsequently, the Working Group and Project Team incorporated community input into the plan development process, as described in the next section. Figure 3 illustrates the goals and issues solicitation process.

Final Stage of Plan Development

One of the last steps for the Working Group was to develop goals for revitalization over a series of meetings. The Working Group already clarified their goals by going through the process of developing input process (Smardon, pers. comm.). Next, based on the Working Group's plan components, the Project Team then developed the text for the OCRP. As part of the Plan, the Project Team developed specific action items and pilot projects to support the Working Group's goals and to make recommendations for future steps in creek revitalization. The goals, action items and pilot projects were presented in the final plan.

The Working Group's last responsibility was to review and make revisions to the conceptual revitalization plan document. Since the OCRP must reflect the ideas and intentions of the Working Group, this last step was an important final review before release of the plan for sponsor and public review.

Summary and Conclusions

In terms of inclusion or 'finding voice' for communities, not usually participating in such projects, we had a fair representation of urban minority groups within the city, particularly benefiting from the assistance and participation of the Partnership for Onondaga Creek, an environmental justice organization based in the south side of the city. For the Native American community, the Onondagas – this was one of the very few planning exercises that they had fully participated in. The degree of inclusion of the Onondaga Nation is documented in a master's thesis by Barnhill (2009). In terms of process – we extensively utilized co-production with the working group and the project team throughout the planning process. This co-production is emphasized by other work in Europe (Petts 2006 & 2007) as well as North America (Carrol & Hendrix 1992, Daniels and Walker 1996, Firehock et al 2002, Lubell et al 2002, McGinnis et al 2006, Smolko et al 2002, and Walker et al 2006). From an environmental justice perspective, such a process is critical in overcoming previous real and perceived injury to the communities previously impacted (Gottlieb 2009, Light & Higgs 1996, Moran 2010, Perreault et al 2012 and Riley 1989).

As discussed, other projects for restoration and revitalization displayed a range of approaches that helped inform how we chose to structure OCRP. Differences in project goals and community context were significant but we gleaned useful perspectives from them, as discussed previously. Concerning the creation of the Onondaga Creek Revitalization Plan, we were extremely fortunate in that our community had committed people, sound institutions, and a shared vision that helped people transcend many of the problems that have challenged other communities. Some of the projects envisioned have moved forward to completion, such as the creek walk extension within the City of Syracuse from Armory Square to Onondaga Lake, use of green infrastructure to reduce storm flow to the CSO's as well as actual storm flow treatment facilities, and upstream water quality and access improvement projects. All of these projects were subject to higher levels of quality control as well as multiple functionality, due to the participatory nature of the Onondaga Creek Conceptual Revitalization Planning Process.

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List of Figures & Tables

Table 1: Restoration Projects Informing the Onondaga Creek Revitalization Planning Process

	Location	Size	Time Period	Initiating Factors	Number of Orgs.	Extent. Of Public Planning Process	Other Points
Bronx River	Bronx, NY						
Guadalupe River	San Jose, CA		1992 - 2005	Endangered trout	<5	+	Uses adapt. Manag.effectively - Greenspace expanded
South Platte River	Denver, CO		1995 -?		5-10	++	
Wildcat-San Pablo	San Pablo, CA		1980 -?	Flood planning	?	++	Strong advoc. impt.
Milwaukee River Greenway	Milwaukee, WI			CSOs			
Tennessee River	Chattanooga, TN	27 K acres	1986 - 2005	Dev. pressure	>10	+	-private funding -riverfront access -commercial dev.
Onondaga Creek	Syracuse, NY	21 miles (?)	2004 - present	CSOs	5-10	+++	

Extent of Public Participation Planning: (0 = none, + = basic, ++ = moderate, +++ = extensive)

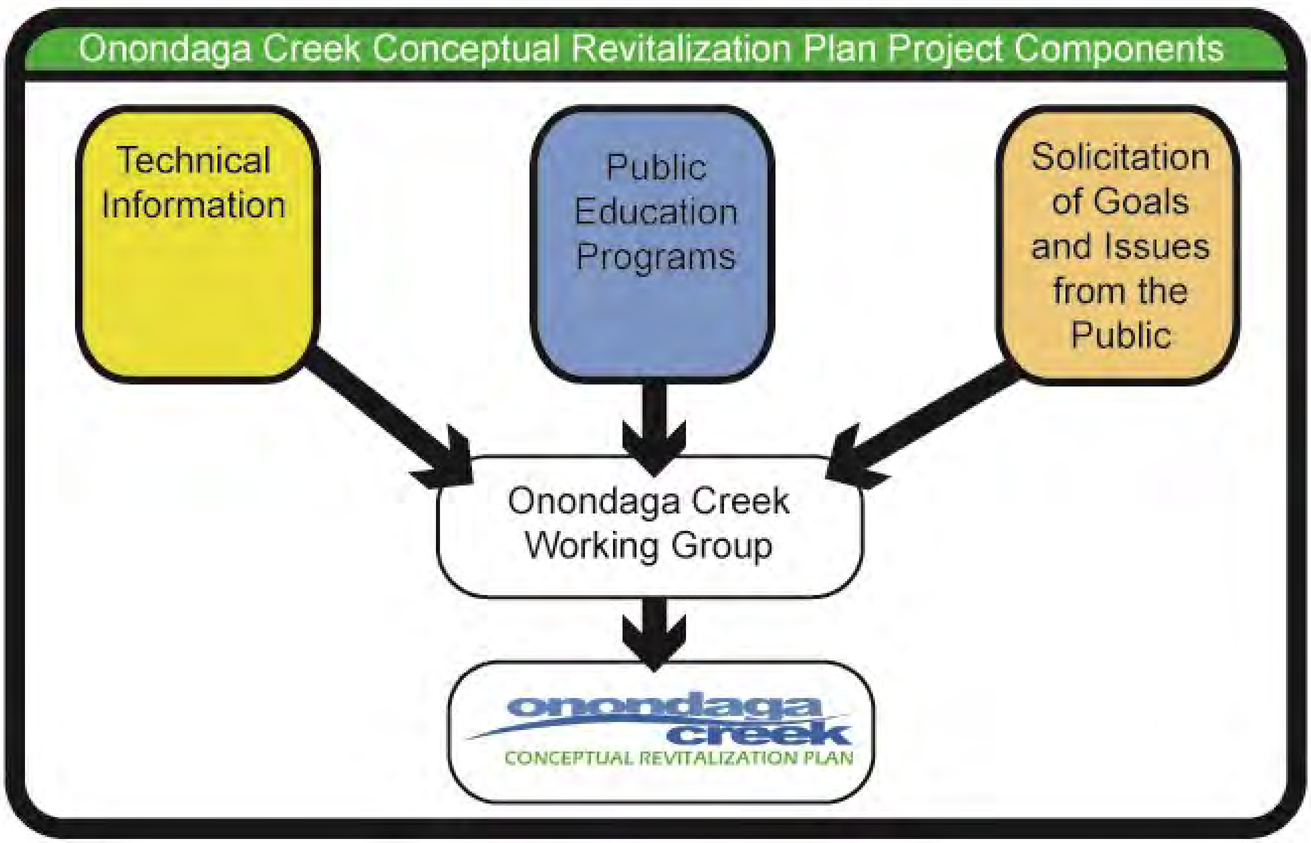

Figure 1: Project Components and Relationship to the Working Group. Source: Onondaga Environmental Institute, 2008, Onondaga Creek Revitalization plan, p.27

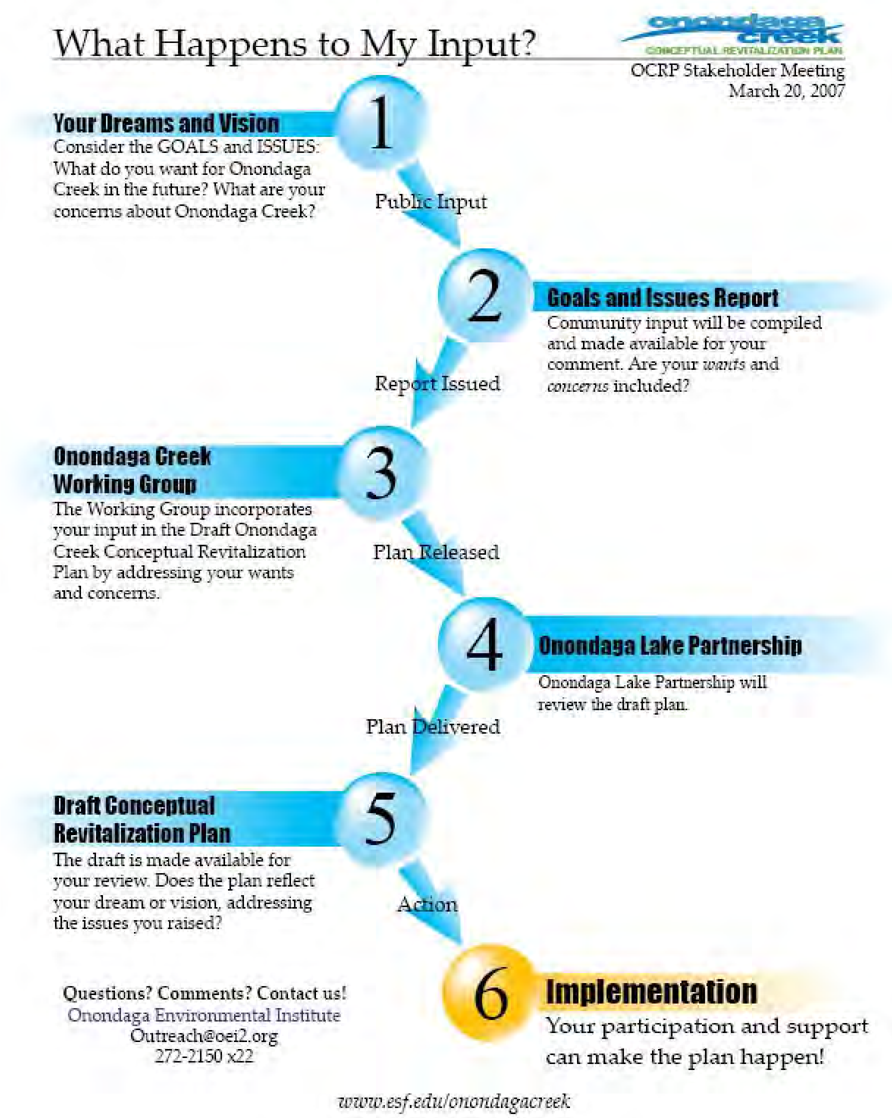

Figure 2: What Happens to My Input. Source: Onondaga Environmental Institute, 2008, Onondaga Creek Revitalization plan, p.30

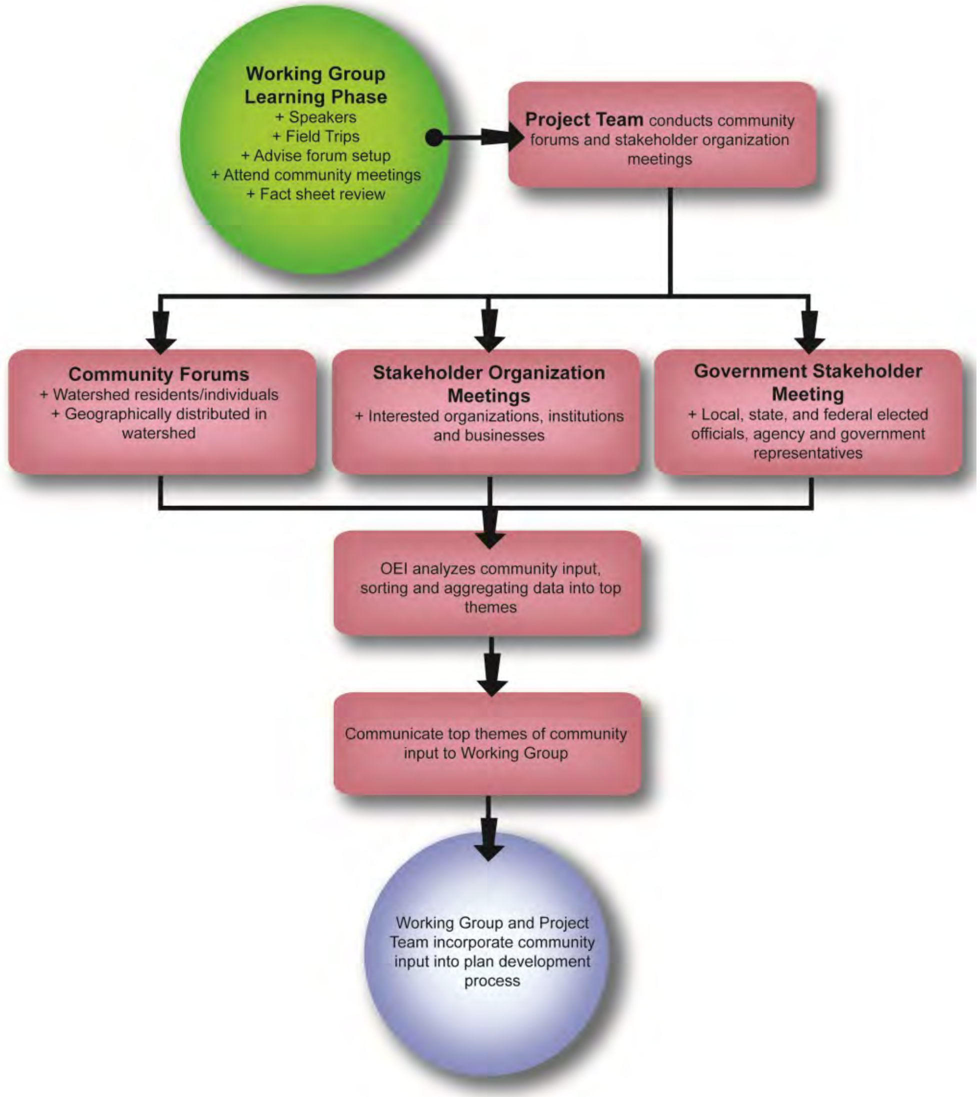

Figure 3: Solicitation of goals process. Source: Onondaga Environmental Institute, 2008, Onondaga Creek Revitalization plan, p.32

A Watershed Event: Communicating Landscape Processes

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Abstract

A watershed event was created to illustrate and quantify how water from precipitation moves across a land surface. This illustration is one of many that would be useful in developing the environmental literacy of greenway and open space supporters. The physical activity of marking the small sub-watersheds generated discussion and collaboration between volunteers. Stopping to watch the occasion of water shedding created a notable event. The materials assembled for documenting the event have provided materials for website presentation and lectures. The basic process is fairly easy to organize and recommended for use by greenway and open space groups who are interested in this type of combined environmental art/ outreach education event.

Introduction

This project began as a collaboration between an artist (Webb) and an ecologist (Hartman). We share an interest in the environment as well as predilections toward the other's area of expertise. Although the overriding idea of the project, making the invisible visible, resonates with both disciplines, we are definitely interested in different aspects of the effort. Our common language is design. When we talk about design principles such as repetition and variation, gradation, value, symmetry, etc., we are able to connect. Applying these principles to those things most invisible in our environment is a shared passion. Invisibility can be the result of two things. The first is literally being out of sight. Ground water is invisible for this reason. The second is caused by a ubiquitous presence. A parking lot is invisible for this reason.

Many landscape processes that land planners wish to protect are invisible to the untrained eye. For instance, can you see the sequestering of nutrients and carbon in a wetland; can you see the migration of woodland mammals along a greenway corridor; can you see the distribution of storm water in an undisturbed watershed? Our thesis is that you can learn to read the markings of the processes, if you are taught what traces of the process you can look for.

In watershed planning, understanding storm water, its volume and its impacts, has become increasingly important due to increasingly intense storms and flooding. However, environmental processes, like runoff and erosion, are very difficult for most people to picture or understand. Large scale landscape plans often claim beneficial roles for storm water management. Yet, most of the general public lacks training in spatial thinking that helps them understand these roles.

As a way to ensure that a part of our collaborations included the arts, we investigated the landscape surrounding the Myers School of Art, at the University of Akron. Webb was amazed at the way the grounds, that she barely looked at every day, opened up as a water system, with the guidance of looking to subtle evidence by pointed out by Hartman. We see the importance of sharing this view with the students and faculty in the school. We also realized that every building and parking lot on campus could be a watershed demonstration site. Not only might this help our students understand the larger concept of watersheds but could foster an individual sense of responsibility for the water system.

Background

We are also interested in environmental literacy and spatial thinking. According to the Environmental Literacy Council, "environmental literacy requires a fundamental understanding of the systems of the natural world, the relationships and interactions between the living and non-living environment, and ability to deal sensibly with problems that involve scientific evidence, uncertainty, and economic, aesthetic, and ethical considerations" (ref). Spatial thinking is thinking that finds meaning in the shape, size, orientation, location, direction or trajectory, of objects, processes or phenomena, or the relative positions in space of multiple objects, processes or phenomena. If we talk about these using the elements of design (line, shape, direction, size, texture, color, value) and the principals of design (balance, gradation, repetition, contrast, harmony, dominance, unity), you can see that a fruitful discussion can happen.

The environmental topic we address is the watershed. The watershed is a spatial entity that can be analyzed with geodesign and landscape ecology methods (Tulloch 2013). The environmental structure and ecological functions of watershed are critical in many of today's open space issues (Hersch et al. 2012) and are the purview of many governmental and non-governmental organizations (Dykman and Paulson 2012). We believe that a basic level of environmental literacy requires the understanding of the spatial structure and water shedding process of a watershed. We use a parking lot with three storm drains to reveal the structure and process.

Methods

With the goals of:

a) providing education about watersheds and
b) demonstrating a watershed process,
c) creating an environmental art event (Bachelard 1958)

the parking lot of the Myers School of Art at the University of Akron was turned into a contour map with watershed boundaries marked.

The Myers School of Art is located on an interesting piece of land that is perched between a higher, extensively built-up piece of land (including parking lots) and a lower piece of land through which a well-traveled road, called Wolfs Ledges as well as rail road tracks, create boundaries. There are many features of the property including drainage pipes and storm sewers that go unnoticed by the students and faculty who are in the building, parking, and walking across the site on a daily basis. Much of the Myers School of Art site is covered by an asphalted parking lot with all the typical drainage features. We looked at it to consider: How did that water move? How could we visualize that movement? We agreed to work with non-toxic temporary paints to create an environmental art piece.

We then contacted the University of Akron Parking Services for permission use the surface of the parking lot to demonstrate the movement of water across the site. We wanted to leave a temporary visual record of the movement by using non-toxic water based paint and we wanted the event to take place early in the fall semester. Although we had anticipated resistance, the Director of Parking Services became part of our animated discussion and even told us of a faculty member in the engineering department who used parking structures as a place to create small experimental structures. His chief concern was that whatever we put onto the surface must not confuse those who needed to park. He did not want anyone saying that they could not park properly or were confused because of something we had done to the surface. We were not entirely sure that our project would not confuse those parking, but we were reasonably sure that it would not. To address his concern, we created a plan to inform users of the parking lot through flyers and email announcements about the project. We soon arranged a schedule: on the evening of Thursday Oct. 6, 2011, Parking Services would clean the lot; Friday, Oct. 7, after 5pm, initial marking of the elevations would begin; and Saturday, Oct. 8, the watershed drawing and demonstration would be created.

When classes started in September, we began contacting student groups and got enthusiastic response from the Civil and Environmental Engineering club for students and Environmental Akron, the student group on campus active in recycling. We recruited them for the event.

Our goal was to create a large scale drawing on the parking lot that represented the movement of the water. We were concerned that the lines have the fluidity that we normally associate with gestural freehand drawing. For Webb this was one of the big challenges and not one that we immediately knew how to solve. We wanted to give the art students the chance to create a drawing that they could control within the limits of the elevations set by the surveying students.

After some testing, we determined that weed sprayers could be fitted to the task of making fluid lines on the asphalt with our paint. The Campus Grounds crew loaned us portable tanks that could be easily carried, with tubing and wands that delivered a focused spray of color. Because the parking lot was so large the three inch wide spray was an appropriate scale for the "drawing". The asphalt of the parking lot was in just the right condition. It was not so new as to be impervious to the water based paint. (The newer lots on campus also were the source of pride and not as readily turned over to artists who might deface them in some way.) The asphalt around the Myers School of Art was slightly textured and open without being deeply scared and checked.

As the work day ended on October 7, Parking Services also put up barricades to entering the lot and signage to prevent students from parking during the event. A group from the Civil and Environmental Engineering Club arrived on Friday evening and began to mark elevations (at six inch intervals) out from each of the three storm drains that made up the parking lot watershed system.

Saturday morning dawned clear and bright and warm with the temperatures reaching 80 degrees in the afternoon. Art students and alums began using the weed sprayers to connect the elevations. They used orange paint to create these contour lines.

Figure 1. A template for the 1' grid of dots speeded the marking process by eliminating the need for measuring.

We initially planned to mark a large part of the parking lot with a one foot grid of two inch round dots of blue to represent the water (Fig. 1). After several hours of general application of the blue dots, we to focused on the smallest of our three watersheds. This one ran down steeply into a loading dock area and was perfect for a demonstration of the potential of the watershed to clear water from the lot.

The Environmental Akron members had obtained a very large supply of empty 12oz soda cans. We placed them on a one foot grid within our smallest water shed, after filling them with water (Fig. 2).

Figure 2. Recycled 12 ounce cans were filled with water and placed on top of the 1' grid of blue dots. Twelve ounces per square foot represent approximately 1/6" of rain.

Once the stage was set, students with wide brooms began the sweep of cans towards the storm sewer (Figure 3). We documented the set-up, beginning, and process. The water first drained in small streams from top towards the storm sewer (Fig. 4a), but it soon changed to a broad sheet flow that constricted towards the storm drain (Fig. 4b). The roar of the water filled cans provided one of the most dramatic aspects of the event. The sound seemed very like an icebreaker pressing forward thru icy water. It was exhilarating.

a  b 

Figure 3 a & b. The shedding of water was accomplished by volunteers sweeping the cans downhill with janitorial brooms.

Capturing the event was done by photos taken by people on the ground and by Matthew Kolodziej's video camera. We also had photos of the overall watershed system and the watershed demonstration taken by a camera mounted on the Biology Department research blimp and manned by graduate student in biology, Heath Garris.

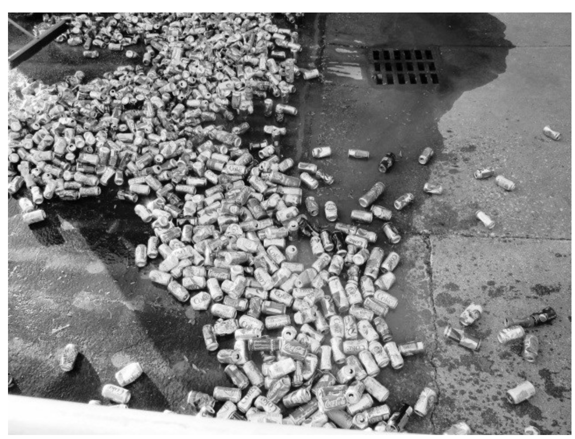
a  b 

Figure 4 a & b

A video of the event was posted on YouTube, a website, called “Land Water”, was set up by Hartman and a departmental lecture was given at Rutgers.

Results

The event can be evaluated in a number of ways. We drew volunteers from the College of Engineering School, the Buchtel College of Arts and Sciences, Myers School of Art, Cuyahoga Community College and the public. The cross section of ages and backgrounds energized the event and promoted wide ranging discussion about the work and the results.

The act of marking/painting the parking lot brought attention to many overlooked details of a site that many pass through regularly and look at rarely (Fig. 5). Not only was the attention focused on the parking lot during the event, but the markings lasted for at least two more weeks – fading away and smearing with rain and sun. This generated observation and discussion far beyond the collection of volunteers and observers on the days of the Watershed Event.

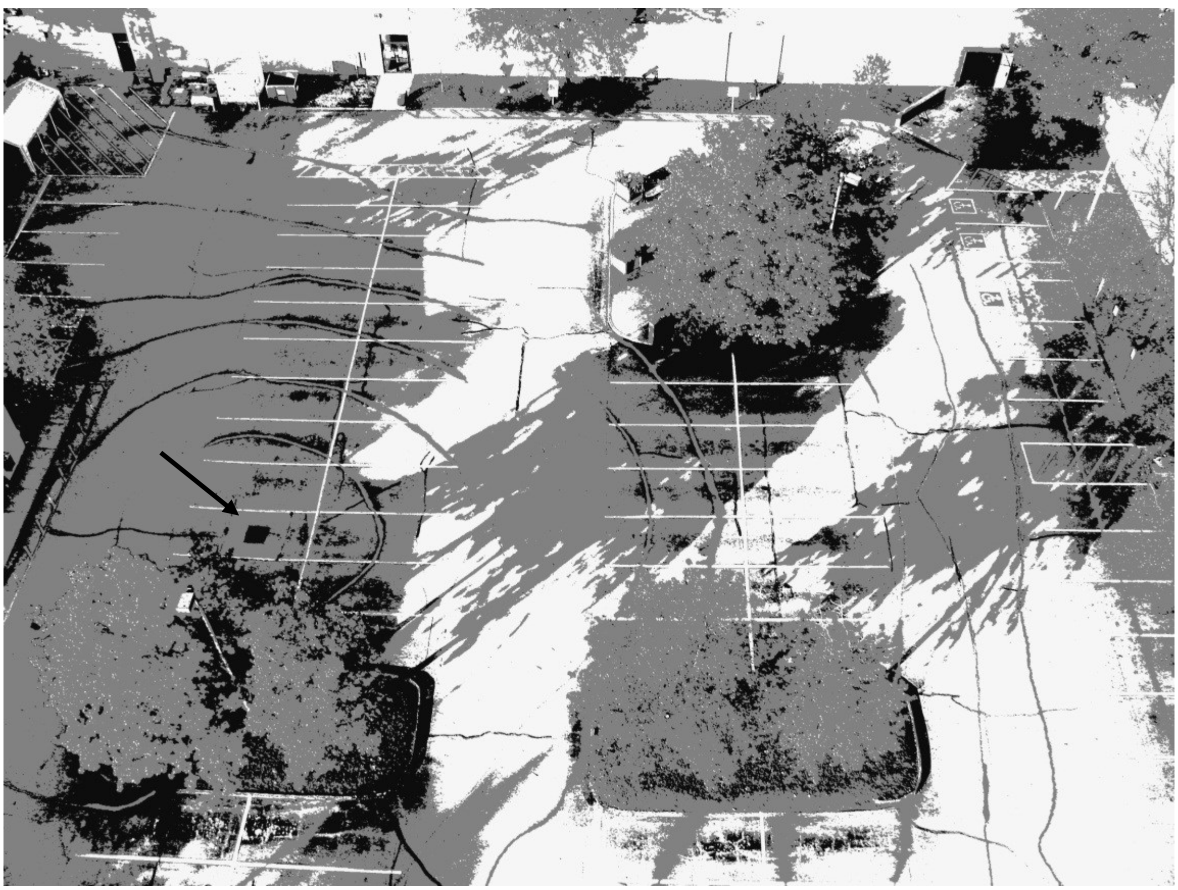


Figure 5. The storm drain (noted by arrow on left of picture) appears as the center of concentric contour lines in this section of the parking lot.

The initial concern that the lines defining the watershed would confuse those using the lot for parking gave way to regret that the lines would soon disappear. The two systems of lines did not negate one another. They seemed to exist in contrast and harmony. This reveals how systems like parking lots perform more than one task at a time.

In addition to running and hosting the event, we photographed it and one of our colleagues recorded a video. It is this archive of the event that has had the broadest impact. During an exhibition at the Sculpture Center, Cleveland, OH, a slideshow loop was run and viewed by many of visitors. A lecture to the Department of Landscape Architecture at Rutgers focused on Watershed Event I. After discussing Watershed Event I in a planning class, the students decided to create Watershed Event II. Their idea of exceeding the experiential learning in the first event generated discussion, energy, and carry-through.

Discussion

This project can be perceived as a teaching module or an environmental art project. As the former, it provided a quantitative demonstration (Fig. 6) of a process that occurs at much larger scales throughout our landscape. As the latter, it gained a larger and receptive audience. The paint lasted for nearly two weeks in the parking lot and, therefore, could continue to generate discussion after the event was over. It serves as an example of the spatial thinking that must be applied to landscape problems as well as a small step towards making this kind of thinking more accessible to the general population.

Figure 6. The volume of cans was the lasting visible evidence of the volume of water shed.

Small modifications could be made to this project to emphasize potential benefits of a greenway system to the ecological function of a watershed or large area, especially as they relate to storm water planning or water quality improvement.

This project might also create awareness of the existence of watershed processes in smaller greenway systems by pointing out the ways in which those smaller watersheds enhance and define the larger systems and ways in which the smaller green areas, for example around schools and campuses, enhance and define the larger systems.

Once you look closely at a parking lot, you see that it is designed for flow of vehicles, storage of vehicles, flow of water, and removal of snow; all these are constituents of a safety plan. In the best cases, parking lots also provide safe spaces for pedestrian flow, safe places for pedestrian waiting, plantings to mitigate the heat build-up of summers, and drainage systems that re-use rather than discharge precipitation.

Mapping has emerged as one of the most important processes or ways of thinking in the art world (Harmon 2009). Maps are made of every conceivable space, event and feeling and of every conceivable media. Site specific, temporary art works have emerged to allow us to see a place or space in a new way. Our avenue into mapping occurred during talks with the Synapse, a newly formed group made up of artists and scientists, when we all realized that mapping was one of the few ways that we might be able to make sense of many of the water issues we were trying to come to terms with. We had set ourselves the task of finding ways in which artists and scientists could collaborate on projects about water; we found that the invisible aspects of water rather than water as landscape element was most challenging and interesting. For the uninitiated map-maker the scale of 1 to 1 is the most comprehensible. Though it is seldom practical, it was effective in this case in allowing visualization of the paths taken by water across the parking lots. It had the additional advantage of challenging us to make the biggest drawing we had ever created. It was both site specific and temporary, allowing us to see the Myers School of Art and its surrounds in a new way.

The parking lot itself was also a subject matter in the artwork.

> *The ancient Egyptians organized their life and their gods in reference to the life giving Nile. Colonial New Englanders organized their village life around the axis mundi of the meetinghouse, the place that manifested their connection to the cosmos. Although it happens just below the level of awareness, the parking space probably generates the most significant sense of personal and social place in the cosmos for today's urban Americans/ it is their major axis mundi.* Paul Groth (as quoted in Ben-Joseph 2012).

Although the topographic lines on the parking lot surface logically describe the elevations and therefore the path of rain water movement across the lot, they also create a lyrical drawing and suggest, subtly, an unresolved conflict between man and nature.

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2. Landscape Planning Strategies

Understanding the Evolution of Landscape Planning Strategy in China: From "Fragmented" Urban Green Space System to Regional Greenway Network across Cities

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1. Introduction

In China, urban green space system (UGSS) is defined as a network of all sorts of green spaces in city built-up area which supports ecological and recreational functions (Wang, 2009). The implementation of UGSS indicates several common problems, such as overemphasizing green spaces in the built area of city, losing stability and rationality in spatial patterns, and mismatching the progress of ecological restoration cycles (Liu & Wen, 2007; Wang, 2009).
Greenways represent a distinctly strategic approach to landscape planning through combinations of spatially and functionally compatible land uses within a network (Ahern, 1995). Specially, four principal strategies (Protective, Defensive, Offensive, and Opportunistic) are recognized as an overall planning strategy for greenway (Ahern, 1995). Inspired by the greenway concept, China has constructed 2,372 kilometers of greenway network at Pearl River Delta (PRD), in order to maintain regional ecological safety, to improve regional livability, to stimulate economic growth, and to protect cultural and historic resources (He et al, 2010). Meanwhile, various cities in China have initiated their own greenway network planning for implementation. This indicates a potential greenway movement during the next few years in this country, following the global interest in greenways as a sustainable landscape planning strategy. Through historical review of urban green space system in China and a case study of PRD greenway network, this research attempts to answer the following questions: (1) how contemporary greenway network is planned and implemented in China? (2) How Ahern's four principal strategies (protective, defensive, offensive and opportunistic) have been applied within PRD regional greenway network as landscape planning strategy?

The purpose of this research is to provide a holistic perspective on greenway planning and development in China. Specially, this paper will (1) present evolution of UGSS planning and recent greenway development in China; (2) discuss the practice of implementing greenway network as landscape planning strategy; and (3) discuss the future greenway development in China.

2. Background and Literature Review

2.1 Green space, Greenway, and Contemporary Landscape Planning Strategy

Green space is broadly defined as "open, undeveloped land with natural vegetation including parks, forests, playing fields, and river corridors" (Mitchell & Popham, 2008). Since the garden city idea advocated by Ebenezer Howard (1898) in UK and the urban park movement propounded by Frederick Law Olmsted in US during the 19th century, urban green space has become a crucial part of the urban environment that supports the physical, social, and mental health of the entire region.

From 1960s, a plenty of landscape planning has adopted a "defensive" strategy, based primarily on McHarg's theory (1969) of "constraint-based exclusionary planning" (Ahern, 1995). The core idea of "constraint-based exclusionary planning" is to assess and save resources on their intrinsic and individual values during the planning process. Although this "defensive" planning strategy has achieved successes in many cases, the defect of the strategy is evident as well: landscape fragmentation. Thus, ecologists and landscape planners suggest offensive strategies to confront landscape degradation and advocate a sustainable form of ecological infrastructure which has "connection" to link isolated natural areas (Forman & Godron 1986). The debates on which form is more sustainable are continuing; yet, greenway (or named ecological infrastructure, ecological network, or extensive open space system) might be a good solution. Through combinations of spatially and functionally compatible land uses along linear areas and within a network, greenways represent a distinctly strategic approach to achieve multiple benefits; rather than a framework for comprehensive landscape planning (Ahern, 2002). Four principal strategies (Protective, Defensive, Offensive, and Opportunistic) are recognized as an overall planning strategy for greenway (Ahern, 1995): Protective strategy focused on eventual landscape pattern; defensive strategy often applied on fragmented or isolated landscape; offensive strategy attempted to regenerate disturbed landscape; and opportunistic strategy tried to explore unique landscape features.

2.2 Evolution of urban green space system (1950-2010) in China
The Early Urban Green Space System from 1950s to 1980s

In China, the UGSS planning was originally developed in 1950s while the Soviet Union model, was learnt and adopted by Chinese scholars. The Soviet Union model focused on urban parks and recreational function, and its content includes quantity index, such as the green space ratio, green space coverage, and public green area per capita (Qian & Chen, 2004; Wang, 2009). However, before 1980s, China has implemented restricted policies, causing slow urbanization process and low investments in urban green space construction.

Exploration of Urban Green Space System from 1980s to 2000s

UGSS planning has become a part of city master plan until 1989 when the "National Urban Planning Act" issued (Wang, 2009). A series of regulation on UGSS planning successively initiated to promote the quality and quantity of UGSS in terms of green space overall layout, city parks, community parks, parkways, and greenbelts. Meanwhile, researchers in China have started to explore the ecological benefits of UGSS. During this period, because of lacking a complete framework theory to support, UGSS planning is hardly to serve a strategic function, in order to solve urban environmental issues. Still a considerable number of cities do not have their UGSS plans.

The Contemporary Urban Green Space System from 2000s to 2010s

Regulated as an individual and mandatory document in 2001, UGSS planning is no longer a supplement of city master plan. Inspired by patches-corridors-matrix pattern of landscape ecology, UGSS planning has initiated its core pattern: nodes-lines-areas, in order to form systematic and ecological network of green space (Pan, 2006). Usually, nodes refer to urban parks, community parks and open space; lines refer to urban rivers, linear green space and greenbelts; and areas refer to urban forests, urban agricultural lands, and large lakes. Since a great number of cities in China have planned and implemented their own UGSS to amend their environment, UGSS has started to play a significant role in the development and conservation of urban areas over the past several years. However, general limitations of UGSS practice in China include: (1) overemphasizing green spaces in the built area of city (Liu & Wen, 2007); (2) losing stability and rationality in spatial patterns; and (3) mismatching the progress of ecological restoration cycles (Wang, 2009).

2.3 Emerging Regional Greenway Networks

Although the concept of contemporary greenway originated from the Western World, in China the origin of greenway can be traced 3000 years ago (Yu, 2006). Historically greenways are categorized into three types: riparian greenways along rivers, streams and water channels, greenways along transportation corridors and greenways along farmland for wind protection (Yu, 2006). Until 2010, China has started to build up its first contemporary greenway network, which is located in the Pearl River Delta. The purpose of developing PRD greenway network is to conserve regional ecological environment, and to improve life quality of residents (Guangzhou Housing and Urban-rural Construction Bureau, 2010). In China, Greenways are primarily planned and implemented through top-down planning application, which is highly effective under a centralized system (Yu, 2006), especially at a national dimension. Besides Pearl River Delta, a tremendous number of regions and cities in China have started to plan their own greenway network, and also a national landscape security pattern has proposed to address meager natural resource, fragile ecosystems and urbanization (Yu, 2012). Greenway has already been recognized as a new strategy of spatial development of Chinese urban and town green space (Liu, 2012). Chronologically greenways have evolved in China from protection to multiple functions.

The literature indicates UGSS planning is a considerably mature and dominant approach with decades' practice while regional greenway network is an innovative approach in China; yet few studies discussed regional greenway network as a new landscape planning strategy.

3. Method

This paper will conduct a case study of regional greenway network at Pearl River Delta in three main phases: (1) describe the case study area to give a comprehensive context to help understand greenway planning and development; (2) analyze PRD Greenway comprehensive plan to illustrate landscape planning strategy; and (3) compare UGSS and regional greenway network to discuss the transition.

4. Case Study

4.1 Study Area

The term Pearl River Delta (PRD) refers to the dense network of cities that covers nine cities(Guangzhou, Shenzhen, Zhuhai, Dongguan, Zhongshan, Foshan, Huizhou, Jiangmen a nd Zhaoqing) of Guangdong Province in China. It is one of the most densely urbanized regions in the world with the population of 120 million, and it has become one of the main hubs of China's economic growth since the launch of China's reform in 1979. However, with the great economic achievement, the traditional growth method (unlimited sprawl of urbanized regions and built-up areas) has negatively impacts on the natural environment, which is not sustainable developing. Thus, the Pearl River Delta initiated regional greenway network as an alternative strategy to amend ecological environment, to enhance living conditions, and to stimulate economic transformation.

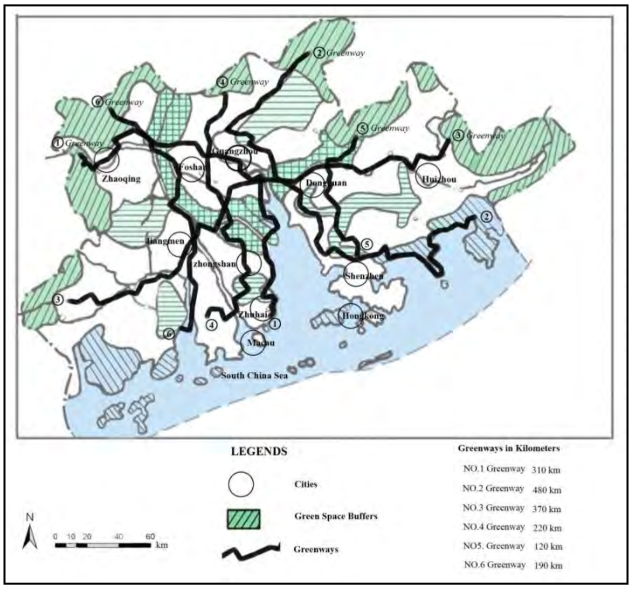


Figure 1. Regional Greenway Routes Network, redrawn by Di Lu

Source: Guangzhou Housing and Urban-rural Construction Bureau, 2010

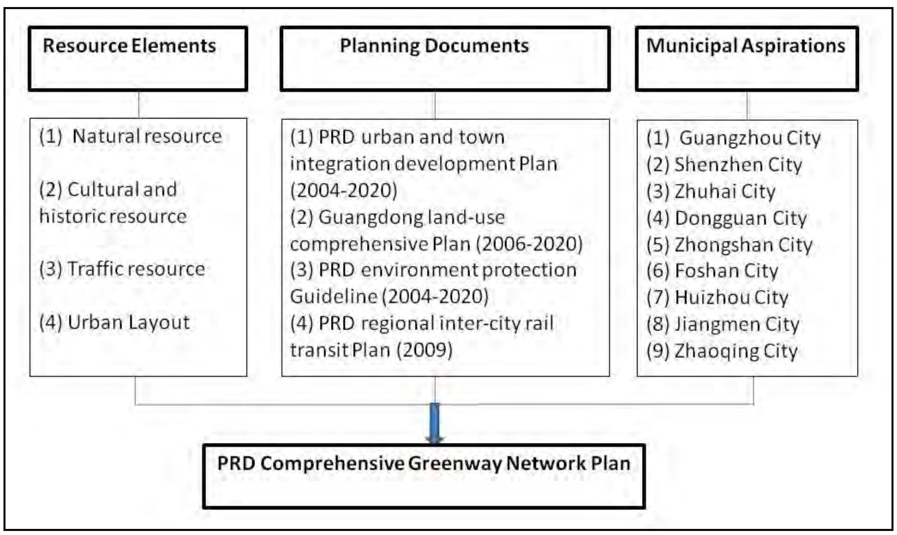
4.2 Analysis of PRD Comprehensive Greenway Network

Launched in 2009, the first contemporary, comprehensive greenway network in China have planned and constructed at Pearl River Delta area, including six regional greenway routes (Figure 1) and covering more than 200 tourist attractions in nine cities (He et al, 2010). Besides six regional greenway routes in Pearl River Delta, city level greenways and community level greenways are also proposed sequentially as extending of greenway networks into the inner-city fabric to satisfy ecological and social demands. These greenways connect to the shopping districts, sports venues, office building blocks, and residential estates, boasting beautiful scenery and convenient bicycle paths and providing local residents with easy access (Guangzhou Housing and Urban-rural Construction Bureau, 2010).

Purpose

The purpose of developing regional greenway network at Pearl River Delta includes:
(1) Maintaining regional ecological safety.
To employ green buffers as ecological context, PRD greenway network could connect fragmented ecological matrix and corridor to help repairing ecological network; maintain diversity of wildlife and provide them habitats and migratory corridors; absorb pollution and

purify the air.
(2) Improving regional livability.
PRD greenway network would connect urban parks, open space, rural parks, wetlands, and national forest parks to provide network of green open space for recreation and ecological protection.
(3) Increasing domestic demand in order to stimulate economic growth.
Besides ecological benefits, PRD greenway network would directly stimulate tourism industry, recreation and leisure industry, food and beverage industry, and also indirectly stimulate agriculture, construction industry, and real estate industry by providing more working opportunities and increasing domestic demand.
(4) Protecting cultural and historic resources.
PRD greenway network would protect cultural and historic resources and connect them with the surrounding environment, to enhance the city's cultural identity and citizens' place belonging.



Layout

The layout of PRD comprehensive greenway network plan is synthesized primarily basing on resource elements, planning documents and municipal aspirations (Figure 2).
(1) Resource elements
Four major elements are recognized as resource elements: natural resource, cultural and historic resource, traffic resource, and urban layout. Thus, the criteria of selecting greenway route include: be close to rivers, valleys, and mountains; be able to connect cultural heritages and historic villages; be accessible to communities; and take advantage of existing road and abandoned railways.
(2) Planning documents
Referred from existing planning documents, the layout planning of PRD greenway network tries to integrate with urban and town layout, regional traffic network and regional ecological pattern.
(3) Municipal aspirations
The layout of PRD greenway network also absorbs aspirations from local governments. In

addition, the opinions from local bicycle association and local hiking association are also considered.

Landscape Planning Strategy

Four principal strategies (Protective, Defensive, Offensive, and Opportunistic) are employed within PRD regional greenway network as an overall landscape planning strategy (Ahern, 1995), through combining ecological planning, tourism planning and urban transformation to achieve. Protective strategy defines eventual greenway landscape pattern is protected while surrounding landscape might experience changes (Ahern, 1995). Overall, PRD regional greenway network is protective in terms of its policy, purpose and layout towards sustainable development.
(1) Ecological Planning
Regional ecological corridors refer to paths that connect large ecological patches and natural area, which is usually broken up by urban blocks. When the existing landscape is fragmented, and the core areas isolated, a defensive strategy is often applied (Ahern, 1995). At Pearl River Delta, defensive strategies are applied to connect eco-sensitive areas within cities through regional greenway network to construct systems of ecological corridors and ecological patches, in order to ensure regional ecological safety.
(2) Tourism Planning
Through connecting urban parks and green space, urban greenway creates pedestrian-friendly environment and provides space for recreation and leisure activity that would stimulate urban tourism. In order to facilitate residences and tourists to use greenways, the regional greenway network is also allocated with signage system, public transit system, parking lots, lighting system, restrooms and service areas.
Landscape contains unique features, such as cultural or historic landscapes might provide outstanding opportunities for greenway planning (Ahern, 1995). At Pearl River Delta, Erxianguan greenway in Shenzhen is mainly developed basing on historic hiking trails. Through renovation, the planners preserved most original paving, designed more access points, and connected communities to ecological forest, in order to facilitate tourists.
(3) Urban and Town Transformation
Offensive strategy often employs nature development to build new elements in previously disturbed landscape (Ahern, 1995). As a great opportunity, PRD greenway network has not only promoted urban ecological infrastructure construction, but also helped urban transformation: facilitating public infrastructure construction and helping brown-field redevelop, to improve the urban environment. For example, financed by PRD greenway project, an abandoned factory with a 250-Acre brown-field in Nanzhuang, has been transformed into a recreational wetland with multiple-functional greenways.

4.3 Transition

Table 1. Comparing Urban Green Space System with Regional Greenway Network

Name	**Urban Green Space System (UGSS)**	**Regional Greenway Network (RGN)**
Scale	Municipal	Regional (across cities)
Spatial Structure	System of Distributed Nodes, Lines and Areas	Connected Linear Network

Function	Recreational Ecological Social	Recreational, Historic/ Cultural preservation Ecological Economic Social

Directly influenced by UGSS planning, the landscape planning strategy has chronically emphasized green spaces in built area while ignoring surrounding area of cities; emphasized quantity of green spaces while neglecting connectivity (Wang, 2009). Today, the landscape planning strategy in Pearl River Delta has gradually evolved from a city-based "fragmented" UGSS approach to a holistic regional greenway network approach (Table 1). A multi-level, multi-function and comprehensive Pearl River Delta Greenway Network has been built while incorporating principles of sustainability, increasing connectivity of multiple land use, and expanding of public participation. The Pearl River Delta greenway network is not only a supplement of urban green space system, but more importantly, it indicates an innovative landscape planning strategy at an extensive scope. Greenway is an essential feature of integrating rural with the urban landscape system, and it is also a form of ecological network (Liu & Wen, 2006). Regional greenway network could be illustrated as a kind of "extensive green space system".

5. Discussion and Conclusion

5.1 Discussion

The central thesis presented in this paper is that greenway network is a significant landscape planning strategy to address challenges of urbanizations and sustainable development in China.
In North America, centralized planning approach is less common; while greenway plans initiated at local and regional scale, and then greenways tend to involve a diverse and broad supports (Ahern, 2002). In China, top-down planning approach is still dominating while providing an excellent opportunity for large scale planning, such as regional greenway network. The pilot application of greenway network at Pearl River Delta demonstrates that it is feasible to construct greenway network to connect high-density compact Chinese cities, and also to connect green space within and outside of cities.

The benefits of greenway are obvious: social, ecological, economic, and recreational. However, there are a lot of issues to deal with: guideline formulation, policy support, organization structure, public participation, and funding source. For example, government investment should be a guarantee, because greenway is a public project and in China land property belongs to the nation.
Besides, there is a considerable potential for China to establish national greenway network through combing existing and proposed regional greenway networks. Currently, to establish regional greenway network is a strategic landscape planning approach. Hopefully, this landscape planning strategy could be applied at a broader scope soon.

5.2 Conclusion

A historical review of urban green space system and a case study of PRD regional greenway network were presented to illustrate how greenways are planned and implemented in Pearl River Delta; how Ahern's four principal strategies (protective, defensive, offensive and opportunistic) have been applied within PRD regional greenway network; and this will also provide a model for future greenway development in other Chinese regions. The key findings revealed that:

(1) Although UGSS planning approach has dominated in China for a few decades, the implementation of PRD regional greenway network indicates a transition of landscape planning strategy in China: from "fragmented" urban green space system to regional greenway network across cities.

(2) Four principal strategies (Protective, Defensive, Offensive, and Opportunistic) are successfully employed within PRD regional greenway network as an overall landscape planning strategy.

(3) Top-down planning approach provides an excellent opportunity for developing regional and national greenway network; yet, public participation is still lacking.

Acknowledgement

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The Portuguese National Ecological Reserve – a mapping tool for Landscape Planning

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Introduction

In Portugal, one of the legal frameworks which directly protect the fundamental systems of landscape is the National Ecological Reserve (REN). This instrument was created by the landscape architect Ribeiro Telles in 1983 and at that time its inclusion in the legislative system was considered a pioneering concept in the field of environmental protection. Alongside, it was created the National Agricultural Reserve (1982) that aims agricultural land protection which together with the Natura 2000, other classified areas, and National Ecological Reserve assembles the Fundamental Network of Nature Conservation (2008).

The National Ecological Reserve safeguards fundamental natural cycles and also a wide range of interfaces with high ecological value and sensitivity (beaches, marshes, dunes, cliffs, banks and flood threatened area by floods and sea). This legal framework includes the landscape systems which are critical to ecological stability assurance. Therefore, it constitutes a basic and diversified biophysical structure that guarantees the ecosystems protection which is essential to human activities.

At the municipal land use plan the Ecological Reserve delimitation is mandatory and forbids urban construction on those areas. It has been understood by local administration and private promoters as a blockage for local development by preventing built up areas. Until now, it has been pointed some difficulties regarding the clarity of the delimitation criteria that led to discontinuities between adjacent municipalities and created some obstacles to its implementation. However, this legal framework has allowed landscape protection and prevented some serious environmental problems.

Currently, National Ecological Reserve is undergoing through profound regulation changes that are leading to its dissolution. This fact has become inconsistent with the current European guidelines which strengthen the necessity of biodiversity protection - European biodiversity strategy (2011) - and nature conservation through the implementation of green infrastructures. These infrastructures are a support network of biodiversity and ecosystems that integrate the National Ecological Reserve.

Since the beginning of the 90's, the Research Centre for Landscape Architecture "Prof. Caldeira Cabral" (CEAP / TUL) has been developing methodologies to improve the delineation of National Ecological Reserve criteria as part of the Ecological Network. This research is based on a positive vision of landscape as a resource of life-support services enlarging the current restrictive view of land use to a multifunctional approach.

Background and Literature Review

Ecology is the center and the basis for landscape planning (Magalhães *et al.,* 2007). Forman and Godron (1986) define landscape ecology as the study of structure, function and change in a heterogeneous land where ecosystems interact. Ecology is also intended by Odum (2004) as the study of structure and nature's functioning. These are the principles and concepts that sustain Nacional Ecological Reserve and allow the integration of ecology in landscape planning. REN has also became an important legal instrument that also protects landscape quality by defining the most valuable and fragile resources (Ribeiro & Beirão, 2006).

As an open system, landscape encompasses energy and matter exchanges between its components. Those ecological and cultural systems interact and are in permanent evolution (Pena & Abreu, 2012). Therefore, an important goal to achieve in planning is the positive balance between those two structures promoting landscape stability (Tricart, 1977; Pena *et al.*, 2010).
Ecological integration in planning is a component of the Landscape-System methodology (Magalhães *et al*., 2007), that is being developed in the Research Centre for Landscape Architecture and which starting point is the landscape planning through two networks: the Ecological and Cultural Networks mapping.

REN is a part of the ecological network and also part of Fundamental Network of Nature Conservation (Table 1).

Table 1 - Relation between legal REN, Fundamental Network of Nature Conservation and Ecological Network from Lansdscape-Methodology approach

<table>
<tr><th></th><th>Fundamental Network of Nature Conservation</th><th>Landscape-System Methodology</th></tr>
<tr><td>National Ecological Reserve (REN)</td><td rowspan="2">Corridor areas</td><td rowspan="4">Ecological Network</td></tr>
<tr><td>National Agricultural Reserve (RAN)</td></tr>
<tr><td>Habitats Directive</td><td rowspan="2">Core Areas</td></tr>
<tr><td>Geological and Geomorphologic patrimony</td></tr>
</table>

The *continuum naturale* concept, created by Cabral (1980), is also the conceptual base of REN by considering the necessity of a continuous system of natural occurrences that contributes to the balance and stability of landscape by supporting wildlife and maintaining genetic potential.
The National Ecological Reserve by itself protects different ecosystems with high ecological value. Besides this, it establishes the connection between different core areas (Table 1). The main characteristic of these corridor areas is that they result from the main physical structure of landscape, signifying more than a buffer area. The recognition of the importance of connecting isolated natural areas (Ahern, 1995) is also the basis of REN.

More recently, with the development of an European strategy for biodiversity (European Commission, 2011), the emergence of a new concept of green infrastructure (prosecutors of ecological network) (Council of Europe, 2011, European Commission, 2012; Shanfeng *et al,* 2011; Weber *et al.,* 2006; Whickham et al., 2010; Greca *et al.,* 2011) and the awareness of the ecosystems services and landscape services (Termoshuizen & Opdam, 2009), highlights the REN's potential for implementing these strategies.

In Portugal the REN legislation has been changing since 1983, and nowadays its substitution by risk assessment plan and water law has been operated. In this work it is considered that REN congregates high ecological value areas which are more than only risk areas and water features. The evolution of REN concept is presented in Table 2.

Table 2 - Evolution of legal REN concept

Decree-law n.º 321/83	Decree-law n.º 96/90	Decree-law n.º 166/2008
Areas necessary for the ecological stability of the environment and the rational use of natural resources to attain good planning	Biophysical and diversified structure which ensures the ecosystems protection and biological processes enhancement essential for the balanced framework of human activities	Biophysical structure that integrates all areas with ecological sensitivity and value or areas with susceptibility against natural hazards It is a restriction of public utility which applies a special territorial regime establishing a set of constraints to the occupation, use and processing of soil, identifying the uses and activities consistent with the objectives. Aims to contribute to the sustainable use of the territory by promoting: a) water and soil resources protection b) risk prevention and reduction c) ecological coherence and connectivity with Network Foundation for Nature Conservation; d) priorities of the Territorial Agenda of the European Union in the fields of environmental management and natural hazards.

REN legislation was established in a fast growing urban development context without any sound planning. The delimitation of REN areas had a strongly preventive character which avoided environmental problems during an accelerated urban growth. Currently, the European directives give priority to the achievement of biodiversity and green infrastructure mapping. In this framework, REN can be an opportunity to implement those priorities, by seeking compatible multifunctional uses.

However there are some fragilities of this legal feature:

- Lack of solid delimitation criteria;
- Absence of national and regional strategy of delimitation;
- Absence of articulation between adjacent municipalities;
- The social aversion to REN (consequence of its preventive character);
- Exclusion of REN delimitation in urban areas.

The considered principles in this research acknowledge landscape as a dynamic and open system where a set of interdependent processes interact to accomplish a natural equilibrium. Therefore, it is necessary to take into account the dynamic of landscape in the National Ecological Reserve criteria definition.

Goals

The main goal of this paper is to present the National Ecological Reserve framework, the improvement in REN delimitation that have been developed in CEAP / TUL and the changes that should be considered in this legal framework to allow the protection of a multifunctional landscape in accordance with land use suitability.
It will be present different case studies at the municipal scale in rural, peri-urban and highly dense urban areas that will demonstrate the strengths and opportunities of the National Ecological Reserve in the landscape planning.

Methods

The methodology (Figure 1) is embedded in the "landscape-system" methodology (Magalhães *et al.*, 2007) that considers the importance an ecologic based plan in the establishment of land use policies, using the ecological land suitability for different human activities perspective. For that, REN is not seen as a constraint but as a potentiality for other human activities besides those that need buildings.

The concepts underlying the National Ecological Reserve have already potentialities to be the base of green infrastructure delimitation. However there are some difficulties in the definition of REN criteria.

The first phase of the methodology is to improve the National Ecological Reserve delimitation with the definition of the landscape structural systems, which are the main physical systems of landscape. The REN's main landscape structural systems are hydrologic ecosystem, soil ecosystem and coastal ecosystem. The concept of each feature from the three systems is developed, and the mapping criteria are set out. In the second phase each feature is tested in order to create and improve a Geographic Information System model.

The third phase is to apply the methodology at national scale, regional scale and municipal scale. As it was already said, the REN delimitation is mandatory at municipal scale, being part of the municipal land use plan. It will be possible to improve the articulation between scales and regulate the use of REN areas.

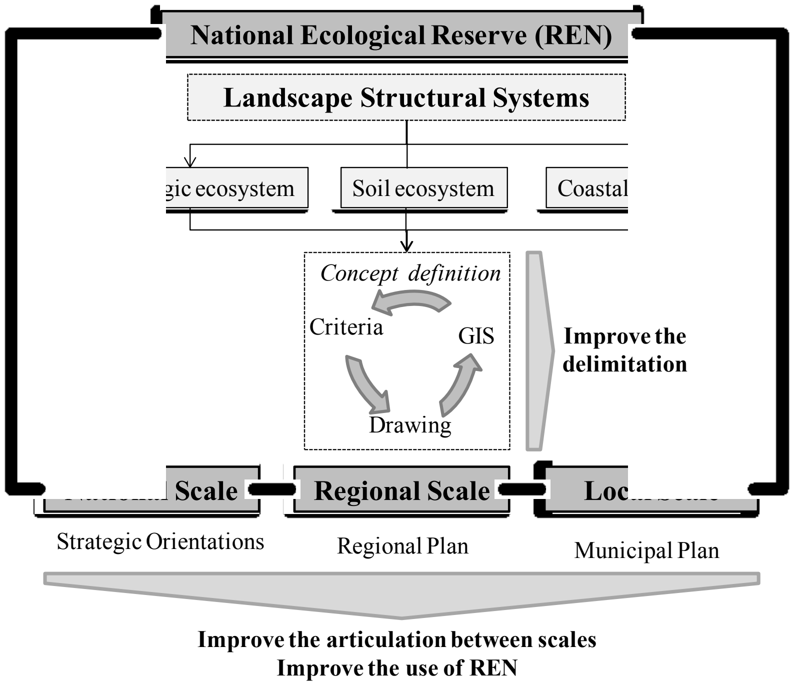

Figure 1 - Methodology scheme

Results

The methodologies to better define the typologies of REN are being tested and applied to different municipal case studies and also at national scale. In this paper it is presented the REN delimitation – according to CEAP methodology – in Sintra, Loures and Odivelas (Figure 2). These municipalities belong to Lisbon Metropolitan Area and they are characterized by highly dense urban areas alternating with rural areas. Among the three case studies Odivelas municipality had the biggest urban growth rate, with 70% of urban area (Table 3).

Table 3 - Area and percentage of urban areas in the case studies – from Corine Land Cover 2006

	Urban areas (artifical surfaces)		**other uses (agriculture, forest, wetlands, water bodies)**	
	Area (ha)	% in the total municipality area	Area (ha)	% in the total municipality area
Loures	4539	27	12391	73
Sintra	8839	28	23084	72
Odivelas	1833	**70**	803	30

In the table 4 it is summarized the developed components, concepts, methods and cartography that are related to each structural system of REN. All the procedures were applied into a Geographic Information System.

Table 4 Concept, methods and cartography needed to define different REN delimitation

Structural	**Components**	**Concept**	**Method**	**Cartography**

Systems				
Hydrologic ecosystem	Streams	Areas determinant for the good functioning of hydrologic basin (energy and water circulation).	Study the terrain morphology, the geology and soil map	Water Lines Terrain Morphology Soil Map Geology Map
	Contiguous areas to streams			
	Headwater stream area			
	Maximum infiltration areas			
Soil ecosystem	Soil erosion risk areas	Soil is an important system witch support different functions on the landscape.	Evaluate the soil characteristics and the slope degree	Soil Map Slope Map
Coastal ecosystem	Coastal morphology (dunes, beaches, cliffs)	The coastal areas have important geomorphologic dynamics and high ecologic value.	Study the coastal morphology, its fragility and ecological value	Geology Map Hypsometric Map
	Bathymetric (30 m)			
	Protection strip			

The REN delimitation in the three case studies is presented in the figure 2, with the different typologies and the same criteria to define them. The protected area of Sintra/ Cascais and the Natura 2000 network site - Tagus Estuary is also represented.

The arrow represents a potential REN corridor that connects both Natura 2000 network site and Sintra/Cascais protected area.

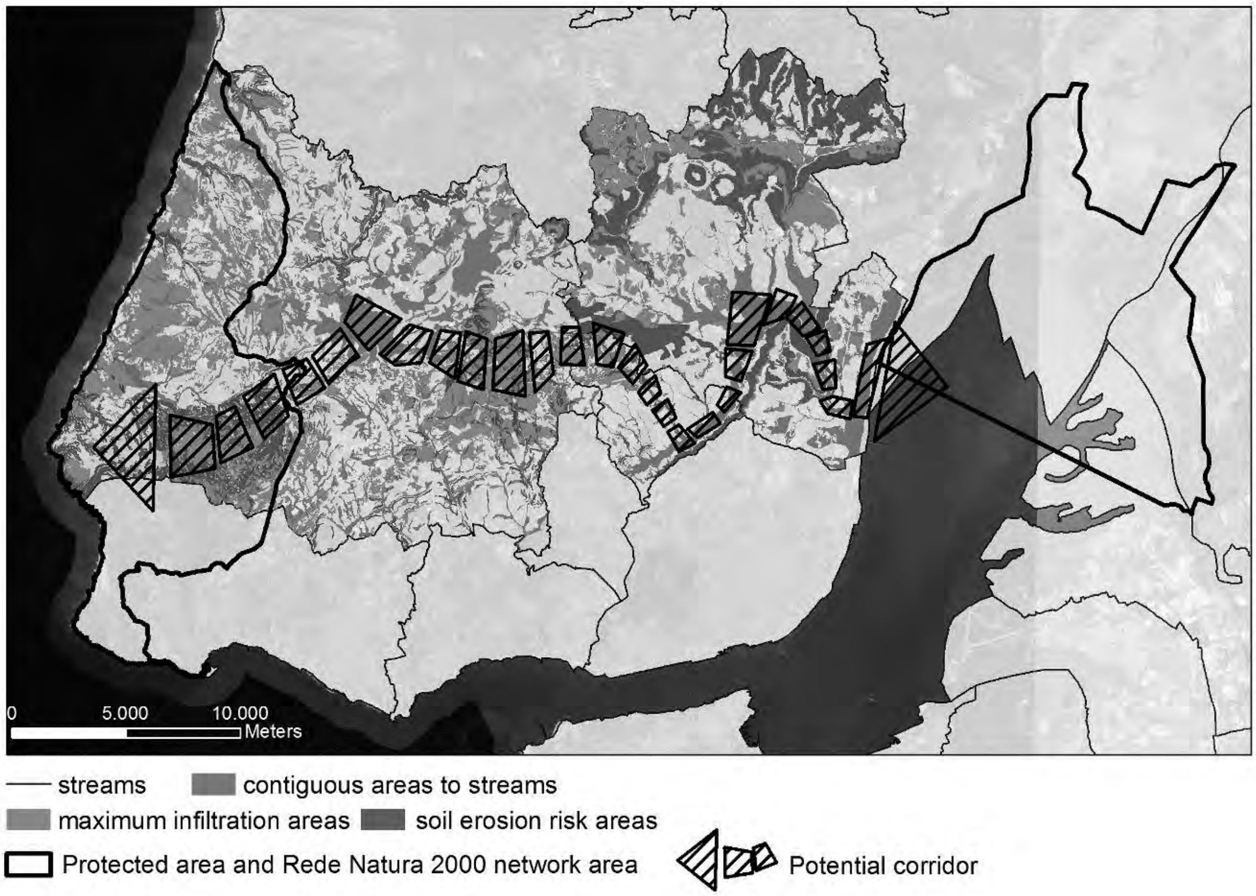

Figure 2 REN delimitation and potential corridor (arrow)

By comparing the proposed (Figure 3) and the approved REN (Figure 4) it can be said that the case study of Odivelas municipality is an example of an insufficient REN delimitation. As an exemple, Odivelas had two major floods in 1967 and 1983 and this is not mapped in the approved REN. In Table 5 is the comparison between REN approved and proposed in Odivelas municipality.

Table 5 Comparison between REN approved and proposed

	REN		without REN	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
REN - approved	264	10	2375	90
REN - proposed	1018	39	1618	61

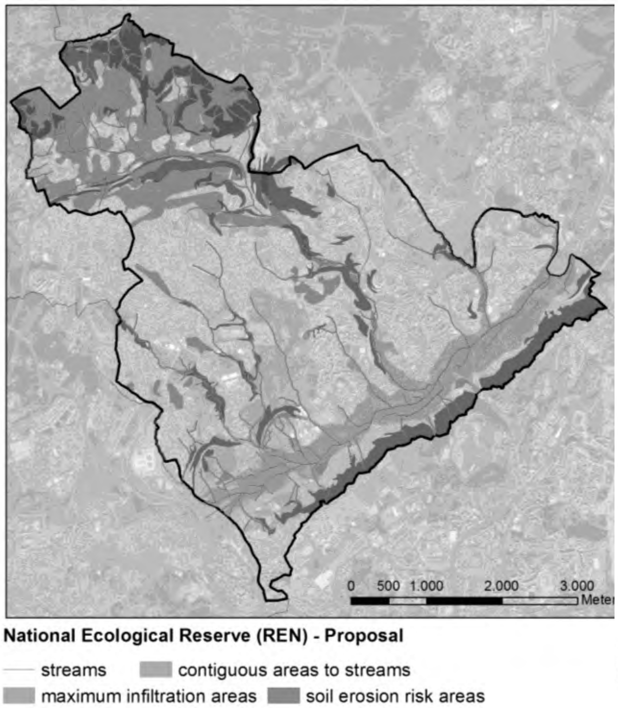

Figure 3 Odivelas REN - Proposal

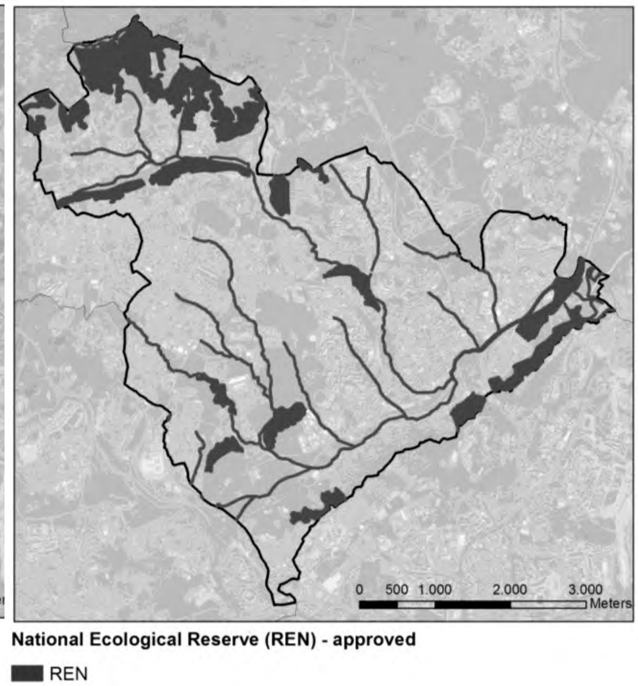

Figure 4 Odivelas REN approved

Discussion and conclusion

This paper demonstrates the importance of having consistent criteria to map REN. This will bring advantages in the vertical relation of plans (national – regional – local) and in the horizontal articulation with adjacent municipalities.

REN is an important Portuguese legal tool and could be seen as the basis of green infrastructure plan, achieving the purpose of connecting natural and high ecological values areas. The biggest advantage of using REN to map connectivitues is its structural character by resulting from landscape ecological interpretation, instead of a buffer corridor approach.

Mapping National Ecological Reserve allows the integration of green areas in urban dense territories in a continuous system connecting urban areas with peri-urban and rural areas.

Very dense urban municipalities should have a higher attention to the necessity of REN delimitation, and this should not be excluded from urban perimeter. The REN areas in urban areas can have the potentiality to be use as parks, cycle paths, for example, maintaining its functionality according to each REN typology.

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Landscape in the spatial planning system of European countries

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Introduction

Several researches, projects were launched about the varied spatial planning systems of European countries. For example an extensive comparison analysis was carried out by the guidance of the Directorate-General for Regional policy and Cohesion of the European Commission about the spatial policy of the member states (15 members) in 1997. However researches dealing with the state and scope of landscape planning country by country are quite unique. Conflicts of landscape planning and protection differ just mostly because of the different landscape conditions in Europe, but for the way and method how the issues of landscape planning are integrated in the spatial planning systems of European countries have diverse solutions.
In our research study we had the following goals:

- Exploring the influence of the European integration on the spatial and landscape planning of countries;
- Highlighting the main differences of spatial planning system in the countries (system, focus);
- Comparison among the forms and mechanisms of integration and implementation of landscape issues and landscape planning in the spatial planning system.

Materials and Methods

We carried out an extensive research exploring the main differences and similarities in spatial planning systems and the landscape issues integrated into spatial planning system of the European countries. The literature overview was supplemented by a comparison analysis of the Vital Landscape project co-financed by Interreg CE. Our research covered Germany, Austria, Slovenia, Poland, Slovakia, Hungary, Check Republic and Norway. The observed countries are the member states of the European Union with exception of Norway, which is a member of the European Economic Area, so it participates in the EU's Internal Market. From this point of view it is also interesting what kind of differences arise from the membership.
This work builds on national reviews of landscape protection (country report on European Landscape Convention) and national concepts (Land use development principles, Land use development principles – Czech Republic; Spatial Development Strategy and Spatial Order of Slovenia, Act on spatial planning in Slovenia etc.), acts in sectors influencing spatial planning (Act on Spatial Planning and Development – Poland; Nature Diversity Act – Norway). Most of the countries ratified European Landscape Convention and it opened up a broad forum on landscape protection and planning. Mostly all of the countries elaborated reports on the state and efforts in the field of landscape protection. We scanned the country reports and documents focusing on the following questions:

- Which is the territorial unit where the regulation of spatial planning is formed?
- What are the territorial levels of spatial planning?

- Whether the regional planning and land use regulation are divided?
- What are the forms of integration of landscape into spatial planning and in local plans?
- Were any changes in attitude toward landscape in the last two decades?
- Whether European Landscape Convention (ELC) influenced landscape planning in the observed countries?
- Is there any independent landscape plan?
- Are there any special mechanisms for implementation of landscape plans, landscape issues?
- Are there any specific difficulties in implementation of landscape plans or landscape issues related to spatial plans?
- Are there any consultation/coordination forums among sectors influencing the landscape changes?

Results

In the **European Union** the concept of spatial planning is used in a wider sense. It is an important tool for reaching social, economic objectives particularly in mitigation of territorial differences. In most countries spatial planning covers regional development and land use planning as well in practice. Our research analyzed how the legislation of EU and the Council of Europe formed the landscape and spatial planning systems of the countries. This system of Eastern-Central European countries went through comprehensive revisions during the 1990's because of the political changes and in order to adopt the legislation of the EU. Spatial planning does not belong in to the scope of the common EU policies so there are just recommendations elaborated by the institutions of the EU in this sphere. The *European Spatial Development Perspective* (ESDP, 1999) was a great progress in the history of EU regional policy. Although it does not mean any new responsibilities for the member states, it formulated common objectives for the balanced and sustainable regional development of the entire territory of the EU and gave guidance for spatial planning of the member states. The ESDP called the attention to that the natural and cultural heritage are economic factors which are becoming increasingly important for regional development. Cultural places of interest are also an essential precondition for the development of tourism. The ESDP warned us of the common feature of many European landscapes which is their constant further development. Unfortunately this is mostly leading to more uniformity and to the loss of biodiversity. Several guidelines of the ESDP served the protection and consideration of landscape values as resources for spatial development. The ESDP introduced such new concepts as the term of cultural landscape or the European ecologic network of Natura 2000 areas which breaks with the past idea of nature conservation and introduced the practice of protection by use. The *Territorial Agenda of the European Union* as a continuation of the ESDP was adopted in 2011. The Agenda as a short policy paper aims at mobilizing the potentials of European regions and cities for sustainable economic growth facing the economic, social and environmental challenges.

The **Council of Europe** has a great role in emphasizing European landscape values. A number of existing international legal instruments have some bearing upon landscape, either directly or indirectly. However, there has been no international legal instrument for years that dealt directly, specifically and comprehensively with European landscapes and their preservation. The *European Landscape Convention* was designed to fill that gap. The specialty of the European Landscape Convention is that its recommendations and measures cover all the forms of landscape which European countries possess. The general purpose of the convention is to encourage public authorities to adopt policies and measures at local, regional, national and international level for protecting, managing and planning landscapes throughout Europe so as to maintain and improve landscape quality and bring the public institutions and local and regional authorities to recognize the value and importance of landscape and to take part in related public decisions. The European Landscape Convention (ELC) adopted by the Council of Europe has a great effect on landscape planning, some of the observed countries signed and /or ratified it and some of them not (Figure 1.).

States	Signature	Ratification	Entry into force
Austria	No	No	No
Czech Republic	28/11/2002	3/6/2004	1/10/2004
Germany	No	No	No
Hungary	28/9/2005	26/10/2007	1/2/2008
Norway	20/10/2000	23/10/2001	1/3/2004
Poland	21/12/2001	27/9/2004	1/1/2005
Slovakia	30/5/2005	9/8/2005	1/12/2005
Slovenia	7/3/2001	25/9/2003	1/3/2004

Figure 1. Ratification process of ELC

Source**:** http://www.coe.int/t/dg4/cultureheritage/heritage/landscape/default_en.asp

Spatial planning systems in all examined countries work on different levels as each member state has a unique government structure. Broadly the states can be categorized as federal (Germany, Austria), regionalized (Poland) and unitary (Slovenia, Norway, Hungary, Slovakia, Czech Republic) countries. In the classical unitary countries self-governance of territorial units is limited. The regions of regionalized or federal countries possess over significant regulation power, separateness, and financial independence *(Illés, 2011))*. Due to its federal structure in Germany and Austria the regions are responsible for establishing the legislative framework for spatial development. In the unitary or regionalized countries the state governments are responsible for shaping the legislative framework of spatial planning system and the preparation of spatial development plans/strategies. In all unitary countries we can witness the process of decentralization because of the influence of the EU so in almost all country's regions were set up (up till now with the exception of Slovenia despite of the commitments).

<table>
<tr><th>Planning sphere</th><th>Western-Central-Europe</th><th>Hungary</th></tr>
<tr><td>Land use</td><td rowspan="4">Spatial planning</td><td rowspan="2">Land use planning</td></tr>
<tr><td>Transport infrastructure</td></tr>
<tr><td>Settlement development</td><td rowspan="2">Regional development</td></tr>
<tr><td>Demography, employment</td></tr>
</table>

Social welfare		
Economic structure		
Financial subsidies for enterprises	*Regional planning*	

Figure 2. Focus of spatial plans in Hungary Source: Illés, 2011.

If we look at the **focus of spatial plans** on higher territorial level mostly focus on development strategies, guidelines. On local level the land use regulation is the most important part of them. In some countries the spatial planning system is divided by two planning branches: regional development plans and land use framework plans (Figure 1.). The levels, the connection, and content of the two planning branches are regulated in detail in Czech Republic and Poland as well (Figure 3.). In *Hungary* the coherence of regional and land use planning is incomplete: on different territorial levels the two plan types are sometimes elaborated and adopted by different institutional bodies which hinders the effective and successful implementation of plans.

Figure 3. Relation between the spatial and strategic planning in Czech Republic
Source: adapted from Kašparová, Půček (2008) viz.www.uur.cz. Arrows marked in full colour represent legally binding relationships

Overall in all countries, the local authorities are responsible for detailed spatial planning and the preparation of land use plans. Each country has a unique solution about how the **landscape issues** and topics are integrated **in the spatial planning system**. In most of the countries legal documents related to biodiversity, nature protection or landscape protection have strong influence on the spatial plans. The landscape issues mostly as analysis of the observed territory's conditions as landscape structure, landscape ecology (Norway, Slovenia) or as a step at the beginning of the processes of territorial planning (Slovakia) but also as special regulation zones in spatial plans as ecologic network, or landscape scenery protection areas (Figure 4.). In *Slovenia* landscape development is an integral part of spatial plans, mostly landscape issues are considered as protected areas of different sectors. In *Poland* voivodeship spatial management plan (regional level) always defines areas under a special planning regime (e.g. ecologically protected areas and areas of restricted land use).

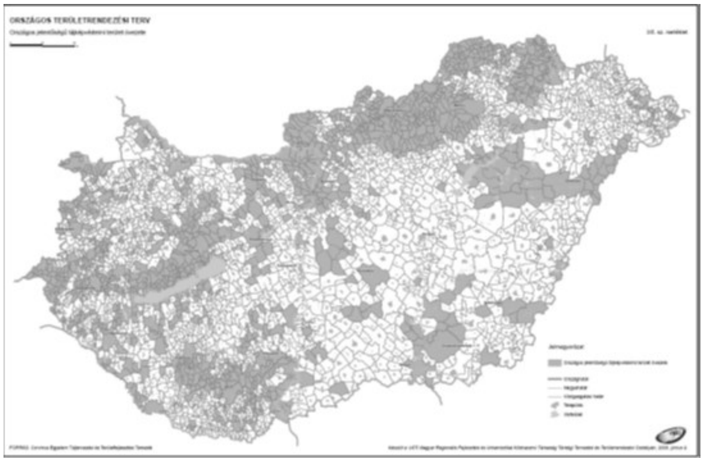

Figure 4. Landscape scenery protection areas from the National Land Use Framework Plan of Hungary

Source: National Land Use Framework Plan of Hungary, http://www.vati.hu/index.php?page=main&menu=19819&langcode=hu

In most of the countries there are special **landscape plans** or more precisely management plans for protected areas (Norway, Czech, Hungary). In *Norway* management plans are made for protected areas, but landscape is not a dominant aspect of these plans. The plans are part of the protection decision making process /designation. Landscape protection in *Poland* concerns mainly conservation of huge landscapes parks and cultural parks. On operation level it is implemented in the framework of landscape plans by municipalities (Majchrowska, 2011). At present, the landscape planning is missing in the *Czech Republic* and therefore conflicts arise with the application of the strict landscape protection programs. The management of large-scale protected areas has been institutionalized and the management (attendance) plans for protected landscape areas represent specific tools to ensure attainment of goals in terms of landscape formation, even if the individual components of landscape are given more attention than the whole systems (Plesník, 2008). In *Slovakia* landscape plan has a position only as a base document in the frame of land use planning called as "Landscape-ecological plan" which is the analytical back-ground for a spatial plan. Reasons why landscape-ecological plan was included into land planning documentation:

- tradition of landscape-ecological school in Slovakia
- the methodology of landscape-ecological planning (LANDEP) developed and used
- the concept of "Territorial system of ecological stability of landscape" (ÚSES) included into legislation: the Act on nature and landscape conservation No. 287/1994 Z.z. and 543/2002. (Halada, 2005). Unfortunately the gap in Slovak legislation allows skipping this phase in the case, if the municipality has not enough financial resources. The landscape-ecological plan is often replaced by the older type of the document called "territorial system of the ecological stability" which is sort of reduced document dealing only with the ecological stability of the territory, not with the complex knowledge of potentials, characteristic features and limits of the landscape (Synthesis report, 2011; Halada, 2005). It's quite unique that like the spatial plans on all planning levels there are landscape plans or programs. In *Germany* landscape planning is the

basis for nature and landscape protection on regional level. Since 1976 when the Federal Nature Conservation Act was adapted landscape programs were drawn up for the federal states (www.bfn.de). As the only one among the observed countries on all spatial level landscape plans are elaborated (Figure 5.)

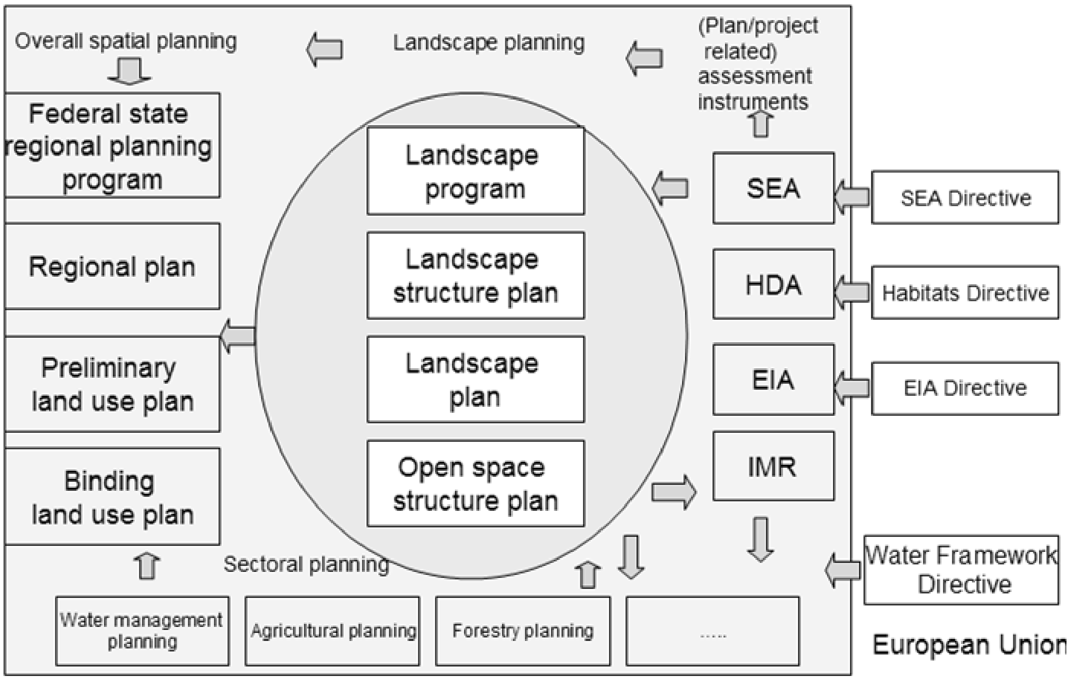

Figure 5. Position of landscape planning in the planning system in Germany
Source:http://www.bfn.de/fileadmin/MDB/documents/themen/landschaftsplanung/landscape_planning_basis.pdf

Regarding **implementation of landscape plans** or **issues** related to landscape planning in spatial plans in almost all countries we witnessed **difficulties** and problems. In *Hungary* the problem is the monitoring and implementation of the guidelines of land use plans. For example all the national and county land use framework plans to designate the areas for landscape rehabilitation but there are neither financial resources nor detailed plans for the implementation. So the realization mostly depends on the financial resources of the owner of the area. Mostly the guidelines and restrictions of the county and national land use framework plan will be implemented through the land use plans and environmental programs of the settlements. In *Slovenia* the PLUREL project report highlighted the lack of instruments for supervising the location of activities, and for monitoring the implementation of adopted spatial planning documents which caused many conflicts as uneven urban development, suburbanization pressures along motorways, uncontrolled dispersed building construction, restructuring of rural areas due to a changed role of agriculture etc. (PLUERL report).

In the last two decades in several countries can be witnessed a **growing awareness for landscape protection**: examples include encouraging instances of good practice in landscape matters at the local and regional levels in civic, administrative, and professional circles, photography contests, ecomuseums (Ekomuzea n.d.), greenways (Program Greenways w Polsce n.d.), nature parks and regional landscape strategies in *Poland*, Hungary, Slovenia etc. In spite of the general picture that the theme of landscape has a second place behind the economic development as in Slovenia and Hungary. After 1990, because of the political changes, the system of spatial planning changed as well partly because the hierarchy of the institutions of different spatial levels changed in *Hungary*. For example during the socialism the institutions of the counties were really strong, have high authority above the settlements. Nowadays the counties can not control the settlements that is why a national land use framework plan in the form of an act was elaborated. It essentially changed the role of the landscape and the role and the means of landscape plans as well. During the socialist regime the private ownership had a really low rate in the land ownership. Thus the state or the state owned companies: agricultural co-operatives, forestries, mines etc. had a great role in forming of the landscape and land structure . For the national parks and landscape protection areas regional landscape plans were elaborated (official statement 9007/1983). Nowadays such landscape plans are not prepared any more.

In all countries **many different sectors influence landscape planning** as environmental, nature protection, forestry, agriculture, infrastructure development, regional and urban planning, rural development etc. Many countries reported difficulties in harmonizing different needs and problems of **consultations**. In *Slovenia* all the sectors relevant for the planning issue are to take part of planning procedures from the very beginning. In case of disparities, these have to be mitigated with meetings where everybody try to achieve the harmonized solution. Unfortunately this is complicated and time consuming procedures which makes the harmonization very un-efficient in acceptable time (Synthesis report, 2011; PLUREL, 2011). For the vertical and horizontal partnership *Norway* is a good example (Figure 6.). All the county authorities have for nowadays set up 'planning forums', which are coordination bodies at regional level in which municipal land use plans are discussed with central government and regional authorities (http://www.regjeringen.no). Due to it's federal structure in *Austria* spatial planning is regulated mostly on regional level with the significant influence of national sectoral policies. So it was also important to set up efficient consultation forum for all the relevant bodies, stakeholders and sectors which is the *Österrreichishe Raumordnungskonferenz* (OEROK) founded in 1971. On various issues also relevant for landscapes frameworks for consultation exist, but these are not specifically dedicated to landscape; as regards issues related to biodiversity and the implementation of the Convention on Biological Diversity in Austria: "National Biodiversity – Commission"; as regards forest issues: "National Forest Dialog"; as regards the implementation of the Alpine Convention and its Protocols: National Alpine Committee; as regards rural development: "Rural Development Board"; National UNESCO Commission, etc. (country report on ELC).

Figure 6. Regional planning strategy as an arena for dialogue and cooperation in Norway
Source: adapted from http://www.regjeringen.no

Discussion and conclusion

The observed countries **face** more or less **similar problems and conflicts** related to spatial planning. Analyzing the questions we can find these but good examples as well.
Generally differences of the spatial planning system and landscape planning do not originate from different membership (EU) or ratification of any convention (ELC) but rather the different traditions of administration, government and importance of nature and landscape protection. So however Germany has not signed the ELC yet it has long traditions in nature conservation and strong legal instruments related to landscape protection and planning.
The **European integration** has a great effect on spatial planning on the observed countries even though it does not belong in the sphere of community policies, but through a number of common policies such as environmental-, nature protection, regional planning, transport planning etc. the EU legislation has a significant influence on spatial planning. In the field of landscape planning the Council of Euope through the European Landscape Convention has a great influence. The ELC has such professional significance that it influenced landscape planning in all European countries. One of its greatest achievements is that it opened up an international forum, knowledge platform for exchanging know-how and experiences in the field of landscape planning and protection. Mostly in the countries in the field of mapping, analysis and evaluation of landscape has been launched efforts and landscape award competitions or photo competitions have been launched for awareness raising (Hungary, Czechs). The countries mostly follow the landscape definition of the ELC with the exception of Poland as it rejects the traditional distinction between cultural and natural landscape (Majchrowska, 2011).
One of the main differences was that in some countries planning branches are divided. In countries where the coherence of regional and land use planning is regulated in detail and there

are well functioning consultation mechanisms between the planning activities this type of division does not cause difficulties.
As a conclusion of our comparison analysis we can state that the main problem because of which the measures and activities can not be efficient is that the **landscape issues** are mostly **divided among different bodies** but also **between different spatial levels** as well. Norway and Austria are good examples for vertical and horizontal co-operation.
Common problem is the **lack of guaranteed ways of co-operation**. Very good example for that is Austria however here as well are problems in implementation of landscape plans. In Austria there are controlled ways and methods of co-operation in spite of the fact that there is no independent sector of landscape planning.

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Scenario Planning for the Boston Metropolitan Region:
Exploring Environmental and Social Implications of Alternative Futures

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The Boston Metropolitan Area Urban Long-term Ecological Research Area (BMA-ULTRA-EX) Project is an interdisciplinary project that is studying the effects of socio-economic and bio-physical drivers on urban ecosystems. The Boston region is experiencing low-density urban sprawl (suburbanization) on the rural-urban fringes of the metropolitan area that is creating environmental impacts to natural resources. At the same time, central cities such as Boston are seeing disinvestment in some low-income neighborhoods causing property abandonment, along with limited infill development (densification) near the commercial core and transit hubs. These competing socio-economic forces of suburbanization, densification, and disinvestment have environmental implications for urban ecosystems, including urban forest canopy, water quantity and quality, and biodiversity. Landscape planning initiatives to address these issues will require a pro-active approach to concentrating development on currently built lands and in the suburban fringe to protect forests, farms and other natural resources, while greening and enhancing ecosystem services in the current high-density urban core.

It is within this landscape planning setting that the research team used a stakeholder- driven process to develop a set of four planning scenarios to explore the future of the region. This paper will describe the planning process with stakeholders to develop these plans, along with the preliminary analyses. It will conclude with insights for other landscape planners engaged in scenario planning.

Background

Scenario planning is a unique tool that allows planners to visualize alternative futures in order to deal with temporal change and multiple spatial scales (Myers and Kitsuse, 2000). Scenarios are flexible and adaptable to potential future conditions; providing a strategy for responding to the uncertainty inherent in land use planning (Peterson et al., 2003; Klosterman; 2007; Steinitz et al., 2003). They allow planners to develop benchmarks that illustrate the implications of different futures for a range of systems, including economic, ecological, and social. They are also very useful tools for engaging stakeholders and the public in landscape planning by showing them the ramifications of different decisions, making the planning process more visible and transparent (Gunder, 2008).

The Boston Metropolitan Region with a population of 4.48 million is the 10th most populous in the U.S., yet is expected to only experience moderate population growth in the coming decades. However, new development, primarily at the urban fringe, is expected to consume 152,000 acres of open space, including 58,000 acres of rare and endangered species habitat (Metro Future, 2009). This urban sprawl has precipitated planning efforts to try to concentrate new development within existing urban centers. At the same time, Boston has a long history of proactive open space planning beginning with Olmsted's Emerald Necklace to create a multifunctional greenway in this densely populated city (Fábos, 2004). Currently, Boston's

Mayor Menino has pledged to plant 100,000 trees to increase the urban tree canopy, as well as completed the Rose Kennedy Greenway on top of the Central Artery Project.

It is under this rich history of urban greening projects that an interdisciplinary research program was developed for the Boston Metropolitan Area to understand the historical and socio-economic processes that led to the current landscape pattern and to project future landscape change scenarios for the region. This project team involves the City of Boston, non-profit Urban Ecology Institute, and researchers from six universities, led by the University of Massachusetts Amherst. The project was funded by a new joint initiative of the National Science Foundation and USDA Forest Service known as the ULTRA-Ex (Urban Long-term Research Areas Exploratory) program.

The research team developed a set of four scenarios in conjunction with stakeholder groups to understand the competing forces of **urban greening** at the local scale, and **urban growth**, including suburbanization and densification at the larger scales. Urban greening, including tree planting and community gardens, allowed us to study the impacts of municipal investment in community-focused small-scale projects on the larger ecosystem-scale. In addition, we studied the impact of different controlled growth efforts on population, housing density and subsequent land-use and land-cover changes at the city and metropolitan scales. We also explored the relationship between these two forces of urban greening and controlling growth.

Goals and Objectives

Our goal was to develop alternative future growth scenarios in the Boston Metropolitan Region with stakeholder input that aim to:

- Explore outcomes for people and the environment of different levels of investment in urban greening, particularly tree canopy cover in already urbanized areas;
- Quantify impacts on both people and the environment of varying levels of restrictions on suburbanization versus the impacts of increased densification in inner core communities;
- Identify potential tradeoffs, constraints and unforeseen consequences of four different combinations of greening investment (or disinvestment) and controlled or uncontrolled growth.

Each scenario takes a regional perspective and looks at population changes in urban inner core, suburbs, and region. Our workshops focused on the Boston and inner core portion, and other studies are looking at impacts on the suburbanizing portion of the region, focusing on the Ipswich watershed. The combined results of the scenario analysis will support policy makers and nonprofits in their ongoing efforts to engage the public in achieving a sustainable future.

Scenario Planning Process

Our study builds on the existing planning studies for the region: the Metropolitan Area Planning Council's (MAPC) MetroFuture plan (http://metrofuture.org). We used the MAPC's population projections for the region, and detailed sub-units, called Transportation Analysis Zones (TAZs) in order to determine future land use for the 101 municipalities in the Boston Metropolitan Area, including the City of Boston. The scenarios were developed in conjunction with 45 stakeholders from 18 organizations during two workshops. At the first workshop in spring 2011, the research team presented a range of preliminary scenarios that stakeholders selected and modified for future development. The research team then developed tools and projected draft maps of future population growth in Boston and in the broader metropolitan area under each scenario. At the second workshop in spring 2012, academic researchers, non-profit members, and municipal and state decision makers gathered to provide feedback on these draft scenario maps and analyses. The research team made modifications to the analysis and continues to work on more detailed regional-scale land-use change projections.

Scenario Descriptions

The first scenario (Current Trends) follows the status-quo of uncontrolled growth with increased urban sprawl and increasing socio-economic inequities between suburbs and the central core cities. The other three scenarios (MetroFuture, Green Equity, and Compact Core) have some form of controlled growth, but differ in the ratio of new development allocated to the central cities and suburbs. The MetroFuture scenario is based on MAPC's existing plan that includes densification of the inner core cities and regional centers, which slows the rate of suburbanization and protects more open space and farmland than the Current Trend scenario. The Green Equity scenario prioritizes greening lower-income communities over urban density, while reducing inequalities in tree canopy cover. Urban greening is prioritized over urban density or protection of open space and farmland outside the urban core. Finally, the Compact Core scenario concentrates population and economic investment infill in inner cities such as Boston but downplays urban greening efforts. This strategy slows development in the outer-ring suburbs, which protects large tracts of connected open space and farmland.

Scenario Development Methodology

We used the MAPC's existing population projections for the MetroFuture and Current Trends plans. For the Compact Core, the growth rate for the inner core communities was increased, which resulted in a suburban growth rate of approximately half the Current Trends scenario. The population growth was then used to project changes in land use and urban tree canopy for the planning sub-units (TAZ's) within the study area. We used simple rules described above to allocate the amount of new development to different land use categories.

Based on MAPC's population projection in each TAZ, we used the demand of housing units as an indicator in gauging the potential housing density change for estimating associated land use and land cover change in the Boston Metropolitan Area. Several steps have been involved in transforming MAPC's population projection into land use and land cover change. First, developable lands based on zoning allowance and protected open space were identified, including current commercial, industrial, and residential land uses that could be infilled and redeveloped to accommodate projected housing units increase. Second, assumptions for a range of projected density increase in the Boston Metropolitan Area were made from very low density (more than one housing unit per acre) in rural communities to very high density (up to 200 housing units per acre) in the urban core areas. Finally, a set of decision rules were made to allocate projected housing units in each TAZ between inner core and non-core (suburban and rural) communities based on MAPC's projected development trends in greenfill (development on unprotected forest and agriculture lands) and infill (redevelopment in existing commercial and residential lands) in the region. The scenarios allowed us to study varying distributions of growth across the region, which were based upon allocating the projected regional population to different areas. Thus, while the regional population changes were similar, the allocation of growth between suburbs and the inner core differed (Figure 1).

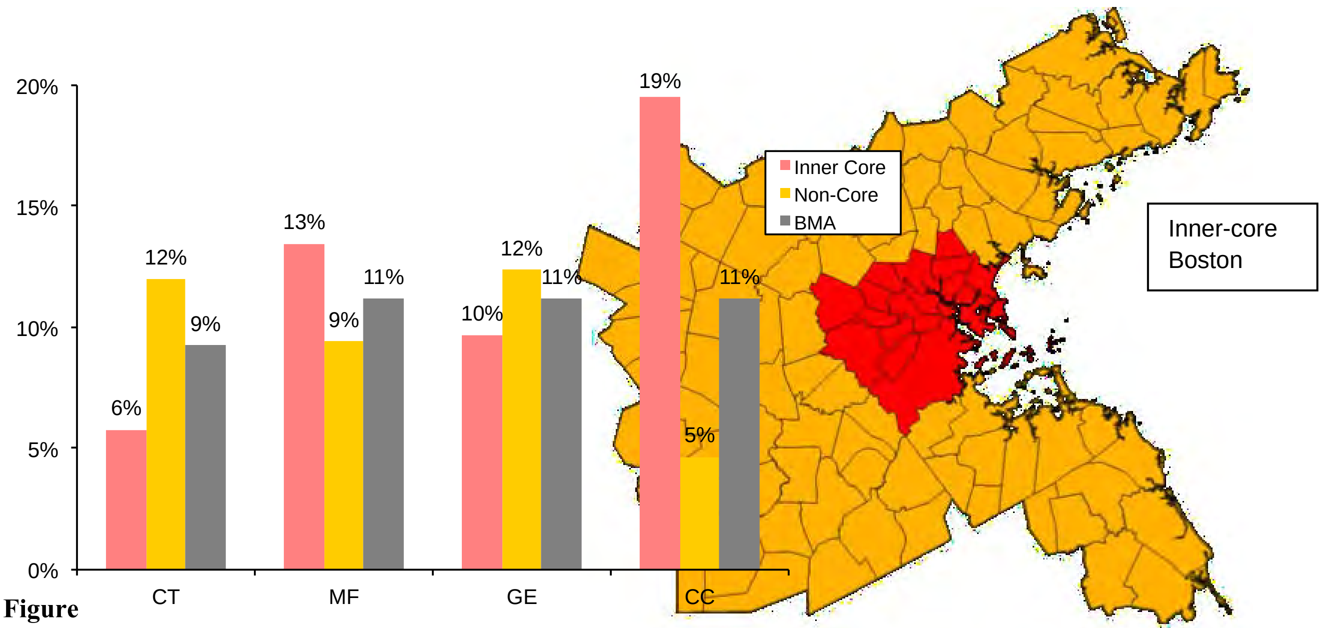

Figure 1.Population change between 2000 and 2030 in the inner core and non-core communities

Results

One of the research questions was whether the inner-core cities including Boston would have enough room to fit the high density projected land use change associated with this population growth. The changes in land use type (Figure 2) show that under the Current Trends scenario, only about 10% of the planning units would need to accept infill development to accommodate the modest increase in population, while over 25% of planning units in the Compact Core scenario would have increased density.

We were also interested in whether there would be trade-offs between densification of the inner core areas and urban greening, especially in the form of tree canopy. However, the trade-offs may not be straightforward. One could imagine a high-density infill project that minimizes the building footprint and increases tree plantings. However, due to the complexity of the scenario modeling, the tree canopy part of the study was limited to the City of Boston and inner core cities. The tree canopy study (described in detail in Danford et al., in review) used population change to determine the negative impacts of increased density on existing tree canopy. The study then looked at tree planting potential in pervious areas, impervious areas (i.e., parking lots); and along streets to determine the ability to "green" urban neighborhoods in Boston.

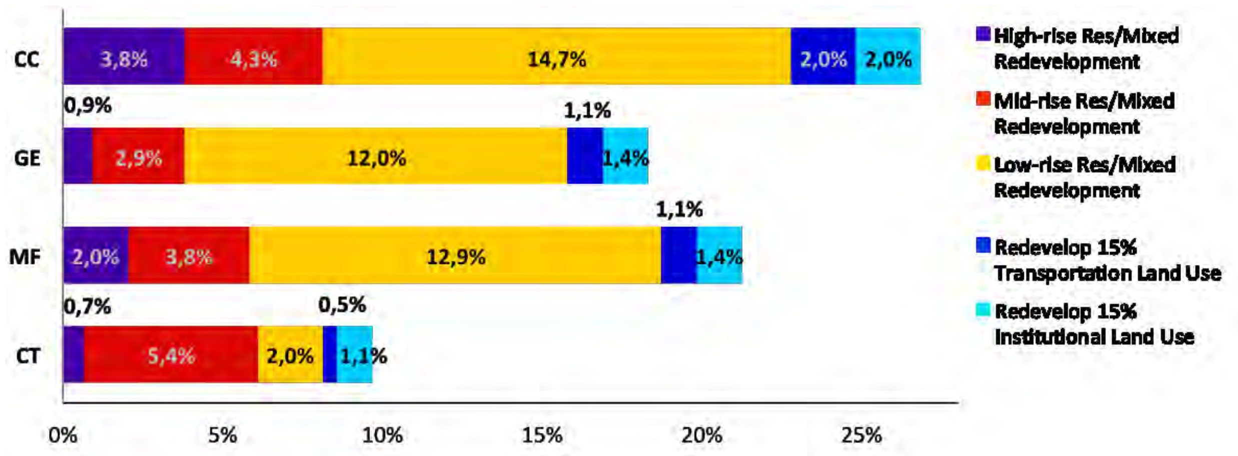

Figure 2. Changes to urban form in Boston under the four scenarios, shown as percentage of subunits (TAZs) projected to receive each type of development

Currently, tree canopies range from under 10% to over 75% canopy cover between Boston neighborhoods. In particular, this study was interested in understanding if focusing tree planting in under-served neighborhoods could overcome the inequities in tree canopy based upon income. The study allocated the tree canopy differently for each scenario. For example, the MetroFuture plan focused tree planting in the new higher density infill areas (greater than 13,000 people per sq. mi.), while the Green Equity scenario focused tree plantings in low-income neighborhoods.

The preliminary results indicate that it is difficult to achieve some of the desired outcomes identified by stakeholders, such as social equity with respect to urban tree canopy (Figure 3 & 4). For example, even increasing tree canopy in all potential areas, did not significantly bring many environmental justice neighborhoods up to the city-wide average in tree canopy of 25% (Danford et al. under review). Thus, there may be a need for more aggressive greening efforts that occur as part of redevelopment as land uses change or buildings are actually removed.

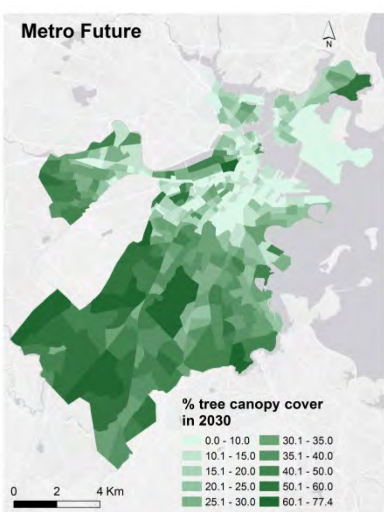

Figure 3. Projected tree canopy in Boston for MetroFuture Scenario in 2030

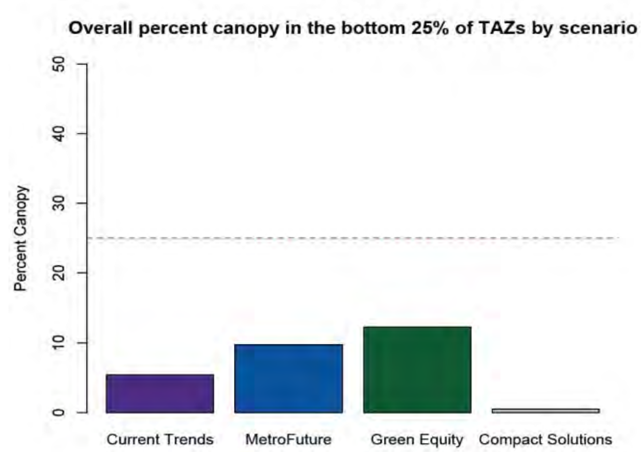

Figure 4. Even the Green Equity scenario which targets low income and minority neighborhoods did not bring the least treed neighborhoods up to the city-wide average.

We were also interested in applying some of the research team's studies of biodiversity to the scenario efforts. Our initial studies in Boston, previous to conducting the scenarios, found that bird diversity increases even with small amounts of additional green space, but suggests that this effect is more pronounced when the new green space is contiguous with existing green spaces (Strohbach et al, 2013) (Figure 5). Applying this to the scenario results to date suggests that efforts to promote urban biodiversity should focus on expanding tree canopy around existing green spaces. However, our tree canopy research suggests that this strategy would further exacerbate the existing socio-economic inequities between lower-income neighborhood with fewer trees and high-income areas that are already very green.

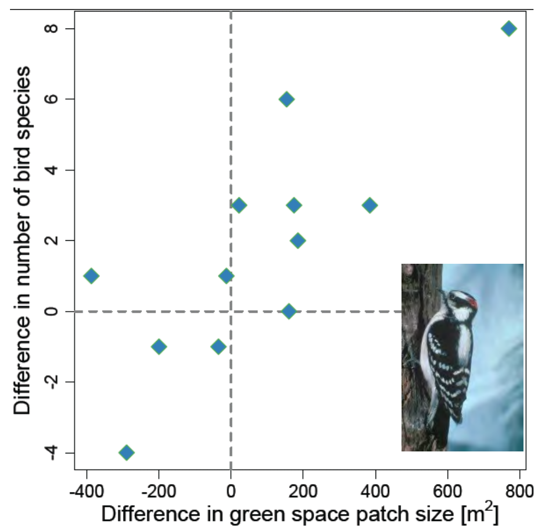

Figure 5. Bird diversity increases with patch size, suggesting that biodiversity would most benefit by planting trees near existing green spaces, rather than distributing them evenly across the city as the Green Equity scenario would do

Stakeholder feedback during the planning workshops highlighted four important areas for further study and refinement of our scenarios. First, since our initial analysis focused primarily on the City of Boston, stakeholders were interested in knowing the regional implications of the scenarios. The team is currently working at the regional scale, particularly with regards to the relationship between land use change and water quality. Second, stakeholders were interested in learning more about the implications of other green infrastructure techniques besides tree canopy, especially those related to stormwater management. Third, stakeholders wanted to the discussion of equity to include more than lack of green space. According to them, jobs and employment are a major issue for improving lower-income neighborhoods that needs to accompany greening efforts. Finally, stakeholders were very interested in quantifying the impacts of the different scenarios. In particular, quantifying the economic impacts of the ecosystem services provided by urban greening and/or open space protection was seen as vital to convince stakeholders and government officials in the region about the efficacy of continued government investment in green space and greening projects.

Implications for Scenario Planning

This research study can offer several insights for landscape planners who are engaged in scenario planning. We found that engaging stakeholders in the scenario planning process allowed us to add a much needed "reality check." The stakeholders pointed out relevant areas of interest, questioned assumptions that were being made, and were keenly interested that the final scenarios were realistic and addressed the unique characteristics and settings found within the Boston region. We also found that converting proposed population changes to actual land-use and land cover change to be more challenging than expected. In an existing highly developed city such as Boston, increasing density requires infill of new development within either existing neighborhoods or redevelopment of commercial and old industrial land. We had to develop our own set of rules and guidelines for infill based on densities that already occur within Boston. Future landscape planning efforts could benefit from having standardized infill development models to help replicate scenarios across a larger region. Working with stakeholders to determine realistic infill densities and appropriate land-uses to change is an important part of the process. In summary, scenarios are very useful for landscape planners to help their communities articulate a vision for a more sustainable future that increases urban green space while accommodating the need of growing urban populations.

Acknowledgements

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3. LANDSCAPE PLANNING

Greenways for a Greater Good- An Indian Perspective

Prof. Samir Mathur, Sandeep B. Menon, Priyadarshini Kacker

1. Introduction

Cities have developed on the banks of rivers from the dawn of civilizations. The urban fabric of Indian cities is an intricate tapestry composed of settlements that span almost 4000 years of urban history. Cities as old as 2500 B.C co-exist sometimes in harmony and sometimes in conflict with cities that are still being conceived. The pace of urbanization in India is unprecedented and the country hosts some of the most populous cities in the world. According to the 2011 census, urbanization in India has increased faster than expected reversing the declining trends of the earlier decades. (Census of India, 2011) This boom presents its own set of challenges and opportunities. The role of a Landscape Planner becomes prominent since ensuring the balance of ecological processes and the components of Master Plans are imperative to ensure a sustainable future

2. Background:

2.1 Ecological Ethos and Cosmic Connections: The cities and landscapes of Indian settlements have always strived for balance with the universe. Cosmic geometries as applied to Indian settlements spoke of 3 realms of the cosmos consisting of "The macrocosm (stars, planets, moon and Sun), the mesocosm (Atmosphere, Mountains, Lakes, Oceans and Rivers) and the microcosm (City, temple, home and body)" (Malville & Gujral, 2000).This practice takes physical form in the linear movement patterns often observed in Pilgrimage routes. Studies of ancient movement patterns reveal that travel ideally occurs along rivers, mountain ranges and along forests. Irrespective of the effects of modernity these patterns stay intact and find resonance across civilizations. Pilgrimage paths and trade routes are probably the earliest examples of Greenways in India as they were planned as transport linkages with green landscaped areas on either side. The ancient pilgrimage routes and their origins can be traced back to mythological texts such as the Ramayana. During the rule of the Mauryan Dynasty, Emperor Asoka (304-232 BC) planned wells, shade giving trees and religious structures along the route to cater to the travelers. These routes came into prominence again centuries later under the leadership of Sher Shah Suri (1486-1554 AD), in the form of the Grand Trunk road (*Sadak-e-Azam*). (Farooque, 1977)

2.2 The Lost Rivers: The ancient Indian treatise Vastusastra states that a city should be founded on the banks of a perennial source of water. In fact, River Saraswati, one of the most important rivers in Hindu mythology has been exalted to the status of a goddess and attributed with divine powers was long considered metaphysical until recent geological expeditions which suggest that not only did the river exist but it may have been responsible for the flourishing Indus valley civilization founded on its banks. (Danino, 2010). The studies suggest that geologic disturbances may have caused a shift in the tectonic plates which led to the river shifting its course and this eventually led to a slow abandonment of the settlements along it leading to the disappearance of an entire civilization. Such was the inherent dependence of urbanity in India on the ecological processes of a river system. Cities on floodplains are extremely vulnerable to catastrophes and impact of climate change. But cities have been developing historically on the river edges due to availability of water, arable land and trade possibilities. The river was regarded much more than an ecological entity, it was considered as a cultural essence, an emotional power and a philosophical idea (Jain, 2011). However as cities developed and with the advent of technology and industrial development, the dependence on the river reduced. Many of the present city developments have engulfed the floodplains and have their backs to the river which in most cases have become an open sewer.

3. Goals and Objectives:

The main objective of the paper is to present with the help of three case examples, the challenges faced by a Landscape planner in rapidly developing riverfront cities in India and to address these concerns through the usage of Greenway Planning Theory. The three case examples are of landscape and environmental interventions in cities on the edge of River Yamuna, in one of the world's highest population density zones. The paper aims to formulate a strategy for Greenway Planning for highly urbanized riverfront cities based on the hands-on experience of working on these projects.

4. Methods:

The study is structured around the analysis and assessment of three Indian cities along the River Yamuna. The site conditions and context of each of these cities are unique and needed different responses in terms of the intervention. One of the projects deals with exploring green linkages to connect the existing natural and designed green patches within the city to the riverfront in order to enhance the coherence of the open spaces within the city core. The second project explores the use of greenways as urban infrastructure to resolve issues of accessibility and mobility within a dense urban fabric populated by monuments and various layers of history. The third project uses Greenway Planning, not as a retrofit, but as the main organizing principle along which a new city would come up.

The landscape interventions were based on a thorough analysis of the conditions at site using five broad parameters. They include ecology, socio-cultural aspect, Infrastructure, Aesthetics and Economical aspect. The analytical results were used to generate scenarios of development which would respond to variable futures. After discussions with the stakeholders and evaluating the options, one of the scenarios was chosen and detailed out for execution in each case.

The results of these interventions were synthesized to arrive at a strategy for Greenway Planning for highly urbanized riverfront cities based on the hands-on experience of working on these projects.

5. Case Examples:

5.1. The Central City Core, New Delhi:

Delhi as it stands today is an amalgamation of seven cities built over a span of 2000 years. Interestingly, all the historic cities came up on the western bank of the river sandwiched between the river and the Aravalli mountain range which act as natural barriers while the eastern bank of Yamuna was left natural because it was subject to inundation in the monsoon months. New Delhi, the newest city, was laid out in 1911.A city designed by the English Architect Edwin Lutyens and loosely based on the utopian ideas of Garden Cities (Ebenezer Howard, 1898) with emphasis on large, geometric plazas with fountains and formal geometry. However the city was

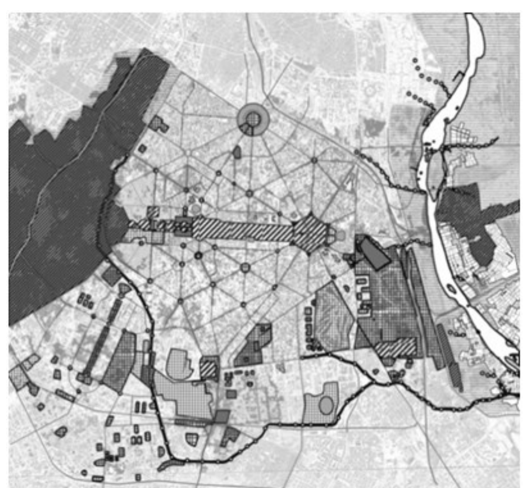

FIGURE 9: EXISTING NETWORK OF OPEN SPACES

primarily designed for the Automobile and pedestrian linkages and human scale were often overlooked. The Delhi Urban Arts Commission (DUAC) and Government of Delhi, commissioned a study as part of the Zonal Development Plan (henceforth referred to as the ZDP) in lieu of the proposed Delhi Master Plan 2021 for analyzing the existing open space framework in the Central City Zone and suggesting improvements for the same. The guidelines for organizing the open spaces are aimed at creating a visually pleasing and functionally linked system of open spaces within the city through roadside landscape improvement, urban open space improvement of areas with social, historical and cultural significance and development of greens along the drainage channels.

The existing classification used for open spaces in the city was studied to understand the diversity in the usage pattern and to pin point the lacunae in the existing landscape designation. A parallel study for analyzing the existing conditions of the open space was also undertaken. The open spaces within the city were found to be fragmented and enveloped by various physical boundaries reducing the chances of them being perceived as a contiguous network. Further analysis revealed that there does exist a pattern in the urban matrix which allows the fragmented patches to be linked to one another and eventually to the vast river floodplains by retrofitting a network of green linkages which could double up as ecological corridors connecting the two large patches of undisturbed natural landscape in the city - the Central Ridge Forest in the west of the Heritage zone and the vast River floodplains to the east. The **'Eco-Streets'**, as they would be called were designed to offer opportunities for moving through the city on foot or on cycle, thus reducing the dependency on vehicles. The "Eco-Streets" were

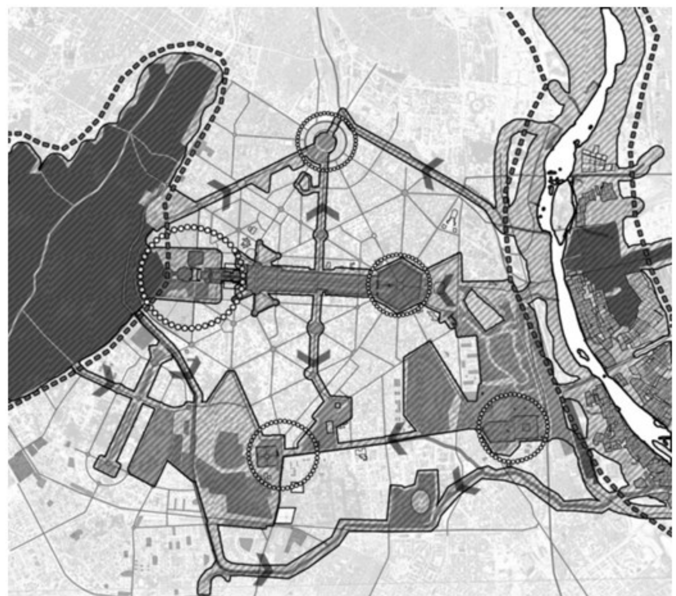

FIGURE 10: PROPOSED NETWORK OF OPEN SPACES SHOWING LINK BETWEEN

FIGURE 1: RIVER YAMUNA WITH NATURAL DRAINS AND

FIGURE 2: IMPORTANT LANDMARKS AND HERITAGE AREAS

FIGURE 3: ROAD NETWORK

FIGURE 4: TREE COVER

FIGURE 5: REGIONAL GREENS

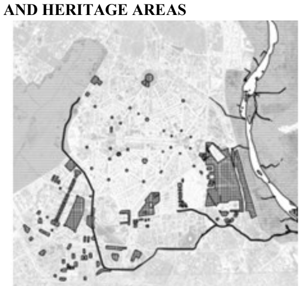

FIGURE 6: DISTRICT/COMMUNITY GREENS

FIGURE 7: HERITAGE GREENS & RECREATIONAL GREENS

FIGURE 8: FARM GREENS

identified on existing roads; the Right of Ways of which could be tweaked to accommodate enough space for pedestrian movement and dedicated cycling corridors with ample planted buffers of native vegetation. The heavy infrastructure on these streets was designated to be replaced by soft infrastructure, built into the streets in the form of bioswales, rain gardens and curb cuts for seamless runoff connectivity. The existing drainage channels which are in a state of disrepair have been proposed to be converted into constructed wetlands for filtering and purifying the run off before it reaches the river.

Evaluation: The goals of the intervention proposed are multifunctional in nature. It will have an appreciable value in terms of the ecological functions that it would render in terms of connecting the ridge forest patch to the river floodplains, the connections which got fragmented while the city developed. The linking up of various culturally important spaces like the Central Vista, the India gate Monument and the historic gardens would add to the cultural significance of the intervention. The possibility of extending this greenway to the rest of the city using the right of way of the existing disused drainage channels and the river floodplains offers an exciting opportunity to connect the landscape patches within the city to form a strong ecological and cultural network weaving through the urban fabric and holding it together.

5.2 Agra Heritage Riverfront Corridor: One of the oldest cities founded on the banks of this river is the historical city of Agra. The history of present day Agra is intrinsically linked to the history of the river upon whose shore it's founded. Though present day Agra is known primarily for its most iconic monument- the Taj Mahal, lost in the chaos of the city, are a number of lesser known Mughal monuments constructed along the Yamuna riverfront but bad planning has caused the other monuments along the riverfront to be neglected and ignored. The Riverfront in the 16th and 17th century was composed of a symphony of private pleasure gardens of the nobility. This green buffer formed an ecological buffer between the urban settlements of the city and the river. The river which was the raison d'être for the origin and evolution of the city has now been forgotten and the lack of a cogent riverfront is evident. Rapid urbanization and unplanned growth coupled with short sighted building practices and lack of environmental sensitivity has led to degradation of the living conditions in the city, it is now plagued by congestion, chaos and pollution. The city is frequented by tourists both national and International. The role of enhancing the city and creating a legible network of connectivity between the monuments, the river and the city are essential for this. The Agra Development Authority (ADA) commissioned a Detailed Project Report on what could be done in terms of environmental upgradation for the city to reintegrate the monuments to the tourist circuit and to develop the riverfront, parks. The approach adopted in the study was to propose urban improvements in order to aid the local community ameliorate the effects of haphazard development and while doing so create a coherent network of spaces for the tourists to experience while moving through the city.

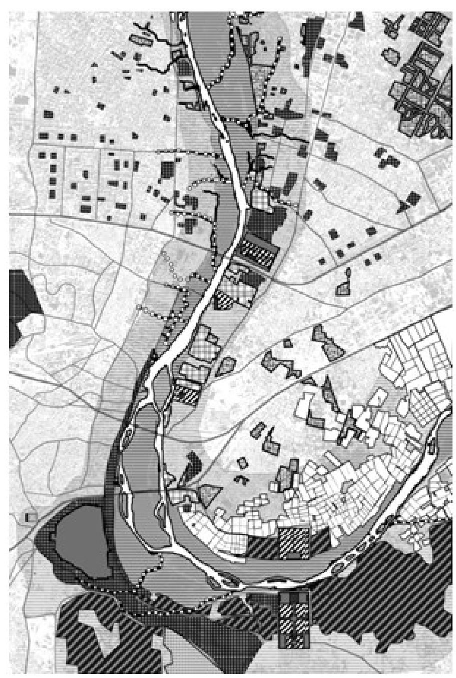

FIGURE 9: EXISTING NETWORK OF OPEN

The City Master Plan document for the city, City Development Plans, Jawaharlal Nehru National Urban Renewal Mission (JNNRUM) Guidelines, Satellite imagery and Site physical surveys, riverine ecological processes, cultural and ecological data were compiled and studied. The zones of intervention were identified and classified based on the study as to the extent of intervention.

Four distinct types of possible spaces were identified:

a. The Heritage Riverfront Promenade Edge: Present conditions were analyzed to assess whether the edge will be built or left natural. The existing and proposed edge conditions were overlaid to find out whether the slopes would be self-stabilizing or would need protection.

b. The Connections to the Monuments: Existing linkages were analyzed and the prominent, easily accessible links were identified to be developed as pedestrian and non-motorized connections to the various protected monuments.

c. The Secondary Routes through the Urban Fabric: The existing roads and by lanes with regular

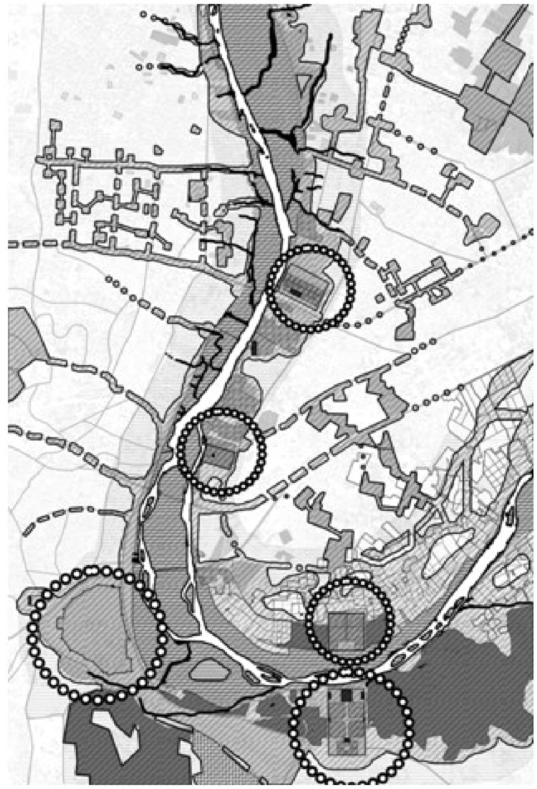

FIGURE 10: PROPOSED NETWORK OF GREENWAYS

FIGURE 1: RIVER YAMUNA AND DRAINAGE AND RIVER BED WITH

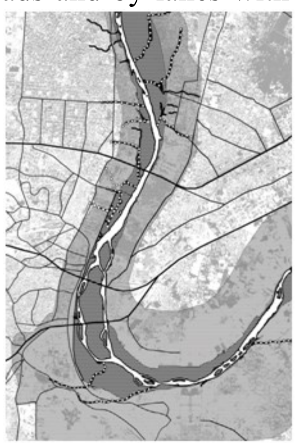

FIGURE 2: ROAD NETWORK

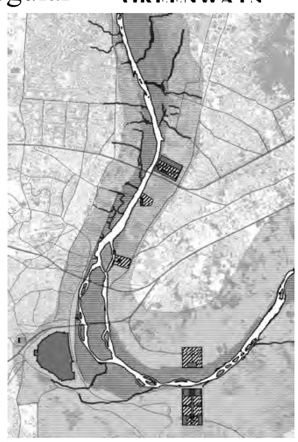

FIGURE 3: HERITAGE BUILDINGS WITH HERITAGE GREENS

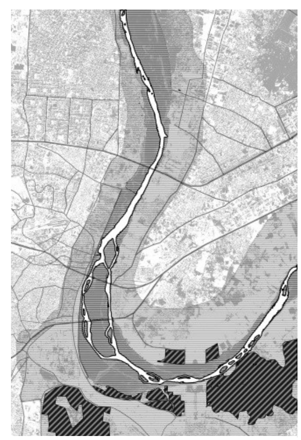

FIGURE 4: REGIONAL GREENS

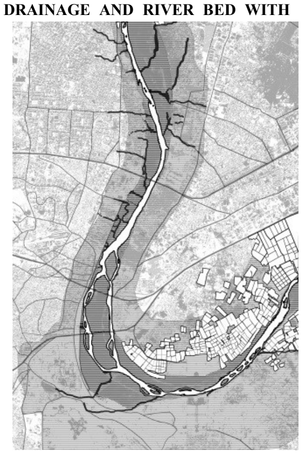

FIGURE 5: FARMING GREENS

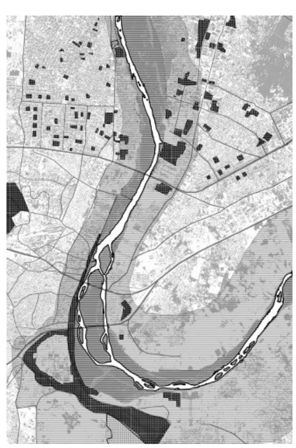

FIGURE 6: DISTRICT/COMMUNITY AND RECREATIONAL GREENS

FIGURE 7: CITY GREENS

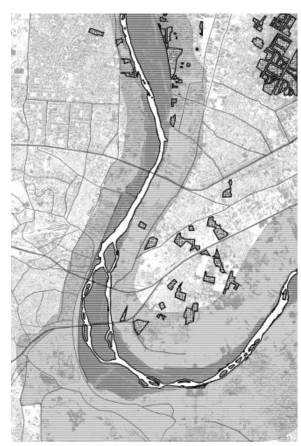

FIGURE 8: POTENTIAL GREENS

use by the local population are to remain ‘status quo’ usage while improving on the infrastructure giving predominance to ‘Low Impact Development (LID) Infrastructure’.
d. The Existing Green Patches and Monument Fringe Open Spaces: These existing spaces within the city are analyzed with respect to their context, character, possibilities and future scenarios and the synthesized results evaluated in order to formulate a strategy for connecting these spaces.
Evaluation: The interventions are biased towards the anthropocentric dimension with emphasis on socio-cultural aspects, improving the urban aesthetics and green infrastructural inputs. The riverfront intervention and the overall storm water management strategy are designed to be ecologically sensitive and to augment the depleting water resources. The project will aid in improving the surrounding areas directly leading to the image of the city core and contributing to an appreciable improvement in the economic conditions.

5.3 Sports City, National Capital Region: 5.3 Sports City, National Capital Region: The Sports City is a new satellite city of Delhi being developed by a private developer to establish a modern city anchored by business, sports, health and educational enterprise. The city is envisioned for a resident population of approximately 900,000 people and a daytime population of approximately 2.2 million people including the workforce and day time visitors.
This city has been planned to be built around an extensive greenway which includes a series of retention lakes and native forests. The greenway spans and interconnects the entire city like a central spine and incorporates transit, active and passive recreational areas, a comprehensive storm water management system to naturally filter water and return it to the ground and a geothermal district cooling system. The project site is approximately 40 km from the city center of Delhi on a flat, alluvial plain adjacent to the Yamuna River and protected by an earthen bund/levee.
This open space planning is proposed to follow and capitalize on the natural cycles of water to help create a sustainable city that is economical to build and maintain. A series of “bio-corridors” which are more naturalized and forested areas, branch out of the boulevard and serve primarily as water conveyances and seasonal water detention areas. These connect the ‘Central Greenway’ to the Yamuna floodplains beyond the levee that protects the site. All parks will have facility for water storage and infiltration based on variations of vernacular examples of step wells and riverfront *ghats* that serve to cleanly organize seasonal water surges.

FIGURE 1 DETAIL PLAN OF PROPOSED GREEN AND GREY INFRASTRUCTURE NETWORKS | SOURCE: TOM LEADER STUDIO & INTEGRAL DESIGNS

The greenway is designed as an extended ‘Central Park’ for the city with the socio-cultural hubs located alongside. It also generates the core identity of the City through the range of programs and activities that are designed to fit into it thereby creating local identities around which housing, workplace, and commercial activity can be oriented.

Evaluation: The interventions in this case were different from the earlier case examples owing to the fact that this was a newly conceived development where the Greenway Planning Theory was introduced as the central theme of the development. The ‘Central Greenway’ along with the peripheral ‘Bio-corridors’ forms the main organizing axes on which the city would come up. The greenway takes on a synergistic role of a multifunctional landscape in the city. The planning of the greenway was done so as to cater to all the values identified. The emphasis on Low Impact Development based infrastructure and planning of spaces to cater to storm water retention are imperative for the design of the river edge city since it caters to augmenting the ground water resources of the bio-region. The planning of the city based on a greenway spine could be replicated in newer cities which are being planned along the riverfront corridor.

FIGURE 1: RIVER YAMUNA AND MAIN

FIGURE 2: 3 LAND PARCELS

FIGURE 3: ROAD NETWORK

FIGURE 4: PROPOSED URBAN

FIGURE 5: MAIN GREENWAY LINKING 3

FIGURE 6: PROPOSED GREENWAY

FIGURE 7: PROPOSED DRAINAGE

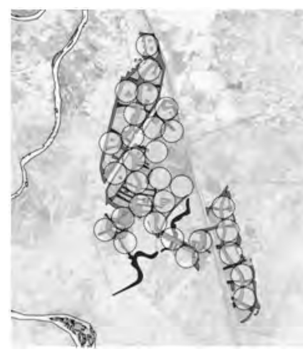

FIGURE 8: ACCESSIBILITY-10 MINUTE WALKING

6. Cconclusions:

6.1. Lessons Learnt: The results and experiences of working on the case examples were synthesized to form a general framework for developing greenways in the riverine tropical cities. The main observations are as follows:

- Greenway interventions in tropical cities in developing countries have to be ‘multifunctional in nature’. The high density core areas would require both the anthropocentric as well as the ecological functions to be catered to.
- The multifunctional nature of the greenway design could create conflicts of interests. For example, ecological functions of a greenway can be compromised when emphasis is on catering to the socio-cultural aspects. The solution is to arrive at a resolution based on the context of the project and the natural processes of the city.

• Existing notions have to be challenged. For example, the traditional outlook of linking infrastructure with heavy engineering which has high embodied energy systems and maintenance will have to be reviewed using Low Impact Development (LID) models & Green Infrastructure.
• The effective participation of Stakeholders and Community has to be ensured for a successful completion of the project. This would be a true representation of democracy with the users being a part of the decision making process.
• The gap between research and ground practice has to be bridged. Research projects have to augment the practice and challenges in the practical fields should trigger reasons for research.

6.2. Challenges to the Process: The main challenges to the process of implementing greenway projects in India are as follows:
• Multiplicity of organizations and Government bodies
• Misplaced priorities of the decision makers
• Archaic guidelines and policies
• Lack of comprehensive scientific databases
• Available Funding and Affordability
• Community Preference and Adaptability to the users to change

6.3. Way forward: The learning's from the projects could be used as a broad framework within which urban greenway projects could be implemented in India. The following are the main considerations identified:
• There is no one 'cookie cutter solution'. The template of introducing Greenway Planning Theory has to be adapted to the natural processes and community needs of each city.
• Master Planning is to be an 'inclusive interdisciplinary process' with Planners, Landscape Architects, Urban Designers, Ecological Planners, Bio-Geo-Scientific Experts and Architects to be working in synergistic tandem. The preparation of Master Plans has to consciously avoid the current system of laying out the land uses with mandatory green areas as mindless infill.
• Greenways are to be employed as an augmenting tool to the other types of open spaces within the city. Overemphasis on them should not shift the focus from the other types of open spaces in a city.
Greenways can be used as successful tools to reinforce this idea of nature conservation and environmental sensitivity. Ecological ways of thinking and development have been an ingrained aspect of the Indian culture which is being compromised by the recent wave of globalization. It is imperative to adopt sustainable models of city development at the master planning stage as well as detailed design stages to ensure a stable future.

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Here Comes the Boom: shale gas, landscapes and an ecological planning imperative

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Introduction

Shale gas development in the United States is destined to bring about major long-term changes to the rural landscape. While popular media regularly reports on disputes over the role of hydraulic fracturing, "fracking", on domestic water supplies, we believe that the more significant impacts on landscapes and communities lie in the less noted but nevertheless extensive footprint of land use changes that accompany this massive economic development. Four land use conversion topics faced by communities in north-central Pennsylvania were examined in order to scope out fruitful directions for more comprehensive study. First we projected, based on the locations of existing road and pipeline infrastructure, the areal land use change that would result from access roads and pipelines to support projections of gas development developed by the Nature Conservancy. Next we investigated the watershed-scale impacts of those changes in land cover and using TR-55 estimated the likely downstream flooding at the mouth of a significant tributary of the Susquehanna River. Recognizing the importance of the tourism industry in Pennsylvania we then developed a regression model of visual quality for the region, based on land use and scenic attributes, and estimated the impact on visual quality of the same projected land use changes. Finally we examined the potential of this same landscape as a source of renewable energy and then the implications of reorganizing gas development to optimize land use change toward a sustainable energy future. The results indicate that impacts on timber and habitat resources are substantial as a result of the fragmentation resulting from development. Further, the potential flood effects are significant and can only be partly moderated by the application of best management practices for land restoration. The impacts on visual quality are dispersed and thus may result in gradual erosion of scenic benefits and, regrettably, go unnoticed. The potential for energy development is high but the opportunity costs of planning for future development probably far outweigh the net present value of the future benefits.

Background

The pace, scale and distribution of unconventional natural gas extraction in North America demands a concerted landscape ecological planning response. In the mid-Atlantic, this imperative has arisen in Pennsylvania, New York, Ohio and West Virginia as communities manage the feverish pace of development associated with the Marcellus Shale natural gas deposit. The applications of new technology to extract shale gas and the wide distribution of shale deposits, driven by national ideologies of foreign oil independence and job creation suggest we have only witnessed the early days of what is sure to be a dominant activity on the landscape. While many of the regions witnessing this new energy 'boom' are the same places where oil and coal extraction were carried out in previous years, the organization and structure of gas extraction is categorically different. Shale deposits and the associated extraction activities are relatively dispersed. While the individual site footprint of gas extraction is not as visibly shocking and demonstrative as mountain top removal, the thousands of well pads spanning the landscape generate thousands of acres of connecting infrastructure impacts. These impacts are not monolithic and highly related to the specific extraction task and geographic context. Furthermore, workers in this energy revolution will not be housed in coal towns near to pits and mines. They are far fewer in number, widely dispersed, and highly mobile. The complexities of developing this energy resource necessitate an equally complex landscape ecological planning strategy to address its substantial natural and cultural impacts. This paper details and describes our recent efforts to engage these complex issues, relying on primary research in Pennsylvania.

The emergence of this windfall of energy development comes at a critical time for the US and global economies, but has characteristics distinct from the timber, oil and coal booms that preceded it. The nature of this boom presents special challenges for land-use planning in the face of minimally regulated development. The current boom is the result of new technologies, precision horizontal drilling and hydraulic fracturing. Key to exploiting these resources is a highly capitalized industry with little local participation, and a fast-moving installation of extensive infrastructure that provides little in the way of ongoing jobs or other expenditures beyond maintenance—the industry appears, disrupts, and is gone. The impacts vary widely, influenced by both the process of extraction and the specific spatial context and while individually these activities small from an environmental review perspective [2], they are numerically and spatially much more extensive than the earlier energy boom. The speed of development coupled with the localized scale and temporary nature of major disruptions provides limited opportunities to intervene and negotiate to achieve community and environmental benefits.

There are already barriers to planned development in rural areas between major cities. Sparse population has lost its “clout” with politicians in state assemblies, while lobbying campaigns of the gas industry strive to achieve relaxed regulation of its activities. Cultural traditions, such as an emphasis on individuals’ freedom to determine the future of their land or community, can impede regional and local planning. Few municipalities have any form of zoning control. The Pennsylvania Governor has sought (so far unsuccessfully) to withhold compensatory payments of gas industry impact fees from municipalities whose zoning restricts gas development. Authors have long pointed to the challenges energy booms bring to rural communities (Gilmore, 1976; Perry, 2012). Simply, shale gas development is a high paced, extensive and relies on a larger footprint than perceived and its impacts vary both spatially and temporally not only because of the process of extraction, but also because of the natural and cultural contexts where it takes place.

Shale gas extraction is transforming not only the physical environment of energy decisions in North America but also the ideas that shape our thinking about energy investment and development. Although there are few government-inspired plans to achieve this, the opportunity afforded by this energy boom could still be the key to transforming an inherently ineffective mode of rural economic development into a new adaptive and sustainable landscape. We argue that the means to achieve this lies in informing and empowering individuals and communities to understand their central role in shaping the development of the landscape around them. To date

[2] The Pan-European Biological and Landscape Diversity Strategy, that was endorsed by 54 countries in the UN-ECE region on 25 October 1995, provides for the establishment by 2005 of the Pan-European Ecological Network.

these groups have neither understood their prime role, nor have had access to the information needed to help them make decisions. A landscape ecological planning strategy to achieve future sustainability requires a broader understanding of the shaping roles played by legislation vs. individual landowner decisions, and the necessity to articulate individual and community landscape values alongside the powerful rhetoric of energy independence and job creation.

About Marcellus Shale

The Marcellus shale is an organic rich shale underlying much of Pennsylvania and parts of New York, Ohio West Virginia and Maryland (Figure 1a). Named for a surface outcrop in Marcellus, New York, the formation dips to nearly 9,000 feet deep in southern Pennsylvania. Ranging up to 900 feet thick, the deposit varies between 1% and 11% organic content. While occurring as oil and "wet" gas (including higher order hydrocarbons such as ethane and butane suitable for plastics) in the west, the more thermally mature parts of the formation to the east yield primarily methane gas. The existence of the gas has been known for many years, but attempts to access the resource by conventional drilling were proven inefficient. The development of horizontal drilling and application of a technique called slick-water hydraulic fracturing (now widely known as "fracking") elsewhere showed that development of shale gases could be made economically viable. Estimates for how much extractable shale gas there is in the Marcellus deposit vary widely. In 2002 the USGS estimated the Marcellus contained 1.9 trillion cubic feet (TCF) and more recently Terry Engelder revised that estimate to 363 TCF, still enough to supply the entire US energy demand for fourteen years. Range Resources, a Texas company, drilled the first unconventional Marcellus well in 2007.

The economic benefits of development of the Marcellus are considerable, Engelder's numbers equating to $1.25 trillion at a market price of $4.00 per thousand cubic feet. Typical royalty rates of 15-18% landowners estimate $250 billion in gas royalty checks. The contribution to national energy security has also been used to argue for the imperative for immediate Marcellus extraction. This combined with other energy development in the US contribute to projections of the US reaching energy self-sufficiency. Evidence of the boom in fossil energy availability, of which natural gas is one facet, is seen in the plunge in natural gas prices that occurred between 2009 and 2013. This is a complex resource with an equally complex future. Utica black shale underlies the Marcellus and includes oil resources as well as natural gas. Moreover, drilling must respond to market demand and profit margins, so active drilling has currently shifted to those areas in Ohio and western Pennsylvania seeking the higher-value oil and "wet" gas.

Framing the energy benefits there are a range of known and unknown environmental impacts, some much publicized but localized such as instances of groundwater contamination, others perhaps less evident but potentially of much broader and long-term impact. The latter are the subject of this paper. In 1859 the Drake oil well in Titusville, Pennsylvania, was the birthplace of the oil industry in the USA. Since then, more than 350,000 oil and gas wells have been drilled in Pennsylvania. As of December 2012, 6012 of those are *unconventional* wells targeting gas in the Marcellus and Utica formations (Figure 1b). However, by comparison with the "footprint" of a conventional well, unconventional gas development is more dispersed and each site exerts a significantly higher toll in terms of land clearing, site compaction, infrastructure development and fresh water usage.

To date development has been most vigorous in the northeast and southwest parts of Pennsylvania. The resources have proven to be highly productive in these areas. Major infrastructure is in place regionally, but new pipelines are needed to bring the gas to market. For example, a new interstate pipeline, the MARC-1, is under construction running SW-NE. The studies reported below take that new infrastructure into account.

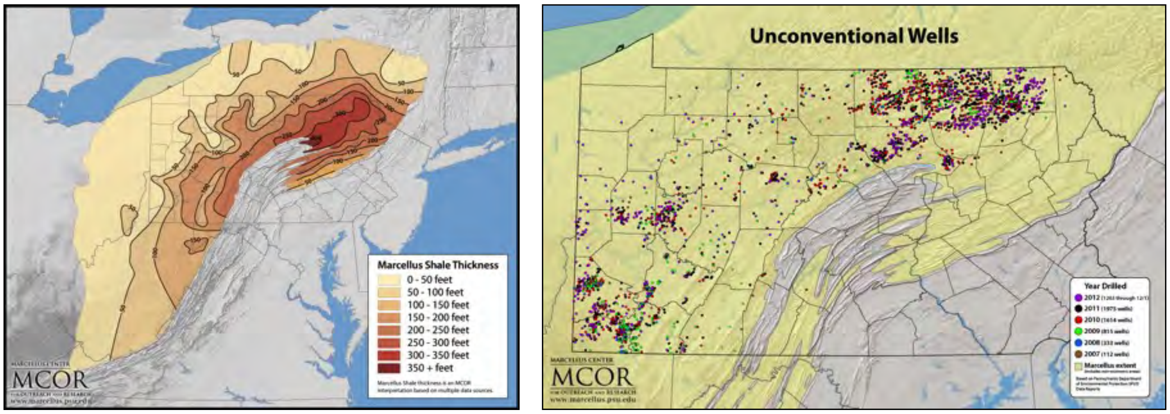

Figure 1. (a) Extent of Marcellus shale. (b) Unconventional wells as of December 1, 2012 (see MCOR 2012).

Despite the potential risks, natural gas development is exempted from key parts of the federal regulations normally applied to major development projects. Exemptions include portions of the National Environmental Policy Act (1969), Clean Air Act (1970), Clean Water Act (1972), and Safe Drinking Water Act (1974). Instead the burden of regulation falls on the individual states so that exploration and drilling in Pennsylvania is administered via the Bureau of Oil and Gas in the Pennsylvania Department of Environmental Protection. At the state level the major controlling law is the Pennsylvania Public Utility Commission Act 13 (2012), which enacts environmental standards such as setback requirements for unconventional gas development. While the federal laws regulated by the state require a range of important environmental protections, they affect a relatively small proportion of Pennsylvania's landscape, PA Act 13 does essentially exclude drilling from communities through the provision of set-backs to buildings and water bodies. Figure 2 (a) illustrates the protections provided by Act 13 in the small town of Laporte, Sullivan County, PA.

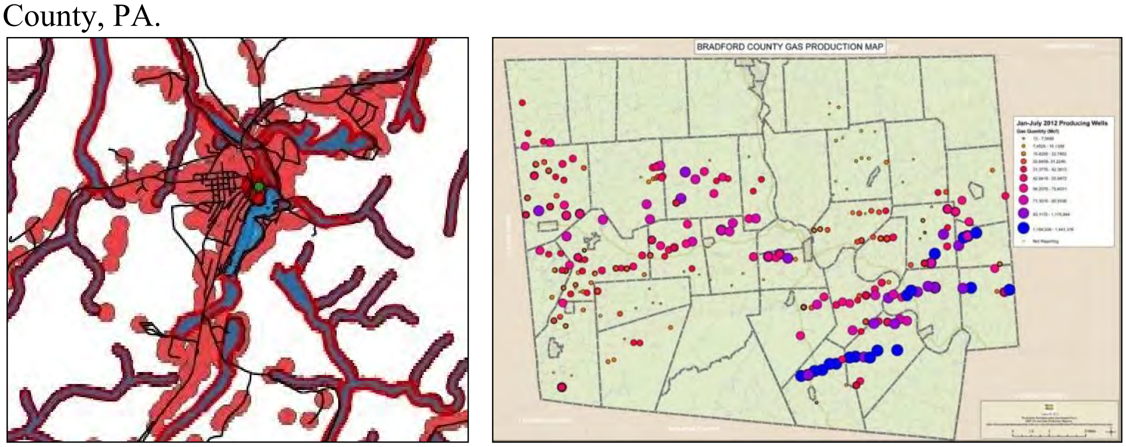

Figure 2. (a) PA Act 13 set-backs. (b) Unconventional gas wells in Bradford County, PA

Set against these protections is the primacy of mineral rights over surface rights in land use determinations. In places where surface and mineral rights are severed, oil and gas law requires that landowners provide access for the development of mineral resources, which may include the construction of drilling pads, access roads, water impoundments and pipeline access corridors. The optimal location of gas wells is driven by underlying geology so that, as seen in Figure 2 (b), the location of well pads will follow paths of preferential access to drilling units that are established by the mineral rights owners or lessees and may ignore surface landscape features.

Goals and Objectives

Planning for Marcellus Shale might be classified a “wicked problem” in that it is a unique situation; not informed by any precedent; and there is no identifiable set of solutions (Balassiano, 2011; Rittel and Webber, 1973). Rather than attempt to address the entire scope of Marcellus-related issues, we instead have undertaken four critical analyses that emerge from the single issue of pipeline placement in order to understand and interpret how one network of relationships has implications across a complex system of resource extraction-driven landscape changes. This work was conducted by the authors working with an advanced landscape design studio and also contributes to the development of a tool set intended to help inform the public about the role of land-use design and planning in this complex, fast-moving and un-planned energy boom.

Methods

Our approach generally follows the Geodesign framework described by Steinitz (2012). We conducted initial scoping exercises to identify salient land planning issues in the region of Sullivan County, Pennsylvania. The county is the second smallest, by population, in the state, encompassing 450 square miles split 60:40 between forest cover and rural farmland. Our first analysis documents the critical impacts of land cover conversion associated with gas pads and pipeline development. We use a projection of Marcellus gas activity provided by the Nature Conservancy (Johnson 2010) to estimate the location of proposed well pads under the Conservancy’s fully developed scenario. While individual impacts might be viewed as contained, the repetition of impacts in numerous drilling locations and the linear extent of pipelines in a densely connected network accumulate to significant acreages of land conversion. We then investigate watershed scale issues of stormwater management and flooding, little addressed by the current environmental conservation efforts targeting methane gas pollution of drinking water. Our hydrological projections estimate the effects of the pad and pipeline developments identified above and project the downstream flooding implications of the resulting change in surface cover. We also examine the mitigating effects of applying the best management practices to the cleared areas.

The third analysis develops a model of landscape visual quality as a surrogate for the range of cultural landscape issues that would need to be considered in comprehensive planning. The model, based on existing landscape conditions, is used to evaluate the impact of the fully developed projection of Marcellus gas activity provided by the Nature Conservancy vs the current conditions in the *Endless Mountains* of eastern Pennsylvania. Our final analysis focuses on longer-term land-use decisions, sustainability and the potential of renewable energy resource development as antidotes to post-boom economic decline. In this case the eventual, post-gas, landscape infrastructure is optimized for the location of wind farms, solar energy and biomass generation for biofuels. In this scenario we examine design and planning responses where current natural gas development anticipates and funds future renewable energy infrastructure, avoiding redundancy and offering long-term benefits driven by longest-term land use changes.

Results

All of the following analyses take a single set of assumptions for future well-pad location. The Nature Conservancy has projected probable well locations using three intensity models, low, moderate and high. We used high estimates for all of our analyses (see Johnson 2010).

Pipeline land use change

Gas wells are of little use unless the gas can be transported and sold and pipelines are the most economical means of conveyance. "Gathering lines" connect to the well head and transport gas to larger interstate pipeline systems that connect with major gas markets. While pipeline systems themselves are complex with compressor stations and other infrastructure, for this analysis we considered only the impact of the pipeline and its surface right of way. Using the projected well-pad locations and taking into account a new interstate pipeline running N-S through Sullivan County, three pipeline location scenarios were developed:

1. Shortest-distance from well-head to interstate pipeline
2. Industry-preferred—minimizing property lines crossed
3. Conservation—minimizing habitat fragmentation, especially forest areas

These three alternatives are simplified, but they address important design issues. In scenario 1 the only formal controls on placement are the needs to protect wetlands and water bodies. Otherwise, the requirement of oil and gas laws to allow access to the resource means that landowners have limited influence on location, which may cut through forests and across agricultural fields. Scenario 2 uses property lines as a surrogate for the challenges a pipeline company may face in minimizing land leasing costs, *i.e.,* the more owners, the higher the cost. Scenario 3 ignores property boundary issues but is designed to avoid areas of high habitat value, in most cases, minimizing divisions of continuous blocks of forest, a major habitat, tourism and timber resource in Sullivan County.

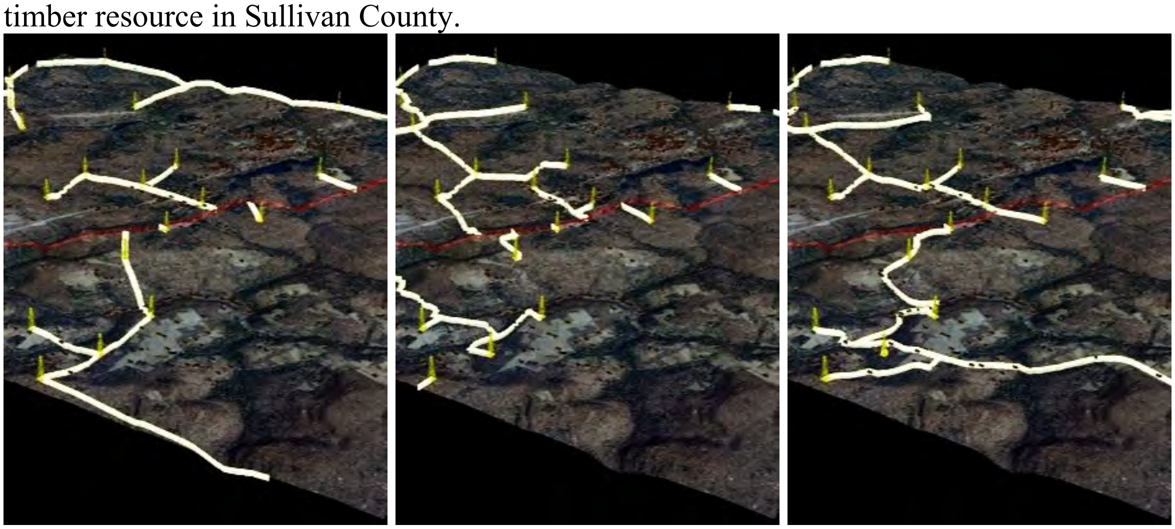

Figure 3: Pipeline placement scenarios: Shortest-distance, Market-preferred, Conservation

Shortest-distance	Market-preferred	Conservation
158 Stream crossings 18 Homes displaced 84 Wetlands impacted 1,648 Properties impacted 0.56 Miles per well	148 Stream crossings 3 Homes displaced 49 Wetlands impacted 1,248 Properties impacted 0.63 Miles per well	124 Stream crossings 10 Homes displaced 19 Wetlands impacted 2,198 Properties impacted 0.66 Miles per well

Table 1: Impacts of alternative pipeline scenarios

Each existing well in Sullivan County requires, on average, 1.06 miles of pipeline. The right-of-way for protecting pipelines varies from 75 to 100 feet. Use of the right of way is restricted to annual crops once constructed, and much of the land impacted in unsuitable for agriculture due to various landscape factors. One mile of pipeline (100 feet wide) changes the land use of 13 acres of land for at least a sixty-year window while gas development continues. Our analyses above indicate the important role of design in minimizing quality and quantity of landscape change, but the land use change can become a driver for down the line impacts, including increased stormwater run-off and impacts on scenic beauty, among others. If planned appropriately infrastructure needs might provide opportunities for new land uses, which we investigate in the next three analyses.

Increased run-off and downstream impacts

The Lake Mokoma watershed contributes to the Loyalsock Creek watershed. Loyalsock Creek is a major tributary of the Susquehanna River. Montoursville, PA, at the confluence, has suffered major flooding in recent storm events and is vulnerable to increased run-off in the Loyalsock watershed. For this analysis the performance of sub-watersheds were modeled using TR-55 under three conditions: (1) current conditions, (2) the Nature Conservancy projections of gas development using customary minimal treatment of pipeline right of ways and (3) the same projections assuming best management practices for minimizing run-off. Extrapolating typical sub-watershed behavior to the entire watershed resulted in estimates of moderately increased run-off. Interestingly, applying BMPs reduced peak discharge, noticeably.

Visual quality changes

Our visual quality analysis was completed in several phases. First, photos from sampled sites throughout Sullivan County were scored by various groups in order qualitatively rank the visual quality of photos. Second, photos were analyzed for their composite elements in order to test correlation between coverage in the photo and visual quality (Figure 4). Here, photos were coded by key land use categories visible in the photo, such as forested, recreation and industrial and compared to the visual quality scores in phase one, using the approach of Shafer and Brush (1976). Third, photo locations were georeferenced and photo scores were compared to the existing land cover, taken from the 2006 NLCD. Using this analysis, we then projected potential future changes to visual quality for Sullivan County, based on changes in land use relying on the high impact estimates from the Nature Conservancy, including pipleline development. Recognizing the limitations of such a model to encapsulate the nuanced and important details of visual quality, we conclude that an approach like this is useful for identifying key spatial zones wherein substantial changes to land use (for infrastructure) can result in changes to the way in which these places are perceived.

Renewable energy potential

Our final analysis investigated the spatial and temporal dimensions of Marcellus extraction, not only as a resource goal, but as part of a larger and potentially renewable energy agenda. Essentially, we looked at the ways in which a full suite of energy decisions could play out spatially and temporally for a section of Sullivan County. At each step, landscape, energy and cost variables were compared. Figure 5 illustrates some of the ways we visualized and analyzed these decisions. There are a number of nuanced conclusions we will derive from these studies, but our key conclusions are: (1) landowners need broader context and information when evaluating, not just whether to lease, but how to lease in a way that reflects their key intersts and (2) energy decisions, while traditionally focused on fossil fuels **or** renewables, should be focused on leverage points to shift from fossil fuels **to** renewables. Therefore, the Marcellus resource questions no longer are focused on how much is there, but what can Marcellus provide on the path to sustainable energy development.

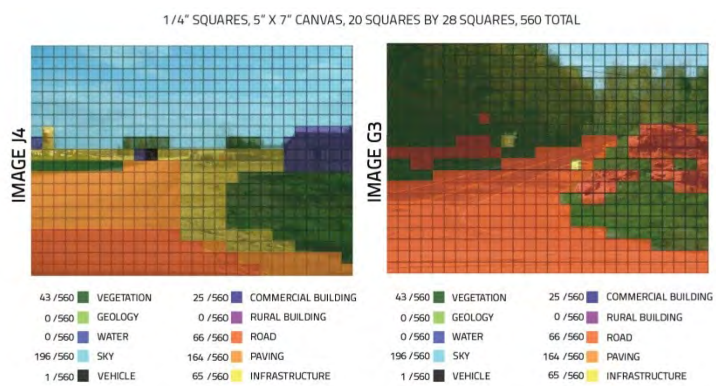

Figure 4: Photo analysis for visual elements.

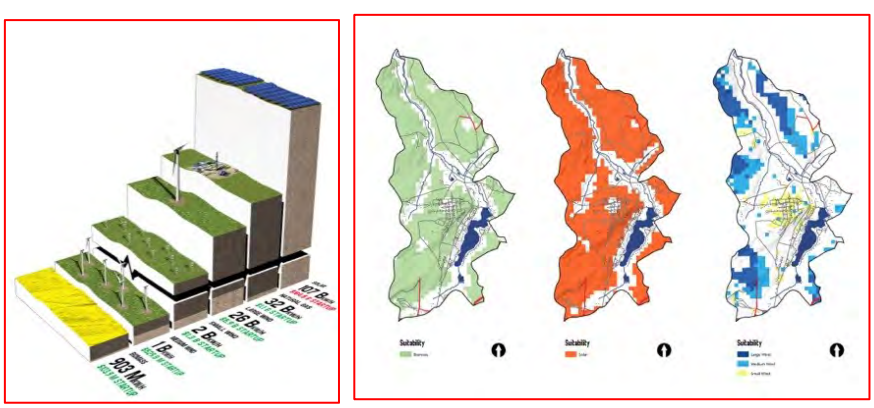

Figure 5: Energy potential and land-use potential in Lake Mocoma watershed

Conclusions

We conclude that while much public attention has addressed fracking technologies and issues associated with well pad construction, the potential landscape impacts from changes in transportation infrastructure and the development of required pipelines will be substantially greater, transforming landscapes largely perceived to be 'natural'—the *Pennsylvania Wilds* in the west, the *Endless Mountains* in the east—irrevocably impacting wildlife habitat and fisheries as well as cultural and aesthetic resources. We also recognize a need to develop a complex set of planning tools that addresses the spatio-temporal variability of shale gas development. These tools need to address broad water systems, aesthetic and cultural elements of the landscape, and provide a broader context for resource use.

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Legible Greenways: Enhancing the Visual Coherence and Imageability of the Western Sydney Parklands

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1. Introduction

This paper reports on a studio-based project which developed and tested a framework for assessing the legibility of Western Sydney Parklands (WSP) in Australia and preparing proposals to enhance its visual coherence and imageability. Comprising 5280 contiguous hectares (over 13,000 acres) of public land and 27 km (about 17 miles) long, the WSP is a significant recreation resource and an important greenway corridor in the urban ecology of the Sydney basin. Despite its size, the WSP does not register in the mental maps of most Sydney residents, including many who live nearby. This is explained in part by the complex array of land uses within the WSP, the range of social and ecological values associated with it, and the generally weak legibility of the landform and its dispersed vegetation cover. Combined with the extraordinary amount of area the WSP covers, these factors contribute to the poor imageability of WSP in people's minds, and have led to a weak relationship between the parklands and its urban context.

The Western Sydney Parklands Trust faces a major challenge in making this significant greenway corridor more legible. Strategic planning for the WSP focuses on attracting increased visitation and use while at the same time distinguishing it from adjoining urban development. The current Plan of Management for the Parklands (the main instrument for directing design and development within the parkland) addresses the establishment of a cohesive image for the Parklands (WSPT 2010) as one of several objectives focused on improving recreation and parkland infrastructure. The image issue is a high priority for the WSP Trust and has led to several design-focused initiatives, including a design manual and a community art project.

A third and ongoing initiative is focused on developing design proposals to enhance the identity and awareness of the boundaries of the WSP. As a preliminary step in developing the brief for this initiative, a pilot study was undertaken in collaboration with the Landscape Architecture Program at the University of New South Wales. The study was structured as an interdisciplinary, elective studio in 2012 called 'Legible Landscapes,' which adopted a landscape-based approach to theories and concepts of legibility, coherence and experience to generate design proposals. This paper reports on the value and significance of the process and outcomes of this pilot project, for both the students and the WSPT. We reflect on and assess the relevance of the selected theoretical frameworks, and the relevance of employing the resultant 'blended' frameworks as a basis for increasing greenway visual coherence and imageability in the metropolitan context of Western Sydney.

2. Background

When set out over forty years ago, the WSP corridor occupied a broad swath of rural land uses located at the urban/suburban/rural fringe of greater Sydney. Today it sits like an island in the geographic heart of the metropolitan region, between suburban development to the east and small rural land holdings to the west, its ridge line providing subtle relief from suburbs pressing the edges. The corridor was intended to accommodate utilitarian functions of a large city. Four decades of debate on how to use this land allowed for the regeneration of “threatened” and/or “endangered” vegetation communities (URS 2004) within it as well as the establishment of several large regional recreational facilities—including a baseball stadium, an equestrian center, and two car racing tracks.

The WSP is one of the largest contiguous landholdings in the Southern Hemisphere, and as an urban parkland it is complex, particularly in terms of land uses and program. Its strongest organizing landscape elements are the ecological ‘spine’ of the regenerated vegetation communities and a major portion of the Eastern Creek catchment. A prominent ridge line defines the southern sector of the corridor while the relatively new M7 motorway defines most of its western perimeter. The corridor contains a diversity of pre-existing land uses, mainly cleared agricultural lands, of various lots sizes and uses, an important aspect of the cultural landscape of the area’s post-colonial era. There is also a city farm, market gardens, Prospect Reservoir, a historic source of Sydney’s water; large scale landfill and brick making industries; race tracks and several venues developed for the 2000 Olympic Games. In addition, the corridor is intersected in all directions by major roads, water supply and energy infrastructure.

In addition to its diverse mix of program and large scale, the WSP has a long, narrow and irregular shape, and a high degree of road fragmentation, all of which conspire to prevent the parklands/greenway from becoming readily identifiable in Sydney’s metropolitan landscape. In general, rather than responding to physiographic features, the corridor’s irregular boundaries reflect historic patterns of landholding and road networks that have been subsumed into the greenway over time. In addition, the few distinctive landforms or areas of dense vegetation are highly localized. For example, the ridgeline in the southern section of the WSP potentially provides a strong visual backdrop and buffer to the surrounding development, but only at discrete viewing points. Instead, the greenway is viewed primarily from the roads that transect it or mark its edges, meaning that opportunities to view into the parklands or create a sense of arrival or destination are few and far between. This is further complicated by the fact that viewers travel at speeds of 60-120 km/hr (40-75 miles/hr) when driving around or through the corridor.

Corkery and Marshall’s survey-based research carried out at various locations in or proximal to the WSP (2009, 45) confirmed that people in the area had little recognition of the WSP as an entity, even though they might be familiar with individual venues. Nor did they recognize the Parklands boundaries or were aware they were within the WSP corridor. For the WSP Trust, whose main focus is attracting people into the greenway to participate and develop an appreciation for its diverse resources and values, the fact that this Parklands does not register strongly in people’s mental maps of western Sydney presents a major concern. In addition to generating local commitment to the Parklands, visitor numbers are also linked to capacity for income-generation, an increasingly serious concern for managers of large parklands.

The *Western Sydney Parklands Plan of Management 2020* addresses these concerns, but is based primarily on research into large parks—the Plan of Management does not reflect the diverse alternate conceptual frameworks for large urban landscapes, such as green infrastructure, landscape urbanism or greenways. Research that emerged concurrently with the PoM established the value of recasting the WSP as a "greenway" rather than the more typical designation (in Australia) of "parklands" (XXXX, 2010 Masked for Blind Review). In this research, four keys to success for greenway implementation were identified: clear and varied objectives; a legible and meaningful context (including response to natural and cultural factors); effective institutional structures, and public involvement and use. A greenway approach was found to offer three main benefits for the WSP: it would highlight the role of these landscapes in the overall structure, form and flow of the metropolitan region; encourage consideration of the role of transport and recreational infrastructure as complementary rather than competitive, and offer opportunities for cultivating community awareness, involvement and ultimately stewardship of the parklands.

With the creation of the WSP Trust in 2008 and the gazettal of the Plan of Management in 2010, the institutional arrangements and objectives for the next decade are set. The state-legislated WSP Trust negotiates land acquisition and rezoning, and manages leases, design and planning. Most importantly, it has a mandate to be self-funding, and its strategic vision is highly focused on transforming the WSP into a recreational resource for the community.

The WSP Trust has worked quickly to encourage public involvement and use of the Parklands, and recently reported a 20% increase in visitation (WSPT 2012, 5). With institutional stability, strong management, and rising community involvement, one of the major remaining objectives for the WSPT, as a parkland/ greenway, is the articulation of a cohesive identity and strengthening legibility. As discussed earlier, the context, scale and form of the parklands present substantial challenges to these efforts. Recent initiatives to address this by the Trust include the publication of a Design Manual and the announcement of a Community Art Project; both are seen to be important contributions to enhancing awareness, cohesion and identity, but both are limited scope. The former is a typical design manual focused on ensuring consistent 'language' of site signage and furnishings; the latter, a community art billboard project that had a two month installation period.

Cognizant of these limitations, the WSP Trust is looking to undertake a longer term and more in-depth investigation to develop specific design proposals for improving the coherence of the Parkland edges. Because legibility and identity depend on the experience and perception of the viewer, the first phase of this effort has focused on mapping and analyzing the boundaries through the lenses of relevant theoretical frameworks, in particular visual landscape assessment, landscape perception and experiential aspects of landscape. The Trust contacted the authors to work with them in developing a student research project that could inform their thinking about these issues. As a result, a special elective course was developed to engage students in investigating the legibility of a portion of the WSP boundary.

3. Methods, Goals and Objectives

What emerged was a multi-dimensional engaged action research with an overarching constructivist strategy (Deming and Swaffield, 2011) in that the authors sought to consciously use the project to pilot a learning and teaching approach to generate new knowledge—for us as educators, for the students in their learning, and for our colleagues in the WSPT. The engagement with state government officers of the Trust allowed them to participate as fellow researchers, in that the problem they need to solve—clarifying and articulating the identity of the WSP—is one that could benefit from an innovative approach. Ultimately, the aim was that the findings of our project would broaden the scope of planning approaches taken in the WSP, and make a significant contribution to design outcomes for the Western Sydney Parklands, in the form of creative proposals for improving parklands identity and community awareness.

The proposed project methodology was developed in collaboration with the WSP Trust to ensure its objectives would contribute new ways of thinking about management issues while also meeting the pedagogical goal of engaging students in visual assessment and experiential approaches to landscape planning and design. In addition to introducing and applying key theoretical foundations of visual assessment, there were a number of discrete 'deliverables' to be produced by the students, including:

- a statement of design principles and strategies for the Parklands boundaries which could inform future design briefs
- preparation of base information focused on an inventory of WSP edges
- desktop and on-site landscape analyses of the edge conditions of the Parklands.

To achieve our pedagogical aim of the students constructing a knowledge base to underpin their design proposals, the learning process focused on developing, sharing, testing, synthesizing and refining ideas. The repertoire of group activities was limited to in-class discussion, presentation, and field observation. Our role as educators was to identify resources, facilitate group discussion, and encourage critical thinking and reflection.

3.1 Structuring the landscape inventory and description

The entire perimeter of the WSP is approximately 100 kilometres (approx. 62 miles), so to ensure that the project was a manageable scale for the class of 12 mostly Landscape Architecture students, we focused on the four northern precincts of the WSP. These encompass areas of the Parklands that face considerable development pressure at their edges and also have the potential for highly visible design interventions. This area represented approximately 18kms (11 miles), which the students divided into 10 segments for each to study in more detail.

3.2 Constructing the framework

Students were each assigned a reading on what we presented as a selection of the foundational theories of landscape perception, visual assessment, landscape ecology and/or experiential aspects of landscape (Appleyard 1964; Bell 1993; Dramstaad et al 1996; Lynch 1960; Nassauer 1997; Relph 1976; Thwaites 2007; and Tuan 1974, 1977). They then had to prepare a short discussion paper on their assigned reading and present this to the class. The group discussion identified a number of commonalities across these diverse approaches to visual and experiential indicators of legibility for the WSP, the most prominent of which were edge conditions, qualities of 'hereness /thereness', and landmarks.

To further distil these theoretical positions and construct a method for our fieldwork, students were paired on the basis of common theoretical concepts, and prepared poster papers illustrating the main points of both theories and their potential applicability to WSP. Through a third review and discussion with the course convenors and the client representatives, the group developed a synthesised or 'blended' inventory and assessment framework which could be applied to the specific urban conditions of the WSP landscapes.

The resulting approach drew primarily on two visual landscape attributes—coherence and legibility. Palmer's landscape descriptors (2000, 167, 173) categorize these as 'informational content', and notes their origins in the work of Stephen and Rachel Kaplan (1989). Additionally, the students drew on Lynch's key urban element, 'landmarks', and Thwaites' notion of 'hereness-and-thereness' to complete their own theoretical framework for understanding how/if visitor attraction to the WSP could be increased by enhancing the coherence and/or legibility of its boundary conditions.

The students applied their framework to the WSP starting with a desktop analysis using Google Earth air photos, followed by on site validation of what they had 'discovered' in reviewing the photos. While in the field, they photographed and mapped their segments, using a common graphic language of symbols. In a group discussion of their results, students identified desirable design outcomes for the WSP periphery, which in turn generated a set of design principles. With design principles articulated, the students returned to their specific segment of the Parklands boundary and mapped optimum locations for applying the design principles. A consolidated plan of their mappings, along with the inventory and an executive summary authored by the students, was presented to client in a final group review.

4. Results

As mentioned above, the first group discussion revealed commonalities and synergies across the diverse theoretical approaches. In addition to edge conditions, qualities of 'hereness /thereness', and landmarks, several other important concepts emerged in both the submitted work and the group discussions. These included connectivity—visual, social, physical and ecological; diverse ways of classifying spaces, such as nodes, patches and focus points; and concepts of layering and nesting. The students recognized the importance of developing an awareness of visual clues to place, to culture, and embedded narratives, and questioned how they might evoke memories and an awareness of the varied lived experiences on offer within and around the parkland. In considering how and what is perceived, and how and what is legible, the group confirmed the primacy of the view from the road--as well as from across the road.
In order to elaborate and clarify what it might mean to strengthen the identity and cohesiveness of the WSP, the students used these fundamental concepts to develop six broad design outcomes, as follows:

- Community ownership
- Articulation of identity/ies
- Clear entry points, signage, corners
- Attention to path definition and condition; attention to edge definition and condition
- Social framework extended beyond park and into park
- Interaction between park and residential areas, as zones of transition, or 'ecotones'

The students conceptualised their study of the perimeter of the WSP as a "necklace" of elements, or a series of features or links with a syntax specific to the Parklands and its context. This 'Necklace of Legibility' had 9 components, each grounded in theoretical readings and the desktop inventory of the parklands. These are elaborated on below:

- **Thresholds** (Thwaites, Dee) Distinctive elements that mark the transitions between areas work to establish a sense of arriving at or departing from a distinctive place, or simply and an awareness of moving through.
- **Hereness-thereness**: Drawing on Thwaites' and Simkins' work, 'hereness' refers to the experience of arrival and centredness, while 'thereness' refers to the interest and intrigue offered by glimpses/views of a distinctive destination; prospect and refuge.
- **Landmarks** (Lynch) An easily identified and powerful visual cue
- **Edges**: (Lynch, Thwaites, Dee, Forman) gives strong visual and physical definition
- **Pathway** (Lynch) either physical or visual; strong directional qualities
- **Road** (Appleyard, Lynch) Experience of moving along a road is often the way people 'visit' a place. Planning and designing specific images or sequences of views can construct identity, or elicit a sense of place.
- **Speed** (Appleyard) Because of the importance of the mode and rate of travel to experience of place, the variety of road and path categories was considered an important attribute of the necklace.
- **Stewardship** (Nassauer, Forman, Dee) Visual evidence of a 'cared-for' environment; obviously a 'tended' landscape and not neglected.

Each student mapped their own segment, identifying the 'beads' of the necklace (as per the list above) and then amalgamated these findings onto a single map of the study area. Once this inventory was complete, the design outcomes were revisited to consider how these outcomes might be achieved. The students identified specific locations and opportunities for applying the resultant set of design principles (listed below) to the perimeter.

Proposed Design Principles:

P1: Prioritise the view from the road—create enticing views into the Parklands

P2: Optimise design and placement of elements to increase legibility and contrast

P3: Express stewardship of the environment, particularly at key intersections and thresholds

P4: Articulate a clear and consistent agency ethic, evident in consistent and coordinated use of materials and signage that is respectful of context; capture and reveal narratives of experience of the landscape

P5: Activate edges judiciously—adopt the 'ecotone' concept of transitioning from suburban context into the Parklands at key points.

5. Discussion

By comparing the proposed design principles generated by the students with the greenway principles and the aims and objectives of the WSP's Plan of Management, we can clarify the nature and quality of the studio's contribution to the WSP. The PoM sets out seven management principles for the WSP, all typical of contemporary large urban parks: 'enjoyable; sustainable; identifiable; educational; accessible; viable; in partnership' (WSP 2010). These are consistent with contemporary park management principles, and set the direction in general terms, rather than taking a culturally or geographically specific approach. The five Strategic Directions from the PoM also highlight familiar themes for planning of large contemporary parks: recreation and parkland infrastructure; environment and conservation; culture and participation; urban farming; parklands development and management (WSP 2010).

From these high level principle statements, the PoM offers more concrete and specific objectives, actions and outcomes. However, with a total of 24 objectives and 89 actions, the scope and complexity of the challenge for WSPT is clear. Indeed, developing a high level landscape strategy is a particularly complex challenge with such a diversity of areas to manage. To date the ‘strategy’ in the WSP has been largely to avoid a one-size-fits-all approach to design and building works that are carried out throughout the parklands, and this is WSPT’s first attempt to find an alternate approach, with “imageable” outcomes.

In light of this, important and new ways for the Trust to approach their image challenge were revealed through the studio. Most important is the concept of ‘hereness and thereness,’ and applying it to identify places where visitors can gain views from within the Parklands to the distant mountains or the city skyline, views that are not available anywhere else in Western Sydney. They are a distinctly WSP experience. Students also noted the importance of strategic gaps or breaks in the boundary edges, providing views into the Parklands, for example to landmarks like Rooty Hill, a distinctive landform in an otherwise fairly flat, open area. If the students’ methodology is extended further to the southern precincts of the Parklands, a sequence of distinctive, only-in-the-WSP views could be structured using landform and planting to establish the awareness that you are in the Parklands. The concept of ‘hereness/thereness’ also highlighted the importance of designing for intrigue, for example using visual cues and/or landmarks to motivate/attract people into and through the parklands.

In their observations, students also noted inconsistent evidence of “stewardship” along the perimeter of the parklands. A sense of stewardship could be easily strengthened by developing a consistent planting structure and palette, a key principle for any landscape strategy. Stewardship could also be conveyed with distinctive layering of spatial as well as vegetated elements. With the large scale of the parklands, the concept of ecotones could be used to signal transition zones, and reinforce the relationship between the structure of plant communities and the regional area. Finally, but most importantly, students also saw stewardship as a significant opportunity to elicit the many regional narratives and threads of cultural landscape history.

Not surprisingly then, when assessed against our earlier findings, the studio outputs reinforce the importance of establishing a legible and meaningful context, and responding to natural and cultural factors when planning and developing a greenway. In our view, as the project leaders, the strongest contribution of the student work was helping the Trust to—quite literally—think beyond the precinct boundaries; to consider the parklands in its context (for example, views into it, or lack of opportunities to view into it) and the importance of attending to specific visitor experiences as a means of cultivating distinctive identity for the Parklands. The billboard project, for example, showcased the artwork of a talented artist/photographer whose shots captured aspects of the Parklands identity, but it is difficult to gauge the outcome of this temporary display on viewers, or to assess it as a memorable experience of the place.

It is worth noting that with the establishment of the WSP Trust and publication of its first PoM, the intentions are for a broader scope of community consultation and participation. Much of the proposed program is directed at encouraging use in the Parklands, for example, urban farming. The Trust now has ‘clear and varied objectives,’ but must remain focused on generating AUS$10 million/year of income. Their ongoing management challenge is to balance this fiscal pressure with the demonstrated benefits of investing in greenway infrastructure that may have no direct financial benefit, such as fences, large-scale planting along the boundaries to demarcate their holdings, but which might, in fact, make a major difference in the level of public awareness, legibility and coherence for the corridor's edges.

6. Conclusion

The output of the studio sheds light on potential new directions for how a distinctive, cohesive, landscape-based identity for the WSP might be developed. The students have initiated the process of codifying the diverse landscape elements and experiences in the WSP, and, with their work on design principles, offered preliminary thoughts on what and where interventions might occur. While this process could be repeated to test its reliability, a major drawback is that the findings –the design opportunities—have yet to be tested in the field.

Nonetheless, the value of this studio to the Trust lies in developing a systematic, objective, and reliable means of assessing the visual qualities of the WSP edges to locate opportunities for design interventions and prepare appropriate design briefs that could enhance identity of the Parklands and invite visitors into it where desired. Ultimately, the Trust wants to increase the community's appreciation and use of the WSP so they become advocates for these lands, value the work of the Trust, and understand the ecological and cultural contribution of the Parklands. Without that local support, the WSPT will struggle to gain widespread support at the metropolitan scale.

As noted earlier, this study of legible landscapes reinforces the authors' earlier findings (2010) of the benefit of applying 'greenway thinking' to the WSP to supplement current Parkland management principles; in particular, that achieving legibility and context benefits from an approach that synthesises landscape theory encompassing visual perception, experiential landscapes and landscape ecology. The hybrid methodology trialled in this studio presents a way to comprehensively evaluate and assess legibility and coherence of greenway boundaries. It now needs to be tested for its reliability and transferability to other greenways. For the WSP Trust, this initial studio provided insights into how the perimeter of the Parklands might be re-formed to strengthen its identity and imageability within in the metropolitan context, to attract visitors into its precincts, and clearly demarcate the distinctiveness of this greenway corridor.

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Revisiting Urban Brownfield Regeneration and Beyond within the Lens of Green Infrastructure-based Design and Management

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Introduction

The typical showcase of urban transformation practice can be experienced mostly in the core or close proximity of downtowns as either replacing a series of existing vacant or deserted lots along with exacerbated natural system or retrofitting built-up areas and housing affordability. In this way, regardless of their size but their linkage with nearby land uses and down to the urban core, brownfields necessitate urban regeneration practice whereas charging the city with discriminatory land use policies as well as a multitude of social and ecological problems. Urban brownfields consisting of natural assets -including river, wetlands, delta etc.-, post-industrial facilities and districts, dysfunctional settlement patterns and slums, and leftover areas make up of depressed, yet significant regions of urban fabric. Having traces of very natural and cultural threads of urban communities, these specific places as a basic 'urban regenerator' are capable of revising physical and social aspects of downtowns or urban core areas.

The basic argument raised in the paper engages urban brownfield(s) within fast growing metropolitan cities across the globe into urban regeneration policy through hands-on experience of green infrastructure concept. Based on this fact, this paper aims at;
- introducing green infrastructure-based design and management approach that claims to mitigate present and likely effects of social and ecological problems particularly on both urban fabric and the brownfield itself while recognizing the importance of urban (brownfield) regeneration policy,
- studying the theme in the case of a strategically significant and centrally located brownfield of İzmir coastal metropolitan city that embraces post-industrial sites, slums and abandoned lots along with delta and hydrological system. This brownfield and its urban-wide ecological, social and historical traces have nowadays been a central concern of urban regeneration in İzmir.

Methods

To achieve a sustainable urban brownfield regeneration project, the paper builds upon green infrastructure-based design and management concept in which the complex of Meles Delta and its hydrological pattern has been envisioned as a spin of green infrastructure (i.e. urban brownfield generator) intertwining post-industrial sites, abandoned lands, slums as well as new residential districts and coastal landscape into a whole entity (Fig. 1). The case study area is considered an exemplar for any urban brownfield in fast-growing metropolitan cities.

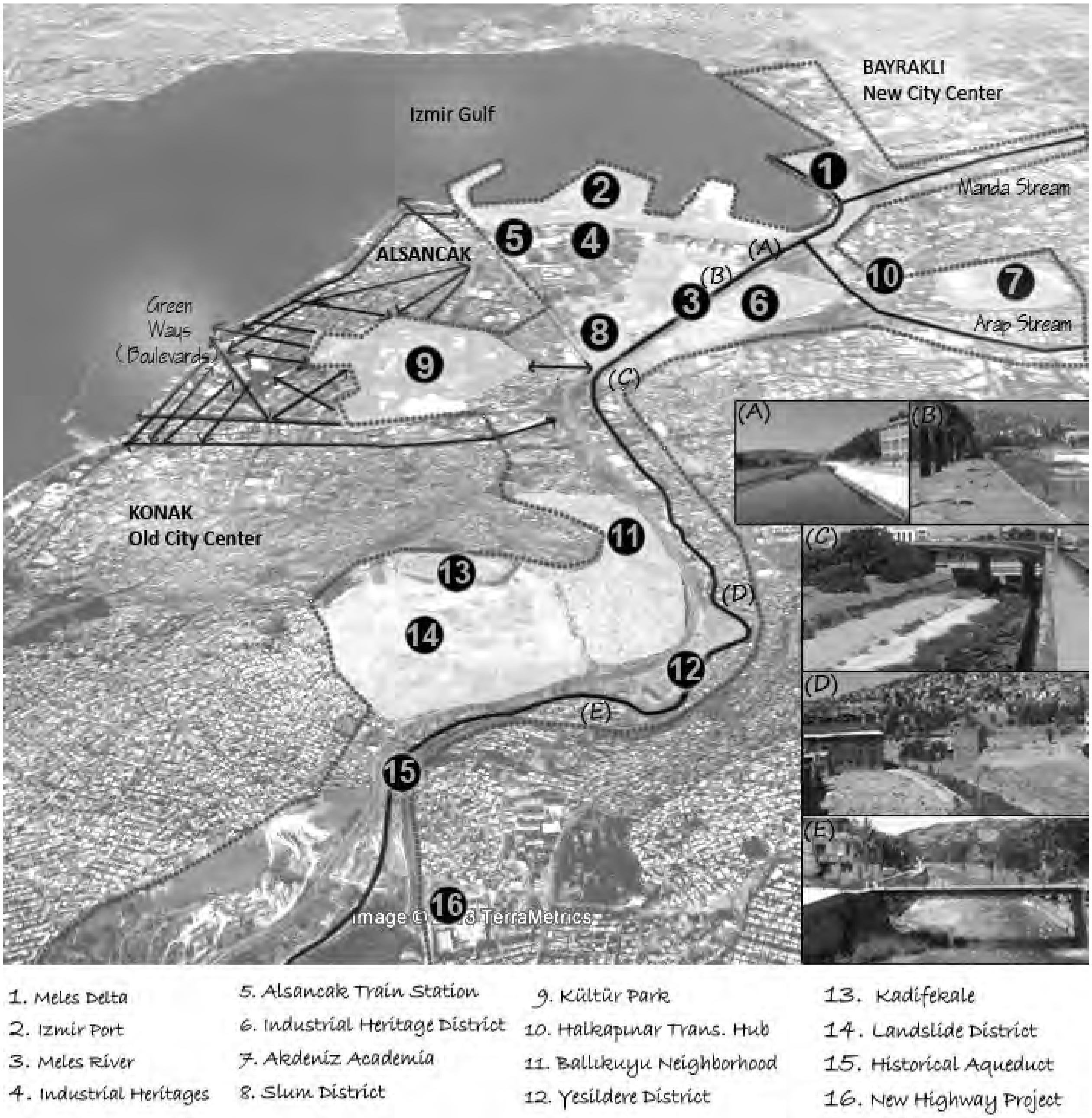

Figure 1. The case study area

The ‘gap analysis’ has been applied through measuring differences between actual situation or reality of urban brownfield and its environs and green infrastructure-based design and management requirements supported by green infrastructure-based, idealized projects or thoughts of the authors, as depicted in Fig. 3 and 4.

Gap analysis is a simple technique when predicting the size of the gap between current state and desired future. To assess the possible risks it is generally used by private firms at the beginning of any project. Conducting the gap analysis usually follows three-step processes:

- Identify your future state, where do you want to reach?

- Analyze your existing situation, where are you now? (reality)
- Identify the gap between the two and think about how you will bridge the gap (gap bridging strategy)

In this study, this simple tool is used since the expectations on the brownfield (Fig. 1) is numerous and uncertain. To discover the assumed gap, five basic dimensions were distinguished as follows; social and cultural assets, governance, ecological concerns, engineering and technical aspects, land use and urban design. Then, thematic explanations were produced in Tables for each dimension indicating;

- Reality (existing situation)
- Challenges (reaction to problems of the brownfield, partial solutions developed by respected organizations)
- Design and management requirements (future state of the brownfield and the urban tissue based on green infrastructure concept) (Fig. 2).

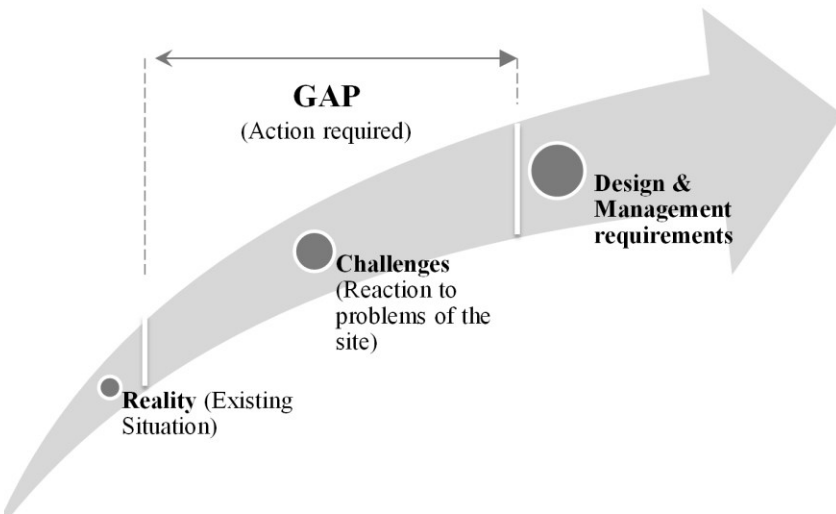

Figure 2. Gap Analysis Framework

Gap Analysis Dimensions

Each dimension has been elaborated according to its reality, challenges and the requirements in Tables (1 - 5). These all determine the boundary of urban brownfield including its immediate environment up to the downtown (Fig. 1), and the graphical expression of design and management requirements (interventions) for some particular regions (Fig. 3, 4).

Table 1. Social and cultural assets

REALITY	CHALLENGES	DESIGN AND MANAGEMENT REQUIREMENTS
The case study area, once significant for urban history and social attachment, occupied by brownfields and slums.	Metropolitan municipality sets the schedule of urban renewal of the brownfield, but in lack of holistic vision.	Green infrastructure concept is able to intertwine riverfronts, slums and post-industrial quarters into a vast region.
Community life of post-industrial sites and slums, and natural structure are introvert and isolated from the city itself.	Metropolitan government is preparing urban renewal projects in order to enrich socio-cultural assets of the region.	Social structure and neighborhoods of the region should be renovated to provide a magnet for social life.
Introvert type of development generates its own character areas, different from nearby uses.	Any project or endeavor related to the linking socially the brownfield with the city center is not available yet.	Providing social interaction with the center through well-conceived pedestrian and bicycle tracks.

Demolishing of historical references and their vicinity accounts for cutting off social binding with the city.	Connection of each project site under urban renewal act is troublesome.	Physical and social access between historic references would facilitate a historical sequence throughout the city.

Table 2. Governance

REALITY	CHALLENGES	DESIGN AND MANAGEMENT REQUIREMENTS
Central and local governments and related bodies independently set their own agendas and projects for the city	Metropolitan government endeavors to run urban renewal projects with related public bodies in a participatory way.	An autonomous, public-private partnership should be authorized to implement green infrastructure program.
Public and private initiatives exploit their own lands as per regulations of urban development plans.	Metropolitan government has recently expropriated some private lands for urban renewal projects.	The aforementioned partnership designates land uses with regard to the right of property.
Urban planning and management interventions are contingent upon jurisdictions of related public bodies.	Although metropolitan government aspires cross institutional policy, any tangible progress has not been recorded.	The code relating to green infrastructure planning and management should be issued for the case study area.
Property rights and subsequently land speculations generate inappropriate climate of investment.	Regular investment policy is insufficient to hold future scenarios of the city in an integrative manner.	Public-private partnership should spur green infrastructure policy to further develop the climate of investment.
Rehabilitation and design of riverfronts and streams are splitted up to existing jurisdictions of public bodies.	Metropolitan government initiates some joint works for waterways in partnership with related public bodies.	Legal framework featuring green infrastructure policy should be passed into law to manage waterways wholly.

Table 3. Ecological structure

REALITY	CHALLENGES	DESIGN AND MANAGEMENT REQUIREMENTS
Delta and its associated water ecosystem manipulated by man-made interventions is poor in natural resources, biodiversity.	Natural system has been conceived as a basic engineering matter only.	Defining the natural system as a spin of green infrastructure provides ecological services for urban community.
Urban development plans have long partly or fully destroyed traces of some lakes, wetlands and streams.	Natural structure within the urban brownfield has been deteriorated due to ad hoc planning and decision making.	Recuperation of hydrologic pattern of lakes, streams and the delta to create a comprehensive green infrastructure.
There is not any explicit ecological connection particularly between İzmir Bay, streams and the downtown itself.	İzmir Bay and its coastal landscapes have not been evaluated within the regional hydrological pattern.	Greenways to bind the Bay with the hydrological system should be extended through the brownfield.
Ecologically sound land use and habitat management are lacking in administrative policies.	Urban planning policy and property rights have resulted in fragmented urban tissue.	Green infrastructure should associate different land uses to form a substantial urban ecological system.

Table 4. Engineering and technical aspects

REALITY	CHALLENGES	DESIGN AND MANAGEMENT REQUIREMENTS
Major part of existing Meles Delta has been reserved for 'urban greening' only	Natural structure of the delta was partly transformed into urban recreation park.	Extending current wetland on the delta to improve the capacity of engineering works (i.e. bioremediation measures).
Seasonal streams act as 'collector' diverting the rain water down to the Bay and 'flooding storage area'.	Channeling the stream pattern to mitigate soil and water erosion and to dispose of pollution sources.	Through some niches (or small pools) on either side of stream banks to enlarge the water surface for habitat enhancement and flood protection.
Planning and transportation policies have resulted in adverse effect on urban ecosystem.	Related public bodies are in lack of referring reclamation program for naturally significant parts.	Once naturally significant lands should be recuperated and extended to improve the coverage of green network.
Discharge of slums' and industrial waste into the streams and down the Bay.	Stream rehabilitation work is manually managed at some intervals.	Biological treatment and landscape reclamation work to mitigate multiple effects of contaminants.
Od leather factories have been relocated, but the site (Yeşildere) is still underused.	Following the removal of the factories, rehabilitation of the region to turn into a socially recognizable recreational asset.	Implementing the sanitary program to cleanse off water and soil contaminants and to take measures against erosion.
Dismantling landslides-prone parts of slum district (Ballıkuyu, Kadifekale) under the urban revitalization program	Demolishing the slum in Kadifekale, an afforestation program is scheduled to benefit a recreational use.	Landscape reclamation work is needed to stabilize the earth against any likely landslide and resulting erosion effects.

Table 5. Land use and urban design

REALITY	CHALLENGES	DESIGN AND MANAGEMENT REQUIREMENTS
Designation of land uses is determined independently by property ownership and planning decisions.	Statutory planning practice is unable to deliver problem-based and innovative approaches.	Green infrastructure discourse frames the linkage between the brownfield and downtown, and drive land use and urban design policies.
Current and prospective land uses are unable to cater a synergy for a comprehensive urban regeneration task.	Statutory planning process fails to address a corporate and participatory development scheme for urban futures.	Green infrastructure-based scenario introduces expropriation program and readjustment of legal jurisdictions.
The urban brownfield as an ecological entity has almost been neglected in municipal planning and design projects.	Future conceptions of reports, plans and projects for the city have failed to correspond well with each other.	These all documents should be merged with green infrastructure framework to accomplish road map for the city.
Spatial, socio-economic and ecological effects of urban renewal projects regarding the brownfield are not clear.	The metropolitan government is in preparation of revealing a historic axis nearby Meles River.	Green infrastructure program should be interacted with urban renewal projects to increase the feasibility of them all.
Meles River and other natural entities are in isolation from the downtown.	There is a lack of any urban design approach supporting the brownfield, historic axis and the downtown linkage.	Green infrastructure design approaches the historic axis to identify the thorough brownfield with the urban center.
The case study area retains its brownfield properties as an inner city district.	Qualifying riverfronts and post-industrial sites as an investment entity.	Stream pattern and associated lands together should be conceptualized as community areas and natural reserves.
Natural system has been too often treated in isolation from urban land uses.	Riverfronts are approached as technical and engineering matter and more recently as recreational reserves.	Widening the stream corridors helps shape water bodies in engagement with the surrounding public space system.

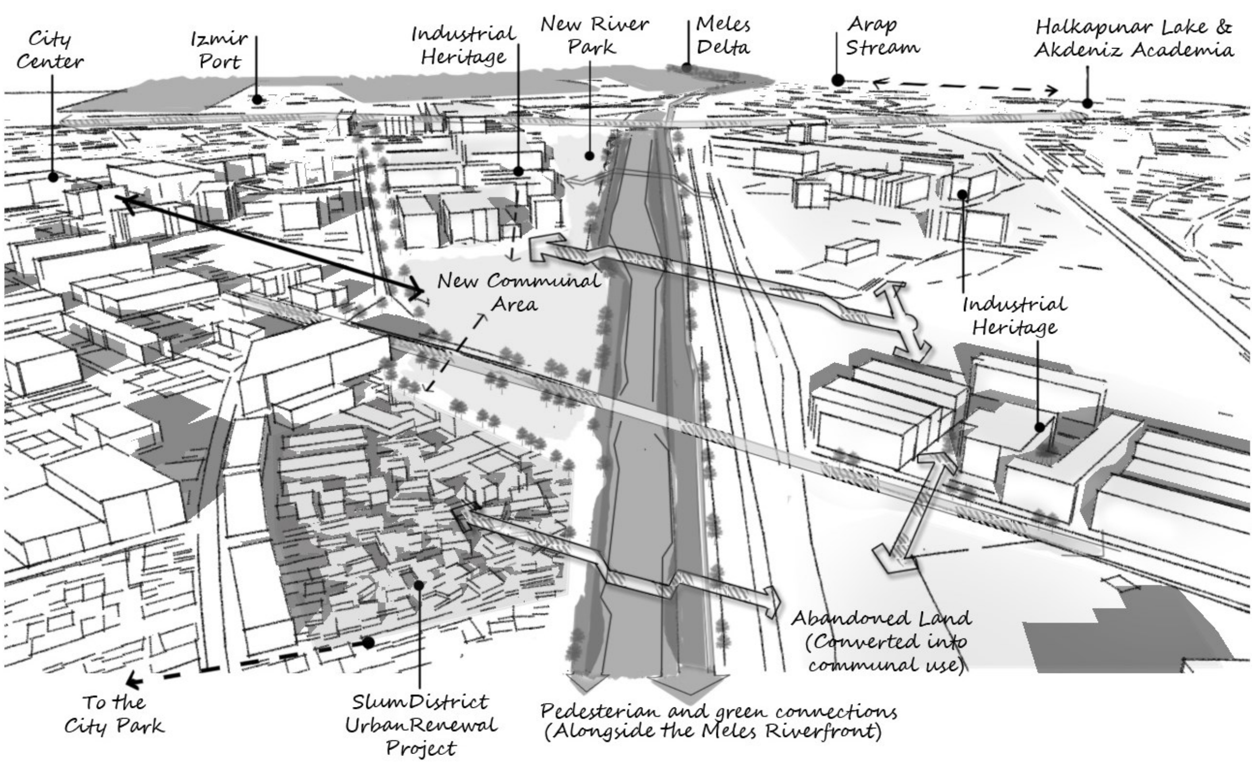

Figure 3. Design and management intervention identifies the Meles Riverfront as a spin connecting different land uses while emphasizing physical alteration and linkages for an urban-wide green infrastructure scheme.

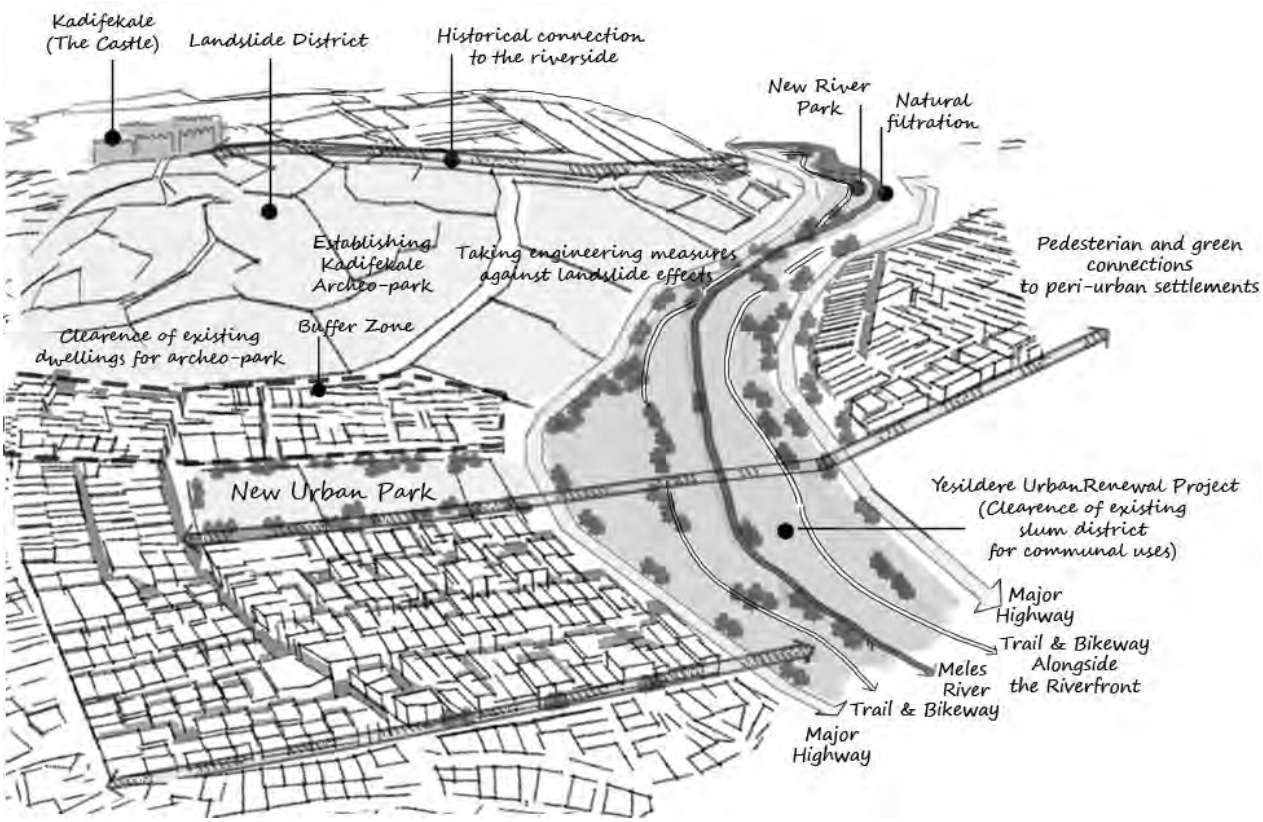

Figure 4. Design and management intervention deals with various social and ecological challenges such as landslide effect, urban renewal and slum upgrading programs, earth and water contamination besides pedestrian and green connections (to historical references).

Implementation of Gap Analysis and Results

The gap was measured in a two-step process (Heeks, 2003), and investigated reality and challenges of the brownfield posed by respected institutions. This does not give much concerted effort to reverse the current negative situation. Secondly, the nature of challenges and design and management requirements was scrutinized to access the idealized situation based on green infrastructure framework.

To measure the assumed gap between these parameters as per each dimension, 'gap rating' system (1=no change, 2= some degree of change, 3=radical change) as indicated in the tables above was applied, and then attributed weight to each item within each 5 dimensions according to their relative importance (1= less important, 2= important, 3= the most important). Each rating score was determined by the authors' consensus. Finally, overall rating scheme that is equal to weight of each item multiplying with its gap rating (overall rating= gap rating x weight) was calculated. Results of each category were collected to represent the gap between 'reality-design' and 'challenge-design' peers. The dimensions indicating the lowest score are the most likely causes of 'plan and project failure' underway (Fig. 5).

Gap analysis illustrated that careful risk assessment can be made according to overall rating scores. In terms of reality-design peer, there will be a risk for 'partial failure' in social and cultural assets, governance and more specifically ecological structure. In other words, any green infrastructure-based design and management framework applied in the urban brownfield may well consider peculiarities of tarnished ecological structure, uncoordinated governance efforts, and fragility of special social and cultural assets such as ethnic groups and industrial heritage sites. On the other hand, challenge-design scores are more encouraging. Social and cultural assets and governance dimensions have some improvements via interventions throughout the brownfield. However, ecological structure is still the weakest dimension and needs to be seriously improved.

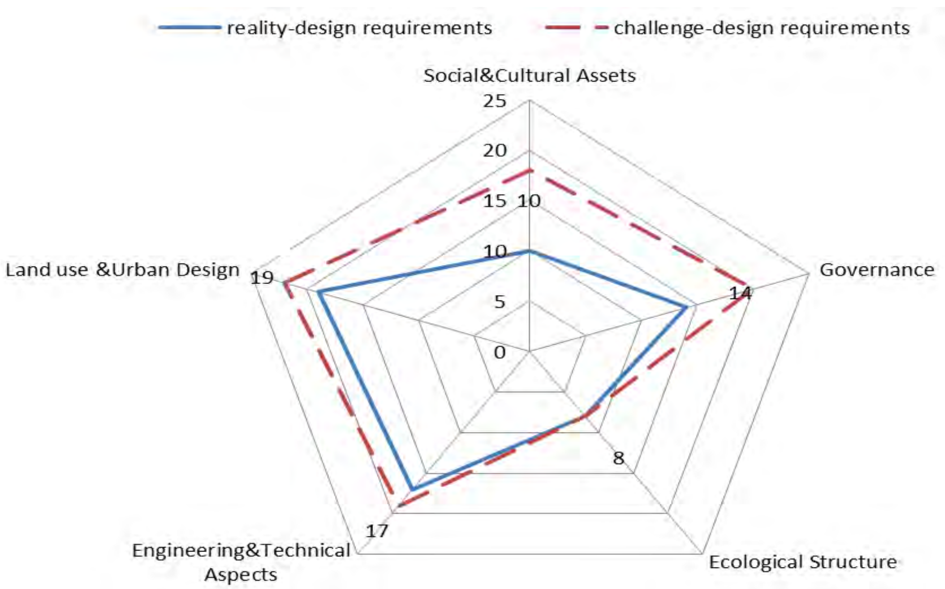

Figure 5. Overall representation of reality-design and challenge-design scores by dimensions

Discussion and Conclusion

This work inquires urban brownfield regeneration and green infrastructure engagement through some scholarly works on the case study area such as Erdik and Kaplan (2009), Kılıçaslan (2004), Özeren (2012), Velibeyoğlu and İnce (2012) and on European case studies such as RESCUE (2004) and Siebielec (2012). The gap analysis has thus been assigned a critical role of measuring the urban brownfield position in relation to green infrastructure based design and management requirements. The analysis indicated the complexity of urban brownfield regeneration along the hydrological system. It also reveals that socio-cultural assets, governance and ecological structure should be substantially managed within green infrastructure program (Fig. 5). Traditional planning schemes and land speculations are yet unable to make inroads into these complicated gaps. Nonetheless, the management of this controversial brownfield very complicated in nature is basically reserved to independent, but not well-administrated public bodies. This type of management practice is distant from deploying sound and holistic measures against present urban development challenges, and generates depressed urban patches such as the brownfield.

There is a clear 'mind gap' between engineers and designers in ways to understand technical solutions just like the difference between officials and politics. Eventually, delta and river systems have been introduced as a basic engineering matter omitting its ecological and social linkage with İzmir Bay, coastal strip and nearby communities. When introducing new design and management approach like green infrastructure 'skill gap' should be considered between requirements of design conceptions and reality of availability and expertise of the staff. Furthermore, it is reasonable to expect 'communications gap' that can be attributed to miscommunications between the parties involved.

Nonetheless, gaps are not necessarily high. It must require some kind of gaps as both risks and benefits. For example, larger reality-design gaps may bring greater risks of failure besides greater organizational benefits. If these gaps could be managed as both desirable and feasible changes to current reality, it would bring greater chance of success in the solution of complex problems through green infrastructure system. In other words, the strategies or items of design and management requirements concerning each dimension be incorporated into the exemplary green infrastructure-based design and management framework

In recognition of the fact above, green infrastructure based design and management exploring all aspects of the brownfield with a focus of urban sustainability should be recognized. According to RESCUE Working Group (2004), the sustainable regeneration of urban brownfield sites requires both the identification of suitable use options and their implementation in an environmentally, economically, socially and institutionally sound way. To be sustainable, brownfield projects have to refer both to the regional context of the sites and the restrictions and potentials that have their origins in the site and its specific local or neighborhood context. However, it is highly notable, as Siebielec (ed.) (2012) articulated that there are no specific national or regional regulations for brownfield management and regeneration in countries of Central Europe. Lack of information in spatial format on number and area of brownfields is one of major bottlenecks for development of effective transformation programs and real knowledge on the potential of inner city development.

To sum up, this paper accounts the indispensable role of green infrastructure practice on urban brownfield regeneration. However, further research is needed on how green infrastructure-based model could be justified in urban planning/design and management.

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4. GREEN INFRASTRUCTURE

Potentials and Limitations of Implementing Linear Infiltration Systems on Urban Streets

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Introduction

Increasing infiltration systems in urban environments has become a major focus of our discipline to reduce the harmful impact of stormwater on urban watersheds. Two recent studies were conducted by the author of this paper (Sleegers and Brabec; 2013, Sleegers, 2013) with the focus on evaluating the aesthetics of linear urban infiltration systems on urban streets. Each study revealed challenges and limitations of these systems on various levels. What are the crucial criteria to propagate infiltration along streets, raise their acceptance and make them more usable? The purpose of this paper is to investigate the challenges and limitations of urban infiltration systems and propose recommendations for further implementation.

Background and Literature Review

Landscape Perception and their Qualities:

Within the body of environmental aesthetics and the qualitative assessment of designed landscapes theory, there are two primary approaches: the **design-based** approach that translates biophysical features of the landscape into formal design parameters, and a subjective **perception– based** approach that treats biophysical features of the landscape as stimuli that evoke aesthetically relevant psychological responses (Daniel 2001; Panagopulous 2009). Rachel and Stephen Kaplan (1989) categorized complex landscape aesthetic qualities in a preference matrix: coherence, complexity, legibility, and mystery. **Coherence** provides a sense of order and directing attention. Coeterier differentiates coherence from **unity**. If the parts fit together and function as a whole the landscape has the quality of unity. (Coeterier, 1996; Loidl and Bernard, 2003). The Kaplans define **complexity** in terms of the number of different visual elements in a scene, how intricate the scene is, its richness, and how much there is to look at. **Legibility** is introduced by the Kaplans with reference to Lynch. The Kaplans define legibility as a place that is easy to understand and remember, well-structured with distinctive elements such as landmarks. **Mystery** is the fourth fundamental attribute of preference explained in the model; mystery is involved if the observer is encouraged to further explore a situation or if this is not possible inspire the viewer's fancy. **Spaciousness** is describing the spatial definition of a scene through presence of distinct edges or landmarks (Kaplan S. and R., 1989). Different aspects of a landscape affect spaciousness: size and form of the open space, height of elements, texture of the surface, and composition of the elements (Coeterier, 1996; 1994). **Naturalness** is describing the biotic component of landscape perception. Its importance has been proven in the research of landscape preference; diverse public groups prefer natural scenes over artificial components or settings in the landscape (Kaplan S. and R., 1989). Naturalness should also be seen in the contextof use (Ulrich, 1986).

Methods and Scopes of Landscape Perception:

Shafer and his research team measured attributes of photographs taken at eye-level to assess larger scale landscapes. This approach implies a causal link between landscapes composition and the perception of scenic value (Shafer 1969). Coeterier (1996) uses panorama photographs because they show the viewshed in a more realistic way to assess urban streets. In the application of this body of theory to landscape assessment, most tools and techniques have examined natural landscapes rather than urban landscapes (Bernasconi et al. , 2009). Little attention has been paid to the systematic aesthetic evaluation of infiltration in urban streetscapes. A study conducted by Echols and Pennypacker (2008) is a notable exception. It described aesthetic richness as a goal for the creation of amenity value through making stormwater an interesting experience of beauty or pleasure. An investigation of the inherent qualitative, perception-based attributes that give aesthetic value to users is missing in the current research.

Case study areas: Three infiltration systems from two exemplary and highly published projects of alternative rainwater management were chosen to investigate their aesthetic values: Hannover – Kronsberg in Germany (Santner, 2009), and High Point in Seattle, USA (Farr, 2008). Kronsberg and High Point are large-scale housing development projects of approximately the same size, address infiltration on higher-density residential street corridors as a strategy, and were implemented in the last ten years.

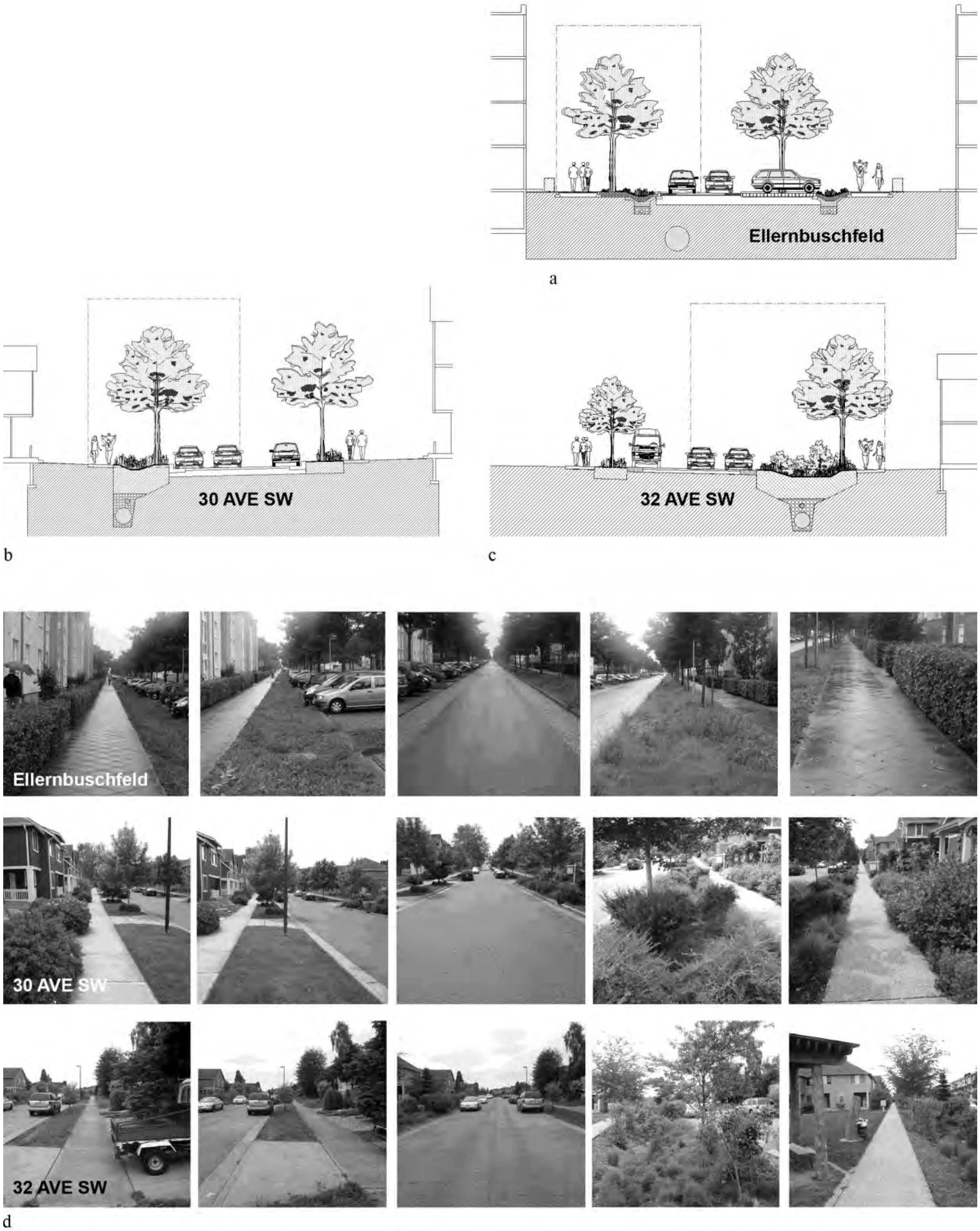

Figure 1. The three infiltration systems in sections and comprehensive sequential street views: (a) Hannover – Kronsberg, Ellernbuschfeld; (b and c) 30th Ave SW and 32nd Ave SW Section in Seattle – Highpoint. (Photos by the Author 2010 and 2012)

Goals and Objectives

This paper investigates stormwater designs through an assessment of commonly used qualitative attributes in landscape perception and reframes planning and design objectives that are relevant for the profession and the implementation of infiltration systems along urban streets.

Methods

This is a mixed-method that synthesizes the results of two studies: an expert-based investigation and a perception-based survey. The first study compared and assessed the aesthetic values of three linear infiltration system case studies in a comprehensive qualitative–quantitative expert-based method. It compared five common visual aesthetic criteria of landscape perception theory, including unity, complexity, legibility, mystery, spaciousness, and naturalness.

The second study investigated people's opinion on the previously assessed three infiltration systems as a perception – based method. Do people think infiltration systems along urban streets are beautiful and why? Do they understand the function of infiltration systems and how important are ecological functions to people? What other design elements do people appreciate in the context of the infiltration system and how important is the aesthetic value of a street?

The perception-based study was conducted as a standard survey with open-ended interview techniques. Using a standard surveys and open ended-interview techniques, people on the streets of the respective case study locations - mostly residents - were asked to participate in the questionnaire. The interviews were conducted during different times of the day and week on the 400 feet long street segments. In Hanover-Kronsberg, about 30 people participated; on 30 and 32nd Ave. in Seattle the interviews were conducted to a total of 30 people on the respective streets. The survey reached out to about 40% -50% of all households and had an equal mix of genders. General questions focused on the importance of beauty and aesthetics in the streetscape and the perceived aesthetics and legibility of the swale as an infiltration system. The answers were ranked from yes, moderately/sometimes to no. More specific questions investigated the aesthetic values of specific design elements of the street and were again ranked. To obtain more precise information the interviewees were always asked to give always specific explanations and reasons for their rankings. This provided supplemental information for the qualitative assessment.

Results

Expert-based study: The findings of the first study demonstrated that the design of infiltration systems on narrow streets have the potential to engage aesthetic values through the use of basic design principles and the enhanced legibility of infiltration. The objectives of this study were to develop a landscape evaluation model for the design of surface infiltration systems on urban streets, and to identify the design parameters that can be improved, and which will enhance the aesthetic perception of the created landscapes.

The results of the comparison of the three schemes (one from the Kronsberg case and two from High Point) indicate that the design with the highest sense of **unity** is less **complex** than the most intricate one - 32nd Ave SW. In the larger context of the development, it is problematic that the design of 32nd Ave SW is unique: the aesthetic quality of that portion of the street is not representative for the whole housing development. Even the design of the opposite side of the street has a poor aesthetic quality. All of these design aspects affect the element of **unity** as an aesthetic attribute. The case study of the residential street in Hannover – Kronsberg demonstrates the other extreme in design attributes: this design demonstrates a lack of diversity within an otherwise well-balanced streetscape. The result is a visual composition that lacks interest due to low levels of mystery and complexity. However, infiltration functions as a unifying design element within the whole development.

The results of the case studies have also shown that trees play an important role in creating the attribute of mystery, through their creation of shadow vs. light, and also partially obstructing views through branches. Trees also play an important role in the creation of spatial enclosure, an aspect of the streetscape designs that is reinforced through understory plantings. Deficits in the tree plantings on 32nd Ave SW have a detrimental effect on spatial enclosure, however the lack of understory plantings in Hannover-Kronsberg compromises the coherence of the design created by the tree canopy. Both the plant palette and planting scheme are also important for the perception of **naturalness** as demonstrated on 32nd Ave SW. On a smaller scale planting schemes of perennials and shrubs can create improve the complexity of the scheme.

Legibility of the design intent is another challenging attribute. In all of the case studies the infiltration is not legible; e.g. none of the designs showcases the flow of water, nor do they have a plant palette that that could make the idea of water part of the experience during dry periods. The landscape might be overall aesthetically very pleasing such as in the example of Seattle's 32nd Ave SW, but this is not achieved through design elements that articulate the idea of stormwater infiltration.

Perception-based study: The results of the most relevant general questions, including the aesthetic perception of the swales, are displayed in Table 1; the results that focused on the specific design elements in the street are displayed in Table 2.

All interviewed persons think that the appearance of their street is important for their neighborhood. Many of the interviewees expressed that appearance relates to other aspects like perceived safety and even steady or increasing property values. Generally the residents in all of the three case studies acknowledge and value the executed ecological approach of their housing developments and think that this creates a high sense of identity. Almost concordantly do people recognize the infiltration swales and relate the function to water and infiltration. Divergences emerge concerning the overall planting and the aesthetic quality of the swale (Table 1, Question 1 and 3). The planting and the swale on Seattle's 32nd Ave SW is rated very high; the ratings for the 30th Ave SW and Hannover's residential street are lower for the quality of the planting scheme and about the same. In comparison, the swale on Hannover's street seems to have the least acceptance; many interviewed residents complained about a lack of maintenance, trash and dog excrements. The people who gave better ratings acknowledge the positive function of infiltration.

Ranking	Hannover Ellernbuschfeld	Seattle 30th AVE SW	Seattle 32nd AVE SW
1. Do you like the street planting on this street?			
yes	**69%**	**69%**	**92%**
moderately	**21%**	**23%**	**8%**
no	**10%**	**8%**	**0%**
2. Did you notice that the street has a swale on one side of the road?			
yes	**100%**	**77%**	**100%**
no	**0%**	**23%**	**0%**
3. Do you think the swale is a beautiful element in the street?			
yes	**41%**	**69%**	**75%**
moderately	**28%**	**8%**	**25%**
no	**31%**	**15%**	**0%**
4. Do you think that the appearance of this street is important for the whole neighborhood?			
yes	**97%**	**100%**	**92%**
moderately	**0%**	**0%**	**8%**
no	**3%**	**0%**	**0%**

Table 1: General questions. Selection of the four most relevant and revealing questions from the perception – based survey and their results in the three case study streets.

The more specific investigation about the beauty and uniqueness of specific design elements in the street expanded the more general questions. The interviewees took the opportunity to name other design elements that connote to beauty and character such as an infiltration pond in High Point or the intricate agricultural landscapes that surround the Kronsberg neighborhood and are connected through large alleys of trees and greenways.

In all of the three case studies trees are seen as the most successful design element to make the respective street aesthetically pleasing. In Seattle the existence and of saved old, mature trees was mentioned many times. The relatively low values for grasses and perennials in Hannover were again expressed in relationship to maintenance. Remarkable is that people lowered their aesthetic appreciation of the swales in comparison to the previous, more general part of the survey. In Hannover and on 30th Ave SW people complained about the swales as barriers, e.g. while carrying groceries across from the on-street parking. One resident from 30th Ave SW related the swale with a negatively connoted ditch. On Seattle's 32nd Ave SW some of the people who gave moderate ratings for the swale expressed the desire to have more flowering trees planted within or adjacent to the swale. Others expressed that this swale offers a range of possibilities besides its infiltration function; e.g. it is used for fruit picking and playing. Visible water in the swale after heavy rainfall has low to moderate aesthetic value for the residents; on 30th Ave SW again mainly due to a reduced accessibility of the adjacent sidewalks while crossing the streets. Sometimes negative comments were articulated due to the implied collection of contaminants from the streets' runoff. The cleansing function of swales was only articulated by a few people. This result was also remarkable in relationship to the individually expressed aesthetic value of bigger, permanent water bodies like the nearby pond in Seattle, High Point. Almost every interviewed person appreciated the high quality of the neighborhood in relationship to their pond as a place to relax or exercise. On Hannover's residential street the role of the water in the swale could not be answered because runoff that from the streets percolates immediately in the both-sided swales. On another note this reveals also the good function of this system. The comparatively lower overall rating of the streetscape in Hanover was also mentioned with respect to a lack of variety in the planting schemes and the impression of monotony. This stands in contrast to the highly appreciated destinations in the larger context; the green courtyards, the nearby agricultural landscapes are valued for their opportunities to relax, exercise or play. Within the street corridor the patterns of natural pavements were emphasized by some residents.

Design Medium	Ranking	Hannover Ellernbuschfeld	Seattle 30th AVE SW	Seattle 32nd AVE SW
Trees	Adds **a lot** of beauty	**100%**	**85%**	**92%**
	Adds **some** beauty	**0%**	**8%**	**8%**
	Adds **no** beauty	**0%**	**8%**	**0%**
Grasses and Perennials	Adds **a lot** of beauty	**45%**	**77%**	**92%**
	Adds **some** beauty	**45%**	**15%**	**8%**
	Adds **no** beauty	**10%**	**8%**	**0%**
Turf	Adds **a lot** of beauty	**0%**	**38%**	**25%**
	Adds **some** beauty	**97%**	**54%**	**75%**
	Adds **no** beauty	**0%**	**0%**	**0%**
Swale	Adds **a lot** of beauty	**21%**	**54%**	**67%**
	Adds **some** beauty	**59%**	**23%**	**25%**
	Adds **no** beauty	**21%**	**23%**	**8%**
Water after Rain	Adds **a lot** of beauty	**n.a***	**23%**	**50%**
	Adds **some** beauty	**n.a**	**23%**	**50%**
	Adds **no** beauty	**n.a**	**54%**	**0%**

* none of the interviewees had observed standing water in the swales. An evaluation was not applicable.

Table 2: Specific results from the perception – based survey investigated selected design elements of the infiltration system and their perceived impact on beauty. Which element adds the most beauty to this street – what makes it unique?

Discussion and Conclusion

The results are primarily discussed with a focus on affirmative and diverging results in comparison of the two methodologies – expert-based and perception-based; secondarily the complementary outcomes of the two methodologies are highlighted; finally conclusions are made for the planning and design of infiltration systems along urban streets.

Affirmative and diverging results: Some of the results of the expert-based evaluation were confirmed by the perception-based approach. These are the lack of complexity and mystery in Hanover's residential street. Not surprising is the high appreciation of the continuous street tree plantings in Hanover. In all three case studies does the design element of trees get a far superior rating than the swales. The people who gave better ratings acknowledge the positive function of infiltration; it is not clear though if this is seen as an unavoidable compromise towards a higher aesthetic quality. 32nd Ave SW was the infiltration system that offered, in comparison, the most complexity, sensation of naturalness and opportunities for other uses. The expert-based approach revealed a lack of legibility of infiltration in the streetscape. Surprisingly in this context is the comparatively negative image of visible water in the swale after heavy rainfall that was identified by the residents.

Complementary results: The relatively moderate acceptance of the infiltration systems in Hanover and 30th Ave SW seem to relate directly to utility values and maintenance. These were findings that were revealed through the survey. Other results revealed the importance of context; the overall high quality of the public open space system in the two neighborhoods seems to balance even some deficits of function or maintenance.

Conclusion: In conclusion the evaluation of the investigated design of infiltration systems along urban streets demonstrated the following potentials and limitations:

1. Infiltration systems can add to the complexity, mystery and naturalness of residential streetscapes; specifically wider infiltration coridors can offer more choice for people to use them as playscapes and edible landscapes.

2. The beauty of streets is very important and affects the reputation and value of a whole neighborhood. e.g. trees and specifically old trees that have been saved during development are considered to have high aesthetic value.

3. The design of the streetscapes system creates a high sense of identity affected the positive perception of the landscape.

4. Lack of maintenance of infiltration system has a considerably high impact on the aesthetic qualities.

5. Impediments created by the infiltration systems, e.g. standing water, that impede daily functions diminish the aesthetic value.

6. Standing water in an infiltration system is perceived negatively; larger water bodies such as ponds with permanent water very positive responses.

7. The lack of legibility of the design intent that was identified by the first study was not a relevant factor for aesthetic value. The legibility of a landscape's ecological functions does not seem to be important to people.

The applied combination of an – expert-based and perception-based methodology is a valuable approach to evaluate urban landscapes in a comprehensive way. Further research is necessary though with focus on legibility in designed landscapes that approach ecology.

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Assessing public health benefits through green infrastructure strategies in medium-sized cities in Spain. Case study: La Coruña.

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Introduction

The last UNFPA statistical data show up that over the 50% of the world´s population has lived in urban areas since 2010. Although it´s true that cities offer multiple opportunities (job, knowledge, culture,…) also it is true that they have a negative aspect in everything related with the fast pace of life, the lack of leisure areas, the social incohesion and the public health. Among the different alternatives that may be suggested to try to minimize this problem and look for more healthy cities, inside a global sustainability framework, stands out green infrastructure (GI). As we know, green infrastructure, regardless of their different conceptual approaches and contexts, discussed deeply by many authors (Benedict and McMahon, 2006; Sylwester, 2009), is a strong multiscale planning strategy whose use is booming in the international panorama. Undeniably, both GI and its various components as green corridors, parks, gardens, etc ... have a strong nature of multifunctionality that is supported by numerous scientific and technical studies (Fabos, 1995; Tzoulas *et al*. 2007) and form a complex system that produces multiple benefits, including public health (PH).

Through a case study of La Coruña city (northeast of Spain, Fig.1) (LCG), we have analyzed as the approach of GI on a municipal and provincial scale may be the suitable solution to numerous existing problems in medium-sized cities, with a high population density and with some appearance peculiarities, geographical siting and psychology barriers, connecting it with the benefits that are generated to public health in a double aspect: prevention and economical saving.

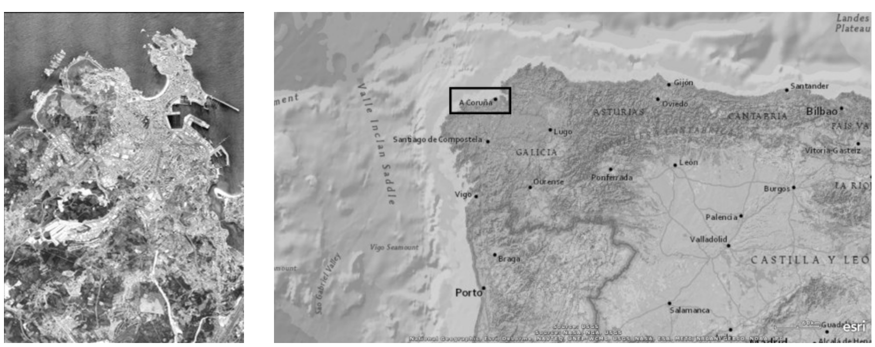

Figure 1. La Coruña (location; physiognomy.)

Background and Literature review

We are aware that the rapid urbanization has caused numerous changes in public health and in social welfare because the nature has been replaced with modern environments, holding the population up to complicated situations. This fact is aggravated in more overcrowded cities with little public space where the incidence of diseases is greater owing to a lack of space to practice sports, heat island effect, greater level of pollution, etc. It´s the case of cities as LCG which don´t offer, in general, some appropriate surroundings for the inhabitants above all because they lack suitable areas that cause numerous and valuable ecosystemic benefits that work synergistically like palliative of diseases and systems of public health prevention.

A rising body of scientific evidences suggests that the contact with green spaces (GS) in its different typologies improves the health visibly, perhaps, by the biofilic feeling, term coined by Erich Fromm. A study of Maas et al. (2006) shows a positive relationship among the number of green spaces in the environment where people live and their health perception. Other studies show up that the residents of areas with a suitable GI are more long-lived, do more physical activity and are healthier. If we remember the definition adopted by the WHO: "health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity", we can deduce a direct connection with the green planning of the cities because the health is considered as a phenomenon not only somatic (biological) and psychological, but also social.

It is important keep in mind that one of GI benefits is to protect the populations vulnerable to factors that cause the diseases, that is, the primary preventive intervention (PPI) of a public health system that is applied before the disease occurs, in the end the most effective of all them, in economic savings and fighting against diseases. This perspective appears from the PH origins and has been considered by its founders as Virchow. Therefore, we share the ideas of Kuppuswamy (2009) who indicates that exists a clear need of evaluate the potential economic implications of the GI linked to health effects and the budget of health services facilitating interdisciplinary studies for urban planning.

The advantage of the use of territorial planning approaches that is aimed at the hybridization between grey and green infrastructure is evident, on an urban scale, in numerous studies and theories that pursue the use of technical and scientific guidelines to make an urbanism and nicer environments, or in words of Mohsen Mostafavi, an ecological urbanism, landscape urbanism according to Charles Waldheim or James Corner approaches, looking for "landscape in the city and the city in the landscape" and, in a landscape planning and design more coherent in the conceptual line of the greenways (Fabos, 1995) and green infrastructure (Benedict and McMahon, 2006). The result of this perspective, in short, and by definition is multiscalar (municipality, region, state…) and multifunctional because it generates different types of benefits such as a) minimize the effects of climate change: temperature regulation, fixation of CO_2, VOCs and O_3, b) regeneration territories; c) conservation of biodiversity and wildlife, d) improving interaction, inclusion and social cohesion (Forest Research, 2008), e) economic growth and investment. But perhaps one of the most important is the aim of this paper: f) public health and well-being, GI is key for improvement both physically and psychologically, recognition based on a body of evidences that shows that it can improve the life quality, psychological health, welfare, increase life expectancy, etc. Many studies show that the use of vegetation is suitable to fight these diseases such as asthma and to minimize the presence of sunburn and skin cancer by lowering the temperature. Tzoulas *et al.* (2007) studied the implementation of GI and public health in its different variants (cardiovascular, immune, respiratory, digestive, skeletal, stress, positive emotions, attention and cognitive ability). In particular, it is associated with relaxation and to combat depression and promote general health (Stigsdotter, 2005). Furthermore, Ribeiro and Dias (2010) argue that the benefits generated by green corridors can strongly contribute to place the urban landscape on the right track to improving the quality of cities and therefore its competitiveness. Another important point in this topic is the location and accessibility; there are different studies and experiences that relate directly the size, quality and location of green areas improvements in quality of life and public health (Maas et al., 2006). All these benefits represent convincing arguments that can serve as base for change proposals in the territorial planning and to add new natural elements like thousands of trees, as happened in New York (Wells, 2012).

The implementation of GI strategies at municipal level represents a competitive benefit of comprehensive planning more effective that reinforces the areas character, improves the connectivity and the cohesivity, the biodiversity, minimizes the fragmentation and works in more rational parameters of ecological coherence and of preservation, part of these proposals has been analyzed by different authors like Ribero y Barao (2005). By other hand, moreover, it includes strategies for the protection of the heritage, of the population identity, to avoid deterioration processes of urban landscape, of *urbanalización*, term coined by the Spanish geographer Frances Muñoz who combines the two Spanish words *urbanización* (urbanization) and *banalización* (trivialize). Through all these perspectives, we put forward a thesis that GI can contribute significantly to improvement of public health and quality of life, with the consequent economical saving, for that, the accessibility of all population to this kind of spaces must be guaranteed.

Goals and objectives

The main purpose is to explore, conceptualize and show, through LCG case study, that GI is a necessary planning strategy for improving competitiveness and quality of life and are key to reduce public health problems in its double aspect, prevention and economical saving. As objective it is considered the suitability of integrating these approaches in medium-sized cities with a high population density and with singular characteristics of appearance, size and types of green spaces such as the city of La Coruña. An incorporation that allows to suggest strategies to guarantee the accessibility of all the citizens to green spaces and guarantee the ecological connectivity.

In the same way, it is studied the possibility of suturing and giving continuity to this green local strategy with the candidacy of "Mariñas coruñesas e Terras do Mandeo" for World Biosphere Reserve by Unesco, because it represents a hub with natural value and the opening of Northern Spain ecological network which covers from Pyrenees to the Atlantic Ocean.

Methods

The methodology involves the analysis and estimation of the current state of the green system and the new masterplan of La Coruña. The analysis is drawn from different perspectives: continuity of the system of green spaces, areas of influence, spatial distribution, type, accessibility and harmonization with European standards.

A SWOT analysis to evaluate the different variables that should be taken into account in the proposal of GI planning and a territorial analysis of green spaces distribution were used. To study the thesis that the green corridors and the GI are very important to the improvement of the PH, it was evaluated, by means of the GVSIG program, its applicability to La Coruña city in terms of accessibility, defined using a maximum distance of 300 m to some green area of a minimum size determined as a reference, measure proposed by the CE (ECI, 2003) and recommended by ANGST of Natural England and different studies like Wendel-Vos et al. (2004) among others.

The minimum size selected is 5000 m^2 (dismissing those areas in median strips and hard to access places) because, besides to be the dimension recommended in Europe, fulfill the appropriate conditions to do different physical activities like walking or jogging for a minimum of 30 minutes, the recommended daily value of exercise to fight against diabetes, cholesterol, etc, enjoying a natural environment unconnected with urban life.

Also, potential ecological networks, that allow to improve the accessibility, hubs (of natural, historic or social value) and connection points with the most agricultural periurban areas, offering spatial continuity of green mass, were identified. The approach is enriched with the incorporation of viewpoints emanated from the analysis of green strategies in other cities of Spain.

Results

The need to improve the green planning of La Coruña (LCG)

In Europe there are numerous initiatives and recommendations for GI implementation at different scales (Mazza *et al.*, 2011; Nauman *et al.*, 2011), and day by day applied in more scenarios with different characteristics, with more or less success due to the existence of barriers, often surmountable, of technical, financial, physical and legal nature, or simply because of a lack of deep knowledge of this philosophy. The case of the city of LCG, the most urban of this autonomous community, is an interesting case of medium-sized city (310,000 real inhabitants) with a high density (6417 inhab./km^2) that shows singularities in size, appearance (peninsula), typology of green spaces, urban peculiarities, that lend a special character to the city and, also, problems when it comes time to can improve its structure and to suggest a strategic change of planning and management of its green system.

The city has very good transport infrastructures, by land (N VI y A9), sea (traditional harbor and new foreign harbor) and air (Alvedro airport) but it has a very little municipal area (37, 83 Km^2) which prevents its spatial growth and causes the mass situation, in fact is one of the cities with greatest population density of Spain, which has increasing fivefold from 1900. The analysis of the current situation and of the historic evolution shows up that a territorial development of integration with the part most natural hasn´t been followed.

The new master plan (PGOM), which raises these approaches although some what away from the more academic line, represents an interesting starting point with interesting proposals as Parque Alto, although, as a constructive criticism, only gives some limited proposals superficially from a perspective more comprehensive and complex in the GI conceptual line (connectivity, multifunctional, public health, accessibility,…).

Another important handicap perceived in La Coruña is that the marked rural character of Galicia, in general, and of the periurban areas of the city, in particular, by other hand, a great advantage which would be able to serve as a link with the more urbanest parts, has stressed the psychological perception of the GI different parts enormously, which means that the population doesn´t understand the approach of this kind of territorial planning.

In the same way, this green system seems interesting to be sutured with adjacent areas, taking advantage of the possible declaration of a World Biosphere Reserve of "*Mariñas coruñesas e*

Terras do Mandeo", UNESCO candidate, which includes neighboring municipalities, as it would mean giving continuity to the ecological network in northern Spain and open it to the Atlantic.

Spatial analysis

The first analysis relating to the situation of GS in LGC supplies us with the details to know if the citizens´ needs are well covered and the zones whose green system need be improved. To this end, an analysis with influence zones of 300 m (dismissing those areas located in median strips and hard to access places) was carried out. After GIS analysis, we identified the weak points where would be precise to make proposals (Fig.2) to guarantee the accessibility of all the population.

The results emanated of the current situation show that there is a ratio of 8,2m^2 /hab., very close to the ratio proposed by WHO, although on the international level exists quite controversy, for example, Abercrombie suggested 16,2m^2/hab. in his plan to London (1943-1944). Currently, developed countries are adopting a general standard of green space of 20m^2 park area per capita. If this standard is adopted, we have a lot of hard work ahead of us.

It is estimated that the spatial distribution of green areas is adequate, although the most are small GS. For this reason, it is proposed that the critical points were analyzed based on results of GIS analysis (Fig. 2), in spite of they are also important because, as Fu y Zhao (2010) pointed out in their study, sometimes they are more frequently used to rest and to do exercise since, in certain situations, the residents prefer near small areas than far and big zones.

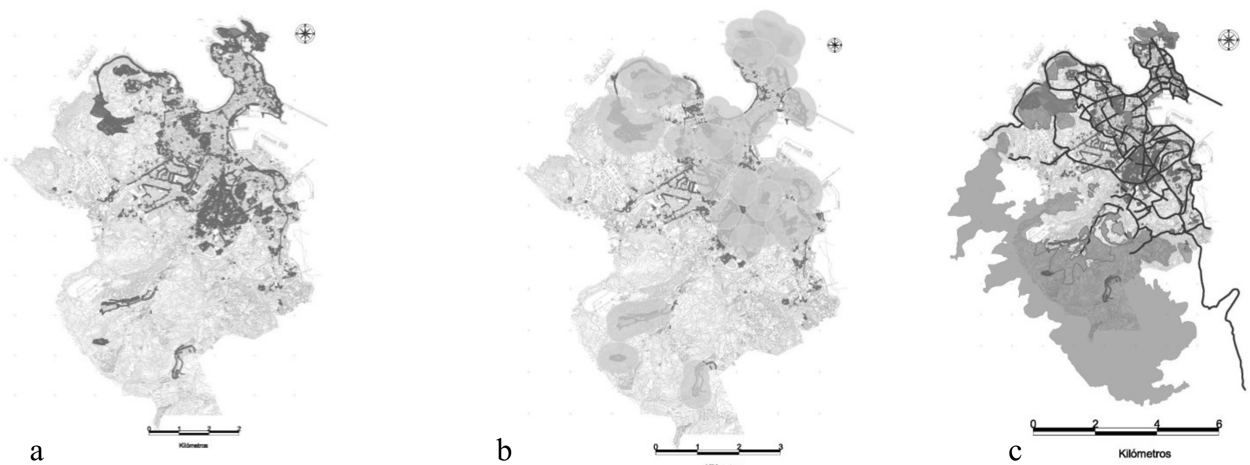

Figure 2. (a) Spatial distribution of green areas in La Coruña. (b) Accessibility analysis to green spaces with S > 5000 m^2 and distance < 300m. Critic zones identification. (c) Green corridors network, Parque Alto of PGOM 2012 and proposal of hubs (natural, historic and cultural) incorporation and connections.

The spatial distribution of parks and gardens system is very broad although the most part of them (177) are microspaces smaller than 1000m^2 (Table 1), in fact, almost the 100% of the residences have access to green zones (any type and size) within a radius of 300 meters, but few of them have access to parks of minimum dimensions (>5000m^2). Large parks exist only in the most perimeter zones, parks that have been designed *ex novo* using either old military installations, thanks to which, in certain way, a great natural biodiversity has been kept and it was possible to outline a 205.000 m^2 park (San Pedro Park) or old municipal areas like Bens Park (600.000 m^2), old municipal landfill, or Saint Margarita Park, old urban camping (50.000 m^2).

Different areas, that would be able to work perfectly as hubs (Fig.2), have been identified and classified in three typologies: a) natural: Parque de los Rosales. Parque de la Torre de Hércules. Paseo marítimo del Portiño. Punta Herminia; b) Historic Gardens: Méndez Nuñez (1867). Jardín de San Carlos (1834). Plaza de Azcarraga (circa 1896) and c) Cultural: Parque de la Torre de Hércules (World Heritage) and Castro de Elviña. These cores would be able to be part of the backbone of the spatially interconnected new system, linked by means of corridors and offering new spaces and opportunities to be in touch with nature.

Figure 3. San Pedro Park (old military battery), Bens Park (old municipal garbage dump), and surrounding area of the Torre de Hércules (World Heritage).

One factor hugely important besides the quantity is the quality, in that sense, the municipal government is generous because it is one of the city councils of Spain that invests the most ratio of euros/m^2 in its management and the result is very positive in population opinion.

Table 1: Distribution of green spaces surfaces at La Coruña.

Units	Size interval (m^2)	Total S (m^2)	High quality S. (m^2)	Medium quality S. (m^2)
177	<1000	54.094	47.776	6.318
85	$1000 \le x < 5000$	193.370	157.817	35.553
19	$5000 \le x < 20000$	184.385	124.129	60.256
23	$x > 20000$	1.078.969	515.439	563.530

Regarding green corridors, the new PGOM proposal has been analyzed and it has been complemented with new contributions more realist with GI concept, sometimes it is not possible because of the city urban typology. By other way, the preliminary spatial analysis would allow to join the potential GI of La Coruña with the area proposed to be declared Reserve Biosphere by the UNESCO (Fig. 4).

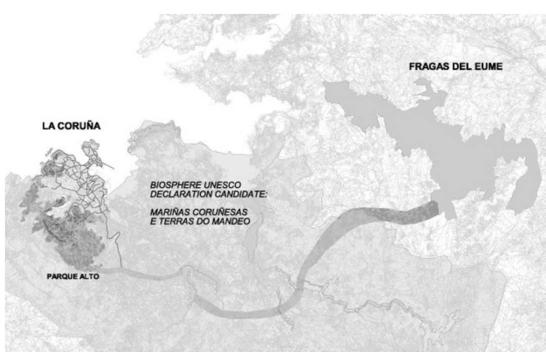

Figure 4. Potentiality of city spatial connection with the peripheral agricultural zones and network of protected spaces in Spain

Analysis of other experiences in Spain

Different experiences carried out in Spain were analyzed, characterized by a large casuistry owing to the historic evolution, the morphology, physical environment, population, budget, etc, and three of them were selected by its similarities or by provide inspiration for La Coruña.

Vitoria has a number of inhabitants similar to La Coruña (243.298 inh.) although with a minor density, 840 inh/km^2. Its green planning represents the Spanish paradigm, evidence of that fact has been the appointment as "Green European Capital" (2012). Its green belt, 645 has, the result of an ambitious plan that was started at the beginning of the years 90 of the last century, is a group of periurban parks with a high ecological and landscape value connected strategically by means of corridors which, in part, has enabled it to reach the second place among the cities with the greatest quality of life in Spain in a recent study carries out in 30 Spanish cities, taking into account 11 relevant indicators. The same study shows that one of the biggest worries is the health.

This example interests us owing to its integral management, its protocol of public broadcasting, its social participative approach and its spatial singularity that can be used as guide for cities like La Coruña, and moreover, its policymakers are analyzing the integration of all the area that forms the highland belt in a group by means of Biosphere Reserve UNESCO Declaration of the whole area. One of the goals of this study is precisely to analyze the stitches of the green system of LVG with the possible appointment of Mariñas coruñesas e Terras do Mandeo.

Another interesting example is Valencia due to its high urban density (5.995,7 inh/km^2), its metropolitan area is a territory of environmental and landscape excellence owing to the convergence of 4 great landscape. They try to make the protection and connection of the landscapes with urban surroundings and agricultural, cultural and natural spaces, in the same way that it would be able to put into practice in the hubs identified in our case. The last example is Murcia (430.571 inh) although it is a regional initiative, we have a special interest in the experience of its participation in European projects (Reverse y Surf-Nature) with relation to financial, technical and political alternatives to carry out GI initiatives.

SWOT analysis

Strengths:

1. Physical environment very suitable for territorial planning proposals of integration with the natural environment. Capacity of response very fast.
2. The city physiognomy allows the inclusion of Blue Infrastructure.
3. Possible planning with perimeter growth in more rural zones.
4. Sensibility to urban regeneration.

Weaknesses:

1. Ignorance in relation to green infrastructure concepts and principles. Lack of dialogue among departments originated by the absence of a global project and a clear leadership.
2. Singular territorial physiognomy. Complication in planning.
3. Urban typology (narrow streets, little free areas, etc.)
4. High urban density.

5. Disjointed historic planning.
6. Legal and financial framework

Opportunities:
1. Information and education. Social participation. Social consciousness raising.
2. Territorial planning joining the city closely to the most agricultural or natural environment.
3. Identification and presence of hubs with special historic, natural or cultural importance.
4. Savings of maintenance costs and derived from ecosystem benefits.
5. Public health and quality of life improvement. The impact evaluation of health is important and very useful to make decisions in politics evaluation.
6. Possible declaration of "Mariñas coruñesas e Terras do Mandeo" like Reserve of the Biosphere.
7. Potentiality of economic regeneration.

Threats:
1. Economic crisis.
2. Social pressure. Psychological barrier.
3. Particular interests.
4. New urban interventions took out of context.
5. The lack of methodologies that assess health benefits can affect its implementation.

Discussion and conclusion

Studies developed and currently underway highlight the need to integrate and implement these planning strategies in dense cities with similar physical characteristics to those of La Coruña as they involve improving public health, quality of life and landscape, functioning as a competitive advantage globally.

Synthesis of the preliminary research work, supported by the SWOT matrix and the geographical study, shows a strategic opportunity for the incorporation of GI in LGC that allows and guarantees the accessibility to green spaces bigger than 5000 m^2 located within a radius minor than 300 m, following the European recommendations with the consequent improvement of public health.

It shows the need for regional planning to enhance and strengthen supramunicipal spatial connectivity of the protected areas network in northern Spain and open it to the Atlantic. GI planning must be accompanied by an informative and educational campaign adapted to the psychological bias of the population, transmitting its concept and its varied benefits with the aim of changing the current concept that exists in Spain of "public equipment" to "green infrastructure".

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The Importance of Urban Corridors in Improving the Green Infrastructure in Cities: Case Study Gaziantep-Turkey

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Introduction

Rapid urbanization in parallel with population growth is the phenomenon of our century. Urbanization implies great pressure on natural resources and the environment (Rees, 1997; Sandstrom, 2002). Urban growth, by altering cities and the surrounding countryside, presents numerous challenges in urban environment (Tzoulas et al., 2007). As a result of these rapid alterations in urban land use; loss of natural areas, fragmentation of open spaces and degradation of water resources have been occurred over the years. Furthermore, these changes have been influenced the function of ecological services such as provisioning services (e.g. food, fuel, water) to regulating (e.g. climate/air pollution regulation, waste assimilation, flood and fire regulation) that emerged many environmental problems which influenced the quality of human life. Therefore, concerns about the future of cities and next generations' life in urban area caused the improvement of environmental quality and long-term livability become the main goal of urban planning process.

Based on these objectives, the concept of *Green Infrastructure* gets importance in urban planning and design over the past few decades. Integrating green infrastructure into the land planning process in cities can prevent many environmental problems associated with the human population and protect the natural ecosystem values as well as contribution to the health and quality of life for communities and people. Therefore, the concept of green infrastructure, its benefits and the urban corridors as a tool for improving green infrastructure are focused in this article. Also, Gaziantep city located in Turkey is selected as a case study to clarify these issues.

Background / Literature Review

Cities can be described as an ecosystem having interacting biological and physical complexes. There are different organisms in this ecosystem as well as air, soil, water, light, and physical regulators such as temperature and day length (Cadenasso &Pickett 2008). Today, alteration in land use, consumption and fragmentation of green areas effecting urban ecosystem is taking place faster than ever. As a result, fragmented dysfunctional ecosystems will not provide long-term sustainability nor benefit society and the global environment (Cook, 2007).

Planning the green infrastructure is the key concept improving the function of dynamic urban ecosystem and as a means of spatially organizing urban environments to support a suite of ecological and cultural functions (Ahern 2007). Also, green infrastructure is related to environmental or sustainable goals that cities are trying to achieve through a mix of natural approaches (Foster et al., 2011). The concept of urban green infrastructure is new term in urban planning, but the roots of this idea started more than 100 years ago. As Charles Little indicated in his book; the *Greenways for America*, Frederick Law Olmsted planned green infrastructure in his project 130 years ago.

Today, the concept of green infrastructure is explained in different terms. This concept is defined by Benedict & Macmahon (2002) as "*interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations*. In other words, green infrastructure (GI) refers to the network of living green spaces that play a fundamental role in helping us address climate change, public health, biodiversity and community cohesion. In short term, it can be defined as nation's life sustaining system (Comhar 2010). In addition to variations in definition, there are differences in the type of work being undertaken in developing Green Infrastructure in different countries (Comhar 2010). Green infrastructure also can be created in different scales; state, regional, metropolitan area, and local community (McMahon 2000).

For a long time, Communities that planned for open space primarily thought about preserving land for parks and these parks were often viewed as a community amenity, an extra, even a frill (McMahon 2000). Now, Green infrastructure can link the parks and green areas for recreation and benefit of people and link natural areas for improving biodiversity and habitat fragmentation. Likewise, it also can shape urban form and provide a framework for growth.

Briefly, the benefits of Green infrastructure can be categorized as; Environmental benefits (air, soil and water quality, climate change adaptability, landscape amenity, biodiversity, flood alleviation & water management and landscape character), Social & Community Benefits (bringing people together, health and well-being, culture & heritage, education & life-long learning, culture & heritage aesthetics and a sense of place) and Economic Benefits (adds value to land and property increases productivity, provides jobs, decrease public costs). In addition, it can strengthen the landscape identity of city which is defined as the individual identity of a city which clearly distinguishes it from other cities (Xuesong & 2008).

The evaluation of green infrastructure predicts that *Hubs* and *Links* are two major components of green infrastructure plan. Hubs are variety of natural and restored ecosystems and landscape features and links are the connections tying the system together and enabling green infrastructure networks to work (Benedict & Macmahon 2002).

Due to the definition of Green infrastructure components, urban corridors can have significant role as linkage between natural and green areas improving the green infrastructure. Urban corridors can tie different areas with diverse function. Also, if these corridors are planned or designed according to ecological and cultural values, they can be an attraction point in the urban circulation spaces. Roads, waterways, railways, pedestrians zones are some examples of urban corridors. In this research for emphasizing the impacts of urban corridors for improving the urban green infrastructure, Gaziantep city is chosen as case study.

Gaziantep is located in south-central part of Turkey. Geomorphologic structure of the city is mountainous and rugged. Geographically, being located on the historical Silk Way and founded near to the first civilizations of Mesopotamia and the Mediterranean caused that the city became the settlement of human populations since prehistoric times. Over the years, the population growth and expanding the industrial areas around the city caused rapid urbanization in the city.

Historically, residential areas developed around the Alleben River the most significant corridor of Gaziantep landscape in central part of the city. The first regular apartment-style housing area is zoned and developed in the west part of the city for high income group. In addition, around these areas sub region with different functions are located that meet the needs of urban residents. During the years, development of industrial areas in the southwest and northwest parts of city and the need for workers caused the migration of low-income groups to the city. As a result, for residing these low-income immigrants illegal and unplanned constructions occurred in the south and north part of the city. Therefore, over the past century the main purposes of development plans of Gaziantep were planning residential and industrial areas. In other words, urbanization in Gaziantep has occurred in a demographically. Likewise Gaziantep, there are evidences to suggest that in many 'advanced' industrialized countries there has been a reversal in the rural-to-urban shift of populations (Sandstrom 2002)

Urbanization with rapid and uncontrolled manner caused socio-economic context and the internal migration. Therefore, it is difficult to describe these alterations as the process of urbanization. As a result; natural areas and corridors usually were ignored during the urbanization planning. Therefore, over the years constructional areas are expanded and natural landscape and green areas of the city have been disappeared. Also, the land use of the farms and forests inside the city borders were changed and most of these areas were fragmented. In addition, most of the productive farmland are isolated and lose their ecological function.

Today the only natural green areas are located in north and west part of the city as urban forest. In addition, in urban scale there is a park in parallel with Alleben River which does not have design accordance with ecological goals. Also, there are small scales parks that are separated inside city (Figure 1).

Fig 1. The distribution of green areas inside Gaziantep

Goals and objectives

Green infrastructure has a significant role in improving the urban ecosystem and quality of life. Urban corridors are important tool for promoting green infrastructure in urban areas. Therefore, the quantitative, qualitative, distribution and connection of these elements are determinant factor affecting the quality of urban Green infrastructure. In this research, identification and detection of corridors of Gaziantep are the basic concepts that will be covered to demonstrate the importance of urban green infrastructure and its tools in the urban planning process.

Methods

In this research, books and electronic journals database that are related to the concept of green infrastructure, its benefits and planning methods were first reviewed. Consequently, the Gaziantep city is chosen as case study. After the site survey and evaluation of the Gaziantep recent maps, the map of green areas of Gaziantep had drawn.

Furthermore, the corridors of the Gaziantep including Alleben River and roads are evaluated in city plan using GIS. In this stage, the city is separated to sub-regions and corridors. Consequently, the relations of these regions and city corridors are discussed. Additionally, the potential of these corridors for improving the urban green infrastructure in sub-regions and in city as whole are determined. Finally, the methods of integrating the open and green areas of city by using the urban corridors are assessed.

Results

Gaziantep plan does not have an integrated system of open green space. Also, the distribution of green areas inside the city is not equal. Therefore, the city separated to sub regions to overcome the deficiency of open and green space system and to ensure the distribution of green areas in city. The intervention and improvement of green areas and corridors in sub regions will improve the green infrastructure in city as whole. As it presented, in figure (2) city contains different size of open and green areas. But, these areas are not integrated to structural areas. There are also problems of accessibility as well as security in these places. On the other hand, these areas have potential to contribute the quality of life in urban area. Forest and parks of Gaziantep have an important role in meeting the need for recreation of residents, especially on the weekends. Integrating the urban forests and green areas to urban open spaces, squares and commercial zones can create a circulation in the city. Integrating urban corridors to this circulation can promote the green infrastructure and transform these areas into attraction areas for recreation.

An assessment of Gaziantep corridors indicate that Alleben River in central part of the city is the main corridor that can connect natural green areas and parks and improve the green infrastructure of the city. Evolution of the road inside city represents that a large part of the historic center of Gaziantep in the south-west, and south-east of the castle have organic and narrow road system. On the other hand, the roads of urban fabric in low income group zones and slums in contrast to other cities slums areas have wide and smooth roads. The majority of residential zones in western and eastern areas of urban structure developing after 1970 have suitable and wide roads. Besides the vehicle roads, there are a large amount of pedestrian corridors inside the city. The reason is that most of the urban residents are low-income groups that use these pedestrian for transportation. Weather conditions, topographic structure and inadequate public transport systems are the other reasons for the large amount of pedestrian areas.

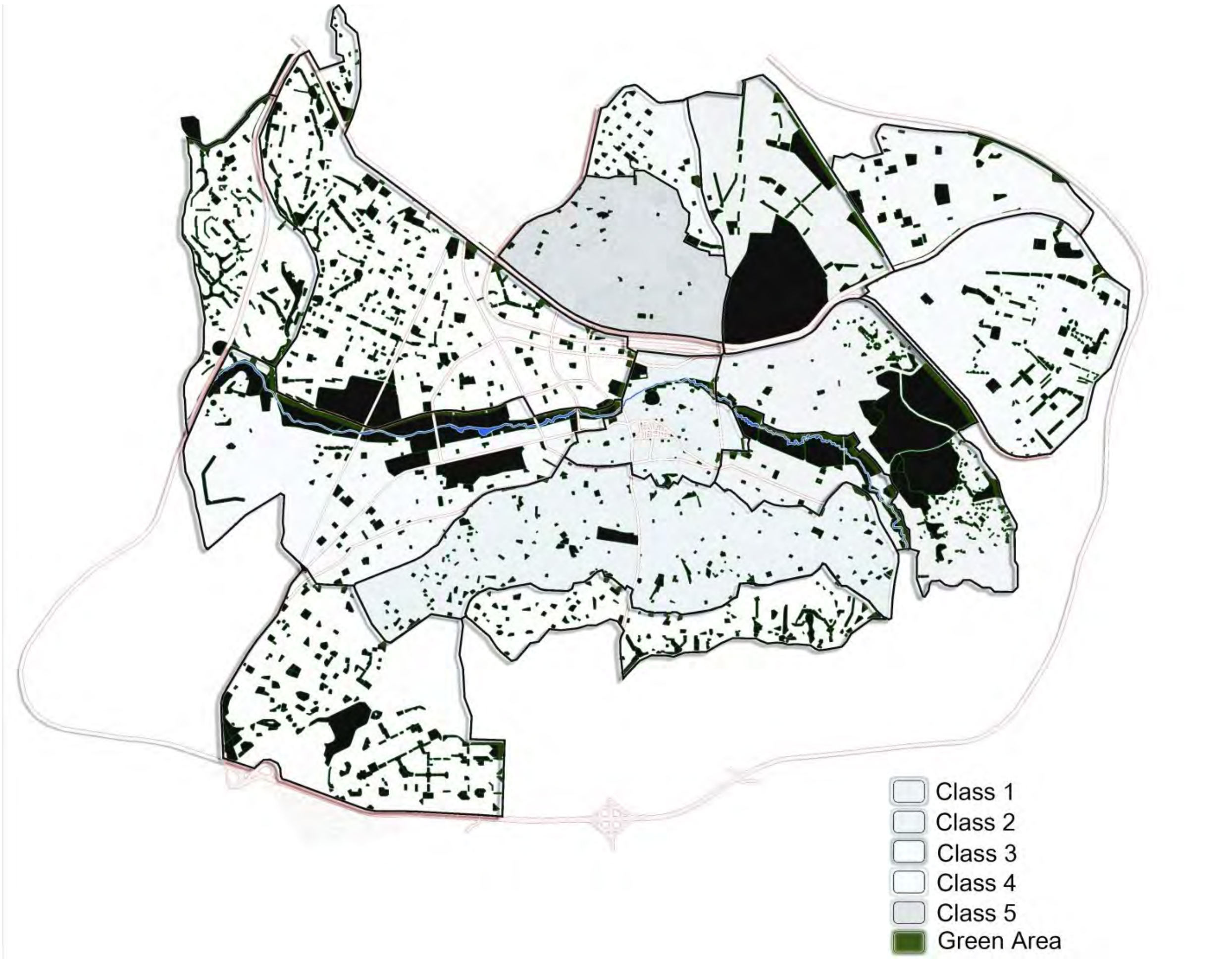


Fig 2. Gaziantep is separated to 14 sub regions in this plan and sub regions are classified to 5 classes according the quantity of open and green areas. Class 1 indicates the maximum and 5 in the minimum amount of green areas.

Determination of potential urban corridors in sub-regions and urban overall

Alleben River is the main corridor that can play as a hub as well. If the areas around the Alleben River are planned, designed and planted well, it can be the main hub connecting the other green areas using urban roads. Therefore, roads those are perpendicular and parallel with Alleben River have potential to be used as green corridors linking urban green areas. Also, the main corridors of Gaziantep green infrastructure are investigated in each sub region. In addition linkage corridors between the Alleben River and main corridors are determined (Figure 3).

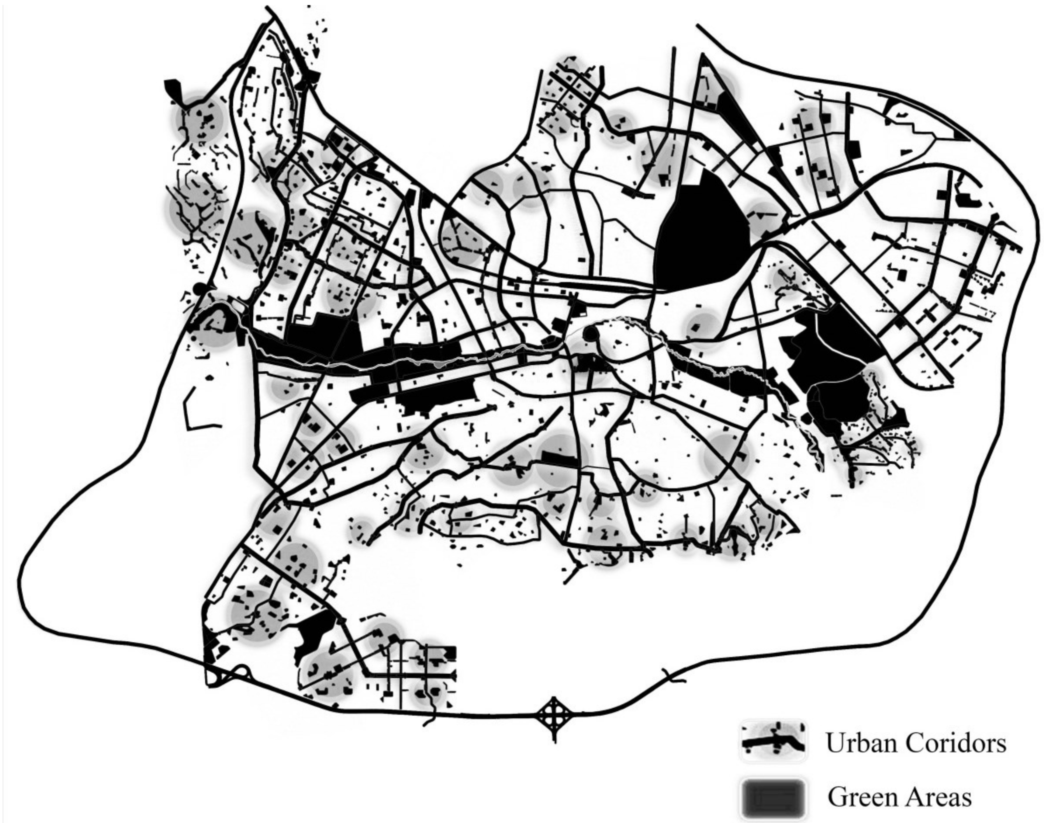
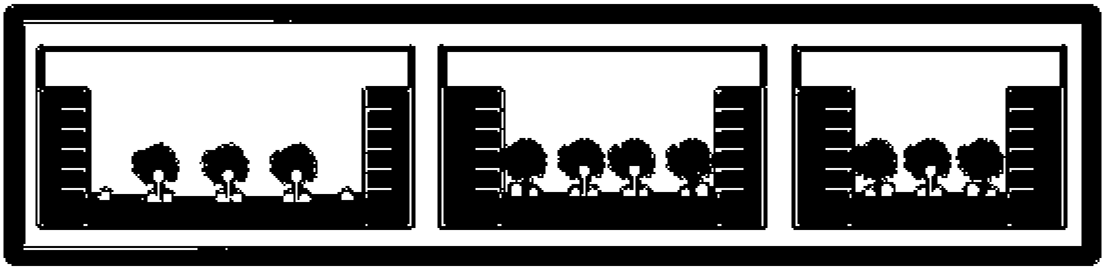


Fig 3. Gaziantep green infrastructure plan.

For improving the green infrastructure of Gaziantep, the function of the roads that are the linkage corridors between Alleben River Park and other green areas must be converted to pedestrian zones or semi pedestrian. Furthermore, like the method for Green Tokyo project (Tokyo Metropolitan Government, 2007) for enhancing "green road network" connecting large scale plots of greenery, the number of roadside trees must be doubled or in some cases roadside trees must be planted (Figure 4). Some factors should be determined in the selection of the trees and plants. First, selecting the areas native trees and plants has advantages of easily adaption as well as improving the urban biodiversity. Considering the air pollution in Gaziantep, the trees species must be resistant to air pollution. Also using the indigenous species will contribute the identity of the region.

(A) 

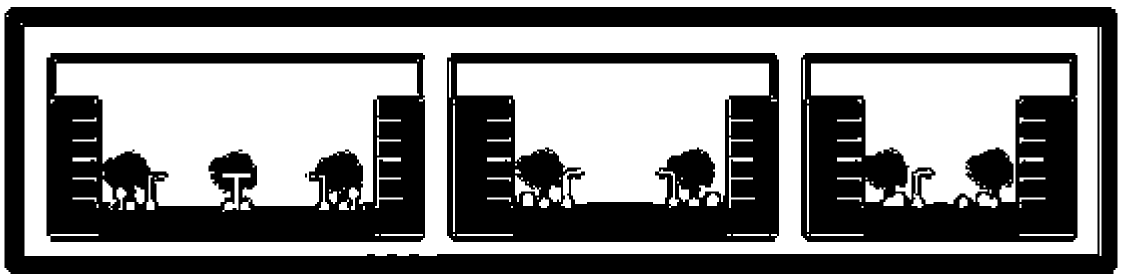
(B) 

Fig 4. Sections of the urban corridors for improving green infrastructure (A) Roads that are converted into a pedestrian zone (B) Roads that are converted to semi-pedestrian area

Discussion and conclusion

Although a modern ecological framework exists, unfortunately inappropriate or outdated concepts continue to be used in the context of land-use and planning decision making in many cities of developing countries (Flores et al., 1998). Emphasizing the new approaches of urban planning such as planning green infrastructure, their application tools and benefits in different research can contribute the local government to be aware about these concepts.

Green infrastructure planning must be the first step in developing land-use plans as communities grow, and should be coordinated with planning and design of other essential gray infrastructure in effective, economic and sustainable manner. Also, it must be noted that the green infrastructure should plan comprehensively, implemented publicly, practice of diverse professions and mange in long-term period with realistic perspective to gain the successful result. In this research Gaziantep city was investigated not only to emphasize the importance of urban corridors in improving the green infrastructure but also as an example for many developing city with the same planning problems and circumstances in enhancing green infrastructure.

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Green Infrastructure, Greenways, and Trail Planning:
Frameworks for Sustainability in Maryland

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Introduction

The State of Maryland has been a leader in a number of state-wide environmental efforts. As part of the work published by the Maryland Greenway Commission in 2000, a green infrastructure (GI) assessment was included to provide a greater "*emphasis on the ecologic network*" (Maryland Greenway Commission, 2000, p. 3). This inclusion, while building off of decades of land conservation and greenway planning, recognized the need to provide a more science-based approach to integrated and comprehensive land conservation. In addition to this recognition, this GI assessment was also intended to identify the best ecological lands in Maryland for potential protection as well as potential areas for restoration. The GreenPrint program that evolved from this original GI assessment was reorganized in 2008 and became a first-in-the-nation web-enabled map showing the relative ecological importance of every parcel of land in the State (Maryland Department of Natural Resources, 2012a). In addition to these efforts that focused on land conservation, other efforts in the state included the evolution of environmental site design (ESD) to include low impact development (LID) methods and innovative site design practices. Maryland, in part as the result of new EPA water quality requirements has established some of the most stringent statewide regulations that are impacting the land development process. These ESD and stormwater interventions have been popularized as *green infrastructure* as well. Thus, the term *green infrastructure* serves as a robust but diffuse term capturing both broad scale land conservation as well as micro-scale storm water practices.

In 2000, the Maryland Greenway Commission defined *greenways* as

> "*natural corridors set aside to connect larger areas of open space and to provide for the conservation of natural resources, protection of habitat, movement of plants and animals, and to offer opportunities for linear recreation, alternative transportation, and nature study. Maryland has over 1,500 miles of protected greenways corridors, including over 600 miles of trails*." (p.1)

Thus while trail planning played a central role in both greenways and initial green infrastructure developments, more recent trail efforts have been less connected with green infrastructure (and the term *greenways*) and more focused on the recreation and economics benefits. The current trails web page at Maryland Department of Natural Resources states:

> *"[t]rails provide many economic benefits to local communities and create a wide range of jobs, from B&B's to bike shops. They also help tell the wonderful stories of Maryland and its rich history. And hiking and bicycle trails are for the whole family. They make us all healthier and happier while opening up the natural world around us. The Maryland Department of Natural Resources (DNR) is*

currently working closely with the National Park Service, the Maryland Department of Transportation, State Highway Administration, Department of Planning, Office of Tourism, local governments, trail groups, and volunteer citizens on a wide assortment of trails throughout the state." (Maryland Department of Natural Resources, 2012b)

How do greenways now relate to green infrastructure? Is the term *greenway* still useful in the Maryland context and if so, why. This paper explores the benefits and issues related to greenways and GI. This presentation is organized into four sections. First, I will present a framework for GI in the state of Maryland. The proposed conceptual framework may have applicability for other settings. Second, I will provide examples from Maryland for this GI framework. These examples, from different scales, include policy and regulatory programs from land conservation, forest parcel conservation, stream restoration, and stormwater interventions. Third, I will explore the integral role that greenways could and should play at various scales for GI. How do greenways benefit the proposed GI framework? Last, where this framework is applicable to other settings, I will argue the need to recommit to collaborative holistic approaches that support economic, ecological, and cultural sustainability.

A Green Infrastructure Framework

Green infrastructure is now a widely used term that is advocated to address a variety of environmental problems. Government agencies, non-profit entities, academia, and private companies are promoting green infrastructure to solve problems from land conservation to water quality. As a practice, a plan, a set of principles, a philosophy, or all-of-the-above, green infrastructure has become a defining umbrella for organizing the critical component or toolbox kit for addressing old and new urbanization, land conservation, and dispersed site-scale stormwater hydrology interventions. As the term green infrastructure becomes more widely adopted, it might be helpful to organize different scales and types of green infrastructure approaches into a framework in order to communicate the complexity and interrelationships. In one sense the need for a framework stems from the following question: *How can the complexities of green infrastructure approaches being described at vastly different scales be conveyed?*

The following simple framework is used to define green infrastructure on the basis of scale and focus of intervention:

Land	**Water**
GI	**gI**
Gi	**gi**

GI: Broad scale efforts at a national, state or county planning scales that focus on land conservation and broad land use policy;

Gi: Landscape scale efforts that focus on conservation or restoration of vegetation patches;

gI: Landscape scale efforts that focus on linear systems, especially riparian and linear stream wetland systems and the adjacent vegetation;

gi: Finer scale interventions at the habitat or site level that focus on addressing hydrological vegetation benefits .

While the acronyms and their variations all define a type of green infrastructure in the framework, all the efforts above are currently being defined by many entities as green infrastructure. This framework is further explored by using programs and practices from the State of Maryland. While not exhaustive, the examples from Maryland provide examples of each of the four defined types of green infrastructure GI, Gi, gI, and gi. In addition, this exercise provides an opportunity to provide a snapshot across scales to explore the interconnectedness or lack of interconnectedness between these various green infrastructure practices and approaches.

Framework Examples

GI

Like other urbanizing states on the eastern seaboard of the United States, the State of Maryland is undergoing continuing long term land use reallocation. Two important drivers of this land use reallocation include continuing population growth and increasing per capita land utilization for primarily low-density residential housing. The Maryland Department of Planning (MDP) and DNR classifies landscapes into two broad categories: 1) resource lands and 2) non- resource lands. Like other urbanizing states, historical land used trends indicate that resource lands (e.g., agriculture, forest, and mining) are declining while non-resource lands (e.g., urban, etc.) are increasing.

> *"If Trends Continue: By 2035, MDP's analysis estimates that an additional 404,000 acres of land will be developed, and Maryland will lose an additional 226,000 acres of farmland and 176,000 acres of forest. More than 87 percent of these acres will be converted to low or very-low density residential development." (Maryland Department of Planning, 2011, p. 2-4)*

Maryland has a long history of greenway development. This long term effort provided the backbone for current land conservation efforts in the state. In the late 1990's efforts integrated greenway planning and landscape ecology in land conservation efforts. Weber and Wolf (2000) document the ongoing effort in the development of the Green Infrastructure Assessment (GIA) tool that was developed to assist in helping to identify and prioritize landscapes for land conservation and restoration. One of the most critical aspects of this program was the use of science-based criteria to develop a GIS based model and the utilization of landscape ecology principles to develop a hub and corridor framework. Using the GIA as a guiding tool and as part broader Smart Growth efforts, the GreenPrint was established in 2001 with a state budget of 35 million to protect landscapes using the green infrastructure framework approach. This was primarily through outright acquisition purchase or the purchase of conservation easements (i.e., paying the owner to restrict development on the property in perpetuity). The Green print program was "aimed at protecting Maryland's most valuable remaining ecological lands -- two million acres of which have already been identified by DNR -- which are quickly becoming fragmented, or are disappearing altogether, particularly in developing areas." (Maryland Department of Natural Resources, 2001). In 2003, green infrastructure was institutionalized into land conservation planning efforts by expanding the criteria used to evaluate land preservation purchases to include a comprehensive set of ecological indicators. Through this initiative, state land conservation programs such as Rural Legacy and Program Open Space prioritized their conservation activities on areas identified as green infrastructure. In 2008, the state re-launched the GreenPrint program (http://www.greenprint.maryland.gov). The resultant map continued to identify 33% of Maryland's total land area that was considered the most important ecological landscape of the state. The program continues to employ a hub and corridor based system to provide guidance for land conservation decisions at state and county scales. The managers of the GreenPrint program recently incorporated new criteria recognizing global climate change.

Gi

The Forest Conservation Act (FCA) provides an example of Gi where the outcome of the intervention is the conservation or restoration of a forest patch. While not initially discussed as green infrastructure when the law was created, the cumulative addition of these protected landscape patches have contributed to the overall forest creation and protection in counties, particularly those under development pressure. The State of Maryland enacted the FCA in 1991 (Natural Resources Article Section 5-1601 through 5-1613). The purpose of the FCA was not to stop all forest loss due to development but to conserve and provide for the creation of forests in the development process. The FCA requires a developer to provide two documents during the planning and site design approval process. The first is the documentation of the site condition prior to development. The identification of forest stands, specimen trees, and an ecological description of the site is documented in a Forest Stand Delineation (FSD) or as part of a Natural Resource Inventory (NRI). This critical information provides a baseline for design decision and regulatory approvals. The FSD/NRI serves to provide guidance where development will have the least impact on existing forested areas and important environmental features. The second document, a Forest Conservation Plan (FCP), is required establishing both the proposed design, the area for clearing, areas for saving existing forest in easements and, if needed, the reestablishment of forest in easements (Galvin, M. F., et. al. 2000).

While the outcome of the FCA has mitigated forest loss as a result of new exurban and suburban development, it has not stopped the significant estimated annual loss of forest at the state level (DNR, 2004). A new state effort coordinated by the Sustainable Forestry Council defines the no-net-loss of forest policy as the stabilization of the rate of loss by 2020 with the goal of maintaining the state's existing 40% forest coverage. The target year of 2020 is intended to provide enough time to develop proposed statutory and planning requirements. It is likely that both GI (land conservation) and Gi (development forest retention and creation) will be needed to accomplish this goal.

gI

Almost twenty percent of streams of Maryland stream are channelized, primarily as a result of damage from agriculture and urbanization. Most of these streams are geographically located in the Coastal Plain province in eastern Maryland. Stream restoration, while an important ongoing tool utilized by county manager, is slated to be an important tool as part of the set of green infrastructure tools to clean up the Chesapeake Bay.

gi

The effects of urbanization on hydrological systems have been well documented. Major impacts due to the increase in impervious cover include increased flooding, decreased lag time for flooding, and reduced base flow due to a lack of infiltration. In 2008, spurred by Environmental Protection Agency (EPA) law, the state developed Environmental Site Design (ESD) to address these issues. The new ESD regulations, at the site scale, incorporate low impact development (LID) principles to provide for distributed hydrology and attempts to mimic nature by infiltrating and retaining water. Existing built areas are significant in area are unregulated in terms of stormwater and will be addressed over time with capital improvement projects. New stormwater laws have led to the promulgation of new stormwater laws at the county scale where they have been implemented in the development plan review process. The EPA recently issued National Pollutant Discharge Elimination System (NPDES) and Municipal Separate Storm Sewer Systems (MS4) permits. Maryland counties have modified their development guidelines to meet the requirements of these new permits with the goal of improving water quality. The new regulations promote green infrastructure practices that can infiltrate, retain, and evapotranspirate rainwater on or within the site. The EPA has defined green infrastructure at the site scale as "stormwater management systems that mimic nature by soaking up and storing water."

Greenways and Green Infrastructure

How do greenways now relate to green infrastructure? Is there a benefit of maintaining and promoting a connection between the use of the term *greenway* and *green infrastructure* in policy and programs in MD? While recent trail efforts have been less connected with green infrastructure and more focused on the recreation and economics benefits of trails, there is a need to reassess the utility of the term greenway to encompass green infrastructure practices ***across*** scales. Greenways still have an important role as a term to encompass a landscape as connector between park systems. This corresponds to GI and the benefits of broad land conservation and state-wide trail development efforts. The use of the term greenway in these efforts defines both green infrastructure and associated human activities that can be compatible in some of these landscapes. gI and gi both have direct involvement with water within the landscape. With gI, greenways provide opportunities to see stream restoration, to provide stakeholder support, and to provide for educational opportunities. Here the use of the term greenway defines linear green infrastructure interventions that are enhanced by multiple benefits with the addition of human interaction through exposure to restored environmental features. For gi, similarly, greenways provide opportunities to see community-based ESD practices. Where possible, greenways can provide connections between various hydrologic interventions. The educational opportunities to improve awareness are also likely benefits of greenways that connect restored landscapes. Gi provides an opportunity to increase the buffering of greenways, thus providing a more natural experience for the user.

Land	Water
GI Greenways as connectors between parks	**gI** Greenways provide opportunities to see stream restoration
Gi These landscape have the potential to improve buffers for greenways	**gi** Greenways provide opportunities to see community base ESD practices

Conclusion

The term green infrastructure is likely to play a continuing role in helping define and promote interventions that provide environmental benefits at many scales. In addition, the most recent focus on defining green infrastructure as water-related interventions will likely continue. The term greenway provides an opportunity to integrate many of the features that are being defined as green infrastructure. The need for stakeholder interaction and educational integration between water-related intervention and trail-related improvements suggests that the term greenway is still important and useful in conceptualizing a holistic approach that supports economic, ecological, and cultural sustainability.

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5. ECOLOGICAL NETWORKS

Which local approaches for European green infrastructures concept? Case analysis of the Angers and Porto

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Introduction

In the last fifty years European cities has been experiencing high dynamics of landscape change. The environmental and social impacts of urban sprawl are widely discussed among researchers. There is a growing pattern of population movement into suburban areas, and a commonly cited reason is the attraction to rural areas because of the associated aesthetics of the landscape. Indeed, for them, naturalness is the most attractive value of this landscape. The periurban nature is predominantly characterized by a rural matrix (90% of suburban areas) (Cavailhès, 2009). Paradoxically, at the same time that urban sprawl is affecting surrounding rural landscapes, suburban landscapes continue to attract new residents. The consequences of urban sprawl and landscape fragmentation have becomes problematic for planners. Urban sprawl has been linked to an array of economic and social costs for communities wanting to meet the quality of life expectations of their citizens. Furthermore, urban sprawl is increasing seen as one crucial contributor to the disappearance and fragmentation of natural areas and to biodiversity losses (Mcdonald *et al,* 2008). In order to answer to current ecological crisis, European Union has been adopting diverse environmental policies, including biodiversity conservation strategies. The term "green infrastructure" is being adopted by the European urban policy deliverables and becomes the subject of increasing research projects. Green infrastructure is a recent term, but it has roots in planning and conservation efforts that started a hundred and fifty years ago, including greenways, ecological corridors or ecological networks.

In France, since late 1990s, the concept of greenways is increasingly being recognized in planning. It was first used in a broad social and environmental perspective. However, the global recognition of the disastrous results of biodiversity loss has led to increasing efforts to combat the landscape fragmentation. Based on the theories of landscape ecology, the ecological corridor concept emerges as a means to fight against landscape fragmentation. With the adoption of the laws Grenelle 1 and 2 (2009 and 2010), the green infrastructure concept embodies the importance of ecological connectivity. Thus, each metropolitan area has to "take into account" the green infrastructures in its local project planning (SCoT and PLU).

Having creating the "Reserva Ecologica Nacional" (National Ecological Reserve) in 1983, Portugal is at the forefront in the design and application of the concept of ecological network (Andresen *et al*, 2005). At local level, however, more recent regulations (2005) calls for the delimitation of a municipal ecological network in the master plan based on both ecological and cultural values. The municipal ecological network favors multi-functionality and connectivity of green areas, representing clear progress in terms of a holistic concept of the city's green structure.

2/ Background and literature review

The concept of green infrastructure has been receiving widespread attention among both researchers and practitioners on open spaces planning. Two main key principles are often associated with the green infrastructure concept. Despite the difficulties in achieving a single definition of green infrastructure, it is possible to identify some underlying features, such as connectivity and multifunctionality. On a theoretical perspective, we will focus on these two key concepts to understand its dissemination in open spaces planning approaches.

The idea of connecting open spaces knows a history of more than a hundred years and, in fact, is not a new idea in urban planning thinking. However, the motivations and objectives for connecting open spaces changed over time. If today connectivity of open spaces has, especially in Europe, a strong ecological connotation, it was originally envisioned for aesthetic and social purposes. Having developed the parkway concept in late 19th century, Olmsted is usually claimed as a pioneer in this concept. With a system of connected open spaces, users could travel throughout the system without leaving the natural atmosphere. The concept was exported to Europe and especially to France by Forestier in the late 19thcentury. The open spaces spatial continuity idea was also explored during the 20th century with the aim of containing urban development, following the "garden cities" theories developed by the British urban planner Ebenezer Howard (late 19th century). "Green belts" plans were developed in several European cities, as London green belt (1944) or Paris green belt (1976), with the objective of confining the urbanization of cities (Laruelle et al., 2008). In addition, with the rise of environmental concerns in the second half of the 20th century, the connectivity concept embraced a new meaning. It no longer meets anthropocentric objectives but biocentric objectives. Indeed, scientists and naturalists have been highlighting the effects of terrestrial fragmentation on biodiversity decline. The fragmentation of natural and semi-natural areas as a result of urbanization is seen as key process on ecosystem degradation. In order to answer to this ecological crisis, landscape ecology science has been advocating the restoration of functional ecological connectivity between hotspots of biodiversity and habitats through corridors. Europe as promptly incorporated this concept in several legal frameworks. Indeed, in 1995, several European countries have endorsed the Sofia Convention, that provided the creation of a Pan-European Ecological Network[3] in order to halt biodiversity loss. The ratification of the convention by the European countries induces the

[*] The word "eco-museum" comes from two Greek words: oikos, which means "house" in a symbolic sense, meaning the environment, and which corresponds to today's concept of "small homeland", and museion - set of things, a collection. Eco-museum connects the tangible and intangible heritage related to the place of origin and the life of real people.

development of public policies in order to introduce ecological networks at national scale. Thus, whether in an anthropocentric vision or in a biocentric vision, open space connectivity appears, for more than one century, as a key element of urban and landscape planning.

The second associated with the green infrastructure concept is The second key principle associated with the green infrastructure concept is multifunctionality.For most European cities the second half of twentieth century was marked by an unprecedented planning paradigm closely supported in the spirit of the Charter of Athens (1933). Functionalist planning produced mono-functional territories based on the spatial separation of industrial, housing or recreational functions. Social and environment crises led to a diametrically opposite repositioning of urbanism vision. A space couldn't be reduced to a single function and must support multiple issues. At the time that was being developed the sustainable development principles, the Aalborg Charter (1994) suggests the implementation of transversal urban policies that encompass planning impacts - ecological and social - on environment at multiple scales (Emilianoff, 2004). It focuses on the potential ability of cities to solve some environmental and social problems. Open spaces are increasing perceived by its multiple benefits and functions, which planners have to take into account in a global vision for the city.

Social functions most frequently cited in literature include the biological human need of nature, that what Edward Wilson calls "biophily" (Beatley, 2010). Thus, the accessibility to open spaces becomes a major concern in cities. They respond to the growing demand for recreational areas and recreational nature in the city (Berque, 2002; Emelianoff, 2010; Madureira et al., 2011). The presence of open spaces in residential areas is also associated with a greater social cohesion. The frequency of public green spaces encourages social interactions and the community sense of place (Tzoulas et al., 2007). In addition, numerous studies have shown positive effects of green spaces proximity on human health: sports practice and physical activity, reduction of blood pressure, health benefits on Alzheimer patients…

Researchers also attribute many environmental functions to open spaces in cities. They contribute to foster and develop urban resilience. Urban areas are often considered as degraded ecosystems. Thus, open spaces allow large environmental benefits: preservation of biodiversity, atmospheric purification, mitigation of the effects of urban heat islands and heat waves, or restoration of the urban water cycles.

Finally, open spaces play an important role in the urban structure and contribute to an attractive image of cities (Blanc, 2008). In fact, numerous studies demonstrate the increase of property values near green spaces.

3/ Goals and objectives

Connectivity and multifunctionality concepts take a central role in the emergence of green infrastructure concept. Multifunctionality meets multiple ecological and social functions of urban open spaces. Connectivity seeks to increase the social perception of urban nature and to promote the ecological processes. In spite of these concepts being discussed and implemented by the EU and national authorities, the implementation at the local level reflects different interpretations of the "concepts". The aim of this paper is to evaluate and discuss the incorporation of concepts concerning connectivity and multifunctionality in local planning. Using the examples of two different European cities, Angers (France) and Porto (Portugal), we discuss the issues of transferability and specificity in local green infrastructure plans implementation.

4/ Methods

For the purpose of evaluating and discussing the incorporation of concepts concerning connectivity and multifunctionality in local planning, two methodological steps were taken.

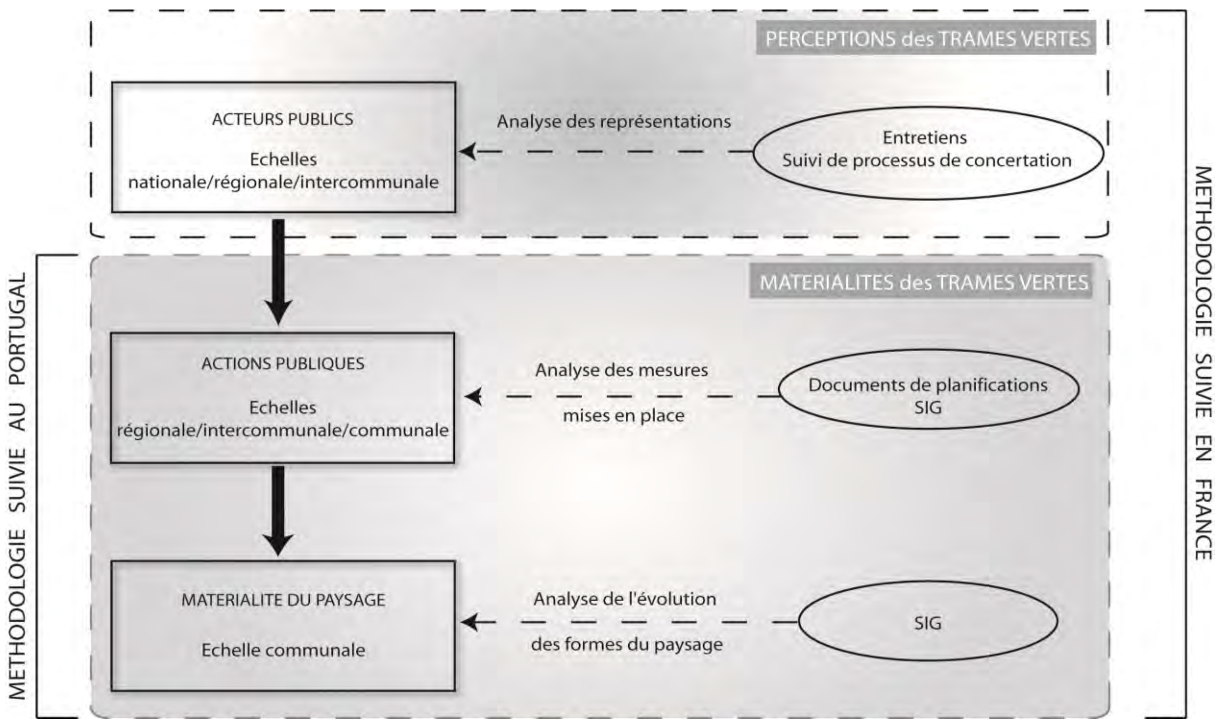
First, we evaluated the incorporation of the principles of connectivity and multifunctionality on French and Portuguese legal frameworks in a multi-scalar approach. In fact, these principles have in both cases a declination at national, regional and local levels.

Second, we evaluate the incorporation of the principles of connectivity and multifunctionality in local planning using the examples of Angers (France) and Porto (Portugal).

For both case studies we analyzed the local regulatory instruments and planning tools as well as its declination on the national legal framework; using a GIS, we inferred the local strategies for the green infrastructure.

It is important to note that analytical approach adopted by researchers in both countries, to respond to this research problem, does not follow exactly same methodology. Without making a strict comparison between sites, this reflection however try to understand mechanisms of a similar urban policy in two European countries. This research allows us to identify blocking factors inherent to consideration of green infrastructure concept locally.

Regarding the French analysis, methodology developed here, with Angers metropolitan case study, is based on thesis works conducted between 2008 and 2011. The joint study of the physical structure of the landscape, planning documents and representations of public actors, allows us to analyze actors' discourse and materiality areas affected by a green infrastructure plan. Therefore, our analysis focuses both on stakeholder’s perception and regulatory implementation of green infrastructure. We summarize our approach with the following figure.



5/ Results

Neither France nor Portugal has the designation of "green infrastructure" in their legal framework. In this article, we focus on instruments or regulations that can be considered closer to the concept of green infrastructure. In the French case, we focus on the recently implemented "Trame Verte et Bleue" (2009), while in the Portuguese case we selected the “Reserva Ecológica Nacional” (National Ecological Reserve) and the “Estrutura Ecológica” (Ecological Structure) (Figure 1).

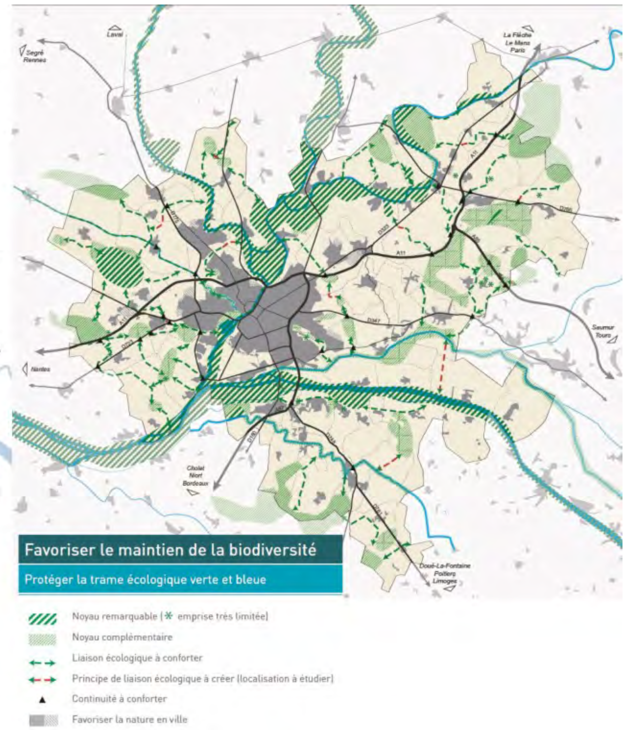
A comparative analysis of the integration modes of the principles of connectivity and multifunctionality in France and Portugal leads us, first of all, to the need to differentiate the legal frameworks. France started in recent years a reformulation of nature conservation policies in order to establish integrated instrument to be applied at multiple scales: the “trame verte et bleue”. By contrast, Portugal is characterized by a wider range of instruments in the field of nature conservation. Despite these differences, we can systematize some key ideas about the integration of the principles of connectivity and multifunctionality in France and Portugal.

The recognition of the importance of ecological connectivity is clearly explicit on the analyzed policies and tools. We can even state that the establishment or the maintenance of ecological connectivity is currently one of the main goals of nature conservation policies in France and Portugal. The French “Trame Verte et Bleue” is expected to be a key planning tool to limit biodiversity loss throughout the creation of protected areas and ecological networks. The protection of core natural areas and the promotion of ecological connectivity are defined as the main strategies to combat biodiversity loss. It is applied over different spatial scales, namely the regional and municipal scales. The Portuguese "Reserva Ecológica Nacional" is also addressed as a primary tool to establish the connectivity between the national protected areas under the national strategy to combat biodiversity loss, and is also applied over different spatial scales. Both the tools follow the general trend of moving from isolation to connection and from a concentric to a peripheral approach (Jongman and Pungetti 2004). The challenge is to maintain consistency between national guidelines and priorities and the definition of the "Trame Verte" or the "Reserva Ecológica Nacional" at the regional and local levels.

The integration of the principle of multifunctionality is not directly made explicit on the analyzed policies and tools. In fact, we identify a remarkable supremacy of the ecological dimension over the other services provided by green structures. It is just at the local scale that the larger scope of the planning tools opens the way to the presence of the multifunctionality principle. The aims of Portuguese the "Estrutura Ecológica Municipal" (Municipal Ecological Structure) and the implementation of the "trame verte" at the local level provide a wide range of interpretations to answer to a need of adaptation to specific territorial contexts.

In fact, if at the national scale the "trames vertes" are essentially interpreted in an ecological perspective, at local scale planners should take into account the concept in a more broadly way. The example of Angers Metropole shows the integration of multifunctionality at the metropolitan scale. The "trame verte" vision is inscribed in three dimentions at the metropolitan planning document (1996): a landscape dimension with the preservation of landscape identity; an urban dimension with regulation of urban sprawl; and a recreational dimension with the aim to create recreational open spaces. The integration of the "trame verte" in dense urban areas is done by public urban spaces: core areas are comprised by parks and green spaces, and continuity is held by tree-lines along driveways. This continuity reflects more landscape issues than environmental issues. But since 2010, the new metropolitan urban plan integrates the "trame verte" concept with an ecological perspective. This focal change is due to debates generated by the Grenelle Environment Forum. However the document uses another term, "armature verte", expressing the idea of green infrastructure. By using a distinct vocabulary than "trame verte", which is now strongly linked to planning dispositions, it allows a wide range of interpretation for planners, particularly in terms of mobilized resources, management disposition, and affected areas. Thus, multifunctionality is ensured in a more effective way by this kind of semantic variation of "trame verte".

Metropolitan urban plan (1996)



Metropolitan urban plan (2010)

The Porto Master Plan (2006), which is currently in force, reflects the recent regulations for the delimitation of a Municipal Ecological Structure in the master plans. We can argue that the principle of multifunctionality is partially incorporated by the diversification of the comprised green areas categories: in addition to the traditionally valued public parks, other categories were defined, like agricultural or forested structures, private green areas or green areas along transport corridors. On the other hand, we can point out an attempt of incorporation of the connectivity principles. The plan introduces linear spaces in order to establish the connectivity between the main green areas. However, connectivity is only artificially assured along transport corridors, specifically, straight green corridors related to the high-speed roads that cross the city.

There is thus a mismatch between the general legal frameworks focused on ecological issues and the local applications focused primarily on recreation and aesthetics issues. Despite recent efforts to introduce ecological approaches, namely the principle of connectivity, there remains the difficulty to apply at local scale the ecological principles that have been primarily developed and applied to broader scales (Cormier *et al*., 2010).

The effective implementation of the principles of multifunctionality and connectivity needs therefore to be supported by local assessments that inform about the relevance and the effectiveness of these principles in specific local contexts.

6/ Discussion and conclusion

The concepts of multifunctionality and connectivity are recognized as being closely related to the notion of green infrastructure. They aim is to go beyond the logic of territorial fragmentation between public and private spaces and to incorporate a broader thinking about open spaces. In addition, these two concepts allow recognizing the environmental issues at the same level of the economic, housing or travel issues that have traditionally prevailed in territorial planning. Open spaces should not be only protected by its individual exceptional value, but for their ability to ensure the resilience of all the system.

In this regard, open spaces become common goods, so that the functions and services that they deliver must be useful for human society. This paradigm shift is the evidence of an evolution taking into account the valorization of the environmental issues in the urban production processes. However, many problems emerge in the local application of the concepts of multifunctionality and connectivity.

In spite of being widely recognized as a key concept of green infrastructures, its local application stills imprecise. Physical connectivity tends to supplant functional connectivity. The necessary simplification of the ecological model in order of its integration into spatial planning frameworks, has tended to reduce it to one schema patch/corridor. Linearity gradually became the only issue of the national and regional green infrastructure policies. Given the local constraints (urban structure, private space / public space) this linearity is justified with difficulty by the famous "Japanese steps". Functional connectivity then resurfaced timidly, while it should be the center of attention. If researchers in ecology have demonstrated the importance of connectivity for ecosystems preservation, the ambiguity lies in the impossibility to define a single continuity for all biodiversity (as in an urban plan). Each species has its own system of dissemination, which theoretically should match a suitable ecological continuity.

In addition, in both Portuguese and French study cases, the legal framework states regulatory tools for local green infrastructure implementation. That regulatory tools involves mapping, define limits. But the integration of multifunctionality requires some flexibility regarding the issues where limits are specific to each function. So we may ask about the usefulness of regulatory tools in the integration of multifunctionality principle in urban contexts. Should we not consider the project as a pertinent way to integrate multifunctionality on green infrastructures? The project doesn’t fit its objectives within strict limits, but promotes both the mobilization of various tools (management, contractual, regulatory, sensibilization) and the co-production of territories.

Finally, ecological connectivity leads us to consider biodiversity as a flow of living beings dependent on each other, and both their sum and their interactions contribute to defining functional biodiversity. Biodiversity, as a scientific and mediatized concept, becomes a "common natural resource" in the sense given by Elinor Ostrom (Nobel Prize in economics / 2009) (2010). Therefore she argues for a public goods management. The common interest becomes a collective interest, co-constructed, contextualized and dependent of the scales and arenas in which decision-making or actions are developed.

Collective interest leads us necessarily to think the multifunctionality of places, to integrate the various functions and actors operating on the territory. Implementation of governance processes becomes a key issue regarding green infrastructure implementation. In addition, the role of inhabitants and residents' associations is based on a growing claim of territory appropriation, namely territories with environmental values. So this patrimonialisation of nature, including the green infrastructures, contributes to strengthening the link between societies and their territories.

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Incorporating Wildlife Conservation within Local Land Use Planning and Zoning: Ability of Circuitscape to Model Conservation Corridors

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Introduction

Allocation of our world's natural resources will become increasingly important as the human population continues to grow. Apportionment is especially imperative when considering the health of wildlife populations' worldwide (Svoray, Bar, & Bannet, 2005; Theobald, Hobbs, Bearly, Zack, Shenk, & Riebsame, 2000). Efforts to provide basic infrastructure, housing, and food for a growing human population confounds the ability of wildlife to meet their own needs (Lagabrielle, Botta, Dare, David, Aubert, & Fabricius, 2010; Svoray et al., 2005). Previous research indicates that human conversion of native habitat is the leading threat to wildlife in the United States and throughout the world (Lagabrielle et al., 2010; Miller, Groom, Hess, Steelman, Stokes, Thompson, Bowman, Fricke, King, & Marquardt, 2009; Polasky, Nelson, Lonsdorf, Fackler, & Starfield, 2005; Stokes, Hanson, Oaks, Straub, & Ponio, 2009). Habitat conversion of the native landscape often results in the fragmentation of the landscape mosaic, severing the connection between habitat patches used by wildlife and populations of wildlife (Beir & Noss, 1998). Connectivity is crucial to wildlife for several reasons including dispersal, gene flow, and population persistence among other reasons (McRae, Dickson, Keitt, & Sirah, 2008).

Conservation planning seldom occurs at local levels (i.e. municipal, county) rather it is often a product of national, state, or regional decision-making (Press, Doak, & Steinberg, 1996). The government levels at which the majority of wildlife management transpires is rarely the level at which habitat conversion takes place, the local level (Azzerad & Nilon, 2006). Increasingly scientists, ecologists, planners, and community members have been converging to incorporate wildlife and other ecological information into local land-use planning and decision-making (Theobald et al., 2000). Their ability to achieve this goal has evolved with the advancement of technology, specifically habitat models and geographic information system (GIS) (Roloff, Donovan, Linden, & Strong, 2009).

This paper is a chapter within the context of a broader problem – loss of biodiversity worldwide, and its goal is to provide a summation of previous work centered on incorporating wildlife planning and subsequent ecological data within the framework of local land-use planning. In it, a review of current literature is summarized. In addition, 'Circuitscape,' a new and increasingly accepted corridor identification model is also examined. The primary objective of it is to provide techniques, tools, and processes by which planners and developers can attain wildlife conservation data in a format and scale deemed both meaningful and helpful.

Overview of Previous Work

Prior work concerning the integration of conservation and ecological data within land-use planning frameworks revealed a variety of processes, tools, and models by which this assimilation can be accomplished (Azerrad & Nilon, 2006; Darr, Dawson, & Robbins, 1998; Lagabrielle et al., 2010; Lopez, Hays, Wagner, Locke, McCleery, & Silvy, 2006; Miller et al., 2009; Newburn, Reed, Berck, & Merenlender, 2005; Pierce, Cowling, Knight, Lombard, Rouget, & Wolf, 2005; Press et al., 1996; Stokes et al., 2009; Svoray et al., 2005; Theobald et al., 2000;

Underwood, Francis, & Gerber, 2011). The majority of literature on this issue appeared in the 2000's. The reasons are unknown for the inundation of papers on this subject; however, two are conceivable: (a) previous work was inspired by a change in cultural ideology or (b) advancements in specific technology at this point.

Literature on the subject revealed three common premises by which researchers attempted to integrate ecological data within land-use planning frameworks: (1) process and model based approaches, (2) planning-based approaches, and (3) conservation tools and programs. While three primary themes were identified in the literature, it was not so easy to place all selected papers into a single category or for that matter within any of the three categories above. Two papers in particular (Miller et al., 2009; Stokes et al., 2009) were the results of two independent studies which conducted surveys on the topic of conservation and land-use planning. Yet another by Polasky et al. (2005) focused on the economics of conservation efforts.

Process and Model Based Approaches

Three primary processes were found in the literature by which planners and ecologists introduced ecological data into existing land-use planning structures. Fundamental to all three were collaborative planning and participatory processes (Lagabrielle et al., 2010; Pierce et al., 2005; Theobald et al., 2000). The System for Conservation Planning (SCoP) developed by Theobald et al. (2000) strongly emphasizes collaborative design and produced end products such as wildlife diversity, habitat, and connectivity maps which were made accessible to the community via the Internet. Lagabrielle et al. (2010) also used a participatory process in which participant input was used to build land-use scenarios which were then entered into a model named MARXAN which measured the conservation benefit of each land-use scenario. Interestingly, while the maps MARXAN produced were generally approved of, the model itself was primarily detested because of its complexity and further limited by its lack of an implementation plan. A third process led by Pierce et al. (2005) used the systematic conservation planning process originally created by Margules and Pressey (2000) as the basis for their approach and expanded upon it by finding ways to implement their resulting products into land-use planning frameworks. They included a Mapbook and Handbook which were designed to be used in synchrony by planners to inform future land-use decisions. Similar to Theobald et al. (2000), Pierce et al. (2005) also made their products available to planners over the Internet. Responses from planners using this system were favorable but this process still needs improvement, especially in identifying areas more suitable for development. In contrast to process-based approaches, Svoray et al. (2005) developed a model referred to as the Habitat Heterogeneity Model which uses habitat heterogeneity to inform biodiversity conservation efforts. Maps produced from this model were made available to planners who could then determine areas which needed protected and those locations suitable to future development.

Planning-based Approaches

On the topic of incorporating ecological data with land-use planning frameworks, a majority of papers were comprised of planning-based approaches. These approaches ranged from the use of Smart Growth Planning to amendments of existing land-use ordinances and direct acquisition of land by local governments for conservation purposes. Another approach even explored the potential for wildlife students to serve as conservation planning consultants to private landowners under the supervision of professional wildlife experts.

Smart Growth Planning is a form of development in which developers seek to provide necessary infrastructure while maintaining and preserving ecological features in the landscape (Underwood et al., 2011). Many developers using this design approach would often like to include more ecological data within their plans, but are often limited by those data which are available or lack thereof. Consequently, Underwood et al. (2011) created a flexible framework by which species threats and richness could be modeled, and by which planners could delineate areas for both conservation efforts and development.

Two process-based approaches identified in our review required greater involvement by local governments in conservation affairs. Research by Darr et al. (1998) involved amending an existing conservation tree ordinance in order to preserve large contiguous tracts of forest for the benefit of vulnerable species of birds. As part of their planning approach they created what they referred to as a "forest banking account" which was used to maintain connectivity between habitat patches above a minimum amount of land designated to preserve the forest's patch connectivity. Alternatively, Press et al. (1996) propose that direct acquisition of land by local governments for conservation is favorable, especially in the case of rare and endangered species because: (a) many of these species occur on small pieces of land which are more economically feasible for local governments to purchase and manage, (b) many endangered species are associated with specialized habitat that typically only represent a small percentage of the total landscape and (c) once such land has been acquired it is no longer threatened by development or the changing political views of the time.

Conservation planning consultation led students specializing in wildlife at institutions of higher learning was cited by both Lopez et al. (2006) and Stokes et al. (2009) as a way to help local landowners implement wildlife management plans. Lopez et al. (2006) provide a case study in which students and faculty from a state university along with state wildlife biologists partnered together to give students the opportunity to help local landowners create active management plans for their land to receive tax credit. The project proved to be of benefit to both local landowners and students who participated.

Conservation Tools and Programs

A variety of conservation tools and incentive-based programs exist to help advance conservation efforts. Incentive-based programs have increased in recent years as people began to realize the critical role private lands play in conservation endeavors. Yet in a review of protected area planning literature it was found that few programs had specific approaches for promoting such opportunities (Newburn et al. (2005). Likewise, results from a survey conducted by Miller et al. (2009) found that while many planning departments had access to conservation planning tools, few actually employed the use of such tools. Conservation tools and programs found in the literature include growth management programs (Azerrad et al., 2006; Miller et al., 2009), performance zoning (Miller et al., 2009), cluster zoning (Miller et al., 2009; Stokes et al., 2009), incentive zoning (Stokes et al., 2009), planned unit developments (Stokes et al., 2009), conservation easements (Newburn et al., 2005; Press et al. 1996), short-term management plans (Newburn et al., 2005), transferable development rights (Press et al., 1996; Stokes et al., 2009), and purchased development rights (Press et al., 1996). Other potential tools include state wildlife agency publications such as Washington State's Priority Habitat and Species (PHS) guidelines which provide information on the state's wildlife and critical habitats to aid planners in land-use planning decisions. In addition to such guidelines, the creation of newsletters and publications providing information on new articles and case studies related to conservation efforts could greatly aid planners in the decision-making ring (Azerrad et al., 2006).

Socio-economic Literature on Wildlife Conservation

Additional literature on the topic was discovered in the form of economic information and survey responses. Within the U.S. a majority of lands fall under private ownership and economics are a large determinant in conservation efforts. Contrary to customary thought, Polasky et al. (2005) reveal that in the majority of cases, careful selection of economic activities that align with species conservation can result in minimal effect on economic returns. This is good news in light of results from two independent studies which surveyed local planners and revealed that the greatest inhibitor to conservation at the local scale was funding (Miller et al., 2009; Stokes et al., 2009). With this knowledge it is conceivable that through thoughtful land-use planning and decision making, greater conservation objectives could be achieved while lessening the amount of funding needed to achieve conservation targets. Research by Polasky et al. (2005) reaffirms the importance of working with private landowners to achieve conservation objectives. Stokes et al. (2009) suggest that further support of conservation by local community members could be garnered through identifying benefits to people which are derived through conservation. Moreover, while state and federal mandates were acknowledged by local planners to have significant influence on a local jurisdiction's participation in conservation efforts, so were community values. A jurisdiction's participation in conservation activities was also found to be influenced by the composition of its staff as those jurisdictions with a conservation expert in the planning office were more likely to be involved in conservation efforts (Miller et al., 2009; Stokes et al., 2009).

Synopsis of Existing Literature

In summary, previous studies provided a range of methods and processes by which conservation data and subsequent ecological data can be included within land-use planning frameworks. Yet, few studies provide a holistic approach to accomplishing such a fusion. Furthermore, very little monitoring has occurred to evaluate the successes and limitations of each of these methods, processes, and tools. Further work needs to fill this gap to help determine the best methods by which planners and developers can plan for wildlife at the local level. In addition, new methods and processes need to be documented for the benefit of both the scientific and planning communities.

Data and Tools for Analysis

Connectivity between habitat patches and wildlife populations plays an integral role in the conservation efforts of wildlife species. Linkage allows for gene flow between populations and dispersal of individuals from one habitat patch or population to another for the purpose of finding mates, food, or establishing territories (Beier & Loe, 1992; McRae et al., 2008). While a few of the previously mentioned papers addressed connectivity in their research, none focused on it exclusively. Connectivity maps alone will not provide any standalone solution by which integration between conservation and land-use planning can occur, yet no solution would be complete without information regarding it. Any process used to integrate conservation data within land-use planning frameworks will require a variety of means to ensure a scientifically valid, user-friendly integration solution. With this in mind, we have elected to experiment with

Circuitscape, a corridor identification model which represents one possible solution to modeling connectivity for wildlife.

Circuitscape was released in 2008 and is based on principles used in electronic circuit theory. It has been used in previous research to model gene flow in both plants and animals in diverse landscapes (McRae, 2007). Similar to least-cost path models, it takes into account all feasible travel paths and their outcomes concurrently. Furthermore, Circuitscape is a flexible model that can be used at a variety of scales, but creators, Brad McRae and Viral Shah, encourage users to operate it at a scale in which "bottlenecks" inhibiting passage are visible. The term "bottlenecks" refers to elements such as roads and development (McRae et al., 2008).

This software was adopted to this research project due to its easiness, knowledge embedded in it and general acceptance by the community for wildlife preservation. Circuitscape presented a great potential to experiment with as it appeared fresh, user-friendly, required only minimal input data and was encouraged for use at the same scale as conservation land-use planning projects. It also provided the researchers with an ability to explore a holistic process by which we could incorporate conservation data within land-use planning frameworks. Because of the shortened time to identify potential connectivity, we were able to devote our effort to a literature review on the topic as appeared above and explore the issue of wildlife habitat linkage in depth. To reiterate, linkage is a critical component within wildlife conservation efforts.

Methods

Our project took place in Latah County, Idaho, located at the base of the Idaho panhandle. Latah County is primarily associated as being part of the Palouse Prairie (Latah County, 2007a), but it is also covered in large part by coniferous forest (Muir, 2006). The county itself has seen a small but steady increase in population over the last decade, and the largest economic drivers are agriculture and forestry (Latah County, 2007b; United States Census Bureau, 2013). The county has also been identified by Idaho Department of Fish & Game (IDFG) as being home to several species of greatest conservation need in the state comprehensive wildlife conservation strategy (CWCS).

The objective of the CWCS is to identify both species of greatest conservation need and habitats critical to their survival with the intent to minimize future listings under the federal Endangered Species Act. The CWCS Action Plan and Focal Areas Guide help give precedence to particular conservation actions at the local scale (Idaho Department of Fish & Game, 2013a). IDFG claim that this guide is beneficial for several reasons including helping parties interested in conservation make educated decisions, and promoting pro-active, cost-effective conservation measures.

The CWCS process revealed that a large portion of Latah County was identified as having three unique focal areas with an emphasis on resources, management, or both. Resource focal areas are those areas deemed essential for the continuation of a particular species and their habitats, while management focal areas are areas that can benefit a majority of species and habitats of greatest conservation need (Idaho Department of Fish & Game, 2013b).

Based on the CWCS, a prototypical township, T40N R4W, was selected to test the ability of Circuitscape for the identification of critical habitat and conservation corridors. The township includes typical land uses in the county, i.e., agriculture and forestry. It also presents land use features and patterns very common across the U.S. and around the world, namely urban and suburban expansion into rural landscapes. Figure 1 shows the location of our study area within the county.

Figure 2 Location of study - township T40N R4W, Latah County, Idaho, USA.

The prototypical township encompasses the majority of Moscow Mountain and lies approximately 6.4 kilometers to the northeast of the city of Moscow, Idaho at its southwest corner. The Palouse Prairie extends only faintly into the selected township as it serves as a transitory zone between the Palouse Prairie and the tips of the Clearwater Mountains. Elevations in the township range from 798.27 to 1521.6 meters. Agriculture and scattered development dominate the southern foothills of the township, while primarily coniferous forests compose the rest of it.

The township contains two of the three CWCS focal areas located in Latah County. First, Palouse R2, identified by the CWCS as a management focal area, has cultural significance for the Nez Perce tribe and lists several plants, animals and a landscape in need of conservation efforts. Among them is the Palouse Prairie, of which it is estimated that less than 1% of native prairie remains. The second focal area, Potlatch River, is deemed significant from a resource and management standpoint. It again has cultural significance for the Nez Perce tribe and lists several habitats and species in need of conservation efforts (Idaho Department of Fish & Game, 2013c).

To examine the applicability of Circuitscape, a common species, the moose (*Alces alces*) was selected. It is found in both focal areas mentioned above. Both focal area listings state that winter habitat is considered critical for moose within their boundaries (Idaho Department of Fish & Game, 2013c). In Idaho, moose are considered both an iconic and desirable game animal. A recent report on moose in Idaho found that hunters consider moose to be one of the most sought after trophy species in the state (Toweill, 2008).

Circuitscape requires two types of input data in the raster format; (a) a habitat map and (b) a focal area map. It also requires the same spatial extent and grid-cell size for the two. First, habitat maps display the ability of each cell in the landscape to carry current and are coded in either resistance or conductance. "Current" in this sense serves as a metaphor for the landscape's level of penetrability as seen by a particular animal. In habitat maps coded for resistance, higher cell values equate to those areas seen by animals as more hostile, less favored, or difficult to cross. For example, the cells with higher values may represent areas of development or habitat patches not utilized by a particular animal. Higher values associated with conductance maps indicate those areas of the landscape which are seen as more favorable or preferred by an animal. Therefore, resistance and conductance are simply the inverse of each other. Second, "Focal

Area" maps are comprised of focal nodes or regions and represent areas such as habitat patches or critical areas used or needed by an animal (McRae et al., 2008).

To create our habitat and focal area maps for use within Circuitscape, a specific literature review was conducted on habitat preferences for moose during the winter months as summarized in Table 1. In addition, the following data sets were obtained to construct our habitat and focal area maps: land cover, land use, roads, surface water sources, and a digital elevation model from which slopes, aspects, and elevation levels were calculated, as summarized in Table 2. Using Arc GIS Version 10.x (ESRI, 2011), these data sets were each re-classified into several categories and coded for their resistance. The resistance values ranged from 100-500, with 100 representing the lowest level of resistance to an animal and 500 representing the highest level or resistance to an animal. Table 3 lists the preference characteristics, their categories, and the resistance values used to construct the habitat map. As required by Circuitscape, spatial extent and grid-cell size were set consistently for all data layers. Consequently, the Raster Calculator tool was used to overlay all the layers together to create a cumulative or composite map, which shows a gradient of values representing areas of lesser or greater impedance to animals. It led us to select two areas of least impedance to serve as focal areas and was done by creating a new layer and manually creating polygons over those areas of least impedance.

Preference Variable/Factor	Supporting Literature
Dense Cover	Dussault, Courtois, & Ouellet, 2006 Phillips, Berg, & Siniff, 1973 Pierce & Peek, 1984 Poole & Stuart-Smith, 2006
Forage Availability	Dussault, Courtois, & Ouellet, 2006 Dussault, Courtois, Ouellet, & Girard, 2005 Pierce & Peek, 1984 Poole & Stuart-Smith, 2006
Interspersion of Food & Cover	Dussault, Courtois, & Ouellet, 2006 Dussault, Courtois, Ouellet, & Girard, 2005
Snow Constraint	Dussault, Courtois, & Ouellet, 2006 Dussault, Courtois, Ouellet, & Girard, 2005 Poole & Stuart-Smith, 2006
Distance to Geographic Features	Dussault, Courtois, & Ouellet, 2006 Poole & Stuart-Smith, 2006
Lower Elevations	Pierce & Peek, 1984 Poole & Stuart-Smith, 2006
Slope	Poole & Stuart-Smith, 2006
Solar Aspect (Southerly & Westerly Slopes)	Poole & Stuart-Smith, 2006

Table 1. Moose winter habitat preferences as identified by previous literature.

Title	Originator	Publisher	Publication Place	Publication Date
National Elevation Dataset for Idaho (1/3 arc second, 10-meter)	U.S. Geological Survey (USGS), EROS Data Center	U.S. Geological Survey	Sioux Falls, SD	1999
Land Use Map	Batha	Batha	Moscow, ID	2012
National Land Cover Database 2001 – Land Cover of Idaho (source NLCD 2001)	Idaho Department of Water Resources (IDWR) (source NLCD 2001)	Idaho Department of Water Resources	Boise, ID	2007
Idaho 1999 Average Annual Daily Traffic	ITD PLANNING DIVISION	Idaho Transportation Department (ITD)	ITD HQ Boise, ID	2008
Streams of Idaho (303(d) Impaired – 1998)	Idaho Department of Environmental Quality	Idaho Department of Environmental Quality	Boise, ID	2002

Table 2. Datasets used in the construction of project's habitat and focal area maps.

Habitat Preference Characteristic	Resistance Value (higher values = higher resistance)
Land Cover	
Evergreen Forest	100
Shrubland/Scrub	300
Deciduous Forest	300
Wetlands - Woody & Herbaceous	400
Grassland/Herbaceous	500
Crops	500
Developed	500
Slope	
<u><</u>10%	100
<u>></u>30%	250
<u><</u>90%	500
Aspect	
South	100
West	250
East	250
North	500
Elevation	
$\leq$914.4 meters	100
$\leq$1219.2 meters	250
$\geq$1524.0 meters	500
Land Use	
Minimal (Forestland, Recreational, Meadow)	100
Intermediate (Grazing and Mining)	250
High Obstruction (Agricultural Land, Residential, Commercial, Industrial)	500
Distance to Road	
0.40 km	250
0.80 km	500
Distance to Stream	
0.80 km	100
1.60 km	200
3.21 km	300
6.43 km	400
9.65 km	500

Table 3. moose winter habitat preferences with re-classified categories and resistance values.

Preference Variable/Factor	Supporting Literature
Forage Availability in Open, Seral Habitats	Dussault, Courtois, Ouellet, & Girard, 2005 Muir, 2006 Peek, Urich, & Mackie, 1976 Phillips, Berge, Siniff, 1973 Pierce & Peek, 1984
Mature Cover for Shade & Concealment	Dussault, Courtois, & Ouellet, 2006 Muir, 2006 Pierce & Peek, 1984
Higher Elevations	Muir, 2006 Pierce & Peek, 1984
Cooler Aspects (Easterly Slopes)	Muir, 2006
Avoidance of Human Settlement	Muir, 2006
Closer Proximity to Water	Muir, 2006
Closer Proximity to Secondary Roads	Muir, 2006

Table 4. Moose summer habitat preferences as identified by previous literature.

Habitat Preference Characteristic	Resistance Value (higher values = higher resistance)
Land Cover	
Evergreen Forest	100
Shrubland/Scrub	100
Deciduous Forest	100
Wetlands - Woody & Herbaceous	200
Grassland/Herbaceous	200
Crops	400
Developed	500
Slope	
≤10%	100
≥30%	250
≤90%	500
Aspect	
East	100
West	250
East	250
North	500
Elevation	
≥1524.0 meters	100
≤1219.2 meters	250
<9.14.4 meters	500
Land Use	
Minimal (Forestland, Recreational, Meadow)	100
Intermediate (Grazing and Mining)	250
High Obstruction (Agricultural Land, Residential, Commercial, Industrial)	500
Distance to Road	
0.40 km	250
0.80 km	500
Distance to Stream	
0.80 km	100
1.60 km	200
3.21 km	300
6.43 km	400
9.65 km	500

Table 5. Moose summer habitat preferences with re-classified categories and resistance values.

Next, the GRIDASCII tool in Arc GIS was used to convert the two layers, the habitat and focal area maps, for input to Circuitscape. In the software menu, two options were chosen: (a) the pairwise iteration mode, which compares connectivity between focal node pairs, and (b) a cell connection of four neighbors. With the selection of all input requirements, the Circuitscape model was executed finally.

To help evaluate the model, we obtained the VHF location data of moose collected from a 2004-2005 wildlife study conducted in the same geographic area as our study. However, the data set was not collected during the winter months and only included locations of moose from the months of May to September (Muir, 2006). Consequently, another literature review revealed general moose habitat preferences in the summer months, as summarized in Table 4. This review enabled us to generate new habitat map and focal area maps for summer using the same procedure as the winter season as outlined previously. Table 5 lists the preference characteristics, their categories, and the resistance values used to construct the habitat map. Again, with all required layers converted to the ASCII format, Circuitscape was executed for the summer habitat maintaining all options as were used in the winter habitat evaluation.

Results

In both seasonal scenarios, the final cumulative habitat maps revealed distinct areas with minimal resistance. The winter habitat map depicts two distinct areas of least resistance, while the summer habitat map shows a total of three areas which were then used as the basis for our focal area maps. The winter map displayed a noticeable but not entirely distinctive path by which movement could occur between the focal areas. Figure 2 displays the connective strength of the winter data inputted to Circuitscape. The strength of the connection becomes most faint between the two locations, but the results indicate that a moderate amount of energy exists by which connectivity can be maintained. Alternatively, Circuitscape's summer

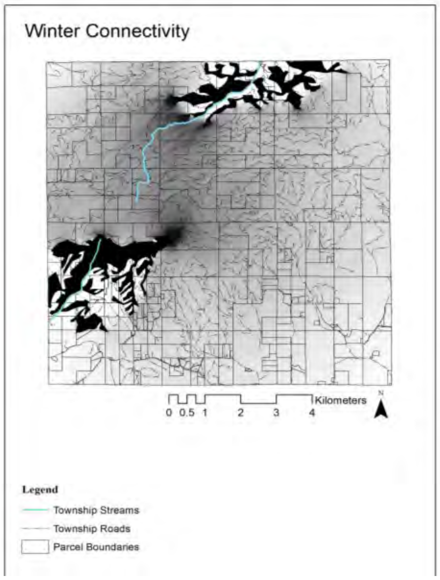

Figure 4. Predicted strength of connectivity between township's winter focal areas. Darker areas denote focal areas and a stronger connection. All layers projected as NAD 83 Zone 11N.

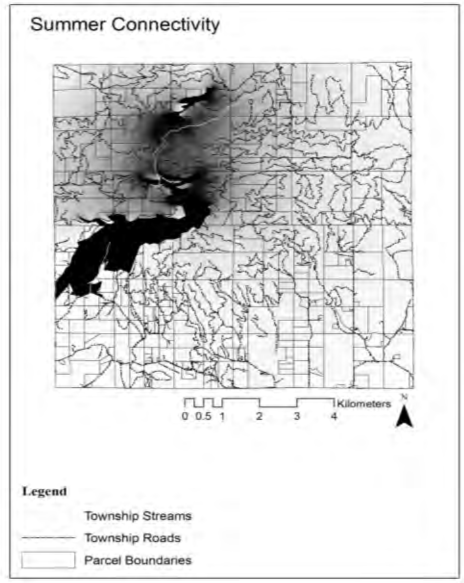

Figure 3. Predicted strength of summer connectivity between township's focal areas. Darker areas denote focal areas and a stronger connection. All layers projected as NAD 83 Zone 11N.

output map denoted a markedly strong connection between focal areas, as shown in Figure 3. It also exhibits an extremely strong, unbroken connection between focal areas, and seems to coincide in large part with the presence of the creek in this area.

As part of our validation of Circuitscape, we compared VHF location data on moose in this area against Circuitscape's summer current map, as shown in Figure 4. Comparison of the two revealed that while some of the moose locations occurred within the focal areas and strongest predicted connections, the majority of locations were distributed to the south and east of those locations they were predicted to occur. However, closer inspection of the data revealed that while the final output map by Circuitscape seemed to produce mediocre results, the habitat map used in its computation performed outstandingly. Close scrutiny of the habitat map and moose locations revealed that a majority of the sightings were located in those areas predicted by our habitat map to be of least resistance otherwise or those areas preferred by moose.

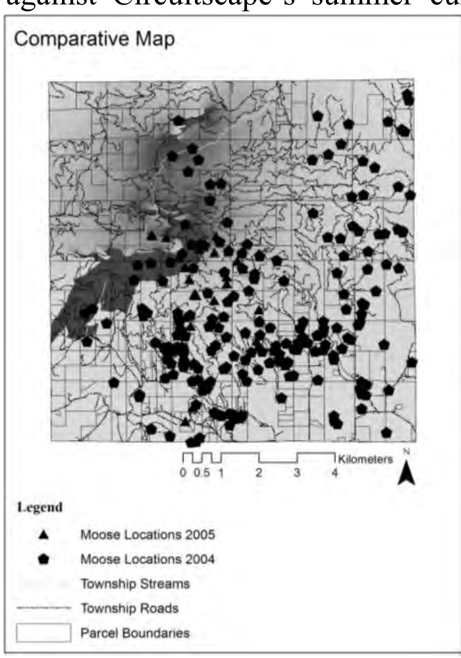

Figure 5. Comparative map of summer output map produced by Circuitscape and VHF location data of moose. All layers projected as NAD 83 Zone 11N.

Discussion

Our findings indicate that Circuitscape should not be the only tool used in the analysis and integration of conservation data into local land-use planning frameworks, although it is very useful. While the creation of habitat and focal area maps is relatively easy, it is highly recommended that those wishing to use this model consult with conservation experts regarding the criteria and variables of the model. Although previous literature by wildlife experts was referenced to construct maps for this study, an actual wildlife expert was not, thus limiting our predictive capabilities to some degree. As both our literature review and prototypical experiment reveal, a collaborative approach is necessary if true progress is to be made in the integration of conservation and local land-use planning.

Results from our modeling revealed three interesting points of discussion which are elaborated below: (a) the notable difference in the strength of connection between the seasonal connectivity maps, (b) the distribution of actual moose locations compared against those locations identified by Circuitscape, and (c) the support of our findings by Polasky et al. (2005).

First, we examined the difference in the strength of connection between Circuitscape's winter and summer linkage maps more closely. As previously noted, the winter season results displayed a faint but present connection between the two featured focal areas, whereas the summer season produced a markedly strong connection between the three featured focal areas. We hypothesize this difference in the strength of "current" exists because of assumptions previously made with the seasonal movement of this species. To elaborate, literature on this species habitat preferences and seasonal movements revealed that while moose are able to access a variety of habitats in the summer, they have limited accessibility in the winter due to the constraint of snow. Ultimately, this knowledge was applied to assigning resistance scores to the habitat variables and criteria used in the construction of our habitat maps which were then used in Circuitscape. We hypothesize that these greater restrictions on winter habitat criteria could have influenced the strength of the "current" in the winter linkage map to appear much weaker than that of the summer linkage map which had fewer resistances tied to its criteria.

Second, we analyzed more in depth Circuitscape's summer linkage map against the distribution of actual moose locations. Results from the summer linkage map by Circuitscape generate several thoughts. Though some of the reported sightings of moose occurred in locations identified as being part of focal areas and linkages, the majority of moose sightings were distributed outside of these areas. However, when the habitat map used in this scenario was inspected closely, it was revealed that a majority coincided with the locations of least resistance in the habitat map, which may otherwise be thought of as areas preferred by moose. These results invoke two thoughts, both related to scale. First, these results suggest that our focal areas in this situation were perhaps at a scale too coarse and that subsequent focal areas should encompass both smaller sizes and a larger number of locations. Second, these results placate the idea that while our broad landscape-level approach was successful in predicting critical linkages across a broader landscape, the locations observed by the VHF study (Muir, 2006) were actually just an example of habitat selection by moose at a finer scale. Previous work on this species and by experts in the wildlife profession supports the idea of multi-scale habitat selection by animals (Johnson, 1980; Muir, 2006). For example, moose must interpret their environment at several levels including the geographic range in which they chose to reside, the habitat patches they select to inhabit, and the plants upon which they choose to browse. Thus, the results from

Circuitscape in this scenario are not simply erroneous and are implying the importance of partnering with wildlife experts in to construct maps at an appropriate scale.

Finally, we conclude that our results further support work by Polasky et al. (2005) which provided that with careful selection of both economic activities and land-use decisions, conservation efforts can in most cases minimally affect economic returns. Our research supports this work as the majority of land in our prototypical township is owned by two timber companies which manage their land for the main purpose of timber harvest. In this particular situation, both their economic objective and conservation targets may be achieved as their land-use activities actually promote the type of habitats preferred by moose. While in this particular case such land-use activities help promote conservation efforts, it may not always be true for other species. Therefore, it is imperative that land-use planners and conservation experts work collaboratively to make the best decisions possible.

Conclusion

As previously noted, various literature indicates that our societies are trending towards a seamless cohesion between conservation planning and land-use planning. Yet gaps still exist in our efforts to create this seamless cohesion of conservation and land-use planning. Namely, encouraging the use of a variety of conservation tools and planning methods which are widely available but not utilized to their fullest extent (Miller et al., 2009; Stokes et al., 2009). Greater levels of refinement and monitoring of implementation methods also need to occur so that we can measure such methods level of effectiveness in integrating conservation data within existing land-use planning frameworks.

While our research was unable to conduct a holistic approach to integrating conservation data into existing land-use planning frameworks, we were able to focus our efforts on a comprehensive literature review of previous research conducted on the topic, and explore extensively the topic of linkage. In addition, our research provides a critical analysis of Circuitscape an increasingly popular corridor identification tool. While Circuitscape represents only one such tool by which linage can be analyzed, the concept of habitat linkage is imperative to any holistic conservation attempt. In conclusion, our research provides a valuable service to planners and conservation experts alike by providing them with techniques, tools, and processes by which they can attain wildlife conservation data in a format and scale both meaningful and helpful to their conservation endeavors.

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Scientific approaches for Designing Ecological Networks: a Case Study for the Faunal Species of Inland Wetlands of Lower Saxony, Germany

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Introduction

Several methods and tools have been developed to achieve the goals of nature conservation and for the design of ecological networks. In that sense, some frameworks proposed by several authors are applied to all levels of biodiversity conservation. One goal of the ecological networks is to represent and to promote the persistence of biodiversity within a region, however few efforts have concentrated the tools or methods useful to implement such frameworks. In several cases, the focus is on the quantitative area selection methods, others on the focal species approach or just on the species persistence and viability analysis. Nonetheless, when developing ecological networks at broad scales, concentrating the attention in just one of these approaches does not ensure that the most valuable areas for species conservation in wetlands or any other systems are selected. For this reason, the basic step to identify the useful tools to apply for achieving specific conservation goals is to have the scientific background to guide the conservation planning process. Some of the biggest problems to apply more than one of these approaches are the availability of data, the available resources, the financial support and time.

This study compares different approaches of conservation planning that guide the design of ecological networks and identifies different available methods used to support such a design. Moreover, applies different methods for the design of a network for the conservation of faunal species of in-land wetlands of Lower Saxony, following a systematic conservation planning framework. The goal is to concentrate and to compare different methodologies, and to identify its role in the conservation planning frameworks, as well as to identify the lack of information to achieve certain conservation goals in order to direct the future efforts in the collection of data and information of the region, and finally to point in the most urgent local studies.

Background and Literature Review

Throughout the world, scientific conservation planning frameworks have been developed. For example, Margules and Pressey (2000) proposed a framework based on the systematic conservation planning. As well, Groves et al. (2002) developed a framework for conservation planning in terrestrial, freshwater, and near-shore marine environments. Both frameworks have some similarities and can be comparable with the German Nature conservation criteria for the implementation of Article 3 of the Federal Nature Conservation Act on habitat connectivity, which concerns different spatial levels (inter)national, regional and local (Burkhardt et al., 2003; Burkhardt et al., 2004; BfN, 2004).

Because it is impossible to measure all of biodiversity, biodiversity surrogates have to be used. Examples are taxa sub-sets, species assemblages and environmental domains. An achievable goal is to represent at some agreed level, each of the biodiversity features chosen as surrogates (Margules et al., 2002). Selecting conservation areas in an *ad hoc* manner or selecting for the protection of a particular species generally results in the conservation of economically marginal land and unrepresentative reserve networks (Groves et al., 2002; Possingham et al., 2006).

Alternatively, information that is easily understood by policy makers and stakeholders have been introduced. An example is the BIO-SAFE model (a trans-national model), which constitutes an effort to integrate biological indicators with policy- and legislation based biodiversity indicators, i.e. threatened species. BIO-SAFE has been used as a tool for the assessment of impacts of physical reconstruction on biodiversity (De Nooij et al., 2001; De Nooij et al., 2004). As another alternative, many studies have chosen to use complementarity methods where certain species or other biodiversity surrogates are concerned. These have been proved as a more efficient approximation than only using hotspots (Williams et al., 1991).

Focal species identify additional high-value habitats and address the questions: What is the quality of the habitat? How much area is needed? And in what configuration should the components of a reserve network be designed?. Focal species (objective, target, umbrella, keystone, indicator, etc.) are organisms used in planning and managing nature reserves. They are used because their requirements for survival represent important factors to maintaining ecologically healthy conditions. Ultimately, questions about ecological patterns and process cannot be answered without reference to the species that live in a landscape (Foreman et al., 2000).

To promote persistence and the viability of species, a key concept in conservation planning is that of the metapopulation. Indices that may express characteristics of metapopulations with the feature of the landscape network are needed to assess wheter the spatial conditions of a network allow for persistent metapopulations (Verboom et al., 2001). This approach has been integrated into the LARCH model (Landscape Ecological Rules for the configuration of Habitat) (Chardon et al., 2000).

Study Area

Lower Saxony is located in the northwestern part of Germany, it stretches from the East Frisian Isles in the north Sea to the Harz mountains (971 m), the most northern chain of the central German low mountains. The wetlands in Lower Saxony, which are specially represented, are species-rich habitats for flora and fauna. However, as in Central and Western Europe, they have suffered a declination due to habitat fragmentation and other factors (Stähle et al., 1997; Chardon et al., 2000). Because of their declination, The State of Lower Saxony has recognized their protection as a main goal of the nature conservation efforts (Stähle et al., 1997).

Methods

After a literature review three conservation planning frameworks were compared and different methodologies were organized in each of their stages where they could be applied. The three first stages of the Conservation planning framework proposed by Margules and Pressey (2000) were used as a guide of the ecological network design, along with the application of the BIOSAFE Model (De Nooij et al., 2001 and 2004), the Focal Species Approach, the LARCH Model (Chardon et al., 2000) and the Gap Analysis (Possingham, et al., 2006).

Collection of Data Surrogates Selection and Mapping

*Selection of target species:*the term surrogates (Margules and Pressey, 2000) or target (Groves et al., 2002) are used here only to refer the consistent species data available for the design of networks on this study case. For convenience, only the term target will be used. The selection of the target species was defined through different criteria, including the exploration of the Species specific score and the Potential Biodiversity Assessment of the BIO-SAFE Model (De Nooij et al., 2001 and 2004). A total of 34 target species were selected: 19 Odonata, 11 Amphibia and 4 Mammalia. All of them corresponding to the species with the highest priority status of the Habitats Directive and/or the National and State Red lists (Table 1).

Table 1. The target species list (taxonomic group and species scientific name)

DRAGONFLIES AND DAMSELFLIES (ODONATA)	AMPHIBIANS
Coenagrion mercuriale	*Bombina bombina*
Ophiogomphus cecilia	*Bombina variegata*
Coenagrion ornatum	*Bufo viridis*
Aeshna viridis	*Triturus cristatus*
Gomphus flavipes	*Pelobates fuscus*
Leucorrhinia caudalis	*Hyla arborea*
Leucorrhinia albifrons	*Rana arvalis*
Leucorrhinia pectoralis	*Rana dalmatina*
Sympecma paedisca	*Rana lessonae*
Ceriagrion tenellum	*Alytes obstetricans*
Erytromma viridulum	*Bufo calamita*
Nehalennia speciosa	
Aeshna subartica	
Aeshna isosceles	**MAMMALS**
Gomphus vulgatissimus	*Castor fiber*
Cordulegaster bidentata	*Lutra lutra*
Somatochlora alpestris	*Myotis dasycneme*
Somatochlora arctica	*Myotis daubentonii*
Libellula fulva	

The digital processing of the target species distribution: a digital map containing all possible species presence records from 1980 to 2006 for each species was obtained. The maps were constructed from paper maps with a cell resolution of approximately 5 X 5 Km from different sources: public government data, books or scientific papers and digital maps and non-published paper maps of the Lower Saxony supplied by members of the department of Landscape Planning and Nature Conservation (Lipski and Reich, personal communication, 5, October, 2006).

*Defining planning units and habitat suitability maps:*a total of 73 biotopes and subtypes were selected with expert advise (Reich, personal comunication 10 june, 2006) from the total biotope types classification available for the State and used as surrogate planning units. The selection of the specific wetland biotope subtypes used for each species was based on literature review and assessed by Reich (personal communication, February, 2007) then a habitat suitability map for each species was elaborated.

Conservation goals

Two conservation goals for the study case were achieved: 1) The design of a wetland biotopes network with representative areas for the conservation of protected and focal species and 2) The proof of the persistence of species in such a network.

Review of existing areas

The selection of representative areas: the network of representative areas for the conservation of protected species was designed based on the Taxonomic group Biodiversity Saturation of the BIO-SAFE model (De Nooij et al., 2001 and 2004. Several concepts of the focal species (co-ocurrence of species, ecological profiles, and species with large area requirements, functional guilds, habitat quality indicator and key stone) were tested to obtain the best suite of species for the representation of both species and biotopes with four network scenarios. Finally the proposed biotopes network for the conservation of target species was obtained with the integration of both approaches (the representation of protected species and the scenario 3 of the focal species).

The viability analysis: the viability analysis of the wetland biotopes network was explored based on the LARCH Model (Chardon et al., 2000). The first step was to determine whether the resolution of the biotope maps was enough to assess the viability of the network. Because the biotope maps are not enough detailed to identify the biotope subtypes, it was decided to choose two specialist species of running waters (*Castor fiber* and *Ophiogomphus cecilia*) as study cases.

The analysis of gaps: a Gap Analysis (Possingham et al., 2006) was conducted to find the gaps of representation, two categories of the Protected Areas considered by the Nature Protection Law "Naturschutzrechtlich geschützte Gebiete" were used (the Biosphere Reserve and Protected Areas), as well as the Habitats Directive Areas and the Main protected areas according to the EU-Birds Habitats Directive (Niedersächsisches Umweltministerium, accesed on line 2007). All these areas were named Protected Areas in this study.

Results

The network of representative areas of in-land wetlands protected species covers an area of 463.75 km^2. The representation of these areas with respect to the surface of the State of Lower Saxony and the biotope types is resumed in Table 2, . All the species are represented by this network, except the odonata species *Somatochlora alpestris*.

Table 2. Area represented by the network of representative areas of in-land wetlands protected species, based on the Taxonomic group Biodiversity Saturation (TBS).

Different spatial levels:	Percentage cover by the representative areas of wetlands protected species
State of Lower Saxony	0.98
All the biotope types	9.11
The selected biotope types*	17.91
The selected biotope types with presence of target species	21.85

* It refers to the biotopes which contain wetland subtypes

With the results of the focal species approach, seven of the 34 target species were selected.Four scenarios were proposed: scenario1 with 5 species (*Castor fiber Pelobates fuscus, Hyla arborea, Leucorrhinia pectoralis* and *Ceriagrion tenellum*); scenario 2 adding one more species *Ophiogomphus Cecilia*; scenario 3 with the seven focal species, and scenario 4 only considering the species with the largest area requirements (*Lutra lutra*). Scenario 4 only represents 55.17% of the biotope types with target species presence (Figures 1 and 2). The results of this work revealed that the network of representative areas of protected species, are almost covered for the network designed considering seven focal species which represents all the target species and 38% of the good quality wetland subtypes of Lower Saxony. Table 3 compares the percentage of area necessary for each scenario and their representation in the different systems.

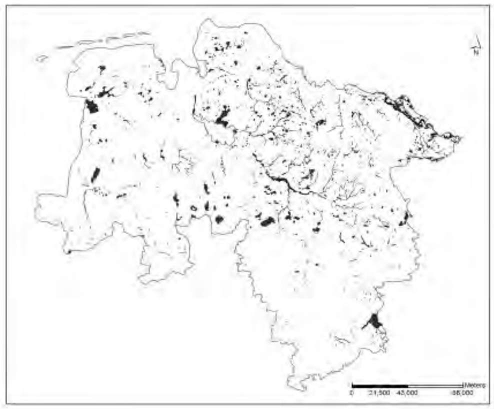

Figure 1. Scenario 3 (the seven focal species)

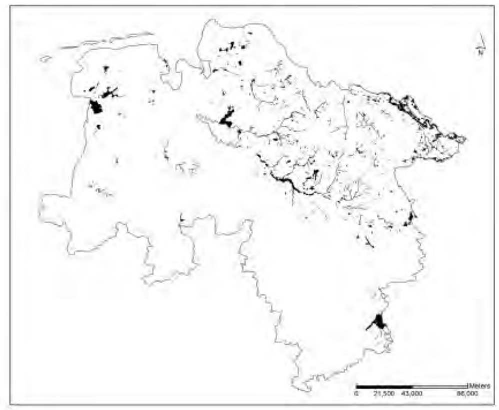

Figure 2. Scenario 4 (the focal species with the largest area requirements)

The final proposed biotopes network for the conservation of target in-land wetland species was designed with the integration of scenario 3 (the seven focal species) and the network of representative areas of in-land wetlands of protected species. When considering only the network of representative areas just the 17.91% of the selected biotope types that contain wetland subtypes is represented while the network of focal species confers more than double (46.36%).

Table 3. Comparative table of representative area per scenario and systems.

	Percentage of area per scenario with respect to different spatial levels:				**Species represented at least in one unit**	**Systems represented by the species**
	State of Lower Saxony	All the biotope types	The biotope types selected*	The biotope types with presence of the target species		
Scenario 1 (5 focal species)	1.66	15.52	30.51	50.59	32 species. *C. ornatum and S. alpestris* are not represented	All the systems
Scenario 2 (6 focal species)	1.78	16.56	32.55	58.98	32 species. *C. ornatum and S. alpestris* are not represented	All the systems
Scenario 3 (7 focal species)	**2.53**	**23.59**	**46.36**	**76.88**	**All the 34 species**	**All the systems**
Scenario 4 (The network of the species of largest area requirements)	**1.82**	**16.92**	**33.28**	**55.17**	**33 species. *Bombina variegata* is not represented**	**3 systems: Running and Standing Waters and Forest**
Proposed network for the conservation of faunal inland wetland species	**2.53**	**23.60**	**46.39**	**76.94**	**All the species**	**All the systems**

*It refers to the biotopes (ERKO) which contain wetland subtypes

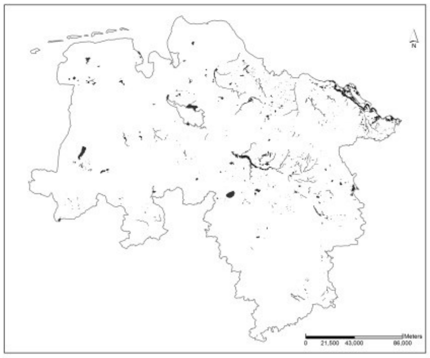

Figure 3. Biotopes network for the conservation of protected species

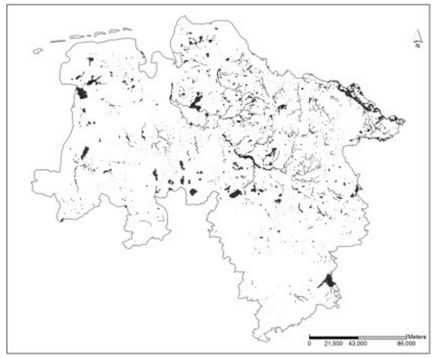

Figure 4. Proposed network for the conservation of faunal in-land wetland species

The resulted gaps of representation for the proposed final network are described in terms of percentage of area no included in the Protected Areas (Table 4). The Figure 5 shows the proposed biotopes network for the conservation of target in-land wetland species of the state of Lower Saxony, and the areas covered and not covered by the Protected Areas, also it is possible to observe how the proposal bring more cohesion to the in-land network of Protected Areas.

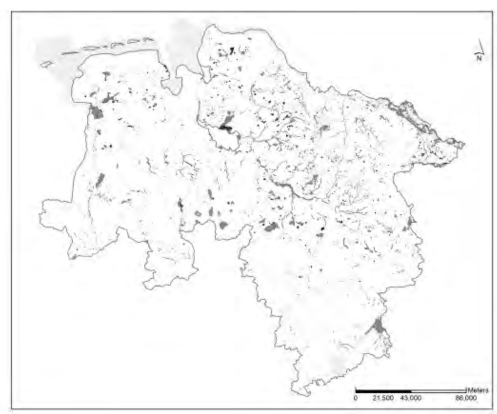

Figure 5. The analysis of gaps in the proposed biotopes network

- Protected Areas of the State of Lower Saxony
- Covered areas of the biotopes network
- Gaps (not covered areas)

Table 4. The analysis of gaps in the proposed biotopes network

Network	Covered area	Not covered area (gaps)
Proposed Biotopes Network for the conservation of target in-land wetland species	81.1 %	18.9%

Discussion

One of the main differences of the frameworks of Groves (et al., 2002) and Burkhardt (et al., 2003, 2004) and the systematic conservation planning of Margules and Pressey is that they specify and evaluate the ability of conservation targets to persist with a qualitative ranking system that employs criteria such as the following: size, condition and landscape context and each criteria is rated as “very good”, “good”, “fair” or “poor”. Both of them apply this evaluation before and after the implementation of the steps or criteria equivalents to the stage 3 of the Margules and Pressey (2000) framework.

The systematic conservation planning framework recommends some tools or theories for the implementation of stages 1 and 2. However, the specific methods to achieve the representation and persistence of the surrogates for achieving stage 3 (Review existing conservation areas) are not clearly specified.

The results of the viability analysis were only approximation exercises of the proposed method, in which an overestimation of the areas is expected, because the resolution of the species distribution maps is not detailed at a biotope subtype level. Thus a distribution unit can contain several biotope subtypes, including those in which the species is not distributed. The results obtained for both species accumulated overestimations of adding the biotope subtypes that are not used by the species, which is more evident for *Ophiogomphus cecilia*. These results suggest that for network viability analyses a better detail of the spatial data is necessary.

The selected target species of dragonflies and damselflies, amphibians and reptiles and mammals using wetlands in Lower Saxony were restricted to the most threatened species due to the digital availability of data. Despite the biotope types selected as surrogate planning units for the design of the network of representation do not cover the entire state of Lower Saxony, they correspond to the most valuable areas for nature conservation and are the most detailed available units. However, the spatial definition of the biotope subtypes would bring about better approximations.

Conclusions

The Systematic Conservation Planning Framework, in addition to other methods, is a useful guide to: assess networks of representation, carry out viability analysis of the networks, and to identify gaps. However, these results are only a scientific basis on the species approach, and should be integrated with the physical functions of ecological networks and the landscape planning process.

A network confers more protection to the target species when the focal species represent different levels of the habitat scale perception and when the species occur in different biotope subtypes and systems. Whereas a network designed only with species of larger area requirements is less effective to protect both species and biotope subtypes.

The co-occurrence of species and the persistence characteristics are complementary for the selection of focal species. While the habitat quality indicators or keystone species are only characteristics that support the selection of species.

There is a necessity of more detailed units to corroborate whether the focal species are persistent in the network of representation and to evaluate whether these species do really promote the persistence of other target species.

The main lacks of information identified to apply the methodologies are the following: a) the public unavailability of the digital presence records of species and the urban characteristics ("Landesraumordnungsprogramm"); b) the lack of data bases with the characteristics of the species distributed in Lower Saxony, and c) the no delimitation of the biotope subtypes.

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The Portuguese National Ecological Network - A mapping proposal

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Introduction

In Portugal, the Ecological Network (EN) was included in the Portuguese legal system in 1999 according to which it must be considered, delineated and implemented in all landscape plans at all spatial scales. Despite of all EU policies, in Portugal the EN is defined by the set of areas, values and key systems for environmental protection (article 14th of the Decree Law n. º 46/2009). Furthermore, at national level there is only the Program for National Planning Policy, which doesn't include any EN delimitation.

This paper presents a methodology for the delineation of the National Ecological Network (NEN) based on: a) the physical sub-system which refers to physical components and their interactions; b) biological sub-system composed by habitats and flora; c) the network concept which is based on the vertical and horizontal connection of structures and information within the ecological system (Jongman, 1995; Magalhães, 2001). Moreover, the main notion of EN is to link ecosystems into a spatially coherent system through which materials and organisms flow (Opdam et al., 2006), as reflected in the Landscape-System methodology (Magalhães et al., 2007).

The Portuguese ecological networks, at different scales, has been developed according with the theoretical research and actual field of studies carried out by the Landscape Architecture Research Centre (CEAP/ISA/TUL) since the beginning of the 90s, and is closely related to the ecological landscape planning methods and policies adopted in European countries. The CEAP/ISA/TUL is developing a research project, funded by the Foundation for Science and Technology's, aiming the proposal of a methodology for mapping and policies implementation for the NEN (Project reference: FCT-PTDC/AUR-URB/102578/2008).

The main goal of this paper is to present the NEN methodology as a component of the Landscape-System methodology (Magalhães et al., 2007) whose objectives are the maintenance, restoration or enhancement of nature conservation and biodiversity within a coherent system, safeguarding ecological and cultural values, complemented with potential multiple uses and respective evolution tendencies.

This study will focus on the NEN and will compare it with the regional and local case studies at scales 1/100.000 and 1/25.000 respectively.

Background and Literature Review

Ecological networks represent one of the most widely applied concepts in current approaches to nature conservation (Harfst et al, 2010). Nevertheless, about 82% of EU territory is falling outside the Natura 2000 network (EC/CIRCABC, 2012) and the natural habitats in many European cities are fragmented due to historical socio-economic and land use changing processes

(Jongman and Pungetti, 2004), including transportation infrastructure (ECNC, 2003; Forman et al., 2003; Tillmann, 2005). Consequently, landscape fragmentation (Jaeger *et al*., 2011) and homogeneity, due to dispersion of habitat patches and small size corridors ignoring the quality of the matrix (Forman, 1995), are important factors to consider in biophysical resources conservation, biodiversity and ecological continuity. Therefore, the need of creating green continuities became a reality since the 19th century with Olmsted, Arturo Soria and Mata's Linear City, and Ebenezer Howard's Garden City (Magalhães, 2001). However, park creation and nature conservation took place in what was left remnant or unused. Nowadays, it is accepted that protected areas alone will not adequately provide long-term protection and management of biodiversity, so 'ecological networks' and ecological connectivity became a new paradigm to nature conservation in the 21st century (ECNC, 2010).

The EN is a well-known concept, emerged in the past century from the Continuum Naturale concept to 'greenways', up to the post-modern concept of landscape multifunctionality (Magalhães et al., 2007; Selman, 2009) promoted through the European Landscape Convention. Greenways are often used to refer to: a) 'linear open space established along either a natural corridor, or overland along a railroad right-of-way converted to recreational use, a canal, a scenic road, or other route' (Fabos, 1995; Flink and Searns, 1993), b) 'ecological corridor' that connects systems of green and open space in urban areas; c) 'greenway networks' include ecological, recreational and cultural heritage aspects (Fabos, 1995; Magalhães *et al*., 2007).

In this paper, the EN is a spatial concept, considered as a planned network, designed and managed for various purposes (Ahern, 1995) and recognized as a framework of ecological components (Jogman and Pungetti, 2004) which provide physical conditions that are necessary for maintaining or restoring ecological functions, supporting biological and landscape biodiversity and promoting the sustainable use of natural resources (Forman, 1995; Bennett and Wit, 2001; Jongman and Pungetti, 2004).

Furthermore, the idea of EN is embedded in several political strategies and legislative documents at European and international levels (Harfst et al., 2010). The most important policies on EN are: a) the Birds Directive (79/409/EEC, 1979), the Bern Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1979), the Habitats Directive (92/43/EEC, 1992) – Natura 2000; b) Pan-European Biological and Landscape Diversity Strategy (PEBLDS, 1995) – PEEN; c) the Water Framework Directive (Directive 2000/60/EC, WFD 2000); and, d) the latest Biodiversity Strategy in 2011 with Action 6 - Development of a Green Infrastructure Strategy that aims to halt the loss of biodiversity in the EU by 2020 (EC/CIRCABC, 2012).

At the same time, there are several initiatives to prevent landscape fragmentation (Tillmann, 2005) and the Pan-European Ecological Network - PEEN (CE, 1996; Jongman et al., 2011) is one of those, in which the improvement of biodiversity through EN is the main objective.

In these recent European biodiversity policies, "green infrastructure" has become synonymous of "ecological network". Green infrastructure is considered as 'the network of natural and semi-natural areas, features and green spaces in rural and urban, terrestrial, freshwater, coastal and marine areas which together enhance ecosystem health and resilience, contribute to biodiversity conservation and benefit human populations through the maintenance and enhancement of ecosystem services' (Naumann et al., 2011).

In this paper, the use of the EN expression is due to Portuguese legislation. The EN was established in the national legal regime for territorial management tools in 1999, under Decree-Law nº 380/99, as a tool for landscape planning and management at national, regional and municipal level. In the amendment of the law made by the DL nº 46/2009 (Article 14), EN aims to define areas, values and key systems for environmental protection and the enhancement of urban and rural areas, connecting with another planning tool, the National Ecological Reserve (REN). The REN was created in 1983 under DL nº 321/83, last modified by DL nº 166/2008, and is a biophysical structure that integrates all areas according to their value and ecological sensitivity or exposure, and susceptibility to natural hazards to which should be given special protection. This includes coastal and river areas, aquifer recharge and steep-slope areas for erosion protection.

However, the recent definition is simplistic because, in the 80's, Portuguese law had already established the basis for the EN definition, including National Agricultural Reserve (RAN) under DL nº451/82, last modified by DL nº 73/2009, and the Public Hydric Domain (DPH) under DL nº 468/7 (Magalhães et al., 2007). Also, currently there is the Fundamental Network of Nature Conservation (RFCN), under DL nº 142/2008 which defines a network of conservation areas that integrates these last tools and also includes the National System of Classified Areas (NSCA).

At national level, there is the Program for National Planning Policy (PNPOT) as a strategic tool for territory management. PNPOT, under the Law nº 58/2007, assures the integration of different spatial policies and provides the guidelines to develop the territorial management tools at regional level through regional plans (PROT). PROTs define the regional territorial development strategy, integrating the options established at national level and considering municipal territory development strategies, creating a reference framework for management municipal plans (PMOT). Concerning the EN delimitation in these plans, the national level didn't include any EN delimitation and the regional plan (PROT) establishes the Regional Ecological Network, named as Regional Structure Plan for Environmental Protection and Enhancement (ERPVA), under the Article 51º DL nº46/2009.

Table 1. Relation between EN and the other Portuguese landscape planning tools at national, regional and municipal level

<table>
<tr><th></th><th colspan="2">NATIONAL</th><th>REGIONAL</th><th>MUNICIPAL</th></tr>
<tr><th></th><th>PNPOT</th><th>RFCN</th><th>PROT</th><th>PMOT</th></tr>
<tr><td>EE</td><td>-</td><td>-</td><td>ERPVA</td><td>EEM</td></tr>
<tr><td>DPH</td><td rowspan="5">Natural systems and agro-forestry</td><td rowspan="3">Continuity Areas</td><td rowspan="3">Strategic Guidelines and risk areas</td><td rowspan="3">Restriction Areas</td></tr>
<tr><td>RAN</td></tr>
<tr><td>REN</td></tr>
<tr><td>NSCA</td><td rowspan="2">Nuclear Areas</td><td rowspan="2">Conservation Areas</td><td rowspan="2">Natural Areas</td></tr>
<tr><td>Conservation Areas
Natura 2000, IBAs, Ramsar list, Biosphere and Biogenetic Reserves</td></tr>
</table>

According to this, some gaps in the Portuguese Legal system can be summarized: a) The current legislation does not consider the EN as a single entity, having different names and representations; b) Criteria and composition of EN is omitted at every scale, emerging therefore, different names, definitions and detailed representations even at the same scale; c) There is no national figure as mandatory and refers to RFCN; d) RFCN is composed by REN, RAN, DPH and NSCA, but in a non-integrated physical and biological base, with particular relevance to nature conservation areas and risk areas; e) the components of RFCN also don't have well-defined criteria. For instance, in the soil protection law (RAN), the soils within urban perimeters (urban and urbanized areas) are excluded from this evaluation, logically compromising the sustainability of urban and peri-urban areas.

The main goal of this paper is to map the EN at national scale. A comparison between our EN delimitation and those made for the plans (PNPOT and PROT) with the purpose of a critical evaluation f these last ones; In order to identify differences between EN delimitation at different scales a comparison was made between National, Regional (Lisbon Metropolitan Area) and Municipal (Lisbon) scales of EN.

Methods

The NEN methodology is composed by two main sub-systems: physical and biological (Figure 1). The physical sub-system includes: a) Water – includes the hydrographic network, water bodies and wetlands. Streams and ridgelines were ranked into four levels according to their watersheds length and area. These elements are integrated in the water legislation (Water Framework Directive) and river basin management plans; b) Land morphology – the inland morphology is characterized by the following ecological situations: wet systems (contiguous areas of water lines), hill tops and slopes; coastal morphology is composed by areas with strong interaction between land and ocean. It includes the beaches, cliffs, geological formations (Quaternary), coastal wetlands (marshes, salt marshes and coastal aquaculture; intertidal zones), transitional waters (estuaries) and marine and coastal waters; c) Soil - with very high and high ecological value constituted of soils with considerable soil depth and the highest rates of fertility, as well soils associated with traditional agro-forestry ecosystems, e.g. Fluvisols, Antrosols, humics Cambisols (FAO and WRB classifications) and aluviosols (Portuguese classification); d) Geology-geomorphology – soil and sub-soil permeability and maximum infiltration areas; e) Climate – cold air corridors and most exposure areas to dominant winds.

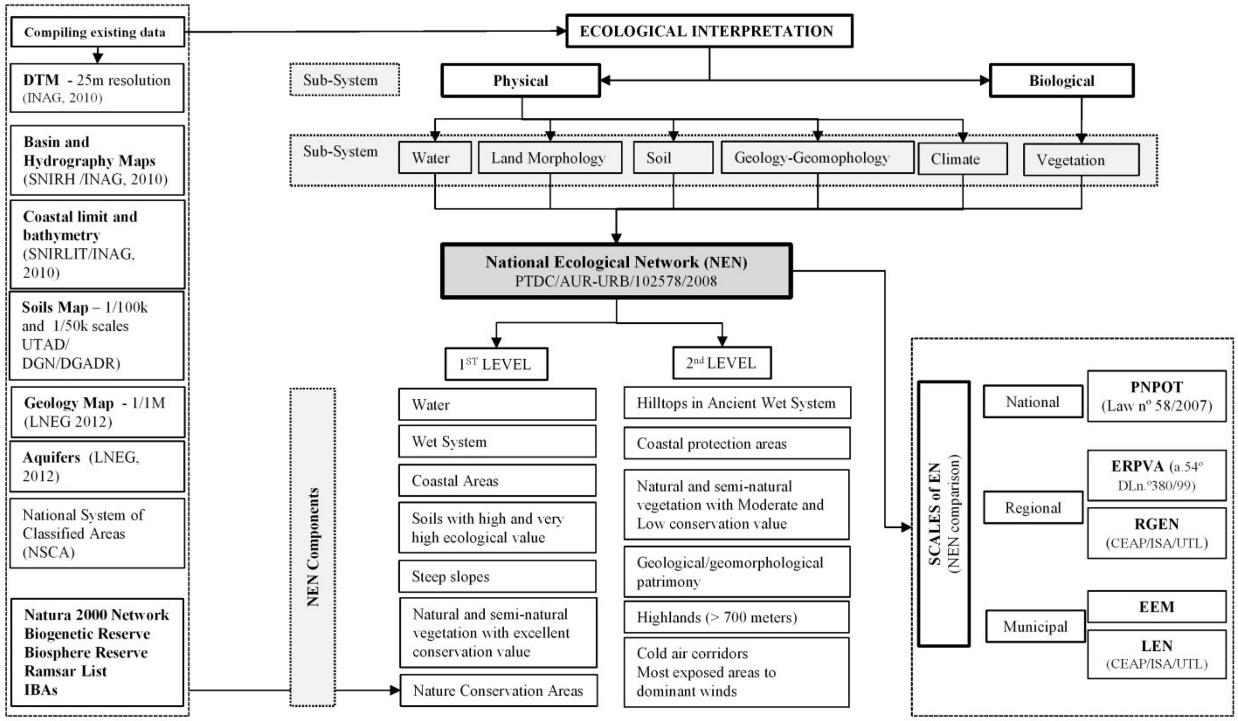


Figure 1. Methodology for NEN mapping

The biological system is composed by: natural and semi-natural vegetation with conservation value, which includes preservation of plant biodiversity (species) and maintenance of the integrity of plant communities (habitats) and vegetation mosaics (complex habitats). This classification considers not only the intrinsic value of the mapped communities, but also the potential occurrence of rare or endangered plants in them.

The integration of all components resulted in a far too extensive area of the country in order to be subjected to significant restrictions in the future. For that reason, it was decided to hierarchize the NEN in two levels, according to the value or degree of ecological sensibility assigned to each component. This paper presents the results of the first level of the NEN as well as its comparison at various scales.

Results

The delimitation of EN at national level (NEN) with the application of the described methodology was implemented through a GIS, using Argis10 software.

The NEN components were systematized and they were given priorities, as presented in Figure 2.a and Figure 3, according the two sub-systems that includes: 1- Water System: water bodies and wet lands; 10 – Wet System (WS): water lines and contiguous areas; 100 - Soil System: with very high and high ecological value; 1000 - Coastal System - beaches, cliffs, geological formations (Quaternary), coastal wetlands, marine, coastal and transitional waters; 10000 – Steep Slopes; 10000 – Vegetation with excellent conservation value. The first level of NEN is composed by these components and nature conservation areas (Figure 5).

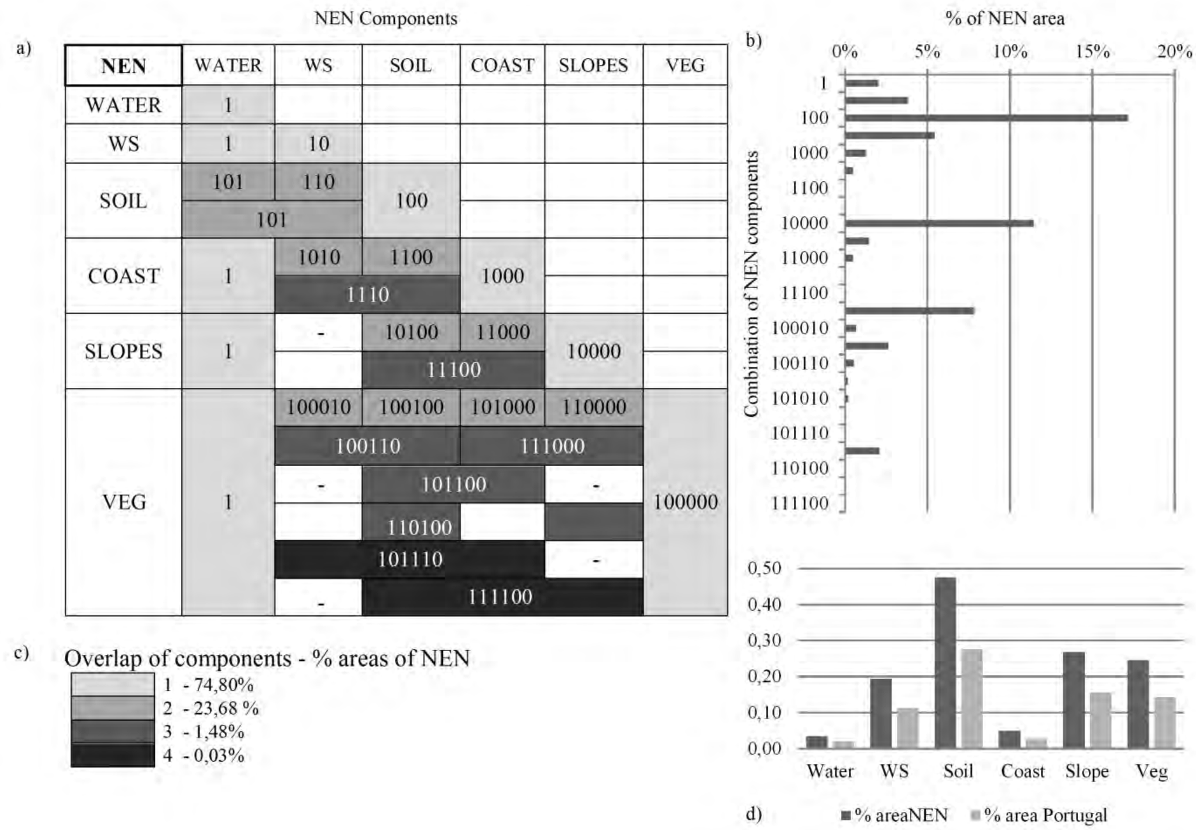


Figure 2. a) Systematization of NEN components; b) NEN components combinations in all NEN area (percentage); c) overlapping components in NEN area (percentage); d) individual components in NEN area and in Portugal area (percentage).

The proposed NEN totalizes 67% of Portugal's area from which 8.5% is composed only by nature conservation areas. Very high and high ecological value soils represent the higher percentage, with 47% of NEN and 27% of country's area. Vegetation and steep slopes represent 25% and 27% of NEN respectively, but only 4% of these components are coincident, representing only 2% of the country. The wet system counts 20% of NEN, 11% of the country, from which 10% are coincident with very high and high ecological value soils (Figure 2.b).

Relatively to NEN as a whole, 74,8 % consists of individual components (Figure 2.c). The dimension of each individual component, relatively to the NEN total area, by decreasing order: soil, slope, vegetation, wet system, coastal areas and water bodies (Fig2.d).

Nature conservation areas (Figure 4) including Natura 2000, IBAs, Ramsar list, Biosphere and Biogenetic Reserves correspond to 25% of the country area but only 16,5 % are coincident with NEN.

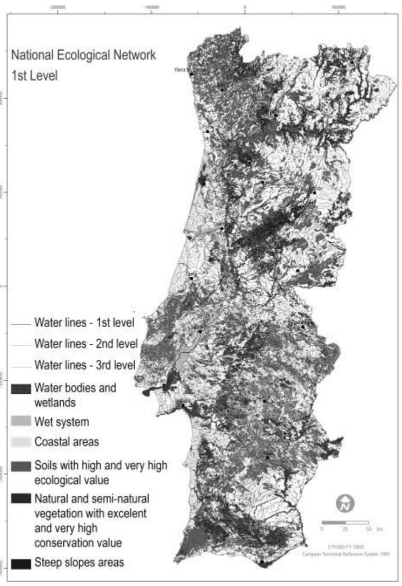


Figure 3. NEN components -1st level

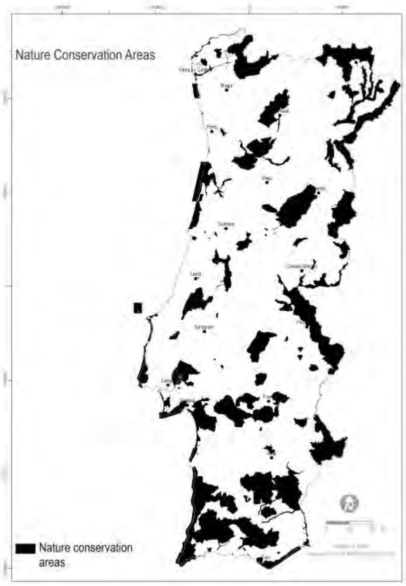


Figure 4. Nature Conservation Areas

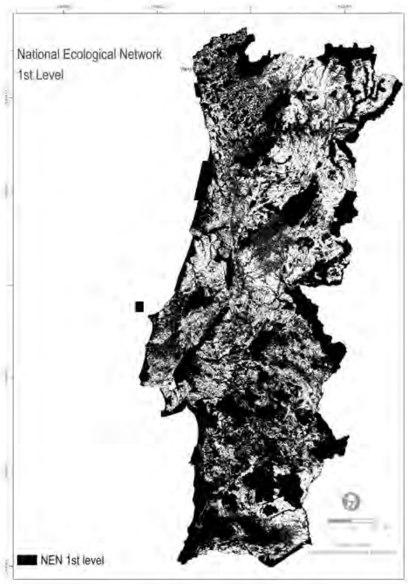


Figure 5. NEN - 1st level

Discussion of results

As mentioned in literature review, the national level of landscape planning tools doesn't include any EN delimitation. The PNPOT only ensures that, at the regional and municipal levels, EN must be consistent and compatible with the ERPVA and Municipal EN provided by plans respectively. PNPOT strongest message about biodiversity enhance is that the three main systems to conservation and sustainable management of natural resources are (Figure 6): water, agricultural and forest land, and nature conservation (DGOTDU, 2007).

However, the considered systems do not constitute a network of natural resources and completely fails the two main objectives that characterize the EN: (1) maintaining the functioning of ecosystems and conservation of species and habitats; and (2) promoting the sustainable use of natural resources in order to reduce the impacts of human activities on biodiversity (Bennett and Wit, 2001). Therefore PNPOT defines: a) 'pine and eucalyptus trees' as agro-forestry systems to be protected. Both of them correspond to intensive monoculture and highly inflammable forest, what is inconsistent with PNPOT's goals, namely with forest fires prevention; and b) 'areas with special agricultural potentiality' refers to the most cultivated areas and not to the soil itself that should be treated as exhaustible resource, a heritage, which by any means should be degraded, regardless of becoming used or not by agriculture, and beyond that is necessary to identify agro-systems that will enable agricultural use (Magalhães, 2001). The used methodology in NEN includes a soil evaluation according with its ecological value which did not exist before.

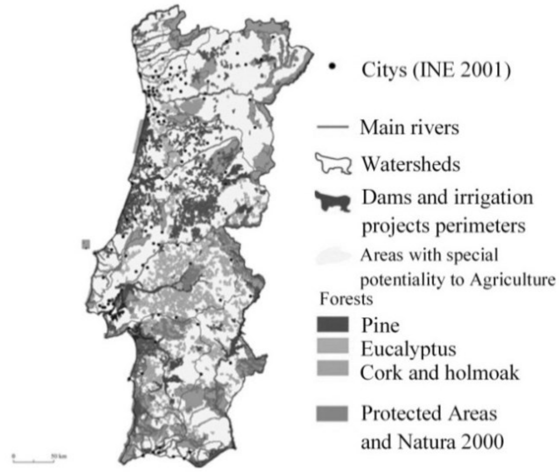


Figure 6. Natural systems and agro-forestry in Portugal (DGOTDU, 2007)

At regional level, the PROT establishes the Regional Ecological Network named as Regional Structure Plan for Environmental Protection and Enhancement (ERPVA).The selected example for this analysis is the Lisbon Metropolitan Area ERPVA (Figure 7). ERPVA comprises a hierarchical network composed of areas and ecological corridors (primary, secondary and complementary networks) linked to each other by protected areas. Nevertheless these areas selection were based only on land use criteria in a specific period and not in the ecological suitability to human activities. The major review is that these networks are schematically represented and we believe that it´s possible to detail the EN components at all scales, as represented in Figures 8 and 10, with the comparison of NEN with regional and municipal EN (RGEN and LEN) proposed by CEAP/ISA/UTL.

For Lisbon Metropolitan Area, NEN corresponds to 53,21% of this area and 92,55% of this NEN are coincident with the RGEN. However RGEN is more accurate and has 16,85 % more area than NEN, due to a more precise land use data, namely vegetation inventory and the hydrographic system that includes a lower hierarchy of water lines.

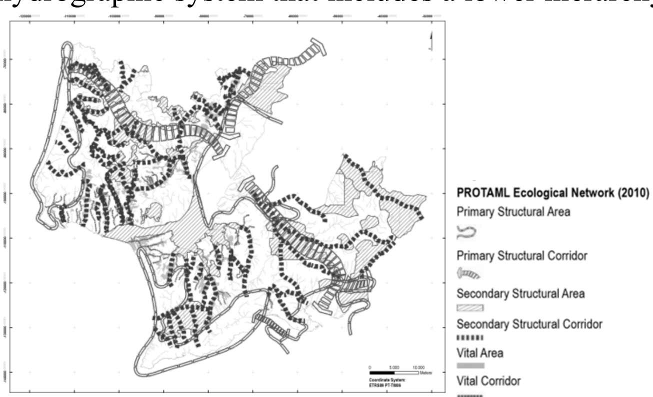
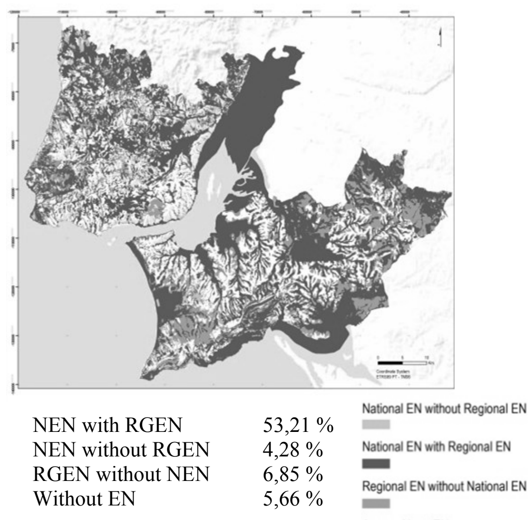


Figure 7. ERPVA of Lisbon Metropolitan Area



NEN with RGEN	53,21 %
NEN without RGEN	4,28 %
RGEN without NEN	6,85 %
Without EN	5,66 %

Figure 8. Comparison between NEN and RGEN (CEAP/ISA/UTL)

Legally, municipalities must have an EN mapped in their municipal plan (PDM), but there are no established criteria on how to define and develop it. Figures 9 and 10 represent the proposed EN for Lisbon's municipality (CEAP/ISA/UTL), according to the same methodology of NEN. However Lisbon's EN (LEN) included green spaces in urban areas, such as parks, permeable open spaces and urban elements hosting biodiversity, this justifies the difference between NEN and LEN area (Figure 10), more 43,8% area in LEN.

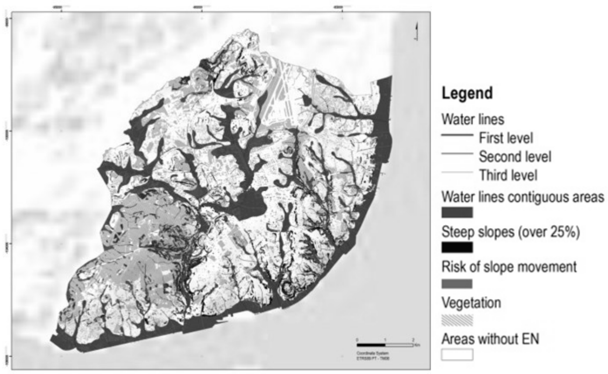
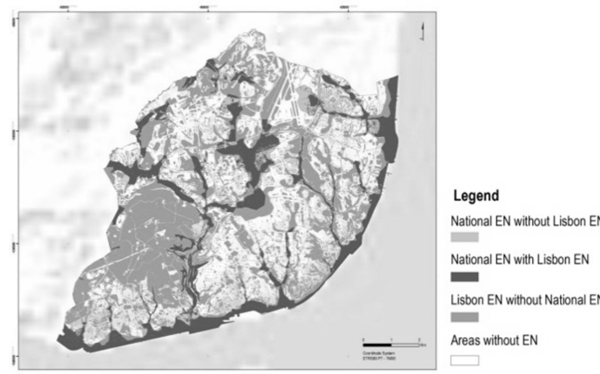


Figure 9. EN for Lisbon municipality (CEAP/ISA/UTL)



NEN with LEN	15,96%
NEN without LEN	3,14%
LEN without NEN	43,87%
Without EN	37,03%

Figure 10. Comparison between NEN and LEN

Conclusions

The first conclusion is that is possible to delimitate the EN at national level with an accuracy that allows its transposition to the scale of 1/25.000. This finding contradicts what has been done in Portugal, particularly in the PNPOT and in the PROTs, and underpin the European recommendations about green infrastructures.

Regarding its dimensions, the NEN corresponds approximately to 58% of Portugal's total area. On the other hand, the nature conservation areas (Natura 2000, IBAs, Ramsar list, Biosphere and Biogenetic Reserves) represents 25% of the country, of which only 16,5% matches the NEN. The difference between these two values is explained by the fact of the NEN is including the physical sub-system of the landscape, rather than focusing only on the biotic systems, as do the nature conservation areas.

Regarding NEN components overlapping, it was verified that 14% of the vegetation areas with conservation value do not overlap to other components of the NEN, corresponding mostly to oak forests (*Quercus suber e Quercus rotundifolia*) of the South of Portugal, particularly adapted to the extreme conditions of climate, soil and water availability. Moreover, 10% of the NEN corresponds to the overlap of soils and wet system, which matches aluviosoils and fluvisoils.

Finally, 75% of the physical sub-system areas (water, wet system, soils, coastal areas and slopes) do not host relevant vegetation and only 9% of the physical sub-system matches the vegetation with conservation value. These numbers allow concluding that there is, in fact, a biological sub-system dissociated of the physical sub-system of the landscape, so the protection given the last years to the biotic system is insufficient to ensure the ecological balance of the landscape. The concept of Ecological Network in this paper is widely justifiable and should be considered as a reference to future law modifications.

Acknowledgements

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6. GREENWAY PLANNING

The way towards landscape integrity
Integration of social framework: The intangible value-based landscape planning

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Introduction

The regions face nowadays with environmental, economic, social expectations and conflicts, they have to manage the contradictory interests of localization and globalization. In this challenging environment the decisions-making is very hard, which provide the regional competitiveness and satisfy the requirements of sustainability. This makes more and more responsibility for the decision makers and planners. The planning system needs changes to be able to make sustainable decisions, to support the coordinated, balanced development of regions and to ensure the spatial competitiveness. We should think the planning methods, the planning thinking, the planning and developing system and the planner's attitudes over, which allows a high-level resource-management, a more effective conflict-management and increases the plans' efficiency. Beside the new innovative design approach, the new planner attitudes, the new set of methodology we should turn to **local communities and local intangible values.**

This study discusses a new approach of landscape planning: the intangible value-, and community-based landscape management. This approach integrates the communities into the landscape planning as the participant of the process and as a development dimension of landscapes. It deals with the ***communities' intangible values, the method, and the possibility of developing a regional intangible value*** frame. It is a hardly researched, but more important issue. As in the Hungarian National Spatial Development Concept *(97/2005(XII.25.)* is written: a common regional intangible value system - which gives a frame for the planning system- should be developed; it is necessary to ensure the consistency of booming regional planning activities.

Background and Literature Review

The definitions of values are defined in many ways according to the science. According to many authors *(e.g. Hajnal, 1987;* Rohan, 2000) the intangible values are such motivating factors – regarding to a desirable state -, which determine our activities, the way of thinking, our attitudes and norms. The intangible values influences which things, events, facts of the world are important for us; they lead our life (Hajnal, 1987). The values are the basic elements of the culture (Ságvári, 2009). The complex attributes of these elements determine the persons', the communities' and the whole society's reactions, goals and their actions (Swedberg, 2003). Many author grouped the values. Milton Rokeach (1973) divided them into terminal value (why we act) and instrumental values (how we act). Hankiss (1987) divided them into objective (necessary for system's operation) and subjective (necessary for system's development) values. Most of the systems try to explore the objective values, and the subjective values build on them. Schwartz (2007) summerized the features of intangible values in six points. (1) They have affects on our emotions and feelings. (2) They are the base of our motivations and the resultant of our actions. (3) Values go beyond specific situations. (4) Turn signals, that determine when and how to act. (5) The values are arranged in order of their importance. Relative order can be formed between them, but the different intangible value groups, value clusters can appear together. The number of common values is low (Ságvári, 2009). (6) The values are continuously interacting with each other. Their relative importance determines the actions.

Intangible values and spatiality

In the 1990's appeared the main trend of legal geography, which said, that the normative regulation can't be separate from spatiality. This trend says the mutual changing of the values and the space (Blomley, 2009). The values take "shape" in space. The spatial processes, the spatial structures, the use of spatial and every kind of change in the space are the consequence of these invisible system's actions. (Kondor, 2010) The values and their relations are the resultant of society's acts, the inducement of different spatial and social processions. All in all, they determine the direction of development and innovation.

The changing regional development in Hungary

During the 20th century the institutional system of regional development in Hungary was built similar to other countries in order to reduce regional conflicts and territorial tensions. (Bartke, 1995) The territorial impact and regional development policies were effective in regulation of territorial process, but their role and the public sector's impact on territorial process – the regulatory role of the state - weakened because of the strengthen globalisation, so the norms' (laws) affects are limited. The base of spatial planning and the regional development is the legal structure established by the state and its toolbar, the territorial regulation. This means, that the regulatory bodies, - first of all the state - are the only ones, who shape the normative space. This is a false idea, because the territory is shot by not only formal (laws) but also by informal (intangible values) rules. Ignoring these informal rules causes the failure of territorial regulation (Kondor, 2010). The recent development and planning practice in Hungary take notice of only the formal rules. The common territorial value frame miss, which would show the way along common territorial values to the sustainable future.

It is a big barrier of the regional development's success, that the local regulation, the self government do not involve the social-economic sector and even its inflexible system pushes away the external actors (Kondor, 2010). It is more and more important that the public sector and civil society work together in developing of the regions. The intangible values of civil networks have great affects on the governance's performance (Putnam, 2002). Great emphasise should be placed on working out, realize common strategies. As Ságvári (2009) says, this helps the development, which occurs there, where the intangible values make for the strengthening social cohesion, innovation, and getting creative energy.

From professional, economical, management and political point of view it is logical and expedient to determine the landscapes' spatial, material, immaterial (value) frames in a common document. This complex approach is subservient, because of the complexity of landscapes (*Szilvácsku, 2012).* The landscapes determine the creatures', the people's physical frame, but include the area-specific, dynamic relationships of communities and their intangible values. If the planners want to take part consciously, actively in landscape processions, they have to deal not only with the ecologic, economic, aesthetic site of landscape, but also with the values, norms and relationships and community-networking.

Goals and objectives

As planners we deal with the human living space: the landscape. The sustainability of this spatial frame would be impossible without the integration of social dimension and without making dynamic and active connection between the landscape's soft and hard structures. The landscape planning and development will be sustainable, if not only the physical frame, the landscape elements and structures are involved to the planning process but also the social aspect.

This research identifies the problems of nowadays' planning practice, deals with the role of intangible values in landscape development processes, in landscape development planning and draws up the conception of this new method. Our goal was to establish the base of a new landscape management model, which focuses not only on the physical structures of landscapes and on the tangible landscape character, but also on the intangible systems, the human landscape character. This model can be the way towards the landscape integrity and the coordinated, community-supported, sustainable landscape-development. Beside the methodical aspects I deal with the accompanying measures necessary to the operation, implementation and practical application of the method and determine the new required competencies, roles of planners, decision makers and citizens. This study is rather an overview, it might be considered as the first step of the dissection of a methodological issue. It does not intend to describe an exact, detailed method, rather than present the principles, opportunities and constraints.

Methods

The intangible values' operation and their impacts on human behaviour and spatial using must have known. The base of method development was **analysing, systematization and conclusions of the literature** – focusing on relationship between the values, human behaviour, spatial process and competitiveness. The **questionnaires** examined the value preferences and the role of communities in Hungary's two micro-regions: in Esztergom micro-region and in Zsámbék-basin. The **interviews** focused on the issue of problems and limits of the recent settlement-, and regional development practice, the target groups were the decision makers and inhabitants. The goal of development **document-analysis** was their coherence survey and the analysis of their value system. The current situation and problems were uncovered by these methods.

We examined a **case study**: the development model of Sárvíz micro region and Aba settlement (Szilvácsku & Szabó, 2012). With the initiative of the mayor of Aba a special model experiment was launched – the program of participatory democracy – which is the most outstanding Hungarian example of bottom-up, community- and local resources-based development, and the high level of community collaboration. This system allows in an institutional form to participate in shaping the future involving the civil and economic sector, the council and the churches. It aims at a strong, converging community, which realize their own vision and take part continuously in the settlement development. It does not aimed at individual actions, but support the self organization of local communities. This method based on the German model: doing the tasks more effectively together.

Results

The lack of regional vision and coherent regional development

The strategic way of thinking is absent. There is **no regional intangible value system and visions supported by local communities**, which control the development thus the sectoral policies determine and realize purposes representing their own interests and intangible values, not the community ones. The development documents prepared for regions, settlement are not coherent with each others, they draw up measures, which are incompatible with each other, and they reflect different intangible values, interests ignoring the regional and other communities' intangible value system. These documents are individual units "live" next to each other instead of helping the harmonic development towards the common vision by working in symbiosis.

The lack of dynamic relationship and cooperation between society's different levels

As Hankiss (1987) said, the missing relationship between the society's vertical and horizontal levels is a huge problem in Hungary. The decision makers, the civil and economic sector do not communicate with each other, the networking and its background institution, a conciliation platform (forum) is missing. With networking the principle of subsidiary can be satisfied: the utilisation of resource capacity and the conflict management is more effective, the number of false decisions decrease as the Aba model shows.

Active communities can be the driving forces of regional development. Basic failure in Hungary that the planning procedure doesn't build on the social framework — on the **norms and the intangible values of the communities —** and the actors of regions have no role in visioning and in the goals determination. In the development processes the intangible values of local communities is not taken into consideration. This causes social, environmental, economical conflicts, unsuccessful plans. The active communities are characterized by fast information flow, dynamic communication and knowledge exchange; the strong civil sector can stand up for their interests. This statements are verified by the example of Aba model or by the results of the questionnaire in Zsámbék-basin (As most of the inhabitants (90%) see: The NGOs can do the most thing for the developing and value protection, thus the community space developing is one of the most important developing goal). Involving local communities into the decision making process is good for community life: 10-20 active NGO working in Sárvíz micro-region.

The intangible values of different groups should confront

In a micro-region there are many interests and intangible value systems, which try to predominate without any development frame (Kondor, 2010). As Hankiss (2004) says, one of the most basic precondition of social development is **the different interests and values to be determined, formulated clearly and to clash with each other and to be linked to each other in orderly conditions**. The interests and intangible values do not meet and confront each other, thus a lot of hidden conflicts are under the surface. The common practice is value hiding, -collusion and fusing with any other values as the result of document analysis shows. The methodical, institutional and attitude background are missing, which would provide the intangible value encounter and approximation.

Discussion and conclusion

The Hungarian planning-developing system suffers from weaknesses. The recent practice does not provide the harmonic; community supported regional and settlement development and does not allow the real public participation in these processes and no reflect the communities' values but the small groups' interests. These problems results unsustainable and uncompetitive regions.

Rethinking the system: The model of regional intangible value-based development system

The intangible value mapping; the value conciliation; the value approximation; identification and fixation of micro regional actors' common and different value systems etc. are very important to create sustainable regions. This procedure called **consensus based value conciliation** (Fig 1) — involving and supported by the local communities and presenting the local interests — is the key of regional sustainability and competitiveness. At first, common regional intangible values must be determined in an organised way, than the developing activities and documents are matched to this common regional intangible value frame. These intangible values — the quality and the patterns of this intangible frame of landscapes — is at least as important aspects of landscape development, as the ecological, economic and aesthetic ones. These values determine the success of plans. If the plans don't care with the locals, do not base on communities' norms and their value preferences; the final goal - the local community's development (Pataki, 1998) – can't be achieved. Ignoring this aspect causes conflicts, failed plans, non-competitive, unsustainable regions because of the value differences. Without common values the sense of public togetherness weaken, the people will be dependent upon own short-term interest (Hoppál, 1987).

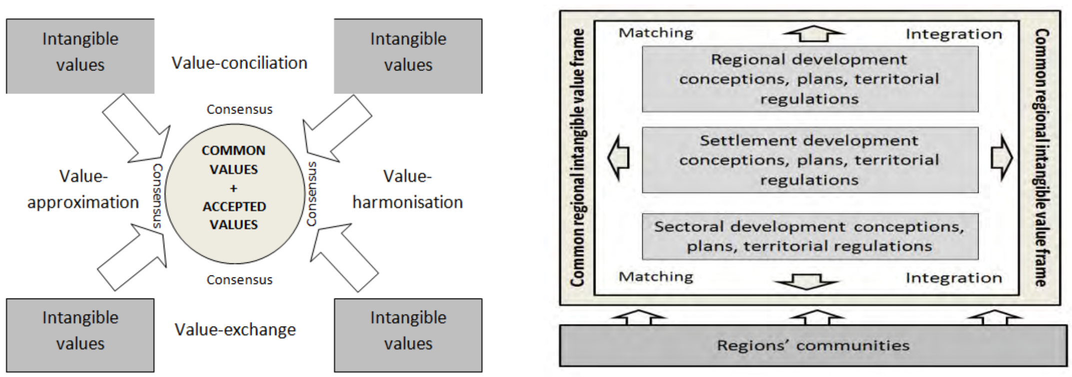

Fig 1. Procedure of consensus based value conciliation (left) and the intangible value frame's practical function (right)

This system's output is a document, called **common regional intangible value system,** which is a framework. It determines the area's vision and appoints the common goals. It contains the common, accepted intangible values of local communities and provides a framework for the developments activities. The different development documents and plans have to be integrated and match to this framework. (Fig 1) According to these processes, this frame provides for the coherence of development documents and plans, and all-in-all for harmonic, sustainable development. The future of micro-regions and settlements depend on how to shape common intangible spatial value systems, which support the collaborations and the actions; and how to do consensus based value conciliation and value approximation. These are necessary to avoid the land use conflicts, which are derived from the value differences. The **common intangible value-**

based development system is the basic of the landscapes' and the society's competitiveness and sustainability.

Regional intangible consultation platform development

It is necessary to develop an intangible value consultation platform, called **landscape forum** (Szilvácsku & Szabó, 2012), which is based on the local communities' and stakeholders intangible values and reflect their interests (Fig 2). This forum allows the participation of stakeholders, the intangible value representation and collision. It **makes continuous connection between the social-economic-political-administrative norms and value systems** and it allows of the continuous communication. The participation is satisfied by representatives of decision-makers, the deputies of sectors and the inhabitants, professions of different speciality (nature conservation, national monument protection, landscape architectures etc), civil organization, etc. and the method of structured dialogue. The active, dynamic communication, the flexible connection and dialogue are very important, because the values and the environment always change and develop. The intangible value-based development system ensures the determination of driver values, the region's common values and interests; and determines the common vision and the common goals, which are the basis of the development in future.

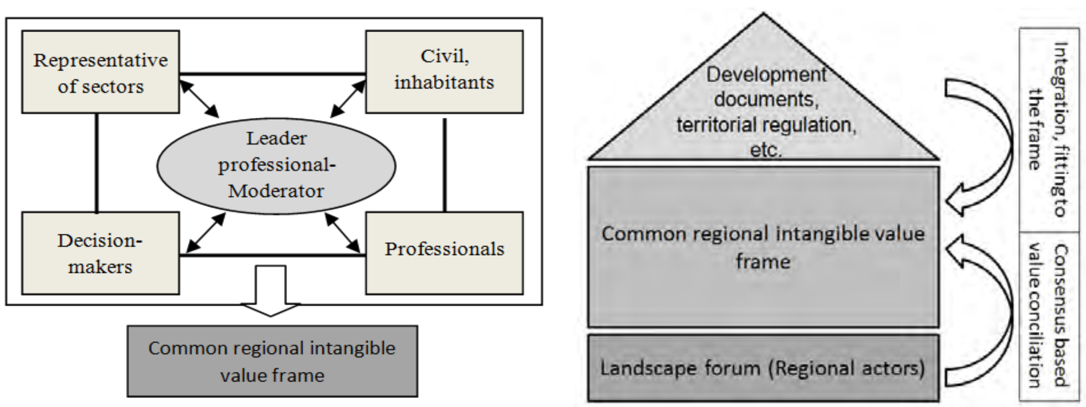

Fig 2. Regional intangible consultation platform (left), and the regional intangible value-based system's function (right)

Networking and community building- increasing role of communities

As many author say e.g. Ludescher (2009), the **role of local communities are relevant in landscape development**. The success and efficiency of plans' and conceptions' realization depends on these communities. The public participating is not relevant in Hungary, because of the lack of methods, attitudes and way of thinking. The power and relevance of community was not realized yet. There is a study (Csepeli, 2010) that deals with the European society's activity and reflects the Hungarian mentality. It shows that as long as in Sweden the society's 6,9% suffer, 18,2 % rebel, 74,9% active, in Hungary this pyramid is converse: 65,9% suffer, 23,5% rebel, 10,6% active. **Without operable communities couldn't be talked about sustainable development** (Hankiss, 2004): networking and community building should antedate every kind of development activity. To realize it, the best method and communication tools - according to the scale and contents of the community - must be found (Tomka, 1987). The networking's level is the locality, its base is the operable community and its goal is the community participating.

The relation between the different levels of society should be developed. As the example of Aba shows, strong communities can born by networking. According to Antony Cohen's (1985) researches, it has to be realized 4 conditions to community formation: 1) social space, locality; (2) interests, identity; (3) social interactions among the members of community; (4) the community identifies own self in collective social activities.

Rethinking the roles

This new value-based system is a great challenge to our profession. It requires continuous innovation, adaptation, new professional competencies, developing new solutions and methods. The professional mentality should be changed; the role and the functions of professionals and decision-makers should be reconsidered in this system and a shared self-government should be realized like in Aba settlement. **The general political mentality should be reconsidered**. Acclimatization and propagation of a result-oriented, value-driven public politic and the value-based developments should be inspired. To realize it, the methodical, regulation and institutional bases should be laid down. The partnerships, the collaboration of regional actors, the stretch of open policy; feedback and observance of opinions and reactions are very important; facilities should be provided for assessment and continuous information (Fig 3).

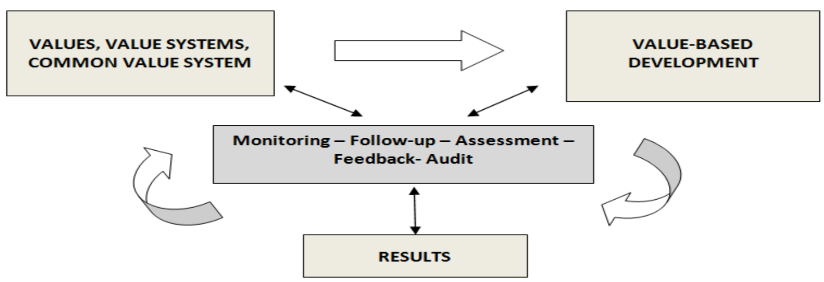

Fig 3. Value-based policy's basic relationship

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Retrofitting Cities: A Case Study in Baltimore - Exploring New Trends in Urban Greenways

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Introduction

Landscape Architecture is presented with a unique design challenge in the contemporary city as ideas of green infrastructure and sustainability are gaining significance, and the emerging role of greenways' importance in shaping future urban form. There is significant discussion of the role of urban greenways along natural corridors providing recreation and environmental services in cities (Gobster &Westphal et al., 2004) as well as the role of greenways in creating synergy on differing scales addressing sustainability and connectivity in urban areas (Sharma, 2010). Additionally there has been an emerging discussion of how Detroit and other "blighted" or "legacy" rust-belt cities are turning to urban agriculture, new economies and other progressive or adaptive land uses to address sustainability, community development, and urban infill (Reed 2012, et al). However it is unclear how or if these land uses are part of a larger systems wide approach and to what extent already existing greenways can anchor these objectives.

This ongoing project is a critical review of how cities such as Baltimore can use established design approaches paired with greenway development to address the underutilization of space and lack of connectivity which have resulted in urban fragmentation, population loss and declining economic activity in recent decades. Are these design approaches sufficient to retrofit a city? Can landscape architecture provide design solutions by extending greenways technology and theory out from the stream valleys and onto the ground plane of our urban public realm to meet those goals of connectivity? Landscape ecological urbanism provides a foundation to bridge the gaps between theoretical approaches of landscape urbanism and the scientific approaches of urban ecology by recognizing that cities are essentially human dominated ecosystems (Steiner 2012). By acknowledging that landscape urbanism projects can improve the quality of life in cities, we can now advance our systems thinking as to how these projects can become more integrated into the related discussions of ecosystem services and future urban form. This project looks at those related and evolving theories to examine which landscape design approaches are relevant and what the future might look like for cities with shrinking populations, an abundance of space, and rich cultural and ecological diversity – with a focus on the role of current and future greenways in those cities.
The underlying intention of this research is to look at how the built environment between greenways can be adapted to create a meaningful sense of place and synergy to an emerging greenway network.

What is a Greenway?

As we know Greenways have many definitions, ranging from ecosystem corridors, to biking/hiking trails, commuter routes, recreational areas, river valleys, and so on. From the environmental perspective, Ndubusi argues "Environmentally sensitive areas when interconnected, could serve as greenway corridors consisting of networks of linked landscape elements that provide ecological, recreational, and cultural benefits to a community. By implication, the process of protecting environmental sensitive areas could serve as a tool for locating and managing greenways" (1995). Or as Ahern notes in a nod to strategic planning, "Greenways, do not attempt to transform or control the entire landscape, but by focusing on riparian corridors, and other environmentally sensitive areas, greenways are more modest in their ambitions, while exploiting selected linear elements in a strategic and synergenistic manner" (1995). With varying definitions and changing scales though, there is a unifying theme though as Chuck Flink noted at the 2012 ASLA conference is that Greenways connect us with the outdoors, with each other, and with popular destinations.

Although emergent, there is still a lack of deliberately planned greenways in the already built environment. Walmsley approaches the subject from a distinctly urban point of view, articulating that there is no 'kit of parts' for green infrastructure, and that urban theorists often overlook streets as available public space to be incorporated into green infrastructure. It could be argued that contemporary green infrastructure advocates have taken the public street into consideration with the growing prominence of complete streets, walkable communities, and New Urbanism, but his concern holds true today in that we don't see much in the systems wide theory of the street gird becoming part of green infrastructure on a large scale. We are beginning to see case studies examining how public infrastructure is being considered in creating urban networks of connectivity, and even greenways. Walmsley refers to the premise that "a better understanding and application of natural processes (climate, water, plants, soils, wildlife, and food growing) could shape a more productive and sustainable design form for the modern city (1995 p.82). He goes on to talk about how the majority of greenways come from "residual leftovers after development, natural corridors, abandoned railroads, canals, and other rights of way" (1995 p.82) and how these neglected lands could prove ecologically rich due to their not being overlaid with "biologically sterile manmade landscapes." These ideals and strategies are further articulated through various design phases, mainly ecological urbanism, and sustainability movements nearly 20 years later.

There are still gaps in contemporary practice as urban greenways are less common than those found in rural areas and are not often used in the same discussions of synergy. Walmsley notes that these 'make-up' connections might not relate to natural features or ecologically derived criteria, but they will more likely be based on historical, cultural, functional, or political factors or "ridge-ways, transportation crossings, city and town lines, planned routes, and other human interventions which have influenced desire lines and destinations impacting urban development" (1995 p. 84). These green extensions can complete a metropolitan greenway system comprised of waterfronts, bicycle paths, tree lined promenades, streets, pedestrian ways, and resurgent boulevards and avenues to produce essential connections within the built-up city. As Sharma notes, "Greenways should be approached as synergistic landscapes that create harmony amongst the urban system with the broader biophysical system" (2010). Baltimore has the existing ecological corridors in three stream valleys, and the ground plane of the city above provides interesting opportunities to explore the development of ecological, cultural, and economic connections by looking at existing infrastructure, vacant land, public land, and a meaningful analysis of space.

Historical Context for Baltimore

The city of Baltimore has three greenways which helped the city grow from a colonial harbor town to one of the world's busiest ports centered on industry, transportation, and production. These greenways provided the economic and ecological fuel to support a growing population and expanding boundaries. From the Gwynns Falls stream valley on the west, to the centrally located Jones Falls valley, and to the Herring Run in the east, Baltimore is a town which was built on valley and stream economies. Today, however the industries are gone, the population is physically and socially fragmented, and there is little recognition of the potential contemporary value of past and future greenway systems.

The three stream systems acted as economic generators for a new colonial city in the 1600s as human settlement followed the Gwynns Falls and Jones Falls west and north out from the main Harbor. These streams were the foundation for early colonial plantation economies centered on farming, fishing, and access to sea trading routes. As the town developed an urban core on the shores of the harbor, human settlement moved further upstream through to the 20th century, harnessing the power of streams themselves for grist mills and textile production, or taking advantage of the relatively gradual contours and for accessible transportation, such as railway lines, mill races, and carriage paths through to the 20th century (Orser, 2008). Meanwhile in east Baltimore the Herring run evolved from a fishery, to granite quarry acting as economic generator further away from the urban core.

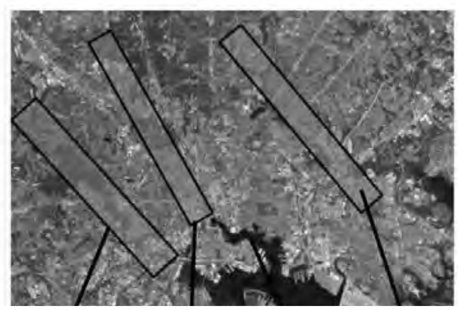

FIGURE 5. BALTIMORE'S THREE STREAM VALLEY GREENWAYS, DIAGRAM BY AUTHOR, GOOGLEEARTH

Today all three stream valleys are within the city limits of Baltimore, city of nearly 620,000 people and comprising a total land area of nearly 81 square miles (U.S. Census).

The Gwynns Falls hosts a multi-purpose 14 mile pedestrian/cyclist trail from the western edge of the city to the middle branch of the inner harbor in a mostly natural wooded setting with some adjacent to residential and industrial uses. The Jones Falls valley, now host to an interstate highway and light rail line has a planned greenway trail from the northern edge of the city to the inner harbor, through natural and urban settings. The Herring Run stream and wooded valley runs through suburban northeast Baltimore before out falling into Back River and the Chesapeake Bay. It also has gone through the master planning phases for a linear multi-functional greenway trail. The three valleys alone are ecological amenities - forested stream corridors in a highly urbanized area. However there is a lack of connectivity between the three greenway valleys, and between the communities and the ecological corridors. By using the three existing valleys as a framework for a broader system, we will begin to address issues of connectivity, ecology, and urban communities through greenway design.

The Process for Baltimore - Programming the City

It is proposed that combining the thinking of greenways theorists with the sustainable ecological urbanism theories to construct real value laden greenways in our urban areas will transform our outdated and fragmented grid into a vibrant, responsive network of community and ecological amenities. Research has found the majority of greenway planning has been in the pre-development stage of planning or in the left over spaces of stream valleys and undevelopable land. In urban areas such as Baltimore though, there is now an availability of land that doesn't fit into those categories. With the emergence of sustainable urbanism, can this unused land be used by designing greenways to connect these projects? Can these efforts be supported by finding value and using those values as anchors along the physical route to retrofit the city?

In many urban areas there may be an acknowledgement of the natural world, but there is often little recognition of the valuable interdependency that human systems, urban systems, and the natural world have in shaping an interconnected public realm. Greenway planning and progressive land design methods may be able to address fragmentation and stitch the surface of the city through green networks. The emergent urban construct is possibly synergistic, "a hybrid that is not entirely one or the other" (Beardsley, 2007, 202). Meyer's articulation expresses that "replacing this binary way of thinking with other conceptual strategies, landscape architecture can foster a land ethic and an aesthetic predicated upon a continuum between human nature and nonhuman nature, upon a recognition that the land is a cultural and physical product and that people are living organisms" (Meyer, 1997, 51). New greenways purposely designed as part of a larger green infrastructure can define public space as an infrastructure to dismantle disconnects between nature and culture.

In *Programming the Urban Surface* Alex Wall talks about the contemporary metropolis and how peripheral sites are often overlooked by designers as the core downtown areas are heavily programmed for tourists, or visitors, or day time workers, he observes that" The grafting of new instruments and equipment onto strategically staged surfaces allows for a transformation of the ground-plane into a living connective tissue between increasingly disparate and unforeseen programs" (Wall, 1999, 234).

New greenways or adaptive networks can act as infrastructure – as the basis for future growth or current connection, and that previously built on sites can be reactivated both as places of their own and as parts of a larger network as instruments unfolding the new urban realities. This also enables the landscape architect to become more intrinsically engaged in "programming the urban surface." The physical connections which will activate peripheral zones by infilling blighted cities through realizing new greenway networks based on recognition of the interaction between the public and private realms, and the built and natural environments as all interconnected parts of one larger system of urban synergy.

As Steiner suggests, landscape ecological urbanism provides a foundation to bridge the gaps between theoretical approaches of landscape urbanism and the scientific approaches of urban ecology by recognizing that cities are essentially human dominated ecosystems (Steiner, 2012). By acknowledging that landscape urbanism projects can improve the quality of life in cities, we can now advance our systems thinking as to how these projects can become more integrated into the related discussions of ecosystem services and the future of urban form. Is it possible to begin to think of greenways, not in terms of left over spaces, but more in terms of promoters of value in a city? Can a new type of deliberate greenway planning connect valuable amenities in our cities? Will the new type of greenway planning be that of the value laden greenway? That is to say, that it will be planned by analyzing existing amenities such as schools, parks.

Designing a Value Laden Greenway for Baltimore

By looking at historical and emerging trends in landscape architecture we are given perspectives for which to approach these legacy cities and propose design solutions. By taking into account physiographic, cultural and ecological inventories with modern and evolving land use and design practices we are able to move forward in implementing the re-adaptation of urban spaces to be new types of greenway networks and sustainable urban infill projects. The concurrent phases of this project will look at how Baltimore fits all the criteria of "Legacy City" as a result of declining industry, social stress, shifting economics, there exists a city now, which was built for 1,000,000 residents, but now has nearly half that, with an outdated and aging infrastructure. The city is becoming increasingly fragmented, (spatially and socially) as a result of shifting demographics, social responses to development trends, and the physical geography.

Baltimore's gridded system stemming from spoke and wheel planning has guided land use policies stemming from the foundation of the city as a seaport through to today. Most movement and activity is organized along north - south running collector streets acting as the spokes while there is significantly less infrastructure dedicated to lateral east west movements of people. And all movement is relegated to the automobile which has severe economic and environmental consequences. There is however an engaged civil society, a number of active large private institutions (namely medical and educational), a large (but perpetually diminishing) Recreation and Parks Department, an expansive but inefficient public transit system and a noteworthy green infrastructure. Of particular interested is high number of vacant and empty lots within the city. Their number and proximity offer an interesting perspective for which to view their future uses as connecting points between residual spaces and potential increase in their ecological as well as cultural value.

Chief among this significant green infrastructure are the Gwynns Falls, Jones Falls, and Herring Run stream valleys. While these are cultural and ecological assets for the city, the fact that they are not part of the same unified network system is a detriment to the greenways themselves and the communities that make up Baltimore. It is proposed that by looking at the land in between the greenways we will be able to propose a value laden connecting route, based on anchors.
Anchors to be considered to help delineate a meaningful route are cultural amenities, schools, universities, public open space, parks, vacant land, brownfields, highpoints with views, historically significant spots, new economic opportunities, and existing economic opportunities. It is thought that by creating a unifying route anchored by these institutions there is the real opportunity to increase access between existing neighborhoods and between the three Baltimore greenways so that social and ecological systems can be made stronger.

Figures 6-4: Examples of possible anchors located between the stream valleys to determine future greenway network route- vacant land, public park, and existing infrastructure corridors

As the greenway network brings more social connectivity in and between neighborhoods there emerges the next phase of addressing how to activate underused land along the route in an economically and ecologically productive manner. Four categories of future land use to consider along this new greenway network are public works assistance, public open space, regenerative land, and productive land. Looking at the new greenway network through these lenses will offer design interventions which help define the greenway as more than just a connecting route, but as an emerging and cultural and ecological amenity that is adapting to new forms or economy and geography.

Conclusion

It is thought that the network will take on various forms as it integrates the duality of the existing urban grid and the existing natural green stream corridors. It will provide unique user experiences of new ways to engage the various local systems which are interconnected. The previously discussed theories of ecological urbanism, synergism, and the role of ecosystem services through place making will act as a guide in land-use issues and networking in a "Legacy," post-industrial, fragmented city of Baltimore, so that a responsive, holistic network can emerge, highlighting issues of multifunctional systems, sustainability and urban livability. An inventory and analysis process which defines a proposed route and design interventions which make that route a reality in response to physiology, changing economies, and adaptations to climate change can act as an example for cities as they morph through various phases into a sustainable post-industrial urban economy.

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Civilizing Ecological Landscape through Assimilation of Urban Parks & Vacancy: A Case Study Baltimore, MD

Elizabeth Carroll

A gap between public support and urban sustainable design is evident through acknowledging the majority of the work done in urban sustainability efforts has been led by architects and has been relatively limited. Leadership in Energy and Environmental Design (LEED) certification for example was a sustainability effort developed by and for architects therefore lacks in identifying sustainable practices beyond the building. Only until recently has there been a system of identifying sustainable practices among our larger infrastructure and territory, the Sustainable Sites Initiative (SITES) which itself has not become fully integrated within city planning and design. Sustainable landscape practices have yet to be frequent in urban cultural norms. A reason for this is may be partly due to the traditional urban parks' 'formal' design specifically with distinct borders separating itself from everyday living thus adding to the disconnected impression of ecological design. A new sensitivity and outlook between ecological design and public perception needs to be examined in order to discover the links between ecological design integrity and ambiguity.

A first step towards filling this gap is to understand the existing assimilation of ecological practices within urban communities, thereafter investigating how successes may be expanded upon, and lastly filling in city-wide issues with innovative strategies to connect with a broader audience than its present. In order to tackle this ambitious assimilation a new perspective on the conceptual framework of urban park design it required. One of the ways to begin to shift the conceptual outlook is to observe city issues as opportunities to change or design accordingly. For example as industrial cities across the United States continue to decrease their populations, in cities such as Cleveland, OH, Detroit MI, and Baltimore, MD, vacancy has become a major concern. Particularly in Baltimore City currently one in nine properties are vacant 65% of which are in an area without development demand. Further, Baltimore is only the 26th worst vacancy rate in the United States, clearly depicting national concern (Hopkins, 2012). A new outlook addressing vacancy as an opportunity to build or connect with existing landscapes such as urban parks could begin to shift the assimilation.

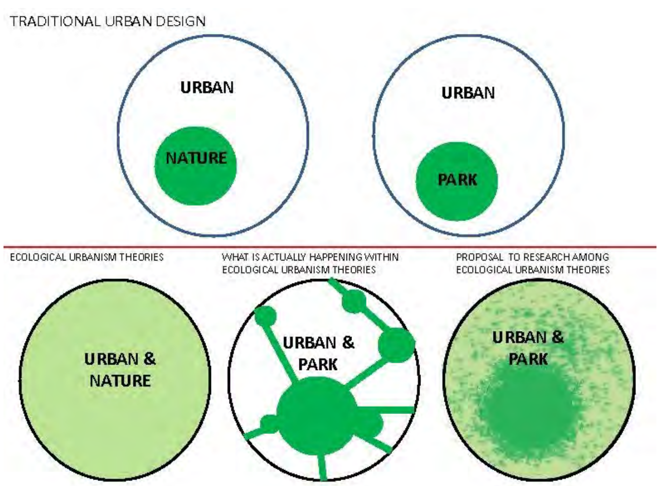


Figure 7. Conceptual Diagram demonstrating the 'blurring of urban park boundaries' and how it may differentiate itself from current theories

This research will focus on a synergistic approach amongst urban park systems and their city structure. It is aimed to discover how to better synthesize ecologically beneficial landscape among community cultural language in order to generate informative influences of ecological practice throughout the public realm; through design alteration of existing public parks using an existing city-wide concern, vacancy as an opportunity to transform the ecological lens.

Cultural Perception of Ecological Landscapes

Ecological quality is understood through a cultural lens. In the United States this often reverts back to the naturalistic style of urban parks originated back to the 19th century outdated design principles. These American cultural norms have changed the cultural perception of nature. Nature is seen through a secondary lens and often understood as a discrete component rather than understood as a dynamic system (Spirn,1998). This current perception is ultimately what needs to be attended to and shifted and can be through exposure and experiential ecological design in familiar spaces.

Studies have been done on the ecological cultural values of residential design. Research found American cultural values of ecological design norms to conform to what 'the neighbors appear to prefer' as stronger than cultural norms that favor particular conventional landscape characteristics, like large areas of mown turf. In other words, residents will become more attracted to ecological design and integrate them in their landscape if others around them do or if they become acquainted through their peers. Cultural values of residential design favor 'acceptance' over conventionality, and a sense of pride or sense of neighborliness is integral to the progression of ecological design. (Nassauer, Iverson, Zhifang, Dayrell, 2009). This research exposes the possibility a slow integration into social norms among neighborhoods will ultimately encourage a new ecological perspective.

Biodiversity Concerns in Urban Communities

The generalization that urban vacant land encompasses a large proportion of exotic species classified as agricultural nuisances and garden escapes is apparent in Baltimore City. Researchers in Baltimore, MD measured the spatial heterogeneity of vacant lots surrounding an urban park in the downtown district, Harlem Park. Within this study vacant lots and residential backyards were identified within a nine block square area surrounding Harlem Park. The study identified 117 species, 21% were identified as native, while 47% were identified as invasive.(Tauzer, Pickett 2009). The Harlem Park study also found a significant negative linear regression between species and lot area. This finding indicates backyards size lots typically have higher species richness than larger lots, revealing the fact communities can have a significant influence of the biodiversity of an area, even within even as small of a space as a backyard.

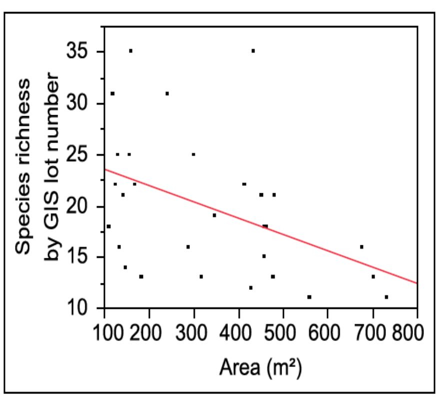


FIGURE 8. HARLEM PARK SPECIES RICHNESS & AREA REGRESSION ANALYSIS

The scientific consequences among community involvement recently have been researched.

Researchers found community characteristics and traits of the landscape can affect urban biodiversity. Research found, "distribution of the species was largely conditioned by the management methods applied to the green spaces: specific management strategies were associated with specific community traits and composition" (Bertoncini, Machon, Pavoine, Muratet, 2012). These research results demonstrate an established relationship between human practices and characteristics of plant communities and how they may positively affect one another. From these results we can assume there is an opportunity to affect plant and animal ecological habitats through community common routine behavior. A synergistic approach to the connection between biodiversity, park systems, vacant land, and backyards (communities) is integral to the ecological perception and urban ecological biodiversity.

Landscape Ecology

Richard Formans' landscape ecology is based on spatial relationships, changes in species, energy, and materials as key elements of sustainable development. The theory describes a "specific juxtaposition, adjacency, and connection of spatial units has manifold effects on the system, including regulatory processes" (Forman, 1990). Foreman takes a structural approach to landscape ecology and explains the objects, species, energy and materials are distributed in relation to the size, shape, numbers, kinds and configuration of the ecosystems and landscape present. Forman proposes adjacencies will ultimately form a landscape type and shape. The four basic landscape types contain two landscape elements, ecosystems and land uses indicated in black and white (Forman, 1990).

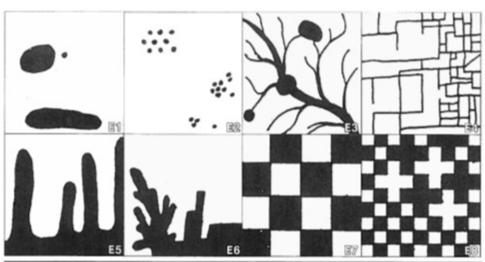


Figure 3. Richard Foreman's landscape types: E1:E2: scattered patch landscape E3:E4: network landscapes E5:E6: interdigitated landscape E7:E8 checkerboard landscape

Forman's landscape ecology tells us two specific points 1. biodiversity will be affected by the spatial configuration of landscapes and 2. adjacencies will form the landscape type, ecological value and landscape shape. The study of spatial units and spatial configuration is an essential component to the research on a new urban park perspective. The shapes and types of landscapes that may form its adjacencies need to be studied at a scale of an urban park structure itself. Specifically, what should be studied is how boundaries may be transformed to form a new landscape types integrating ecology into new forms. Landscape ecology can be built upon within the urban context by not only looking at existing landscape but opportunities of landscape and how those shapes and adjacencies will affect each other over time.

Landscape Urbanism

Charles Waldheim coined the term Landscape urbanism (Waldheim, 2006; Steiner, 2011) in the mid 1990's. Landscape urbanism holds the belief landscapes should be the fundamental building block of city design as opposed to the former, in which city planning designated green space as only the leftovers after buildings, streets, and infrastructure. In other words, the landscape or natural processes within landscape urbanism forms the city planner's decisions.

Although Landscape urbanism remains a relatively new theory there are a few examples of the conceptual workings coming to play. New York City's Fresh Kills Park located in Staten Island is over 2200 acres once a designated landfill has been redesigned with a 30-year plan to be restored and converted into a park including reclaiming toxic wetlands surrounding the landfill (Steiner, 2011). What makes Fresh Kills Park so unique not only is the idea of reclaiming the largest landfill in the world, but the integration of time within design allowing for flexibility through phases of the park design(See figure 1). Often landscape urbanism project designs blur the boundaries between paved or urban design and planted, soft surfaces, while suggesting evolutions in human use (Steiner, 2011). Landscape urbanism projects also often contain a common theme of bringing the people within the natural ecological designs along with reclaiming and restoring neglected or harmed habitats. Bringing the public and nature together to occupy the same space has underlying goals off addressing social, cultural and environmental dynamics playing off one another (Steiner, 2011). Landscape urbanism addresses the cultural and economic influences while intertwining them in landscape design.

Figure 4. Fresh Kills Park Staten Island: Example of Landscape Urbanism stresses the importance of time and phase flexibility integral to cultural and economic influences

Although landscape urbanism focuses on reclaiming space as ecological, it insinuates ecological practices will develop within the public mind set, when not addressing beyond the park. The urban park itself is reinforcing the idea that nature is separate from one's everyday life. Particularly the park used in this example, Fresh Kills Park is beautifully designed ecologically-driven public park which would enhance the lives of many people. A gap in the thought is the park is not fully integral to a city, when designed as destination. Park systems should be integrated within the whole society as part of the ecological shift there will be a greater influence on ecological value throughout the urban context publically and privately, as the cultural language shifts to a more ecological enthusiasm. The proposal becomes to observe existing public parks beyond their perceived boundaries looking further than the parks themselves in order to connect with a broader audience.

Ecological Urbanism

As the population growth increased dramatically after the Industrial Revolution, the housing market boomed and new neighborhoods formed, the conventional methods of city design could not keep up with ecological function. Industrial cities have since shifted as populations have moved out of urban settings leaving a higher supply of housing than current demand. The urban context particularly in these types of cities is essential to be aware of within sustainability studies and design strategies, as they are integral to the urban fabric.

Ecological urbanism embraces the idea our natural resources are depleting and uses it as an opportunity for exploratory design innovations rather than as a form of technical regulations of conventional solutions (Mostafavi, Doherty, 2011). Ultimately this means urban issues faced today should shape our actions and create opportunities to define new approaches to design rather than be seen as detriment or a set of required regulations within to urban design.

Ecological urbanism observes traditional scientific study of ecology which focuses on entities and classification while noting contemporary scientific ecology emphasizes change and process. Current ecological design has begun to but has not fully progressed to emphasize change and process within its theories, as it should to coincide with scientific ecology progression. This shift in thinking Gregory Bateson calls the "economy of flexibility" entails the "dynamic interrelationship between flexibility and formed habits, or habits that must be open to their own conditions of instability and change- that produces the ecology of ideas as an evolutionary process (Bateson, 1989). In other words, it is the combination of traditional knowledge and the flexibility of responding to physical and non-physical variables that create the evolutionary processes that which ecological urbanism addresses. Ecological urbanism analyzes and strategizes design principles using time and flexibility as a vital variable within its structural analysis. Within its flexibility ecological urbanism combines the benefits of both bottom up and top down approaches to urban planning through a multidisciplinary approach that is understood and implied through many cultural facets and fields of education. In this way the conceptual theory is very malleable. It is here where the theory is reputable.

Ecological urbanism is useful in its conceptual framework of flexibility and malleability, its bottom up, top down approaches but lacks to address the question, how do you steer the public in the right direction? Ecological urbanism seems to be quite general its theories and does not specifically address how an ecological shift may happen through public influence. The theory assumes flexibility will allow or insinuate an ecological shift to happen, without any proof. The theory could be strengthened for example by focusing on a catalyst to steer the progression of a project in the ecological direction, with such a variable as community interest.

Goals & Objectives

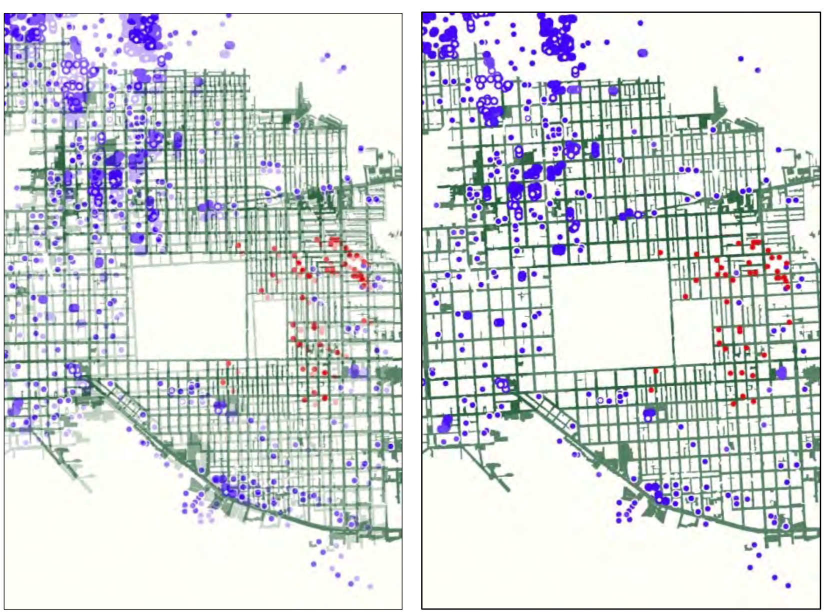
The goal of this project is to 'blur the boundaries' of existing urban parks through a slow, flexible strategy of social-ecological integration, ultimately improving an area's biodiversity. Objectives include increase public interest, address vacancy as an opportunity to improve ecosystems, and establish time and flexibility of a fluctuating urban context within the landscape design principles.

Methods

This project will conduct on a case study on an urban park in Baltimore, MD, Patterson Park, a 155-acre park traditionally designed space containing green space with tennis courts, softball and football fields, walking paths, garden clubs, an ice rink and swimming pool. Patterson Park is located in a neighborhood with a wide range of demographic characteristics and is known as "The Best Backyard in Baltimore." This project will aim to increase plant and animal biodiversity within a five mile radius of Patterson Park, truly into 'Baltimore backyards.'

The project will identify vacant lots within a five mile radius of the park. Using the structure of a similar project conducted in Baltimore City on the biodiversity of vacant lots, these vacant lots will be measured by Area (ft^2), length/width, distance from Patterson Park, distance to nearest lot, Area(ft^2) of other vacant lots within half a block buffer, and distance to private residential property, all in correspondence to their species richness. The patterns of biodiversity progression will be identified frequently and shape the design process along the way. The success of the project would be determined by the amount of biodiversity increase within the 5 mile radius.

This process will also use landscape ecology as a technique to analyze and discover relationships between landscape types and other existing city conditions. It will identify the matrix, patches, corridors, and interdigitized landscapes. This project identifies landscape types through landscape and vacancy as part of the adjacency identification. The matrix will identify backyards and vacant lots, the streets and alleys as corridors and the existing parks, open lawns and bodies of water as patches. These landscape forms will then be layered and analyzed as to how they may positively affect one another. This analysis will develop a theoretical strategy to "grow" the park itself. It should be noted this strategy does not specifically require vacancy as a variable. The observation of industrial cities and their 'patches' of vacancy could be very beneficial to become part of the theory and gather a more informative argument to the process of ecological landscape planning.



Results

This ongoing project will conduct the analysis and design methods described above.

Figure 5. The start of the identification the matrix, patches, corridors

Discussion

Landscape architecture has progressed in recent years through such theories as landscape urbanism and ecological urbanism both of which claim bringing people into ecological design coupled with a concept based on flexibility and time will ultimately affect the greater social and economic influences in a beneficial way. However these theories have not addressed their theories among a broad enough audience. The theories fail to address public assimilation as integral to their concepts. It has been found that perception of nature is cultural and public perception of ecological design has been found to be strongly influenced by a sense of pride among a neighborhood, revealing an opportunity to adjust perception of nature to have a higher ecological value through 'neighborhood culture.' Landscape urbanism has produced beneficial results within park systems themselves but has failed to address conceptual thinking outside of the park itself, and into cultural neighborhoods. Ecological urbanism has allowed for a flexibility 'timeline' predicting for a greater possible outcome over a longer period of time, although it does not address how to pursue the public interest to advocate an ecological direction. Landscape urbanism and ecological urbanism theories seem to be designing with the outdated traditional existing park design, specifically with distinct borders. The common park system design is outdated and requires a fresh adjustment on existing design in order to improve its connection among the city and its people. A new design outlook is required in which there is a 'blurring of urban park systems' encompassing direct community involvement, an emphasis on urban park adjacencies or borders within the design mechanism and an integration of time and flexibility within city design. If landscape urbanism and ecological urbanism foresee the integration of ecological design within the city, there must first be a collaborative effort among a broader audience by starting with design amendments among existing conditions.

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7. GREEN INFRASTRUCTURE AND ECOLOGY

Synthesizing an Integrated Green Infrastructure - Establishing a Conceptual Planning Framework in the Western United State's Urbanizing Communities

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Introduction

Planning methodologies in the United States have continually evolved and adapted to address the myriad of environmental and social issues faced by contemporary culture (e.g., Thompson and Steiner, 1997; Calthorpe, 1993), but few have provided the framework to successfully address these subjects simultaneously and comprehensively, and fewer effectively meet the evolving demands society places on human and ecological systems, especially in urbanizing areas, where ecological fragmentation and land use conflict predominates.

Currently, most spatial planning frameworks assess ecological-based and social-based systems as separate entities (Weber et al., 2006; Daniels, 2009), and our understanding of the interrelationships between these systems is incomplete (Wu, 2006). In the United States's continually transmuting landscapes, planning practices must modify and expand (Armitage et al., 2009) to support an integrated approach to solve modern society's complex temporal and socio-spatial problems (Berkes et al., 2003; Waltner-Toews et al., 2003). In 2009, Termorshuizen and colleagues indicated the absence of such an integrated planning methodology, and to date (2013) this has not been accomplished. A crucial first step in contributing to such an approach is the initiation of a clear and consistent conceptual planning framework. This paper will provide such a framework.

Context

Social concerns and ecological functions were effectively combined as early as 1857 with the work of Frederick Law Olmsted in New York's Central and Prospect Park as well as Boston's Emerald Necklace (Daniels, 2009). Ebenezer Howard's early work for Garden Cities (1902) in the United Kingdom built upon Olmsted's concepts (Daniels, 2009) to include greenbelts to facilitate balanced urban growth and "a steady state of green and service infrastructures to support the communities that reside there" (Mell, 2007).

Though Ian McHarg did contribute an influential model for analyzing and combining "social values" of the landscape in the late 1960's (McHarg, 1969), this early approach was broad, vague, and analyzed the situation with respect to the "costs to society" from an environmentally-exclusionary perspective. McHarg's overlay technique (e.g. social values and hazardous areas concurrently) promoted a rationalist, spatially-explicit land use planning technique which directed the location of the social and ecological systems, and did not integrate them.

Though current practice and research now frame these early pioneering concepts within contemporary landscape and urban planning, this multi-functional landscape ideal has been

largely forgotten, particularly through the conservation and preservation priorities prevalent in the United States, isolating large tracts of land with limited management cohesion and disconnect from the broader ecological network and systems (Miller and Hobbs, 2002).
Since the mid 1990s, ecosystem theory has broadened to incorporate humans not just as outside disturbances but as integrated with other biological and physical processes and their structures (e.g., McDonnell and Pickett, 1993; Alberti, 2008). However, spatial planning paradigms in the United States perpetuate the independence of sociological systems and ecological systems.

This ideological division between the social sciences and the natural sciences regards each as autonomous systems (Koomen et al., 2008) where the human or sociological-based systems view all processes internally without external or ecological impacts (Berkes et al., 2003) and the natural or ecological-based systems consider humans and their actions as external or segregated from the ecosystems (Liu et al., 2009). As interrelated systems thinking has increased within the discipline of spatial planning and landscape architecture, so too has the need for improved theory and concepts.

Green infrastructure, a relatively new methodology in spatial planning, utilizes systems theory and presents a compelling approach to resolve many of contemporary society's land use concerns and merits further examination. The term 'green infrastructure' was first developed by Mark Benedict and Ed McMahon (2002) of The Conservation Fund (TCF) in the early part of this century and is defined as follows:

> *Green infrastructure is an interconnected network of waterways, wetlands, woodlands, wildlife habitats and other natural areas; greenways, parks and other conservation lands; working farms, ranches and forests; and wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources and contribute to the health and quality of life for (American) communities and people. (p. 6)*

Though this definition goes beyond traditional environmental planning concepts to incorporate human livability while maintaining natural-system importance (Kambites and Owen, 2007), its focus on ecological processes misses a more inclusive framework for applying systems thinking and interconnected strategies to a broader range of elements beyond ecological systems to include cultural, social, historical, economic, and political resources, among others.

Green infrastructure practices in the United States primarily focus on ecological and natural system conservation (e.g., The Conservation Fund, 2007; The Trust for Public Land, 2010; Weber et al., 2006) and emphasize analyses and critical land protection that support biodiversity and conservation biology (Weber et al., 2006). Though Benedict and McMahon's definition of green infrastructure provides an anthropological approach (i.e. ecosystem services), the fluid integration of nature-centered and human-centered strategies is not yet fully represented in current United States based spatial planning practices (Kambites and Owen, 2007). Evidence that green infrastructure planning can successfully transcend an ecological framework is evident outside the United States, particularly in Western Europe and the United Kingdom, where green infrastructure planning is being practiced comprehensively (e.g., Science for Environment Policy, 2012; GIFT-T, 2012; Cambridgeshire Horizons, 2011), but only as an integrated outcome (i.e. benefits for humans *and* people), not the methodology itself.

While the idea of identification of ecological resources is a vital part of any spatial planning effort, acknowledgement of the validity in including human-based, or sociological, considerations in green infrastructure planning is predominately relegated to economic valuations of ecosystem services (Costanza et al., 1997), or the benefits people obtain from ecosystems (e.g., Paetzold et al., 2010, de Groot et al., 2002). This shift in approaches from a preservation and conservation emphasis towards ecosystem services and multifunctional benefits presents a strategy to evaluate resources in terms of how they support human well-being (Paetzold et al., 2010), but researchers must not limit the values to strictly economic or ecological measurements.

Green infrastructure can potentially provide a wide range of social, economic and ecological benefits (e.g., Kambites and Owen, 2007; Benedict and McMahon, 2006), but it is the merit of the comprehensive planning concept itself, not just the benefits, which must be acknowledged to structure a revised methodology. The challenge is to bring together socio-ecological systems in a comprehensible, replicable and integrated framework. Through the assimilation of broader typologies within green infrastructure's ecologically-based planning matrix, a more complete interconnected systems approach that allows for richer ecological analysis (Mell, 2008), socio-cultural-based resource acknowledgement, and increased understanding of contemporary urbanizing society can be achieved.

Goals and Objectives

The goal of this paper is: 1) to validate the need for a more integrated spatial planning framework in urbanizing landscapes, 2) to show how a case study did produce such an integrated framework, 3) to critically analyze the case study's strengths and weaknesses, and 4) to provide a discourse to improve future frameworks to incorporate socio-ecological systems.

The objective of this paper is to illustrate a conceptual framework which recognizes the importance of ecosystem services, landscape integrity, and stewardship in urbanizing landscapes of the western United States.

The paper illustrates through a case study examination how to successfully acknowledge, document, and synthesize a comprehensive system of resources, placing what have been traditionally disparate approaches (i.e. anthropological-based and ecological-based resources) within the context of a proven yet expanded green infrastructure methodology.

Case Study Introduction

A new approach to land use planning was essential to prepare for the projected 2.3 million residents (WFRC, 2012) who will occupy the Wasatch Front by 2040, most of whom will reside along the region's urban corridor (Ogden-Salt Lake City-Provo). *(re)connect: The Wasatch Front Green Infrastructure Plan* (2012) is currently undergoing implementation in the Salt Lake City Metropolitan Region by the Wasatch Front Regional Council; a 60 city, 5 county planning organization promoting cooperative problem resolution and planning coordination among local governments (WFRC, 2012). It must be noted that the author of this paper was also the lead consultant for the case study. In the case study presented, social and ecological-based resource frameworks were merged into a single green infrastructure planning approach in northern Utah, one of the most rapidly expanding areas within the United States.

This case study review does not to discuss the data, rationale, or criteria in determining the green infrastructure networks themselves, but does emphasize that these steps provided a methodology to facilitate comprehensive green infrastructure planning. Separate sets of criteria determining the highest quality green infrastructure resources were used to identify and map the green infrastructure networks – their cores, hubs, and corridors - traditional green infrastructure components. The primary spatial modeling tool used in (re)connect to complete the mapping process was ArcGIS ArcMap 10.

(re)connect incorporated sociological resources in its spatial planning framework for two reasons: First, (re)connect's asset-based approach to green infrastructure intended to be as thorough as possible in the identification of landscape resources that provided benefits and services to the region's residents. There were many ecological as well as socio-cultural resources that provide recreational, psychological, economic, and public health benefits (Paetzold et al., 2010, de Groot et al., 2002) which this methodology endeavored to denote.

Second, (re)connect promoted the understanding that socio-cultural systems need not be viewed as inherently separate from natural systems. Human land-use patterns often conflict with natural systems (e.g., Lyle, 1999; Turner et al., 1990) which is why human-affected landscapes are so ubiquitously regarded as distinct from the surrounding "natural landscapes" (Steiner, 2002) in planning disciplines. This notion of separation perpetuates in the dissociated development patterns and fragmentation of landscapes (Tzoulas et al., 2007) throughout the western United States. Socio-ecological systems, as supported by Berkes and Folke (2003), are interrelated and in flux; this viewpoint also positions humans as part of nature and the authors consider the separate characterization of these two systems to be assumed, culturally induced and inconstant.

Each green infrastructure project requires a slightly different planning approach based on its objectives and the regional differences in green infrastructure resources. The Conservation Fund has used an array of methodologies. (re)connect selected from, and slightly modified, those strategies to arrive at a green infrastructure network approach that accounted for the specific context of the Wasatch Front. This case study demonstrates how an integrated socio-ecological network might be developed and utilized by planners in making proactive, sustainable decisions.

Case Study Framework Development

Ecological-based resources are important components of any green infrastructure planning approach, but they were only one of five resource categories examined; (re)connect developed a unique methodology to enable the assessment of sociological landscape benefits and community resources in addition to the more commonly evaluated natural-based resources.

(re)connect viewed the Wasatch Front's resources from an asset-based perspective, not the common reactive or 'fear of loss' position. This approach first identified the service-providing socio-ecological systems, or comprehensive green infrastructure resources, then discerned ways to strengthen them through stewardship actions, spatial connection, planning recommendations, and land use strategies, the latter of which is not discussed in this paper but important to the context of the methodology.

The following steps outline the integrated green infrastructure methodology utilized in (re)connect:

Step 1: Development of the Socio-Ecological Green Infrastructure Typology Spectrum

(re)connect's integrated methodology represented resources from across the spectrum between natural-based and social-based typologies (figure 1). These resources were not mutually exclusive, and did not always conflict with one another. Conversely, these had the capacity to strengthen one another (e.g. mountain trails and water quality), particularly when recognized through the conception of ecosystem services and stewardship.

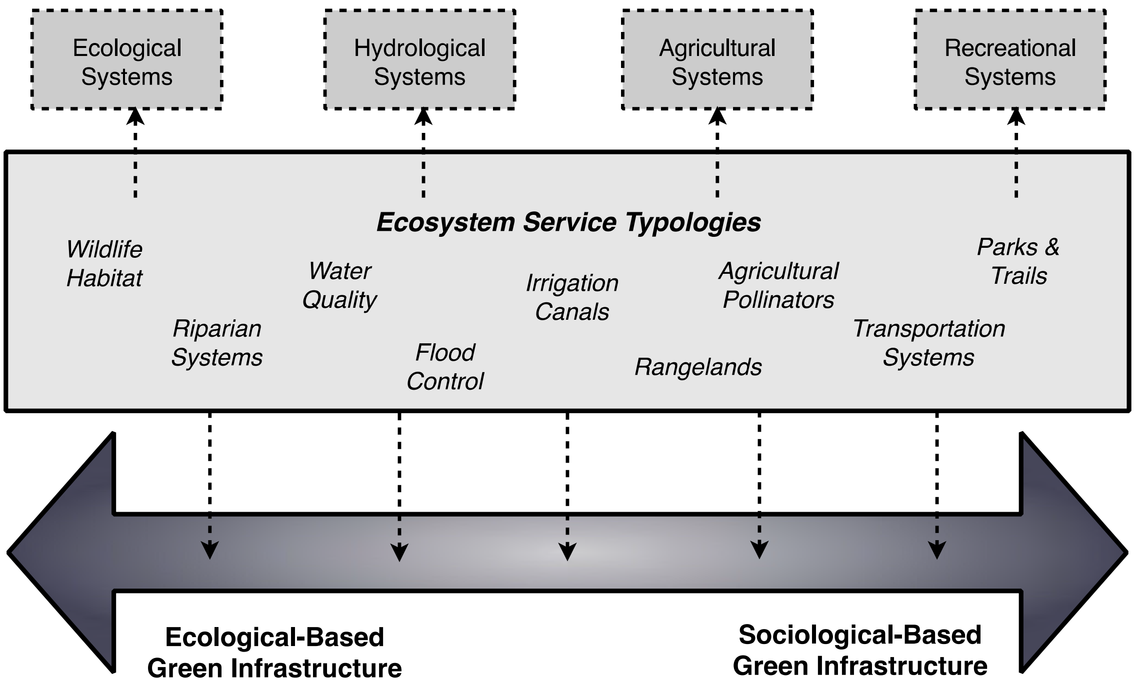

Figure 1: Socio-Ecological Green Infrastructure Typology Spectrum Diagram
The ecosystem services listed on the far left were important for ecological-based (natural) system performance. Those on the far right were beneficial to sociological-based (human) system functionality, and those in the middle were of value to both natural and social systems.

Ecosystem services, or benefits that people derive from ecosystems (Daily, 1999), provided this planning methodology with a means to initiate the social green infrastructure framework, and was similar to that of the natural, or traditional, green infrastructure approach.

Step 2: Definition of the Asset Network Typologies

(re)connect's methodology identified the predominant resource priorities and goals held in common by the many and diverse stakeholders. These collective planning considerations were organized into five (5) asset network typologies or categories (figure 2, top) as defined through the resource system typology spectrum (figure 1, top)

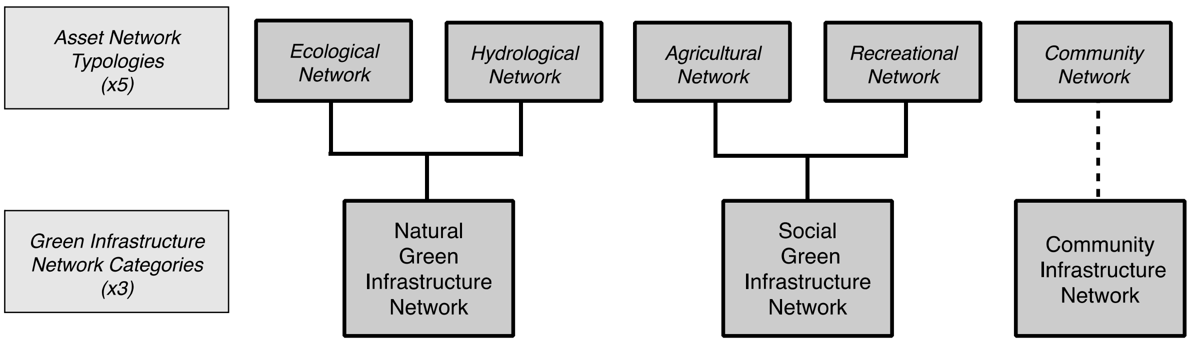

Figure 2: Asset Network Typologies and Green Infrastructure Network Categories

Step 3: Aggregation of the Asset Network Typologies into Infrastructure Network Categories

A set of composite, or combined, infrastructure networks were synthesized to better assess the interrelations of the individual asset network typologies (figure 2, bottom). Being aware of the foundational contradiction between ecosystem integrity and human land uses (Forman, 1995), the five (5) asset networks were combined into two (2) final green infrastructure networks rather than one (1) overall network, and one (1) community infrastructure network. For the purposes of this paper, ecological integrity is defined as the ability of an ecological system to support and maintain a functional community of organisms and hold resilience to disturbances (Parrish et al., 2003).

The natural green infrastructure network synthesized the ecological and hydrological assets. Since recreational and agricultural or working lands assets represent human benefits, and cultural land uses contrast natural processes (Forman, 1995), they were combined into the social green infrastructure network. The community asset network, comprised predominately of built infrastructure, was not incorporated into these two composite green infrastructure networks, but was simply renamed the community infrastructure network and is utilized later in the methodology's process. Though this last network was not given the 'green infrastructure' nomenclature, it does retain the concept of interconnected and service-providing 'infrastructure' and the network's composition applied the same criteria and componentry as the others to the best extent possible.

Step 4: Establishment of the Socio-Ecological Green Infrastructure Network

Through an additive process, the social and green infrastructure networks were combined to create the socio-ecological green infrastructure network (figure 3). This composite network exemplified an important tenet of (re)connect's interrelated green infrastructure approach: landscape integrity.

Figure 3: The Socio-Ecological Green Infrastructure Network

Step 5: Incorporation of the Community Infrastructure Network

The community infrastructure network (see step 1 & figure 2) consisted of built landscapes and systems that contributed to the community livability and economic vitality of the region. These resources, such as public and private institutions (e.g. libraries, schools, hospitals), transit centers, and other cultural features, are valued by humans only, and had the capacity to impact green infrastructure networks far beyond a region's physical borders.

Step 6: Synthesis of the Areas of Stewardship Opportunity

To better understand the interconnectivity of the two (2) green infrastructure and community networks, another composite network was generated which illustrated the areas of spatial overlap between: 1) the community infrastructure network and the natural green infrastructure network, and 2) the community infrastructure network and the social green infrastructure network. This was referred to as areas of stewardship opportunity (figure 4).

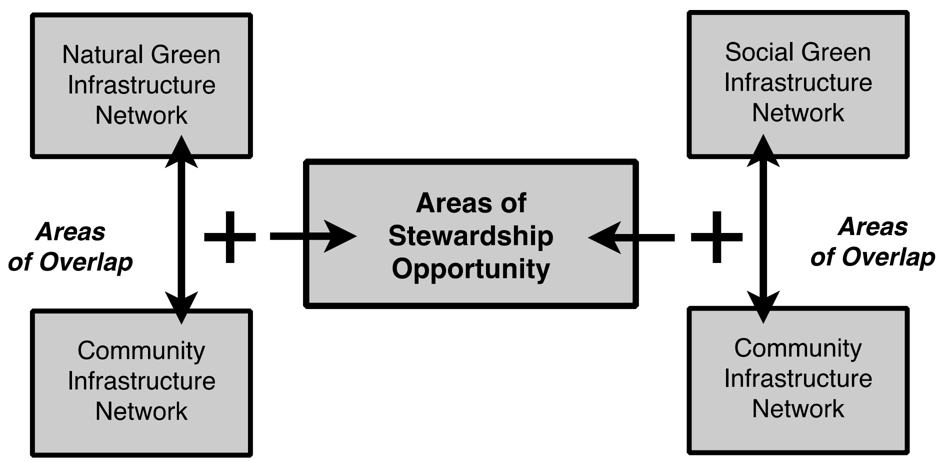

Figure 4: Areas of Stewardship Opportunity

This combined diagram simply illustrated the areas where community infrastructure resources were concurrent spatially with green infrastructure resources. These were areas where community systems may potentially have significant impacts, positive or negative, upon green infrastructure systems. As such, the network can be viewed as potential areas of opportunity for stewardship actions.

Case Study Summary

(re)connect: The Wasatch Front Green Infrastructure Plan has illustrated a comprehensive methodology for analyzing and integrating two disparate frameworks into a conceptual planning approach which acknowledges their distinction yet interrelatedness. The purpose of this green infrastructure planning framework was to first identify then synthesize the highest quality ecosystem service providing resources into various networks which provide the basis to make proactive spatial planning decisions.

This case study has promoted an inclusive understanding of the Wasatch Front's resources which enabled the recognition of not only the natural systems, but also the built, designed, and sociological systems of the region; and it provides a characterization of how these systems contribute to the region's economic vitality, social livability, and regional sustainability. The many distinct systems (figure 1, top) that intermix and connect communities are the foundation for this methodology. These networks of resources and systems perform a wide range of functions and deliver many services. Augmenting green infrastructure in the Wasatch Front, a process which will require stewardship, provides an opportunity to accomplish many planning goals held in common by the varied stakeholders.

There were significant findings from the development of this case study's framework. The traditional green infrastructure planning approach (Benedict and McMahon, 2002; TCF, 2006) is based on landscape ecology principles and green infrastructure planning projects completed to date (2012) in the United States have been in largely undeveloped, natural areas. The Wasatch Front region and Salt Lake metropolitan area is heavily developed and urbanized yet surrounded by dense pockets and large tracts of unimproved, wilderness expanses. The principles of green infrastructure as developed by The Conservation Fund had to be slightly modified to work within the context of the region's urbanized landscape. As shown, this challenge was met by separating the green infrastructure networks into social-based and natural-based resources.

Discussion of Results

(re)connect: The Wasatch Front Green Infrastructure Plan demonstrated an alternative approach to spatial planning in the western United State's urbanizing regions. Though there is a breadth of literature advocating socio-ecological network interrelationships, planning disciplines have not yet fully facilitated an approach to address these systems concurrently and completely. This paper summarizes such a framework; however there are both advantages and disadvantages to this conceptual planning framework.

As shown, this new approach to spatial planning provided pragmatic insight and theoretical relation to important emerging planning principles: community infrastructure, stewardship, ecosystems services, and landscape integrity.

Community systems interrelated with the green infrastructure networks through the concept of stewardship (figure 4). Worrell and Appleby's (2000) ethical and practical definition of stewardship supports this comprehensive socio-ecological framework (figure 3); it recognizes ecological health, a long-term perspective, and the integrated societal interests including private and economic concerns in the responsible utilization of natural resources.

Stewardship is critical to maintaining diverse capacities and benefits and the delineation of areas of stewardship opportunity (figure 4) is a key knowledge tool for planners. Through stewardship of the natural green infrastructure network, communities received improved ecosystem services (figure 1 - left). Likewise, enhanced regional and community identity, public health, as well as increased landscape productivity (figure 1 - right) resulted from the stewardship of the sociological green infrastructure network.

A comprehensive green infrastructure approach can provide a more integrated framework for applying systems thinking and interconnected strategies to a broader range of resources than ecological. Spatial planning frameworks that look beyond traditional ecological components and conservation priorities to apply a green infrastructure methodology that includes sociological and community typologies capitalize on the multifunctional benefits an interconnected system inherently provides (Lovell and Johnston, 2009).

The connectivity and performance of landscapes, whether built or natural, are key concepts that make the green infrastructure approach an important part of spatial planning in the expanding urbanizations of the United States, particularly when the definition of ecosystem services is continually expanding (e.g., Bolund and Hunhammar, 1999; Carpenter and Folke, 2006).

The term 'landscape integrity' has been primarily discussed within landscape ecological disciplines often to refer to 'ecological integrity' or 'ecological health' and frequently disregards the sociological context of the conjoined anthropological systems (Hellmund and Smith, 2006). As interrelated systems thinking has increased within the discipline of landscape architecture and spatial planning, the concept of landscape integrity has advanced to consider ecological and sociological functions within the landscape as an indicator of overall health or quality (Hellmund and Smith, 2006).

But this conceptual planning framework is not without its points of contention. Though this integrated conceptual planning framework does account for oft-omitted typologies and benefits (see figure 1), it is still limited to bio-physical elements and does not completely account for the phenomenological or ecopsychological benefits of socio-ecological networks. Furthermore, it is not known if the goal of landscape integrity can be realized through the foundation of an ecological-based methodology.

Additionally, the integration of sociological and ecological systems may not provide the outcome desired. Ecologists have warned that merging the two systems may result in undesired outcomes such as habitat and species loss (Agrawal and Gibson, 1999). Sociologists cite the lack of demand for a more integrated form of green space planning and design (Bowman and Thompson, 2009), such as new urbanism.

Notwithstanding, both humans and nature benefit when these resources are perceived and planned as an interconnected network (figure 3), whether directly or indirectly (Lovell and Johnston, 2009). Green infrastructure planning provides the foremost framework to understand these concepts within the larger context of the fields of natural sciences and social sciences. It is through this evolving integrated socio-ecological framework in spatial planning that the numerous and diverse benefits and services to humans and nature (e.g., de Groot et al., 2002; Benedict and McMahon, 2002) can be further studied and acknowledged.

Conclusion

Spatial planning practices must evolve to consider the social, cultural, and economic benefits a community receives from its landscapes, which in turn must maintain their saliency and productiveness in both their natural (ecological) and anthropological (social) frameworks, particularly in urbanizing areas.

The conceptual approach presented is a fundamental shift from traditional green infrastructure planning in the United States and supports a paradigm shift towards integrated systems thinking in the planning disciplines. Researchers have noted the lack of innovative planning approaches that integrate ecological and social frameworks in planning models (Groves, 2008). Broadening the concept of green infrastructure provides a valuable planning methodology to the service and application of resources. The issues contemporary society faces today are socio-ecological (e.g. resource consumption, population and housing, food production) and the solutions must then be socio-ecological based. Continued exploration, analysis, and discourse is needed; this paper adds to the increasing mix of planning theory and is a step towards the needed coalescence.

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Synergistic design: Detailing the benefits of a Green Infrastructure approach in a Western Australian Landscape

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Introduction

The National Green Network (NGN) (Kilbane 2013) is a continental-scale Green Infrastructure (GI) research project that spans the Australian continent (Fig. 1). The research intent is to create an ecologically robust and interconnected protected area network design to enhance the resilience of the nation's landscape, biota and peoples. It prescribes a framework of ecological corridors and vegetated linkages as a structure for ecological connectivity and to meet protected area policy targets defined by the Convention on Biological Diversity (CBD, United Nations Environment Program 2010) and the National Reserve System (NRS, Commonwealth of Australia & National Reserve System Task Group 2009). The NGN was conceived through a design based approach which included ecological modelling, ground truthing and detailed design stages. The ground-truth stage conducted within a 25 x 25km study area at York in south-western Australia. This location was chosen as an exemplar of the complexity needed to be addressed to create a robust system and to test the pragmatics of implementing the design. This led to confirmation of the NGN as an over-arching framework that was then broadly adjusted by participants through a design charrette workshop. The creation of a final detailed NGN design is the focus of this paper. While the research method thus far created a flexible and ground-truthed design, to ensure accurate, measurable and visualised outcomes further work was required. Three different final design options were considered in terms of relative costs and benefits. The final preferred design outcome represents a 'middle ground', a synergistic design outcome that offers multiple ecological benefits and an array of ecosystem services.

Figure 9 | NGN as framework across the south-western Australia, showing the location of the York study area

Background

GI is described by Benedict & McMahon (2006) as 'the ecological framework for environmental, social, and economic health – in short, our natural life-support system'. Benefits of a GI approach include the ability to go beyond conservation planning and to explore the cultural as well as ecological benefits through designs that address climate and land-use change and increase ecological and cultural resilience. This mandates therefore that design flexibility should be exercised in order to reconcile goals with the existing land-uses and cultural values that landscapes hold. Such planning is also referred to as 'holistic landscape planning'(Hobbs 1993), the 'ecosystem approach' (Smith & Maltby 2003, United Nations 2010) and 'multi-functional' or 'integrated' approach (Bennett 2003, European Commission 2012, Van Der Windt & Swart 2008).

This research investigated the potential of this new Australian GI, the NGN, to shift from policy to practice; from continental to local scales; from conceptual model to precise and detailed designs. A 25 x 25 km site at York in south-western Australia established a study area within which to further assess the NGN potential. Located within one of the nation's only two recognised biodiversity hotspots (Myers et al. 2000) nominated for its high degree of biological endemism (Hopper & Gioia 2004) and threatening processes including land conversion and ecological fragmentation (Hobbs 1993), this landscape crystallises many of the problems facing the region. The soils are poor (Hopper 2009) and the removal of vegetation, in particular deep-rooted trees has resulted in saline groundwater intrusion exacerbating degradation and erosion. Faunal species are in decline or extinct through predatory carnivores such as the cat and fox and climate change is increasingly altering species' range, food resources, rainfall patterns and fire frequency. Most importantly the landscape is replete with existing land-uses. High value agricultural land and existing towns have created a highly fragmented landscape matrix containing less than 8.8% remnant vegetation and less than 0.1% as formal protected area (Western Australian Land Information Authority 2012).

While efforts to enhance landscape and ecological resilience through revegetation have been undertaken in the region this has not arrested the steady decline of this landscape and its' biota. In conjunction with revegetation, increasingly sustainable agricultural practices and halting vegetation clearing has meant an increase in vegetation cover, albeit to arrest the spread of salt and maintain arability (Smith 2008). Such revegetation generally utilises indigenous species that can also benefit resident biodiversity as food source, habitat and landscape linkages. However revegetation efforts occur in a piecemeal fashion, lacking a large-scale spatial framework to provide for meaningful ecological outcomes. Furthermore these landscapes are notoriously difficult if not impossible to restore to pre-European vegetation patterns, prompting a 'novel ecosystem' approach (Hobbs et al. 2009). Such an approach can enable addressing ecological connectivity, meet CBD and NRS targets and increase ecosystem health so as to provide robust ecosystem services (Millennium Ecosystem Assessment 2005).

The Design Charrette

An evaluation of the NGN was made by stakeholders within the York study area to test the veracity of the original NGN design. A design charrette, defined as 'a time-limited, multiparty design event organized to generate a collaboratively produced plan for a sustainable community'

(Condon 2008) gave the opportunity for participants to 'ground-truth' the NGN design. This resulted in spatial adjustments to the NGN based upon their own local knowledge and expertise and refined the design from broad conceptual corridors and linkages derived from an ecological modelling process (McRae & Kavanagh 2011) to more precise and feasible designs (Fig. 2). The reconfiguration and realignment of the NGN by charrette participants did not reach a final resolved design (i.e. one that could be implemented). It did however confirm the potential of the NGN as a broad spatial framework which could then be adjusted and refined through local input. It was also noticeable how participants in the charette seemed willing to ensure that their local area would meet the overarching aims of the NGN, ensuring a broader focus to the exercise. Two 'rules of adjustment' to which the design was altered emerged from the charrette. First 'Form': the re-alignment of the NGN to landscape elements such as remnant vegetation, roads and cadastre. Second, 'Function': an exploration of multi-functionality and potential for novel ecosystem approaches to revegetation and ecological restoration.

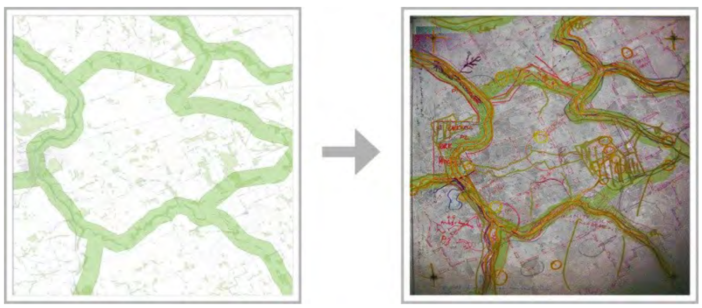

Figure 10 | Original NGN and adjusted design charrette outcome

Research Objective

The research accepted that no design can operate in isolation of real landscapes: pragmatic and place-specific designs are required. In seeking a response to the complexities and challenges previously outlined, the NGN design seeks to be a flexible entity, ably reconciling differences and bridging the gap between idea and practice through aligning this ideal model to real landscapes. This is a design that operates as a flexible framework and point-of-departure for iterative design and not as a final model, as is common in conservation planning. Therefore further to the iterative design process involving local stakeholders, the NGN required detailed designs and (at least) a rudimentary cost/benefit analysis. This was achieved by translating the charette results into an accurate, quantifiable and detailed plan for the York study area. This plan would not only 'join the dots' but also explore the potential for synergistic benefits and trade-offs between multiple land-uses. The design explores species assemblage and structure via restoration efforts to achieve multi-functional and 'synergistic' benefits, those that simultaneously maximise both ecological and cultural outcomes. Finally, designs aimed to be visual. The final design would be costed and benefits and impacts summarised with visualisations of the proposal.

Design Process (Method)

Detailed design occurred in three stages. First the 'digitisation' of the charrette design and the correction of inaccuracies. Second the trimming and adjustment of the 'form' through realignment to rural cadastre, landform and remnant vegetation. Third the exploration of ‘function’ (and multi-functionality) offered via the synergistic possibilities of ecological restoration. Calculations were then made by:

1. accounting for the area impacted under the proposal and potential income loss;
2. calculating vegetation already in existence; costs attributed restoration/revegetation efforts such as ripping of land, planting and new fence lines;
3. calculating the carbon sequestration potential ($) via the national carbon farming initiative (Australian Government 2012) and costing the relative ecosystem service benefits of mitigating salinity and soil erosion protection, increasing property values, tourism opportunities and so on.

Digitisation of the original charrette outcome

In order to create accurate and measurable designs that could be recognised for their potential benefits a translation of imprecise drawings to the digital was made (Fig. 3). To remain without bias this occurred through precise redrafting of the charrette informed by the revision of notes, recorded discussions and adherence to the rules of adjustment established at the charrette. Consequently, drawing inaccuracies were rectified where in conflict with the charrette intent.

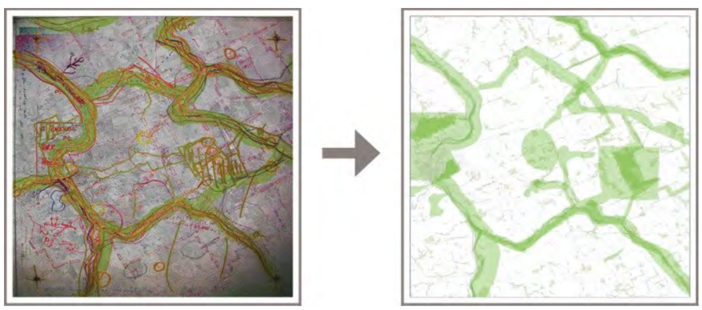

Figure 11 | A digitised version was created from the design charrette outcome

Refining the NGN Form

The second step concerned the fine scale re-alignment to landscape elements (such as remnant vegetation, roads and cadastre) to create a network hierarchy of corridors, stepping stone linkages and new core areas. The existing land cadastre was used as the basic building block for the detailed design with affected land parcels chosen and, if necessary, trimmed to align to landscape elements. As this new form wherever possible enveloped remnant vegetation patches and accepted the rural cadastre, a reduced number of land-holders are affected. This resulted in an overall reduction of the land (and therefore cost) required for ecological restoration from 10594 ha to 8039 ha as well as a reduction in fencing to just 30 linear kilometres. This resulted in a more pragmatic design (Fig 4) that closely reflects the charrette intent. The final form also created a hierarchy of connectivity linkages of varying widths and contiguousness as promoted by the charrette.

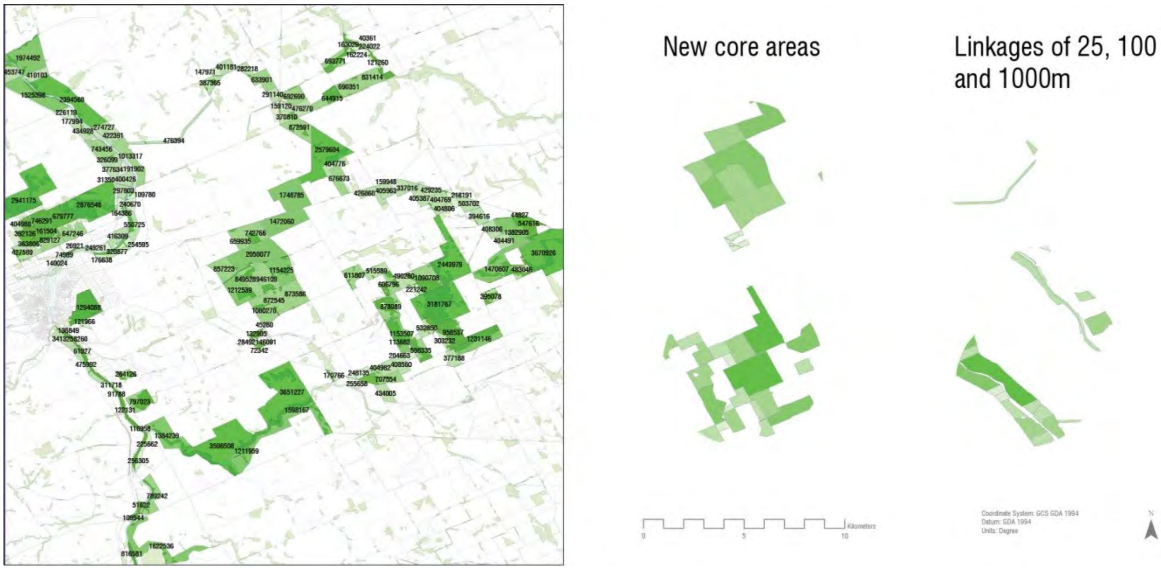

Figure 12 | Final detailed design. Inset: Detail of affected parcels of land reduced in number and trimmed.

Defining the NGN Function

While the form of the linkages was finalised; their function still required resolution. This third step explored a range of functions via ecological restoration approaches. This included high standard 'ecological' restoration, 'cultural' and alternative 'synergistic' opportunities. These created a range of 'functions' and highlighted future ecological trajectories and cultural benefits.

1. ECOLOGICAL FUNCTION. The first was a restoration approach that maximised the number and diversity of endemic species with a structure and high fidelity to pre-European ecological state. Cultural benefits, including CO2 sequestration were secondary. The cost to establish this scenario was estimated at $10,000/ha.

2. CULTURAL FUNCTION. The second scenario was revegetation as agro-forestry. Native and exotic tree species (*Eucalyptus, Pinus* spp.) 'minimum stem' count was assigned to maximise carbon sequestration potential. Function was considered economic, but some secondary ecological benefits would inevitably entail. The cost to establish this scenario was estimated at $3000/ha.

3. SYNERGISTIC (multi)FUNCTION. The third scenario was a synergistic middle-ground. The design provides for the minimum planting to sustain CO_2 credits yet also maintains biodiversity benefits through augmenting the overall endemic species numbers and diversity, through the selection of species that could benefit the wider landscape and biota yet could also provide cash-cropping e.g. Oil Mallee (*Eucalyptus* spp.) and Sandalwood (*Santalum* spp.). The final structure is a novel ecosystem characterised by greater structural and species diversity than 'Cultural' yet less than 'Ecological' scenarios. The cost to establish this scenario was estimated at $6000/ha.

Final Calculations

Results aimed to be spatially accurate, measurable and visual. Final costs and benefits (Table 1) of the refined design reflect land cost, change in rural income and the cost of revegetation. Benefits of the system were also calculated including the carbon sequestration capacity of the proposed system and reflect benefits such as securing biodiversity, increasing property values, long-term landscape health and the creation of large scale recreational and aesthetic amenity. These figures were drawn from industry practice and literature following extensive calculations.

Table 2 | Cost benefit summary of three scenarios

	TOTAL COST	TOTAL BENEFIT/Year	BALANCE (Over 20 years)
Scenario 1 'Ecological'	$80,875,340	$4,030,405	- $267,240
Scenario 2 'Cultural'	$24,602,340	$3,901,096	+ $53,419,580
Scenario 3 'Synergistic'	$48,719,340	$5,209,770	+ $55,476,060

Final Visualisations

As spatially accurate plans with encoded geo-spatial information, exploration is possible at the desktop with freely available Google Earth files, *in situ* via Augmented Reality (AR) with smart phone or GPS and/or by Computer Generated Image (CGI) in hard copy or on screen or website (Fig. 5).

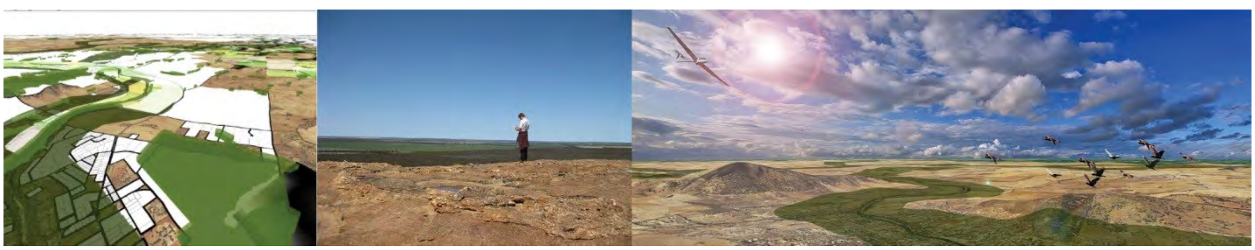

Figure 13 | Examples of the visualisation of the NGN: Google Earth; on-site with AR; and CGI.

Discussion and Conclusion: Assessing the Research Benefits

This paper has presented the results of research towards creating a new green infrastructure within a 25 x 25km study site in rural Western Australia. A Landscape Architectural projective design approach established a pragmatic and final detailed design. This design demonstrates that accurate, measurable and visual designs are required to shift from the theoretical to the practical. Through establishing a blueprint to recreate ecological connectivity linkages across fragmented landscapes, to meet biodiversity policy targets and provide robust ecosystem services, the design is reconciled with existing land-use. Research interpreted 'rules of adjustment', drawn from a design charrette with local stakeholders, then finalised the NGN 'form and function' design through detailed design resolution. This created spatially accurate, measurable and visually explicit final designs. A broad cost/benefit analysis of three scenarios, dependent upon the fidelity to ecological restoration, highlighted the benefits of an interconnected network of protected areas and confirmed the potential of this approach.

The final design expresses more than just habitat restoration for the long-term survival of the Australian biota. A spectrum of design intervention possibilities created landscape linkages of differing geometries and structural compositions. In this research a design approach with exploration via scenarios enabled the exploration of potential benefits beyond pure conservation objectives. These include the establishment of recreational greenways and cultural corridors that can be related to indigenous culture; agro-forestry to sequester carbon; and, a plan for degraded rural landscapes to deal with erosion, salinity and water security. These final multi-functional NGN designs break down the nature/culture binary and create hybrids of ecological and cultural functions, a new landscape characterised by novel ecosystems with measurable benefits for ecology and culture. The 'synergistic' scenario – the one that provided a balance of ecological and cultural benefits – proved not only to be the cheapest, but the outcome most likely to be implemented due to its broader appeal and suite of benefits.

The research created a plan that confirms the need for a flexible and holistic approach. Consideration must be made of the realities of working landscapes and their composite parts, be they ecological or cultural, when creating robust landscape designs. Factoring in of all variables and opportunities into a design process means that complementary or 'synergistic' potential benefits can be realised. GI as an ideological framework and organiser of landscape can help achieve this aim. GI can extend beyond greenways and ecological network approaches to offer a holistic spatial planning solution, exploring synergistic ecological and cultural benefits and help to create more resilient landscapes.

This paper argues that a broad spectrum of landscape possibilities such as those uncovered by the research will help to establish greater ecological and cultural resilience in complex landscapes and offer holistic 'win-win' approach to landscape planning. Engagement with real landscapes, land-uses and the limits and constraints that they impose allowed for iterative and adaptive designs which can only be described as 'synergistic'. Flexible, accurate, measurable and visual: these final designs express more than just habitat restoration to protect the Australian biota against climate change. Rather these synergistic designs negotiate a new path towards holistic landscape planning. The exploration and visualisation of scenarios – accompanied by visualisation, measurement and quantification of both ecological and of cultural benefits – means that the real work of restoration can now begin.

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Assessment Matrix Based Evaluation of Ecosystem Services in Relation to Land Use Change Scenarios

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1. Introduction

The ecosystem services are natural assets and services, which are used by humans directly or indirectly over their respective lifetimes (MEA, 2005). Several authors and organizations describe these goods of nature in different ways. Some authors use ecological concepts as the basis for categorization (Norberg, 1999), others concentrate on different human needs (Wallace, 2007), however the most common categories are based on some functional distinction (MEA, 2005; de Groot, 2006; Hein et al., 2006). Authors representing this latter group usually mention the following classification: provisioning, regulating, supporting and cultural services. The provisioning services like water, wood or timber are used directly by people. The regulating services are climate regulation, water purification and other similar processes. The cultural services are for example education, recreation potential and spiritual inspiration. The supporting services ensure the clear functioning of the three groups, for example soil formation and photosynthesis (MEA, 2005).

The methodology of valuing ecosystem services is an effective decision support tool, because this highlights the natural, social and economic values of the goods and services of the living system for decision-making and planning. Despite the availability of a wide range of valuation methods (Chen et al., 2009; Kiss et al., 2012), there are still unresolved issues (de Groot et al., 2010). Its important elements are revealing the spatial characterization and the dynamics of the landscape and ecosystem services, for which there are effective methods among the dynamically developing GIS analysis tools. This usually does not create a comprehensive inventory of all the ecosystem services, but analysis several selected services in detail, primarily in context with the potentials and land use changes (Willemen et al., 2008). One of the most promising methods of ecosystem services valuation is the assessment matrix, a great advantage of the method is that it can be aggregated at the landscape-level (Burkhard et al., 2009).

The major account of the processing and analysis of the historical maps is that allows of understanding of the past human land use, the long-term landscape changes and the dynamics of the landscape. The knowledge of the past also contributes to the exploration of the main driving forces and use them to anticipate the future changes (Swetnam et al., 2011). Modeling of future land use change is proved to be a very efficient method among many types of landscape change analysis (Pontius et al., 2001; Goldstein et al., 2004; Kline et al., 2007), and a frequent tool in climate change analysis (IPCC, 2007), land use planning (Xiang & Clarke, 2003), conservation planning (Osvaldo et al., 2000) and recently it has been increasingly used in the assessment of the ecosystem services (MEA, 2005). The evaluation of the ecosystem services and the modeling of the future land use changes have an increasing role in regional politics. The consistency between these two topics would be a very important step forward (Estoque et al., 2012).

In this study we describe an assessment framework of ecosystem services analysis in a pilot area of Southwest-Hungary called Nagyberek, used to be the largest swampy bay of Lake Balaton. The method using GIS analysis of historic maps and recent land cover dataset explores the main land use types. It concentrates also on those driving forces which are directly influenced by the land use of the area. We plan three future land use scenarios based on the main driving forces, with the help of the CLUE-S (Verburg et al., 2002), the integrated land use modeling tool. We select and assess a certain part of the ecosystem services according to the Burkhard's study (2009), their trends, with the help of the assessment matrix.

2. Methods

2.1. Study area

The pilot area of Southwest-Hungary called Nagyberek is about 1200 km^2, it is situated on the South-western shore of Lake Balaton (Figure 1). This is one of the most transformed rural landscapes of Hungary with many contradictory characteristics. The landscape structure was very heterogeneous in the past with the zigzaggy brooks and lakes, marshes, rich fens, wetlands, sandbanks and dense, impenetrable reed. The area abounded in water, it provided livelihood for the inhabitants in several manners: they fished in the shallow water, reed was used as building material, they cultivated vineyards on the hillsides and the permanently wet meadow was waiting the cattle with a rich grass yield in the driest years as well. But the pilot area was regulated in the 19th and in the 20th century, and this wealth was eliminated by the draining works and the agricultural intensification. Besides the remaining and protected valuable wetlands, nowadays in most of the area is cultivated with intensive agriculture and hunting is also intensive, moreover there are many demographic problems, for example the high level of migration and negative birth rate.

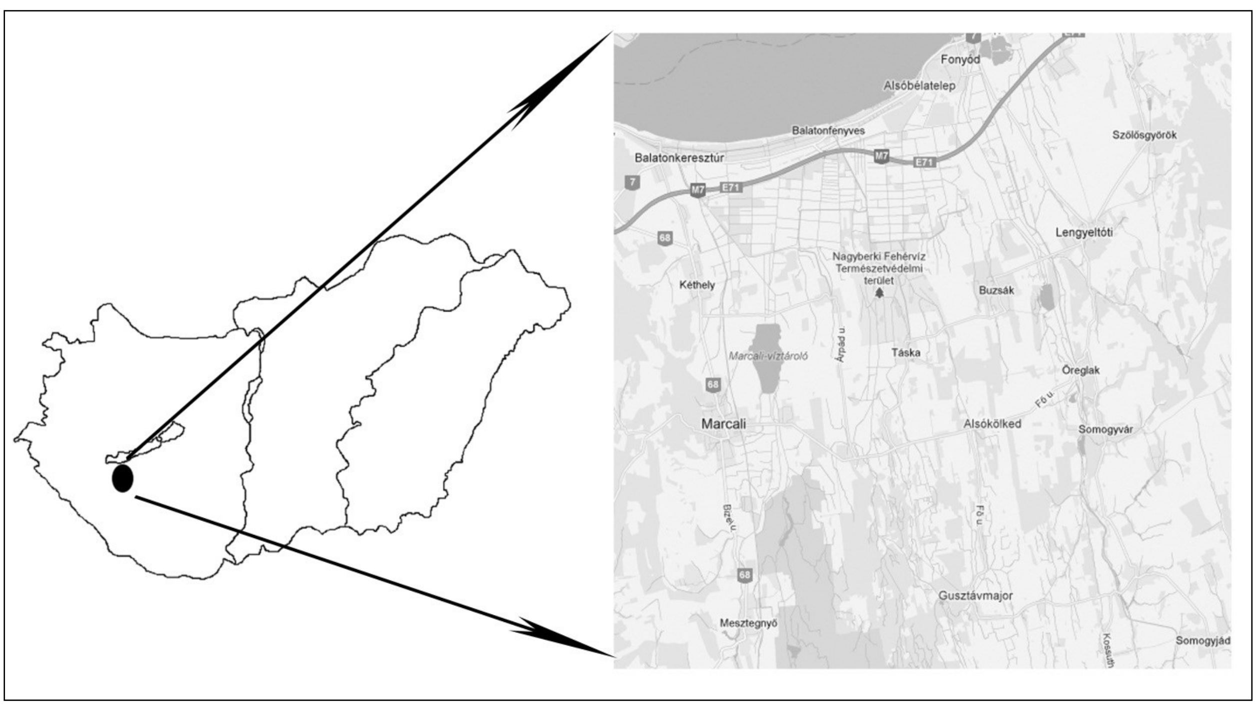

Figure 1. The location of Nagyberek in Hungary

2.2. Analysis of historic maps and recent land cover dataset

In the beginning of the processing of the maps we developed eight land use categories, which are different from the CORINE Land Cover categories, because of the analysis of the social aspect of biophysical land cover, also the new classification is called as „land cover with the land use aspects" (Table 1).

CLC CODE	CLC LEVEL 3	CLC LEVEL 2	Land use category
111	Continuous urban fabric	**Urban fabric**	**Built up area**
112	Discontinuous urban fabric		
121	Industrial or commercial units	**Industrial, commercial and transport units**	
122	Road and rail networks and associated land		
131	Mineral extraction sites	**Mine, dump and construction sites**	
132	Dump sites		
133	Construction sites		
141	Green urban areas	**Artificial non-agricultural vegetated areas**	
142	Sport and leisure facilities		
211	Non-irrigated arable land	**Arable land**	**Arable land**
213	Rice fields		
221	Vineyards	**Permanent crops**	**Vineyard and orchard**
222	Fruit trees and berry plantations		
231	Pastures	**Pastures**	**Pasture and meadow**
242	Complex cultivation	**Heterogeneous agricultural areas**	**Garden**
243	Land principally occupied by agriculture, with significant areas of natural vegetation		
311	Broad-leaved forest	**Forests**	**Forest**
312	Coniferous forest		
313	Mixed forest		
321	Natural grassland	**Shrub and/or herbaceous vegetation association**	
324	Transitional woodland shrub		
333	Sparsely vegetated areas	**Open spaces with little or no vegetation**	
411	Inland marshes	**Inland wetlands**	**Wetland**
412	Peat bogs		
511	Water courses	**Inland waters**	**Water surface**
512	Water bodies		

Table 1. The eight land use category with the corresponding CORINE Land Cover classes

The goal of the analysis and processing of the historical maps was to explore the main driving forces and determine the historical pattern of the land use, thus providing a base for the future landscape models' completion. The widely historical maps of Hungary are the military surveys, which provide quite detailed information. We analyzed the I. (1783-1784), the II. (1856-1860) and the III. (1880) military surveys, in addition, the present situation, 2012 was analyzed too. Due to the comparison, we fitted the historical maps in the same coordinate system (EOV). The digitalization and georeferencing of the military surveys were made by the ERDAS Imagine software package. The interpretation of the land use and the other informations of map were performed with screen digitizing with ArcGIS 9.3 software package, they were adapted to the above described eight land use categories. The smallest circumscribed patch was 0,01 km^2. The first created map was based on the land cover map of 2012, after the merging of the land use types to the abovementioned eight main categories. Thereafter the so-called „backspace method" was used to move backwards in time, than the next stop was the III. military survey. For it we fitted the previously created 2012 map, thereafter we transformed the boundaries of the patches. This was followed by the processing of the II. and I. military survey.

2.3. Modeling of the future land use

In the initial phase of the preparation process we set the policies and conversion rules from the story lines that influence land use transitions. Land use requirements are calculated at the aggregate level of the case study as a whole as part of a specific scenario. The land use requirements constrain the simulation by defining the totally required change in land use. The extrapolation of trends in land use change of the recent past into the near future is a common technique to calculate land use requirements. When necessary, these trends can be corrected for changes in population growth and/or diminishing land resources. Land use type specific conversion settings determine the temporal dynamics of the simulations. Two sets of parameters are needed to characterize the individual land use types: conversion elasticities and land use transition sequences. The second set of land use type characteristics that needs to be specified are the allowed land use transition sequences. Not all land use changes are possible – e.g., arable land cannot be converted into primary forest directly – and many land use conversions follow a certain sequence. During the simulation we evaluated the land use configurations of 25 years, from 2012 to 2037. In this study we have analyzed just the year of 2037. The "present tendencies going on" is the scenario of present tendencies going on, where the area of meadows, pastures and gardens are in decline, wetlands are stable and the demand for other land uses types is increasing. The "strong agricultural expansion" scenario, the area of arable lands increase strongly, the orchards, gardens and pastures expand moderately. The wetlands reduced moderately, while the forest and semi-natural areas more strongly. In the "increasing role of nature protection" scenario the nature protection activities are strong, hence the wetlands are increasing intensively. The water surfaces are also increasing, moreover, supposed that the arable land will be abandoned (following the natural succession) areas of pastures will be increasing.

2.4. Evaluation of ecosystem services: assessment matrix

For evaluating ecosystem services we tried to apply the assessment matrix developed by Burkhard and his colleagues (2009). The y-axis of this matrix contains the types of ecosystem services (ignoring the many controversial supporting services), while the x-axis of this matrix contains the abovementioned eight land use categories. In their crossroad is a value that expresses the category's potential to provide the service. The scale of possible values ranges from 0 to 5, 0 means that land cover class has no capacity to supply the service, and 5 means that land cover type has very high relevant capacity to provide it. This study compares the past, the current and the future land use using ecosystem assessment matrix developed by Burkhard et al. (2009) as a basis. These values are obviously weighted in proportion to the area, one area unit was 1000km$^{2.}$ We illustrated the exact steps of evaluation by the "arable land" land use category:

a) we selected the appropriate CORINE Land Cover classes from the Burkhard's assessment matrix (non-irrigated arable land; ricefields);

b) together the two CORINE Land Cover classes we calculated the scores for the three types of ecosystem services (provisioning services: 28, regulating services: 9, cultural services: 2);

c) we calculated the extent of the arable land use category for each maps

d) under the b) point calculated total values we weighted in proportion to the area, one area was 1000km^2, to give the final values (Figure 2).

a)- b)

		Provisioning services Σ	Crops	Livestock	Fodder	Capture Fisheries	Acquculture	Wild Foods	Timber	Wood fuel	Energy (Biomass)	Biochemicals/Medicine	Freshwater	Regulating services Σ	Local climate regulation	Global climate regulation	Flood protection	Groundwater rechage	Air Quality Regulation	Erosion Regulation	Nutrient regulation	Water purification	Pollination	Cultural sevicies Σ	Recreations and Aesthetic Values	Intrinsic Values of Biodiversity
Arable land	Non-irrigated arabie land	21	5	5	5	0	0	0	0	0	5	1	0	5	2	1	1	1	0	0	0	0	0	1	1	0
	Ricefields	7	5	0	2	0	0	0	0	0	0	0	0	4	2	0	0	2	0	0	0	0	0	1	1	0
	TOTAL	**28**												**9**										**2**		

c)- d)

	Land use category	Area (km^2)	Area unit (km^2)	Total value of provisioning services according to Burkhard et al. 2009	**Provisioning services, weighted in proportion to the area**	Total value of regulating services according to Burkhard et al. 2009	**Regulating services, weighted in proportion to the area**	Total value of cultural services according to Burkhard et al. 2009	**Cultural services, weighted in proportion to the area**	**TOTAL VALUE**
I. Military Survey (1783-1784)	Arable land	344,9673	1000	28	9,659085	9	3,104706	2	0,689935	13,45373
II. Military Survey (1856-1860)	Arable land	428,2487	1000	28	11,99096	9	3,854238	2	0,856497	16,7017
III. Military Survey (1880)	Arable land	438,8272	1000	28	12,28716	9	3,949445	2	0,877654	17,11426
CLC2012	Arable land	451,93	1000	28	12,65404	9	4,06737	2	0,90386	17,62527
Present tendencies going on	Arable land	473,21	1000	28	13,24988	9	4,25889	2	0,94642	18,45519
Strong agriculture expansion	Arable land	627,22	1000	28	17,56216	9	5,64498	2	1,25444	24,46158
Increasing role of nature protection	Arable land	52,57	1000	28	1,47196	9	0,47313	2	0,10514	2,05023

Figure 2. Example: Evaluation of ecosystem services by “arable land” use category (according Burkhard and his colleagues 2009).

3. Results

3.1. The results of the analysis of the historical maps and future land use scenarios

At the time of the I. military survey (1783-1784) the most typical land use types were forests (33%) and arable lands (28,9%), but wetlands (16,3%) and water surfaces (10,4%) were still present. During the years of the II. military survey (1856-1860) the land use was similar to the I. military survey, but the forest was reduced (22,8%) in parallel the arable land increased (35,9%). The effect of the drainage works is visible in the III. military survey (1880): the pasture and meadow (17%) took place the wetland, which reduced significantly (12,5%). Another difference is that, the forest reduced again (16,8%). Up to 2012, the wetlands almost disappeared (3,6%), the built-up areas (5,7%) and the forest (26,3%) increased significantly (Figure 3).

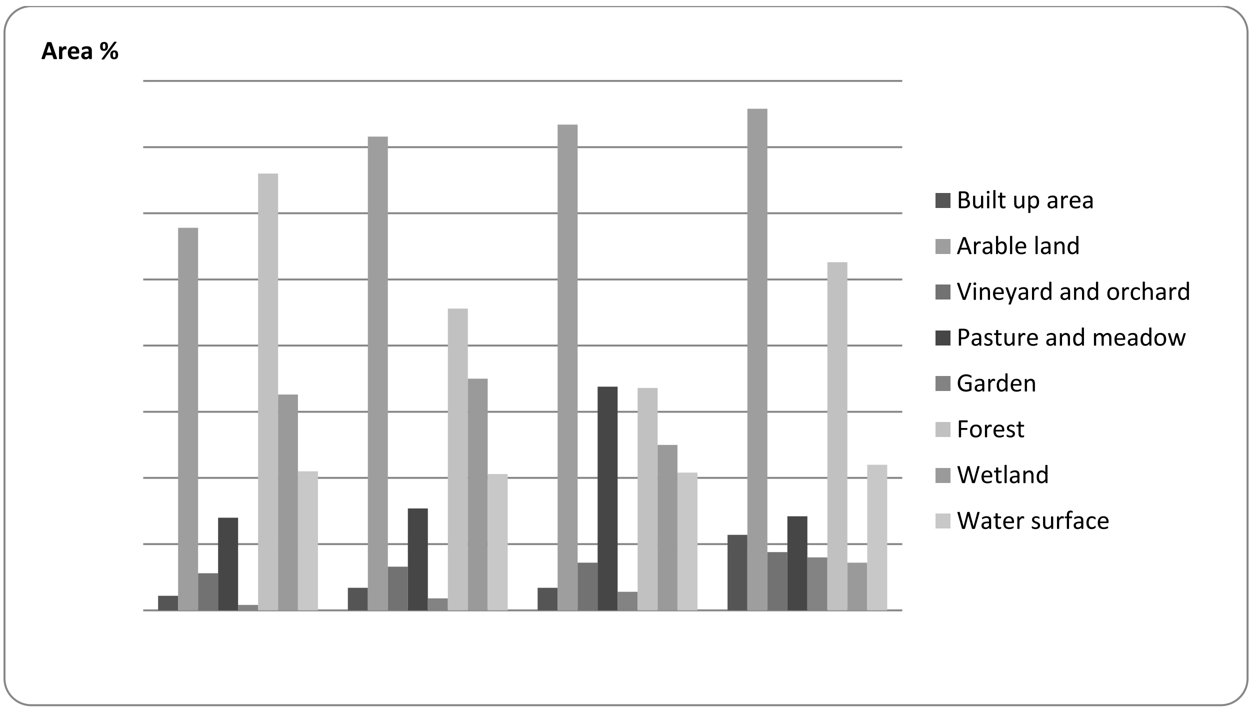

Figure 3. Land use change during the I. (1783-1784), the II. (1856-1860), the III. (1881) military surveys and in 2012

When we analyzed the states of 2037, the following statements can be made: The „present tendencies going on” scenario is similar to the 2012. In case of „strong agricultural expansion” scenario (the land use will change more intensively) the arable land will dramatically increase (52,5%) in contrast with forests (5,8%). In case of „increasing role of nature protection” scenario, the water surface (18,1%), the wetland (32,9%) and the forest (26,3%) will increase, but all of the other land use categories reduced (Figure 4).

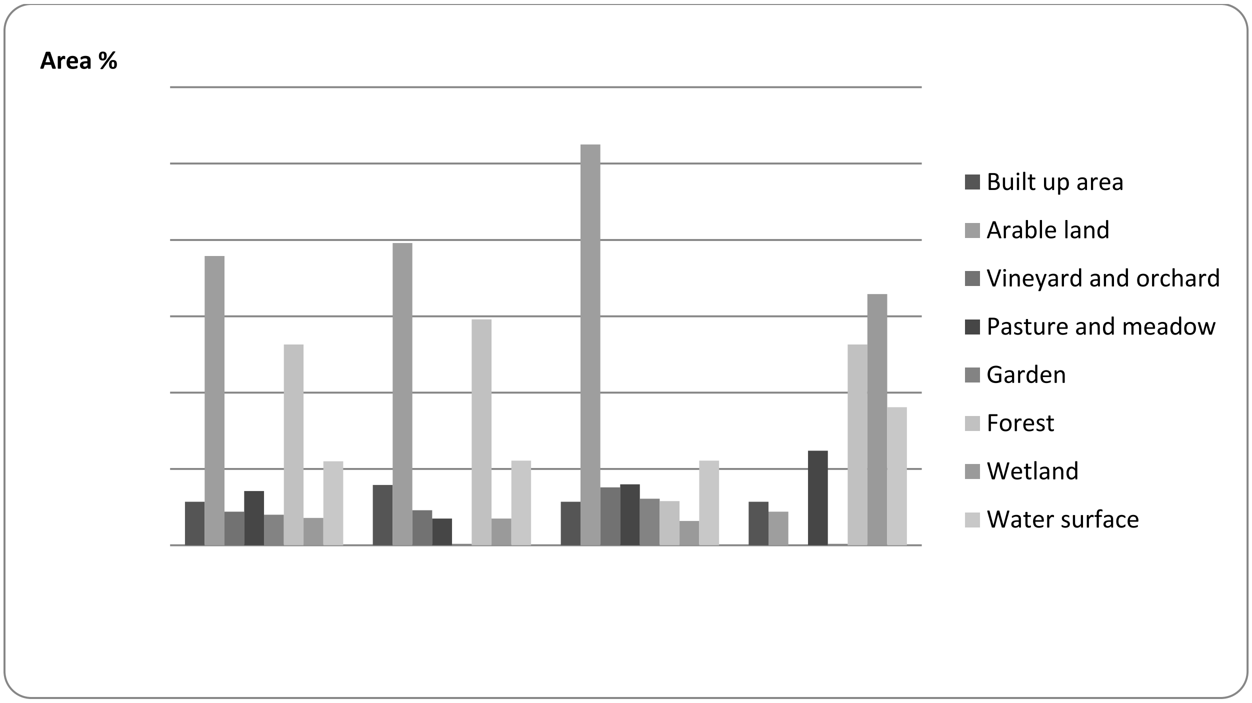

Figure 4. Land use change during in 2012 and in the three future land use scenarios in 2037

3.2. The change of the ecosystem sevices values

The growth of the arable land might be expected to increase the quantity of provisioning services, instead of this we observed a small and steady decrease still the III. military survey. The probable reason is the significant reduction of the forest which was overall contributed very significant to the provisioning services (wild food, timber, wood fuel, biochemical/medicine). We experienced that the values of the provisioning services increased again in 2012 because of the forest areas' re-growing. However the values reached just the measured values during the II. military survey. The values of regulating services' changes are similar to the values of provisioning services' changes, but here the values decreased very sharply, which were not recovered still 2012 (is similar to the values of provisioning services). In case of cultural services we found similar values along, there were no clear trend (Figure 5).

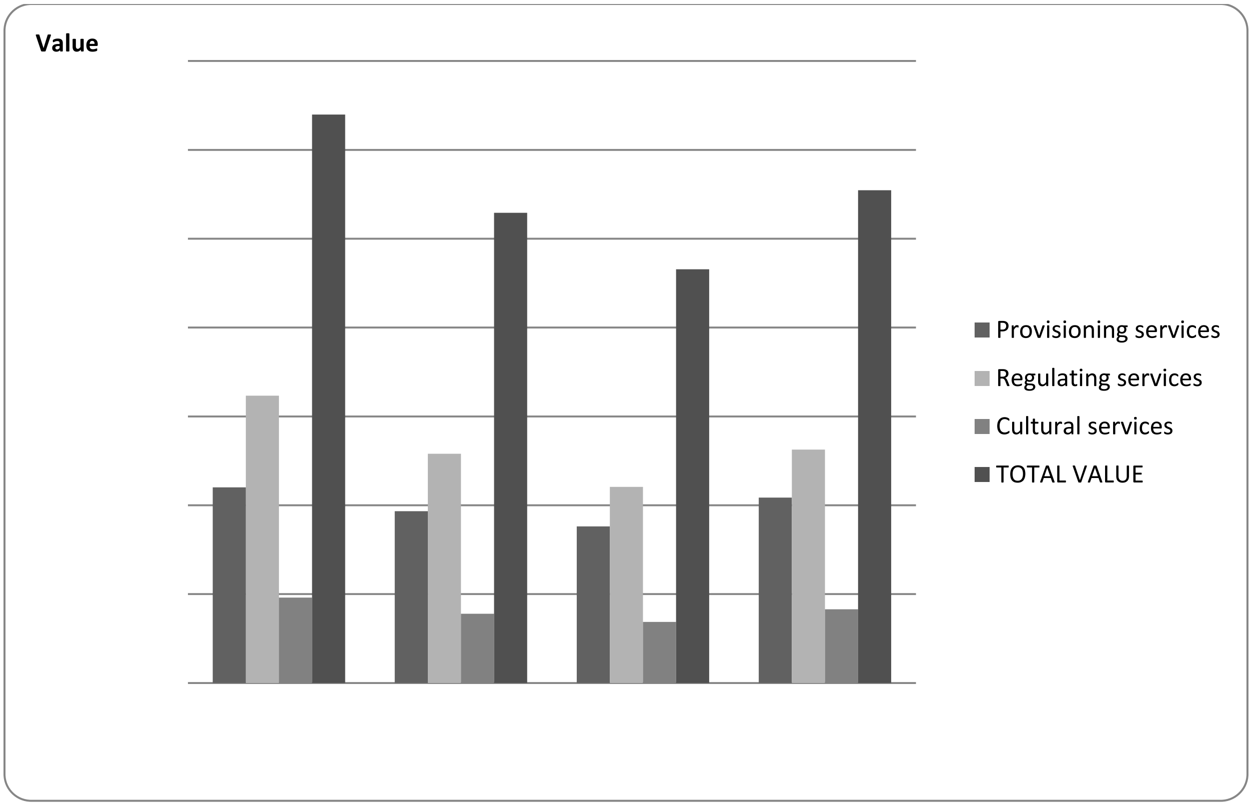

Figure 5. Changes of ecosystem services' values during the I. (1783-1784), the II. (1856-1860), the III. (1881) military surveys and in 2012

After the examination of future land use scenarios, it is obvious that the values of the "present tendencies going on" and the „increasing role of nature protection" scenarios are similar between the three types of ecosystem services and the total value as well. It is notable that there is no difference between these two 2037 scenarios and the one for 2012. In contrast we experienced that the values of the „strong agricultural expansion" scenario everywhere were about half of the measured values in 2037. If we compare with the 2012 state, the difference is not significant at the provisioning and the cultural services, however in case of the regulating services the value was halved, due to the high degree of the forest decrease.

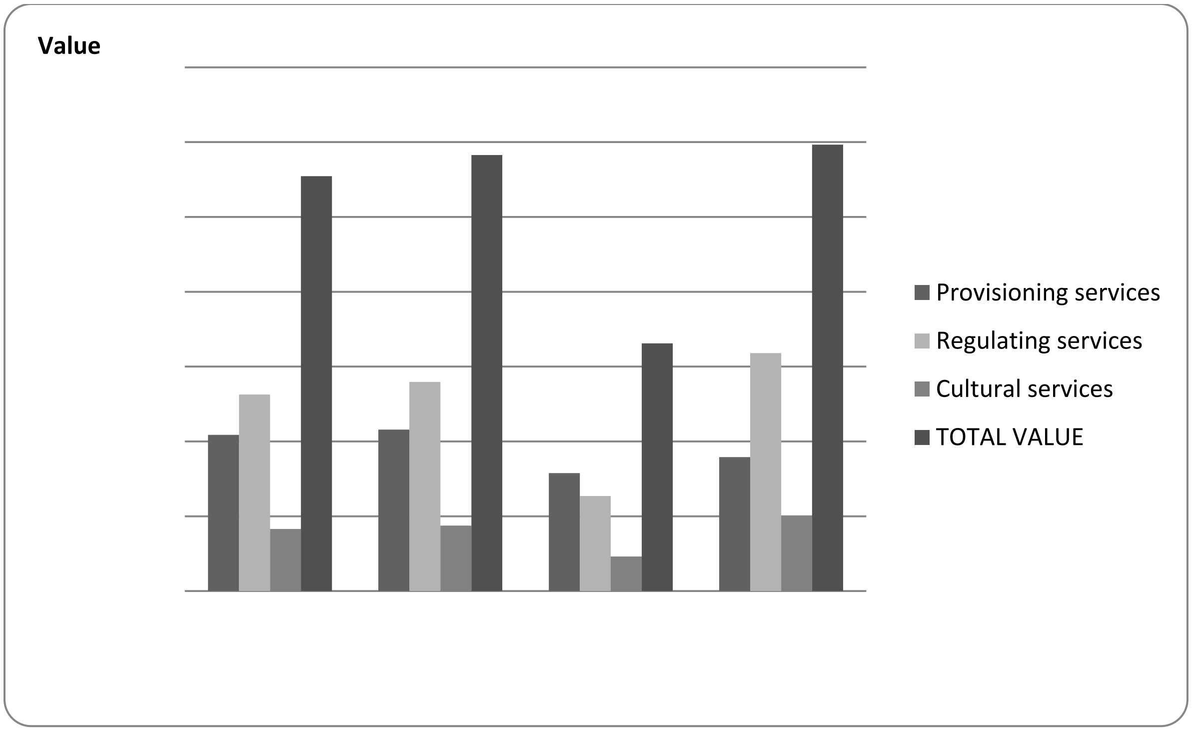

Figure 6. Changes of ecosystem services' values during in 2012 and in the three future land use scenarios in 2037

4. Discussion and conclusion

In the course of the analysis of the military surveys, the direction of land use change was obvious: the former semi-natural land use have been transformed into an intensive agriculture system. Despite the fact that on the I. military survey maps there were very large arable lands, at that time the agriculture system was extensive, nature-friendly. As time passed, the area of arable lands has increased because of the destroyed forest and drainage works, and the people gradually populated the region, significantly reducing the area of wetlands. Until the time of the III. military survey the forest decreased gradually, after the II. world war, thanks for the afforestation program, the forest area increased.

The important "index" of the ecosystems' condition and function is their measure of the ecosystem services, which is one of the most important factor is the land use change. The ecosystem services of the natural and semi-natural land use differ a slightly from each other. The intensive land use (especially in arable land areas) dramatically increased the rate of provisioning services, at the same time significantly decreased the rate of regulating services (Braat & ten Brink, 2008). These facts are supported in part by the analysis of the historical maps: the regulating services significantly decreased, however provisioning services – contrary to our expectations – did not increase but slightly decreased. The reason is clearly due to the loss of forests, which significant contribution to the provisioning services (see above). Despite the increase of the arable lands, the loss of forest influence negatively the provisioning services' values.

The important role of the forest is very obvious by the three future land use scenarios too. Where the forest cover large areas („present tendencies going on" and „increasing role of nature protection") the regulating services' values are very high, compared to the "strong agricultural expansion" scenarios where the forest areas are very low. All in all, forests have an important role not only in regulating but in provisioning services as well. This result is consistent with Costanza's matrix, in which the food production is examined, the cropland and the forest have similar importance (Costanza, 1997).

This method itself is strongly artificial, since the values of the individual services cannot be transposed to Hungarian habitats without changes, yet they provide approximate results. The following actions need to be taken as next steps: a) "translation" of the abovementioned eight land use categories to set up a typology better suited to the values of ecosystem services and habitat types b) taking into account the naturalness of the habitats c) creation of a matrix developed specially for the valuation of ecosystem services and completion of it by experts based on Hungarian case studies and investigations d) determination of additional steps in order to make the matrix more accurate.

5. Acknowledgement

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Tree alleys – specific green corridors and their disappearance from cultural landscape of Nitra region

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Abstract

Tree alleys, specific forms of green corridors, represent a characteristic phenomenon of historic cultural landscape in Slovakia. The research aims to examine the contemporary patterns of tree alleys appearance in cultural landscape of Nitra region and their potential to serve as green corridors, whether providing ecological functions, recreational functions or cultural heritage and aesthetic values, as defined by conceptual framework of greenways theory.

For purposes of identification of contemporary patterns of tree alleys, current aerial photographs were used. The potential of identified cases to serve for certain functions of green corridors was examined in the place. The comparison of current aerial photographs with historical photographs, maps and on-site observation shows that tree alleys disappear from cultural landscape of Nitra region. However, their remnants hold a strong potential for greenway functions provision. Especially in cases when new routing of high-speed roads allows new uses of old roads in landscape, for example for recreational purposes.

The results of the research suggest that more attention should be given to the issues of protection and restoration of tree alleys and to their use as green corridors within the framework of cultural, historical and aesthetic values preservation concepts. The legislative aspects of protection and preservation of tree alleys, within the framework of nature protection and cultural monument protection are discussed, as well as socio-cultural aspects of their preservation - enhancement of motivations and place attachment by multifunctional use of tree alleys as green corridors.

KEY WORDS
tree alleys
greenways
cultural landscape
place attachment

1. Introduction

Tree alleys, specific forms of green corridors, represent a characteristic phenomenon of historic cultural landscape in Slovakia. Importance of planting trees along roads is familiar to different cultures and different historical periods. Since the 18th and the 19th century tree alleys became a characteristic element of cultural landscape in Slovak territory, as in other parts of former Austro-Hungarian monarchy (Storm, 2008; Esterka, Hendrych, Storm, Matějka, Létal, Valečík, Skalský, 2010; Kristiánová & Štěpánková, 2012). The duty to plant trees along roads was stressed by official decrees, for example that of Maria Theresa from 1769. Tree alleys were planted from economic, aesthetic, orientation and safety purposes. Trees planted in rows, as composed elements of cultural landscape, archetypal representatives of rhythm, symbolise the presence of man in landscape, and his sensitive approach towards landscape (Kristiánová & Štěpánková, 2012). Their meanings in Slovak rural landscape are similar to social, aesthetic and ecological aspects of hedgerows in the English landscape (Burel & Baudry, 1995; Oreszczyn & Lane, 2000). Like hedgerows, tree alleys or tree rows accompanying roads possess a potential to serve as a framework for greenways.

During the 20th century the socio-economic conditions of socialism, collectivization and changes in agricultural land cultivation resulting in large blocks of arable land, as well as increase of automobile transport, did not favour existence of tree alleys.

The new conditions of tree alleys existence in the contemporary cultural landscape are influenced by current socio-economic and cultural conditions. Reflections of transition from centrally planned towards market economy in farming, reintroduction of property rights towards agricultural land, have not resulted in significant retrieval of small-block mosaic agricultural landscape, or increase of division elements as hedgerows or tree rows (Kristiánová & Adámková, 2010). The rapid increase of transport demands, on the one hand demanding tree rows removal along existing roads, on the other hand, in many cases, resulted in new routing of high-speed roads and opened the possibilities of the new use of old roads in landscape, for example for recreational purposes.

2. Background and Literature Review

The disappearance of tree alleys from cultural landscape became widely discussed in countries, where tree-lined roads created the characteristic feature of their historical cultural landscape, as for example in Germany or Czech Republic. In Germany, since many of the tree avenues fell victim to a new road construction, several programs and projects for their preservation at governmental and non-governmental levels aim to rehabilitate the old and to plant new tree alleys, involving public campaigns explaining their values. In Czech Republic non-governmental civic organizations are active in efforts to preserve the values of tree alleys and conceptions of their preservation have been elaborated (Esterka, Hendrych, Storm, Matějka, Létal, Valečík, Skalský, 2010).

In the Slovak landscape, tree rows were traditionally planted not only along roads, but also along other line elements of landscape – along rivers, or as field dividing elements with a windbreak function, often marking the cadastral borders of fields. They often served multiple functions, providing connection, shade, protection against wind and the significant reason for their use was their aesthetic influence, so they were much favoured as borders enhancing the entrance routes to country manor houses, even in double or multiple rows. Trees preferred for these alleys were selected for their height and speed of growth, such as lime or poplar, fruit trees were planted during period of enlightenment along country roads. Some of the tree alleys have entered the history, for example the historic Rákóczi tree alley of hundred lime trees still lives in literary sources and historical photographs, though no one of its limes remained. Tree alleys, as elements of historical landscape, associated with identity, or memory of landscape, possess the strong potential for creating and enhancing the sense of belonging, the feelings of place attachment, which are motivations for land protection and stewardship (Lokocz, Ryan, Sadler, 2011).

The ecological approaches governing current landscape research and landscape planning practices in Slovakia, focusing on monitoring of territorial systems of ecological stability, appreciating non-forest woody vegetation formations of shrubs and trees of native vegetation as bio-corridors, underestimate, or do not fully recognize the values of tree alleys in cultural, man managed landscapes. Tree alleys as symbols of artificial intervention of man into the landscape, historically often planted from introduced tree species do not seem to be valuable enough within the ecological concept approaches. The values connected to visual, cultural or historical are forgotten, what reflects the less successful attempts to assess those qualities of landscapes, which are difficult to measure and quantify, the values based on subjective and individual (Jessel, 2006). To study the issues of bridging the gaps and linking the "cultural" and "natural" represents the constant challenge for research and professional practice (Naveh, 1995).

4. Goals and objectives

Tree alleys fulfilled their "greenway" functions in history. An assumption is that also today they possess the strong potential to fulfill the greenway functions - to provide ecological and recreational functions, as well as cultural heritage and aesthetic values, as defined by conceptual framework of greenways theory (Fábos, 1995; Ahern, 1995; Fábos & Ryan, 2004). In this context the research aims to examine the contemporary patterns of tree alleys appearance in cultural landscape of Nitra region in Slovakia and their potential to serve as green corridors, whether providing ecological functions, recreational functions or cultural heritage and aesthetic values. One of the objectives of the study is to observe the changes of their presence in the landscape, and answer the question whether they disappear from contemporary cultural landscape.

5. Material

For the purposes of the contemporary patterns of tree alleys examination the area of the Nitra region – Nitra District (Figure 1) was used. It represents a typical rural agricultural region in Slovakia, with different landscape types of agricultural land including arable land, meadow pastures, orchards, vineyards and forests, varying from hilly parts of the Tribeč Mountains to flat parts of Nitra river valley. In the same time it is a typical representative of historical cultural landscape, with significant aesthetic and historical values. Main urban centre of the district is the city of Nitra, with a population around 85,000. This city is the fourth largest city in Slovakia. Nitra is regarded one of the oldest cities in Slovakia, the area around was inhabited since the 4th century BC. In 1248 Nitra was given the privileges of a free royal town by Béla IV. The historical heritage and the long history of urbanization patterns and land use patterns are mirrored in surrounding rural agricultural landscape and surrounding villages. The study was conducted in cadastral areas of Cabaj, Čápor, Svätoplukovo, Mojmírovce, Poľný Kesov, Štefanovičová.

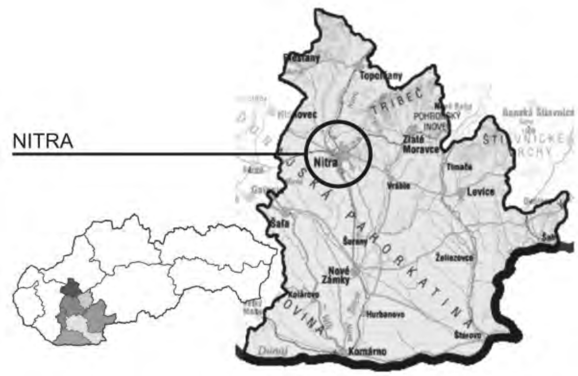

Figure 1: The study area - Nitra district in Nitra region in Slovakia.

6. Methods

The research followed three main steps: 1. identification of the contemporary patterns of tree alleys in the current landscape structure, 2. comparison of the contemporary tree alley patterns with the historical patterns and 3.identification of the various potential of the current patterns to serve multiple greenways functions. For the purposes of identification of the contemporary patterns of tree alleys, the current aerial photographs were used. The comparison of current aerial photographs with the historical maps was used to explore the changes between the past and the present framework of the tree alley patterns. The use of aerial photographs and historical map sources is a method often used for identification of patterns of non-forest woody vegetation and landscape change (Skalos & Engstova, 2010). The potential of identified cases to serve for certain functions of green corridors was examined in the place and with the help of spatial planning, transport and recreation development planning documents.

There are several variations in the spatial formations of trees planted in rows. When trees are planted in one row (or two and multiple rows), usually the term tree row is used, and when trees are planted along a road (in one, two or multiple rows), the term tree alley is usually used.
The cases when the tree rows are associated with roads have been examined, but in some cases difficulties occurred with distinguishing the trees planted in rows from other forms of line non-forest woody vegetation formations in aerial photographs, and with distinguishing the road routings, so these cases have been distinguished with the help of cadastral maps and have been checked on the place.

The comparison of current aerial photographs with historical photographs, historical maps and on-site observation was used to explore the changes between the past and the present framework of the tree alley patterns. From historical map sources, the maps of the second military mapping provide a good source of the past tree alley patterns in Nitra district. Observation on sites complemented the methods used.

The potential of identified cases to serve for certain functions of green corridors was examined with the help of spatial planning, transport and recreation development planning documents and by on-site observations. To explore the potential of identified tree alleys for greenways functions provision, the current patterns of roads and their categorization have been examined, as well as spatial and transport planning development documents at regional and local levels, and documents of development of bike and tourist trails.

6. Results

The research of current patterns of tree alleys examined from aerial photographs, with the help of Google Earth 3D imagery and on site observation show, that most of existing formations of the tree alleys along roads become disintegrated. Their linear rhythmical structure becomes decomposed by the emerging gaps between existing trees (Figure 2). The gaps are not replanted and tree alleys are not revitalized as a whole. Only few cases of new plantations have been identified.

Figure 2: Disintegration of rhythmical structure means gradual disappearance of tree alleys, example of the road n. 562/ II. between Cabaj-Pereš and Cabaj-Čápor (Source: Google Earth and Google Earth 3D imagery).

The examination of tree alley patterns in the historical maps of the second military mapping shows the existence of places with a higher concentration of tree alley patterns. The comparison with current patterns of tree alleys shows, that today the patterns follow the same places, where they were planted in the past, but often just their remnants remained (Figure 3).

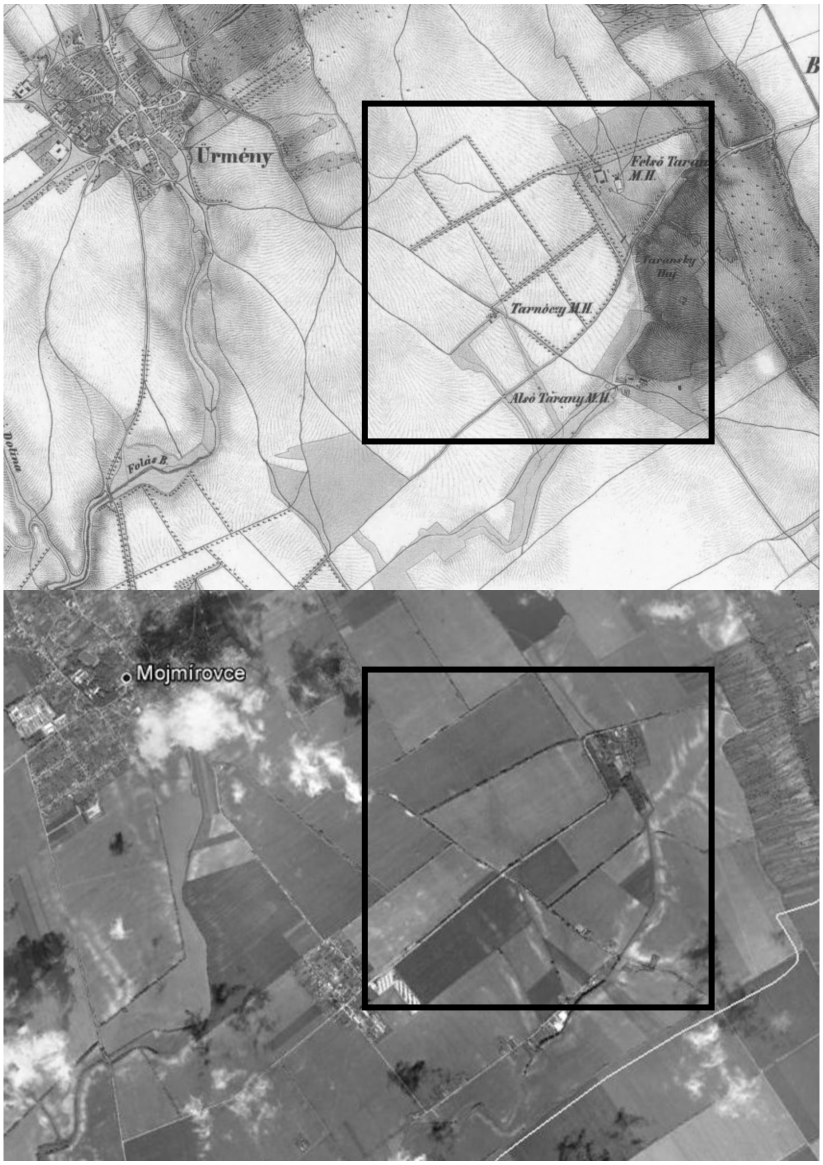

Figure 3: Comparison of historical map of the second military mapping from around 1837-1858 with aerial photograph from 2006 showing the example of places with concentration of tree alleys - their past and present patterns in the cadastral areas of Mojmírovce, Poľný Kesov, Štefanovičová.

In some cases the linear elements of former tree alleys have been replaced by other linear vegetation elements – stripes of woody vegetation of shrubs and trees, without rhythmical arrangement, as a result of succession and lack of tree alleys maintenance. The cases, when contemporary tree alley patterns occur in new locations in comparison with historical sources are found, but they usually suffer the described maintenance and disintegration problems. However, in many cases, the vegetation of the tree alleys has been removed (Figure 4).

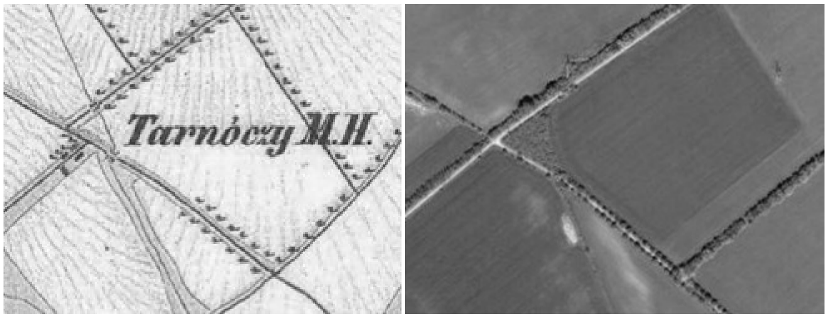

Figure 4: Detailed view of the comparison of historical map of the second military mapping from around 1837-1858 with current aerial photograph, the cadastral area of Štefanovičová.

The results of the research show the overwhelming trend that the tree alleys disappear from the contemporary cultural landscape of Nitra region, either as a result of clear cut removal, replacement by other types of linear woody vegetation formations, or as a result of gradual degradation.

To explore the question of possibility and suitability of tree alleys to serve for greenway functions, especially recreation, the current patterns of roads and their categorization have been examined. The research shows, that in the examined area an intensive framework of field roads exists, which are suitable for recreational use, hiking or bicycle connections between villages and city of Nitra. The framework of field roads in certain cases is framed by tree alleys or vegetation stripes, enhancing their attractiveness. The examination of spatial planning, transport and recreation development planning documents shows, that several documents recognize the needs for greenway connections planning. For example the spatial plan of Cabaj-Čápor (Figure 5) incorporates a proposal for various line vegetation formations, distinguishing between the spatial and visual aspects of tree alleys, tree rows and woody vegetation stripes. However, these proposals for the plantings are not executed.

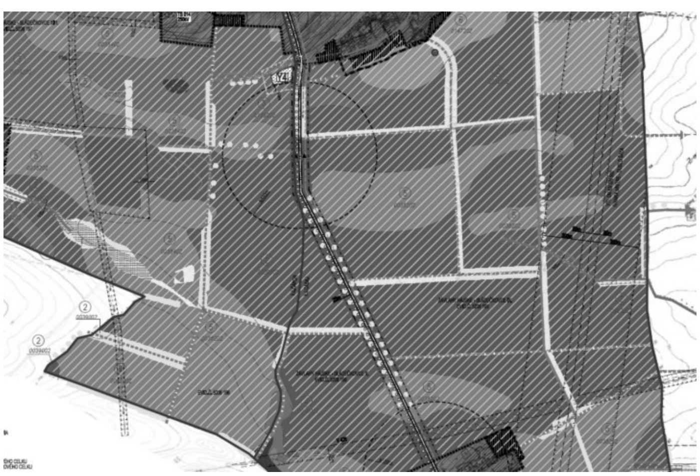

Figure 5: Agricultural landscape in the cadastral area of Cabaj and Čápor - woody vegetation stripes, tree rows and tree alleys proposed in the spatial plan (Mizia, Černá, Privalincová, 2011)
The proposal for bicycle routes development, elaborated as the initiative at regional level, in some cases utilizes the potential of green connections - the field roads and the roads which lost

their functions for automobile transport, but on the other hand, in other parts it forgets to take their advantages.

In general the research shows, that the framework of the field roads with the fragments of tree alleys and other vegetation formations holds the potential to create green recreational connections with a high aesthetic quality and this potential is not used today. In addition, regarding the historical background of the examined sites, this framework includes also historical and cultural values.

7. Discussion and conclusion

The conditions of tree alleys existence in the contemporary cultural landscape are influenced by current socio-economic and cultural conditions. The disappearance of tree alleys from the rural agricultural landscape of Nitra region reflects the current socio-economic conditions of agricultural landscape use and the road network management policies.

Landscape and spatial planning instruments underestimate the value of tree alleys in comparison with other types of vegetation elements which are favoured as bio-corridors in planning documents. Even in the cases when the values of tree alleys are recognized, the proposals for plantings are often not executed, as the questions who is planting and maintaining and who is paying, for what and why, are not clear (Smith, 2008).

The existence of tree alleys in current agricultural, farming landscape reflects the willingness, respectively unwillingness to pay for their multiple benefits, from ecological, windbreak functions, to aesthetic qualities (Grala, Tyndall, Mize, 2012). In the past their existence also reflected the will of landowners to maintain them, even only for aesthetic reasons. Today the current conditions of farming in Slovakia, when relationships between owners of land and farming subjects are not readjusted and still undergo transformation processes (Kristiánová, Adámková, 2010), do not create favourable environment for existence of tree alleys.

Tree alleys accompanying automobile road network are managed by road agencies from state to regional level. The maintenance of tree alleys means higher costs, in some cases requires compromises between traffic needs and needs to preserve cultural, historical and aesthetic values.

The legislative concepts of protection and preservation of tree alleys within the framework of nature protection and cultural monument protection show shortcomings in using the institutes of protected tree, protected landscape element, or local place of interest (Kristiánová & Štěpánková, 2012). The results of the research suggest that more attention should be given to the issues of protection and restoration of tree alleys within the framework of natural, cultural, historical and aesthetic values preservation concepts.

As observed from historical maps, or from preserved remnants of historical landscape structures, traditional agricultural landscape of the past reflected the close relationship between man and landscape, enhanced by ties of ownership and farming. The research shows that the framework of field roads, together with remnants of tree alleys is suitable for greenway functions provision.

Tree alleys, elements of historical landscape associated with identity, memory of landscape, and their multiple use as green corridors to access the rural agricultural landscape, possess the strong potential for rebuilding the lost ties with farm land, enhancing the sense of belonging and place attachment, which are considered to be the motivations for engagement in land stewardship and land protection efforts (Lokocz, Ryan, Sadler, 2011).

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8. URBAN GREENWAY PLANNING

A Greenway Network Vision for Metro Boston

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Abstract

Urban greenways are attractive for walking and especially for bicycling because they offer a pleasant and near-traffic-free environment in an area with high population density and rich with destinations. Unfortunately, urban greenways are often not connected to one another, requiring cyclists to negotiate heavy traffic getting from one greenway to another and thus diminishing their utility. In the Boston region, a planning and visioning effort is underway to promote the vision of a *network* of connected greenways offering continuous pleasant, low-stress routes by bicycle or by foot between origins and destinations across the urban area. The network plan emphasizes both connecting existing greenways and creating new greenways. Opportunities for new greenway corridors are described, including radical road diets that remove two lanes from overly-wide roads in order to create parkland strips that can host a shared use path.

Greenway network planning involves balancing the desire to increase the network's reach and connectivity by adding segments against the need to preserve the integrity of the "greenway" brand. We show that using strict criteria that emphasize low traffic stress, an extensive and dense greenway network is feasible using creative engineering solutions such as road diets and cycle tracks. Evaluation measures examine the quality, reach, geographic distribution, and connectivity of the network.

Introduction

Greenways offer an attractive environment for active recreation such as walking, jogging, and cycling. In urban areas, they are especially attractive for cycling because they can offer near-traffic-free cycling routes in areas rich with destinations. Traffic danger is a major deterrent to cycling (Winter et al. 2011), and is undoubtedly a major reason that cycling rates in most American cities are more than ten times below those of European cities such as Copenhagen, Amsterdam, and Munich that routinely provide traffic-protected bike routes (Pucher and Buehler 2008). However, the potential of greenways to meet the need for safe and attractive cycling routes depends on their being connected to form a network. Without connections, only cyclists whose origin and destination both lie along the same greenway can make a trip without having to negotiate through stressful traffic to get from one greenway to another, limiting the network's ability to serve the mainstream population that has been described as "traffic-intolerant" or "interested but concerned" cyclists (Furth 2012; City of Portland 2010). In contrast, a network of greenways in an urban area offers a radically different and attractive option for transportation and recreation with substantial attendant societal benefits in the areas of public health, energy consumption, air quality, traffic congestion, economy, and mobility.

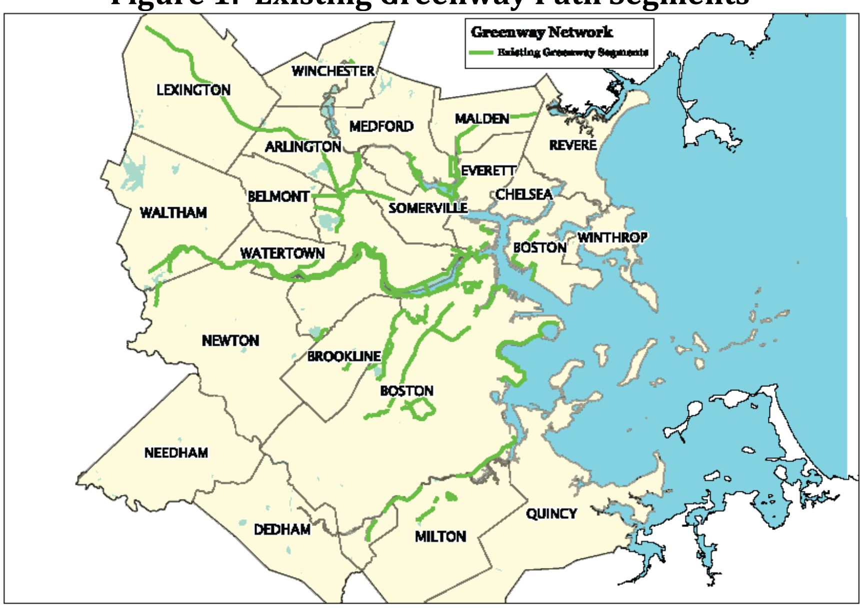
This paper describes the plan for a greenway network for the Boston's inner metropolitan area encompassing 21 cities and towns bounded roughly by the Middlesex Fells Reservation, the Blue Hills Reservation, and Route 128. Emphasis is given to opportunities for creating connections, extensions, and new corridors, to criteria that help ensure the quality and integrity of the greenway vision, and to network evaluation measures.

Connections to Form a Network

Parks movements prior to 1960 gave the Boston area a legacy of four greenway corridors extending at least three miles – one along the seashore and paths along the Charles, Mystic, and Muddy Rivers. The Muddy River greenway forms the bulk of the Emerald Necklace, a string of parks that originally had continuous walking, bridle, and carriage paths developed by Olmsted in the 1880s that claims the title of America's first greenway. However, the priority given to highway development in the period 1930-1970 created major gaps in the Muddy River and Mystic River greenways. Modern times saw two movements that added additional greenways: the highway revolt of 1967-1972 resulted in the Southwest Corridor greenway, and the rail-trail movement gave the region the Minuteman / Community Path corridor, with four additional corridors partly built out (Neponset, East Boston, Watertown Branch, and Northern Strand).

A map of the area's existing greenway paths (Figure 1) reveals not only frequent interruptions on particular corridors, but also an obvious lack of connectivity between greenways. None of the region's long greenway corridors meet. For example, at Charlesgate, where the Muddy River meets the Charles River, the Muddy River path ends 0.3 miles from the Charles River path, separated by a gap traversed by two highways and a railroad.

Figure 1: Existing Greenway Path Segments

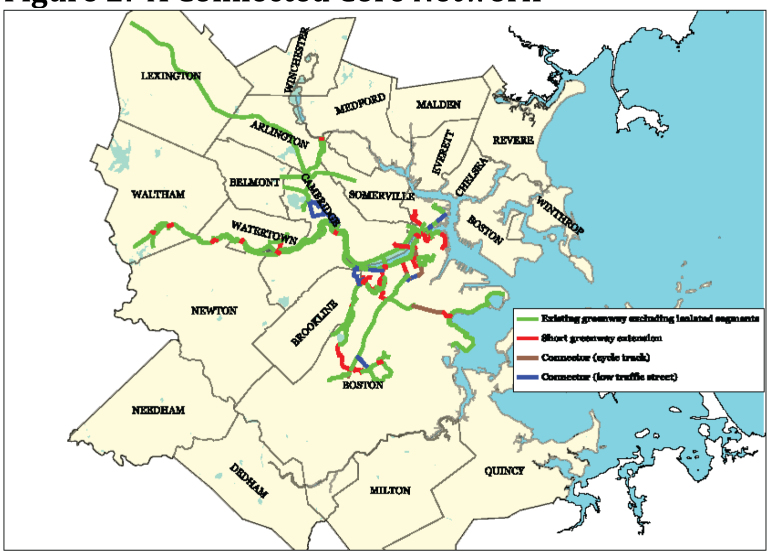


Since Olmsted's time, people have dreamed of parks being connected. The recent surge of interest in bicycling gives new impetus to the need to connect greenways, because serving the mainstream population requires providing an uninterrupted network of bike routes involving low traffic stress (Mekuria,Furth, and Nixon 2012). Since 2004, civil engineering students at Northeastern University have based several senior design projects on this challenge, and have found solutions to the many of the most vexing gaps in the greenway network including

Charlesgate (Northeastern University College of Engineering, 2012). It is now evident that a *network of connected greenways* in metro Boston is feasible.

Figure 2 shows the core of this connected network. It consists of five existing corridors – the Emerald Necklace and the four existing corridors that permit uninterrupted travel for at least 3 miles – and short projects that tie them together. Some of the connection projects are themselves short greenways; others are connectors that will meet the low level of traffic stress people expect on a greenway path, either by following low traffic streets or by means of a cycle track along a busy road (NACTO 2012). This core network consists of 69 miles of existing greenway, 12 miles of new greenway paths, and 8 miles of connectors.

Figure 2: A Connected Core Network



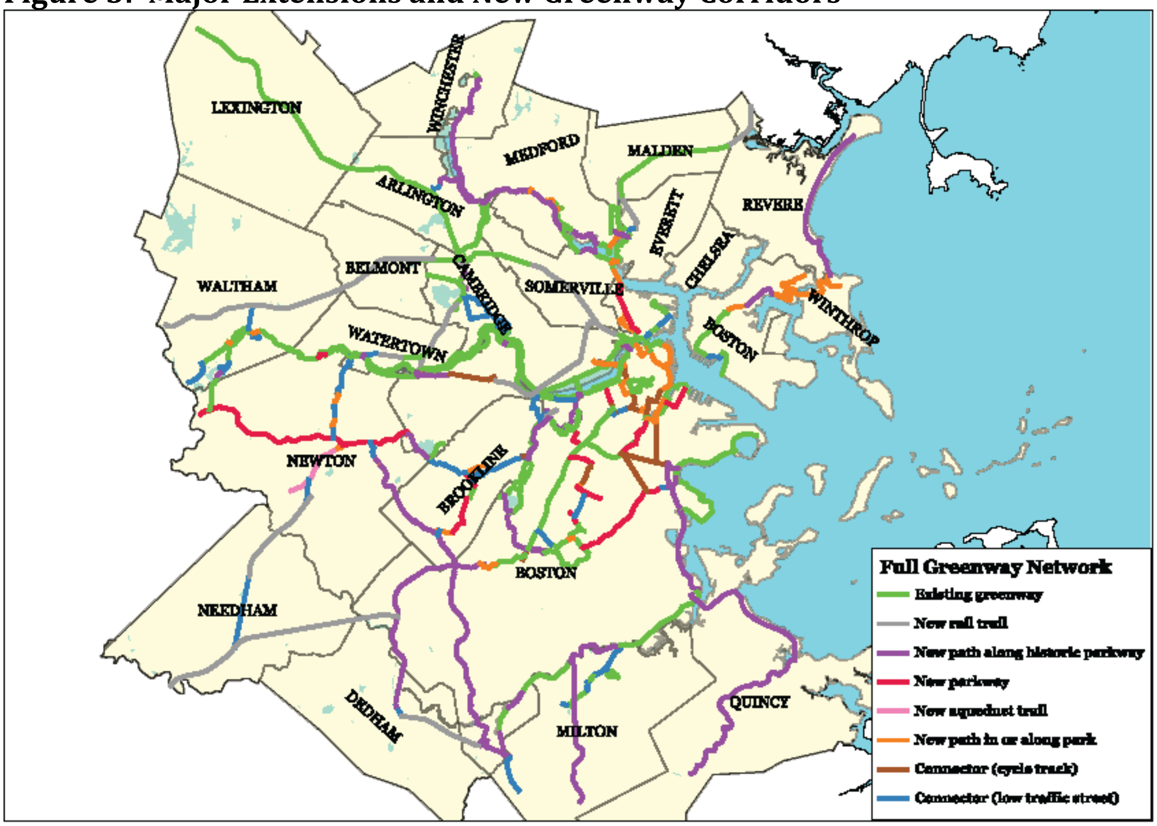
Compiling plans for other new greenways and extensions in the region – including projects currently being advanced by state and local government as well as projects being advanced by advocates, a regional greenway network can be proposed, shown in Figure 3, reaching all of the region's 21 communities except one (Chelsea). It contains 203 miles of greenway and 26 miles of connector. Of course, the network plan is open to revision as new opportunities are discovered and conceptual plans develop.

The network vision exploits five kinds of opportunities for greenway extension and new greenway corridors, highlighted in Figure 3:

- *Rail Trails.* Six new rail trail corridors and four corridors with major extensions are proposed, totaling 27 miles. Four projects involve trails along active rights of way.
- *Paths along Historic Parkways.* The Boston region has a large number of historic parkways, many of them planned in the 1910-1950 period with a focus on "pleasure driving" and often with no provision for non-motorized travel other than a narrow sidewalk. Many of them lie within reserved strips of parkland wide enough that they could host a shared use path as well as the parkway road. In some cases, space for a greenway path can be obtained by means of a "radical road diet" – eliminating two travel lanes where they are not needed to fulfill the road to fulfill its traffic function. The proposed network adds 55 miles of paths along historic parkway corridors.

- *Road Diets to Create New Parkways.* Besides historical parkways, the region has other wide roads that could fulfill their traffic function with a much smaller footprint, allowing the redeemed space to become a parkway strip with a shared use path. Such conversions offer the prospect of expanding the region's parkland resources as well as its path network. Traffic capacity analysis supports the feasibility of 11 such new parkways with a combined length of 14 miles. An example is Rutherford Avenue in Charlestown, which can be reduced to 4 lanes from an existing 6-8 lane cross section, allowing construction of a new parkland strip 0.9 miles long on the edge of one of the region's densest neighborhoods. In some cases, the greenway path can double as an access drive to abutting homes – a compatible use in conjunction with access and speed control measures that assure motor traffic speeds below 10 mph.

Figure 3: Major Extensions and New Greenway Corridors



- *New Paths Through or Along Existing Parks.* Several new paths totaling 15 miles are proposed through or alongside parks. Many of them are links between other greenway segments. An example is downtown Boston's Rose Kennedy Greenway, which currently does not allow bicycling, but has space to create paths that would form a critical link between greenways north and south downtown Boston.
- *Aqueducts.* A series of publicly owned aqueduct rights of way in the western suburbs of Boston has recently been released for trail development (Loutzenheiser et al. 2013). While most are beyond the geographical boundaries of this planning effort, a 1.5 miles section of aqueduct trail in Newton is part of the proposed greenway network.

Criteria for Greenways and Greenway Connectors

Creating a network plan involves a tension between forces of inclusion and exclusion. To expand the network reach and connectivity, there is strong force favoring adding more links; at the same time there is a need for criteria that ensure the quality and integrity of the "greenway" brand. For the public to comprehend and embrace the vision, *greenways* should be in parks or parkway strips and offer paths that are nearly free of traffic stress, and *connectors* should be short so that they don't dilute the park-like character of the network, and should involve the same low traffic stress that people expect on greenways.

Criteria for Greenway Segments

Greenway segments should meet five general criteria:

- They should be in a green or blue setting: in a park or parkway strip, or bordering a park or body of water.
- They should be physically segregated from motor traffic. Bike lanes do not qualify except on two-lane park roads with no curbside parking. Traffic limited to 10 mph can be permitted for local access.
- They should be open to both walking and bicycling, and traversable with a common road bicycle (thus excluding mountain bike trails).
- They should be suitable for travel for at least three miles along a desire line, thus excluding short, isolated segments as well as paths meant only for circulation within a large park.

Most greenway segments will be shared use paths, though some corridors may provide separate walking and cycling paths. They may be soft surface paths provided they are designed to resist rutting and are suitable most of the year for common road bikes.

Criteria for Greenway Connectors

Criteria for connectors apply to connector routes as a whole as well as to the links that make up a connector route. For the greenway network to be cohesive, connectors have to offer the same low-stress environment for bicycling and walking that people expect on a greenway. Mekuria and Furth (2012) give criteria for links to meet different levels of traffic stress (LTS) for bicycling. Using criteria for Level of Traffic Stress 2, the level that applies for the mainstream, traffic-intolerant adult population, options for connector links are as follow:

- If a road has more than two lanes, a speed limit 35 mph or more, or high parking turnover, a cycle track required. Cycle tracks (NACTO, 2012) are a zone for riding a bike that is physically segregated from moving traffic by barriers such as curbs, flexpost bollards, or a parking lane and distinct from the walking path. Where there are no abutting land uses such as homes or businesses, a shared use path can be used instead. Cycle tracks can be one-way (on either side of a road) or two-way. Two-way cycle tracks will often be preferred because they require less space than a pair of one-way cycle tracks while offering users more space. They also connect better to greenway paths which are virtually always two-way, and offer a more trail-like environment.

- On two-lane roads with speed limit 30 mph or less and either no parallel parking or parking lanes with low turnover and little or no double parking, bike lanes can achieve a sufficiently low level of traffic stress.
- On streets without any marked lanes (and therefore no centerline marking) where the prevailing motor vehicle speed is 25 mph or less and traffic volume is less than 3,000 vehicles per day, bikes can share the road with motor traffic..
- The walking path should be physically protected from motor traffic except where traffic calming limits speeds to under 10 mph.
- Unsignalized crossings should not require crossing more than two through lanes of traffic at a time.

Criteria for connector routes as a whole are:

- Connector routes should be direct. Human nature is such that people want to use the shortest path and will not go far out of their way to use a low-stress alternative route. The emphasis in network development should be on making the direct route low-stress rather than try to make people follow a circuitous route.
- Connector routes should be short – preferably one mile or less, with a suggested maximum length of two miles.
- Connector routes should aim to pass through pleasant and safe environments, avoiding, for example, ugly industrial areas and back alleys.
- Where possible, connectors should be routed so that they pass through or alongside parks that may be too small to qualify in themselves as greenways.

Many of the region's low-traffic routes that are otherwise ideal as connectors are one-way streets. Making them greenway connectors involves permitting contraflow bicycling (NACTO 2012). The network plan proposes contraflow for 13 one-way local streets, in addition to several cases in which two-way cycle tracks are proposed for busier one-way streets.

Finding space for a cycle track on a major road in a crowded urban area may seem like a daunting task, but it is surprising how often it is possible while still preserving the road's other functions. In some cases, it is possible to eliminate a travel lane; in others, space can be found by eliminating parking on one side of the street, or by making travel lanes and medians narrower. On bridges and on streets without any abutting homes or businesses, space efficiency can be found by having bicycles and pedestrians share a common path.

Relationship of the Greenway Network to the Bicycling Network

A region's greenway network will overlap its bicycling network, but they are not synonymous. A regional bike network will include many important routes that are not "green" and that may not be low-stress; including them all in the greenway network would severely dilute its park-like character. The greenway network is also more than just a bicycling network; it's also a resource for walking, jogging, and other forms of outdoor recreation, and offers substantial environmental and ecological benefits.

Within the bicycling network, some greenways may play the role of "bicycle superhighways" by offering long routes with few traffic crossing along important commuting corridors. Other greenways may play a minor role in the cycing network, serving as scenic byways.

In urban areas, greenways will inevitably serve both recreational and transportation (utilitarian) trips, and usage will often be dominated by the transportation function. However, there will usually be many more *individuals* who use the greenways for recreation than for transportation. Therefore, for developing public support for the greenway network vision, it is important to emphasize the recreational function. While relatively few citizens can see themselves riding a bike to work or to run errands, nearly all can see themselves cycling, walking, or jogging along greenway.

Evaluating a Greenway Network

Evaluating the network is important for network design as well as for making the case for public support. This section describes metrics that can be used to describe the quality, reach, and connectivity of a network plan.

Quantity and Quality of the Facilities

Table 1 shows a distribution of greenway segments by facility type. Compared to what exists today, the proposed network offers more than double the milage of greenway paths. The quality of the proposed network can be seen in the small fraction of network mileage in connectors as opposed to greenway paths, and the small fraction consisting of bike lanes as opposed to traffic-protected paths and bike routes along low-volume, low-speed roads. Nearly all of the connector routes are in pleasant surroundings; the only exceptions are a few miles of cycle track that have to pass through industial areas in order to connect parks.

Table 1: Distribution of Greenway Network by Facility Type (miles)

Existing greenway	91	
New paths along historic parkway	55	
New rail trails	27	
New paths in parks	15	
New parkway paths	14	
Aqueduct paths	2	
Subtotal, greenway paths		*203*
Connector, low traffic	19	
Connector, cycle track	7	
Subtotal, connector		*26*
Network total		***229***
Fraction connector		11%
Fraction bike lanes		4%

Geographic Distribution and Network Reach

Table 2 shows the distribution of the proposed network over the 21 municipalities in the target area. Most communities have a supply close to the regional average of 1.3 miles of greenway per 10,000 population. A supply of 2.0 or more only occurs when towns have paths running along rivers at the town edge. Chelsea, Everett, and Malden, a cluster of older industrial towns north of Boston, have the least supply. Contributing factors include wide rivers acting as barriers, a historical lack of regional parks, few unused railroads; also commercial strip development was allowed along their main historic parkway in place of parkland.

Table 2 also shows that 72% of the regional population lives within 1 km (0.62 mi) of the proposed greenway network, indicating reasonable good coverage. A buffer width of 1 km was chosen rather than 1 mile because it was believed that having to walk or cycle 1 mile to get to a greenway would be considered a deterrent to many people (especially where there is no safe access route for bicycling), while a distance of 1 km would not. A more detailed analysis would account for the existence of low-stress bike routes that can be used to access the network.

Coverage by community is more than 80% for Boston and for communities closest to downtown Boston, a natural hub considering the regional layout of railroads and rivers, which greenway paths often follow. Except for Chelsea, coverage tends to be lowest in the most distant suburbs, where the population is more spread out. Malden has a low supply of greenways, but 74% coverage because of its dense population and because its main greenway is centrally located; conversely, Milton, with the greatest supply of greenways, has only 53% coverage because its greenways are concentrated along a river that forms the edge of town.

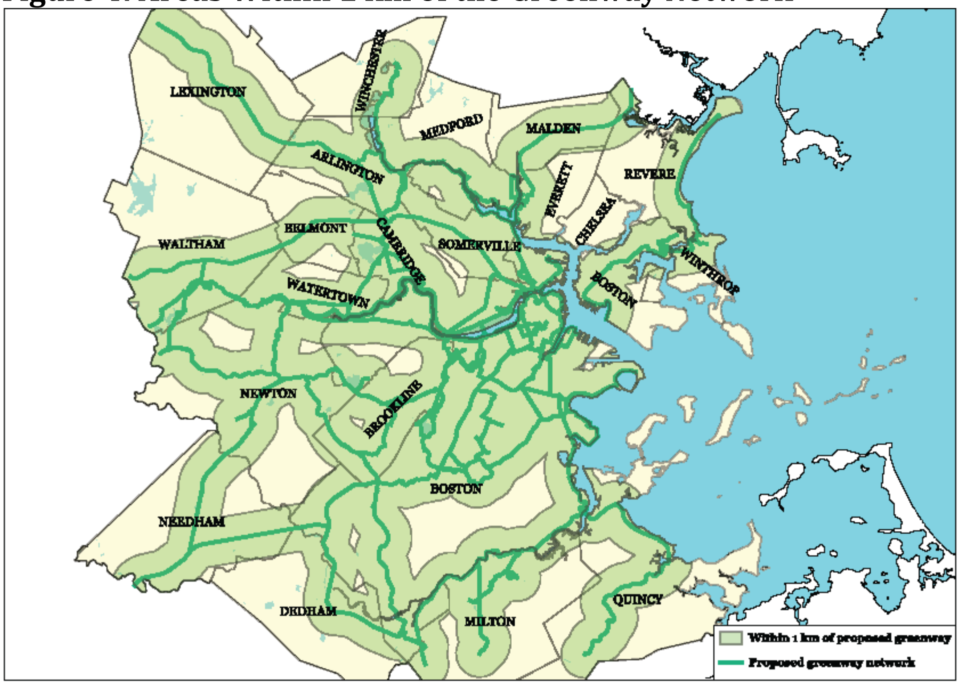
Table 2: Geographic Distribution of the Proposed Network

	Greenway miles (excluding connectors)	population	Greenway miles per 10,000 people	population within 1 km of network	% within 1 km of network
Cambridge	17.8	109,000	1.6	104,000	96%
Somerville	6	79,000	0.8	75,000	95%
Brookline	7	59,000	1.2	54,000	92%
Arlington	7.3	43,000	1.7	36,000	84%
Boston	81.7	608,000	1.3	506,000	83%
Malden	3.2	59,000	0.5	43,000	74%
Newton	12.8	84,000	1.5	59,000	69%
Needham	5.8	30,000	1.9	19,000	63%
Belmont	3.3	25,000	1.3	15,000	60%
Medford	11.4	57,000	2.0	33,000	58%
Watertown	7.3	33,000	2.2	18 ,000	56%
Revere	4.7	49,000	1.0	27,000	56%
Milton	7.6	27,000	2.8	14,000	53%
Waltham	8.1	62,000	1.3	31,000	50%
Everett	2.1	39,000	0.5	18,000	47%
Quincy	7.6	90,000	0.8	40,000	44%
Winchester	1.9	21,000	0.9	9,000	42%
Lexington	5	32,000	1.6	12,000	39%
Dedham	2.5	26,000	1.0	10,000	38%
Chelsea	0	37,000	0.0	2,000	7%
TOTAL	**203.1**	**1,567,000**	**1.3**	**1,126,000**	**72%**

Figure 4 shows the proposed network with 1 km buffers indicated. It clearly reveals several “greenway deserts” in the region. Greenway deserts in densely settled, park-poor communities such as the Mattapan- Dorchester area of Boston and Chelsea generate an impetus to find new opportunities create greenways. Bertulis and Furth (2013) describe an effort to create a new kind of greenway in Dorchester by converting local streets to linear parks. Greenway deserts in leafy suburbs are less of a concern because many of their streets offer a pleasant environment for wal king and cycling.

The network provides close access to all of the region's main recreational areas and activity centers other than suburban office parks. However, the network's break in connectivity (discussed later) makes destinations on the north shore such as Logan Airport and Revere Beach inaccessible by greenway from most of the metro area.

Figure 4: Areas Within 1 km of the Greenway Network



Connectivity and Mesh Density

From inspection, the proposed network is clearly better connected than the existing one. At the same time, one obvious shortcoming remains in the proposed network – the complete separation of the East Boston / Revere Beach corridor from the rest of the network. They are coastal communities bordered on three sides by wide bodies of water, making connections difficult.

The Dutch guide for bicycle network planning uses an indirect way of getting at the objective of connecting people's homes with destinations. It stresses that the biycling network should form a relatively dense mesh (CROW 2007). A dense mesh will enable people to travel between any pair of points with little off-network travel to access the network and with little detour. Inspection of the network reveals that much the proposed greenway network offers a mesh density that meets those objectives, especially considering local and non-greenway bike routes that may be available. The exceptions are the greenway deserts pointed out earlier and the large break that cuts East Boston and Revere Beach from the rest of the city. During planning,several of the network's connectors were added precisely in order to fill what would otherwise be gaps in the mesh. The greenway deserts that persist give a clear impetus for finding additional opportuntities for new greenways and low-stress connectors.

Discussion and Conclusion

Connecting parks has long been a goal of park planning, and the recent surge of interest in bicycling for transportation gives new impetus to this goal. This study shows that by using innovative engineering solutions such as radical road diets, cycle tracks, bicycle contraflow, and rail-with-trail, far greater connectivity and reach are possible than many people had imagined, with At the same time, the failure of the network plan at present to reach and connect all communities gives impetus to find a way to create additional greenways and connectors.

Regionally, greenway development has often advanced piecemeal, as advocates have pushed for this or that trail. This effort puts forth the vision forthe radically different and larger idea of a *network of greenways*, a concept that has the potential to capture the imagination of the public like a transit network or a freeway network. This concept also has the potential to unify and strengthen advocates for parks, trails, and bicycling paths, with each one seeing how their project becomes so much more valuable when it's connected to a network.

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Link Detroit! A New Paradigm for Detroit's Non-Motorized Community

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Introduction

Detroit is experiencing a watershed moment in its non-motorized connectivity. Despite the economic issues facing the city over the last several decades, an interest in revitalizing the riverfront has resulted in the Detroit RiverWalk, a major land reclamation along the Detroit River promoting highly desired public access. Another realized gem is the first phase of the Dequindre Cut greenway in an abandoned rail corridor. This corridor was known worldwide for its underground graffiti art and has become a popular destination for Detroit residents as well as visitors. In parallel with these efforts, and separate from the downtown core, Midtown Detroit, Inc., implemented the initial segments of a multiphase greenway, Midtown Loop, connecting local universities with a revitalized business core and numerous cultural destinations.

While substantial in their individual contributions, the Detroit RiverWalk, Dequindre Cut and Midtown Loop lacked a collective capacity for connectivity that could make them successful from a citywide network perspective. Master plans identified the potential to realize these connections but the funding required for implementation was far beyond any individual project budget. The Transportation Infrastructure to Generate Economic Recovery (TIGER) Discretionary Grant program offered a way for the City of Detroit (City), in collaboration with several non-profit organizations, to realize a true paradigm shift in establishing a collective vision.

Background

In 2011, the City and a dedicated group of non-profit leaders developed the concept of Link Detroit! Link Detroit! includes a series of multimodal infrastructure improvements that will create a non-motorized network through the Midtown area to Eastern Market, continuing on to the Detroit RiverWalk, extending into the heart of downtown and north to Hamtramck (Figure 1). Specifically, Link Detroit! includes construction of: (1) Dequindre Cut Phase II, (2) Midtown Loop Phase IV, (3) Eastern Market streetscape and pedestrian improvements including reconstruction of three critical bridges, and (4) the Hamtramck Connector. This represents a $23 million infrastructure investment.

These improvements will link several of Detroit's wonderful assets—the Detroit RiverWalk, downtown Detroit, Eastern Market, Midtown and surrounding neighborhoods—creating improved access for residents and visitors. They will also generate opportunities for economic reinvestment, support the local and regional community, and provide convenient and cost-effective transportation options to residents who live and work in the city. These projects will extend and complete the substantial investments already made in the development of greenways, streetscapes, bicycle paths and associated infrastructure enhancements, enabling residents and visitors to better access the city's commercial, recreational, educational and cultural offerings.

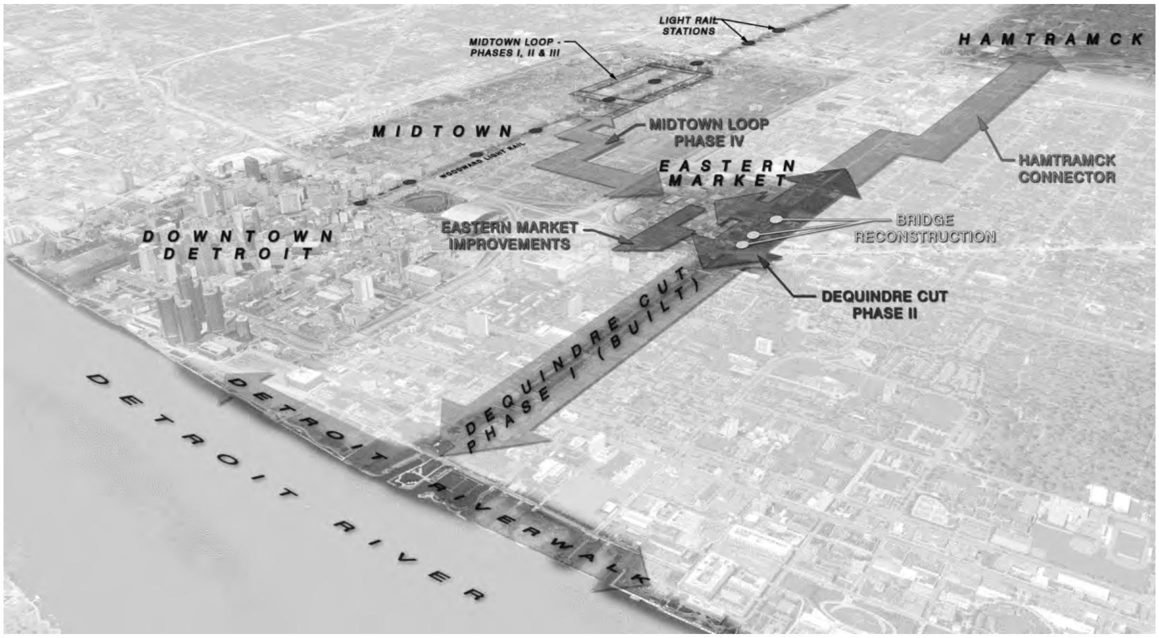

Figure 1: Link Detroit! project location

Guiding Principles

Link Detroit! includes greenway, streetscape, roadway and infrastructure improvements focused on the following guiding principles:

A. Improve multimodal transportation options to major employment centers, universities and hospitals while providing increased access for surrounding neighborhood residents to strategic Detroit destinations.
B. Improve non-motorized connections by linking the Detroit RiverWalk and Dequindre Cut greenway with the Midtown Loop and the Hamtramck Trail, creating a connected network for those who live, work and play in the city.
C. Strengthen Eastern Market's identity as a district by enhancing the operations and functionality of the existing public market.
D. Take advantage of the numerous economic development opportunities available throughout the Eastern Market district, Midtown and along the greenway connections while maintaining authenticity in the neighborhoods and using Link Detroit!'s image to attract people to live in, work in and visit Detroit.
E. Incorporate sustainable strategies through the use of street tree plantings, landscaping, stormwater management and LED lighting.
F. Promote mixed-use neighborhoods that improve the business climate and enliven streets and public spaces by carefully blending a variety of uses that support the identity of Eastern Market, Midtown and those districts located along the greenway connections.

Planning Approach
The City was the lead agency in executing Link Detroit! and the recipient of the TIGER Grant. The City provided their expertise developing transportation projects that included collaborating with the Federal Highway Administration, the Michigan Department of Transportation and three

non-profit organizations – the Eastern Market Corporation (EMC), Midtown Detroit, Inc. (MDI) and the Community Foundation for Southeast Michigan (CFSEM). Link Detroit! builds on a history of completed planning and project development tasks for each of the proposed improvements. These investments ensured that the projects were feasible, were planned to support each other, and had a solid foundation for implementation.

Eastern Market District Core Improvements

Detroit's Eastern Market is the largest historic public market district in the United States. Founded in 1891, it hosts both retail and wholesale markets. On any given Saturday, as many as 40,000 customers shop elbow-to-elbow for fruits, vegetables, breads, specialty foods, jams, honey, apple cider, cheeses, spices, herbs, plants and flowers—all from the marvelous bounty of farms from Michigan, Ohio and Ontario, Canada. The EMC is implementing a phased capital improvements program focusing on their building assets, food distribution network and training programs. This effort involved the preparation of the *Eastern Market 360° Capital Improvement Program for Eastern Market* (Eastern Market Corporation, 2011a) for the core area and a market-oriented development plan *Defining the Market Oriented Development District for Eastern Market Corporation* (SmithGroupJJR, 2011) for the entire 43-acre district. Link Detroit! provides streetscape enhancements, including sidewalk paving, improved bicycle and transit facilities, site amenities, stormwater management, landscaping and pedestrian lights. This will improve the circulation, access, safety and experience for patrons and vendors at Eastern Market, resulting in higher visitation, expanded job opportunities and reinvestment in the district.

Midtown Loop Phase IV Greenway

MDI is focusing on programs and initiatives helping to encourage and develop a positive environment within Detroit's Midtown district. One of these initiatives is to improve non-motorized connections and the pedestrian environment throughout the district. They have invested in the planning of the four-phase *Midtown Loop Greenway Master Plan* (SmithGroupJJR, 2009) to meet the goal of connecting Midtown with Eastern Market. Phase I is complete, Phase II is under construction, and Phase III is in design, representing an investment of approximately $5.2 million. The Phase IV connection provides a critical 1.2-mile linkage from the Midtown area to key Detroit destinations and neighborhoods including Eastern Market, the Dequindre Cut, the Detroit RiverWalk and the downtown core. The project will provide a walkable, bikeable trail for residents and visitors within Midtown and connect the Midtown educational, cultural and medical institutions to the larger system of greenways. The Midtown Loop greenway will also help the community reclaim much needed green space and positively contribute to the community's quality of life.

Dequindre Cut Phase II Greenway/Hamtramck Connector

Approximately 8 years ago, the City took advantage of an opportunity to acquire 1.2 miles of an abandoned rail corridor depressed 25 feet below grade and developed the *Dequindre Cut Greenway Master Plan* (SmithGroupJJR, 2007; updated 2009). Phase I formally opened in 2009 to great acclaim and has been considered a model for revitalization of abandoned urban rail corridors. The severely deteriorated conditions, access requirements and safety features resulted in a project costing approximately $4 million. Link Detroit! allows the extension of Phase I along the abandoned rail corridor, making a critical connection between Eastern Market, Midtown Loop and the Detroit RiverWalk.

It will also extend the trail north two miles through on- and off-street bike lanes connecting with the city of Hamtramck, one of the most demographically diverse populations in Southeast Michigan, and their greenway system.

Adelaide, Wilkins and Division Street Bridge Reconstruction
The City is responsible for maintaining a complex network of surface streets and bridges. As is common throughout the United States, the City is facing a budget crisis resulting in deteriorating infrastructure and unfunded projects. Detroit recently received a local bridge program award for the reconstruction of the Wilkins Street bridge. Link Detroit! allows the City to replace the deteriorating Adelaide Street and Division Street bridges over the Grand Trunk Railroad east of the Eastern Market core. This will maintain and enhance critical road linkages over the railroad, allowing adjacent neighborhoods to better access Eastern Market and facilitating more efficient truck traffic to vendors and local businesses. It will also provide improved non-motorized connections for residents and business owners.

Anticipated Results

It is important to note that the various elements of Link Detroit! have not been implemented. The project is currently in the engineering phase. Construction is scheduled to start in August 2013, with completion estimated in November 2014. Nevertheless, a discussion of the project's anticipated results provides valuable insight into the relationships and benefits it is expected to create in the urban network.

The City has experienced a series of financial setbacks over the past decade that reached its peak with the bank crisis and resulting impact to the industrial sector. This resulted in a serious rise in unemployment and related defaults on home and business loans. The City faced several challenges prior to this crisis, including a shrinking population still spread across a large geography, a market where the supply of housing exceeded the demand, a declining tax base, older housing stock and an old infrastructure system.

In the face of these challenges, Mayor Bing initiated the Detroit Works Project to redefine the physical, social and economic landscape of the city. Short-term strategies have been developed to align city services, resources and investments in neighborhoods based on existing market conditions. Link Detroit! was designed to support these short-term strategies.

Detroit has active and organized greenway planning throughout many of its neighborhoods, as well as an adopted non-motorized plan. However, of the over 400 miles of non-motorized facilities proposed in the City's plan, only 73 miles have been implemented. Many of the existing non-motorized facilities are disjointed and do not provide an interconnected network for bicyclists and pedestrians who live, work and recreate in the city. Link Detroit! represents a nexus of three central greenway projects designed around Eastern Market as a core of food security and economic revitalization.

Economic Competitiveness
This project will greatly improve the economic competitiveness of the city by providing transportation options, enhancing existing infrastructure, and facilitating investment and

redevelopment. Adaptive reuse and redevelopment are identified by the City and EMC as key ingredients in revitalizing Detroit's urban core.

Link Detroit! will connect three greenways in the existing greenway network, linking adjacent neighborhoods with important destinations such as Eastern Market (jobs and fresh food), the Detroit RiverWalk (recreation and access to downtown and the Detroit River), and Midtown (higher education, health care and jobs). This connected system will provide improved access to the existing Detroit Department of Transportation bus transit system as well as the proposed Woodward Light Rail system. This will greatly improve the multimodal capacity in the city by expanding the number of safe options for residents and covering a larger geographic area.

In addition to improved access, an active and connected greenway system can provide a dramatic boost to the economy. It is anticipated that the proposed improvements will stimulate economic reinvestment in the Eastern Market District. The EMC is poised to capture this benefit as documented in its *Eastern Market District Economic Development Strategy* (Chan Krieger Sieniewicz, 2008) and *Eastern Market 360^{o} Capital Improvement Program for Eastern Market* (Eastern Market Corporation, 2011a). The latter study estimates that a revitalized Eastern Market district could result in:

- 58 new market vendors.
- 3-5 additional retail market days.
- 1,890 new or retained jobs.
- 15,000 additional weekly visitors.
- 20 new retail businesses.
- 20 new market-related businesses.
- 600 new housing units.

The market-oriented development plan for Eastern Market (SmithGroupJJR, 2011) estimates that there is currently 812,000 gross square feet of building reuse capacity and over 1.9 million gross square feet of proposed redevelopment capacity in the district, including both residential and non-residential uses. This excess capacity along with the projected growth could result in an increase of $9.9 million in annual property tax revenue and an increase of $5.8 million in income tax revenue.

<u>Livability</u>
Improving non-motorized transportation options, the pedestrian street environment and the surface transportation system will significantly improve livability and reinvestment in the city by providing more mobility options to residents and creating a more vital, energized urban environment. Nearly two in ten Detroit households, and nearly half within half a mile of Eastern Market are estimated to have no personal vehicle (Poole, 2011). This presents serious issues in getting to jobs, education and health care, which are problems that can be alleviated by an expanded non-motorized network connecting multiple transit options. For those with a vehicle, expanded non-motorized options can reduce costs of travel and allow a redistribution of household income from auto-related expenses to other purposes. This has been estimated to be between $3,000 and $6,000 per year for grocery store trips alone (Poole, 2011).

Link Detroit! has been developed considering the six livability principles identified by the U.S. Department of Transportation in conjunction with Department of Housing and Urban Development and the Environmental Protection Agency in their joint interagency Partnership for Sustainable Communities. These principles focus on helping communities improve access to affordable housing, expanding transportation options and lowering transportation costs while protecting the environment.

<u>Sustainability</u>
Link Detroit! will improve the environment by reducing vehicle miles travelled and consequently the use of fossil fuels and greenhouse gas emissions. Analysis of potential trip reductions in the Eastern Market district alone could lower CO_2 emissions from an estimated 90,000 metric tons per year to as low as an estimated 12,282 metric tons per year (Poole, 2011). It will also promote redevelopment of underutilized or vacant urban land, reducing pressure to build in surrounding areas. This project will connect various modes of transportation including bus and light rail transit, non-motorized transportation and passenger vehicles.

A majority of the work planned for Link Detroit! is located within city right-of-ways; the portion that is not (Dequindre Cut Phase II) is owned by the City. The City has a policy that all new lighting and all replacement lighting will utilize LED technology, resulting in reduced energy demand from the lighting grid.

Link Detroit! will include an increase in green, landscaped areas. This will provide opportunities for implementing Low Impact Development stormwater management strategies, which promote infiltration while improving air quality and the carbon sequestration capacity of the urban environment.

Link Detroit! will also spur mixed-use residential development in and around the Eastern Market district. Most importantly, it will improve social equity by providing residents of Detroit's greater downtown with better access to sustainably grown and transported food.

<u>Job Creation and Near-Term Economic Activity</u>
The public infrastructure proposed as part of Link Detroit! provides critical connections in the surface and non-motorized transportation network. This, in turn, will help to attract new residents and businesses to the city, stimulating job growth and redevelopment. Link Detroit! is projected to generate 289 additional jobs, largely in the construction and engineering fields, as well as a total of nearly $40 million in economic output throughout Wayne County (Poole, 2011).

<u>Innovation</u>
Link Detroit! will serve to stimulate and expand the healthy metropolitan food hub that is currently under development at Eastern Market. Eastern Market is committed to helping rebuild the region's local food system. This large public market, with both wholesale and retail operations at its core and a cluster of smaller food processors and distributors in immediate proximity, provides an opportunity to jump-start a robust local food system. This will not only provide fresher, more nutritious food options, but will also reduce the environmental impact of food production. At the national level, Eastern Market is working closely with the United States Department of Agriculture to develop the local food hub concept needed to strengthen the performance of regional food economies. Energized by improvements to the multimodal transportation system, Eastern Market is positioned to become the most comprehensive food hub in the United States (Eastern Market Corporation, 2011b).

The close proximity of food production, processing, distribution, preparation, retailing and education will not only serve regional residents but will become a national laboratory to encourage other cities to weave local food districts back into the urban fabric, as they were before food systems became more global in scale. The goal is not only to provide fresher, more nutritious food, but also to reduce the energy consumption of food production, processing and distribution.

Further, local food system development can foster employment opportunities to reduce the structural unemployment of central cities. The Initiative for a Competitive Inner City (ICIC), a national think tank, spent the summer of 2011 investigating Detroit and Boston to understand the potential contribution of local food system development to overall area economic development. While the results have not yet been released, an earlier study by EMC (2011a) estimated that the economic impact of Detroit obtaining 20 percent of food from local sources could result in 4,700 new jobs and earnings over $124 million. Link Detroit! will be an active element in this local system.

Discussion and Conclusion

Link Detroit! focuses on critical infrastructure investments in an economically distressed city. A series of multimodal infrastructure improvements are being implemented to create a fully functional transportation system through the Midtown area to Eastern Market, continuing on to the Detroit RiverWalk, then extending into the heart of downtown and north to Hamtramck. The improvements will link several of Detroit's key assets—the Detroit RiverWalk, downtown Detroit, Eastern Market, Midtown and surrounding neighborhoods—increasing access for residents and visitors. These improvements will also generate opportunities for economic reinvestment, support the local and regional community, and provide convenient and cost-effective transportation options to residents who live and work in the city. These projects will infill, extend and complete the substantial investments already made in bridge reconstruction and the development of greenways, streetscapes, bicycle paths and associated infrastructure enhancements. The unified approach facilitates the completion of proposed phases of ongoing projects that currently have limited probability of being implemented in the near future due to funding shortages. In addition, it will leverage other key local infrastructure projects, such as the proposed Woodward Light Rail and regional bus rapid transit, by improving the functionality of Detroit's multimodal system, enabling visitors and residents to better access the city's commercial, recreational, educational and cultural offerings.

As part of the City's commitment to this effort, the City has developed a set of performance measures that will be used to evaluate the success of the project. These measures include documenting and reporting bicycle and pedestrian usage and annual rates of visitor traffic on the various greenway segments, as well as job growth and parcel occupancy in the Eastern Market district over a 5-year period.

Link Detroit! will enhance Eastern Market, one of the oldest and most successful public markets in the country. In addition, it will connect the market district to an existing non-motorized network and the Detroit RiverWalk while providing access to employment opportunities, educational facilities and enhanced recreational experiences. Improved economic vitality and non-motorized connectivity in Detroit are key contributors to the city's long-term sustainability and viability. Link Detroit! provides another great step towards a more sustainable and livable Detroit—a renaissance that will be walked, biked and bussed as much as it is driven.

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The Role of Sustainable Greenways in Achievement of Improving the Quality of Life (Tehran's greenways as a case study)

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Introduction

Urban growth and development is caused to increase exploitation of natural resources more than environmental capacity and lead to instability in the cities than ever before. Accordingly sustainable development emphasizes the role of green area and in order to achieve this goal, "greenway" is considered as one of the most important tools for improving urban sustainable development. Moreover, urban green spaces and elements consider as a main factor in the improving of quality of life. Greenways are "green infrastructure" to link people and places (Fabos, 1995) and can be planned at different scales and for multiple purposes, "including ecological, recreational, cultural, aesthetic" (Ahern, 1995), and also to provide people with access to open spaces close to each other where they live. At the city scale, the urban greenways can help improve the city, making it more livable, equitable and environmentally sustainable. In addition, urban greenways provide pleasant, efficient, and healthful and environmentally travel by foot or bicycle. The most important benefits of greenways in urban areas are environmental protection, recreation, and alternative transportation. These benefits cannot be realized unless the greenway planners take a multifunctional approach to the greenway paths and also consider the main role of settlements who lived there as a key factor (Shahani, 2010).

In the present study, the greenways of Tehran (Islamic republic of Iran) are analyzed more in-depth to evaluate the quality of life based on perception of people who lived there and the study sources in this field. Tehran urban area and its greenway's parts are the main material of this research and the greenways of Tehran are evaluated in the frame of urban natural formations of research. Besides, the data that would form the base of the Tehran greenways proposal is gathered from the literature study, greenway theoretical study and international greenway planning applications.

This paper is formed of three phases. A literature review is made to establish a theoretical base for the study. Then, Tehran city and its greenways are analyzed. In this regard, city's green space compounds are recognized as a major structural component in the process of green paths influence. The most important goals of this paper are considering greenways as a main factor of quality of life in urban area to improve sustainable development. To achieve the main goal at the third part, required index is determined in the study area and evaluated. Some of the main factors which are assessed the quality of life in the main greenways of Tehran in this research are: access to transportation, pollution, accessibility, social interaction, people's health and fitness, recreation and economic growth. Three main greenways of Tehran (Vali-Asr St- Shariati St- Mirdamad Blv) are considered to evaluate sustainable development indexes in the field of quality of life. To reach this, the questionnaire regarding quality of life is designed. Analysis of Questioners about the concept and understanding of greenways are prepared and evaluated based on responses for ranking indicators. Finally, after a detailed analysis and comparative result, some strategies and solutions are proposed for Tehran's greenways as an applied tools or factors to enhance the quality of life as the most important index of sustainable development.

Literature Review

Sustainability is a vision and it was born by changing people's view in the world. The views of environmental issues are mentioned in the Brantland Report of World Development Commission. In an exact definition "sustainable development is the progress of life quality for protecting environment"(Shearman, 1990), and in this expression, the concepts of “development” and “environment” are comparable each other and describe one goal. In the environment, functions of human being are so considerable and sustainable development emphasizes human's rights for health and new life with nature harmony. All the recent numerous and complex environmental problems in sustainable development planning, lead to consider sustainable development strategy as a main tool to use green and sociable spaces. The balance between various parts of city development and between city and green spaces are considered by the most effective and relevant components of sustainable development such as, “favorable city image with human proportions”,” urban identity” and “green and active spaces in the urban environment” (Chiesura, 2004).

Previous studies on the human ecosystem perspective and sustainable communities provided the basis for a conceptual model to integrate these ideas in the context of urban facilities (Fig 1). The model is developed in an attempt to recognize the basic relationships between component parts of a place in terms of its physical, social and economic realms. The model also indicates that quality of life is created by an ongoing interaction between community, environmental and economic qualities. Another basic idea about this model is that a sustainable community cannot be accomplished by focusing on just one of these three (economic, social, or environmental) aspects of the place and needs other facilities that should be planned and designed for a balance among the economic, environmental, and social characteristics of an area so that its residents can lead healthy, productive, and enjoyable lives (Shaffer, et al, 2000). For this reason, the quality of life is considered in the middle of the model as a main and effective element in humans being.

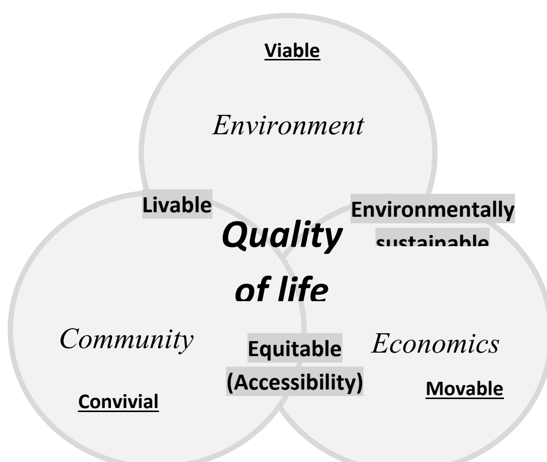

Fig 1. A Conceptual Model of Factors that Contribute to Community Quality of Life.

There are five key ideas contained the definition of greenways: First, the spatial configuration of greenways is primarily liner; Second, linkage; Third, multi-functional based on compatibility of certain uses; Fourth, complementarity between nature protection and economic development and the Fifth factor is greenways represent a distinct spatial strategy based on the particular items and advantages of integrate linear systems (Ahern, 1995). Greenway planning and design corroborate the principles of landscape planning and design, focusing on valuable areas and resources (Fabos, et al, 1993) and also promoting better metropolitan landscapes.

Greenways have some social benefits those are helped the sustainability such as: Improve leisure time and sport facilities, Have an alternative transport route, Help the public mobility, Enhance well-being through contact with nature, Prepare healthier lifestyles, Facilitate social equity, social cohesion and Have a positive influence on human behavior (Vasconcelos Silva, 2006). The greenways profits are reinforced when they are connected in a comprehensive greenway network, linking the main significant areas of natural, ecological, scenic, social, economic, recreational, historical and cultural values of an urban area. Through these benefits, greenways are an appropriate response towards greater urban sustainability. In other words, greenways are a vital planning tool and can help make progress towards greater urban sustainability as well as more general benefits. One of the most important of social benefits in greenways definition is quality of life (Fig 2).

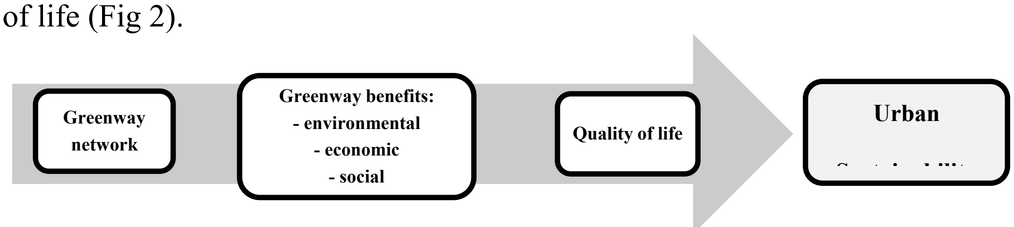

Fig 2. Greenways Network and Urban Sustainability.

Greenways are a part of a resource that has the potential to influence many quality of life factors. In a study of greenway in the urban it is found that, more than anything else, people like them for its scenic beauty. Responses about `nature' and `trees' are also among the top characteristics that people like about greenways uses (Gobster, 1995). Users of a greenway appreciate them most for opportunities to exercise, relax and appreciate nature, regardless of whether they are walking, running or biking. The two largest benefits perceived by residents around greenway study are related to health or fitness and preservation of open space, while recreation, community pride and aesthetic beauty are stated.

This study wants to measure user perceptions to evaluate the effectiveness of greenway in terms of quality of life. It is also examined the ranking of characteristics of quality of life by people. Understanding public perceptions about these facilities provides useful information which can be employed to identify shortcomings in current facilities, to develop new facilities, to develop and justify planning strategies or evaluate usefulness in achieving objectives. There are many indexes for evaluation quality of life, but based on the similar research or studies -Shaffer, et al, 2000, and Shahani, 2010- the most important and applied factors are selected. These characteristics are Natural areas present, Access to public transportation, Amount of pollution, New business development, Opportunity for other transportation use, Accessibility to shopping areas, Social interaction among residents, Conditions of people's health and fitness, Accessibility to work/school, Cost of transportation, Residents pride in community, Time spent on commuting and shopping, Accessibility to recreation, Economic growth and Features contributing to community identity. These are all listed characteristics related to the quality of life neede to help sustain a community; In addition these factors are extracted from literature review and some research that is related to the subject of this study. These fifteen indexes are examined for ranking importance and contribution of greenways in the study area and considered quality of life as a main factor of people who lived there for achieving sustainable development.

Goals and objectives

The most important and obvious goal in this paper is quality of life and how can be achieved it in the green way based of sustainable development. In the three green ways of Tehran (Iran) some special characteristics that are related to the improvement of quality of life are examined by the people with questionnaires. The main output of this research is ranking the key characteristics of quality of life and proposing the strategies and solutions to develop it in urban area. The presentation will promote the concept that greenways are more than just roads. There are several key factors that show a greenway can help create an acceptable city with including promotion of the connection and continuity, the aesthetics and multi-function and environmental protection. Without these key pillars of support greenways become unsustainable. A Successful Greenway should be considering the quality of life for their settlements as a basic feature besides other roles of them.

Methods

Location of Tehran (Islamic republic of Iran) in the southern slopes of Alborz Mountain range gives special benefits to it. Most of green ways in Tehran are gathered in the north part of it and they are near rivers or valleys. They work as recreation or health area for people who live in Tehran. The shape of city's relationship with nature in north part is different in various sections, the three selected greenways are on the northern sections in Tehran and due to their green masses with beautiful scenery they are considered to evaluate exiting green liner patterns. The composition and distribution of urban greenways in Tehran have been more related with the specified purposes and has linked elements in the environment and liner structure and also consider specific spatial and functional feature for multi-functional purposes.

The three main greenways of Tehran in connected each other in the north part of it; they are Vali-Asr St- Shariati St- Mirdamad Blv, (Fig 3). Mirdamad Blv is cuts off Vali-Asr St and Shariati St, in another word Mirdamad Blv is in the middle of this map of Tehran’s greenways and is created the backbone of “H shape” in their structure. These roads were selected as greenways in the Master plan of Tehran (2007), Detail plan of Tehran (2012) and Tehran vision (2024), moreover the green spaces and social interaction in these ways among people are so obvious, and therefore these three ways are the places that this research examines the characteristics of quality of life in greenways. The paper purpose is to demonstrate greenway significance towards the improvement of sustainable development in urban area. The case of Tehran’s greenways wants to present the achievements on urban planning and the receiving the factors of quality of life.

In order to accomplish the purpose of this study, a survey procedure was conducted from May to June 2012. Users of each way were sampled on all the days of a week and users were intercepted between 3 p.m. and 7 p.m. daily. A table was set up at the intercept point and signs were placed down the ways in both directions indicating that a study was in progress. An effort was made to invite every user who passed the intercept point to take part in the survey.

One questionnaire forms was developed. Fifteen items were selected and adopted from literature related to quality of life and sustainable development. Respondents were asked to provide their perceptions twice regarding these items. First, respondents were asked to rate the importance of each item (on a five-point Likert type scale, 1: very unimportant, 5: very important) to their community's quality of life in general.

Then they were asked to score (on a five-point Likert type scale, 1: poorly to 5: extremely well), and also requested how they perceived their greenways to contribute to each quality of life item. Questioning people about both the importance of characteristics and their performance of contribution allowed for a more complete evaluation of their relevance.

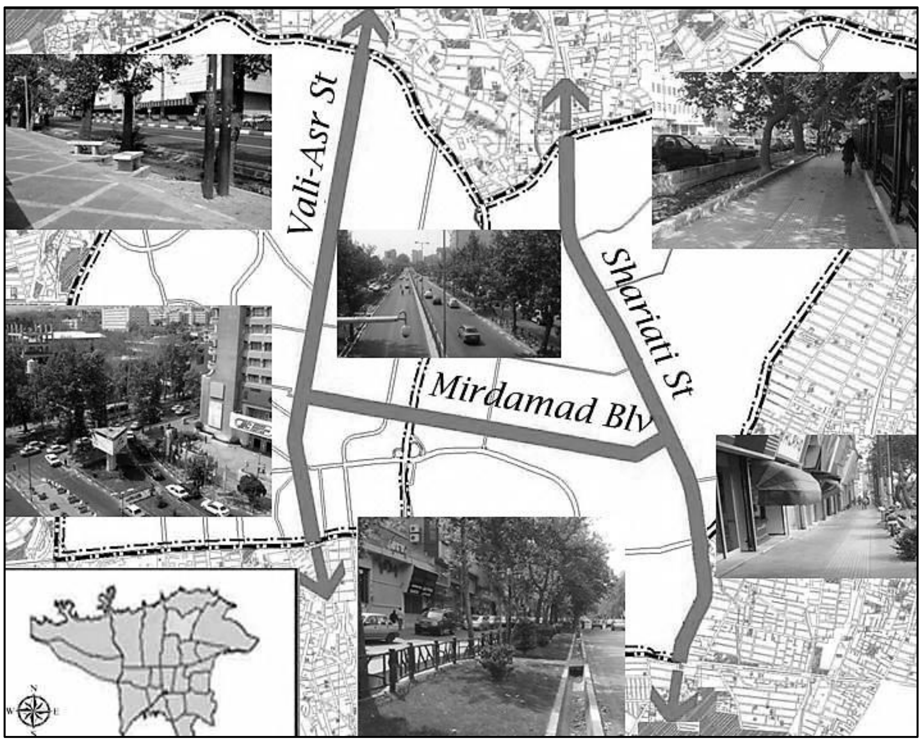

Fig 3. The General View of Three Main Greenways of Tehran.

After that section, data are analyzed using descriptive statistics, and ‘an importance-contribution analysis” is used to examine how greenways might influence community’s quality of life. Mean values for importance and contribution provide plot points for “an importance-contribution analysis” grid. Importance scores are placed on the horizontal (x) axis and contribution scores are placed on the vertical (y) axis. Interpreting the importance-contribution grid into action is fairly straightforward. Each of four quadrants in the grid represents considerations for planning and management, (Fig 4). Issues of importance to users, and those to which ways contribute well, will fall into the upper right quadrant of the grid. Greenway planners and managers can point to these items as `Quality of life performers'. These items act as indicators of how the greenway is best meeting concerns. Items that are seen as important to quality of life, but to which the greenways do not contribute, fall into the lower right part of the grid. These items may require attention in future planning and management efforts if those are to meet full potential. Items in this area might be labeled ` Quality of life priorities'. Issues of low importance, but to which the greenway is seen as contributing well would fall in the upper left quadrant and might be considered ` Quality of life windfall'. Finally, some items may be perceived as unimportant and also receive a low contribution score. Based on user perceptions, these items are apparently of little to no concern and the fact that greenways do not contribute may not matter much. These items would fall in the lower left part of the grid and might be labeled ` Quality of life inconsequential'.

Results

At first the user characteristics information are described. The average age of respondents is 38 years old. Overall, approximately 40% of respondents are female and 60% of them are male. Greenways users in this sample are well educated. Over 75% has a college degree and 46% has a graduate or professional degree. These demographic variables suggest a need to look more closely at socio-cultural `equity' on urban greenways. The meaning of these three greenways to quality of life is presented in this part. Table 1 shows the importance that users put on 15 characteristics related to community quality of life. Overall, respondents indicate that the things most important to their community's quality of life are the presence of natural areas, amount of pollution, social interaction among residents, and accessibility to work and school. Each of these characteristics is scored over 4.3 on a five-point scale (between `important' and `very important'). On the other hand, such things as accessibility to shopping areas, time spent on commuting and shopping, and features contributing to community identity are perceived to be the five least important characteristics (mean scores are <3.6 on a five-point scale). Generally, respondents from each road perceive these characteristics similarly in their levels of importance.

Main characteristics of quality of life	Overall sample in the three greenways (Vali-Asr St- Shariati St- Mirdamad Blv)	
	Mean	Rank
Natural areas present	4.50	3
Access to public transportation	3.98	9
Amount of pollution	4.38	4
New business development	3.87	10
Opportunity for other transportation use	3.82	11
Accessibility to shopping areas	3.50	13
Social interaction among residents	4.61	1
Conditions of people's health and fitness	4.22	6
Accessibility to work/school	4.53	2
Cost of transportation	3.74	12
Residents pride in community	4.11	8
Time spent on commuting and shopping	3.40	15
Accessibility to recreation	4.26	5
Economic growth	4.17	7
Features contributing to community identity	3.46	14

Mean values are calculated based on a five-point scale where 1: very unimportant, 2: unimportant, 3: neither, 4: important, 5: very important.

Table 1. The Level of Importance That Users of Three Greenways Placed on Quality of Life Characteristics

As shown in Table 2, respondents indicate that greenways have contributed most to community quality of life through natural areas present, social interaction among residents, conditions of people's health and fitness, and accessibility to recreation (mean scores are >4.2 on a five-point scale). These users generally perceive that their greenways do not contribute much to quality of life through access to public transportation, opportunity for other transportation use, and cost of transportation (mean scores are <3.7 on a five-point scale).

Main characteristics of quality of life	Overall sample in the three greenways (Vali-Asr St- Shariati St- Mirdamad Blv)	
	Mean	Rank
Natural areas present	4.38	1
Access to public transportation	3.66	14
Amount of pollution	4.14	6
New business development	4.03	8
Opportunity for other transportation use	3.61	15
Accessibility to shopping areas	3.97	9
Social interaction among residents	4.33	2
Conditions of people's health and fitness	4.25	4
Accessibility to work/school	3.79	12
Cost of transportation	3.69	13
Residents pride in community	4.09	7
Time spent on commuting and shopping	3.85	11
Accessibility to recreation	4.30	3
Economic growth	4.18	5
Features contributing to community identity	3.88	10
Mean values are calculated based on a five-point scale where 1: poorly, 2: fairly well, 3: well, 4: very well, 5: extremely well.		

Table 2. The Level of Contribution Those Users Felt the Greenways Made Toward Quality of Life

Quality of life characteristics are plotted based on both the importance people placed on them and how well they felt greenways contributed to the community quality of life. Plotted points represent the characteristics listed in Tables 1 and 2. Quadrants are devised using the midpoint in the two response scales. (Fig 4) includes visual plots for the three greenways and indicates that most of the quality of life characteristics are perceived both as important and that the greenways are perceived as contributing well to quality of life in those ways. That is, the items are almost all located in the upper right quadrant as quality of life performers.

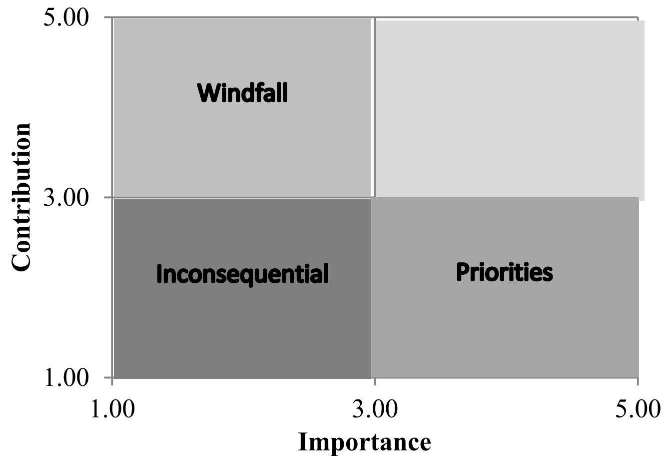

Fig 4. Importance-Contribution Grids of Main Characteristics of Quality of Life

An examination of the spatial pattern of plots for all greenways suggests that certain characteristics clustered into good, better and best categories of performers. Access to public transportation, opportunity for other transportation use, and cost of transportation are generally seen as least important and as receiving the lowest contribution. These items receive scores that could still be interpreted as good. But, when placed in the mix with other items they might also be considered quality of life inconsequential in order to focus energy elsewhere. Economic growth with new business development, access to work or shopping area besides residents' pride fell in the better or middle range. Respondents seem to feel that these items are very important to quality of life and that their greenways also contributed to them very well. Finally, quality of life characteristics like social interaction, natural area, access to recreation along with considering amount of pollution and health represent the best of the quality of life performers. These characteristics are seen as extremely important and as receiving the highest contributions from these greenways.

Discussion and conclusion

Greenways have the capability to protect and link natural, historical, cultural, ecological and economic resources into a type of system that has greater value and higher use than each of its parts. Greenways respect the carrying capacity of the natural environment and they take into account the balance among the three parts of (urban) sustainability: environmental, economic and social. They help make urban areas more environmental responsible, healthy, attractive, vibrant and in one word sustainable. Greenways system help place particular emphasis on the question of how it is possible to move towards urban areas that are more enjoyable, more interesting, more humane and more legible.

Greenways like roads are used in different ways and for different reasons. The location of these greenways within their respective communities, the character and management policies all influenced these use patterns. Time spent on site inventorying, site characteristics and interviewing users led to that the greenways received more use from commuters because it prepared accessibility for them to work or school. The greenways have been especially helpful to cycling and pedestrian because it was relatively straight, paved and had grade separations at many major intersections, these characteristics made it a relatively fast and safe for them and particularly it can help the social interaction in the urban area. Connections between the three greenways made it an attractive place for who work or live in that area especially for the lunch hour. The greenways may be serving to enhance relationships through the residents' pride and also they provide facilities to growth new business opportunity. Connectivity is a critical functional characteristic for people in greenway environments. Access to the greenway through good connections from work to home, entertainments and shopping area with considering health and fitness help determines influence and types of using.

The finding shows that greenways contributed to quality of life mostly through what they contributed to the natural and social environments in their communities. The model in (Fig 1) suggests that quality of life is composed of at least three major variables in a society. The community of people (social environment), the environment (physical surroundings) and the economy (jobs, income) overlap to create a quality of life for the community. Results here suggest that greenways are contributing most to quality of life through what the model represents as "livability", in this case the interaction between a community and the environment is mentioned. Respondents in Tehran case study are appeared to value greenways for their support of the social and physical environments as same as the economic one. Urban greenways provide places for daily recreation and alternative transportation (especially public one) and encouraging positive personally interaction with other people. They also provide "nearby nature", a break and escape from the hard surfaces and noise levels of surrounding roadways and other development with considering public health. The emotions suggested by a place can be indicators of livability and people's quality of life.

Greenways are appeared to perform well in their contributions to almost all quality of life items in this study. This is good from the standpoint of justifying greenway designation and development. The clustering of good, better and best `performers' suggests that planners and managers can gain insight through such an analysis prior to development. In this study all of the characteristics are being in the performance area and it is represented that the contribution and importance of the quality of life are approximately in the same level position. Differing approaches are important to understand if greenways are to maximize their utility as quality of life enhancement or not, these users perceived that greenways made strong contributions to reducing transportation costs and accessing local destinations because they, at least occasionally, used them for transportation. The fact they used greenways for several reasons have also lead to their stronger feelings about the way that greenways contributed to a community's identity and to positive social interactions among users.

A Successful Greenway becomes a backbone along which various sustainable development factors can be implemented including access to transportation, pollution, accessibility, social interaction, people's health and fitness, recreation and economic growth. According to conclusion, the main point is that before any action in the case study, should be prepared essential backgrounds in environmental, functional and social fields; otherwise any actions for promoting quality of life in the greenways will not be achieved any success.

Results are based on research finding, theoretical concept and along with principles of sustainable development and users perception about quality of life in the Tehran's greenways. Therefore via them, it can be organized necessary fields in direction of future policy, move to improve exited shortcomings and create new facilities to improve the quality of life. The research is demonstrated that greenways program can be a good tool for the protection of the landscape heritage and also for strengthening the achievement toward quality of life for inhabitants of Tehran. As it is showed in Table 1and 2 and also in (Fig 4), natural area, social interaction and accessibility are most important and key factors for improving quality of life in user's view. In conclusion, greenways are an important planning tool for achieving greater urban sustainability with quality of life. The expected outcome of this study is that the potential of greenways for enhancement sustainable development in urban environments is high, but will vary greatly depending on the details of configuration and composition of existing social interaction and also the people's view. In addition, the use of urban greenways as a tool for promotes the sustainable development should be with an emphasis on quality of life. Through these outcomes, this paper has demonstrated that greenways are a path towards urban sustainability with use of some key characteristics to improve quality of life in urban area. At the end of this research ,based on finding and characteristics of case study area ,some essential strategies and solutions which green ways can be progressed quality of life is expressed, however, they are so extended in different study fields. Thus, the effective and applied strategies and solutions are explained and in order to reach and improve mentioned characteristics, they are suggested in Table 3.

Strategies	Solutions
Emphasizing the integration of pedestrian and driving networks	- Reorganization of existing area in greenways and adaptation to surrounding land uses. - Considering greenways in urban transportation systems as main or secondary ways or roads in categories and providing the free movement of pedestrians. - Creating safe and quick access routes pedestrians and cyclists. - Give priority to pedestrians in passing the intersections.
enhancement social efficiency and performance	- Providing necessary infrastructures for entering people as pedestrians and cyclists. - Strengthening social stability in greenways by encouraging recreational and community activities. - Encourage residents to enhance community sustainability.
Prepare entertainment and attractiveness in greenways	- Creating spaces to satisfy the essential needs of pedestrians and bicyclists. - Providing recreational facilities such as a water fountain and green spaces to rest. - Organizing and forming business and market spaces. - Preparing Social and cultural attractions. - Considering surplus value for the owners of the surrounding area.
Use urban furniture to compliment and emphasize the space	- Locate and establish urban furniture along the walking path. - Improved pedestrian entrance and bridge. - Reforming and development route entrance to define and emphasize them.

Table 3. Proposal Strategies and Solutions for Improving Quality of Life in Tehran's Greenways

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Green structure under pressure – about knowledge in planning processes. Case study from Oslo

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1. Introduction

Compact city development has obtained a hegemonic status as a model for sustainable urban development in the Norwegian context as well as internationally. However, cities are also dependent on the natural environment to function properly, according to the report ” Norway´s Environmental Targets” (Norwegian Ministry of the Environment, 2012). A sound principle of sustainable urban developments is consequently to take care of continuous green structure with green corridors that link urban districts and green spaces with surrounding countryside. Such areas are important for the health and life quality for the urban population, but the authorities also underline the areas' important function retaining a variety of habitats that support biodiversity in and around urban areas. Knowledge is also important: "Research and monitoring provide us with a sound knowledge of the environment, which is the foundation for our knowledge – based environmental management regime." (Norwegian Ministry of the Environment, 2012 p. 50). What kind of knowledge is then needed? The report underlines knowledge about population status of species, the range of and ecological status of habitat types, and the impact of environmental pressures. There is less emphasis on "everyday nature". The aim of the article is to investigate how knowledge about nature diversity is viewed and used in green structure planning, and we use a case study from Oslo as an example.

2. Background

There are few studies addressing how nature diversity is handled when making plans for urban green structures. A Norwegian study showed that the theme had little attention in municipal planning (A.-K. H. Thorén & Opedal, 1997). The focus was on recreation and outdoor activities. This is also found in a Swedish study (Sandström, Angelstam, & Khakee, 2005). Previous studies have also pointed to the problem of making knowledge on nature diversity useful for planners as a main obstacle (Ernstson, Barthel, Andersson, & Borgstrom, 2010; Sandström et al., 2005). In spite of knowledge about species, the planners were unable to translate this knowledge into a landscape ecology/ structural approach. There is little awareness about the various scales that is necessary for ensuring the ecological functions of green areas, including the local green area scale, city scale green networks and at regional level. Of central importance are midscale managers who may be able to view the whole green network and act as a node between the local and regional network. In this study of Stockholm, Ernstson et al (2010) also showed lack of knowledge and suboptimal organization of the work, resulting in lack of connection between the ecological importance and the land use categories. However, some positive examples exist. Löfvenhaft et al (2004) has shown alternative practices in mapping and valuation in order to integrate biodiversity issues in spatial planning. The general impression, however, is that there are few examples of municipal planning practice within this field, particularly few investigation about the extent and type of knowledge that is used, how to assess the values of nature and the to which degree knowledge about nature diversity has influenced the content of green structure plans. The aim of the article is to investigate this field more in depth.

3. Theoretical perspective, goals and objectives of the study

Figure 1shows our theoretical approach. While framing the perspective on urban nature is important in determining what type of scientific knowledge that is relevant, applying knowledge in the planning and policy making is not a simple linear model (step 1). Science and policy making are mutually constitutive, produced in complex social, cultural and political contexts. Hunt and Shackeley (1999) argue that there are three poles. One pole is the scientific, academic way of producing knowledge, where academics address other academics (step 2). A second pole is the translation of knowledge that meets the planners and policy makers' need with a strong emphasis on application and use (step 3). Landscape ecology is an example where knowledge about species and habitats are translated into space requirement, which is useful for land use planners. In this pole scientists address the planning community. The third pole is the bureaucratic knowledge (Step 4) where bureaucrats address other bureaucrats as well as scientists and other stakeholders involved. Public planners operate within a planning institution with their own norms and rules for conduct, including e.g. requirements for due process, viable options, local social and political context, allocation of duties and responsibilities. In planning, the bureaucrats/planners have to secure a planning process that is open, transparent, democratic ensuring important stakeholders to be heard. Another example is that land use planners have to bear property ownership in mind, as public intervention is much easier on public than on private land.

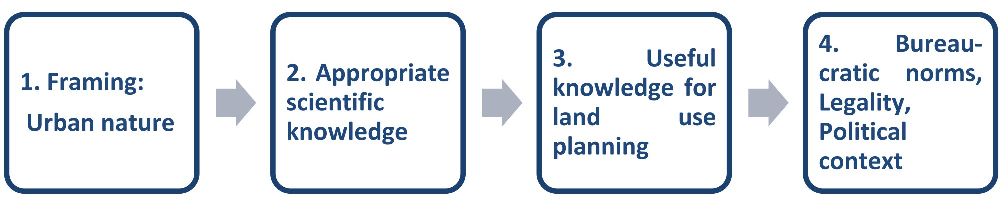

Figure 14 Stages in the knowledge/planning interface

Based on the model the research questions addressed in this paper is the following: 1) which framing or concepts is embedded in nature diversity values in the green structure plan? 2) What is the scientific knowledge about nature diversity values that the plan is built upon? 3) To which extent is the knowledge base translated into useful knowledge for planners? 4) To which extent has bureaucratic norms affected the knowledge base used by planners?

3. Methods

The project is based on case study methodology and the case is Oslo´s green planning with emphasis on nature diversity. By Norwegian standards Oslo must be regarded as pioneer in this field, and in line with Flyvbjerg (2001) characterized as a best case and thus an instructive example. To answer the research questions, we conducted a document study of the last green planning document that has been out for consultation since 2009, but not yet adopted (Oslo kommune Plan- og bygningsetaten, 2009). We have also analyzed the consultation documents related the plan and conducted some preliminary interviews with key persons in the municipal administration.

4. Results

Oslo's current green structure plan was adopted in 1993. The plan was considered so groundbreaking that it received a price for the best Norwegian plan that year. One of the reasons was the innovative way in which biodiversity was handled based on landscape ecological approach. Still it took many years before the municipality initiated a revision, but in 2005 it was decided to renew the plan. One of the reasons was extensive protests at the loss of green areas due to the densification policy that accelerated from the end of the 1980s but also new laws and policies in the environmental field. A draft for a new green structure plan was finished 2009 and is still discussed among the politicians.

Framing or concepts: The goals of the green structure plan correspond with national environmental objectives (Norwegian Ministry of the Environment, 2012) which is to ensure a structure of parks, wildlife and recreation areas within the built up area of Oslo. In the plan this is referred to as the blue-green structure because the municipality places great emphasis on the concept of an interconnected structure of green areas and the blue; rivers, streams, lakes etc. " The structural approach to the green areas are no novelty in Oslo and has remained unchanged since the first overall plan from 1929 (Hals, 1929), albeit described as park system. The term green structure is defined as a "web of small and large nature areas in the city" also called "green infrastructure" (Oslo kommune Plan- og bygningsetaten, 2009 p.16.).

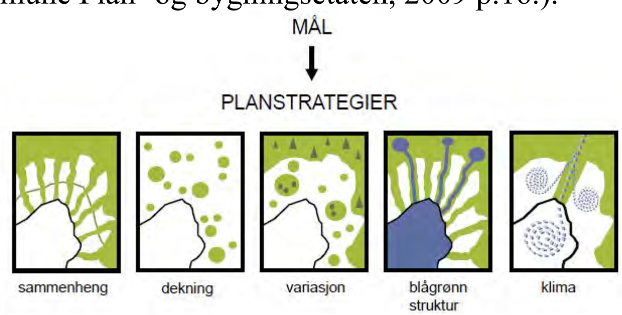

Figure 15 gives a good visual impression of the framework of the plan: Coherence, coverage, diversity, connection between blue and green structures and finally climate (Oslo kommune Plan- og bygningsetaten, 2009 p. 11)

Figure 2 reveals the multi-functional approach of the plan.

Scientific knowledge about nature diversity: The planning and building department of the municipality was responsible for the planning process, while expertise on outdoor recreation and biodiversity were found in another agency, Recreation and Leisure Service. The basic survey of relevant areas for future planning, the so-called "green area register", was not performed by the green expertise but by the planning and building authorities. Students did the field work. The survey includes unbuilt green spaces, secured by law and also unsecured areas. Nature categories' included were: water, forest, trees, lawn, meadow, other vegetation, artificial surface.

The municipality´s nature database is mentioned as an important source to identify biological diversity. The database includes registration and valuation of nature types, areas for wildlife and rare and endangered species. Although this was intended as an important tool for maintaining biodiversity in Oslo in daily planning (Pedersen, Nyhuus, Blindheim, & Krog, 2004) it does not appear that the tool is fully utilized. Consultative statement to the plan from the Recreation and Leisure Service illustrates the problem. They raise questions as to how the selection of important nature types has taken place and how they are presented on the map.

Translation into useful knowledge for planners: Landscape ecological approaches are given relatively much space in the plan. The purpose of the approach is to ensure the structure as a whole and to cover a wide range of nature qualities. Figure 3

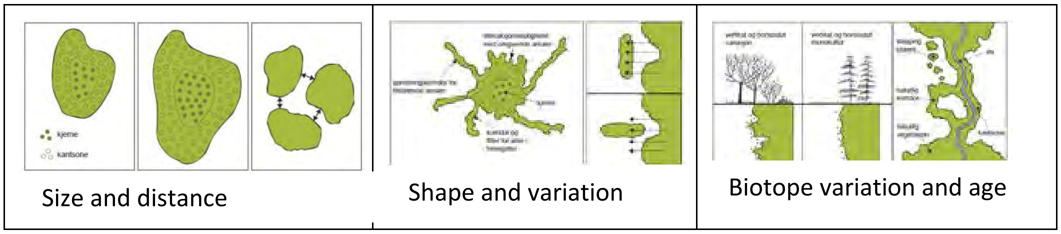

Figure 16 Landscape ecological principles presented in the plan. (Oslo kommune Plan- og bygningsetaten, 2009- p. 42) with reference to Dramstad et al (1996)

The plan introduces so-called ecological zones consisting of large undeveloped green areas, areas along watercourses, contiguous areas along the coast, etc. It is not stated what connection there is between the ecological zones, green area register, nature type survey and landscape ecological principles. Recreation and Leisure Service also is questioning this and does not consider what is stated as ecological principles as sufficient.

Most of the suggestions that came in early stages are largely met according to the plan. By using zoning categories, guidelines, etc. it is shown in a detailed way how a multi-functional green structure must be maintained. Land use categories are indicating which areas should be public sector´s responsibility, and some of the areas with specified nature values are included. General provisions and guidelines also specify how to deal with blue and green values on private land, but there are no map information revealing prioritized areas. In general, it appears that the preservation and development of the vegetation has had an impact of the plan. The requirements and arguments seem mainly to be related to aesthetics and recreation and not to nature diversity. It is stated that there is a need for further registration and protection of biological diversity and it is proposed to carry out a comprehensive mapping of biotopes in the building zone.

Knowledge base used by planners and bureaucratic norms: To identify what is meant to be private and public responsibility is central in planning. Thus it is interesting to see whether there is any connection between the knowledge base and what the plan is meant to solve. In this case the basic knowledge input comes from the “green area register” which mainly gives an overview of publicly owned land or areas planned for public ownership. The nature types are however on public as well as on private land. The main aim of the plan seems to be to protect what one may call the public blue and green structure, but there is some confusion regard to which areas are included. Many of the various values and functions related to the blue green structure of the plan including regulations and provisions are namely to found on private land. Valuation and use of norms is central to the planners. In this case, we have identified using the standard classification system which goes from very important (national value), important (regional value) or locally important (local value) for biodiversity. It is not clear how these values are weighted relative to each other, and there is no mapping of this material in the plan.

6. Discussion and conclusion

The perspective on nature presented in Oslo´s green plan is quite clear, it´s a multifunctional structure/ system of blue and green areas. The knowledge used in the plan is mainly about areas publicly owned or planned for public use. This is quite close to the American greenway thinking (Turner, 2006) where the green structure is viewed as a multifunctional linear system. The idea that green areas should be incorporated in a system has long traditions in Oslo, showing the importance and strength of the concept. Indeed, "the blue and the green" has been used in branding Oslo in the international competition for attention and investment.

Our findings is in line with both Sandström (2005) and Löfvenhaft et al (2004) showing that the knowledge base is not good enough. In addition, the competencies on nature diversity within the municipal administration has not been used in a satisfactorily way, also in line Sandströms findings.

To which extent is scientific knowledge translated into useful knowledge for planners? The landscape ecological principles referred to in the plan, are useful for handling nature diversity at a system level. However, our studies reveal that there is no connection between the use of the scientific knowledge of the urban nature and the analytic tool provided by the landscape ecological principles. Löfvenhaft et al. (2004) have shown that the use of indicator species is a way to integrate biodiversity issues in spatial planning. Oslo's well developed Naturbase (nature base) is a good foundation for choosing well suited indicator species that could have been used in the same way. The lack of planners with competencies within nature diversity in the planning process may have contributed to the lack of taking advantage of this opportunity. The way the green areas were mapped did not help in this respect either. There is in other words a fundamental mismatch between the knowledge base and the analytical tools that were presented.

In principle, nature diversity doe not relate to property rights and boundaries, as pointed out by national authorities in their guidelines for managing the green structure. . (A.-K. H. Thorén & Nyhuus, 1994). Consequently, it is not sufficient to map the publicly owned areas, all blue-green areas in the urban area should have been mapped. A method for doing so has been developed (K. Thorén, Due Trier, Lieng, & Aradi, 2010). Oslo municipality has chosen to concentrate on public blue-green areas. This is rational seen from a land use planner's view, but does not take care of nature diversity and ecosystem thinking. Ernstson et al. (2010) have shown that it is possible to think differently in a nested scale- and network governance perspective.

For planners, norms and value assessment is important when negotiating conflicting demands on land use. In the Oslo case, we found that the planners had to take the traditional hierarchic perspective on nature values from national, via regional to local into account, as implementation of national policy. The starting point was *Naturbase* (the nature base), representing an emphasis on protection of nature diversity. From the public hearing of the plan, other perspectives were presented, e.g. by the cultural heritage authorities at local and national level. They ask: what kind of nature is of importance? What about nature that is viewed as important for human use and experience? Bärring and Grahn (1995) has documented that people in general value a varied green structure highly. The question is: what kind of knowledge need to be produced in order to be taken into account when managing the green structure? Our conclusion is as follows:

1. Conceptual approaches is important, and should be used purposefully to decide which knowledge base should be used.
2. The scientific knowledge base is inadequate and not suitable as a basis for identifying the values and functions of multi-functional green structures.
3. There is a need for better cooperation and utilization of green expertise in municipal administrations.
4. The definition of the areas that should be included in the planning process must be adapted to ecosystem thinking.
5. There is a need to develop methodologies that can contribute to management of protected species / areas as well as the varied green structure humans are calling for.

Acknowledgements

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9. GREENWAYS AND AGRICULTURE

Opportunities for Greenways development in the south wine region of Ensenada, Baja California, Mexico

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Introduction

Ensenada has a winemaking tradition deeply rooted, as it is considered as the main wine-producing region in Mexico. The wine industry in Ensenada is developed in two regions: the northern region and the southern region. In recent years the tourism sector of Ensenada has seen a remarkable increase, particularly in the case of wine tourism in the north region. The Regional Development Programme for the Wine Region was created in 2006, to reach an optimal balance between economic and social activities and the sustainable development of the region; however, this programme only covers the north wine region. Recently, the interest for greenways and their application in landscape planning has grown internationally. According to Bischof, greenways can offer a way to unify several disciplines to move towards a commonality of purpose. Thus, considering this wine tourism scenario in Ensenada and the recent introduction of the greenway concept into regional planning, we identified the need for information that can be used for the creation of tools that support the development of the south wine region, as well as the enhancement of its tradition, through the identification of greenways with ecological, historical and cultural value.

Background and Literature Review

According to the Environmental Programs of the United Nations (2003), the concept of sustainability is to meet the needs of current and future generations through integration of environmental protection, social progress and economic prosperity.

The *sustainable tourism* concept is promoted by the socio-economic and technological changes, which have modified the behavior of tourists and travel patterns. Thus, post-industrial tourism has emerged, commonly known as *sustainable tourism* (De Leon, 2011). The concept refers to a type of tourism that involves the search of experiences, preferences diversification, interest in differentiated products, more closeness to nature and culture of each place, its services and connections, as well as a greater awareness of their impact on the environment (De Leon, 2011).

During the landscape planning process, it is necessary to consider the spatial and temporal variation of landscape resources, as part of a whole. That is, the integration of abiotic, biotic and cultural resources to the planning process. The multifunctionality of the landscape is understood as the integration of ecological, historical, socio-cultural, economic and aesthetic functions (Brandt, 2000).

Andresen et al. (2007) documented the application of greenways concept in the region of Alto Douro, in northern Portugal, in order to maintain cohesion between the natural system of the Douro River and the different land uses, considering the cultural value that this region represents, as it is considered as the oldest controlled winemaking region in the world (Andresen, et al. 2007).

Greenways are defined by Fabos as "corridors of various widths, linked together in a network in much the same way as our networks of highways and railroads have been linked. The major difference is that nature's super infrastructure—the greenway corridor networks—is pre-existent" (Fabos, 1995). According to Fabos, there are three types of greenways: ecological greenways and natural systems, recreational greenways, and greenways with historical heritage and cultural value (ASLA, 2007).

Firstly, ecological greenways and natural systems are usually along rivers, streams and ridgelines, which have the function of transporting matter and energy through ecosystems and providing habitat for species as well as connecting landscapes. Due to their attributes, greenways have the ability to function as recreational areas. Certain activities that may be performed in recreational greenways include walking, hiking, cycling and swimming, among others. (Fabos, 2004) "Many successful recreational greenways and green spaces, occur where networks of trails link with water-based recreational sites and areas" (ASLA, 2007).

The presence and quality of water in greenways is particularly important, as it keeps the natural ecosystem's viability and availability of resources. Therefore, historically greenways have been recognized as an important resource for communities, as for example, the presence of archaeological remains of ancient civilizations located in the beds of streams. This type of evidence can provide historical and cultural value to greenways, which can be used to attract tourists, as well as to provide educational, scenic, recreational, and economic benefits. Greenways with historic and cultural value are usually found along roads or highways (ASLA, 2007).

Greenways provide both economic and ecological benefits, such as ecosystem functions and environmental services, including water resource protection and pollution abatement, riparian habitat enhancement and biodiversity, as well as flood hazard reduction, recreation, environmental education, noise attenuation, microclimate enhancement, among others (Platt, 1994). Within the aesthetic function, it is the ability to provide psychological benefits for users. "Greenways and green spaces have enhanced livability and quality of life" (ASLA, 2007). Therefore, when the greenway concept is applied, from a multifunctional approach in planning and landscape design, it can be used as an excellent tool to promote sustainable development in rural landscapes.

Goals and objectives

To demarcate the southern wine region of Ensenada Baja California, at different spatial scales, through the identification of permanent landscape features, as basic elements for a general land classification system, to support the creation of sustainable landscape planning proposals for the region.

Specific objectives

- To demarcate the area of interest through the identification of watersheds.
- To demarcate within the watersheds, the fringe that contains the southern wine region.
- To characterize the natural and cultural context of the wine fringe.
- To analyze the spatial context, through the use of GIS, to provide a general proposal for the land classification system of the wine fringe. Determine the differences amongst the natural elements observed in each zone and identify greenways with ecological interest and with cultural -historic value.

Study Area

The southern wine region is located some 50 km south of the city of Ensenada in Baja California, Mexico. The region covers four areas of interest, known as: Grulla valley, Santo Tomas valley, San Vicente valley and the Llano Colorado. These four areas are within the watershed called "Animas-Santo Domingo". Each area is located in a different sub-basin (Fig. 1). The Grulla valley is located in the sub-basin called "Las Animas", Santo Tomas valley is located in the sub-basin "Santo Tomas", San Vicente Valley is located in the sub-basin "San Vicente" and the Llano Colorado in the sub-basin "El Salado".

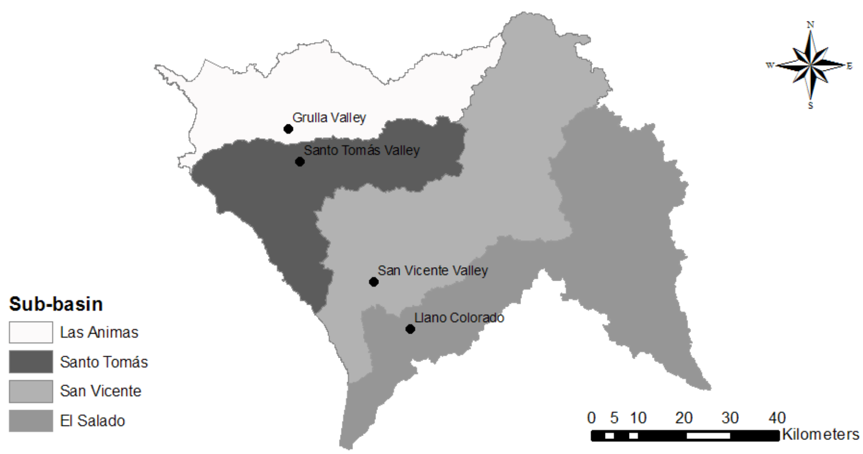

Fig 1. General study area location map.

Methods

We used a landscape planning model process to design greenway corridors at two different scales (Fig. 2). The first scale at a regional level, corresponded to the four sub-basins within the study area. At this level, a land classification system was developed including the evaluation of the different land cover types, both natural and anthropogenic, in a gradient which ranges from the coastal zone to the mountain range context. And secondly, at a local scale corresponding to the demarcation of the wine fringe, at this stage biophysical and cultural attributes were analyze to identified ecological greenways, as well as greenways with historical-cultural value and with recreational interest. An important aspect to consider, during the plan formulation phase, is the community involvement, considering the public information and participation.

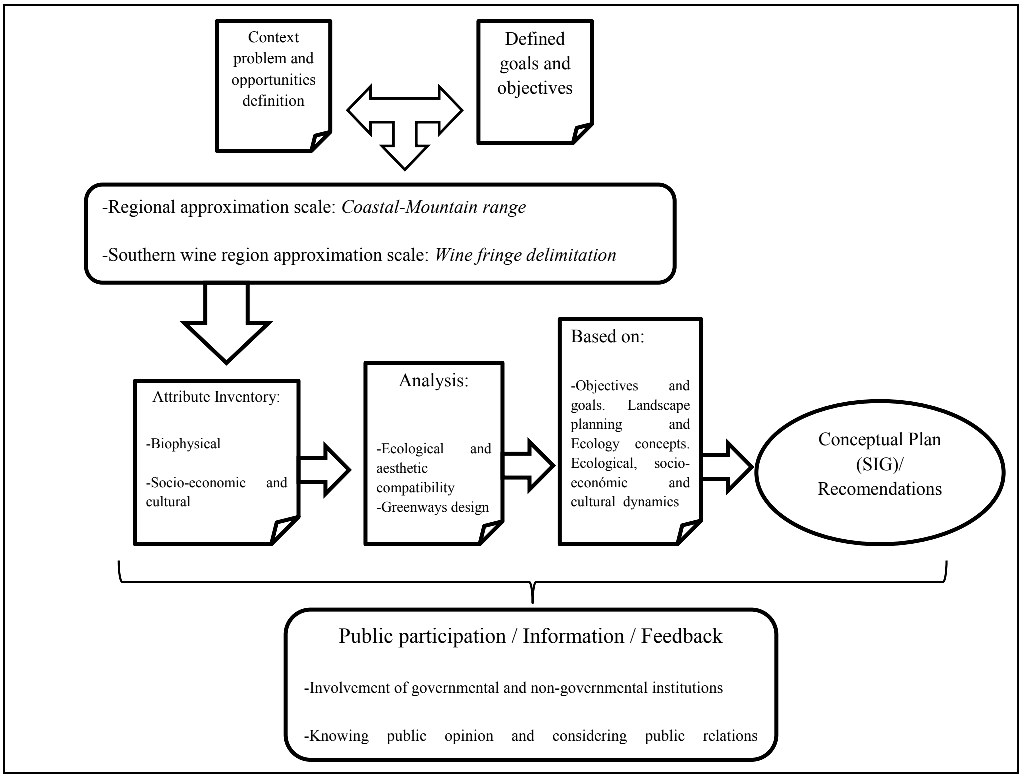

Fig 2. Plan formulation phase, based on the landscape planning process (Kiemstedt et al. 1998)

Results

The total area at the regional level is 5,757 Km^2, of which the natural component covers 4,868 Km^2(84.5%) corresponding to marshes, coastal dune vegetation, coastal scrub, desert scrub, gallery forest, chaparral, oak forest, juniper forest and pine forest. The natural land cover type dominating is chaparral. On the other hand, the anthropogenic component covers 889 Km^2 (15.5%) of the total region, corresponding mainly to agricultural cover, as well as animal husbandry (both were classified as “transformed” cover type) and urban cover in the minor proportion. The highest elevations we found, at the regional scale, are up to 2860 meters above the sea level. We used the DEM at the regional level, to demarcate the wine fringe along the 100-400 meters range. The highest elevations within the wine fringe are up to 780 meters above the sea level and the lower height range can be found along streams and valleys (Fig 3). The scenic component was determined by a demarcation with eastern boundaries at 580m, and to the west by the boundary of the sub-basins.

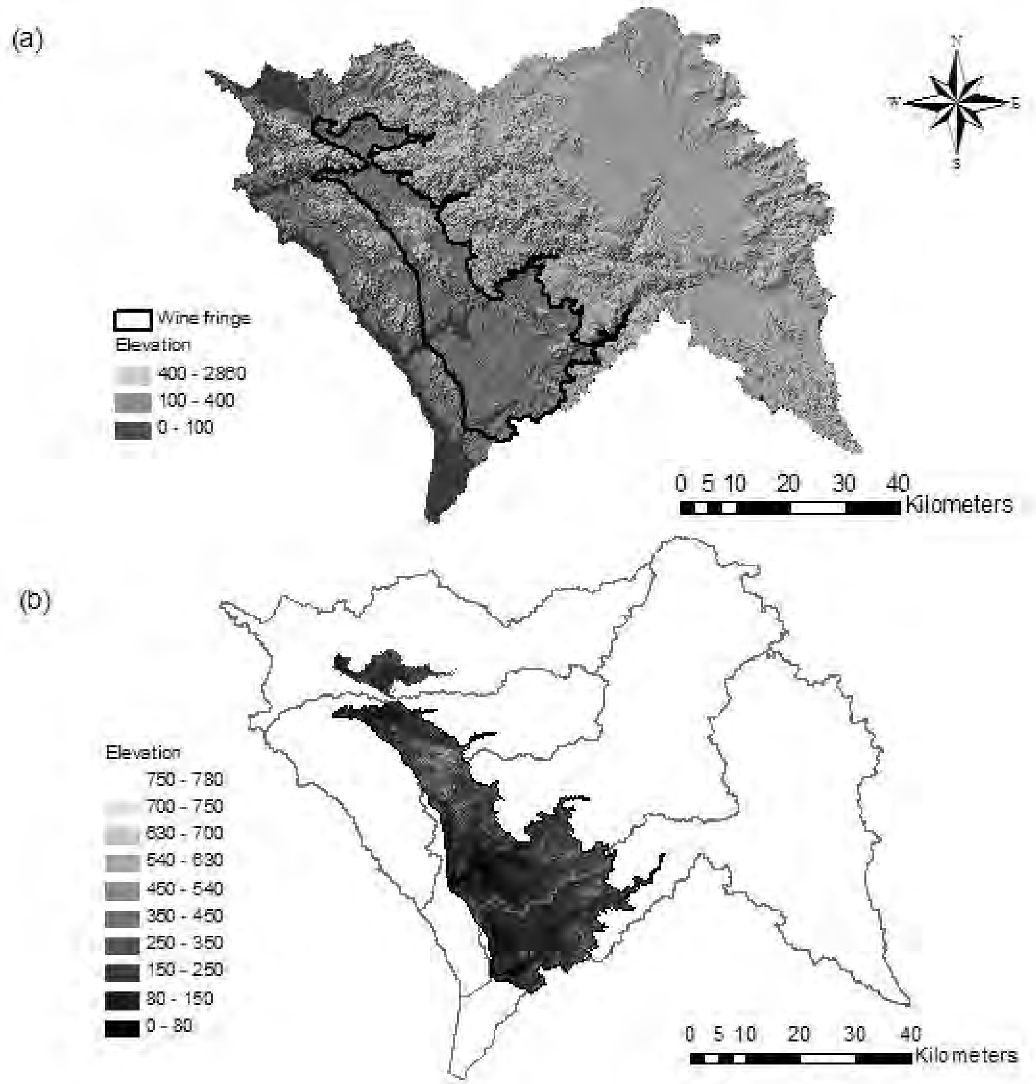

Fig 3. DEM reclassification at regional scale for the determination of the wine fringe (a). DEM at local scale, corresponding to the wine fringe demarcation (b).

The fringe is approximately 938 Km^2. The natural component of the wine fringe covers 612 Km^2 (65%) and is composed by coastal scrub, chaparral and gallery forest, with dominance of chaparral. The anthropogenic or transformed component corresponds to a 35% of the wine fringe and it is dominated by agriculture, which covers 271.5 Km^2 and in less extent for urban use (Fig 4).

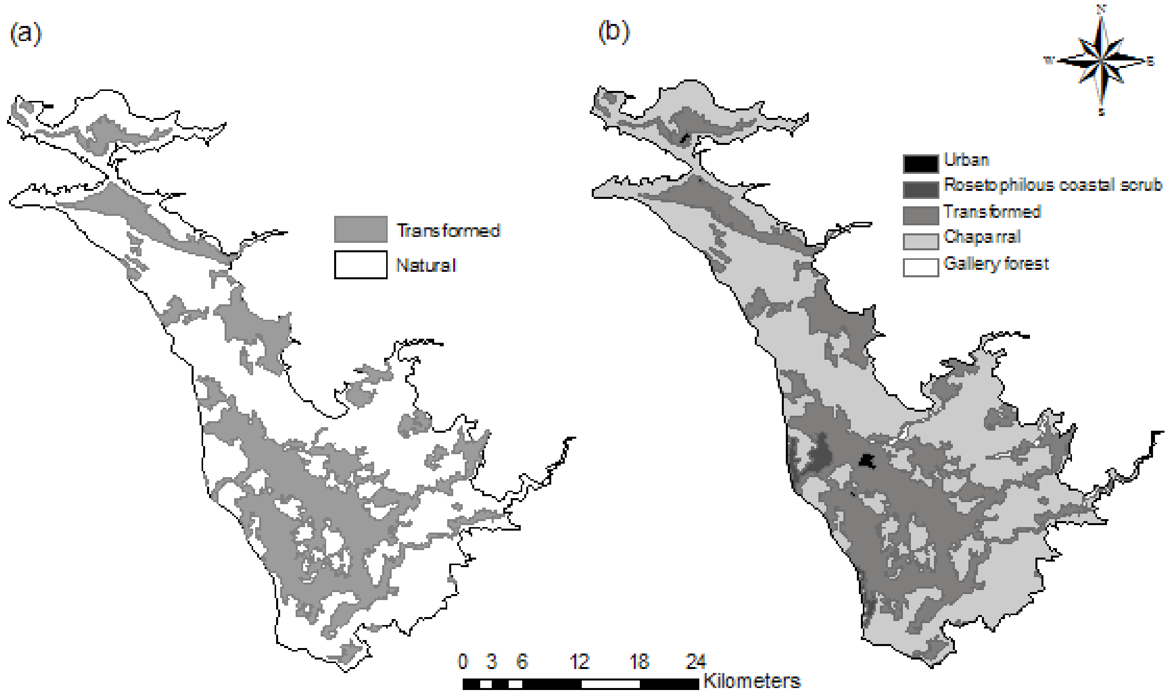

Fig 4. Wine fringe natural and transformed land classification (a). Land cover types identified within the wine fringe (b)

To determine the location of greenways with ecological interest at a regional and local scale, a series of criteria were specified. At a regional level, the criteria corresponded to the identification of: streams with order higher than 5, geological faults and potential wetlands. At a local scale, the criteria corresponded to: streams with order higher than 3, geological faults, gallery forest and aquifers recharge area. For this last criteria (aquifers recharge area) the consolidated material with low recharge possibility covers 713.5 Km^2 while the non-consolidated material, with high recharge possibility covers 168 Km^2, non-consolidated with medium recharge possibilities covers 2.5 Km^2 and non-consolidated material with low recharge possibility cover 53.7 Km^2. To determine the greenways with historical and cultural value as well as recreational interest, we identified 270 vine patches, 50 wine producers, 4 recreational sites and the location of roads and the main highway that connect the region (Fig 5).

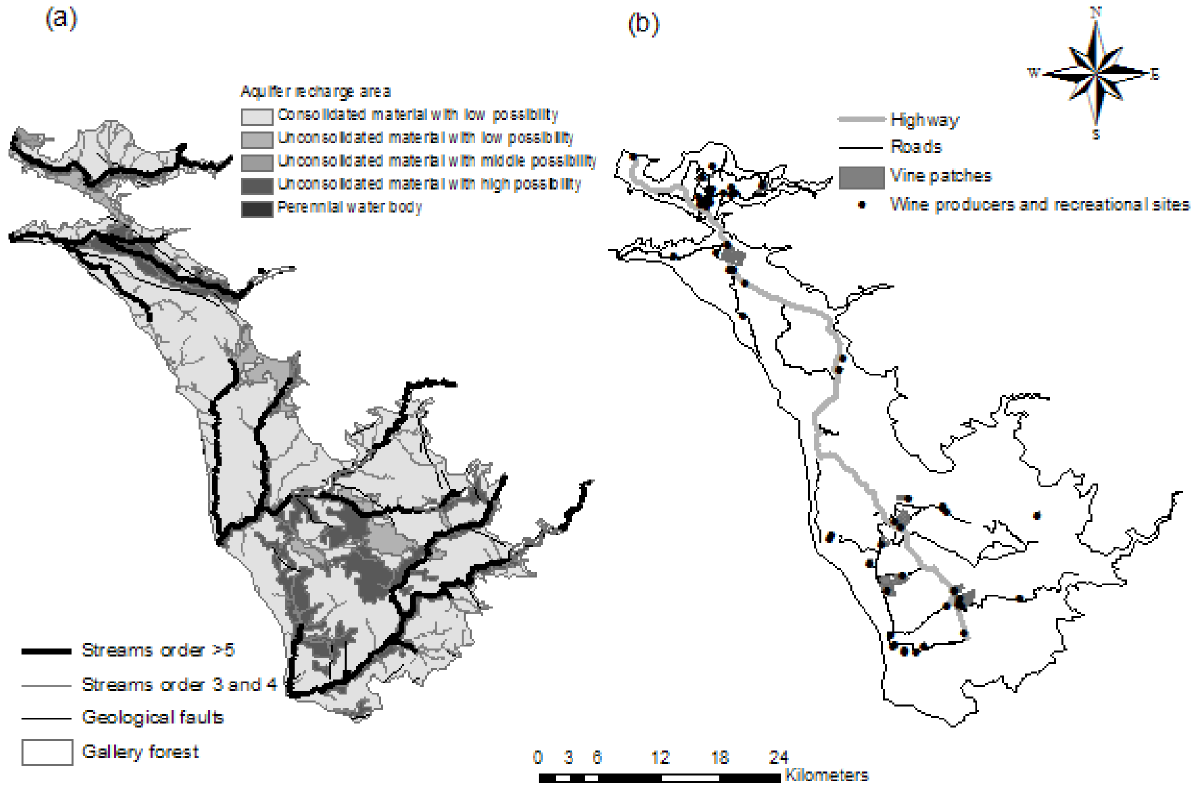

Fig 5. Greenways with ecological interest, proposed in the wine fringe (a). Greenways with cultural and historical value founded in the wine fringe (b).

Discussion and conclusion

The regional level includes a higher degree of naturalness than the local level, because of the wine making activity within the southern wine region, which is highly perceived at a local level. The only cultural connection available within the wine fringe is the 74 km long highway, which provides the facility to travel along the southern wine region. The tendency of development in the wine fringe is the fragmentation of natural habitat and the loss of the landscape functions. The wine production sector enhances the idea of greenways design, however it is important to consider other sectors, including the urban zone and the incorporation of the aesthetic quality concept for the towns within the wine fringe. To maintain the landscape character of the areas it is important to plan at different scales with the local community participation and key actors. The alternative we argue, at the wine fringe region and for more located scales, is that of the multifunctional landscapes, where economic activities, social wellness and natural landscape functions conservation could be together. For this reason we found that the greenway concept, when applied to the southern wine region of Ensenada becomes a solid and effective landscape planning tool for the sustainability of the zone and its wine making tradition.

Acknowledgments

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Integrating Agriculture in Greenways: a Methodology for Planning Connected Urban and Peri-Urban Farmlands in a Mediterranean City Luca Barbarossa, Daniele La Rosa, Riccardo Privitera
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Introduction and Literature Review

Cities are often threatened by a loss of environmental quality due the rapid increase of urbanized areas that fragment natural landscapes. This is particularly true at the cities' fringe where uncontrolled urbanization is often characterized by discontinuous patterns and consequent fragmentation of farmlands. These phenomena are particularly relevant in Mediterranean cities, where the high degree of land-use transitions, a consequence of urban growth with poor environmental regulations produce urban landscapes characterized by a lack of green areas and high levels of ecological fragmentation (EEA, 2006).

Greenways are one of the most powerful and widespread tools used at urban, metropolitan and regional scales. Their aim is to counteract ecological fragmentation and to integrate urban development, nature conservation and public health promotion (Ahern, 1995; Fabos & Ryan, 2006). They facilitate linkages between rural and urban spaces along the rural-urban interface through linear systems (Walmsley, 2006). As networks of linear elements they are planned, designed and managed for multiple purposes, including the provision of ecosystem services such as purification of air and water, mitigation of floods, climate regulation, generation and renewal of soil fertility, accessibility to open spaces and intellectual stimulation. Urban contexts present particular challenges for greenways development due to the complex arrangement of urban landscape features. The large number and diversity of land-cover types often produce high degrees of fragmentation of open spaces and heterogeneity of their roles and functions. For this reason a number of different types of patches of Non Urbanized Areas (NUAs) are present in urban contexts: this calls for a characterization of these spaces in order to highlight their physical features and their ecological and social functions. Particularly, they could represent a big opportunity for planning policies oriented to support new forms of urban agriculture (La Greca et al., 2011a).

When formulating planning approaches to greenways in urban contexts, new forms of agriculture have been the focus of very few studies and applications but they can significantly contribute to cities' sustainability (Zasada, 2011). Proposing an agricultural greenway that integrates different NUAs into a network of farmlands and other green spaces (parks, playgrounds and so on) could significantly improve the overall accessibility of these areas, redefining the rural-urban interface and enhancing the provision of urban ecosystem services.

Goals and Objectives

This paper presents a method to characterize and connect patches of agricultural land uses via a greenway approach. NUAs located on the urban fringe were analyzed with different parameters and criteria in order to ascertain which forms of agricultural land uses could be addressed and linked with other green spaces nearby through an Agricultural Greenway (AG). The proposed method checks the suitability of transformations of the areas toward new forms of agriculture thereby enhancing their ecological and social function, as well as accessibility and overall connectivity. This proposed method was tested in a concrete urban planning case, the revision of the *Land Use Plan* of the city of Catania, south Italy.

The Study Area and Available Geo-Data Set

Catania is one of the main cities in southern Italy, with an administrative area of 180 km^2 and a population of 293,458. The city is the centre of a large conurbation that represents the largest metropolitan area in Sicily, a settlement system characterized by extensive urban sprawl (La Greca et al. 2011b). The favourable location of the city along the coast, well connected to the motorway and railway system and the presence of a commercial port and busy airport give to the city a strategic role in the region. Existing settlement has developed around the historical center and has grown beyond the city administrative borders, incorporating existing agricultural and fishing villages into one large metropolitan area. The result is a rather heterogeneous aggregate of settlements. Rich and vital urban fragments are intertwined with poor and marginal ones, the latter often corresponding with social housing schemes or illegal settlements. The main city in characterized by a relevant shortage of public spaces and services, especially green space. Currently the amount of public green space is about 3 m^2/ inhabitant much less than the minimum amount stated by the national legislation (9 m^2/inhabitant).

At the end of 2009, the municipality of Catania started a new revision of the city land-use plan, based on the idea of achieving a more sustainable future for the city. This plan addresses several critical issues: the high level of congestion of the mobility system; concentration of residential uses in peripheral neighbourhoods; and, enhancing the number of public spaces especially greenspaces. To a high number of NUAs, located on the fringe of the city, the new zoning plan assigned a status of public green space, using a transfer of development rights program. For these green spaces, the plan defined a set of new land-uses, including urban agriculture. Despite these efforts, most of new public green spaces were planned without considering specific criteria to determine more suitable areas that could become urban agriculture. In order to overcome this limitation, this paper proposes a method to characterize NUAs patches as new forms of agriculture and proposes a design of a greenway of these identified patches.

Method

The proposed Multi Criteria Suitability Model aimed to produce different scenarios of new Prospected Land Uses (PLUs) with a view to new forms of agriculture. The model characterizes the patches of NUAs to obtain different spatial configurations of agricultural land uses with a multi-attribute approach. These criteria are intended as prerequisites such that a single patch of NUA could modify its land-use to become a new form of agricultural space. Criteria were derived by literature review and analysis of physical features of existing fabric of NUAs.
The following new forms of agriculture were prospected:

- Urban Farms. They represent the primary form of urban and multi-functional agriculture (Aubry et al., 2010) and are characterized by the production of fresh products. They clean up the city by recycling waste (Mougeot, 2005), provide landscape and socio-educational functions (Ba and Moustier, 2010) and contribute to urban employment and reduction of inequalities (Dubbeling et al., 2010). Urban Farms are often conducted according to Community supported agriculture (CSA) model (Wells and Gradwell, 2001) and can have different sizes, starting from a minimum size of 0,8 Ha, and providing fifty shares (2-4 persons) of products per hectare (Van En, 1995).

- Allotment Gardens. They are places for leisure and integration of elder people and socially deprived groups (Rubino, 2007) where gardening is the main activity. The minimum plot area can vary from 50-100 m^2 to 200-400 m^2 (Rubino, 2007). According to NSALG (no date) a single plot of about 250 m^2 can provide food for 4 persons per year.
- Agricultural Parks. They are large farmland areas where productive uses (usually organic farming) are implemented along with rural landscape protection and enjoyment. Sizes can vary from 10 to 10,000 Ha in France (Donadieu, 1998). Other examples include of 7 Ha in the US Sunol AgPark in the US (7 ha) and Parco Agricolo Sud Milano in Italy (46,000 ha).

Each criteria was described by an indicator that calculated in GIS from the available land-use layer, following two main phases.
The **first phase** analyzed the existing fabric of NUAs in order to find a first set of areas to be addressed for new PLUs. This phase considered as main criterion the compatibility of transition from current land-use toward one PLUs. The following cases were observed:

- Farmlands and Abandoned Farmlands were considered always compatible to a transition toward one PLU, as their soil and physical characteristics of these land uses would be conserved in case of transformation.
- Bare soil was considered compatible under the condition of existence of contiguity with an existing farmland. This condition assumes that a bare soil can be transformed into new forms of agriculture if it is geographical contiguous to other agricultural land uses. This would make the transformation more feasible from an economic point of view.
- Woods and Shrubs were considered compatible under the condition of the presence of tree land cover below 20%. This condition assumes that if the amount of existing semi-natural features is below this percentage the single patch might be more susceptible of transformation toward a PLUs, while, on the contrary, for higher percentages it might be more suitable for other forms of green areas (i.e. small urban parks).
- Lava Fields were considered not compatible, because any agricultural land uses would not be appropriate on these types of land.
- Urban Greenspaces were not compatible as transformations would significantly alter the natural or semi-natural characteristics of these lands.
-

According to the above criteria, two indicators were used in this phase to check the compatibility of transformation of Bare Soil and Woods and Shrubs patches, respectively Contiguity to Farmlands and Trees Land Cover.

Contiguity to Farmlands (CO_F)
This indicator verifies the existence of contiguity between patches of bare soil to each patch of farmlands. Operationally, the indicator is calculated using a spatial join function of GIS between the layers of bare soil patches and farmlands. A new binary attribute (CO_F) was added to the bare soil layer and calculated as "Y" for patches with contiguity or "N" on the contrary.

Trees Land Cover (TLC)
This indicator evaluates the percentage of land cover comprised by Wood and Shrub patches. Trees Land Covers were manually identified and digitalized by interpreting 2008 available orthophotos. A detailed feature extraction was possible thanks to the high resolution of orthophotos (0.25 meters), enabling the identify of individual trees. TLC was then calculated as the percentage of surface covered by trees and the area of the single patch.

After the calculation of the two indicators, a GIS query identified the first set of suitable NUAs to be addressed with new forms of agriculture and included in the AG according to the proposed criteria.

The **second phase** is aimed at further defining the most suitable NUAs for new forms of agriculture among the areas already selected in the previous phase. PLUs are defined according to criteria of size, accessibility of patches by people, presence of tree land cover and contiguity to farmlands. For each PLU, criteria follow the conditions listed below.

- Agricultural Parks: minimum patch size of 20,000 m^2 to allow productive uses and other functions (landscape protection and leisure). Moreover, contiguity of patches to farmlands was required for ensure economic feasibility and accessibility.
- Urban Farms: size ranking from 5000 to 20,000 m^2 and accessibility of 2,000 inhabitants for 1 ha of land within a pedestrian distance buffer of 500 m. Considering that 1 ha of land can produce food for 200 people - 50 shares of food for 4 persons (Van En, 1995) -, the condition of 2000 inhabitants per hectare would ensure the economic feasibility of Urban Farms, even if only 10% of the population would be interested in purchasing products. Moreover, a minimum percentage of tree land cover is required as an indicator of agricultural productive potential of current Farmlands patches or vegetation features for Woods and Shrubs.
- Allotment Gardens: maximum patch size of 5000 m^2 and accessibility of 100 inhabitants for 1,000 m^2 of land within a pedestrian distance buffer of 250 m. Considering that 1000 m^2 of land can be accessed by 20 people - 1 lot of 50 m^2 for 1 person (NSALG, no date) -, the condition of 100 inhabitants per 1000 m^2 ensure the accessibility to Allotment Gardens because they are mainly oriented to elder people and socially deprived groups. Moreover, the above mentioned criteria of contiguity to farmlands and % of tree land cover are requested.

Table 1 shows all possible transitions between current land uses (farmlands, abandoned farmlands, woods and shrubs, bare soil) and prospected one (urban Farms, allotment gardens, agricultural park),. Each transition is considered to be suitable if each patch presents particular values of indicators. The same table also contains a first indication of indicators' values for suitable transitions. As an example, in order to be transformed into an Urban Farm, a patch of farmlands must have the following indicators' values, according to the above discussed criteria: size between 2000 m^2 and 5000 m^2, more than 2000 people in a buffer of 500 m from the patch.

Current Land Uses	Prospected Land Uses	A	PR_Res	CO_F	TLC
F	UF	Min 5000 m^2, max 20000 m^2	Min 2000 inhab. within 500 m buffer for each 1ha of land	/	/
	AG	**Not suitable**			
	AP	min 20000 m^2	/	Yes	/
AB F	UF	Min 5000 m^2, max 20000 m^2	Min 2000 inhab. within 500 m buffer for each 1ha of land		Min 30 %
	AG	max 5000 m^2	Min 100 ab di UF in raggio di 250 m		/
	AP	min 20000 m^2	/	Yes	Min 50%
WS	UF	Min 5000 m^2, max 20000 m^2	Min 2000 inhab. within 500 m buffer for each 1ha of land		/
	AP	**Not suitable**			
	AG	max 5000 m^2	Min 100 ab di UF in raggio di 250 m		/
BS	UF	Min 5000 m^2, max 20000 m^2	Min 2000 inhab. within 500 m buffer for each 1ha of land		/
	AG	**Not suitable**			
	AP	min 20000 m^2	/	/	/

Table 1. Possible transition between current land use and PLUs with relative criteria and indicators.

All these conditions are represented by one or more indicators that are calculated with GIS.
Size (A) records the area of the single patch.
Proximity to residential areas (PR_Res) accounts for the total number of people that can access each patch of NUAs. The indicator is weighted with patch size, as the bigger a patch is, the higher can be its influence in "attracting" people. Two distance thresholds are fixed: 500 m for Urban Farm and 250 m for Allotment Gardens. Operationally, the indicator is calculated using GIS functions of overlay analysis and spatial join. The number of people inside each buffer area was derived by a census data layer. A geographical intersection of census tracts and buffer area was performed to estimate the population. Finally, the indicator is calculated as: Pop_buf/A, where Pop_buf is the total population estimated in the buffer area and A is the patch size.

Trees Land Cover (TLC) is calculated for Woods and Shrubs and Abandoned farmlands as reported in the first phase of the methodology. The tree surface cover that represents in the first case the natural or semi-natural vegetation, while in the second case represent the last remnants of agricultural trees once present in patches of abandoned farmlands.
Contiguity to Farmlands (CO_F) is calculated for Bare Soil as reported in the previous phase of the methodology.

Sensitivity and Scenarios analysis for Prospected Land Uses
Since these criteria are represented with indicators' values, different scenarios of new forms of agriculture - in terms of number of PLUs - can be defined as planning alternatives. Fixing different indicators' thresholds, the number of occurrence for each PLU will vary according to thresholds' values. Operationally, scenarios are produced with GIS multi attributes queries that

seek the satisfaction of requested indicators' values. ArcGis model builder environment was used to parameter these values.

To understand how the scenarios can produce a different numbers and types of PLUs, a sensitivity analysis was carried out. Simulating a change in indicators' values and fixing different thresholds, it is possible to explore the change in number and types of resulting PLUs, as well as their spatial configuration. For each transition from current land-use to prospected one, a number of finite combinations of thresholds values was tested in order to understand whether one indicator was more influential than another, or, to establish within which value range the number of resulted PLUs remained stable.

Three planning Scenarios were tested. The first one was the *Mixed Land Use Scenario* (S1), aimed at minimizing the difference of resulted occurrences of patches belonging to the 3 PLUs and producing a more differentiated spatial configuration. This scenario was obtained by finding the indicators' values that respect the condition *Min (Std_Dev (#UF, #AP, #AG)*, where *#UF*, *#AP*, *#AG* are the number of occurrences respectively for Urban Farms, Agricultural Parks and Allotment Gardens and *Std_Dev* is the standard deviation.
The second scenario is the Max Urban Agriculture (S2) that maximises the number of occurrences of patches of UF and AG, that are more related to urban forms of agriculture. S2 was obtained with the condition *Max (#UF + #AG)*.

The third scenario was the Max Agriculture (S3), aim to maximize the number of occurrences of Farmlands and Agricultural Park. The following condition was required *Max (#F + #AP), where #F* is the number of occurrences of Farmlands.

All scenarios were derived in GIS by iteratively changing indicators thresholds in the multi attributes queries.

The Agricultural Greenway (AG) approach
In the last phase cycle-pedestrians connections were chosen among the areas identified in the Scenario 2 of mixed uses. The AG approach was based on the main concept of creating a network of PLUs involving existing farmlands, public greenspaces and currently unmanaged NUAs. The design proposal follows a greenway multifunctional approach for urban contexts (Walmsley, 1995; Ahern, 1995). AG aimed to enhance the role of agriculture in urban contexts (Thornton, 2008) re-designing the urban fringe to ensure the congruence with the city form and urban landscape and thereby enhancing of city's accessibility, safety and attractiveness.
According these aims, the AG definition followed 5 qualitative steps:
1.Selection of most accessible and large patches of PLUs as the first elements of the AG.
2.Selection of secondary elements of the AG, including other NUAs and greenspaces.
3.Selection of the linear connecting elements, taking into account geometrical features of roads, abandoned rail tracks and other linear spaces beside roads.
4.Verification of connections' limitations (slope, physical barriers, road features).
5.Design of a main greenway connection and other secondary corridors.
6.Verification of the attractiveness and safety of the greenway, considering road crossings, unprotected pedestrian, cycling lanes, landscape features.

Results

Within the study area of the municipality of Catania, 201 patches of NUAs are present (fig. 1). The first phase of the methodology assessed the compatibility between current land-use and PLUs. 127 patches were found to be compatible: 43 Farmlands, 57 Abandoned Farmlands, 23 Woods and Shrubs and 4 Bare soils. These patches represent the first set of PLUs to be used as PLUs in for the Greenway design. Even if the main characterizing element is the very different size of these patches (with relative high standard deviation), it is interesting to see how also very large patches (more than 5 ha) are present in the area, considering that all patches are generally close to dense urban fabric boundary or to the city center.

As introduced in the previous section, results of the second phase produce spatial configurations of PLUs. This configuration was dependent on the applied criteria, indicators used to describe these criteria and consequently the indicator's values. Overall the most influential indicators in number of occurrences of the PLUs were A and TLC, while less significant was the PR_RES. The contiguity condition described by indicator CO_F was not significant as the relative condition was always verified. However, these results were different according to the land-use transitions reported in Table 1: for instance, variation of A thresholds were highly relevant for the transitions from Far and Abandoned Farmlands to Urban Farm, but less relevant from Bare Soil and Agricultural Park.

The three proposed scenarios produced different configurations in terms of number of involved patches and spatial localization. Figure 1 shows the relative maps and table 2 summarizes the number and typologies of PLUs for each Scenario.

PLUS	**Scenario 1**	**Scenario 2**	**Scenario 3**
UF	26	36	17
AG	7	7	3
AP	23	23	32
F	11	4	13
TOT	**67**	**70**	**65**

Tab. 2 – Number of patches for each PLU in the 3 proposed Scenario.

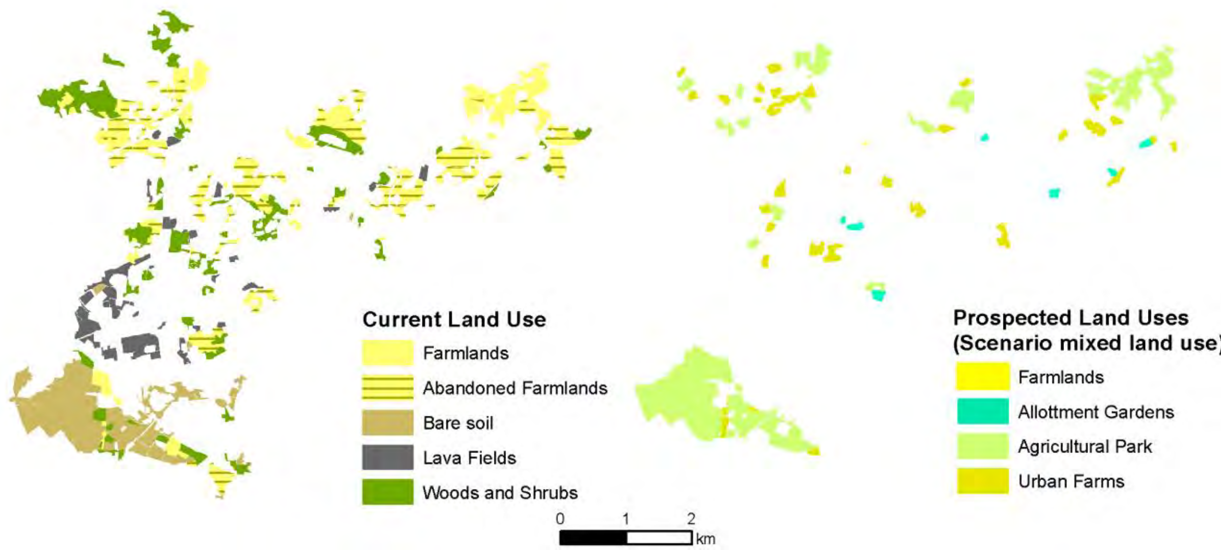

Fig. 1 – Existing Land Use and Prospected Land Use for Scenario 2

Figure 2 shows the final configuration of AG as a network of PLUs, NUAs and other greenspaces. It is composed of a main track of 20 km and four secondary tracks 11.7 km in length. Most of the segments of the main track are located inside the PLUs patches (44%) and other green areas (42%). While only 14% of AG is designed along existing roads. The maximum slope value is 4% with a mean value of 2%. Most of the segments of the secondary tracks are mainly located along roads (55%) and railway (14%). Only 25% and 6% are located within PLUs and other greenspaces areas. The maximum slope value is 2% with a mean value of 1%. The comparison between main and secondary tracks shows that the former is located along the urban fringe and mainly involves PLUs, while the latter are located inside the urban core and mainly involve existing roads. Interestingly, most of the AG network (65%) is based on existing or available green corridors.

Discussions and Conclusions

Obtained results offer different considerations both on the method and planning outcomes. Although not numerous, existing patches of agricultural NUAs present an overall medium-large size. This is partly due to their peri-urban location, resulting in low number of patches that have the best size to be addressed as Allotment Gardens. On the contrary, Urban Farms resulted the more frequent PLU according to the patch size. Accessibility of patches was not a significant indicator in dense urban contexts, as almost all patch can be reachable from a high number of people living within a buffer area of about 250-500 m. Results also showed that Scenario 2 (Urban Agriculture) was the scenario involving the highest number of patches: this was related to the high number of patches suitable for Urban Farms (more than half of involved patches of the Scenario).

The method also produced scenarios with a differentiated number of patches: this might be useful for small local municipalities that have restricted financial resources to develop projects for green areas and can now prioritise from different possibilities for greenway implementation. Another important consideration of the Agricultural Greenway Design was that not all the proposed patches to be included in the Greenway were linkable, mainly because of morphology features of the Catania area. This result can have some relevant planning consequence, as it might be preferable to assign disconnected patches the role of node with functions such as leisure where overall accessibility are more important than connectivity.

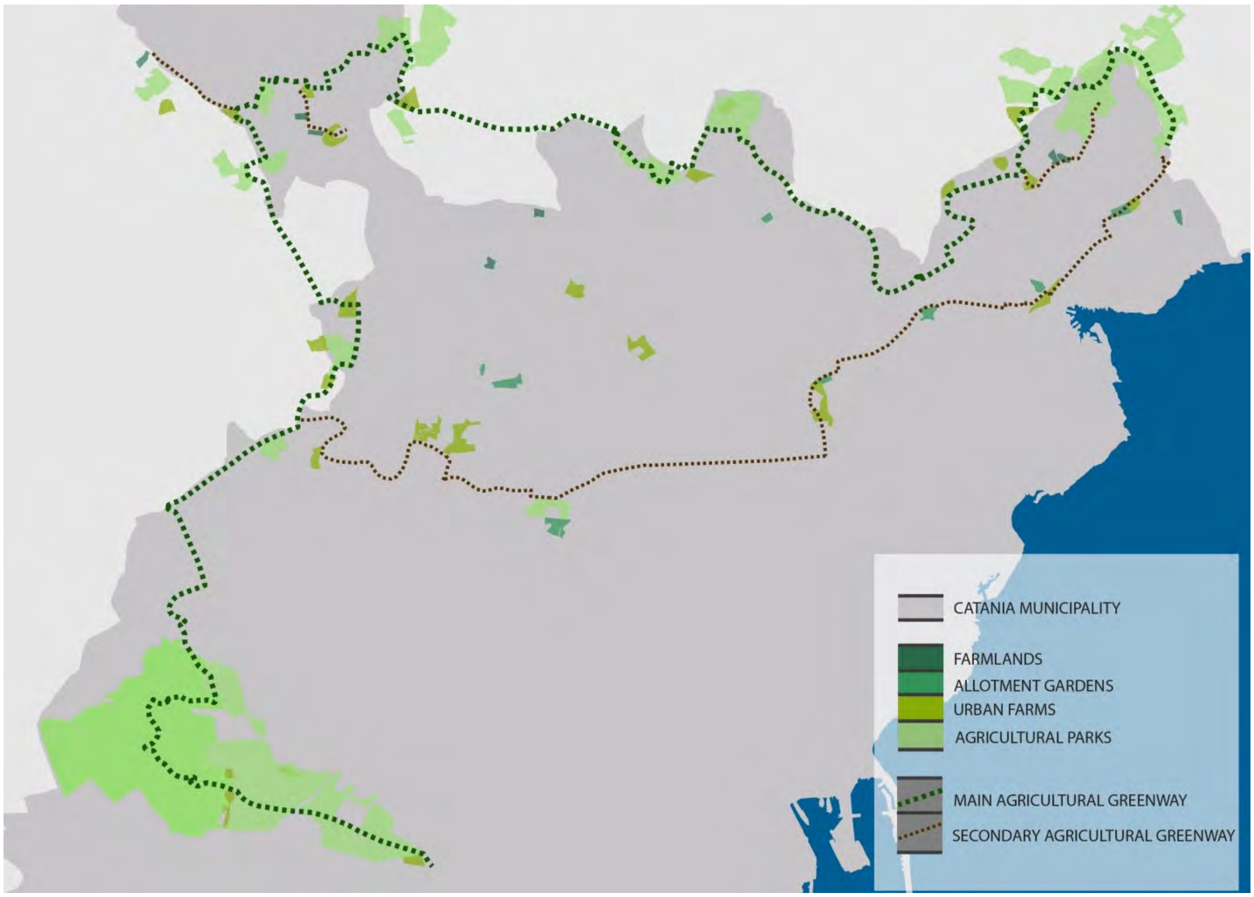

Fig. 2 – The proposed Agricultural Greenway

Improvements of the methodology may involve the inclusion of additional criteria and indicators such as terrain morphology; land ownership and parcels fragmentation. This is dependent upon the inclusion of NUA ecosystem services in the assessment (La Rosa and Privitera, 2013) in order to further characterize their nature and more suitable transformations toward PLUs.

The proposed AG allowed the integration of different and abandoned farmlands to produce new spatial configurations of NUAs with the ability to increase the provision of urban ecosystem services such as accessibility to greenspaces for leisure and food production in urban contexts. Furthermore by creating a new cycle-pedestrian urban network the overall accessibility to urban open spaces was dramatically increased. Moreover the proposed scenario of new land uses of urban and peri-urban farmlands was considered useful to protect existing productive farmlands from urban development as well as increasing productive agricultural uses (preferably organic farming) that could be implemented along with rural landscape protection and enjoyment. Finally, the scenario might enhance the overall quality of urban landscape, support climate change adaptation policies, increase economic values of parcels involved with the AG. The proposed scenario delineates a more liveable and healthy urban environment, in comparison with the current condition.

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Chelas Valley and Coina Wetlands Agricultural Parks

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1. Introduction

Over 70% of Europe's population now lives in urban areas (EEA, 2006) and there is a substantial rural-urban migration causing a rapid expansion of the peri-urban interface, where domestic and industrial modifications of the environment interact strongly with agricultural production (Brook & Davila, 2000). Portugal, as the rest of Western Europe, has been through a profound process of urbanization beyond former city limits over the past decades, and even in regions where the population is decreasing, urban areas are still growing (Piorr, Ravetz & Tosics, 2011). As the urban pattern gradually distanced itself from the traditional compact city model, the urban fabric became scattered and fragmented, unfolding itself at the expense of the surrounding rural landscape (EEA, 2006).

Today, the non-built areas take on a major importance in metropolitan areas planning process. As urban life demands the existence of open green spaces to contribute for the quality of the urban environment and the wellbeing of the population, urban voids are essential to the implementation of green corridors and ecological networks.

In order to materialize these networks, there is a need to design also at site scale and the creation of agricultural parks reveals itself as a significant strategy, which integrates production, recreation and conservation functions and applies the principles contained in the European and international recommendations, including the European Sustainable Cities Report (European Commission, 1996), which states that the objectives of sustainability are more easily achievable acting from small areas, and involving the communities most directly concerned.

If food production is a permanent function of urban and peri-urban agriculture, it is above all its multifunctional role that matters to address through the latest advances at a conceptual level, framed from the perspective of sustainable urban development.

This paper aims to provide a framework for the design and implementation of two agricultural parks – Chelas valley and Coina wetlands – embedded in the context of municipal ecological networks. Both projects correspond to the preliminary study phase and were recently carried out in the Landscape Architecture Research Centre "Prof. Caldeira Cabral" of the Technical University of Lisbon (CEAP / UTL). The Chelas Valley project had its origin on an initiative of Lisbon's municipality, while the Coina Wetlands agricultural park saw its beginning in the scope of the European project "Naturba – Interreg IV-B SUDOE", whose purpose is to develop urban sustainable projects on cities fringes in order to overcome land use conflicts.

2. Background and Literature Review

Urban growth is occurring at an unprecedented rate worldwide with 65% of the population expected to reside in urban areas by 2025. Portugal has experienced some of the most rapid increases in urban development in the EU, focused around major cities and the coast (EEA, 2006).

Although there is legislation in Portugal for the protection of soil and other natural resources, urban planning did not always complied and edification proliferated in areas of high ecological sensitivity. That's because urban development and agriculture compete for the same land, as agricultural lands adjacent to existing urban areas are also ideal for urban expansion (EEA, 2006). It's in the non-built areas of higher ecological value, preferably the ones with fertile soils, that is now possible to establish urban and peri-urban agricultural projects, included within the scope of ecological networks and metropolitan agri-food planning.

On the past few decades, urban and peri-urban agriculture has been practiced in Portugal as an informal productive sector, not legitimized in the municipal and regional planning process. More recently, the importance of this activity to local economies and the promotion of social cohesion and interaction has been defended and affirmed, relying on municipal and national programs supported by international development agencies (including IDRC, FAO, UNCHS, UNDP, CIRAD, NRI, CGIAR, GTZ, ETC and others) (De Zeeuw, 2003).

On the other hand, there has been recognition by policy makers of the importance of green spaces and urban agriculture for mitigating persistent environmental urban problems such as floods, waste and wastewater disposal or the heat island effect. Also, growing concerns about unemployment and urban poverty, the quality and cost of food, the cumulative energy costs and food insecurity have increased the interest in growing food locally in cities, including in community gardens.

Despite the importance of this recent legitimacy, urban and peri-urban agriculture should be embedded in the implementation of Municipal Ecological Structures, by its compatibility with the protection and management of essential areas to the maintenance of ecological balance (Magalhães, 2007).

There are already some European places like Guipúzcoa and Barcelona (Spain), Milano (Italy) or Toulouse and Île-de-France (France) that have practical examples of agricultural parks, implemented in the context of ecological networks. For instance, the Baix Llobregat agricultural park (BLAP) in Barcelona is part of one of the twelve linked areas which make up the Network of Natural Spaces managed by the Department of Natural Spaces of the Provincial Council of Barcelona (Maranges, n.d.).

The BLAP was not an imposed land protection device, but rather a farmers' initiative to preserve their livelihood, the value of which was ultimately recognized and valued by governments and the broader community. It emerged as a bottom-up initiative rather than the more usual top-down bureaucratic policy-making in Europe (Kazancigil, 2010; Brunori & Rossi, 2007). The viability of agriculture in metropolitan areas has been defended internationally in agro-urbanism projects, seeking the integration of this activity in the planning process through the involvement of stakeholders in the governance of metropolitan landscapes (DERF, 2001; Biasi, Pujol, 2005). So, the need for good governance is critical for the future of urban and peri-urban agricultural areas, underpinned by stakeholder participation throughout the planning process and implementation, for attaining effective outputs (EESC, 2004; Piorr, Ravetz & Tosics, 2011).

Another example of agro-urbanism metropolitan projects is the Île-de-France region, where this approach has been developed also as a bottom-up initiative of the local collectivities and agricultural associations, and integrated in the planning process with the scope of maintaining the periurban agriculture mostly in the Regional Green Belt (Biasi, Pujol, 2005).

Hence, a positive outcome of the agro-urbanism projects is the contribution for the planning of agri-food systems at metropolitan scale as a wide socio-political construction that considers all stakeholders, including the development of food networks through short circuits for marketing local produce. The importance of planning agri-food regional systems and agro-urbanism projects has been recently recognized and supported in European and American urban planning (Biasi, Pujol, 2005; APA, 2007; Forman, 2008). However, in Portugal, the integration of the agri-food system in the planning, designing and functioning of the metropolitan areas is still beginning, in the scope of the implementation of Municipal Ecological Structures.

3. Methods

3.1. Site study

Chelas Valley, with an area of 13 hectares, and Coina Wetlands, with an area of 82 hectares, are located in Lisbon Metropolitan Area (LMA) (Figure 1), Portugal's most populated region. Both sites are located along streams that flow into Tagus River, which splits LMA in north and south bank. They are surrounded by dense urban fabric and located in former farming land, semi-abandoned in the mid-nineteenth century due to industrialization. Since then, both sites continued to be informally cultivated by some residents as a mean to strengthen their household economy or just as a hobby. They do it in an unplanned way, most of the times under precarious conditions, such as low quality of the irrigation water, the poor quality of materials or the lack of supporting facilities. The crops are mainly edible horticultural species and there are also some fruit trees scattered throughout both areas with the purpose of harvesting certain types of fruit while providing shade.

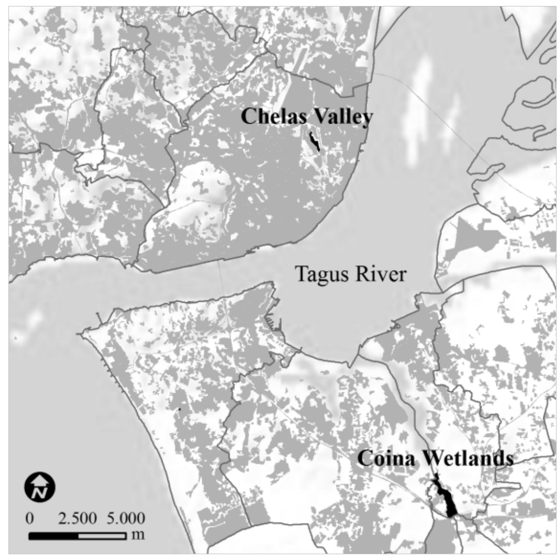

FIGURE 17 – LOCATION OF BOTH PARKS IN LMA.

In Chelas Valley, the soil derives from a limestone geological substrate, low in organic matter, with the exception of the parcels which have been continuously improved with the incorporation of compost. Due to gradual abandonment of the site, some infesting species, such as giant cane (*Arundo donax*) proliferated and were controlled only in the areas of permanent cultivation. In Coina Wetlands, the soil is alluvial and rich in organic matter. The water table is permanently near the surface and there is some vegetation with high conservation value, such as the spiny rush (*Juncus acutus*), lesser bulrush (*Typha angustifolia*) and common reed (*Phragmites australis*), as well as willows (*Salix alba*) and poplars (*Populus nigra*), typical species of the riparian gallery.

At both sites there is an informal trail network, already with some degree of sedimentation, which should be taken into account since they represent the most frequently used itineraries by the farmers and other pedestrians.

As to land ownership, Chelas Valley is exclusively Lisbon municipality's property, while the majority of Coina Wetlands belongs to private owners, some of them related to the real estate business. In the future, this may add in some difficulties around the project implementation in Coina Wetlands. Nevertheless, regarding the potentialities, both sites prove suitability for the establishment of agricultural communities based on a combination of multifamily-oriented production units with areas of conservation and recreational functions, along with soft mobility infrastructures based on the existing trail network.

3.2. Planning procedures

The first step of the design process consisted of several meetings with the municipalities' technicians in order to clearly define the intervention objectives, along with a set of technical studies to be carried out. Considering the landscape as a system, these studies concern its two main sub-systems: the ecological and the cultural. (Magalhães, 2007)

About the ecological sub-system, studies were conducted and cartography was made to determine components such as slopes, hydrography, land morphology, types of soil and an assessment of its capacity to produce biomass, soil permeability and natural and semi-natural vegetation of high conservation value. The cultural interpretation of the sites included the built heritage, road network, power lines, evolution of land use and land ownership.

In order to achieve a better site interpretation, the field visits were of critical importance. They permitted a better understanding of the dynamics inherent to the biophysical and cultural components of the space. In these visits, there were two main priorities: to rectify some features in the cartography such as the typologies of open spaces and the dimensions of the horticultural units; to establish a connection with the farmers and other stakeholders in order to realize what were their cultivation methods, their motivations and expectations, their necessities, their difficulties, among other issues.

The following phase was a landscape plan (Figure 2) based on the ecological suitability of the land to several uses. This proposal was based on a multifunctional framework and took into account, as much as possible, the stakeholders' necessities. For future project implementation, there is a need for a more detailed design of the space in order to integrate these areas with each other and within the Municipal Ecological Structures.

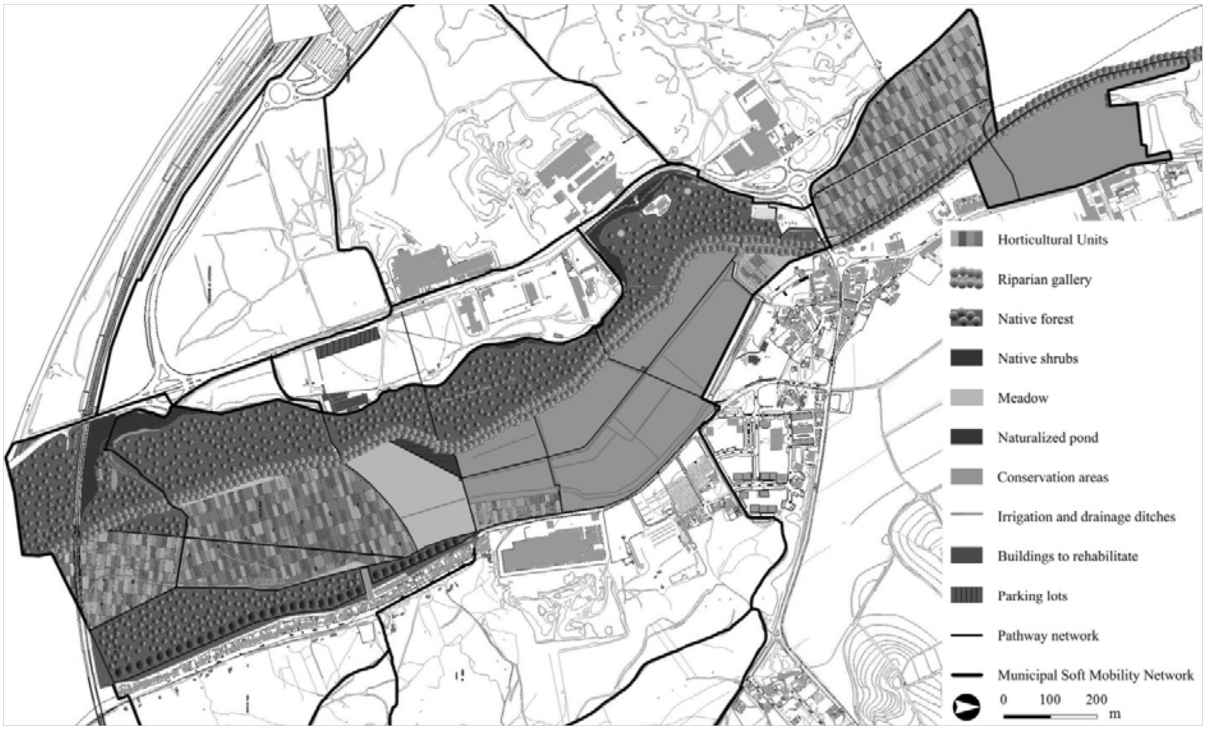

Figure 18 – Coina Wetlands Agricultural Park Landscape Plan.

4. Results

The projects of Chelas Valley and Coina Wetlands Agricultural Parks have taken into account an integrated approach that considers the ancient interdependence between cities and the surrounding rural areas. It was intended to create conditions for the promotion of two multifunctional sites with solid bonds to the neighboring communities that could combine production, conservation and recreational functions, while contributing to the closure of the energy and waste cycles at local level.

The agricultural areas (Figure 3) proposed for both sites are an extension of the existing ones, which are already located in some of the most suitable locations for this activity. The production system was designed aiming the exclusion of fertilizers, pesticides and growth regulators. Based on the use of compost, manure, crop rotation and biological control of pests and diseases, the purpose was to contribute for the maintenance of organic matter in the soil, closing the nutrient and energy cycles internally.

Figure 19 – Overall view of the agricultural areas in Coina Wetlands (3D rendering)

With the purpose of a logical spatial organization and according to the sense of ownership and community, the agricultural areas were divided into Horticultural Units (HU), constituted by individual plots and a multifunctional support structure. The HUs, separated by fences from one another, are intended to accommodate an average group of 12 horticulturists each. The dimensions of each plot were calculated regarding the terrain morphology and the dimensions of the preexisting plots, which are a good indication of the average area needed by each farmer. The support structure (Figure 4) was designed to accommodate a variety of functions needed to the practical and sustainable management of the vegetable gardens. It includes a tool house, a hennery, a hutch, a pigeonry and a composter. The proposed support structures and fences,

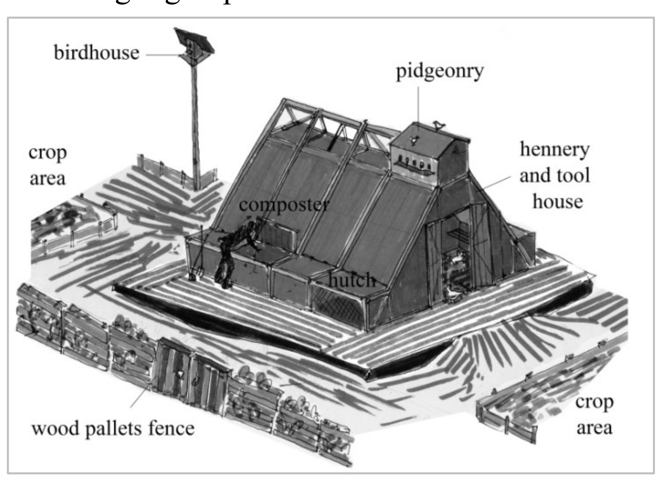

FIGURE 20 – SKETCH OF THE MULTIFUNCTIONAL SUPPORT STRUCTURE (LUÍS REIS DESIGN)

as other small-scale constructions should be built, as much as possible, making use of recycled or reused materials, such as wood pallets.

The irrigation network designed for Chelas Valley Agricultural Park, where the actual water for irrigation is polluted, is to be supplied from a borehole with a depth of 200 m to be held on the western slope of the valley. For storage and regulation of this water, a reservoir will be constructed with the possibility for rainwater usage as well. In Coina Wetlands, due to the almost permanent waterlogging, irrigation is done superficially through a network of ditches and floodgates, which ensures the distribution of water to the parcels. The ditches also ensure drainage of the land during the winter, leading the excess water to the river.

Along the streams, the projects also foresee the recovery of the riparian gallery, preceded by the cleaning of the margins and removal of invasive plants, especially the reed (*Arundo donax*). It were also proposed some native forested areas which, in addition to its ecological and productive functions, promote leisure, provide shade to visitors and conceal the network of overhead power lines that cut across the area of intervention, as well as roads and tall buildings closer to their limits.

For the steepest areas, mainly located on the borders of both parks, the use of native shrub species such as strawberry tree (*Arbutus unedo*) and common broom (*Cytisus* sp.) was proposed in order to reduce soil erosion and visually demarcate its boundaries. In Coina Wetlands, where plant communities of great ecological and aesthetic interest like the spiny rush (*Juncus acutus*), lesser bulrush (*Typha angustifolia*) and common reed (*Phragmites australis*) are found, the principal management strategy is their conservation. Similarly to other sites in Portugal classified as Natura 2000, the centerpiece of EU nature and biodiversity policy materialized by a network of important ecological sites (European Commission, n. d.), the use of these areas must be restricted. Due to the previous existence of some small cattle flocks, several meadow areas were planned in order to maintain and possibly propel the extensive pastoral activity. Since both parks have a strong relation to water, the intention was to integrate some naturalized ponds to shelter aquatic birds. Apart from the direct productive and ecological services provided, all these areas can work as poles of attraction for visitors.

For both parks, an internal pathway network was designed based on the analysis of the preexistent trails and their surrounding connections. These networks, featuring specific signage, were hierarchized and organized in different typologies that allow crossing through the parks, either transversally or longitudinally, and simultaneously link them to the respective municipal's soft mobility network. In the areas where plant communities of high ecological value are found, the solution was to elevate the paths (Figure 5) in order to preserve them from an excessive load, while allowing water, air and animal circulation.

After some conversations with local farmers, the need of a local farmer's association was a relevant conclusion. Then, a place to host each Local Farmer's Association was planned, which should lodge the park administration and serve as the location for

FIGURE 21 – ELEVATED PATHS IN COINA WETLANDS (3D RENDERING)

farmer's formation on varied issues (ecological agriculture, nutrition, food safety, certification processes, etc.). Furthermore, there is a will to bring the farmers closer to the final consumers, encouraging direct selling and the creation of specific labeling identifying product origin, etc. For Coina Wetlands Agricultural Park, the location of this center is planned to be in one of the two abandoned historic buildings, which was previously the Royal Glass Factory, while the other must seek to host a sports facility because of its lack in the region. In Chelas Valley, this structure is to be constructed from scratch.

5. Discussion and conclusion

This paper focused mainly on practical issues about the planning and design process of two agricultural parks located in LMA, aiming the development of spatial and functional solutions with low environmental impact to support agricultural production. Agricultural production is not the antithesis of the city, as modernist understandings of urbanity suggests, being in many cases a fully integrated urban activity that should be considered of equal importance to other typical urban services like transportation, cultural events, sewage or energy supply.

The importance of the recent legitimacy given to agri-food planning through urban and peri-urban agriculture with municipal support was considered in the Chelas Valley and Coina Wetlands Agricultural Parks within the scope of the implementation of Municipal Ecological Structures. As stated, the creation of agricultural parks takes on an important role in planning today's metropolitan areas, contributing to the ecological balance of the landscape and to economic and social wellbeing. In fact, as it was learned from successful examples in other European countries, agricultural parks should not be isolated elements, but rather integrated in an ecological network.

Also, agricultural parks can be integrated in the scope of Agro-urbanism projects, if considered as political processes of decentralization or relocation of decisional power actuating in the reconfiguration of peri-urban territories. This can only be achieved according to the interests formulated within a political community and the other stakeholders, whose identity is defined based on the interests, rights and obligations of a variety of stakeholders. Inherent in these projects is thus the creation of a political and institutional design, which exceeds the planning and design project, to become also a project of environmental and landscape citizenship.

The design is founded on scientific knowledge from different disciplines and an active participation of the community will follow with the help of the municipalities involved. In the context of frequent marginalization of urban spaces by the users themselves, dialogue between the designers and those users can be rewarding, trying to take positive actions from that contact. Moreover, the responsibility in the technical areas requires the assessment of the effects and benefits of the recommendations given by the various project teams. From the conceptual to the implementation stage, must be ensured that every choice made leaves alternatives to those who will benefit.

These projects, as models of urban environmental effectiveness and fulfilling the ecological requirements, should act as pilot projects which can be replicated in other Portugal areas. As a strategy, the incorporation in the design process, in addition to environmental criteria, of ethical and social affairs, is of outmost importance. Thus, the next phase of Chelas Valley and Coina Wetlands Agricultural Parks should allow the creation of a cooperation network of public and private stakeholders around which common interests and goals are brought together to launch specific actions in order to achieve the agro-urbanism territorial project, through a specific implementation and management plan.

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Ankara- Sakarya Greenway Planning

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INTRODUCTION

Greenways have many distinct functions. The purposes of greenways may generally be described as the: protection of biological diversity, to establish connections between habitats, to supply the orientation of urban development and the development of recreational uses and tourism throughout rural and urban landscapes and also to preserve both historical and cultural sources and ecological assets.

Greenway is the creation of an outdoor green zone, which atteches settlements to each other either in rural and urban environments and people with nature, and which may be considered as a connection between different settlements. Greenways are green connections in the form of linear parks, open spaces, protected nature reserves located within cities, or rural settlements, in which people will enjoy to be, and where they may carry out certain activities. Some of these may be at local scale, and some atregional or national scale. Some appear in towns-villages, some in cities, and some in both. While some greenways are used for recreational and tourism-related purposes, others may be used for ecological, aesthetical purposes or for the purpose of environmental management.

The purpose of the Ankara-Sakarya Greenway proposal is to evaluate this national route consisting Ayaş, Beypazarı, Güdül, Çayırhan, Nallıhan, Göynük, Mudurnu, Taraklı and their close vicinity, which is extremely rich in terms of historical, natural and cultural assets, through an integrated planning approach.

The successful examples of greenway planning, which allows various usages through approaching the natural and cultural environment as a whole, may be seen in American and European cities, particularly since recent years. When examples supported by the European Greenway Association, such as Krakow – Vienna Greenway Planning, Poland – Slovakia – Ukraine Green Way Planning, Amber Greenway Planning, etc., are examined, it can be clearly observed that greenways not only allow conscious decisions to be given concerning the sustainable usage of historical, cultural and natural sources, but also are important tools for regional development, they also enable the diversification of tourism and recreational usages.

Furthermore, if public participation can be ensured during the inventory, planning, implementation and management stages of the effort, it would enable activities towards contributing to the improvement and orientation of the human resources capacity in the region.

By the greenway that was proposed from Ankara to Sakarya, preservation and development of environmental, historical, cultural, natural and social assets of the area, it is aimed for the development of recreational usages throughout the rural and urban landscape, diversification of tourism, development of traditional values through approaching them with scientific methods, upon determining the agricultural production potential, and protection of historical, cultural and natural sources.

Ankara - Sakarya Greenway Planning primarily involves the formation of a comprehensive inventory of the area's natural, historical and cultural assets, through an integrated approach. Through the inventory study to be carried out concerning determined fields throughout the effort, the concept of greenway and the purpose and stages of the project was shared with the people to be affected from the application and public participation to the design of draft project was ensured.

Another important purpose of the project, is to handle the Ankara-Sakarya Greenway Project, which is aimed to be conducted as a further comprehensive and international project by the work team in question, as a pioneer effort on the scale of the City of Ankara. The purpose is, to protect biological diversity in the area, which covers an important portion of the Silk Road, to establish connections between habitats, to develop recreational uses and tourism activities throughout the rural and urban landscape and to protect historical, cultural and ecological activities.

2. MATERIAL AND METHOD

2.1. Material

The main material of the research in which the concept of greenway is thoroughly examined, and the greenway that is proposed as Ankara Sakarya Greenway Planning, including Ayaş, Beypazarı, Çayırhan, Nallıhan, Göynük, Mudanya and Taraklı settlements located in the provinces of Ankara, Bolu and Sakarya, and their near environs. Within this context, the cultural and historical assets, open green spaces, green belts, highway routes, urban natural thresholds, natural corridors, natural formations, agricultural areas, enterprises and water surfaces appearing in and surrounding the determined area were evaluated within the scope of the research.

Satellite images, topographic and geomorphologic maps used as base for the Ankara, Bolu and Sakarya provinces, and maps and data concerning the Ankara Beypazarı Taraklı transportation system, was among the materials of the research.

Besides the abovementioned data, visual materials such as numerous photos taken during the land survey-analysis efforts, were used within this framework. On the other hand, the national and international literature relevant to the concept, planning and stages of the concept of greenway involved in the research, as another material, in order to compile and synthesize data, which constitutes basis for proposal development concerning Ankara - Sakarya route.

2.2. Method

The research carried out for the provinces of Ankara, Bolu and Sakarya covers the literature study and evaluation, land survey-analysis efforts, and the development of the city of Ankara greenway planning proposal through synthesizing of these data.

Within this context, the concept of greenway was examined, the functions and categorization of greenways that was made and the concept/draft Ankara - Sakarya Greenway plan proposal stages and greenway management and greenway planning examples were revealed. Furthermore, the outdoor green zone system of the settlements located on the determined route, was thoroughly examined within the context of historical development process and zoned plan process, and the geographical position, topography, geomorphologic and geologic structure, soil data, climate, water sources, vegetation, population status, social structure and transportation of the area was revealed.

At the second stage, potential areas for the establishment of the determined greenway was proposed through the survey and land survey-analysis works performed throughout the determined greenway route, by performing visual analysis in order to monitor the historical and cultural assets, which will constitute the basis for the greenway implementation, along with wild life corridors, landscape quality, green belts, highway routes, ecologically natural corridors and existing green pattern seasonal changes and landscape features.

At the last stage, suggestions concerning the Ankara Sakarya Greenway Planning was developed according to the findings obtained through the literature study, data obtained from application examples and results of the land study-analysis efforts.

It is aimed to hold meetings as part of the effort, in order to ensure public participation at every stage of the project, and to explain the concept of greenway and the project in question with successful international examples. For, it is extremely important to assure public participation to greenway planning. In addition to persons, organizations, land and facility owners to be directly affected from greenway, it is also necessary to inform the natural and cultural resources preservation associations, persons practicing outdoor sports, concerned persons from relevant local administrations, university representatives and private organizations.

In order to apply a successful greenway planning and get access to reliable data during every stage of the research and to reach feasible results, it is extremely important to cooperate with public and local administrations. Efforts addressed towards implementation, management and training concerning the determined activities, after the completion of the project planning works in question, also are a subject, which requires sustainability. Due to this reason, it will be ensured for activities such as meetings, festivals and courses, also through the contribution of concerned persons from local administrations, to be held from time to time, in order to inform the public and assure their participation.

3. RESULTS

The successful examples of greenway planning, which allows various usages through approaching the natural and cultural environment as a whole, may be seen in American and European cities, particularly in recent years. Greenways not only allow conscious decisions to be given concerning the sustainable usage of historical, cultural and natural sources, but also are important tools for regional development, since they enable the diversification of tourism and recreational uses. Furthermore, an important criterion for success, is ensuring public participation to the effort’s inventory, planning, implementation and management stages.

Ankara – Sakarya Greenway Planning, primarily involves the formation of comprehensive inventory works of the area’s natural, historical and cultural assets, through an integrated approach consisting Ayaş, Güdül, Beypazarı, Çayırhan, Nallıhan, Göynük and Taraklı settlements and their near environs (Figure 1).

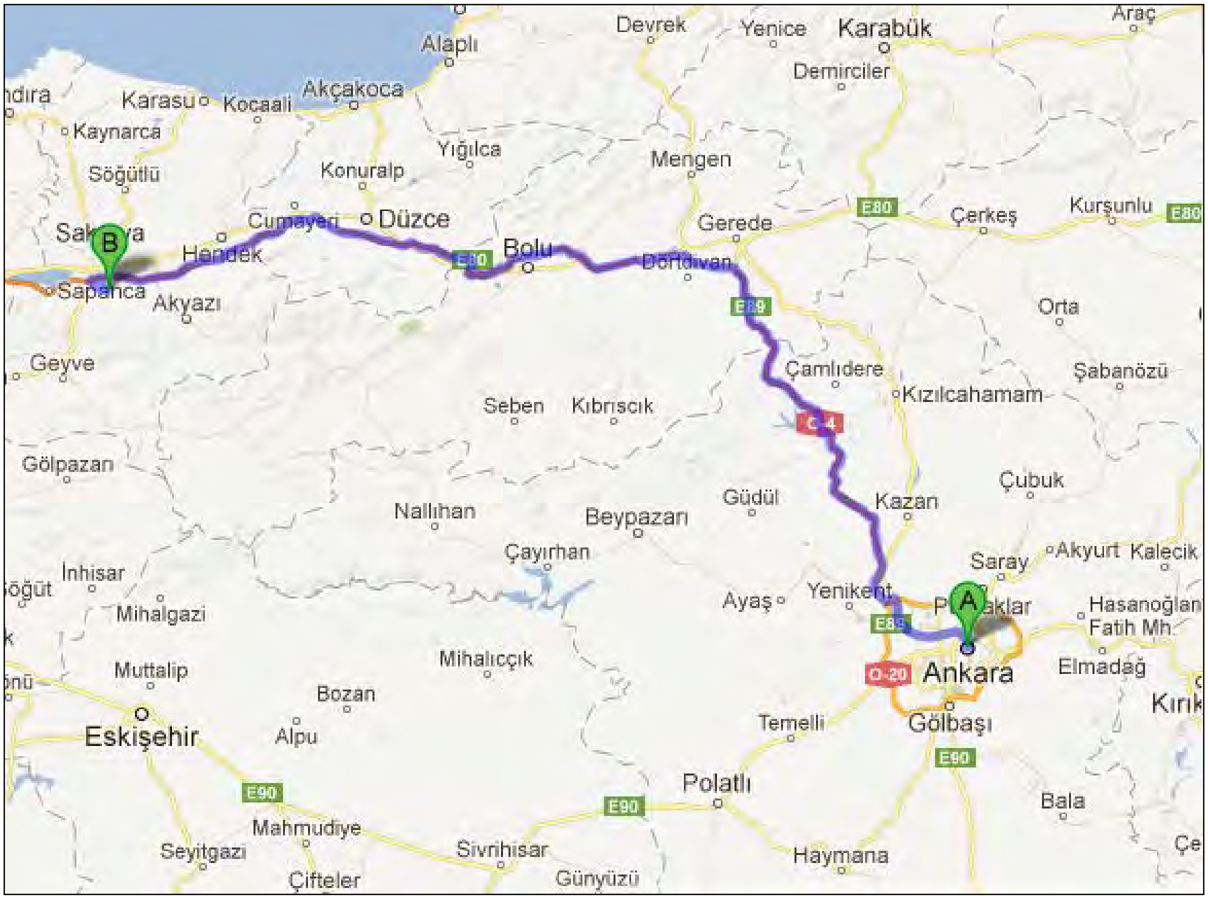

Figure 1. Ankara-Sakarya Greenway Route Proposal (http://maps.google.com)

Greenways may be designed near a railroad route or water channels throughout a river or a valley, establish functional connections between historical settlements themselves through appearing throughout important historical trade routes, like in the Vienna – Prague Greenway, and they establish contact with the surrounding landscape structures of all scales, and have the quality of connecting people to nature, and cities to rural areas. Another important aspect of Ankara-Sakarya Greenway is the existence of Silk Road in this route and the use of the natural, historical and cultural properties towards diversifying tourism.

Physical planning in tourism is to develop an infrastructure enabling the fulfillment of touristic needs, which arise from the desires of the communities to spend their spare time, benefiting from open air, resting and gaining good health. In physical planning and design, actual needs are shaping through the growing and changing desires of the consumers or the tourists. These changes are evaluated by the planners and the designers and lead to new pursuits. The sources of settlements involved in the Ankara – Sakarya Greenway approach, have the richness and diversity to answer the different wants and expectations of the users. The region/route is very rich in terms of historical and cultural assets which the main source of tourism.

The proposed greenway route that was used as settlemets since pre-historical times, have been ruled by the Hittites, Phrygians, the Galateans and the Romans. After the arrival of the Turks, Ankara had become part of the dominions of the Mongols, and afterwards the Il-Khanate during the second half of the 13th century. Ankara and its surroundings were added to the Ottoman country in 1354, during the rule of Orhan I. The settlements, which are among the oldest ones of Anatolia, valuable cultural heritages from past to present, with their very narrow streets embellished with the traditional houses, fountains and mosques located in every part of the settlement at the openings which were formed in these streets.

The traditional settlements were attracting attention with its houses reflecting the traditional way of life and with its organic settlement formation. Bringing together peace and calm, art and culture, and a historical and very well preserved architectural environment with a protective/conservative tourism approach, will make the area as one of the important tourism centers of the region.

The research area is also rich in terms of agricultural fields, and its characteristic of being the place answering the vegetable and fruit needs of the surrounding provinces to a considerable extent. For the area, both the continuation of the conscious agricultural activities, and the promotion of agricultural tourism emphasize the importance of the effort. The relevant areas with the highest tourism potential are the valleys located in the area with their interesting topography, vegetation and traditional vineyard houses. It may be possible to offer all the options of the farm tourism to the visitors arriving from big cities and offering visitors to be in touch with nature, wishing to be involved in the agricultural production of different seasons.

Besides, in line with the route recommended within the scope of the greenway, many activities, such as trekking, climbing, cycling, monitoring plant species and animal presence and picnicking may be carried out simultaneously. In this manner, an attraction would be created for the visitors, and also different opportunities were offered for them.

One of the targets of the work is to ensure the area, which is rich in case of thermal resources, to become an important center of thermal tourism. In this way, the opportunity for 12 months of tourism, the provision of regional balanced tourism development, through easy integration with other types of alternative tourism such as winter tourism, plateau tourism and congress tourism were also be proposed/offered, and by courtesy of these, along with the presence of means of creating healthy, energetic people in thermal facilities, alongside activities towards healing human health, can be a driving factor towards the improvement of the economy.

4. DISCUSSION AND CONCLUSION

- With the research that was carried out, first of all, the inventory of the natural and cultural assets located in the Ankara-Güdül-Beypazarı-Nallıhan route, were registered. In this respect, data, that constitutes the basis to the natural and cultural assets inventory both on the Ankara scale and on national scale, have been compiled.
- By courtesy of the greenway planning that was proposed on the route the asset potential of the area was put to an effective use, leading to the tourism activities to be diversified, and to economic development of the area and employment opportunities to arise, through the envisaged recreational uses.

- The greenway planning which was proposed at the end of the research, will constitute a model for the similar efforts to be performed on the national scale.

- The destruction of natural and cultural assets located in the research area due to abandonment or insensible usage was prevented. On the other hand, it will be ensured for the environmental sources to be protected through being put into good use, and to be handed down to next generations, by courtesy of the greenway planning the management model that was offered.

- With the project in question, it is aimed to preserve the biological diversity in the research/study area, to establish connections between habitats, to protect historical and cultural resources and ecologic assets. In this context, the natural, historical and cultural assets will have been protected, the future generations will also be able to benefit from these assets, and their usages will be assured.
- One of the most important solution for improving the life and environmental quality of Ankara – Sakarya Route can be supplied by the preservation of ecological balance both the whole and the settlements situated on this route. This can be supported by protecting existing natural and green areas and establishing green network planned both for recreation, tourism and natüre protection purposes offering alternative cultural, social, agricultural uses.

In conclusion, the development of national greenways consisting (multi) cities as in Ankara – Sakarya Greenway case sets/shows a comprehensive way of acologically based planning and design in the case of holistic greenway approach.

On the other hand by creating such a greenway between the cities of Ankara and Sakarya, the subsettlements in this route will become identified and qualified both culturally, socialy and geographically. Ankara – Sakarya Greenway proposal not only revetalize this road, it also supports and rn rich is the ecology of the region as forming habitat for various living components of natüre.

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10. GREENWAY PLANNING

Greenways: An American Model Takes Root in Belarus

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Introduction

The paper is dedicated to developing Greenways in Belarus – the country with transition economy, different mentality and great resources for tourism. Greenways concept is understood in various countries differently: sometimes further and broader then in the U.S., sometimes narrower and more functional. It depends a lot on natural, political, economic environment in the countries and initiatives of local communities. In Belarus Greenways is considered as a model which provides not only access to the nature but rather acts as an instrument for economic development of rural areas based on sustainability principles. Greenways also support development of civil society in the country after the collapse of communism. Greenways act as a tool for 'creative economy' and 'learning arena' for tourists.

Background

The term 'Greenways' appeared in the U.S. in the late XIX century. The idea of Greenways gained great attention of the American public, including the concerned government agencies, NGOs, private business. As a result, most states have designed programs to implement long term strategies for the development of Greenways. Today, the total Greenways network spans about 30 thousand kilometers in the USA.

The majority of Greenways Concepts and related publications are based on American experience (Fabos and Ahern, 1995, Ahern 2002). Greenways development in other countries may provide a further and boarder understanding of this concept.

J.Fabos classified Greenways mainly into three categories: ecological, recreational Greenways and historical corridors, which can be clearly recognized in Greenways development in U.S. (Fabos, 1995, Zube, 1995).

European countries generally lag behind the U.S. in development and promotion of Greenways. To date, these countries have gained rather varied experience. Some of them have been engaged in Greenways for more than three decades, others are just beginning their path.

Greenways were introduced in Central Europe through direct cooperation with the U.S. based initiatives in the early and mid 1990s as part of a wider initiative to promote civic engagement in environmental improvement and decision making in an effort to re-establish a functioning and vibrant civic society. Greenways were viewed as a useful tool for promoting NGOs, environmental and heritage protection, responsible tourism development in the regions. Since these early initiatives, the Greenways movement has undergone many changes in vision, impact and purpose. Greenways now present a flexible umbrella methodology for promoting sustainable development in many varied communities and geographic locations. (Murphy, Mourek, 2010).

The Central European Greenways network currently includes 8 long-distance Greenways and a dozen or more local trails – over 8000 km of 'eco-trails'.

In China – a country with huge population, unwise use of natural resources and many natural disasters (floods, sandwind, draught, soil erosion, desertification, etc.) - Greenways development has different approach. The major function of Greenways in this country is protection from natural disasters. Recreational function is not so important. Moreover most of Greenways are mainly planned with a top down approach with little public participation. This approach is a reflection of the centralized government system (Dihua Li, Nuyu Li, 2006).

Belarus is the first country of former Soviet Union that started to develop Greenways. The idea of Greenways came to Belarus in 2005, when our country was visited by a group of experts who gave their recommendations for creation of the first two Greenways in the country. The idea was pioneered by the Belarusian Association 'Country escape' which started implementation of activities for development of the national Greenways (www.greenways.by) (Klitsounova, 2010).

Since that time Greenways movement in the country became stronger and acquired new features and functions which are described in this paper.

Goal and Objectives

The goal of this paper is to evaluate the role and functions of an American model – Greenways in Belarus which is a non-traditional tourism destination with different socio-economic system.

Objectives:

- to define major functions and peculiarities of Greenways in Belarus
- to retrace Greenways role in sustainable development
- to provide recommendations for further Greenways development in Belarus

Results

Belarus is situated in the center of European continent. It is one of the former Soviet Union countries. It borders on Russia, the Ukraine, Poland, Lithuania and Latvia. The area of the country is 207 500 km2. Belarus boasts unique beautiful nature (20 000 rivers, 10 000 lakes, 36% of the territory is forested). The biggest peat bogs and fen mires in Europe and the oldest forest in Europe (the National Park of Belavezhskaya Puscha) are situated in Belarus.

The forests, rural countryside, villages, towns and cities of Belarus provide an excellent venue for an outstanding, world-class visitor experience. One of the most important elements of this experience is interacting with the warm, friendly and hospitable citizens of Belarus.

The Belarusian terrain itself, with its gentle hills and broad flat plains, is generally accessible to people of all ages and abilities who want to walk, bicycle or ride a horse. In addition, the numerous lakes and rivers provide opportunities for creating greenway water routes.

The rural landscapes in Belarus remind of the upper Midwestern United States. In the Dakota's, Wyoming, Montana, Colorado, Idaho and Utah, a similar pattern of rural development exists.

Over the past decade, Belarus has made a strong beginning in creating a national system of Greenways which celebrate the country's rich heritage of natural and cultural resources. The first Greenways were created by the initiative and expertise of a small group of energetic Belarusian greenway pioneers, a group which included individuals, professionals, local authorities and private organizations.

Few projects in the sphere of Greenways development were implemented in Belarus. The most significant ones are 'Greenways – working out environmentally friendly trails in Belarus' (supported by OSCE office in Minsk, 2005-2006) and EU/UNDP project 'Sustainable development on the Local Level' (2008-2010). They helped to develop eight flagship Greenway initiatives in different parts of the country and to create a network.

Today, Greenways in Belarus are ready to enter a new phase, which will emphasize making Greenways more accessible and attractive to tourists. This next phase of greenway development can significantly increase national and international ecotourism.

Greenways are becoming an essential component of strategies for sustainable development of many territories. Dozens of workshops, seminars and meetings have seen genuine interest in the topic of Greenways. Partnership initiative groups were formed and started creating and developing Greenways in many pilot regions. These are large geographic regions and the available Greenways consist of four types of facilities: long distance Greenways, local Greenways, urban Greenways and ecoroutes. These varying types of Greenways provide a range of visitor experience and make use of different native landscapes and cultural facilities within each of pilot regions.

The team of professionals trained in the field of Greenways was formed. There were produced few documents – 'Greenways development concept in Belarus' and 'Guidelines for the opening and operation of Greenways', which can be used as a tool for creation and development of such routes.

While introducing American model of Greenways in Belarus a range of local peculiarities revealed connected with the particular features of our country. Belarus is a country in the period of transition, where one can find both market economy and strong socialism elements. Civil society is at the initial stage of development. That's why Belarusian Greenways acquire new functions compared to American ones.

There is no private ownership for land and the function of accessibility to natural attractions in the regions is not so important in Belarus.

But at the same time Greenways in our country are becoming a tool that promotes sustainable development in different regions. They form the sound basis for quadruple bottom-line dimensions of ecological, social, economic and cultural sustainability.

Greenways attract attention to environmental protection, promote healthy lifestyle, add to biodiversity protection in the regions.

Greenways initiate processes that contribute to establishment of civil society – the new model for our country. The process of Greenways development involves local community, representatives of local authorities, local business and non-governmental organizations. It is a democratic platform that provides private-public partnership.

Greenways stimulate economic development of the regions. New small and medium size businesses in tourism sphere appear – homestays, B&Bs, farms, ecomuseums, cafés, bicycle, canoe, ski rentals, and the like. Tourist flow increases. Money spent in the region brings multiplication effect.

Greenways contribute to cultural and historical heritage preservation (both tangible and intangible). Local heritage sites turn into popular tourist sites. Local folklore, crafts, rites and rituals are interpreted through festivals, holidays, workshops, books, brochures, souvenirs, etc. It raises interest among tourists and stimulates pride and self-identification of local community.

All the above mentioned arguments show that Greenways concept in Belarus is seen as a pathway to sustainability.

In Belarus Greenways combine all the three categories defined by J.Fabos: ecological, recreational Greenways and historical corridors. Greenways act as a good platform for new sustainable tourism product. Non-urban area of Belarus possesses significant tourism potential but lacks infrastructure, formulated tourism product, brands, etc. It is Greenways that is a basis that unites various tourism initiatives of local population based on natural and cultural heritage under one theme. The theme predetermines logo, brand and content of a Greenway. Here new for our country ideas are implemented – heritage interpretation and creative economy. These are approaches for people with big ideas and small budgets.

Belarusian Greenways are based on a fundamental concept in Greenways design - the ‘visitor experience’. In essence, the greenway ‘visitor experience’ involves moving through the landscape, usually by non-motorized transport (walking, bicycling, paddling, riding) along a continuous linear Greenway route that connects sites of natural, historic or cultural significance. The quality of the visitor experience is determined by the environment (for example, the weather or physical characteristics of the trail, roadway, or waterway) and by the information (for example, greenway brochures, websites, tour guides, or interpretive signs) provided to the visitor to help understand the significance of the sites and region. The goal in designing the ideal ‘visitor experience’ is to touch all the visitor’s senses in a deep and memorable way through interpretation.

Freeman Tilden defined interpretation as ‘an educational activity which aims to reveal meanings and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information’. This is a communication process that involves tourists and forges emotional and intellectual connection between the audience and the meaning inherent in the resource (Tilden F., 2009; Pine, J. and Gilmore, J., 1999). Chinese proverb says *'Tell me* and I'll forget; show me and I may remember; involve me and I'll understand'.

The abovementioned concept became a basis for the new model of 'creative economy' that does not require significant financial investments but can generate significant income and, what is more important, can leave a mark in tourist's soul (Ham S., 1992).

Belarusian village is becoming a 'learning arena' for tourists, where they receive non-traditional information though informal communicative channels. And this information is something that is hard to forget.

One of the most successful examples which illustrate the points mentioned above is Greenway 'Volozhynskie gostintsy' (from Russian – 'The Volozhin roads').

There are several items that make the Volozhin region an excellent destination for tourists. First, the natural and cultural landscapes are outstanding. The Naliboki Forest is one of the best ecosystems anywhere in Europe. It also contains a fascinating human story that was transformed into the movie "Defiance." There are 184 heritage sites here which are included in state Belarusian heritage list. Second, the region has a number of established homestays that can accomodate tourists. Third, there is a variety of other activities for tourists to enjoy, from the Monkey EcoPark, to river canoeing and kayaking, to hiking and bicycling trails.

Five years ago initiative group was formed for Greenways designing. It was a bottom-up approach and now Volozhin region benefits from strong local leadership. Initiative group includes around 20 active people – country homestay owners, craftsmen, historians, representatives of local natural reserve, artists, farmers, representatives of museums, etc. This group has become a real team, a motor of Greenways development and managed to win the contest. Volozhin became a pilot territory of international project "Sustainable development on local level" (2009-2011). In frame of this project the route was developed as well as Greenway logo, brand and name (Figure 1). Several banners, signs, booklets were produced and mini-grants program supported local tourism initiatives. Real public-private partnership was established (local authorities, local community, business, NGOs). Nowadays various financial resources are used for Greenways development – donors programs' money (EU, USAID, American Embassy, UNDP, etc.), as well as private and state money.

Figure 1. Map and logo of a Greenway 'Volozhinskye gostintsy'

Some facilities on the ground that support tourism started to be developed. The photos below show one of the most readily available routes of travel in the region, rural roads that can accommodate cyclists and pedestrians (Figure 2).

Figure 2. Different types of roads and their users on Greenway 'Volozhinskie gostintsy'

The Greenway has become an innovative tourism product with a variety of activities, tourist sites and festivals which provide unique visitor experience. Newly created ecomuseums* attract particular tourist attention – these are places where one can get acquainted with bee life, taste pancakes with honey, learn to dance and sing Belarusian songs, do something with clay and the like. (Figure 3)

Figure 3. Activities on Greenway 'Volozhynskie gostintsy'

Modeling excursion along the Greenway was developed which was presented on International tourism exhibition in Minsk (capital of Belarus). (It was financed by the Ministry of sports and tourism of Belarus). The informational center was established. It is planned to develop Greenway's own web-site. These processes led to rapid tourism development in the region (Table 1).

Table 1.

Tourism development in Volozhin region

Indicator/Index	**Year**					
	2007	**2008**	**2009**	**2010**	**2011**	**2012**
1. Tourism receipts ($)	11.721 $	64.854 $	127.174 $	250.133 $	199.246 $	284.269 $
2. Number of homestays	3	13	20	25	29	29

Nowadays Greenway 'Volozhinskie gostintsy' plans to reach new level and according to experts' recommendations it is necessary:

- provide Access to Unique Natural and Cultural Attractions;

- wayfinding and Signage Systems should be improved;
- visitor Lodging needs upgrading and certification;
- visitor Support Services are to be developed;
- guided Tours should be designed and guides should be developed;
- local Food should be promoted;
- local Festivals are needed to Highlight Tourism and Generate Revenue.

Summing up the abovementioned example one can point out a range of Greenways functions in Belarus. Among the main are:

- Supporting and strengthening local communities: development of local entrepreneurship, creation of new jobs and additional sources of income, preservation and revival of traditional crafts.
- Development of civil society and public-private partnership.
- Preservation of natural and cultural heritage, and protection of natural landscapes.
- Promoting the sustainable use of local resources for infrastructure, accommodation, catering, guided tours, local industrial and agricultural products.
- Development of cooperation between regions, cities and rural settlements and their residents.
- Assisting local communities in enhancing their socio-cultural identity and improving the quality of life.
- Encouraging travel using the most environmentally-friendly transport: walking, cycling, canoeing, horseback riding, and public transportation instead of a personal vehicle.
- Helping to form and develop branded innovative tourism product on the basis of Greenways.

The following seven actions provide a focused strategy to support and stimulate Greenways development taking into consideration the above mentioned functions:

1. Fully integrate the concept of “Greenways” into the National Tourism Development Program till 2015 and other relevant regulations, as well as recommend the establishment of at least one pilot Greenway in each region with tourism potential.
2. Conduct a series of informational seminars for the general public, in cooperation with government and local authorities, to promote the concept of Greenways as an instrument for effective use of local resources to develop innovative tourism products on the basis of sustainability principles.
3. Create a special Program and Development Fund for Greenways in Belarus, mobilizing intellectual resources and public, private and donor funding.
4. Create a national steering body to develop Greenways - a non-profit association (or an NGO) to guide and promote Belarusian Greenways. (Currently, this function can be performed the Belarusian Association ‘Country Escape’).
5. Train a team of specialists to provide guidance, technical assistance and coordination to local and regional Greenways initiatives.
6. Create an inventory of Greenways in Belarus which contains relevant information about the infrastructure, available services, and charts the progress of Belarusian Greenway development
7. Develop and adopt a national system of standards, symbols and principles of environmental management for Belarusian Greenways.

All of this will help to make Belarusian Greenways Vision which has been formulated come true.

Belarus is a land of deep forests, sparkling rivers, and welcoming people who honor their traditions and care deeply for their lands. Greenways in Belarus provide a network of alternative transportation linking our towns and villages. While exploring our diverse Greenways by bicycle, on foot, by canoe or on horseback, you can experience the beauty of our landscapes, learn about our customs, crafts, songs and dances, enjoy local cuisine, improve your health and connect with nature.

Conclusion

Greenways is a universal model which may be successfully implemented in countries with various natural and cultural resources and different economic and political environment. However it is important to know the peculiarities of Greenways development in different countries as it will enrich, broaden and extend this model and will allow to implement this model more efficiently and creatively. This model could be used not only by planners, researcher and designers but also by community leaders, local authorities, businessmen and NGOs for sustainable regional development.

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Green Space Typologies in the City of Porto – Portugal: Identifying nodes and links for greenway planning

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Introduction

In the XIX century, Porto was a small and compact urban centre surrounded by a large belt of agriculture and forest. Since the mid XX century, as a consequence of the industrial revolution, the city sprawled throughout the rural fringes up to its administrative limits creating an urban continuum with the adjacent municipalities. As a result, the current green structure of the city lacks a long-term planning strategy with resulting breakdown of the rural matrix, fragmentation and discontinuity of main green systems.

Functioning as habitat and corridors, urban greenways are very effective strategies for minimizing overall impacts of ecological fragmentation: habitat loss and habitat isolation. A greenway system articulates ecological structure and function, providing simultaneously recreational opportunities, biodiversity protection and assuring present and future open space needs (Ahern, 2002). Currently, greenways are being established in cities worldwide, proving their relevance, especially in rapidly changing urban contexts.

Supported by these assumptions and the results of current studies on Porto green structure, this work aims at proposing a greenway network for the city, grounded on an integrated and coherent system of multifunctional green areas. The adopted approach relies on the premise that a structure of green nodes and links (corridors) should act as the framework for that greenway system.

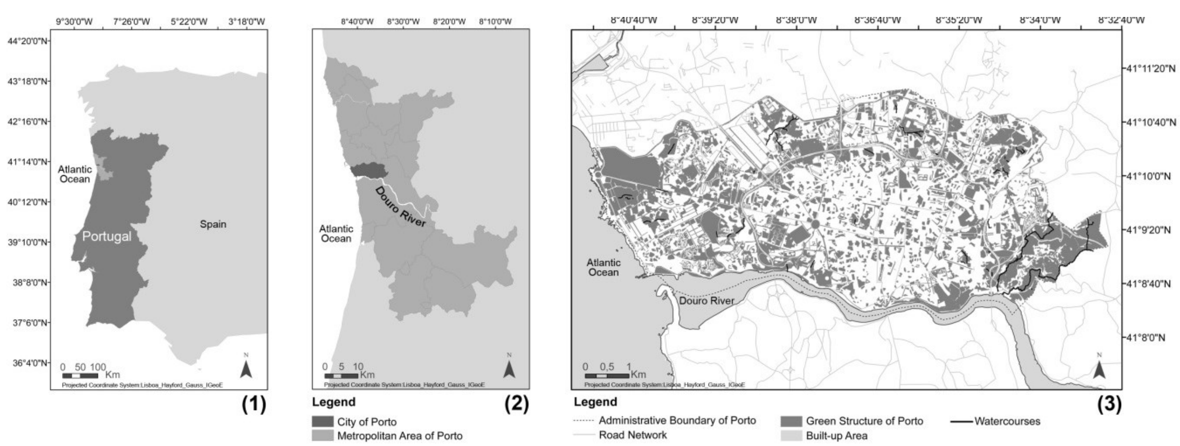

Fig. 1. Study area: (1) Greater metropolitan area of Porto (GAMP), Portugal; (2) Administrative boundaries of Porto; (3) Green Structure of Porto.

Background and Literature Review

The concept of urban greenways and networks emerged in the 19th century, with the purpose of protecting major green areas and their wildlife from the urban sprawl and fragmentation (Jongman 2003). Greenways have been defined by Ahern (1995) as "networks of land containing linear elements that are planned, designed and managed for multiple purposes including ecological, recreational, cultural, aesthetic, or other purposes compatible with the concept of sustainable land use". An urban network is thus composed by strips of green areas, with a strong linear character, connecting larger green units with socio-ecological relevance in a sustainable system.

Multi-functionality is an important aspect of greenways. One of the main goals of greenway planning is directed at wildlife and habitat conservation (Linehan et al 1995, Briffett 2001). Greenways have a significant role in urban biodiversity protection: they fulfill the needs of several fauna and flora species, by acting as dispersion and migration corridors and by providing suitable habitats (Briffett 2001, Ignatieva 2011). Additionally, these areas help to maintain urban ecosystem services at healthy levels (Tzoulas et al, 2007), by controlling flood damage, enhancing water quality, balancing nutrient cycles and mitigating the heat-island effect (Searns 1995, Ahern 1995, Pauleit and Duhme 2000).

Recently, there's also a growing focus on the direct benefits for the human population. Many of the greenways traditionally have a recreational purpose on their origin and often include trails or bicycle paths. These structures promote not only the physical health and but also psychological well being brought by the visualization and overall experience of natural sceneries (Tzoulas et al 2007). Greenways in close proximity to the urban residents may also become an important resource for environmental education and nature conservation awareness (Searns 1995).

The coexistence of varied land covers and land uses supports the multi-functionality of the green infrastructure. Different land cover types can accommodate multiple human activities and can create diverse opportunities for wildlife (Pauleit and Duhme 2000, James and Bound 2009, Farinha-Marques et al 2011).

Porto's green structure has suffered major modifications, especially in the last century, which resulted in a highly fragmented landscape comprised of small and isolated patches of different typologies of green spaces. The urban core green areas are historically dominated by residential yards and private gardens, whereas the larger peripheral belt of woodlands and agricultural areas that once existed are highly reduced and fragmented nowadays. Contradicting the general trend of green space decline, public parks, gardens and squares became more frequent and developed an important role as part of the urban green structure (Madureira et al 2011).

Goals and objectives

- Provide a framework for greenway planning, supported by a system of multifunctional green centres (nodes) and green corridors (links) for the city of Porto;

- Propose a systematic methodology for the definition of nodes and links;
- Outline the areas with greater ecological potential, aiming at preserving green spaces with higher ecological interest, improve their accessibility and protect them from urban development.

Methods

Aiming at defining a framework for greenway planning in the city of Porto, a methodology was adopted concerning three main features: 1) Porto's green structure and green space typologies 2) Node analysis 3) Link analysis

<u>1) Porto's green structure and green space typologies</u>

The present study relied on green space typologies defined in the ongoing research project "Urban Green Structure: Study of the relation between public space morphology and flora and fauna diversity in the city of Porto". According to this project Porto's green structure represents 39.8% of total urban area, mainly distributed by wasteland/vacant lots (W/VL, 18.7%), public parks and gardens (PPG, 12.7%), green spaces associated with civic buildings (CBGS, 12.4%) and urban yards (UY, 10.4%); these typologies represent 54.2 % of the total green structure.

Private gardens (PG) and agricultural areas (AA) are also relevant with a proportion, respectively of 9.3% and 8.2%. The remaining green space typologies are distributed as follows: tree lined streets (TLS, 6.9%); urban woodlands (UW, 6.8%); multi-story housing green spaces (MHGS, 6.1%); green spaces associated with main roads (GSMR, 5.4%); public squares (PS, 1.1%); cemeteries (CE, 1.1%) and cliffs (CL, 0.9%). Additionally, there are approximately 22 km of open watercourses, 3.8 km of Atlantic shore and 9.2 km of River Douro banks.

<u>2) Node analysis</u>

Nodes are non-linear elements with prevalence of open green spaces whose area and ecological value are considerably relevant when compared to the scale of the city. Criteria used for node definition:

- 70% of the area is occupied by green spaces;
- High diversity of green space typologies
- Non-linear to a semi-globular shape (landscape metrics indicate a high value of circularity and low aspect ratio);

The comparison between the node area and the total area of the city allowed the definition of two node typologies:

a) Main nodes - node area is higher than 1% and contains at least 8 typologies - half of the identified typologies
b) Secondary nodes - node area is lower than 1%

<u>3) Links analysis</u>

Links can be understood as green corridors; they are defined as linear spatial elements that promote connectivity and facilitate the flow of energy, matter or species (Linehan, Gross, & Finn, 1995). Within the city frame four types of links were identified; the criteria used is as follows:

a) Natural Blue Link:

- Defines greater ecological continuity;
- Includes Douro River and the Atlantic Ocean coastal areas;

b) First Order Links:

- Display a very high connectivity (high continuity, no gaps between green spaces in the link)
- Connect the main nodes to each other;
- Connect the main nodes with the Natural Blue Link;

c) Second Order Links:

- Display a very high connectivity (high continuity, no gaps between green spaces in the link);
- Connect main and secondary nodes;
- Connect secondary nodes;

d) Third Order Links:

- Display lower level of connectivity (these include stepping stones);
- Connect links to each other.

In Fig.2 a proposed framework for greenway planning is presented: supported by the green space typologies map, a proposal for nodes a links was outlined.

Results

Eight main green nodes were identified as well as nine secondary nodes (Fig. 2, Table 1). Main nodes have, on average, 75.7% of green area and ten different green space typologies; secondary nodes have on average 78.7% of green area and close to five green space typologies. Major green nodes and secondary nodes accomplish 25.5% of the area of the city of Porto and correspond to 64% of its green structure.

With regard to their spatial arrangement, main nodes occupy a peripheral position, distributing along, and close to, the administrative boundaries of the city. Yet, the secondary nodes tend to appear closer to the inner city.

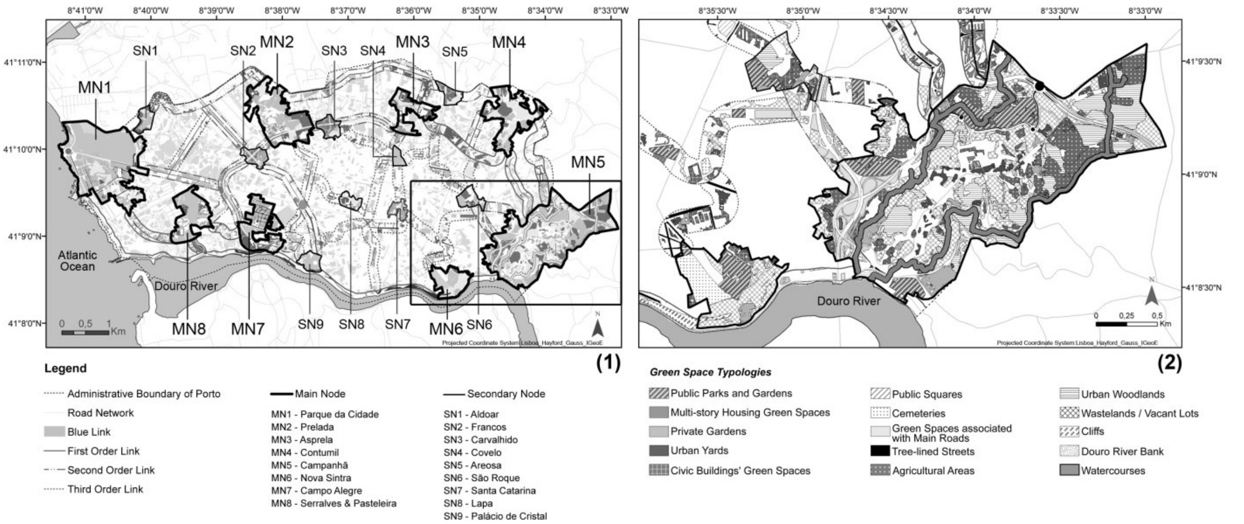

Fig. 2. (1) Areas with greater ecological potential (main nodes and secondary nodes) and links between them. (2) Detail of the southeast area of the city revealing the green spaces typologies composition of nodes and links.

The identified nodes are very heterogeneous regarding their green space typologies: 1) southern and western main nodes are dominated by public parks and gardens, private gardens, multi-story housing green spaces as well as some wasteland/vacant lot patches; 2) northern and eastern main nodes are dominated by wastelands/vacant lots and civic buildings' green spaces but, in here, urban woodlands, agricultural areas and water courses are of great importance.

According to Table 1, *wasteland/vacant lots* and *public parks and gardens* are, on average, the leading typologies in main nodes (23.5% and 18.9%, respectively); secondary nodes display a slightly different composition being led by *public parks and gardens, green spaces associated with main roads* and *wasteland/vacant lots* (23.5%, 17,5% and 17,0%, respectively). *Green spaces associated with main roads* have also relevance in secondary nodes (17.5%). A common feature shared by all the main nodes is the presence of *civic buildings' green spaces*, *wasteland/vacant lots* and *tree-lined streets*. *Cliffs*, *cemeteries*, *public squares*, *Douro River banks* and *beaches/coastal zones* were the less represented typologies. In secondary nodes it should also be highlighted the ecological value of *urban yards* (11.2%) particularly in Santa Catarina Node where they occupy 91.7% of the green area.

A total of 41 links were identified and hierarchized as follows: the natural blue link (Douro River and the Atlantic Ocean coastal areas), six links of first order, eighteen of second order and sixteen of third order. Although it was not a criteria for their delimitation, a gradual increment in the green area of the links, according to their order, was detected, starting in third order links with 28.6%, second order links with 34.4% until first order links with 42.5%.

The average length of links is 1.1 km, excluding the blue link that extends along 13 km. Links have, on average, 33.3 % of green area and nearly seven different green space typologies. The most frequent typologies are *multi-story housing green spaces* which dominate in first order links (22.4%), *green spaces associated with main roads* (25.4%) leading in second order links, and *urban yards* (19.9%) that, along with *civic buildings' green spaces* (19.3%) and *private gardens* (15.2%) are the most relevant typologies in third order link. Despite their natural linear configuration, *watercourses* were not relevant in links delimitation, partially because the most part is piped and those that remain in open air were absorbed in the main nodes.

The Atlantic Ocean and the Douro River act as the main corridor ensuring connectivity in southern and western limits of the city. Additionally, the occurrence of a large number of different types of green space proves its multifunctional quality: *beaches*, *banks* of the river, *cliffs*, *tree lined streets*, *parks and gardens* and *public squares*, guarantee, further than its contribution to the promotion of biodiversity, wildlife migration, flood control and water quality, an important performance in the recreation of Porto habitants.

First order links provide important connections between the main nodes located in the southwest and in the northeast areas of the city; second order links ensure connectivity especially along the periphery while the third order links are concentrated in the city center, more densely urbanized.

Discussion and conclusion

The proposed network was built upon the existing urban green space pattern (Kong et al 2010) and assumes the form of a closed loop consisting of complex organization of highly differentiated nodes and a myriad of links with distinct capacity of connection. The uniqueness of each node as well as the differentiated character of the links, addresses additionally challenges to their planning process but at the same time reveals emerging opportunities for the greenway planning purposes.

Two leading nodes, Parque da Cidade and Campanhã were identified in the west and east limits of the city. Because of their size, location and green space composition (they include the two largest public city parks), these two nodes act as the largest biodiversity spots of Porto; they are fundamental to its green structure and therefore should be carefully addressed by all planning regulations from the municipal level to regional level.

W*asteland/vacant lots* is a very important typology in both main and secondary nodes. As they are often considered as spaces without a clear function, they are the less stable and very susceptible to urban sprawl of the considered typologies. However they act as important seed banks for wild species colonization of neighboring patches, and in that sense, should be considered as significant conservation spots. *Green spaces associated to the main roads* are present both in nodes and in links; this raises the attention for the importance of such typology and the need to improve its spatial quality and diversity.

The protection of agricultural land and urban woodland is also a relevant matter in the planning of the city not only because of the ecological services they provide but also because they have an important as a food production strategy and source of natural resources.

The compact historic city center reveals a significant absence of green areas either integrated in nodes or in links. The green structure of the inner city is much supported by *urban yards* and *private gardens*. This fact brings about sensitive issues in the planning process, as these are both private areas. Nevertheless, they play an essential ecologic function by ensuring permeability, clean air, habitats and visual amenity, and therefore they should be effectively preserved and new green spaces should be promoted to strength connectivity.

The proposed green network may contribute for the framework of a more ecologically oriented planning program for Porto. In its current form it provides an initial identification of the major green areas in the city, the existing or potential connectivity between them, and which green space typologies provide higher contribute for the multi purposes goals of this promising urban greenway system.

				% Green Space Typologies (GST)															
MAIN NODES	Area (ha)	% Green area	Numb. GST	PPG	MHGS	PG	UY	CBGS	PS	CE	GSMR	TLS	AA	UW	W/VL	CL	WC	DRB	B/CZ
MN1 - Parque Cidade	226.3	79.2	14	44.4	1.0	16.3	6.1	1.3	0.8	0.1	0.8	4.5	4.0	0.4	14.7		1.1		4.4
MN2 - Prelada	112.3	70.8	10		8.6	4.7	1.8	12.0			2.9	3.2	33.4	12.2	17.4		3.8		
MN3 - Asprela	42.8	72.9	8		1.0	0.7		41.7			10.2	3.7	7.7	0.0	30.2		4.9		
MN4 - Contumil	86.4	80.2	9		0.7	2.6	3.8	5.1				1.3	14.8	21.1	48.4		2.3		
MN5 - Campanhã	298.9	75.3	13	7.5	0.3	3.7	3.2	0.9			5.1	0.6	15.7	20.8	27.7		14.1	0.3	
MN6 - Nova Sintra	39.9	84.6	8	19.7		4.3		4.3		25.6		0.1	0.5		43.3	2.2			
MN7 - Campo Alegre	68.0	70.0	11	18.7	2.3	17.1	12.1	15.4			9.1	12.0	1.5	8.3	2.9		0.4		
MN8 - Serralves	61.7	72.6	9	60.6	16.3	0.9	5.5	11.0				1.4		2.3	0.9		1.1		
mean	117.0	75.7	10.3	**18.9**	3.8	6.3	4.1	11.5	0.1	3.2	3.5	3.3	9.7	8.2	**23.2**	0.3	3.5	0.04	0.6
SECONDARY NODES																			
SN1 - Aldoar	15.1	93.9	7			1.7		17.1				1.5	38.3	18.6	19.7		3.2		
SN2 - Francos	17.1	60.5	4		33.9						56.0	0.6			9.5				
SN3 - Carvalhido	17.3	78.8	4		0.6						68.0		8.8		22.6				
SN4 - Covelo	8.0	95.4	1	100.0															
SN5 - Areosa	14.6	87.2	5								30.7	7.1		22.4	37.8				
SN6 - São Roque	17.4	73.3	8	31.2		7.6	4.5	10.0			2.8		13.3	20.2	10.4				
SN7 - Santa Catarina	10.8	64.1	2			8.3	91.7												
SN8 - Lapa	12.2	71.7	5				5.0	38.3					9.2		45.8		2.0		
SN9 - Palácio Cristal	15.6	83.4	5	80.5		6.0						0.9			7.3	5.3			
mean	14.2	78.7	4.6	**23.5**	4.3	2.6	11.2	7.5			**17.5**	1.1	7.7	6.8	**17.0**	0.6	0.6		
	Length (km)	% Green area	Numb. GST	PPG	MHGS	PG	UY	CBGS	PS	CE	GSMR	TLS	AA	UW	W/VL	CL	WC	DRB	B/CZ
LINKS (means)																			
First order	1.3	42.5	7.8	2.3	22.4	3.4	5.0	12.6			5.0	12.6	4.8	20.4	22.1		0.1		
Second order	1.1	34.4	6.4	4.3	5.2	10.1	10.3	9.8	1.6	0.3	25.4	11.1	2.3	2.0	16.1		1.5		
Third order	1.1	28.6	6.3	5.3	3.5	15.2	19.9	19.3	3.2	2.0	2.6	12.8	0.7	3.0	12.4				
mean	**1.1**	**33.3**	6.6	4.4	7.1	**11.1**	**13.4**	**14.0**	2.0	1.0	**13.2**	**12.0**	2.1	3.8	**12.4**		0.7		
Natural Blue Link	13.0	74.1	13	2.3	0.4	0.9	0.2	0.7	1.5		0.2	3.6	0.1		0.3	5.7			5.9

Table 1. Green space typology composition of nodes and links (see Methods, pag. 3)

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Factors influencing greenways use in Italy: definition of a method for estimation

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1. Introduction

The issue of non-motorized mobility in the last decades has seen increasing attention at the international level. Also in Italy we assisted at the creation of hundreds of miles of trails dedicated to cycling and walking, many of which meet the greenway definition of the European Greenways Association: "*Communication routes reserved exclusively for non-motorized journeys, developed in an integrated manner which enhances both the environment and quality of life of the surrounding area. These routes should meet satisfactory standards of width, gradient, and surface condition to ensure that they are both user-friendly and low-risk for users of all abilities. In this respect, canal towpaths and disused railway lines are a highly suitable resource for the development of greenways*" (EGWA, 2002).

More generally, greenways are green infrastructures that can be planned at different scales and for multiple purposes (ecological, recreational, cultural, non-motorized mobility) (Fabos, 1995; Ahern, 1995).

Various methodologies and several studies on greenways planning have been conducted also in Italy (Rovelli et al., 2004; Toccolini et al., 2006; Senes et al., 2010).

The growing number of infrastructures built and the related costs, combined with the recent economic crisis, led to an increasing need for public bodies to evaluate each project in terms of its ability to meet the needs of the communities, particularly in terms of attractiveness for users and benefits (not only economic) for local communities. To do this, planners and decision makers need to be provided with: 1) updated and consistent data on greenways and trails users; 2) models, based on the previous data, that can help to "predict" the number of users on a planned infrastructure.

In such a context, the aim of this research was to assess the relationships between the number of users detected along some Italian greenways and the characteristics of the territory crossed (in terms of population and environment), in order to define a model capable of estimating the potential users of a greenway before it is realized. It represents one of the first attempts in Italy.

2. Background and Literature Review

Several authors (Wigan et al., 1998; Eash, 1999; Betz et al., 2003; Rodriguez and Joo, 2004; Furuseth and Altman, 2004; Barnes and Krizek, 2005; Lindsey et al., 2006; Lindsey et al., 2007) have addressed the issue over the past two decades, highlighting the main factors that influence the use of greenways and proposing some methods for its estimation, based on the collection of available users data for similar paths or surveys of the population potentially affected.

Unfortunately, these methods are often applicable only in similar contexts and require baseline data usually not available in Italy. For a general review of the used methods in literature it is possible to see Turner et al. (1997), Federal Highway Administration (1999), and Porter et al. (1999).

Factors influencing greenways and trails use, are linked to the characteristics of (Federal Highway Administration, 1999; Bhat et al., 2005):

- the greenways and trails themselves (accessibility, safety, surface, length etc.) (Hopkinson and Wardman, 1996; Wigan et al., 1998; Cervero and Duncan, 2003; McDonald et al., 2007);
- the population (social, economic and demographic characteristics) (Baltes, 1996; Ortuzar et al., 2000; Betz et al., 2003; Cervero and Duncan, 2003; Dill and Carr, 2003; Furuseth and Altman, 2004; Krizek et al., 2007; Lindsey et al., 2007; Arnberger et al., 2010);
- the landscape (land-use, topography etc.) (Cervero and Duncan, 2003; Rodriguez and Joo, 2004, Lindsey et al., 2007);
- the climate and the season (Baltes, 1996; Dill and Carr, 2003; Ploner and Brandenburg, 2003; Lindsey et al., 2007).

The variables (proxies) used in the different models and case-studies can vary considerably, depending on the goals of the investigation and the available resources (Parkin et al., 2008). The linear regression is one of the most used technique for modeling the relationship between the greenways/trails users and the different variables (Baltes, 1996; Dill and Carr, 2003; Ploner and Brandenburg, 2003; Lindsey et al., 2007).

Apart from the model choice, it is essential to have the availability of data on the users (Lindsey, 1999).

3. Methods

3.1 Greenway traffic counts

In order to develop a model for the estimation of the potential users of a greenway, in the present study we gathered data on users from 13 automatic counters, over a period of four years, along 7 greenways in Northern Italy: the greenways of Adige Valley (100 km), Val Rendena (23 km), Valsugana (50 km), Val di Fiemme (36 km) and Valley of Lakes (15 km) in Trentino-Alto Adige Region, and the greenways of Mantova-Peschiera (45 km) and Mantova-Bagnolo San Vito (11 km) in Lombardy Region (Fig. 1). All the greenways considered run mainly in rural areas, crossing the Po valley or mountain valleys, along streams or disused railways lines. They have a mild average slope and are mainly used for tourist-recreational purposes, for walking, cycling or skating. Their choice was determined by the limited availability in Italy of systematic data on greenways and trails users, and with the objective of analyzing greenways with heterogeneous characteristics.

The automatic counters allow to detect the users 24 hours a day, 365 days a year, recording the users passages at fixed points of the track, but cannot distinguish the different types of users (cyclists, pedestrians, skaters, etc.) neither the number of users from the number of passages.

The data collected by each counter were aggregated on a monthly basis, thus creating a dataset of 337 observations used for the development of the model. This number could have been higher if we had not been obliged to discard 140 monthly observations (29%), due to the climatic conditions of some mountain areas and faults of the automatic counters.

The monthly mean traffic varies from a minimum of 57 passages detected by the counter C1 in January along the Mantova-Peschiera greenway to a maximum of more than 85,000 passages registered in August by the counter C13 along the Valley of Lakes greenway, with a total average value of 13,600 passages per month (Fig. 2). The annual mean traffic varies from a minimum of 30,000 passages detected by the counter C3 along the Mantova-Bagnolo S. Vito greenway to a maximum of more than 350,000 passages registered by the counter C13. The Valley of Lakes greenway presents a number of passages significantly higher than the others greenways, due to the presence of the Garda Lake, an important tourist attraction.

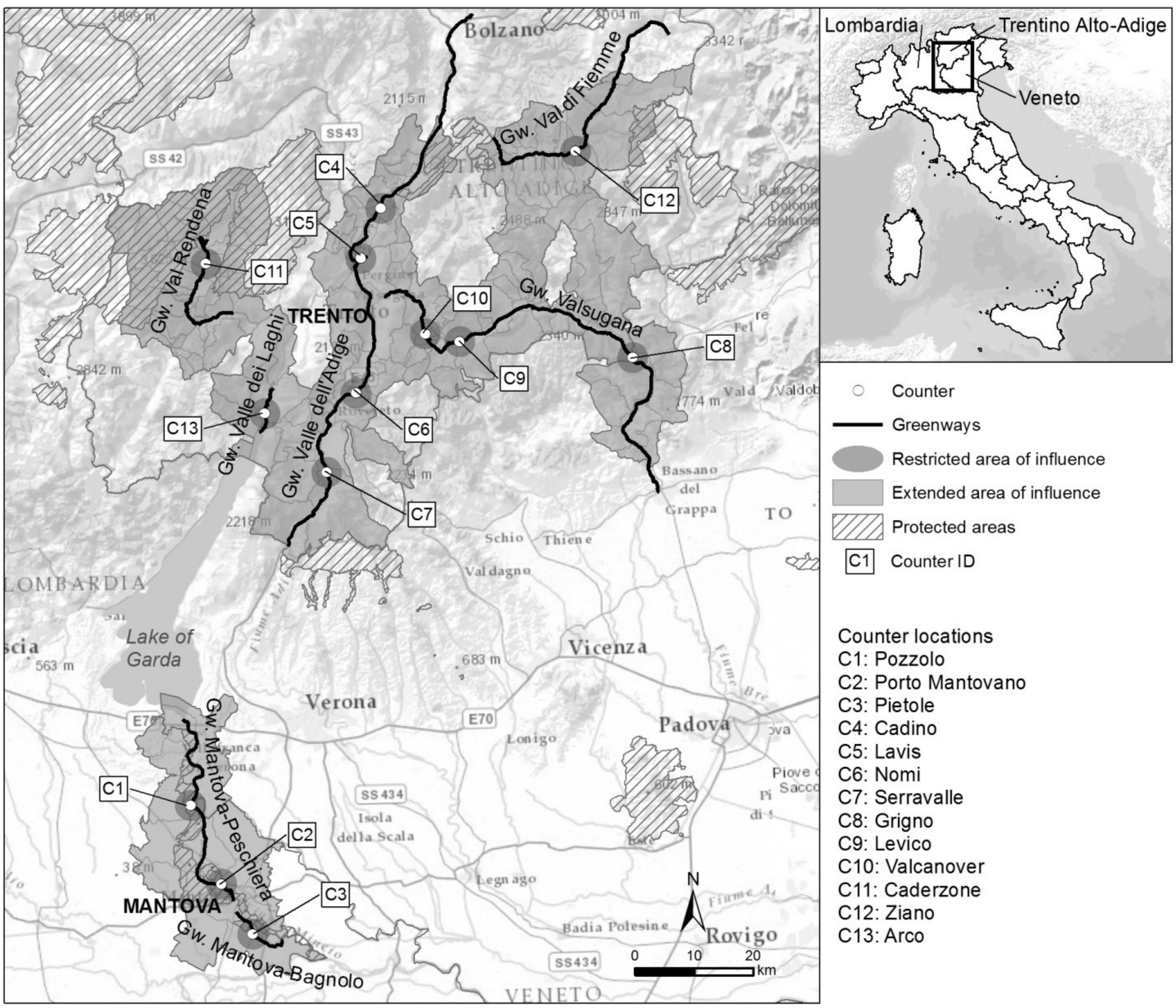

Fig. 1 – The study area and the location of the automatic counters

In general, most users can be seen from April to September, with a peak in the spring months for greenways in Lombardy (located in lowland areas) and in the summer for greenways in Trentino-Alto Adige (located in mountain valleys) (Fig. 2).

3.2 Measures of socio-demographic characteristics of potential users and geographical characteristics of the area

The data gathered from the automatic counters have been related with the main variables influencing the greenways use, based on the available literature. We divided them into four categories:

- socio-demographic characteristics of the potential users, both residents and tourists (population density, age, level of education and income, number of tourists);
- accessibility of the greenway (presence of roads and railways nearby, intersections between the greenway and the road network);
- geographical characteristics of the area (topography, land use, historical-cultural and natural resources, presence of other greenways);
- time and climatic variables (month, holidays per month).

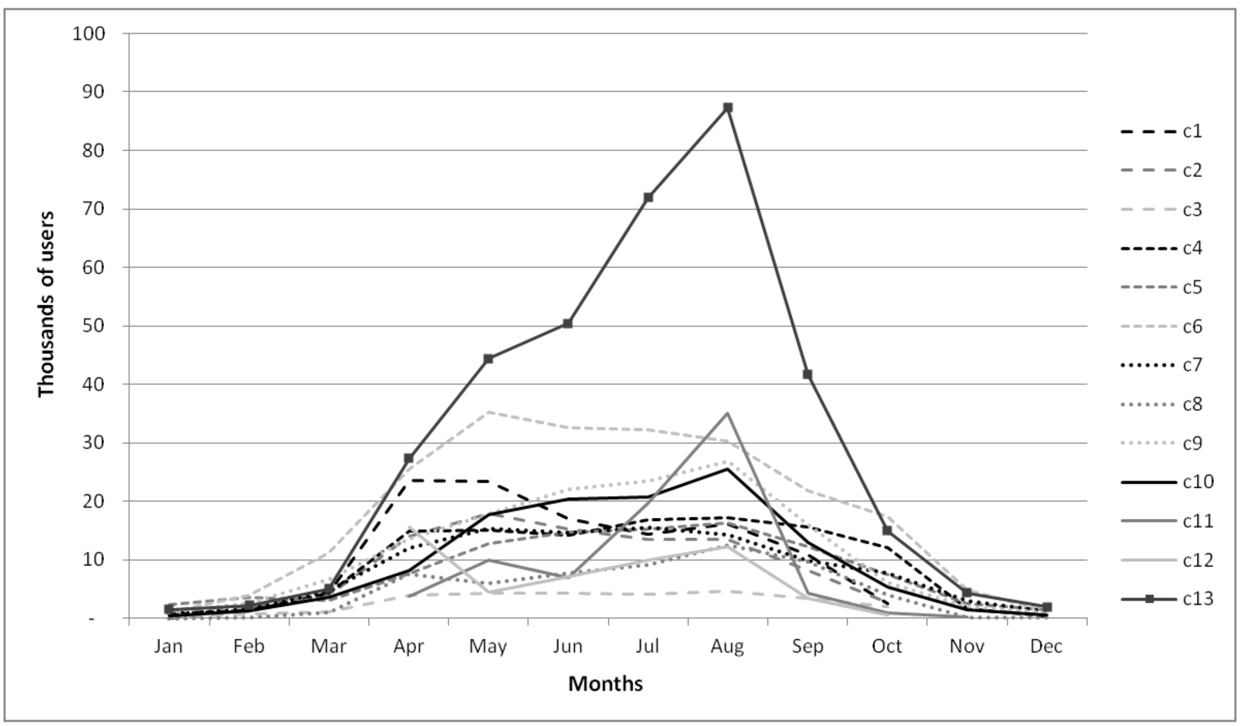

Fig. 2 – Number of monthly passages registered by the automatic counters

The variables were chosen with the dual aim of characterizing both the greenways themselves and the surroundings of the counters. To this end, two different areas of influence for each counter have been defined (Fig. 1) using a Geographical Information System (GIS), taking into account the level of detail of the data available for the calculation of the variables (Toccolini et al., 2004):

- a "restricted" area of influence, defined by a circular buffer of 2.5 km around the point of installation of the counter (Barnes et al., 2005);

- an "extended" area of influence, defined by the intersection of a 16 km circular buffer around the counter with a linear buffer of 6 km along the greenway.

Since the statistical data used for the calculation of some variables are only available at the municipal level, all the municipal territory has been included in the extended area of influence if:

- more than 50% of the municipal land area or all the residential area falls within the area of influence, and
- the municipal territory has a difference of less than 1,000 m respect to the counter elevation.

In Table 1 the variables considered in this study are summarized, with the indication of the area of influence to which they have been calculated and the expected effect on monthly users. Table 2 shows the most significant statistical values for each variable (mean, standard deviation, minimum and maximum value).

Variable names	Definition	Area of influence	Hypothetical effect
Dependent variable			
Users	The monthly traffic of each counter	-	
Socio-demographic variables			
Density	Population density (inhabitants per sq. km of land area)	Extended	Positive
%young	% of the population aged less than 15 years	Extended	Negative
%old	% of the population aged more than 64 years	Extended	Negative
Education	% of the population having an education level ISCED 3 or upper	Extended	Positive
Income	Per capita Gross Domestic Product (€)	Extended	Positive
Tourism	Annual number of overnight stays in tourist accommodations per sq. km of land area	Extended	Positive
Accessibility variables			
Road density	Length of roads per sq. km of land area (km)	Extended	Positive
Intersections	Number of intersections between greenways and roads	Restricted	Positive
Railways	Number of railway stations	Extended	Positive
Highways	Number of highways toll-booths	Extended	Positive
Landscape variables			
Parks_small	% of total land area covered by protected areas	Restricted	Positive
Parks_large	% of total land area covered by protected areas	Extended	Positive
Forests_small	% of total land area covered by woodlands	Restricted	Positive
Forests_large	% of total land area covered by woodlands	Extended	Positive
Lakes_small	% of total land area covered by lakes	Restricted	Positive
Lakes_large	% of total land area covered by lakes	Extended	Positive
Rivers_small	Length of rivers per sq. km of land area	Restricted	Positive
Rivers_large	Length of rivers per sq. km of land area	Extended	Positive
Urban_small	% of total land area covered by urbanized areas	Restricted	Positive
Urban_large	% of total land area covered by urbanized areas	Extended	Positive

Elements of interest	Number of elements of historical and cultural interest	Restricted	Positive
Orography	Standard deviation of elevations	Restricted	Negative
Cycle trails	Presence of other cycle trails in the study area (yes/no)	Extended	Negative
Temporal variables			
Holiday	% of holidays in the month	-	Positive

Tab. 1 – Description of the variables considered in the study

The variables used to describe the socio-demographic characteristics of potential users were calculated at the municipal level and include population density, age, level of education and income (census data from the National Institute of Statistics - ISTAT) and the number of overnight touristic stays (Provincial Tourist Offices). The expected effect is positive for all the variables, with the exception of the percentage of the population under 15 and over 64 years old, that, according to the literature, is expected to have a negative effect on the number of users.

Variables	Mean	Std. Dev.	Minimum	Maximum
Dependent variable				
Users	13,657	17,634	57	162,297
Socio-demographic variables				
Density	216.63	120.39	38.80	443.11
%young	14.39	1.34	11.20	16.24
%old	20.34	1.83	18.18	25.24
Education	32.50	3.83	25.17	38.66
Income	14,013	1,226	10,946	15,887
Tourism	3,239	3,752	216.24	12,306
Accessibility variables				
Road density	0.751	0.190	0.293	1.072
Intersections	1.486	0.381	0.880	2.072
Railways	3.887	3.689	0	11
Highways	1.181	1.086	0	3
Landscape variables				
Parks_small	15.46	18.77	0	65.45
Parks_large	17.99	11.53	3.57	59.53
Forests_small	33.42	21.31	0	69.39
Forests_large	43.23	22.11	0.59	65.27
Lakes_small	1.675	5.084	0	26.77
Lakes_large	1.640	2.101	0.082	6.183
Rivers_small	0.854	0.395	0.186	1.569
Rivers_large	0.541	0.185	0.315	0.924
Urban_small	11.79	6.049	3.941	21.21
Urban_large	6.665	3.649	1.647	14.85
Elements of interest	5.42	5.72	0	17
Orography	170.46	108.68	2.52	370.69
Cycle trails	0.365	0.482	0	1

Temporal variables				
Holiday	30.64	3.17	25.81	40.00

Tab. 2 – Most significant statistical values for the variables considered in the study

The variables used to describe the greenways accessibility are: the presence of tollbooths and railway stations, the road network density and its intersections with the greenways. These variables were calculated using GIS, starting from the cartographic data available on the National Geoportal of the Italian Ministry of Environment. The expected effect on the number of greenways users is positive for all the variables.

The variables used to describe the characteristics of the territory crossed by the greenways are: the presence (% of the area of influence) of protected areas and certain land uses (urban areas, forests, water bodies), the length of the rivers and the number of elements of historical and cultural interest (churches, museums, historic buildings, etc..). The topography was calculated as the standard deviation of the elevations in the restricted area of influence. The presence of other pedestrian and cycle paths was represented by a binary variable that takes the value 0 (no other paths) or 1 (presence of other paths). Almost all of the "landscape variables" were calculated using GIS, both for the extended and restricted area of influence, starting from cartographic data available on the National Geoportal and from the Italian Touring Club (TCI) data for the tourist attractions. The expected effect on the number of greenways users is positive, with the exception of the variables related to the topography and the presence of other greenways.

Finally, monthly dummy variables were included to check the effect of seasons and the percentage of non-working days for each month was calculated in order to take into account the effect of public holidays. We expect a positive effect on the number of users from all these last variables.

4. Results and discussion

Variables potentially influencing the traffic dynamics in Italian greenways have been statistically tested by mean of a regression analysis with the method of the Ordinary Least Squares (OLS). In selecting the final specification of the model we adopted the following strategy. In a first step we performed a correlation analysis in order to exclude correlated variables. In a second step we modeled a specification that considers the effect of all the categories of determinants and their specific proxies. Then we simplify it, putting emphasis on both theoretical consideration and the robustness of the different determinants.

The result is a model specification (Model I), we tested on the whole sample of 337 observations (all the 13 counters).

As previously highlighted, our greenways are located in two quite different geographical contests. In fact, 10 counters stay in the Alpine Region, while 3 counters have been positioned in the Po Valley, that is the main Italian flatland. For this reason, in a second step we tested the final specification only on a sub-sample of the 10 counters located in the mountain area (Model II).

In a last step (Model III), we excluded from the Model II the observations belonging to counter C13. In fact this counter seems to distinguish itself as an outlier, because of its location in the middle a famous touristic town and the subsequent number of users that is significantly higher than others (Fig. 2).

Following Lindsey et al. (2007) the dependent variable is converted in a logarithmic form in order to normalize the distribution, respecting OLS assumptions.
Given a log-linear form of the model:

$$Ln\ U = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n \quad (1)$$

where U is the monthly number of greenways users,

the expected value of U can be predicted as:

$$E(U|x_1, x_2 \dots) = \hat{U} = e^{\hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \cdots + \hat{\beta}_n x_n} \quad (2)$$

from which the estimated marginal effect $\frac{d\hat{U}}{dx_n}$ of the variable x_n on U, that has to be read as a percent increase of the users consequential to one unit increase of x_n (all other factors held constant), is expressed by the formula:

$$\frac{d\hat{U}}{dx_n} = \left(e^{\hat{\beta}_n} - 1\right) \times 100 \quad (3)$$

Table 3 displays the regression results of the three models, in which we controlled for month fixed effects with the use of specific dummies. For each model, we report the estimated coefficients, and their respective p-value. For comparability and symmetry, we chose to include in the final specification the same set of variables for all the three models. The criterion adopted for the final specification is to include a variable only if it results to be significantly different from zero in at least one model (p-value < 0.1).

All the three models have a significant χ^2, meaning that all the regressors are jointly significantly different from zero, thus the set of our explanatory variables plays a role in estimating greenways monthly potential users.

	Model I		**Model II**		**Model III**	
	Coefficient	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**
Temporal variables						
January	-0.2828791	0.267	-0.2701101	0.305	-0.1745205	0.517
February	0.5621449	0.018	0.4779576	0.063	0.6710171	0.010
March	1.559288	0.000	1.526959	0.000	1742953	0.000
April	2.750626	0.000	2.692144	0.000	2.718508	0.000
May	2.99123	0.000	2.971842	0.000	2965159	0.000
June	3.056132	0.000	3.08846	0.000	3.0727	0.000
July	3.180259	0.000	3.289552	0.000	3.263584	0.000
August	3.356938	0.000	3.50448	0.000	3.488594	0.000
September	2.756585	0.000	2.845388	0.000	2.847208	0.000
October	1.918765	0.000	1.99794	0.000	2145008	0.000

November	0.7455168	0.001	0.7504362	0.001	0.7592061	0.002
Socio-demographic variables						
Population density	-0.0154728	0.000	-0.0230691	0.002	-0.0214335	0.003
%young	-0.7045987	0.000	-2.528816	0.002	-1.960272	0.010
%old	-0.5348318	0.000	-1.694303	0.017	-1.601141	0.022
Education	0.2873542	0.000	0.2828231	0.000	0.2443862	0.000
Tourism	0.0000501	0.013	0.0000139	0.728	-0.0001317	0.027
Accessibility variables						
Road density	4.3832	0.000	4.95718	0.057	5.768171	0.060
Landscape variables						
Orography	-0.0030615	0.000	-0.0068234	0.000	-0.0052962	0.002
Elements of interest	0.0380183	0.003	0.0471008	0.004	0.0314481	0.182
Intercept	18.77017	0.001	70.6318	0.005	605573	0.011
Nr. of observations	337		263		219	
Adjusted R-squared	0.80		0.81		0.82	
F-statistic	71.9		58.1		64.3	

Tab. 3 - Regression results of the three models used

Particularly, Model I, that has been tested on the whole sample, accounts for about 80% of the variation in monthly use of the considered greenways; this is an outcome in line with Lindsey et al. (2007) results. The restriction of the analysis to the sub-samples increases the adjusted R-squared, but to a slightly extent. In fact, in Model II the overall explanatory power reaches 81%, while in Model III it raises 82%.

Going in-depth to the different categories of determinants, almost all proxies related to socio-demographic characteristics of potential users appears to be strongly significant. Indeed, only the income does not present any effect in all the three explained models, while the others are generally significant at the 1 or 5 percent level.

In line with the *a-priori* expectations the percentages of younger and older people are negatively and significantly correlated to the fruition of greenways, as well the tourism intensity and the level of education show a positive effect. Contrary both to Lindsey et al. (2007) and our expectations, population density coefficient takes a negative value. This is probably due to a different influence of the population density on urban (Lindsey et al., 2007) and rural greenways (the present study). Making reference to the Model I, the marginal effect magnitude of demographic variables is very high, as well as the education's one (+33.3%). An increase of the tourism intensity, equal to its standard deviation, should cause an users growth of 20.7%. Notably, the absolute value of socio-demographic variables coefficients, as well the population density one, increases in model II and III, whereas tourism either is not significant (model II) or turns to be slightly negative (model III).

Accessibility plays an important role in all the three presented models, but only if we refer to the road density proxy, calculated on the extended area of influence. Instead, the other proxies, such as intersections, railways and highways, either do not capture the effect or are not important.
With regards to the landscape variables we find a negative correlation with the orography and a positive correlation with the presence of elements of historical and cultural interest. An increase

of the orography variable, equal to its standard deviation, lead to a 28.3% decrease of the potential users. The marginal effect of an additional element of interest is 3.9%.
In our analysis we have not found any effect of the others landscape and natural characteristics, but we are conscious of the difficulties to model landscape attractiveness with quantitative proxies such as lakes, rivers and forests. Probably, further research is needed to investigate this issue. Also the cycle trails variable does not show any significant effect.

Finally, the holidays variable has not been included in the model, because its effect is largely absorbed by the month fixed effects.

5. Conclusions

The present study has confirmed, also in the Italian context examined, a significant correlation between a great part of the variables chosen and the greenways use:

- socio-demographic variables, all the proxies appears to be strongly significant, except for income;
- accessibility variables, only if we refer to the road density proxy;
- landscape variables, only for orography and presence of elements of historical and cultural interest.

Compared to the literature, it is possible to make two kinds of considerations:

- there are some variables that are in contrast with the literature (income is usually considered an important variable, population density is usually positively related to the number of users);
- there is a general difficulty to define and calculate the proxies for some variables.

This kind of problems could be caused by calculation procedure or by the lack (availability and quality) of data; or could be related to a typical Italian situation. Further research should be carried out in order to better understand these causes.
The present study has several limitations, some of them typical of the Italian situation:

- limited availability of data on the number of greenways users;
- inadequate time scale of data (a lot of data are available only on annual basis or may even be considered as constant);
- inadequate spatial scale of data (a lot of data are available only at municipal level);
- the method used to define and calculate the areas of influence (the “extended” area of influence seems to be of little significance).

Further research should be carried out in order to validate the results of the present study on other Italian greenways with other data. A very first validation performed on the same dataset shows for each counter an average deviation of the estimated annual users from the measured of 23% in Model I and 18.4% in the Model III (counters with less passages show an higher deviation).

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Perceptions and Implementations of Urban Green Infrastructures in France: Three cases of studies (Paris, Marseille, Strasbourg)

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Introduction

Green infrastructures have gradually become imperative in planning since the end of 1990s in Europe (Jongman *et al*, 2004). Numerous urban areas in France mobilize and reinterpret the notion according to stakes of their territory (Blanc, 2012). With the promulgation of Grenelle 1 and 2 Laws (in 2009 and 2010), today every local authorities have to integrate an ecological reflection on green infrastructures into its planning projects at metropolitan and local scales, called "trame verte". To cover a plurality of contexts of cultural, social, geographical and eco-systematic levels, three cities were retained to understand how this reflection is set up: the municipalities of Paris, Marseille, and Strasbourg. Indeed, in Ile-de-France, a number of initiatives reflect the interest of the regional, departmental and municipal authorities for green infrastructures and biodiversity issues: the Seine St-Denis departmental observatory of biodiversity and natural habitats (City hall of Paris, on 2004), the creation of the regional agency Natureparif (2006), the regional strategy for biodiversity (2007), the Paris biodiversity plan (2011). Furthermore, the city of Marseille, influenced by the example of Barcelona metropolitan area and its anellaverda (green ring), plans the development of a green infrastructure on its municipal territory. It confided the study to the Planning Agency of Marseille Urban area (AGAM) which elaborates scenarios for connecting the residual non-constructed spaces, to endow the city of a green infrastructure addressing the environmental issues of sustainable development. Finally, the region Alsace was one of the first regions to integrate a reflection into these environmental policies on green infrastructure in France (in the late 1990s). The Strasbourg local planning in 1992 and the metropolitan plan in 2007 (SCOTER) mention the term "greenway" in their statutory documents. Currently, as part of the development of the urban local plan (PLU), Strasbourg urban community defines a network of greenways in an ecological perspective.

Through the consideration of vegetable continuities in town, the notion of green infrastructures brings a revival in the current urban thinking. If scientists in ecological sciences were interested since a few years in this question to fight against biodiversity erosion, green infrastructures appear as a new field of investigation for human sciences. Multifunctionality associated with this notion of meshing offers new challenges as for practices and perceptions of inhabitants. How decision making can take into account and translate their expectations regarding scientific models proposed and political issues? Its diverse dimensions introduce inevitably new modalities of the public debate organization which remain to invent in most cases today. We have compared in each of the studied sites the three following spheres, often distinct from one another: political, scientific and inhabitants.

I/ SIMILARITIES AND HETEROGENEITY OF GREEN INFRASTRUCTURE POLICIES

Strong common characteristics

In view of the analysis of these three municipalities, the first observation that can be made is the absence of zoning statutory integration of green infrastructure in the urban local plan (PLU). Indeed, none of the three PLU reserve in their rules and graphic document refer to a consideration of an ecological network. However, these documents are old, and the three PLUs are under review. Laws Grenelle 1 and 2 bring a new dimension in the development of these documents by requiring municipalities to "take into account" ecological continuity in their regulation.

The orientation of the three new local development plans reflects this evolution. Zoning documents have not yet been made, but cartographic definition of green infrastructure is underway in the three municipalities, mainly using method based on photo-interpretation. It is undertaken by a design office of landscape/environment/ecology for Marseille, and by municipality's services for Strasbourg and Paris. To integrate statutorily green continuities in local urban planning documents, the legislator may act on different devices that could interest both to public and private spaces. However, regarding planning documents of the three cities, spaces included in this definition are almost essentially public: roadside trees, parks and gardens, the edges of banks ... to act statutorily on ecological continuity issues requires a political courage which local councilors in France are quite reluctant to show. However, there is a true will from the municipality of Paris to act on private space from a regulatory point of view by defining the notion of « protected green space » for « durable private green space […] aiming at improving the global quality of those spaces and their plantations » (PADD PLU, Paris).

Finally, reading the various scenarios, we understand the difficult existence and prospects of the idea of continuity in the city, intrinsically linked to the concept of green infrastructure. If it appears cartographically, it's because of a particular geographic location. The green continuity requires support, and so is therefore strongly imbricated to with the road or watershed networks. In town, building densification allows the creation of a green physical continuity only on spaces along streets or rivers. So As a result, we could observe a strong correlation of green and blue frames as evidence, particularly in the example of Strasbourg. However, reading the various documents, we can observe a general trend that aims to overcome the generic term “trame verte et bleue”, which is now strongly linked to a planning disposition because of Grenelle’s laws.

Using a distinct vocabulary to express the idea of green continuity, "ecological networks" for Strasbourg, "ecological corridor" for Paris, allows greater interpretation latitude for planner, particularly in resources mobilized and areas concerned. Thus, it is associated with the definition of “trame verte” in a regulatory perspective, the desire to integrate different forms of ecological management for more spaces (Cemetery / sports field) that does not seem to be covered by Grenelle laws. This linguistic demarcation, that may seem insignificant, reflects planner’s unease in front of the regulatory aspect of “trame verte”. Thus, in view of the various interviews we have carried out in these three cities, this regulatory dimension appears too restrictive for two essential points. It raised the relevance of such a device on the real effect on the biodiversity increasing; regulation does not intend to act on management of the areas concerned. Futhermore, the range of regulatory tools for green spaces in planning law, relatively small, do not seem suited to urban logics (Camproux-Duffrène and Lucas, 2012).

Moreover, even if green infrastructure policy in France today, as intended by Grenelle laws, aims to act mainly on biodiversity, various actions on the three cities highlight a social dimension that cannot be ousted in favor of a single ecological vision. Green infrastructure social functions are strongly associated with ecological functions, and in some cases are the main arguments of planners especially in order to convince elected officials. Indeed, considering the economic and the quality of life issues, preservation of biodiversity does hardly make sense for them. Planners in charge of green infrastructure in the three municipalities unanimously raise the necessary scientific caution that should bring researchers in an ecological definition. Waiting for clear criteria to recognize the ecological character of a space, they want to have a flawless argument in order to pressure on local officials.

The importance of local context

If there are similarities between these cities, there are also differences. The greatest disparity relates to the progress thought on green infrastructures between three cities. While Marseille is currently committed in this green infrastructure definition, Strasbourg approached it since 1992 in its planning documents and Paris especially from 2011 through its biodiversity plan sets a broad plan of action for biodiversity. The concept of “trame verte” takes different meanings in those three cases, depending on areas identified, objectives and regulatory means mobilized.

Green infrastructure concept in Marseille is a new idea for the public decision maker. Only a few planning documents refers to it explicitly, and they are recent. However, the city reflection on this topic has been engaged for 7 years. Various documents and testimonies agree to draw a green infrastructure in a peripheral position of the dense city. It identifies forests and creeks recognized by various levels of protection: Natura 2000 ZNIEFF 1 and 2... While metropolitan political discourse oriented green infrastructure policy serving biodiversity, its statement in the text is not so obvious. Indeed, stated objectives seem more akin to orders under tourist, recreational and urban than ecological, ensuring "the attractiveness of the conurbation." Along with this metropolitan policy definition, the municipality of Marseille is currently reviewing its urban local planning. Although planning document convenes ecological and sociological arguments, working papers are primarily focused on the quality of life by organizing "network of all urban nature parks, gardens, neighborhood gardens, trails, quality urban". Local elected officials seem reluctant to develop a green infrastructure politics (chargé de mission of the city, Consales et al. 2012), a phenomenon observed in many cities in France (Cormier, 2011). However, the green space and planning department of municipality statutorily registered in a frame a minima in urban local plan. It will set aside areas for a potential political will in the future. The frame is then defined as a patch primarily based on areas not carrying conflicting issues, public green spaces. There is not a linear and continuous infrastructure; strictly speaking, it is more a succession of patch based on non-conflicting issues spaces: mainly public green spaces. Consales and colleagues (2012) denounce the weakness of political commitment on these ecological issues in front of "a powerful densification process which tends to be superimposed on a vast network of green natural spaces potentially be mobilized in a project of green infrastructure". This lack of political commitment tends to favor the loss of semi-natural areas, particularly vulnerable when they are not protected by an environmental legislation.

In Strasbourg, green infrastructure concept has reached a political maturity. The first document to be referenced is local urban plan of 1992, essentially declined in anthropocentric paradigm, where vegetated area allows the city to heal its urbanity. Consideration of the idea of continuity is already in the planning early 1990s and is strongly associated with the hydrological context. But it was not until early 2000 that environmental issues were considered in planning documents. This concern is greatly influenced by pressures of environmental groups and regional policy. Indeed, Alsace is one of the first states to become interested in green infrastructure characterization in order to halt the loss of biodiversity. In 2007, the metropolitan plan devotes its second and third chapters to natural areas preservation of by stating the objective of keeping "natural areas to ensure global ecological balance". Despite this ambitious goal, the concept of green infrastructure is unclear. The green infrastructure term is associated with the preservation of exceptional areas (natural spaces, linear streams, varied landscapes) but is never actually defined. Today, the metropolitan level is in the implementation phase of a document defining the spaces belonging to the ecological network. It is a preliminary step for the identification of green infrastructure in the urban local plan. The use of ecological network term is not a chance, it responds to a desire to adopt an environmental policy wider than a “trame verte” policy.

The consideration of green continuities has a past in the French capital. Since city planning works undertaken by Haussmann and Alphan late 19th (Arrif et al., 2011; Carcaud Cormier, 2010) to the Biodiversity plan of 2011, we can observe a large change in its consideration. The first mention of green infrastructure term at the local level is supported by a study, in 2003, for its integration into urban local plan. This document defines it as "all green spaces constituting parks, squares, public gardens and promenades of the city." the green infrastructure concerns, therefore, all green spaces and tree lines. In an anthropocentric paradigm, Paris green infrastructure has to assume objectives which are essentially social, aesthetic, and improvment of the quality of life. Paris urban local plan (2006) fits well in this thought, relying on key spaces: green spaces, woods, Seine, canals, cemeteries. However, it adds another dimension by integrating a specific regulation on private spaces for green infrastructure. This device translates a political will to have control over private spaces, through regulatory tool, to sustain green spaces. We must await the adoption of the Biodiversity plan (November 2011) by Paris Council for a real display of the city ecological policy. The Parisian green infrastructure is clearly defined through linear forms and punctual forms. The elements taken into account, more varied and at different scales compared to the local urban plan, show a biocentric vision of the green infrastructure. Semantics mobilized in the text essentially belong to ecological vocabulary. Various concrete measures are proposed to achieve this goal: both regulatory (eg. Stopping the use of synthetic herbicides and pesticides in all green spaces, including private spaces), creation or restoration of spaces (eg. creation of 40 ponds or wetlands to 2020), knowledge and awareness (eg. creation of a biodiversity observatory).

II/ THREE CITIES, THREE IMAGINARY PEOPLE

In all three cities, twenty-four "focus groups" composed of six to nine people were gathered around two to three researchers. The focus group method does not bring out the diversity of representations but the significant number of the participating citizens (total 160), the sampling technique, and some redundancies in the comments encourage us to think that despite the lack of representativeness, we are facing a satisfactory significance of the remarks.

Two methods have been developed to study the speech of the inhabitants. The first seeks to quantify the words with the Alceste software. It distinguishes classes by frequencies and degrees of meaning of word association by calculations of statistical indices such as Chi2. The Chi-square index identifies words significantly associated with a class of speech. The second method is to identify ideas and themes specific to the greenway. These two analysis have described the practices and representations specific to the three urban areas.

Different discourses in relation to greenways

Throughout the text focus group the classification descendant of Alceste has determined that each city develops has different discourses (Table 1). Lexicometric analysis shows that Parisians are concerned about wildlife. They first speak of unwanted animals strongly related to humans (dove, rats). They want managers to limit their spatial progress because they see wildlife as potential pests. Then they talk about desirable animals like squirrel, fish, and rabbits. They would like green infrastructure to increase their number. Parisians don’t see what these corridors or developments could look like in a dense city. And a Parisian says that " I imagine urban green infrastructures means mesh, maybe something that would link city to countryside, but it is true, I cannot visualize it. I don’t know what form it might take in a big city like Paris."

Table 1: Classification proposed by the Alceste software with the most used words (Σ) and significant (ΣCHI ²) showing the importance of the city.

Class 1			Class 2			Class 3		
Word / descriptor(*)	∑	∑CHI²	Word / descriptor(*)	∑	∑CHI²	Word / descriptor(*)	∑	∑CHI²
Paris (*)	376	517	Marseille (*)	521	456	Species	116	402
Dove	88	402	Dustbin	248	325	Animal	112	288
Rat	80	240	Pick up	46	163	Vegetable	52	280
Squirrel	40	225	Dog	80	147	Corridor	56	143
Fish	30	131	Shit	20	68	Strasbourg (*)	183	85

In Marseille, the stakes are different and the environment first evokes problems of public health. Greenspace focus on issues related to the treatment of waste (garbage collection, excrement) and dogs on leash. For inhabitants of Marseilles environmental projects are not yet a priority. We must first address incivility problems. The urban green infrastructures refer primarily to the tramway built. Then, it is a potential link between surrounding hills and city center.

In Strasbourg, vocabulary used is similar to ecologists and environmentalists discourses. People are familiar with concepts attached to urban green infrastructure (corridor, biodiversity). Environmental groups in Strasbourg explicitly mention (sometimes spontaneously and at the beginning of interviews) greenway expression. For non-environmentalists, though the term itself is not quoted, the description of places of naturalness clearly shows this strong idea of continuity for plants and animals movement. However, it is when urban people practice green infrastructure daily that it is best known, and rather for "human" uses. In addition, nature is a necessity and will recharge a major goal of urban life as evidenced by these words: "I saw nature in two ways: firstly, in terms of observation, watch this space there, and on the other hand, try to integrate more. First, for reasons of health "and to" observe nature, contemplate, managing to join in this observation the whole society, it creates an urban fabric. The city back to life." For Strasbourg, urbanization is not incompatible with preservation of nature. They are willing to change their mode transport and to review the design of their city.

These large differences induce visions of urban green infrastructures, very different attitudes and behaviors from one city to another.

Urban practices are also different

Elements of a urban green infrastructure are more known in Strasbourg than in other cities because urban people use them daily. Continuities are apparent, perceived and described. Strasbourg inhabitants observe and contemplate nature by walking, cycling.

In Paris and Marseille on the contrary, nature elements are rather related to stationary practices in parks. In Paris, parks and gardens are always mentioned. In both cities, people come to sit, read, relax, listen to music, play and their children often run into these parks and gardens. That's why continuity is much less easy to perceive or project.

Marseille is a singular cases, unlike any other cities with presence of wilderness (Calanques for exemple) close to dense city. On the one hand, parks (Borely, Longchamp) that form the urban nature which found many problems civility. On the other hand the creeks are areas perceived as more authentic but different from the city with other laws. The creeks are compared to haven of peace or areas of escape. For some Marseilles urban inhabitants, the center is the opposite of a natural area. A woman "prefers to go by the sea in the wild creeks, (...), there are no buildings, it's natural, it's wild." Another resident is in creeks because she has the "feeling of choking, I'm choking in my neighborhood, I cannot breathe ... I really need" to recharge "in quotation marks, to have an environment that soothes me, either by sight, the sun is on the horizon, the sea, I need to hear these animals, these wasps, to see these little gnats to see these flowers ... ".

Eventually, because of structure of the city, and building lines made by canals and bike lanes, the inhabitants of Strasbourg associate nature with their mobility. Whereas Parisians and the inhabitants of Marseilles go to a park and don’t move of it. They come to these spaces to have a rest and enjoy the quiet. Natural spaces make a break with urban frenzy. Parks and gardens are the opposite of stress, noise and agitation of urban people or traffic.

For all nature is a purveyor of well-being in which the senses have an important role. Despite of the fact that, for some, nature has something synthetic and does not seem quite "real" in town.

III / POSITIONING OF SCIENTIFIC ACTORS IN TERMS OF GREENWAYS

We examined the implications of planners, elected officials and citizens in the construction of green infrastructures in Strasbourg, Paris and Marseille. However, it is important to highlight the importance of the position of scientists in the public debate. Public procurement needs expertise to guide its approach, mainly in the green infrastructure definition. Researchers participate actively in these projects. Thanks to scientific expertise, municipalities acquire academic skills and political justifications. We focused on the position the research teams involved in the ANR in the three cities. In general, we can observe a strong involvement of researchers with municipalities.

In Strasbourg, local scientists have clearly contributed to support green infrastructure thoughts, which was already underway at metropolitan or municipality level. Metropolitan level has called on scientists (of ecological and human sciences) to discuss their project. Numerous collaborations materialize mainly through internships by students of Strasbourg University in the CUS, the setting up of working group university / metropolitan around environmental issues (biodiversity, urban nature and peri-urban agriculture, urban water and floods).

In Paris, researchers were very busy in projects development, including the "Biodiversity Plan" of Paris. Numerous workshops organized by municipality had created constructive confrontations on the various elements between researchers and council services. It is at these meetings that the feasibility of a green infrastructure has been proposed and well advanced in final report "Biodiversity Plan de Paris - Nature in city - 30 actions." Even though diagnosis and proposals are then assigned to only one design office (which surprises researchers involved in the original project but thus excluded from the operational thinking), the ambition is very strong and subsequently causes the emergence of a real project.

In Marseille, the scientist's role was crucial. Researchers have highlighted policies inconsistencies and governance issues. They were also privileged interlocutors on urban development projects underway. Thus, in the urban local plan of Marseille, through collaboration and committed geographers among planning services, ecological continuity was included in regulatory documents to preserve it from the urban pressure. An approach was initiated in sociology through artistic mediation with locals. Indeed, a dialogue with an artistic association allowed to understand the city of Marseille and its nature spaces from a different angle.

Depending on situations, scientists are either asked to give infrastructure key definition or as to legitimize steps already initiated. Indispensable actors in the knowledge share, their positions may still be ambiguous in the public debate. Indeed, in general, the expertise is sought to clarify the difficulties inherent in the decision process for a policy. Local elected then turn to a person or institution providing the necessary knowledge to take decisions. Several difficulties arise when experts are then involved in the decision process.

The first is inherent to scientific knowledge and discipline that are related to a specific methodology. For example, corridor width in the city is a recurrent issue asked by planners to scientists. But ecologists couldn't give a clear answer. They will provide orders of magnitude for each specie. They provide factors which are detached from the political field. In principle, the scientist gives results that are intended to be reproducible and universal, while local elected reason with local issues and a specific temporality. These questions lead to in many cases difficulties between scientific sphere and political sphere.

The second difficulty emerges around the green infrastructure concept. Grenelle laws, to define this notion, relied on concepts from landscape ecology science. Thus the green infrastructure plan develops a vision of space linked to a scientific construction. This view of green infrastructure develops relationships between planning and landscape ecology. Ecologist becomes the privileged actors for politic sphere to grasp the concept. But scientist is gradually assuming an arbitrator position that exceeds his powers which are strictly scientific. This arbitrage position is not the scientist competence, but of the representative of citizens.

The last difficulty that can be raised concerns directly the researcher profession. In order to do research, one needs a distance between the studied object and the researcher. The scientist must question if the distance necessary to analyze a phenomena is sufficient in order to keep the greatest integrity. Indeed, expertise could sometimes be dangerous in search results.

CONCLUSION

Thus, these three contexts allow us to evaluate consideration of green infrastructure concept in different spheres of actors system.

Firstly, some logic emerges from the objectives assumed by a green infrastructure policy. We observe a shift of its declination in metropolitan level planning: if greenways were first considered in their social and recreational functions, they are now more mobilized for their ecological functions. But local officials are suspicious of media coverage and the regulatory nature of “trame verte” concept. This reluctance has a semantic consequence in local politics by using many other terms for their green politics. Thus the semantic avoidance offers more freedom of interpretation. “Trame verte” is now associated almost exclusively with regulatory fields. This legislation inhibits any latitude of interpretation which however could contribute to promote biodiversity in city.

These three cases illustrate the diversity of “trame verte” policies that can be carried out in France in their progress, theirs objectives, spaces concerned, and enforced measures. The heterogeneity of these politics is closely related to both geographical and socio-economic conditions of each site. From these three contexts, several factors may be involved in the awareness of elected officials. They are influenced by the local culture versus nature in the city, the system of actors and especially the charisma of the project leader of the green infrastructure policy.

For the implementation of green infrastructure, planners have to understand perceptions inhabitant on a lengthy time at scale of official planning calendar (10 years). Thus, Strasbourg are most sensitive to green infrastructures because of their access to physical continuities. It is important to ensure opening of green infrastructures. If planners close to public spaces reserved for green infrastructure, rejection risk of inhabitants is strengthened. It is necessary to ensure and enroll in green infrastructures in mobile practices (cycling, walking) and static practices (reading, contemplation) of inhabitants.

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Connecting the "Big Easy": Lessons from the people surrounding the Lafitte Greenway in New Orleans, Louisiana

Philip Koske

Introduction

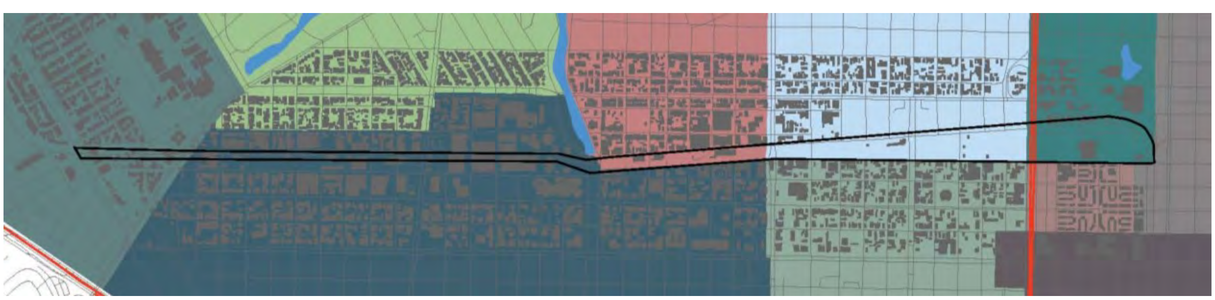
The 3.1-mile (4.99-kilometer) linear Lafitte Greenway, one of the first revitalization projects since Hurricane Katrina (2005), is designed to become a vibrant bicycle and pedestrian transportation corridor linking users to the world-famous French Quarter and central business district. As an emerging city, New Orleans generally developed sections of swamp land starting near the French Quarter and growing outward in most directions. The resulting transect of neighborhoods with access to the Lafitte Greenway begins with areas associated with early development, such as Fauborg Tremé and Bayou St. John, to 20th Century development found within the Navarre and Mid City Neighborhoods. In all, the Greenway directly impacts nine distinct neighborhoods with several documented sub-districts, including the Tremé neighborhood which has the distinction of being the first freed black neighborhood in America, a hot spot in the southern civil rights movement, and the starting point of a great jazz tradition.

A multi-disciplinary team of landscape architects, civil engineers, ecologists, economists, crime prevention experts, park management consultants, and public engagement specialists incorporated public input, synthesized measurable objectives, and worked across a range of scales to plan and design one of the most important planned public spaces since the hurricane. The project began in spring 2009 and is scheduled to begin the first phase of construction in the fall of 2013.

Background

The 54-acre (21.9-hectare) *Lafitte Greenway* (hereafter Greenway) includes what was once the Carondelet Canal (in existence between the 1790s and the 1930s) and a major railroad right-of-way, which was highly active in the 1850s and1950s but with only limited portions active today. The Carondelet Canal, connecting colonial New Orleans to Bayou St. John and then to Lake Pontchartrain, was one route through which commercial goods from the northern states entered the city, first on shallow-draft boats until the 1840s when rail service was introduced.

The *Lafitte Corridor* (hereafter Corridor) is a 1,375-acre (556-hectare) district that includes the Lafitte Greenway and a rich mix of residential, retail and industrial uses. The Corridor contains 13,583 residents and includes the canal site and rail rights-of-way as well as adjacent neighborhoods within 0.25 miles (0.4 kilometers) of the Greenway (Figure 1).



This diagram shows the ten neighborhoods that cross or are adjacent to the Corridor. Eight of these neighborhoods cross the Greenway.

This district contains a distinct split of education levels, socio-economic conditions and racial compositions, creating a challenging context for community engagement. Census data indicates that Broad Street forms a dividing line in general characteristics. The income east of the Broad Street (Tremé, Lafitte, etc.) generally top at $30,000 ($186,354 RMB) in earnings per household with a home ownership rate of 25 percent, while areas west of the bayou (Mid City, Bayou St John) register an average income starting at $30,000 ($186,354 RMB) and home ownership approaching 50 percent in most areas. Community members from the respective neighborhoods had differing ideas about the future role of the Greenway despite close proximity and the post-Katrina surge in civic cohesion. In addition, there existed a palpable sense of mistrust between different portions of the community.

This paper describes how the design process and proposed design interventions as developed by Design Workshop (DW) for the Lafitte Project (Project) were shaped by the public process and community engagement, which includes design strategies for the Greenway and an economic revitalization plan for the Corridor. The design approach deploys research methods that seek to accomplish three objectives:

1) To measure the baseline site and community conditions,
2) To establish benchmarks with which the proposed design can be measured against comparable projects and established standards, and
3) To broadly and deeply engage the public in shaping the program for the greenway and the design of the open space.

Literature Review

The design team drew upon a broad range of writings, research, and previous experience to inform the design process and research methodologies. These resources can generally be categorized into groups including design related, recreation related, public engagement related, previous study review, and culture related. Examples related to physical design include authors such as Patrick Geddes (Geddes, 'Cities in Evolution'), Ian McHarg (McHarg, 'Design with Nature'), Ann Spirn (Spirn, 'The Granite Garden'), Michael Hough (Hough, 'Cities and Nature Process'), Danilo Palazzo and Frederick Steiner (Palazzo and Steiner, 'Urban Ecological Design'), and others who have sought to define an ecological approach to urban design and planning. Resources related to public engagement included Randy Hester's Ecological Democracy, Daniel Kemmis Community and the Politics of Place, Daniel Yankelovich's Coming to Public Judgment as well as writings by Clare Cooper Marcus and Walter Hood. The team carefully considered research published by the National Recreation and Park Association (NRPA) and *Time Saver Standards for Landscape Architects* as guides for recreation and program-related topics. Culture-related examples included *An Unnatural Metropolis: Wresting New Orleans from Nature* by Craig E. Colten and the PBS documentary *Faubourg Tremé The Untold Story of Black New Orleans,* 2009. Both the Greenway and Corridor have been the focus of many previous research and planning efforts. These include "The Lafitte Greenway: A Master Plan for the Lafitte Corridor," Brown+Danos Land Design (2007), "Lafitte Greenway: Sustainable Water Design," Waggonner+Ball Architects (2010), and "Plan for the 21st Century: New Orleans 2030," City of New Orleans (2010).

Over 100 metrics-based rating and certification systems have been created world-wide for design projects, including LEED, SITES, and the Greenroads© program. Only a few require participation by stakeholders. Though the effectiveness of these engagement efforts is not currently analyzed, their requirement is a step in the right direction for both public and private-led teams working toward sustainable solutions. The documentation of landscape architecture research and evidence-based design is accelerating in the United States, in large measure due to the Case Studies Initiative of the Landscape Architecture Foundation (LAF). The organization's landscape performance series matches private firms with university programs in landscape architecture to critically evaluate the performance of built landscapes against measurable objectives. This experience in assessing the performance of new community and streetscape projects informed the methodologies for the Greenway and Corridor. It is anticipated that the project (including specific strategies for both the Greenway and the Corridor) will be a future subject of the LAF Case Study Initiative.

Goals and Objectives

The overall goal for public outreach related to the Lafitte Greenway was to attract a broad cross section of involvement within a largely fragmented series of neighborhoods. Given the range of social, cultural, financial, and educational conditions found within the study area, it was a multi-layered challenge. The complexities of the task required tremendous preparation, respect for those participating, and trust-building transparency. Objectives of the public participation plan included:

- Allowing the public to shape the design,
- Utilizing the creative nature of New Orleans,
- Connecting communities,
- Allowing the public to prioritize proposed improvements,
- Utilizing the public's knowledge of the area to verify existing conditions,
- Engaging the public in interesting and creative ways,
- Making the public feel comfortable about participation, and
- Confirming conclusions generated by the team.

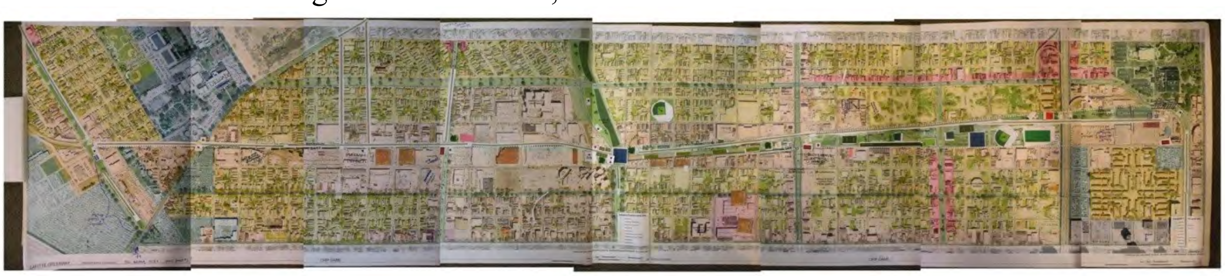
Methods

The community engagement approach was comprehensive and inclusive of all segments of the New Orleans community, with specific focus on those neighborhoods and organizations within the Corridor. The consultant team organized and led eight public presentations, held over 75 stakeholder meetings, posted on-line surveys and directly engaged approximately 1,000 people in the process. In a community continually plagued by unrealized planning projects and unproductive public processes, the approach needed to be a balance of comprehensive data-collection and efficiency.

In addition to the logistical aspects of public engagement, the team emphasized utilizing tools that accommodated a range of educational levels (literacy), access to technology and work schedule or child care responsibilities. For example, the national average for adults reading at the lowest functional level is around 25 percent of a given population. In New Orleans, that number exceeds 40 percent. This fact presented a serious challenge in making participants feel comfortable and in being able to obtain useful information from them. Another issue related to palpable disconnects linked social justice and race in differing parts of the Greenway. Early meetings with community leaders pointed to the need to host the same meeting in two different locations, due to the cultural and social disparity between the neighborhoods in the Corridor and many citizens resistance to attending a meeting in a nearby neighborhood. Given the scale and scope of the Greenway and Corridor, this approach made sense geographically as well. In both locations the team employed several methods to achieve a productive result.

"Chip Game." The design team engaged both groups of stakeholders at community meetings and more specific focus groups with a "Chip Game" exercise. In this format, users were given a scaled map of the study area and asked to place and glue scaled pieces representing program elements such as a soccer field or water feature along the Greenway. Once participants completed the activity, the team scanned the map and studied it for patterns. The foundation of the game was developed through recommendations for area space standards for outdoor recreation facilities by Time Saver Standards for Landscape Architecture and NRPA based on a general population of 13,583 (the pre-Katrina population to which we were planning in the Corridor). This Chip Game was played at initial public meetings, within smaller community or social group meetings, and with both high school and elementary school groups. Lessons learned from this exercise included:

- The physical size of the maps necessary to include a 3.1-mile (4.99-kilometer) linear Greenway was difficult to manage in small rooms;
- The maps and necessary supplies were expensive to produce, costing upwards of $500 ($3,106 RMB) per set;
- Due to length, users tended to only work in particular parts of the map, leaving other parts empty or working to fill gaps without critical thinking;
- Users working in the same area sometimes had conflicting opinions, with no mechanism to resolve issues before gluing pieces to the map;
- In an "open house" format, stakeholders arriving at times when a fresh map was not available caused some confusion and visitors questioned why they were not able to add to or change maps that were completed;
- The chips are somewhat difficult to work with for long/linear program elements such as trails, pathways, roads or rain gardens;
- This project included two scales of assignment: Corridor and Greenway. Participants tried to fit all chips on the Greenway, despite the fact that chips provided were intended to fill needs throughout the Corridor;



The "chip game" involved users gluing program pieces to a large base plan as part of either a focus group meeting or public open house.

The chip game did reveal a dramatic difference of opinion between neighborhoods about the Greenway's possible role within their community. On the heels of Hurricane Katrina, much publicity existed and a lot of study was conducted on how under-utilized open spaces could be used to defer or reduce future flooding in low portions of the city. The other perspective related to the lack of community and recreational facilities available within the Corridor. With the space given, it became clear that supporting both goals successfully would not be possible. However,the main difficulty in accommodating both community programming and storm water management was not due to park area, with even the most aggressive storm water concepts proposed for the Greenway dominated only 25 percent for water storage/surface area. Instead, the issue was in the cross section. Providing a contiguous water conveyance system splits an already narrow space into two or three narrow spaces, mostly eliminating the possibility of medium- or large-scale programmed recreation. This was also an issue with the trail location, but the footprint of that feature requires around 15 feet (4.6 meters) compared to a canal needing at least 60 feet (18.3 meters).

"Open House" hours. The team had two points of focus related to the "open house" outreach method. The first was to provide stakeholders who had irregular work schedules or child care obligations the chance to engage the design team and take a look at progress. In many cases, visitors brought children with them or were on their way to or from work obligations. Focus discussions related to a range of topics were scheduled during the open house so stakeholders with specific areas of interest (storm water, crime prevention, etc.) were able to have a detailed dialogue with design team members. For visitors who casually stopped by, docents were at the entry ready to show visitors around and answer basic questions or make introductions to specific team members.

"Dot" exercises. During general public meetings, the team employed simple "dot" exercises which allowed users to prioritize improvements in both map format and chart format. This was done as a supplemental exercise to keypad polling. Due to the high-profile nature and complexities of the project, many of the general meetings were fairly long. For this reason, the design team felt it would be helpful to include at least some physical activity as part of the meeting. These exercises also gave stakeholders who were unable to follow the polling questions an opportunity to interact with the site map and document their priorities.

Dot exercises are a quick and inexpensive way to solicit basic feedback at meetings, but there are social limitations that should be considered before relying on this exercise as the only means of direct engagement. The results of these exercises are somewhat influenced by peer pressure. A participant may be excited about a particular program item but feel intimidated about placing his or her dot next to a topic to which no one else has responded favorably. In general, Dot exercises are an effective tool for getting participants active and for identifying trends but have limitations when applied to complex projects.

Keypad polling. Remote polling tools are endlessly flexible and accurate, and participants typically enjoy the interactivity within slideshow presentations. The design team utilized keypad polling in all open meeting formats to track the flow of information, to all for anonymity, and to document demographic data. Demographic data for any public process is critical for qualifying both a process and outcome, and can help alert a design team when particular segments of the public are not being reached, as well as help to provide valuable political cover for decisions in instances where controversy is inevitable. An additional benefit is that all participants are given an equal voice during meetings, unlike more conversational meeting formats where often only the most vocal individuals dominate response time, which in turn yield unproductive results and tend to discourage many participants.

Public input generated by the keypad polling dramatically shaped both physical planning and general goals for the project. During the design charrette and open house, the team used feedback related to goals and priorities to form a preferred design from two concepts generated based on initial feedback from the public. An example of a question used includes "The location that I prefer for the volleyball courts complex is:" Choices related to locations shown on the alternatives were included as well as a "none of the above" option. This approach may seem simple, but the complexities of the stakeholder group made such transparency essential for both the community and City leadership. Such questions were asked for topics ranging from programming to operations and maintenance. The outcomes proved that despite community differences, expectations for the project were generally more aligned than initially expected. Two distinct concepts began to form; the first was characterized by a linear trail that connected a broad range of programmed activities, while the second concept included much more passive space and naturalistic landscape character.

Designers, experts and the general public often fall prey to preconceptions based on their own understanding of matters related to everything from ecology to finances to art to functionality, and creating an open dialogue around these ideas to can be difficult. An example from the Lafitte process related to proposed "native" or "naturalized" landscape character helps illustrate this challenge. Many people in urbanized portions of Louisiana view snakes, rats, ants and mosquitos as "nature" and have an accordingly adversarial relationship with the natural environment. This attitude has been well documented over the last 300 years of settlement in the area and remains pervasive to this today. Thomas Jefferson wrote about the "yeoman farmer" and the importance of an educated populous. Designers are in many ways the "educated elite" that Jefferson describes, and our ability to either educate or embrace "native intelligence" should be a consideration in any public process. The design team identified this issue and tested it with the public.

The design team approached the topic by educating the public on the full range of benefits of such landscapes and talked about examples of other landscapes in the New Orleans area that represented the intent. When asked about the proposed development program, around 30 percent thought that the proposed plans were too intense, suggesting a high desire for non-programmed or naturalized landscape. 84 percent responded favorably to a landscape transect that took users through distinct native landscape typologies based on topographic elevation. Finally, "passive recreation lands" consistently ranked as a top 3 priority in all study areas. The ability of the team to communicate the full range of benefits associated with such landscapes, successful examples within the community and their role in defining a "passive" experience within the Greenway was a significant part of the success of the design.

The team used a large illustrative cross section to describe key relationships and vegetation types within the New Orleans area landscape.

The design team also considered several additional tools that would have been helpful at the outset of the project and some that were applied to the process later. Online polling tools such as Survey Monkey or MetroQuest were not employed for the project due to a disparate lack of internet access across communities. For teams planning to use these tools they should plan for how responses will be weighed against in-person meeting data. Additionally, content being tested online is exactly the same as the content from meetings. It is important to generate an "apples to apples" comparison of data and to communicate to both the client and public how each data set is to be weighted to. In hindsight, it would have been helpful to have collected online survey data to track as an additional point of reference.

Results

The range of meetings and workshops during the Lafitte process resulted in the direct engagement of approximately 1,000 individuals and 73 organized community groups. While the interaction with community groups was successful, the engagement with the general public was limited to 0.5% of the population living in the study area. Data collected during the final public meetings helped to validate both the design process and its resulting products. The recorded data also sent a powerful political message to City leadership: "Build the Greenway now!"

The final plan balances hydrologic, recreational, cultural and historical considerations in the context of a design that incorporates sustainable storm water infrastructure, native plantings, adaptive re-use of existing buildings, much needed program elements like practice fields for local high school sports and rain gardens and pathways located in the historic alignments of the canal and railroad.

In addition to the Greenway design, the team developed an economic revitalization strategy for the Corridor including strategies for a dramatic expansion of the community gardening program, a projected score of 78 ("Gold" rating) using LEED® standards; and for the creation of mixed-use developments at major intersections. A set of form-based development standards will supplement the City's new zoning ordinance to ensure orderly infill in response to this new civic asset. A Corridor-wide strategy for storm water management will also address the district's historic flooding problems.

The proposed storm water strategy for the Greenway focuses less on conveyance and more on absorption. This strategy reduces flooding, allows for large recreational areas, and may help to reduce soil subsidence, which is a common issue in the Corridor and a major reason for parts of the city sitting below sea level.

As the Greenway will employ the most extensive use of green infrastructure and native plant material in New Orleans, the design team knew that it would be insufficient to merely build the Greenway.It will also be necessary to outline strategies and guidelines for operation and management. New Orleans may be unique among American cities in that responsibilities for its open spaces are divided between two City agencies: Parks and Parkways and the New Orleans Recreational Development Commission. The consulting team prepared maintenance budgets and protocols and facilitated management strategies of the Greenway between these two entities. Although it is estimated to cost $35 million ($217.4 million RMB) to construct the Greenway as fully realized, the City has only $6.5 million ($40.4 million RMB) dollars available for construction. In this climate of severe fiscal austerity, the consultant team was also asked to develop partnership programs in which various civic groups could develop and fund portions of the project.

Discussion

A key factor to consider when measuring the success of a public process is the diversity and level of attendance. Despite the range of efforts and accessibility the Lafitte Greenway process yielded less than 1/3 of the participants needed to constitute a statically valid sample. Given the low turn-outs in both local and national elections common in many parts of the country, it should not be surprising that such a local process falls short of statistical validity. The key question that needs to be addressed with the team responsible for judging the validity of workshop results is this: does statistical validity matter in a participatory democracy or are the decisions to be left to those who show up?

Getting members of the public to attend an in-person meeting, interact with an online resource or participate in a small focus group is a challenge with any process. A cross section of participation that parallels the characteristics of a target population is very rare and difficult to achieve. Data may be collected related to active participants, but we can assume that many stakeholders monitor progress by checking in with published material or in casual conversation with trusted community leaders. In the case of the Lafitte process, the demographics for general attendance at meetings did not match the documented demographics of the study area, yet there was representation from nearly every stakeholder group.

The need to understand the impact of design interventions on social factors will be important to funding and prioritizing greenway projects in the years to come. For example, baseline data now exists to that can help explain changes over time in the economic, education, public health and safety conditions of corridor residents. It is plausible that the creation of a major park within a given area will provide opportunities for recreation,, improved public health, employment, poverty reduction and in general alternatives to crime . This requires multivariate analysis and some mechanism within the planning process to document adequate baselines, set measurable objectives and the creation of a protocol for ongoing monitoring. This could be a future role for Fábos-directed study and the Landscape Architecture Foundation.

Demonstrating that improvements in the study area are a direct result of the creation of the Lafitte Greenway will be difficult, but the process employed at least documents the baseline conditions at a critical time in post-Katrina New Orleans.

The final greenway design created a balance of recreation, trail space, and storm water management.

Conclusion

The Lafitte Greenway and Corridor plans seek to capitalize on under-utilized public open spaces, bringing residents of nine New Orleans neighborhoods together on a common ground. Taking a comprehensive approach to analysis and implementing a robust outreach process, the team's plans for the Greenway and Corridor consider all represented voices and are a true reflection of the New Orleans public. The design team's intent was to create a community supported and implementable solution for the Greenway and revitalization of the surrounding Corridor. The success of the project in achieving these objectives, however, can only be determined over time.

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New Villages:
Planning and Design of Compact Growth Centers
Shaped by Natural, Cultural and Recreational Greenways

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Introduction

The last several decades have seen the emergence of numerous planning strategies and implementation techniques to preserve open space and promote Smart Growth and Sustainable Development at the local level:

- Greenway networks that preserve intact ecosystems.
- Green Infrastructure systems that protect floodplains, water supplies and other assets.
- Recreational greenways that link key locations with hiking, biking and other trail networks.
- Agricultural preserves that protect local food supplies.
- Cultural landscape protection that preserves visual and historic character.
- Revitalization of Main Streets and suburban commercial strips.
- Open Space Subdivisions/ Conservation Development.
- Masterplanned Growth Centers implemented with Form-Based Codes

While many cities and towns have adopted these strategies as part of their community plans, implementation is often haphazard and uncoordinated. Usually the Conservation Commission or local land trust pursues conservation of farmland and wildlife habitat – sometimes with reference to a town or regional plan, but often simply in response to the opportunities (or threats) of the moment. The local economic development office, meanwhile, is busy trying to fill up the local industrial park and support existing businesses. The Planning Board is reacting to whatever development proposals happen to come before it. The story continues with transportation improvements, provision of affordable housing, and planning for schools and other public facilities.

In recent years, however, as creative conservation and development strategies become more widely adopted, cities and towns are starting to explore how they can be combined into a more comprehensive and coordinated approach. The goal of this study is to explore an emerging Village Planning Paradigm that forges a direct link between greenway planning and the creation of compact growth centers. Its objectives include:

- Identifying case study precedents that show how creative development and conservation can go together at the scale of an entire community.
- Understanding how greenway planning can be used to identify natural, cultural and recreational systems that can be used to shape future growth and conservation
- Proposing a community and regional scale planning method for using greenways to shape growth centers.

Background and Literature Review

A new approach to greenway planning in Rhode Island began in 2002 with the initiation of the **Rhode Island Greenspace Program** (Flinker, 2008). Where most previous plans focused on protection of natural resources at the local level, the Greenspace Program uses the power of GIS, supported by extensive public participation, to give equal attention to cultural landscapes and recreational networks. Based on an understanding of landscape systems, the program provides a flexible strategy for guiding future growth and conservation at scales that range from a single site to the entire region.

Accomplished through a series of local meetings and volunteer efforts, the process revolves around creating separate inventories of natural, cultural and recreational resources. Selection of priorities centers on landscape systems that must be protected intact if the essential services provided by those systems are to be preserved. For all the towns, promoting tourism, enhancing the sense of place and protecting the quality of life were fundamental goals of the process. Implementation strategies developed during the project are focused on the local level, including changes to local comprehensive plans and zoning ordinances, and projects to enhance recreation and tourism. To date, Greenspace plans have been completed for the nine towns of the Pawcatuck Watershed, for the six towns of the Woonasquatucket Watershed, and for five towns that make up the watershed of the Scituate Reservoir, the water supply for greater Providence.

The program is specifically designed to go beyond open space planning focused on ecosystems to incorporate cultural resources and recreational networks (Flinker, 2003). Through a series of four workshops with each community, volunteers develop a separate inventory and priority conservation plan for natural, cultural and recreational resources. Priorities are established for preserving and enhancing each of these three elements as a sustainable, functioning system – whether that represents a river corridor with its associated wetland and upland habitat, a recreational greenway linking village centers to regional parks, or an historic agricultural landscape with a complex mix of farmland, forest, homesteads and hamlets. After each town sets separate priorities for these landscape systems, they are overlaid with each other to identify areas that are critical to protecting each community's environmental health, sense of place and quality of life. Finally, regional workshops for each major watershed bring communities together to identify shared priorities and develop joint conservation strategies.

The project methodology was rooted in an understanding that cultural resources – often absent from local and regional open space planning – are critical to protecting visual character and quality of life. If we protect natural areas, while allowing development to sprawl across our historic and archaeological sites, scenic resources and working landscapes, we will lose an irreplaceable heritage. The Greenspace method is thus purposely designed to bring new people to the planning process: involving local historians, farmers, artists, and others in mapping and evaluating "heritage landscapes" critical to the region's quality of life and sense of place. The results confirm what many local planners know intuitively but previously lacked the tools to demonstrate – that cultural resources and working landscapes form complex, interconnected systems that, like natural systems, need to be protected as a functional whole if their full value is to be preserved (Flinker, 2004).

While Rhode Island is at the forefront in greenway planning, there are few examples of integrating development projects with conservation of open space resources that go beyond individual sites. Several examples in the literature were identified that serve as a model for implementing regional conservation and growth center development across the state.

The first is **Chesterfield Township, New Jersey,** which created a masterplan for a new village and has successfully induced developers to use TDR to purchase development rights on farmland and use them to build at higher density in the designated village zone. Chesterfield, which had just 924 units on 21 square miles of farmland and forest, has been a leader in protection of its agricultural land. Increasing development pressure in the 1990s, however, led the town to look at Transfer of Development Rights (TDR) as a way to preserve more land without public funds. In 1997 and 1998 the township adopted a master plan that established a 560 acre receiving area, and changed the zoning to create a neo-traditional village center to be known as Old York Village (Chesterfield Township, 2013).

The village will allow for over 1,200 housing units, as well as a new elementary school, a mixed-use village center, and networks of parks, trails, and protected stream corridors. Design standards were established to guide the character of the streets, architecture and open spaces, using the township's existing historic villages as a model. So far, over 1100 homes, representing over 66% of the township's total development capacity, have been approved, and more than 500 homes have been completed. Through the TDR process, meanwhile, more than 2,750 acres of farmland have been permanently protected.

Another interesting project that combined conservation with a new village is **The Middle Green Valley Specific Plan** in Solano County, California, which created a masterplan for villages within a context of preserved farmland, and implemented it through California's specific plan legislation (Solano County, 2013). The Middle Green Valley includes some 1,905 acres of grazing land, forest and vineyards, interspersed with 55 scattered homes. Sandwiched between existing suburban residential areas, it is cherished by residents and neighbors for its rural character.

To protect the valley, Solano County sponsored the creation of a masterplan that designated about 1,490 acres of the area as permanent open space, of which 440 acres would be working farmland. Transfer of Development Rights would be used to shift up to 400 potential homes off of the open space areas into four new village areas totally 337 acres. Other areas would be set aside for community services, a small commercial area, and roads, trails and other infrastructure necessary to serve the new neighborhoods. To support the farmers and enhance tourism, there would be allowed up to 50,000 s.f. of agricultural commodity processing, 10,000 s.f. of agricultural tourism-related retail, and an inn with up to 25 rooms. The plan was created by a consulting team through an extensive process of public meetings and discussion. Helping to implement it is a New Urbanist design code and hundreds of pages of supporting materials describing financing, infrastructure and administration.

Planning for Sustainable Growth Centers at the Community Scale: Exeter, Rhode Island

While the Greenspace project is helping to understand and preserve Rhode Island's functioning landscape systems, a local effort called "A Vision for Exeter" demonstrates how towns can use a

GIS-based development suitability model to identify the best areas for village growth. When combined with a Transfer of Development Rights program, this approach will allow Exeter to build the kind of compact, walkable villages that residents desire while preserving thousands of acres of farmland and other resources (Flinker, 2012).

Like many small New England towns, Exeter is struggling to preserve its rural identity and quality of life in the face of sprawling residential development. Located within driving distance of Providence and the University of Rhode Island, most of the town's undeveloped land is zoned for three- and four-acre house lots. Even with these relatively large lots, under current zoning today's population of 6,590 could grow to more than 15,000, with some 3,000 house lots replacing the farms and forests that embody the town's rural character.

The gradual erosion of Exeter's rural landscape led the town to pursue a town-wide visioning effort in 2008. In Phase 1, the consulting team helped the town develop a "Game Plan for our Future," founded on an extensive public participation process that included creative use of Community Viz, game playing workshops, keypad polling, small-group interviews and on-line polling. This allowed residents to explore the implications of their current large lot zoning and test ideas for village development in an objective, non-confrontational atmosphere. The result was a strong consensus that village development is a better way to preserve working farm and forest landscapes while developing residential and commercial uses that would be a good fit for Exeter's future needs.

In Phase Two the town has been "Implementing the Game Plan" – looking in detail at potential village locations and developing a design template for what a village can and should be in the 21st Century. Through a detailed analysis of the economic, environmental, and social costs and benefits of village development, the project created a shared understanding of likely future growth under existing large-lot zoning, and compared that with a more sustainable village alternative. The consultants identified four village sites with significant growth potential, and used one of them as a model for more detailed design studies. The result is a Village Design Manual that will act as a guide for developers, designers, and town boards as they go through the process of village design and permitting.

To bring the effort from vision to reality, the consulting team drew up a Village Zoning Ordinance – essentially a hybrid form-based code – to guide the village planning and design process. Perhaps most significantly, a 32-fold increase in density (from the current minimum of four acres per home to eight units per acre in the village) would be achieved through a Transfer of Development Rights process that would directly link village development to preservation of farmland and other open space resources.

Planning for Growth Centers at the Regional Scale: Sustainable Rhode Island

Early in 2012 the State of Rhode Island was awarded a $1.9 million Sustainable Communities Regional Planning Grant from the US Dept. of Housing and Urban Development (HUD). An outgrowth of a national collaboration known as the Sustainable Communities partnership, which includes HUD, the US Environmental Protection Agency and US Dept. of Transportation, the grant is designed to encourage regional planning that integrates land use, housing, economic development, transportation and infrastructure into a single plan for sustainable growth and conservation. The outcome of the project will be a “Sustainable Rhode Island” plan. A key outcome of the plan will be the designation of growth centers in rural, suburban and urban communities. Included in statewide planning as a goal for more than a decade, growth centers have been identified previously, but never supported with dedicated funding for infrastructure or other needs.

The goal of the current effort is to create and implement a detailed planning method for planning growth centers across the state, supported by coordinated investment in transportation, infrastructure, housing and services from every state agency. The approach will essentially combine the methodology of the Rhode Island Greenspace program with a development suitability analysis similar to that used in the “Vision for Exeter” project, combined with other efforts to identify the social infrastructure of the state. Success in this endeavor will require an extraordinary level of coordination between state and local agencies, planners and government, as well as a robust public participation process at every level.

The Growth Centers planning process will begin with a **Green Infrastructure planning process** that will determine the key landscape systems within each community and region of the state that must be protected in order to sustain Rhode Island’s biodiversity, water supply, food security, recreational opportunity and cultural heritage. Each of these systems depends on a core network of areas and corridors which must be preserved intact if the whole is not to be gradually degraded and ultimately lost forever. The initial maps will include:

- Biodiversity – may include natural heritage sites, habitat types, ecological land units
- Water Resources – may include all land encompassed within a State designated surface or groundwater drinking water supply protection area, aquifer or aquifer recharge areas, plus wetlands, hydric soils, low order streams
- Agricultural Resources – may include farmland, prime and important farmland soils
- Forest Resources – may include forested wetlands, forested upland, core habitat areas, conservation lands, blocks of contiguous forest over specified size and shape
- Cultural and Historic Resources – may include historic sites, historic districts, archaeological sites, historic cemeteries
- Recreational Assets – may include parks, recreation sites, hiking, biking and water trails, public access at coastline

Each of these resource maps will be made available to the local communities for review through a simple interactive web mapping tool. Esri’s ArcGIS Online provides an easy-to-use online service that allows for uploading, downloading and streaming maps and geographic data on the web and can be embedded in the project website. Users will be able to turn on/off layers, pan and zoom, print a map, and interactively explore their local community’s or region’s assets. The initial maps for each resource value will be a simple grid-based cell in which each input layer is coded 0 or 1 for the absence/presence of the particular resource.

In addition to reviewing map content, each community will also be asked to establish the relative importance of each map theme for local conservation planning. The results will be used to create a weighting system that will allow for development of regional maps that highlight areas with coincident resources and, to the extent possible, are cognizant of local priorities. Based on this local weighting process, the resource maps created for each community will be reorganized into maps that will emphasize the key landscape systems that make up the Green Infrastructure element. These may include:

- Natural Systems
- Cultural Systems
- Working Landscape Systems
- Recreational Systems

While the Green Infrastructure maps will define the landscape systems that need to be protected and enhanced, a separate mapping process will help to identify the best locations for Growth Centers. Like the Green Infrastructure mapping process, this will start with local maps, which will be reviewed, prioritized by each town, and ultimately merged into regional plans. This will include three maps for each community: **Economic Infrastructure, Social Infrastructure, and Development Suitability.**

The Economic Infrastructure Maps will include:
- Transportation
- Institutions
- Residential, Commercial and Industrial Land Uses
- Infrastructure
- Economic Development Assets

Social Infrastructure will include:
- Community Facilities, such as schools, libraries, parks, playgrounds.
- Social services
- Public Transportation
- Neighborhood Assets
- Equity populations and other demographic data

Development Suitability will include:
- Protected land
- Topography and Slopes
- Soils
- Drainage
- Environmental Constraints
- Water Supply
- Wastewater capacity

After local and state review of the separate map themes, the maps of Green Infrastructure systems will be overlaid with those for Economic and Social Infrastructure. This will illustrate areas of the state most appropriate for growth centers, which have the best economic and social infrastructure and manageable impacts on important natural and cultural assets. These will be discussed at a series of regional meetings to be held simultaneously in eight subregions of the state. After an introductory meeting to explain the process and introduce the mapping process, each subsequent meeting will take on a particular theme, working up to a final meeting where it all comes together into a regional plan for Green Infrastructure and Growth Centers:

- **Regional Working Group Meeting #1 – Introduction:** Representatives from each town will meet together to learn about the project as a whole and will be introduced to the mapping process for Green Infrastructure, Economic Infrastructure and Social Infrastructure. This will provide an opportunity for questions and comments, and provide local representatives with enough background to conduct an effective review of the on-line maps for their community.

- **Regional Working Group Meeting #2 - Green Infrastructure:** Following local review, maps will be compiled for each of the eight regions, representing the weighted priorities of each community. At the second Working Group meeting, the consulting team will present the regional Green Infrastructure maps and facilitate a workshop on how best to balance the various elements and blend them into a regional Green Infrastructure Plan.

- **Regional Working Group Meeting #3 - Economic and Social Infrastructure:** Following local review, maps will be prepared for each of the eight regions that depict Economic and Social Infrastructure. Attendees will work to identify potential growth centers and discuss the range of growth center types that may be appropriate for each location. The project team will facilitate discussion to explore the relationship between economic, social and environmental assets, implications for growth center planning, and regional priorities for conservation and economic development.

- **Regional Working Group Meeting #4 - Review of Statewide Growth Center Plan:** Following meetings with the statewide Growth Center Committee, revised plans will be drafted showing recommended Green Infrastructure and potential growth centers for each region. At the meeting, local representatives will review the draft plans and provide feedback.

The size and make up of growth centers will necessarily change dependent on the context, market served, proposed mix of uses and other factors. To better define how each growth center most appropriately reflects its context, the project team will prepare a **typology of growth centers** that explores the full range of potential approaches from rural to urban sites. This will include:

Urban

- Downtown revitalization
- Neighborhood infill
- Urban Mixed-use Corridor

Suburban

- Town Center/Main Street Infill
- Strip Commercial Retrofit

- Transit-oriented Development

Rural

- Infill of a Historic Village
- New Village Surrounded by Open Space
- Small Hamlet

The results will be compiled into an illustrated guide to growth centers in urban, suburban, and rural contexts. This will include photographs and descriptive text showing existing examples from around Rhode Island and neighboring states. These examples will help to explore the range of uses, intensity of development and architectural style that is possible even within a single context type. Of particular importance will be showing a range of densities within similar contexts, so that users of the guide can get a sense of how the look, feel and functioning of a particular growth center type changes (or remains the same) as density rises or falls.

Conclusions

The last 30-40 years have seen the construction of many projects that combine conservation with compact development, guided by an overall masterplan. Ranging from small conservation subdivisions to New Urbanist communities with thousands of homes, these have, however, largely been limited to a single ownership or consortium of owners, usually with a short-term buildout. They often do little to further local goals for either conservation or development, especially in the more common planning context, where there are scores of owners and a development process that may take many decades. The examples described in this paper, however, point towards a new and very exciting approach, where the tools of conservation development are brought together with the local and regional greenway planning process to guide growth and conservation across entire towns and regions.

This approach is possible because of a convergence of planning theory, digital mapping tools, creative zoning approaches and political will that makes it possible for communities to plan for sustainable growth and conservation at an unprecedented level of complexity and detail. While many of the individual parts of this approach have been in existence for decades, this convergence of interests and opportunity has allowed for an integrated approach – rooted in specific, physical plans for real places – that combines smart growth with smart conservation. This process has also been made possible by a decades-long growth in available GIS data, allowing for detailed planning across scales from site to region. This wealth of information has also allowed for a deeper understanding of the landscape – not as a collection of isolated and static elements, but rather as a network of functioning, complex and adaptive landscape systems, each of which contributes to the success of the communities of plants, animals and humans that are supported by that landscape.

An understanding of these landscape systems – which can include ecology, culture, recreation, agriculture and others – allows for plans which reflect the complex relationships and organic growth patterns that allow these systems to adapt to changing circumstances and continue to flourish. This is the essence of sustainability. The Sustainable Rhode Island project, which unites green infrastructure, economic infrastructure and social infrastructure into an integrated planning process, will be an important test of this approach. While this will initially focus on identifying the best locations for growth and the most important lands for conservation, it also holds the promise for villages that do not merely help preserve open space, but have an intimate functional relationship with the landscape which surrounds them.

At one time, of course, this relationship was a necessity, and villages by definition depended on the surrounding working landscape. It was only in the industrial age when villages began to be separated from that landscape, later devolving into mere nodes within suburbia, and eventually vanishing completely from the typology of development types. Today the lens of sustainability is revealing ancient truths about how people can live together in communities where the surrounding landscape provides a substantial amount of their food, water, recreational, spiritual and other needs. Greenway planning based on an understanding of functioning landscape systems is an essential ingredient in identifying the best locations for these sustainable growth centers and designing them to fit the needs of coming generations.

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Aqueduct Trail Network Development in Metro Boston

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MAPC
METROPOLITAN AREA PLANNING COUNCIL
50 YEARS
SMART GROWTH AND REGIONAL COLLABORATION

Aqueduct Trails
MASSACHUSETTS WATER RESOURCES AUTHORITY

Abstract

The Massachusetts Water Resources Authority (MWRA) and the Metropolitan Area Planning Council (MAPC) are collaborating with associated cities and towns to open up 40 + miles of existing and former aqueduct right-of-ways are available to be permitted for public access for the first time in the western suburbs of Boston. Four aqueducts are being considered for public access.

The first one-mile section along the Weston Aqueduct in Framingham opened to the public in October 2012. By eventually connecting these aqueducts with existing trail systems, we are ultimately creating a 50+ mile continuous greenway network, primarily using existing public land permitted at no cost to municipalities, requiring minimal investment, and creating a maintenance partnership between the MWRA and cities and towns.

The MWRA is working with each of the communities to issue public access permits. Each town will be able to conduct limited improvements to the right-of-way to allow for improved hiking, cycling, and dog-walking activities. A number of schools are adjacent or close to the aqueduct corridors and will provide car-free access for children to walk between school and home. Sections of these aqueduct corridors have been used as informal trails for a number of years. Under the new policy, public access activities will now be authorized and maintenance responsibilities will be split between the MWRA and municipalities.

MAPC is working with each of the communities to connect the disjointed aqueduct segments into a seamless, continuous, connected greenway network. Working through each town's public process, MAPC is identifying the trail segments that will connect with existing regional rail trails, including the circumferential Bay Circuit Trail around Boston and numerous others. MAPC expects to complete an implementation plan in 2013 that identifies the proposed alignment of the completed aqueduct trail network system.

Introduction

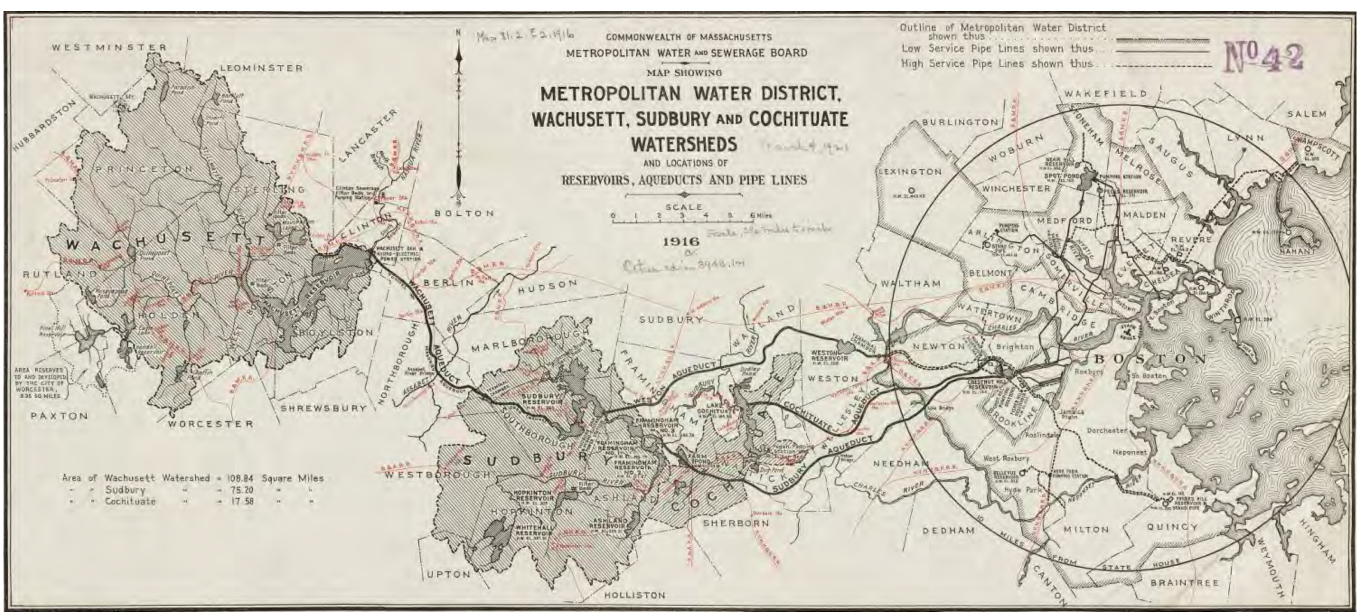
The Massachusetts Water Resources Authority (MWRA) and the Metropolitan Area Planning Council (MAPC) are collaborating with associated cities and towns to open up 40 + miles of existing and former aqueduct right-of-ways are available to be permitted for public access for the first time in the western suburbs of Boston. Four aqueducts are being considered for public access. THE MWRA, led by Executive Director Fred Laskey, is an independent authority that provides wholesale water and wastewater services to 2.5 million people. The entire system of aqueduct trails, rail trails, and trails along rivers will eventually form the planned metro greenway system.

The aqueducts under consideration in this program are noted in the following figure.

AQUEDUCTS AVAILABLE FOR PUBLIC ACCESS

Aqueduct Description and History

The history of the aqueducts dates back to 1846, when construction started on the Cochituate Aqueduct bringin water from Lake Cochituate in Natick to the City of Boston. In flat areas, the aqueducts are located a few feet underground in a raised berm. Tunnel sections and bridges were constructed where topography and water bodies required additional structures to avoid the need for mechanical pumping.



HISTORIC MAP OF AQUEDUCTS – 1916

Cochituate Aqueduct – 1846

Lake Cochituate, originally known as Long Pond, was first considered as a water source as early as 1834. By 1845, the city of Boston, after years of consideration, settled on Lake Cochituate as a water source for the city. The Cochituate water system included the lake and Dug, Dudley and Fisk ponds.

Today, the lake is a state park, operated by the Department of Conservation and Recreation. The Town of Wellesley and City of Newton have care and control of the Cochituate right-of-way and have established trails open to the public. MAPC will be working with the municipalities to include them in the aqueduct trail network.

Sudbury Aqueduct – 1875

The Sudbury Aqueduct was built from 1875 to 1878 and begins at Farm Pond in Framingham and runs eastward for 16 ½ miles to Chestnut Hill Reservoir in Boston. Built at an incline to avoid pumping, towards Boston of one foot per mile, at capacity, the aqueduct carried 80,000,000 gals/day.

The Aqueduct and its structures including tunnels, bridges, and gatehouses, are listed on the State and National Registers of Historic Places.

Waban Bridge, which spans the Charles River in Wellesley, is 536 feet long, 40 feet high, and includes nine semi-circular arches, each with a 22-foot, 4-inch radius. It was built to carry the Sudbury Aqueduct across a valley. The conduit, lined with cement, crosses the bridge in a well featuring a flagstone bottom and brick sidewalls that are topped with a decorative iron fence.

Echo Bridge, officially known as the Charles River Bridge, spans the Charles River and Ellis Street, connecting the city of Newton and the town of Needham. Echo Bridge is primarily an aqueduct built to carry water from the Sudbury River to Boston. Constructed in 1876, the stone and brick bridge is 475 feet long and 19 feet wide, with seven stone arches.

The arches vary in span from 127 to 28 feet in length, and are 19 feet wide with seven stone arches. The 127-foot arch was recognized in 1988 as the second longest span in North America and one of the largest stone arches in the world.

The Sudbury Aqueduct was taken out of daily service in 1974 because of poor water quality but is used occasionally to dump water into the Charles River via Lake Cochituate and the Cochituate Aqueduct when the Charles is too low. In May 2010, MWRA activated the Sudbury Aqueduct during a water transmission emergency. In the future, MWRA plans to upgrade and pressurize portions of the alignment by sliplining the brick and mortar aqueduct.

Wachusett Aqueduct – 1896

First built by Metropolitan Water Board, the Wachusett Aqueduct began construction in 1896 and was completed in 1898 at 12 miles long. Its construction marked the first phase of taking water from the south branch of the Nashua River to supply the water needs of Metropolitan Boston. Completion of the Wachusett Reservoir Dam in 1906 and 1907 created what became the principal water source for the Metro Boston area until completion of the Quabbin Reservoir in the 1940s. The Wachusett Aqueduct was removed from service when the Wachusett-Marlborough Tunnel came online in the 1960s.

Weston Aqueduct – 1896

Between 1901 and 1903, the Metropolitan Water and Sewerage Board constructed the Weston aqueduct, 13.5 miles long from Sudbury Reservoir in Southborough to the Town of Weston including Weston Reservoir. including Weston Reservoir. The aqueduct is a brick and mortal horseshoe shaped conduit.

Although the aqueduct corridors have been informally used as trails for many years, official MWRA policy has not historically allowed public access on their property except in limited locations. Most sections of the aqueduct have been fenced off with no trespassing signs. The new MWRA policy on access changes all of this.

MWRA Policy on Access

In May 2012, the MWRA announced a new public access policy for aqueduct right-of-ways, officially allowing the 14 municipalities along the aqueduct rights-of-way to apply for public access.

> "GOAL - To protect and preserve existing lands under the care and control of MWRA for water supply purposes, while authorizing and permitting public access consistent with good water supply practices. MWRA recognizes the importance of enhancing public access and public involvement in its facilities as a means of improving its own performance in facilities maintenance and building support from its ratepayers."

In 1998, the MWRA in cooperation with MAPC and the communities commissioned a feasibility study on authorizing public access to retired aqueduct right-of-ways. The report included discussion on the types of appropriate uses and the legal, jurisdictional and management decisions that would be required to establish such a policy.

In the intervening years, MWRA has established formal agreements with a few host communities in the form of 8(m) permits and a Memorandum of Understanding to allow public access to land under their control. It is important to note that each location has unique characteristics and therefore requires the necessary flexibility to address those characteristics, which will be accomplished by customizing the terms of MWRA's required 8(m) permit to be issued for each community.

In 2010, a subcommittee, chaired by Board Member Joel Barrera, was established by the MWRA Board of Directors to develop the parameters for public access. The Committee expressed the opinion that more eyes and ears by the public while using the right-of-ways would provide additional safety and security for the water system. There was a broad recognition that there would be a great public benefit from opening the trails to the communities.

In May 2012, the MWRA Board of Directors, led by its Chairman Secretary Richard Sullivan, voted to approve a formal public access policy with guidelines. Since the policy has been announced, MWRA and MAPC have been working with individual communities and are in various stages of executing permits for each community. Framingham and Natick have permits.

Wellesley, Northborough, and Weston are pending. The remaining communities have initiated the permit process.

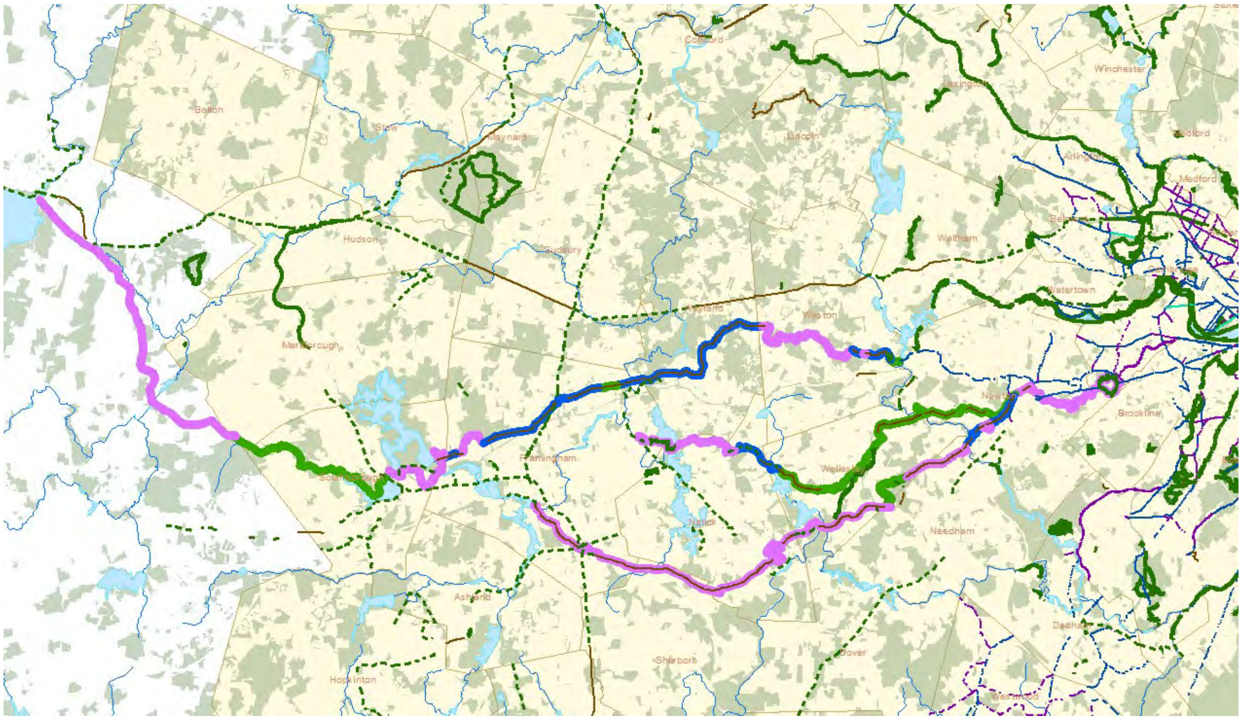
MAPC Aqueduct Trail Planning

The Metropolitan Area Planning Council is working with each of the 14 communities to connect the disjointed aqueduct segments into a trail network. A number of gaps in the aqueduct network still exist, requiring alternate trail routes. These include:

- **Tunnels.** Land above the tunnels are often developed with other uses, primarily housing.
- **Private Property.** The MWRA owns in fee most of the Weston and Wachusett Aqueducts. However, the Sudbury Aqueduct has numerous sections that are privately owned and feature easements.
- **Highways.** Aqueducts run under interstate highways in several locations.
- **Street Crossings.** Crosswalks and/or signals may need to be provided at street crossings.

Working through each town's often unique and respective public process, MAPC is identifying the trail segments where the eventual aqueduct trail network will connect with regional rail trails and the circumferential Bay Circuit Trail around Boston. An implementation plan will be completed in early 2013, identifying the proposed alignment of the completed Aqueduct trail network system.

The map below shows the current status of the proposed complete trail network. Open sections are indicated in green, planned sections in blue, and proposed locations in purple at the time of this writing. MAPC will work with each of the communities through 2013 to open as many aqueduct sections as possible, or to confirm the alignment of alternate sections.



PLANNED NETWORK WITH REGIONAL TRAILS

Opening Day

On October 22, 2012, the first section of aqueduct trail under the new policy was opened for public use. The one-mile section is located in Framingham on the Weston Aqueduct. Support for this groundbreaking event was generously provided through the Community Transformation Grant (CTG) program—a Centers for Disease Control and Prevention (CDC) grant aimed at tackling the root causes of chronic illness such as smoking, poor diet, and physical inactivity under the Massachusetts Department of Public Health (MDPH).

Additional sections of the aqueduct are scheduled to open in 2013, with the goal of completely opening the Weston aqueduct trail in Weston, Wayland, and Framingham by the end of the year.

To celebrate the opening of the first section of trail, MAPC prepared a 3-minute video describing the benefits of the future trail network.

OPENING DAY IN FRAMINGHAM, OCTOBER 2012

The presenters would like to acknowledge and thank the work of trail advocates, legislators, municipal officials, MWRA Board of Directors and staff and the staff at MAPC for a successful kick-off to a program and policy that will have long lasting positive benefits to the Commonwealth.

Impressions from a Lost World, the Connecticut River Valley Trackway Plan:

Preliminary Concepts

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in collaboration with the Pocumtuck Valley Memorial Association (PVMA) and in gratitude to Sarah Doyle for orchestrating the grant from which the historical background in this paper is extracted

Introduction

This researcher serves as both a consultant to and member of the project team with the Pocumtuck Valley Memorial Association (PVMA), a nationally recognized history museum and library. PVMA is working in collaboration with institutional partners and other consultants on an ambitious National Endowment for the Humanities (NEH) preliminary planning grant (awarded in 2012) entitled "*Impressions from a Lost World*" under the *Interpreting America's Historic Places Planning Project* program. With the focus to tell a compelling story about the early 19th century discovery of three-toed dinosaur tracks along a sixty-mile stretch of the Connecticut River Valley in Massachusetts and Connecticut, the innovative concept of a greenway plan as the vehicle to help relay this story is particularly exciting. The approach to the greenway concept with this project is unique because of the significance of the rich historic layers and the way they will be interpreted. This paper will convey the significance of the story of these early dinosaur track discoveries, so that the conceptual challenges to the future greenway planning process can be better understood. That process will also be guided by classic literature on greenways (Lewis 1964; Fabos 1996; Little 1990; Flink and Searns 1993).

Project Goals

As part of the current and initial planning grant, scholars are working to refine the humanities content, to create a unified image and identity for the project, and to suggest final formats for interpretative materials for the next anticipated implementation phase. The greenway plan, tentatively and innovatively to be called a "trackway," weaves in the rich roots of the story of historic discoveries, while emphasizing the physical landscape where this historic richness can be read. Planned additional formats to augment the physical greenway plan include a web site, applications for hand-held devices, printed and iPod auto tours, promotional brochures/maps, and themed public events and artwork. Planning will also incorporate a detailed media plan for raising public awareness among diverse audiences. These interpretive materials will tell the story of the tracks' discovery and subsequent controversies in an engaging way that will also connect identified individual sites around the Connecticut River Valley. The main interpretive goal is to present the story of the early discovery of dinosaur tracks in the Connecticut River Valley and the profound impact of this discovery upon American thought and culture. A secondary goal is to reach a diverse audience, including repeat and first time users, in an engaging and effective way.

Historic Background of the Story

As PVMA wrote in the NEH planning grant proposal, the initial discovery of the "fossil bird-tracks" in the Connecticut River Valley had significance far beyond the emerging scientific community. The implications of these discoveries exerted revolutionary and profound effects upon religion, art, and culture in this country at the time. And these effects continue to reverberate on American culture today. The broad public appeal of dinosaurs can today engage a wide audience not only through the stories of the tracks' discoverers, but also with the first public reactions to the finds. The discovery in 1802 of the tracks of small, carnivorous theropod dinosaurs of the Late Triassic – Early Jurassic was interpreted within an essentially biblical framework. Dubbed the tracks of "Noah's raven," the discovery was regarded as a curiosity. Reactions were quite different when, in 1835, more tracks, 30 miles north of the earlier discovery, caught the eye of a day laborer. These tracks were brought to the attention of professional scientists, who concluded the tracks had been made by large prehistoric birds. It was decades before the connection was drawn between these "bird tracks" and dinosaur bones found elsewhere.

More specifically the first appearance of the tracks in the historical record was in South Hadley, Massachusetts, in 1802, when a farm boy named Pliny Moody uncovered a set of footprints while plowing his father's fields. According to local popular belief residents and clergy called them the tracks of Noah's raven. Thirty three years later in 1835 and 30 miles further north, Dexter Marsh, a laborer and church sexton, while laying sidewalk in the town of Greenfield noticed footmarks in a slab he was just about to place. Instead of consulting clergy about the discovery, Marsh's neighbor, a physician named James Deane, wrote to scientists in Philadelphia, Albany, New Haven, and then-new Amherst College. There Edward Hitchcock was professor of chemistry and natural history. Hitchcock's subsequent paper on the tracks, published in *American Journal of Science* in January 1836, was the first paper on fossil "bird-tracks" in the scientific world. He studied the tracks and other fossil traces (raindrop impressions, mud cracks, insect trails, etc.) until his death nearly 30 years later, while along the way inventing a new subscience of paleontology called ichnology. And his precepts are still used today. Although Hitchcock lived to read Darwin's *Origin of Species*, he had deep reservations about Darwin's views on evolution. Still the two men had pleasant correspondence. Hitchcock's second published response to the footprints took the form of a poem. Published in a New York literary magazine in June 1836, "The Sandstone Bird" told of a geologist who calls upon a sorceress to summon up the creature that had made the tracks; he envisioned a huge bird looking disdainfully at how small the world it had once inhabited now looked. Poems like Shelley's "Ozymandias" remind us that poetic reactions to science, such as Hitchcock's, were not uncommon.

So the scientist credited with discovering the fossil footprints, Edward Hitchcock, was a professor of chemistry and natural history at Amherst College and later its president. But he was also a Congregationalist pastor who viewed himself as a bridge between the Scriptural and scientific worlds. Hitchcock's career is thus a window onto mid-19th century convictions about the unity of knowledge. Hitchcock was a scientist of considerable achievement. For example, he organized the first geological survey of Massachusetts and cofounded national scientific institutions. Throughout his life, he remained confident that the worlds of science, religion, and culture could be integrated seamlessly; he believed in the essential unity of the various kinds of knowledge he sought. In the broader culture, that conviction about the unity of knowledge gave way to increasing specialization. The history of the footprints reflects this transition. In examining professionalization and specialization, PVMA will use the rather feisty struggle between Edward Hitchcock and James Deane, an amateur geologist, over who should receive official credit for the tracks' discovery, as an avenue for exploring issues of who "owns" science and controls its process.

Through Hitchcock and other figures in the story, PVMA will trace the shift away from Transcendental Romanticism, with its attitude of awe and mystery in the face of nature, and toward knowledge of natural history as a serious intellectual pursuit. The study of natural history alongside music, drawing, dancing, and other refinements in the 19th century provides a useful lens to view differences between men and women. The participation of women in this early science will be interpreted through the stories of Orra White Hitchcock and Jennie Arms Sheldon, who lived in Deerfield, Hitchcock's home town. Women's experiences with natural science also will be viewed through Mary Lyons, founder of Mount Holyoke College (1837) and close family friend of the Hitchcocks. Lyons included the study of sciences in the curriculum at her religiously orthodox female seminary from the beginning, and her students studied from a textbook written by Hitchcock.

Identifying Notable Sites in the Valley

To begin to list significant resources within this area, an abundance of rich sites is readily apparent. A windshield survey of notable natural and cultural sites includes:

- Amherst College Beneski Museum of Natural History, Amherst MA
- Barton Cove Campground, Gill MA
- Dinosaur Footprint Reservation, Holyoke MA
- Discovery Center, Turners Falls MA
- Dinosaur State Park, Rocky Hill CT
- Nash Dinosaur Track and Rock Shop, South Hadley MA
- Springfield Science Museum, Springfield MA

Other significant geologic sites well off the beaten path augment this list (Little 2003; McDonald 2010). Connecting the dots of these resources will not be difficult. Certainly care to protect the landscape, while promoting a new network for users, will need to be considered (Birnbaum

1994). The major design challenge will be to interweave the historic layers together to tell the exciting story PVMA is unfolding. The Amherst College Library holds the single largest repository of document resources related to the Hitchcocks. Many of these resources have been extensively researched by one of PVMA's core scholars, Dr. Robert L. Herbert. He has written articles on the Hitchcocks and personally transcribed many of the Hitchcock letters, notes, and diaries. He also (with former Amherst archivist Daria D'Arienzo) co-curated and co-wrote the catalogue for a 2011 exhibit of the work of Orra White Hitchcock at the Mead Museum at Amherst College. His work on the subject will be extremely helpful toward informing and shaping the story. The research will serve as an inspiration to the design of the historic layers for the trackway, as well as possible artwork for the trackway.

Plans and Goals for the Trackway Study

To help teach this complex, multifaceted story about 19th century American nature study and science with its broader cultural impact, the team is formulating a plan for a physical trackway to interconnect all of the rich and sundry resources within the Connecticut River Valley in ways that are both accessible and engaging to a variety of people. Awaiting the outcome of the most recent NEH grant application (submitted in January 2013) before more serious work can continue, team collaborators are voluntarily working on preliminary concepts. Team member and artist Will Sillin has started collecting historic geologic tours within the study area. Over the next few months this researcher will coordinate with Will Sillin to brainstorm further ideas for both planning and interpretation related to the historic tour guides. An important part of this work will include conceiving ideas for future public art installations which can help enrich the visitor experience (Borrup 2006). Help for planning the artwork will be supported by grants and be aided by guides (Korza 2007). Art for the trackway could support three different purposes: 1. Explaining concepts of natural history, 2. Conveying found connections between nature and the arts, and 3. Inspiring entirely new expressions of art in response to the story. The first purpose will help visitors understand more about natural history and science through art installations. To that end an example might be an explanation of how fossil dinosaur tracks were formed. This could be an idea for one interpretive artwork along the trackway.

Fig. 1. Sketch showing how fossil dinosaur tracks are made from a dinosaur three-toed footprint in the sediment, track-bearing layer buried over time with the sediment hardening to rock, then the rock splitting apart with exposure to erosion at the seam of the original track-bearing layer, thus forming a negative mold and a positive cast.

Fig.2. The Dinosaur Tracks at the Nash site, where both negative molds and positive casts are viewable, could be more readily understood with the help of interpretive art as in Fig. 1.

Second more connections to the tracks and natural history in19th century art, poetry and literary references will be studied and gathered to weave into public displays for the trackway, (as well as for the web site and for planned special events). Such interpretations through art installations can convey information, ideas, and insights. A third direction for trackway art will be to inspire artists to conceive new works in creative response to this history. When funding comes forward, there will be opportunities to develop the trackway more systematically. Preliminary ideas, the identification of resources, and the compilation of useful materials fuel this early conceptual stage. Hopefully, the Department of Landscape Architecture & Regional Planning will assist this project through greenway studios when new funding is secured.

Case Studies

To help plan for the trackway, this researcher has started compiling case studies which can offer ideas and lessons (Bischoff, 2008). As one example, the 1.28 mile "Walkway over the Hudson," in Highland NY, http://www.walkway.org/ offers an example of branding, utilizing the stylized image of its historic railroad bridge as a logo which appears on the designed entrance gates to the walkway. The logo also appears on Tee shirts, as well as on artistic metal plates on the benches along the deck of the walkway, among many other places. The logo is also used with the developed "talkway" program developed to deliver innovative interpretive information. Visitors can take advantage of several daily use activities, including:

- Audio-Visual programs – "Talkway" Over the Walkway
- Bike riding
- Bird watching
- Dog walking
- Jogging
- Roller skating, in-line skating
- Picnicking
- River traffic observation
- Scenic Views
- Self-guided tours
- Train spotting
- Walking

Fig. 3. The Bridge Logo on the Designed Gate of the Walkway over the Hudson

Fig. 4. The benches along the walkway artistically integrate the bridge logo (as seen in the gate) on the footing of the bench on an artistic cast metal plate.

Conclusion

With the rich history to a variety of geologic sites the inventory of resources in the valley includes the likes of the Amherst College collection at the Beneski Museum of Natural to the Nash Dinosaur Tracks and Rock Shop. Through a comprehensive inventory of all the resources and sites the 'trackway' greenway plan will knit the pieces together so the rich, multifaceted story can unfold. With this rich, unique, and significant history, the trackway plan will make the history of the tracks themselves come alive, as well as their continually evolving interpretation.

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The Mill River Greenway Initiative:
Community-Based, Long-Term Greenway Planning and Design
In Williamsburg and Northampton, Massachusetts

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Smith College
*Mill River Greenway Initiative

1. Introduction

Puritans first settled Northampton, Massachusetts in the mid-17th century with a vision in mind – that of a well-ordered community in which the Mill River would play an integral part in their lives. So long as the community hewed to the right path, the river would accommodate the community's needs. Primary among those needs was waterpower, so the anchor sites for development along the river were the falls. Over the next 200 years, as the Puritan mind metamorphosed into an American industrial mentality, the Mill River's residents created an industrial necklace with mills and factories decorating a ribbon of water. By the mid-19th century, more than 70 mills and factories were established along 15 miles of river from Northampton's Lower Mills up to Devil's Den near the headwaters of the river in Goshen. By the mid-20th century, with the Mill River Valley's industrial base in rapid decline, the necklace deteriorated into a sad scattering of empty factory buildings with little connection to one another. The vision perished and the river escaped the minds of most residents, especially in Northampton where the Corps of Engineers relocated its flow away from the town center.

Industry along the river is all but gone. Relic industrial sites now dot the Mill River's banks, separated by flat stretches of the river that were never appealing for water-powered manufacturing. Though more prone to flooding, many of those stretches have been developed as recreational destinations. The Daughters of the American Revolution (D.A.R.) State Forest in Goshen and Look Park in Florence are just such places, but substantial inaccessible gaps remain between the old factory sites. The factories turned their backs to the river, severing any remaining connection to residents and visitors. There cannot be a true, continuous greenway if these key spots are not renewed and connected. The industrial sites themselves, called "anchor sites," can serve as gateways and destination points along one continuous greenway, providing access to the stretches of river between them.

A few anchor sites have been resuscitated or renovated, such as Meekins Library in Williamsburg Center and old mill buildings in Florence. People are returning, but the ways in which people and these sites relate to the river need to be addressed so that people can come back and reconnect to the river at historically and geographically significant locations.

The Mill River Greenway Initiative is the story of a renewed vision, which, like the original, is being pieced together by individuals and small groups -- the creation of a new kind of necklace composed of those same sites at falls and bridges, which, when linked, will provide fulfillment for walkers, naturalists, and anglers, history buffs, artists, and tourists. The river will, once again, play an integral role in the lives of residents.

2. Geography of the Mill River Watershed

Tumbling out of its headwaters at almost 1,500 feet above sea level in the hilltowns of the Berkshire Hills in Western Massachusetts, the Mill River's east and west Branches drop 900 feet and converge at the center of Williamsburg. The topography then flattens out, and, after two more dams at waterfalls, flows into the agricultural fields of Florence Village in Northampton. After one more dam site in Florence, it continues through another old industrial site to Paradise Pond at Smith College. Just past Paradise Pond, the Corps of Engineers diverted the river in 1940 away from the center of Northampton, but the palimpsest of the former Mill River remains in the city center. (*nb. A topo map of the watershed will accompany the presentation and available in the final version of the paper.)*

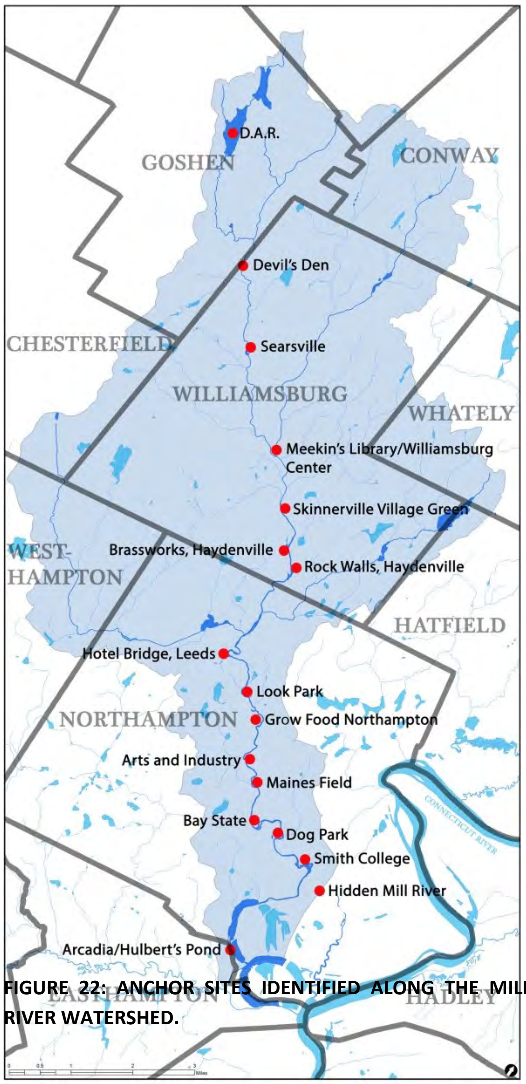

FIGURE 22: ANCHOR SITES IDENTIFIED ALONG THE MILL RIVER WATERSHED.

3. Mapping out The Sites

Along the entirety of the Mill River there exists a rich collection of identified sites and spaces, all highlighted for their historic, recreational, educational, and environmental value. The anchor sites have either actual or potential value for residents and visitors while the connections are linear paths, walks, and multi-use trails that run from one anchor site to the next, allowing for continuous access and recreation. The Mill River Greenway Initiative envisions joining anchor sites and connections to create one complete Mill River Greenway.

Each site and connection bears the stamp of its own personality. The headwaters from the hilltowns to Searsville in Williamsburg offer splendid hiking, camping, and multi-use trails, starting with the D.A.R. State Forest and Devil's Den. This area also includes the Williamsburg Reservoir, where a terrible flood in 1874 wiped out the dam and bridges – even one whole village – the most devastating dam disaster to that point in American history. The second distinct area starts in Williamsburg Center and runs along Rt. 9 to Haydenville, Williamsburg's southernmost village.

The Mill River is Williamsburg Center's signature feature. It rushes under bridges and alongside houses, lapping against the sides of the 18th and 19th century stone walls that border and guide it. Landscape architect Nick Dines took advantage of the site to establish a small park at Meekins Library, in the center of town, which created an opportunity for a weekly farmers' market. The riverfront park at Meekins sets an example for other significant and historic points along the river to foster a connection between building, land, and river in order to reinforce the connection between the people and the river, to act as a destination and entry point to a continuous experience with the river.

Haydenville is the next anchor point, home to historical buildings including the Brassworks, a beautiful old mill site that has been revitalized for business and commercial use with great potential to take advantage of its riverside property like the Meekins Library. Then comes the former site of Skinnerville, destroyed in the 1874 flood, with its popular community space, snack bar, and ice cream stand. The Williamsburg Greenway Committee (see below Section 4.e) has almost completed a study to connect these anchor sites with a multi-use trail, thereby creating one fluid opportunity for access and recreation along the river, turning the community's focus back toward the river that was once such a vital part of the town's existence.

Near the Williamsburg/Northampton town line is a walking trail along the former rail bed that connects to a multi-use path in the village of Leeds, another 19th-century mill town with historic sites, such as 3 dams and the Hotel Bridge. Leeds is ripe for development as an anchor site.

The river's path then flows between two key features in the village of Florence -- a multi-purpose park of regional importance called Look Park and large open fields devoted to community agricultural and town-owned athletic fields. The agricultural land is owned by Grow Food Northampton, a private non-profit devoted to food security and overcoming the barriers of farm entry in densely populated areas. Grow Food Northampton manages and leases out the land to a number of agricultural ventures on multiple scales. Two private farms lease out 108 acres of the 181-acre site. The City of Northampton leases 7 acres of its land to members of the Florence Organic Community Garden, and the city's recreation department is in charge of the athletic fields. A few more acres are set aside for micro farm ventures and all the land directly abutting the river is conserved riparian zone, a mile-long section with opportunities for environmental education.

The river immediately enters another industrial area, flowing by the old mills of Arts and Industry and Nonotuck Mills, a half-mile-long reach of major historical importance, including abolitionist and Underground Railroad sites. Arts and Industry is one of the most impressive mill sites along the river today, now home to businesses dedicated to arts and crafts, education and health, with studio spaces for over 50 local artists. Just downstream is a historic dam with a fine renovated mill building that houses businesses and a large practice floor for roller derby.
Just south of these mill sites is Maine's Field, a popular park, swimming hole, and baseball diamond. Another quarter mile downstream is the last industrial site with extant factory buildings, called Bay State. One such building still houses a manufacturing concern, while the other hosts a number businesses and creative ventures.

The last portion of the river is a rich mix of recreation and education, starting with trails at the bottom of a hill called "Hospital Hill," the site of the 19th-century Northampton State Hospital, demolished in 2006. Several trails along the river, popular with dog-walkers, who call it "the Dog Park," lead to Smith College and Paradise Pond, a heavily used recreation spot for students, residents, and tourists, especially Smith alumnae. Paradise Pond has had a mill dam since 1666, the most important mill site during the first 200 years of Northampton's colonial settlement. Downstream, the Army Corp of Engineers diverted the river away from central

Northampton in 1940, but the bike path, which now occupies an old rail line, follows the original course of the river, now called the Hidden Mill River. The Hidden Mill River offers a unique opportunity to combine recreation with education, and bring to light the layers of history that have left the downtown as it appears today. The currently diverted flow of the Mill River then finally empties out into Hulbert's Pond in Mass Audubon's Arcadia Wildlife Sanctuary in Easthampton, which offers wonderful opportunities for recreation, as well as habitat and wildlife education. During seasonal high water, a two-mile- long paddlers' trail is available that runs from the wildlife refuge through the floodplain forest to a barrier under a bridge at the end of South Street at the southern end of Northampton.

4. Players and Process

a. Historical Roots

Beautification schemes for the Mill River cropped up in the last quarter of the 19th century at the height of the river's industrialization when a "Paradise Park" plan was proposed in the 1880s and Smith College hired Olmsted, Olmsted and Eliot to plan its campus. Then, just 2 years prior to the great flood of 1936 and hurricane of 1938, Gerald Stanley Lee, a well-known local resident, wrote a full-blown proposal for a Calvin Coolidge Riverpath Park. After the river diversion in 1940, no further thought was given during the next generation. Since the 1970s, however, the city of Northampton has produced a number of planning documents to return the river to the life of the city. Northampton's city planner, Wayne Feiden, has been acquiring open space along the river in Northampton since the 1990s, labeling each new acquisition as part of a Mill River Greenway. Meanwhile, in Williamsburg during the late eighties and early nineties, private property rights advocates waylaid an attempt to extend Northampton's multi-purpose path along the former rail line.

b. MRGI – The Mill River Greenway Initiative

In 2010, some three dozen residents of the Mill River Watershed, with backgrounds from the blue-collar trades, the ecological and design professions, and staff from governmental and non-profit agencies met to discuss the possibilities of a greenway. In spring of 2011 MRGI built a website and asked the general public to join in designing and building a greenway with the ultimate goal of creating access and a series of riverwalks and bikeways that would connect the length of the Mill River.

Two co-moderators emerged from the MRGI membership, one in Williamsburg, a town of 2,500, and one in Northampton, a city with almost 30,000 people. While MRGI has no structured organization (just 2 moderators and 110 members), it does have an umbrella group for 501 non-profit status. On the website, the moderators update events and projects along the length of the river, mindful that the ultimate goal is to connect the dots, to link the projects together, and reconnect the people to the river. Projects emerge from the interests and efforts of local residents, some initiated or nudged along by MRGI and some not.

c. Smith College – The River Runs Through It

Smith students have a long history of engaging with Smith's frontage on the Mill River, which includes Paradise Pond. Both the Pond and the river have been sites for active and passive recreation, field research, ecological academic pursuits, and artistic inspiration. Recent projects include mapping storm water outflows and invasive species, community workshops to learn about invasive species removal, native planting plans, broad-scale planning, and adaptive reuse and site redevelopment of historic industrial sites along the river.

Since 2010, Smith, students from two scholarship programs have engaged directly with MRGI to support the establishment a *Greenway* along the Mill River. Students have provided design and planning services for the Williamsburg Greenway Committee's multi-use path between the villages of Williamsburg Center and Haydenville and have conducted field work and developed new layers of data for use in Geographic Information Systems (GIS) mapping applications. These same students are also working with MRGI and a design professional to develop interpretive brochures for self-guided walking tours of the Mill River. Finally, Smith students in landscape design courses have produced several reports on the river.

d. The University of Massachusetts

MRGI has also facilitated design studio work from students at the University of Massachusetts Department of Landscape Architecture and Regional Planning. MRGI and these design programs have developed a mutually beneficial relationship that will lead to a well-conceived greenway plan that will benefit the watershed and leave a legacy of good town-gown relations.

e. The Public Process in Two Communities

In 2012, MRGI members successfully requested the Williamsburg Board of Selectmen to create a special Mill River Greenway Committee to explore the feasibility of linking together the two village centers with a multi-use path. The Williamsburg Greenway Committee followed on the heels of a collaborative town-wide envisioning process, which placed the Mill River at the center of future planning efforts. The path will create access to the Mill River, allow students and residents a safe path between villages, encourage the preservation of cultural and natural features, and help concentrate village growth close to the corridor, relieving development pressure on open space. Finally, a multi-use corridor will serve as a spine for the network of trails that Williamsburg's Woodland Trail Committee has been steadily developing throughout the town, paying homage to the town's rich history and scenic woodlands.

Meanwhile, in Northampton, the Director of Planning and Development, Wayne Feiden, has guided the city's acquisition of land along the Mill River, culminating in 2011 with the purchase of the 181-acre site in Florence co-owned with Grow Food Northampton. A host of potential Mill River initiatives await realization between a series of anchor sites: nature study and cultural conservation in Florence, walking paths from Bay State down through Northampton, and scientific study opportunities throughout the corridor.

5. Realizing the Power of Collaboration: Site Design at a Historic Mill

MRGI can draw on the resources of the of the Pioneer Valley's Five College Consortium, which includes the University of Massachusetts, Amherst, as well as Amherst, Hampshire, Mount Holyoke and Smith Colleges. Collaboration between MRGI and institutions of the consortium, particularly Smith College, has led to more than a score of research projects and design proposals addressing the visions of a Mill River greenway. Two recent student projects, one from the University of Massachusetts and one from Smith College addressed the Arts and Industry building in Florence, one of the key anchor sites along the Mill River, assessing current conditions and offering comprehensive plans to revitalize the area and reconnect it to the river.

Scott Fulford, a graduate student in the Landscape Architecture and Regional Planning Department at the University of Massachusetts, examined the cultural, recreational, and ecological significance of a spot he called "Florence Point" that lies at a node between two 19th-century factory buildings. He described the history and current uses of the site, including business and commercial areas, bus and bike routes, and the dam and falls. He then offered several schemes for the redevelopment of the area, with a park as the key feature in the now vacant land adjacent to the pool above the falls. His proposal turns Florence Point into a legible landscape that signifies a culturally rich and community-centered space. Florence Point has the potential to act as a node, Fulford's word for a gathering point and gateway to riverside recreation and the larger Mill River Greenway.

Sophia Geller (class of 2013) in the Landscape Studies department at Smith College, addressed the same site for a project in a broad-scale design and planning studio in the fall of 2012. After assessing the ecological, physical and cultural realities and potentials of the site, she created a series of bylaws which would promote ecologically responsible storm water management and public access to the riverfront. Her proposed bylaws offered increased opportunity for mixed-use development and the building of new structures in exchange for publicly accessible recreational spaces directly abutting the river, while simultaneously catching and filtering storm water runoff and decreasing the total amount of impervious surface on the property. Geller's design concepts allow people to re-engage with the historic Mill River through entry points to experience more thoroughly the landscapes of their towns.

FIGURE 23:INACCESSIBLE AND UNUSED PORTION OF THE ARTS AND INDUSTRY SITE ABUTTING THE RIVER.

FIGURE 3: EXAMPLE PROPOSED BY GELLER OF A RIVER WALK ACCESSIBLE TO THE PUBLIC.

6. Conclusions

a. The Process

- MRGI gathered together a group of local residents who cared deeply enough about the place in which they live to attend 3 or 4 meetings a year and contribute whatever time they had available.
- We asked our members to develop an overall vision for a Mill River Greenway.
- We prepared a long list of projects, from mapping and photographing to writing and designing and then encouraged members to participate in whichever ones they wished.
- We ensured that every member had a chance to match his or her skill and interest with a particular project.

- We developed an attractive website and gave annual parties.
- We approached every person who might help the cause of the greenway, especially politicians, colleges and the university, and staff in local, regional, and state government departments.
- We incorporated projects that others had initiated into our greenway plan, making sure to give them credit and exposure.

b. Lessons Learned

The MRGI moderators came to the initiative with some lessons already learned and others instilled in them over two years of patiently piecing together the wherewithal to fulfill the greenway vision. We had read well into the enormous literature on community-based, collaborative planning and design approaches, of which Steinitz's recent *Framework for Geodesign* (2012) is a fine compendium of examples. Like most such initiatives, however, MRGI cobbled together the sources of success from the ground up rather than starting with an established framework.

Following are some lessons learned during the *ad hoc* process MRGI engaged in:

- *Shared Passion*. The process must begin with a passion for the place in which one is working, more specifically, a passion that other residents share.
- *Leadership and Vision*. There must be leaders who are in it for the duration of the project, generally at least 5 years. The leaders' vision must be clear and derived from the shared passion. In the case of MRGI we can actually envision what a greenway would look like on most reaches of the Mill River.
- *Expertise*. Without expertise the chance of success is small.
- *Expectations*. Be realistic in your expectations. The usual rule applies – 10 or 20% of the people do 80 or 90% of the work.
- *Homework*. Do your homework about the place, do a great deal of research, interviewing, and interrogation. Know what you're talking about, whether it's history, natural phenomena, or the political climate
- *Historical Awareness*. (Part of your homework) The place you're working with did not hatch out of an egg. Others have had visions of that place, often generations back. Find out about them.
- *Humility*. …but don't assume you'll ever know it all – to assume makes an ass out of u and me.
- *Patience*… a lot of patience.
- *Rewards*. Don't expect them. When and if they come, relish them.

c. Strengths and Weaknesses of the Process

We consider a tiny budget, flexibility, and time our greatest strengths. We can get by on very little money because we have thus far remained primarily advocates rather than managers. Our process is flexible by definition because we can respond to any situation or project that needs attention since time is not a major factor. That is, we meet few deadlines, save those that require the completion of small projects or applications for grants. We depend on others to complete projects while we play a supporting role…

…which is a weakness, as well. Since we have few funds, we can initiate and complete only small projects, such as brochures and publicity. There will come a time when we will have to step up and find funds to develop design projects for such sites as "Florence Point" or the "Hidden Mill River" in Northampton's downtown. Furthermore, MRGI alone is a fragile organization, dependent on two co-moderators and members with little spare time.

In our first year, we lacked the consistency only an institution can supply. Smith College, via the Landscape Studies program and the Center for the Environment, Ecological Design, and Sustainability (CEEDS) has served as the institutional backbone for the MRGI. Smith College has been a resource, a memory, and a facilitator for projects related to the Mill River Greenway. Discrete projects, small and large, come and go. Smith College serves to ensure that these projects build on one another. When new groups, projects, or initiatives surface, Smith College can facilitate the alignment of these new projects with projects of the recent and more distant past. For Greenway visioning and planning to work, local groups with local knowledge must take the lead. MRGI has enlisted Smith College to work in the background help realize the broader vision. Greenways inevitably cross political boundaries and only hang together when all involved can see the benefits. Institutions such as colleges, universities, and regional planning agencies can help.

d. A Final Few Words

In broad outline, the Mill River Greenway Initiative has revived the original process that towns and entrepreneurs used in developing anchors and connections along the Mill River. Beginning in the 17th century, with the help of local government and private funds, millers and factory owners built enterprises on dam sites up and down the river, first connecting them with streets and roads, then with a railroad. Each anchor site reflected its owner's and residents' vision, while the connections were created with government aid. This is the same process we are following, and, while it will likely take many years to develop each site, it will be worth the wait.

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A Vision for Future Development in Historic District: greenway planning, green infrastructure adaptation and landscape design in historic districts of US and China

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1. Introduction

This paper is trying to explore the future development for historic district. "Historic districts" talked in this paper are mostly part of modern cities and have valuable architectures and profuse cultural backgrounds. These historic districts now are legally protected by policies and also by the government, and most of those are involving supremely significant green spaces or greenway systems which can also date hundreds of years ago. However, some of them are still facing serious problem of losing the green patterns of the city and therefore become a scattered puzzle of urban open space system; and some others facing the problem of building facilities decomposed and keep distant to fulfill urban sustainable development. So whether, greenway planning can be adapted to the future development of these historic districts, and can green infrastructure adaptation make their functions to turn the communities green and sustainable? These are the research questions this paper will discuss.

The two study sites that the paper will discuss are Back Bay historic district in Boston, Massachusetts in US and former Concession in Wuhan, China.

2. Background and Literature reviews

2.1 Case studies in development of historic districts
The first law of preserving historic district is passed in France in 1840. And later in 1887, another law called "Monument Protection Act" also came into being and raises the idea of preserving all the valuable historic buildings and relics. After that, England, United States and other countries all around the world start to publish laws about protecting historic buildings.
There are several stages of historic preservation in history. The first stage is to restore the buildings and structures. And the second stage is to take into the considerations of landscape preservation and atmosphere recreation. French Quarter in New Orleans is a good example that government restored most of the buildings after the area had suffered from the Great New Orleans Fire in 1788. There were some adaptive ideas of the buildings such as the design of fire wall and replace the peaked roofs of old French style to flat tiled roofs.

Another great example for adaptive reuse of historic buildings is the New Earth and Heaven in Shanghai, China. The unique architectural style is called Shikumen Architectural style (or "Stone Warehouse Gate"). Shikumens are two or three-story buildings resembling Anglo-American terrace houses or townhouses. The high brick walls enclosing a narrow front yard distinguish them. It is a kind of buildings has strong gateways and made for people of mid-level income. After the World War II, the architectures were heavily subdivided and turned into a messy condition. With the development of the cities, Shikumen cannot survive in the city of Shanghai because of its bad maintain and unsafe environment. Until some buildings have already been torn

down, people started to realize that the unique building style should be a part of the cultural resource that we kept.
In 1997, many architects around the world including Benjamin Wood turned the messy buildings into new markets and shops. It becomes a modern community including all the facilities and entertainments. Now this area becomes the new center for the city and a new landmark for tourists. It is an example of both building restoration and atmosphere recreation.

2.2 Definition and adaptation of Greenway and Green Infrastructure

Julius Gy. Fabos defines greenways as "corridors of various widths, linked together in a network in much the same way as our networks of highways and railroads have been connected. The major difference is that nature's super infrastructure - the greenway corridor networks - is pre-existent. The river valleys have been carved out over many thousands of years. Our linear coastal system with thousands of miles of barrier beaches, rugged cliffs, or extensive Coastal wetland and floodplain systems have been formed by nature. This 'giant circulating system' identified by the US President's Commission (1987) is our greenway corridor network which needs to be treated with special care." (1995)

Fabos also points out in *Greenways--the beginning of an international movement* that majority of greenways fall into one of three major categories, and that the three types are increasingly overlapping in comprehensive greenway systems or networks:
1. Greenways of ecologically significant corridors and natural systems...
2. Recreational greenways...
3. Greenways with historical heritage and cultural values: to attract tourists and to provide recreational educational, scenic and economic benefits; to provide high-quality housing environments at greenway edges for permanents and seasonal housing; to accommodate water resources and flood prevention and sensitively located alternative infrastructure for commuting; to offer vehicles of expression among many other possibilities. (Fabos, 1995)

Jack Ahern concluded five key ideas of greenway definition, which are:

The spatial configuration is linear; Linkage is the key; Multifunctional; The greenway strategy is consistent with the concept of sustainable development and finally, greenway should be considered as a complement to comprehensive landscape and physical planning, not a replacement. (Ahern, 1995) In recent literature there are some new ideas about greenway, such as ecological network, ecological infrastructure, extensive open space systems, multiple use modules, wildlife corridors, and landscape restoration framework. (Ahern, 2002)

Green Infrastructure is a concept originating in the United States in the mid-1990s that highlights the importance of the natural environment in decisions about land use planning. Green infrastructure has its origin in two important concepts: (1) linking parks and other green spaces for the benefit of people, and (2) preserving and linking natural areas to benefit biodiversity and counter habitat fragmentation (Benedict and McMahon 2006). In Jack Ahern’s point of view, green infrastructure is defined as “spatially and functionally integrated systems and networks of protected landscapes supported with protected, artificial and hybrid infrastructures of built landscapes that provide multiple, complementary ecosystem and landscape functions to a broad public, in support of sustainability” .(Ahern, 2003)

The main benefits of Green Infrastructure are about hydrology include rainfall interception, water storage, increased soil infiltration, decreasing peak flows and so on. The most Successful and famous examples are: Street Edge Alternatives (SEA Streets) Project in northwest Seattle and the Staten Island Blue Belt in New York. They vary at scale but both use green infrastructure instead of sewer construction to manage storm water.

2.2 History of study areas

History of Back Bay Neighborhood in Boston, Massachusetts

Back Bay neighborhood got its name because it was literally the back by for Boston before it was filled in in 1800s. In 1814, a mill dam was constructed to serve as a toll road connecting Boston to Watertown, and later was buried under the present day Beacon Street.

Nancy Seasholes discuss in the Book *Gaining ground that:* O*ne of the major projects that affected landmaking in Back Bay was called the Mill Dam between 1818 and 1821. This project did not actually create much land but did produce a structure that ultimately led to the filling of the whole Back Bay.(Seasholes, 2003)* Soon after the Mill Dam was finished, more land was made on the south of the dam. The landmaking of now called public garden was happening in 1830s. Then in 1849, there had been a great problem in Back Bay that all the sewage drained into the receiving basin. Far more serious, the city committee reported that: *Back Bay at this hour is nothing less than a great cesspool, into which is daily deposited all the filth of a large and constantly increasing population.(Seasholes, 2003)* Later on, two solutions were adopted to work with this problem, and the second one had been selected at last which is to fill in Back Bay, covering the sewage on the flats. After that, the Back Bay was created by filling the tidewater flats of Charles River. The massive project was begun in 1857, and the filling was completed by 1880. The project reached Kenmore Square in 1890, and got to the Back Bay Fens in 1900. This project was the largest number of land reclamation and would have been impossible to achieve under modern regulations.

Early between 1879 and 1895, Olmsted and Eliot integrated parkways and stream valley parks named Emerald Necklace. Anthony Walmsley talked emerald necklace in his paper Greenways and the making of urban form.: *It is based on the distinctive regional ecologies with the join of historic public grounds of the old city--Boston Common and Public Garden, by way of Commonwealth Avenue and the development of Back Bay, to the Necklace's outward continuation to the country by way of the Arborway, Arnold Arboretum and West Roxbury Park(now Franklin Park).(2003)* This park system had become one of the largest in the country by 1902. (See Figure 1)

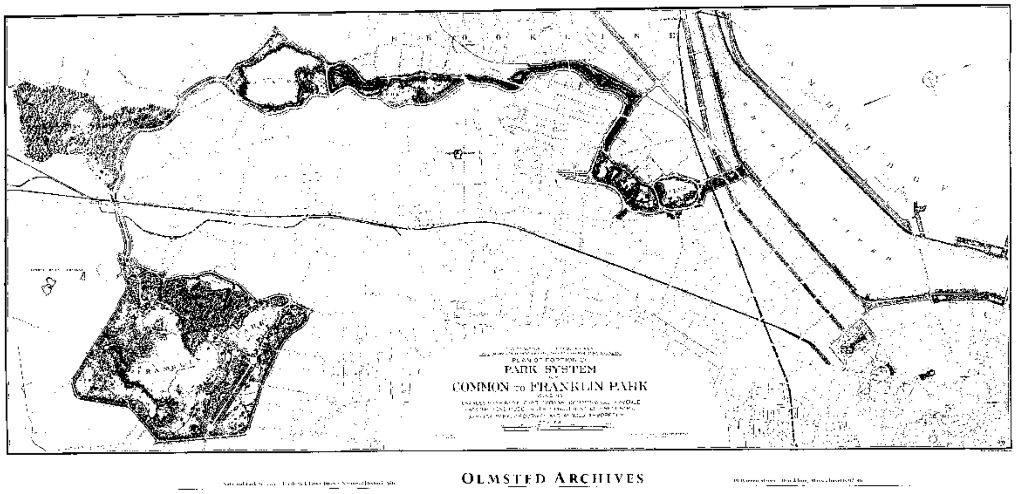

Fig. 1. Plan of Portion of Park System from Common to Franklin Park, 1894(highlight the greenway section as green, and delineate the location of Back Bay)

The Commonwealth Avenue Mall was designed by the famous architect at that time-- Arthur Delevan Gilman. Frederick Law Olmsted designed the Newton portion of Commonwealth Ave and included the parkway as part of the Emerald Necklace park system. The first statue on the Commonwealth Avenue Mall was erected in 1865 at Arlington Street.
The middle park then officially named Commonwealth Avenue Mall, and become a significant part of the whole greenway system of Emerald Necklace.

History of Concession in Wuhan, China

Concessions in China were a group of concession territories within China that were governed and occupied by foreign powers. They are frequently associated with colonialism. Most had extraterritoriality and were enclaves inside key cities that were treaty ports. Other than other minor extraterritorial regions, these concessions no longer exist.

Wuhan is a harbor city along Yangtze River. It is famous for its connectivity to other main nine cities, so it also became one of the dominant areas for foreign powers. Hankow, the district in Wuhan with the longest history is the concession area that foreign countries picked. The first two countries--England and France, started their landing in 1861 after the Second Opium War. The concession area take 246 square kilometers of the land, and divided into five pieces for five different countries.

Concessions in many ways are the shame of the history and the un-healing scars of many Chinese people. But on the cultural viewpoint, this area contains many outstanding architects and extraordinary landscape that will never appear again. So the Wuhan Government started to preserve this area in 1980s and publish laws to preserve buildings and structures.

2.3 Greening historic districts

With the time passed by, there appears the rising concern of people that sustainable becomes a main theme of the urban growth and landscape planning. In the meantime, EPA rises up the idea that we need to find a way to think "Smart Growth and Sustainable Preservation of Existing and

Historic Buildings". However, *the existing problems in historic street blocks are: incorrect preservation ideas, incorrect preservation modes and destroyed habitation and life network.* (Li, Ding. 2003) In this way, there is a gap come into format, which indicates the importance of making historic communities/districts more sustainable.

Then on June 15th, 2011, the U.S. Environmental Protection Agency convened a Symposium on “Greening Historic Communities”. The theme of the symposium is “What Works, What Doesn’t, and What Should Change?” at the Hotel du Pont in Wilmington, Delaware. Apparently, this symposium is aiming at the future development of historic communities.

Throughout the symposium, participants were encouraged to reflect on what’s working, what’s not, and what needs to change. The following are key themes that emerged from the presentations and discussions:

• *There is an urgency to these issues that wasn’t there 20 years ago. Cities and regions are taking an increasingly proactive and innovative approach to promoting more sustainable development patterns that encourage higher densities, mixed-use development, and increased walkability.*

• *There needs to be a culture-shift towards a culture of re-use, stewardship, and a focus on future generations. Efforts need to look beyond buildings to the communities, recognizing their context and acknowledging their role in maintaining a sense of place.*

• *Standards and policies, both local and federal, need to reflect stronger values around sustainability and preservation, particularly in the face of climate change. Our standards and policies should prevent or disincentive tearing down older buildings to build new LEED certified buildings.*[4]

3. Research Objectives

The goals of this project is to make an evaluation of the ecological patterns of the site, find out the existing condition and problems these sites are facing, and make suggestions to the future development. The best future vision includes creating adaptive ecological habitat, reasonable space arrangement and comfortable living spaces satisfying both the residents’ needs and social requirement. By achieve the objectives, the research needs:

-To understand the definition the green way, green infrastructures and sustainable neighborhood, raising possible solutions that may be adopted in historic districts;
-To use certain software to analysis the ecological patterns of the historic districts, invest historic maps and GIS data, including historic records of buildings and surrounding landscape;
-To compare the two study areas, conclude both the merit and deficiency, conclude the problems that historic districts are facing and make recommendations of the process to improve existing conditions and also the future trends.

4. Research Questions

[4] Greening Historic Communities Meeting Synopsis, June, 2011

● Can cultural greenway be included in these historic districts and connected to the existing regional greenway system?
●How can we include green infrastructure to help improve the existing problems of water management?

FIG 2. GIS OVERLAY ANALYSIS
(PHOTO CREDIT: YIWEI HUANG)

5. Methodology

Since different historic districts have different form patterns and different green space type, various methods will be adopted to research these areas. (1) In Wuhan's part, remote sensing, Fragstats and ArcGIS analysis will be used to investigate the ecological spatial patterns and connectivity of Hankow Historic District; (2) In Back Bay's part, the paper will use detailed inventory and analysis (including GIS analysis and measurements) of existing conditions to develop through the understanding of both greenway scale and landscape pattern; (3) The paper will make a conclusion and assessment of whether greenway planning and green infrastructure can be an answer which satisfy the future development of historic district.

6. Research analysis and results

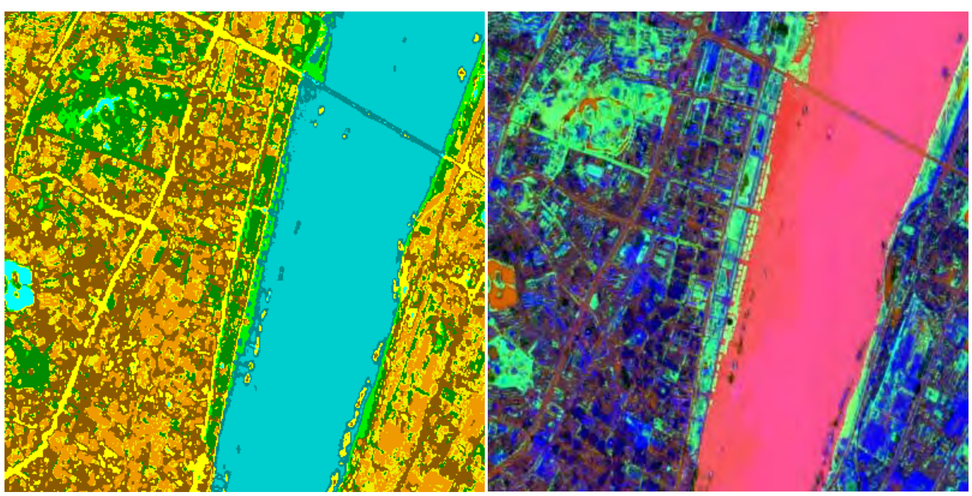

FIGURE 3. REMOTE SENSING PICTURE OF HANKOW CONCESSION IN WUHAN, CHINA
Photo credit: Yiwei Huang

In this project, five categories are divided in terms of the green space. They are vacant space, building surrounding space, green plaza, street trees or tree alley and affiliate space of institution.

The remote sensing picture was first used to get the overall picture of the concession. After that, GIS grids of 2.5cm*2.5 cm squares were drawn on the map. The project also uses CAD to revise some of the remote data that is not correct comparing to the current situations. After all these pictures prepared, Fragstats software was used to calculate the spatial landscape pattern on site.

Table Data result of Landscape Metrics

ID	LID	CA	NP	PD	LSI	AREA_MN	PLADJ	COHESION	AI
1	Vacant Space	0.29	3.00	1038.96	1.93	0.10	91.02	99.75	95.46
2	Building surrounding space	1.25	51.00	4077.96	9.47	0.02	78.71	95.25	80.52
3	Green plaza	0.11	5.00	4733.73	2.35	0.02	81.95	94.88	88.78
4	Tree Alley	1.23	135.00	10942.25	14.47	0.01	67.38	84.59	68.93
5	Affiliate space of institution	0.37	3.00	802.68	2.41	0.12	90.13	97.45	93.98

The table above shows the number the project get from Russian Concession. Each number can find scientific meaning by comparison to other numbers and the definition of the metric configuration.

Here are some definitions of the configurations:

Core Area (CA)--Core area represents the interior area of patches after a user-specified edge buffer is eliminated. All other things equal, smaller patches with greater shape complexity have less core area.

Isolation/Proximity (PD)--Isolation/proximity refers to the tendency for patches to be relatively isolated in space (i.e., distant) from other patches of the same or similar (ecologically friendly) class.

Number of Patches (NP) --The higher degree of fragmentation, the higher NP the area has.

So after all these calculations and comparisons, it is easy to get that the vacant spaces, urban green plazas and affiliate spaces of institution has very limited biodiversity comparing to building surrounding spaces or tree alleys; On the other hand, the PD and NP of Tree alleys is much higher than other green spaces, which means the degree of fragmentation of street trees is much higher than others.

After this project, we can draw some conclusions that the biodiversity of historic districts is limited, and especially in urban plazas and affiliate spaces of institutions; and the street trees lack connection to each other so that they will become scattered point of green space but not providing any benefit to ecosystem service. The whole green space inside the historic district lacks connection to the green space in the city outside the historic district.

In Back Bay historic district, although Emerald necklace is one the most famous cultural greenway system in the country, the Back Bay neighborhood can be still improved in some way. The most severe problem that Back Bay neighborhood is facing is the decrease of ground water level. It is mentioned in the report *Back Bay Boston, Part II: Groundwater Levels:* With construction of sewers, drains, subways and the basements of buildings below the water table, some of which leak, the groundwater level has dropped in Back Bay. Where wood piles have been exposed to air for some time, the piles have rotted when attacked by fungi, borers and other organisms. A few buildings have settled and cracked, requiring owners to underpin their structures at great cost in order to restore the foundations. (Aldrich, Lambrechts.1986)

And in the MBTA Groundwater Action Plan in 2006 also mentions that: the current causes of groundwater removal are Construction dewatering, Leakage into deep sewer pipes, Sump pumping from residences, deep basements and transportation corridors and Loss of infiltration due to surface cover and so on.

Based on the analysis result from the GIS map, the emerald necklace greenway system is only connected through the commonwealth avenue within the Back Bay historic district. Besides, the land cover on both sides of the avenue is a impervious pavement. (Fig 5) The bike trail system, although connecting the way from Arlington Street to Massachusetts Avenue, the on-street parking is big obstacle to prevent people from engaging with the Commonwealth Avenue Mall.

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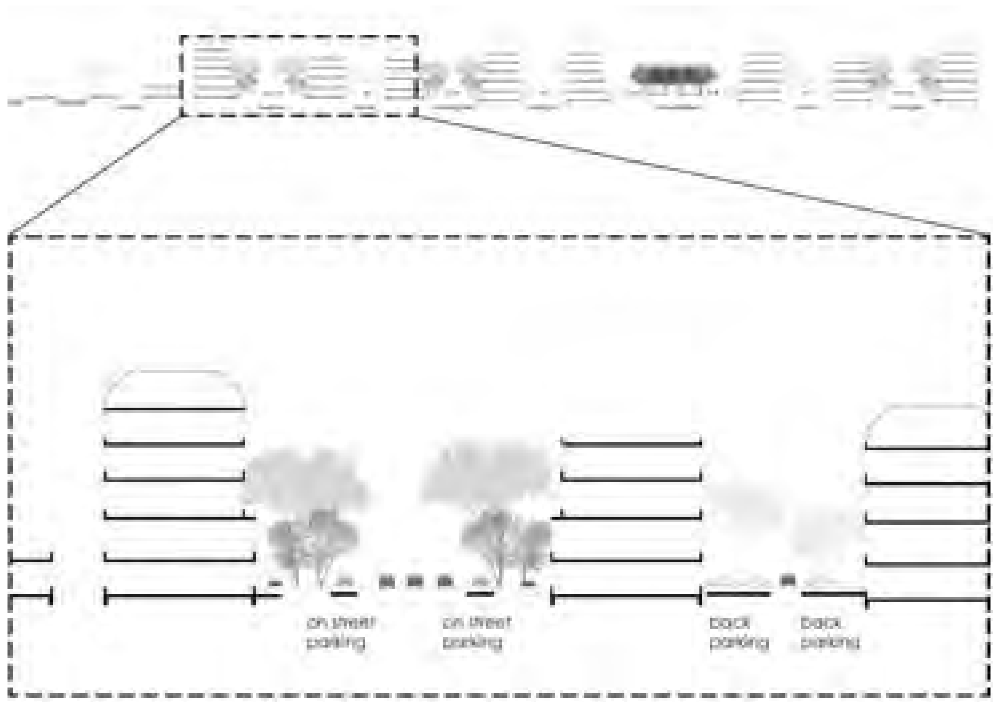

FIGURE 7 EXISTING CONDITION CUTTING PERPENDICULAR TO COMMONWEALTH AVENUE, PHOTO CREDIT: YIWEI HUANG

It can be concluded from the above that impervious pavement has been the problem of this site. Despite other fact, replace impervious pavement with permeable pavers can maintain the amount of groundwater. So green infrastructures, such as bio swales, permeable pavement, and LID projects such as green-parking spaces can be the solution to the site. (Figure 8)

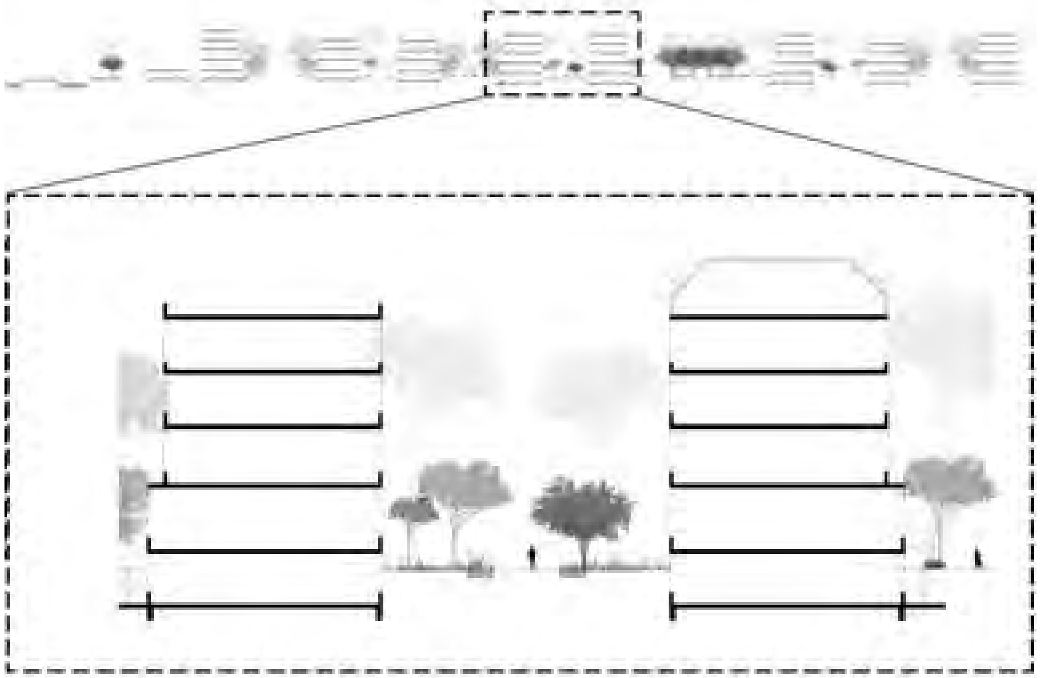

FIGURE 8 PROPOSED SECTION CUTTING PERPENDICULAR TO COMMONWEALTH AVENUE, PHOTO CREDIT: YIWEI HUANG

And also, in terms of the whole communities, green infrastructures can be adapted to become a branch for the historic greenway on Commonwealth Avenue.

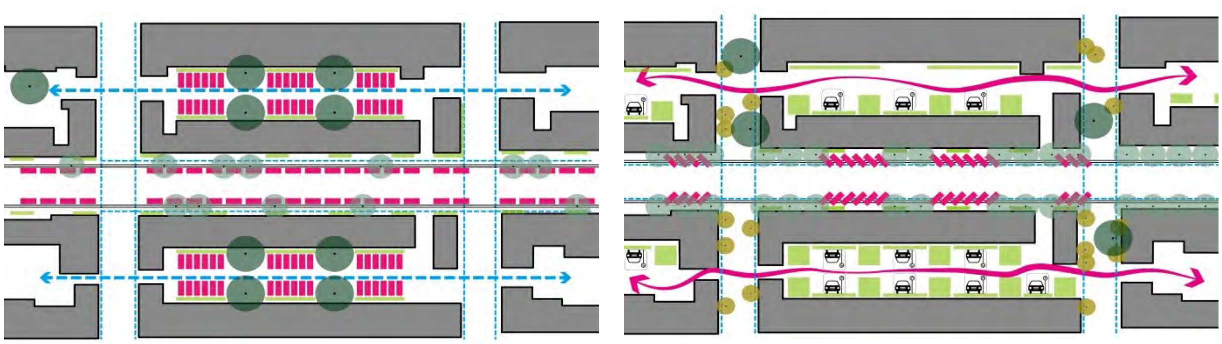

FIGURE 9 EXISTING AND PROPOSED CONDITION OF ONE BLOCK, PHOTO CREDIT: YIWEI HUANG

The figure above shows one possible way to adapt green infrastructure on the site. By not change the building but change some part of the road such as add bio-swales, rain garden, and even small green backyard, we can achieve the goal of water management. Other possible solutions can be green roof, vertical gardens and small rain gardens. Those green infrastructures take little space but do function well to control the water. So green infrastructure can be one way to improve the condition of water problem. But in terms of keep the French style feature, bioswales; underground water tunnels, permeable pavement and green parking lots can be suitable answer to the question.

7. Conclusions:

Cultural greenway system is a significantly powerful axis that the urban buildings should follow. At the same time, historic buildings can be powerful edges on both sides of the greenway system. And with the time pass by, the greenway system or green infrastructure nowadays should not just provide the function of connecting the two green spaces or provide recreation space for humans, it also require the function of prevent hazards, maintain groundwater and connect the fragmented patches for ecosystem.

Specifically in historic districts, large scale planning combined with human scale green infrastructure can be an answer to the future development in terms of the continuity and stability of ecosystem. At the same time, since the historic features are still preserved in many places, these green elements should be carefully designed to keep the origin features of the historic districts by following the grids and the edge of the buildings. The historic greenway, at this point, is also a central park space for both local residents and tourists. In sum, the way searching future for historic districts has various answers, and there is always a long way to go.

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Water-related Ecosystem Services from Green Infrastructure

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Abstract

Green infrastructure is currently in common use to provide water-related ecosystem services. Common applications include: use include bio-retention basins, green roofs, constructed wetlands, permeable pavement, and sidewalk planter. These applications collectively can contribute to a city and region's alternative infrastructure. They help to improve the water quality of streams and drinking water supplies as well as manage and reduce the amount of storm water runoff.

While green infrastructure is increasingly applied, it is not consistently monitored to learn how it performs regarding specific ecosystem services. Ecosystem services are the benefits that people can get from nature ecosystem. In this paper we discuss specific methods and procedures to evaluate the effectiveness of specific ecosystem services related to water quality and quantity.

1. Introduction

The term green infrastructure is appearing more and more frequently in land conservation and land development discussions across the world, and many cities have introduced green infrastructure to manage stormwater, and improve water quality, among other ecosystem services. But there are not exactly answers about how effective green infrastructure is in practice to improve water quality and control water quantity. In this paper, we discuss specific methods and practices to measure how rain gardens, green roofs, bio-swales, bio-retention, constructed wetlands, and permeable pavement clean, infiltrate, evaporate, or reuse storm water on the site. Thus, what to measure and how to measure the success of green infrastructure dealing with water quality improvement and water quantity control become the top priorities of this study.

2. Ecosystem Services and Green Infrastructure

"Ecosystem services can be defined as the benefits we receive from nature: resource services, such as food, water, and energy; regulatory services, such as purification of water, carbon sequestration and climate regulation, waste decomposition and detoxification, crop pollination, and pest and disease control; support services, such as nutrient dispersal and cycling, and seed dispersal; and cultural services, including cultural, intellectual, and spiritual inspiration, recreational experiences, ecotourism, and scientific discovery." (Steiner, 2011) Ecosystem services are important portion of the total contribution of human welfare. Green Infrastructure support such functions and services, which include temperature regulation, energy conservation, water run-off management and flooding control, biodiversity, waste treatment, nutrient cycling, erosion control and sediment retention. The water-related ecosystem services that green infrastructure can provided are water quality improvement and water quantity control. Green infrastructure improves water quality by the processes of sediment removal, nitrogen removal, phosphorous removal, pollution control. And green infrastructure controls water quantity through the processes of stormwater runoff management, stormwater infiltration, and flooding control.

2.1 Water quality improvement

Green infrastructure improves water quality in particularly four ways: sediment removal, nitrogen removal, phosphorous removal, and organic pollution control.

2.1.1 Sediment removal

Sediment that comes from stormwater runoff strong affects the water quality. Green infrastructure remove the sediment by deposit it through the plants. Water turbidity is a good indicator to tell us the quality of water body. Scientists can easily measure turbidity of certain water sample in the laboratory. Alternatively, a handheld turbidity meter help scientist and landscape architects get to know water turbidity in the field. Another indicator related to the sediment removal is the Total Suspend Solids (TSS) of water. By installing sediment trap which is a small instrument bordered by a small beam that captures and collects sediment at the entrance to a bio-retention area, we can easily obtain the TSS of water. Thirdly, water turbidity is usually measured using Secchi disk test. A white and black disk is lowered into the water until the disk is no longer visible; this depth is regarded as the water turbidity depth. Typically, the deeper the disk is, the clearer the water is.

2.1.2 Nitrogen and Phosphorous removal

Stormwater from parking lots, driveways and building roofs usually contains high quantity of nitrogen and phosphorous which will cause significant water pollution problem. Even worse, high concentration of nitrogen and phosphorous lead to eutrophication which dirty water body and decrease dissolved oxygen. As a result, the absence of sufficient oxygen will kill large numbers of aquatic life. Plant roots and soils in the green infrastructure can ease pollution by absorbing nitrogen and phosphorous pollutants through chemical and biological reactions and then the stormwater is cleaned and filtered before infiltrating into the ground.

By measuring the total nitrogen and phosphorous that entering and exiting green infrastructure, the nitrogen and phosphorous removal rates of this system are evaluated. The quantity of aquatic plants like algae, plankton in are also good indicators of nitrogen and phosphorous concentration in Some types of green infrastructure like bio-retention, constructed wetlands, as the more nitrogen and phosphorous concentration, the larger number of those aquatic plants.

2.1.3 Organic Pollution control

Green infrastructure also improve water quality by controlling pollutants such as oil, asphalt pavement, and rubber tires that come from parking lots, roads, and automobiles. These kinds of pollutions will serious contaminate water, and then compact even kill some organisms that living in water. Plants and soils in green infrastructure play an important role in trapping and dissolving those pollutants, and then the stormwater is purified before entering river.

2.2 Water quantity control

Through stormwater management, which includes reduce stormwater runoff and increase stormwater infiltration, green infrastructure control water quantity, and then reduce flooding, and recharge groundwater. Green infrastructure reduces stormwater runoff by directing stormwater runoff to the green structure which contains soils and native plants. Stormwater infiltrates into the ground instead of flowing into the public drain pipe directly. In this way, the water that flow into river is greatly decreased and thus flooding risk is reduced spontaneously. On one hand, plants play an important role in recycling the water because they absorb and keep stormwater as resources for photosynthesis and evapotranspiration. On the other hand, stormwater infiltrates into the soil and recharge the groundwater. Inflow and outflow are two important parameters normally used to measure the change of water quantity in green infrastructure system. By measuring inflow and outflow of a green infrastructure system, we can calculate how much runoff has been reduced.

3. Monitoring of green infrastructure benefits

Monitoring is a process of routinely gathering information on all aspects of the project through the regular observation and recording of activities taking place in a project to check on how project is progressing. Monitoring of green infrastructure benefits can easily be done by installing some related monitors in the green infrastructures and then observation, recording and analyses the records to get the conclusions. Monitoring the ecosystem services benefits of green infrastructure as an opportunity to "learn-by-doing" will help us understand whether green infrastructure benefits or supports water-related ecosystem services (Ahern, 2011). While green infrastructure has been practiced successfully around the world for decades, its monitoring hasn't it been done more regularly. This due to the several reasons: 1) green infrastructure is a new idea and is in the developing process and people still in practice the green infrastructure, 2) monitoring costs time and money and is typically not budgeted into green infrastructure projects, 3) monitoring risks the possibility to disclose poor performance or even failure. If green infrastructure benefits the water-related services has an inherent potential to fail, these monitoring experiments can reduce the risk failure as "safe-to-fail".

4. Types of Green Infrastructure

4.1 Bio-retention basin

Bio-retention basins are open, shallow, constructed depressions planted with native plants and grasses. There are there kinds of bio-retention basins according to the size of bio-retention basins, which include rain gardens, bio-retention, and bio-swale. Water quality management and water quantity control are two basic benefits that bio-retention basins can provide to the ecosystem services. Retention basins are designed to receive runoff from impervious surfaces such as building roofs, sidewalk, driveway, and parking lots. The stormwater of parking lot, driveway, and building roofs contain sediments, oil, as well as chemical pollutants like nitrogen and phosphorous. Bio-retention basins capture this water before it flows into the storm sewer. Bio-retention basins slow down water from these imperious surfaces and hold the water in the shallow depression for a short period of time. They allow the water to slowly filter into the ground, rather than running off into the drain pipe directly and then flow into nearby streams and lakes. Sediments and pollutants settle out of the water and are absorbed by plant roots or treated through chemical processes in the soil.

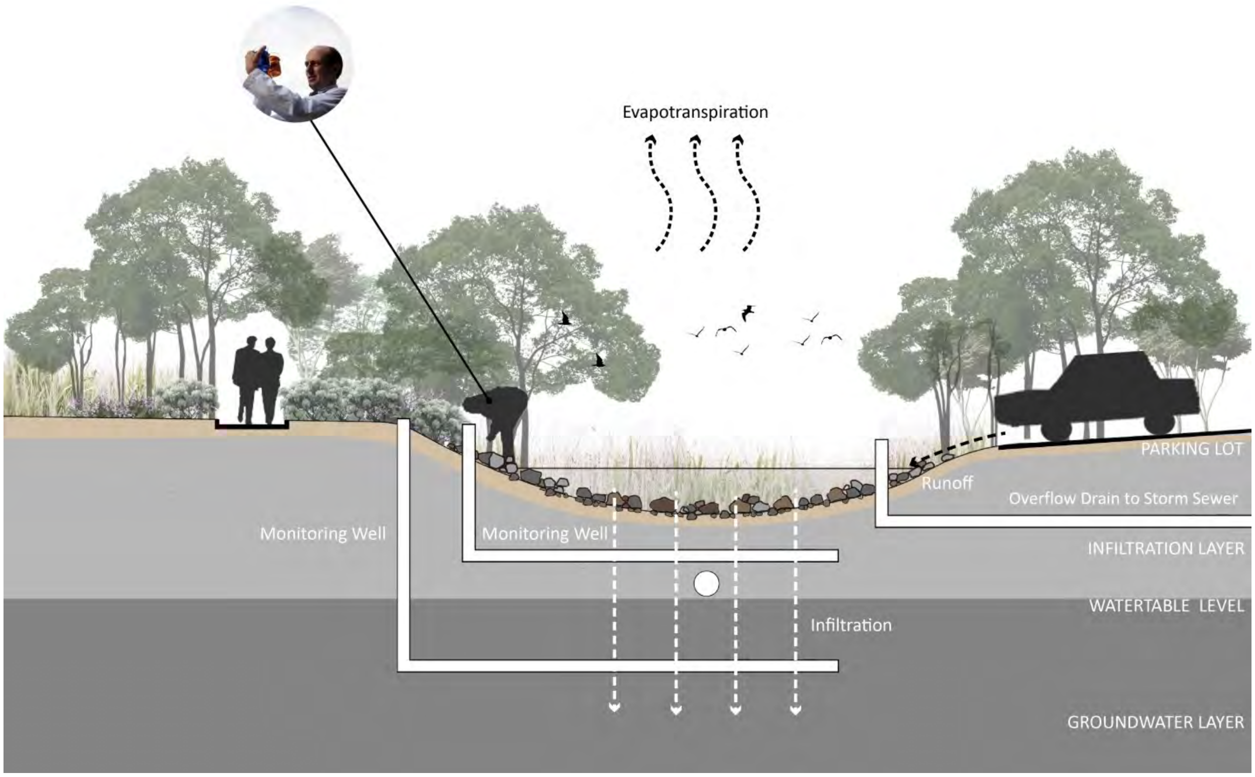

Figure 1. How to include monitoring devices in a typical rain garden

Multiple monitoring wells can be installed under the bio-retention basin: one is in the infiltration layer, the other in the groundwater layer (Figure 1). With these two sampling wells water samples can be collected to measure nutrient/pollutant levels before, and after treatment by subsoil. Samples can be analyzed for nitrogen, phosphorous, and other pollutants in the monitoring well. Water quality improvement can be analyzed by comparing the water quality of stormwater flow into bio-retention basin and the water quality of stormwater that is cleaned and filtered by this system collected in the monitoring well.

V-notch (Figure 2) and flow gauge (Figure3) are two basic tools to measure water quantity. A V-notch is integrated with a check dam/weir which contains scale to monitor the water quantity. In order to evaluate the success of bio-retention basin, this modified V-notch is putted at the outflow of bio-retention basin. Alternatively, the flow gauge can also be used to measure the outflow come from green infrastructure. By comparing the water quantity of stormwater that flow into the green infrastructure and the water quantity of stormwater that is processed by this system, the success of bio-retention is evaluated.

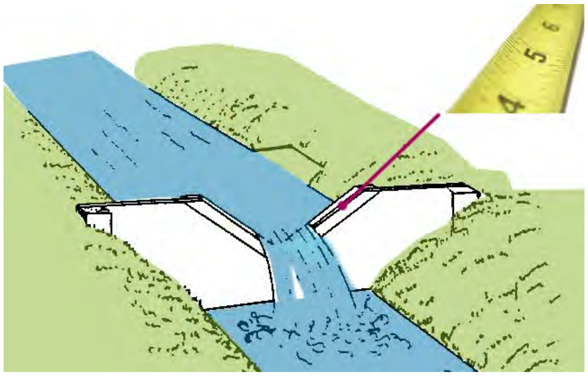

Figure 2. V-notch measure water quantity

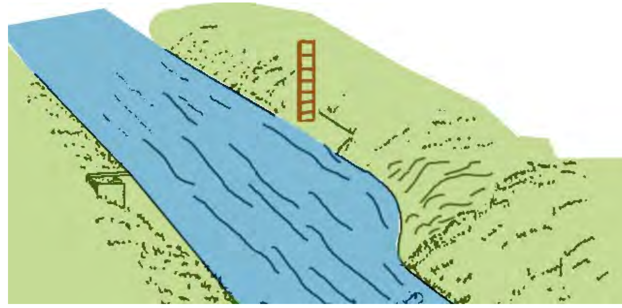

Figure 3. Flow Gauge measure water quantity

4.2 Green roof

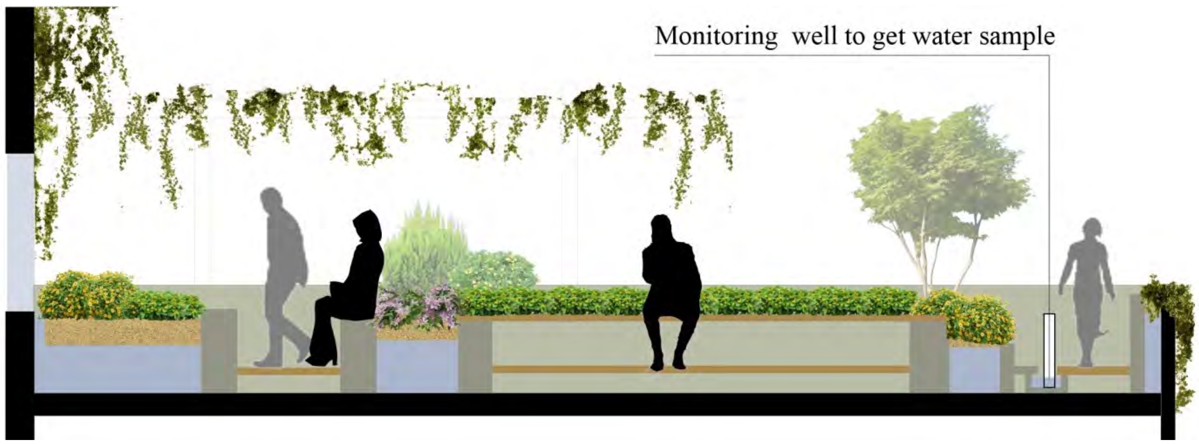

Figure 4. Structure of green roof

Green roofs (Figure 4) a permanent rooftop planting system containing living plants in a light-weight engineered soil medium. Through a variety of biological and chemical processes that filter pollutants, green roofs reduce the amount of pollution delivered to the local drainage system. These processes retain and filter the rainwater not only through the uptake zone of soils and plant roots, but also through foliage that collect dusts, transpire moisture and provide shades. Green roofs are easy to be incorporated into new constructions and can also be built on many existing buildings.

The pollutants in stormwater that run through roofs come from two major ways. One is inherited in the stormwater itself that stormwater formed in pollution air which contain with dust, sulfur, and carbonic oxide, another comes from the grey roofs that contain a lot of pollutant. Compared with the traditional grey roofs, green roofs do not contain so much pollutant, and the plants of the green roof can hold and absorb pollutants. Thus, to test whether the green roofs can improve the water quality or not, we need to compare the water quality that stormwater run through the small sampling green roofs and grey roofs (Figure 5). By evaluating the water quality run through the two different kinds of roofs, we can get the conclusion that whether green roof can improve the water quality or not.

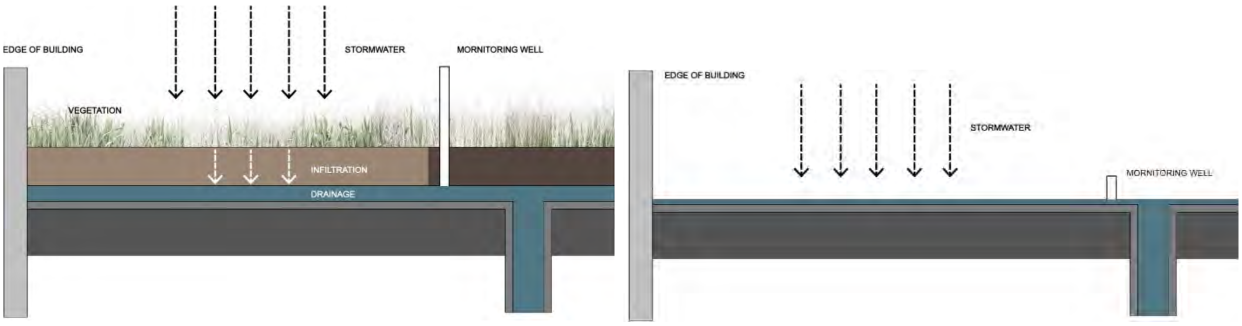

Figure 5. Location to get water sample on green roof and grey roof

To demonstrate that whether the green roofs can control the water quantity, we also need to do the control experiments. First, we need to compare the time that the same amount of water run through the two different kinds of roofs. If the water run through green roofs need more time than the water run through grey roofs, it proves that the green roof can hold the water for a certain time and thus may benefit to reducing the stormwater peak flow and control the water quantity. Secondly, we also need to collect and measure the water volume of water run through these two kinds of roofs. If the quantity of water that run through the green roof less than the stormwater run through the grey roof, we can conclude that green roof is beneficial to controlling stormwater quantity.

4.3 Constructed wetland

A constructed (Figure 6) wetland is an artificial wetland that performs many functions that benefit human and environment. Natural wetlands improve water quality by intercepting surface runoff and removing or retaining inorganic nutrients, processing organic wastes, and reducing suspended sediments before they reach open water, and constructed wetland can be designed to emulate these featured.

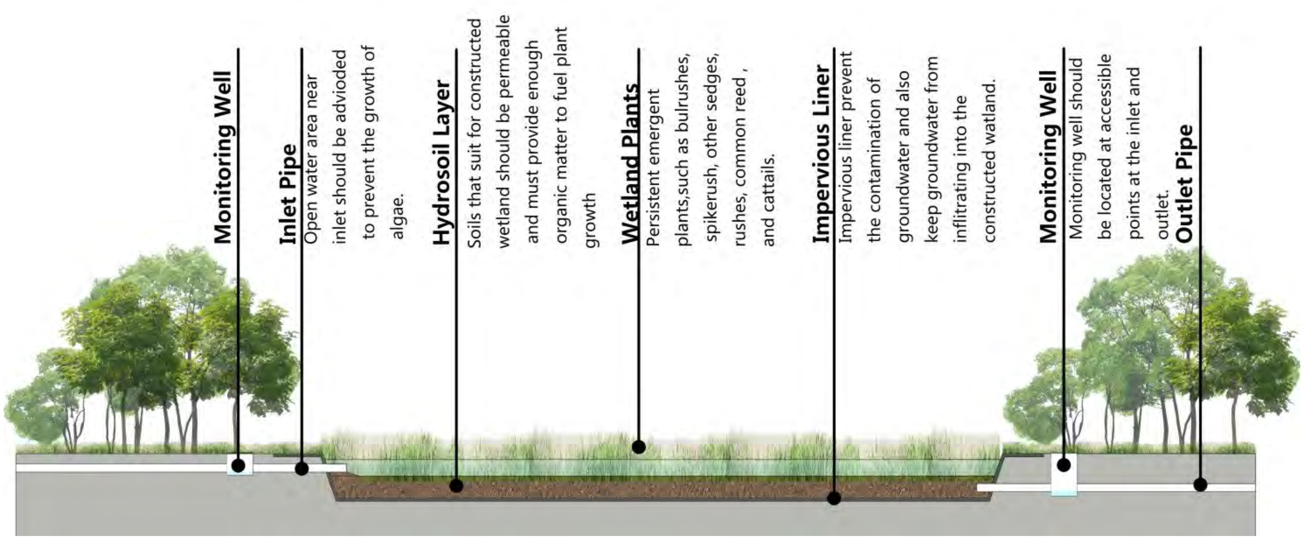

Figure 6. Structure of constructed wetland

Constructed wetland performances are estimated by inflow and outflow rates, and water quality changes between inflow and outflow. The effectiveness of contaminant removal can be determined by the difference between influent loads (inflow volume x contaminant concentration) and effluent loads (discharge volume x contaminant concentration). Monitoring wells are located at the points that near outlet and inlet. Weir boxes are installed to measure the inflow and outflow volumes. (Figure 7) Water samples should be monitored periodically to check the water quality.

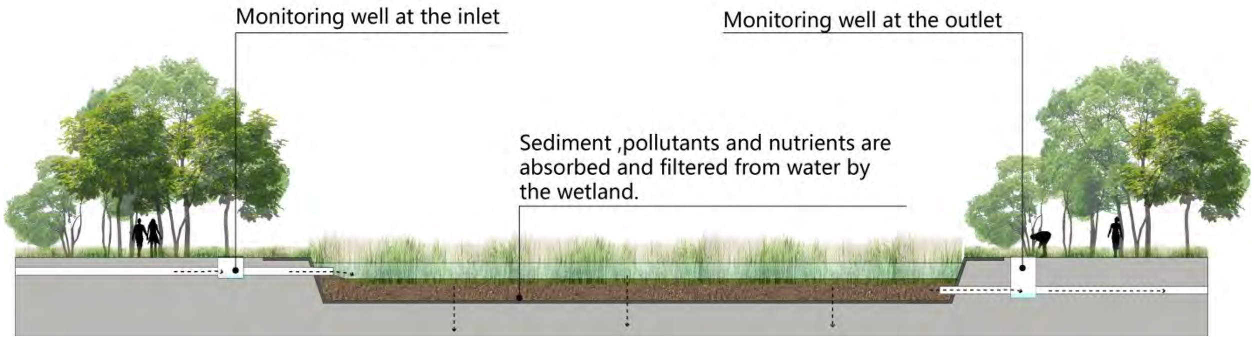

Figure 7. Methods of measuring the effectiveness of constructed wetland

4.4 Permeable pavement

Permeable pavement (Figure 8) is one of the widely used green infrastructure practices, especially in parking lots and driveway. Parking lots are typically sized to accommodate peak traffic usage, which occurs only occasionally, leaving most of the area unused during a majority of the time (Brattebo and Booth, 2003). Permeable pavement systems are commonly made up of a matrix of concrete blocks or a plastic web-type structure with voids filled with sand, gravel, or soil (Booth and Leavitt, 1999). The stormwater is infiltrated through these voids into underlying soil, which can significantly reduce stormwater runoff. In addition to control stormwater runoff, permeable pavement can capture and absorb pollutants.

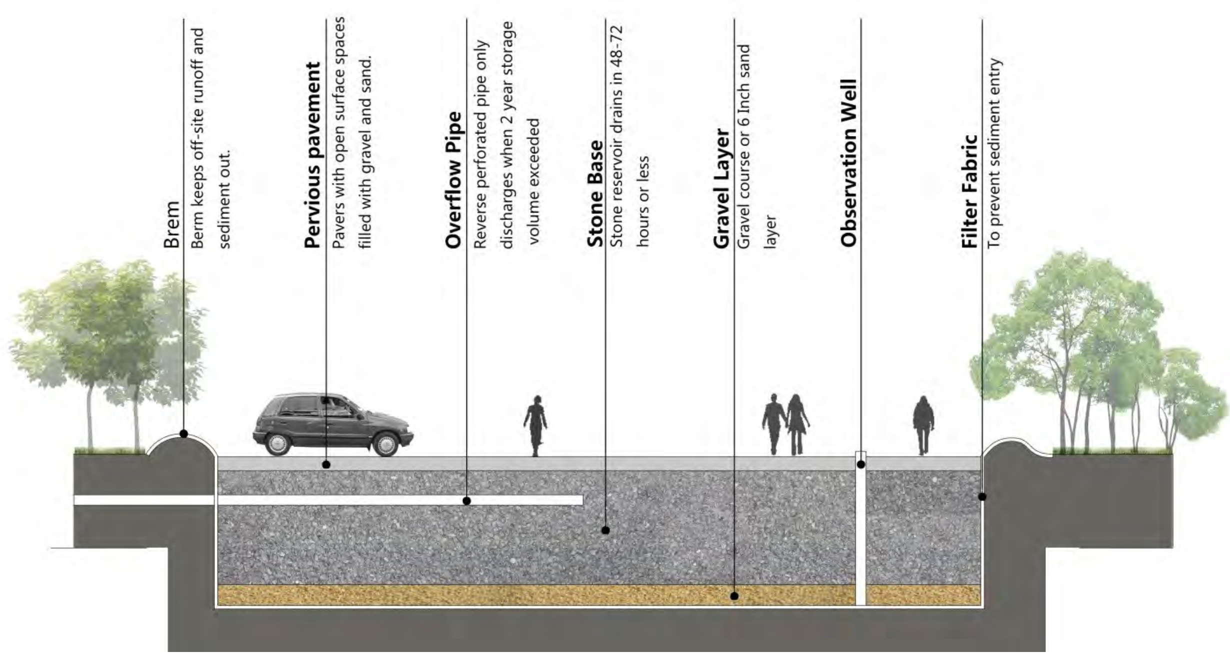

Figure 8. Structure of permeable pavement

Permeable pavement has the filtering capability to keep sediments in place, underlying soils and it also can filter pollutants from water. Turbidity and the total amount of suspended sediment (TTS) are two effective indicators of water quality. By measuring these two indicators can help to estimate the efficiency of water quality improvement provided by the pervious pavement. At first, we install wells (Figure 9) in permeable pavement and impervious pavement, and then we get the water samples from these wells to test the water quality.

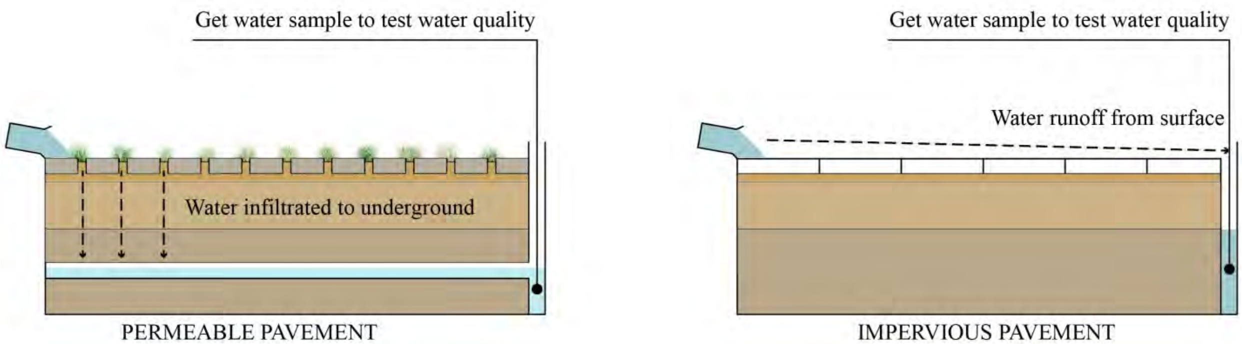

Figure 9. Get water sample to test water quality that runs through permeable pavement and impervious pavement

Permeable pavement allows stormwater to infiltrate into the underlying soils and minimize runoff volumes. By measuring the volume of water runoff in permeable pavement and impervious pavement, we can conclude that whether permeable pavement can help us reduce stromwater runoff. To test this, we also need to install wells in permeable pavement and impervious pavement (Figure 10). Then we measure the volume of water in these two wells that stormwater runoff and get the conclusion that whether permeable can help us reduce stormwater runoff.

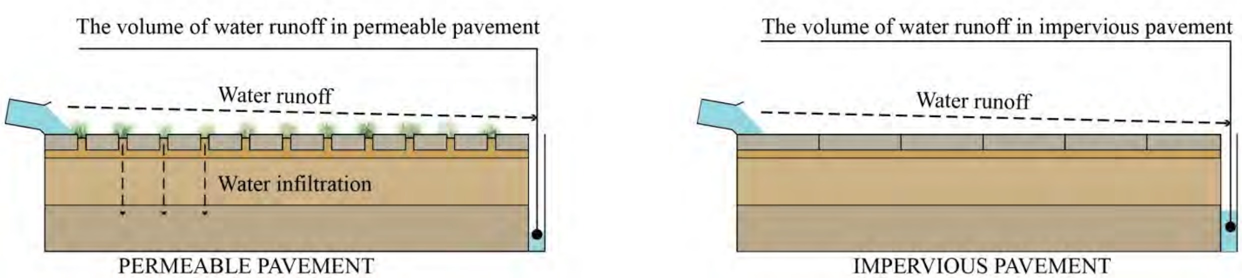

Figure 10. Get water sample to test stormwater runoff in permeable pavement and impervious pavement

5. Conclusion

Green infrastructure is a great opportunity in urban city and is smart conservation that addresses the ecology and the fragmentation of open land (Mark A. Benedict and Edward T. McMahon). The hydrology in urban area often fails with respect to other landscape or ecological functions stable stream flow, flood protection, groundwater recharge and infiltration. Thus, we need to use the green infrastructure to turn the problems that brought to us into opportunities and do it from right now (Nelson, A.C, 2004). This strategy is not only important to the developed cities that need innovation, but also relevant to the unprecedented period of economic growth and urban development area.

The value of water-related ecosystem services that green infrastructure provided will solve many serious problems that urbanization has brought. Of cause, whether green infrastructure will improve water quality and water quantity needs to be tested by designing multiple monitoring devices in green infrastructure system, monitor the changes of water quality and quantity in this system. Scientific methods and devices will be used to test the sampling water and the results will tell us whether green infrastructure system works or not. Through the process of leaning-by-doing, we will reduce the risk of failure, that is, safe to fail. Thus, to understand how green infrastructure works to improve water quality and quantity is quite profound for sustainable development.

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11. URBAN GREENWAYS AND ECOLOGY

The Knowledge and Attitude to Species Invasion Issue in Greenway Planning: A Study in China

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Introduction

Greenway is important green infrastructure which has ecological, recreational and cultural/historic functions applied in macro(country), medium(region) and micro(city) levels. Generally, greenway is in linear or reticular forms so that it is called "way". Greenway has a long history in United States and Europe, and many successful projects have been implemented. Conversely, greenway has a very short history in China, because China lately started it urbanization in 1990s with a low degree of urbanization, which had grown from 26.37% in 1991 to 36.22% to 2000. Thus, for a long time, Chinese landscape architects had focuses on the level of urban area and lower ones, rather than higher levels of region and nation. The first paper on greenway in China published on a journal of urban planning, introducing greenway movement in United States [1]. Unfortunately, this paper had not drawn enough attention of landscape architects, because of the disciplinary separation of landscape architecture and urban planning in China. There had been no paper on greenway for 10 years since then.

In the new century, greenway starts to be paid attention. In 2001, it was first time when paper on greenway was published in a journal of landscape architecture in China, which introduced the development of greenway in United States [2]. After it, the number of papers on greenway increases. Two groups of papers selected from the 2rd Fobos International Conference on Greenway and Landscape Planning 2010 were published as special topic on the Journal of Chinese Landscape Architecture and the Journal of Landscape Architecture, China, which introduced greenway development and projects in United States and European countries to Chinese professionals, and evoked wide repercussions. Two books on greenway, *Greenways: A Guide To Planning Design And Development* by Charles Flink (Author), Robert Searns (Author), Loring LaB. Schwarz (Editor) and *Ecological Networks And Greenways: Concept, Design, Implementation* by Rob H. G. Jongman and Gloria Pungetti (Editor) was published in China in 2009 and 2011, and became "must read" books for greenway planners. As the result of rapid urbanization, a growth from 36% to 50% during the first decade of new century, and rethinking of urban-rural integration, greenway projects starts in China. Though Zhejiang government first made its provincial greenway planning in 2004, Guangdong is the first province who started greenway implementation in 2010. Guangdong plans to build 8770 km province-level greenway by 2015, and it had finished 2372 km province-level greenway and 4978 km city-level greenway by the end of 2012. Stimulated by Guangdong, other provinces or metropolises have started their ambitious plans of greenways, as rapid and colossal as their urbanization plans (Table 1). Moreover, during the project of Supplying Water from South China to North, and the project of historic preservation of the Grant Canal for World Heritage application, national greenways are surmised to be built along the canals and pipelines. Now, greenway planning projects have been a new growth point of landscape architecture industry.

Table 1. Some greenway plans in China

Province or Metropolis	Year to Start	Year to End	Total Length
Beijing	2012	2020	1000 kilometers
Hebei	2011	2013	More than 660 kilometers
Anhui	2012	2016	3000 kilometers
Zhejiang	2012	2020	4000 kilometers
Guangdong	2010	2015	8770 kilometers
Fujian	2012	2020	3100 kilometers
Hunan	2012	2015	More than 3000 kilometers

Though many landscape architecture firms and contractors benefit from the prosperity of greenway, as well as the users, the speed of greenway movement is worrying. The procedure of decision making is hasty. Many decision makers don't know what the definition of greenway is, how it functions, whether they need it, but they decide to build it because other provinces or cities have greenway plans. Some even believe greenway is just another name for trial or parkway. The hasty decision also causes irrational plans characterized by oversized scale, fast period, and repeated duplication, which leave insufficient time to study, plan, and implement. Moreover, the greenway planners don't have enough experience and knowledge so that they underestimate the potential hazards. Therefore, under such a situation, fast and large greenway plans might lead to grave consequences.

Literal review

Greenway is linear or reticular structured green land system. Olmstead is considered as the founder of the greenway movement. His Boston Emerald Necklace project was the first greenway, though the rudiment of greenway can be traced back to earlier boulevards in Europe. In its development, greenway has many different definitions in different countries under different cultural context. Ahern gave a widely accepted definition [3].

Greenway has similar spatial pattern to ecological network, but the original intentions were different. The former addressed human being, while the latter emphasized species and habitats, but the two concepts have been merging gradually, and now describe the green infrastructure where species communities (including human being) survive and move [4]. The conceptual merging results in some functions of corridor, component of ecological network, implemented in greenways.

Fábos divided greenways into three major categories: ecological greenways, recreational greenways and greenways with historical/cultural values [5]. Other important functions of greenways are catalyst to tourism, stimulus to economy, and preparation for urbanization, which are more concern in China, so that greenway is considered as a key approach to urban-rural integration. In addition, the traditional culture of recreation and landscape makes Chinese greenways pay more attention to the usage of human being.

Because of the merging of the concepts of greenway and ecological network, greenway borrows ideas of corridor from ecological network. Ecological corridors has important effects on ecology to protect biodiversity [6-8], but it could be the route of exotic species invasion [9], which promotes predators and competing species spreading, speeding invasion into communities [10], especially along rivers and roads [11-13]. Bio-invasion may cause biodiversity loss [14], and even the crash of local ecological system and the changes of landscape [15].

Urbanization and globalization exacerbates exotic species invasion [16-17]. Urbanization aggravates habitat fragmentation, so that wildlife has to invade other patches to survive. Linkage of transportation network, like channels and roads, provides pathway of invasion and makes the activities easier than those in natural processes. Urbanization also results in direct human caused invasion. For example, plenty of exotic species are introduced as landscape plants, and some exclusive species, like *Rhus typhina Nut*, are changing landscape patterns of urban and rural areas, and expanding to natural areas. Globalization makes exotic species invasion across a long distance range possible, as line-haul increases [18]. Invasive species overgrow without competitors and predators, squeezes spaces of local species, and cause ecological disasters to local ecological systems. The European rabbits in Australia, Chinese mitten crabs in German, ragweed in China, and Asian carps in United States are typical cases. In most cases, the invasive species spread over corridors along roads, rivers and railways, and the damages are more severe than before.

Therefore, as spatial corridors linking urban, rural and natural areas, larger greenways with more branches and higher connectivity are getting more dangerous. Invasive species spread long greenways, from urban areas to rural and natural areas.

The exotic species invasion is not a popular issue in greenway research, and there are a few papers and publications in China mention the potential invasion in greenway. Jongman [7] cited Noss′ finding on the negative impact of greenway [9], Ahern discussed the potential possibility that connectivity causes species invasion [19], Flink and Searns pointed out the potential hazards of species invasion along corridors and suggested to make a plan in greenway planning to eliminate invasive species [20], and Fu and Luo analyzed the possibility that species invade along corridors in green land systems [21].

Goal and objective

After analyzing some greenway planning projects in China, the researchers found that most of them over-emphasized the spatially linear pattern and connectivity, but didn′t consider the species invasion problem, and even used exotic plants. It shows that greenway planners have not enough ecological knowledge, especially on exotic species invasion, and this affects their attitudes in greenway planning. The purpose of the present study was to find out **whether** and **how** well potential species invasion is considered in greenway planning by landscape architects, **what** attitude they hold toward species invasion, and **what** results in these.

The basic hypothesis for the present study was that landscape architects, which work on greenway planning projects in China, haven′t enough knowledge on potential species invasion in greenways, thus, they paid less attention to it during greenway planning. This hypothesis was based on review of greenway papers and greenway projects, and communication with some greenway planners. The main objectives with the study were 1) to prove the hypothesis by a survey which aimed to answer the questions: **whether** and **how** well potential species invasion is considered in greenway planning, and **what** attitude is held by landscape architects; and 2) to find out **what** reason cause the result by an investigation including interviews and discussions. The questions in survey are divided into two categories: 1) the basic knowledge of species invasion, and 2) the consideration of species invasion in greenway planning (Table 2). In addition, in order to find out the reasons to ignore species invasion, another two categories of questions are prepared for the survey: 1) the background of surveyed landscape architects, and 2) the basic knowledge of greenways (Table 3).

Table 2. Questions on species invasion issues

basic knowledge of species invasion	consideration of species invasion in greenway planning
do you know greenways will cause species invasion	*will you consider ecological issues if you do a greenway planning*
what do you think is the main invasive type	*will you suggest the clients hire ecologists for greenway planning*
is species invasion a severe problem	*have you seen ecological feasibility reports for your greenway projects*
which methods can prevent invasion (multiple choice)	*have any ecologists joined in your projects*
do you think the probability of invasion is high in greenways	*will you consider species invasion in greenway planning*
	will you consider preventive approaches if your greenway have potential invasion
	will you suggest your clients cancel it, if your greenway planning project is potential to be invaded and the invasion is hard to be solved

Table 3. General questions

background of surveyed landscape architects	basic knowledge of greenways
what is your educational background	do you think greenways will have a successful prospect in China
what is your working experience	do you think greenways will improve city images
do you know greenways	Are you more interested in greenway projects than other landscape architecture project
do you have or having any greenway project	what are the main services proposed in your greenway projects
	what are the types of your greenway projects (multiple choice)

Methodology

The research strategy is based on qualitative and quantitative research methodology. The former is used to confirm **when**, **how** and **what** attitude is considered to species invasion in greenway planning, in order to prove the hypothesis presented above; the latter is used to discuss the results of quantitative research, and then demonstrate **what** reasons cause the results. The study was carried out in different stages. First, communications were established between the researchers and professionals who are interested in the issue. In these communications, the purpose of the study was presented and the categories of questions were discussed. Secondly, questionnaires including four categories of questions were sent to more than 100 landscape architects of 18 design firms all over China. The third stage involved an analysis of the answer from the questionnaires. The results were preliminarily discussed for the stage of interviews. In the fourth stage, interviews were carried out with landscape architects selected from the survey. Finally, the researchers summed up the discussions and answers in interviews, and then gave suggestions. The interviewees were selected after the results of questionnaires, in order to make the selection representative. The 14 interviewees from different firms are of different educational background, in different positions, have different understanding of species invasion, and different attitudes to species invasion in greenway planning.

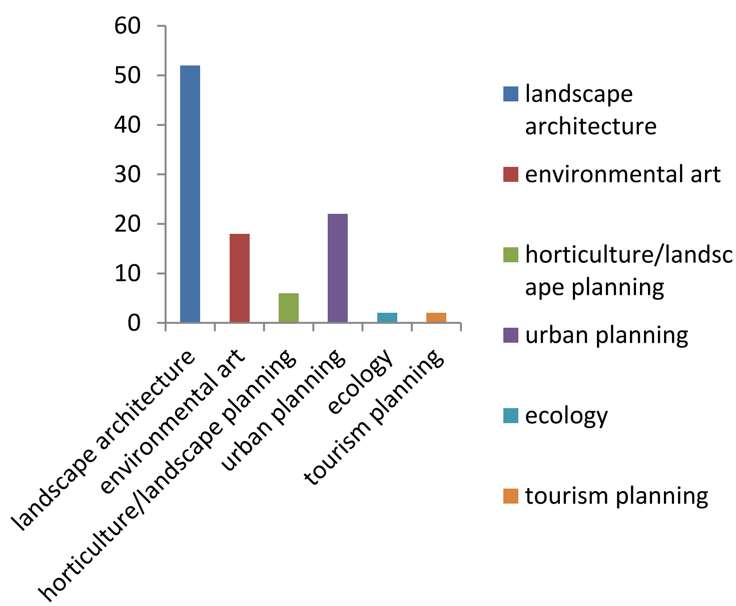
Results

The results presented below are based on data from questionnaires. The questionnaires were sent to 18 landscape design firms all over China, and 112 landscape architects answered and returned questionnaires. The researchers accepted 102 questionnaires as valid ones giving an 89% validity rate, because other respondents didn't know greenways. The researchers supposed that respondents without greenway knowledge cannot give precise answers.

17 of the 21 firms were doing or had done greenway planning, and the projects spread across China. This shows that greenway has been a main type of landscape architecture projects.

The respondents had various educational backgrounds, including landscape architecture, urban planning, environmental art* and other majors (Fig. 1.). 52 of them had landscape architecture degrees, about 51% of the total. Two respondents with ecology background show a gratifying progress that ecological graduates join in landscape architecture as the profession more concerns ecological issues.

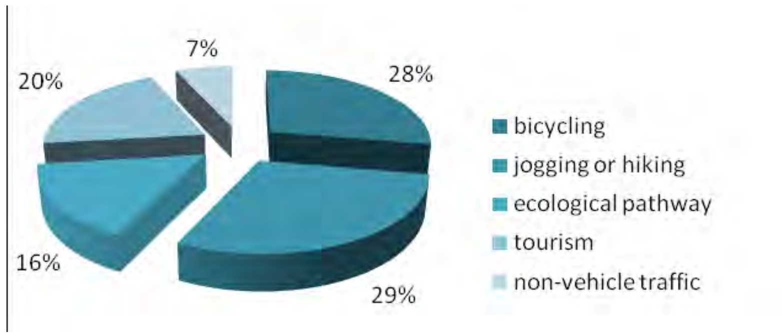
Fig. 1. Educational background of respondents



The majority of the respondents had a positive impression to greenways. 88.2% respondents believed that greenways would have a successful prospect in China, and 98% thought greenways would improve city images. 85.3% respondents showed that they had more or equal interests in greenway projects than other landscape architecture projects.

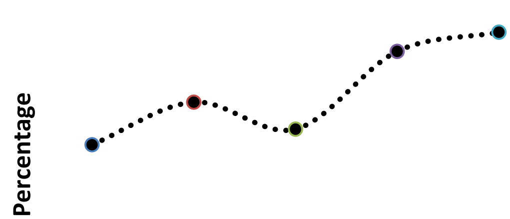
67 respondents did or were doing greenway projects, and the main services (multiple choice) proposed in the projects are for jogging or hiking (29%), bicycling (28%), tourism (20%), ecological pathway (16%) and non-vehicle traffic (7%) (Fig. 2). It shows that the key functions of Chinese greenways are recreational.

Fig. 2. Main services proposed in greenway projects



The category of basic knowledge of species invasion is a main part of the questionnaires. To the question "do you know greenways might cause species invasion", 54 respondents answered "yes" while other 48 said "no". It proves that landscape architects pay little attention to this problem. To their educational background, 28 of 52 landscape architecture background, 12 of 22 urban planning, 12 of 18 environmental art and 2 of 6 horticulture/landscape planting respondents answered "yes". The percentage doesn't show a correlation between the knowledge and educational background. It is incredible that the only 2 ecological background respondents answered "no", and it needs to be concerned even though it might be an individual case. 66.7% respondents who had working experience more than 10 years answered "yes", followed by experience of 5-10 years (62.5%), 1-3 years (51.4%), 3-5years (45.5%) and less than 1 year (42%) (Fig. 3). It can be deduced that greenway planners will learn more on species invasion as they work longer.

Fig. 3. Respondents knowing species invasion in greenway analyzed with working experience



To the question "what do you think is the main invasive type", 14 chose "not sure", 2 chose "animals", 22 chose "plants", 5 chose "microbes", 12 chose "animals and plants", 1 chose "animals and microbes", 3 chose "plants and microbes" and others chose "all the three"(Fig. 4). To the question "is species invasion a severe problem", 74.5% respondents answered "yes", 18.6% answered "no", and 6.9% answered "not sure". However, to answer the question "do you think the probability of invasion is high in greenways", 41 chose "yes", 24 chose "no", 37 chose "not sure". To the question "which methods can prevent invasion (multiple choice)", the answers from high percentages to low were "to consult ecologists" (44.7%), "to monitor in real time" (19.9%), "to set hence in greenways" (16.8%), "to introduce the predators of the invasive species" (9.3%), "to decrease the connectivity of greenways" (6.8%), and "to increase the density of plants" (2.5%) (Fig. 5).

Fig. 4. Main invasion types

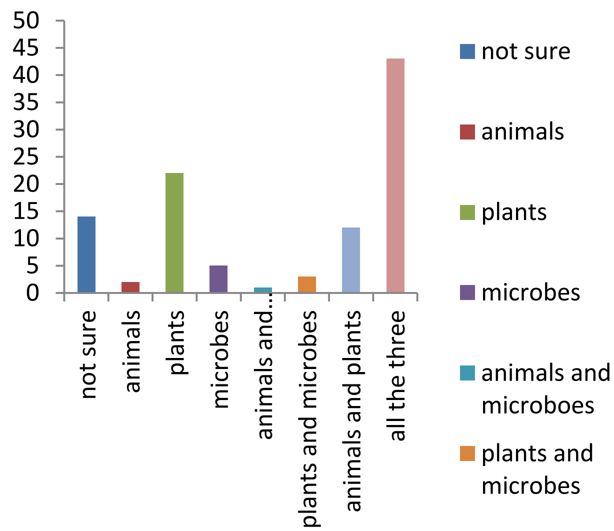
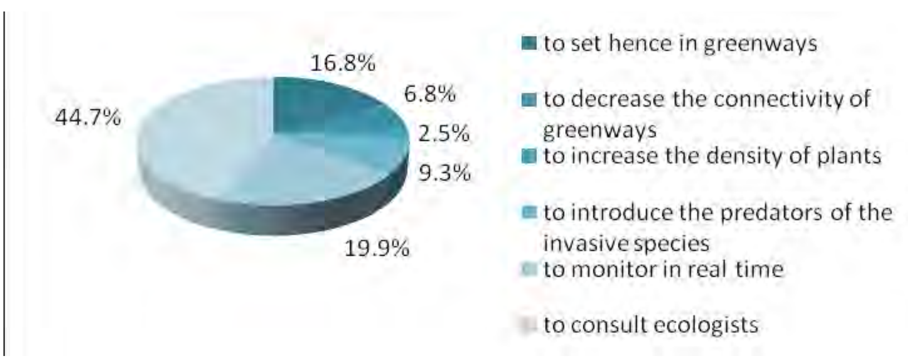
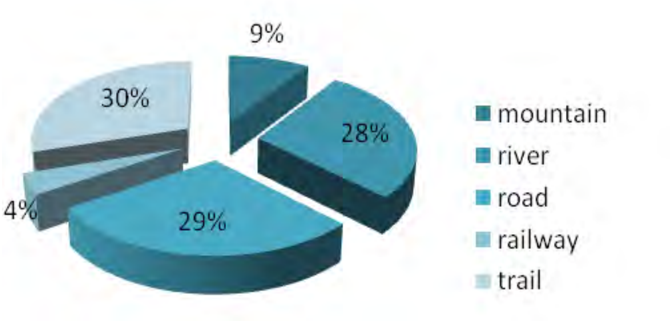


Fig. 5. Methods to prevent species invasion



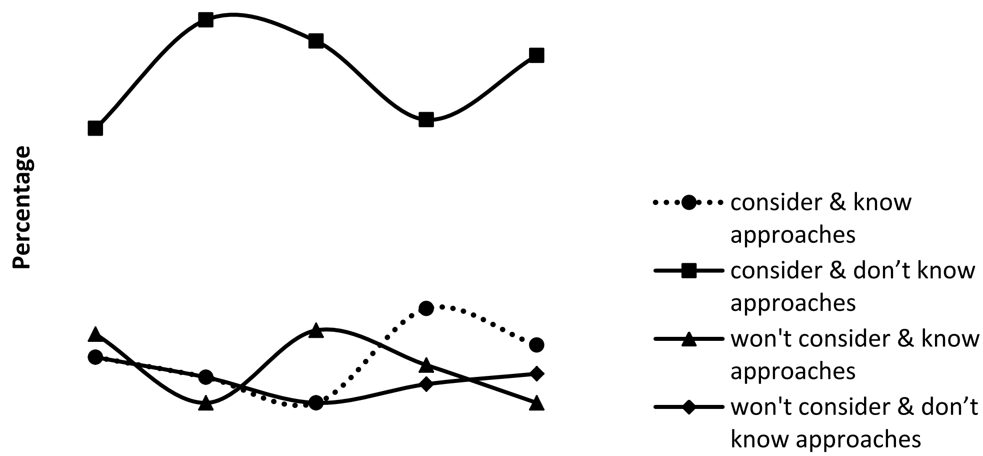
The category consideration of species invasion in greenway planning is another main part of questionnaires. To the question "will you consider ecological issues when you do a greenway planning", 83.3% of the 102 respondents answered "yes", and 4.9% answered "no", and 11.8% answered "not sure". The high percentage of positive answers showed that greenway planners concerned ecological issues in planning. However, among the 67 respondents who had greenway planning experience, only 18 answered "yes" to the question "have you seen ecological feasibility reports for your greenway projects", 28 answered "no", and 21 answered "not sure". To the question "will you suggest the clients hire ecologists for greenway planning", 89.2% of the 102 respondents answered "yes", 3.9% answered "no", and 6.9% answered "not sure". However, among the 67 respondents with greenway experience, only 22 answered "yes" to the question "have any ecologists joined in your projects", 31 answered "no", and 13 answered "not sure". These revealed the difference between the ideal and the reality, and proved that ecological issues were not paid enough attention. Moreover, the trail, greenway along road, and greenway along water had the highest percentages of all planning projects, respectively 30%, 29% and 28% (Fig. 6), but greenway along road and water are vulnerable to species invasion.

Fig. 6. Geographical types of greenways



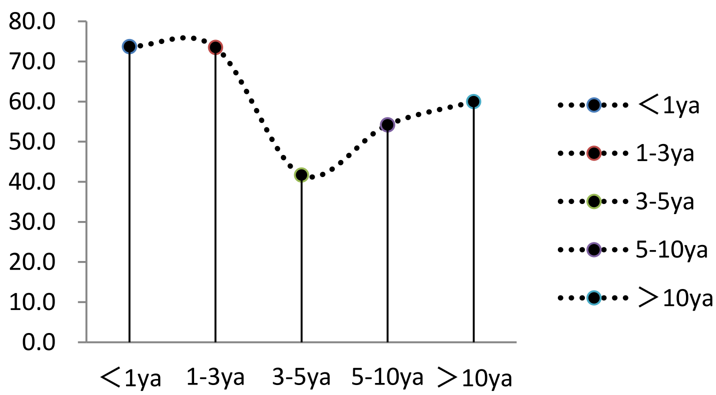
To answer the question "will you consider species invasion in greenway planning", 79.4% of the 102 respondents chose "yes", 9.8% chose "no", and 10.8% chose "not sure". To the question "will you consider preventive approaches if your greenway have potential invasion", 10.8% answered "yes, and I know the approaches", 76.5% answered "yes, but I don't know the approaches", 6.9% answered "no, but I know the approaches", and the rest answered "no, and I don't know the approaches". It showed that majority of the respondents will consider preventive approaches, but 87.6% of them don't know the approaches. For their working experience, 21.7% respondent with 5-10 year experience would consider and know the preventive approaches, followed by those with over 10 year experience. It revealed that greenway planners with longer experience would consider more and know better (Fig. 7). 88.2% of the respondents with 1-3 year experience, higher than other ones, would consider preventive approaches but they didn't how to do. It showed that planners worked 1-3 years began to concern the issues, unfortunately, they knew little to prevent.

Fig. 7. Knowledge of preventive methods analyzed with working experience



To the question “will you suggest your clients cancel it, if your greenway planning project is potential to be invaded and the invasion is hard to be solved”, 64.7% of the 102 respondents answered “yes”, and 31.4% answered “no”, and 3.9% answered “not sure”. Considered the seriousness of species invasion, 31.4% is a large proportion, in contrast to the respondents’ concern to ecological and invasion issues. For the working experience (Fig. 8), most respondents with 1-3 or less than 1 year experience would suggest the clients to cancel, respectively 73.7% and 73.5%. However, least respondents with 3-5 year experience, 41.7%, would do so. Higher than them, 54.2% and 60% respondents with 5-10 year or longer experience would suggest clients.

Fig. 8. Analysis with working experience



Discussion and suggestion

Results proved the hypothesis that greenway planners don't have enough knowledge on bio-invasion in greenway. Although they were willing to show attention to species invasion issues in greenway projects, it couldn’t be proved in their planning and by their actual attitudes.

Results also showed that plenty of greenway projects had been being extensively spread all over China. Many landscape design firms and designers surveyed did or were doing greenway projects. They were interested in greenways, and they expected greenway have a brilliant prospect in China. However, this optimism is worried by researchers, because there are lots of issues needed to study before a greenway boom.

In terms of project category, recreation is the main purpose and main function of greenways in China, because greenways are proposed to promote tourism and then rural economy. Therefore, the function of biological corridor isn't emphasized, so that greenway planners pay not enough attention to species invasion. These have been proved by the interviews.

Landscape architects knowing the possibility of species invasion in greenways aren't in a dominant majority. Although most respondents know the severe consequence of invasion, they don't think the possibility of invasion in greenways will be high. Even though a majority of landscape architects present their intension to consider ecological and species invasion issues in planning process, most of them don't know valid methods to prevent. A considerable portion of landscape architects won't suggest clients cancel the projects which cause species invasion. This could be a dangerous sign.

Through interviews to the selected respondents, researches summed up the reasons which caused the results. First, the professional education hasn't provided enough ecological knowledge. Most landscape architects are of landscape architecture, urban planning, and environmental art majors. The former two majors offer some ecological courses, which are not core courses, but the education more emphasizes the aesthetic related skills of the students. More important, because there is no registration for landscape architects in China, anyone with visual design skills could be a landscape architect. Secondly, landscape architects lack of a comprehensive cognition of greenway. Many interviewees thought greenways are just landscape architecture projects, instead of interdisciplinary. They thought greenways were proposed for human being, so the recreational functions were most important, instead of biodiversity. Some even thought that the human activities in greenways would reduce the species invasion. Thirdly, the absence of administration and technical requirement had a negative impact on the attitudes of greenway planners. Most guidelines and standards of greenway planning by governmental agencies had no requirement to prevent potential invasion, even those having the requirement didn't provide explicit technical criteria. Thus, the planners followed the requirement, and ignored the issues not required. Last but not least, pressure of projects and financial consideration has a main impact. Because of the short time for the large greenway plans, both of the clients and planners tend to avoid ecologists, who might make the process complicated and prolong the planning time. More important, if the projects are cancelled for some reason, it means a financial loss for the greenway planners and their firms, as well as the clients. Working experience of 3-5 years is a step to promotion, and a financial loss of the firms will impact the planners' careers, so planners with this situation are not willing to suggest the clients cancel projects for species invasion.

According to the reasons above, the researchers gave suggestion as follows. First, basic knowledge of biodiversity and species invasion should be provided in the education of landscape architecture and other related majors. Also, the national professional education councils should require this ecological knowledge in the guidelines for professional education. Secondly, the greenway projects should have ecological feasibility reports, especially the contents of species invasion and environmental effects. Ecologists should be invited to join the projects and play an irreplaceable role. Finally, administration should monitor completed greenways, in order to estimate the conditions of species invasion.

Conclusion

Greenway is an important green infrastructure with multi-functions, and plays important roles for the integration of urban and rural areas, economic and ecological development in China. As a result, greenways are being quickly developed all over China. In this process, ecological issues including species invasion are ignored, whose consequence might be serious. Through an investigation to landscape firms and landscape architects, it was found that landscape architects have not enough knowledge of species invasion and pay less attention to this issue in greenway planning. The main reasons include lack of ecology-related education, vague definition for greenway, lack of related requirements in guidelines, as well as financial consideration and pressure of projects. Therefore, a comprehensive structure of knowledge and a strict supervision to planning process is necessary and crucial. Administrations and professional associations should issue guidelines and regulations for greenway planning and education, introduce ecologists into planning process, and more important, slow down the greenway development.

*Environmental art is a discipline focusing on ornamental landscape design and interior decoration, but there are no ecological courses involved in its educational program.

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Opportunities for greenways through development of ecological and green corridor landscape planning in Hungary

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1. Introduction

In the specialist literature on landscape design, greenways are multi-functional routes which optimally have both recreational and ecological functions. The recreational function of greenways is primarily use by pedestrians, cyclists and horse-riders. The ecological role of greenways means that optimally they are part of a given landscape's ecological system. In the course of our research – taking into account the natural, social and economic conditions, as well as landscape and design precedents – we are seeking answers to questions within the following categories: (1) justifications for the creation of greenways in Hungary; (2) the geographical areas in which greenways may be required; (3) the type of landscape features that facilitate the establishment of greenways.

2. Data and methods

2.1. Historical context

In Hungary there is a centuries-old tradition of walking trips in natural environments. Organized walking tours emerged in the age of industrialization and the rise of the middle class. In 1873 the development of hiking trails, shelters, viewpoints and other tourist facilities in the Tatra Mountains started under the auspices of the Hungarian Carpathian Society, and in 1929 a unified national route-marking system was introduced. In 1938 Hungary saw creation of the National Blue Trail – a nationwide route which is popular to this day. Since 1981 a system of timed hiking has been organized, which has proved increasingly popular: in 2012 nearly one hundred thousand people took part in such hikes.

The first bicycle in Hungary appeared in 1878, with the first group cycling tour being organized in 1881 at Easter, between Budapest City Park and the town of Gödöllő – a distance of around thirty kilometres. Starting in 1911 the Hungarian Cycling Association organized Sunday road and track racing. After the Second World War cycling traditions entered a slight decline, but by the beginning of the 21st century national movements emerged to promote and create further opportunities for cycling. At present the main initiatives are the construction of cycle paths alongside roads, while at the same time an increasing number of cycle routes are being created in natural environments.

The horse and horse riding have played a fundamental role in the history of Hungarians, from the audacious warrior campaigns of the medieval conquest period to the golden age of horse breeding in the 19th century and the emergence of the hussars as a military force. After the Second World War horse breeding fell to a new low, but since 1990 riding has revived, and now the *Kincsem* National Equestrian Programme is being developed, with the main goal of designating riding trails throughout the country.

2.2. The appearance of the concept of 'greenway' in Hungary

2.2.1. Landscape design research

Since 2000 the Faculty of Landscape Architecture at Corvinus University of Budapest has been conducting research on the landscape design of greenways. Research so far has resulted in several design proposals, which mainly focus on the integration of green corridors in the vicinity of Budapest into the urban and peri-urban spatial structure.

The main obstruction to the optimal landscape development of greenways in Hungary is the fact that the concept of 'greenway' does not officially play a part in regional and landscape planning. Another problem is that the definition of 'greenway' is unclear in the scientific ecological concept system dealing with ecological and green corridors, and also in relation to other existing routes with recreational roles (walking, cycling, horse riding).

Therefore our main research goals have become the following: to arrive at a definition of greenway (as a new land use form playing several major ecological and recreation roles) which can be integrated into Hungary's regional and landscape planning system, and which is compatible with the concept system of related disciplines; and to lay the methodological foundations for greenway planning in Hungary.

2.2.2. Civil society movements

Since 2005 greenways have been formed at the initiative of the Hungarian Environmental Partnership Foundation, based on guidelines from the Central and Eastern European Greenways programme. These have followed the guidelines of the Central and Eastern European Greenways programme. The main goal of greenways planned by NGOs has been the designation as greenways of existing routes suitable for non-motorised use (especially walking and cycling), and then, associated with this, an increase in these areas' attractiveness for tourism.

2.3. Investigation of the potential for greenways

2.3.1. Needs

Considering historical antecedents of hiking, cycling and horse-riding trails, and current development concepts, the question that arises is whether there is justification in Hungary for planning routes in the classic sense, for a variety of non-motorized uses. From the 1990s onwards, motorized traffic in Hungary has increased exponentially. A result of insufficient physical exercise is a statistical rise in cardiovascular diseases, and the emergence of a generation of the overweight. The need for creation of routes and networks for hiking, cycling and horse riding has been clearly expressed in a variety of programmes and plans.

From a landscape design point of view, the following question arises: Where is there the need or the opportunity to establish greenways to meet the emerging demands? In terms of the classic greenway model and Hungarian practice, the response can be formulated thus: there is a need in Hungary for greenways where optimal routes for at least two of the main greenway functions – walking, cycling and horse riding – coincide. On such routes specific measurement or practical experience will show the expected level of non-motorized traffic to be substantial. Our specific measurement data for a given route only relates to cycling and one location. Our practical experience, however, shows that there are routes on which various non-motorized uses appear spontaneously or by design: Budapest’s Danube embankments, alongside watercourses in provincial towns, routes near riding centres, agricultural and forest paths, etc.

In our present study, therefore – in the absence so far of specific, quantitative data – we attempt to identify those landscape elements which may be suitable contexts for the optimal spatial development of multifunctional non-motorized routes in the manner of classic greenways; we pay special attention to Hungarian landscape features, and current planning systems.

2.3.2. Alongside rivers and streams

Hungary's two main rivers are the Danube and the Tisza. The environs of the Danube are part of both the National Ecological Network and the Danube section of the Pan-European Ecological Network. The Danube floodplain forests, in particular, are of great ecological value. The Danube flows through Budapest and several of our larger cities, and many settlements have created promenades or cycle paths along the banks of the river. These routes appear intermittently, however, and are often only suitable for one use or another. In some locations routes for pedestrians and cyclists appear next to each other, and horse riding can also appear alongside these. In some cases use has been designed, and in others it is the spontaneous result of existing opportunities. The Hungarian sections of the EuroVelo European cycle route alongside the Danube and the Tisza represent a coordinated route, connecting existing and planned cycle routes. Similarly to American greenways, the EuroVelo routes can be seen as based on non-governmental initiatives: sections suitable for cycling are formed using existing features and as a result of local initiatives. Among non-motorized modes of transport, the study focuses primarily on the development of cycle routes. Use of the Budapest section of the Danube for public recreational use was tabled decades ago, and this is now an element of the city's long-term development concept.

The first cycle route to be planned along a tributary of the Danube was that alongside the raised embankment of the Raba. Smaller watercourses can provide ideal opportunities for greenways. Problems are hydraulic engineering features which are alien to the landscape surroundings and a lack of trees, due to riverbed maintenance criteria. A significant number of streams are part of the National Ecological Network. Recreational opportunities can be established after examination of the width and diversity of the accompanying vegetation zones forming ecological corridors. Greenway development alongside streams should be connected to plans for revitalization of watercourses.

2.3.3. Areas alongside railway lines

The first Hungarian railway line – between Pest and Vác – was opened on July 15 1846. The railway network developed continuously up until the outbreak of the First World War, with several thousand kilometres of local railway line being built in Hungary by the turn of the 20th century. For historical or economic reasons, however, partial or complete closure of railway lines has repeatedly occurred. The first line closures took place after the First World War on lines severed by the new borders dictated by the Treaty of Trianon. A second wave of line closures took place after the Second World War, as a result of development of the road network. In the 1960s electrification of railways began, in the process of which there were amendments to routes, and so stretches of line of varying length became abandoned.

The largest package of line closures occurred as a result of the 1968 transport plan: 1,200 km of standard gauge, low-traffic line and all narrow gauge freight line was eliminated. At the end of the 20th century necessary improvements were neglected due to the increasingly difficult economic situation, and a new wave of line closures began. In the first half of the 1990s three passenger lines were lost, and in December 2009 a further twenty-four were closed. There are several arguments for reinstatement of railway lines, however. A line running alongside the River Ipoly was reinstated with the aid of a study launched by Euroregion regional railways, following the example of re-launched German railways.

By the beginning of the 21st century, because of high levels of pollution, the environmental impact of different modes of transport became an increasingly important consideration. Rail transport is one of the most environmentally-friendly in terms of energy use and emissions, as well as in terms of space requirements and capacity.

Disused railway lines from different periods are in various states of repair. There are lines which currently only carry freight, and others where track has been taken up, so any use is impossible. On certain sections only the old railway embankment can be identified, but old bridges and stations remain – although in a steadily deteriorating condition. There are sections where cycle paths or bypass roads have been created on the routes of abandoned lines.

The question arises: in Hungary, is the creation of greenways alongside abandoned railway lines justified? An important argument in favour of such greenway construction is that railway lines were built at very low gradients – a feature which is especially suited to walking or cycling. Secondly, the space requirements of railway lines are excellently suited to multifunctional non-motorized transport. Thirdly, the substrate for railway lines can be the basis for greenways – with minimal work, proper maintenance and appropriate flexible surfacing. However, as previously stated, existing and abandoned lines have significant potential as transport routes in the future.

In each case the appropriate response can be made according to a given area's geography, social and economic needs and potential. In general, during the modernisation of routes greenway development is most appropriate on sections which have been abandoned. On other initially disused sections, technical solutions for establishment of greenways are possible which allow for reinstatement of rail services in the future if needed. If enough space is available, greenways may be created alongside railway tracks.

2.3.4. Historical trails and local cart tracks

In the 18th and 19th centuries fine maps based on military surveys and containing a wealth of information were made of the settlements of Hungary and the road system connecting them. Clearly visible on the surveys are the main trade roads and less heavily used cart tracks, which were easily passable for horse-drawn carriages, and so for centuries proved to be reliable routes. In later centuries some of them became part of the evolving road network, while others are now mainly used for agricultural and forest management purposes.

Historical routes are characterized by rational courses with optimal distances and topographical characteristics, so these routes may also be suitable for pedestrian and cycle traffic. In some areas these tracks have spontaneously acquired these functions, and in many cases local initiatives exploring the potential they have as cycle routes have led to proposals for their designation as such. Therefore these routes can be valuable parts of a given landscape for a variety of recreational non-motorized transport. The task in each case is that the recreational use must be reconciled with the existing forms of land use, and in the interest of the further usefulness of routes they should be integrated into regional and landscape plans.

In many cases certain sections of historical trails are the best routes for walking, cycling and horse riding. In low traffic conditions this is not a problem, but where there is more traffic there is a case for the establishment of greenways suitable for several uses. For optimal solutions an appropriate width (as determined in regulations) is required, to include tree planting.

Greenway development along historical routes can link well to tree planting and road surface improvement – both necessary from an agricultural point of view.

3. Results

3.1 The potential for greenway planning in Hungary

On the basis of our analyses we have concluded that in Hungary the creation of greenways suitable for various non-motorized uses is justified where significant levels of traffic in at least two non-motorized modes must be accommodated. The potential areas for greenway development are Budapest and certain other cities, together with their surroundings. In Hungary there is the opportunity to establish greenways primarily along existing or proposed routes typically following rational paths and related to ecological and green corridors. Therefore potential greenway routes are to be found alongside watercourses, railway lines and historic trails.

Tried and tested foreign examples can serve as the basis for the optimal spatial design of greenways. A survey of local conditions, needs and opportunities should always be carried out as part of the landscape design of any greenway. During the design process, special attention must be paid to the unique natural and historical features of the locale and the design environment of the given area.

3.2. A definition of 'greenway' that can form part of the planning process

Our research indicates that in Hungary we should interpret the greenway concept as a linear green space which: offers recreational and various non-motorized transport opportunities in a physical context which is free of environment and transport hazards, or in which they are at acceptably low levels; and which contributes to the maintenance– or optimally the increase – of ecological assets in a given landscape. The determination with scientific accuracy of acceptable levels of environmental and traffic pressure and the expected traffic loads in the area of greenways is necessary for their optimal design. We see the linking of other green areas and landscape assets to routes and the expression of the particular character of a given landscape in the detailed design as further important objectives in the landscape design of greenways as multi-functional linear landscape elements.

3.3 Possible basic cases for the establishment of greenways in Hungary

From our studies so far we have found that the introduction of the original concept of 'greenway' appropriate to Hungary's circumstances is primarily justified in Budapest and its surrounding agglomeration. Furthermore, the concept should be utilised in the system of partly existing and partly unrealised green spaces in the city and its agglomeration. The national network of ecological areas to be protected – such as environmental corridors – appears on a separate zoning page in the Regional Development Plan for the Budapest Agglomeration (2010). However, green corridors (such as shelterbelts of woodland and lines of trees), which are also of significant ecological value, are not included. The reason for this omission is that the concept of 'green corridor' is not clear from a legal viewpoint. In our opinion greenways can be included in the ecological zoning page of urban and regional plans, alongside ecological and green corridors.

Perhaps the most fundamental aspect of the design of greenways is the clarification of the relationship between greenways, other recreational routes, and ecological and green corridors. This is because ecologically valuable ecological and green corridors and routes with recreational value cannot automatically be classified as greenways. They may become greenways if the ecological and recreational functions are simultaneously present and form linear space of structural importance in the landscape. Our findings so far have shown four basic potential models for these functions' simultaneous presence in Hungary, as illustrated in the diagram below:

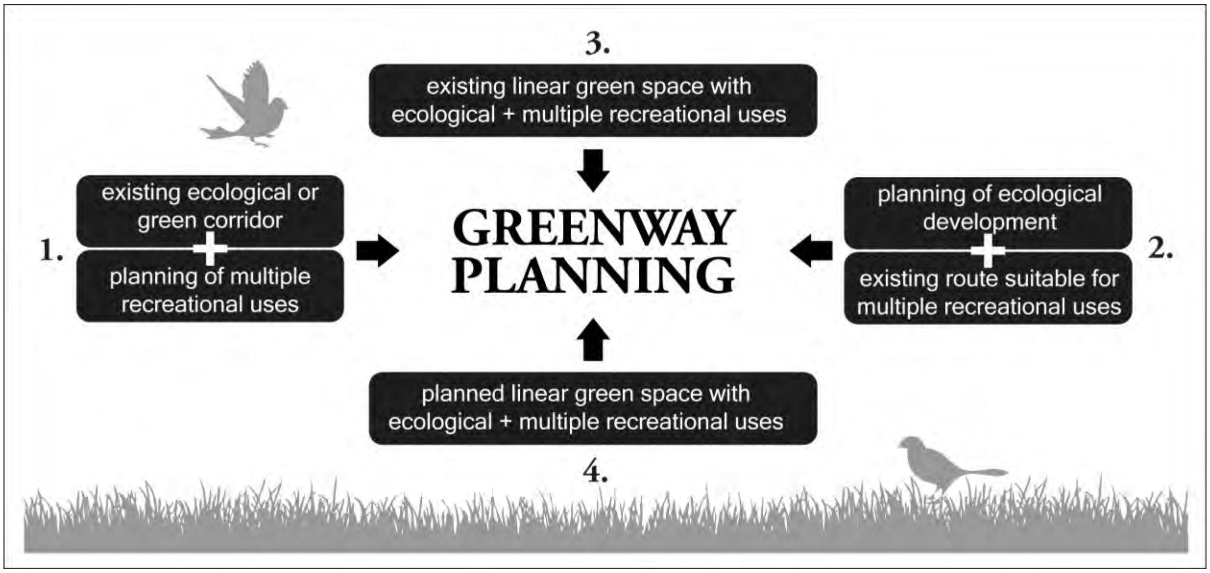

Figure 1: Basic potential models for creation of greenways in Hungary

Based on Hungarian circumstances, the main questions for the potential integration of greenway design into urban and regional planning can be stated as the following:

(1) What solutions can provide existing ecological and green corridors with various recreational functions appropriate to the expected level of use, whilst at least avoiding a reduction in ecological diversity, and possibly increasing it?
(2) Which of the existing routes suitable for walking, cycling and horse riding can become ecologically valuable elements in the landscape, and with what means can this be achieved?
(3) Which existing routes with multiple recreational uses and associated green areas can be considered to be greenways, and how can they be optimally developed?
(4) In certain regions, which areas show the need or potential for creation of new green corridors with multiple recreational uses?

4. Discussion

The introduction in Hungary of greenway design can provide a new opportunity to meet the growing demand for outdoor activity. Forest hiking trails can be augmented by tree-lined agricultural roads. Greenways far from roads in surroundings with no (or acceptably low) environmental or traffic dangers are an alternative to cycle paths alongside roads, while also offering active recreation. The greenway design of certain sections of horse riding trails can resolve or avoid conflicts of use arising from a variety of non-motorized transport modes on one route.

The introduction of greenway design can result in the landscape-scale expansion of green space system planning in Hungary. Expansion of the recreational function of ecological corridors can lead to the harmonization of protection of ecosystems and satisfaction of recreational demands. Greenways can create a good opportunity to exploit river banks. Along railway lines the formation of greenways is suitable for abandoned areas' change or extension of function on a temporary or permanent basis. Greenway routes which can be formed along historical routes and local dirt tracks can be important elements in the much-needed process of tree planting in the landscape.

A number of other possibilities can be built on developments based on a composite approach to greenway design: the protection of natural and cultural heritage, environmental education in schools, the expansion of local services, and development of tourism (especially water tourism).

5. Conclusion

In the last two decades, the sudden development of personal motorized transport in Hungary has also seen a growing demand for outdoor activities. Traditionally, a variety of recreational routes have been constructed with separate functions. Tourist trails typically run through forests. Cycle paths primarily occur alongside roads. Horse riding has been unconstrained by fixed routes. The development of major proposed horse riding trails is under way. On some routes lack of the necessary space causes use conflicts between the needs of walkers and cyclists or cyclists and horse riders. The formation of greenways is thus justified and expedient on routes where a variety and significant amount of non-motorized traffic is expected. The routes appropriate for the spatial development of greenways are selected sections along watercourses, railway lines and some parts of the historical and local network of unsurfaced roads. Greenway design related to ecological corridors and the design of green space systems should be introduced. Existing non-motorized routes with independent functions are also potential greenways. In every case the design of greenways must be based on the coordinated analysis of the natural features of a given landscape, economic possibilities and the predicted level of non-motorized traffic.

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A New Approach - Dealing with the Challenges of Rapid Urbanization in Hainan, China

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1. Introduction:

During the rushed process to urbanize, land development practices can be harsh on local people as well as the natural and cultural character of the land. With strong governmental power in China, land acquisition by government and developers is usually much easier than in the US. Local residents may be relocated without asking for their input, making way for expensive housing and large hotels; the land they depended on to earn their living may be replaced by seemingly endless identical luxury vacation villas, shopping complexes, and theme parks. Residents face the threat of losing the traditional income source and, later, becoming a part of the social problems of the local society. In the conventional practice, the landscape architects' role in urbanization development is limited in China. The government, the developer, and the local people all have their own different objectives. The team's task becomes a key role in coordinating and guiding them, in creatively leading the development process

This presentation, using the Yanoda Ecotourism Zone Planning project of Hainan, China as an example, demonstrates the landscape architecture team's successful attempt to work in a leading role and propose an Ecotourism and Sustainable Development method, a creative way to plan the land use that rejects the conventional model in favor of a progressive blend of ideas, directly involving and benefiting the local people in an ecologically and culturally sustainable way.

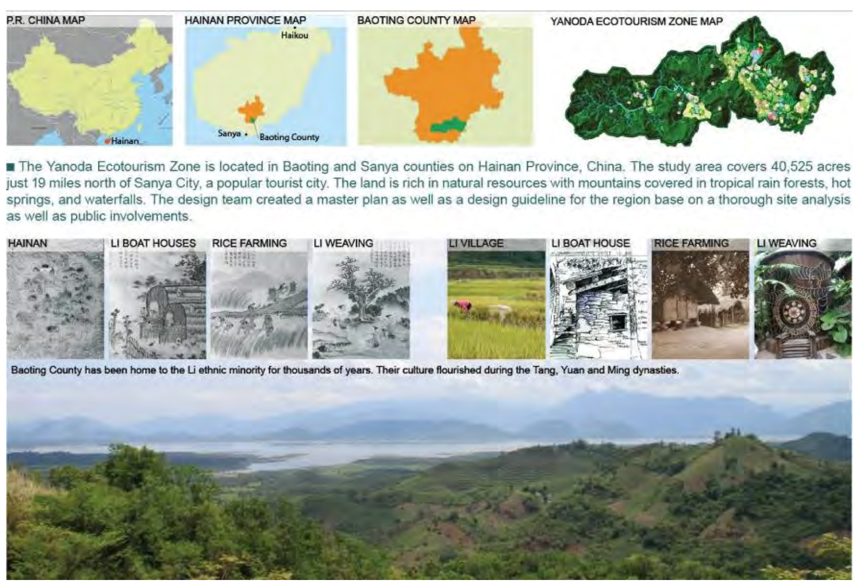


FIG. 1. PROJECT LOCATION AND HISTORIC CHARACTER OF THE AREA

2. Project Background

The Yanoda Ecotourism Zone is located in Baoting and Sanya counties on Hainan Province, in the South China Sea (Fig.1). The study area covers 164 Km^2 (40,525 acres) near the Wuzhi Mountains. This project was a collaborative project between the developer and two county jurisdictions. Initially, when the ECOLAND design team was called in, the plan showed no connection to the local land which is rich in natural resources and culture, but was also home to extreme poverty. Its residents, the Li people, are one of China's 55 ethnic minorities living among mountains covered in tropical rain forests, hot springs, and waterfalls, they have little access to electricity, plumbing, or clean drinking water. The widespread poverty and uncontrolled local construction, if left to continue, would have been harmful to the ecological system. (Fig. 2) At the same time, the developer is accustomed to the conventional approach for development. Their original plan would have called for the common practice, simply relocating the local people to make space, replacing their farmland with golf courses and 'Spanish-Mediterranean' style resorts. Since the local government has a strong influence in land acquisitions, the local people would have been removed from their land, and thus their source of income and cultural heritage, with little improvement to their situation. In all, no value was placed on the unique character of Yanoda prior to the changes made by the design team. (Fig. 3)

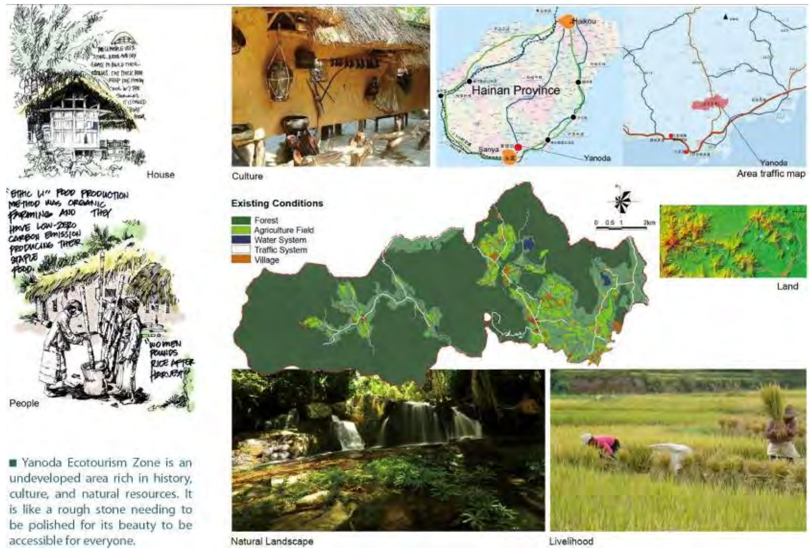


FIG.2. BACKGROUND OF THE YANODA REGION

3. Goals and Objectives:

The design team realized that to only meet the objectives of the developer was not enough to fulfill landscape architect's own social responsibilities and professional ethics. They had the opportunity to creatively establish a planning process that involves all three parties to coordinate a master plan that best reflects the interest of all parties as well as respects the richness of the land itself. The ECOLAND landscape architectural team decided to take the higher goal. The objectives of ecological, cultural, and economic sustainability can be combined creatively to propose a successful development for all parties involved – developer and local government, as well as for the local Li people and their land. (Fig 4)

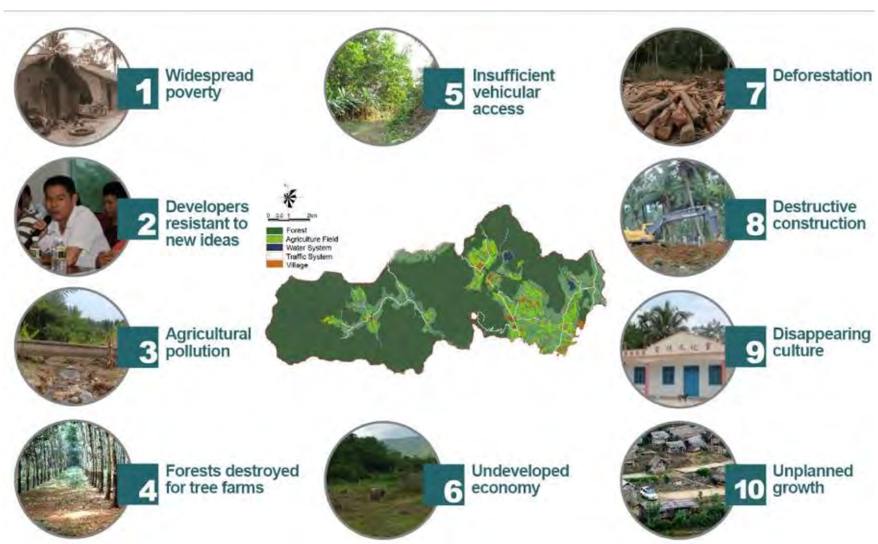


FIG.3. PROBLEMS AND ISSUES

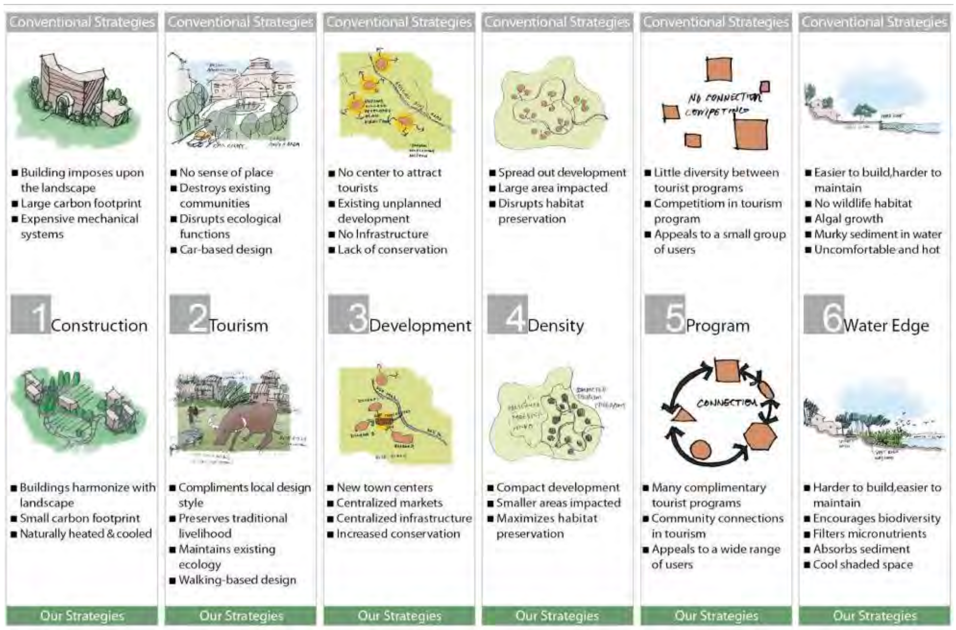


FIG.4. CONVENTIONAL STRATEGIES VS. CREATIVE STRATEGIES

4. Master Planning Process

A. Site Analysis

The data collection and analysis phases are the foundation of an intellectually honest program (Fig 5, 6). The landscape architects of ECOLAND conducted a thorough site analysis, including the compiling of information with GIS Spatial Analysis to generate a study of water loss, soil erosion, and mountain development. Greenway and Blueway ecological corridors were also identified for protection. The team conducted numerous field visits, which included an investigation of how poverty had affected the character of the land. The Li people lived in 43 spread-out villages of 300 to 500 residents each, with scattered commercial centers and few

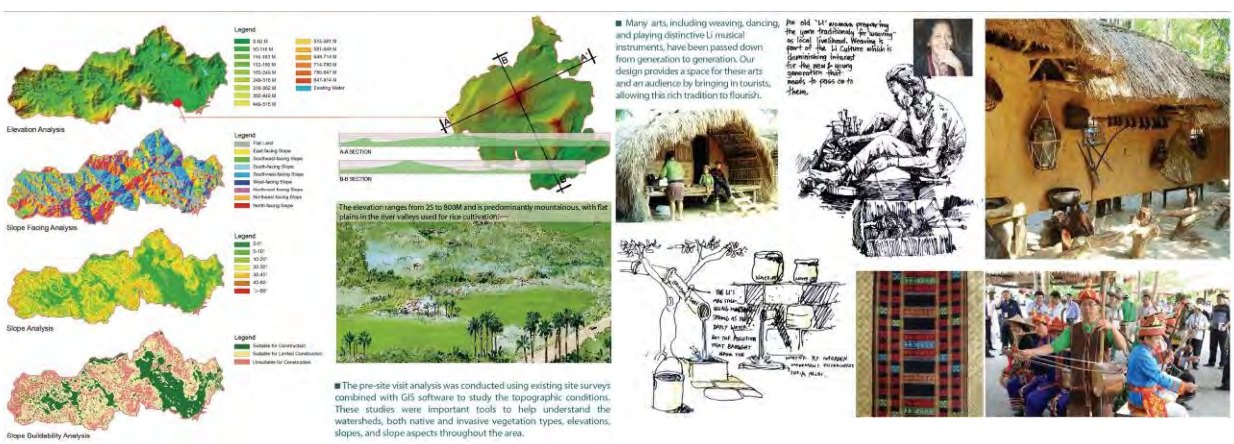


FIG.5. SITE ANALYSIS INCLUDING NATURAL AND CULTURAL ASPECTS

paved roads. The lack of a proper sewage system not only increased the incidence of disease, but also polluted the environment. There was little education or access to markets, and farming was their primary source of income. Heavy fertilizer and pesticide use polluted waterways and infiltrated sources of drinking water. Without a system to store water from the heavy summer rains, high-intensity irrigation was required during the dry winter, straining water reserves. To supplement their incomes some residents had been illegally harvesting natural rain forest trees, and replanting with monotonous tree farms, lacking in diversity, for paper and rubber production. Such practices were very detrimental to the ecosystem. Despite these problems the site, with tropical rain forests and mountains, has many features conductive to tourism, most notably areas of beautiful scenery and a unique culture. Li architecture excels at natural climate control, using local materials without concrete or metal. The Li minority people are famous for their weaving, which is used to make clothes and to decorate homes, and their rich festival traditions are all tourist attraction opportunities.

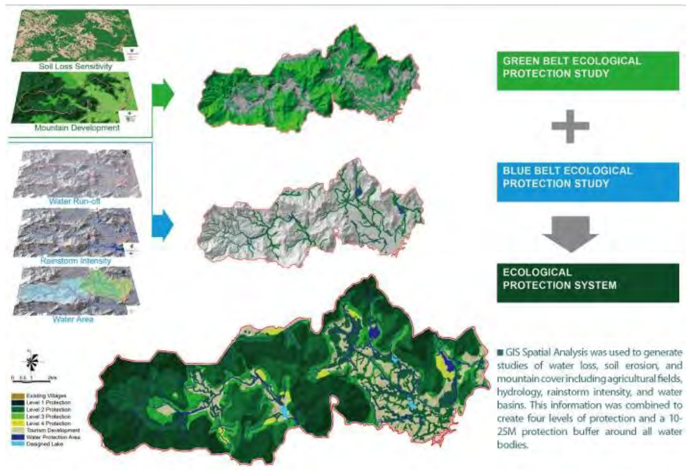


FIG .6. GREENWAY - ECOLOGICAL CORRIDORS

Although there was little awareness of the site as a tourist location before the project began, many local people were trying to attract visitors by displaying their culture. These scattered efforts only competed with each other, failing to make a large impact. A comprehensive tourism program was needed, including marketing, access from regional airports, and a plan for directed growth and preservation to stop the cycle of poverty. The developer's conventional plan did not address these issues and would have caused additional destruction with its lack of regard for existing conditions or conservation ideals. The design team identified the challenges and opportunities and presented a new plan. The proposed master plan calls for protection of the land and the people, at the same time enriching the tourist program with organic experiences increasingly sought by modern travelers. Incompatible program elements were eliminated and local involvement was brought into the project. Realizing that the future of tourism lies with this Ecotourism approach, the government enthusiastically supported the project as a development model worthy of following. A phase I demonstration project commissioned by the government to apply these planning principles, called Zajin Village Center and Forest Park, is already nearing completion.

B. Strategies and Empowerment of Local Public

Using an approach that had never been tried in the region before, a series of public meetings was held with all residents of the study area invited to attend prior to finalization of the master plan. Once ideas were generated regarding the plan, they had the opportunity to vote on their favorite ideas. People were slow to participate at first, having never been asked for their input before. As they realized the direct impact that they could have on a plan that would shape their futures, the response was overwhelming. This unique experience in the residents' lives generated meaningful design and program input and gave the Li a sense of investment and ownership in the changes taking place, increasing chances for the project's success, both for the people and for the developer.(Fig 7)

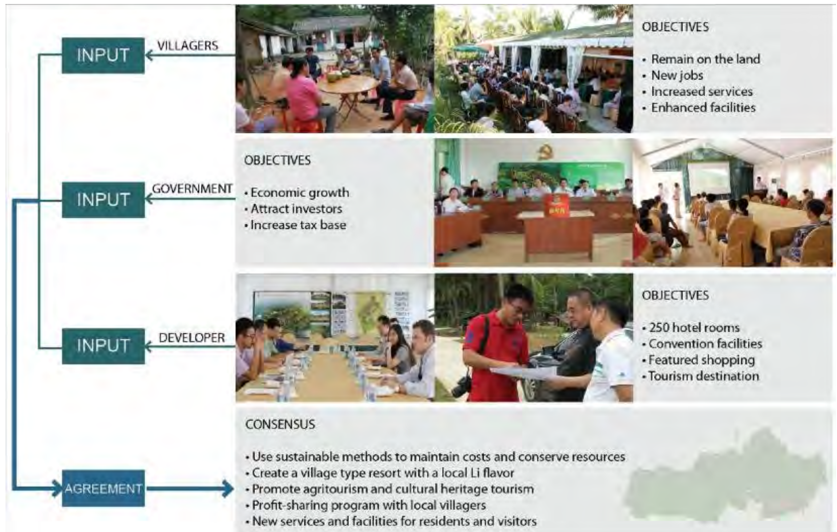


FIG.7. PUBLIC EMPOWERMENT

C. Establishing and Finalizing Master Plan Objectives

The master plan developed from the site analysis and community meetings expanded tourist access to the beauty of the land and the unique crafts of the Li people through directed growth that values environmental protection, improves infrastructure, and increases business opportunities. A road connecting to Sanya, an internationally known tourist city, leads to and from the site. Vehicular access is limited to areas close to this road, with parking provided at key locations. Further tourist access beyond this area is encouraged by electric vehicles, horse carts, bicycles, and walking. A system with four levels of land protection was designated, serving the interests of each stakeholder based on ecological and cultural value. (Fig.8).

- **Rain forest protection zone:** The first level calls for a government sanctioned high-priority conservation area with a ban on farming and construction. This area will experience very little development, leaving the rainforest intact, and has no thru-traffic, making it a natural choice for preservation and scientific research.
- **Mountain hiking zone:** The second level provides limited access to wilderness areas and requires some future restoration to revert the paper and rubber plantations back to natural forest. The High Mountains and steep slopes in this area offer plenty of

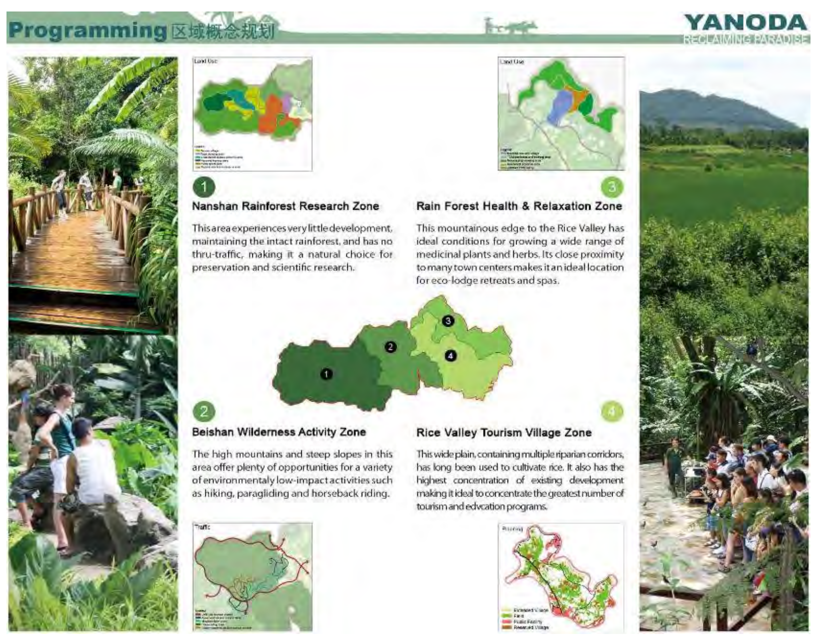


FIG. 8. FOUR LEVELS OF ECOLOGICAL PROTECTION

opportunities for hiking, horseback riding and mountain biking. It will include small parks and botanical gardens, showcasing native flora and fauna.

- **Eco-lodge retreats zone:** The third level allows only low impact development such as Chinese herbal medicine centers and small boutique hotels. The mountain edge adjacent to the rice valley has ideal conditions for growing a wide range of medical plants and herbs. Its proximity to many town centers also makes it an ideal location for eco-lodge retreats and spas.
- **Tourist resort village zone:** The last level, designated for areas with poor soil and forest growth, proposes guided growth and site amenities including new town centers, eco-resorts, services, farmer's markets, and a training center. This wide plain, containing multiple riparian corridors, has long been used to cultivate rice and had the greatest concentration of development on the site. It will handle the greatest volume of tourism programs.

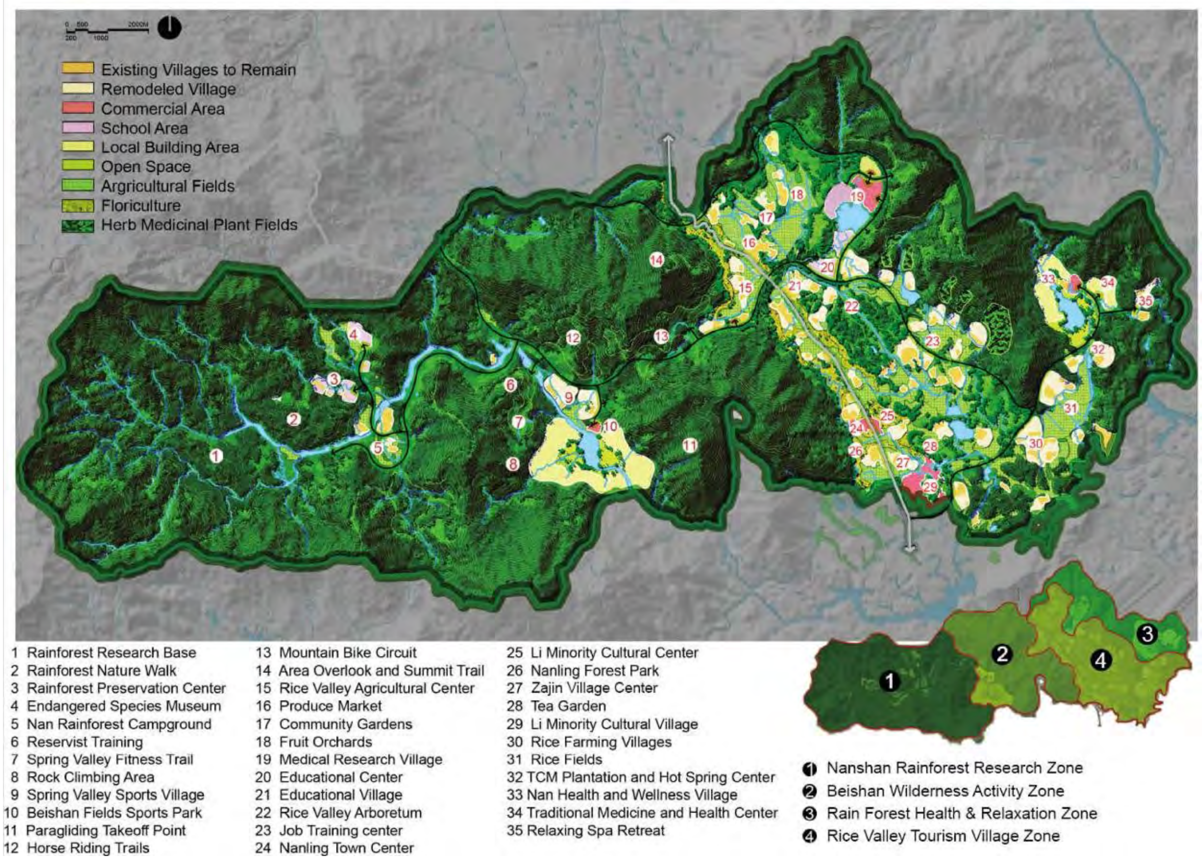


FIG.9. MASTER PLAN OF YANODA ECOTOURISM ZONE, HAINAN, CHINA

D. Phase I Development Detailed Demonstration Plan and Design Guidelines

The phase I area demonstrates the model for future urbanization in the area -The designers designated twelve new centralized town centers, minimizing random sprawl and increasing the amount of contiguous land available for preservation. These centers allowed improved infrastructure to reach all the residents, routing them through the town centers. They also created centralized locations for farmer's markets, restaurants, inns, etc, concentrating tourists in a few areas, in order to minimize the disturbance of the natural surroundings.

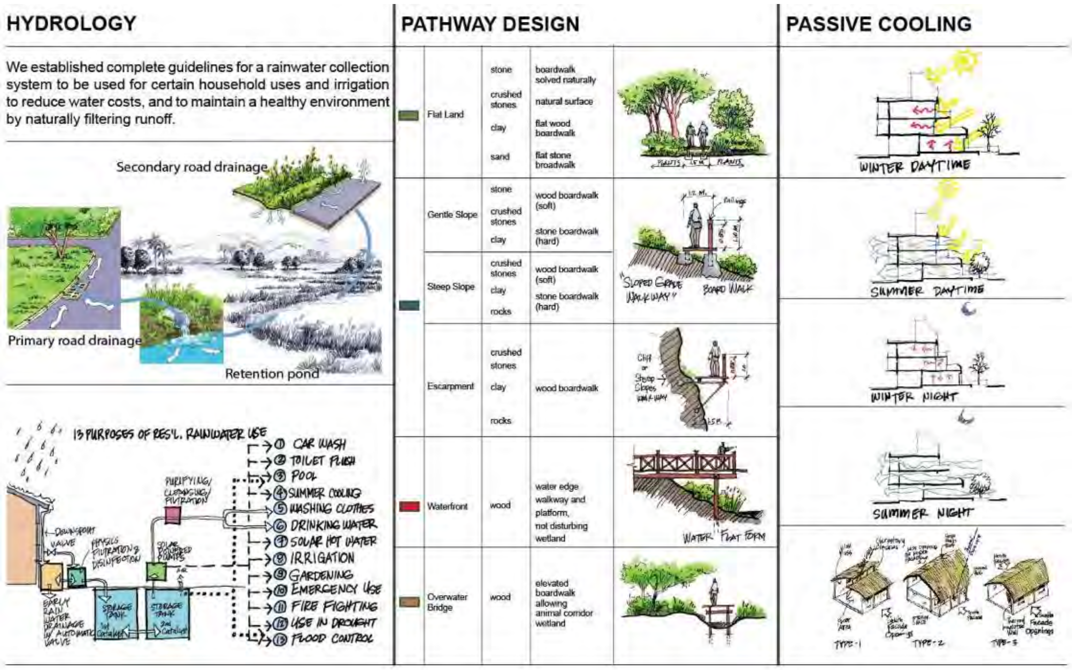
a. Local residents picked a theme for each town such as medicinal plants, water sports, art and regional cuisine, highlighting the many unique features of the area and attracting a wide range of visitors without competition between the town centers. Existing farmhouses were remodeled, sometimes adding guesthouses overlooking the rice fields to give locals an additional source of income.
b. One of the twelve town centers, the Zajin Village was selected to be the first area for implementation of urbanization of sustainable growth. Zaijin is located between three small villages on land that was once a rubber tree plantation. It includes a tropical park on the edge of the rainforest reserve with a walking trails, and educational trails for children. It also provided the infrastructure service to nearby villages eliminating the need to build duplicate facilities for their own, controlling the sprawl of the three small villages. All new buildings use Li architectural elements and reflect a sophisticated aesthetic. They feature locally sourced materials and no concrete.
c. The regional governments authorized an initiative to apply the same guidelines and style of planning to the entire region. For example, raising floor levels high above the ground reduces the need for destructive re-grading of the land and captures breezes, as well as allowing for the creation of unique experiences that increase one's sense of connection with nature. Following the established transportation guidelines, electric and horse driven carts are used, contributing to the special experience.

V. Outcome and Benefits of the Master Plan

The phase I development area has become a popular destination that is a success for all parties involved.

a. Environmental benefit – Reforested degraded areas are recovering, water bodies have become cleaner, encouraging biodiversity
b. Tourist Benefit – The master plan fosters unique experiences, creates connections to nature, provides a wide range of visitor's activities, yet still in a limited area that reduces the disturbance of the rainforest.
c. Economic benefit – A rise in annual income, more job opportunities, and a successful tourism program. Local residents have seen an increase in average per capita income from 2,170 RMB/year in 2008 to 5,280 RMB/year in 2010 with a projected income of 10,000RMB/year in 2015.
d. Social Benefit – improves living standards and local incomes, protects the local culture, improved local education.

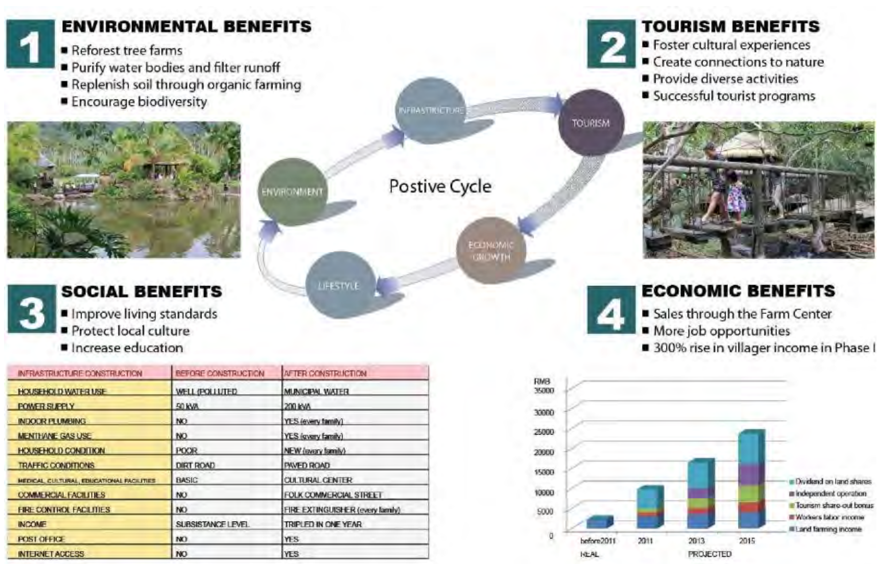
FIG.10. EXAMPLE OF DESIGN GUIDELINES



VI. Conclusion: What We Can Learn from This Case and Apply to Practice in a Wider Scope

The benefit of expanding the role of the traditional landscape architect in urban development is obvious. The master plan for Yanoda is not merely a development guideline for the areas in the un-avoidable urbanization process, but a model for a system of continued sustainability and growth for the region. By incorporating scientific research and education, infrastructure, and job training, the master plan shows that the goals of ecological, cultural, and economic sustainability can be combined to create a successful development for all parties involved.

A win-win master plan can be achieved by evolving the relationship between government, developer and residents and the role of the landscape architect. Lessons can be learned from this development model. The result is a popular tourist destination that has the support of both the people and the government. Although the interests of the individual have not always come first in the rush to build in China, Yanoda



INFRASTRUCTURE CONSTRUCTION	BEFORE CONSTRUCTION	AFTER CONSTRUCTION
HOUSEHOLD WATER USE	WELL (POLLUTED	MUNICIPAL WATER
POWER SUPPLY	50 KVA	200 KVA
INDOOR PLUMBING	NO	YES (every family)
MENTHANE GAS USE	NO	YES (every family)
HOUSEHOLD CONDITION	POOR	NEW (every family)
TRAFFIC CONDITIONS	DIRT ROAD	PAVED ROAD
MEDICAL, CULTURAL, EDUCATIONAL FACILITIES	BASIC	CULTURAL CENTER
COMMERCIAL FACILITIES	NO	FOLK COMMERCIAL STREET
FIRE CONTROL FACILITIES	NO	FIRE EXTINGUISHER (every family)
INCOME	SUBSISTANCE LEVEL	TRIPLED IN ONE YEAR
POST OFFICE	NO	YES
INTERNET ACCESS	NO	YES

FIG.11. ENVIRONMENTAL, TOURISM, ECONOMIC AND SOCIAL BENEFITS

Ecotourism Zone shows how a different model can lead to successful future growth in a guided sustainable way.

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Taking the High Line:
Elevated Parks, Evolving Neighborhoods, and the Ever Changing Relationship between Urban and Nature

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Introduction

"If you were actually able to make a park on the High Line, it would be great for property values. But this will never happen; it is just too far-fetched. These people are dreamers." (A local property owner at a Community hearing, April 2001 David and Hammond 2011 p. 31)

Everyone talks about it and everyone wants one; *The High Line* in New York City started a worldwide trend of elevated parks. Old and unused rail lines are transformed into exciting urban environments. New York's Mayor Bloomberg has noted that the project has ushered in a renaissance for the area impacting the real estate values and development in the surrounding vicinity. This was one of the main arguments for the realization of the project and even though there's been strong community support for the project, voices have been raised on how this change is affecting the neighborhood.

The aim of this paper is to critically discuss the evolving trend of *elevated parks* and especially *the High Line project*, by investigating what reactions and debates it has triggered. Highly acclaimed as an expression of *Landscape Urbanism,* it focuses on the reuse of abandoned infrastructure and active landscapes. The project has been a success, seeing millions of visitors since its opening, but the neighborhoods around it have undergone changes. Gentrification raises alarms as projects like these have a dual function in both increasing property values (as intended by supporters), and causing friction with those negatively impacted by those forces.

The High Line story is one of an evolving view on urban planning and design; a product of a constantly changing view on parks and public places. Robert Hammond, one of the activists behind the creation of the High Line commented that: "*Central Park was meant to be an escape (…) On the High Line, you're in nature, but you can hear the traffic, you can see the Empire State Building*" (Jacobs, 2012), highlighting the interrelationship between the 'urban' and nature.

Methods

The idea for this paper sprung up from a visit to the High Line, following a discussion with the Project for Public Spaces senior vice president, Kathy Madden. Enchanting as it is, as soon as the first bliss wears off, the complexity of the project raises interesting questions. It is highly relevant not only for landscape architects, designers and architects, but also planners, since the High Line has influenced many other projects. This influence raises questions of *who* is initiating the provision of public space, *who* public space is intended for, and what consequences a project of this magnitude can have on the surrounding locale.

This paper is an analysis of the High Line case through explorative and observational methods, including the analysis of documents, blogs, reviews, and journals. As one aim is to identify and follow the debate, an open search was made in the initial phases of the work to identify the relevant sources. Observational methods here refer to the site visit and direct observations of photos to identify possible areas of conflict, such as issues of access, shortage of amenities and preservation. The theoretical basis for the discussion in this paper connects to both the project itself and the effects and processes the changes have caused in connection to the surrounding area. Landscape urbanism is a concept gaining attention and is acknowledging the diverse role that urban parks can play in today's society. The High Line has been discussed in terms of gentrification impacts to the surrounding neighborhoods. Both gentrification and landscape urbanism are concepts important for the understanding of the context this project has emerged within, and the complexity of contemporary design, and management of parks and public spaces.

Landscape Urbanism- A New Frontier between Urban and Nature

Landscape urbanism is an emerging concept involving the ecology of the city, the multi-functionality of nature and landscape, and the interrelationship with the urban environment. What is considered an urban park and what functions should be supplied by one has shifted dramatically over time and is still evolving. In the United States the first urban parks were unimproved commons at the edge of cities which were developed into pastoral landscapes with a narrative of nature, as opposed to the urban, the park acting as a refuge from the city. At first parks were enjoyed by the upper class as the working class lived too far away and did not have the time or access. At the end of the 19th century, parks underwent a social reform changing the relation between park and nature as parks aimed to be a public common, and not a mere resemblance of pastoral landscapes (Cranz, 1997 & Low et al. 2005). In the 1930's more focus was put on recreational services, widening the definition of parks. In the 1960's this developed into recognition that a wide range of places can be used for recreational uses, not only parks (Cranz, 1997). According to Cranz, society is currently experiencing a fifth model, understanding that parks have the potential to contribute to sustainable lifestyles by bridging the divide between production of resources and consumption of resources. This new era also recognizes the need to reclaim places previously used in other ways for parks and the wider public space uses (1997).

Landscape urbanism is an attempt at finding a balance between the built and natural environments (Duany & Talen, 2013). There is a need to plan, design, and maintain various places - foremost through understanding their identity, physical pattern, meaning, and setting. According to Mohsen Mostafavi, this is the territory of ecological urbanism, with the capacity to accommodate the inherent conflictual conditions between ecology and urbanism (2011). The last decade has seen a rise of a new paradigm in architecture and urban design - landscape urbanism. The variety and divergence of this in combination with its broad approach on the urbanist agenda sometimes makes it difficult to define what it is all about, however, the concept of using landscape as a model for urbanism holds the framework together (Assargård, 2011).

According to James Corner (2006), landscape urbanism has the potential to contribute to the need to fully understand the cultural, social, political and economic environments as embedded in, and symmetrical with, the natural world. Landscape urbanism fundamentally draws attention to the key elements of contextualization, complexity, and contingency promoting an understanding of places and projects based on a ‘systems ecology view’, which includes people and what they do and have done in the same frame as a comprehensive view of the natural world (Assargård, 2011). The motivation of landscape urbanism is the creation of a sustainable city regarding several parameters, such as ecological, social, economic and aesthetic aspects (Waldheim, 2010). Landscape urbanism and its proponents have been criticized for being overly interested in building large urban parks that give way to a sort of “green sprawl”. Charles Waldheim claims that the whole movement and paradigm of landscape urbanism is much more a way to describe urban form differently; where the ecology is being reconstructed and combined with architectural ideas, rather than simply planning for parks in cities (2006 & 2010). Landscape, sustainable, and ecological approaches in urbanism are critically needed in organizing our cities and communities.

About the High Line

The High Line is a former train track now transformed to a publicly owned but privately managed park situated on an elevated structure running on Manhattan’s West Side, Chelsea, and The Meatpacking districts. The High Line was built in the 1930’s to get the freight traffic from Manhattan’s industrial districts off the street level and was running until 1980 as part of the public-private West Side Improvement project. In the 1950’s trucks took over as the main transport mode and the last train operating on the High Line ran in 1980. The south most part of the line was demolished in the 1960’s and by the end of the 1990’s the High Line was considered an eyesore, at its best, just forgotten (thehighline.org, undated a).

Two local residents, Joshua David and Robert Hammond met at a community board meeting in 1999 where the future of the High Line was to be discussed. Officials in the Giuliani administration and local business owners were at that time convinced that the only way forward was to tear down the High Line. Having fallen in love with the structure, David and Hammond founded Friends of the High Line (FHL) as a community-based non-profit organization which today manages the park (David & Hammond 2011).

Saving the High Line was a prolonged process fighting both local property owners and a political administration who wanted to demolish the structure in order to develop the area below. In David and Hammonds own book *High Line - the Inside Story of New York’s Park in the Sky* (2011), the process to secure the preservation of the High Line is described in detail. In the beginning, public opinion about the structure was that it was a dark and dangerous place, full of crime, prostitution, homelessness and pigeon shit. The founders of FHL wanted to involve celebrities from the very beginning, reaching out to local gallery owners and personal contacts as they understood that they had to get attention and change the politician’s minds as well as the public opinion. By using the media power of celebrities, involvement of the community and gaining attention through special events, parties, fundraising, idea competitions, these private citizens, essentially became un-trained planners, yet they managed to accomplish a great feat by swaying public and governing opinions, representing a new way of non-traditional urban planning working to develop the urban environment; an example of citizens taking planning into their own hands.

The park was designed by landscape architecture firm, James Corner Field Operations and architects Diller Scofidio+Renfro in cooperation with the Friends of the High Line and input from the community through the open meetings held by the Friends of the High Line (thehighline.org undated a). The ribbon for the first part was cut June 8th 2009 (the second part opened 2011) and since then more than 4 million people have visited the High Line (thehighline.org, undated b, David & Hammond 2011).

Trendsetting: Elevated Urban Parks

The success of the High Line in New York City started a worldwide trend of elevated parks, giving attention to other similar projects springing up. In Jerusalem the "Train Track Park" connects rich and poor neighborhoods (Holmes, 2012 & Dvir, 2012) and in London ideas have been put forward to create a mushroom garden in an old railway tunnel beneath Oxford Street (Pouls, 2012). Officials in Mexico City, likely inspired by the High Line, plan to build an elevated park from scratch (Jacobs, 2012), in contrast to both the local initiative of the High Line project and the underlying idea to give old structures new uses. In the US, the Bloomingdale Line in Chicago (bloomingdaletrail.org undated) and the Reading Viaduct in Philadelphia are examples of a nationwide trend. Reading Viaduct is a locally initiated project aiming to create a public green space on an old train viaduct in rapidly redeveloping neighborhoods and is described by proposers as a magnet for residential and commercial development (readingviaduct.org undated). The acclaimed original inspiration for the High Line and other elevated park projects comes from Paris. Viaduc des Arts and Promenade Plantee, was initiated by the city of Paris and *Semaest*, an arts and crafts association, and in the beginning of the 1990's the abandoned track was turned into a pedestrian walkway on top of arches renovated to house workshops and galleries for artists and craftsmen (Campbell, 2002). These may seem similar to the "rails to trails" movement in the US where rail beds have been repurposed to bike trails, but it is inherently different as landscape urbanism views the remaining underutilized infrastructure not as something to remove to gain space for another use, but as an asset to be repurposed.

The High Line wasn't the first of its kind but the huge success of it has started the discussion of if elevated parks can experience similar success in other American cities (Jaffe, 2011). As a response to this debate, Witold Rybczynski (2011), professor of urbanism at the University of Pennsylvania wrote an Op-ed in *The New York Times*, discussing the designers wish to make the project a new model for town planning and the beacon of landscape urbanism. Referring to other elevated park projects in the US, such as the Sixth Street Embankment in Jersey City, and The Iron Horse Trestle in St. Louis, he criticizes the idea of seeing the High Line as a quick fix to revive declining downtowns. In both Manhattan and the modern and wealthy 12th Arrondissement in Paris where Promenade Plantee is situated have been crucial to the success of the project, according to Rybczynski, we find examples not of "build it and they will come" but of "build it were they are" (2011). The high design, high maintenance model the High Line represents would not be sustainable anywhere else (Lange, 2011) because not everyplace is Manhattan or Paris, and these types of projects may not be suitable in other locations and cities experiencing different economic and social realities.

Critical Reflections

While the High Line is undoubtedly a loved place and a huge success, as predicted, the property values have risen, increasing the tax revenues for the city. *Travel + Leisure* magazine named the High Line the 10th most popular landmark of the world (travelandleisure.com, 2012). The experience of the place has been described with words like “serenity” and “exhilarating” and that the elevated structure works as a “refuge,” an “altar” (Golden, 2011). One writer expresses that strolling along the High Line resembles a main street in a small town (Cardwell, 2009). *The New York Times* describes the High Line as a play between contemporary and historical, an immediate sense of calm, a thoughtful, sensitively designed public place that alters your perspective of the city, the height makes views possible but *“(a)t the same time, you are still close enough to make eye contact with people on the sidewalks, so that you never lose your connection to the street life*” (Ouroussoff, 2009).

The critical remarks that have been made concern the structure and design, details such as, “are there too many or too few entrances?” Even though the Friends of the High Line have the outspoken value that the High Line is a place for all people regardless of socioeconomic status, and having held continuous community meetings (thehighline.org undated a), issues are being raised about the “publicness” of the place (see comment by Rwordplay in Moss 2012b). In online magazine *Planetizen* Sam Hall Kapland stated that:

> *“The High Line obviously was not designed for these persevering dwellers, or the neighborhood. If so, from my public planning perspective, the generous funds received from its well-heeled patrons and the city should have been first used at the street level, to improve pedestrian safety and connectivity, contain the noxious traffic, and purchase a few of the area's unsightly parking lots for active playgrounds, pocket parks and common gardens that have been on the community's wish list for decades.”* (Kaplan, 2012)

This raises concerns for whom the project is design and its role in the ongoing gentrification of the surrounding neighborhoods. The term “*gentrification*” came about in 1964, coined by a British sociologist, Ruth Glass, who defined it as a process where one class is “invaded” by a class with more buying power, and that once the process starts, “it goes on rapidly until all or most of the original working-class occupiers are displaced and the whole social character of the district is changed” (Glass 1964: xviii). The term has grown since then into a large area of scholarly research of its own, and is often situated in proximity to similar terms such as *urban regeneration, revitalization, renewal, re-invasion, and ‘back-to-the-city movement’* (London and Palen, 1984, p.6). London and Palen (1984) listed five explanations for gentrification, which they likened with “reinvasion”, playing off of Park and Burgess’s (1925) invasion and succession cycles (1984, p. 8), those explanations pointed to: “(1) demographic-ecological, (2) sociocultural, (3) political-economic, (4) community networks, and (5) social movements” (1984, p.14). Theories abound on the cause and effect of gentrification, ranging from Neil Smith’s *production side theory* that points to economic and capital restructuring of space (1986), to David Ley’s *consumption side theory* that points to an influx and “geography of a new cultural class” into the city (1996, p.68), to theories surrounding *globalization* and *the new economy* (Sassen, 1995 &

Smith 2002). A more contemporary notion of gentrification comes from Richard Florida's, *The Rise of the Creative Class* (2002).

In "*New Globalism, New Urbanism*," Neil Smith (2002) points out a "third-wave" generalized gentrification (in contrast to the sporadic in the 50's and urban economic restructuring in the 70's and 80's) has focused on bringing the middle-class back to the city through more than only providing housing options, but that it has "evolved into a vehicle for transforming whole areas into new landscape complexes that pioneer a comprehensive class-inflected urban remake" (2002, p.443), including new "cultural facilities, open space, complexes of recreation and pleasure" (443). This description fits well into the context of the High Line, in which gentrification is not solely about housing, but more about bringing in attractive urban amenities to spur further reinvestment in the city. In the context of this paper, gentrification processes are less a result of more affluent people moving into the area, then they are the result of a new "object" transforming the area and attracting more people, the High Line itself is the "*gentrifier*", which speaks to other towns and cities who have similar infrastructure and inspires them to seek the same results.

Even though the connection between the High Line and the changes in the neighbourhood have been ongoing during the whole life time of the project (the possible impacts were discussed already by the friends of the High Line in the initial stages) (David & Hammond, 2012), a heated debate was triggered by the article entitled *Disney World on the Hudson* published as an op-ed in *The New York Times*, August 2012. Pen named blogger Jeremiah Moss heavily criticized the project blaming the gentrification and "Disneyfication" of the West Side on the High Line. According to Moss the High Line is an attempt to tame the environment, scrubbing away the originality of the place and being a tool of the Bloomberg administration to justify the rezoning of the surroundings, focusing on luxury residential development. The original businesses have been hard hit, especially the gasoline industry, and will be replaced by chain stores and tourist friendly restaurants (Moss, 2012a).

In *The New York Times*, letters responding the Op-ed by Moss were published both praising the project and describing the changing of the neighborhood as something healthy and normal (nytimes.com, 2012). Blogger Matthew Gallaway accuses Moss of being too conservative, ignoring the need for development and arguing that the problem is not the High Line but an unfettered system that does not support affordable housing or spend tax money on non-profit cultural development (Gallaway, 2012). An even more nuanced critique is put forward saying that there is no question that the High Line *is* connected to gentrification, but that change itself must not be feared and Moss still points out important issues. Issues of socioeconomic and cultural plurality are important to discuss as New York is a place that experiences huge inequality (Chan, 2012). Other writers disagree completely, Elisabeth Licata for *Garden Rant* argues that "(b)laming projects like the High Line for gentrification is kind of like blaming the egg for the chicken" (Licata, 2012).

The new development in the area is directly connected to the rezoning allowing new residential development, first associated with the New York Olympics bid (David & Hammond, 2011). According to the founders of FHL the zoning process has been parallel to the High Line, and that the Friends of the High Line have tried to distance themselves from that process. Regardless who and what is to blame for the changes, property values rose 103% between 2003 and 2011 (nycedc.com, 2011), and the project has generated 2 billion dollar worth of private investment surrounding the park and is predicted to exceed 900 million in new tax revenues for the city over the next 20 years (Illman, 2012). Local businesses have witness of hard times loosing profits since the High Line was built (Feeney, 2011).

The friends of the High Line have been countering this critique. The same day Moss's Op-Ed was printed Joshua David and Robert Hammond published an open letter on the Friends of the High Lines homepage (thehighline.org, 2012; David & Hammond, 2012) as well as letters from volunteers and supporters expressing their love for the High Line. Reservations about crowding, noise, and elite status have been expressed in an article in the local magazine *The Villager* (Humm, 2012). But important to remember is that the major argument to save the High Line was from the beginning that a new park would increase the value of the surrounding real estate which would raise property taxes and be economically beneficial for the city (David & Hammond, 2011 p.45).

Today's prevailing term to soften the emotiveness of "gentrification" has become "*urban regeneration*" (Smith, 2002, p. 444), essentially becoming a more advanced and coordinated style of gentrification, and Smith notes that urban regeneration constitutes the "next wave of gentrification" (2002, p. 445). As gentrification has warped into a new more palatable term, it has become part of a "global urban strategy" which is an "expression of neoliberal urbanism," (2002, p. 446). This shows gentrification in a light that is not as simple as young urban professionals moving into an abandoned neighborhood and trying to transform it through improving one house at a time, or by adding a small business. In "*New Globalism, New Urbanism*," Smith demonstrates that gentrification has transformed from the Bohemian-Yuppie types that moved into neighborhoods, turning into a "competitive urban strategy within the global economy" (2002, p. 446). Gentrification abounds in pros and cons depending on the stakeholder and the point of view. For some it is a natural evolution of a transforming city. Matthew Carmona writes that London's public spaces that have been regenerated "simply reflect the changing nature of the city, change that in recent times has manifested itself socially, economically, and culturally, as well as physically" (2013, p.68).

Discussion

The reactions and critique concerning the High Line focuses mostly on the ongoing gentrification of the area and the role the High Line has played in this. Gentrification has long been a term of multiple meanings depending on the point of view. For the poor and disadvantaged it can mean economic eviction from a place long called home. For real estate developers it can spell huge financial gains, for architects it's a big opportunity to put their stamp on the city, for municipal officials it's a chance to tout a victory for the city, while for those seeking a lifestyle change, it may mean living in a trendy city condo with walking distance access to cafe latte's and parks. The idea of a gentrified neighborhood changes the "urban image" into one that Richard Florida describes as "Street Level Culture," which is a "teeming blend of cafes, sidewalk musicians, and small galleries and bistros, where it is hard to draw the line between participant and observer, or between creativity and its creators" (Florida, 2002, p. 165).

Gentrification has always had its proponents and opponents. Those who claim that the city has a right to renew itself and improve over time praise gentrification processes for the transformation of neighborhoods. Opponents of gentrification proclaim inequality and injustices and criticize the process for displacing the impoverished long-term residents of a community. A rezoning process that has been going on in parallel to the High Line project has sped up the gentrification of the surrounding neighbourhoods and a direct effect of the rezoning allowed for new development and expanded residential area. The property owners who wanted to demolish the structure in the end of the 1990's wanted to do so to be able to develop their properties; instead a solution was found transferring the property rights. This points to that the changes was going to happen, regardless of the High Line, but it can also be interpreted seeing the zoning and the High Line both being products of the same social and economic development. The High Line fits in well in the broader context and conditions for contemporary urban planning.

When it comes to feelings towards change and gentrification the ownership of the process is crucial. In this same line, The High Line started as a small-scale project and has been accused of being "hijacked" by the political administration, according to Jeremiah Moss *"it quickly became a tool for the Bloomberg administration's creation of a new, upscale, corporatized stretch along the West Side. As socialites and celebrities championed the designer park during its early planning stages, whipping community support into a heady froth, the city rezoned West Chelsea for luxury development in 2005*" (Moss 2012a). The story provided by the founders of FHL describes a 'David and Goliath' struggle and eventually support from the city administration. The truth is most likely somewhere in between but the raised property values and the harder times experienced by the local, original businesses are an effect of a changing city.

While the High Line exists on the community level, it has become a global phenomenon, prompting other cities to search for leftover tracks. Like the famed "Bilbao Effect" in which cities worldwide scrambled to have a museum built by Frank Gehry or other "Starchitects" as a tool for urban regeneration, so too the High Line has produced its own effect within the emerging field of landscape urbanism. Today, landscape urbanism is looking to utilize spaces and structures previously unconsidered for park uses, thus creating a gentrification of infrastructure that is tied to neighborhoods and districts. Even though the High Line was not the first elevated park the attention the project has gained has increased the interest for this type of project. This is of course connected to other contemporary developments in urban design and planning such as inner-city renewal within the post-industrial landscape. The strength of the High Line is its context, the site itself, and writers like Witold Rybczynski and other critiques fear that the elevated park as such can become a 'cheesy' and dated concept, even though it was an original response to genuine social phenomena. The secret of the High Line success is according to Charles Birnbaum at the *Huffington Post* not necessarily a determined leadership and a public/private partnership but a triumph of historic preservation and design, and describes the project as a role model for showing how development and preservation can work together as the project focuses on site specific, adaptive reuse approach with an holistic embrace both change and continuity (Nettler 2012). The focus on the site and the sense of place created by the ability to outlast the original use, local and material response to societal and economical changes, can be a reminder of the possibilities that the future will hold (Baldwin 2009).

The structure itself and the design features have been both praised and criticized, the location and numbers of access points and the restricted opening hours can affect who is using the structure, and for what? The Friends of the High Line and the design team had the wish to limit access and commercialization and made some very active choices to protection the High Line, but can this outdate the park? What will happen when the bliss wears off? The choice to not let single houses and private users to have their own access points may hinder a bottom-up privatization, but is this an expression of a top-down privatization - the fact that the private manager Friends of the High Line is the only force deciding what will happen on the High Line. The design team didn't want to include the mundane aspects of everyday life to differentiate the High Line from the street below. Everywhere else on Manhattan you can get a coffee, why here (David & Hammond, 2011, p.97)? Classic urban ideas about how to make public places inviting, lively and attractive from writers such as Jane Jacobs and William Whyte points at the need to be able to sit, eat, observe or meet. The key to success includes enabling diverse groups of visitors, at different times and for various reasons to use and enjoy the place. While many of these amenities are available near the High Line, this may not be the case in other locations where other leftover tracks exist and are being eyed for development. The concept and strategies of the High Line cannot therefore be copy pasted; the demands and needs at each specific location must be taken in account.

Landscape urbanism is investigating the ecology of a city and the interrelationship between nature and the urban. What is perceived as a park is constantly changing and the borders between parks, plazas as public space is becoming blurred. The multi-functionality of these places as well as an increased acknowledgment of the importance of green elements and nature in cities is challenging what a park is. The relationship between park and nature has changed over time, from imitation to separation to something new, nature and urban merged. Robert Hammond expresses that *"(s)ome people think of parks as being an escape from the city, but the High Line works because it never takes you away from New York. You are not in a botanical garden. You can hear horns honking. You can see traffic and taxis"* (David & Hammond, 2011, p. 12). By making a virtue of an industrial relic a new experience of the city emerges, which at the same time works as a green lung. The High Line shows the potential of forgotten spaces, and the multi-functionality of parks (Illman, 2012).

The High Line is a landmark in contemporary urban planning and design. Not that it is a truly unique design project, but it mirrors the complex reality for contemporary provision of public space. The surroundings have changed and the project itself is the center of the change, it can neither be separated from it nor completely blamed. According to Low et al. (2005) public space is facing new challenges of reduction of social and cultural diversity due to a changing society, exclusion, management, access and privatization and commercialization are potentially harmful to democratic practices.

Conclusions

A growing urban population of the world, focus on sustainability and densification makes land a scarce resource and the High Line project suggests that elevated parks can bring new nature into cities without occupying ground floor space. Implementations of concepts like the High Line in other places must be made with regard to geographical, cultural, social and political circumstances as well as incorporation within the larger planning context. If the High Line is a result of the paradigm of landscape urbanism one conclusion is a reflection thereof; great landscaping cannot create a great place without a sensitive approach towards the neighborhood in question, the local physical structures and connectedness between them and the needs and wishes among the users of today and tomorrow.

Manhattan is a showroom for the rest of the world and the millions of visitors have spread the word. Regardless of the critiques some facts remain. The High Line is a pleasure to visit an example of astonishing entrepreneurship and a highly relevant project for urban planners and designers all over the world. Change is inevitable, but consequences need to be acknowledged; gentrification is for good and bad happening all around the world. For further discussion we would like to raise some questions: How can flagship landscape urbanist projects succeed at bringing the "green elements" into the city without driving out the liveliness of mixed income neighborhoods? Is a new narrative emerging in the city that combines urban and nature equally?

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12. Cultural Heritage Panel

National Heritage Areas: Evaluating Past Practices as a Foundation for the Future

Brenda Barrett

Introduction

The United States National Heritage Areas (NHA) are congressionally designated lived-in landscapes that reflect the nation's significant and diverse landscape. The management of these areas is based on a community-driven approach to heritage conservation and economic development. Beginning in 1984, the movement took root and rapidly grew to its present number of 49 NHAs with dozens of proposed areas under consideration ("National Heritage Areas" National Park Service). The idea was founded in many of same impulses as the early greenway approach. Glenn Eugester traces the evolution the idea to a number of separate, but related ideas to coordinate natural resource conservation, historic preservation, land use and economic development on a regional scale. While there were multiple factors at work, in his opinion what defines the movement is its focus on place and story of place combined with advocacy, civic engagement, inter-disciplinary planning, and action (Eugester 50).

The NHA program was seen as a new and revolutionary way for the National Park Service to engage public/private partnerships in conserving large landscapes such as river corridors, canal systems, industrial complexes, and agricultural regions. When originally conceived the approach was seen as untested and experimental. (Barrett 2003) It was thought that National Park Service funding for a period of 10 to 15 years might be adequate to launch each new heritage area. Over the past decades, congress recognizing the value of the NHA programs, the challenge of finding dollars for regional initiatives, and the program's growing popularity, has provided the earliest NHAs with multiple funding extensions (Barrett 2012).

In 2008 Congress fashioned a legislative solution to the funding issue for nine of the NHAs whose funding authorization expired in 2012. It mandated an evaluation of the accomplishments of the nine areas. Based on these evaluations, recommendations would be made as to the future role of the National Park Service including funding (Public Law 110-229 U.S. Statutes at Large, May 8, 2008). This approach was seen as a possible model for evaluating all the NHAs within the program.

Background Literature

A literature review to place the evaluation of NHAs in context should start with the National Park Service National Heritage Areas office. They have developed an inventory of resources including guidance on the NHAs planning framework, which is available on the agency's web site ("National Heritage Areas" National Park Service). The information includes preparation a feasibility study to assess the suitability and feasibility of an area for NHA designation. It also includes a management-planning handbook *Components of a Successful National Heritage Area Management Plan* (National Park Service). The management-planning requirement is a key element of the legislation for every NHA and identifies the goals of the NHA and describes implementations steps, partnerships, and funding needs. The Secretary of the Interior must approve a completed plan within three years of the area's designation. These documents and the examples of feasibility studies and management plans are an important starting point for understanding the NHA process.

Another source are governmental reviews of the NHAs program. The most comprehensive was the 2006 study by the congressionally chartered National Park System Advisory Board, *Charting a Future for National Heritage Areas.* Appointed by the Secretary of the Interior, the Advisory Board has 12 members and is charged with offering guidance to the agency. This report, made a number of major recommendations for the improvement of the NHAs program including the need for research to ''better understand the process of collaborative conservation'' and to better ''evaluate the outcomes'' of NHA activity at the landscape scale (National Park System Advisory Board 25).

The first effort to evaluate the impact of NHAs was initiated in 2004 by the Conservation Study Institute, an arm of the National Park Service. The institute undertook a series of evaluations on three of the earliest NHA: The Blackstone River Valley National Heritage Corridor (Tuxill 2005), The Cane River National Heritage Area (Tuxill 2008) and the Delaware and Lehigh National Heritage Corridor (Copping 2006). Styled as Technical Assistance studies, the studies reviewed investments and accomplishments in three of the heritage areas to determine progress towards their stated goals and made recommendation on their future sustainability. The studies also interviewed many NHA stakeholders to better understand the NHA partnership process (Tuxill, Tuxill, Copping). An advisory body of experts further reviewed the information from these studies including the multiple partnership interviews conducted in the three areas. This information was used to build a model on the development on NHAs to inform future evaluations
(Jewiss 2008).

Daniel Laven and others have used the extensive body of data from these three NHAs evaluations to build a dynamic model of these complex systems that is tied to network theory. The models demonstrate how NHAs activate networks of partners from national, state and local sectors. This work explored the connection between network structures with NHA effectiveness concluded that NHAs could be seen as "venues for partnership". They provide a strength and resilience in the face of dynamic changes to their landscapes from flooding, immigration, and shifts in governmental funding sources (Laven 2010). In the most recent analysis of this data, Laven and all, place the information in a broader context of the field of evaluation and looks at some of the critical factors that distinguish the effectiveness of NHAs. It emphasizes the importance of the idea of "heritage" as a method of public engagement and a strategy for initiating discourse and the collaborative approach employed in NHA management and the development of intersectoral networks (Laven 2012).

Another group of studies has looked at the economic impact of NHAs on local economy. The Alliance of National Heritage Areas has recognized that the goals related to economic sustainability are important to popular and political support for NHA. The alliance worked Michigan State University to adapt their Money Generation model to evaluate the economic impact of NHAs on a region. This model was originally developed by for use by National Park

Service for assessing the economic impact of park units (Stynes and Sun 2004 2005)

As discussed in the introduction, the National Park Service commissioned nine evaluation studies to meet the congressional mandate to evaluate NHAs is of most interest for this paper. These evaluations were not done by a part of the National Service. The agency commissioned the National Park and Conservation Association to undertake the work. The evaluation of the Essex National Heritage Area was conducted by the association's Center for Park Management (November 2011). The National Park and Conservation Association then contracted with Westat, an external evaluation firm, to conduct the following eight evaluations: the Augusta Canal National Heritage Area (Rog, Koenig and Jain May 2011), the Hudson River Valley National Heritage Area, (Henderson et al. September 2012), the Ohio and Erie Canal National Heritage Corridor (George et al. July 2012), the Rivers of Steel National Heritage Area (Myers et a. September 2012), the South Carolina National Heritage Corridor (Helba, George and Jones August 2011), the Silos and Smokestacks National Heritage Area (Helba, Jain and Rog March 2011), and the Tennessee Civil War National Heritage Area (Myers e al. June 2012) and the West Virginia National Coal Heritage Area (Marshall et al. September 2012)

Goals and Objectives

The purpose of this paper is to summarize and provide a high level overview of the common findings from the twelve evaluation studies that have been completed over the last ten years. The paper is focused on assessing the National Heritage Areas management entities progress in accomplishing their legislative purpose and achieving the goals and objectives identified in the area's approved management plan. The primary reason for undertaking this review is to share the major outcomes and findings of the twelve evaluations with policy makers both in the National Park Service and in Congress. The review undertook to categorize the NHAs major accomplishments, consolidate common recommendations, and offer conclusions on how this information can be used in the context of NHA program and within the broader landscape scale initiatives. Taken together these evaluations comprise a significant body of data that document an extensive body of work over very large geographic areas and a time frame of 15-20 years.

The initial overview of the twelve evaluations was prepared at the request of the Alliance of National Heritage Areas National Heritage Areas and was distributed under the title of *National Park Services Evaluations Find National Heritage Areas are achieving their Purpose and Accomplishing their Goals* ("Evaluations" Living Landscape Observer).

Methods

The author prepared a high level overview of the program management and accomplishments of the twelve NHAs by focusing on common qualitative and quantitative data sets presented in these evaluations. The more recent evaluations directed their research to answering the questions posed in the 2008 congressional request. The questions focused on assessing 1) whether the NHAs had made progress in accomplishing the goals identified in their authorizing legislation and management plans 2) analyzing the investments of state, federal and local government and other dollars to determine their impact and 3) reviewing the management structure, partnership relationship and funding of the NHAs for the purpose of identifying the critical components of sustainability. (Public Law 110-229 U.S. Statutes at Large, May 8, 2008) The data review to develop the overview began with these queries as the largest and most comparable data source. In addition to the using the qualitative data, the author was able in some cases to compare dollar investments in certain categories as another measure to track importance of effort in the areas.

While the information from the evaluations undertaken by the Conservation Study Institute is not completely comparable with the later nine reports, all twelve studies track accomplishments, governance, financial investments and sustainability. All included interviews with partners and stakeholders. All used some form of logic models. These models saw some evolution overtime. The Westat model identified overarching goals and tracked inputs, organizations and partners, strategies and both short term and long term outcomes. The Westat reports noted that their research built on the work of the Conservation Study Institute and on the one evaluation study by the Center for Park Management. Finally, the methodology for the twelve studies was developed with advisory committees that included many of the same experts from National Park Service staff and National Heritage Area leaders.

One challenge in making assumptions about the NHA program has been the lack program legislation setting specific standards and criteria for designation and management. Congress established each NHA with its own individually created legislative designation. While this has allowed the statement significance, partnerships, and over arching goals to be tailored to individual circumstances and geographic area, it also has lead to concerns that the program had no standard framework. However, a review of the twelve NHAs showed a great similarity in their legislative elements. These included a statement of national significance or importance of the cultural, historical and natural values of the region, the purpose of designation usually to preserve, promote, interpret resources and in some cases make them available for economic benefit of the community, and the requirement to develop a management plan to implement the areas goals. The similarity of the legislative templates also extended to the management plans, which also made the data easier to compare between the areas.

Findings on National Heritage Area Program Management

Overall the evaluations of the twelve NHAs reported positive findings. Starting at the most elemental level, the evaluations documented that all, but one of the NHAs, addressed each of the goals identified in the areas legislation and approved management plan. ("Evaluation" Living landscape Observer) One of the twelve areas struggled with changes in management, structure and financial uncertainty. The evaluation found that the area stayed true to its mission, but expended limited National Park Servce funds and was able to address only half of the program goals (Marshal et al. September 2012 S-2)

From a financial management perspective the results were also positive. The evaluations determined that the NHAs showed responsible fiscal practices. Every NHA had an audited financial statement and met the statutory match requirements. The reports documented that the federal funding and required match were allocated to achieve the NHAs programmatic objectives**.** NHAs met and in most cases exceed the 50% required match. In addition the NHAs leveraged National Park Service Heritage Area Funding with other Federal, state, local and private sources to implement planned resource conservation, recreation and economic development projects. On average the NHAs leveraged additional funds for heritage infrastructure at a ratio of up to 4 to 1. For example, the Augusta Canal NHA matched $5.2 million of Federal funds with $21 million of other grants and revenues. (Rog May 2011 19)

The areas show effective management practices. The evaluations found that the management structure, partnerships, and current funding levels contributed to the NHA's sustainability. The NHAs developed effective board governance structure, capable and experienced leadership and staff, and responsible fiscal management. The reports noted that in general the leaders of NHA organization have exceptional skills in partnership development, strategic planning and long track record with their organization. Also documented was deployment of adaptive management strategies that reflected changing public needs. The reports singled out Hudson River Valley (Henderson September 2012 5-76), Rivers of Steel (Myers September 2012 5-99) and Silos and Smokestacks (Helba March 2011 67) NHAs for their adaptive approach.

NHA's depend on public participation and partnerships networks to carry out the area's mission. The reports demonstrated that NHAs implement the legislative mandate and management plans through partnerships and with a high level of continued citizen involvement over time. The strength of the areas partnership networks were well documented. Most areas manage by developing an extensive network of partnerships. For example Silos and Smokestacks NHA has 108 formal partners in 37 counties (Helba March 2011 672-63), Tennessee Civil War NHA made 306 consultations (Myers June 2012 3-44), and South Carolina NHA has 175 community partners (Helba August 2012 2-35).

The twelve studies documented the importance of National Park Service support. Although the NHAs demonstrated effective governance and responsible financial management, the evaluations concluded that in every case the loss of NPS funding would reduce the capacity and flexibility of the twelve NHA to achieve the statutory mission of the organization. The more recent evaluations also documented the significant drop in state funding commitments starting with the recession in 2008. These reports found that replacement of federal funds with private sector dollars or other government funds is not a likely outcome. The National Park Service funding was identified as the consistent, flexible seed money in accomplishing the NHAs program goals. In a majority of cases loss of this funding would threaten the area's viability or very existence.

Findings on National Heritage Area Programmatic Accomplishments

Based on NHA's individual legation and the management plans, the evaluations identified the most important overarching goals for each of the NHAs. Across all twelve studies, there was a broad congruence in the most commonly reported program goals. These goals were cultural and natural resource conservation, education and interpretation and recreational development, also important were marketing and economic development primarily through heritage tourism. Each of the report analyzed programmatic expenditures, defined as federal appropriations and external match, by these broad program categories. Based on expenditure information, the highest priority work for all twelve of the NHAs was cultural and natural resource conservation. The nine recent evaluations documented that an average of 31% of the areas' programmatic dollars were invested in this type of work, which ranged from restoration of river corridors, preservation of landmark properties, to documentation of historic African American churches and folk traditions. The Rivers of Steel NHA has protected the Carrie Furnace, the adjacent Hot Metal Bridge and restored the two landmarks of labor history the Bost Building and the Pump House. The Homestead Historic District and Carrie Furnace Landmark site are undergoing a multi-million restoration with State and Federal funds for a mixed-use industrial and commercial development (Myers September 2012)

The second highest priority for all twelve areas was to educate residents and visitors about the history of the region and to interpret the special qualities of the man-made and natural landscape, as well as the culture and people. The nine most recent evaluations showed that on average 26% of programmatic dollars went into this activity. Essex NHA connected their region with signage, visitor centers and reinforced the message with special events and educational programing. Silos and Smokestacks NHA overcomes great distances with the award winning Camp Silos providing online experience to over 500,000 visitors. (Helba 44)

Another important investment for many NHA was investment in the region's recreational assets such as long distance trails and water based recreation. For example the towpaths of the Ohio and Erie Canalway National Canalway (87 miles) and the Delaware and Lehigh Canal (160) have been reclaimed as major hiking and biking destinations. The Hudson River Valley NHA added over 200 miles of trail with the assistance of 95,000 volunteer hours (Henderson 6).

While resource conservation, education and recreational development were identified as important in all areas, every NHA tailored its work to meet the needs identified in their individual plans. Those areas where community and economic development is part of the mission have made promotional efforts a priority. Working in close partnership with tourism providers South Carolina NHA has developed four regional visitor centers and promoted NHA assets like the Agriculture Tourism Trail (Helba 10). Although a smaller part of expenditures, marketing and promotional efforts were judged very important to residents in certain NHA. For example experiences offered by the Augusta Canal Heritage Area enhance the regions "eco-tourism" strategies. However, a more direct impact was the acquisition and reuse of the King Mill that preserved jobs for almost 300 mill hands (Rog 50).

Specific Recommendations for National Heritage Areas

All of the evaluations made recommendations to improve the management of the NHAs. The most consistent recommendations were as follows:

Foster a closer working relationship with the NPS both with adjacent units and the assigned NPS regional offices. Overall the evaluations portray a lessening of engagement between the NHA and NPS partners. One interesting suggestion was to pair NHAs with sites interpreting similar subject matter even if they are not geographically adjacent.

Increase quality and quantity of data collection on the outcomes of NHA programs. The reports recommended going beyond just counting student in programs to determining educational outcomes, beyond recording volunteer hours to assessing levels of stewardship.

Enhance the fundraising skills and awareness of NHA boards and commissions. This has not always been seen as priority or as part of their position description.

Address succession planning in the leadership of NHA management organizations. The strength of current leaders of NHAs could also be a future weakness if the management of a NHA does not develop the capacity of new leaders for the future.

Discussion

The evaluations show that the benefits for NHAs and the National Park Service flow in both directions. The NHAs receive predictable support, technical assistance, and as mentioned in many of the evaluation's interviews "the good housekeeping seal of approval" from association with the agency. The evaluations also documented that the NHAs were conserving and interpreting cultural and natural resources of national significance. In this way the NHAs extend the reach of the National Park Service's mission to the conservation of iconic landscapes of the Hudson River Valley or preservation the industrial landmarks of the steel industry in Pittsburgh without the cost of acquiring the properties and managing them to more exacting park service standards. Many of the twelve NHAs also have integrated their resource management with a National Park unit as in the Cane River National Heritage Area, which preserves the living cultural traditions for the Cane River National Historic Site and Essex National Heritage, which provides the landscape setting for Salem Maritime National Historic Site and the Saugus Ironwork National Historic Site.

The National Park System Advisory Board in *Charting a Future for National Heritage Areas* found that NHAs provide case studies to the National Park Service in new opportunities for resource stewardship and found the need for more research on the network approach and the ability to leverage resources (2006 20). The services recent strategic vision *Call to Action* reinforces these recommendations in first action # 1 calls for filling the gaps between park units with entities such as the NHAs. In addition the plan in action #22 calls for the agency to be a leader in scaling up the large landscape movement ("Call to Action" National Park Service). The lessons learned in these evaluations are an important first step. However, this data need to be further mined to better understand and implement partnership management. The National Park Service should correlate the results with the in depth research that has been undertaken on the network systems of three on the twelve area (Laven et al. 2010, 2012).

Evaluation of work on a landscape scale is not a simple task. It is a challenge to measure and link outcomes from what are often small inputs on a large geographic scale. However, it is more important than ever, today many of these NHA strategies are being recast as part of the emerging large landscape large landscape movement (McKinney). The NHA idea is becoming more important with the emerging interest in large landscapes as a conservation strategy. A recent study by the Regional Plan Association identified over 160 landscape scale projects in the northeast in the Northeastern United States alone (Regional Plan Association 2011).

Conclusion

The twelve evaluations concluded that the NHAs have adhered to the individual statutory mission, carried out the goals and objectives in the approved management plans, created new organizations for effective governance, and responsibly used appropriated funding. They have contributed to the sense of place and the economic well being of local communities. Most importantly the NHAs have enriched our shared heritage by interpreting nationally significant stories, preserving historic landmarks in a cost effective manner, offering recreational opportunities for residents and visitors, and enhanced regional economic vitality. Taken together these evaluations document impressive range of accomplishments over very large geographic areas using limited dollars and a complex array of partnerships.

However, it is a very present reality that without sustained federal financial support and assistance this good work will not continue. National Park Service funding and support was seen as essential seed money to make projects and programs happen. The more recent evaluations starkly document the significant drop in state funding commitments starting with the recession in 2008. These reports found that replacement of federal funds with private sector dollars or other government funds is not a likely outcome. The twelve NHAs either will go out of business or grind to a slow halt.

Findings from these evaluations come at a critical time as the United State's National Park Service and congress decide whether to support reauthorization of twelve of the first designated National Heritage Areas. They also offers a playbook for the emerging large landscapes movement to better understand how to successfully manage regional landscapes threatened by shifts in industrial economies, agricultural policy, and climate change. This is clearest evidence to date that a program of recognition, management planning, partnership and a shared commitment can help sustain the essential character of place for the benefit of residents, visitors and the next generations. Let's not lose our nerve now.

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Industrial Heritage at Risk: How National Heritage Areas Have Preserved the Landscapes of American Labor and Why This Capacity is Now in Jeopardy

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Introduction

More than any other initiative affiliated with the National Park Service (NPS), the National Heritage Areas (NHA) program has emphasized preservation of sites associated with industrial heritage. Of the close to 400 NPS units, only a handful of locations focus specifically on stories and places associated with labor, while the majority of NHAs take this theme as a critical part of their mission. Whether textiles, railroads, coal, automobiles or steel, heritage areas have played a key role in protecting, interpreting and, when appropriate, imaginatively adapting landscapes linked to the history of work. This paper will examine the central role that industry has played in the designation and management of heritage areas, using specific examples from NHAs in Pennsylvania, with an emphasis on how the landscape-scale approach associated with the program has allowed for the implementation of innovative interpretive, preservation and conservation strategies.

Background/Context

Almost a decade ago, in June 2003, the George Wright Society, a leading conservation policy institute, dedicated an issue of its journal, the *George Wright Forum*, to the burgeoning National Heritage Areas movement. Situating heritage areas within a broader international context, the volume called attention to changing norms in protected area planning and management. In particular, a marked shift away from what one contributor called "protected areas in their classic form, as government-owned, government-run areas set aside for protection and enjoyment," and towards a more collaborative, de-centralized approach, emphasizing the dynamic interactions of people and place, rather than a forced severing of the human from the 'natural' world. (Phillips 2003, 9)

In the United States, the acceptance of these new and different models for protected area management have been comparatively slow in gaining traction, owing, at least in part, to the iconic status of the traditional National Park concept as well as long held ideas concerning land use norms and private property rights. Yet, important examples of non-traditional, cooperatively managed protected areas do exist on the local, state and national level, such as Cape Cod National Seashore and Lowell National Historical Park in Massachusetts, Ebey's Landing National Historical Reserve in Washington State and the Pinelands National Reserve in New Jersey. Created largely since the 1970s, these landscapes often comprise urban and suburban areas, feature diverse public and private ownership patterns and include significant historic resources

Among the themes that garnered significant attention in the journal's pages was the connection between heritage areas and industrial landscapes. Multiple authors highlighted the important steps that state NHAs had taken to not only preserve the history of late 19th and 20th century work in the United States, especially in mass production industries such as steel, automobiles and textiles, but also to coordinate the process of environmental restoration and reconnection so often necessary in de-industrialized landscapes. Beginning in 1984, with the Illinois and Michigan Canal National Heritage Corridor, and continuing with the Blackstone River Valley National Heritage Corridor in 1986, the Delaware and Lehigh Canal National Heritage Corridor in 1988, the Rivers of Steel National Heritage Area in 1996 and the MotorCities National Heritage Area in 2000 (among others), heritage areas have endeavored to situate labor and economy as central elements in the future of large landscape conservation efforts.

The emphasis that heritage area organizers placed on industry, whether as an interpretive theme, a physical space to be preserved or as a bridge to the outdoors and recreation, put them at odds with prevailing norms in the National Park Service (NPS), and to a lesser extent with local and state historic preservation and conservation agencies. Writing in the 2003 issue, architect and planner Constant Bodurow cogently argued that, "20th century industry left an indelible mark on the American consciousness, identity, heritage, and landscape…our nation, NPS, and its partners have not done an effective job in conserving and interpreting the nation's nationally and internationally significant industrial resources." Heritage Areas, in contrast, had attempted, "to address industrial themes and resources that convey this transcendentally important heritage." (Bodurow 2003, 68)

In the ten years that have passed since the publication of the *George Wright Forum* issue, the Heritage Area movement, at least at the federal level, has expanded rapidly. In 2003, there were 23 congressionally designated areas. Now, in 2013, there are 49, with many more actively seeking recognition. New regions, especially west of the Mississippi, have joined the program and, in the eastern United States, internationally significant landscapes, including the Gullah Geechee Cultural Heritage Corridor on the Atlantic coast gained designation. At least with the public then, the heritage area concept remains popular, offering communities a viable framework for partnership-based planning and community development.

Yet, despite the program's expansion and appeal to diverse stakeholders, the essence of what Bodoruw wrote a decade ago remains valid. Heritage Areas, especially at the national level, are still one of only a handful of initiatives dedicated to the conservation and interpretation of sites and stories associated with work, especially in the 20th century context. In the ten years since the *George Wright Forum* released its special issue, only two new units with labor connections, César E. Chávez National Monument and Patterson Great Falls National Historic Park, joined the NPS system and it remains too early to determine the scope of their future interpretive and preservation activities. Why do so few sites address these themes? What can we learn from the heritage areas, which have, with varying degrees of success, taken on the difficult challenge of interpreting and preserving America's recent industrial past?

Challenges/Planning Insights

On a practical level, industrial sites are expensive to restore, maintain and insure. They also frequently require extensive and complex environmental cleanup. Consider the example of Carrie Furnaces, one of the centerpieces of the Rivers of Steel National Heritage Area in southwest Pennsylvania. Built in 1884, the furnaces worked for roughly a century, producing iron for U.S. Steel Corporation's Homestead Works near Pittsburgh. Two furnaces, numbers 6 and 7, remain on site. A recent article in the *Pittsburgh Post-Gazette* highlighted the efforts of Rivers of Steel National Heritage Area (ROSNHA) to both interpret and protect the site, including receipt of a $500,000 grant from the Pennsylvania Department of Conservation and Natural Resources for maintenance and repairs, including roof work. (Siebert 2012) A half-million dollars may seem like a significant amount, but it only scratches the surface of projected expenditures. The full costs of stabilizing and renovating the Carrie Furnaces will likely run between $75 million and $100 million. (Ackerman 2006) A significant sum considering that the annual budget for Yellowstone National Park in fiscal years 2013 is roughly $35 million.

In addition to the financial challenges of doing industrial history, the political stakes are also high. Labor and work, especially in the context of union organizing, continue to be contentious issues, which can divide communities for decades and jeopardize partnership-based planning efforts. Interpreting capitalism, in particular, is extremely difficult as there is no national or usually even local consensus or narrative to draw upon. As Geographer Kenneth Foote has noted "The issue here is one of unresolved meaning – what to make of a struggle that was instrumental in shaping elements of contemporary American society but has gradually faded from view…One aspect of the problem is that the United States itself has yet to come to terms with some elements of its past." (Foote 2003, 296-298)

Not surprisingly then, few sites, including some NHAs, have explored the subject in sufficient depth, especially in making linkages between industrialization, de-industrialization and the workings of capital. Interpretation frequently overlaps with promotion, branding or celebration, ignoring difficult questions about the nature and course of economic development – past, present and future. As Cathy Stanton perceptively asked in her text on public history efforts at Lowell National Historic Site in Massachusetts, "[w]hat are the social costs, in terms of our ability to understand and respond to the changing economic circumstances of our lives, of linking the production of knowledge so closely with the quest for economic growth?" (Stanton 2006, 8)

Similarly, Don Mitchell, a geographer, criticized heritage-based economic development in and around Johnstown, Pennsylvania in the 1980's for its focus on "the *industrial* rather than the *labor* history of the city." (Mitchell 2000, 97) In Mitchell's analysis, creating a "sellable history" became more important that representing the full and often contradictory sweep of the city's past. "There were thus no plans to represent the history of strikes, the geography of violence, or the *politics* of deindustrialization," Mitchell writes, "…[b]y stressing *industrial* history - the history of development, innovation, and the mechanics of making steel – the Johnstown landscape would minimize the contentious past within which such developments and innovations took place. The *work* of the landscape – the role it was assigned by planners – was to represent a heroic history, not a history of conflict." (Mitchell 2000, 98, italics in original)

Despite, or perhaps because of these challenges, both practical and ideological, it is useful to see what heritage areas have been able to accomplish over the past three decades, as their work can serve as a model for other communities seeking to preserve and interpret the recent history of work and industry. Such reflection is especially critical because of severe funding cuts at both the state and the federal level, with twelve National Heritage Areas facing the distinct possibility of losing their authorization to receive federal funds. Such action would be devastating to labor history efforts as the heritage areas in question serve as critical catalysts in regional efforts to interpret the stories of coal, steel, transportation, textiles, agriculture and even deindustrialization. Many have also played a crucial role in environmental restoration efforts. Keeping this worrying funding reality in mind, here then are three key lessons we can learn from the story of heritage areas and industrial landscapes.

Lesson 1: Plan and be prepared to act quickly because no industry is safe This may seem like a particularly dire or even morbid recommendation, but the recent experience of American industry in an age of global capital reveals the devastating speed with which whole sectors of the economy can change or decline. As historian Jefferson Cowie has written, in regards to capital flight more generally, "[a]dvances in communication and transportation, hastened by interregional rivalries for investment…have largely liberated firms from such considerations and allowed capital to evolve from a pattern of centralization into an increasingly dispersed geography of production." (Cowie 1999, 6)

In the eight-county Rivers of Steel National Heritage Area, the decline of steel production came faster than anyone anticipated. One resident of Homestead, Pennsylvania, for example, commented in a 1988 news article that, "The impact of it didn't hit at one time…Most steelworkers felt it was another layoff. They were never called back. It has only been in the last two years they've realized the age of steelmaking in the valley is over." (Eshleman, 1988) Echoing this sentiment, Augie Carlino, Chief Executive Officer (CEO) of the ROSNHA, noted that "...mills were being torn down…they often closed with long or short term lay-offs…None of them had ever closed for a long period of time, and then they never opened, and they started being torn down. The realization set in they weren't coming back." (Carlino 2013)

The experience of southwest Pennsylvania provides a telling example of why a heritage area is important. Unfortunately, in the case of ROSNHA, its creation occurred only in the wake of the mill closures. However, with both the initial planning that went into its establishment and the subsequent work done in partnership with local communities and organizations, the ROSNHA region will have a far better system in place to respond to future challenges and threats.

Lesson 2: <u>Practice a regional, rather than site based, approach</u> Telling a complex story of work and industry requires not only the preservation and interpretation of specific sites, but also the integration of those sites with a broader landscape, which is likely in mixed public/private ownership. In discussing the story of steel in southwest Pennsylvania, for example, Augie Carlino commented, "You can't think of this as just a site project without understanding the dynamic of the relationship of the sites to the other industries in relationship to a mill. Homestead doesn't exist in a vacuum. The whole concept behind an industrial region is that Homestead lived and existed because of the industrial complex that existed around it. Not only the workers and the community, but the capital that was provided, capital in the sense of money, engineering, natural resources like the rivers by providing a transportation nexus…You can't just look at the mills without looking at their related industries…what went into railroads, coal and coking and riverboat transportation" (Carlino 2013)

Similarly, Allen Sachse, retired Executive Director of the Delaware and Lehigh National Heritage Corridor (DLNHC) in Northeast Pennsylvania, noted that, "We (the DLNHC) deal with the landscape where people live…the park service deals with specific individuals who were giants in movements…they don't have parks related to the common man...The heritage area does because we deal with their landscape. " (Sachse 2013)

This distinction is quite significant, especially when considering the history of industrial capitalism in the United States. One of the drivers of development in many urban centers, like Pittsburgh or Philadelphia, was the incorporation of the natural and human resources of the surrounding region. A nuanced story of capital in America must focus not only on particular sites of a production, a mill here or a factory there, but the whole landscape, including the experiences of residents, who labored in the industrial spaces. In explaining the early rationale behind the DLNHC, Sachse explained, "The public could embrace the big concept of a corridor like the Delaware and Lehigh. Where the coal is mined in the north, and it got on the canal system and went to the Lehigh Valley. There, it was used to make cement, to make iron, to make steel, and then either the finished product was moved further or the coal went to New York, Philadelphia or was put on a ship to London. It was an integrated system of mining, industry and marketing, all tied into a transportation network. It became an easy thing for people to understand." (Sachse 2013)

Lesson 3: The Ability to Function as an "honest" broker is key to preserving industrial sites and interpreting recent labor history As I noted earlier, labor history is almost inherently controversial. Not only because of the violence that frequently accompanied early 20th century attempts at union organizing, but also because of politics surrounding environmental degradation and deindustrialization. In multiple regions, heritage areas have brought diverse and even hostile stakeholders into dialogue with one another in order to develop common goals. A 2006 evaluation of the DLNHC by the National Park Service found that one of the corridor's key strengths lay its collaborative potential.

> The Corridor story and activities encourage collaboration by providing an integrated perspective. Because Corridor goals reflect thematic interests, partnerships can transcend governmental sectors and cross political and administrative boundaries. In this way, the concept of heritage creates a platform for engaging people and communities Corridor-wide in ways that directly influence and support local efforts to revitalize the region. Partners note that working on Corridor projects has broadened their perspectives and their willingness to work in partnerships across multiple interests. This suggests that over time these collaborative relationships may alter the way organizations and community leaders think about the future of the D&L region. Partners also note that the D&L initiative has empowered them to think more boldly. (Copping et al 2006, 8)

Goals and Objectives

The goal of this paper is to make planners and conservation and preservation professionals aware of the unique role played by National Heritage Areas in interpreting the United State's recent industrial heritage. In particular, this paper reveals that scale and collaboration matter when it comes to telling a story of capital and labor and the heritage area model has been far more responsive to these realities than the more traditional protected area approach. An additional objective of the paper was to highlight the precarious nature of funding and support for heritage areas, calling attention to the void that would be left should the program contract significantly.

Conclusion

For close to 30 years, heritage areas at the state and federal level have represented the definitive effort aimed at conserving the United States' recent industrial past. No other initiative has come close in both the range of landscapes represented and the scale of work undertaken. Heritage Areas have been successful because of their regional, rather than site based, approach, their responsive management and fundraising structures, which vary according to the preferences of local stakeholders and allow for the development of flexible planning models, and their ability to function as hub of collaboration and dialogue in frequently contentious environments. If program funding is cut, especially at the national level, the United States risks losing its most successful mechanism for interpreting and preserving the landscapes of American labor and industry.

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The Emergence and Significance of Heritage Areas in New York State and the Northeast

Paul M. Bray

Introduction

Heritage areas originally known as urban cultural parks are a form of park that emerged in the 1960s and has grown to include 49 national heritage areas and state heritage areas in New York State, Pennsylvania, Massachusetts and Maryland. As a park, heritage areas are urban settings or regional landscapes that expand the traditional elements of national and state parks in that they are a means under a heritage theme to preserve and manage an amalgam of natural and cultural resources to provide forms of recreation and foster sustainable economic development.

This paper will provide an overview of New York State heritage areas, their system and program and relate this to national and some other northeastern heritage area initiatives from a writer who has been an organizer of New York's first heritage area (Riverspark), the legislative drafter of New York heritage areas law, a member of the New York state and national heritage area advisory council, a lecturer on heritage areas at universities and a long-time advisor and advocate of heritage areas. Therefore, the sources for this paper are both from first-hand experience as well as research into particular circumstances in heritage areas where the writer was not directly engaged.

Its objectives are to introduce and expand knowledge about the origin and roles of heritage areas particularly in New York and the northeast and foster a better understanding of the forces behind the establishment of heritage areas and their contributions to society.

Historical Context of Parks

In order to understand the meaning and significance of heritage areas it is useful to have an overview of the historical context of parks in the USA.

Galen Cranz in her 1982 book on the history of urban parks in the USA, The Politics of Park Design: The History of Urban Parks in America, identifies 4 epochs of urban parks: the Pleasure Ground (1850-1900) like Frederick Law Olmsted's Central Park in New York City; the Reform Park (1900-1930), the Recreational Facility (1930-1965) and the Open-Space System (1965 and After).

Each epoch represented a response to the societal conditions and needs of its time. What distinguishes urban parks in the modern 19th and 20th centuries as cities and urban areas grew and mostly flourished is that the model of each epoch endured and was augmented and not replaced by new models. Central Park, hard surface play grounds and recreation facilities like urban skating rinks, public swimming pools and baseball fields, for example, are all part of current park inventory. Cranz's final epoch is dynamic with the city flowing into pastoral gardens and traditional park like conditions flowing into the landscape of the city in the form, for example, of tot lots, "happenings" and street marathons. Cranz wrote, "More than a simple experience, it (the happening) was an aesthetic event whose subject, typically, was the urban population which participated in it."[5]

With respect to the urban setting as a park, "In the late 1970s municipal, regional, and federal agencies cooperated to preserve segments of historic towns and landscapes such as Lowell, Massachusetts. These urban cultural parks, which were intended to preserve an important part of the nation's industrial and economic history for educational and recreational purposes, were established on the assumption that all parts of the city-its work spaces, living quarters, and connecting streets-had equal aesthetic and recreational potential, that the city was in fact a work of art worthy of appreciation and objectification."[6]

American national parks like Olmsted's urban pleasure grounds took shape as landscapes separate and apart from surrounding land uses. Park advocates for the most part distained any direct presence of commercial activity within parks, but great park leaders like Stephen Mather, first Director of the National Park Service, and Frederick Law Olmsted, fully understood their separate and apart parks depended on generating economic activity. This economic activity, for example, was a symbiotic relationship between the national parks in the west with the growing railroads. Olmsted understood and carefully followed the development and increase in land values generated by his urban parks. He was also described by writer and public intellectual Lewis Mumford as being in the vanguard of urban planning. While Olmsted parks were physically separate and apart from other city land uses, Olmsted used parkways connecting his pleasure ground parks with establishment of various parks in order to shape the development of cities like Buffalo and Boston. The seeds for parks to encompass whole urban settings as happened in Lowell, Massachusetts or whole regions like heritage areas have evolved throughout the history of parks.

Background to Emergence of Heritage Areas

Author Chuck Little traces the origin of heritage areas back to the Federal writer's project that produced state and place guides in the 1930s, a New Deal "government-sponsored national self-portraiture."

A number of forces were at work beginning in the 1960s to foster the creation of new parks and new ideas about what and where these parks should be.

Historic preservation blossomed from its roots with historic house museums to the advancement of the National Register of Historic Places in 1966 and historic districts which were portions of

[5] Galen Cranz, The Politics of Park Design: A History of Urban Parks in America. The MIT Press. Cambridge, Massachusetts, 1985 at 141

[666] *See id.*

cities. The Report from the Conservation foundation entitled *National Parks for a New Generation* in 1985 noted that "newer historic preservation trends that move beyond the "feature" to an entire setting, offering insights into the distinctive human and economic forces that shaped our cities and countryside" was troublesome to the National Park Service. In part, this was due to the fact that "conserving and maintaining such special places requires respect for lesser buildings that make up the 'historic fabric' or 'cultural landscape' and different management responses to retain residents and encourage appropriate uses."[7]

The Conservation Foundation report also highlighted greenline or cooperative parks. It declared that: "The scale of the park system of the future depends in part on the success of greenline or cooperative parks that incorporate private property within park boundaries and sometimes state and local lands as well." It noted "the approach borrows from British 'greenline' parks, admired in recent years by American planners and conservationists seeking ways to protect major landscapes, natural systems, and recreational resources without incurring astronomical purchase costs or displacing desirable residential communities and economic activities."

New York's Adirondack Park now 6 million acres in size, larger than the State of Massachusetts, with more than half of its area under private ownership, was designated by the State to be the Adirondack Park in 1892.

The Adirondack Park on its 100th anniversary in 1992 was called a park in the painful process of becoming a park and a "contested landscape". This experience helps explain why officials in the National Park Service were lukewarm about being responsible for parks that were not under its ownership.

In brief, the expansive and sometimes clashing visions for the National Park System in the future have increasingly embraced living landscapes like the Pinelands National Reserve, the Lowell National Historical Park and the Santa Monica Mountains National Recreation Area. Ambivalence about taking responsibilities for living landscapes from the National Park Service and state park agencies led local governments and the private sector to be the engines for a new form of park now called the heritage area.

Creation of Riverspark

Riverspark Heritage Area (initially named the Hudson Mohawk Urban Cultural Park) is the first heritage area in New York.

It was established in 1977 through an inter-municipal agreement by the Mayors, Supervisors and City Manager of the neighboring cities of Troy, Cohoes and Watervliet, Villages of Green Island and Waterford and the Town of Waterford located near the confluence of the Hudson and Mohawk Rivers. The suburban town of Colonie was added later. The original municipalities

[7] National Parks for a New Generation: Visions, Realities, Prospects. Report from The Conservation Foundation. Washington, D.C. 1985, at 117

were 19th century industrial communities that shared a proximity to the Hudson River and a significant industrial heritage. Yet, they were in three separate counties and can be characterized as independent of each other and not prosperous.

In the early 1970s a group of residents mostly from Troy established a civic, nonprofit organization named the Hudson Mohawk Industrial Gateway with the intention of celebrating and preserving the industrial heritage of the Hudson Mohawk region. The Gateway was known for its bus tours that enlightened residents and visitors alike to the rich heritage of the region including its Tiffany windows, interesting 19th century industrial, church and residential architecture and diversity of industries created in the 19th century including the still functioning Watervliet Arsenal commemorating its 200th anniversary in 2013. Labor historian Daniel Walkowitz, for example, wrote the book *Worker City, Company Town* contrasting Troy with its unionized Iron industry and Cohoes with its massive company town cotton mills some of which are being adaptively reused to house workers in today's high tech businesses.

The Gateway saw the Hudson Mohawk region as being national in significance and appropriate for the Smithsonian Institute to establish a museum of industrial history in the region to tell the story of this "birthplace of the Industrial Revolution".

In the early 1970s the Hudson Mohawk municipalities were not prospering or benefiting from urban renewal, the approach of demolishing the old to be replaced with new development. They wanted to have new manufacturing jobs and were not very interested in historic preservation or the coastal zone management act which some advocates hoped would leader to revitalization of riverfront communities.

Under these circumstances, a farsighted new Mayor of the City of Cohoes, Ronald Canestrari, forged the intermunicipal agreement in 1977 to establish the Hudson Mohawk Urban Cultural Park (HMUCP) Commission committing this group of communities to the new idea of a park, an urban cultural park. A source of the urban cultural park idea or at least name came from efforts to preserve the Louis Sullivan buildings in the Chicago Loop in the 1960s, the work of the Gateway, planning efforts in Lowell, Massachusetts that included the National Park Service and trends in the environmental and historic preservation fields. Simply stated, an urban cultural park was urban or a settled area with an "amalgam of natural and cultural resources" designated to celebrate significant and related human attainments for an urban setting in a manner that integrated goals of conservation, education, recreation and sustainable development.

Former Mayor Canestrari set in motion a process of recognition, celebration and capitalization of an inter-municipal area that is a unique American cultural treasure. The HMUCP began the institutionalization of a living or inhabited urban park and the creation of a widening circle of partnerships that has been ongoing.

In 1977 the HMUCP made a proposal to the State Legislature for state designation. It led to the enactment of two laws, one designating HMUCP as a state urban cultural park and providing for a heritage trail plan to connect the heritage resources therein. The other law provided for a plan for a statewide system of urban cultural parks.

Between 1977 and 1982 when a state urban cultural park system with designation of 13 areas of the state ranging from the 400 square mile New York City Harbor to upstate village like Sackets Harbor on Lake Ontario and including the HMUCP, the HMUCP was moving ahead with planning and projects on its own initiative. The HMUCP changed its name to Riverspark (where water ignited a revolution).

The New York State urban cultural park system is designed to be a partnership with coordination and consistency between the State with its various functions like transportation, environmental conservation, housing and community renewal and economic development and locally created urban cultural parks that are designated by the State Legislature and have successfully complete a management plan approved by the State Office of Parks, Recreation and Historic Preservation. The System law establishes an Advisory Council to help connect the urban cultural parks and state agencies. The state legislature changed the name urban cultural park to heritage area when regional additions were made to the system. Today the state heritage area system is made up of 20 state designated heritages areas that include both urban setting and regional areas.

Overview of Achievements of Riverspark

Riverspark is guided by a state approved management plan under the theme of industry and labor which includes an extensive natural and cultural resources inventory of the whole areas of each or the original member communities, designation of a 26 mile heritage trail linking most of the resources, theme attractions like the Watervliet Arsenal museum and the Erie Canal Lock 2 Park, interpretive and recreational elements and a preservation strategy for both register properties and districts protected by local preservation ordinances and contributing properties. Three visitor centers have been established, though regrettably the Troy visitor center was recently closed. The original Commission, now a public benefit corporation, is the planning and programming entity while the member communities and private entities are responsible for individual Riverspark facilities.

Riverspark partners have included corporations who help underwrite Riverspark festivals like the annual Canalfest at the annual opening of the State Canal System in the Village of Waterford and nonprofit museums for whom Riverspark has been able to obtain State grants. A long term partnership has been undertaken with the State AFL-CIO to commemorate, celebrate and tell the story of industrial working life within Riverspark. The AFL-CIO called Riverspark “Labor’s Williamsburg.”

The transition from an agrarian to industrial society produced examples of dramatically different relationships between workers and employers. On the west shore of the Hudson River, Troy was a breeding ground of union activity. The Troy union of iron molders was the largest local in America at one time and the Trojan laundry workers organized the first female union in the nation. “Troy was the banner city of Americans for the trade union sentiment” declared William Sylvis, National Labor Union President in 1866.

A short distance to the north on the east shore of the Hudson River, the Harmony Mills Complex, once America’s largest complete cotton mill, made Cohoes into a company town. “Harmony Mills paternalism was distinguished by its thoroughness pervading almost every aspect of working-class life.”

The aforementioned Gateway has been restoring the historic Burden Building, the office for the 19th century Burden Iron Works, is the designated heritage tourism director for Riverspark and now is Riverspark’s managing director. The Burden Building doesn’t draw a large number of visitors, but the visitors that come are from many states and nations around the world.

The portions of the historic Harmony Mills in Cohoes overlooking the Mohawk River have been adaptively reused for 320 apartments that have attracted new residents to the Riverspark area who are finding jobs in an emerging high tech economy. Modern apartments and condominiums have been built along the Hudson River in Cohoes and a growing number of shops have opened along Remsen Street, the main street in Cohoes. A new park and overview has been developed to view the Cohoes Falls . The Cohoes Falls, also called The Great Falls of the Mohawk, were regarded as the second most beautiful cataract in New York State after Niagara Falls.

The Hudson River front in Troy has a growing number of river tour boats that stop in Troy for Gateway tours of Riverspark. Historic RPI is advancing cutting edge technologies and recently built a 21st century performing arts center, EMPAC, dedicated to advancing research and artistic production at the intersection of technology, media and the performing arts. Woodside in Troy is a restored 19th century church for the industrial barons of its time and is now a Contemporary Artists Center for artists to live/work with studios, gallery and performance events.

The Kate Mullany House in Troy was identified in a Riverspark study of site associated with labor unions in the 19th century has received status as a National Landmark and an affiliated National Heritage Site. It is now part of the National Park System, though the affiliated status it shares with sites like the Tenement Museum in New York City and the Thomas Cole House in the Hudson Valley, means the National Park Service is not predominately responsible for restoration and management of the site. Paul Cole who started the American Labor Study Center with an office in the Mullany House has recently raised adequate State funding to restore Kate’s living quarters. Once this is completed, the Mullany House will be open to the public for tours.

The Village of Waterford in Riverspark has capitalized on its location on the Erie Canal to host an annual Tug Boat roundup and other festivities. Watervliet in Riverspark is home of the Watervliet Arsenal. The Arsenal founded in 1813 to support the War of 1812 is the oldest continuously active arsenal in the United States, and today produces much of the artillery for the army, as well as gun tubes for cannons, mortars, and tanks. It has been a National Historic Landmark since 1966. The Iron Building is a historic building at the Watervliet Arsenal used as the Watervliet Arsenal Museum. The Iron Building was built in 1859 and is "an outstanding example" of pre-fabricated cast iron construction. It is also the only building at the Arsenal to have a strong degree of Italianate styling.

The Arsenal celebrating its 200th anniversary in 2013 has become a critical hub in New York's Tech Valley. Today it is also the home of a growing number of high tech companies like Vistec Lithography that moved to the Arsenal from Great Britain and M&WM+W U.S., Inc. that is part of the M+W Group, a worldwide leader in advanced technology facilities.

The aforementioned are only some of the highlights relating to heritage tourism, education, livability and high tech growth that have occurred since Riverspark was established in 1977.

The role of the Riverspark Heritage Area has varied on each of the highlights but overall it has connected seven communities with a shared geography and heritage, fostered the ideals of historic preservation, celebrated the shared heritage that has led some to call the Hudson Mohawk area "the 19th century Silicon Valley" and has helped make the past a living part of an emerging future economy that didn't exist before Riverspark was born.

The Larger Picture

Riverspark and New York State are proud of their leadership role with heritage areas, but there have been other leaders deserving of recognition. "Massachusetts developed a strategy, based on the success of Lowell, for conserving and promoting the cultural resources of aging and declining cities to build community pride, enhance quality of life, and stimulate economic revitalization."[8] Pennsylvania has been another leader in the heritage areas movement. "The commonwealth was well versed in integrating state-run environmental, cultural, and economic programs in cities and communities and had been exploring the state heritage park approach. In 1984 the commonwealth developed a framework for a Pennsylvania Heritage Parks Program 'to preserve cultural resources in a manner which provides educational, recreational and economic benefits.'"[9]

Maryland is another state with a heritage area program. Heritage Areas are locally designated and State certified regions where public and private partners are committed to preserving

[8] J. Glenn Eugster, Evolution of the Heritage Areas Movement, The George Wright FORUM, Vol. 20, No. 2, 2004, at 55.

[9] *See id*. at 58.

historical, cultural and natural resources for sustainable economic development through heritage tourism. The Maryland Heritage Areas Authority (MHAA) provides targeted State financial and technical assistance within a limited number of areas designated as “Certified Heritage Areas.”

The first generation of national heritage areas surfaced in 1984 with the designation of the Illinois and Michigan Canal National Heritage Corridor. Today, there are 49 national heritage areas designated by Congress, four of which are within New York State. National heritage areas have been regional and some like the Tennessee National Heritage area encompasses the whole state of Tennessee while the Erie Canalway National Heritage Corridor in New York State stretches for 542 miles across the state to include state’s whole system of canals.

Conclusion

The American heritage areas movement has been diverse. Some heritage areas have been urban and many have been regional. It is still looking for a permanent, nurturing home like the National Park Service for national heritage areas and state park agencies for state heritage areas. Heritage areas are also still looking for acceptance in the American family of parks. The notion of a city or region as a park remains hard for many park professionals to accept and for the public to understand. Although the Adirondack Park is more than 100 years old, one can still find bumper stickers on the cars of residents declaring “This is no damn Park, I live here”. Fortunately, in the case of the Adirondack Park, in recent years there has been for the first time real signs of collaboration between park residents, park advocates and park managers to find their common ground that the park really is a park. For heritage areas we need more conversations in many forums to be able to full take advantage of this wonderful civic achievement the heritage area movement has given us in the last four decades.

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The Hudson River Valley Greenway and Beyond:
How a Word Can Change the Way We Think About Our Land

David S. Sampson, Esq.

Introduction

> *"Most American places do not feel haunted…they do not play upon the imagination in such a way as to produce near tangible impressions of ages and people long gone.*
>
> *The Hudson River Valley is a great exception to this American rule. The windows on all its eras are nearly always open, so that despite whatever modern progress its communities may make, it is never difficult for a visitor to conjure the faces and voices of the Valley's past. This is the river of Franklin Roosevelt, of Frederic Church and Benedict Arnold and 'Gentleman Johnny' Burgoyne. Washington Irving owns it still, and Hendrick Hudson forever sails upstream toward its hidden heart."(Scheller, 1988)*

When I was in my early twenties, I found myself at the site of the Great Pyramids and Sphinx in Egypt. There, following a camel ride into the desert, I sat at an outdoor bar with friends sipping a beer, watching the sun go down and the sky turn dark. When the night had come, spotlights came on and a deep voice, in English, began telling the history of the pyramids. This *Son et Lumpier* production was my first awareness that landscapes are not simply views and vistas;, our perceptions of them are shaped by history, and that if there is no context for a landscape, the viewer cannot fully understand what he/she is looking at. Why is this important? Because, as the National Park Service likes to say, people will not try to protect resources that they do not know are there.

Today we call these landscapes "Cultural Landscapes", and it is under their umbrella that we have greenways, greenline parks, and living landscapes, among others. There are probably as many definitions of cultural landscapes as there are landscapes. Here are some:

-- "*Landscape is the work of the mind. Its scenery is built up as much from the strata of memory as from layers of rock." (*Schama,**,** 1995)

-- *A landscape shaped through human intervention*. New York State Department of Transportation:

--*"A way of seeing landscapes that emphasizes the interaction between human beings and nature over time; also–Any landscape people have created, modified or protected–from historic gardens and urban parks to conservation reserves, from neighborhood streetscapes to working farms and forests."* The Institute for Landscape Studies, Harvard University

My favorite, however, is not a definition at all but a description from the American Battlefield Protection Program that tells the meaning perfectly:

"Battlefields are historic landscapes. Across farmers' fields armies clashed and moved on, leaving only blackened earth, hasty burials, scattered bullets and shell fragments, the litter of combat. Residents returning to the site picked up pieces of their lives, rebuilt their burned-out homes and planted the fields anew. Hastily buried bodies were unearthed and interred in local and national cemeteries. Relics were discarded. Life went on.

"Yet the passing event fundamentally altered the relationship of the community to the land. Once obscure places became associated forever with the momentous events of America's wars. So long as the memory is nourished, people will point and say that is where the battle happened."(Lowe, 2000)

Background and Literature

Charles E Little, in his 1990 book *Greenways for America*, wrote that "There are a good many experts around the country who seriously doubt that the Hudson River Valley Greenway (HRVG), the most ambitious river-based greenway effort in the nation, can ever be more than a paper project-a greenway by declaration as opposed to organized effort that brings about a palpable change in land use throughout the corridor by physically weaving the parks and historic areas together. (Little, 1975)"

Little, the acknowledged godfather of Greenline Parks, the philosophical cousins of Greenways, was right to be skeptical of an effort to unite 154.8 miles of Hudson River comprised of 12 counties, 591.239 acres of riverfront and 3,967,930 acres of countryside, 100 National Historic Landmarks, 89 Historic District Districts and 697,828 acres of agricultural land (HRVG Study Figures).

Yet 23 years later, the Hudson River Valley Greenway still exists as a program of both the State of New York and the Department of Interior. Its staff is small, its offices modest, and many people who come into contact with it are unaware that it is a federal or state program. Yet its influence has far exceeded its Hudson River boundaries to include Greenway programs in the Czech Republic, Slovakia, Poland and Hungary.

Little says that that great landscapes carry with them great literature. He sought to prove his own point in a paper he wrote in 1975 for the Congressional Research Service (CRS*): Green-Line Parks: An Approach to Preserving Recreational landscapes in Urban Areas.* The paper was based on the premise that "The days of simply purchasing large areas for public parkland in or near urban areas may well lie behind us, no longer an option in a time of economic uncertainty…." In his paper, Little traced the history of landscape preservation in England's Lake District, where "In the most elementary of terms, the primary implication is that there is a species of "public rights" in such landscapes that flows from the nature of the landscape itself." (Little,1975).
This concept, he wrote, was not new. In 1810, the poet William Wordsworth in 1810 wrote of visitors to the English Lake District

"who, by their visits (often repeated) to the Lakes in the North of England, testify that they deem the district a sort of national property, in which every man has a right and interest who has an eye to perceive and a heart to enjoy." (as quoted by Little, 1975)

It would be decades later before the idea of "national property" took hold in America. When it did, the concept went in two directions: the designation of Yosemite as the nation's first state park, and the creation of Olmsted's "Emerald Necklace" around Boston. Each in its own way manifested Wordsworth's doctrine.

The National Park concept was first espoused by George Caitlin, an artist worried about the effect of expansion on Native American cultures in 1860s:

As described by the Museum of the American West, "The more Caitlin traveled among Plains Indians, the more he became an outspoken advocate for the preservation of their culture. He believed that the Euro-Americans' policies, alcohol and disease would wipe out the Indians, the buffalo, and the Great Plains as he knew them. To preserve this splendid world, he advocated that the Great Plains be set aside as a "nation's park."

More than any other source, this paper was informed by "The People of the Hudson River Valley". Whether through the direct testimony of the speakers (including Pete Seeger singing his testimony in Beacon) the Hudson River Greenway process was driven by the Valley's residents. Their thoughts are reflected in the two Greenway reports and this paper.

Next to them is Chuck Little, whose writings and wisdom have greatly influenced my (and countless others) thoughts on landscapes, and whose ability to think beyond current dogma is remarkable. I also have a wealth of Hudson River Greenway/Heritage Area materials, including drafts, reports, studies and letters, many of which are reflected this paper.

Goals and Objectives

This paper will explore the evolution of the Hudson River Greenway from a concept derived and nurtured from literature to a voluntary regional structure called for by the people of the Hudson Valley.

It will discuss the Council's decision to create two Greenway organizations—the Council as a state agency and a Greenway Conservancy as a New York State Public Benefit Corporation with an attached not-for-profit, and how that affected the Greenway's implementation.

Its implementation has also helped test the idea voiced by Charles Little that organizations with no power have a greater chance of succeeding than organizations with some limited authority, especially in states where Home Rule is part of a community's structure.

The presentation will trace the Hudson River Greenway's beginnings from three points of origin: the New York State Legislature and its State Urban Cultural Park legislation; the environmental community, where Scenic Hudson helped lead a series of meetings aimed at developing a regional environmental effort, and the philanthropic efforts of Laurance S. Rockefeller and the Jackson Hole Preserve, Inc. to create a program of cultural tourism in the Hudson Valley that ultimately helped tie the disparate efforts together to present a Greenway agenda to then Gov. Mario Cuomo.

Finally, the presentation will discuss the implementation of the Greenway, its relationship to the Hudson River Valley National Heritage Area, its influence on Central European Greenways, and its successes and failures in working with what the author considers to be potentially the three most problematic constituencies in the Hudson Valley—Home Rule, tourism and agriculture. This will include a discussion of the Greenway Planning Compact, a legislative package of monetary assistance and programmatic carrots designed to entice communities into a regional planning process.

It poses these broad questions:

- Was Chuck Little right about the Hudson River Greenway? Can it only exist on paper?
- Is Chuck Little also right about his theory that organizations that have no power tend to be more successful than those that do?
- Can an effort as large and complex as the Greenway be fueled only by public hearings?
- Should the term "Greenway" be defined in projects such as the Hudson River Greenway?
- Can Greenways be successful in "Home Rule" states?

Methods

The primary methodology has been the review of documents, drafts, studies and other materials as they affected the development of the Greenway. In turn, those documents would elicit memories of the hundreds of meetings, hearings and conversations. I also talked with Klara Sauer, formerly of Scenic Hudson, whose reflections of the HRVG in its infancy and before, were especially compelling. Chuck Little's article for the Congressional Research Service remains something that I review from time to time.

Results

In a time of tight budgets and government disfavor, the Greenway still exists. It has actually grown since it started, adding Saratoga and Washington counties to its membership. These initially were left out by the late US Rep. Gerald Solomon, who believed the Greenway was too governmental for his constituents.

Discussion and Conclusions

In the mid-1980s, Sleepy Hollow Restorations, Inc.(today Historic Hudson Valley ,Inc.(HHV) undertook a study of the Hudson Valley to demonstrate whether a regional cultural tourism effort could help preserve and enhance the Valley's historic and cultural resources Getting a positive response, within months Sleepy Hollow had resurrected the Hudson River Valley Association (HRVA), a sort of regional chamber of commerce stressing the economic possibilities of tourism, both cultural and otherwise.

At the same time, Scenic Hudson, under Executive Director Klara Sauer, had begun meeting with the Valley's environmental community to discuss a regional approach to preserving the Valley's resources. Klara would send minutes of her Annandale meetings to other interested parties most in the future of the Valley, chief among them Laurance S. Rockefeller and his

Jackson Hole Preserve, Inc., foundation (JHPI). [10] JHPI, under the guidance of Henry L. Diamond, a board member and former Commissioner of the New York State Department of Environmental Conservation, undertook the task of bringing many of the interested parties together to write booklet called *A Greenway For The Hudson River: A New Strategy for Preserving An American Treasure*, and sent it to Governor Cuomo.

As Klara remembers:

> *" You may recall, initially there were five of us who'd meet about every other month for over 2 years from19 86 – 1988 brainstorming about creating a regionally mechanism for igniting public imagination and support for protecting what's unique and precious in the H.V.*
>
> *Ultimately we came up with the word Greenway that was being used in other areas of the country, especially by Patrick Noonan, President of the Conservation Fund.*
>
> *In 1988 I hired Barry Didato who went around the Valley and made over 200 slide presentations; we also published a wonderful little booklet that[partially funded by National Geographic] gave examples of small greenways already underway in various places of the Hudson Valley and that were being created by local grassroots orgs. We also got New York State Council On The Arts to underwrite a brochure that was mailed to 8,000 interested or potentially interested people4.*
>
> *Barry and I lined up over 150 organizations to create the Greenway Coalition, which ultimately included IBM, Central Hudson, and several banks and businesses .In 1988 Marist Institute of Public Opinion conducted a poll the findings of which were released between Christmas and New Year's which demonstrated overwhelming public support for the Greenway. Everyone had a different idea of what it meant, and everybody LOVED the idea. This helped enormously when it came to lobbying the legislature and Cuomo, as did the Rockefeller report that was also released in the same time frame. Folks got really excited. This led to the Study Bill and you know the rest."*
>
> *I worked day and night on this initiative for nearly 6 years; this way when everything was done manually - no computers, no e-mail, everything was hugely expensive and time consuming. But, it was fun."*

The strategy worked, as Cuomo put the Greenway idea into his State of the State message on January 6, 1988. On August 16, 1988, Gov. Cuomo signed into law a bill creating the Hudson River Valley Greenway Council .Importantly, the legislation was introduced and championed by then-Assemblyman Maurice Hinchey, Chair of the Assembly Environmental Conservation Committee, and who, in 1996 as a congressman, was to lead the effort to designate the Hudson River Valley as a National Heritage Area

In New York State it was a good time for a Greenway. The Environmental Quality Bond Act of 1986 had passed, making money available for purchase of lands, rehabilitation of historic structures, and upgrading of parks, marinas and public access areas along waterways.

In the late 1970s, New York State had passed a conservation easement law, allowing non-profit environmental organizations to purchase and receive easements, even if they were "in grosse and in perpetuity". New York State's Urban Cultural Park Law designates certain urban areas as living landscapes and allocates monies for visitor centers and other amenities.

In a second addition of the report, published in 1989 by HHV, Rockefeller set the stage for an approach to creating a real greenway out of the legislation:

"The long tradition of American citizen action applies particularly to the Hudson. Much of the land now preserved for posterity was protected by private initiatives. The needs are different now, but there is still great power in citizens joining with their government to act. That is what the report is about. It is time to create a Hudson River Valley Greenway."

It also helped that the 1987 President's Commission on American's Outdoors had called for a "prairie fire" of support for the creation of greenways across the United States."

- **The Greenway Comes Alive (But Is Still Not Defined)**

The first formal meeting of the Hudson River Valley Greenway study council was held March 7, 1989 in the Senate Conference Room of the New York State Capitol. One of the most important items to arise from the meeting was the decision to include all of the counties along the Hudson River from Battery Park in New York City to the confluence of the Hudson and Mohawk Rivers, or , as the Greenway later discovered, from Battery Park in New York City to Battery Park in Waterford. This was important, as the definition of the "Hudson Valley" was different from agency to agency, and usually did not include Rensselaer or Albany counties. The Greenway added those two and parts of Saratoga as well for both political (Albany as state capital) and geographic reasons.

At that meeting, the Council also made a commitment to hold extensive public hearings as part of the Greenway process. Also discussed, but not recorded in the minutes, were proposals to create more of a regulatory process, including a moratorium on development along the river. This was not seen as a viable alternative, and was never seriously discussed again.

The Greenway study process that followed was designed t to be" totally transparent and relentlessly positive". While some background studies were prepared, the Hudson River Greenway's engine was powered on the fuel of public comment at its hearings—over 17—up and down the river over a two year period.

It was during the hearing process that we discovered the inherent power of the word "greenway". Our enabling legislation did not give a definition for the word. Other definitions were sited, but during the hearing process each speaker carried with them their own internal definition. The Council came to realize that defining Greenway would limit it. Undefined, it could accommodate many varying ideas. Thus the final legislation does not define "Greenway".

The testimony delivered was primarily the wish list of a population that yearned to be able to get to the river; to have trails and bikeways running along it; to maintain the rural character of what we termed our "countryside" area, and to help prevent the next " big thing" that could ruin the character of the Valley.

That one decision was to serve the Greenway well. When the Greenway study began, the Greenway shared office space with the Commission on the Adirondacks in the 21st Century, headed by George Davis and chaired by the late Peter Berle. (The Greenway staff watched in awe as George Davis received word that he had received a McArthur Foundation "genius grant" for his previous work in the Adirondacks).

The Adirondack project was very much oriented toward studies and less so by public hearings. That led to inevitable comparisons with the Greenway's public hearing approach, prompting the Capital District Business Review on May 14, 1990, to note that "…the Greenway Council, while no less vigilant in its goal of protecting the land in the river valley, took a different tack….That one difference, involving the affected municipalities rather than holding them at arm's length—bodes well for the Greenway."

And the hearing path worked at both the micro and macro levels. The Greenway process made friends. The Greenway was supported by nearly every newspaper in the Greenway area. Potential adversaries--sportsmen, farmers—were generally won over by the openness of the process. One newspaper reporter, suspicious of the Rockefeller origins of the Greenway, was told he was welcome to come in and peruse our records rather than go through a freedom of information act process. Because we were pretty small as a state entity we were able to do things like that. It made us friends. At a micro level, the testimony gave us our direction. Our decision to call for a " planning compact" among Greenway communities, for example, came directly from testimony in Troy from John Buono, then the Rensselaer County Executive:

"I view the Greenway as an opportunity to develop a treaty among all of the governments, councils, private landowners and others who have a real or potential impact on the Hudson River Valley" (Troy, June 16, 1989). That became the basis for the Greenway planning compact called for in the resulting Greenway legislation.

- **The Greenway Legislation**

The final Greenway report called for the creation of a Hudson River Greenway Communities Council, a state agency that would primarily be the regional planning entity, and a Greenway Heritage Conservancy to develop Hudson River Greenway water, hiking and biking trails, and to work with the region on a regional tourism strategy.

Two organizations were recommended after Greenway staff visited California, where a Coastal Conservancy worked with trails and water access, and a Coastal Commission dealt primarily with planning and regulatory issues.

Given the eventual size of the Greenway budget (always around $1 million),two organizations may have been unwarranted. But because the Council was a state agency and the Conservancy a public benefit corporation with a non-profit attached, the Greenway had (and has) an enormous amount of flexibility.

The essence of the legislation was a two-step process where communities could voluntarily agree to use Greenway criteria and apply for assistance and grants, and the grant of additional incentives to encourage communities in the Greenway to adopt more extensive planning programs that took into account five Greenway Criteria: Natural and cultural resource protection, regional planning, economic development, public access, and heritage and environmental education. For communities that choose to participate, a variety of financial and procedural benefits are available.

The Greenway tested this new legislation by choosing "model communities" in each Greenway county. In Newburgh-Beacon, the Greenway established a joint, cross river, model project and connected the two riverfront communities by a "Trail of Two Cities."

Currently, 261 of the 324 communities within the Hudson River Valley Greenway Area have passed resolutions in support of designation as Greenway Communities, a good indication that the Greenway's light touch continues to work.

The first true Greenway compact plan was done by Duchess County. It is explained at the Greenway's web site:

A Model Greenway Compact: Dutchess County's Greenway Connections. Dutchess County developed the first model compact plan in 2000 that serves as the benchmark for future compact planning. Dutchess County's Compact, *Greenway Connections*, has translated into numerous intermunicipal partnerships and projects, and has served as a guide for the coordination of state, county and local government priorities.

Twenty-nine of the 30 communities in Dutchess have adopted the Compact and more than half have undertaken revisions to their comprehensive plans and zoning ordinances to implement it. At the same time, the County has appropriated $5 million and committed an additional $2 million to its open space and Farmland Protection program. Projects completed and pending will protect 2,465 acres of farmland through PDR and 556 acres of public open space through fee simple acquisition.

The initial success of these county programs have led municipalities in Dutchess to appropriate more than $9.7 million in matching local funds for open space and farmland protection.

The Dutchess County Greenway plan, spearheaded by then Commissioner Roger P. Akeley and John Clark, now the Planning Commissioner, defined Greenways as "connections between people and places, both cooperative agreements among neighboring communities, and paths where the natural and human landscapes coincide."

It was in Dutchess County that one of the key "carrots" was tested for the first time. The Town of Milan was sued by a gravel pit operator because it had put restrictions in new legislation adopted by the Town Board. The New York Attorney General, as per the legislation, went to court for the town and was successful. That provision was another direct outgrowth of the public hearing process, as several town officials testified that they were afraid of getting sued if they put Greenway criteria in their plans. Other areas with Compact Plans Now include Westchester, Rockland, Putnam, Orange and Ulster Counties. More complete information on today's Greenway may be found at http://www.hudsongreenway.ny.gov/home.aspx

A word about Home Rule. …At first the Greenway was prepared to view Home Rule as an adversary, something to be fought .We came to realize, however, that one of the biggest impediments to good planning was money, and that $30,000, plus staff planning assistance, changed our relationships with communities for the better .Municipal leaders wanted to plan well, but they couldn't afford to.

The Hudson River Valley National Heritage Area: "The Landscape that Defined America"

America's environmental movement began in the Hudson Valley—twice. The artists of the Hudson River School helped to create America's first environmental ethic in the early 1800s. Thomas Cole, Frederic Church and others were the first to show Europeans -- and Americans -- an American landscape of beauty, not the dark forested lands that came with the Puritan vision of America. The importance of their work went beyond the landscapes they painted:

> *The rise of a native school of landscape painting in New York in the middle decades of the nineteenth century must surely be reckoned as one of the most important developments to have taken place in the still short cultural history of the United States. Not only did the creation of a distinctive style of landscape painting hold enormous significance as a manifestation of increasing maturity in the field of art, it was a palpable embodiment of a host of ideas either deeply held or deeply pondered by the American people at the time. Major human concerns–relating to God, nature and morality, as well as to the nation's mission and the future, the management of its resources, and the achievement of social stability and happiness–all found their way into works of art. (Roque, 1987)*

Schama's "strata of memory" runs deep in the Hudson Valley, a fact that Congress legislatively recognized in creating the Hudson River Valley National Heritage Area. It is not just the Hudson River School that gives the Valley its sense of history and place. Besides Cole and the Hudson River School, Congress identified the Knickerbocker writers, the Revolutionary War, the iron, textile and collar and cuff industries, the women's labor and education movements, the Dutch and Huguenot settlements of the 17th and 18th centuries, and the patterns of settlement themselves throughout the Valley.

The Knickerbocker School, our the first American literary movement, coincided with the Hudson River School and illustrates how the layers of history and memory overlap different parts of our heritage. Washington Irving is considered by many to be the first American man of letters and its first short story writer; James Fenimore Cooper wrote the first novel of the Revolutionary War; Clement Moore (or Henry Livingston) wrote "The Night Before Christmas; William Cullen Bryant and Lydia Child were among America's first abolitionists.[11]

Again in the 1960s, he Hudson River Valley helped create modern environmental law when Scenic Hudson Preservation Conference–now Scenic Hudson and celebrating its 50th anniversary-- was formed to protect Storm King Mountain from the hydroelectric pumped-storage facility proposed there by Con Edison. The project was ultimately withdrawn after a 17 year legal battle which culminated in the historic Hudson River Settlement Agreement. The litigation spawned by that fight ultimately led Congress to pass the National Environmental Policy Act,(NEPA) the cornerstone of all subsequent federal environmental law). That statute led directly to the "little NEPA's of the states, such as the New York State Environmental Quality Review Act Equally important, the Storm King case established the rights of citizen groups to take part in legal actions concerning the environment.

Nearly 40 years after *Storm King,* the Hudson River Valley stands as one of the most "designated" areas in the United States. The National Park Service calls it "the landscape that defined America." [12] In describing the valley the Park Service wrote: "The outstanding scenic quality of the Hudson River Valley inspired the works of early American writers, artists and designers, contributed to an appreciation of the natural environment, fostered early environmental activism, and is reflected in existing historic properties."

It is also wonderfully ironic that Wordsworth's belief in the expression of public rights in private lands should gain legal approval in a case involving the Hudson Valley.

Under the heritage area legislation, the Greenway Council and Conservancy were designated Management Entities of The Heritage Area. There were two aspects that made Hudson Valley different:

--The congressional designation was made before, not after a Natural Resource Study was prepared. Generally it is the other way around, as the resource report justifies the designation. The timing was right, however, for Congressman Hinchey to get a designation, however, and so he did.

--The HRVNHA actually has some modest teeth in it:

Sec. 908(b). Duties of Federal Entities.--Any Federal entity conducting or supporting activities directly affecting the Heritage Area, and any unit of government acting pursuant to a grant of Federal funds or a federal permit or agreement conducting or supporting such activities, ***shall to the maximum extent practicable****--*

1. consult with the Secretary and the management entities with respect to such activities.

2. cooperate with the Secretary and the management entities in carrying out their duties under this title and coordinate such activities with the carrying out of such duties; and

*3****. conduct or support such activities in a manner consistent with the management plan unless the Federal entity, after consultation with the management entities, determines there is no practicable alternative*** **(emphasis added).** (National Park Service, 1998)

- **Awash in Heritage Areas**

If you live in Waterford, New York, you may be at the epicenter of the National Heritage Area world. That is because you could paddle from Waterford to New York City; from Waterford to Canada, and from Waterford to Niagara Falls, and never leave a National Heritage Area (some portage required).

This wealth of history and culture includes the HRVNHA, the Erie Canal National Heritage Corridor, the Champlain Valley National Heritage Partnership, and the Niagara Falls National Heritage Area, representing some of the richest cultural fabric of any such area in the nation. Here is a brief description of each:

The Erie Canalway National Heritage Corridor. Visitors to the Erie Canal are often surprised that the Canal is a subsidiary of the New York State Thruway. And is in the center of a statewide system of water, walking and biking trails. The Canalway is run by the New York State Canal Corporation, a subsidiary of the NYS Thruway Authority. It includes 524 miles of Canal along the Erie, Cayuga-Seneca, Oswego and Champlain Canals; 4,834 square miles, and 2.7 million people in 23 counties. What makes the Erie Canal so interesting, however, (aside from the mule Sal, which is as much of a brand as you could wish for) is the fact that the Commission has established a Erie Canalway Heritage Fund, and not-for-profit whose purpose is to raise funds for canal projects and programs in the face of dwindling federal funds. As one Board Member said at a recent meeting: “We have to find our Laurance Rockefeller”.

The **Champlain Valley National Heritage Partnership (CVNHP)** The national heritage area includes the interconnected waterways of Lake Champlain, Lake George, the Champlain Canal and portions of the Upper Hudson River in Vermont and New York.

Congress authorized **The Niagara Falls National Heritage Area** in 2008. In its enabling legislation, Congress spells out the purposes of the heritage area, the requirements of the management plan, the roles and responsibilities of the commission and the local coordinating entity, and other regulations concerning funding, property rights, and assistance through other federal agencies.

The public has supported the establishment of a national heritage area since 2000, when local leaders met with National Park Service officials to discuss the concept. This interest is related to a number of planning and heritage initiatives, including the Urban Design Project of the University of Buffalo, the Bi-national Niagara Tourism Alliance, and the Buffalo Niagara Cultural Tourism Initiative; and efforts to redevelop and promote Niagara Falls by the City of Niagara Falls, the New York State Office of Parks, Recreation, and Historic Preservation, USA Niagara, and the Niagara Tourism and Convention Corporation.

- **Greenways Go Abroad to Help with the “Velocity of Change”**

A remarkable lesson learned by the Hudson River Greenway people was how easily the Greenway traveled across local, state, federal and international boundaries. After reading the materials below on the Greenway’s international influence, it is hard not to come to the conclusion that our European partners, particularly the Eastern European countries, have ,in some cases, gone far beyond the efforts of their American friends.

We also recognized a profound sense of history among the eastern Europeans. One Czech mayor told us of a fire 500 years ago that killed many in his village. By the end of his description he had tears in his eyes. Greenways can do that.

Who can resist, for example, the Iron Curtain Bikeway?

Bill Moody, formerly of the Rockefeller Brothers Fund, likes to call the results of the fall of the Iron Curtain the "velocity of change" that was going to overtake Eastern Europe without careful planning.

If the communities of the Hudson River Valley were built upon the concept of Home Rule, the communities of Central Europe, after the fall of communism in 1989, were built upon no concepts at all. The fall of communism in 1989 left, literally, a blank slate upon which to build a program to preserve the lands that had been hidden to the world by communism for 40 years.

A report in 2000 by the Environmental Partnership for Central Europe, a foundation-supported initiative of the Rockefeller Brothers Fund for environment and civil society in Hungary, Poland, the Czech Republic, Slovakia and Romania, described the situation this way:

> *With the collapse of communism, the situation for citizens groups and environmental conservation changed rapidly. The environment was a major issue in the first elections in 1989 and 1990. New civic groups mushroomed throughout the region. However, the concept of a private, voluntary, nongovernmental sector working on social problems was largely alien to the region. The organizations had limited experience in proposing constructive alternatives to government policies and practices. There was no adequate legal framework sanctioning the nonprofit sector, no existing infrastructure, few trained leaders, no experience with Western-style fiscal and management practices and no funding for such organizations. There was, moreover, a severe legacy of distrust and totalitarian conditioning to overcome. Four decades of centralized decision-making had undermined individual creativity and initiative.*

What was left was a landscape that in many ways was environmentally devastated in terms of air and water pollution, but also one that was remarkably intact in terms of history and culture, and a fierce love on the part of its citizens for the history and beauty of the countryside.

The Czech Republic. Into this background stepped the Hudson River Valley Greenway, encouraged by a Czech-born resident of the Valley, Lubomir Chmelar and his wife, Tiree. Representatives of the Hudson Greenway made several trips to the Czech Republic, one in which nearly two dozen valley representatives spent a week touring Czech towns and villages and explaining the American Greenway process to the Czechs.

The Hudson River Valley Greenway was asked to help design a strategy that would enable the development of cultural tourism and at the same time preserve the unique cultural and natural heritage of what was then Czechoslovakia. Through a proclamation signed by then Gov. Mario Cuomo, with financial assistance from the Rockefeller Brothers Fund, the Hudson and Czech Greenways became partners.

> *Whereas the people of the Czech Republic have emerged from the darkness of communism to the sunlight of democracy, and whereas, the beauty, history, culture and natural resources of the Czech Republic are now available to the world community....whereas, there would be no greater demonstration of the power of greenways to bring people, ideas and nations together then the joining of our two greenways, Now therefore I, Mario M. Cuomo, Governor of the State of New York, proclaim that the Hudson River Greenway and the Greenway of the Czech Republic shall be joined together in spirit to become the Czech-Hudson Greenway."* (Cuomo, May 1993)

That twinning took place in the Greenway offices on top of the Empire State Plaza. Czech and American miniature flags were in front of the participants. The Czech President, Vaclav Havel, had already signed a Czech version which we never saw The Hudson River Greenway visits to the Czech Republic and Slovakia resulted in the untranslated use of the word "Greenway" to describe projects, rather than its native translation of "Zelene Stezky".

The Czech Greenway adopted an intensive campaign to meet with local elected officials, the tourism industry and the central government. These efforts have resulted in among other things, a Prague-Vienna Greenway Trail, a Moravian Wine Trail and a leading role in the development of Greenways throughout Europe.

Today, Czech Greenways, part of the EPCE in the Czech Republic, describes its efforts this way:

> *Development of the Prague-Vienna route through the Czech Greenways is part of a broader purpose: to create a model for sustainable regional development, conservation of cultural and natural heritage, and promotion of local and regional identity.*

The Amber Trail Greenway. The Amber Trail Greenway begins in Krakow, Poland, crosses Slovakia and ends in Budapest, Hungary .It is based upon the experience of the Czech Greenways, but in many ways is more complex because it deals with three different countries. The name, Amber Trail, derives from the ancient Amber Trail that merchants in the region used to exchange goods and ideas. Here is how the coordinators of the program describe it:

> *The Amber Trail Greenway resonates with the numerous roles played by trade routes in earlier times -- economic, communication, religious, military, diplomacy, cultural exchange*

and social interaction. Trade relations were always accompanied by exchange of information for building local understanding about the wider world in terms of social, intellectual, religious, cultural and economic issues. By building strong local partners committed to sustainable development, the Amber Trail Greenways seeks to create a rich resource of practical action and good practice at the level of a micro-region. "Amber" initiatives are focal points for local economic development rooted in political awareness and protection of the history, culture, tradition and nature of the place. The challenge now is to make the linked local projects of the Amber Trail attractive to visitors and connect them to other local initiated heritage trails and regions in other parts of the world.

The report continues:

From Cracow to Budapest and back, a renewed spirit of cooperation along this historic corridor empowers people and communities to generate sustainable economic development while protecting, restoring and preserving traditional cultural and natural values and landscapes. The ATG provides the framework for local regional and cross-border cooperation expanding upon a historical context while building bridges to the future.
(Amber Trail Greenway Report, 2001)

One such bridge was being built one evening two years ago in a small Slovakian village with a project funded through the Amber Trail Greenway program. It was called the "listening project" and it taught elected officials how to listen to what their constituencies were saying.

It is worth repeating that this is from an area that 24 years ago, had absolutely no framework at all for governance, let alone regional planning.

Acknowledgements

Reviewing the materials I remembered how efforts like the Greenway require countless meetings, mostly at night, along a 150-mile corridor. It was not unusual for staff to leave the office at 4, be in Westchester County at 6 or so, and be back home by midnight. Happily, the HRVG Council had enormously dedicated staff.

Thank you, Chuck Little.

Many thanks to my wife, Arlene, for great editing and encouragement.

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Special note: The original members of the Hudson River Valley Greenway Council were Barnabas McHenry, Chair; Anna Buchholz, supervisor of the Town of Poughkeepsie; Joan Davidson, President of the J.M. Kaplan Fund; John C. Egan, Commissioner, New York State Office of General Services; Constantine Sidamon-Eristof, attorney; Richard Jenrette, Chair of the Equitable; Thomas C. Jorling, Commissioner, New York State Department of Environmental Conservation; Orin Lehman, Commissioner, New York State Office of Parks, Recreation and Historic Preservation; NYS Senator Franz Leichter (D-NYC); Francis Murray, Deputy Secretary to the Governor for Energy and the Environment; Klara Sauer, Executive Director, Scenic Hudson; Richard Schwartz, businessman; Gail Shaffer, NY Secretary of State; Vincent Tese Commissioner, NY Department of Economic Development, and Franklin White ,Commissioner, NYS Department of Transportation.

13. URBAN GREENWAY PLANNING

Greenway Patterns and City Planning

Archana Sharma

Abstract

Greenway lies at the intesection of citified nature and naturalized city, which is a powerful performative position to occupy. Yet the current discourse, largely approaches Greenway as a program that is inserted in the urban fabric to form a micro-scale connective between homogenous or heterogenous landscape. This article is motivated by the nostalgic reality of agricultural times when the urban pattern was guided by rivers and floodplains, and explores the counter programming position on cities which is inserting urban fabric into the greenway or landscape matrix. The design with nature and for all biotic species theses of Ian McHarg and Richard Forman has already laid the foundation for further discussion on landscape patterns and city planning. Yet, current discussion on the topic is not voluminous or critical enough. This article addresses the gap by explicitly investigating greenways patterns and its position in informing future design/ planning of cities. In conclusion, Greenways patterns are diagrammed and synthesized as a template to study urban landscape patterns. Green Network Oriented Zoning -GNOZO map, a combination of greenway pattern, land valuation economics, land suitability analyses, and eco-civic optimization, is put forth as a potential framework for designing and planning future city development.

Keywords: Greenway network, landscape pattern, city and urban planning, design syntax

1. Introduction

Greenway has been traditionally understood as a multi-functional, multi-objective linear landscape with potential to address socio-cultural, recreational, tourism and ecological concerns. A range of positive values such as environmental, psychological, safety and aesthetic enhancements due to parks, greenways and open areas have been projected through multitude of contemporary research. Yet, each city and suburb is not infused with well planned and internally connected open space and green networks since the final manifestation of these plans requires many complex factors to align such as community engagement, costs of land acquisitions, political will, design sensibilities and other contextual variables. Considering that the traditional approach of preservation and conservation oriented Greenways, applicable at regional scales, has now filtered into urban constructs and city planning meetings, it is reasonable to assume that the multiple complex factors could align if so desired by each involved stakeholder. The question is that once that happens, do we have guiding frameworks to implement these, city wide, city-country, or city-city and country-country green networks. This article inquires into this question, unravels current greenway patterns in the process, and in conclusion, offers, another mapping based framework of GNOZO Map for consideration in future city planning. The underlying intention s GNOZO Map is to advocate and facilitate integration green network as a key component of inhabitable urban constructs.

2. Method

This article critically examines recent theories and practice of greenways design and planning with specific attention to emerging patterns. The scholastic publications, design proposals, reports by government and other participating agencies are critically reviewed. A critical, constructive and interpretative approach is employed to examine theory and practice of Greenways and emerging patterns. As Christopher Alexander noted in explaining the logic for his book -*A Pattern Language,* the patterns need to be revealed before they can be improved. This article mimics Alexandrian logic in that sense and reveals contemporary greenways pattern to further assess implications to future city planning. Diagramming is therefore critical to research methodology.

3. Greenway Patterns and Theory

Ian McHarg and Richard Forman examined and advocated for designing landscape patterns with conscientiousness towards ecology and biodiversity through their respective books on Design with Nature (1969) and Land Mosaic (1995). The suggestion on greenway systems as purveyors of fertilizers (Fabos, 1995, 9) indicates leaning towards linear corridor or conduit kind of a pattern, also favored by policy planners of alternative transportation mode (Shafer, Lee and Turner, 2000, 164). Greenway as a promising strategy, incorporating wetland filtering and buffering functions (Ahern, 1995), re-appears in articulation of green infrastructure as connected landscape including ecological hubs and critical landscape linkages (Benedict and McMahon, 2006, 35).

In Beijing, a heterogeneous green network is proposed for different scales of region, city, and neighborhood to address urban sprawl (Li, Wang et al et al, 2005). A large forested corridor in the northwest and the southeast periphery of the regions was proposed as means of protecting environmental quality and providing habitats for wildlife, at the regional level. At the city level, a system of green wedges, parks and green corridors was recommended, primarily, towards limiting the future urban expansion. Gridiron green extensions along the rivers and streets linking existing and new green spaces were suggested for neighborhood scale. The breach of rigid greenbelt is observed in Nanjing as well, thus leading to the proposal of hierarchically scaled interventions, similar to Beijing, through city-circuiting greenway, green wedges in median strip to guide sprawl and inner city riparian and roadside greenways for connectivity (Jim and Chen, 2003). The formal pattern of green wedge, urban fingers and greenway network Nanjing and Beijing cities in China resonate with Forman's Patch-corridor-matrix approach (Jim and Chen, 2003, 106,107; Li,Wang et al 2005). The existing green patterns are concentric radial and are envisioned to shift to dispersive radial over time.

A dissipative dispersive pattern shows up in yet another Asian example from Japan. The green networks proposed in 1960s and more recently were assessed in relation to the corresponding statutory mandates through the cases of Tsukuba and Kohaku (Yokohari, et al, 2006). The Tsukuba New Town greenway plan was guided by Urban Park act and called for a series of block parks having their own catchment areas catchment radius of 250 m to 1000 m, connected by a web of greenways connecting the block parks and other green spaces. The grid of dissipative green network pattern has a strong central spine with nodes of green patches. The development in Kohaku, Japan guided by Green Matrix system –a land conservation tool, embraced a more organic radii pattern, best described as two facing green arcs with green patches organized in dissipative pattern (Yokohari et al, 2006, 215, 216).

For greenways planning oriented to nature tourism, education and culture in urban areas, Pena et al recommend that the unique landscape elements and characteristics are highlighted; unstable areas are recovered and cultural elements integrated (2010, 982). For rural areas, the authors recommend critical thinking n greenways to address socio-economic and health problems of the area. A greenway network planned for the UNESCO world Heritage site in Sintra was approached greenway as a critical infrastructure contributing towards sustainable development and equally significant as conventional infrastructure systems of water, sewerage, transportation and energy (Ribeiro and Baroa, 2005, 7). A greenway network connecting valuable resources delineated as Corridors of Outstanding landscape Quality was proposed as a strategy to conserve cultural, historic quality of the place while allowing for new development. The formal design decision favored by a local firm comprised of topography and hydrology guided organic patch shape and curvilinear corridors (Ribeiro and Baroa, 2005, 8). Another study from Europe by Brunckhorst, Coop, and Reeve (2006) suggest resource governance as sustainable regional development and the approach of eco-civic optimization. The authors assert that judicious selection of the conservation areas need to be critically reviewed if the ecological conservation is to be effective. The areas of ecological and political concerns should be identified and the areas of high civic attachment should be mapped; land area lying at the intersection of eco-political-civic concerns should be then selected for conservation (Brunckhorst, Coop, and Reeve, 2006).. The closest reference to design patterns is in terms of demarcation of boundaries and thresholds.

Kuhn inquired into the greenways patterns through studies on urbanization patterns in Berlin, Germany and Randstad, Holland (Kuhn, 2003). The study attempted to address the contentious question of which of the Green-belts or Green hearts typology is better, one that acts as a connector or a *separator* for urban and suburban regions (Kuhn, 2003, 19-27). In the process, the article brings out the two broadly debated approaches of one large patch over a concentric ring of small multiple patches, in context of urban spatial organization design, more popular in landscape ecology as Forman's SLOSS (single-large or several-small patches/ ecosystem) concept. The verdict seems to be favoring a combinatory pattern. A reiteration on grid pattern comes from another study on urbanization patterns in Holland (Schrijnen, 2000). The study advocates a dynamic grid pattern connecting the local infrastructure with the green network where the dynamic grid is based in landscape ecology principle that the survival of a species often depends on the access to larger areas since that allows flexibility to cope with variations in conditions. The grid pattern allows multiple mutual crossings or interfaces between infrastructure and green networks. Essential design principles embedded in this pattern are polarity, de-centrality, equality, continuity and formality.

4. Greenway Patterns and Practice

Patch-Corridor-Matrix theory of Richard Forman was an inspiration world over even if the translation to practice is more of a progressive education. To cite an example, the city country of Singapore's park connector network is designed as a multipurpose, multifunctional, socially and environmentally responsible landscape system with patches of fragile ecosystems connected by multipurpose corridors (Tan, 2004, 5). Another example is of a riparian greenway from Australian city of Adelaide (Mugavin, 2004). The key goals of the River Torrens Landscape plan, were listed as eco-system conservation, protection of cultural landscape values, restoration of river and recreation. The Torrens river greenways as re-presented by Mugavin has a linear, connective form (Mugavin, 2004, 232-233).

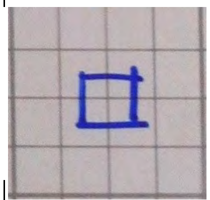
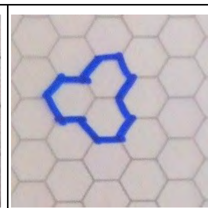
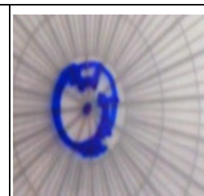
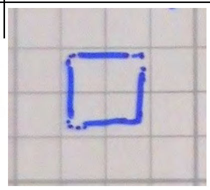
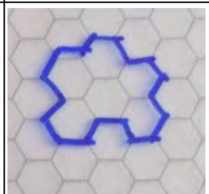
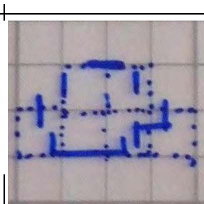
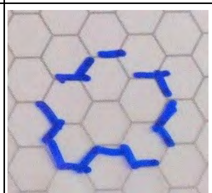
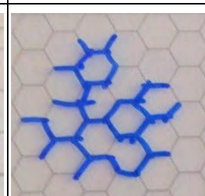
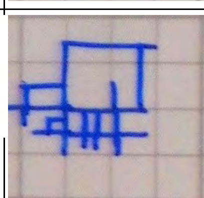
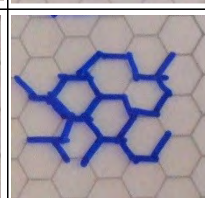
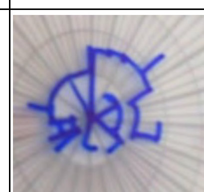
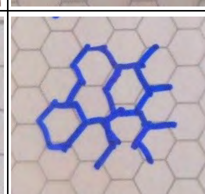
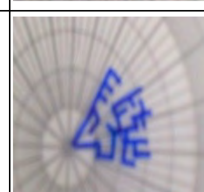
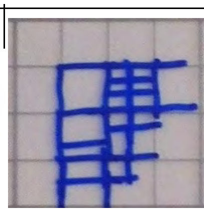
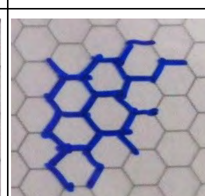
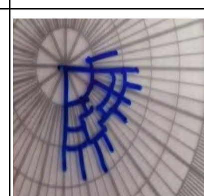
To review greenway practice at home ground in America, some projects from Appalachian corridor are examined. The Knoxville, Knox County Greenway plan is said to be a culmination of Knoxville Greenways and Community Trails Commission Report, 1992, the Knox County Greenways Plan, 1994, Knox County Park and Recreation Facility Plan, 1998, and Knoxville Parks, Greenways and Open Space Resource Inventory, 1999. The Greenway aims to provide a connected and cohesive system of parks and recreation facilities while facilitating the preservation of important natural resources (Knoxville Metropolitan Planning Commission-KMPC, 2009, 7,10). The greenways plan thus focuses on connecting parks, recreational areas and water bodies so as to protect open space systems, reinforce the pedestrian transportation network, and facilitate avenues of economic vitality.

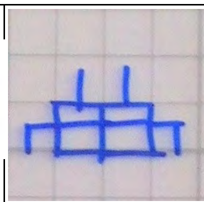
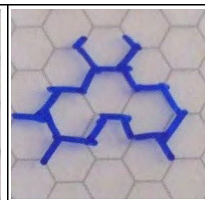
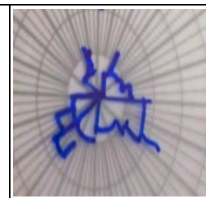
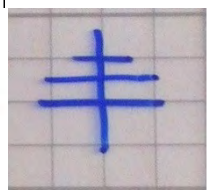
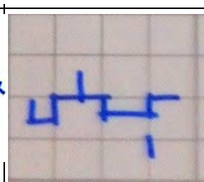
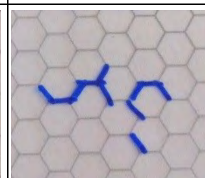
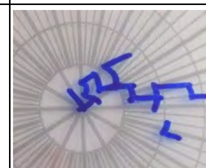
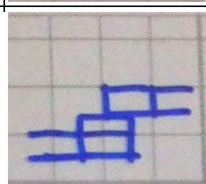
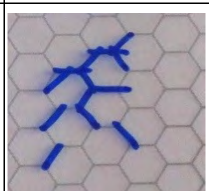
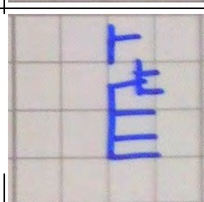
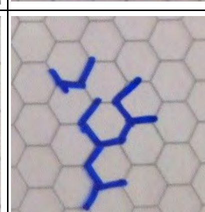
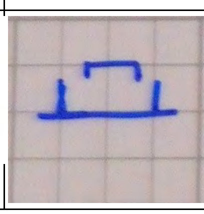
Greenways in Nashville, middle Tennessee are primarily designed to connect the places of natural beauty with the neighborhoods. The fundamental belief that guides the plan is that Greenway should provide all citizens with barrier-free access to natural resources and recreational opportunities (Metropolitan Government of Nashville and Davidson County, 2010). Mecklenburg County's Greenway System in North Carolina, initially proposed in 1980 as an aesthetics and access to nature based "green necklace" along the creeks and streams of the County was updated in 1998 to include floodplain management objectives. The idea was to protect stream corridors and floodplains from degradation due to poor land management practices, which in turn, caused flooding through the city. Provision of walking and biking as an alternative transportation mode were additional motives of the plan (Haden and Stanziale, 1999, 2010).

5. Discussion: Greenway patterns and implications for city planning

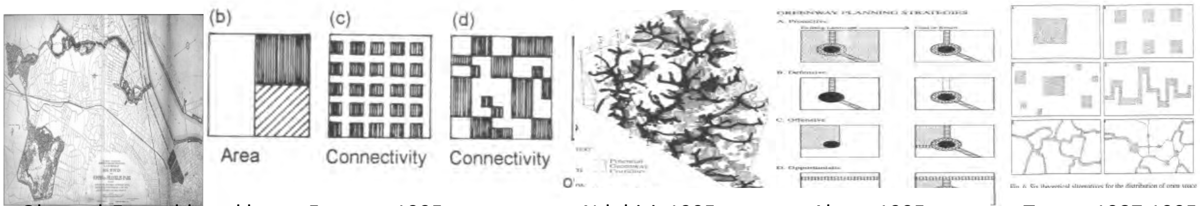
The Greenway patterns are essentially design manifestations of desired objectives such as connectivity or containment (Sharma, 2010), patterns presented in first column of Table 1indicates that most patterns lean towards connectivity, with some greenway plan employing containment employed only in parts, as a sub-set of the connective pattern, only rarely did patterns such as the ones from Randstad, Holland and Beijing, China come close in practice of containment, when looked at exclusively through pattern based view as used in this article. Superimposing the greenway patterns on a range of geometric grids such as cartesian, hexagonal and polar, helps extrapolate the reductive patterns, thus transforming them from specific to generic diagrams, which are ideally and hypothetically more amenable to replication. The variation based on underlying geometric grid to synthesize reductive patterns is shown in Table 1.

Table 1. Exploring reductive pattern for Greenways

Location	Greenway patterns	Greenway patterns on geometric grids which are popular as underlays for city design			Objectives	Pattern types
Randstand, Holland					Contain-ment	Radial Concentric
Beijing, China						
Berlin,Germany					Contain-ment + Connective	
Singapore					Connective	Poly-Centric Radial Dispersive
Knoxville, TN, USA						
Sintra, Portugal						
Holland						Poly-Centric Grid Dispersive

Nanjing, China						
Tsukuba, Japan						Axially Dispersive
Nashville, TN, USA						
Adelaide, Australia						
Lisbon, Portugal						Poly-Axes Dispersive
Mecklenburg county, NC, USA						
Kohaku, Japan						

The most iconic theorizations on greenway patterns to date are Olmsted's Emerald necklace, Richard Forman's PCM: Patch-Corridor-Matrix , Ndubisi's ESA:Environmentally sensitive areas, Jack Ahern's PODO: Protective, Offesnive, Defensive, Opportunistic approach, and Tom Turner's Open Space Network alternatives; see Figure 1. Besides Olmsted's Emerald necklace drawing which despite being descriptive serves as a genesis, other diagrams were used as means of theorizing approaches to spatial planning. These are significant advance in fractal pattern based study in landscape. The approaches attempt to negotiate a safe ground between planning, politics and design but come across as more reliant on the planning intent and objectives to guide decisions on spatial connections or emergent greenway patterns. The reason probably these approaches have not been popularly embraced in the realm of city planning could be the position rooted in landscape and biodiversity conservation, which may not be highest priority for city planners.



Olmsted Emerald necklace as in Fabos, 1995,2004   Forman, 1995   Ndubisi, 1995   Ahern,1995   Turner 1987,1995

Figure 1. Iconic theorizations and diagrams on greenway patterns

Greenway, like most other public open spaces or commons, is generally perceived as a liability in city planning practice, rather than an opportunity. One of the reasons for this perception could be the widespread impression of Greenway as a fragile instrument requiring continuous maintenance. Benefits of greenway on health, an area under exploration might give a push to the acceptance of idea of greenway as a key instrument of city planning. The idea that currently resonates most with city planning officials is of Greenway as a scenic byway or alternative transportation mode, for the associated revenue generating potential (Shafer and Lee, 2000). There must be other ways to present greenways as appealing to this economics oriented mindset. Statistics on increase in real estate value of properties in proximity to greenways serve most appropriately in building dollar based reasoning. Research shows that proximity to a greenway increases property values, for instance home prices up-surged in the range of \$230 to \$3,200 within the 5,000 feet or roughly a mile of a distance of the greenway in Mecklenburg County, North Carolina (Harrison and Munroe, 2007, 134). This is an attractive incentive to developers despite the high construction and maintenance costs ranging from \$50,000 to \$120,000 per mile (Rails to Trails Conservancy, 2012; Chalkey, 2005).

Superimposing the greenways pattern templates in Table 2 with classic McHargian land suitability analysis maps and the enhanced land valuation for 1 mile zone next to greenways, provides a zoning map that takes into account both the land based and the economic criteria. The approach of eco-civic optimization suggested by Coop and Reeve (2005) is applied as an overlay to account for social concern. This approach negotiates three critical stakeholders to increase chances of accomplishing the objectives of resource conservation over a long term. Three different sets of information datasets favoring three empathies of ecological conservation, political governance and social / emotional care or attachment values are mapped and overlapping areas are marked as an agreeable conservation zone. Combining these maps generates a complex pattern that serves as the fundamental zoning generator map, see Figure 2. The emergent complex pattern could be most aptly termed as Green Network Oriented Zoning - GNOZO map.

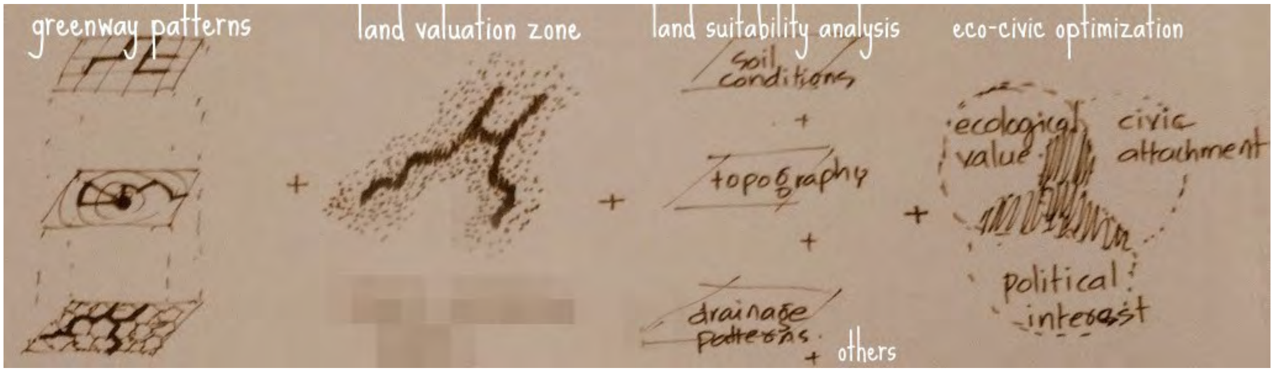


Figure 2. Process of generating a Green Network Oriented Zoning -GNOZO map

The GNOZO map offers city planning authorities, a basis to generate land use zoning maps to plan a complex *green network*, comprised of sub-networks of complete streets, greenways and green trails.

Conclusion

Critical review of greenways design and planning showed that the explicit discussion on greenway patterns and morphology is noticeably weak. The article addressed the gap through fundamental inventorying and creative analysis of greenways patterns. Greenway patterns are mostly a variation on a rectangular grid, convergent circles or dispersive radii. The article also points to greenways pattern based zoning maps for city planning thus opening ground for further discussion on city planning and design syntax. The *GNOZO map* could be strategically employed to enhance the dollar based land values in the economically underprivileged neighborhoods. The zoning map could also be used as a guide for land acquisition by Land trusts. The conceptual framework presented in this article provides two tangential directions for future research, which include: a critical review of city scale zoning policies and, refinement of understanding on citywide greenway patterns through software programs.

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Exploring the significance of greenway concept, to assist landscape planning and design: contributions to theory from African, Asian and European case studies.

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Introduction

The need for a reliable theoretical framework has been identified as unavoidable means to validate strategies and problem solve solutions in landscape architecture. The identification of the international greenway movement as well as its significance in promoting better planning and design (Fabos, 2010; Fabos and Ryan, 2006) enriched significantly the theory to support greenway planning and design. However, the magnitude achieved by the greenway movement across the world at different scales and contexts, deserves a deeper research on the topic. To illustrate this, it is worth mentioning the increasing popularity of green-infrastructures in European Union both in the academic and professional fields (EC, 2010; Magalhães, 2012), or the fact that 55 Km of greenways have been announced to be built in the city of Shenzhen, China in 2012 (Shenzhen Daily, 2012).

Goals and objectives

The goal of this paper is to contribute and highlight the need to strengthen the theory by evaluating the degree of success of landscape plans and the design of projects in diversified geographic, cultural, and scale contexts, which can be regarded as driven by the greenway concept or paradigm. Case studies in Africa, Asia and Europe, are submitted for review in order to ascertain the significance of the greenway concept in assisting the search for adequate planning and design solutions.

Literature review on the need to progress in greenway theory

This theory is considered to be a system of ideas capable of explaining something, which in the case of landscape architecture can be synthesized in two main domains: explaining the landscape (assessment and perceptions), and supporting planning and design (problem-solving solutions).
Over recent decades, landscape planning and design have been challenged by criticism concerning the lack of strong theoretical framework (Hunt, 2000). Post-modern criticism stressed the need to complement rational landscape planning and design with creativity and public participation. Most of the theoretical research work has been directed towards the understanding of the landscape function However, many authors also draw the attention to the theory that validates models or paradigms.
Swaffield (2002) concludes that a structure in Landscape Architecture theory can be found based on common issues. Through these issues it is possible defend that the greenway debate contributes to theory, such as: a) landscape knowledge/analysis/diagnosis as a basis for creativity; b) the need to address the three main scales of approach to landscape study (site, place and region); c) the understanding of relationship between form and processes and how phenomenology provides possibilities to better embrace the tension on landscape design and planning, and the public. Being a concept very much based on the assessment of existing

resources on the land, fostering consensus between stakeholders, greenway discussion may strongly contribute to the evolution of the theoretical structure of landscape architecture identified by Swaffield.
Greenway planning and design theory have been mainly supported by three strong principles: spatial co-occurrence of resources, benefits from connectivity, and synergistic multiple use and purposes (Ahern, 2009). Zube (1984) had argued that the landscape assessment theory should address both quantitative and qualitative data, urban and natural landscapes, and applicability to diverse scales. Further studies concluded on the effectiveness of the greenway concept as a communicative tool capable to use validated scientific knowledge with creativity, therefore fostering consensus between planers, designers and communities (Ribeiro and Dias, 2010).
In conclusion four main topics can be identified in theory: 1) sustainable resources management; 2) continuity, 3) interface with public meanings and perceptions, and 4) communication tool to obtain consensus. These topics will explored through out the following four case studies.

Planning and design case studies in Africa, Asia and Europe

The objective is to assess how the greenway concept has revealed to be useful in inspiring and communicating, planning or designing proposals, as well as obtaining a desirable process of landscape evolution. To pursue this goal, the authors were involved in four case studies which were selected and assessed on the degree of usefulness of the greenway concept for their success. Their selection reflects a large diversity of scale approaches (planning, design and management) within different geo-cultural contexts, though all belonging to CPLP (Community of Portuguese Speaking Countries). The following case studies in were studied in three continents (Fig 1):

1. Landscape plan for the municipality of Dala (14.600,0Km2), northeast Angola, in Africa;
2. Landscape design for University Campus of Dili, East Timor (2.500,0ha), in Asia;
3. Europe mainland: Development plans and garden design in Comporta (12.500,0ha private estate in southwest coast of Portugal), in Europe mainland;
4. Historic garden restoration in S. Miguel, Azores largest island, Portugal, Atlantic Islands.

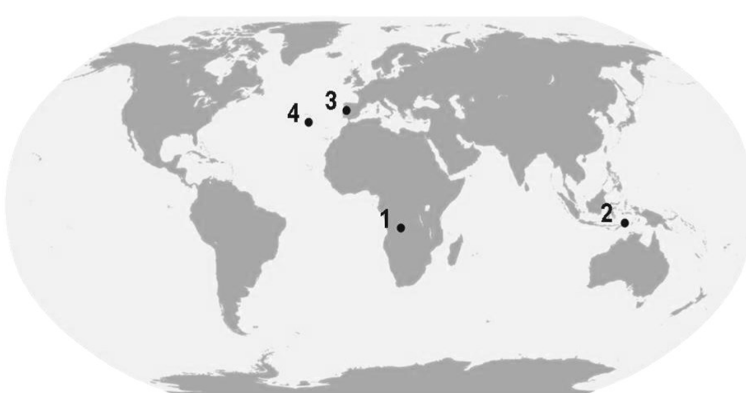

Fig 1. Case studies location: 1-Angola, 2-East Timor, 3-Portugal mainland; 4-Azores islands

Landscape plan for the municipality of Dala, Africa

The Dala municipality is located in the high flat lands of northeast Angola (14.600Km2). The objective was to foster development supported by a sustainable use of land, grounded on natural resources and local land use traditions.
Its geology (Calaári sand formations, and Quaternary Period deposits) determined a smooth land form. In the presence of rock formations, steep slopes appeared, as well as outstanding waterfalls frequent in tropical climates. *Miombo* woods (tropical ecosystems) together with a mosaic of savana with high grass and shrubs dominate. With the presence of impervious layers, wet lands occur in high plateaus.
The natural context determines abundant water resources, from which local culture settlements depend, and that has been understood as a unique differentiating factor in Angola's richness in the context of southern Africa. Its protection under a landscape plan was explained through the delimitation of "continuous natural conservation areas" (Fig 2) that include drainage network and springs, steepest slopes, *Miombo* woodlands, and path network used by local population.
The significance of the greenway concept is demonstrated in the delineation of the natural conservation area network, and seen as a communicative tool to convey the significance of these areas for local planning authorities and communities. It is remarkable how influential it can be in a country that after 30 years of war is now promoting planning for development, under an awareness of sustainability.

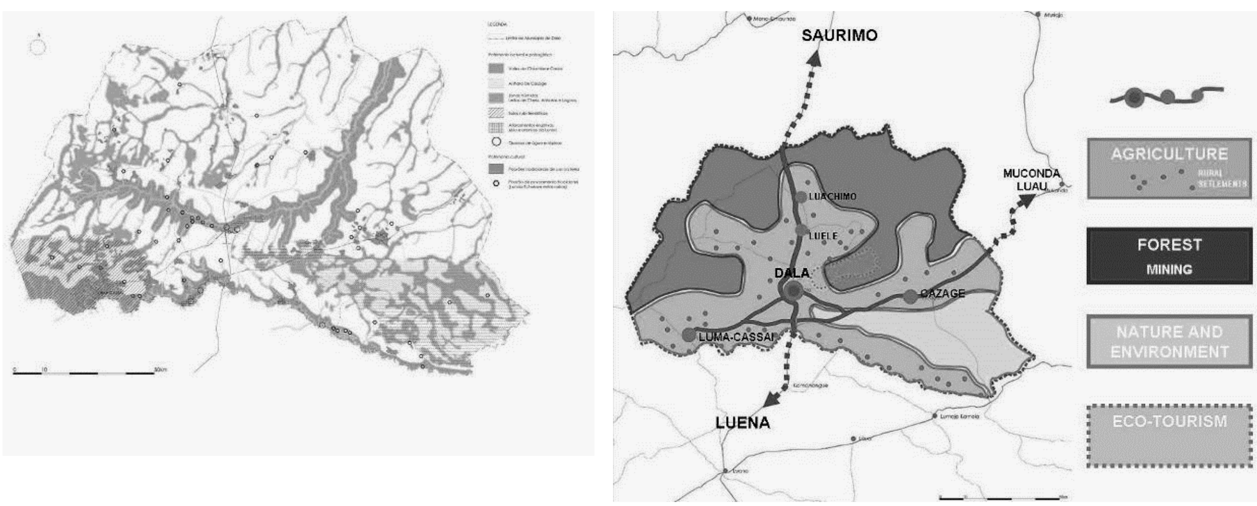

Fig 2. Dala Municipality: Natural Conservation Areas (left) and landscape plan (right)

Landscape design for University Campus of Dili; Asia

The University Campus of Dili, East Timor, intends to be a reference in education, knowledge and as an example of excellent campus planning and design, beyond the national borders.
The land morphology of the site, near Dili the capital, is composed by very steep hills, with flat flood plains, that do not show a clear hierarchy of the drainage network. The steepness of the hills restricts the possibility of construction. The flat plains used by local population for agriculture, contrasts with steep hills devoted to the forest, origin of flood hazards, with no building aptitude.

The campus proposal for the flat areas considered the safeguard of the extensive agriculture plains, and hill reforestation, proposing a spatial pattern of the university facilities that respected the awkward and unpredictable drainage. This was achieved through a continuity of green areas along main drainage lines which includes a comfortable and raised pedestrian circulation system. The landscape assessment determined buildings to be raised from the ground, contributing to the functioning of the complex natural drainage system (Fig 3).
The greenway drainage network inspired the first university campus landscape design of East Timor. Through a greenway reflection, constrains turn into opportunities for a project following the best world standards in one of the world youngest countries (independent since 1999).

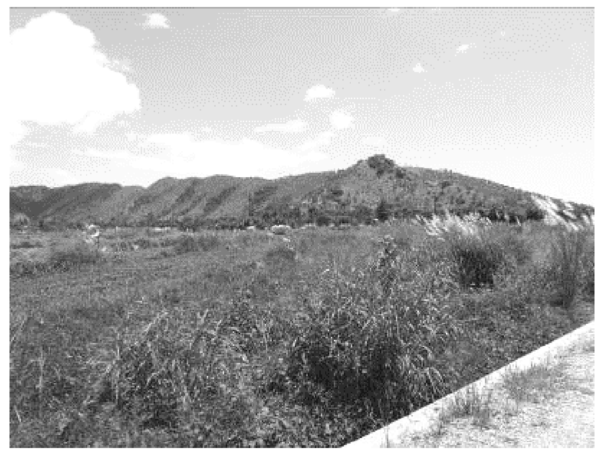

Fig. 3. Dili Campus: landscape design layout(left); the hills vs. flood plains of the site(right)

Development plans and garden design in Comporta, Europe mainland

Comporta private estate, south of Lisbon, encompasses 12.500ha, being one of the largest in Portugal. The morphology is determined by sand dune systems together with low wetlands. Over time the dune systems have been transformed in large forest areas of Atlantic pine and some wet lands in rice fields or community vegetable gardens. Development plans have been under progress in order to accommodate a growing tourism activity heading for low density and high standards in the international tourism market.
The greenway concept was used to support development plans – approved by local and national planning authorities – based on the continuity of dune systems (fig 4), to accommodate and minimize the fragmentation impact of tourist development in this highly ecologic sensitive region, foster the reclamation of the low ecological value of the landscape, due to intensive forest and rice fields production.

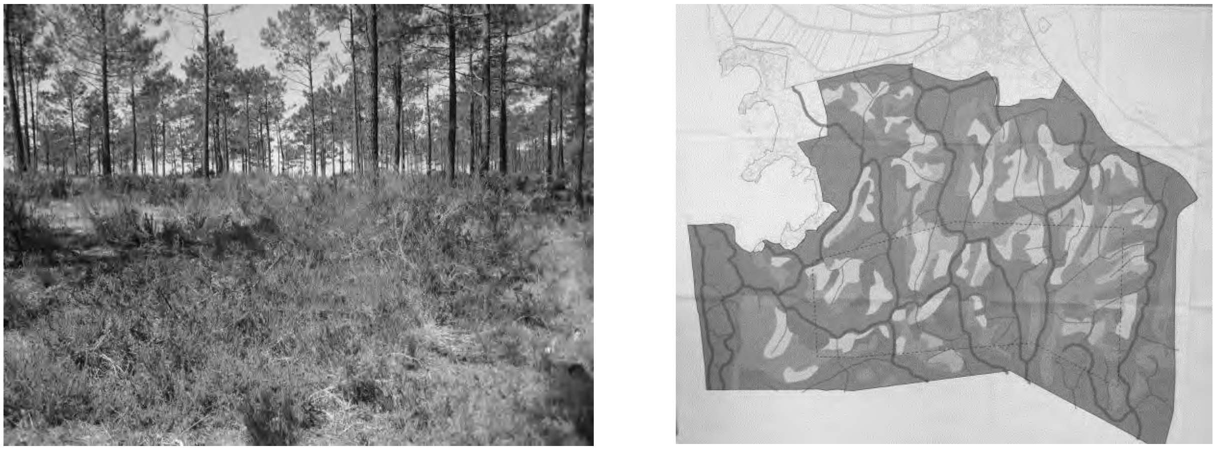

Fig 4. Production forest on dune system (left) and landscape plan for tourism development based on dune system continuity (right)

The concept of greenway in what continuity of reclaimed natural ecosystems is concerned, is also underlying sustainable landscape design. Strategies using and promoting the expansion of natural vegetation were tested in private gardens design (Fig 5), which received international recognition (Standler, 2012). This site level enabled to recover derelict land and established the continuity with the surroundings, hence the gardens constituting clusters for ecological improvement (Fig 6). Further use in high standard resorts in which quality is understood by promoters to be supported by the very natural character of the landscape, were also successful.
The use of natural vegetation restoration in plans, gardens and outdoor resorts, contribute to obtaining a continuity of landscape which the increase of quality is already under progress. In line with the existing planning tools and environmental restrictions, greenway concept promotes creativity, respects site resources and strengths landscape character.

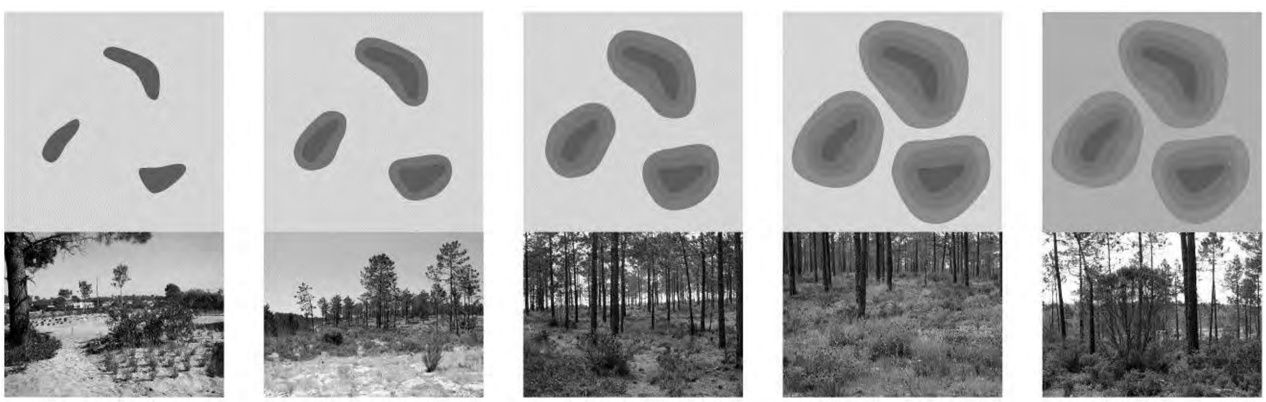

Fig 5. Clusters strategy to expand natural vegetation in landscape design from production forest (left) to more ecological sound woods (right); illustrating diagram

 

Fig 6. Private plot in Comporta, in which strategies of ecological reclamation were incorporated as part of garden design improving continuity with the surrounding landscape

Historic garden restoration in S. Miguel, North Atlantic Islands

Sao Miguel Island, the largest in Azores archipelago, encompasses a unique group of 19th century gardens. They were originated by a group of visionaries that fostered the development of the Island establishing contacts abroad which eventually originated an outstanding garden heritage.
As time passed these gardens went into processes of overuse, abandonment and degradation. Simultaneously, official authorities recognized their artistic value and potential for tourism attraction, which led to restoration processes. The case study includes two parks in the Island capital Ponta Delgada: Antonio Borges Garden (public park) and Santana Garden (Headquarters of Regional Government).

(a)  **(b**) 

Fig 7. Antonio Borges public park: (a) Alleys view; (b) View towards lake

The Greenway concept can be recognized both in the delineation of strategies for restoration, mainly in what concerns to vegetation, drainage and visual continuity which eventually were crucial to explain the outcomes of the restoration process to regional authorities. The restored gardens together with well maintained gardens or under the same process can constitute a network of historical sites to be visited in continuity. Some of them even occur along lake margins or main roads (such as the two referred parks) making possible a sequence of pedestrian visits, therefore becoming a powerful tourist product in which the concept of greenway can be perceived.

(a) (b)

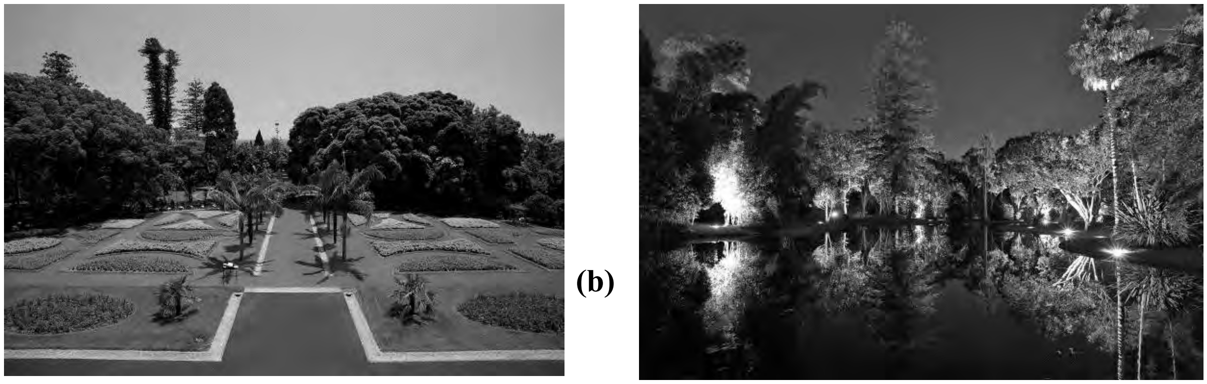

Fig 8. Santana Presidency garden: (a) Parterre view; (b) View towards lake

Discussion and conclusions

The case studies were analyzed in the context, of the greenway concept impact and the outcome of planning and design processes as summarized in table 1.

Table 1. Case studies analysis: impact and outcomes of the greenway concept

CASE STUDIES	SPECIFIC CONTEXT	GREENWAY CONCEPT IMPACT	OUTCOME EVALUATION
Dala Landscape Plan, Africa	- Rich natural resources - *Chokoe* culture - Portuguese influence - Independency: 1975 - 30 years civil war	- Assessment of ecosystems continuity - Land use plan supported by natural areas network - Recent planning efforts	- Communication tool with authorities and public - Influential to recent planning processes
Campus of Dili landscape design, Asia	- Context drainage - *Maubere* culture - Portuguese influence - Indonesia occupation - Independency: 1999	- Drainage assessment - Campus design - Recent planning efforts	- Communication tool with authorities - Contemporary excellent project in line with national expectations
Development and design, Comporta, Europe	- Coastal dune system - Forest production - Large private property - Recent tourist pressure	- Ecosystems assessment - Tourist landscape plans - Strategies for landscape restoration	- Turning restrictions into creative opportunities to improve landscape
S. Miguel historic parks, Atlantic Islands	- Volcanic Atlantic Islands - Significant 19th century parks heritage - Increase of tourism	- Restoration procedures based on continuity - Garden network for tourism experience	- Protecting unique heritage and promoting development opportunities

Two main conclusions are drawn from the reflection on greenway concept influence on theory.

The first concerns the usefulness of the greenway concept as far as it underlies methods for landscape assessment, proposal decisions and the achievement of a consensus between the involved stakeholders. This can be seen across 4 case studies in three continents.

In parallel, complementary conclusions arise from each case study. In Dala Landscape Plan (Angola) the concept's potential was also remarkable to deal with a recent planning system that aims at the Country's development. In Dili Campus (East Timor) the concept enabled to turn constrains into opportunities, bringing the Campus project into a high standard level in line with the expectations of the country. The environmental and planning restrictions in Comporta Estate (Portugal) became a means for planning and design creativity, through an approach inspired by the greenway concept, enabling to set up landscape restoration processes with successful results. Finally greenway as a way of design thinking added to clarifying restoration methods and to foster a unique garden network, preserved for future generations and for touristic development.

These global and complementary conclusions for each case show the viability and advantages of the greenway concept both as a way of thinking and an instrumental tool. The awareness of this potential should be understood as an opportunity to inspire and deepen the greenway theory, advantageous for professional practice and research.

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Soft Mobility Towards Ecological Sustainability in Lisbon Metropolitan Area – case study of Almada Municipality

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Introduction

Automobile traffic congestion and air pollution in the Lisbon Metropolitan Area (LMA), an area with close to 2.8 million people, has increased dramatically in the last 30 years as a result of suburban sprawl. The sheer size peri-urban areas have reached lends itself to urban politics and subsidized rents, an issue that has not yet been resolved due to lack of political will. This has driven down rental prices of old leases, accompanied by the degradation of buildings located in the city's historic centre, and has also resulted in very high pricing of current leases inaccessible to most citizens. This is the way in which the peri-urban areas have grown, much like in many Western cities that have absorbed the rural exodus. Peri-urban areas also offer lower rents and housing prices than what historic centres offer. However, this growth has not been accompanied by a plan that accounts for the supply of transportation infrastructure and other public facilities or by relevant policies for the decentralization of employment.

The relocation of various services, in addition to office locations, from the inner city to peri-urban areas increased inefficiency in regards to transportation and automobile use with serious consequences for public transportation. For example, in 1998 LMA residents completed 4.9 million daily commutes to or from Lisbon of which 24% were on foot and 76% by motorized transportation. Of the motorized commutes, 57% were Individual Transports (IT); 36% were Collective Transports (CT); while 7% were a combination of both (DGTT, 2000).

Of the European Union-15 group members (the number of EU members prior to 2004), Portugal has the fastest-growing greenhouse emissions, with 40.5% in 2002 and 49% in 2010, rather than 27% mandated by the Kyoto Protocol. As a consequence, Portugal is facing a punitive fine in excess of 1.5 thousand million Euros for not complying with the emissions quota (REA, 2005).

In October of 2012, the European Union Court of Justice declared that from 2005 to 2007, the Portuguese Republic did not meet the limit values established in Article 13 of Directive 2008/50/CE of the European Parliament and of the Council on the 21st of May, 2008 regarding the quality of ambient air and cleaner air in Europe.

All these factors have resulted in suburbs where individuals are responsible for their own transportation, spending much of their time commuting to and from work and home, in addition to household budgets with a high incident of transportation costs.

Europe has already proved that augmenting road and highway infrastructures only leads to more automobile traffic congestion, thereby demonstrating the need to find new models of mobility (Export Group on the Urban Environment, 1996)

Containing clearly demarcated urban areas is one of the processes used to reduce traffic congestion and air pollution, among other benefits. Another process is the development of a multi-modal transportation system in which Soft Mobility plays an important role.

It is implicit that transport actors include all means of transportation, not excluding the pedestrian and the bicyclist. Cycling is the fastest mode of transportation in short distances up to 3 kilometres (Dekoster and Schollaert, 2000), which means greater adjustability when connecting to public transportation interfaces. The current lack of accessibility to transportation interfaces is considered to be a factor in the decision individuals make to use automobiles (Lowe, 1990). Addressing this particular aspect calls for the creation of more cycling paths linked to public transportation systems, in addition to improving the security and comfort of bicycle parking facilities. As much as possible, cycling paths should be integrated with ecological structures, thereby raising the standard of environmental quality. This concept is true at local and municipal levels and on a regional scale.

This article addresses this concept, showing the overall planning of projects with different types of Soft Mobility structures in various situations, from the restoration of old railroad lines to urban cycling networks with the underlying assumption of a mutually advantageous association between both mobility and ecological structures.

Background and Literature Review

Since the decade of the 1990s, the presence of sustainability in city planning models has been rigorously discussed with various recommendations, namely from the European Union, in the context of design, urban management and infrastructure. The majority of contemporary studies recognize urban sprawl, and the consequent proliferation of infrastructures as one of the main factors that negatively influence urban mobility (Export Group on the Urban Environment, 1996). The excessive use of individual transport, much to the detriment of collective or soft mobility modes, has resulted in the poor planning of urban expansion, the disarray among diverse modes of collective and individual transportation and a shortage of the former.

In this regard, several European Directives (CEC, 1990; EC, 2001 & 2007; Expert Group on the Urban Environment, 1996;) established lines of action to promote the continuity and connectivity of transportation infrastructures, as well as the integration of all modes of transportation, namely soft modes of transportation.

More recently, the European Commission's Action Plan on Urban Mobility (EC, 2009) recommended larger efforts in the development of sustainable urban mobility plans, proposing twenty measures with the objective of promoting and supporting local, regional and national authorities in policymaking and implementation of sustainable urban mobility plans.

In Portugal, these recommendations were recently included in "The Sustainable Mobility Project" (2006-2010), cofinanced by the European Union (FEDER), which addresses the scope of policymaking efforts for planning sustainable mobility in 40 municipalities, involving 15 research centres and universities. The main conclusion of this project was elaborated in a best practices manual for sustainable mobility (APA & CESUR, 2010). More recently, The Inter-ministerial Working Group finished the "Plan for Promoting the Bicycle and Other Soft Modes" with the objective of recognizing modes of soft transportation and their integration into transportation networks and urban planning (GTI, 2012).

In the Lisbon Metropolitan Area, the Landscape Architecture Research Centre "Prof. Caldeira Cabral" recently studied various cities, namely Lisbon, Seixal, Loures, Almada and Sintra with the goal of integrating cycling networks with ecological networks. The results obtained were then applied to create a model on a larger scale for the greater Lisbon area. The goal of this paper is to present the methodology of planning bicycling networks that are integrated into the ecological structure to the greatest extent possible.

Methods

The first approach to the methodology is mapping the ecological network (**Figure 24**), which is not the goal of this paper but represents the first step in the methodology for planning a Soft Mobility Network associated with the ecological structure to the greatest extent possible.

It is intended, preferably, for the use of existing roads, paths and networks including roads, streets, and rural paths, acting as a base to further develop cycling and pedestrian networks. This underlying assumption reduces the cost of construction, takes advantage of the public space and employs multi-functionality.

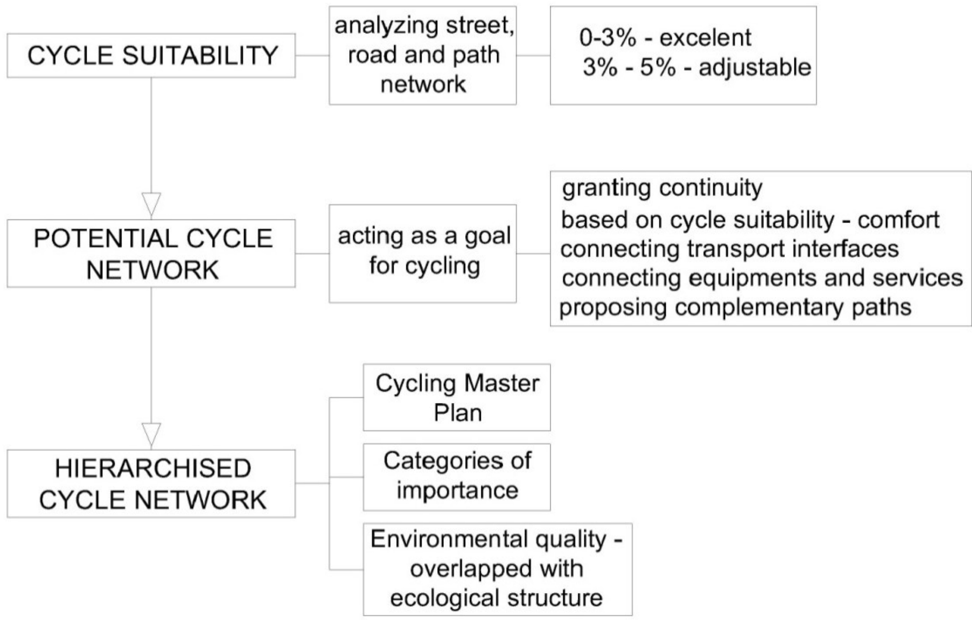

Figure 24 - Cycle Network Methodology scheme

The first phase of planning the cycling network is called Cycle Suitability and begins by calculating the longitudinal declivity of existing roads and path networks, using databases to select chunks that present suitability for cycling with total comfort (declivity adjusted for all ages) and quality (environmental quality). Therefore, the first Cycle Suitability criterion is obtained by the following longitudinal slopes: 0-3% (excellent cycling conditions) and 3%-5% (medium conditions). With Geographic Information System (GIS) technology, it is possible to evaluate the declivity of all paths with considerable detail using a specific algorithm.

The second phase, Potential Cycle Network, reconciles declivity with accessibility to main public facilities, particularly main transportation interfaces, schools and universities, police stations, local institutions, recreational spaces, financial and commercial centres, thereby creating an overall plan for the suitability of cycling. This network proposal includes new cycling paths beyond existing roads, streets and path networks (Cozzi *et al*, 1999).

The third phase reconciles cycling characteristics, derived from the two prior phases, with those of the ecological structure in order to define an integrated master plan, referred to as the Hierarchised Cycle Network, which defines different categories of cycling paths according to their importance.

Defining integration or coexistence typologies among various models of mobility is not an easy task. Modernism passed on the tradition of mono-functional separation, a practice still advocated in Portugal by the majority of experts and also supported by a piece of legislation that gives priority to automobiles. On the other hand, in countries where bicycles are primarily used, as in Holland, legislation increasingly gives priority to bicycles over automobiles and protects the coexistence among the automobile, the bicycle and the pedestrian in accordance with postmodern principles of multi-functionality.

Nonetheless, accidents exist, therefore making it necessary to define a concept in which different typologies address different situations by the speed or volume of traffic.
Obtaining various levels of integration is accomplished through the project and involve, aside from mobility, criteria for the rehabilitation of public space in environmental, cultural, recreational terms, etc. (Selberg, 1996). The creation of a Soft Mobility network creates conditions for urban rehabilitation, not according to area, but through lines that extend the intervention of vast areas of the city with its connection to surrounding areas—establishing itself as a "Trojan Horse" of renovation.
The integration of pedestrians, bicycles and automobiles in the same space requires a speed that does not exceed 30 kilometres per hour along with a lower volume of traffic (Cozzi *et al*, 1999). This objective can be reached with measures that involve human perception and the correction of driver behaviour, which can be fixed by traffic calming designs (Selberg, 1996) and avoiding the utilization of unaesthetic and inefficient signposting. Interventions in the streets can be done with full closures, half closures, middle interruptions or diagonal diverters (Prinz, 1980). This author also classifies interventions as vertical measures that force the reduction of speed and horizontal measures that introduce physical obstructions to the driver's eye and reduce the road space to minimum widths. The specific details of these intervention measures do not fit into the scope of this article, but several authors address them.
The methodology used to reach a definition of cycling path typology, with the function of integrating other modes of transportation, is synthesized in the following diagram (**Figure 25**):

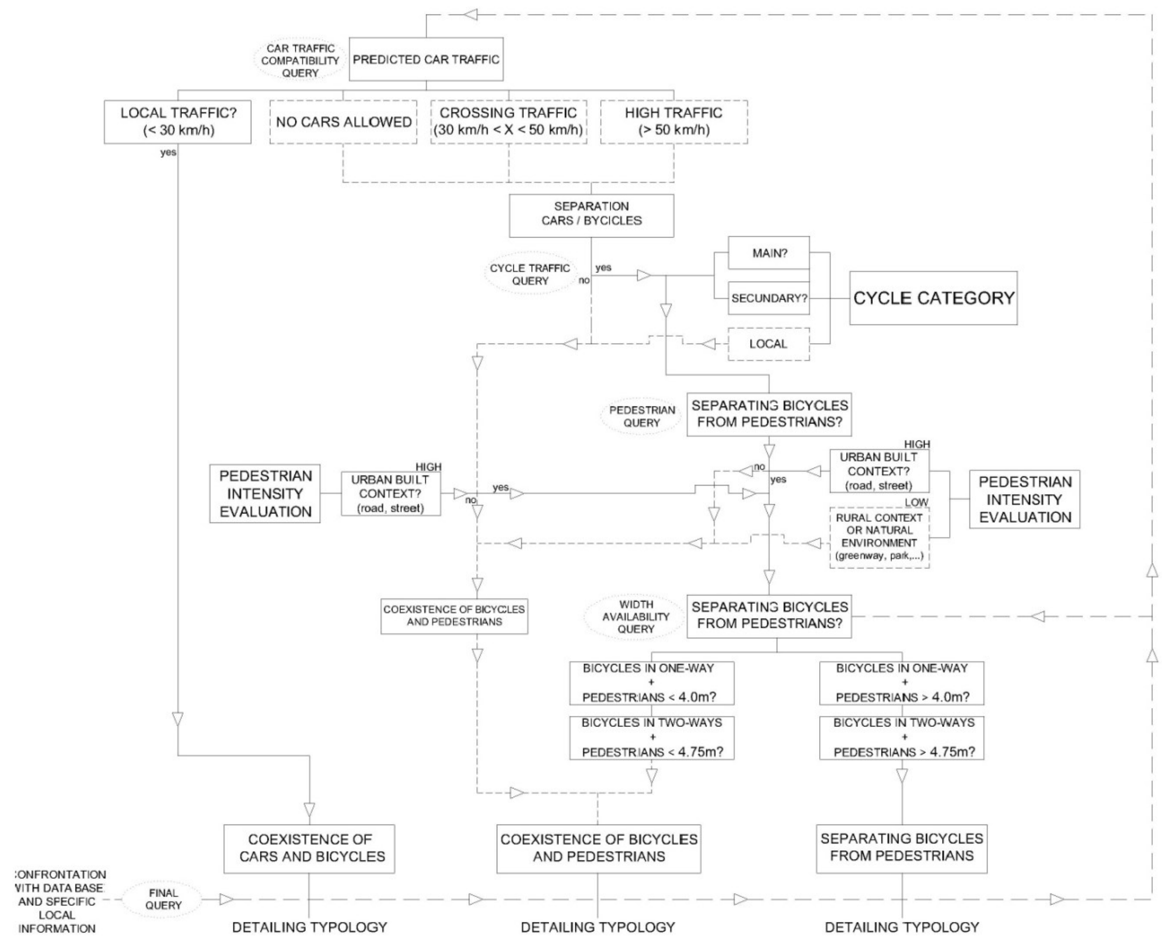

Figure 25 – Model for Cycle Typology definition (Magalhães *et al*, 2005)

One-Way Cycle Lane / Track			Two-Ways Cycle Track		
Bicycles / hour	Width (m)		Bicycles / hour	Width (m)	
	Italy	Almada		Italy	Almada
0 – 150	1,50	1,25 to 1.50	0 – 50	1,50	1,80 to 2,00
150 – 750	2,50	1,50 to 1.80	50 – 150	2,50	2,00 to 2,50
> 750	3,50	1,80 to 2.00	> 150	3,50	3,00

Table 3 – Cycle width requirements in Italy (Cozzi *et al*, 1999) and proposed values for Almada Municipality Cycle Network.

Results

The objective of this paper is to present a planning model for cycling networks that can serve as a guide for city planners, the results of which were obtained from actual drawn up plans based on the agreed protocols of several municipalities. The method presented defines the integration typologies among various modes of transportation (pedestrians, bicycles and automobiles), as well as the integration of cycling networks with ecological structures (Figure 26 and Figure 27).

This methodology was applied to a municipality located in the Metropolitan Area of Lisbon named Almada, which has a Soft Mobility Network constituting part of the Landscape-Land-Use Plan that is currently in the process of being approved by the city.

Figure 26 - Potential Cycle Network for Almada Municipality overlapped with Ecological Network

Figure 27 - Hierarchised Cycle Network for Almada Municipality

The results obtained with the network proposal were used to influence the Almada City Hall by demonstrating the need for an integrated plan among all its components, including Soft Mobility. Its implementation will be gradual, as public spaces are rehabilitated and the new areas of urban expansion are developed by private entities (Figure 28).
Lastly, the proposed methodology has already been tested on a municipal scale and can also be applied to a regional scale.


(a) (b) (c)

Figure 28 - Scene of proposed traffic calming designing measures for Almada Cycle Network coexistence between bicycles (a); pedestrians typology along qualified greenway in Almada Cycle Network (Magalhães & Mata, 2005b) (b) and typology - separated bicycles from pedestrians – in implemented cycleway plan for Almada Cycle Network (c) (Magalhães *et al*, 2005a)

Conclusions

Reducing the private use of the automobile implies improving access to public transportation through a cycling network connected to public transportation interfaces, preferably utilizable up to a distance of 3 kilometres (Dekoster and Schollaert, 2000).
Convincing people to use bicycles as a mode of transportation for commuting to and from home and work requires absolute security in a network. This is where an appropriate selection of integration typologies plays a decisive role. On the other hand, the integration of a cycling network with an ecological structure increases the quality of paths and their appeal. The method of utilizing the two structures (soft mobility and ecology) as the basis for landscape planning is an innovation dependent on current methods. The concretization of these two structures as a tool for rehabilitating the urban and suburban space is beyond the mere implementation of the Soft Mobility structure.

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14. GREENWAY PLANNING AND DESIGN

The Chinese Characteristics in the Planning and Design of Guangdong Greenway

He Fang, Suo Xiu, Li Hui

Introduction

As a typical example of greenway networks in China and Asia, Guangdong Greenway Network is of epoch-making and practical significance. The practice of Pearl River Delta Regional Greenway is instructive for other developing countries and densely-populated urban areas to build their greenway networks. The experience of Guangdong Greenway Network gives new Chinese characteristics to the concept and practice of greenway.

China has a profound history of greenways. Even before the Qin Dynasty was established, there already existed a great number of prototypes of greenway. These greenways were born in ancient era where the original productivity remained at a low level and people had nothing to do but to revere nature. Today, when human being has accumulated a great deal of material and spiritual wealth, they come to realize the importance of balance between man and nature. Therefore, greenway becomes one of the active ways for balancing the development of man and nature. Pearl River Delta Region is one of the most developed areas in China and it is also where the first greenway programs in China are initiated. The Pearl River Delta Regional Greenway has set a typical sample for the greenway movement in China.

1. East Wisdom and Chinese Greenway Concept

The traditional Chinese philosophy emphasizes the harmony between man and nature For Taoists, man is part of the nature.

The greenway planning concept in China can be traced back to Zhou Dynasty, more than 1000 years before Christian Era, Western Zhou Dynasty built the earliest Zhou Way and set a precedent example in the road network and greenery maintenance. *The Book of Poetry* says the Big Dipper is in the north of the sky and Zhou Way is just like a westward spoon that connects the Big Dipper. The Zhou Government encouraged their people to upgrade the roads after rainy days and build bridges in dry areas. The Zhou Government also requested planting rows of trees to define roads and building service stations in the countryside to offer food and drinks for passers-by. *The Interpretation of Names*, an ancient book in East Han Dynasty, interprets road is the place where people walk across. In ancient China, the roads for human and animals can be called greenways.

With the development of productivity, the increasing needs for culture exchange and living conditions, a great number of prototypes of greenway that carry out the linear planning philosophy and the idea of harmony between man and nature come into being. A satellite imagery of Earth shows that there is a green track at the location of E'105.5°and N'30°. This is the famous Cuiyun Corridor, an ancient corridor built in Qin and Han Dynasties. Cuiyun Corridor extends as long as 150km with prosperous Cypress planted along its sides. It is regarded by geographers and historians as a wonder of the World that is more splendid than the Roman Route. Cuiyun Corridor is the oldest and well-preserved ancient greenway in the world. In Lianzhou, a city in the north of Guangdong Province, there is a Nantianmen Qinhan Ancient Track (Fig.01) which is regarded as the first ancient track in Linnan Region. It is about 3 meters wide and is cut out along the rocks. It has about 8800 steps and is the first track that connects the south and north of the Lingnan Region in Qin and Han Dynasties. In addition, the marine silk route that is built in the Han Dynasty and developed in the Tang Dynasty as well as the Tea-Horse Road prosperous in Ming and Qin Dynasties are the typical trade roads that are renovated from natural trails in mountains and along the coast (Fig.02). And the Grand Canal built in Sui Dynasty and developed in Tang, Ming and Qing Dynasties is a prototype of greenway that connects the river networks and the urban-rural areas. The ancient trail and Horse Trail in Tang Dynasty and the Official Trail in Ming and Qing Dynasties are all greenways that are built up by the local people. All these greenways follow the Fengshui principle and offer convenience for people's daily life. They connect different areas with different sceneries and culture and are favorable for the maintenance and management of local government.

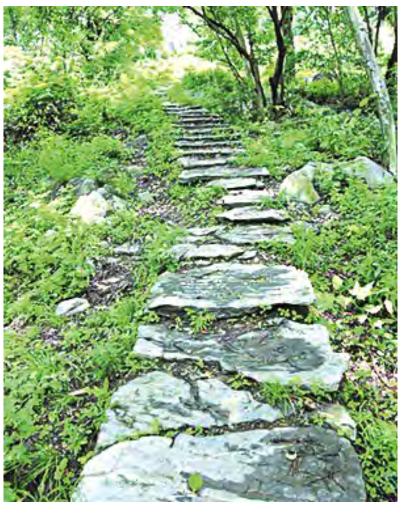

Fig.01 The first ancient trail in Lingnan

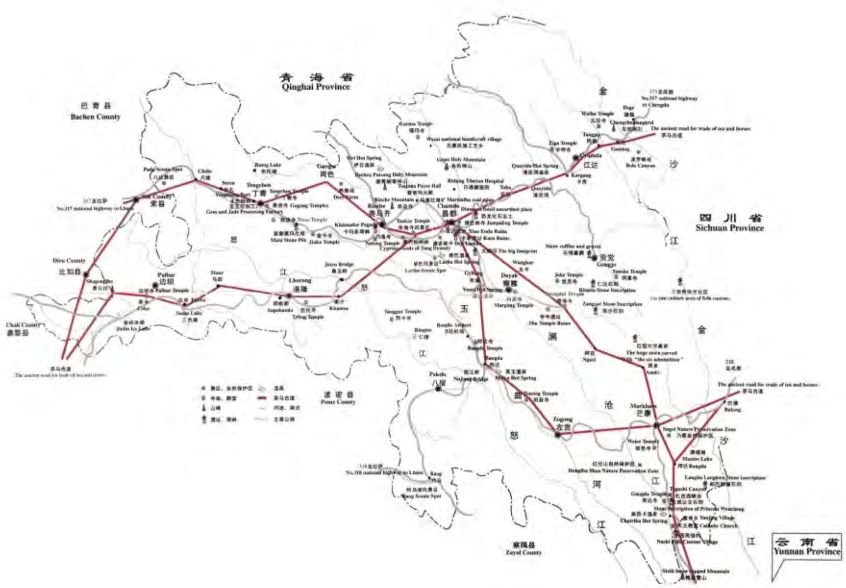

Fig.02 The traditional greenway in Ancient China-Tea-horse Trail

2. Guangdong- The first province in China to launch greenway programs

2.1 Greenway gives us a chance for reflection: From self-aggrandizement to the reverence for nature

Pearl River Delta Regional Greenway plays a strategic role in preserving natural and culture heritage of urban and rural areas and controlling the sprawl in fast urbanization. The planning of greenway network offers structural connections and restoration for the eco-community of metropolis. They connect the isolated eco-patch separated by urban constructions and encourage animals' migration and plants' integration within each eco-patch. Greenways help to improve bio-diversity and balance the eco-system.

2.2 Greenway is a product of balancing the development of urban and rural areas in the fast urbanization

Fig.03 Pearl River Delta Greenway Layout Map

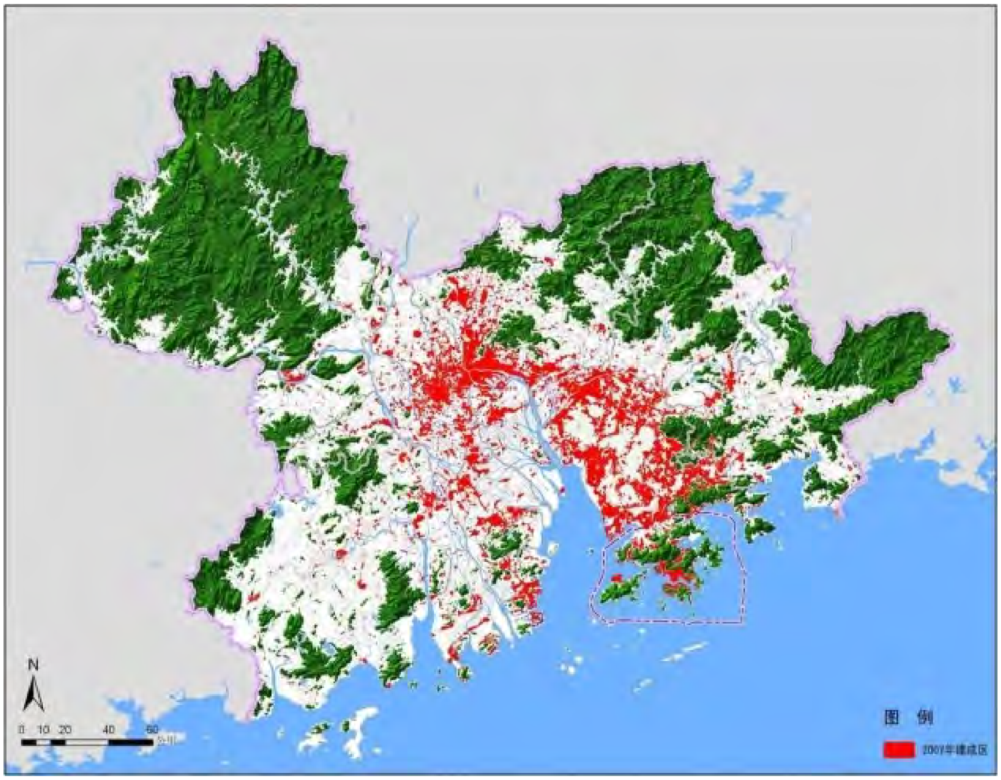

Fig.04 Main Ecological Resources Distribution in Pearl River Delta Area

Greenway network is an exploration of the relationship between green space in urban-rural areas and the urban built-areas under the context of urban-rural integration. The ecological, recreational and landscaping functions of green space are evaluated to create a network that can help improve the eco-capacity of cities.

Greenway networks establish connecting corridors between urban and rural areas at a regional level. It encourages people in rural areas to work in urban areas and people in urban areas to seek recreation in rural areas.

Fig.05 Hiking trail


Fig.06 Trail for the vehicles


Fig.07 Fishway

2.3 From regional green space to greenway and greenway movement in China

From 2004, Guangdong Province started compiling the framework of Pearl River Delta Regional Green Space Planning and Management. This framework proposes eco-patterns for the Pearl River Delta Region and promotes the eco-protection from soft constraints to hard constraints. It helps to create a well-defined, systematic and sustainable green space system.

In studying the regional green space planning, we find out that eco-patch and eco-corridor are two key elements in creating the regional green space system. However, the preservation and management of eco-patch and eco-corridor remain a big difference. The eco-patches composed by farmlands, natural preserve and scenic areas have well-functioning management organizations and systems and most of the eco-patches are well preserved and managed. But eco-corridors are disconnected and not well-maintained, which make the eco-patches isolated. The Pearl River Delta Regional Greenway Network follows the principle of balancing conservation and development and aims at creating a multi-functional greenway network that offers opportunities for eco-conservation, improving people's daily life and developing local economy.

3. The Planning and Construction of Guangdong Greenway Network

3.1 From Pearl River Delta Region to the collaboration between Guangdong, HongKong and Macao

The size of eastern, western and northern areas of Guangdong Province is about four times of that of Pearl River Delta Region. The population of the eastern, western and northern areas of Guangdong Province is about two times of that of the Pearl River Delta Region with different economy development. It is significant to promote the greenway network within Guangdong Province and extend it to the outer eco-conservation areas of Guangdong Province.

3.1.1 An attempt to build greenway in the world-level Metropolis Circle

The Pearl River Delta Regional Greenway Planning covers an area of 41698 square kilometers, with a population of about 42.3 million. Six main greenways go across this area, namely West Coast Recreational Greenway, East Coast Recreational Greenway, East-West Coast Cultural and Recreational Greenway, East Coast Urban Recreational Greenway, West Coast Urban Recreational Greenway and West Coast Waterfront Recreational Greenway. These six greenways extend as long as 1690 kilometers, with a green buffer of 4410 square kilometers. Fifteen branches connect the main greenways and important nodes, with a total length of 470 kilometers. The Pearl River Delta Regional Greenway integrates the ecological, historical and cultural recourse of Pearl River Delta Region. It serves for 25.65 million people, offers about 300,000 job opportunities and brings about 45 billion RMB social consumption. It helps to improve the eco-systems along the greenways.

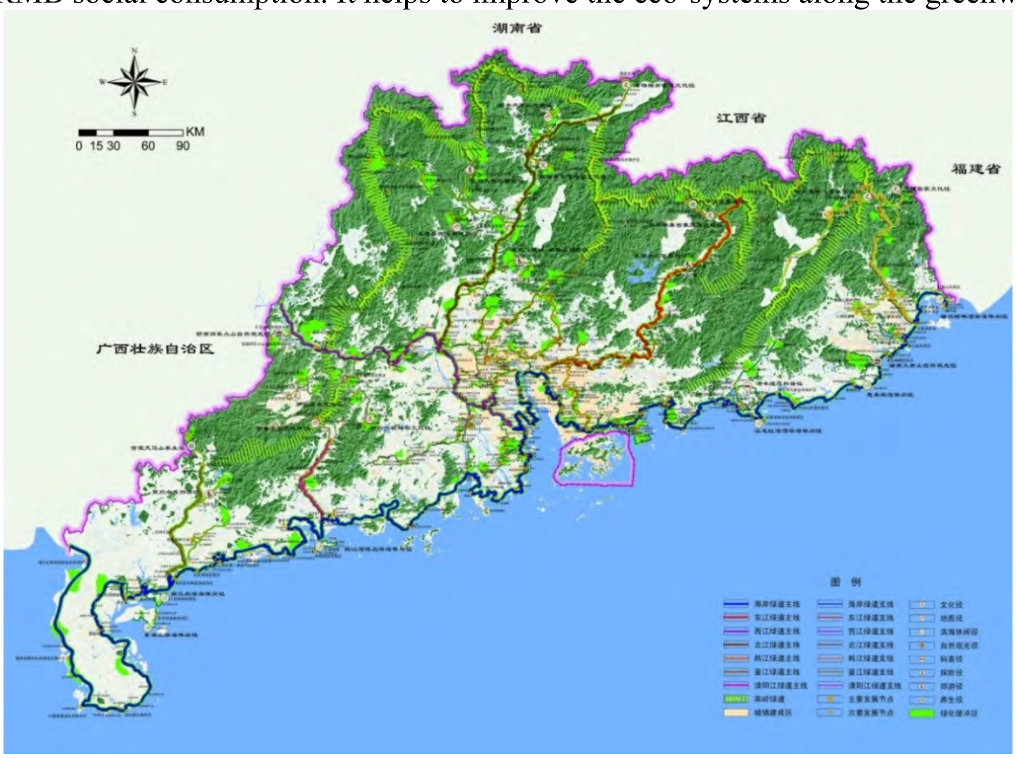

Fig.08 The General Spatial Layout Map of Guangdong Province Greenway Network

Guangdong Province Greenway Network aims at building a greenway network of 8770 kilometers including the completed 2372 kilometers provincial greenway in Pearl River Delta Region by the year of 2015. It is also expected to create a multi-functional provincial greenway network and connect 46 urban-suburban intersections including 18 urban-suburban intersections in Pearl River Delta Region. Guangdong Province Greenway Network will coordinate with the urban traffic system to achieve a seamless connection between greenways and urban public transportation system.

In 2010, the framework of Pearl River Delta Regional Greenway Network Planning was released, the compiling team began to study the collaboration between Guangdong , Hong Kong and Macao in greenway network. They proposed that the *Guangdong- Hong Kong Collaboration Framework* should be seriously implemented and that both Guangdong and Hong Kong should work together to create the inter-regional natural reserve and natural corridors as well as an integrated regional eco-system. In addition, Guangdong and Macau should strengthen their cooperation to create regional eco-barrier that connects Guangdong, Hong Kong and Macau. Guangdong, Hong Kong and Macau should collaborate to construct inter-regional greenways between Shenzhen and Hong Kong, Zhuhai and Macau, to encourage the construction of natural reserve and to protect the sensitive eco-resources and eco-tourism. The Pearl River Delta Regional Greenway Network should be optimized to improve the Pearl River Delta Regional Greenway I,II,V. Pearl River Delta Regional Greenway I will be extended to Macau and Pearl River Delta Regional Greenway II will be extended to Baxianling in Hong Kong through Wutong Mountain in Shenzhen. Pearl River Delta Regional Greenway V will be extended southward to Hong Kong. The integrated regional greenway network for Guangdong, Hong Kong and Macau will help to promote the development of greenways and related facilities in these areas and to create a Greater Pearl River Delta Social Sphere.

3.1.2 Six Measurements to Realize the Large-scale Planning

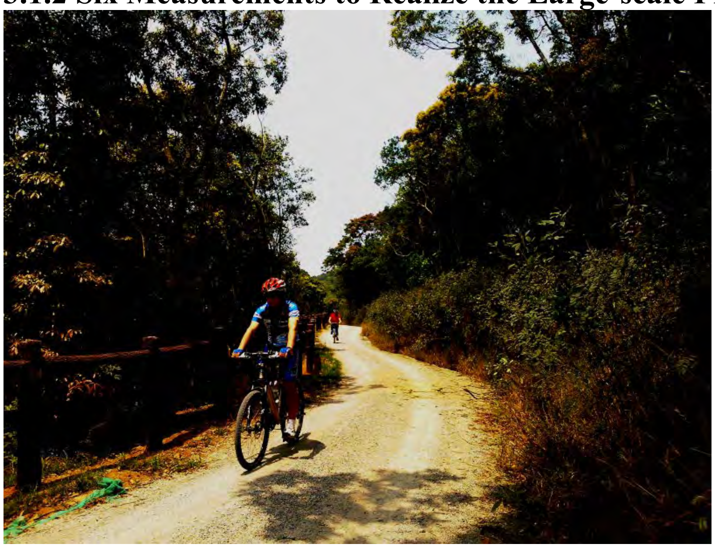

Fig.09 Shenzhen Maluan Mountain Ecological Greenway Connected to Nature

Fig.10(left) Greenway of Shenzhen Meilin Reservoir
Fig.11(right) Shenzhen Demonstration Section in 2nd Line of Pearl River Delta Regional Greenway

Fig.12(left) Shenzhen Bay Greenway
Fig.13(right) Shenzhen Yantian Coastal Greenway

Fig.14 Wutong Mountain Section in 2nd Line of Pearl River Delta Regional Greenway

(1) Establish a greenway eco-pattern with priorities in eco-conservation and cultivation

Guangdong Greenway Network should be focused on utilizing primitive ecological construction methods to protect biological space system. For example, keeping and sowing native wild fauna and flora in the area with better natural conditions where Greenways are connected around Pearl River Delta (PRD), and proceeding interventions as few as possible to maintain a sustainable biological circulatory system in the entire large-scale area; in the upstream areas of Shaoguan, Heyuan etc., developing waterfront greenways along rivers, lakes and reservoirs to raise the awareness for water resources and rare animals and plants protection, meanwhile attracting more funds and applying more advanced technologies to enhance the protection for provenance area.

(2) Facilities and recourses will be distributed according to users' demands

For the PRD area where economy is highly developed and population density is large, Greenway network development is to establish a linear-corridors-dominated network with high density and wide coverage through a multi-pronged working pattern under the guidance of the general strategic framework. As to north, west and east Guangdong where economic development is relatively backward and population is unevenly distributed, the work should firstly focus on the green space construction of key cities, towns and regions, and the inner Greenway system establishment of core areas such as cultural scenic spots etc; secondly, build connective corridors between core areas, and eventually develop a Greenway network with proper spatial density, which combines "stepping stone corridors" with dominated linear corridors.

(3) As to functional development, large scale regional greenway tour route will be established to display the large scale regional landscape and culture features.

The functions of Guangdong Greenway Network depend on the wide coverage of the recourse points and the complete demonstration of regional characteristics. Considering the PRD outskirt area is large and its resources are unevenly distributed, and its ecological environment is more sensitive, a new Greenway function layout structure and a development approach with more regional characteristics are developed. Centered on cities and towns, connect functional node areas such as urban gardens, historical and cultural locates, forest reserves and water source protection areas, establishing an interconnected regional resources green culture area. Isolated areas in eastern, western and northern Guangdong will be integrated into the macro cultural network with local humanistic resources to create a cultural village with distinct features. Promote condensed Greenway tour routes with obvious themes such as "Hakka Culture Tour", "Chao Shan Culture Tour" and "Oversea Chinese Tour".

(4) As to accessibility, greenway network will be connected to different transpiration system

Take the differences within the province's economic development levels and transportation network facilities levels into consideration, lay emphasis on connecting traffic lines and traffic means. Apart from the PRD area, as for other Guangdong regions where transportation is poorly constructed, connect regional road network through highway toll gates and service areas, promote Greenways to passengers from other cities and regions who travel on the highways; by connecting city's conventional public traffic system and slow traffic system, improve the accessibility of Greenways and city's travel environment, so as to increase the city's attractions.

(5) Facilities will be distributed according to sustainable and simple principles

According to the unevenly distributed population, construct Greenway ancillary facilities with different methods. For example, in cities and towns with higher population density, greenway facility construction should aim for serving the local residents, be accordance with the greenway facilities standards of PRD area, and base on the convenience principle, to construct humanized ancillary facilities. As for eco-regions with lower population density, facility construction should base on ecological principle and aim for satisfying visitors' primary needs, reduce the number of artificial facilities.

(6) As to management and operation, a more stable and diversified financing mechanism and a more economic and ecological maintenance scheme will be created.

Due to the backward economic development, lower population density and more sensitive ecological environment of the PRD outskirt area, the financing and maintenance works are more difficult. Therefore, a more stable and diversified financing plan, and a more economic and ecological maintenance scheme will be created, to ease municipal government's financial pressure, ensure the regional ecological safety. Proposed measurements are: strengthen the connection among greenway planning and other public projects; promote the transactions of the water rights and emission rights of water sources protection regions, utilize ecological compensation of the downstream area to support greenway construction; work out a recuperative maintenance plan with low maintenance frequency; set up a stable, normative greenway construction and protection special fund, etc.

3.1.3 Establish green infrastructure network within large-scale area

As part of the green infrastructure network, the construction of greenway network plays an important role in pushing forward Guangdong's ecological environment protection and improving urban and rural spatial pattern.

(1) Create a continuous green space, and prevent the unordered extension of city construction. Connect and develop fractured and isolated green patches into eco-corridors through Greenway network, which form city patterns and communicate urban and rural areas, providing migration passages for wildlife species and maintaining biodiversity and circulation of ecosystem.

(2) Promote an ecological urban and rural construction model. By connecting Greenways with natural ecological patches such as wetlands and forests, form an interconnected and organically unified network system, realizing a low-impact and ecological urban and rural construction model, so as to save city management cost.

(3) Improve the ability of sustainable development, and forge a new carrier for green industry's development. Apply green development strategy, and combine Greenway construction with promoting green economy. Integrate characteristic tourism resources and make it the development solution for green economy.

(4) Push forward the construction of livable urban and rural areas, establishing a charm stage of the ecological human habitat environment. Considering that the PRD outskirt areas are the key sections for urban and rural coordinating development, it is important to create comfortable housing Greenways, healthy housing Greenways and joyful housing Greenways that run through urban and rural areas, making the areas a charm platform for demonstrating and representing Guangdong's livable urban and rural construction. At the same time, attract urban residents to enjoy the leisure activities in rural areas. So as to drive the rural economic growth and social development and promote interaction and communication between urban and rural areas, creating valuable experience for "bidirectional urban-rural integration".

3.2 Establishment of the Three-stage network of Greenway Network

3.2.1 Regional Greenway: from “spot” to “area”, forge a three-stage greenway network

(1) By making reasonable and ecological measurements to establish a regional ecosystem structure with long lasting effect, compete structure, coordinative relationship and efficient function, creating a integrative Greenway network which combines ecology, recreation and landscape together;
(2) Proceed a general examination on city development planning, distribute Greenway route selection resource according to different situations, and lay stress on the reusing of brownfield: strengthen the connection between Greenway planning and city mater planning, integrating Greenway network into urban form and urban function;
(3) Organize all-level systems of Greenway network, and enhance the connection between urban and neighborhood Greenways and Regional Greenways, achieving the integration of the Greenway system, slow traffic system and service system of the urban and neighborhood.

3.2.2 Urban Greenway: A Happy Trip from Home to Office

Comparing with regional and neighborhood Greenway, urban Greenway undertakes more residential needs for joyful working trips and links the traffic shifts among living area, working places and other destinations. Based on regional greenway, urban greenway integrates urban spatial form and connects urban slow traffic system, adjacent cities areas and greenways, establishing an urban network layout with proper density and balance distribution.

3.2.3 Community Greenway: A Renovation of our Homeland

Combine the planning and construction of neighborhood greenway network with city and regional recreational system, allowing easy access to greenway for neighborhood residents and visitors, at the same time making connection with greenway of upper level, outer traffic system and recreational system. The planning goal of entering neighborhood Greenways within 5-10 minutes will therefore be realized.

Combining with the “three old” reconstruction, by removing illegal and old buildings and building greenways in old cities and urban villages in downtown areas and urban villages in countryside areas where the greenway network goes through, improve the infrastructure conditions in urban villages, realizing the goal of beautifying cities; combining “new countryside” construction, improve human settlement in the countryside by building greenways. Through integrating village road reconstruction, public restroom construction, sanitation maintenance and river treatment with greenway construction, improve the entire environment of the countryside. During the construction, villagers along the greenway lines also renewed their house, making their contribution to the environment improvement in the areas along greenway lines,

4. Guangdong Greenway: A Shift from "Rural China" to "Charming China with Ecological Civilization"

4.1 The Most Beautiful Greenway in China—Shenzhen Dapeng Greenway

Dapeng new district has a combined area of 294.18 square kilometers with 76% of forest coverage rate, more than twice as much of the average rate of the entire Shenzhen. With rich rare animals and plants resources and various old and famous trees, Dapeng is the only "ecological virgin land" whose environment is barely disrupted. The district has a coastline of 133.22 km, taking almost the 1/2 of Shenzhen's shoreline; it has rich landscape resources such as mountains, seas, wetlands, beaches, rivers, villages and relics. The Dongxichong Beach was proud enough to be named as "the top eight most beautiful beaches of China" by China National Geography. In conclusion, Dapeng new district is the most beautiful area with the best ecological environment and landscape of Shenzhen.


Fig.15 Natural Scenery in Dapeng New District


Fig.16 Culture Landscape of Dapeng New District

Integrate the planning and design for rich ecological human resources of Dapeng and Greenways, and connect them into a complete network, so as to improve tourism spatial layout within limited construction funds, providing a wider, safer, and more comfortable and more humanized ecological tourism areas for citizens, and at the same time establish a international and ecological landscape tourism network on such basis, providing the most ecological and beautiful Dapeng image to people all around the world.




Fig.17 Dapeng Greenway

This project tries to integrate China's traditional landscape aesthetic theory with ecological environment quality evaluation method, so as to provide solid supports for the most unique and beautiful Greenway construction.

4.1.1 Aesthetic evaluation of traditional Chinese landscape

China shows special preference of landscape. It is blended in painting, poetry, song and philosophy, and becomes unique culture. With Chinese traditional aesthetic evaluation on pattern of mountain, sea, city and town in Dapeng District, and overall consideration on pattern of mountain and water, scenic landscape, and diversity, 14 landscape districts are divided as follows(Fig.19)..

Fig.18 The Chinese landscape painting art reflects nature

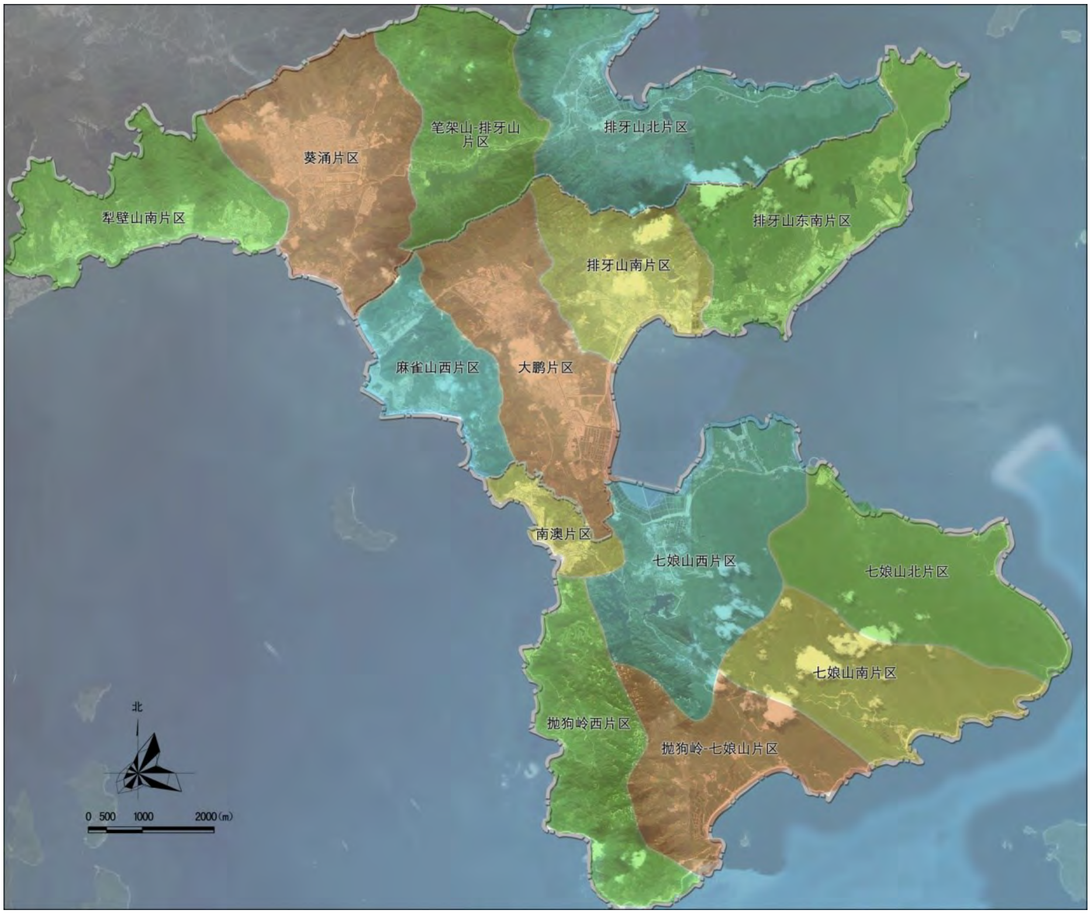

Fig.19 Landscape Districts in Dapeng

Chinese traditional landscape evaluation considers that beauty of nature shows the beauty of image, color, dynamic and obscure. Refining index of five beauties and giving a certain weight, reaches an index system of landscape evaluation in Dapeng.

Table 01 Aesthetic evaluation criteria

First Level Index	Second Lev Index	Weigh	Third Level Index	Evaluation Scale (（Scenic——Poor Scenery）
Aesthetic evaluation of traditional Chinese landscape	Image	0.2	Shape	Massive——Tiny
			Diversity	Abundant——Simple
			Uniformity	Harmonious——Messy
			Loneness	peaceful——bustle
	Color	0.2	Color Harmon	Harmonious——Cluttered
			Color Abundan	Rich——drab
			Color Intensit	bright——dim
	Dynamic	0.2	Movement	Dynamic——undynamic
			Variation	various——single
			rhythm	strong——week
	Sound	0.2	Artistic Conception	With Artistic Conception——Without Artisti Conception
			Mood	happy——gloomy

			Melody	euphonic——noisy
	Obscure	0.2	curiosity	curious——common
			nature	natural——unnatural
			vegetation	lush——sparse

According to markings of experts, and their evaluation on all the landscape districts, they give five levels of each index. The overall evaluation is as below (Fig.20).

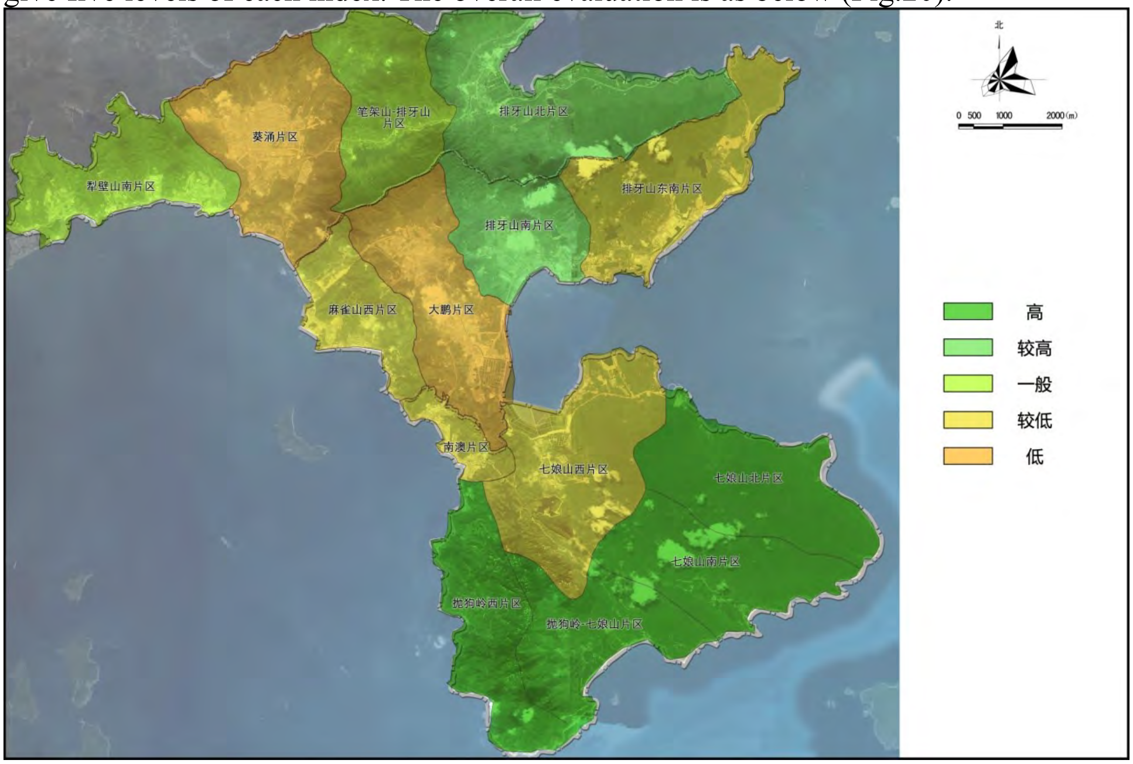

Fig.20 Aesthetic evaluation of landscape in Dapeng

The result shows that the most beautiful district is in the south of Nan'ao sub district office. It has Qiniang Mountain, Paogou Hill, Honghua Hill and other mountain range; Yang Mei Keng, Dong Chong, Xi Chong and other gorgeous coastline; and Ban Tian Yun Village, E Gong traditional old villages and other brilliant landscape resource. It also has a beautiful landscape area from Dapeng Fortress, Paiya Mountain to Baguang. Landscape resource in Dapeng Fortress, Paiya Mountain and Heritiera littoralis Geomantic Forest is more graceful and unique. Landscape quality in Kuichong and Dapeng downtown is worse.

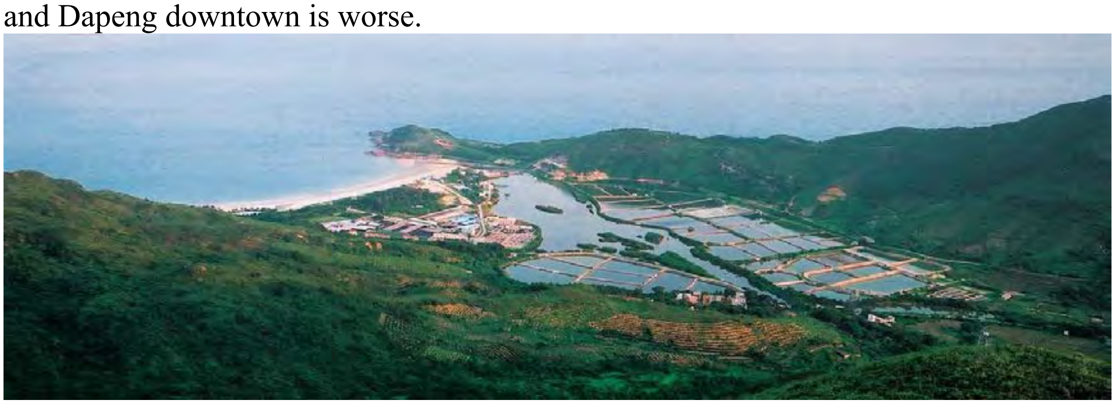

Fig.21 Dong Chong Coastline

Fig.22 Sea Stacks

4.1.2 Ecological Environment Quality Assessment

Ecological environment quality refers to the merits of ecological environment, which reflects the adaptable degree of eco-environment for human's living and the socio-economic sustainable development. The assessment is made on the result of eco-environment's nature and changes according to specific requirement of human beings. Dapeng New District is divided into 22 ecological areas based on the comprehensive consideration of its ecological system types, land use types, administrative unit division, etc(Fig.23).

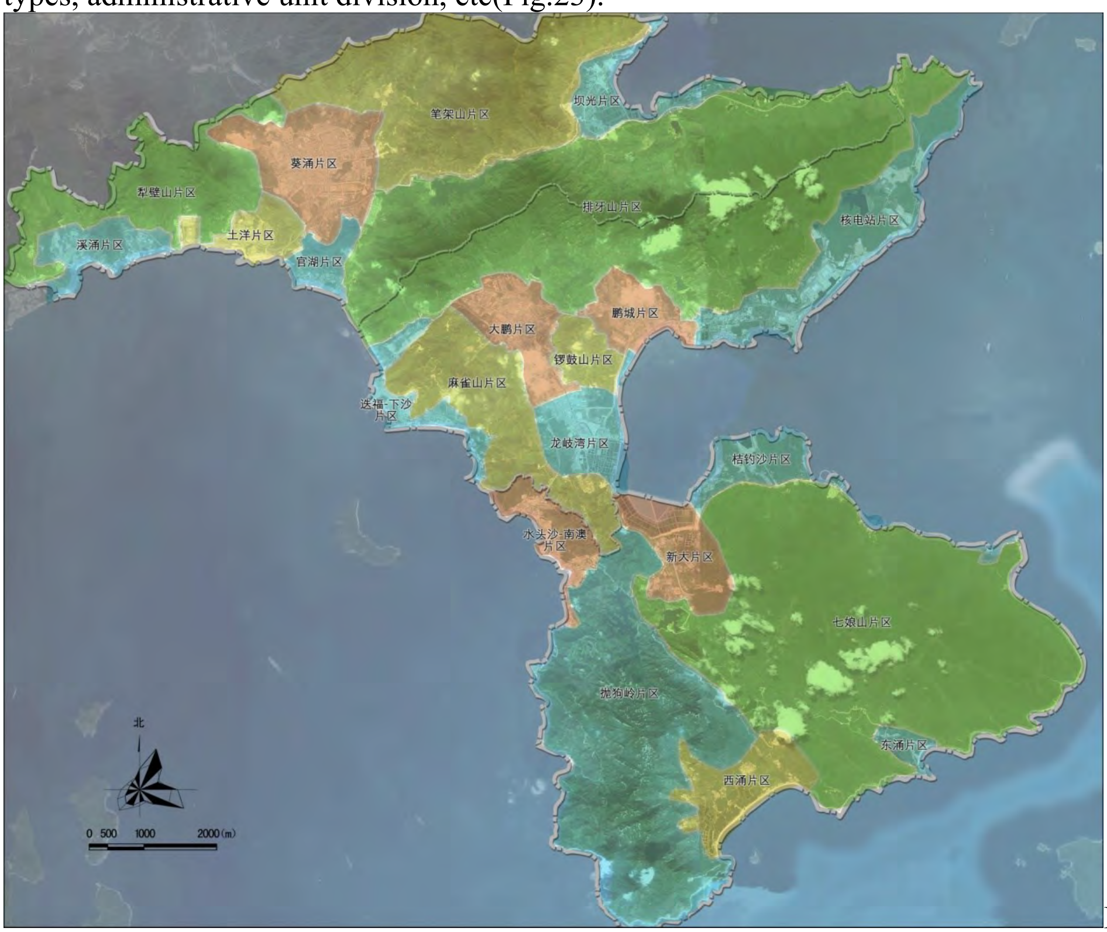

Fig.23 Ecological Area Division of Dapeng New District

Eco-system service quality assessment is one of the best systematic and comprehensive methods of eco-environment quality assessment. Eco-system services mean all the conditions and process beneficial to realize and maintain human living provided by eco-system and the species within it, which fall into 4 levels and 17 categories. This project reconstructs eco-environment quality assessment system on the base of its understanding of Dapeng New District eco-system services together with the existing sorting modes.

Table 02 Eco-environment Quality Assessment Index System of Dapeng New District

First Grade Indicator	Second Gra Indicator	Third Grade Indicator	Weigh
Eco-environment Quality Assessmer	Supply Service	Food,Fresh Water, Raw Materials, Ornamental and Decorative Species, Biochemical Substance, Geneti Resources	0.2860
	Regulatior Service	Climatic Regulation, Disaster interference control, Water Regulation, Biological Control, Disease Contr Erosion Control, Polluting Waste Treatment, Pollination and Breeding	0.1449
	Culture Service	Spiritual Religion, Leisure and Recreation, Aesthetic information, Scientific Education, Culture and Arts, Inspiration Incentives	0.1011
	Support Service	Soil forming, Biodiversity, Geochemical Cycle, Primary Production, Habitat Shelter	0.3784
	Other Services	Future Needs Service, Outer Space Service	0.0897

Expert grading method is adopted to evaluate each ecological area according the characteristics of eco-environment quality by five categories of high, superior, general, lower and low. Assessment results are finally reached by multiplying grades and each index weight(Fig.24).

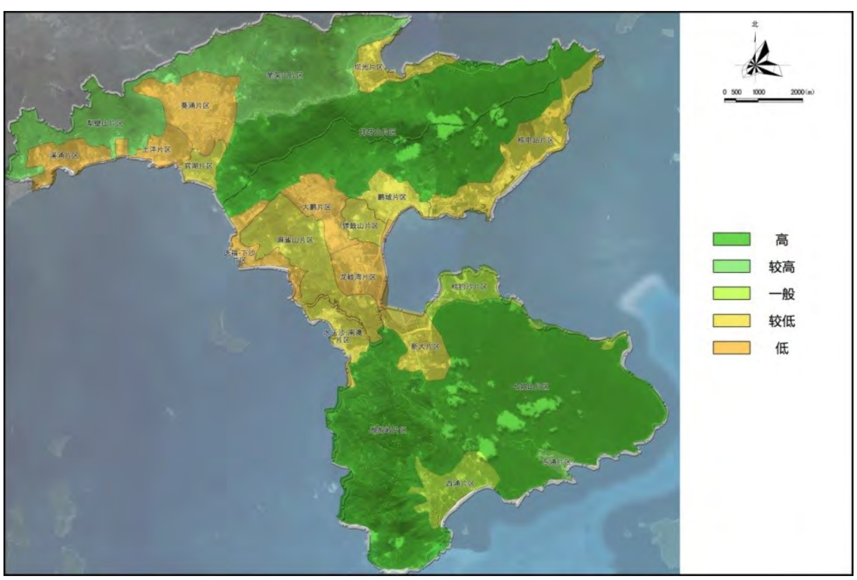

Fig.24 Eco-environment Quality Assessment Results of Dapeng New District

Assessment results find that areas of best eco-environment in Dapeng New District are mainly mountain and forest regions around Qiniang Mountain, Paiya Mountain, Paogou Mountain and so on. Eco-environment of mountain and forest regions around Bijia Mountain, Libi Mountain and others are better too. As for areas like Kuichong, Dapeng, Tuyang, Xichong, with more communities and towns concentrated in the areas, the eco-environment there are relatively poorer.

Fig.25 Ecological Environment in Qiniang Mountain

Fig.25 Geomantic Forest Community

4.1.3 Ecological and Aesthetic Comprehensive Evaluation

Dapeng New District Greenway Planning is dedicated to becoming the most beautiful greenway in Southern China. It pays attention to ecological environment protection, and links all districts of best quality at the New District.

The ecology and landscape are differently positioned, that is to classify the evaluations of landscape aesthetics and ecological environment quality into three levels. The ecological environment quality evaluation is divided into extremely high, comparatively high, medium and low levels; landscape aesthetics one: high, medium and low levels, each level's guiding significance is showed in the table below. At last, the two evaluation results are combined to comprehensively zone the Dapeng New District

Table 03 Ecological Environment Quality Evaluation Index System of Dapeng New District

		Landscape Aesthetics Evaluation		
		High(high appreciation value)	Medium(of som appreciation valu	Low(of appreciation value
Ecological Environme Quality Evaluation	extremely high(Restrictin access)	I Zone	II Zone	III Zone
	Comparativel high(allow small-scale construction)	IV Zone	Nil	V Zone
	Medium and low(allow larg scale construction)	VI Zone	VII Zone	VIII Zone

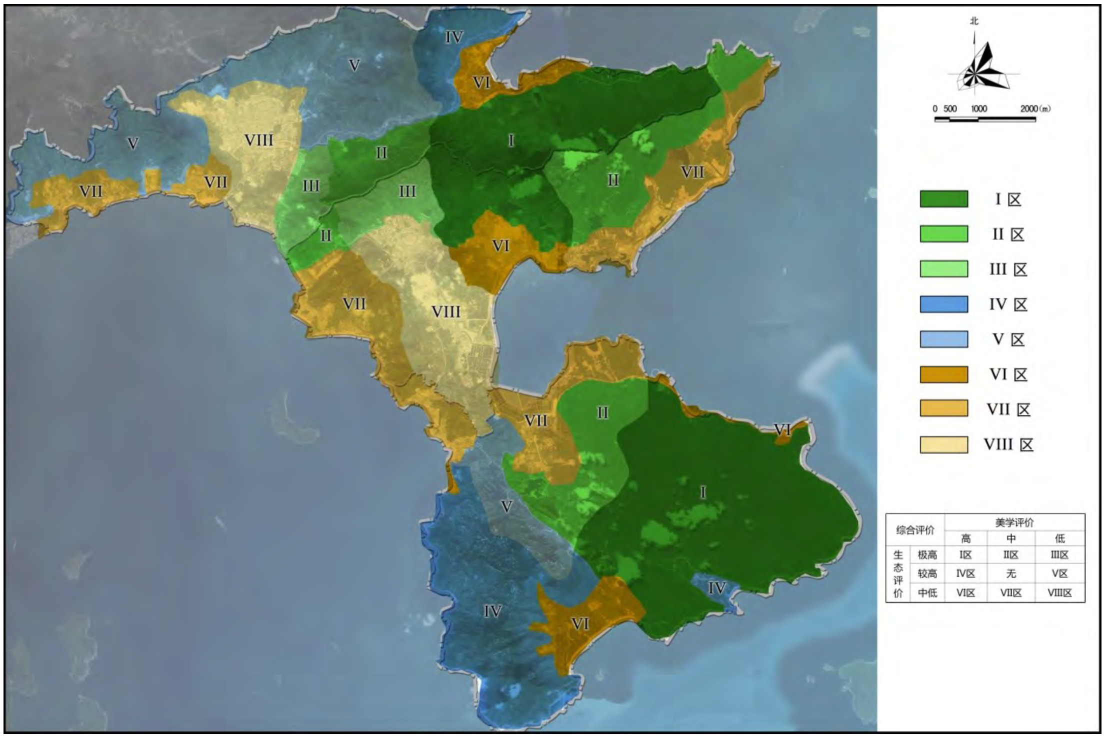

Figure 26 Dapeng New District Ecology and Aesthetics Comprehensive Evaluation Zoning

According to the zoning results, the ecology and environment quality of Qiniang Mountain and Paiya Mountain are both extremely high. They are the representative districts of scenery characteristics. Most coastal areas, beaches such as Dongchong, Xichong, E'gong Bay, and Yang Mei Keng and so on, not only are most beautiful in scenery, but also have very good ecological environment, becoming the first choice for tourists. But due to the concentrated towns in Dapeng and Kuichong District, the ecology and landscape qualities are lower than others'.

Based on the ecological feature, feasibility, diversity, convenient feature, continuity and safe feature principle of Dapeng New District Greenway Planning, the aesthetics and ecology quality evaluation guiding principles are set for each comprehensive evaluation zoning.

Table 04 Greenway Guiding Principle for Dapeng New District on Ecology-Aesthetics Comprehensive Zoning

		Landscape Aesthetics Evaluation		
		High	Medium	Low
Ecologica Environme Quality Evaluatio	Extremely High	Except for part of representative sections, others basically prohibit tl greenway construction.	The greenway c moves around (II Zone)	It is strictly prohibited tc enter(III Zone)
	Comparative high	Needing to empl ecological greenw construction method.(Zone)	Dealing with th greenway ecologically.	Only constructing the necessary greenways. (V Zone)

	Medium an low	Allowing comparatively high-density greenway construction.（VI Zone）	Common greenway construction (V Zone）	The greenway constructi only satisfy the commutir needs or no construction all (VIII Zone)

4.2 Greenway—National Strategy of Chinese Characteristics

The geographical situation in China has one large zonal structure every eight degrees, such as Tian Mountain-Yin Mountain Zonal Structure, Hunlun Mountain-Qinling Mountain Zonal Structure and Nanling Mountain Zonal Structure. Just as the saying in Kao Gong Ji goes, “In geography, there must exist great reiver between two mountains, and roads over the great river.” In Yu Gong, the mountains in China are divided into four columns and nine mountains. In Feng Shui Theory, the stretches of mountains are called dragon veins. “The vast Kunlun Mountain has eight veins.” Dragon Vein roots from the Kunlun Mountain in the northwest, and extends three strings of vast dragon veins to the southeast. The northern dragon vein goes to Shanxi from Yin Mountain and Helan Mountain, thus beginning Taiyuan, ending across the sea. The medium dragon vein comes into Guanzhong from the Min Mountain and goes into sea after Qin Mountain. The northern dragon vein comes into sea from Yungui, Hunan, Fujian, Zhejiang and Guangdong along Yangtze River.

From the perspective of the traditional cognition to the natural geography, the Chinese history can guarantee the preserving and remaining of the humanistic history by national historic way. And it has very important practical significance in increasing national pride and improving cultural quality. As the tentative study of ecological security pattern construction for the national land, the geographic system for the greenway application provides technology support to identify the national corridor system and cultural corridor system of important meaning at the national land level and raise the elementary “national land ecological security pattern”. This pattern can be seen as the basic framework of the national ecological infrastructure or the national greenway system.

Making the greenway construction as the national strategy is a idealized and positive thinking. This thinking is based on the previous urban planning which was limited by the motorway and expressway. When we look back at the green infrastructure layout space, we will rethink and realize that the reverse growth of green is so important for China, which has dense population and limited human habitat ecological resources. In the coming urbanization areas, green farmland space needs to be planned form the overall urban and rural aspect, with urban intensive development and both of the urban and rural areas find their position and task, and reaching the win-win situation. So, we can reasonably surround the cities with the countryside and layout the ideal living environment. Scientific development leads the ecological civilization to become the mainstream in the future. The greenway in the future needs to be built by constructing the ecological safety in vast regions and creating pleasant urban slow system. This can begin new value benchmark and lead people themselves to the ultimate view of the ecological concern.

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**Designing and Building the Wellington Greenway:
Project History and Future Plans**

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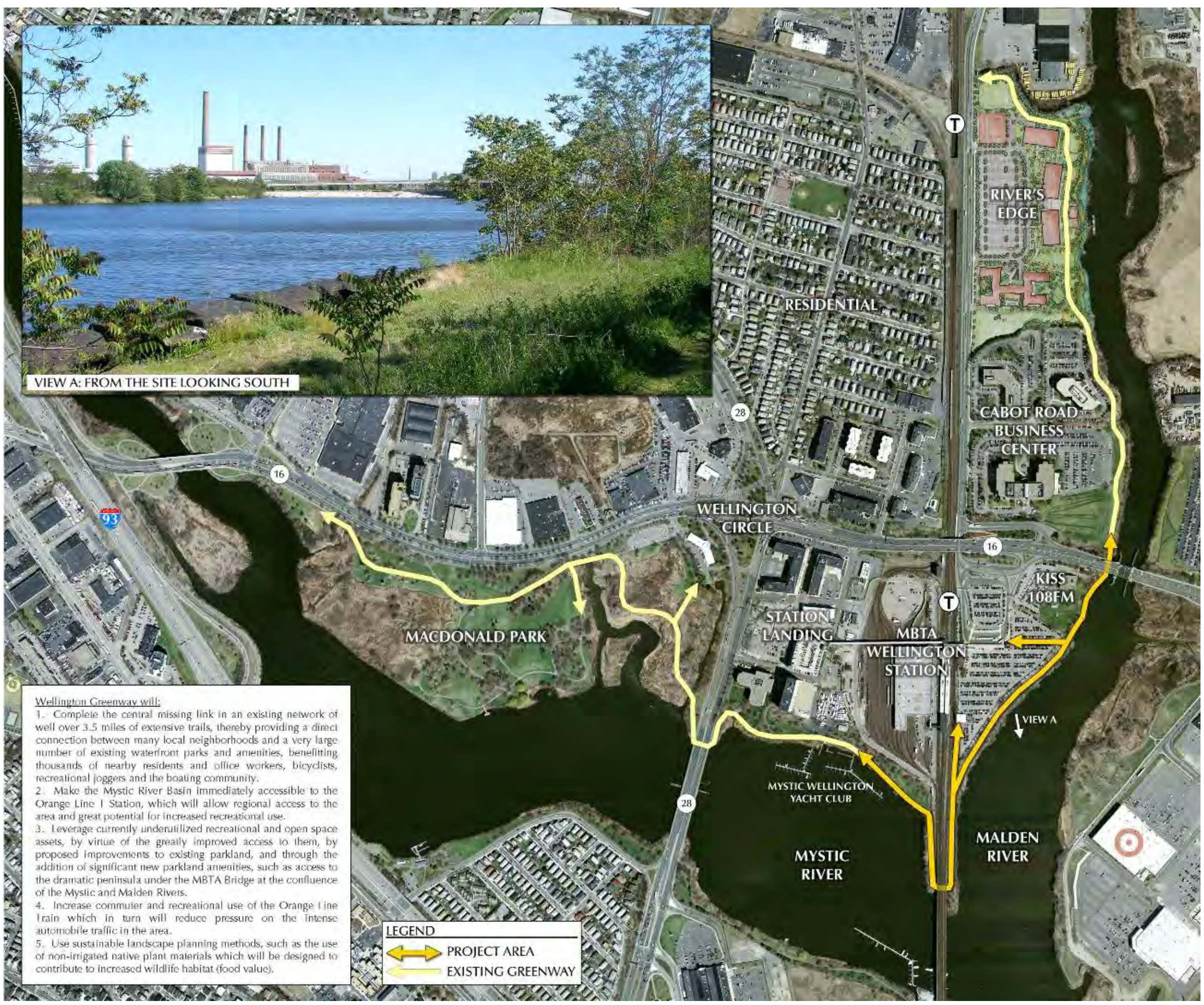
Shadley Associates Landscape Architects, PC

Project Description and Background

The Wellington Greenway is an emerging and nearly-completed 3.5 mile long multi-use trail, which connects beyond its ends to more than 50 miles of other existing and proposed future trails. The Wellington Greenway is an urban greenway; the path traverses six abutting properties located along the Mystic and Malden Rivers in the densely populated cities of Malden and Medford, Massachusetts. Work has been ongoing for over four decades, and while not measured in many miles, much progress has been made. The project is complicated in both technical and political spheres, as the Greenway passes through a mix of public and private properties, crosses major arterial roadways, active commuter rail lines and wetlands, as well as landscapes which vary from naturalistic parklands to urban mixed use developments. The Greenway is a also waterfront and as such it is subject to all of the intense environmental requirements and



jurisdictional reviews of such developments. Finally, the entire project site area was originally a severe brownfield condition.

Site History: From 1850 to 1920 this landscape was at the epicenter of the American Industrial Revolution in the northeastern United States. Originally tidal estuary and extensive marshlands, the area was filled and became the home of heavy industrial users. These included nationally prominent steel mills, paint, textile and chemical manufacturing plants which relied on the river for transportation and a place to dump waste. By the 1980's the site was essentially abandoned by competitive commercial uses, leaving heavily contaminated areas, many derelict buildings, and a forgotten and largely inaccessible riverfront.

1998 photo. Some of the worst of the existing conditions along the Wellington Greenway site – Over a century of abuse had resulted in the natural marshland ecosystem long being obliterated; in many places the polluted riverfront was inaccessible to and completely forgotten by the public.

My experience working on the Greenway began in 1987, when I first walked a desolate project site with Julia O'Brien, then Director of Design for the Massachusetts Metropolitan District Commission (now the DCR, Department of Conservation and Recreation). Since then I have been aware of many relevant and connected projects along and nearby the Greenway, and involved with the design and construction of four projects along its course. I am currently working on the upcoming construction of a fifth project, as part of a team which includes the developer of an adjacent property, the City of Medford, the MBTA, the Massachusetts Environmental Trust, an LSP (Licensed Site Professional), a civil engineer and the General Contractor.

Site Context: The site is located just five miles north of Boston, at the confluence of the Mystic and Malden Rivers, and near the transportation hub of Wellington Circle in Medford, MA. In recent years the area has been the benefactor of numerous public / private collaborations, all under the guidance of the DCR, and many Greenway improvements have been fueled by significant high density "Smart Growth" development projects, with many new residences and supporting mixed use projects.

A major achievement of the Greenway Project has been in bringing people back to the riverfront, by providing access to this valuable public resource. The general demographic shift towards urban living has also greatly benefitted the area. With the direct service to downtown Boston from Wellington Station on the MBTA's Orange Line, these transit-oriented waterfront developments have become popular places to live, and with the new population has come an increased interest and action toward the further improvement of the Greenway.

Recent photo of one of the segments of the Greenway which has been recently refurbished. These projects take time. I had orchestrated the planting of these trees in 1988. In 2010, we repaved the path, repaired and added new benches and other site furnishings, and did a significant amount of invasive vegetation management.

Project Goals and Objectives:
The Wellington Greenway Project has and will:

1. Provide a direct connection between many local urban neighborhoods and a very large number of existing waterfront parks and amenities, benefitting thousands of nearby residents and office workers, bicyclists, recreational joggers and the boating community.

2. Complete a 3.5 mile missing link in a difficult, complex urban section of a much larger network of extensive existing and planned trails beyond.

3. Allow regional access to the area and great potential for increased recreational use and increased awareness of the Rivers and their critical role in the history and ecology of the region.

4. Make the entire Mystic River Basin immediately accessible by foot and bicycle to additional new visitors, via the MBTA Orange Line Station.

5. Increase commuter and recreational use of the Orange Line Train which in turn will reduce pressure on the intense automobile traffic in the area. Consultants from have estimated the next segment of the Greenway will reduce the daily use number by between 1,200-1,750 daily vehicle trips.

6. Leverage currently underutilized open space assets and opportunities. By virtue of the greatly improved access to them, momentum has been created to spin off several significant improvements and amenities to existing parkland, such as access to the

dramatic new overlook at the existing peninsula under the MBTA Bridge at the confluence of the Mystic and Malden Rivers.

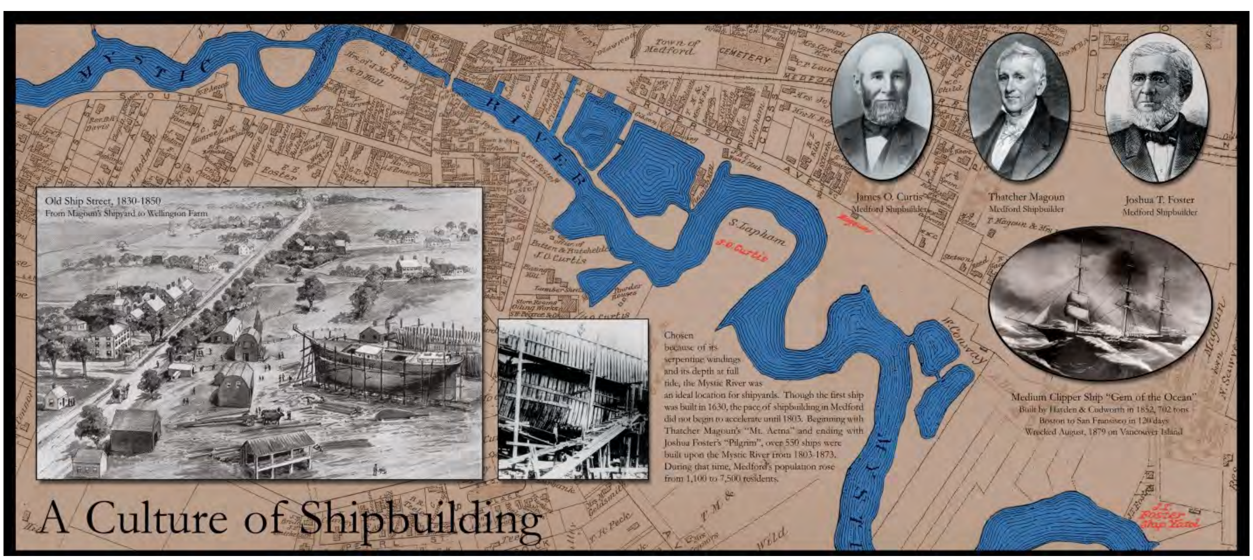
7. Provide many environmental benefits, such as brownfields cleanup, use of many sustainable landscape construction techniques, and ecosystem improvements such as improving wildlife habitat through the almost singular use of non-irrigated native plant materials which reduce water consumption and increased wildlife habitat and food value.

<u>Major Components of the Greenway</u>:

The Wellington Greenway is currently composed of five major segments:

- MacDonald Park and Mystic River Reservation
- Station Landing
- Wellington MBTA Station
- Wellington Business Center
- River's Edge

<u>Revealing this Place of Cultural and Historic Significance.</u>
The Greenway is located entirely within an extremely historic area which time has forgotten, and a significant part of the work of the Greenways is to reveal this history to the public. Perhaps the most celebrated part of the area's history was its leading role in the design and production of sailing ships. At one point in time there were more than ten shipyards located within a mile of each other, and between 1803 and 1873, a total of 568 ships were produced along these very few miles of riverfront, including some of the most successful vessels of the fabled clippership era.



This legacy is revealed and extended in different ways along the Greenway, through interpretive markers, the use of nautical materials, in metaphors and in contemporary use of the rivers, as boat clubs with launches, boathouses, docks and many overlooks of the rivers.

MacDonald Park and Mystic Reservation

Macdonald Park and the Mystic River Reservation were built on a reclaimed dredge spoiled area left after the construction of Route 93. The park serves as a major public open space for the City of Medford and is a link to the larger Mystic River Reservation, as well as the starting point for the Wellington Greenway.

Station Landing

This major, mixed-use waterfront development features approximately 600 new residences, 160,000 square feet of office space and over 30 new retail stores and restaurants. The Park and Greenway acts as the major public space for Station Landing and draws visitors and residents to the edge of the Mystic River.

Wellington MBTA Station

The section of the greenway is currently in development, with construction completed on the first section in the fall of 2012. When completed in its entirety, it will create the critical central link which connects the two major completed section of the Greenway

Different lengths of this section of the trail are owned by various parties:

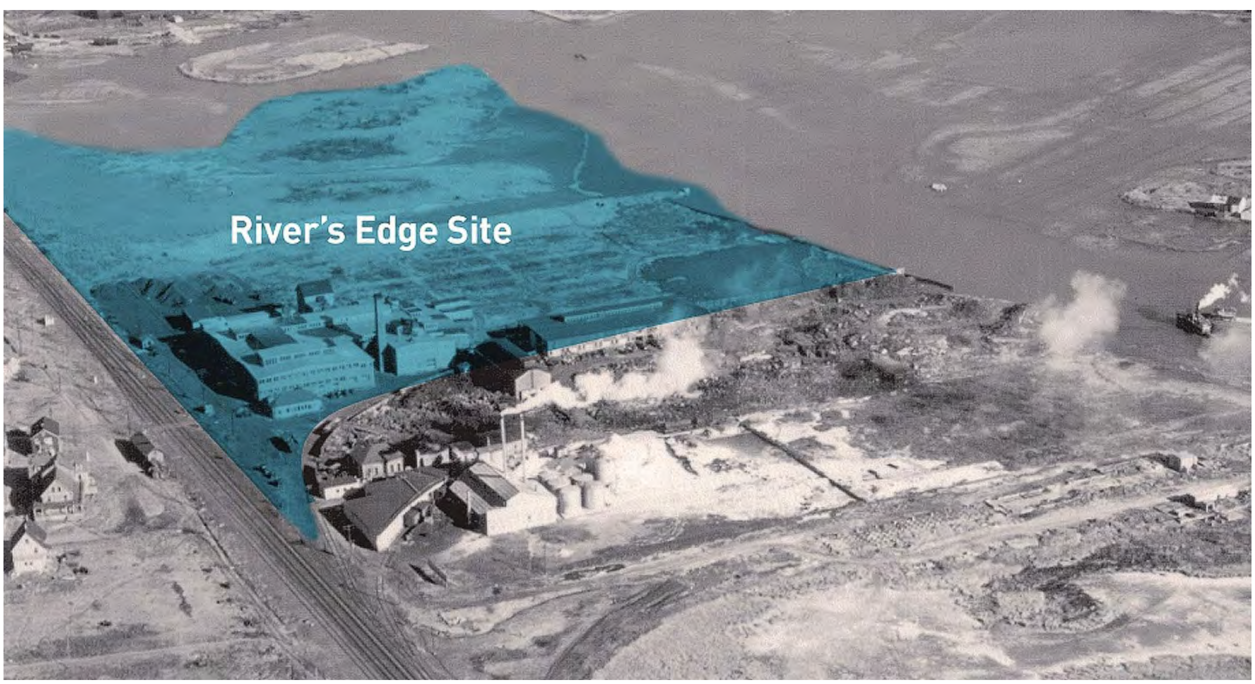
- 1,700 ft are privately owned (existing trail – Wellington Business Center)
- 2,200 ft are owned by the DCR (existing DCR trail)
- 1,000 ft owned by the DCR (no trail)
- 1,200 ft owned by the MBTA
- 500 ft owned by private party (no trail)

The most recent component of the greenway is the “Overlook”, the centerpiece feature at the confluence of the two rivers, which affords a dramatic 270 degree panoramic vista from an abandoned rail bridge abutment. Details of this ongoing project are on the next pages.

River’s Edge

The Greenway currently concludes at The Park at River’s Edge, the most recent and most fully designed area of the Greenway. As the spearhead of a brownfield restoration and 30-acre mixed use Transit Oriented project, River’s Edge has transformed an industrial wasteland and greatly improved the quality of life for an entire community.

Surrounded by underserved dense urban neighborhoods, the project now provides a healthy and well-used waterfront public open space. In design terms, the park is at once wholly contemporary yet profoundly appropriate and fully connected to this regional and historic New England waterfront.


River's Edge Site

Prior to 1845, the site was part of a wetlands ecosystem which extended to Boston Harbor. Implementation of the *Malden Canal Project,* the largest federally funded project in the United States at the time, saw the filling of these wetlands. This image shows how industrial users filled the marshlands ahead of them as they progressed in "improving" the site.

This view shows the site after removal of derelict buildings but prior to removal of the 100-ton, 40' x 270' sunken, and garbage filled barge. Landfill soils were typical of the entire riverbank. Over 17,000 tires were recycled. The nearly completed Tufts University Boathouse is in the center of the photo.

During construction, the bank was relocated by 26’ and extensive care was taken to clean toxic soils and provide the foundation for a renewed ecosystem.

Taken shortly after construction, this view shows the Greenway path as it winds through the large park. This is a rare elevated and open expansive view of the river.

Today, major wetlands planting has filled in, providing valuable habitat for urban wildlife. The boathouse is barely visible in the center of the image. Late summer seasonal color glows in the afternoon light.

The ambience of the riverfront is informal, yet the sculpted landforms are intentional, the plantings are deliberately placed, and strategically located park elements are choreographed to provide a sequence of views, connections, transitions, spaces and experiences.

Preparing for a regatta on a brisk spring morning. The park supports a broad range of activities, from cycling to soccer and cross country skiing to sun bathing. The largest user group is the steady stream of walkers and joggers.


There is a central lawn just off of the main park path, which provides a broad, quiet expanse and it hosts frequent games of catch and many family picnics. The walls are a contemporary and comfortable reinterpretation of the ubiquitous New England Sea Walls found throughout the area.


This overlook off the main path provides a quiet cove from which to enjoy the river. Aggregate paths encourage walking rather than boarding or wheeling. The Massachusetts Audubon Society has recorded a large increase in the number of bird sightings and the species diversity at the site since the park opened.


The flowing site walls are woven with plantings and into rolling landforms, recalling a once-meandering riparian landscape. The wall's materiality, mass and integration within the landforms instilled a sense of permanence in this newly reclaimed landscape.

Edessa Greenways: a land use planning tool promoting sustainable development in Northern Greece

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Introduction

Known historically as the “City of Water”, Edessa is one of many ancient small hill towns situated in a forested river valley found at the northwest part of Greece's Macedonia region. Bordering with FYROM, Albania and Bulgaria, it sits at the edge of a plateau overlooking the historically rich Plains of Hellas; atop a vast agricultural plain that extends east to Thessalonica, some 120 kilometers. Small rivers run through Edessa boasting an intricate system of waterways-canals, rivulets, and waterfalls-intertwined with small streets, walking paths and scenic overlooks. The rivers fall spectacularly 70m down from the ledge to the plain below. These waterfalls are a well-known and celebrated natural feature. The new extended municipality includes both towns of Edessa and neighboring town Anissa encompassing a rural “green corridor” agricultural area between them. It comprises the study area which extends in the valley of the River Edesseos, rising in the Agras Nissi Vritta wetlands and Lake Vegoritida. North of Edessa recreational itineraries include abundant ski resorts, ornithological reserves, lakes and archeological sites.

Unless the municipality of Edessa generates new economic growth, it will continue to lose a valuable human resource, its youth. The mayor wishes to create new hope and energy for the new municipality through economic investment and physical restructuring. Improvements here could reverberate throughout the region and potentially motivate further investment. Renovated small hotels and lodgings have emerged as outsiders begin to see the potential value of Edessa's future. Egnatia Motorway, the region’s greatest infrastructural project, has already transformed travel times and accessibilities across northern Greece bringing closer the emerging economies of Western and Eastern Europe. Environmental considerations for the region are underway as two transnational agreements, the EU's NATURA Network 2000 and the RAMSAR Convention of 1971, continue to ensure the preservation and protection of sensitive ecosystems and wetlands for the foreseeable future. But this green corridor, however scenic, suffers from inattention and minimal investment.

As many regions of great natural beauty dotted with small agricultural towns across Europe continue their dependence upon cultural and ecological tourism, questions that define and frame broader issues of design, sustainability and growth in northern Greece, were considered throughout the planning process: a) How sustainable development and design issues of a region can be sensitively addressed, while developing a strategy that provides socio-cultural, economic and environmental sustainability? b) How can landscape and infrastructure design work synergistically to address the demands of connectivity and increased capacity while also promoting a sense of identity and "placeness" for a rural region? c) How can issues of sustainability and environmental stewardship be calibrated to the specifics of local culture and geography? d) How can recent shifts in the regional geopolitical sphere be actuated to bolster tourism and economic development? e) How can strategic investments in landscape and infrastructure be leveraged to provide development opportunity for the larger region? f) Can a pronounced shift toward high-end tourism reposition the developmental future of the region? g) Can a new strategy of catalytic rural landscape and infrastructure investments improve the internal structure of the landscape and enhance its connection to the larger region?

Like many hill towns across continental Europe impacted by the shift away from small scale agricultural operations and the forces of an increasingly globalized economy, the structural relationship between town and country (in this case, the agrarian hinterlands) has profoundly changed. In the more targeted scope and scale of a municipality, fundamental questions remain: a) What uniquely defining characteristics does Edessa possess? b) What additional attributes does Edessa require? c) What actions can be taken to improve sustainable development and economic growth, while preserving natural resources, promoting cultural resources, and upgrading physical planning integration of Edessa's urban and rural Mediterranean landscape?

Literature Review

Today's fast changing society and environment has resulted in the creation of completely new landscapes and in the rapid deterioration of all previous ones, both natural and cultural. Again new landscapes have been superimposed rather than being integrated (Antrop, 2005). Rural areas, just as their urban counter parts, need to be dynamic, decentralized, recursive, data rich, responsive, parametric, alive, resilient and adaptable to change (Duff, 2010). The paper describes a landscape study based upon precedents employing approaches similar to green infrastructure and greenways projects. The greenway planning approach addresses the role of creativity, encompassing theories, principles and methods of landscape planning. Networks are systems that support functions by way of connectivity (Ahern, 2011). Linearity and connectivity have undoubtedly been applied to address formal, metaphorical and aesthetic issues in landscape design. Inventory, analysis, assessment, and identification of valuable resources, followed by analysis of distribution patterns and delineation of homogeneous areas of landscape are standard current practices in landscape and greenway design studies (Ribeiro & Barao, 2006). Landscape linkages are essential to any landscape design proposal plan as they provide space for the protection of historic sites and opportunities for recreational use (Benedict & McMahon, 2006). A continuity of landscape, as the tangible expression of the history and culture of a society, enhances the qualities of a collective identity (Egoz, 1996). An assessment of cultural/historic resources enables the delineation of spatial patterns that help to support a broad strategy for the conservation of landscape quality in its physical, historical, ecological and cultural components, both at the regional and local scales (Ribeiro, 1997). Because of their low costs and inherent adaptability, conservation plots can become the basic "building block" for creating greenways in their broadest sense: community-wide and regional greenspace networks, as envisioned in most municipal comprehensive plans (Arendt, 2004).

Goals and Objectives

Addressing the issues faced by the region, the paper investigates opportunities for connections and proposes mobility strategies for the new municipality of Edessa relative to its socio-spatial role in the larger region, its economic potential as a tourist destination, and its unique riverine geography. The viability of predominantly agrarian small towns is at the center of this investigation.

The overall objective is focusing on sustainability. Within the umbrella of sustainability at both the environmental and socio-economic levels, mobility incentives in the rural and built environment constitute the prime objective.

The paper's overarching goal is to link the communities and resources of Edessa‘s broader municipal region by employing an innovative greenway network and its related green infrastructure, making it an attractive and integrated place for economic growth throughout the year and a magnet for housing, cultural expression and ecologically compatible recreation and development.

Specifically the paper presents a series of clear study goals and objectives: a) to determine a development strategy for Edessa in order to re-position and re-generate the economy and population, b) to create a synergy between the towns and villages within the municipality and to capture the full potential of the river valley while protecting it for the future, c) to determine highest landscape values and best land-uses in the river area, that the greenway system will link and promote, focusing on its design and development, and d) to improve internal connections throughout the municipality of Edessa via a public open-space system linked by a greenway system.

Methods

The paper explores the research and design methods associated with physical interventions in complex space solving conditions: sites layered with multiple interventions across a long span of history that present issues of connectivity, accessibility, identity, and need for contemporary programs. It aims to apply various forms of research –historical, social, ecological, material, spatial, and technical - to the formulation of project arguments and strategies.

Emphasis was placed on exploring the relationship between documentation, analytical research and design through diverse conceptual frameworks and projective representational techniques.

Edessa can boast of: a) beautiful rural landscapes, b) natural attractions, c) competing tourism, d) agricultural economy, e) diminishing population; but Edessa needs: a) regional connections (destinations, attractions, regional connections), b) population revival (vibrant local base, respectful tourism), c) year-round attractions (summer/winter). So the main **landscape issues studied** were: a) ecological systems (geology, plant ecology, lake ecology, and region's water systems), b) physical environment (history of towns, waste, energy, transportation & connections – regional/ national/international infrastructure, recent developments - Agios Athanasios ski village, ski resort area and history), c) visual analysis (viewing areas and viewsheds in Agras wetlands and Mt. Voras), d) socio-cultural/economic environment (Who lives in the villages around Vegoritida? What is their economic base? What is their future? What changes can be expected in the next 50 years? Agricultural practice as it exists/ future practice, tourism), and e) demographics (Edessa 18,832, Arnissa 1570, Panagitsa 1079, Agras 883, Vryta 506), f) political Landscape (issues facing Edessa/Arnissa's economic challenges, existing policies that guide development of the area, development plans for the Edessa Municipality)

A **Vision Plan** was formulated in trying to fulfill Edessa's need for better connections: "Offer the entire landscape as the attraction" through a greenway system as part of a larger scheme of existing and proposed infrastructures.

A **Strategy/Business Plan** called for this subtle green infrastructure, linking destinations with amenitities. Destinations offered in this greenway system are towns, waterfalls, lake, beaches, thermal baths, and forests. Amenities offered are eating, camping, bathing/hiking, swimming, spas, skiing/hiking. Opportunities offered by the greenway system aim to: a) promote Edessa as a regional center, b) increase local connectivity, c) attract a younger population, d) improve circulation, e) highlight water systems, and f) connect to tourist circuits. Greenway system implementation can be tackled in 3 scales of connectivity: a) international (European Long Distance Footpaths E4 + E6), b) national/regional (Greek National Footpaths), d) local (lake-wetlands-canals-waterfalls). Finally a **Master Plan** included: a) <u>Broader Connections</u>: Thessaloniki, Edessa, Arnissa, b) <u>Regional Greenway Connections</u>: Edessa, Agras, Wetlands, Vryta, Nisi, Xanthogeia, New Xanthogeia, Arnissa, Panagitsa, Zervi, Black forest, Kaimaktsalan ski resort, c) <u>Greenways End Users</u>: environmentalists, birdwatchers, ecologists, nature lovers, outdoor recreational athletes, locals, d) <u>Greenways Typology</u>: agricultural, ecological (bird routes, livestock routes), historical (Via Egnatia, Xanthogeia), cultural (tractor routes), and <u>Greenways Physical Elements</u>: Different typologies/networks broken down into parts, typical path sections, typical entrance conditions, furniture, kiosks, interactive/interpretive signage (daily ecological information/seasonal ecological information/different programs and subprograms for different end users).

The study entitled: "CONNECTING EDESSA: A tangible landscape, a greenway network - Linking history, culture, and ecology", followed the sequence described below:

1. Viewshed Analysis: Agras wetland and Voras mountain vicinity
2. Connecting the town of Edessa with its municipality

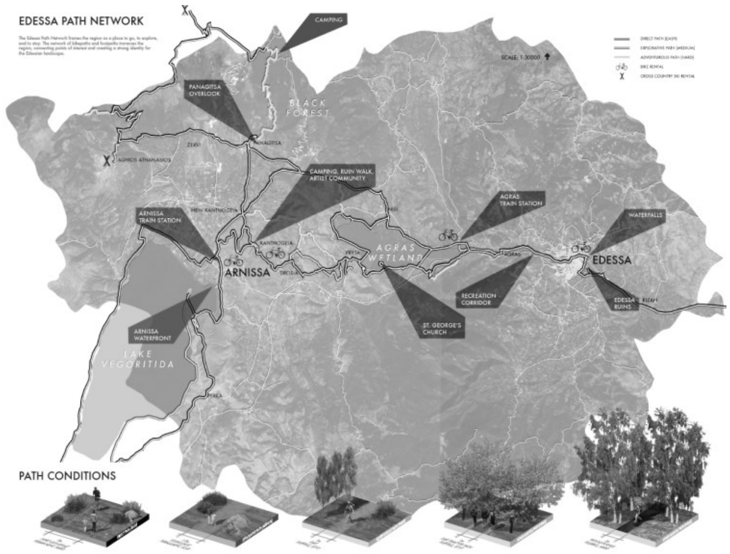

Fig 1. Edessa Greenway network and path types

3. Precedent
   New England Greenway: “Make the connections”
   Prague/Vienna Greenway: “Create an identity”, “Provide amenities”
   Schoneberg Sudgelande Park and Agia Varvara Park: “Tread lightly”
4. Path network types: direct path (easy), explorative (medium), adventurous (hard)
5. Path network attractions: Edessa ancient ruins, Edessa waterfalls, Agras-Edessa recreational corridor, Agras train station, St. George;s church, Xanthogeia camping-ruin walk-artist community, Arnissa train station, Arnissa waterfront, Panagitsa overlook, Mt. Voras camping
6. Path network: bike and cross country ski rentals
7. Path Analysis: direct, explorative, adventurous

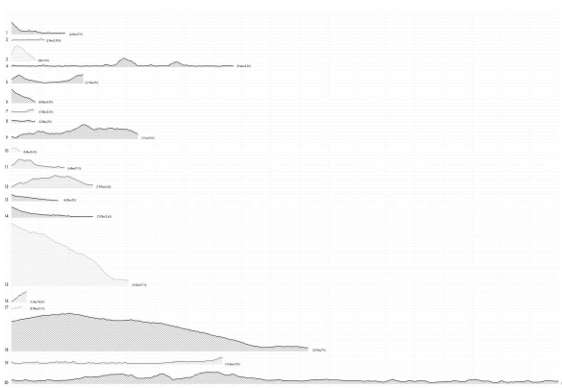

Fig 2. Path Analysis (elevational sections of each type of footpath with slope gradients, hours, and km needed to cover)

8. Path conditions: direct path (easy), explorative (medium), adventurous (hard) (including tractor dirt paths, forest wooden plank paths)
9. Path elements: observation tower, Via Egnatia wall, way-finding, accessories

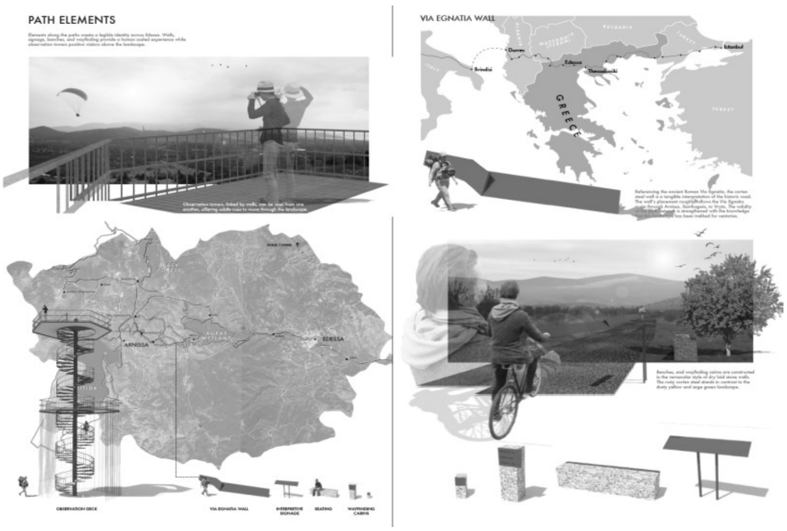

Fig 3. Path elements: observation deck, Via Egnatia wall, observation tower, bike path perpective, design elements (cairns, bench, sign)

10. Xanthogeia: camping, re-use of ruins (modern forms, interaction, lighting, hostel, camping decks, elevated walkway, artists residences, observation towers, Via Egnatia wall precedent: West 8, Wonder Holland, Rome, Parque das Ruinas, Rio de Janeiro), artists' community (artists residences: repurposed buildings, studio/living/communal space, precedent: Headlands Center for the Arts, Marin Headlands, San Fransisco)

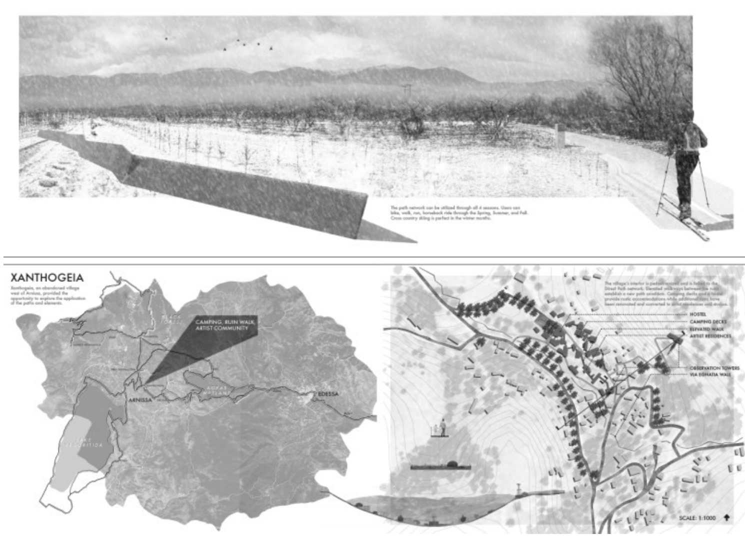

Fig.4 (left) Accessories: cross country ski path, Xanthogeia development plan
Fig.5 (right) Xanhogeia ruins, hostel entrance and elevated walk perspectives

Results – Edessa Greenways: An overall mobility strategy

The regional development and planning of the Edessa municipality seeks to create a strong and well-connected region. It can promote economic independence and a higher quality of life based on three **principles**: a) improving conditions and promoting safety on important links between towns and regional attractions, b) promoting the use of non-motorized sustainable transport options, such as greenways through design and long term policies, c) developing accessibility and connectivity to-and-from Lake Vegoritida.

Strategies for meeting these principles are based on the understanding and analysis of existing conditions including regional, local and site scale analysis. The analysis considers Edessa and Arnissa as the eastern and western connection hubs in the municipality and strategies improving access to these areas are part of an overall **Connections Development Strategy** (CDS).

Pathway connections are currently not a well-defined part of the town and nature experience in the municipality of Edessa. Development of these types of connections minimize negative impacts on existing towns and agricultural lands, and allow the best opportunity for low-impact experience of nature, farms, villages, Vegoritida lake and the Black Forest.
The following recommendations are proposed:
-Establish an extensive network of footpaths that would be utilized as subtle, human scaled infrastructure within the region.
-Designate the areas of Arnissa, Panagitsa, Vryta, Nisa, Agras, the Agras Wetlands, the Wetland info center, the Black forest, the Voras mountains as significant areas of interest.
-Establish recreation and educational opportunities in conjunction with the footpaths to foster ecological and economic linkages.
-Develop footpaths in combination with such recreational activities as: hiking, horseback riding, mountain biking, cross country skiing, bird watching, and camping.
- Design way-finding signage to highlight specific ecological conditions, special habitats, and protected species in order to educate visitors.
-Provide rest stops, historical cultural sites, lodges, bed and breakfasts, rental outfits to provide necessary amenities while providing tourist destinations.
- Connect regional transportation train and bus hubs by means of footpath networks.

Bicycle connections are currently not a well-defined part of the regional or town experience, yet offer a great transportation and connectivity opportunity for the main town hubs as well as the natural areas. In combination with pathways, bicycle connections should be studied as the realistic option between towns, villages, and nature.
The following recommendations are proposed:
-Employ an extensive network of bicycle paths that link with the regional footpath network.
-Identify convenient and practical bicycle connections in addition to more leisurely routes.
-Promote bicycle use in Arnissa and Edessa and to a lesser extent the other villages, as a viable form of regional transportation, and develop strategies for bike access, through rentals or other means.
-Design maps to aid way-finding, detailed bicycle timings and use information suitable for both local residents and tourists.

Discussion and Conclusion

The focus of this greenway study lies upon the long-term improvement of quality of life and environmental quality, which is based on maintaining or improving the natural quality. The holistic basis of landscape implies the integration between natural and human aspects in a sustainable manner. Recent changes are seen as a threat to existing qualities and thus the conservation of these qualities is both an aim in itself as a means to achieve sustainability (Antrop, 2006).

Determination of what will constitute sustainability for the Municipality of Edessa in environmental / economic and social terms was guided by: a) a Development Strategy (land-use zoning, density & grain, links, infrastructure, open space), b) a Connections Development Strategy focusing on the connections offered (links, connections, green infrastructure, open space), and c) a Landscape Master Plan for the proposed Greenway System

The common thread in linking Edessa with its municipality and making the entire region an attractive, sustainable and integrated site for economic growth throughout the year, is the proposed greenway system of foot, bicycle, and equestrian paths. This greenway design project was in scope and scale, consistent with the Connections Development Plan.

Hopefully, the development of an integrated greenway planning strategy within the Municipality of Edessa will not only guarantee a sustainable future but will simultaneously place emphasis on the immediate need of its implementation at the provincial and local, physical and administrative scales.

In addition to the proposal submission to the municipality of Edessa, this landscape study presents a number of significant opportunities pertaining to the learning process and knowledge accumulated within a graduate landscape architecture studio setting that can be reinforced throughout landscape architecture schools globally.

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b) Professor Alexander Kantartzis: senior author, who assisted in the teaching of the design studio as a visiting scholar

c) Nina Chase: graduate MLA II '11 student

15. GREENWAY STRATEGIES

Optimal Routing of Wide Corridors

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Abstract

Techniques for tracing minimum-cost routes between nodes in a cost-weighted network have long been used in conjunction with geographic information systems (GIS) to allocate linear features such as roads, pipes, or cables. One of the problems with such techniques, however, is that they regard these features as truly linear in nature: having length but no appreciable width. When siting features such as rights-of-way, wildlife corridors, or greenways that clearly do encompass two significant dimensions, the whole area of each feature must be considered when attempting to minimize cost. Past approaches to the optimal routing of such wide corridors have generally been either ineffective or prohibitively complex. This paper proposes an alternative strategy that promises both efficiency and effectiveness and does so with both simplicity and flexibility. In fact, this technique requires no new software at all. It merely requires that the routing problem be seen from a different perspective: one that addresses path width not in terms of the path itself but in terms of the field of costs that the path must traverse.

1. Introduction

Greenways are often regarded as corridors: tracts of land associated with some sort of movement from one place to another. In some cases, this movement relates to directly to physical activities such as hiking, biking, or the migration of wildlife. In others, no actual motion is involved, but movement is nonetheless implied by an attempt to achieve physical connectivity among geographical features or conditions. In either case, the task of siting an effective and efficient greenway is sufficiently similar to the task of determining "the best way to get from here to there" that greenway planning often calls for the use of geographic information systems (GIS) to implement formal path-finding procedures.

These are procedures that have long been used in fields ranging from transportation planning to the design of electrical circuits, and they tend to be cast in terms of conventions relating to network theory. Here, a ("graph" or) "network" is a set of ("vertices" or) "nodes," any one of which may be connected to others by way of (an "arc," an "edge," or) a "link" whose traversal incurs a ("weight" or) "cost." An "optimal path" is one that connects one set of (one or more) "origin" nodes to another set of "destination" nodes by way of intervening links such that the accumulation of incremental costs associated with those links is as low as possible. And "optimal routing" is the process of identifying such a path.

Among the most often used algorithms for optimal routing is one (Dijkstra, 1959) that

- assigns a distance value of zero to all origin nodes and infinity to all others;
- places all nodes onto a distance-sorted list of available nodes;
- for the next available node listed, considers each of the other available nodes to which that listed node is directly linked and,
    - for each of those neighbors (unless a lower distance value

has already been assigned to that neighbor);
        - assigns a distance value equal to sum of the listed node's distance plus the cost of its link to that neighbor;
        - notes this was the link responsible for that neighbor's distance; and
        - repositions that neighbor on the distance-sorted list of available nodes; then
    - removes the listed node from the list of those still available; and
- repeats the previous step until no more destination nodes are available.

The effect is analogous to the strategy that a hungry mouse might employ in making its way through a covered maze to a fragrant piece of cheese. How does that mouse know which way to turn? It is, of course, whichever direction yields the most intense scent. And why does this yield the shortest path? It's because of the way scents dissipate. As they waft through that maze, they all diminish at the same rate and are, in effect competing with one another to reach more and more distant locations. Thus, the first scent to reach any given location will always have done so by way of the shortest possible path from the cheese to that location.

Optimal routing techniques like this are often used to determine the shortest, quickest, or least-costly path from one place to another in a transportation network. If that network were to be a system of roads, for example, the nodes would be a set of road intersections or stops along the way; the links would be the stretches of road between those nodes; and the cost of each link would be expressed in terms of miles, minutes, or dollars. Routing capabilities for this sort of network have recently fallen into the hands of millions (quite literally) for whom mobile phones and global positioning systems (GPS) have made their use a routine part of everyday life.

Those with access to geographic information systems (GIS) routinely use optimal routing techniques to find minimum-cost paths not only through networks of well-defined alternatives, but also through landscapes in which there are no well-defined lines of transportation. In this case, "every square inch" of an area is characterized in terms of the incremental cost that would be incurred if that location were to be traversed by a path. This would be the case, for example, if one were to try to minimize the construction cost of a pipeline though a region in which there are no pre-existing rights-of-way, but there are variations topography, hydrology, geology, vegetation, ownership, and development that could all affect those costs.

In order to represent these variations across such a region, digital maps of the region are usually encoded as "raster"-based images (as opposed to "vector"-based drawings) in which "grid cells" act much like the pixels (picture elements) in a digital photograph. They are sample points arranged in a rectilinear grid pattern of equally spaced rows and columns that is projected onto a cartographic plane. Thus, each cell is uniquely associated with a particular point location on the ground. Numerical values are then used to record each cell's geographical conditions, and the set of values representing a particular condition (such as soil type, for example) over all cells within a given region constitute one of that region's cartographic "layers."

In Figure 1 is an example. Here, selected conditions within a typical landscape are depicted in shades of gray that indicate the relative cost of traversing each with a pipeline right-of-way. The darkest (most costly) conditions are ponds and areas in close proximity to buildings. Less dark (and less costly) are wetlands, then roads, then steep forests, then not-so-steep forests, and finally non-forested fields. Within each of these conditions, a subtle mottling of gray represents minor and random variation in these costs. Concentric black circles mark the two (arbitrarily selected) termini that are to be connected by this pipeline. Also in black is the pipeline path that makes this connection in a manner that minimizes the overall amount of darkness (cost) encountered. To generate that path, increments of cost are accumulated in waves that emanate from the left terminus as indicated by pale gray contour lines. The path of lowest total cost from any given location to that left terminus will always run perpendicular to those contours.

Fig. 1. A Path of Minimum Cost. The relative cost of traversing each location within a geographical area is indicated in gray, with darker shades corresponding to higher costs.
The linear path in black connects the two termini depicted as concentric black circles with the lowest possible sum of those incremental costs. Contour lines indicate how these costs accumulate with distance from the left terminus.

One of the fundamental limitations of this path-finding technique is that the path involved is truly linear in nature. Although it has length, it has no appreciable width. When siting features such as rights-of-way, wildlife corridors, or greenways that fully encompass a two dimensional area, that whole area must be considered when attempting to minimize cost.

2. Background

Surprisingly little has been published on the routing of such wide corridors. What is perhaps the most notable to date (Goncalves, 2011) cites only two other attempts. One (LaRue and Nelson,

2008) uses traditional methods to site what amount to the centerlines of paths that are then widened in order to consider costs in their vicinity. The problem with this approach is that the widening process encompasses areas that were never included in the routing procedure and whose costs may therefore result in sub-optimal routes. The second attempt (Majka, *et al.,* 2007) uses a well-known technique for the identification of N^{th}-best paths to delineate swaths whose widths vary according the manner in which those paths happen to meander. While this does allocate wider routes, it does not find the optimal corridor of a specified minimum width. The publication in which these attempts are cited (Goncalves, 2011) presents a new technique that is quite successful in routing optimal corridors of a specified width. It does so, however, by way of a procedure that appears to be much more complex than may be necessary.

3. Objective

This paper proposes an alternative strategy, a technique that promises both efficiency and effectiveness and does so with both remarkable simplicity and welcome flexibility. In fact, this technique requires no new software beyond that which is likely to be available in any general-purpose GIS. It merely requires that the routing problem be seen from a different perspective.

4. Methodology

The key to this strategy is suspiciously straightforward. Rather than attempting to route a wide corridor *per se*, that problem is cast in terms of routing the centerline for such a corridor. Since a centerline is a linear path with no appreciable width, conventional path-finding techniques can be used to find the centerline of minimum cost between two designated termini. And once an optimal centerline has been located, its corridor can be established by simply identifying all locations within a given distance (half the desired corridor width) of that line.

At first glance, this strategy may appear to be identical to that of LaRue and Nelson. Note, however, that the centerline of a wide corridor is not merely a linear path. Whereas an optimal path must thread its way through a field of obstructions in a manner that attempts to avoid them, a corridor's centerline must not only avoid those obstructions but also avoid coming close to them. How close? The minimum distance would be half of the corridor's width. Why? Because any obstruction whose proximity to a corridor's centerline is less than half of the corridor's width will lie within that corridor and therefore increase the corridor's cost.
Given this logic, the incremental cost of traversing any given grid cell with the centerline of a wide corridor must now reflect not only the local cost of that cell itself but also the cost of every other cell within a radius of half the corridor's width. How to do this? Start with the layer of incremental costs through which a corridor is to be routed. For each cell, determine the sum, the maximum, or some other function of those incremental-cost values for all cells that lie within its half-corridor-width vicinity. The result will be a revised layer of incremental costs that can now used in the same manner as the original.

In Figure 2 is an example. Here, the pipeline right-of way to be routed involves the same landscape, the same termini, and the same costs as were shown in Figure 1. In this case, however, those costs (still represented by shades of gray that get darker as costs increase) have been allowed to “blur” in order to reflect the fact that this right-of-way is to be wider. As a result, the centerline for that new right-of-way, again shown in black, is one that not only tries to avoid locations of higher cost but also tries to avoid areas in the vicinity of such locations.

Fig. 2. The Centerline of Minimum Cost. The relative cost of traversing each location within a geographical area is indicated in gray, with darker shades corresponding to higher costs. The linear path in black connects the two termini depicted as concentric black circles with the lowest possible sum of those incremental costs.

3. Results

To appreciate the effect of the routing technique presented in Figure 2, consider the three pipeline rights-of-way depicted in Figure 3. Here, the costs depicted in pale shades of gray are the same as those shown in Figure 1. So are the pipeline termini (concentric black circles) and the linear path of minimum cost (thin black line). In dark gray, however, is the set of all locations within a specified distance of the wider right-of-way centerline that was shown in Figure 2. Those locations comprise the right-of-way of lowest-possible total cost between the two termini at that width. And in a slightly lighter shade of dark gray is the optimal route for an even wider corridor.

Fig. 3. Minimum-cost Corridors of Different Widths. The relative cost of traversing each location within a geographical area is indicated in pale gray, with darker shades corresponding to higher costs. The linear corridor in black connects the two termini depicted as concentric black circles with the lowest possible sum of those incremental costs. The wider corridor in dark gray and the even-wider corridor in a lighter shade of dark gray do the same, given that each of the corridors must maintain a specified width.

4. Discussion

Since the key to this technique lies in the dispersal of incremental travel costs to neighboring locations, and since that can be done in a variety of ways, it is worthwhile to consider how this particular step affects routing results. The relationship is illustrated in Figure 4, where

- each of five typical locations is labeled **A**, **B**, **C**, **D**, or **E**;
- the degree to which each location's cost has been dispersed to neighboring locations is indicated by the gray circle surrounding it, with lighter shades of gray representing lower costs;
- a minimum-cost corridor is stippled; and

- the centerline of that corridor is dashed.

Here, the impact of each of those locations on that corridor is proportional to the total amount of its dispersed cost that is traversed by the corridor's centerline. Thus, the influence of any given location on a corridor that ultimately includes that location will decrease with (the cosine of) distance from the centerline of that corridor.

If each location's cost is dispersed such that less is distributed to more distance neighbors, as illustrated by Figure 4's location **D**, this will cause the influence of any given location to be even greater as the distance between that location and the centerline of a prospective corridor decreases.

Interestingly (and usefully), the converse is also true. If each location's cost is dispersed such that amounts increase with (the sine of) distance, as illustrated by Figure 4's location **E**, this can be used to nullify the inherently greater influence of costs that are located closer to a prospective corridor's centerline.

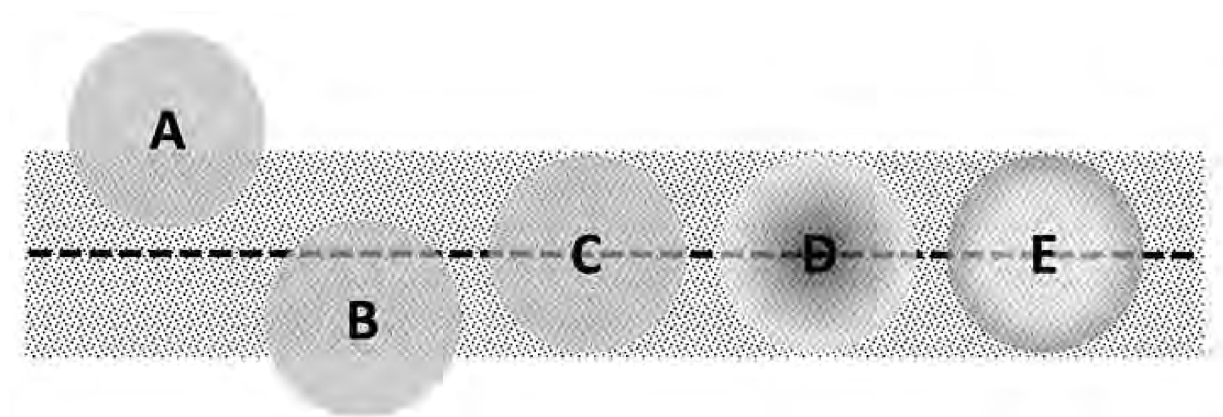

Fig. 4. The Local Effect of Cost Dispersal on Minimum-cost Routing. If the cost of traversing a given location (**A**, **B**, **C**, **D**, or **E**) is dispersed to all neighboring locations within a given distance (shaded in gray), any minimum-cost corridor (stippled) that is ultimately routed in that location's vicinity will be affected by the location's cost to the extent that is indicated by the amount and intensity of cost (grayness) crossed by that corridor's (dashed) centerline.

5. Conclusions

So what about greenways? Can the routing technique that so far been illustrated only by way of a pipeline-siting example be adapted for use in siting environmental corridors? Easily.

Perhaps most fundamental difference between pipeline- and greenway-siting problems is that the latter tend to be cast not only (or even) in terms of costs to be minimized but also (or instead) in terms of benefits to be maximized. To use the routing technique proposed requires that those benefits be expressed as costs that are lower than the norm (though, for technical reasons, are never allowed to be negative). This will cause prospective routes in the vicinity of such beneficial areas to be attracted toward them in order to enjoy their lower costs.

It is also quite easy to increase the geographical reach of this attractive force and thereby cause more distant routes to veer toward such beneficial areas. To do so requires only that proximity to those areas be included among the factors defining incremental costs.

If there are certain beneficial areas that <u>must</u> be included in a greenway to be sited, those areas need only be cast as additional termini. If more that one such additional terminus is introduced, however, this will require an efficient strategy to determine how best (i.e. with minimal cost) to connect those termini to one another, given what may well be a large number of alternatives. Fortunately, this is a familiar problem in network theory for which a number of solutions are available.

And just as fortunately, the wide-corridor routing technique introduced here is generally compatible with them all. This is because the routing component of that routing technique is really nothing new. The only new idea here is just as modest as it is effective: rather than change the optimization procedure, simply change the costs to be optimized. By doing so, well-known tools and techniques for the generation of optimal circuits, trees, networks, and so on can all be applied to problems in which those linear forms are not quite so linear after all.

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Greenways as an Integrative Framework for Campus Green Infrastructure: A Stormwater Masterplan Vision for the University of Connecticut

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Introduction

The increasingly resonant concept of green infrastructure has multiple meanings among different professional sectors and the public. For engineers and others focused on site-scale intervention, green infrastructure is quite specific to the use of low impact development (LID) techniques for stormwater management. To the general public, the concept of green infrastructure may be more simply thought of as environmentally friendly systems of transportation, energy, water, or other communal needs. For land use, urban, and landscape planners, the concept of green infrastructure more broadly represents the idea of open space networks of ecological, social and cultural value – which has its roots in the greenways movement.

This paper will present a recent national design competition submission's framework for campus stormwater masterplanning as it represents the intersection of greenway planning, green infrastructure and stormwater management. Unlike other kinds of complex communities, campuses have the potential to be totally integrated environments, with all land and infrastructure controlled by one entity. Campuses also have distinct combinations of landscape typologies such as quadrangles, pedestrian corridors, outdoor classrooms, athletic fields, and parking lots which present large scale opportunities for integrating the needs of stormwater, green space, pedestrian and vehicular movement, learning, and social interaction. As such, the basics of this greenway-based stormwater framework can be applied to any campus, regardless of setting.

Background and Literature Review

Green Infrastructure: Sustainable Stormwater Management vs. Broader Definitions

The concept of *green infrastructure* is a relatively new construct which has rapidly gained attention within the past five to ten years. The U.S. Environmental Protection Agency promotes a definition for green infrastructure which is focused on water, and the connection and distinction between sites and their multi-scalar contexts within the urban transect: "green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, [it] refers to stormwater management systems that mimic nature by soaking up and storing water." (U.S. EPA) This definition, especially at the site level, can tend to encourage a one-dimensional approach to planning and design that becomes driven by low-impact development (LID) and best-management practices (BMP) that are essentially about stormwater management.

Contrastingly, in Green Infrastructure: Linking Landscapes and Communities, Benedict and

McMahon (2006) define green infrastructure as "an interconnected green space network (including natural areas and feature, public and private conservation lands, working lands with conservation values, and other protected open spaces) that is planned and managed for it natural resource values and for the associated benefits it confers to human populations." This definition, and the planning and implementation methods they outline, focus on preserved or restored natural ecological corridors as opposed to more human ecological corridors which integrate built landscapes and development. As such it is not directly concerned with built landscapes and is broadly aimed at the holistic values that natural networks can provide for general environmental health and connectivity. While this model for green infrastructure is useful in its holistic view, most initiatives dealing with or supporting green infrastructure are, in fact, focused on the more specialized, one-dimensional concerns of stormwater management.

Greenways: Comparison to Green Infrastructure

The more mature concept of *greenways*, which has links to the related concepts of *greenbelts* and *parkways*, has many areas of overlap, some distinct differences from, and a similar divergence of definition in comparison to green infrastructure. In *Greenways for America*, Charles Little (1990), in a call for projects he would analyze for his study, initially defined a greenways as "linear parks, open spaces, and protected natural area in cities, suburbs, or the countryside". His study of the resulting projects led him to categorize greenways into five major project types: urban riverside corridors, recreational corridors, ecologically significant corridors, scenic and historic routes, and comprehensive systems. More recently, Hellmund and Smith (2006) consider the greenway – "linear or linear networks of lands designated or recognized for their special qualities" - as the broader concept under which green infrastructure – in concert with gray infrastructure (roads, utilities, etc.) – is one of 30 specially designated functions or qualities (though not specifically related to water or stormwater infrastructure). The breadth of these functions and qualities suggests a contemporary understanding of greenways similar to Benedict and McMahon's holistic definition of green infrastructure.

Campus Planning, Sustainability Initiatives and the University of Connecticut

Paralleling the recent national focus on green infrastructure and stormwater management, campus environments have embraced the broader sustainability movement on a broad array of academic, administrative, student life and campus planning fronts. Some observe that this fervor has become unbalanced and misplaced. Political scientist Sheryl Breen suggests that the race to join the campus sustainability band wagon has become marked by "an unsettling lack of theoretical and ideological analysis. In fact far from challenging the structural barriers that inhibit holistic, democratic green education, the contemporary drive toward campus sustainability can validate and reinforce the power relations that undermine the rhetoric of green principles now filling campus publications and Web pages on sustainability." (2010) She describes such power relations in terms of decision-making about sustainability initiatives that are often based on reducing costs and attracting external funding, supporters and students rather than their educational, ethical or ecological justifications. Decision-making of this sort is systematized and rewarded by campus sustainability ranking systems that have proliferated.

The University of Connecticut, founded in 1881 as Storrs Agricultural College, is the state's Land Grant institution. Located in the rural northwestern corner of Connecticut, the Storrs campus has undergone a major transformation and period of growth since the late 1990's, facilitated by the $2 billion UConn 2000 campus development program. UConn's heretofore sleepy rural community of Mansfield has a strong track record of conservation and smart growth planning which has focused recent compact, centralized development in the campus/downtown district and preserved an impressive network of protected open space. However, as the campus has implemented its unprecedented period of development and expansion over the past 15 years, it has not been without growing pains, many of them environmental in nature. In addressing these early challenges, the University developed an Office of Environmental Policy which was charged with leading campus sustainability initiatives. Recently UConn has leapt to the top in

national and even international campus sustainability rankings (UConn 2013), with aggressive initiatives in green building, climate action, and alternative energy research. However, the single- minded and super-sized focus on initiatives such as LEED-certified buildings and low-impact development (LID) stormwater management, has created a bewildering lack of integration and coordination with the greater whole of the campus physical environment and social community.

A catalyst for the intense focus on water quality and LID's was the issuance of a Total Maximum Daily Loading analysis from the Connecticut Department of Environmental Protection in 2007. This study was the first of its kind in which the compromised quality of water discharged from one of two major campus watersheds into Eagleville Brook was evaluated and linked to the growth in campus impervious cover (U.S. EPA). The apparent directive of the study was to reduce impervious cover, and there has ensued a flurry of projects all over the related campus watershed area which are aimed at this single goal.

GOALS AND OBJECTIVES

The U.S. Environmental Protection Agency (EPA) has turned its promotion of green infrastructure to the attention of colleges and universities with its first ever 2012-13 Campus Rainworks Challenge student design competition. With a decided focus on the more specific stormwater management definition of green infrastructure, the EPA's general goals are to:

- "engage students in assessing the technical and economic potential of green infrastructure solutions on college and university campuses
- provide hands-on, interdisciplinary learning experience through which students and faculty gain practical experience that they may apply in their future practice; and
- promote the use of green infrastructure practices that provide multiple environmental, social, and economic benefits on college and university campuses." (U.S. EPA)

The Campus Rainworks Challenge was used as a class project for a senior undergraduate landscape architecture studio focused on community planning and sustainable design in fall 2012. Particular to our project submission for this competition, the students were directed by the instructional team to provide an alternative to the current approach to campus planning and design where:

- stormwater management concerns are separated from other campus landscape systems such as vegetation, circulation and wayfinding and
- individual sites' stormwater regimes are treated in a vacuum and not considered in their larger context

- the potential for using the campus landscape as a vehicle for teaching, research and outreach in sustainable design is under-realized

As such, the primary goal is to **frame a holistic greenways approach to campus green infrastructure development**. Specific objectives toward this goal include: 1) developing a general analysis of watershed-level opportunities and constraints; 2) identification of key stormwater problems and innovative successes at specific sites, 3) identification of important connective cultural and ecological corridors 4) integration of the concerns and prior planning work from the of existing campus masterplan, landscape masterplan, LID implementation sites.

Secondary goals for the project include:

- Exploration of a metrics system for supporting a greenways approach to campus stormwater management through both conventional metrics regarding water quality,

- Examining methods for interdisciplinary approaches to green infrastructure by comparing and contrasting the work of two different submissions from UConn

- Developing a **pedagogical framework** for presenting greenway planning and green infrastructure design in an integrated fashion through analysis of a pilot campus planning project in a senior undergraduate landscape planning and design studio in fall 2012

Methods

The project was structured around a two-step process:

1) **Large--group program exploration, watershed inventory & analysis, and framework development** The entire class of 14 students was divided into two teams, each covering one of two main campus watersheds (one being the westerly Eagleville Brook subject of the TMDL study, the being the easterly Fenton River watershed). The intent of the first part of the project was to allow the students to study the concept of green infrastructure, the specifics of the design competition charge, and the campus context for both general planning and design, as well as for stormwater management, in order to develop conceptual planning frameworks, and specific program ideas. During this phase, strategies for collaboration and stakeholder involvement were explored. Students met with various campus planning and stormwater experts, and the possibility of partnering with a small team of interdisciplinary students also engaged in the competition was explored.

2) **Masterplan synthesis and development** In the second part of the project, a smaller group of six students were identified to evaluate the initial planning framework and program ideas, and develop one unified plan. By this time, the other interdisciplinary team which we had considered working with had decided on a small site-based project in one of the dormitory complexes, as opposed to our larger scale masterplanning approach. The students continued to engage with campus planning professionals and stormwater experts involved in the existing LID and TMDL initiatives to integrate the concerns of each. The required products for the competition were produced from the resulting masterplan vision, including a three minute video, a 12 page narrative and two competition boards.

Results

The stormwater masterplan vision that was developed out of this process addresses the entire main campus, including both watersheds that were studied. The final products outline and refine much of the early analysis, articulate a program based on the analysis and a theoretical framework , and provide a specific and detailed layout of the masterplan elements:

Analysis and Program Development

The context analysis locates the campus at the divide of two highly impacted watersheds. Two central waterbodies on campus act as primary sinks for stormwater and disperse their outflow into the Fenton River and the Willimantic River respectively. The aim of the overall project was to develop a series of treatment trains that would clean runoff in a linear and progressive manner before impacting downstream, off-campus areas. Important existing BMP projects were located and linked with a series of additional proposed stormwater projects to act as connective tissue which would overlay with a greenway system of primary campus landscape corridors and nodes. The composition creates an integration of stormwater, wayfinding, and public engagement and awareness.

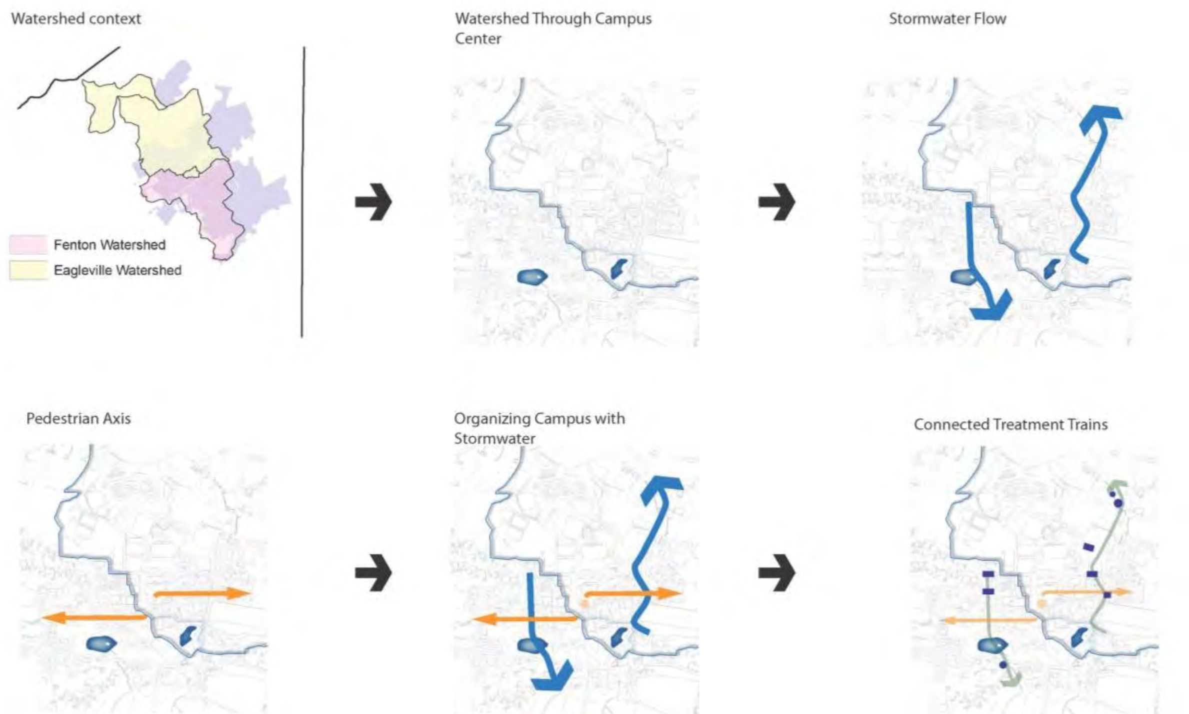

Figure 1 Analysis and program development: watershed-scale stormwater, pedestrian systems.

A **theoretical planning framework** for organizing and giving hierarchical form to the stormwater/ greenway system was developed in which the concept of *density* (building coverage, massing and impervious cover) was examined in relation to the form and function of *greenspace*. (Figure 2) Rural college campuses, as exemplified by UConn, have typically developed and evolved slowly over time into concentric rings of density. High density development occurs in the center of the campus, perhaps with some socially significant outdoor spaces, but relatively little integration of ecologically functional greenspace. Surrounding the high density district a medium density district incorporates more greenspace, though often a pastoral or ornamental approach to landscape form is adopted which is counter to the form and function of typical BMP's and LID's which may be inserted there. The low density external ring is often marked by larger open green spaces and large remote parking surfaces. Generally speaking, these rings are relatively discrete and unrelated to each other, except perhaps through circulation.

In the new model for the density/greenspace relationship, an ecologically functional greenspace node becomes the heart of the campus, integrating social use and meaning with visible natural systems form and function, including stormwater flows and collection. In addition to the ecological services benefits, the integration of ecological and social space can lend a restorative capacity to the space which is often absent in highly competitive and stressful academic environments: "The central core of many of our universities have reached densities of urban proportions, which prompts physical and mental stress. Carefully designed open space provides a welcome contrast to the compact academic core", according to the Journal of Higher Education. To accommodate an expanded central green node, core and medium densities are reinforced with compact infill development to further define and optimize the functional and organizing greenspace. This node extends as connective greenways, or corridors, that link through density rings, and integrated with pedestrian and vehicular circulation route, to the outlying rural landscape matrix. As aging facilities become renovated or replaced, building systems and campus landscape interfaces can be adapted to contribute to this new connective infrastructure of greenspace.

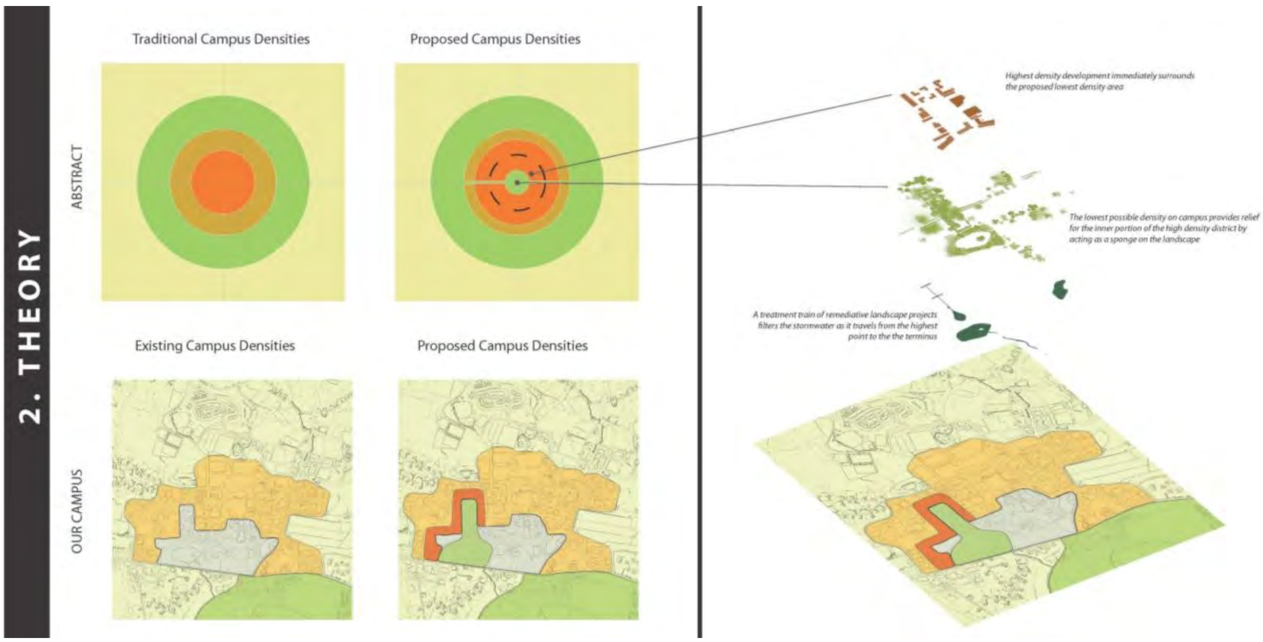

Figure 2 Theoretical framework: campus density and greenspace relationships.

Masterplan Layout (Figures 3 and 4) Applying this general program and theoretical framework to the layout of the UConn campus takes the form of first identifying the optimal greenspace core. The selected core area is centered on a natural landscape remnant in an underutilized part of the current medium density core, known as the Oak Lawn, which provides a direct link to the campus' most important water body, Mirror Lake. This shift to the southeast of the current core, also brings the campus green infrastructure core closer to the new town center core nearby, while still allowing the current main quad to remain as an ancillary node. The campus density districts are shifted (through infill and functional open space creation) to create the highest density district to surround the new greenspace core- to become known as the Oak Lawn Waterway. Plans for new student recreation facility and School of Fine Arts expansion provide needed program for the new density. The waterway function of this space will perform as a sponge for the new high density surrounds.

The second part of the system involves the corridors which extend out from the new core along the existing campus cross-axial pathway system which provide a visual, experiential and functional linkage of the stormwater treatment elements.

Comparative mapping of pre- and post-design stormwater greenway systems are shown in Figure 5. Quantitative analysis of the proposed reductions in impervious cover and resulting stormwater volumes were compared to pre-design conditions (Figure 6).

Project #	Description
1A	Use curb cuts to direct run off onto vegetated slope.
1B	Redirect stormwater towards oak lawn.
1C	Redirect stormwater towards oak lawn.
1D	Add five stories on the existing buildings and increase tree canopy.
1E	Remove existing cottages and increase tree canopy.
1F	Install retention basin near the bottom of oak lawn. The retention basin would collect sediment that can be removed before entering the lake.
1G	Create a constructed wetland on the edge of the lake nearest the interstate. Designed 1 ft. water level rise by replacing existing dam with a v notch weir.
1H	Create a vegetated berm adjacent to wet meadow to treat stormwater and create a buffer between active grazing by live stock and the wet meadow habitat.
2A	Construct a v notched weir prior to the brook being piped underground. The weir would create awarness about the brook and serve as a visual education oppurtunity about the brook being piped underground through the university campus.
2B	Use a bioretention median to collect run off from the road. The median would also increase pedestrain safety by concentrating opportunities to cross the road.
2C	Recommend the implementation of the existing LID project designed by the Department of Architecture and Engineering Services.
2D	Daylight the storm pipe between the parking garage and North Eagleville Road.
2E	Increase the size of the storm grate over the eagleville brook to increase awarness of the underground brook
2F	Use retention pools along eagleville brook to control water flow. Paths and user areas along the brook will increase awarness of LID projects and create an entrance to the campus.
3A	Increase the amount of vegetation to slow down runoff into Mirror Lake.
3B	Lawn restoration
3C	Remove the existing cottages and increase tree canopy.
3D	Planned project with LID features
3E	Existing building with LID features
3F	Existing building with LID features
4A	Nucleous of the pedestrain axis
4B	Existing green roof
4C	Existing bioretention
4D	Existing dry well
4E	Grade the quad at 2% toward bioretention. The bioretention will create a stronger edge of the quad. Increase tree canopy within the quad and use organic landscape maintenance techniques to restore the lawn.
4F	Use a rain garden to collect run off from the roof of the Center for Performing Arts.
4G	Future project with LID features
4H	Reforest the lawn behind the parking garage.

Figure 3 Masterplan diagram: central open space core, shifted density districts, stormwater treatment trains and pedestrian corridors.

Figure 4 Illustrative Masterplan

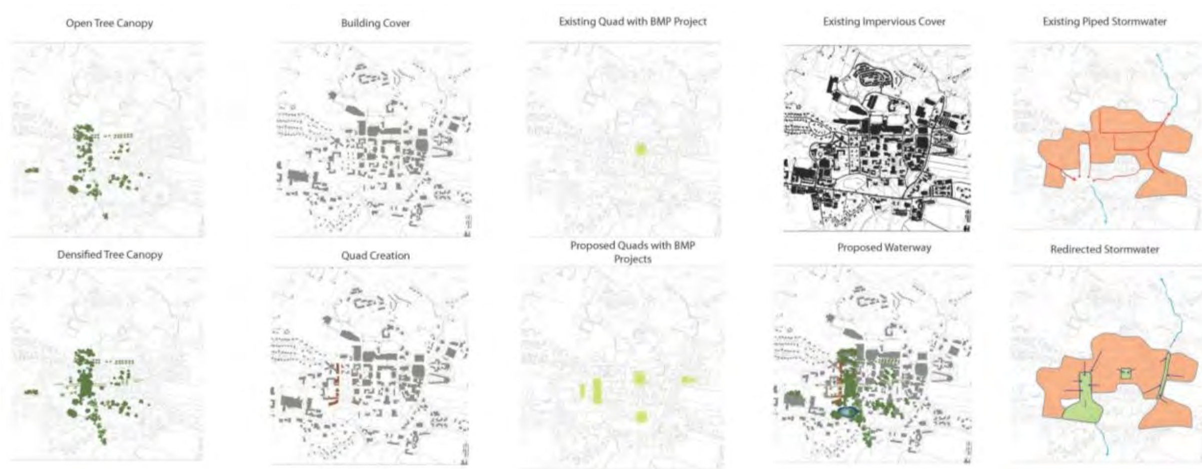

Figure 5 Comparison of pre-design and post design landscape and stormwater systems.

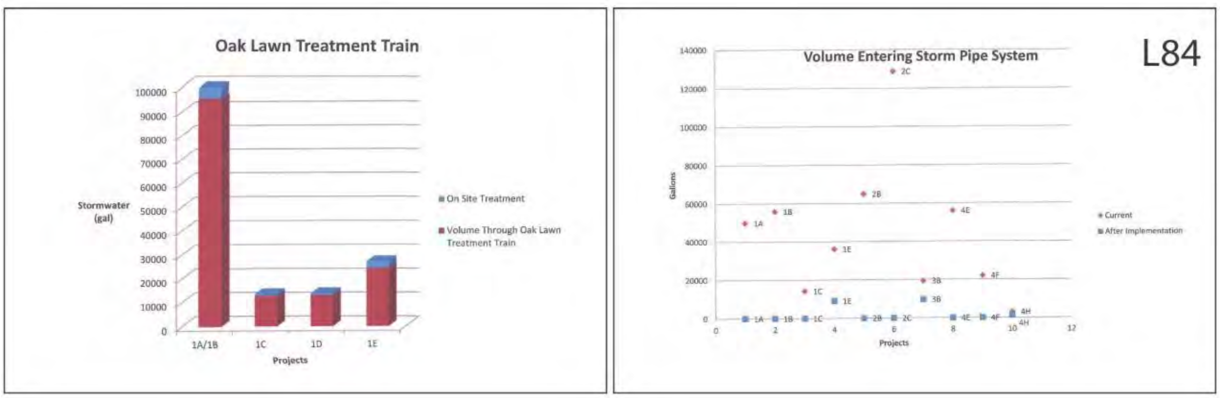

Figure 6 Analysis of Oak Lawn Waterway capacity and comparison of pre- and post-design piped water volumes.

Discussion and Conclusion

Campus landscapes have long been prized for their pedestrian experiences and cultural landscape typologies such as the quadrangle and the lake. The UConn Stormwater Masterplan demonstrates that the contemporary interest in sustainable campus development and green infrastructure can be effectively and efficiently pursued by integrated planning of primary pedestrian systems, social spaces, stormwater systems and vegetated landscapes. Utilizing the greenway concept of interconnected landscape nodes and corridors works well as a mechanism for this integration and realizes the more holistic potential of green infrastructure, which is often overlooked and undervalued. Campus planning staff at UConn have shown interest in pursuing a stormwater masterplan concept based on the students' vision, independent of the competition outcome.

In terms of interdisciplinary collaboration and pedagogical models it is interesting to compare the outcomes of the two teams that submitted to the EPA competition from UConn. The interdisciplinary team, which included natural resource science, engineering, landscape architecture and economics students, was led by engineering and natural resource faculty. Their result was a small site design that focused completely on stormwater treatment. The landscape architecture student reported feeling frustrated by the lack of social and contextual considerations given to the final design. Conversely, the masterplan vision detailed in this study, conducted by landscape architecture students and faculty, was driven by landscape planning and integrated site design approaches. Although engineering and campus planning consultation was conducted throughout the process, the desire and need for more effective and substantive collaboration and exchange was expressed during and after the process. Successful and well-balanced interdisciplinary processes and exchange are critical to both the enterprise of sustainability education as well as the function and perception of sustainable campus environments.

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"But how do we get to the Greenway?"— a multi-disciplinary, multi-jurisdiction, multi-modal strategy to increase connections to the Charles River Basin

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Introduction

The world-famous Charles River Reservation lines both sides of its majestic river for 8-1/2 miles in greater Boston. Created as a State Reservation between 1910 and 1936, this beautiful urban greenway contains continuous, longitudinal paths that serve as "trunk routes" for non-motorized transportation, hourly serving as many as 10,000 cyclists, pedestrians and runners. However, narrow bridges and urban land uses abutting the Reservation (high-volume arterial roads, railyards and car-oriented streets and businesses) present major barriers to access from the adjacent communities and to the greenway and the river.

This paper presents the draft findings and specific strategies of a "Pedestrian and Bicyclist Connectivity Study." It was commissioned jointly by two state agencies—(a) the Massachusetts Department of Transportation, which has primary jurisdiction over the Charles River roads and bridges in the study area; and (b) the Massachusetts Department of Conservation and Recreation, responsible for care and control of the Charles River Reservation.

The Study was prepared between 2009 and 2013 by a team led by the Boston landscape architecture firm of Halvorson Design Partnership, with Alta Planning + Design, multi-modal planners and HDR Engineering, civil engineers.

The research design involved a rigorous, data-driven methodology that analyzed existing "bike-ped" infrastructure and trip generators. The study also assessed the nature and location of barriers to access in and around the Reservation, and the ten bridges that traverse it.

A "toolbox" of 22 specific measures with potential to improve connectivity for the Charles River Reservation was developed.

The overall goal of this project is to improve the quality of life for tens of thousands of people who live or work within walking, running, skating or bicycling distance by increasing use of the greenway as a transportation and recreational resource. Accordingly, more than 100 specific improvements in the approaches to (and river crossings within) the greenway were identified to enhance pedestrian and bicycle connectivity to the adjacent neighborhoods, many of which currently have limited or missing connections to the river. (See Figure 1.)

Changes in the Charles River Basin area do not occur in isolation: roadway projects, new trails and greenways, and renovated bridges are being implemented throughout the region. Non-motorized mobility initiatives, programs and policies are already encouraging a more diverse mix of travel patterns and behaviors, helping the region to move towards a “mode shift” away from private automobiles to more sustainable modes.

[This is happening in Cambridge and Boston already, as each city continues to improve the walking environment, promote universal accessibility and develop a network of integrated bicycle facilities. A notable example of this phenomenon is the implementation in Boston of “Hubway,” a city-wide bicycle sharing system, sponsored by New Balance and operated by Alta Bike Share. In its first 16 months of operation, Hubway recorded more than 675,000 separate trips. 2012 saw the expansion of the system to neighboring Cambridge and Somerville and plans are underway to add Hubway stations and bikes to Brookline, as well. All four municipalities are working with Massachusetts Department of Transportation, Metropolitan Area Planning Council, Massachusetts Bay Transportation Authority and the Federal Transit Administration to continue to fill and expand the system in the Metro Area.]

Background

The eight-and-a-half mile stretch of the Charles River from Watertown and Newton down to Cambridge and Boston is the convergence of the region’s built and natural environments. As the River approaches Boston Harbor, it passes through communities of increasing density.

The path systems that frame each bank and the thirteen bridges across the river comprise a network of popular multi-modal routes—a critical nexus in the metropolitan transportation network.

However, while some of the surrounding urban areas feature well-established bicycle and pedestrian links to the Reservation, many have fragmented or nonexistent connections. (See Figure 3.) This is due to the presence of the adjacent, moderate- to high-speed parkways, the Massachusetts Turnpike, auto-oriented streets and land uses, rail yards, and potentially dangerous intersections. Such barriers that can be particularly discouraging to young families on foot and cyclists with less experience—user groups for whom the greenway would otherwise be very attractive.

Extensive empirical data regarding volumes of non-vehicular trips is being collected by the Project Team at 25 locations. Day-long user counts have been conducted twice a year on weekends and weekdays since 2009. (See Figure 4.) These user count surveys have revealed significant and increasing levels of use —during peak hours, eight to ten thousand people are walking, running, jogging or skating in the Basin.

People use the paths for both recreation and transportation. It is important that the connectivity recommendations address the needs of all users, including those who are less experienced with urban bicycling and walking.

Overuse of the current path system—together with the preference of many runners not to run on pavement—has resulted in multiple ribbons of bare dirt in the green spaces along the river. These “goat tracks,” in turn, cause additional erosion, runoff and maintenance issues.

Regional context

The path system along the Charles River Basin is the backbone of region-wide greenway network in Eastern Massachusetts. (See Figure 5.)

Greater Boston is also blessed with a network of green spaces, trails and parkways that date back to the regional planning efforts Charles Eliot and Frederick Law Olmsted's more than 100 years ago. Called Boston's "Green Routes" by local advocates, many of these regional feeder corridors are currently barred from access to the Charles River Basin by busy parkways, highway overpasses and railyards. The Charles River Basin greenway needs to be understood in this context to appreciate fully the need to improve pedestrian and bicycle connectivity throughout the corridor.

In aggregate, the connectivity recommendations in this report will help to create safe, attractive, and seamless non-motorized connections across the metropolitan area. By promoting connections to the Emerald Necklace, the Boston Harborwalk, the Minuteman Rail Trail (through Bedford, Lexington and Arlington to Cambridge, Somerville's Community Path and the long-distance East Coast Greenway, the Basin will become an even more critical piece of the green "web." This will almost certainly increase the numbers of people walking, running, bicycling and skating for recreation, commuting and utility trips and reduce the region's dependence on motor vehicles for transportation. In consequence, the improved greenway corridors will become a critical component of the Commonwealth's commitment to lessen greenhouse gas emissions and improve public health.

Related studies undertaken by the Study Team

The Connectivity Study consultant team has been working with MassDOT and DCR on site analysis, planning and conceptual design since 2009. These efforts have generally fallen under the umbrella of the Charles River Basin Pedestrian and Bicycle Study for Pathways and Vehicular Bridges.

Since the Fall of 2009, the team has and published the semi-annual user count data in a memo available on the MassDOT website. This non-motorized user count effort is currently planned to continue through Spring 2014, which will provide MassDOT and DCR with a total of over 5 years of count data.

In June 2010 the team published the Charles River Basin Existing Conditions Report, which provided an overview and analysis of the existing condition of the pathways, bridges, and bridge approaches on both sides of the river.

In April 2011, the team published the Leverett Circle Pedestrian and Bicycle Crossing Study. This study includes an evaluation of the potential at-grade and grade-separated options for better pedestrian and bicycle connectivity in the congested Leverett Circle intersection.

The team has also been involved with the ABP projects, by participating in the Longfellow Bridge Task Force and giving feedback on the River Street, Western Avenue, Anderson and Craigie Bridge designs to each bridge team.

The Connectivity Study effort has been made possible by the support of Massachusetts Department of Transportation (MassDOT) and the Department of Conservation and Recreation

(DCR). The team has also worked consistently with the Solomon Foundation, collaborating on design recommendations for Greenough Boulevard and Charlesgate improvements. This included the team's analysis and recommendations related to a potential new traffic signal on the Harvard Bridge, in conjunction with the Foundation's effort to create a path connection through the underutilized DCR parkland between the bridge and the Bowker Overpass.

Goals

The project has three primary goals:

- promoting walking and bicycling as viable transportation options in the Boston metropolitan region;
- highlighting the recreational, environmental and cultural opportunities within the Reservation;
- making the Reservation accessible for all users.

Methods

The study began in August 2011 with a bike tour of the Basin with representatives from MassDOT, DCR, consultants and local bicycle and pedestrian advocates. Public workshops were held in October 2011 to introduce the study and get preliminary feedback on connectivity issues in the Basin. The team also met with city officials of Boston, Cambridge and Watertown to ensure that the report reflected relevant planning efforts from those municipalities.

The team conducted a detailed inventory and analysis of existing conditions throughout the study area. In addition a comprehensive analysis was prepared of locations and districts that generate trip demand for pedestrians and/or bicyclists in the area. These two analyses were compared and used to generate information about specific locations of gaps and problems for connections to the greenway. Case studies were undertaken of comparable situations nationwide, and an extensive photo inventory of conditions was created.

Mid-way through the project, a broadly publicized series of Public Information Hearings were conducted by MassDOT, Highway Division, DCR and the project team. Held on successive Tuesdays, the well attended hearings were held at Shriners Hospital, in Boston, Morse School, in Cambridge, and the community rowing facility, in Brighton. The discussion covered the background and goals of the study, results of the existing conditions analysis and three years of user counts, coordination with the Commonwealth's Accelerated Bridge Program, the pedestrian and bicyclist "toolboxes" of available improvement measures and the Study's preliminary recommendations.

These hearings were important. Comments from the meeting attendees and stakeholders provided critical feedback, which has been factored into the Study's final recommendations.

Results

This comprehensive study generated three categories of results:

- 1. Findings
- 2. “Tools” appropriate for the Charles River greenway situation
- 3. Recommendations

Each of these aspects of the study results is discussed separately below.

Results – Part 1. Findings

Existing infrastructure

The existing bicycle and pedestrian infrastructure within and connecting to the Charles River Basin currently includes sidewalks, crosswalks at both signalized and non-signalized intersections, pedestrian overpasses and underpasses, multi-use paths and limited on-road bicycle facilities. (Figure 6.).

While this infrastructure provides pedestrian and bicycle connectivity to the open-space and path system within the Basin, there are also barriers that deter easy passage. The most significant deterrent are the parkways that line the river, typically four-lane roadways with limited intersections and traffic speeds in the range of 30 to 60 mph.

Additionally, the Massachusetts Turnpike and the rail yards in Allston provide no easy way across or around them. City streets that may have once, provided a link to the river are disconnected because of the roadway infrastructure developed in the decades after World War II. Other barriers are the bridges themselves. Some do not provide connections to the adjacent riverfront path while others contain inadequate sidewalks that lead to potentially dangerous intersections.

Because of these barriers, the number of non-motorized users with the Charles River Basin varies significantly. While fluctuations in the use of the system can be expected along an eight-mile river corridor due to land use, density, etc. the working assumption of this study is that connectivity improvements will, in fact, induce additional use of the Basin’s paths and bridges by walkers and bicyclists.

Trip generators in and around the basin

In addition to looking at the existing physical infrastructure in and around the Basin, connectivity can also be evaluated by understanding the latent demand. The Study documented myriad origins and generators of pedestrian and bicycle activity within study area. These include:

Academic

- Three major university campuses along the river: Harvard University, Boston University and the Massachusetts Institute of Technology (MIT), with a combined student population of nearly 70,000;
- Dozens of smaller colleges, primary and secondary schools;

Commercial

- Major retail districts, including Boylston/Newbury Street in Boston and Cambridge's Central Square and Harvard Square;
- Hundreds of workplaces;

Transportation

- MBTA stations, especially Red Line heavy rail that attracts over 170,000 daily riders, Hubway stations and North Station Commuter Rail;

Residential uses

- Nearby neighborhoods of Beacon Hill, West End, East Cambridge, Cambridgeport, Back Bay, Allston, Brighton and Watertown that include residents who utilize the Basin regularly for both transportation and recreation

Recreation

- Nine boathouses along the river, which provide access for rowing, sailing and other water recreation enthusiasts;
- The parkland of the Charles River shoreline throughout the Reservation; including such specific destinations as the Hatch Shell, Magazine Beach, The Esplanade; the new Esplanade Playspace for older children and "Christian Herter Park;"
- "Riverbend Park," which is not a park per se, but an innovative management program that shuts out vehicular use every Sunday from April to October on two stretches of the Memorial Drive parkway in Cambridge'
- Events year round, including concerts, especially the Boston Pops Fourth of July Celebration, movie nights and fund-raising "walks" year-round;
- Historic and cultural landmarks including Fenway Park, the Boston Public Library, the State House, and the Museum of Science; and
- Other major parks and open spaces in the area, such as Boston Common and the Public Garden, Back Bay Fens, and Mount Auburn Cemetery are major destination parks in the area.

Figure 6. illustrates the activity generators listed above, indicating graphically where existing and future demand for pedestrian and bicycle infrastructure.

Gaps + problem areas

By overlaying maps of the Existing Pedestrian/Bike Infrastructure and the Generators of Pedestrian/Bike Activity, a series of problem areas are apparent. These problem areas (Figure 7.) should be enhanced to meet safety needs as well as existing and future demand. Examples of these improvements include:

- Bridges that do not provide safe and convenient access to the linear path system;
- Long stretches of parkways without traffic signals or well-designed crosswalks;
- Locations where highways, on/off ramps and other roadway infrastructure create barriers to the river from adjacent inland areas.
-

Results – Part 2. Appropriate tools for enhancing Charles River greenway "connectivity"

Pedestrian facility toolbox

Improving the quality of pedestrian facilities means increasing connectivity, designing for all users, and providing amenities to increase attractiveness. In addition, improvements should emphasize safety, particularly at crossings and intersections.

There are a wide range of tools that can be deployed in the Charles River Basin and adjacent neighborhoods to improve pedestrian accessibility and experience. (Figure 8.)

- Improved sidewalk connections
- Universal access curb cuts
- Interpretive and wayfinding signs
- Shared use paths, with adequate width
- Amenities, such as seating and shade
- Pedestrian count-down crossing signals
- Raised crosswalks and median "refuge" islands
- Paved paths with a separate, parallel stonedust path
- Tighter curb radii at corners
- Streetscape/landscape improvements
- Traffic calming

Bicycle facility toolbox

There are also a wide range of bicycle facilities that can dramatically enhance bicycle safety, accessibility and experience crossing the parkways into the Reservation or in the neighborhoods adjacent to the Charles River Basin.
The elements shown here are consistent with the AASHTO Guide to Bicycle Facilities, the AASHTO Manual of Uniform Traffic Control Devices, and the NACTO Urban Bikeway Design Guide. (Figure 9.)

- Bike lanes
- Buffered bike lanes
- Contra-flow bike lanes
- Two-stage turn-queue boxes
- Colored pavement paint
- Shared lane markings
- Cycle tracks
- Bicycle- and pedestrian-only bridges
- Bicycle boulevards
- Signs for wayfinding and orientation
- Roadway-to-bridge transitions

Results – Part 3. Draft Recommendations

The planning-level recommendations developed through this Study include more than 100 site-specific proposals. (See Figure 10. for example.) It is anticipated that they will occur incrementally—designed, funded and implemented over time, in the context of MassDOT's Accelerated Bridge Program projects, the City of Boston's Bike Master Plan, the Esplanade 2020 Plan and DCR's on-going maintenance, management and upgrades of pathways and parkland within the Charles River Reservation.

General recommendations that apply throughout the Basin include:

- DCR should strive to develop a 10'-wide paved path with a parallel soft-surface trail or shoulder for runners where possible. All path widening projects must take into consideration the value of the Reservation as a natural resource. Exceptions to the path-width standards should be made in the presence of historic landscape, riparian habitat or large and mature trees. In "pinch point" conditions, a min. 8' paved path with 3' shoulder on one side should be incorporated.;
- Traffic signals should be examined to determine if concurrent or exclusive pedestrian phases are appropriate. Exclusive signals are recommended where feasible;
- A wayfinding study should be conducted to identify type and location of wayfinding signage to enhance pedestrian and bicycle connectivity and to support environmental stewardship, education and interpretation;
- Branding the pathways along the Basin as the "Charles River Greenway" to support the concept of green infrastructure as an integrated element of the Basin's conservation strategy;
- Regular maintenance of the paths throughout the Reservation is essential to their continued success as a transportation, conservation and recreation corridor.

Other draft key recommendations include:

- Numerous streetscape enhancements are recommended in Watertown and Newton along roadways that should connect directly to the Reservation, but currently do not;
- A new ADA-compliant footbridge over the Charles River that connects Newton and Watertown, providing additional opportunities for walking and bicycling loops between the Galen and North Beacon Street bridges;
- New crosswalks, roadway geometry and bike lanes on or adjacent to the North Beacon Street Bridge;
- The lane reduction of a mile-long stretch of Greenough Boulevard that provides the opportunity for new parkland and paths that form an integrated loop with Herter Park on the south bank of the river;
- A road narrowing along Memorial Drive between Mt. Auburn Hospital and John F Kennedy Park in Cambridge that improves connections to Brattle Street and provides space for separated paved and soft-surface paths;
- Long-term recommendation for providing the link from the Boston University Bridge to the Esplanade, incorporating the rail trestle that may be redeveloped as a part of the Grand Junction trail project;

- A plan to re-connect the Esplanade with the Emerald Necklace, utilizing a new path through DCR-owned land adjacent to the Bowker Overpass, paralleling the Muddy River and along a widened sidewalk of the viaduct over the Mass Pike;
- Previously planned improvements as part of the Memorial Drive Phase II project that will widen the existing path adjacent to the seawall, introduce a parallel soft-surface path in places and planting of additional trees;
- A mix of enhancements to improve connections from the Albany and Sidney Street corridors in Cambridgeport to the river using shared lanes, signage, an improved at-grade railroad crossing and new paths through Fort Washington Park;
- In conjunction with the planned improvements to the Longfellow Bridge through MassDOT's ABP, new traffic signals and crosswalks to link the Broad Canal path to Cambridge Parkway;
- Bicycle connections through Charles Circle that will include green bike lanes, enhanced signage and frequent shared-lane markings on the Boston end of the Longfellow Bridge and a new non-motorized pedestrian/bicyclist bridge/ramp providing direct access between the Bridge and the Esplanade;
- A critical link from the north to the south bank of the Charles utilizing a pair of new foot bridges along the upstream side of the Museum of Science on the old dam (one located at the point where Lechmere Canal and the River join, and the second spanning the channel connecting the Upper and Lower Basins) , ideas being explored in a preliminary study initiated by DCR;
- Building on a separate study completed by the Connectivity Study team in 2011, at-grade pedestrian and bike enhancements at Leverett Circle (with provisions for a pedestrian overpass in the future).

Conclusion

This study addressed the challenge of balancing human use and environmental conservation by enhancing the Basin's green infrastructure for non-motorized mobility in concert with improved safety, access and mobility for all walkers, runners and bicyclists. These efforts can help the region reduce air pollution, encourage physical activity, and support stewardship of the river's, natural, scenic and historic values.

The proposed changes to the Basin are intended to connect the adjacent communities, transit and Hubway stations, and create a more coherent and well-connected network of paths, sidewalks, intersections and bike facilities. These improvements are intended to manage better the wide range of uses along the river, reduce negative impacts caused by overuse of the current infrastructure, and create a greenway network that supports sustainability in the Basin. They take into account the improved pedestrian and bike facilities that have been planned and, in some cases implemented, through MassDOT's Accelerated Bridge Program (ABP).

Taken together, the recommendations of this study offer a blueprint for the Commonwealth and the municipalities of the Charles River Basin to improve the ways for everyone to "get to the Greenway"—helping to achieve the goal, set by Governor Deval Patrick and MassDOT Secretary Richard Davey, to triple walking and bicycling in the Commonwealth.

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Figures

The figures on the following pages are excerpted from the draft report of the 2013 Charles River Basin Pedestrian and Bicycle Connectivity Study.

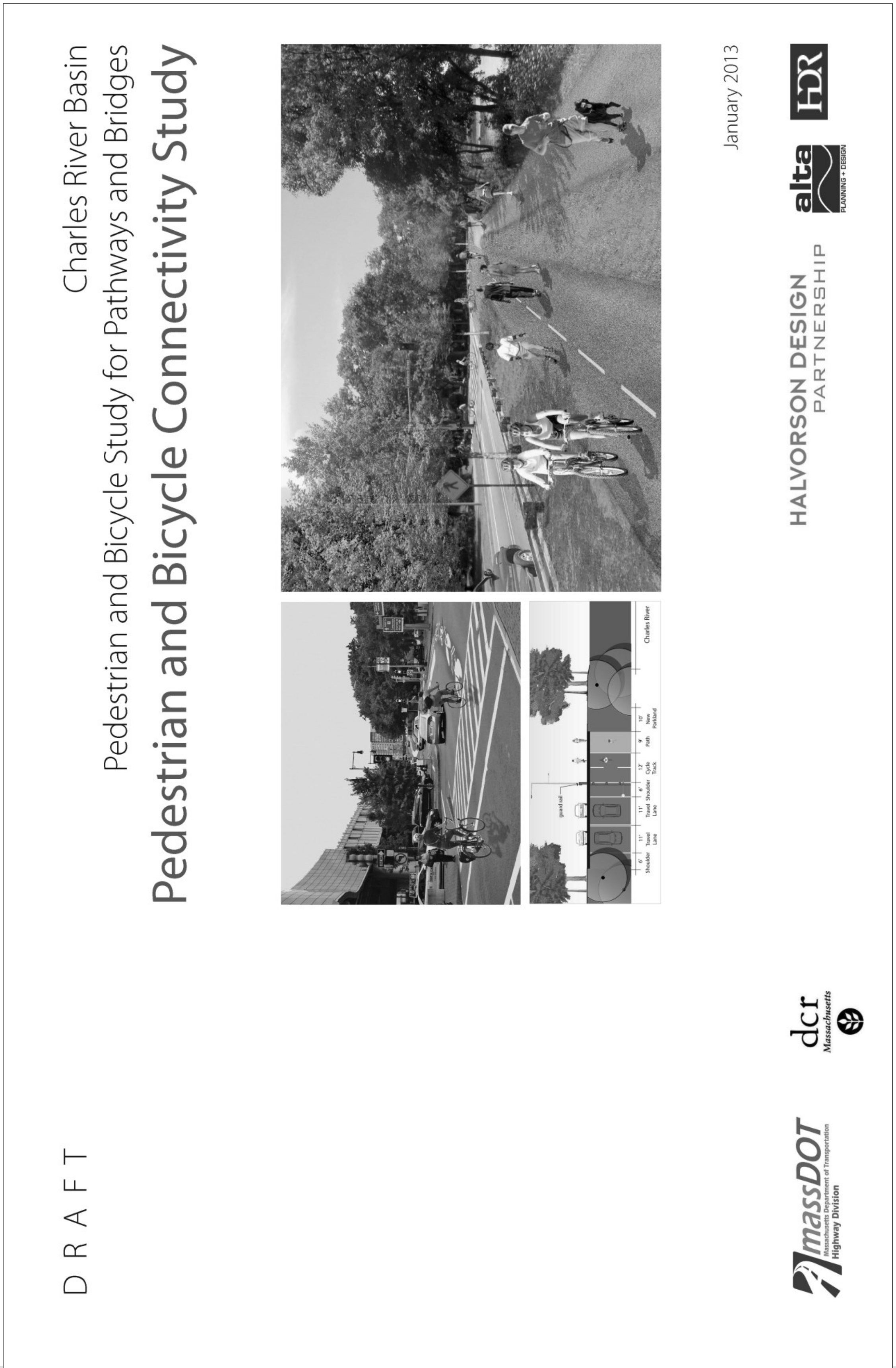
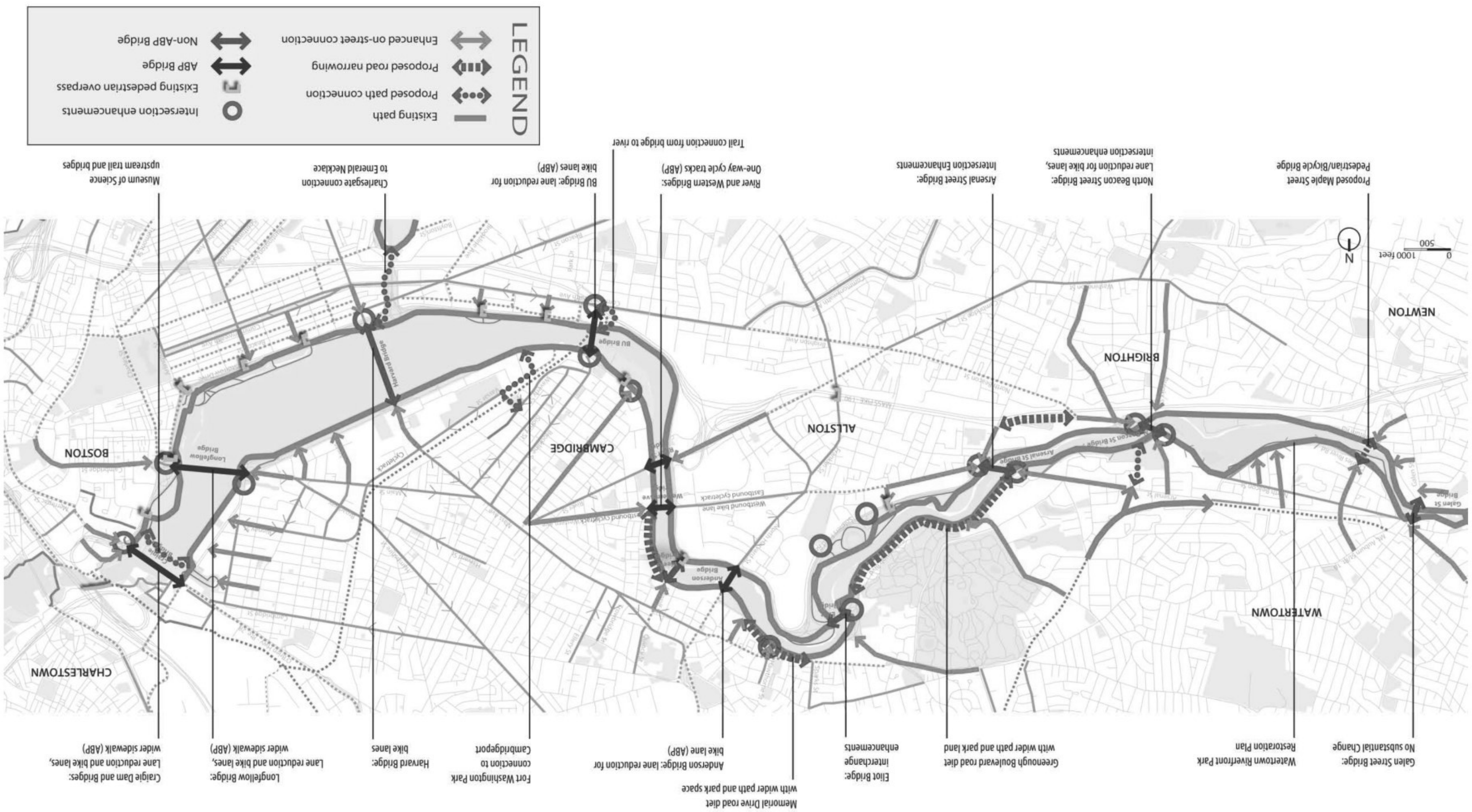


Figure 1. Cover of draft report

Figure 2. Overview of study-wide draft recommendations



Typical conditions in the Connectivity Study area

In some of the upstream portions of the Study Area, the character is more rural.

Access for pedestrians and bicyclists on the important desire line between Arsenal Mall and the River is uncontrolled and unmarked.

User-created "goat tracks" occur when users feel that the path surface provided is too narrow, too hard or both. Here, three informal paths have been created.

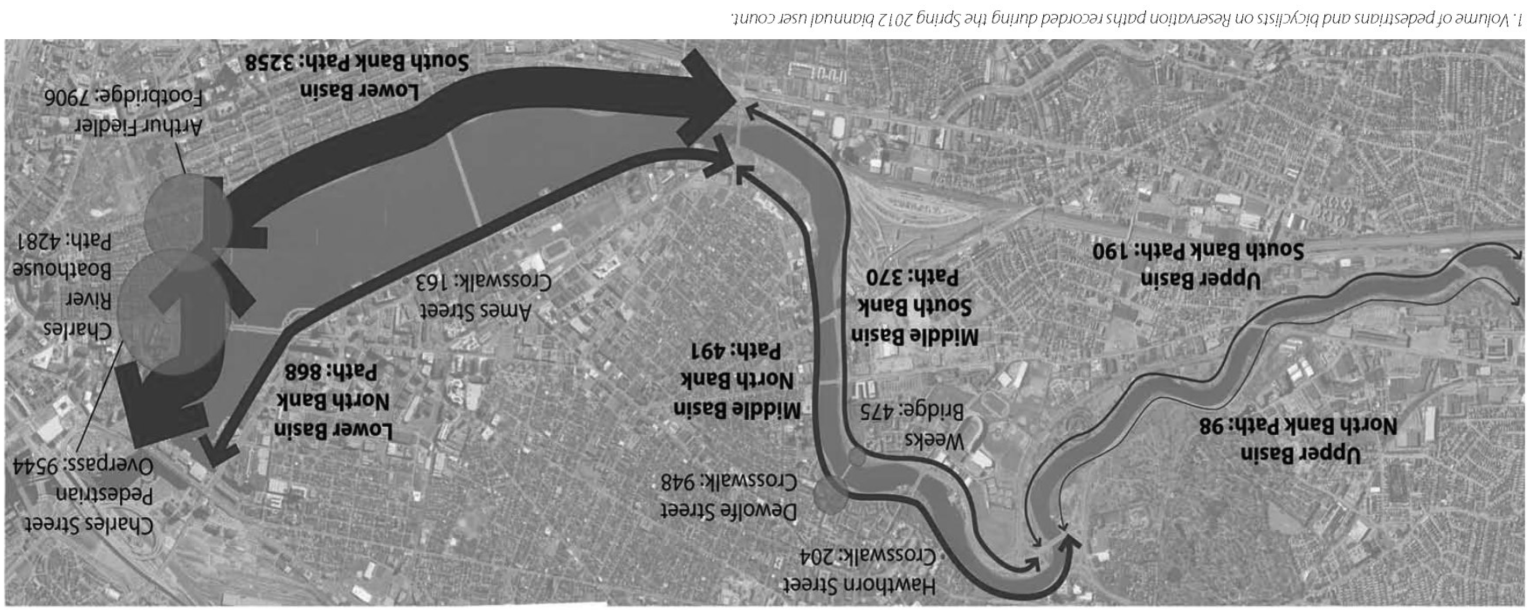
The Bowker Overpass roadway may be wide enough, relative to its anticipated vehicular use, for a dedicated zone for bicycles.

Accommodation for pedestrians and bicycles is needed on many of the the bridges over the river, as well as safe and well-marked ways to negotiate the intersections at either end. This is Charles Circle at the South Bank end of Longfellow Bridge.

A "user counter" on the Esplanade records three different types of user sharing the path right-of-way: a jogger, a cyclist and a stroller.

Figure 3. Sample of existing conditions.

Figure 4. Sample user count findings



Regional context

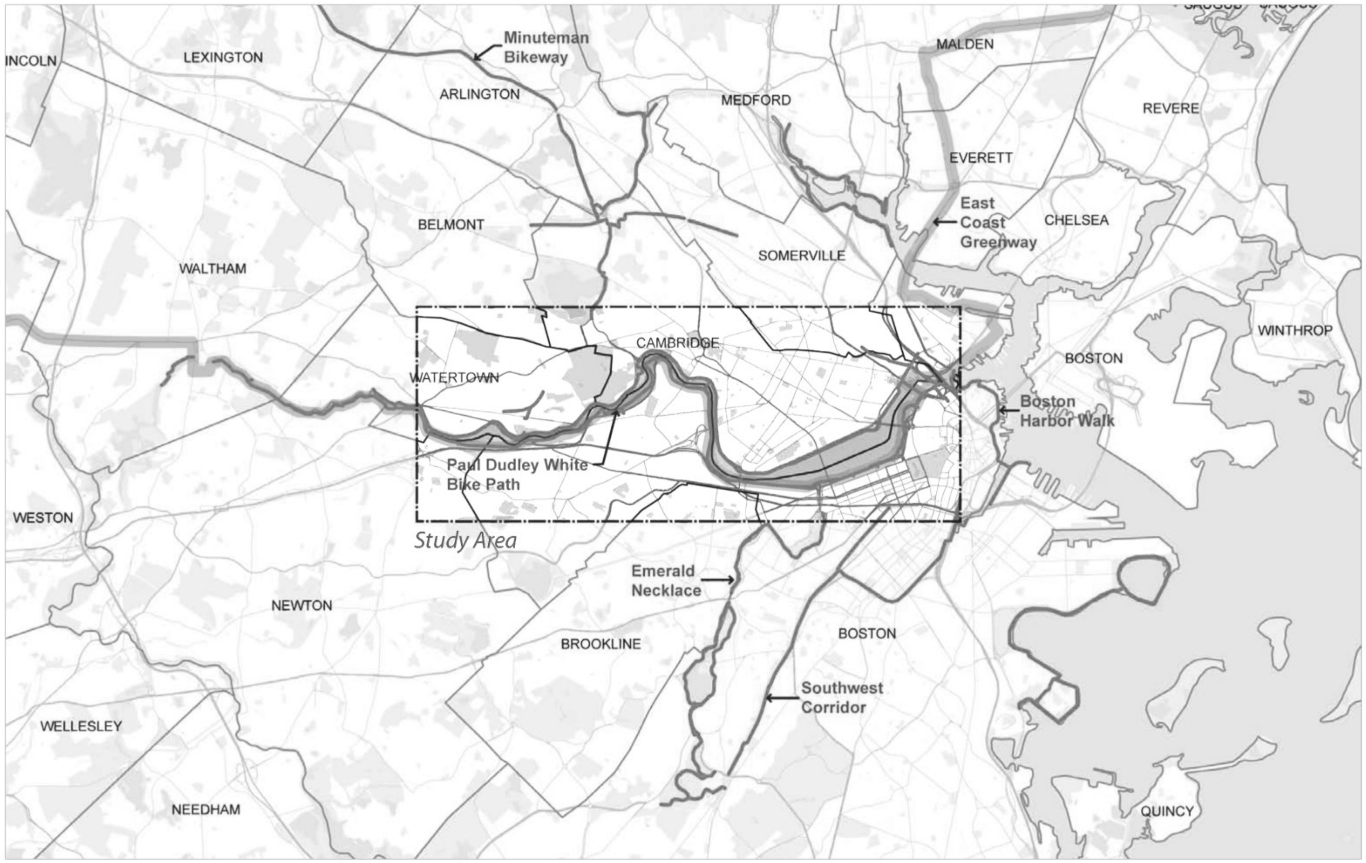


Figure 36

Figure 5. Regional greenway context

Figure 6. Findings regarding existing infrastructure + existing trip generators

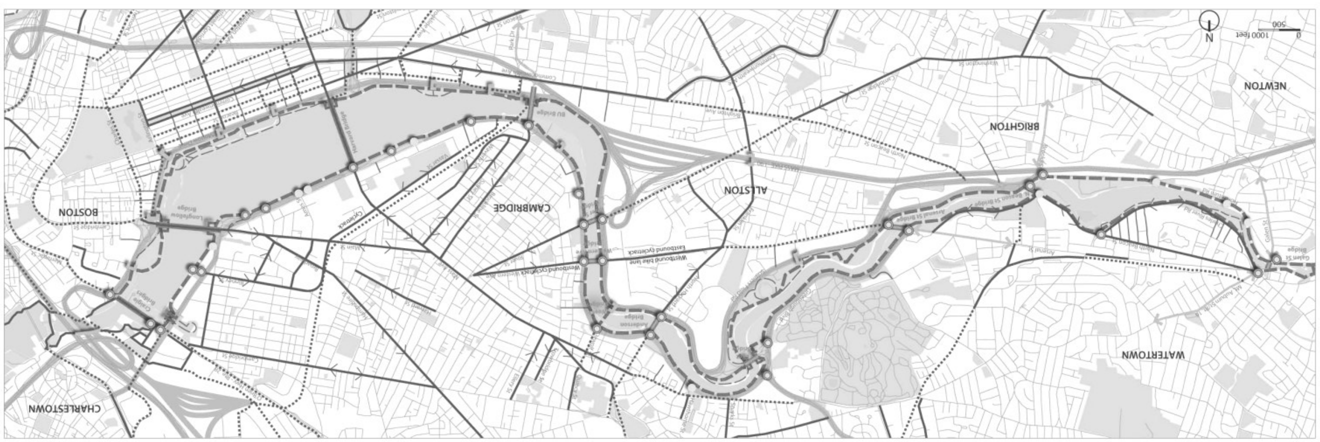


Figure 11

Existing pedestrian + bicycle infrastructure

Legend

- Signalized crosswalk
- Non-signalized crosswalk
- Pedestrian overpass
- Pedestrian underpass
- Existing bicycle facilities
- Proposed bicycle facilities
- Key bridge connection without bicycle facility
- Charles River Basin primary path
- Charles River Basin secondary path
- Sidewalks connect path across bridge
- Sidewalks and on-road bicycle facility connect path across bridge
- Highway or Railroad Barrier
- Street lacking connection to the river
- Parks

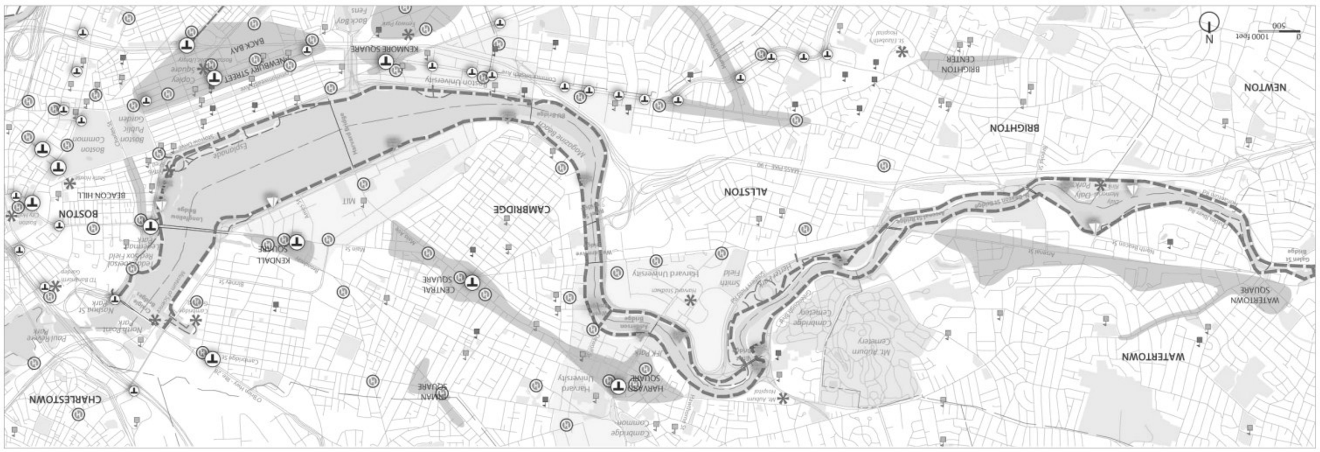


Figure 12

Generators of pedestrian + bicycle activity

Legend

- Landmarks/Destinations
- Primary School
- Secondary School
- College/University
- Large campus
- Key Retail District
- Parks
- Charles River Basin primary path
- Charles River Basin secondary path
- Boat house
- MBTA rapid transit stop
- Hubway Station
- Town Boundary

Analysis of existing pedestrian and bicycle connectivity

Figure 13

Critical connectivity gaps + problem areas

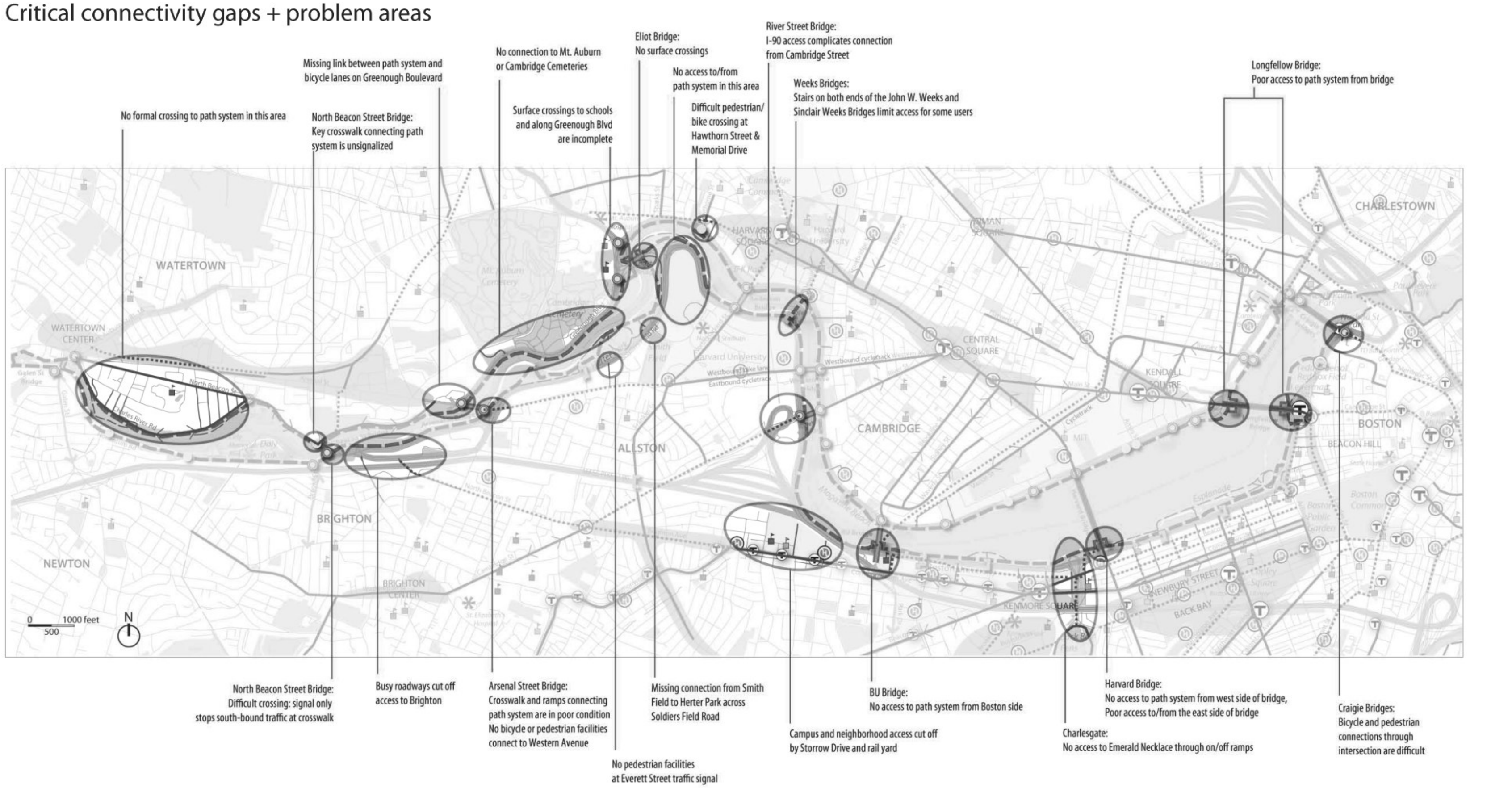


Figure 7. Composite analysis of study-wide connectivity gaps and problem areas

Pedestrian facility toolbox

Improving the quality of pedestrian facilities means increasing connectivity, designing for all users, and providing amenities to increase attractiveness. In addition, improvements should emphasize safety, particularly at crossings and intersections.

There are a wide range of tools that can be deployed in the Charles River Basin and adjacent neighborhoods to improve pedestrian accessibility and experience.

14. **Well-connected sidewalks,** *lined by street trees, create a comfortable buffer from moving or parked cars.*

15. **Curb cuts** *allow pedestrian routes to be accessible for people of all mobility levels.*

16. **Interpretive or wayfinding signage** *and mile markers help people understand the landscape around them.*

17. **Shared use paths** *along the riverfront provide tremendous amenities for cities.*

18. **Seating and shade trees** *are particularly good for the elderly or people with limited mobility.*

19. **Pedestrian countdown signals** *create predictability for pedestrians and discourage jay walking.*

20. **Raised crosswalks and median refuge islands** *improve safety at pedestrian crossings.*

21. **Paved paths with a separate stonedust track** *provide a soft-surface option for walkers and runners.*

22. **Tighter-radius-curb corners** *require motorists to slow down when taking turns and provide shorter pedestrian crossing distances.*

23. **Streetscape elements and landscaping** *help to create a strong sense of place.*

24. **Traffic calming** *measures, such as chicanes, slow traffic and improve the pedestrian environment.*

Figure 8. "Toolbox" of pedestrian-oriented measures appropriate for the Charles River Basin

Bicycle facility toolbox

There are also a wide range of bicycle facilities that can dramatically enhance bicycle safety, accessibility and experience crossing the parkways into the Reservation or in the neighborhoods adjacent to the Charles River Basin.

The elements shown here are consistent with the AASHTO ***Guide to Bicycle Facilities***, the ***Manual of Uniform Traffic Control Devices***, and the NACTO ***Urban Bikeway Design Guide***.

25. **Bike lanes** *create a designated area for cyclists alongside a motor vehicle lane and are typically used on roadways with over 3000 ADT.*

26. **Buffered bike lanes** *create additional separation from opening car doors*

27. **Contra-flow bike lanes** *allow bicyclists to ride against traffic on a one-way street*

28. **Two-stage, turn-queue boxes** *help bicyclists safely make left turns on high volume streets.*

29. **Colored paint** *or other markings may be used to increase the visibility of a bike lane as it goes through an intersection.*

30. **Shared lane markings** *provide guidance on roadways that are not wide enough for bike lanes.*

31. **Cycle tracks** *are protected from adjacent travel lanes through curb separation, a buffer, or parked cars.*

32. **Bicycle- and pedestrian-only bridges** *help to remove gaps in an urban bikeway network.*

33. **Bicycle boulevards** *are streets with signage, markings and other devices to reduce speeds and volumes of motor vehicles.*

34. **Signage** *can greatly improve wayfinding for bicyclists.*

35. **Roadway-to-bridge transitions** *should be clearly defined.*

Figure 9. "Toolbox" of bicyclist-oriented measures appropriate for the Charles River Basin

Figure 39

Recommendations

Section A | west

Galen Street Bridge to North Beacon Street Bridge

Legend

- Existing crosswalk, no improvements needed
- Existing crosswalk, needs improvement
- Proposed crosswalk
- Existing/funded signal
- Proposed signal
- Existing ped bridge/overpass
- Proposed ped bridge/overpass
- Existing Hubway station
- Existing/funded bike lane/cycle track
- Proposed bike lane/cycle track
- Existing/funded multi-use path/sidewalk (primary)
- Existing/funded multi-use path/sidewalk (secondary)
- Proposed multi-use path
- New path/landscaping/reduced lanes
- Proposed bike/ped and streetscape improvements within ROW
- Reconfiguration of intersection recommended
- Entry node to the river with art, seating, lighting, landscape elements and small plaza features

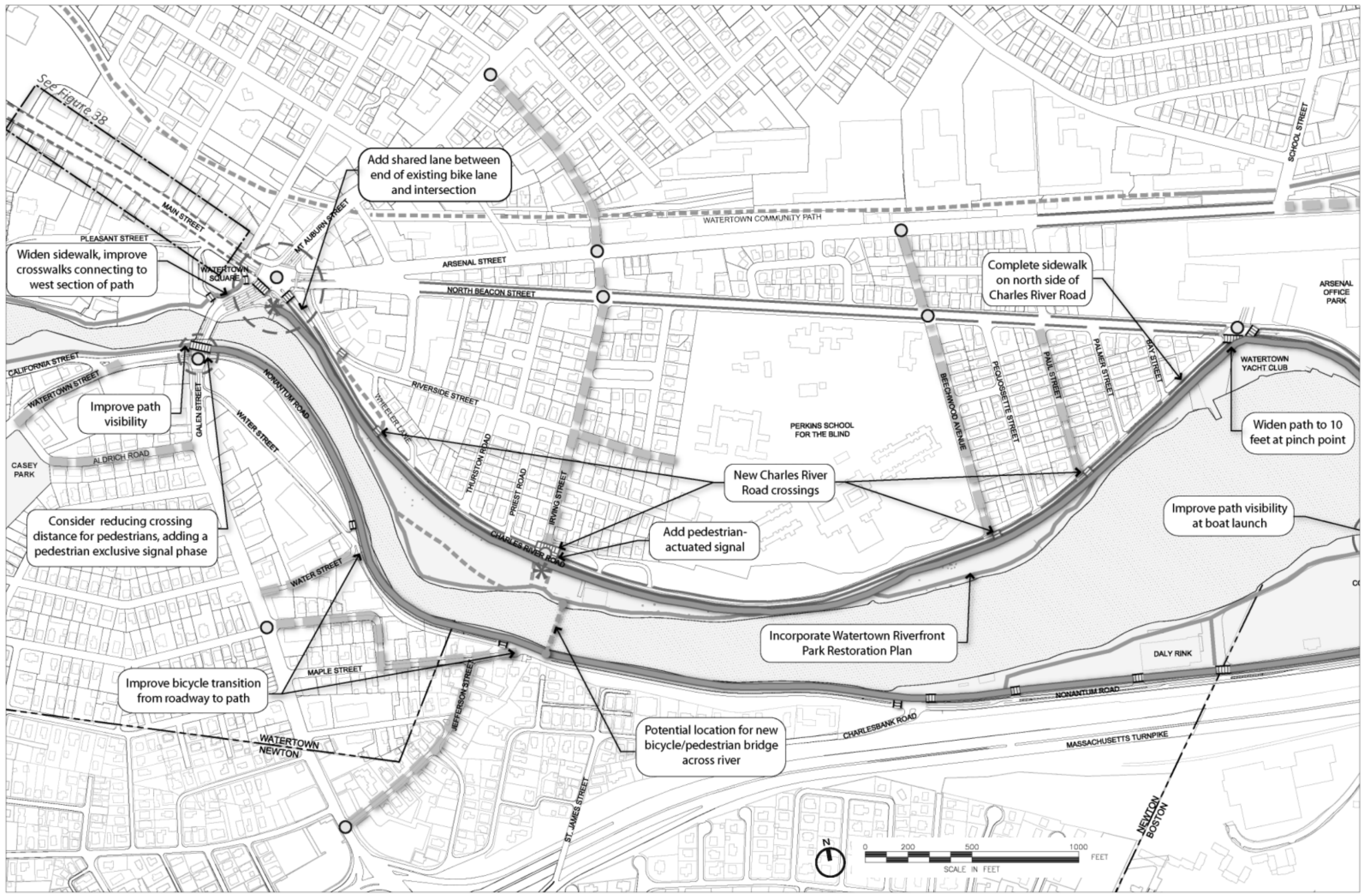
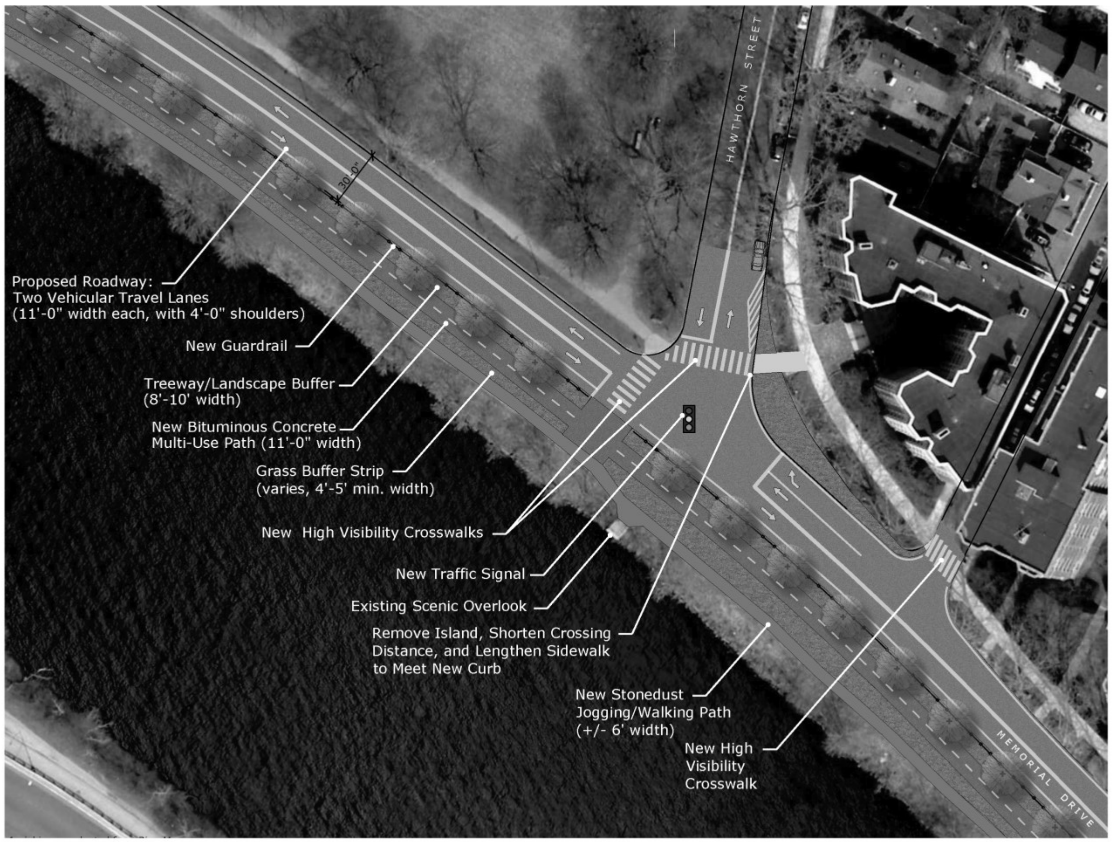


Figure 10. Sample detailed plan showing specific draft recommendations.

Section D **Eliot Bridge - Western Avenue Bridge** continued



53. Plan view showing the Memorial Drive lane reduction, expansion of the adjacent parkland and new traffic signal the Memorial Drive/Hawthorn Street intersection

between Mount Auburn Street and Memorial Drive. At the intersection, a traffic signal or a refuge island is recommended to improve the existing crosswalk (Figure 50).

Further downriver, the planned reconstruction of the Anderson Memorial Bridge includes bike lanes in each direction. These bike lanes should be carried through to the two-way section of JFK Street between Memorial Drive and Eliot Street.

The signalized crossing at Dewolfe Street is an important connector between Mount Auburn Street and the reservation, and should be improved with bicycle facilities, which in the longer term could include striped bike lanes, but in the short term shared-lane markings and signage.

There is very high residential density adjacent to Memorial Drive between Dewolfe Street and Western Avenue but there are no pedestrian crossings between the two intersections. People frequently dash across Memorial Drive here to access the path system along the river. The sidewalk on the Cambridge side of Memorial Drive should be widened and improved to encourage joggers and pedestrians to use it to get to the signalized pedestrian crossings.

The intersection of Western Avenue and Memorial Drive is being redesigned as part of the Western Avenue Bridge reconstruction project by MassDOT. One proposed configuration for the intersection includes only one outbound lane on Memorial Drive. If this becomes the final configuration for the intersection, then road narrowing should be considered for a section of Memorial Drive upriver of Western Avenue. This provides the opportunity to expand the parkland on the river side of Memorial Drive, or to expand the sidewalk on the Cambridge side. Due to the need for queuing at the JFK Street intersection, the lane reduction may function best between Western Avenue and Dewolfe Street.

South Bank. On the south side of the Charles River, the path runs along the edge of Soldiers Field Road from the Eliot Bridge to the Anderson Bridge. Raised and/or high visibility crosswalks should be considered at the driveways of the boathouse.

As part of the Anderson Memorial Bridge reconstruction, removal of the right-turn slip lanes and curb realignments are planned that will reduce the crossing distance for path users on the south end of the bridge.

The Weeks Bridges are currently only accessible by stairs on the north and south ends. In the long term, bicycle accessibility and ADA-compliance should be a goal for the two Weeks Bridges.

Figure 11. Sample recommendations page with text and an enlarged illustration showing specific draft recommendations.

The Art of Managing Long and Skinny Places: A Case for Regional Collaboration

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Introduction

Dollars are disappearing and staff time is diminishing. How can the public landscape thrive in today's economic climate? It is challenging to cobble together the funding and management support to plan for, build and maintain any kind of "long and skinny place" – whether it be for greenways, blueways, multi-use pathways, community walking paths or heritage touring routes. One way to meet these challenges is to make more efficient use of available resources and strengthen the quality of the user experience by managing linear corridors on a regional basis as a system of greenways, blueways and regional touring routes. Regionalism is not a new concept, but reenergizing and leveraging regionalism as a necessary framework for vision, support and funding is imperative in today's political and financial environment.

Background

Long and skinny places such as greenways, whether at the local, regional or statewide level, have lost their stable funding source. Projects relied on an array of publicly funded programs, most originating at the federal level and passed to the locality through state transportation and recreation programs. Acts of Congress authorizing transportation funding in the past twenty years included programs that had dedicated funding streams for trails. The Transportation Equity Act for the 21st Century (TEA-21) and its successor SAFETEA-LU included programs such as the Recreational Trails Program, the Scenic Byway Program, the Congestion Mitigation and Air Quality Management Program and the Safe Routes to Schools Program that distributed funding to states. Greenway and trail organizations tapped into this dedicated funding stream to plan, design and implement projects associated with greenways, blueways, multi-use pathway, community walking paths and heritage touring routes.

The 2007 Great Recession and subsequent federal budgets have diminished the dedicated funding streams used by many greenway organizations and, as of July 2012, for the most part removed the dedications as many states can now opt out of these funding programs. In July 2012, President Obama signed into law "Moving Ahead for Progress in the 21st Century" (MAP-21). Only the Recreational Trails program – typically offering 5,000 to 50,000 dollars in grants with eighty to twenty percent federal to local matching requirements – retained its dedicated funding source (at 2009 levels) within what is now called the "Transportation Alternatives" program of MAP-21 (replacing what was formerly called the Transportation Enhancements Program). The so-called "Transportation Alternatives" program now includes all of the programs that had previously been used in support of trails. However, funding for the consolidated group of programs that support bicycle and pedestrian related projects as part of MAP 21 was reduced from approximately 1.2 billion to 800 million dollars nationwide (Rails-to-Trails, 2013). Eligibility for funding from the former Transportation Enhancement program categories under SAFETEA-LU were reduced from twelve categories to six under MAP-21, with half of each state’s funding share susceptible to an individual state reallocating those funds to other than “transportation alternatives” program uses, including reallocation to highway construction.

Within MAP-21 bicycle transportation, pedestrian walkways, recreational trails and other “Transportation Alternatives” eligible projects can be funded through the Surface Transportation Program (STP). If your local regional planning organization identifies a greenway or trail project as a regional priority, the STP could fund the project, but in competition with other regional transportation demands such as bridge repair or routine roadway maintenance.

Other federal agency programs such as Community Development Block Grants (HUD), Land and Water Conservation Fund (DOI), Conservation Reserve Program and Conservation Reserve Enhancement Program (USDA), Wetlands Reserve Program (USDA), Small Watershed Grants (USEPA), Urban and Community Forestry Assistance (USDA), National Endowment for the Arts, and National Endowment for the Humanities have provided funding in the past for various components of greenways and trails projects. Gaining access to those funds is more competitive than ever, with restrictions on eligibility and fewer funds available. In some cases, the NEA Design Arts program for example, programs have changed from a direct grant program to a technical assistance program – where teams of experts descend upon a willing partner community and offer advice but provide no firm plans or designs that can lead directly to funded implementation projects.

An alternative, nonfederal, funding source is through local, regional and state tools. Communities have used innovative bonding or financing programs that set aside a dedicated amount of a sales or property tax, established a tax benefit district or relied upon tax increment financing. Those that successfully made use of these tools for greenway and trail development are most often regional in nature and have invested years of involvement at the local level to muster the necessary political support. Other communities, such as the City of Raleigh, folded greenway and trail development into larger parks bonds (16 million out of 88.6 million for greenway development in 2007) or transportation bonds (a combined 40 million for transportation projects that, for the first time in the City’s history included greenways, trails, sidewalk repair, streetscape projects, along with general resurfacing projects in 2012) (City of Raleigh, 2013).

Volunteers provide another source of funds and labor for implementing trail and greenway projects. These programs have been most successful when they were defined by a clear vision and included a strong recruitment and supply of healthy and happy trail builders. Walking path construction and maintenance, even in extensive systems as found in Charlottesville VA’s Rivanna River Trail System, make the best use of volunteers.

Thinking Regionally

With dwindling resources and increasing management needs, regional efforts and coalition building are needed to bring together all who are involved in the development of greenways and trails – land conservation interests, recreational interests, heritage tourism advocates, health advocates – to work together on a regional basis as a means of gaining leverage and access to diminishing resources. Funding requests must clearly demonstrate a strong relationship to the broadest array of public values and economic development advantages (heritage, recreational and nature-based tourism, public health, etc.), while presenting a unified, regional, ask.

Regional thinking is not new. From Garden Cities in England to comprehensive park systems in the United States, communities have been thinking regionally about their "greenways" and open space. Frederick Law Olmsted first proposed Boston's Emerald Necklace in Back Bay, a system that evolved into the Metropolitan Park System of Greater Boston. Other regional park systems evolved throughout the late 19th and early 20th century in Buffalo, NY, Louisville, KY, Cleveland, OH and Seattle, WA, many designed by Frederick Law Olmsted or his sons, the Olmsted Brothers. Other luminaries such as Horace Cleveland, the designer of the Minneapolis regional park system, and planners such as John Nolan who incorporated parks and open space into his town planning efforts, spread the regional and holistic approach.

However, not all areas were so fortunate. Today's greatest challenges rest with communities that were not the recipients of earlier generations who laid the groundwork for a regional system of parks, parkways and pathways. This, in combination with a lack of dedicated federal funding, complicates the future development of trail and greenway systems. With the advent of the dedicated funding source for greenway and trail development twenty years ago, a number of communities began to show interest. Groups constructed continuous segments of greenways and trails, partially establishing regional systems. How to finish the job? Are there any organizations that are positioned to build upon these past successes? If so, what opportunities have they taken advantage of to gain that position? The answer may lie with those organizations that articulated a strong vision, capturing their public's attention and combined the twin towers of conserving a region's natural and cultural resources with a companion program that provides public access to those conserved resources. One approach to counter these challenges has been the resurgence in forging regional partnerships and leadership in the effort to articulate, embrace and implement a common vision.

The following case studies are three distinctly different entities that have been "thinking regionally", established a clear and focused vision and have implemented that vision by linking conservation and/or preservation and public access (greenways and trails).

Carolina Thread Trail

The Carolina Thread Trail (The Thread) is literally weaving together a regional network of greenways and trails with the goal of providing better access to nature for 2.3 million people in the Charlotte/Mecklenburg, NC region. To date, they have 'woven' 113 miles of The Thread's trails – opening the trails to the public and linking people together with places and attractions throughout the region. According to the Thread's web page, the Carolina Thread Trail system is conceived "as a 'green interstate system' of major trails and conservation lands created through local efforts throughout the region. The Thread will emerge over time as communities work together to plan and build trails reflecting community character, aspirations and priorities." (Carolina Thread Trail, 2013)

The Thread was conceived in 2005 out of a confab of environmental and community leaders looking to identify the region's most pressing environmental needs and concerns. The Catawba Land Conservancy took up the mantle to lead the fledgling organization's efforts. This was especially prescient as it brought together the twin towers of preserving open space and providing access to that nature that was to be preserved. Initiated in 2007, five plus years later it has established a system of 113 miles of trails with a number of new projects in the planning stages. Covering fifteen counties in two states, it has involved urban, rural and suburban constituents in a unified vision. A mixture of public, private and nonprofit supporters have coalesced to fund and encourage its efforts, including private foundations and corporations. (Duke Energy and others).

Figure 1 –Weaving Communities Together (Carolina Thread Trail)

<u>Rivanna River Greenway, Charlottesville, Virginia</u>

The Rivanna Trails Foundation evolved from a late 1980's and early 1990's community-based vision for a trail system along the Rivanna River and its tributaries. The foundation was established in 1992 to implement that vision by creating <u>and</u> protecting footpaths, trails and greenways within the Rivanna River watershed. The volunteer organization's mission, supported largely by tax-deductible contributions and volunteer effort, is "to create and protect natural footpaths, which follow the Rivanna River and its tributaries, for the enjoyment of all". The end result is a more than twenty-mile "loop" of rustic foot trails over both public and private land (with permission) creating a "greenbelt" around Charlottesville. The Rivanna Trails Foundation has done this with some federal funds for trail development – but most of it is through cajoling landowners to allow access as well as a dedicated trail crew of volunteers that are committed to not only achieving the vision but keeping it that way.

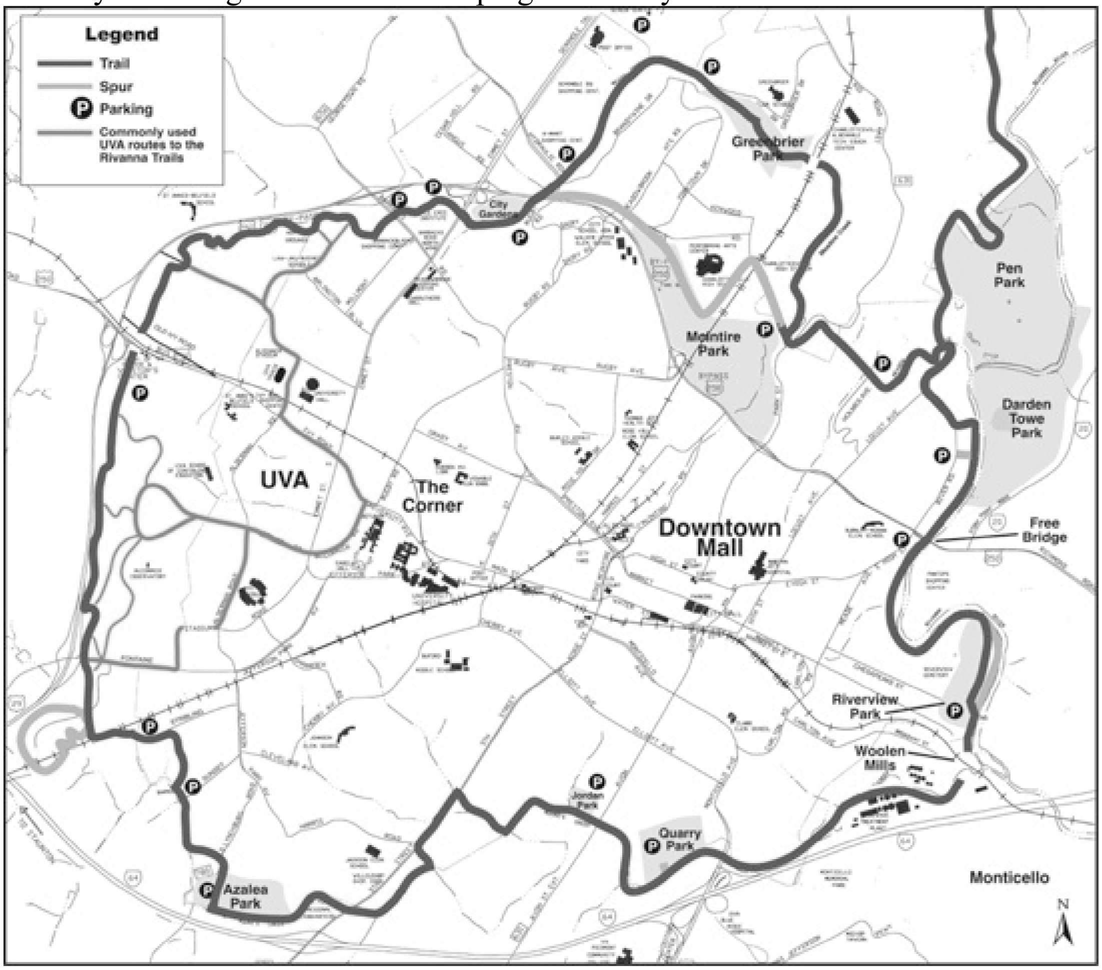

Figure 2 – Rivanna Trails Loop (Rivanna Trails Foundation)

<u>Delaware and Lehigh Canal Corridor, Inc., Pennsylvania</u>

The Delaware and Lehigh Canal Corridor (D&L) is a five-county area within northeastern Pennsylvania, subdivided into three distinct geographic subareas. The D&L, designated by Congress as a National Heritage Area in 1988, has a mission to "restore historic places, conserve green space for public use and preserve and interpret our heritage to enhance life for generations to come". The management entity was created directly from the National Heritage Area designation effort. It is a joint effort of "private groups and interested citizens, county and municipal governments, the Commonwealth of Pennsylvania and the federal government to conserve cultural and natural resources in the five-county region of Pennsylvania that traverses the historic Delaware and Lehigh Canals." The bulk of the management organization's funding (D&L Canal Corridor, Inc.) has come in the past from the National Park Service as a dedicated funding stream associated with its National Heritage Area designation. They have also worked extensively to aggregate federal, state and private funding sources together and pass those through to local projects as part of a community-based grant program.

The 165-mile D&L Trail (including its side trails) is the most visible element of the heritage corridor and therefore plays an important role in maintaining strong public support. The D&L Heritage Corridor Inc. established the D&L Trail Alliance for the purpose of bringing "together municipal, state and non-profit landowners to coordinate the stewardship and promotion of the D&L Trail". Other programs within the D&L Heritage Corridor emphasize preservation, interpretation, way finding, and economic development in support of their mission.

The Benefits of Thinking Regionally

The common theme amongst the three programs – whether locally based and privately funded, mostly public agency funded, or some combination of the two – is that the greenway project or program succeeds using a strong vision and establishes the greenway as a community, regional or state priority. The strong vision must be paired with a regional network of supporters – the developers of the strong vision – who are ready and willing to do the heavy lifting. The benefits of regional collaboration that follow are born out in these three greenway programs - the creation of an entirely new vision of a region woven together such as The Thread; the development of a vision for watershed education and access as in the Rivanna River project; or for a vision of a linear corridor associated with a natural or cultural feature like the D&L.

Benefits of regional management among these and other organizations are multiple:

- **Financial** - The competition for funding from government-sponsored programs as well as from private grantmaking organizations is extremely stiff. Sponsors are looking for ways to make their funds go further and to be utilized more efficiently and effectively. By linking smaller projects and programs together on a regional basis, the benefits can be broadened by tying a community-based project into a larger regional goal. A sponsor is often more interested in funding projects that benefit an entire region, rather than one that only benefits a single community. Metrics are important and often are more demonstrable on a larger scale. By sharing resources, administrative costs can be spread out more broadly as well as making for a more effective use of limited dollars. The Carolina Thread Trail has demonstrated these benefits by leveraging the land conservation mission of the Catawba Land Conservancy with the need to provide public access to the lands preserved.

- **User Experience -** Coordination of signage, enhancement projects, trailheads and other physical improvements that have similar components that must be reviewed and coordinated by the same funding agency (e.g. a DOT) provides another opportunity for implementing a regional outlook. Joint contracting (both on the design and construction side) results in greater value. Joint efforts may reinforce a regional identity and sense of place if the design is conceived at a regional scale. The Rivanna Trails Foundation has successfully focused volunteer efforts on a common goal to create a "loop trail" around the City of Charlottesville. Using volunteer efforts and the willing cooperation of landowners, the circle is complete. The continuity of the trail system is a remarkable accomplishment given that no trails existed prior to 1989 and limited funding. Most important is the community's success in stretching trail segment acquisition funding by making use of voluntary access agreements to privately owned and privately retained lands in a property rights-centric state like Virginia.

- **Interpretation** – There currently is little coordination among agencies and organizations that install interpretive signs or run interpretive programs. Too many signs and unrelated interpretive programs drown out the interpretive message. In addition, existing signs are frequently outdated and not well maintained. The D&L is a good example of developing a coordinated visual and graphic identity that established standards as a very early action (1995) in the implementation of their Heritage Area Management Plan. The established graphic identity creates a way that visitors can link together the stories and places associated with the D&L Canal Corridor through a family of signs, brochures, wayside exhibits, trail markers and wayfinding. The use of the common visual and graphic identity at a regional scale serves as a kind of "good housekeeping seal of approval" so that visitors will know that a particular site or a trail or travel route is part of a nationally significant resource – the Delaware and Lehigh Canal National Heritage Area.

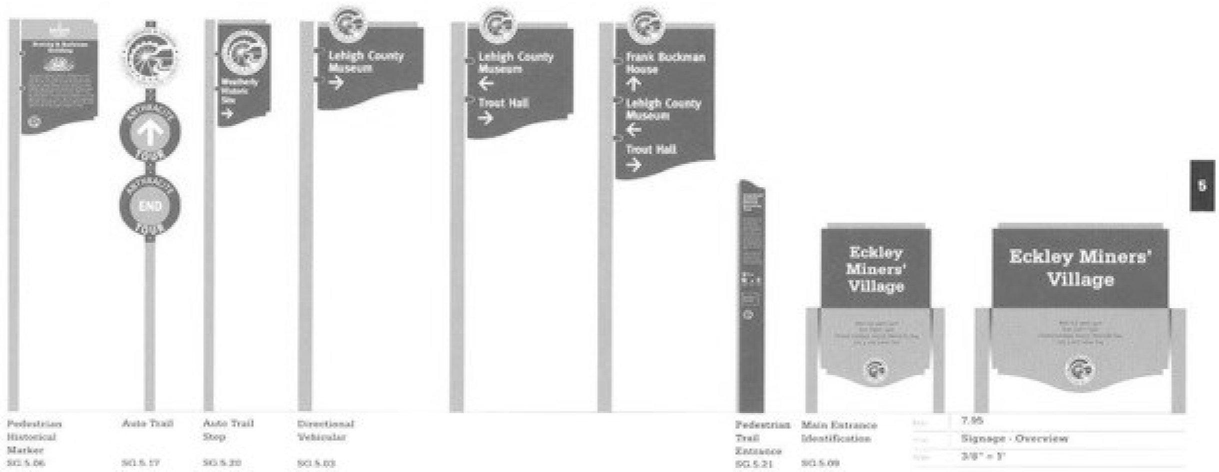

Figure 3 – "Visually Speaking" Design Guidelines (D&L Canal Corridor, Inc.)

- **Conservation and Preservation** – A regional approach is necessary for good coordination and preservation actions that identify and affect critical natural and cultural resources and landscapes. If the intent is to raise the level of awareness and recognition so that conservation and preservation of these lands and sites can be competitive with other regional and national priorities, greater involvement by many partners provides necessary support. All three of the examples noted above have rooted their success in the underlying goal of preserving and conserving the regional landscape within which they reside. Rivanna Trails Foundation mission (emphasis added) is to "*create and protect* natural footpaths, which follow the Rivanna River and its tributaries, for the enjoyment of all." The Catawba Land Conservancy is "dedicated to saving land and connecting lives to nature" and uses the Carolina Thread Trail as the primary vehicle for making the connections. The Delaware and Lehigh Canal Corridor Inc.'s mission is to "restore historic places, conserve green space for public use and *preserve and interpret* our heritage to enhance life for generations to come."

Goals and Objectives

The goal is to encourage greenway and trail enthusiasts to think more regionally about their long and skinny places and to encourage collaboration among regional partners as a means of increasing significance, awareness and leverage associated with such a regional identity. The

Rivanna Trails Foundation's original "greenbelt" evolved to a "loop" which helped the community visualize the benefit of a continuous trail system. The Carolina Thread Trail used the imagery of the rich textile heritage of the region to help their region visualize how such a trail system and communities can be woven like whole cloth. The D&L Canal created a visual and graphic identity early on in the process to help their regional partners and visitors see and understand resources differently. Each strong vision helped these regions establish strong financial, organizational and volunteer partnerships to achieve a common regional goal. Organized into management entities that have helped gain national and regional recognition and awareness of important natural and cultural resources, the entities have also raised and distributed funds for project implementation and drawn together volunteers to work on pieces of larger and more ambitious goals.

Figure 4 – Rivanna River Trails seek to preserve a rustic trail experience within walking distance of City neighborhoods and the University of Virginia (Rivanna Trails Foundation)

Conclusion

Thinking regionally links together similar experiences – making use of a trail and eating or staying overnight in a community along the greenway for example – increasing economic activity for the community and the region. Visitors are more likely to visit a "region" when they are offered a range of choices – whether it is the use of a greenway corridor for recreation, for access to nature, for transportation or heritage tourism. Long and skinny places of all stripes can gain leverage and a stronger identity by finding ways to work together on a regional basis to plan, finance, manage and interpret their greenway assets and infrastructure.

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16. OPEN SPACES TO GREENWAYS

An Evaluation of Open Space Quality in Suburban Residential Communities: A Comparison of Neotraditional, Cluster, and Conventional Developments

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Introduction

In the past 35 years, planning theory for open space in both urban and suburban developments has begun to focus not only on recreation, but on the creation of multifunctional landscapes. The flight of homeowners out of cities to relatively inexpensive land and housing in the suburban fringe during the latter part of the last century, placed tremendous pressure on ecosystems, water quality, visual quality, agricultural land and also recreation opportunities. For these reasons, the goals for open space in many suburban developments over the past three decades have expanded to provide active and passive recreational areas, to serve as stormwater quality enhancements, wildlife habitat, act as a visual buffer to the hard surfaces of urban areas, and finally to accommodate urban agriculture. This was certainly the case with neotraditional and conservation developments of the late 1980´s and 90´s which were simultaneously seen as an antidote to the placeless sprawling suburbs and the environmental degradation that ensued.

Three major approaches for effective suburban development that promised a more sustainable outcome than conventional post-World War II subdivision design have emerged, each with its own solution for the provision of open space: conservation (cluster) development (Arendt 1996; Yaro, Arendt et al. 1988; Arendt, Dodson et al. 1994); transit oriented design (Calthorpe 1995); and neotraditional development (Duany 1995). While each approach has its strong advocates, with the exception of the literature on conservation development, the theory tends to treat open space and its provision of green infrastructure benefits as an afterthought in the design process.

Compounding the issue for the provision of green infrastructure services in the open space system is the fact that theoretical evaluations (Davis, Nelson et al. 1994; Frank 1999; Beatley 2000; Hayden 2001; Hopkins 2001) of the impact of new development and its attendant urbanization have been much more common than empirical studies. The existing empirical studies have largely focused on specific issues such as the effects of urbanization on bird populations (Geis 1974; Beissinger and Osborne 1982; Machtans, Villard et al. 1996; Odell, Theobald et al. 2003; Hostetler and Holling 2004), water quality and quantity (Carignan and Steedman 2000; Harbor 1994; Cifaldi, Allan et al. 2004; Goff and Gentry 2006) and habitat fragmentation (McDonnell and Pickett 1990; Fahrig 1997; Ehrenfeld 2000; Eppinka, Bergha et al. 2004). Comprehensive looks at the interaction of land use and broader ecosystem function have been few (Burke, Lauenroth et al. 1994; McDonnell 1997).

When case study analysis has looked at neotraditional and conservation subdivision developments, it has most often been to evaluate their overall design approach, without a comprehensive analysis of their green infrastructure systems (e.g. Francis 2003a; Francis 2003b). Alternatively, studies have focused on the other end of the spectrum, evaluating the success of one aspect of green infrastructure function (Galuzzi and Pflaum 1996), or one aspect of the impact of alternative design such as gross density (Gordon and Vipond 2005). Although there have been some post-occupancy assessments of the suburban forest and the open space system remaining after development these have focused on the social and psychological impacts of new urbanist developments (Brown and Cropper 2001; Kim and Kaplan 2004), the social importance of green spaces (Burgess, Harrison et al. 1988) and have related the existence of urban green to demographic variables (Emmanuel 1997). In addition, existing studies of specific aspects of the green infrastructure system have largely relied on remote sensing and available GIS data, focusing on area protected (and in some cases patch size) (Brabec 2001; Foresman, Pickett et al. 1997), rather than the functionality and condition of the protected area.

As a result, more than 20 years after neotraditional and conservation developments were brought into common use the question remains: How effective have they been, particularly in comparison with other more conventional development styles, in protecting functioning open space systems? This paper addresses that question with a comprehensive analysis of pre-development goals and codes, and a functional analysis of the open space system 10 to 20 years after development completion. Merging GIS data and on-site assessment of 16 sites across the United States, the project compared development outcomes with original development goals to assess the overall successes and failures. Using case studies from five regions across the country, neotraditional, conservation and conventional residential developments were analyzed and compared for their habitat, recreational, visual landscape quality and water quality goals. The insights gained can result in improvements both design and legislative best practices for community development codes.

Methods and Selection of Case Studies

The project identified and analyzed the following aspects:

1. Open space and green infrastructure protection goals through two methods: a content analysis of public documents filed in connection with development and site plan approvals, and interviews with the developer, planners and designers;
2. Evaluation of pre-development forest stand protection through the comparison of current and pre-development aerial photographs and site level inventory, resulting in a finding of the amount and quality of existing forest stands that were protected during the development process;
3. Open space protection measures and outcomes, using aerial photographs, a detailed site-level inventory of ecosystem, recreational, visual and water quality indicators, and an analysis of local regulatory and homeowners association codes; and
4. Level of compliance and achievement of green infrastructure protection goals through a comparison of current conditions and intended outcomes.

Case study sites were chosen from five regions of the continental United States, with selection of each of the three types – conventional, conservation subdivision and neotraditional or new urbanist - in each region. This allowed comparisons to be made between the cases on a regional as well as a typological level. e.g. comparing the three types of subdivision development occurring in the region, and the comparison of five cases of one type (eg. neotraditional as implemented in five different regions of the United States).

Table 1: Case studies shown by region and subdivision type.

Region	Subdivision Type		
	Neo-traditional	Conservation	Conventional
Mid-Atlantic	Kentlands City of Gaithersburg, Maryland	Wesley Chapel Woods, Baltimore County, Maryland	Dufief City of Gaithersburg, Maryland
Southeast	I'on Mt. Pleasant, South Carolina	Spring Island Beaufort County, South Carolina	Sea Pines Hilton Head Island, South Carolina
Mid-West	Prairie Crossing Lake County, Illinois	The Fields of St. Croix, Lake Elmo, MN	Cloverdale, Washington County, MN
Mountain West	Stapleton Denver, Colorado	Hidden Springs Boise, Idaho	Rosecreek, Herriman, Utah
Pacific Northwest	Northwest Landing, Pierce County, Washington	Defiance and Lincoln Green, Whatcom County, Washington	High Point, Seattle, Washington

Each case was studied according to the following methodology:

1. *Open space, forest stand and green infrastructure protection goals.* Local codes and site plan approval documents were collected for each jurisdiction, analyzed for the protection goals and placed in tabular form. Where possible, codes for the period of approval of the development were collected. This proved difficult in some cases, since several developments were permitted between the early 70's and early 90's. Jurisdictions vary in whether they keep an accessible archive of their old ordinances, so these were variably available. In some instances codes in effect at the time of approval could be interpolated from the legislative history printed within the code, but this also varied with jurisdiction. Interviews with local planners and developers (as available) were completed to expand the understanding of initial goals for green infrastructure, and why those goals were or were not implemented. Code summaries were completed for developments.

2. *Evaluation of pre-development forest stand protection.* Current and pre-development aerial photographs were collected for all sites. These were visually compared in GIS to identify the amount of pre-development forest stand protected during the development process.

3. *Inventory of current forest stand and open space management and protection measures.* Using GIS data the ownership of each protected open space parcel was identified. Using the covenants and restrictions filed with each development in concert with the homeowners' association codes, a comprehensive view of the protection and management measures for the open space in each development was collected and analyzed.

4. *Inventory of current forest stand and open space protection outcomes.* Each open space parcel was mapped with GIS data and aerial photographs at a minimum one-meter resolution. Each site was visited, photographed at ground level, and an analysis protocol completed to assess the level of success of
   i. ecosystem and habitat protection;
   ii. stormwater quantity and quality protection;
   iii. recreational opportunities; and
   iv. visual and aesthetic quality.

The protocol is a mixed methods approach, which includes an on-site rapid assessment technique to inventory each site. The methods and variables evaluated are outlined in table 2 below.

Table 2: Methods used to assess protection outcomes in the 15 sites included in the study.

Protection Outcome		***Method***		
		GIS	*Site Survey*	*Documents*
Ecological	*quality*		rapid assessment	
	patch size	acreage		
	veg. type		transect	
	connectivity	Patches, corridors and distance acreage and feet		
	management			community docs content analysis
Water Quality/ Quantity	*impervious surface*	% land area		
	BMPs		visual/photos existence	
	connectivity			engineering docs
Recreation	*type*		visual/photos existence of facilities	
	amount	Acreage calc.		
Visual	*views*		visual/photos viewshed analysis	
	access	Distance calc.		

Findings and Conclusions

The findings from this analysis are mixed. Success in open space conservation and optimal function with respect to habitat, stormwater, recreation and visual quality, depends as much on the vision and sophistication of the developer as in the development type and design paradigm chosen. In many cases, no matter which development type is chosen, the execution contained serious flaws that compromised the long-term function of the open space system.

Ecological Functions:
Ecological function of the open space system was most impacted by three aspects of the developments: the funding and implementation of maintenance schemes for common areas; the use of private easements to protect ecological function; and the encroachment of private landowners on common areas.

For all of the developments, the proliferation of exotic, invasive plants into natural areas is a critical management problem. Those developments that were the most successful in maintaining native plant species and species diversity (e.g. Prairie Crossing and Spring Island), had a separate foundation established to manage the ecological function of the open space. These entities, separate from the homeowners associations, did not have the voting and financial constraints of typical HOA management, and also were able to maintain focus on the goal of ecological diversity. They were also able to engage in long-term educational programs, to ensure that successive waves of homeowners understood the local ecosystem and the management scheme necessary to maintain it (e.g. prairie burns at Prairie Crossing).

The use of private easements (e.g. Kentlands) to protect tree stands, native vegetation and ecosystem functions was ineffective in reaching those goals. While there was some success at Prairie Crossing in maintaining prairie vegetation on private property, this was accomplished with consistent homeowner education. The City of Gaithersburg noted that they did not have the resources necessary to effectively inspect and manage the easements long term. Therefore, after the initial homeowners turned over, it was difficult to maintain the intent and quality of the easements.

In addition, the details of maintenance schemes for common open space were also key aspects of ecosystem function. Developments tended to focus on tree stands and tree canopies, neglecting the critical composition of the understory. In some cases where the goal was the maintenance of pre-development forest stands (e.g. Kentlands), the tree canopies were protected, but the understory was completely removed by HOA maintenance schemes. This affects not only ecological function, but also stormwater function.

Stormwater Functions:
Although many of the early developments studied did not initially include stormwater functions (e.g. Dufief), all of the case study sites had addressed stormwater functions with some level of retrofit. In some cases (e.g. Kentlands and Dufief), water quality goals were hampered by direct discharge of stormwater into the stream system, and an inability of protected stream buffers and other BMP´s to absorb levels of site runoff created by new development in surrounding

areas. The addition of new, instream BMPs were instituted to mitigate the increased flow. However, with the exception of HighPoint, which was a retrofit of an earlier development, and Spring Island which is isolated form adjacent land uses, each case study site has had to deal with the increase of stormwater from adjacent land uses. These are issues that the initial development design should anticipate, particularly in greenfield development areas.

The increase in stormwater runoff has also increased the need for BMP maintenance measures, an issue that the HOAs were just beginning to deal with. This promises to be in increasing trend as developments (e.g. High Point) implement more onsite infiltration BMPs which catch and hold sediments from stormwater runoff.

Recreation Functions:

All of the case study sites were successful in providing a wide range of recreation functions for the local residents. Although the neotraditional developments touted - and provided – a large range of pedestrian walkways, these were most successful (e.g. Kentlands), when they created a system of pedestrian paths that included mid-block connectors as well as sidewalks and paved trails through open spaces. In addition, the mix of jurisdictional control of protected areas and the lack of removal of invasive exotics in many instances compromised the ability of the areas to serve as native habitat, and attractive, passive recreational areas.

Visual Quality Functions:

Although this aspect of the open spaces was given a more limited, expert-based analysis, it was clear that the inclusion of open space throughout the developments had a positive effect on the visual quality of the developments. Distance to common open space was the lowest for conservation subdivisions, reflecting the design of these developments. Conventional subdivisions, although not necessarily less visually "green," had the highest average distance to open space of all the developments, followed by the neotraditional developments.

Conclusions

This project links three aspects of urban forest and open space protection within residential developments: the science of the benefits of green infrastructure, the design and planning practices intended to achieve those benefits, and the legal tools needed to protect the forests and open spaces. The project identified a number of disconnects between the best design and management practices for green infrastructure in urban and suburban residential developments, and the code requirements that created them. Further research is needed in this area, both for post-occupancy evaluations and also evaluations of developments as they transition from developer control to HOA control, and as the original residents are replaced with new homeowners who may not retain the original values that created the development.

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A Half-Century of Community Effort to Protect Nantucket's Specialness

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Abstract

When those who are not especially familiar with Nantucket hear the name some react by calling to mind its connection to the country's whaling past. But for those who through birth or good fortune have established a personal connection with Nantucket, mentioning the island elicits memories of past travel experiences, friendships made, family milestones shared, or times spent roaming moorlands, cranberry bogs, or miles of sandy beaches, rutted roads, and bike paths.

On Nantucket people are inevitably drawn to the outdoors. They come out to be rejuvenated by the island's exceptional openness, expansive views of the sky, and rolling landscapes not hidden behind tall trees or buildings. The vista often extends miles away to the horizon, far out over the water that surrounds this exceptional place and isolates its people and natural rarities from "America."

Over the past 50 years various segments of the community – nonprofit organizations and town agencies -- have worked creatively, cooperatively, and locally to better understand, protect, and perpetuate the island's natural lands and the elements occurring on them. The result is that nearly 50% of the island is now permanently protected and available for residents and visitors to learn from and enjoy.

Introduction

Managing a region's or community's sustainability for the benefit of its residents provides us with an opportunity to learn from the experiences of others, hopefully avoiding the time and cost of reinventing the wheel. Networking as well as sharing information with those who will ultimately be impacted by planning decisions is a critical component of any well organized effort.

For those who are familiar with Nantucket's reputation as an up-scaled summer vacation destination, fair warning. As hard we have tried, we haven't come up with all of the answers. In fact, as you will read, some of our enviable successes have resulted in unforeseen problems.

A Remote Setting and Its History

Nantucket is an island located in Massachusetts. It lies about 25 miles south of Cape Cod, a sandy, hook-shaped peninsula that extends into the Atlantic Ocean at the southeast corner of Massachusetts. Nantucket is located 90 miles southeast of Boston and about 200 miles east of New York City.

All of Nantucket island is a single governmental unit that is governed day-to-day by five elected Selectmen and a Town Manager. Major policy and fiscal decisions are dealt with by an Annual Town Meeting in which all registered voters may participate. The Town of Nantucket, also its own county, includes three islands, two of which – Tuckernuck and Muskeget – are inhabited only during the summer months. The main island, called Nantucket – a name shared with the island's town center – is approximately 14 miles east and west and 4 miles north and south. It is a windswept, pork chop-shaped, glacially deposited 110-foot high pile of sand. Its shorelines are constantly being reshaped and eroded by hurricanes, 'Noreasters, tides, rainwater, and wind. The island is one of the windiest places in the United States and is also known for the dense fog banks that can move in suddenly and linger during all seasons of the year. As islanders say, "Fog Happens."

Before English settlement, the remote island was home to a large population of Native Americans coming from the Wampanoag tribe. Nantucket was first "sighted" by explorer Bartholomew Gosnold in 1602, but not settled until 1641, when a group of ten Englishmen purchased legal ownership for thirty pounds of silver and two beaver hats.

Many years after its English settlement, whaling put Nantucket on the map and is what many people usually think of when they hear its name. Author Herman Melville, in "Moby Dick," described what he thought the island was like during that era:

"Nantucket! Take out your map and look at it. See what a real corner of the world it occupies; how it stands there, away off shore, more lonely than the Eddystone lighthouse. Look at it - a mere hillock, and elbow of sand; all beach, without a background. There is more sand there than you would use in twenty years as a substitute for blotting paper. . . . that people there plant toadstools before their houses, to get under the shade in summer time . . ."

Beginning in the late 17th century, whaling prospered for nearly 150 years. It made Nantucket a world center for shipbuilding and the services related to maintaining a fleet of small but incredibly sturdy sailing vessels which navigated to the remotest corners of the globe in search of whales. Nantucket's captains and crews were widely regarded for their courage and determination. Due to economic opportunities created by this industry, the island's year-round population swelled to nearly 10,000 people in 1840.

The establishment of the first commercial oil well in Pennsylvania (1859) and a related decrease in the demands for whale oil products, resulted in whaling's gradual decline and Nantucket's population dropping to about 3,700 in 1880. Falling back on their agricultural heritage, those who chose to stay turned to sheep, cattle and horse grazing, which heavily impacted the island's sparse vegetative cover and marginally productive soils. The original English settlers had previously set aside thousands of acres as pasture lands, called "commons," which were nearly denuded by overgrazing caused by the presence more than 17,000 sheep.

By the beginning of the 20th century, commercial grazing had fallen off and Nantucketers were involved in modest agricultural activities that included dairy farming, vegetable farming for local consumption, and cranberry culture. Prior to World War II, approximately 2,000 acres were in various forms of agriculture. By the mid-1960's, this number fell to less than 600 acres divided between vegetable crops and cranberries. While the island's agricultural acreage has remained more or less constant since then, increasing oversupplies produced by cranberry growers nationwide may impact 300 acres of the island's still working cranberry bogs, a farming tradition that began in 1865.

Tourism, the Island's New "Industry"

Island tourism became popular in the late 19th century when people discovered that being on Nantucket during the summer months was far more pleasant than dealing with mainland heat. Air conditioning had not yet been invented and for those city dwellers who could manage to escape, romping in the ocean at Surfside or sailing up harbor in a catboat was a clear choice.

Summer cottages, hotels, and guest houses sprung up on the island, with the number of residences going from 1,800 in 1937 to 3,800 in 1966. Despite building activity, the year-round population remained more or less constant at about 3,500 with an increase to 16,000 when the visitors were added in during a typical mid-1960's summer season.

Nantucket's solitude, its historically important and well preserved collection of 18th and 19th century residential structures, exceptional museums and cultural opportunities, and diversity of "no charge," readily accessible, natural areas (i.e. beaches, moorlands, ponds fronts, forests, etc.) have tempted people for years. Surfcasting, swimming, sailing, motor boating, walking, bicycling, golfing, hunting, shellfishing, nature study, shopping, and people-watching are among the activities available to its seasonal residents and visitors.

Since 1900, many mainland families have traveled to Nantucket for the entire summer season. Back then, a trip from New York City meant a day's trip by rail followed by a five to seven hour steamer crossing from the port of New Bedford. Steamboats would arrive in late June filled with families who would occupy their summer homes through August. Then the family would return to their mainland residence and the house would be shuttered of the off-season. Short-term visitors were also coming to the island during the summer months, but limited by the demand for hotel rooms and guest house spaces.

Today people have a choice of much faster transportation methods: a 40 minute flight from Boston on a 9-passenger plane, an hour long jet flight from New York City; a 2 1/4 hour passenger and automobile ferry from Hyannis on Cape Cod; a 60 minute "fast ferry" trip from Hyannis; or a 15 minute air-taxi flight from Hyannis.

Over the past 25 years these transportation advances have made it possible to get to the island quickly and reliably. The result is that a family from New York, Boston, Washington, or elsewhere can now spend the summer months in their island home while the breadwinner commutes back and forth to Nantucket for a long weekend. Expanded short-term visitor lodging means that larger numbers of visitors can be accommodated on the island. Faster and more frequent boat service also brings day visitors who arrive on the island mid-morning and reboard the Cape Cod bound passenger fast ferries 4 or 5 hours later. With increased tourist activity and second-home construction, Nantucket's character has changed and with it the year-round population has grown from 5,000 in 1985 to 9,500 in 2000, and more than 11,000 in 2013. Nantucket's high-season, combined summer population now reaches about 55,000 people.

Protection Efforts Begin

Concerted efforts to safeguard Nantucket's unusual historic and natural resources began in 1955, when voters established the second historic district in the United States. This was a radical step for a conservative group of New Englanders, but there was a sense that without strict regulation, a museum quality townscape would quickly be transformed into a collection of incompatible architectural styles. In 1971, those regulations were extended to include the entire island.

Efforts to preserve open land began in 1963 when a coalition of respected seasonal and year-round residents, encouraged by the town's Civic League, decided to establish a nonprofit, member-supported organization they chose to call the Nantucket Conservation Foundation, an group that today would be referred to as a "land trust." Fortunately, for the Foundation and town, during the early 1960's, the only land that people considered worth developing was either in or at the edges of the town area or in one of the outlying summer-occupied residential settlements. The small group of land conservation visionaries appreciated that it wouldn't be long before the island's sparsely developed coastline and interior would be at risk.

Through connections made with the University of Massachusetts (Amherst) a team of natural resource experts and planners was assembled, including, then Associate Professor, Julius Gy Fabos. Members of that group spent the summer of 1966 documenting and analyzing the elements contained in a traditional natural resource inventory (topography, geology, soils, water, vegetation, climate, fisheries and wildlife, etc.). The results of this effort, which was funded by island organizations and agencies, were made available in a comprehensive Cooperative Extension Service report entitled the "Selected Resources of the Island of Nantucket." The publication was an effort to engage a diverse group of community leaders, year-round and seasonal residents in a series of wide-ranging discussions about the importance of resource protection and land conservation on Nantucket.

In 1968 the report was followed by an opinion survey conducted by Dr. Hugh C. Davis of the University's Department of Landscape Architecture. Professor Davis asked a reasonably sized random sample of island voters and seasonal residents a number of questions regarding their attitudes towards issues that could ". . . prove a helpful aid toward the perpetuation of the beauty, charm and unique quality of Nantucket Island." Professor Davis' reacted to the 91% "yes" response to his question asking if "more attention should be given to conservation matters on the Island?" by saying " 'Lopsided' is hardly a strong enough term . . . ", later acknowledging that "conservation" obviously meant different things to different people. It was also observed that a better understanding of issues involved in a resource planning process was emerging and there was a greater appreciation for the inevitability of change and the possible consequences of unmanaged change.

Meanwhile, the leaders of the Nantucket Conservation Foundation, relying on contributions of land once owned by its founding supporters, were boasting that nearly 2,500 acres had been protected. Those involved were spreading the message that the community could benefit in other ways by protecting more open space. By 1971, the task of actually having to raise large amounts of money in order to buy conservation land became a reality. The Foundation's Board announced plans to raise $625,000 ─ a huge amount by the day's standard ─ for the purchase of 625 acres being threatened by a large second-home development. At the time, the island had no land use regulations (i.e. Zoning which, after five attempts, was eventually adopted by Town Meeting in 1972). Fortunately, the Foundation's fundraising efforts were successful and that still talked about project served as a model for conservation purchases that followed.

In the early 1970's an innovative land protection idea involving Nantucket, Martha's Vineyard, and the Elizabeth Islands was being pursued at the national level. There was a feeling that community leaders and the islands' year-round residents were unwilling to take charge of their future and the protection of the region's poorly understood uniqueness. The proposal was to establish a Nantucket Sound Islands Trust commission. The commission would consist of local, state, and federal representatives acting under the supervision of the Department of the Interior. Its responsibility would be to guide future land use on each of the islands. Land would be placed into one of three categories: town controlled; a resource planning district with limited development potential; or "forever wild." Highly spirited debates took place over several years with the proposal ultimately lacking public support and being withdrawn. It did, however, leave islanders with an increased awareness of the consequences of inaction.

Throughout this time the Nantucket Conservation Foundation continued to pursue its goal of protecting land through local efforts. In the years that followed it has protected, through gift and purchase, a total of nearly 9,000 acres or 30% of the island's land area. Its 215 properties, including the Nantucket Field Station, a 2004 purchase from the University of Massachusetts for $22 million and the just announced purchase of the Norwood Farm for $19 million, are all open to the public for compatible and responsible use and enjoyment and available to encourage environmental research, awareness, and appreciation.

Additional lands have been protected by other nonprofit organizations and local public agencies. With the exception of a small state forest and even smaller National Wildlife Refuge, the island's protected open spaces, now amounting to more than 13,000 acres, have been preserved through local initiatives.

A New Land Conservation Model

In 1983, frustrated that land protection efforts were falling behind because of a strong economy and a related building boom (the construction of nearly 300 new homes a year), the town's planning director devised an innovative solution to collect funds needed to compete with other buyers and purchase additional public recreation and conservation land. The idea became known as the Nantucket Islands Land Bank, the nation's first such effort. Town Meeting, and the state Legislature authorized a 2% surcharge on all future private real estate purchases. Taxes, now totaling approximately $11 million per year, are collected by an elected, five-member Land Bank Commission which is responsible for purchasing and managing town-owned lands using available resources. In addition, several years ago, recognizing that the Commission was falling behind in its ability to compete for the purchase of choice undeveloped parcels, voters authorized a $25 million bond that was used to supplement the land acquisition budget. To-date, the

Commission has protected nearly 3,000 acres, including the island's only two public golf courses.

Local Conservation Partnerships

For a community its size, Nantucket has an uncommon concentration of nonprofit conservation organizations and public conservation agencies. This stems from the passion for open space shared by its year-round and seasonal residents who are protective of the island's magnificent landscapes and exceptional natural resources. These groups, led by the Foundation and Land Bank Commission, have similar names and goals, but utilize different approaches and shared constituencies. They all work closely with each other and cooperate on many different projects, at many different levels, and fill complementary, non-competing roles.

Other land conservation groups include:

The **Nantucket Land Council**, founded in 1973, is a member-supported organization that acquires and enforces perpetual Conservation Restrictions. These restrictions legally limit the eventual development of a private landowner's property. The Land Council now holds restrictions affecting more than 1,300 acres. It also supports scientific research and carefully reviews development proposals which have been submitted to the town's Planning Board and Conservation Commission.

The '**Sconset Trust** was organized in 1984. It, too, is a member-supported organization that acquires undeveloped land for conservation purposes within Siasconset village, an attractive seasonal neighborhood on the east shore of the island. To-date, the Trust has protected 130 acres through gift and purchase. In 2007 Trust supporters paid $4 million for the relocation of the historic Sankaty Head Lighthouse which was being threatened by shoreline erosion.

The **Massachusetts Audubon Society**, separate from the National Audubon Society, is a state-wide group and one of the nation's most respected member-supported conservation organizations. Mass Audubon owns sanctuaries on Nantucket totaling 947 acres.

The Trustees of Reservations is another member-supported, nonprofit organization which protects conservation properties across Massachusetts. Established in 1891 it is the country's oldest land trust. On Nantucket, it owns 987 acres, most of which are located on the barrier beaches south of Great Point, the island's northernmost tip.

The **Nantucket Conservation Commission** is an appointed town regulatory agency whose primary purpose is to enforce state and local wetlands regulations. The Commission also manages several town-owned pond access sites.

Other active island conservation partner organizations/agencies include the **Maria Mitchell Association** whose interests are focused on natural history, science, and education; the **Nantucket Field Station**, managed by the University of Massachusetts/Boston for research and education; the **Linda Loring Nature Foundation** which hosts environmental education programming on its property; the **Nantucket Garden Club**, an influential group of seasonal and year-round residents which promotes environmental awareness and whose members generously support island conservation initiatives; the **Nantucket Community Preservation Committee** which administers taxpayer-funded grants for open space protection and other community purposes; and the town's **Park and Recreation Commission**.

The Future of Resource Protection and Its Challenges

Now that nearly 50% of the Nantucket’s land area is protected in some way or other, the focus of the Conservation Foundation and other open space landowners has shifted. New priorities include studying the natural and cultural resources occurring on these lands. This leads to the preparation of management plans that will insure the continued existence of numerous rare and endangered plants, insects, and animals known to occur on Nantucket, the Massachusetts county that has the largest number of rare and endangered species.

Sustaining Nantucket’s endangered natural resources and unique landscapes has created some interesting challenges. For example, several large acreage private properties, which were once accessible to the public, are now permanently off limits. As a result, residents and visitors, some of the nearly 55,000 people who inhabit the island during the summer months, are moving their recreational activities to protected natural areas. They assume that these accessible sites are permissible substitutes for their previously favored locations. Whether these are sandy shorelines vegetated with fragile American beach grass or sprawling interior heathland areas, many of Nantucket's protected open spaces host uncommon resources which have a relatively low tolerance for frequent, active group use, especially those involving vehicles.

The native vegetative cover occurring at many popular conservation properties was previously self-sustaining. Extended periods of minimal human use during the late-spring/early-fall growing seasons gave easily damaged plants an opportunity to reestablish themselves. Today the island's popular open spaces areas experience the effects of from increasing shoulder season tourism, more frequent visits by second-home owners who are staying longer or coming earlier, and use by larger numbers of year-round residents. By past island standards, the appeal of certain properties as “unspoiled” or lightly used destinations is changing. Thorough inventories, thoughtful planning and application of field-tested management strategies, monitoring, and increased user awareness and cooperation will hopefully slow and reverse this trend.

Not only do island conservation land managers have to protect threatened natural resources, they must identify effective ways of inspiring high energy, short-term seasonal visitors and summer employees to adopt Nantucket’s long-standing tradition of respecting publicly accessible open spaces as their own and, in some cases, recognize the need to tone down their recreational expectations. Otherwise, today’s uncommon resources an ease of access will become memories.

Conclusion: Continuing to Build Awareness and Appreciation

As well protected and managed as Nantucket seems to be, it has not reached the end of its resource protection road. In addition to priority properties that are left to be conserved using creative combinations of public and private strategies, there must be expanded efforts to heighten everyone's appreciation for the importance of safeguarding the island's specialness while accommodating appropriate types and levels of public use. This will certainly include strategies required to insure the sustainability of the island's unique natural habitats that include globally rare "sandplain grasslands."

In spite of the people/resource management challenges that are ahead of us, Nantucketers are optimistic. Considering where the island could have been had its leaders and community institutions ignored the early signs of change and the need for action, especially in the area of open space protection, Nantucket is way ahead of the curve and the envy of many communities in this country. Furthermore, Nantucket's long-time year-round and seasonal residents "get it." They understand how important quality of life is to them. They have been willing to stand up for it, vote for it, and pay to sustain it. And perhaps most importantly they very much want their children and grandchildren to someday enjoy the same experiences they've had on Nantucket!

The connection between Nantucket's incredible accomplishments and the community's information collection and distribution efforts that took place more than 50 years ago are hard to validate. Nevertheless, documenting existing conditions, identifying threats, explaining the needs of particular resources, and defining possible approaches for their protection got people thinking and more trusting of fellow islanders, fellow voters, fellow taxpayers who they didn't know well.

Like any well-designed planning process, those early public discussions added new words and phrases to the island's vocabulary at a time when "ecology," "environmental protection," and sustaining a community's "quality of life" were only concepts being talked about in the halls of universities. Fortunately, for Nantucket, its residents and the hundreds of thousands of people who annually visit the island, scholars and resource experts were invited to share these emerging concepts with a community that was open-minded enough to consider them and which has benefited greatly from that experience.

Jim Lentowski is Executive Director of the member-supported Nantucket Conservation Foundation, a position that he has held since being hired as the organization's first employee in July 1971. A native of Chicopee, Massachusetts, Jim holds both a Bachelor's and Master's degree in Landscape Architecture from the University of Massachusetts, Amherst. Under his tutelage the Foundation's land holdings have grown from 1,200 acres to 9,000 acres, representing 30% of the island's land area. The Foundation's holdings include the 110 acre harborfront "Nantucket Field Station" which it purchased from UMass in 2004 for $22M. The Foundation has an ongoing partnership with UMass/Boston to advance the Field Station's use for college-level studies and research focused on environmental issues. In addition to his on-island interests, Jim's professional activities include ongoing participation with the Land Trust Alliance (LTA) and serving as a founding Steering Committee member of the Massachusetts Land Trust Coalition. His efforts on behalf of land conservation have been acknowledged locally, by the Massachusetts House of Representatives and by his colleagues during the LTA's 2010 national meeting.

Oasis Greenways: A New Model of Urban Park within Street Right-of-Ways in Dorchester, Massachusetts

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Background and Objective

Parks and greenways can offer many benefits to urban communities in many areas including recreational, public health, and increased land value. However, there are often few opportunities to carve out a narrow, continuous green space in the built-up parts of our cities. One prospect involves using available land in rail or utility corridors; another involves radical road diets to create space along major roads. This paper examines another approach, using the right-of-way (ROW) of local streets to transform pavement into linear parks that we call Oasis Greenways. An Oasis Greenway has ultra-low motor vehicle speeds and volumes, allowing there to be a single, narrow paved area shared by motor traffic, pedestrians, and bicycles. The resulting reduction in road footprint creates space for vegetation bordering the paved area, turning the street into a path through greenway park. This paper describes the development of an Oasis Greenway concept and its application to the Fairmount Corridor in Dorchester, a neighborhood of Boston identified as a "Greenway Desert" (Furth et al, 2013).

Paradigms Useful to Oasis Greenways

The Oasis Greenway concept draws from several paradigms of urban design:

- Pocket parks, including "Parklets" from San Francisco (Salvadori, 2013) and "Better Blocks" from Dallas (Roberts, 2012) involve repurposing parking places and leftover road space for recreation and seating.
- Road diets (Burden and Lagerwey, 1999) or rightsizing (Toth, 2012) removes lanes from roads with unneeded capacity, using the redeemed space for bike lanes, wider sidewalks, and planting strips.
- Bicycle boulevards or neighborhood greenways (Portland Greenways, 2012) are local streets that use traffic diversion and traffic calming to make them suitable through routes for bikes while keeping away all except local motor traffic.
- Courtesy streets or queuing streets allow two-way motor vehicle traffic without providing sufficient width for two travel lanes. Cars pull over in informal spaces (empty parking spots, driveways) to let opposite direction cars pass.
- Woonerfs (Williams, 2012) are shared streets that have a very small footprint due to not having sidewalks or multiple lanes. They are configured to have ultra-low traffic volumes and speeds ("walking pace"), allowing them to be used as play space.
- "Green streets" use vegetation and pavement treatments to reduce stormwater runoff and filter pollutants while making it more attractive for walking and biking.
- Permeable paving allows stormwater to infiltrate, reducing runoff and supporting groundwater recharge.
- Grasscrete (used generically) is a concrete paving layer that not only allows water to filter through, but has many small gaps that allow grass to grow through it, yielding the visual

effect of a lawn while offering a load-bearing surface for vehicles (Grass Concrete Limited, 2012). It has been used for road shoulders, fire lanes, parking areas, and even some roads.

Traffic Design for Oasis Greenways

An Oasis Greenway involves both a spatial design and a traffic design. The traffic design involves getting motor vehicle speeds and volumes low enough for shared space to be comfortable. The chosen thresholds are shown in Table 1. A volume of 900 (300) veh/day means about 90 (30) veh/h during the peak hour, or one vehicle every 40 seconds (every 2 minutes).

Table 1: Speed and Volume Targets for Oasis Greenways

Measure	Target Value
Average Daily Traffic (ADT)	900 veh/day (300 veh/day is desirable)
Traffic speed	10 mph

The most effective way to reduce speed is to install self-enforcement measures in the form of vertical and horizontal traffic calming devices. Possible measures include speed cushions, sinusoidal humps, chicanes, raised intersections, neighborhood traffic circles, and traffic diversion measures that force frequent turns, with slow points spaced close together enough to that they keep traffic at 10 mph or less. Chicanes are particularly attractive for Oasis Greenways because of their "terminal vista" effect, which lower traffic speeds and increases peripheral visual acuity.

With respect to the volume target, traffic design involves diverting traffic so that motor traffic on the greenway is limited to local access only, and keeping segments short in order to prevent a large accumulation of local traffic. Traffic diversion tools include diagonal diverters, half- and full-closures, and alternating one-way streets, a technique that has been applied elsewhere in Boston as well as in the Netherlands.

If traffic can be reduced to local access, then traffic volume can be predicted using trip generation. The Institute of Transportation Engineer (ITE) publishes trip generation rates for homes (and many other land uses) based on self-report data mostly from recent projects that tend to be in suburban, auto-oriented developments. For "Single Family Detached Housing," reported rates range from a low of 4.31 daily trips to a high of 21.85 daily trips (each motor vehicle arrival or departure from a home is a "trip"), with an average rate of 9.57 (ITE, 2012). The study corridor mainly has three-decker buildings (stand-alone and detached building with three units, often with a resident owner); relevant ITE rates are 6.59 for "low-rise apartments" and 5.81 for "residential condos and townhouses." Considering the large variation in reported rates, standard rates like this should be adjusted for demographic and location factors. Because the study corridor has small, older apartments, low income, low auto ownership, and frequent bus service on multiple routes, a trip generation rate of 4 trips/day was considered appropriate.

To verify the chosen rate, volume counts were made on Maybrook Street, a short street in the corridor with 30 dwelling units that is not a convenient route for through traffic and therefore carries local traffic almost exclusively. A peak hour count found there to be 11 vehicle trips; using the standard assumption that 10% of daily trips occur during the evening peak hour, that corresponds to a trip generation rate of 11 / 0.1 / 30 = 3.67 trips/day, in close agreement with the chosen rate.

The map in Figure 1 shows the proposed traffic design for Norwell Street. It includes speed humps and chicanes (described later) for controlling speed and alternating one-way streets to divert through traffic. Traffic volume on the busiest block is predicted to be 260 vehicles per day at any point on the block, based on (1) a trip generation rate of 4 trips / day, (2) considering that on a one-way street two "trips" (one leaving, one entering) produce a single vehicle passing every point along the street, and (3) counting 50% of the trips generated on the parallel one-way street Radcliffe Street, whose residents may use the subject block of Norwell to access their homes. This figure meets the desirable volume target of 300 veh/day.

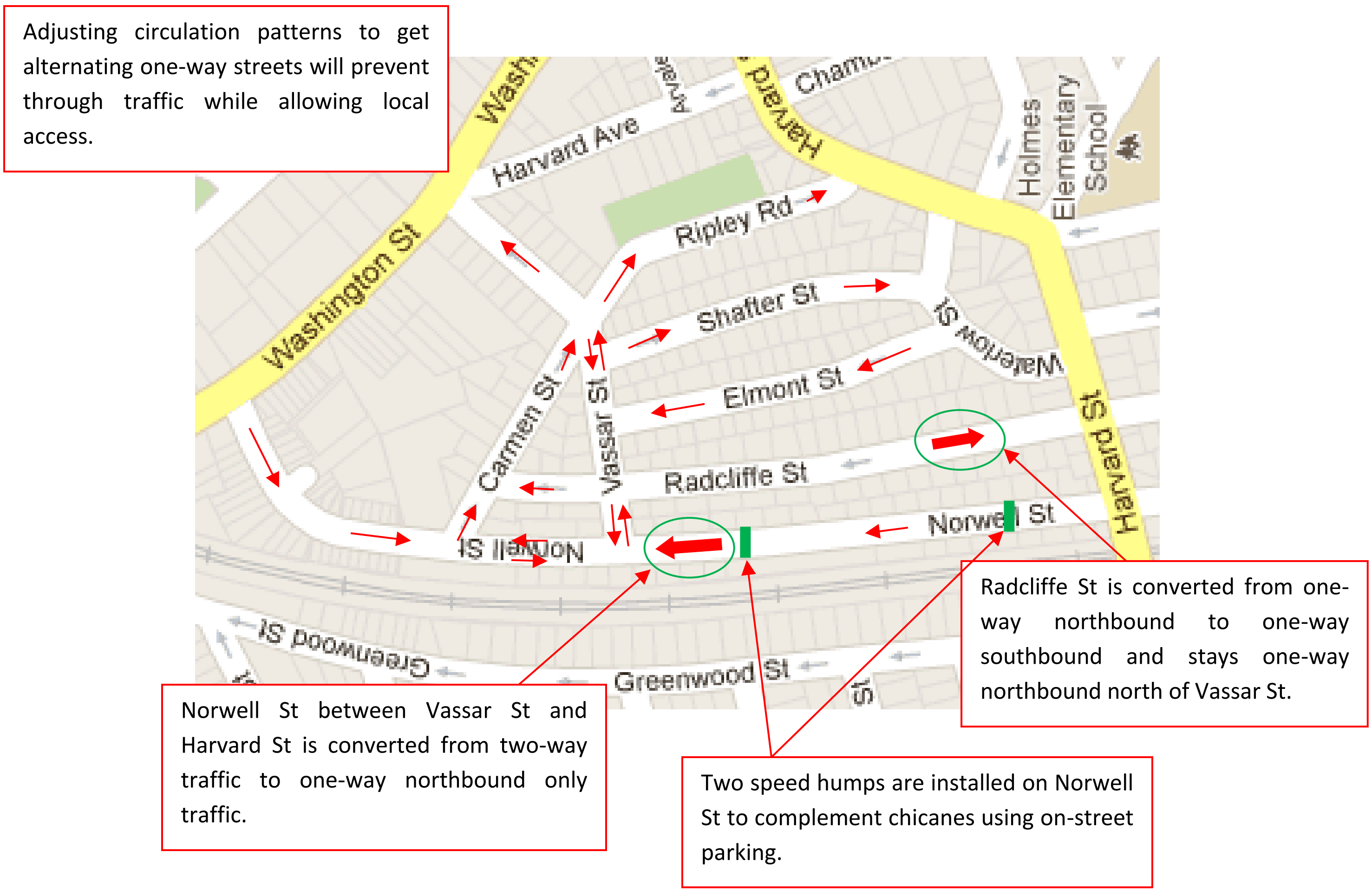

Figure 1: Proposed design for Norwell Street

Spatial Design for Oasis Greenways

A standard cross section for a 40-ft right of way is shown in Figure 2. A 14-ft wide travel zone is on one side, which will allow a slow-moving car to pass by a pair of pedestrians walking side-by-side; then, after a 2 ft buffer, the remaining 24 ft is a zone used for head-out angle parking, plantings, and parklets. Head out angled parking allows drivers pulling out to more easily see playing children and oncoming cyclists or pedestrians.The travel and park / parking zone switch sides regularly to produce a chicane effect to slow traffic and create a terminal vista. For two-way operation, the same cross-section can be used; alternatively, parallel parking can be used with a narrower park / parking zone.

In order to slow speeds and give the street a park-like look, the design uses grasscrete for the travel and parking areas except in three 5-ft no-grass strips of pavement intended to to give pedestrians and cyclists a smooth pavement surface and to allow them to avoid walking through wet grass. Two of the strips are in the travel area in order to accommodate 2-way bike traffic; the third is at the back edge of the parking zone for accessing the car trunk. Motor vehicles wheels can roll on the no-grass strips as well as on the grasscrete.

Demand for on-street parking is then determined for every block. For new apartment developments, the City of Boston recommends 1.0 to 1.5 spaces per dwelling, lowered to 0.75 to 1.25 spaces for developments within a 10 minute walk of a rapid transit station (Boston Transportation Department, 2012). This study used 1.2 spaces per dwelling as the parking supply requirement. The need for on-street parking can then be determined by subtracting off-street parking spaces, but in any event providing at least 0.2 on-street spots per dwelling for visitors (Willson 2011); the remainder of the park / parking zone can be programmed as green space. For example, on Norwell Street between Harvard Street and Vassar, the on-street parking need was determined to be 22 spots, or six for every 300 feet. Even if this supply is doubled to 12 spots every 300 feet, angle parking spaces are only 10 ft wide, leaving 180 ft in every 300 ft for trees and parklets. Some of this green space can be used to separate small groups of parked cars so that there are no long areas without trees; the remainder of the green space can be concentrated and in some cases furnished with play equipment or benches.

A plan view of an example section is shown in Figure 3. It shows the three path strips, a park / parking zone with clumps of parking spaces and clumps of trees, and a chicane where the park / parking strip is shifted to the other side of the street. Compared to the existing cross section (a 26-ft asphalt roadway flanked by a pair of 7-ft concrete sidewalks, with no vegetation in the ROW), the overall character is certainly greener and more pedestrian-scaled. More importantly, it appears that the urban greenway has been met, with a path-like shared space surrounded by a lawn and interesting planting areas offering an attractive environment for sitting, walking, cycling, and playing.

Connectivity: Routing Choices and Dog Legs

Route following residential streets often aren't naturally continuous, because residential streets are often planned with deliberate discontinuities in order to deter through traffic. Figure 4 shows an example of how Norwell Street and Eldon Street, another residential street that could be the continuation of the Oasis Greenway, both meet Washington Street (a minor arterial) at 3-way intersections, with an offset of 360 ft separating the two residential streets. Connecting those streets means that greenway route includes a 360-foot dog-leg along Washington Street.

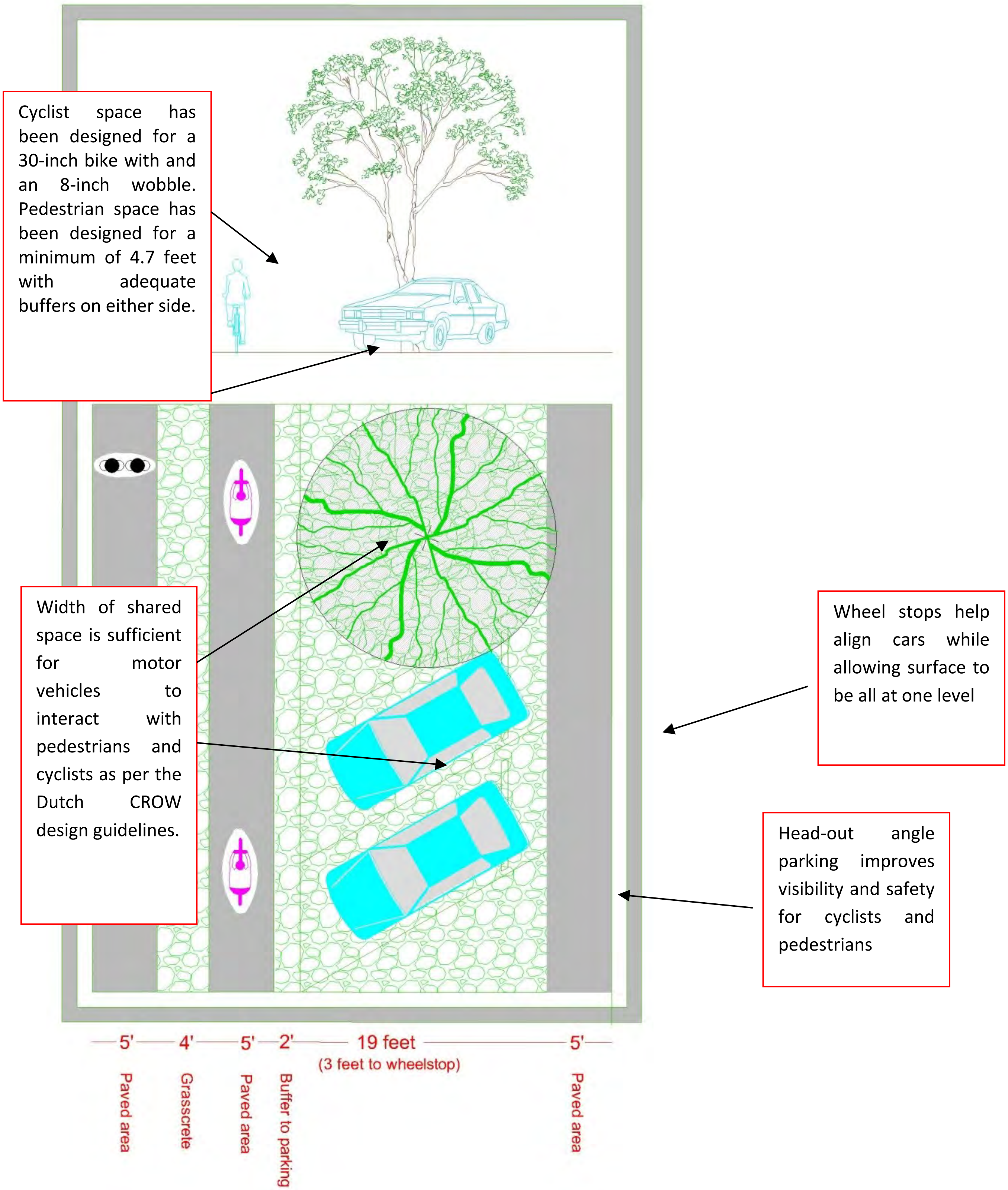

Figure 2: Cross-section and close-up Plan-view for a generic Oasis Greenway

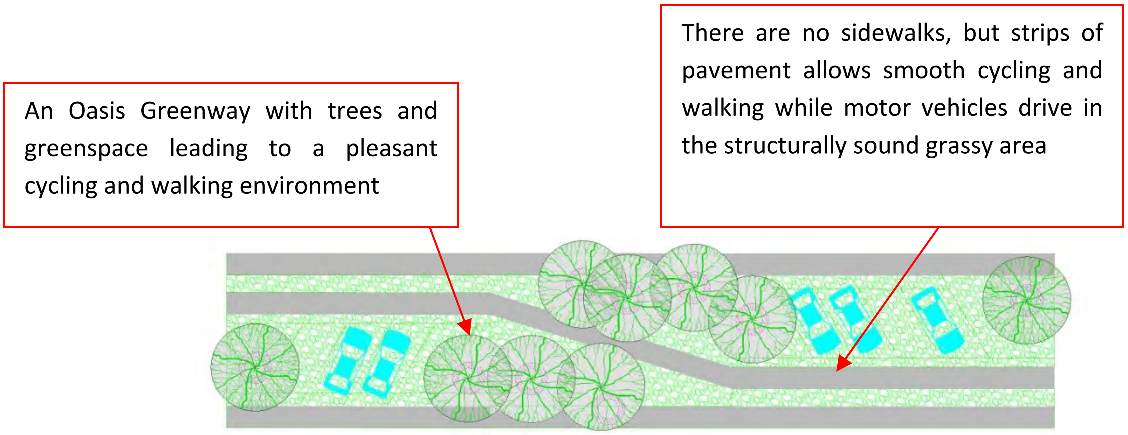

Figure 3: Example Plan for an Oasis Greenway

Figure: D

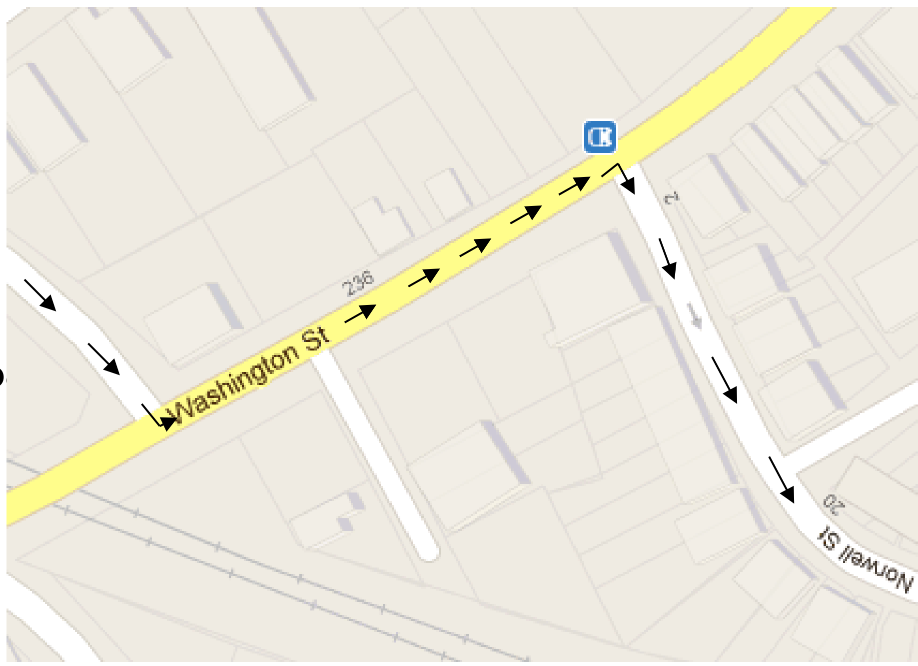

Figure 4: Dog-leg Intersection separating Oasis Greenway Streets

Because sidewalks are available along Washington Street, such a dog-leg is not a substantial deterrent to walking; however, because the sidewalks are too narrow to be shared for cycling and the road carries heavy motor traffic, dog leg intersections can be major obstacles for an Oasis Greenway to serve as a low-stress and continuous bicycling route, unless a low-stress bicycling facility is provided the length of the dog-leg. Figures 5 and 6 show a possible design for a "dog-leg cycle track," a short section of cycle track connecting a pair of offset residential streets. Its design assumes the removal of a parking lane for the dog-leg section, replacing it with a bike path. An existing example of a dog-leg cycle track can be found in Portland, where a short section of sidewalk-level bike path along NE 33rd Avenue connects two offset segments of Going Street, a "neighborhood greenway" offering low-stress bicycling. Unlike Going Street, this proposed jog cycle track includes street trees in order to continue the green character of the route.

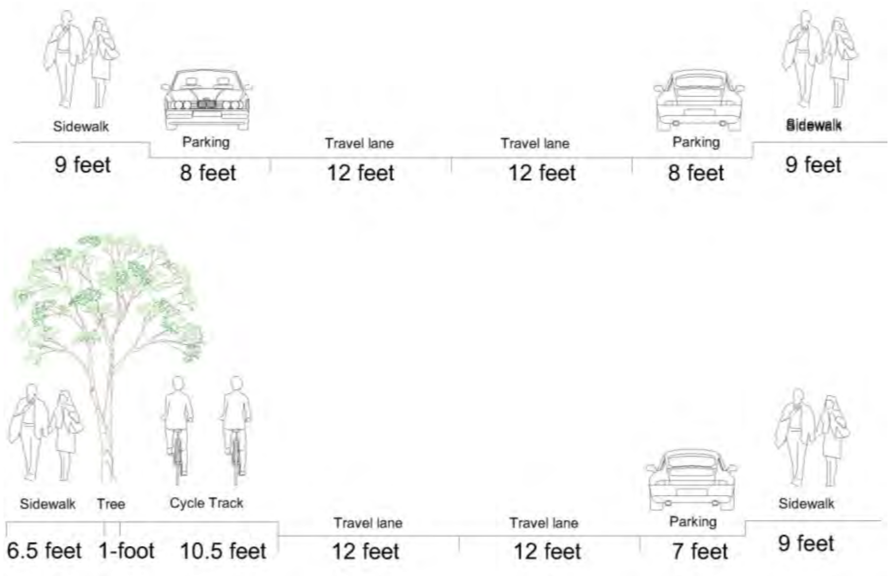

Figure 5: Existing and proposed cross-sections for a Dog-Leg Block on Washington Street

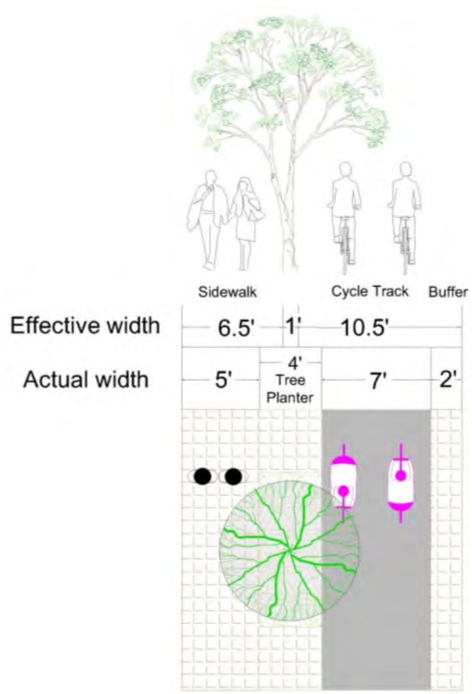

Figure 6: Physical and Functional Dimensions for Jog Cycle-Track Sidewalk Area

Connectivity is also an important consideration in route selection, trying to finds residential streets that can be strung together in a way that minimizes inconvenience and loss of greenway character where the route transitions from one street to the next. For example, in the Fairmount corridor there is a choice between Greenwood Street and Norwell Street, residential streets lying on opposite sides of the railroad tracks between Harvard Street and Washington Street. Both are amenable to Oasis Greenway treatments based on traffic and space criteria. The choice between them therefore depends more on connectivity. At the northern end, Norwell requires a larger jog cycle track to reach Eldon Street than would Greenwood, involving additional parking removal and road construction expense; however, at the southern end, Norwell connects directly to another local street across Harvard Street, while Greenwood Street would require another jog cycle track.

Conclusions

Oasis Greenways have been proposed as a way to create a greenway in a dense urban area using the right of way of local streets. Combining paradigms including the woonerf, bicycle boulevard, parklet, and green street, an Oasis Greenway aims to provide a continuous path in a park environment while preserving access to people’s homes. Application to a short section of the Fairmount corridor in Boston’s Dorchester neighborhood demonstrates the concept, with solutions that address the traffic, space, and connectivity needs inherent in the concept.

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An integrated approach of landscape design in the rehabilitation of an urban river corridor: river Tinto

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Abstract

Due to the increasing demand for its water resources, the changes in land use and the fast urban sprawl, the river Tinto became the mass of surface water of the river Douro´s watershed with lower physicochemical and biological quality. Taking into account its scale and urban context, the severity of the pollution level and the periodic flooding problem, became urgent to accomplish priority solutions for its riverside landscape, based on natural recovery principles and flood protection.

The purpose of this paper is to stress the contribution of the integrated approach of landscape design in the improvement of the life quality and safety assurance of the local population, taking into account information and proposals from previous projects, plans and programmes, bioengineering technical knowledge and the national legal mechanisms related to water resources management. It was intended to rehabilitate a stretch of the river Tinto with the creation of a riverside urban park – Meiral Park. This project’s aim was to extend and qualify the public space, ensuring the river resilience and enhancing the hydraulic connectivity of its ecosystems and the multiple functionality of the place, through the integration of different uses – production, protection and recreation

With this project, it became obvious that landscape planners can take a more active and valid role in the management of water resources, through a multidisciplinary and intersectoral collaboration exercise. Indeed, it is believed that in the current political and economic context, incorporated into the guidelines of the Water Framework Directive, landscape design will gain a new dimension in the sustainable management of water resources.

Keyword: landscape design, water, river corridor, rehabilitation, law.

Introduction

The General Assembly of the United Nations has proclaimed the period 2005-2015 as the International Decade for Action "Water for Life", during which they must ensure the implementation of programmes and projects associated with this feature, by helping to achieve the internationally agreed goals. Concerning this matter, each Member State must set the internal organization and management models (Branco, 2007) that best fit their legal, institutional, economic and financial regime. However, it is clear that the development of water management, in general, remains dependent on the preparation of successive plans and designs, whose practical effectiveness is quite low (Matos, 2007). In part, this problem is due to the dislocation between planning and "the functioning of society as to how decisions are made, priorities are established, resources are affected and benefits are distributed” (Correia, 2007).

The proximity of the water lines to urban centres enhances recreational opportunities and production. However, the growing urban pressure has contributed to a continued artificiality, plumbing and linearization of river corridors. Thus far, considering this situation, it becomes almost imperative to re-evaluate the practice of landscape planning in the rivers' rehabilitation, in order to improve the environmental, functional and visual quality of the riverside landscapes, not burdening the living cost of citizens.

According to Alves (2003), the rehabilitation process of a river must occur along with the definition of a riverside public space design. "In many highly developed areas, restoration may be driven largely by the recognition that stream corridors provide the most satisfactory opportunities to repair and preserve natural environments in the midst of increasingly dense human occupation" (USDA, 2001). However, "(...) the water resource management in contemporary society requires (...) also a better understanding of contextual processes involved in policy formulation and decision making" (Correia, 2007).

The purpose of this paper is to stress the contribution of the integrated approach of landscape design, in the improvement of the quality of life and safety assurance of the riverside population, taking into account information from previous projects and programmes, bioengineering technical knowledge and the national legal mechanisms related to water resources management. This was the starting point of a PhD thesis in Landscape Architecture and Urban Ecology.

It was intended to rehabilitate a stretch of the river Tinto with the creation of a riverside urban park – Meiral Park. The project's aim was to extend and qualify the public space, ensuring the river resilience and enhancing the hydraulic connectivity of its ecosystems and the multiple functionality of the place, through the integration of different uses – production, protection and recreation.

On the specific issue of the river Tinto, several studies and projects have already been developed by some administrative and scientific entities, where we could find data and relevant elements for the proposal (WS ATKINS, 2000; FCUP, 2004; ESB-UCP, 2006; COBA, 2007; FEUP, 2007; JMP, 2008; FCUP, 2009; JMP, 2010; Lemos, 2010; ARH-N, 2011; Teiga, 2011). Nevertheless, none of them uses or advocates in a clearly way the use of the legal mechanisms and the power of water as the primary driving forces of the landscape design development, at its recovery project.

Study Area and Methods

"A project goal of restoring multiple ecological functions might encompass the channel systems, the active floodplain, and possible adjacent hill slopes or other buffer areas that have the potential to, directly and indirectly, influence the stream or protect it from surrounding land uses" (Sedell et al., 1990; USDA, 2001). However, Saraiva (1999) goes further in the characterization of river systems, integrating the anthropic processes in the evolution of drainage networks, in order to "contribute to a better understanding of the role of rivers and river systems in landscape planning (...)" (Saraiva, 1999). In this sense, it is believed that their management should assume the integration of biophysical/chemicals processes and socio-economic and cultural factors that led to the formation, evolution and transformation of the riverside landscape. The river system is the set of these interdependent sub-systems, whose inter-spatial and temporal relationships form the riverside landscape.

Given the increasing demand for its water resources, the changes in land use and the fast urban sprawl, river Tinto became the mass of surface water of the river Douro's watershed with lower physicochemical and biological quality. Taking into account its scale and urban context, the severity of the pollution level and the periodic flooding problem, as well as the expressed will of the public to restore the river and the existence of imminent projects that are already expected to take place in their valley, became urgent to accomplish priority solutions for its riverside landscape, based on natural recovery principles and flood protection.

Meiral Park is located in the river Tinto´s watershed and incorporates a stretch of the main water line that crosses the municipality of Gondomar, near the Wastewater Treatment Station (WTS) of Rio Tinto. The localization of the park allows it to serve as a landmark and a connecting link between the East Park of Oporto and Rio Tinto's historic centre, by anchoring it to the network routes of the municipality of Oporto and the urban centre of Rio Tinto (parish), which already has some public interest infrastructures.

"In many highly developed areas, restoration may be driven largely by several recognition that stream corridors provide the most satisfactory opportunities to repair and preserve natural environments in the midst of increasingly dense human occupation." (USDA, 2001) In fact, within river Tinto's watershed, the park's surrounding area is the most affected by the land speculation and the road network´s development. This situation contributed to the replacement of the "rural organic structure" of its landscape by a "winding urban web, without legibility and generally quite disqualified" (FCUP 2009). The limits of the urban system in the rural areas don't exist, as well as continuous/comfortable pedestrian systems and qualified public spaces, which could function as reference points in this riverside landscape.

The anthropic pressures also led river Tinto and its streams to a loss of connectivity and to the artificiality of its margins and bed. This situation contributes, not only to the difficulty in perceiving the landscape, but also to the degradation of water quality and natural ecosystems of the margins, and therefore the life quality of the riverside population. This situation is especially serious in the municipality of Gondomar, where the "point of ecological characterization (...) has the worst overall quality of habitat (...)" (FEUP, 2007). Currently, the river Tinto has hardly riparian gallery or ecological communities and most of the water body is intubated or walled with concrete walls or gabions.

The plumbing and linearization of the river watercourse, the deposition of waste and landfills, the construction and occupancy of margins and the destruction of riparian vegetation (JMP, 2008) have aggravated its flood regime. According to a study performed by FEUP (2007), in a point nearest Meiral Park, a flood with a return period of 5 years could reach at least 1.5 metres high and 12 metres wide. In turn, in a centennial flood, the water bed can reach 4 metres wide and 50 metres wide. These values are of concern because the WTS of Rio Tinto is located in the river Tinto's floodplain making this situation worse. Besides, in the area contiguous to that infrastructure, the concrete walls on both sides of the river banks are strongly constraining the water line, not allowing water infiltration in the surrounding land.

In order to guide the water policy in the countries of the European Union (EU) and upgrade/integrate/harmonize all the present legislation in this area, the European Parliament decided to approve the WFD, on 23 October 2000. Its implementation has a set of new challenges and responsibilities to the various Member States, in the protection and sustainable use of water bodies in their territories. In Portugal, the Water Framework Directive (WFD) was transposed into the Water Act (Law n. º 58/2005 of 29 December) and establishes various environmental objectives to be achieved until 2015, based on the elaboration of Regional Hydrographical Management Plans (PGRH) and the identification of a series of actions that they should promote. Regarding the river Tinto, the North Region Portugal Hydrographical Management Plan of the river Douro´s watershed (ARH-N, 2011) foresees the redevelopment and enhancement of the river Tinto, during the years 2013 and 2014, based on the change of its hydro morphological conditions. The ultimate goal is to achieve its good ecological status in the year 2027, which naturally requires an integrated and interdisciplinary strategy.

In addition to the legislative instruments that transpose the EU directives, "the legislation on the water was (...) supplemented by important legislative instruments designed to update and harmonize the previous legislation (...) and operate the transposition of the WFD" (MAOTDR, 2008). In fact, "in regard to the relations between the rivers and the organization of the territory, they [the rivers] traditionally have been structural axes in spatial planning" (Saraiva, 1999), under the jurisdiction of several legal figures, such as the Law of Water Resources Ownership (Law n. º 54/2005 of 15 November) and the Public Water Domain (DPH), among others.

"The DPH represents a concept that is the basis of traditional water resources management (…)" (Saraiva, 1999). Nowadays, it consists of a "set of goods which, by their nature, the law submits to a regime of special character" (INAG, 2002). This regime establishes, on a legal support (MAOTDR, 2008), some notions and the correspondent rules that define their legal status. The main instruments in flood defence, in terms of non-structural measures, are the figures of Adjacent Zone (ZA) and the Zone Threatened by Floods (ZAC), whose legal regime establish "restrictions on incompatible or vulnerable land uses and (...) [ensure] the flow of flood runoffs and other hydrological and ecological functions, important to the water cycle and ecosystems that depend on it" (MAOTDR, 2008).

According to the types of rivers in Portugal, established by the National Water Institute, within the implementation of the Water Framework Directive (WFD), the river Tinto is characterized as a surface water body from type "Small Dimension North River" (N1 ≤ 100 km2). According to the Law of Water Resources Ownership (Law n. º 54/2005 of 15 November), the public watercourse comprises "streams not navigable or floatable, with the bed and margins, since located on public land, or that, by law, are recognized as usable for public purposes (...)" (Law n. º 54/2005, art. 5, paragraph c).

In this case, "the remaining water bed is limited by the line which corresponds to the extreme of the land covered by water in conditions of average flood (...)" (Law n º. 54/2005, art. 10, n. º 3). "Average flood" is characterized as a "flood with a return period of once in five years, accepting the matter in the juridical view of Professor Diogo Freitas do Amaral and Dr. Pedro José Fernandes (Commentary on the Law of the land of the Water Resources Dominion, 1978), where is referred, as a comment on Article 2, Decree-Law 468/71, paragraph 24, section B), note (40), that " average floods, according to the understanding of the General Directorate of Hydraulic Resources and Uses, are those whose occurrence can be expected once in every four or five years." In turn, "the margin of non-navigable or non-floatable waters, namely streams, ravines and streams with discontinuous flow, has a width of 10 metres" (FEUP, 2007).

"In relation to public non-navigable or non-floatable waters located in private buildings, their bed and margin are private, under Article 1387 of the Civil Code, submitted to administrative easements" (Law n. º 54/2005, art. 12, n. º 2). However, in case of water breakthrough, "when there are private parcels adjoining to public beds, the portions of land eroded by the waters slowly and successively consider themselves automatically integrated into the public domain [as ZAC], so that there is no place to compensation. If the private parcels adjacent to public domain waters are invaded by water but remain without corrosion of the land, its owners retain their property rights, but the state can expropriate these parcels" (Law n. º 54/2005, art. 14). The ZAC can be considered as the "contiguous areas to the watercourses' banks that extend to the largest flood limit reached with the probability of occurrence in the period of a century (centennial flood)." (INAG, 2002) For instance, if an area is flooded up to 50 metres wide, from the water line, under the law, it can be automatically considered a ZAC, giving rise to a potential expropriation of land.

Once a ZAC is classified as ZA, through a statutory act, the lands covered by it shall be submitted to several restrictions of public utility. (INAG, 2002) The ZA "is understood as the entire area adjacent to the edge that is classified as such for being threatened by sea or by floods. The adjacent zones extend from the edge of the rim to a conventional line set, classified for each case, which corresponds to the largest flood line achieved with a return period of 100 years or the greater flood known, when there is no data to identify the last one" (Law n. º 54/2005, art. 24, n. º 1 and n.º 2). Regarding the ZAC that are not yet classified as ZA, the approval of "land development plans or urbanization contracts, as well as the licensing of any urban operations or urban subdivision, or any works or buildings (…) require assent by the competent authority for the licensing of water use, when they are within the limit of the centennial flood or the range of 100 metres to either side of the bank of the watercourse, when that limit is unknown" (Law n. º 54/2005, art. 25, n. º 9).

The corridor's concept is one of the "core standards of the landscape's organization through which important flows of energy, materials and species are processed" and various resources to human activity are provided. It is therefore within the development/requalification of the river Tinto that the use of its corridor, as a natural linking path, may enhance the connectivity of its permeable areas for recreation, protection and production (e.g. rural areas), building a multifunctional landscape in one of the densest urban area of its watershed. Having the WFD by reference and based on the natural recovery principles, this proposal amend the land use and modelling of river Tinto's surroundings, towards the creation of an urban park, taking into account the data from FEUP (2007), the legal limits related to the Portuguese Law of Water Resources Ownership and bioengineering technical knowledge.

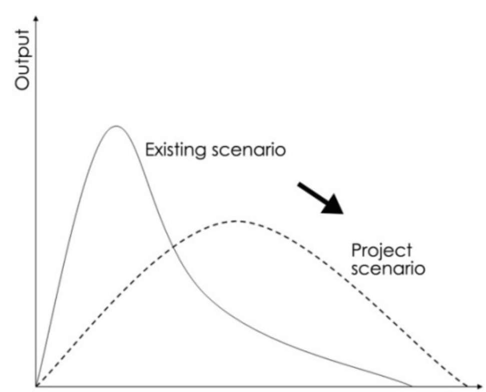

Figure 1 - Flood hydrograph

Results and Discussion

A river corridor includes the main channel, the margins and the floodplain. In Meiral Park, this structure is the element that generates the whole space and its design and delimitation took into account the legal concepts under current law and the values obtained in previous studies

(Figure 2). Thus, within the potential public domain area, it was possible to design a doubly functional area – recreation and protection – by creating paths along the margins and by implementing a meadow for informal use. This particular design element works as an infiltration band, by increasing the permeable area for absorption peak flood (Figure 1) and the hydraulic resilience of the river, while promoting biodiversity. This strategy was essential to avoid flooding the WTS.

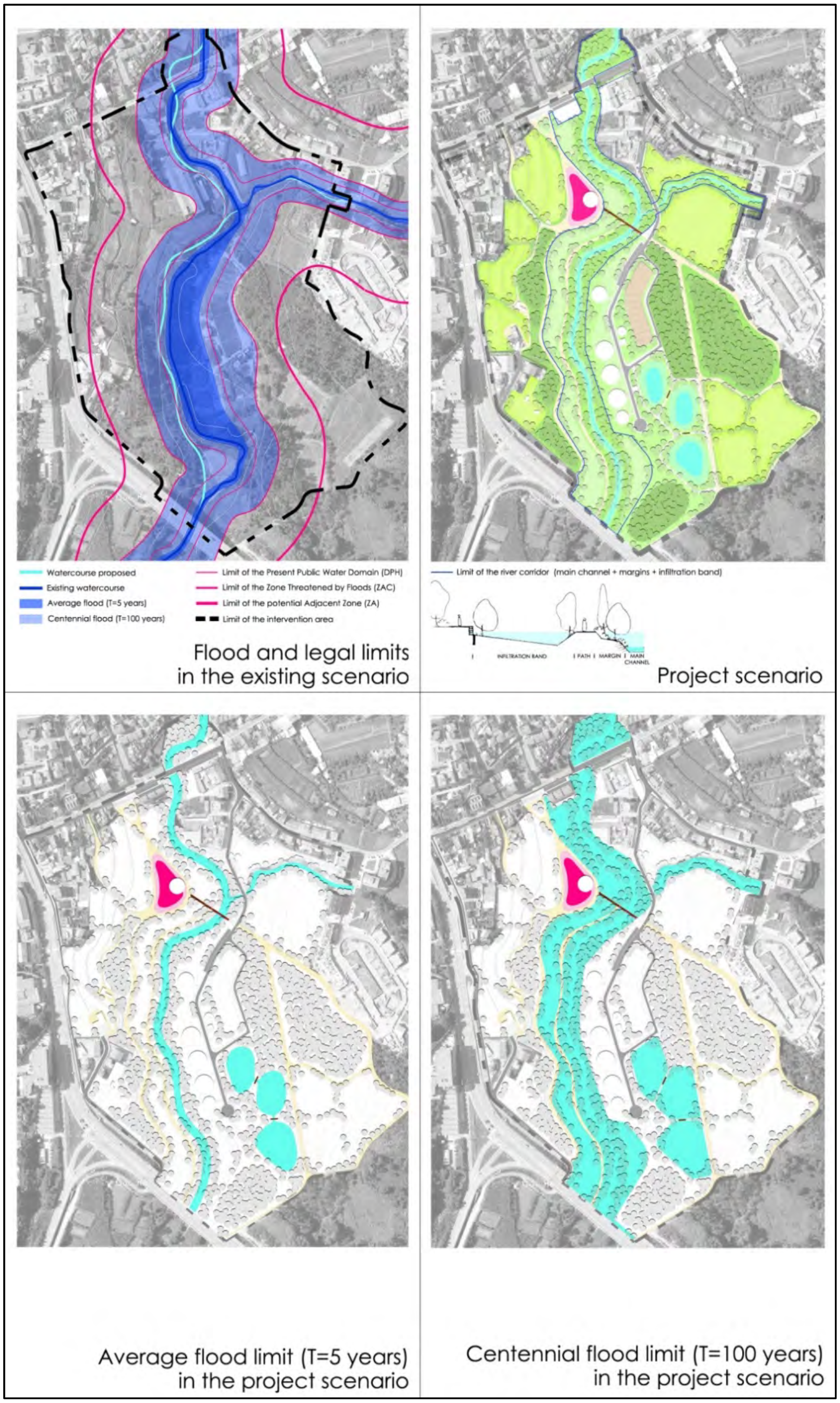

Figure 2 - Cartographic elements, developed for the Meiral Park project, which show the results of the river corridor strategy adopted.

Along with other measures, making it a meandering watercourse even made possible to overcome a number of problems: reduce the water velocity and, therefore, increase the infiltration; reduce sedimentation in the reference section (mouth) of the river; decrease in flow tip; increase reaction time; increase the available area for the installation of plant species; promote biodiversity; and increase capacity of the land to perform water purification.

Outside the limits of the new river corridor (in the range of 100 metres to either side of the bank of the watercourse), where the private lands can't easily be expropriated or mobilized, the redevelopment of the existing farming system becomes the key strategy to ensure the protection of water and soil resources. On account of this, we proposed the promotion of environmental protection techniques within the little producers, the restructuring of farmland borders with native tree and shrub species and the installation of drainage ditches for agricultural effluents. The implementation proposal of a protection forest in the steeper area between the floodplain and the agricultural fields is also an important measure of protection and enhancement of the visual quality of the riverside landscape.

According to Abreu (2007), "the contribution of landscape to the land corresponds to a better understanding of the present complex issues and a demand for more valid proposals for the future.” Indeed, with this multidisciplinary exercise, it became obvious that landscape planners can facilitate the administrative process since the project elaboration to its implementation, taking a more active role in the management of water resources. Through the proposal of design solutions adapted to the specificities of each site and local population needs, the compliance with the principles and concepts emanated from the Water Act and other regulatory instruments and the integration of the guidelines of previous projects, plans and programmes, landscape planners can contribute to an effective implementation of sustainable water management systems in the rehabilitation and recovery of small river corridors.

Conclusions

Assuming that "water is the driving dynamic landscape" (Quintino, 2011), to which a set of environmental services is associated (Tánago, 2011), it becomes evident the need to integrate ecological knowledge of the river systems, the aesthetic appreciation of the role of water in the landscape and the contextual processes involved in policy formulation and decision making in the application of planning and management of riverside landscapes. Based on the multidisciplinary and intersectoral collaboration (Saraiva, 1999), this exercise is, nowadays, a challenge for the professional practice of Landscape Planning and can undoubtedly contribute to the sustainable development of the territory. As a matter of fact, it will be within this political and economic context, properly incorporated into the guidelines of the WFD, that the integrated approach to planning landscape will earn a new dimension in the sustainable management of water resources.

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