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Dynamics of Hydro Landscape in and Around Yamuna River in Parts of Delhi with Special Refrence to Eco Green Areas

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ABSTRACT: The study has been done with the aim to dilute the existing pollution level in the Yamuna River. The study suggests the establishment of water bodies along the river bank, so as to trap the water during peak flood period and its utilization in other seasons. The present study involves dividing the stretch 22km stretch of the river in capital city Delhi into six zones and directs to understand the rivers hydrology and environment on the whole in a stretch from Old Rail Bridge to IP Barrage (ITO area).

1. INTRODUCTION

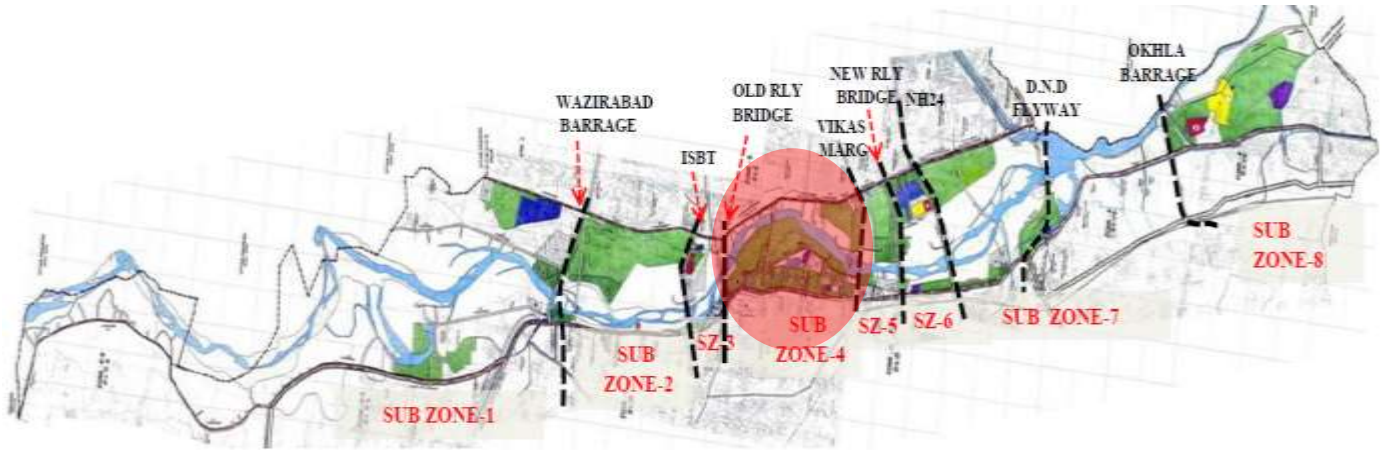
Rivers are inextricably linked to the growth of human settlement. They have played a crucial role in the establishment of settlements and their ongoing formation. Along the banks of rivers, the world's greatest civilizations have grown and prospered. The rivers have always been important as the sources of water for maintaining life as well as the agrarian cultures, whether it was the Egyptian civilisation along the Nile River or the Indus valley civilization. Thus, there were close ties between people and rivers, with the latter frequently worshipped as deities both in antiquity and today. The river played a crucial role in all aspects of human existence, from routine tasks to religious rituals, fairs, and festivals.

One of India's sacred rivers is Yamuna. In addition to the capital city Delhi, Mathura and Agra, two more significant cities within 200 km of Delhi, are of the utmost historical and cultural significance. But this particular section of the river is one of the most polluted and degraded river segments in the nation. Yamuna has now turned into a massive drain conveying the rubbish of this mega-city due to the terrible drainage and solid-waste management of the city. In order to clean the river, administrations have spent millions of rupees, yet nothing much has changed. The areas close to the river are likewise considered to be "lost spaces," and they are home to stadiums, farms, power plants, and memorials. It must be acknowledged that Delhi desperately needs few small stretches of public open space, due to the extremely high densities in the residential areas. The study intends to construct physical links, enhance environmental quality, and open up chances to engage the riverside in order to reconnect the city literally and conceptually to the river.

2. SCOPE OF THE STUDY

Only 22 km of the River Yamuna's 1,370-km journey from its birth place Yamunotri, to the ocean lie in Delhi. Even though it only makes up 2% of the river basin, but is responsible for more than 80% of the pollutant load along the entire river. Almost nine months out of every year, there is no water in the river. Water is impounded at the barrage built at Wazirabad where the river enters the city. Following that, 22 drains from Delhi carrying sewage and waste only, enter the river. In other terms, Wazirabad is a mark after which the water ceases to exist. The River Yamuna's active flood plains have been getting smaller over time, which reduces the area for recharge and subsurface flows, which can further deteriorate the river's character. Less capacity for dilution would mean higher pollution loads, which could be linked to construction activities.

The study involves dividing the stretch into six zones as;



Sub-Zones (Area, Extent, Length)

Sub Zone	Reach	Approx. Area
I	UP Border — Wazirabad Barrage	3620.0
II	Wazirabad Barrage — ISBT Bridge	1100.0
III	ISBT Bridge — Old Rly Bridge	225.0
IV	Old Rly Bridge — I.P. Barrage	800.0
V	I.P. Barrage — New Rly Bridge	365.0
VI	New Rly Bridge — NH 24 Bridge	390.0
VII	NH 24 Bridge — Okhla Barrage	1300.0
VIII	Okhla Barrage — Haryana Border	1900.0

The scope of the study is limited to zone iv i,e Old Rail Bridge - ITO Bridge and the aim is to understand the river's environment and river hydrology on the whole in a stretch from Old Rail Bridge to IP Barrage (ITO area).

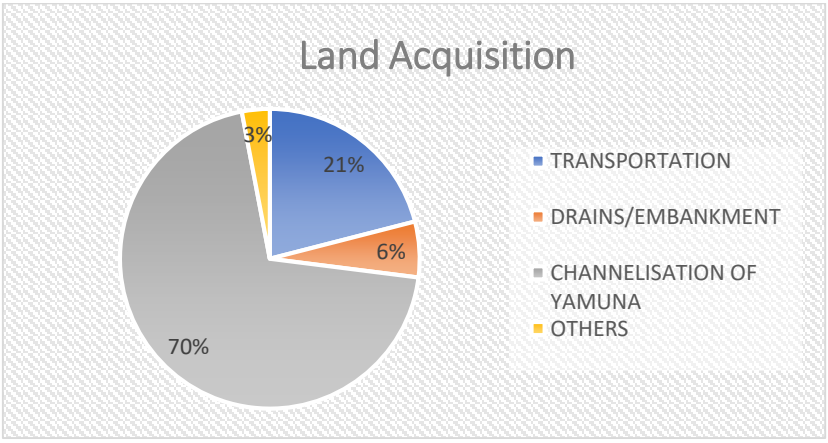
3. METHODOLOGY

The study would examine the potential effects over a period of time, beginning with the construction of various infrastructure in flood plains and taking note of certain recent changes to the area from Old Rail Bridge to IP Barrage (ITO). Main aim would be to create water bodies in a recreational park by gathering the information: River characteristics, Flood data, Rainfall data, Soil data, Vegetation cover and Climatic conditions.

River characteristics:

The river Yamuna has a small portion between the Old Railway Bridge and the Vikas Marg Bridge that is semi-meandering (bending its path in a sinusoidal manner rather than in a straight line). Further erosion on the outer bank and deposition on the inner bank are brought on by the secondary flow that has developed on the river bends. The stream or river lengthens due to the meandering motion, which also tends to make the slope less steep.

Land Acquisition



Land cover type	Old railway to ITO	% area
River	116.08	21.43
Agriculture	347.08	44.78
Built up (others)	113.52	14.65
Built up (specific rail road projects	57.8	7.46
Samadhis, city level recreational	90.55	11.68
Total	775.03	100

The primary roads that border the property, Mahatma Gandhi Marg and Vikas Marg, do not provide sight or physical access to the river. Although the dense plantation prevents access to the railway line from/to the river, it has the potential to be reused as a landscape element. Agriculture continues to be the main activity in the areas enclosed between the embankments, but certain farms are occasionally left fallow. There are many natural kinds of trees, plants, shrubs, and grass that need to be preserved. The amount of vegetation has decreased over time, as seen by the NDVI, and there has also been a large decline in the number of forest clusters. Along the right bank of the river Yamuna, this section of the Old Rail Bridge to IP Barrage is primarily agricultural, followed by city-level recreational areas. Other than the remaining built-up areas in this segment, which is a recent modification in landform.

Flood data

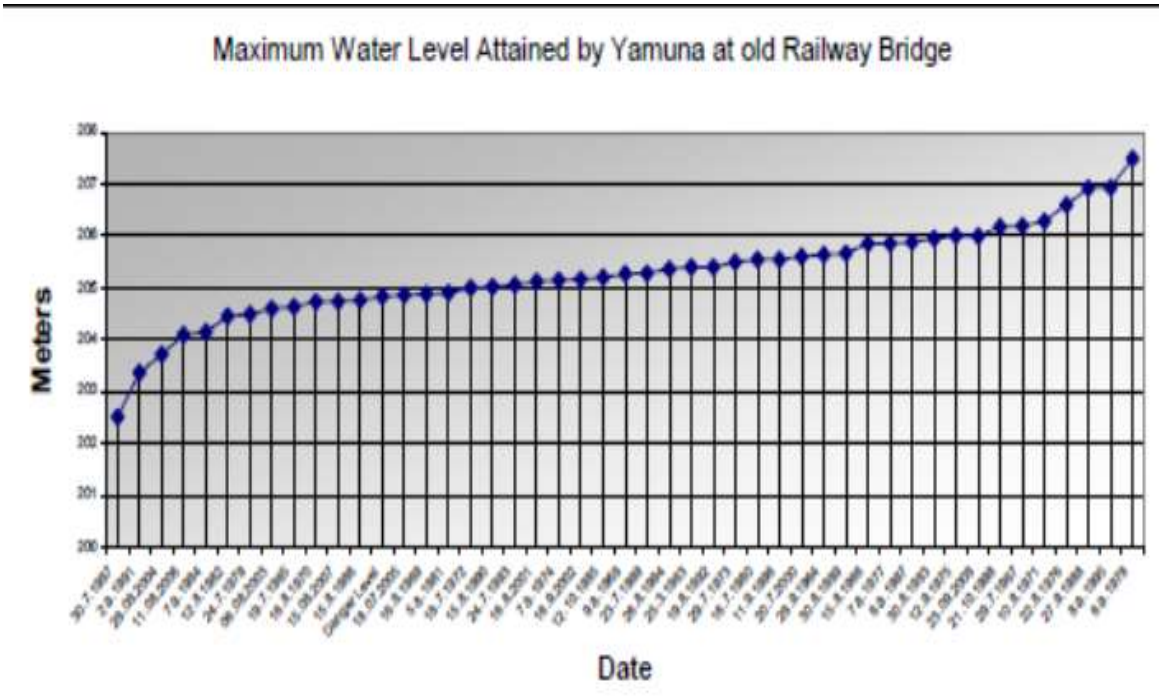


Fig.1 – Maximum Water Level Attained by Yamuna in Delhi

Source: Flood Order of 2009, Irrigation and Flood Control Department, Government of Delhi

Rainfall Data

Thirteen stations in the State have rainfall data available for sufficiently long stretches of time. The State experiences 611.8 mm of rainfall on average per year. The months of July, August, and September are monsoon months, and they bring around 81% of the yearly rainfall. The remaining months prior to and following the monsoon contribute to precipitation fall as winter rain and thunderstorm rain. Rainfall varies significantly from year to year. The highest annual rainfall, 251% above average, occurred in 1933, the year with the highest annual rainfall throughout the 113 years between 1901 and 2013. Only 44% of the average annual rainfall fell in 1951, the year with the least amount. The monthly rainfall was taken as:

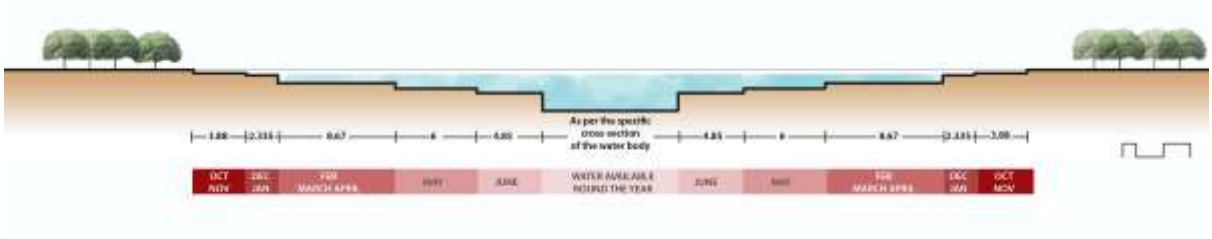
Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Rainfall (mm)	14.5	13.2	9.9	5.5	9.2	38.8	191.6	197.4	105.3	19.3	2.8	4.3	611.3
Rainy days	1.2	1	0.8	0.5	0.8	2.1	7.4	7.9	4	0.8	0.1	0.4	27
Evaporation (mm)	71	101	177	300	400	333	233	133	147	149	102	78	2224

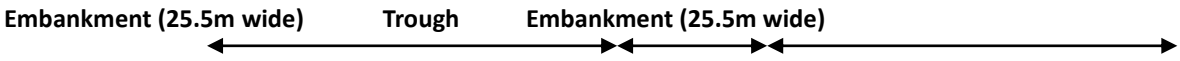
Soil data

As per the CPCB 2006, there are eight different soil types over entire Yamuna basin. Red Sandy soil, Red & Yellow soil, Calcareous Seirozemic soil, Deep Black soil, Medium Black soil, Mixed Red & Black soil, Brown hill soil and Alluvial soil covering about 2.5, 5, 0.5, 5.5, 25.5, 15, 40, 4 and 42 percent of total respectively.

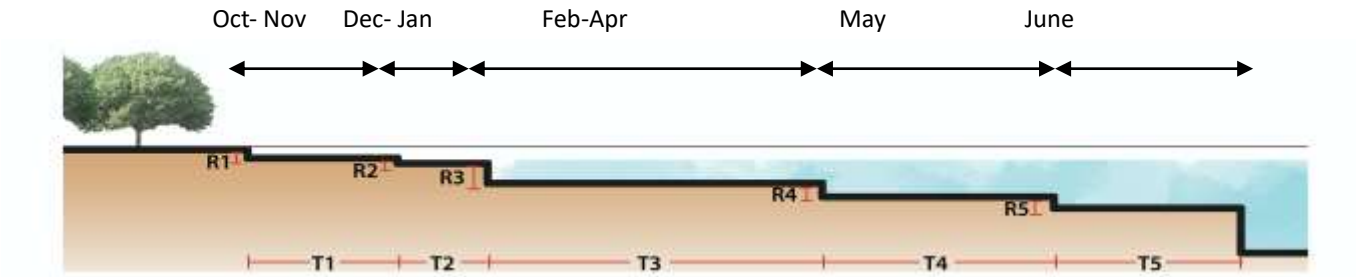
4. ANALYSIS AND DISCUSSION

To provide urban recreation areas for residents, three waterbodies on both banks of the river Yamuna have been planned parallel to its flow. They are encircled by paths that offer beautiful views. Through staggered planting in the direction of the wind flow, the offensive odour has been reduced. To create wetlands on both sides of the canal, the root zone water treatment system has been combined with canal water.





Typical Section of a Water Body



Typical Section and Nomenclature of Terraces

With groundwater level 2.25m, embankment slope 1:15, height of embankment 1.7m and base of embankment as 25.5m

Water Body	Catchment Area	Flooded water Trapped (Area x Depth)	Surface Water C*I*A	Total Volume m^3	Water trapped in Trough as 70% of total volume
WB1	16940	8470	3049.2	11519.2	8063.44
WB2	134682	67341	24242.76	91583.76	64108.632
WB3	56880	28440	10238.4	38678.4	27074.88

Terrace Design:

Month	RAINFALL (m)	Terrace (m) (L = R*S)
OCT- NOV	0.251	3.765
DEC-JAN	0.149	2.235
FEB-APR	0.578	8.67
MAY	0.4	6
JUNE	0.33	4.95

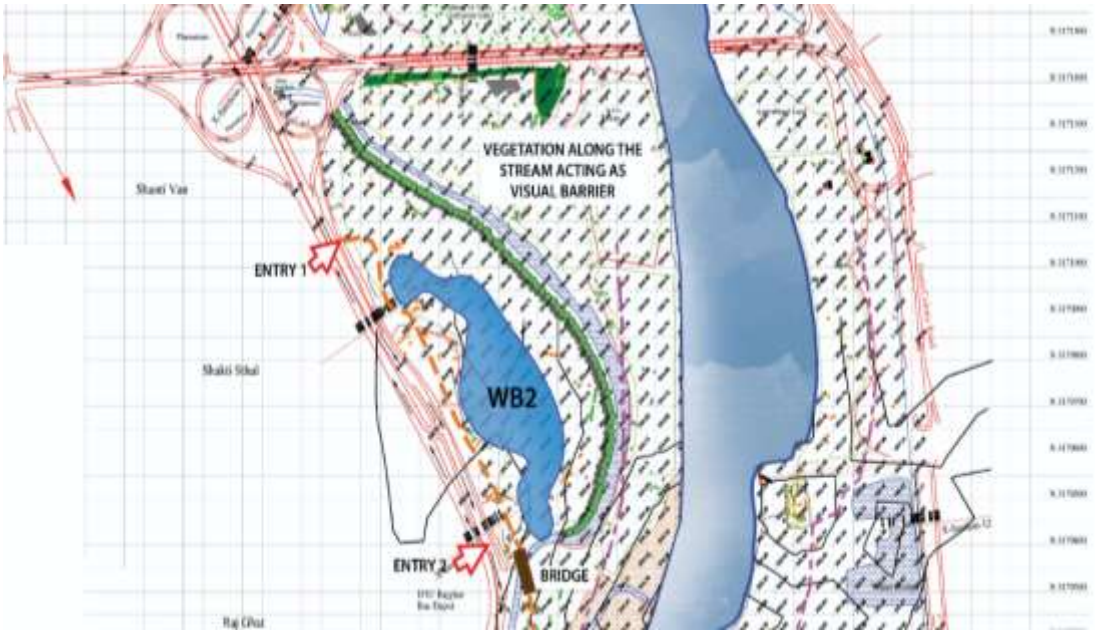
Trough Design

The depth of each water body was considered to be 3m and the available data the evaporation losses from Oct – Jun is 1.71m, hence depth of trough will be 1.29 m

Water Body	Area of Trough (m^2) (Vol/depth)	Total Area of Water body (m^2) (embankment + Trough)
WB1	6250.7	14852.4
WB2	49696.6	60994.0
WB3	20988.3	46824.3

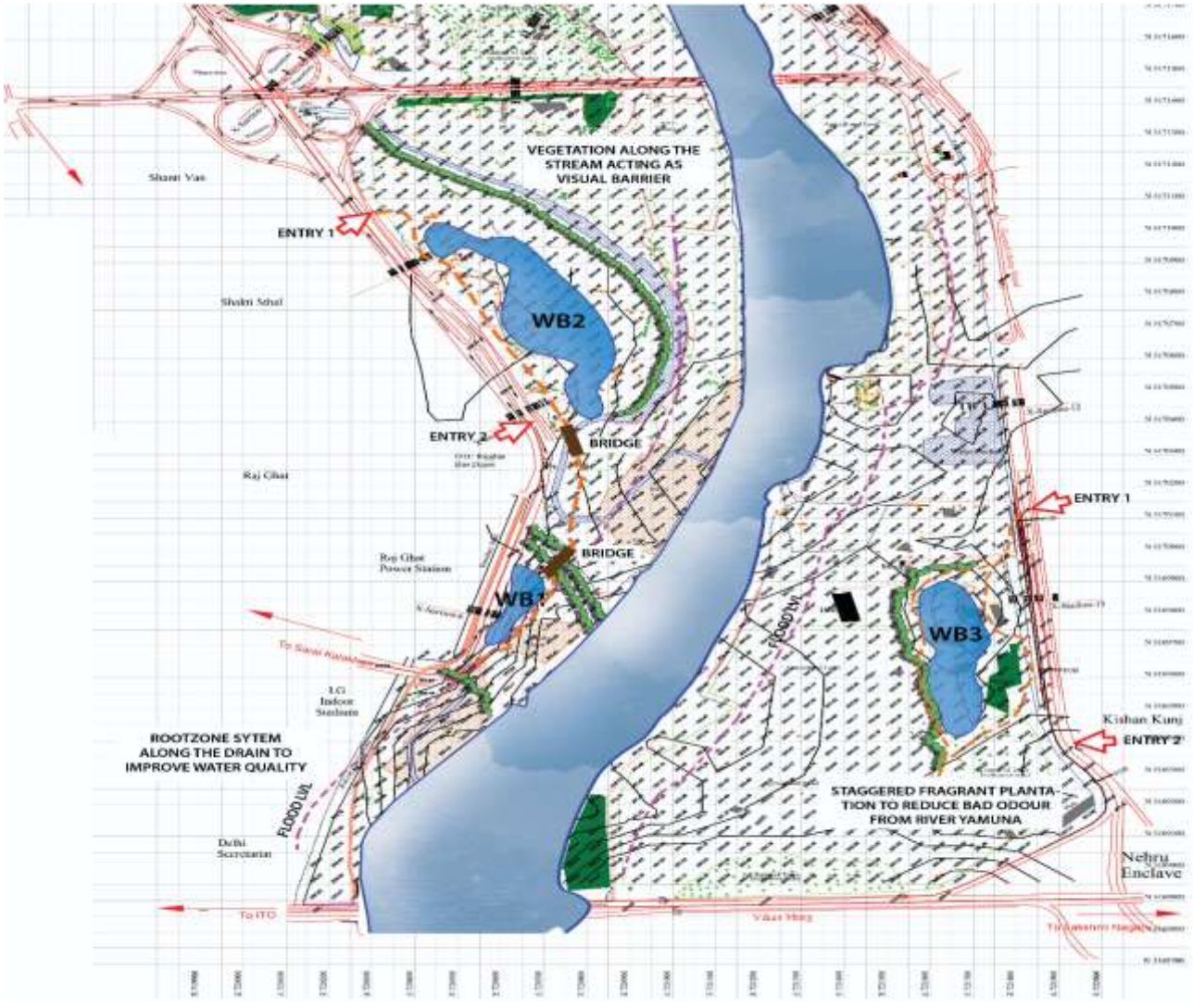
Water Body 1

Water Body 2



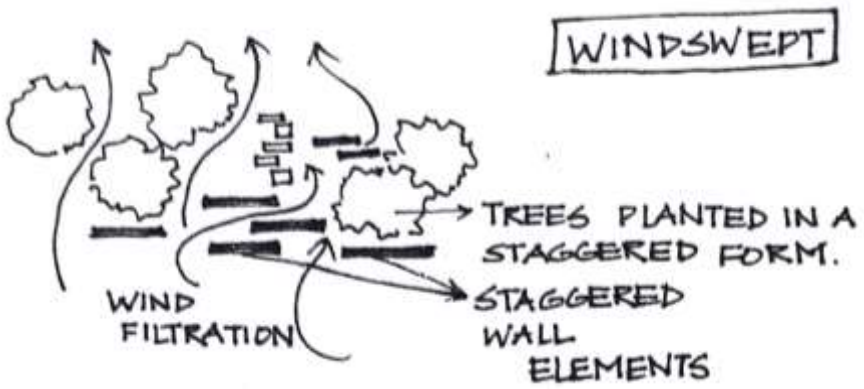
Water Body 3

Yamuna stretch with Water bodies



5. LANDSCAPE POLICY

Plant native or non-invasive plants all along the river corridors, keeping canopy trees as close to the riverbed as possible. Develop a broad hierarchy of landscape cover types. Native plants are preferable for river edge landscapes due to their adaptation to the local environment, reaction to flood conditions, and improvement of biodiversity. By absorbing nutrients, plants near a riverbank not only slow down surface runoff but also clean groundwater before it enters the river.



6. CONCLUSION

The design vision calls for design methods and thoughtful planning of open spaces that achieve a balance between innovation and historic preservation. As a result, the riverfront will have the flexibility to change throughout time. Moreover, A higher degree of physical activity is encouraged by green spaces that are connected to other green or open areas by walking and cycling routes or greenways, which also encourage more visits and longer stays. Additionally, this will help with ecology restoration, water quality improvement, building with nature, and historical preservation. By enhancing the current vegetation, an urban park-like environment will be created. In this way a link will be created so as to improve the quality of the river and open up space to engage the river side effectively.

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