Greenway Planning and Management of Urban Riparian Corridors: the alternative basis for an Integrated System of Urban Green Spaces. Case study: riparian corridors in the city of Igoumenitsa, Greece.

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Abstract: Riparian corridors in urban environment are responsible for the city's stormwater drainage as well as its health and sanitary conditions.
Riparian corridors are also allocated as green non-buildable spaces, often perceived as spaces reserved for leisure time or recreation. Evident is the relationship between these corridors and the scattered green spaces throughout the city (parks, squares, walkways etc.). Greenways can offer the required connectivity, providing the alternative basis for an integrated system of urban green spaces.

Catalyst and case study of the above proposition is the attempt to connect riparian corridors with other open spaces and forming an integrated system of urban green spaces within the city of Igoumenitsa, Greece, thus upgrading the quality of civic life.

Keywords: Greenways, planning and management, riparian corridors, urban green spaces, Igoumenitsa.

1. Terms

Riparian corridors are natural and/or altered courses of vegetated lands along rivers and streams that carry surface water. These vegetated corridors can stretch from a stream's headwaters down to its mouth and are directly influenced by flowing water. Riparian corridors, when appropriately sized, maintain healthy streams and aquatic life as well as protect and improve streamside property values.

They can include open streams, streams that have been placed in culverts or pipes, and drainage ditches with intermittent flow. A naturally vegetated riparian corridor consists of native shrubs, trees and wetland plants. The width of a riparian corridor is influenced by many factors including stream width, drainage area, slope of adjacent land surface and soil types.

2. Functions and Benefits of Riparian Corridors protection

Riparian corridors are important ecosystems that support a wide variety of life. In this ecosystem, plants provide nutrients and habitat for terrestrial and aquatic life. Terrestrial life becomes food for aquatic life and vice versa. People rely upon a healthy environment to provide them with drinking water, food and recreation. How people manage the

environment, ultimately affects their present well being (viability) and their future one (sustainability) [2].

Riparian corridors have important ecological value because they provide a wide range of physical, hydrologic, biological, and chemical functions. Improper clearing and development near a riparian corridor can destroy habitat and introduce pollutants—including fertilizers, oils, pesticides, and heavy metals—directly into the water, which can kill or cause disease in aquatic organisms. Retention of native vegetation can mitigate these effects.

Protecting riparian corridors poses a wealth of benefits. The most important benefits of preserving healthy riparian corridor are: a) property value enhancement, b) reduction of flooding and erosion, c) storm water runoff filtration, d) surficial runoff fluctuates greatly depending on climatic condition, e) stream bioclimatic shading, f) Wildlife habitat connections, g) pollution processing [3].

3. Economic Benefits

Greenway planning and design can bring communities closer to sustainable development patterns of living. It is less expensive for municipalities to let nature restore itself than to pay maintenance fees and is more sustainable in terms of strengthening the functionality of regional ecosystems. Studies have proven that open space and greenways actually raise property values, increasing the city's tax base. Besides a greater tax base, preserving green space, forests, river corridors, maintains the necessary biodiversity that enables this planet to function, creating oxygen, filtering carbon dioxide and other natural effluents; these processes are not only beneficial for quality of life they are critical for life itself.

4. Land Use Impacts on Riparian Corridors

The benefits provided by riparian corridors are disturbed or lost when zoning and development do not recognize and protect these natural features. Potential flooding and erosion damage to downstream property increases and stream pollutant loadings accelerate as a result of riparian corridor disturbances. Some of the main negative impacts of human land use to riparian corridors are: a) increased storm water flow, b) plant removal, c) polluted runoff, d) invasive species, e) channel alteration [6].

5. Principles and Practices of Riparian Corridors Management

Riparian zones have the capacity to buffer streams and other waters from non – point source runoff from agricultural, urban, or other land uses.

Healthy riparian zones can absorb sediments, chemical nutrients, and other substances contained in non-point source runoff. They also provide for aquifer recharge, diverse habitats and water storage and release. A healthy, functioning riparian area and associated uplands dramatically increase benefits such as fish and wildlife habitat, erosion control, forage, late season stream flow, and water quality. Management decisions must be designed with these processes in mind.

Riparian Corridor Management is a system that allows for the protection of water resources while still allowing sustainable mixed use of surrounding riparian area. It is a combination of techniques that protect, and in some cases, improve water quality and biodiversity.

A Riparian Corridor Management Work Group and a Technical Advisory Committee involve individuals, communities and community groups in protecting riparian corridors within a defined program. By participating in such a program, one can learn about riparian corridors, their importance to urban /suburban environment and how small, daily changes and practices can protect lakes, streams and rivers. One can also have the opportunity to participate in programs implementing Riparian Corridor Management principles and practices such as river clean-ups, woody debris management projects, riparian buffer enhancements, stream bank stabilizations, native plant workshops and invasive species removals.

Below are listed the main five Riparian Corridor Management principles:

Principle 1: Riparian Buffers/Corridors are critical.

Principle 2: What happens to the land determines the quality of the water: Knowledge, Education and Advocacy = Public Participation

Principle 3: Logjams, Bank Erosion and Flooding are Natural Processes

Principle 4: Understand that one’s property is part of a larger system.

Principle 5: Asking for advice

Finally, a Management Plan aims to provide a clear, concise and practical framework for the protection, management and rehabilitation of the riparian corridor and immediate environs. Such a plan aims to be performance oriented in order to help a city council achieve its strategic goals, vision, mission and strategic outcomes.

The following key steps have guided the preparation of this Management Plan: a) defining the riparian corridor's role within the local government and regional context area, b) identifying and assessing key values, existing uses, facilities, improvements and their condition, c) identifying and assessing key issues affecting riparian corridors, d) addressing future permitted uses and development (including intensity and scale), e) establishing appropriate management strategies based on a balanced, sustainable approach to conservation, rehabilitation and the recreational needs of the wider community, f) developing performance targets to assess and monitor management objectives, g) assigning directions and priorities spanning at least 5-years.

6. Urban Open Green spaces

Urban Open Spaces according to their dominant physical space organizing and functional features fall under two categories: a) hardscapes, as man-made parts / entities of the urban fabric, such as streets or squares, and b) softscapes, as natural or man made parts / entities of the natural environment within the city, such as runoff streams and torrents, lakes and ponds, wetlands, forests and groves, shorelines, parks etc [1].

Urban streams along with their riparian zones fulfill two different but complementary roles: a) as open spaces which are directly related to the physical elements of the natural environment (sun, air, water, green cover) they allow both presence and function of nature within the urban fabric and also play a regulatory role on urban microclimate and environmental quality, and b) as open urban spaces they provide a social setting for civic life, have it be cultural, recreational commercial or athletic and play a linking/connecting role within the urban mesh of activities, and influxes of the built environment.

7. Urban Environmental Problems

Major environmental problems and their causes within urban fabric are: a) atmospheric pollution / heavy car traffic on densely populated areas, b) noise/ car traffic, intensity and type of activities, concentration of disturbing land uses, c) pedestrian safety / width, materials, and design of walkways, car speed, number of intersections, d) high temperatures / existence and design of open spaces, e) flooding / stormwater runoff and catchments, landform, f) absence of natural elements (vegetation, water) / urban microclimate phenomena (high temperatures, flooding), g) public space hygiene / garbage collection, design-use-management of public open spaces, h) degradation of public open space quality / design-use-management of public open spaces, i) abolishment or degradation of historic and cultural resources / negligence and poor land use management.

8. Urban Riparian Corridors Planning and Management

A. It is the research team's preposition and proposition that the goals for Planning and Managing the Urban Riparian Corridors of Igoumenitsa must include: a) preservation of existing streams and vegetation along urban riparian corridors, b) prevention of urban streams contamination and sedimentation, c) restoration and enhancement of urban streams and riparian corridors where they have been degraded, d) Implementation of a proposed Urban Riparian Corridor Design Manual requirements, e) development along urban riparian corridors by treating urban riparian corridors as open space amenities rather than undesirable elements with back-on treatment, f) accommodation of storm drainage requirements without damaging the natural character of an urban riparian corridor, g) development of an approved urban riparian corridor plan that provides greenway pedestrian and bike paths along urban riparian corridors, h) incorporation of greenway pedestrian/ bike paths as an auxilliary use on existing vehicle service roads along urban riparian corridors.

B. It is the research team's preposition and proposition that the Guidelenes for Planning and Managing the Urban Riparian Corridors of Igoumenitsa must include: a) preservation of waterways in their natural state, b) projects that include channelized waterways should incorporate restoration of the riparian habitat within the landscape design, c) avoid "back-on" treatment (backyards adjacent to a stream) along urban riparian corridors. Streets must be parallel to streams in order to bring riparian corridors into the public

realm, d) construction of secondary channels and landscaping in accordance to greenway plans and requirements where additional channel drainage capacity is needed (appropriate landscaping of secondary channels serves to strengthen the resource value of these channels and augments existing stream side open space which can define and interconnect neighborhoods), e) open channels in the form of natural or landscaped constructed waterways are preferred over closed conduits, f) where the opportunity occurs and when permitted, flood control channels can be used by pedestrians or cyclists (in such cases, design can make use of these channel corridors as part of a larger greenway pedestrian network), g) preservation and protection of critical spaces (eg. where riparian growth extends outside the riparian corridor line), h) when pedestrian and vehicular crossings are needed, provision of structures that limit the disturbance of the stream bed, such as bridges. Culverts are discouraged.

C. It is the research team's preposition and proposition that the Stormwater Guidelenes for Planning and Managing the Urban Riparian Corridors of Igoumenitsa must include: a) creation of open spaces such as parks and play fields for accommodation of temporary ponding during heavy storm periods, b) incorporation of filtering recharge techniques such as detention basins, natural swales and rock filtering to clean pollutants out of storm water collected on a site before the water enters the City's waterway system, c) direct lot drainage to the street is possible, d) except for hillside conditions, designing of building pads must be at or above street level. Secondary drainage will be required to intercept and convey lot drainage which is not to be directed to the street [5].

9. Urban Riparian Corridors in the city of Igoumenitsa Greece

9.1 Igoumenitsa's Urban Development.

Igoumenitsa is a small to medium regional port - city that originated as settlement around 1910 at the north west coast of Greece, under the feet of surrounding hills. Today the city is developed along its physical geographical boundaries between the sea with a western – southwestern orientation and the foothills with an eastern orientation. On the south it borders olive tree cultivations on flat lands that reach the foot of limestone mountains and on the northen part there are low elevation hills. The city rests on alluvial deposits (sand, silt, clay) rich in organic matter that has been destroyed by bad agricultural managment and developmental pressures.

In general soil and rock formation are susceptible to water erosion.

Annual rain fall precipitation is 1300 mm and the number of raining days per year exceed 100. Relative humidity exceeds 75 %, most of it appearing during winter. Prevailing winds of south eastern orientation, are of medium intensity, with a 75 % frequency, where as the remaining 25 % are of north west orientation. There are two main watersheds at the southern part of town and one at the northen that drains at the river Kalamas [4]. In between are smaller watersheds that pass through a network of smaller streams through the city of Hgoumenitsa. Runoff water is been discharged to the sea. There are four main ruoff discharge streams that pass through the city: Ladochori stream, Grecochori stream, Ampelia stream and Selefkia stream that discharge directly to the see. Both watershed areas and their streams are charactirized by mild slopes of low gradient. Though the discharge runoff volume of water is high at the southern watersheds, streams are of relatively small dimension and volume due to soil and rock high level of infiltration. So, most of the water discharge volume occur underground.

Today in spite of the considerable length of these four streams within the urban fabric of Igoumenitsa, non of them has been converted into a closed contuit due to lack of funding, except of the Ladochori and Grecochori streams that have been completely channeled at the port, and the center of town near the seaside.

At 1960-61 the Igoumenitsa – Italy sealine begins. The population rises and so does its need for housing (residances and commerce). That takes place at the regions around the port and Ladochori stream.

After the 1975 – 80 period, a period of population explosion (1981 census recorded a 43 % population increase) there was an imperative need for city expansion. Building could not be confined within the new city boundaries and legal building took place beyond. Lack of buildable space increased the value of land tremendously. Building development covered up open spaces especialy near streams (Selefkia and Ampelia streams). Part of the streams were converted to roads and used for rubbish dumping. It was not until 1993 that the first urban expansion took place with a form of an organized city plan. Second expansion took place at 1999, and the third one at 2000.

Under the fourth and fifth expansions that took place lately, properties near streams have been legalized and part of the streams have been converted to access roads.

9.2 Igoumenitsa's Riparian Corridors

Most of Igoumenitsa's streams have undergone considerable changes to their natural systems in recent decades. The upper reaches are affected by consolidating urban infrastructure in the Igoumenitsa area. The natural riparian vegetation and adjoining bush land of the escarpment and lower slopes is under continuing threat from creeping and cumulative negative development impacts.

The mid to lower sections of the stream, flowing through the city of Igoumenitsa, is similarly impacted by surrounding changes in the urban landscape as well as by continuing inputs from upstream sources. Natural stream flow and drainage pattern have been modified through vegetation clearing, flood mitigation, piping, channel re-alignment, road corridors, filling and re-contouring for recreational and other urban infrastructure. These changes have greatly accelerated over the past 30 years leading to a transformation of the landscape from natural bushland and agricultural land uses to an increasingly urbanized environment. Despite the decline in natural environmental qualities, the riparian corridor still provides an important resource to the local community with open space for recreation as well as aesthetic, social, educational and natural heritage values.

Igoumenitsa's natural areas within the floodplain and study area have been increasingly fragmented by development.

Only a small number of vestigial components from this ecological community are still present within a landscape dominated by urban infrastructure. Igoumenitsa’s all four riparian corridors however, offer special opportunities for enhancing connectivity and bio-linkages between the hills the city and the sea. These linkages are currently extremely volnerable, particularly within the study area. Residential development and roads surround and enclose the riparian corridors and divide open space into a series of disjunctive smaller parcels. Underground piping, storm water culverts under roadways, concrete detention basins and constructed grassed drainage swales have further disrupted the continuity, natural flows and ecological processes of these corridors.

Riparian ecosystems are environmentally sensitive to disturbance and subject to ongoing processes of soil erosion, siltation, nutrient enrichment and weed invasion. This will create further pressure on a valuable but finite resource. A Plan of Management must therefore establish an appropriate balance in protecting and managing this community asset and its key values on a sustainable basis. Recent rehabilitation initiatives, including ecological reconstruction and enhancement strategies in Igoumenitsa, have focused community attention on the need for appropriate conservation strategies.

10. Conclusion: Alternative Development Scenarios and Final Proposal

This paper examines two alternative senarios of urban development with respect to urban riparian corridors: a)following the excisting status quo scenario of urban development, and b) proposed senario of greenway development along urban riparian corridors, the alternative basis for an integrated system of urban green spaces.

10.1 Following the excisting status quo scenario of urban development.

The city expantion plan calls for a) a protective buffer of 15 metters on each side of the stream which remains at its natural position and b) pathway construction and environmental protection zone. Roads and city blocks are been proposed disregarding excisting streams. The later do not contribute in city development and are not connected with other urban open green spaces. Thus, these natural water corridors are been abandoned and their exploitation ignored. Excavations for the construction of Egnatia road, extensive clearing of natural land, paving, building development, waste dumping on urban streams and total lack of rainfall runoff decreased infiltration rate and increased water speed within streams. The expansion city plan competely ignores the Ladochori stream by proposing closed underground conduit and a dense road system on top as well as building blocks for residential use.

Development in or near riparian corridors in Igoumenitsa is not regulated by some special Land Use Code of Sensitive Area Overlay District neither adoptive strategies are used to upgrade water resource management.

10.2 Proposed senario of greenway development along urban riparian corridors,

the alternative basis for an integrated system of urban green spaces.

It is the research team's proposal that the new urban design studies must take into consideration existing and new urban waterways preservation and enhancement with the use of protective buffer zones along urban riparian corridors. Establishing appropriate maintainance and preservation specifications for urban riparian corridors will be an effective physical planning tool. Buffer zone width, water quality, human multi land use along pathways (with alowable, forbidden and under condition activities), are some of the proposed measures, on public and even on private properties. These transitional buffer zones teamed with extensive use of connected urban green space will aid to the better integration of built and open space within the city of Igoumenitsa. They will become not only linear parks but means of of prdestrian and bicycle trensportation within an integrated system of urban green spaces that covers most of the city's territory, unifing the old city with its new northern and southern expansions.

Below are the main points of the proposed action:

-Establishment of three zones: a) 50 meter No build zone – green buffer zone on both sides of the main four urban riparian corridors, b) 100 meter limited building code buffer zone on both sides of the main four urban riparian corridors, c) existing regular zonin

-Provide connections of riparian cooridor paths with the urban network of streetside walkways into an integrated system of urban green spaces. Increased accesibility will be established as higher elevation green spaces (Castle Grove) will be connected with lower elevation seaside recreational areas (Old Port, Old Xenia Hotel) and with nearby beaches through a greenway systaem that can be created with relative ease.

-Due to existing physiographic region characteristics and the linear form of city developmentand / expansion, natural and man landscaped open spaces develop along axes that offer good views to the sea. At points, within the urban fabric, their configuration is disrupted - especialy along and parallel to the sea.Urban riparian corridors along with appropriatelly designed greenways can become unifing organizational elements for the city of Igoumenitsa, tying green open spaces, residential neiborghoods, commercial centers and spaces of recreation.

At the city of Igoumenitsa, available open green spaces are limited, especially at the city center, so riparian corridors as existing urban elements fit more appropriatelly to play this role. Offering improved ecosystem biodiversity over newly designed open spaces, they are characterized by a wealth of natural vegetation, better ecological stamina and stability (already established ecosystems adapted to local climatic conditions) and economical management (reduced need for irrigation and nutrients).

- Urban riparian corridors are interrupted at points along their route to the sea. To ensure continuity, new green open spaces are introduced in order to implement the greenway proposal for Igoumenitsa. These green open spaces along with small dams can function as retention or infiltration ponds within the urban riparian system retaining water year round [7].

- Connection of vertical (riparian corridor pathways) and horizontal (pedestrian / bikeways) alignment of urban green spaces, as well as creation of "soft" mass transportation such as a tram.

Main goal of the paper is to propose Greenway Planning as the appropriate alternative basis for an Integrated Network System of Urban Green Spaces, as well as a Management tool forUrban Riparian Corridors. Thus, improved accessibility and extensive use of pedestrian and bike ways will reduce dramatically automobile congestion and pollution improving the overall quality of urban life at Igoumenitsa while prreserving the ecollogical processes of its urban riparian corridors.

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