INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD
ISSN(O): 2455-0620 [Impact Factor: 9.47]
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value : 86.87
Volume - 10, Issue - 10, October - 2024

DOIs:10.2015/IJIRMF/202410010 --:-- Research Paper / Article / Review

Exploring the potential of Urban Waterways as vibrant Urban Public Spaces

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Abstract: *Urban waterways consisting of rivers, canals, backwaters, lakes, estuaries and tidal inlets are natural centers of gravity for the cities around the world. Cities around the globe are historically built around water bodies because of their role in sustaining resources like agriculture, trade and commerce. The development of water bodies within cities can help in socio-economic development of communities and mitigating climate change. But in recent times, due to rapid urbanization many urban waterways are neglected. Majority of these waterways are turned into canals or drains and are treated as the city's sewage systems. These had led to major problems like urban floods, scarcity in drinking water and loss of urban biodiversity. Most of these waterways have changed their appeal over the time into canals and drains due to over exploitation of its resources. The research focuses on the development of supplementary drain along Najafgarh Drain into community public spaces for recreational and ecological appeal. The paper tends to explore how urban waterways such as rivers, lakes, wetlands and estuaries have changed within the urban cities and are gradually being converted into narrow drains and the possibility of converting them into vibrant public urban spaces for social, cultural and economic development.*

Key Words: *public spaces, communities, urban waterways, open spaces, recreational spaces, socio-economic development*

1. INTRODUCTION:

Urban waterways are generally water bodies located within the cities or towns comprising lakes, rivers and streams that pass through an urban area or receive storm water runoff from an urbanized catchment. Urban waterways generally include rivers, lakes, wetlands and estuaries; open unlined drainage channels; closed pipes and concrete drains; compensating basins and sumps; and water sensitive urban design structures such as rain gardens and swales (Urban waterways management and living streams). Most early settlements have primarily formed along the rivers and rivulets, later giving rise to cities and towns as rivers not only provided the necessary resources for the population and supplied water for irrigation but also served as a means of transportation for goods, commerce and travel; thus forming a valuable relationship between rivers and cities (1). (Ewald, 2021). Due to rapid urbanization trends, cities have started to become denser with increase in population squeezing the urban blue-green infrastructure. Population growth has increased the pressure on water resources present within a city, leading to waterways becoming polluted and scarcity in water supply. The urban development around these water bodies generally increases the amount of impervious surfaces such as concrete and asphalt within the cities. These kinds of surfaces generally do not allow water to infiltrate as easily as any other open green spaces. This creates an issue during monsoon seasons as the high amount of impervious surfaces cause storm water to quickly raise the water level of the river, thus raising concerns of flooding (Tramble, 2019). Also patterns of urban development often make waterways inaccessible to the surrounding neighbourhoods. But if the urban waterways are maintained and treated properly, they can yield positive impacts for urban communities such as public spaces located along rivers, lakes and streams can offer opportunities for urban community gatherings, recreational activities and providing awareness regarding the environment (Why Urban Waters?).

2. LITERATURE REVIEW:

2.1 Global Scenario

Urban growth is rapidly increasing in developing countries all over the world due to which water resources (eg. lakes, rivers and streams) are gradually decreasing. As cities are increasing in size due to urbanization which have led to

increase in population there is a direct consequence to the conservation of the surface waters. Extracting water directly from rivers and springs, exploiting the groundwater with the resulting higher risk of infiltration, field drainage to foster agricultural development, increasing evaporation rates because of the warmer microclimate of urban areas are some of the major consequences that cities are facing globally.

Major rivers around the world such as the Nile and the Tigris-Euphrates attracted a large community of people that led to the creation of the first cities which are also known as the first civilizations around the world. But as industrialization and urbanization accelerated from the late 18th century onward, rivers were subjected to extensive changes to make room for new development. As per the needs they were straightened, shortened, bordered with levees and harnessed into narrow channels. In most of the cases globally, stretches of urban rivers have been paved, filled, or diverted into underground tunnels, making them disappear entirely from the cityscape (Beck & Cruxen, 2019).

Figure 1: The River Thames, London (Source: https://commons.wikimedia.org/wiki/File:London_MMB_P6_River_Thames.jpg)

The River Thames, with a length of 346 km is the longest river in London, flowing through Southern England. Apart from the recreational and commercial activities, the primary resource of the water body is distribution as drinking water. During the time of Industrial Revolution due to rapid urbanization, introduction of new building technologies and lack of proper sewage system in London and its surrounding areas, industrial waste and domestic waste has polluted the river to such an extent leaving a foul smell along its periphery. The river became a repository for waste, with leaking cesspits and dumped rubbish reducing many of its tributaries to running sewers (Adetunji, 2022). Many of these small rivers now lie underneath the streets of London, long covered up to hide their foul smell (Brown, 2022). In order to increase the BOD levels of water, large oxygenators were installed which was considered as one of the turning points. Other steps such as investments from private companies, privatization of water companies were taken to improve its quality.

Figure 3: Pasig River in the Philippines (Source: https://commons.wikimedia.org/wiki/File:Pasig_River_map.png)

The Pasig River is located in the country of Philippines connecting Laguna de Bay to Manila Bay with a stretch of 25.2 kms. It bisects Manila, the Philippine capital and its surrounding urban area into two halves - the northern and the southern halves (Murphy & Anana, 2004). The river is the primary source of water in the Manila regions and was one of the major sources of transportation between the regions. But due to negligence by the local authorities and industrial development, the river suffered a rapid decline in the second half of the 20th century and by the year 1990 was declared biologically dead. Massive population growth, infrastructure construction, and the dispersal of economic activities to Manila's suburbs are the major reasons that left the river neglected (Laurent , Boyan, & Anthony, 2017).

The banks of the river attracted informal settlers and the remaining factories dumped their wastes into the river, making it effectively a huge sewer system. But from 2015 onwards proposals had been put forward to revive this dead river and to include it within the urban frame.

2.2 Indian Scenario

India has eight major river systems which comprises more than 400 rivers and numerous rivulets and smaller water bodies connecting them. Major cities of India are developed near water bodies like rivers or wetlands due to various resources that can be obtained from them. Since India is one of the developing countries globally, so majority of the cities are growing rapidly because of urbanization which provides multiple challenges regarding urban water scenario - impact of flooding during monsoon times as most of these rivers and rivulets in the cities are either clogged up with dumping of garbages or portions of water bodies are filled up with land for future development which in turn leads to increase in water demand for drinking purposes and availability of good water quality. These factors of urbanizing landscapes have led to overall change in the contribution and functions of rivers by converting them into mere drains. Moreover unplanned growth due to urban explosion has led to the use of water bodies as dumping grounds for sewage and industrial effluent. In addition, riverbanks, wetlands, and floodplains have been claimed over time by infrastructure, slums, offices, and housing developments - all of which has narrowed natural river channels and distorted flow, greatly reducing the ability of India's rivers to buffer flooding. It also has taken a toll on biodiversity (Chandrashekhar, 2018).

Kolkata, one of eastern India's megacities, has two prominent rivers, a wetland system of international prominence and an efficient canal system. But various factors like urbanization, overpopulation and exploitation of natural resources have disturbed their natural flow, slaying them with pollution, excess sedimentation and reducing aquatic biodiversity which in turn has reduced the socio-cultural importance of the waterways (Paul & Bardhan, 2022).

Figure 3: Oshiwara River, Mumbai (Source: https://commons.wikimedia.org/wiki/File:Oshiwara_river.JPG)

The Oshiwara River is located in Mumbai, one of the most populated cities in India, flowing through the Aarey Milk Colony cutting through the Goregaon Hills finally emptying on the Malad Creek. It is connected by another creek near Swami Vivekanand Road, before picking up industrial effluents and sewage while crossing the Oshiwara industrial estates and slums of Andheri (Vaishnavi, 2009). The collected industrial effluents and sewage has deteriorated the quality of water over time and has turned the water body into an urban drain. In the year 2005, the Maharashtra Floods occurred, after which substantial efforts were made to clean and rejuvenate the drain and convert it to its previous origin of the river (Lewis, 2005).

2.3 City of Delhi

Delhi has a large network of streams, most of which have become sewage channels or drains over the past 3 to 4 decades (Jacob, 2020). These water bodies generally act as buffers to store flood water, recharge ground water levels, and reduce ambient temperatures and urban heat island effect (City of Lakes). Delhi being a landlocked city, these water bodies also act as natural reservoirs to store excess water during rainfall and prevent flooding. The Yamuna River, the only perennial river in the eastern part of the Union Territory of Delhi, flowing in the southerly direction is a major water channel for the region along with the Najafgarh Drain - the northernmost part of the River Sahibi and Shahdara Drain - east of Delhi, which flows directly into the River Yamuna; Barapullah Drain - a major stormwater drainage; Satpula Drain, Supplementary Drain - a contributor to Najafgarh Drain also flows into the River Yamuna and many others. These seasonal water channels or streams were critical to Delhi's water system in order to bring down the annual monsoon water to different parts of the settlements (Jacob, 2020). In some places, as per the

necessity small dams would retain the water or divert them to different parts of the city. There has been a gradual shift in the attitude of the people towards Yamuna over time. From the sacred river it has become subject of ignorance by the people, transformed into a service corridor today, once it has flowed through the city regardless and forever much before even the first city here was built. From the time of Tuglaq, through the times of Shajahan, the British and now. It even flowed through the 'Red Fort' when it was brought from the nearby city of Karnal by the Emperor Shahjahan through a canal which he called the Nahr – i- Bihishti (ENVIS Center on Human Settlement's). The waters then streamed through the Chandani Chowk and the Emperor's royal darbar itself. Goods were ferried along the river, as were the people and the emperor in his flotilla. The river was (and unknown to most of the city, still is) central to the life of the city and to its ecology. Now that it represents merely an unmet water standard, every other aspect of it is unimportant or even a hindrance. The river is hard to see. Several bridges now span the river, more modern and faster than the aging but classic old Yamuna pull. Very tall high wire meshes protect the river from those who wish to throw marigold malas into it. Instead of trying to build access to it, it has ensured that there is none (ENVIS Center on Human Settlement's).

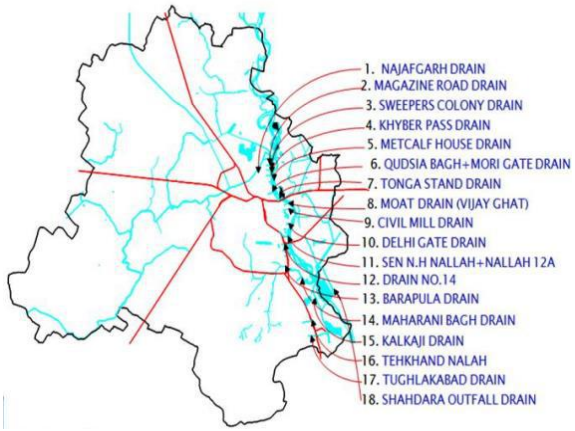

Figure 4: Major drains of Delhi falling in the Yamuna River (Source: Delhi Jal Board)

4. RESEARCH METHOD / METHODOLOGY :

The methodology set for the paper involves a combination of methods that includes site visits and interviews for primary data collection; and literature study, archival research and survey reports for secondary data analysis.

4.1 Study Area

The selected study area for the research is the supplementary drain. The supplementary drain, 25 km in length, originates in Kakrola, South West of Delhi runs along Najafgarh drain for 9km and diverges at Nihal Vihar park further flowing down to Yamuna river. The overall capacity of the supplementary drain is 180 million litres per day (MLD).

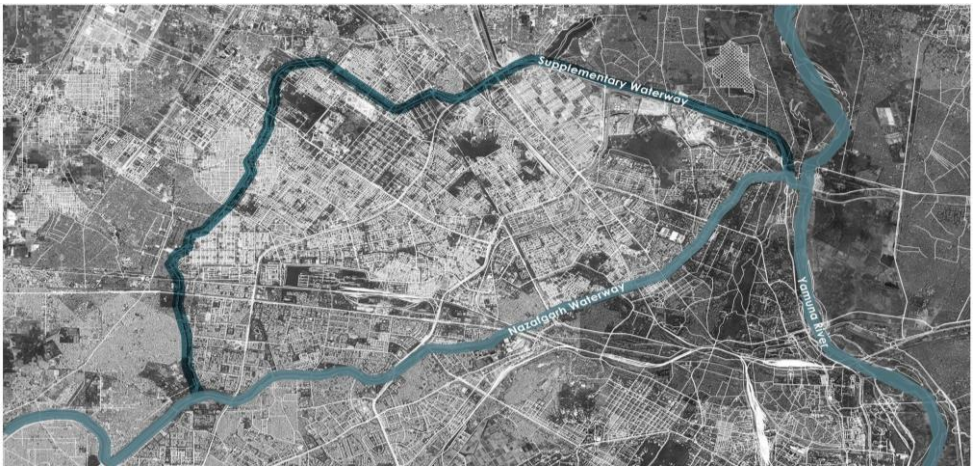

Figure 5 : The 25 km stretch of Supplementary Drain (Source : Author)

For better analysis and understanding, the 25 km of stretch is further divided into five stretches where detailed macro level study is being done.

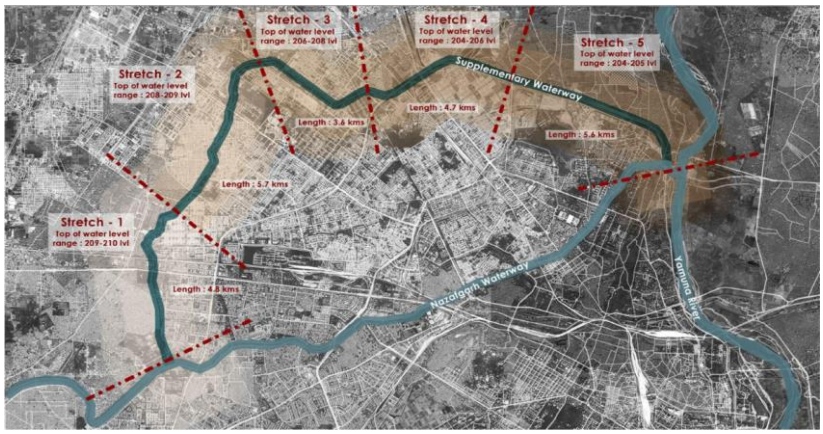

Figure 6: The 25 km stretch of Supplementary Drain is further divided into five stretches (Sources: Author)

5. RESULT / FINDINGS :

Stretch 1:

Location - The overall length of the stretch is 4.8 kms starting from the diversion of Najafgarh Drain at the Delhi-Rohtak railway crossing running parallel NH10 to Paschim Vihar comprising of areas of Nangloi, Sultanpuri, Mangolpuri, and Nihal Vihar. The open spaces along this stretch includes Nihal vihar park,Eco park, Dussehra Ground, Rail neer water treatment plant, Maharaja Surajmal Stadium, Indira park and MCD park, other green spaces along the drain are Maharaja Surajmal Stadium, Cremation Ground. Within the stretch, the residential settlements along the drain are: Nangloi, Sultanpuri, Mangolpuri, and Paschim Vihar. All along the stretch there are bridges both pedestrian and vehicular that connect the supplementary drain. The nearest metro stations are the Maharaja Surajmal Stadium and Udyog nagar (Green Line). All around the stretch auto stands and taxi stands are placed for easy access and circulation.

Issues - The major issue along the stretch are dumping of garbage in the supplementary drain, outlet pipe along the edges which are directly connected to the supplementary drain, encroachment of open spaces along the drain edges comprising of dussehra ground, chhat pooja ground and bridges by vendors and auto stands, use of vacant land for dumping of garbage and parking, no proper pedestrian circulation, no proper lane division along the road running by the supplementary drain, unmaintained greens comprising of Eco Park, MCD Park, DDA Park and Sultanpuri Majra Park. The existing footbridges are currently used as dumping areas making it quite unhealthy for the people. The maximum pollution of water along the drain occurs near the outlet points due to the dumping of garbage. The current ph of the water is 7.8 to 8.3 and the current BOD is 6.8 mg/l while the current should be 3 mg/l or less. The harmful elements present in the water are lead, chromium, cadmium, mercury and arsenic. The existing STP in the area is Keshopur STP which has a current installed capacity of 72 MGD while the actual treatment capacity is 58.34 MGD. The drain in this stretch is now being used as a dumping ground by nearby settlements and is in a dilapidated condition affecting the ecological balance of the area.

There are some existing proposals by Delhi Jal Board to improve the Sludge management, Septage management, solid waste management along this stretch, to develop a green pedestrian corridor along Najafgarh connecting Hast minar and Nihal Vihar park by DUAC and laying Interceptor sewerage system by DDA along Najafgarh, Supplementary and Shahdara drains.

Stretch 2

Location - The stretch length is about 5.7 kms and covers areas from Budh Vihar Phase I to Sector 11D which includes Rithala, Rohini, Naharpur Village, Buddha Vihar and Mangolpur Khurd. The major greens in these areas are the Swarn Jayanti Park, Sector 10 District Park and Avantika Udyaan. There are a number of green spaces along this stretch which are not well maintained and some are presently not active.

Issues - Unmaintained greens along the stretch leading to encroachment and dumping of garbage along the edges of the drain. Unused open spaces along the drain are converted into dumping yards and lack of proper pedestrian ways.

Stretch 3

Location - The overall length of this stretch is 3.6 km. The stretch starts from the junction near Cremation Ground near Shahbad Dairy and ends at the junction where it has NCC Headquarters and Rohini prison Complex on either side. The overall character of this stretch was identified as majorly residential colonies and vacant lands along the

drain edge with few institutional areas. Supplementary drain is surrounded by a compound wall to separate the residential colonies with the waterway. The landmarks here are Rithala STP, power plant, Swarna Jayanti Lake and its adjacent Ramleela ground, ESI Hospital, Haiderpur water treatment plant, NCC HQ, Rohini prison.
Issues - The activity mapping along the blue edge reveals mostly animal grazing along the Supplementary drain and car washing, bathing etc. along the Western Yamuna Canal as the water is cleaner. There is rampant garbage dumping into both water bodies which goes unchecked even as there are physical barriers in the form of compound walls and barriers on the bridge. Along the stretch numerous barriers were there breaking visual continuity in form of walls and fences to hide the unaesthetic nature of the existing drain and High Tension lines and towers forming visual clutter. Encroachment into DDA land, along the footpaths of the B4 Road and along the barren land pieces near Western Yamuna Canal by homeless people have created a disagreeable environment.

Stretch 4

Location - The stretch length is about 4.7 km and covers areas from Badli Bridge to DDA Golf course, which includes Shalimar Bagh, Haiderpur Village, Samaypur Badli, Sanjay Gandhi Transport Nagar, Bhalswa Dairy, Jahangirpuri, and Mukundpur. The nearest metro stations to the stretch are Haiderpur Badli Mor (Yellow line) and Majlis Park (Pink line). The stretch consists of different typologies of greens, namely vegetation in pockets, vegetation along the drain and vegetation along the roads, and blues comprising Bhalswa Lake. It also covers Bhalswa Landfill, Jahangirpuri construction and Demolition Landfill.
Issues - The most unpleasant pedestrian experience is offered by the streets in Bhalswa slum due to the close proximity of the Bhalswa landfill. The traffic density is high in the intersection of the roads and is maximum in the intersection of Maqbara-e-paik as two highways intersect leading to huge inflow of vehicles. The stretch has many open spaces consisting of Chhat Puja Jheel park, Zailderwala Park, DDA park and few unnamed green pockets which are majorly used as a dumping ground, or being encroached by people due to its unmaintained conditions. The presence of bhalswa landfill which affects the air quality and its leachates seeping towards the bhalswa lake, leading to decline in the quality of groundwater. Encroachment towards the landfill and lake area is leading to the dumping of sewage in the lake.

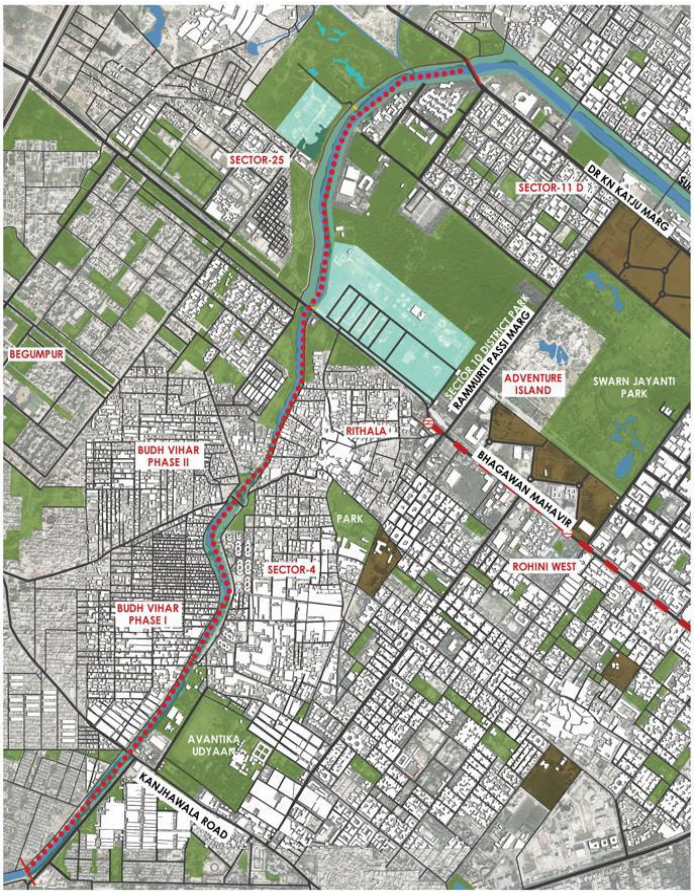

Figure 7 : Stretch 1 plan of the Supplementary Drain (Source : Author)
Figure 8 : Stretch 2 plan of the Supplementary Drain (Source : Author)

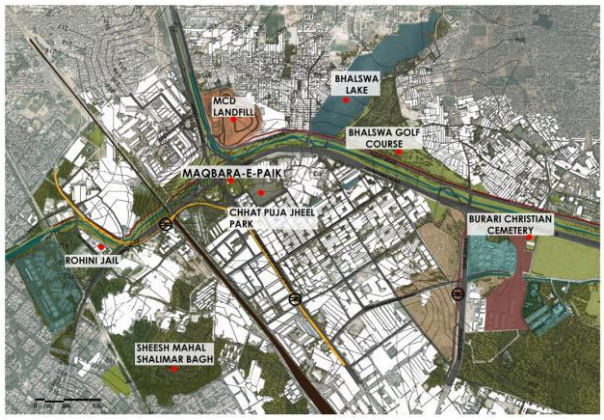

Figure 9 : Stretch 3 plan along the Supplementary Drain (Source : Author)
Figure 10 : Stretch 4 plan along the Supplementary Drain (Source : Author)

Figure 11 : Stretch 5 plan along the Supplementary Drain (Source : Author)

6. DISCUSSION / ANALYSIS:

Combining all the findings for each stretch, the major issue lies is the unmaintained greens which over the time had led to encroachment by different vendors and commercial units which also has led to disposal of garbage along the stretch and degradation of water quality. Another common issue that was seen was lack of proper connectivity from within the site and to the greens which had led to creation of negative spaces. When the area is analysed through the lens of Kevin Lynch the urban fabric can be assessed as:

- Vitality deals with the ability of the settlement to sustain. The concerns in the area are the risks that pedestrians face due to lack of infrastructure and degraded environmental quality.
- Sense is the visual and mental coherence that the area can offer in terms of navigability and legibility. The stretch has a monotonous character and has a lack of identity.
- Access is the extent to which the area is connected and accessible. While the area is connected to the public transit system effectively, the greens lack connection and thus aren't put to use to their full extent. Pedestrians lack enough provision that allows easy movement.
- Control is the territorial expression and Fit is the coherence of the area in its locality.
- Each typology has a different character. While the recreational greens serve the people, the ecological greens are pretty undisturbed. Cultural greens also respond to the socio-cultural aspect of the neighbourhood. This thus offers holistic development of the neighbourhood, addressing all the concerns across the Lynchian dimensions.

Analysing these issues, a comprehensive vision for each individual stretch can be developed with the major idea to 'Revive, Reorganize and Redesign' in order to rejuvenate the areas along the drain as public spaces.

Table 1: Possible Visions for intervention within the Stretch

Stretch 1	The overall vision and objective for the stretch is to create a liveable environment for all communities by rejuvenating and enhancing the natural, social and cultural resources, to

	enhance the mobility network, to restore the existing ecosystems, establishment of a strong visual and physical connectivity with the surroundings by making it accessible to all age groups enhance the overall social and cultural aspect of the place. Improving the existing greens in the parks spaces of Eco Park and MCD Park to increase the carbon footprint of the stretch, development of the chhat puja and dussehra ground for all year round activities so that dumping and encroachment can be removed.
Stretch 2	The idea for this stretch is to create a place where people from all backgrounds can meet, celebrate, play and appreciate the environment.
Stretch 3	The broader vision for the stretch is to enhance the existing pedestrian connectivity of the stretch, revival of the ecologically sensitive areas along the drain, forming a connection with all the green open spaces along the stretch to act as a connecting green link and to redesign the chhath puja kund as the religious context. The removal of compound wall along the supplementary drain to create a visual link with the surroundings and also improving the quality of water.
Stretch 4	The vision for this stretch is to provide interconnected green spaces which will provide an aesthetic link, ecological treatment of the stretch due to the presence of the landfill and to create an identity of the place. It includes identifying and creating green pockets which are connected or depended on each other and link the users physically and visually with the drain and its surroundings; activating the green edges along the drain by incorporating wetlands and stepped cropping.
Stretch 5	The idea for this stretch is to provide recreational green spaces for nearby neighbourhoods, uplifting and maintaining the existing waterway as a visual relief for the surrounding and to eliminate the negative spaces along the drain by forming connections with the surroundings.

After thorough analysing the vision of all the individuals stretches the overall ideology that comes out is that the spaces along the supplementary drain are envisioned as pockets of spaces to accommodate different functions that address all the concerns. The typologies introduced as a response to the local issues and contexts are cultural greens, recreational greens and ecological greens.

8. CONCLUSION / SUMMARY:

Urban waterways are considered important in the structure and planning of the city as it helps in the recharge of groundwater and maintains the ecology of the region. These spaces, if treated properly can be turned into public spaces where interaction among different community members can happen. In cities like Delhi, where population is increasing rapidly, if these waterways are not treated properly then these will be converted permanently into drains or canals losing its natural essence and resources. Initiatives for rejuvenation of waterways within cities should be taken up rather than their beautification. Proposals like creating vibrant street life, redevelopment of settlements along river, recapture value of abandoned and underused sites, with a model development planning like a local area plan along the river will help in establishing the urban connect between the rivers and the cities.

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