Blind Title Page: The first page of the manuscript should be a blind title page. It should not contain author(s) names and affiliations. It should include title, total word count (including text, references, tables or figures), number of tables and number of figures.

Un-Blind Title Page: The second page should be un-blinded title page and should include: name(s) of the author(s), concise title, affiliation(s) and address(es) of the author(s), e-mail address, phone, and fax numbers of the corresponding author.

Urban Integration of Shahdara Canal

Anjora Khatri

School of Art and Architecture, Sushant University, anjorakhatri@gmail.com

***Abstract*— The paper provides an in-depth explanation of the multiple components of the Canal Integration Program. The pilot concept is the Urban Integration of Storm Water Drains which run open through cities and are mismanaged. The river's health is improved by treating the canals and their water. The Noida stretch of Shahdara Canal is taken as a prototype which can be further modified and applied to multiple cities. This improves river and city wellbeing.**

***Keywords*— Urban Integration, Open Canals, Prototype, City Wellbeing,**

I. IDENTITY

A. Prologue

The author grew up in Noida, with the cultural influence of Delhi, where travelling through cities and over the river Yamuna would be a weekly event. Once a week, fifty-two times a year, for twenty years (assuming memory starts at the age of 4). So much time, observing the same river during different events, seasons and times of day makes one begin to wonder. We are taught from a young age about resources and their efficient use. Nature is the most precious and rare resource, and conserving it was the aim.

As the industrial periods have taken over and the efforts of globalisation and the melting of cultures over the age of the internet, we are coming to an understanding of sustainability. Renewable energy and resources, sustainable approaches and method of existence.

B. The Gujjar Demographic

It has always been well understood that the context and the inhabitants of the context are both organisms that affect each other and vice-versa. This principle's importance must be highlighted in the primitive settlement pattern of habiting the land besides flowing water. With Delhi being planned next to the Yamuna and the planning of Noida on the other side of the Yamuna. The land of Noida was occupied by the Gujjar demographic, who were mainly farmers. This meant that the larger agriculture fields required a water supply system. It can be assumed that the low-lying contours of the Noida land area acted to the advantage of these farmers and their fields.

Canals could be drawn from the Yamuna near the upper parts of what is now considered the North Delhi region. These canals would then carry water from the main river and water the farmlands. This can give a substantial inkling to the story of Noida's open drain systems.

Noida is a city which has kilometres of open drain systems, when looked at closely, these drain systems are always existing within the vicinities of the local urban villages. This is an example of context and inhabitant's influence on one another. Which came first – the drain or the village?

C. The Site

The site chosen for the thesis project is the Storm Water Drain turned unofficial sewage drain, Shahdara Canal. The canal was designed by C.W.P.R.S. Pune as an off-season drain into the Hindon channel, to carry the excess stormwater from Shahdara and back to Yamuna. This was done by creating tall embankments of earth, to prevent pollution of the water and to prevent all possibilities of the stormwater overflowing into Noida. The canal was proposed the same year as Noida (1976). So, from the beginning, the destinies of the two have been interlinked.

An opportunity missed, it is a possible connector, a non-motorized transport, a continuous green space, a leisure green space, a bicycle connector joining the Film City, urban village of Naya Baans, slums behind sector 15, high-end residences, Atta Pir market, Mall of India with the IT and institutional sectors adjoining the bund of Yamuna beyond the Okhla Bird Sanctuary. In today's date, the Shahdara Canal flows from Delhi and goes through a significant part of Noida. It has an influential stretch of 6km, starting from the STP station near the New Ashok Nagar bund where the Hindon crosses over the Shahdara SWD1 and drains into the Yamuna while flowing under the DND2. The SWD then travels almost parallel to the Yamuna until it reaches past the Okhla Barrage and then drains into the Yamuna. The water then further flows into the states of U.P. and Haryana to be used as water for irrigation.

There are five bridges which cross over the SWD and act as transition points between Noida and Delhi. The 6km stretch with the 5 bridges going over the Shahdara SWD has a dynamic mix of typologies – Residential, Commercial, Industrial, Historical, Institutional, ISBT, Green, Urban Villages and River quarries. The embankments on either side of the Shahdara SWD are subject to change, encroachment and pollution due to the close-circuited planning of the city of Noida. After these embankments were constructed, the fabric of the spaces around these embankments changed rapidly, due to the vicinity of Delhi and Yamuna.

1 Storm Water Drain

2 Delhi – Noida – Driveway

The volume of water in the river is contributed by the localities of Delhi i.e. where the Shahdara SWD begins and passes through before it reaches its end in Noida. During this process, the dumping of untreated wastewater and sewage from these localities increases the amount of toxicity in the water, which will then further pollute the water of Yamuna and the biodiversity of all the green around it. This has been a persistent problem in the SWD vicinity for the last decade, where people have launched petitions and asked the government to do something but to no avail. With the current progress and mind-set with which the future of the city is being planned, drain might face catastrophic events. The government has begun directing its attention towards the health of its water resources. The larger concept is to bring to people's attention how their ignorance affects the larger ecosystem of the county.

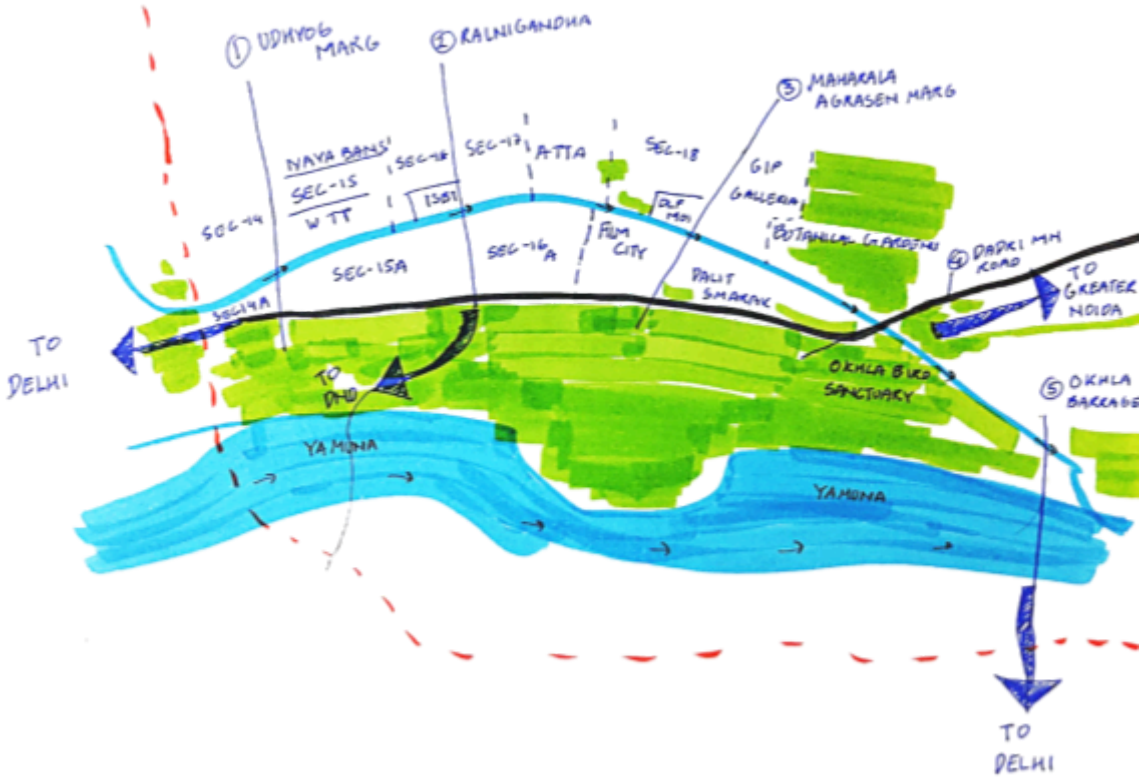


*Illustration SEQ Illustration * ARABIC 1 Flow of Shahdara Canal in Noida Region*

The entire project will be divided into multiple phases, to be carried out successfully. This proposal for the thesis topic has been accepted by the National Institute of Urban Affairs under their Student Thesis Competition along with the National Mission for Clean Ganga which aims to create river-centric thinking.

At the end of the thesis, this proposal will then further be taken to the NOIDA authority.

India and many other Southeast Asian countries have attempted, riverfront developments, which will be explored in the texts further in the thesis, but they all fall short in creating a sense of ownership for the common man. The Government has been working on the idea of directing attention away from problems. In the world of fast-changing trends, the attention span of people receives heavy traffic from social media.

Incremental social validation, short-lived sensorial rewards and small boosts of serotonin from the daily lifestyle have created a demographic that is unable to search for their larger narrative. Stopping to watch the world go by for a moment feels like a theft of time.

'Where' and 'how' people choose to spend their time makes all the difference in the world. The need to conserve comes from a sense of self-preservation and identity of self. The thesis envisions the embankments of the Shahdara Canal being turned into a community engagement space for people via place making.

Multiple activities exist along the Shahdara Canal area in Noida which take place periodically or continuously along the flowing water channel. For consideration of this thesis, we take into account the 6km stretch of the Canal which is separated by 5 bridges till it joins the Yamuna after the Okhla barrage, starting from the Ashok Nagar STP, where the canal passes through residential stretches of sector-14, 14A, 15, 15 A, 16, 16 A, 17 & 18, the commercial stretches of Atta market, the institutional parts of Film City, World trade towers, and the Green areas of Botanical Gardens and Okhla Bird Sanctuary. The canal goes through a very important and diverse vein of Noida, as can be observed. It becomes a crucial part of the entry and exit points of Noida, like a landmark. Influencing the health of the soil and air quality by the water, it is seen as an important environmental factor.

Due to the nature of planning that has preceded the thesis, there has been neglect of the canal. The Storm water drain has been turned into an unofficial nala or wastewater drain. Untreated water from multiple sources gets dumped into the flowing channel, which then becomes one of the many pollutants of the river Yamuna.

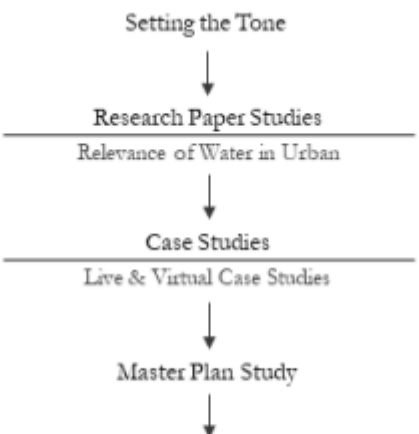
The problem of pollution cannot be solved by just providing plans to clean the water. Regulation of activities and people in a guided fashion can be a long-term solution. It is approached by the idea of community-driven actions. By creating spaces for social and community engagements near the canal, people can gather and recognise their responsibility as a community to help the canal. A sense of ownership must be created within the people of Noida and the nearby residents of the canal, to help maintain its cleanliness. There needs to be an emphasis on solutions that do not require large-footprint buildings near the river.

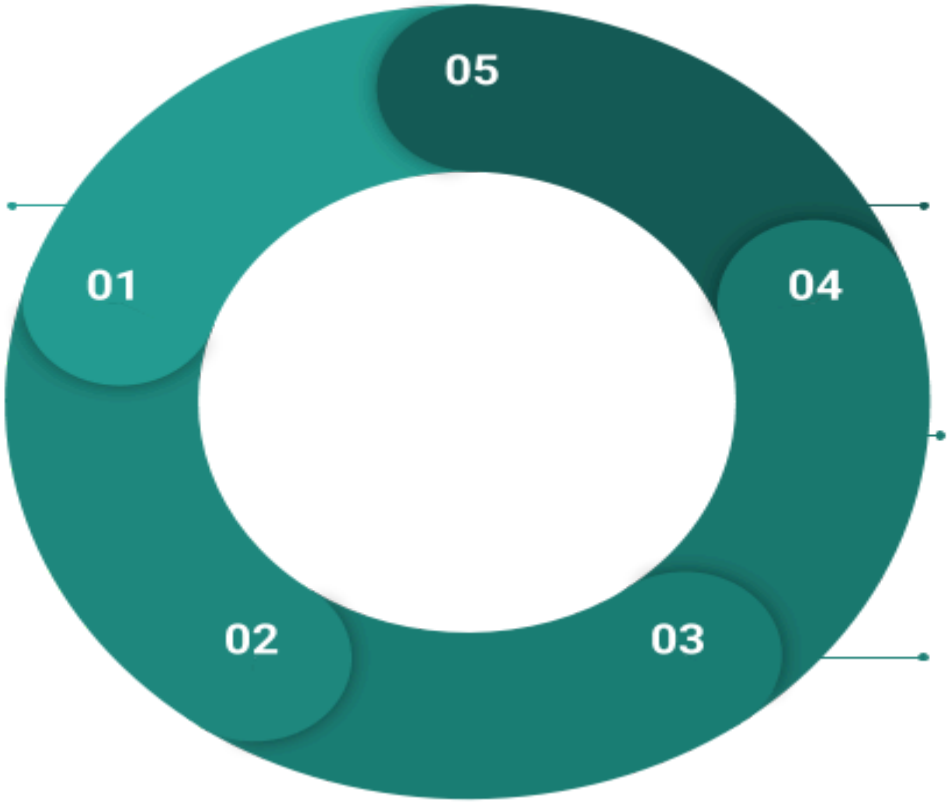
D. Language

In the idea of providing Eco-ventions to the site, we try to look at an area program which provides relief to the people currently living on site but also an opportunity to the local crowd to engage with the canal. Perhaps visually or through a sense of transition. The development of the site and the features to come need to be inspired from what is on site, so as to maintain and – to some extent – magnify the experience. The outstanding feature of any water body is the constant recurring motion, repeated waves and running of water. The name is itself an action "stream" – to flow, run down, out and through planes. The flowing of water is tribute to the shaping of the landscape and the embankments. Soil erosion and geographical formations are all attributed to the flow and current of the water. So 'transition' and 'transit' become a symbol for the stream in this particular case.

Since the landscape of Noida is relatively new and ever changing, the attribution of transition through evolution can be observed. Particular to the site, we see the evolution of the 'Aabadi' i.e. the residential built-up on the encroached land of the Shahdara Canal Embankment. The Aabadi is a settlement which has taken place over a period of time and it's resilience can be seen in the evident language of built-up and how the context reacts to it. The Aabadi becomes a part of the Canal Identity due to the shared fate of being hidden away from public eyes by the developers of the area.

E. Structure





Master Plan

and Design of Master Plan for the
rea to ensure guided urbanisation
d integration of the canal into the
precinct

Cleaning up

tting up STPs and coordination of
e government branches to prevent
ping of pollutants in the canal and
tting up CSR programs for citizen
engagement

Maintenance of surrour

5 year check ups on respective site
and further inclusion of improved bi

Structural Image ability

Converting the bridges to a landmar
entry to Noida and increasing struct
strength to allow easier flow of traffi
between Delhi-Noida

People's Part

Community education, engagement
awareness about their role in the
safekeeping of the ecosystem

II. CASE STUDIES

A. Siem Reap

1) The City and History

The Siem Reap River, is a river flowing through the titular city of Siem Reap, Cambodia. The city is located close to the historical Angkor Wat region, known for its iconic monuments discovered recently. The history of the river is such that during the development of the Angkor Historical Complex, the stream was redirected to be an integral part of the complex as a religious component, a beautification factor and for replenishing the water tanks of the complex.

The river then flows out of the jungle and the complex into what is the modern day city. It flows along the national highway before integrating into the city. The religious significance of the river can be paralleled to that of Ganga for Indians, since the mythology stands that a thousand 'Shivlings' were carved by masons, over which the water passes and is therefore purified to match the powers of Ganga. There are observable similarities in the mythologies present in Angkor Wat and Hinduism, which were created due to the inter-kingdom marriages and the political atmosphere of the time.

Therefore the river is treated like as holy and is safeguarded from developmental encroachments which might harm the ecology of the river. It also prevents from people illegally dumping untreated water into the river.

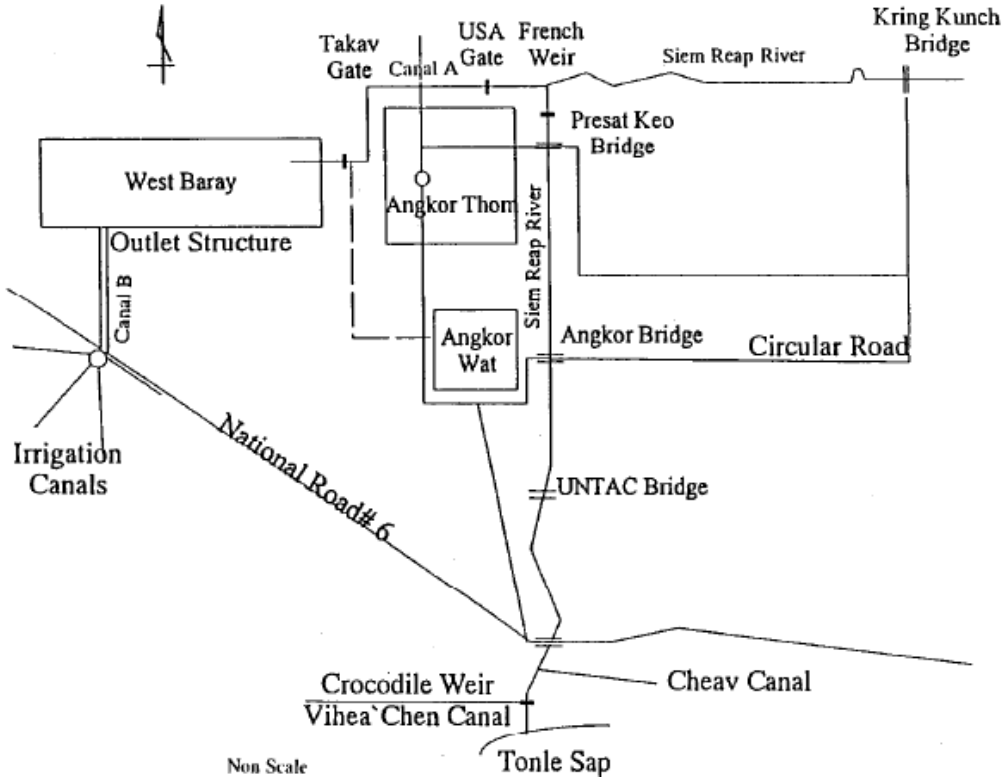


Figure 2 River System in Study Area (Source: Japan International Cooperation Agency)

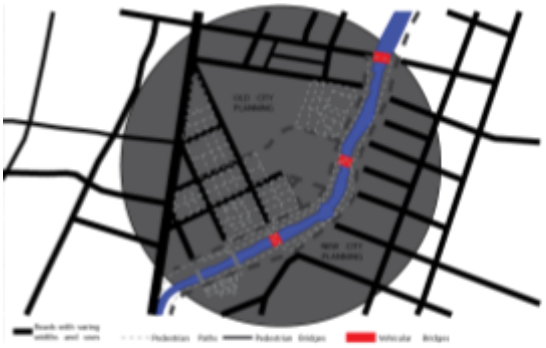


*Illustration SEQ Illustration * ARABIC 3 Path Outlines of Main City Market (Source: Author)*

Currently, the riverfront development is well done, with pedestrian bridges going across the river at multiple avenues. There are allocated spaces next to the river which have a land use decided by the context. For e.g., in the main city market, the land next to the embankment is used for kiosks, eateries and shopping centres, with small green parks along the river. In the more residential parts of the city, the land is used to create public parks with open-air gymnasiums or courts for basketball, tennis, etc. In most other parts where there is motor transition, a Riparian Buffer is provided with smaller pedestrian paths to allow for a continued integrated experience.

The government of the city is currently formulating a more urban approach which upgrades a lot of the existing tactics of the riverfront and further increases the city to river connect through land use and built spaces for the people.

2) The River

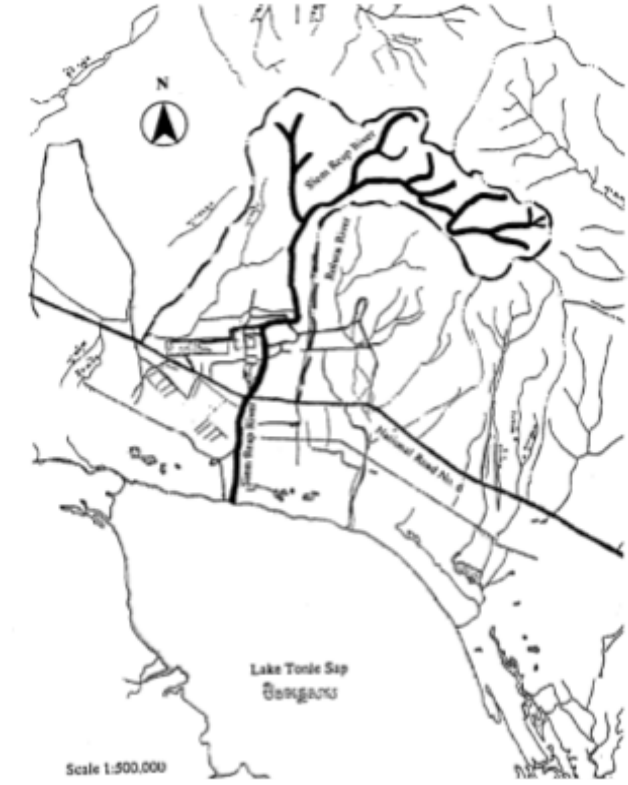


Figure SEQ Figure * ARABIC 3 Water Sheds of Siem Reap River (Source: Hydrology Office in Siem Reap, Ministry of Agriculture and Fishery)

The Siem Reap River is the only permanent stream in Siem Reap region. The watershed of the river is a part of the Lake Tonle Sap basin with 67,600 km2. The watershed of the river approximately amounts to 670 km2 rising in the Kulen Mountains at EL. 420 m, flows through alluvial fans to the Siem Reap Town and finally pours into the Lake Tonle Sap near Phnom Krom.

The watershed of the Siem Reap River and its surrounding. The total length of the river is about 80 km with an average slope of 1/2,000 in lower reaches of the Angkor Heritage Area. The watershed consists mainly of forests and agricultural areas, which could have been a former lake bottom.

The river collects the runoff from the mountains and flows to the northwest until it reaches a gorge from where it changes direction to the southwest. It discharges through this gorge to the plains at El 50 m. The river continues to flow in a southwest direction towards the ancient diversion structure constructed in the 10th century. The present river course diverted at the ancient diversion structure then arrives at the heritage area.

The lower reaches adjacent to Phnom Bok, located about 8 km upstream of the French Weir does not follow its original course at present. During the construction of Angkor Wat and its associated communities, the river was diverted into its current course to provide water supply for both domestic and irrigation uses. The river bed slope is gentler than that of the ground; the valley becomes gradually deeper as going upstream.

3) Challenges

Soil Erosion- the Siem Reap River runs a straight course through the city. In natural landscapes a river meanders overtime, forming Ox bends and re-taking the straighter paths. But, due to the built development of the city around the river, there is no more soft landscape for the river to mould and cut through. Additionally, there is a large volume of water flowing through the river. This causes for the water to erode the embankments, thus causing excessive soil erosion and muddy waters.

Pollution- An unforeseen obstacle which is a part of the river integrated city approach is the pollution. This particular waste falling into the river is the common waste found in urban landscapes such as plastic bags, fallen leaves, dust and dirt collected from the streets, use and throw utensils and items. These are all a result of creating a life and interactive space around the river.

Religious Waste- The religious status creates a different challenge of religious waste being dumped into the river as a part of ceremonies which are followed till date. With multiple monasteries and religious complexes being located around the river, it is often subjected to the dumping.

4) Treatments

Riparian Buffers- As mentioned before Riparian Buffers are provided in the more transit oriented parts of the city.

Seating Areas- Provided along the commercial and tourist frequented spaces as a part of the green spaces.

Slope Bank Treatment- Treatment of the slopes by creating a permeable layer of support which allows the embankment to retain its shape, decrease soil erosion, all without disturbing the recharge of the ground aquifers.

Permaculture Design- Planting of indigenous plant species along the embankment with a water retaining planting style to allow for the plants to take roots without being eroded and therefore contributing to the embankment treatment.

Vendor/Kiosk Platforms- The pedestrian paths provided along the embankment are done such that it invites vendor opportunities to set-up shop and

Riverfront Streets- All of the above approaches contribute in creating riverfront streets which are safe for both – the river and the city.

B. Sabarmati

1) The City and History

The river and the city have a long past of trade and it is Ahmedabad is the oldest city in Gujrat and one of the largest urban agglomerations in the west India today. The river Sabarmati and the city have a long past of trade and it runs through the river, with most of the historic districts settled along its banks. Being the largest producer of cotton in India, it is called “Manchester of India”. This title it shares with Kanpur. The city has 25 km of riverfront and the river that flows through it is narrow, with only a seasonal volume of water. Most of the untreated industrial waste of the city was directed into the river. The riverfront enjoys Biodiversity Park and the Miyawaki plantation along with other Parks & Gardens at Sabarmati Riverfront. It enhances the liability in the neighbourhoods and provides the city with much-needed Green spaces and respite from the dense built environment. The increase in Green covers the City with a variety of native, fruit-bearing trees and many endangered species, which is the underlying purpose of a sustainable city.

Following Section 149(3) of the Indian Companies Act, 1956, the Ahmedabad Municipal Corporation established the Sabarmati Riverfront Development Corporation Limited (SRFDCL) as a Special Purpose Vehicle (SPV) in May 1997. The project intends to revitalize Ahmedabad's character in the vicinity of the river and provide the city with a significant waterfront setting along the banks of the Sabarmati River. The initiative has improved the neglected areas of the riverfront and restored the city's connection to the river.

2) The River

Winding slowly along the industrial city, Sabarmati became polluted in the early 20th century. In Ahmedabad, India, a waterfront development called Sabarmati Riverfront is under development along the banks of the Sabarmati River. Constructed in 2005, the idea was first conceived in the 1960s. Under Phase 1, the waterfront has been progressively accessible to the public since 2012. This is done by the building of various facilities, which are now underway. The three main goals of the initiative are sustainable development, social infrastructure, and environmental enhancement. 2020 saw the approval of Phase 2. 613 million litres of untreated sewage a day escape Ahmedabad's treatment facilities, contaminating the city's Sabarmati River. The volume of sewage is being increased by private communities, business buildings, and industrial facilities taking excessive amounts of groundwater through bore wells.

3) Challenges

Water Pollution - Excessive pollution in the river not just endangers the underground water, but also separates all social functions in the city from the river. The River is thus isolated and does not remain a part of the functioning of people’s lives. What was one a picnic spot where children would happily go with families for a holy dip, becomes a polluted foul smelling spot.

Encroachment - River fronts being the most flooded and hence unsuitable for permanent construction are often infested with slums along the cities. On the outskirts of the city the flood plains are ecological zones with flora and fauna. Pollution of the river not just endangers the life of the people in slums, but also the species which live next to it.

Sewage Influences - A city turns its backs to the foul smelling polluted river. In many cases rive fronts become easy dumping sites for city garbage too

Direct Industrial Discharge

Flooding

4) Treatments

Water Volume More Water was brought in to the river through a canal that fed into Sabarmati from the Narmada River. Water was released into the Sabarmati River through the Sardar Sarovar dam.

City and Water Bringing city close to Water- All efforts were made to care out land and use to bring the city close to water of the river thereby creating more sustainability. Eighteen precincts were identified and their neighbourhoods benefited from the river front projects. Planning and sewer management in these areas led to organization of the river front.

Self-Financing- The project is designed to be self-financing, meaning that it will accomplish its objectives without depending on government money. To raise the necessary funds for administering and developing the riverfront, a tiny section of the reclaimed ground will be put up for commercial development. In order to maintain a harmonious built environment and a striking skyline, volumetric controls will be used to carefully regulate the private developments that are developed on the riverside. The land pockets designated for sale or long-term leasing are indicated by development sites. The project is designed to be self-financing, meaning that it will accomplish its objectives without depending on government money. To raise the necessary funds for administering and developing the riverfront, a tiny section of the reclaimed ground will be put up for commercial development. In order to maintain a harmonious built environment and a striking skyline, volumetric controls will be used to carefully regulate the private developments that are developed on the riverside.

Land Pockets- The land pockets designated for sale or long-term leasing are indicated by development sites.

Reduced erosion and floods- Strategies for flood protection, bank protection, and river training have been formulated based on detailed hydrological and hydraulic analysis and an optimal width of 263 meters for the water way has been selected.

Swage Diversion – To free the river from pollution, a sewage treatment has been implemented.

River cleaning - The floating Trash Skimmer Machine is being used to clean river trash. A lot of fishes have been bred to clean the water too.

C. Cheonggyecheon

1) The City and History

The stream known today as Cheonggyecheon was once known as Gyecheon, a simple water stream which flowed through the city of Seoul in South Korea. There was a lot of onsite degradation which can be traced back to 15th century. The river was used as a part of the waste disposal system at the time. The embankments and sedimentation were also eroded due to the deforestation. During the Era of Japanese rule, the stream was renamed as Cheonggyecheon. The significant placement of the stream resulted in further abuse of the river. Where it was used as a seasonal laundry stream in the 50s, releasing affluent into the water system.

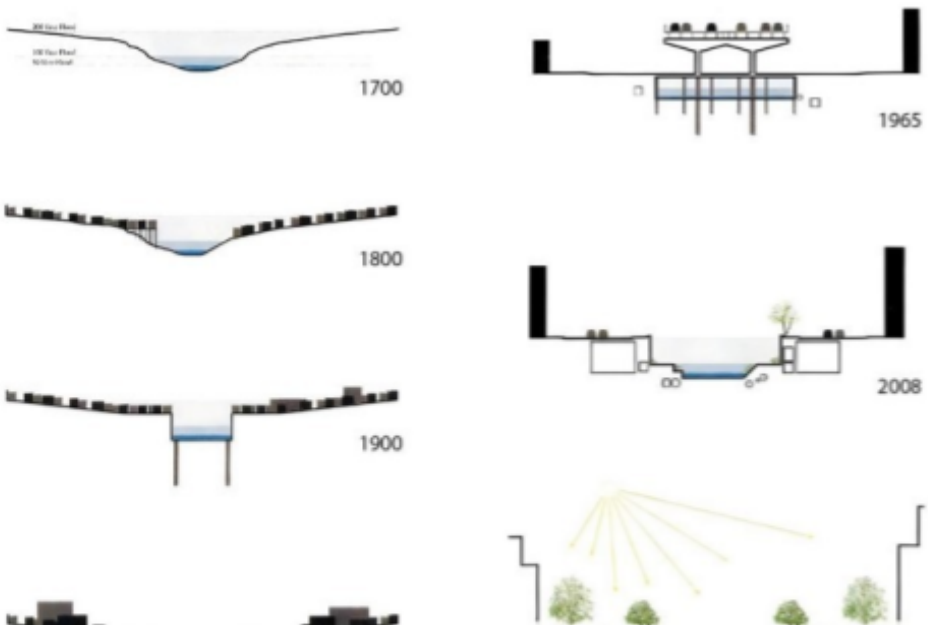
*Figure SEQ Figure * ARABIC 4 Gyecheon Stream in the 1800s (Source: LinkedIn)*

By the 70s slums had sprung along the river. This increased the affluent rate in the river system. Soon it would be seen as a waste drain instead of a river stream. A significant nail in the coffin of the stream was the channelization and concrete layer application along the embankment. This created an encasing of the stream, which blocked the water from being absorbed by the round, thus damaging the water ecosystem.

The riverbed was soon transformed into a 6 km stretch of highway, with reportedly heavy traffic. Since rivers are a natural course of transport, making a highway over it seemed like an obvious choice. The encasing of the stream further degraded the water quality and lack of aeration created anaerobic bacteria which created a foul smelling gas. The gas would then affect the lungs of the residents along the stream. Contributing to the poor air quality, the heavy traffic on the highway contributed to poor air quality index.

Later in the 2000s, an engineering study revealed structural errors in the bridges. This was a pivotal part in the urban renewal of the landscape.

These would be major motivations for the urban renewal



2) Treatments

Restoration of landscape

Established measures of water sustainability

Implementation of sewage systems

Management of traffic flows

Building of bridges across the stream

Preservation of historical assets along the river

Resolving social issues effectively

Restoration of cultural assets

Conservation of dug heritage

Enhancing overall quality of air, water, living

Establishing geo connections b/w two lands divided by the river

People's Place

Landmark of successful urbanisation of Seoul

Respite from dense urbanity

Safety of Biodiversity

Public Art Domains

Location for Lantern Festival

III. INTERVENTIONS

A. Drain

1) Weir Dams - Inflatable rubber dams will be laid along the floor bed of the stream. These can be inflated as per the requirement. The dams will allow the flowing water to be exposed by sunlight and aeration as it falls over the damns and continues on its journey. This will contribute to a slow and natural process of purification of the stream water.

2) *Floating Green Beds* - Floating Green beds are small islands of plant land which absorb the effluents from the water as a part of their growing process. This provides biofiltration and prevents algal bloom in the water. While also providing crops and adding to the eco habitat of the stream.

B. Embankments

1) *Slope Bank Treatment* - To prevent the soil from further eroding or being manipulated by interventions, stabilisation of the slope is required. This will be done in an eco-friendly manner by creating a semi-permeable layer of stones and rocks along the surface, to prevent soil erosion on impact, while allowing the water from the stream to enter the groundwater recharge cycle.

2) *Permaculture Design* - Permaculture is an approach to land management and settlement design that adopts arrangements observed in flourishing natural ecosystems. It includes a set of design principles derived using whole-system thinking. It applies these principles in fields such as regenerative agriculture, town planning, rewilding, and community resilience. The term was coined in 1978 by Bill Mollison and David Holmgren, who formulated the concept in opposition to modern industrialized methods, instead adopting a more traditional or "natural" approach to agriculture.

3) *Riparian Buffer* - Riparian buffers are considered to be the lungs of an aquatic ecosystem. They perform a large number of functions such as home for wildlife, recharging groundwater tables or shallow aquifers, maintaining the ecosystem of the river, safeguarding the river slopes from soil erosion, creating permeable soil membranes for runoff water, acting as wetlands for the urban areas and provide the right atmosphere for essential air and nitrogen cycles (denitrification processes)

C. Community

1) *Cycling and Pedestrian Paths* - Due to the vast stretch of the canal through the Delhi-NCR landscape, in formal utilisation of the route is done by 2-wheelers. By providing an established path, we can encourage a more eco-friendly, easily accessible and safer method of transportation which does not harm the contextual ecology. The provision of pedestrian bridges to and through the canal and its embankments encourages a more through integration of the city and its people with the canal. It aids in creating an urban complex on site, and provides the people with an opportunity to explore their surroundings in a new way. The ease of access also becomes a part of creating a pedestrian friendly environment.

2) Green Bridges - This intervention borders on ecological. It is planned to be done over the bridges to create a thorough connection of the embankments longitudinally. It also provides a relief to the currently wandering urban wildlife largely consisting of cows and buffalos, who displace a large part of the traffic with their presence.

3) *Public Spaces* - With the provision of a channel of motion, there must be a destination as well. By creating seating areas in the vicinity or next to the canal, it declares itself as a people’s area. Largely with the motive of creating a space for the people, in the everyday run of life, to pause and take a breath. To see the world go by is a luxury which people are not able to afford often in the present day. This makes it an approachable opportunity.

IV. CONCLUSIONS

- Ecology adjoining the sector 18 district must be integrated with the mainstream commercial areas as malls, hotels and shopping arcades.
- Buildings must form a network of pedestrian bridges and get connected so that people can walk into ecological zones while they enjoy the experience of malls and other commercial facilities, without having to walk through automobile laden roads.
- Ecological rivulet zone should be made accessible. People living in squatter settlements must find economic opportunity and public squares created where artists, craftsmen display goods in areas woven with cafeterias and small shops.
- New landmarks which are traditionally present in heritage cities and walking districts like obelisk or clock towers or people's memorials must be used. Sector 18 only has big buildings as landmarks.
- Non-commercial Activities in which people engage, like painting, dancing, gyms, art districts, cultural exchange zones, exhibitions, festival spaces, cycling tracks, organic farms, skating areas, picnic zones etc. must be planned so that the district gets a people's connect. The rivulet banks offer this possibility.
- The sector 18 district has buildings amassed within boundary walls. Easy walking paths must be created and the sector 18 district connected to the film city through bridges for easy access and sharing of facilities, thereby giving a boost to commerce and making areas accessible.
- The squatter settlement on the bank of the rivulet is a good manpower resource. Unlike many other slum projects, where people are removed; in this district people can be moved to upper floors while lower areas become easy mixed use zones for people.
- While Sector 18 must become a VISION 2050 zone for noida where all sustainable development goals are met, it should also create a WEAVE of MEMORABLE spaces.
- Central districts can contribute to the development of minds of people, a spirit of cooperation and common growth. The use of rivulet with its repairing buffer, respect for foliage, flora and fauna, nesting space for birds, floating reed-beds, aquatic life and mangroves will stand as a TRENDSETTING for all areas that have grown from Noida eg Greater Noida, Yamuna Expressway etc.
- While commerce is important, democracy is about people. Noida has been a people's area, where migrants from all over the country have mingled to create communities. DEMOCRACY must be felt in planning through urban design and integration of buildings to work as a cohesive whole.

D. References

- Anon. 1976. "MASTER PLAN FOR DRAINAGE OF STORM WATER DRAINAGE OF THE SHAHDARA BASIN IN UNION TERRITORY OF DELHI."
- Anon. 2020a. "'List Pollutants That Flow into Shahdara Drain': Yamuna Monitoring Committee Tells UP Govt." Hindustan Times. Retrieved February 7, 2024 (https://www.hindustantimes.com/cities/submit-report-on-pollutants-flowing-into-shahdara-drain-yamuna-panel-to-up/story-tFMkqeNTNXYIl0UJQurksN.html).
- Anon. 2020b. "Patna Riverfront Development and Revitalization, by NilaA Architecture and Urban Design - ArchitectureLive!" Retrieved February 24, 2024 (https://architecture.live/patna-riverfront-revitalization-by-nilaa-architecture-and-urban-design/).
- Anon. 2020c. "Siem Reap 2.0 – A City on the Cusp of a Massive Transformation | Hello Angkor." Retrieved January 29, 2024 (https://helloangkor.com/siem-reap-2-0-a-city-on-the-cusp-of-a-massive-transformation/).
- Anon. 2023. "NGT Seeks Report from Delhi, UP on Shahdara Drain." Hindustan Times. Retrieved February 7, 2024 (https://www.hindustantimes.com/cities/delhi-news/ngt-orders-action-against-delhi-and-ghaziabad-for-using-shahdara-drain-as-an-open-sewer-101689789839493.html).
- Anon. n.d.-a. "(17) Urban Regeneration: A Case of Cheonggyecheon River | LinkedIn." Retrieved January 26, 2024 (https://www.linkedin.com/pulse/urban-regeneration-case-cheonggyecheon-river-lucas-christopher/?utm_source=share&utm_medium=member_android&utm_campaign=share_via).
- Anon. n.d.-b. "Figure 2. The Tonle Sap Area with Topographic and Urban Zones And..." ResearchGate. Retrieved January 29, 2024 (https://www.researchgate.net/figure/The-Tonle-Sap-Area-with-topographic-and-urban-zones-and-flooded-area-in-2000-Keskinen_fig2_287633663).
- Anon. n.d.-c. "Noida Has 87km of Large, Open Drains | Noida News - Times of India." Retrieved February 7, 2024 (https://timesofindia.indiatimes.com/city/noida/noida-has-87km-of-large-open-drains/articleshow/64021948.cms).
- Anon. n.d.-d. "(PDF) Restoration and Conservation of Stagnant Water Bodies by Gravel-Bed Treatment Wetlands and Artificial Floating Reed Beds in Tropical India." Retrieved March 6, 2024 (https://www.researchgate.net/publication/288952293_Restoration_and_conservation_of_stagnant_water_bodies_by_gravel-bed_treatment_wetlands_and_artificial_floating_reed_beds_in_tropical_India).
- Anon. n.d.-e. "Performing Homogeneous Catalytic Ozonation Using Heterogeneous Mn2+-Bonded Oxidized Carbon

Nanotubes by Self-Driven pH Variation Induced Reversible Desorption and Adsorption of Mn2+ - Environmental Science: Nano (RSC Publishing).” Retrieved April 16, 2024 (https://pubs.rsc.org/en/content/articlelanding/2019/en/c9en00204a#!divCitation).
- Anon. n.d.-f. “Shahdara: Delhi: Plan to Turn Shahdara Drain around in a Year | Delhi News - Times of India.” Retrieved February 7, 2024 (https://timesofindia.indiatimes.com/city/delhi/plan-to-turn-shahdara-drain-around-in-a-yr/articleshow/90921712.cms).
- Anon. n.d.-g. “SkatePark / Promenade Carter Road, Bandra, Mumbai – Bandra Collective.” Architecture BRIO. Retrieved March 6, 2024 (https://www.architecturebrio.com/projects-item/skatepark-promenade-carter-road/).
- Anon. n.d.-h. “Tonle Sap Biosphere Reserve, Cambodia.” Retrieved January 29, 2024 (https://en.unesco.org/biosphere/aspac/tonle-sap).
- Anon. n.d.-i. “Yamuna Riverfront.” Retrieved January 18, 2024 (https://dda.gov.in/horticulture/yamuna-riverfronts).
- Apsunde, Kiran, and Saswat Bandyopadhyay. 2014.“Vulnerability of the Sabarmati Riverfront Development Project to Climate Change,” May 1.
- Dwivedi, Praveen. n.d. “Can Residents Find Respite from the Toxic Fumes of Shahdara Drain This Summer?” Www.Cityspidey.Com. Retrieved February 7, 2024 (https://www.cityspidey.com/news/5997/can-residents-find-respite-from-the-toxic-fumes-of-shahdara-drain-this-summer).
- Ebrahim, Yusuf. 2022.“Riverfront Architecture: Sustainable Site Planning Principles Practices Standards Design and Development,” November 13.
- Gupta, Tanya, and Chandrakala Kesarwani. 2022. “Rivers as Lifeline of Urbanization- An Environmental Case Analysis.” International Journal of Advance Research and Innovation 10(1). doi: 10.51976/ijari.1012201.
- Guturu, Karteek. 2020. “Framework for Revatilizing the Riverfront in Urban Areas.” Aegaeum 8:1–13.
- Islam, Shahid ul, and Arun Kumar. 2016. “Inflatable Dams for Shp Projects.” Renewable and Sustainable Energy Reviews 57:945–52. doi: 10.1016/j.rser.2015.12.115.
- Keskinen, Marko, Jorma Koponen, Matti Kummu, J. Nikula, and Juha Sarkkula. 2005. “Integration of Socio-Economic and Hydrological Data in the Tonle Sap Lake, Cambodia.” Proceedings of the 2005 International Conference on Simulation & Modeling, SimMod’05 309–18.
- Nagpal, Swati, and Amita Sinha. 2009. “The Gomti Riverfront in Lucknow, India: Revitalization of a Cultural Heritage Landscape.” Journal of Urban Design 14:489–506. doi: 10.1080/13574800903264838.
- Paneria, Dipali, Vishwa Mehta, and Bhasker Bhatt. 2017. “Waterfront Development: A Case Study of Sabarmati Riverfront.”
- Rajak, Fulena, Bijay Das, and Sandeep Kumar. 2023. “Ganga Riverfront Development at Patna, India: Urban Rejuvenation Project.”
- Sandhi, Team, and Arpan Paul. 2015. “RIVER BASED CREATIVE ECONOMY REGENERATION The Case of Hooghly River Stretch in the Kolkata Metropolitan Area SandHI Summer Intern Surveys & Analyses Report 2 Project Code: TTK.”
- Singh, Govind, Mihir Deb, and Chirashree Ghosh. 2016. “Urban Metabolism of River Yamuna in the National Capital Territory of Delhi, India.” International Journal of Advanced Research 4:1240–48. doi: 10.21474/IJAR01/1323.
- Sinha, Amita, and D. Ruggles. 2004. “The Yamuna Riverfront, India: A Comparative Study of Islamic And Hindu Traditions In Cultural Landscapes.” Landscape Journal 23:141–52. doi: 10.3368/lj.23.2.141.
- Tandon, Aditi. 2019. “After Pollution, Riverfront Development Chokes Lucknow’s Gomti.” Mongabay-India. Retrieved January 28, 2024 (https://india.mongabay.com/2019/02/after-pollution-riverfront-development-chokes-lucknows-gomti/).

ACKNOWLEDGEMENT

In my own way I have understood myself through you and that has made me the person I am today. Architecture in India, its education and the way we perceive our buildings, especially in India, needs a fresh look. While architects think they are designing walls, they are actually designing spaces. Design is not the only tool that should be used for architecture. Socio-Cultural and Ecological definitions must find a space in Design to make the designed spaces worthwhile.

The project requires a more spatial form of approach and it seems to be battling what the definition of change in our eyes is. I understand that there are certain steps that must be processed before we can say “Lo! Behold my new perspective!” I aim to work on the project further and past this degree so as to take it forward and provide an impact. I want my own work to change me so that I may be able to answer the question I started this thesis with – “How can I make people care?”

I am thankful to my institute guide, Professor Himanshu Sanghani for his encouragement, support and patience with me through this semester and the competition. I am thankful to my guide through NIUA, Ar. Ishleen Kaur. I am not the easiest mind to collaborate with and neither the topic was easy. I owe thanks to my family who has always heard me through, my father Anand Khatri, mother Vinita Khatri Tripathi and sister Shakya Khatri.

FUNDING STATEMENT

The heading of the funding statement section must not be numbered. Acknowledgements of people, grants, funds, etc. should be mentioned wherever applicable.

DECLARATION OF CONFLICTING INTERESTS

The heading of the declaration of conflicting interests section must not be numbered.

REFERENCES

[1]S. M. Metev and V. P. Veiko, *Laser Assisted Microtechnology*, 2nd ed., [2]R. M. Osgood, Jr., Ed. Berlin, Germany: Springer-Verlag, 1998.
[3]J. Breckling, Ed., *The Analysis of Directional Time Series: Applications to Wind Speed and Direction*, ser. Lecture Notes in Statistics. Berlin, Germany: Springer, 1989, vol. 61.
[4]S. Zhang, C. Zhu, J. K. O. Sin, and P. K. T. Mok, "A novel ultrathin elevated channel low-temperature poly-Si TFT," *IEEE Electron Device Lett.*, vol. 20, pp. 569–571, Nov. 1999.
[5]M. Wegmuller, J. P. von der Weid, P. Oberson, and N. Gisin, "High resolution fiber distributed measurements with coherent OFDR," in *Proc. ECOC'00*, 2000, paper 11.3.4, p. 109.
[6]R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, "High-speed digital- to-RF converter," U.S. Patent 5 668 842, Sept. 16, 1997.
[7](2002) The IEEE website. [Online]. Available: http://www.ieee.org/ [8]M. Shell. (2002) IEEEtran homepage on CTAN. [Online]. Available: http://www.ctan.org/tex-archive/macros/latex/contrib/supported/IEEEtran/
[9] *FLEXChip Signal Processor (MC68175/D)*, Motorola, 1996. "PDCA12-70 data sheet," Opto Speed SA, Mezzovico, Switzerland.
[10] A. Karnik, "Performance of TCP congestion control with rate feedback: TCP/ABR and rate adaptive TCP/IP," M. Eng. thesis, Indian Institute of Science, Bangalore, India, Jan. 1999.

****

Generic instructions

Please note that the Maximum word limit for the paper is **7000** **words** including notes and references. The paper shall be submitted in **MS word format ONLY.** Authors, if including figures, tables, or text passages that have already been published elsewhere are required to obtain permission from the copyright owner(s), and to include evidence that such permission has been granted when submitting their papers. Any material received without such evidence will be assumed to originate from the author(s). Submitting the manuscript means that you are submitting your original unpublished work with full rights in the work, that the work has not already been published elsewhere, and that you have obtained and can provide all necessary permissions for the reproduction of any copyright works not owned by you. Articles sent for publication should not have been published earlier or simultaneously submitted for publication to another journal. Submission of a manuscript implies that article has been approved by all co-authors, if any, as well as by the responsible authorities where the work has been carried out.

NIUA - NMCG will not be held legally responsible should there be any claims or complaints.

Manuscripts and all editorial correspondence should be addressed to: **Ms. Manju Rajeev Kanchan, National Institute of Urban Affairs, New Delhi.** Email: **mkanchan@niua.org**. Please mention **Manuscript for STC 4 Submission** in the subject line. Please note that manuscripts not conforming to these guidelines may not be entertained.

Language: The official language of scope of publication is English, and all documents must be written in English, using correct diction, syntax, and grammar. Any phrases in the local language must be translated into English as well. Any manuscript that does not meet a level of English proficiency consistent with English-language journals will be rejected.

Articles should be sent by email in MS Word format as one single file along with the declaration that the article is unpublished and the zip file comprising all the images in high resolution that has been used in this manuscript.

Authors are requested to provide their institutional affiliation (at the time of thesis competition) along with their full name, address for correspondence and specify the corresponding author along with the email id for correspondence.

Only manuscripts of sufficient quality that meet the aims and scope of Publication will be reviewed.

There is **no fees payable to submit or publish your work** in this joint supplementary edition publication.