EVALUATING ECOTOURISM AS A DESIGN STRATEGY FOR THE URBAN SETTING OF THE YAMUNA RIVER, DELHI, INDIA

by

RISHIKA CHAUDHURY

(Under the Direction of Brian Orland)

ABSTRACT

This thesis questions the fundamental of ecotourism discourse and seeks to apply them in an urban setting. The possibility is tested through a framework of ecological urbanism, derived from an analysis of various perspective on urban ecology by ecologists and designers. Yamuna River Delhi, India provides for various challenges like water pollution, encroachment on Yamuna floodplain, and opportunities like the Ridges of Delhi, the biodiverse wetlands near Yamuna river, and Delhi's heritage tourism etc. Detailed analysis of these challenges and opportunities with the principles of ecotourism is done to achieve design priorities to create a platform for ecotourism to happen at an urban level. The three design approaches 'the green lens', 'the human lens' and 'balanced lens' reveal that management of Yamuna River floodplain, conserving Delhi's natural areas, bringing agricultural practices, and changing the perception of Yamuna River through public engagement can shape ecotourism in a city like Delhi.

INDEX WORDS: Yamuna River, Delhi, India, ecotourism, urban Areas, ecological urbanism framework, floodplain, conservation, green corridors, heritage tourism, natural areas, cities and social behavior, urban ecotourism

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CHAPTER 1

INTRODUCTION

1.1 THE PROBLEM

Ecotourism has been described as "Traveling to relatively 'undisturbed or uncontaminated natural areas' with the specific objective of studying, admiring, and enjoying the scenery and its wild plants and animals, as well as any existing cultural manifestations (both past and present) found in these areas" (H. Ceballos-Lascurain 1996). In practice, though, the principles of ecotourism are often played out as a much narrower segment of tourism, that is, traveling to biodiversity hotspots (Mittermeier et al 2000). As a result, the staggering growth in ecotourism to such areas has led to it being identified as a threat as well as an opportunity for biodiversity and human welfare (Hammond 2004). The issue, though, with such one-dimensional focus on hotspots often leads to other potential applications of ecotourism to be overlooked. The question that immediately arises is *'What about the places of ecological importance in urban areas?'*.

Ecotourism is often understood as a facet of sustainable tourism but the terms, in fact, describe different concepts (Hammond 2004). Sustainable tourism is concerned with the sustainability of the *travel and tourism industry* itself, i.e., the minimization of impacts on external systems while ecotourism is a segment within the big picture of sustainable tourism, focused on nature tourism but with the explicit charge to enhance access, educational opportunities and social well-being, i.e., maximizing beneficial impacts on external systems (Figure 1.1). Sustainable tourism is defined as tourism which is more resilient to external forces of change and thus viable over a longer period than mass tourism (Butler 1993) (Fennell, Ecotourism Programme Planning

2002). There is a plethora of definitions of ecotourism, all referencing nature but also encompassing economic empowerment of the local community, tourist satisfaction, education based activities and expanded programming and development of the ecotourism industry. Within all these *open-ended* definitions, though, ecotourism struggles to remain sustainable while supporting the additional demands and "threatens to destroy the resources on which it depends" (Orams 1995).

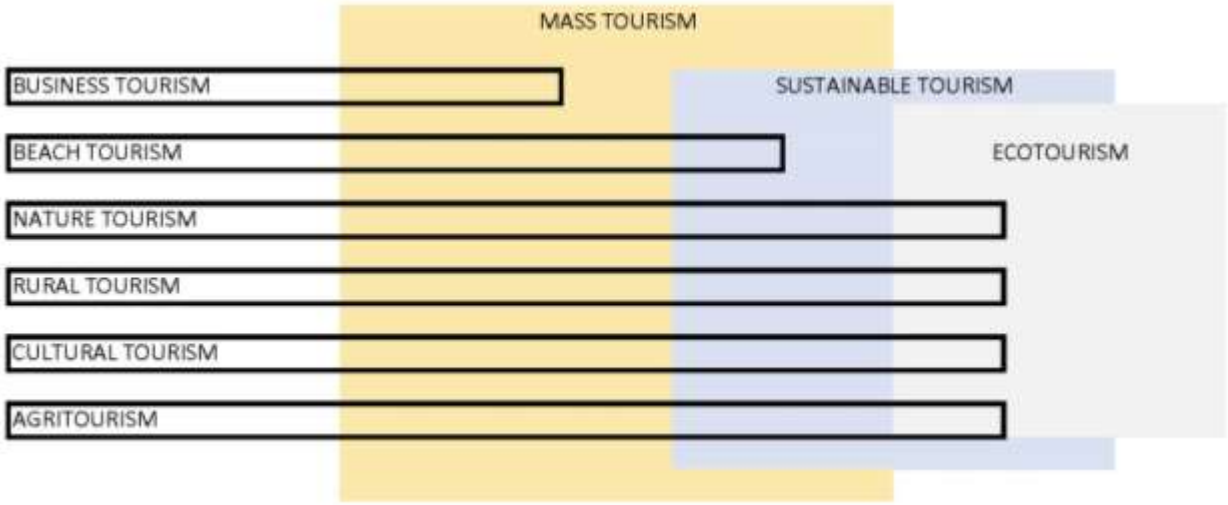


Figure 1.1: Ecotourism in the context of mass tourism and sustainable tourism

A better way of looking at ecotourism is that it can be used to harness funds for conservation and provide local people with an economic incentive to protect biodiversity (Hammond 2004). The more incentive generated by ecotourism, the more conservation of ecology takes place and, in turn, more conservation leads to more eco-tourists, the source of on-going and growing incentives. This forms a chain which hits the three E's of sustainability: environment, economy and ecology, a "symbiotic relationship" where "Increase in the conservation of natural resources leads to an increase in an ecotourism destination's competitiveness, and an increase in ecotourism competitiveness raises awareness of the value of conserving the resource leading to an

increase in land protection and biodiversity enhancement" (Boley and Green n.d.). The challenge of harnessing mutual benefits from conservation of natural resources for ecotourism development should be experimented at an urban scale where the "natural resources are threatened by land conversion" (Boley and Green n.d.). To explore and test the potential benefits and challenges of ecotourism in an urban setting, I have chosen the stretch of River Yamuna in New Delhi, India, to which the city has turned its back since the colonial era, to examine its potential for making a more visible and revitalized contribution to the city. Looking at the site from the lens of ecotourism will not only help to show how the area can thrive socially, economically and ecologically but will also look at ecotourism from a new perspective. Urban areas struggle with their own complex set of problems. Testing the expansive and *open-ended* ideas of ecotourism within the complexity of urban fabric will serve as an interesting platform to elevate both ecotourism and the ideas of urbanism for the Yamuna River, Delhi, India

1.2 THE SETTING

India is the second largest population in the world (United Nations 2015) and the seventh largest country in terms of area (Mattyasovszky 2017). Social, ecological and environmental factors are completely entangled. On the social front, the nation is rich with diverse culture, language, and festivals. Every state in the nation has a unique history, and heritage to be shared. India has distinct geographic regions which demonstrate the ecological diversity of each region, varying from the Thar Desert and Aravalli mountain range – India's oldest mountain range in the west -- to the Gangetic plains and The Himalayas in the north and Deccan Plateau in the south.

The River Yamuna, the biggest tributary of the Ganges, flows through New Delhi, the capital of India. From the influences of the Mughal dynasties to being the capital of India after

independence from the rule of British; and now to one of the fastest growing cities in the world, Delhi is experiencing more growth and change than it can accommodate. The expanding population growth in Delhi, due to in-migration, is creating a city incapable of satisfying the needs of so many. The city is expanding its boundary limits, but is it growing in terms of infrastructure? The growth of the city is a growing stress on the entangled socio-economic-ecological fabric of the area. There is lack of proper sanitation, lack of pollution control, lack of education facilities for everyone, health issues, and an economic crisis seen in a growing percentage of people living below the poverty line. Environmentally, the city struggles as its main source of water – the River Yamuna's stretch through Delhi – is polluted beyond limits. Ecologically, the expanding population of the city forces the natural areas – still comprising 19% of Delhi's areas (Delhi Development Authority n.d.) - to shrink in size and make space for concrete infrastructure.

The River Yamuna was a much celebrated river in ancient times. There are many folklores of Lord Krishna and incidents from *The Mahabharata*[1] occurring in the town of *Indraprastha*[2] near Yamuna River – then called *Jumna*. There are many historical buildings, tombs and monuments from the Islamic era and colonial era in Delhi. The animated stories of the Mahabharata times and the beautiful visual experience of the river from the Islamic era buildings are still told and visited, respectively. The residents of the city turned away from the river during the colonial era and ignored it for years, but still had to rely on it to survive—for water and for the disposal of waste. The methods adopted to revive the city, since then, has always been exclusive of the river, focusing on highways, flyovers, metro stations, temples, and housing, often on the very floodplain of the river. By many measures, the city is thriving on the economic front – high-

[1] 'Mahabharata' is one of the two Sanskrit epics in the Hindu mythology. 'Maha' meaning great and 'Bharata' meaning India – referring to the 'Great epic of India'

[2] Indraprastha is a town – now in Delhi – mentioned in Mahabharata where the Pandavas – the five brothers who fought the great battle in the epic, resided.

income jobs and better housing for the growing middle class and the lure of more job opportunities for newcomers to the city. “Delhi has the highest per capita income of Rs. 2,40,849 ($3752.81) among all the states during 2014-15” (Express News Service 2015) (Delhi Statistical Handbook 2014). Delhi is also known for its Indian heritage tourism. Both domestic and international tourists visit the historic buildings of Delhi but little attention is paid to the river and the Ridges of Delhi by tourists as well as the residents. It seems that the ecological string in the system has been cut.

Rapid urbanization is a major stress to the ecological systems of the city – River Yamuna, its floodplain and the Ridges of Delhi. If the ecological systems of the city functioned as the framework on which urbanization occurs, the fabric of a city like Delhi would look very different from what it is now. This idea lies in the core of ‘ecological urbanism’ – a term made popular by Mohsen Mostafavi, who states “Increased numbers of people and cities go hand in hand with a greater exploitation of the world’s limited resources. Every year, more cities are feeling the devastating impacts of this situation. What are we to do? What means do we have as designers to address this challenging reality?” (Mostafavi 2010). Ecological urbanism is a theory that has its roots in the McHargian theory of designing with nature. With the course of traditional ecology expanding its discipline to the urban areas, ecological urbanism is a theory that suggests “ecologies of a city” as the “fundamental building blocks” for the urban fabric rather than concrete structures painting the image of the city (Steiner 2011).

Tourism is another driving factor leading to increasing exploitation of the world’s limited resources. The impact of tourism in Delhi is not just felt by the ‘pristine’ sites but also by the urban dwellers. While ecotourism is the focus of this thesis I will be looking at ecological urbanism as a framework to place ecotourism in the urban setting and bring up the ecological values of Delhi to the forefront. Ecological Urbanism considers the city from multiple viewpoints and with a

worldview that is fluid in scale and disciplinary focus. Design provides the synthetic key to connect ecology with an urbanism that is not in contradiction with its environment. The promise is nothing short of a new ethics and aesthetics of the urban (Mostafavi 2010). While ecotourism holds great promise as a vehicle for ecological protection and social development its long-term success is only assured if the tenets of ecological urbanism are followed to achieve system resilience and sustainability. Hence, this thesis tests the suitability of ecotourism as a framework for the application of ecological urbanism.

1.3 RESEARCH OBJECTIVES

The focus of ecotourism has been mostly on remote places which have fewer environmental challenges and pressures. Growing tourism in an urban setting can shape the landscape as a contributor to economic and social well-being rather than a burden on already-stretched resources. How can we as landscape architects shape that landscape more resiliently? My thesis will address the question: *What would ecotourism look like in an urban setting like New Delhi?* My thesis will also seek to address many questions such as:

- What are the key principles of ecotourism and how can they be applied in an urban setting?
- Why is ecotourism relevant to this setting?
- What principles of ecotourism can be updated through ecological urbanism framework?
- What infrastructure is required and is ecological urbanism a useful framework for pursuing design?
- How will ecotourism enhance the health of the Yamuna River, Delhi, India?

1.4 LIMITATION

The concept of ecological urbanism stemming from the term landscape urbanism is a broad and new concept being interpreted in various ways by landscape architects, planners, and architects. The ideas of ecological urbanism could be applied at various scales, from a small riverfront development to the expanding limits of a city. This thesis will limit the scale to the Yamuna River corridor in Delhi. The corridor is the Zone O section of the Delhi Masterplan 2021, which is a 22 km stretch of the Yamuna River. Studies have shown that maximum degradation to the river occurs along this stretch due to poorly regulated use of the water by the population of Delhi, a city nearly five times the size of Atlanta.

Also, rather than focusing on the economic policies and inputs of ecotourism, ecological urbanism, and the site, the thesis focuses on the principles that enhance and update the central tenets of ecotourism. Ecotourism as an industry includes planning, programming, management strategies, and policies within a spectrum of '*destination based'* to '*ecotourism programming based'* (R. Jaakson 1997) (D. Diamantis 1998), from "*what ecotourists actually do"* to "*what ecotourists should do"* (Steward and Sekartjakrarini 1994). The thesis only focuses on responding to the cities need and implementing the principles of ecotourism within the framework of ecological urbanism designed for the site.

My approach focuses on analyzing the key problems and showing *typical conditions* of certain sections in Delhi and River Yamuna. The typical conditions are a small piece of the big puzzle of the complex urban fabric, these can either be repeated, modified or completely changed taking the basic idea behind the solution, to direct the urbanization of Delhi with an ecological framework. To research and come up with detailed and implementable solutions, time and a large team consisting of experts from various disciplines are required.

1.5 METHOD

The thesis will proceed with a descriptive background of the Yamuna River in New Delhi, India, and its existing condition. Understanding the ecological and social systems of New Delhi is pivotal to addressing similar systems in the realms of ecotourism and ecological urbanism. It is followed by reviewing existing principles and theories of ecotourism and evaluating the key fundamentals revealed in the literature. The key fundamentals are then ranked to create metrics based on which the proposed design options are evaluated. The literature review on ecotourism will examine various assumptions that have been made in the field of ecotourism, such as *urban spaces are devoid of natural areas*. A precedent study of Toronto's green tourism will help to identify a direction that ecotourism can have in an urban setting. New Delhi's tourism structure and how the principles of ecotourism fit in the city's current condition will also be examined.

The idea of natural areas in urban areas and their importance will be examined from urban ecologists' and designers' perspectives. The evolution of ecological urbanism, its current practices and addressing the human ecology in ecosystem services is critiqued and interpreted to come up with an ecological urbanism framework for design. Three design options are created: one giving priority to green infrastructures, secondly, prioritizing the human ecology of the site and thirdly, an equal priority to both green and human ecology. These proposed designs will be evaluated with the ecotourism metrics to see *what extent ecotourism opportunities can be harnessed in a framework of ecological urbanism* (Figure 1.2).

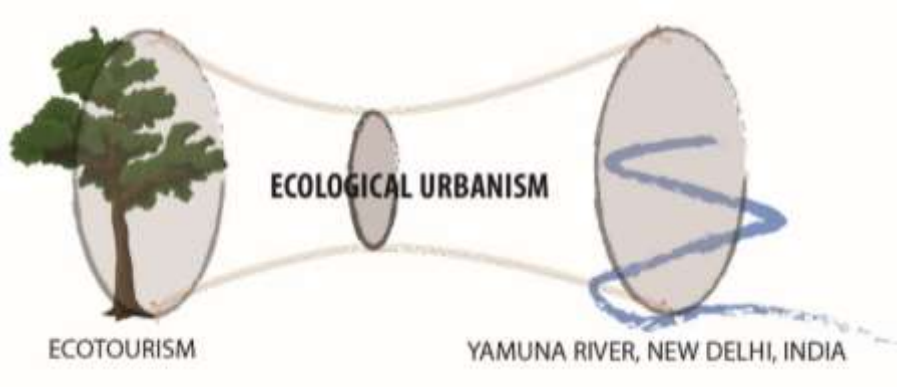


Figure 1.2: The three important lenses in the thesis

1.6 THESIS STRUCTURE

Chapter 2 will cover the history, existing social, ecological and economic conditions of the site near Yamuna River. It will also, graphically, tell the story of Yamuna River, discussing why the chosen stretch is appropriate as a research application.

Chapter 3 focuses on past and current principles, theories, and commentary on ecotourism. There are many available definitions and varying viewpoints. My approach is to deconstruct those definitions, extract the repeated and stressed fundamentals and rank them based on their repetition. This will allow for the creation of metrics that can be used in evaluating design options for the New Delhi stretch of the river.

Chapter 4 addresses the question: *Does ecological urbanism offer a framework for pursuing design and planning of ecotourism in an urban setting?* It goes over existing definitions of ecological urbanism and case studies of implemented projects. With the metrics developed in chapter 3, the case studies will answer *How has ecological urbanism projects addressed certain fundamentals of ecotourism (directly or indirectly)?*

Chapter 5 tests design solutions and evaluates them on the developed metrics to put to test the ecotourism metrics in an urban context (Figure 1.3).

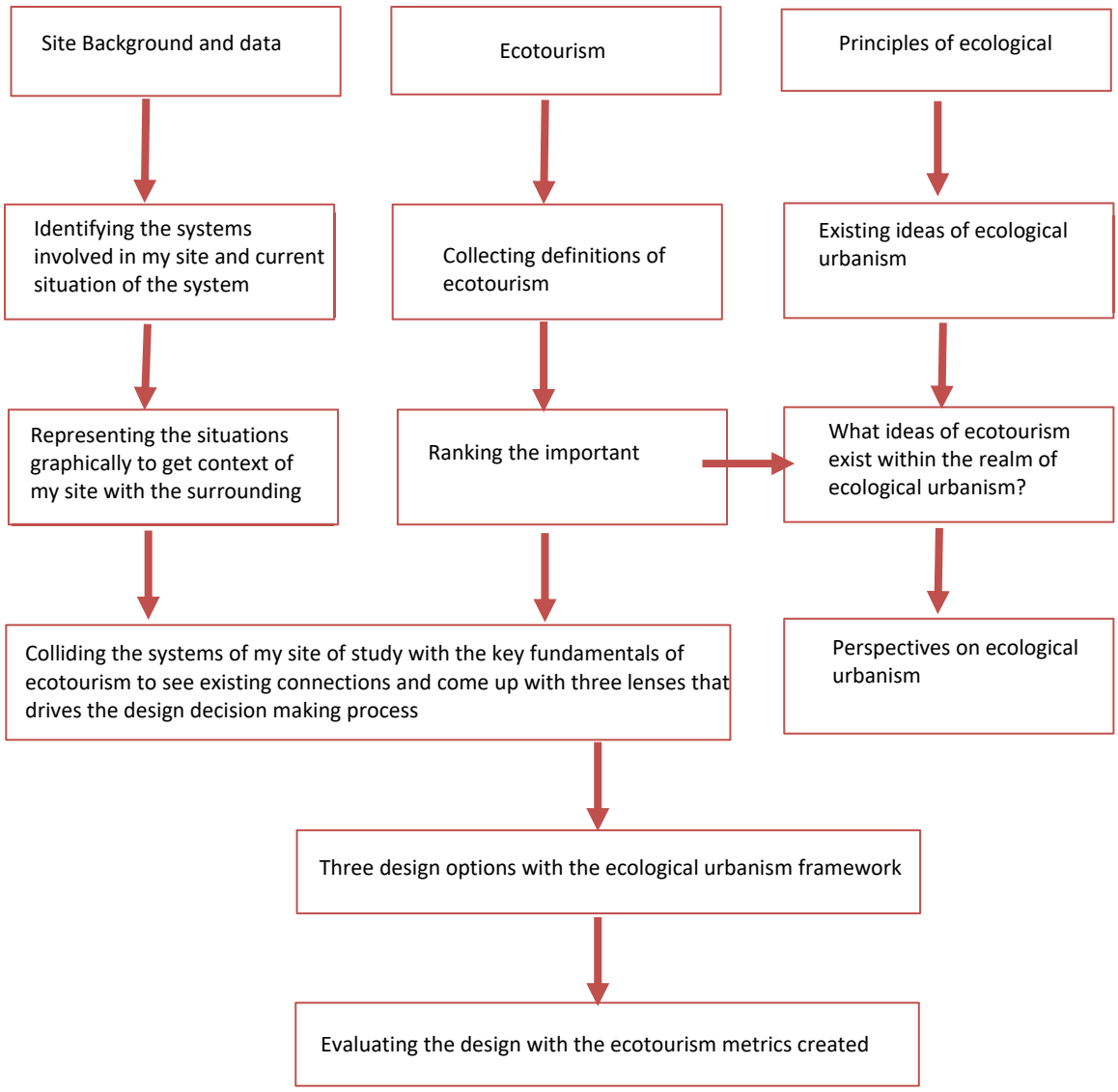


Figure 1.3: Thesis structure diagram of all the chapters

CHAPTER 2

THE STORY OF YAMUNA RIVER, DELHI, INDIA

2.1 WHAT IS THE OVERARCHING ISSUE?

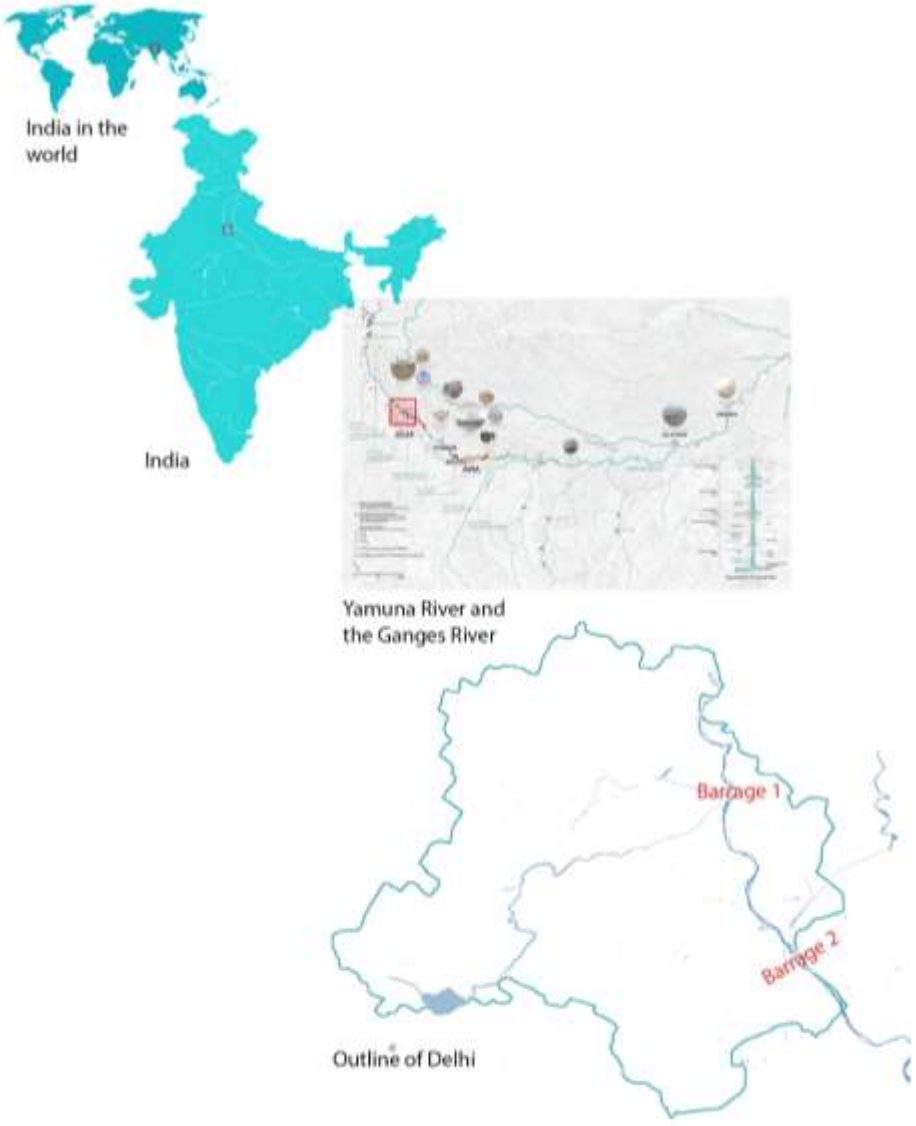


Figure 2.1: Location of Delhi and Yamuna River in India

Yamuna River is considered one of the most sacred rivers in India. The river traverses through four states, starting from Yamunotri in Uttarakhand to Allahabad in Uttar Pradesh where it meets with the Ganga River (Figure 2.1). The stretch of the river where it crosses through Delhi has been identified as the most polluted part of the river. In this journey of the Yamuna River it is faced with various barrages, most importantly in Delhi are the Wazirabad Barrage and the Okhla Barrage. The length of this stretch is approximately 22 km (Figure 2.2).

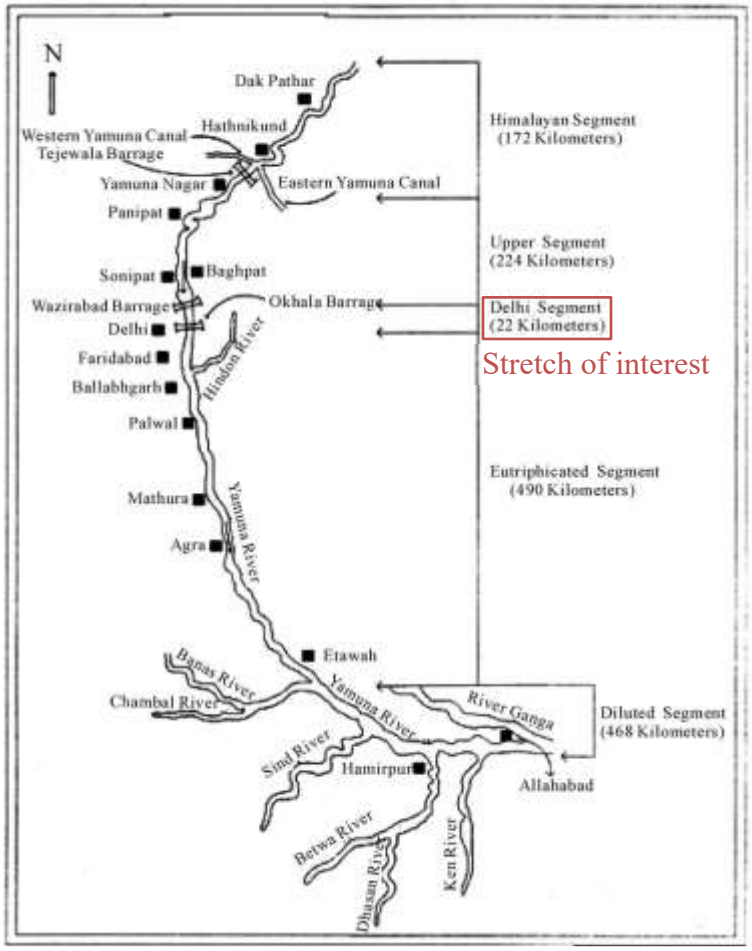


Figure 2.2: Flow diagram of Yamuna River from its start to emergence with the Ganges. Source: (Misra 2010)

The significance of the Yamuna River has changed over the years. In the ancient times, the significance of the river came from the story of the birth of Lord Krishna and his father crossing it

to transport Krishna to his foster parents. Mughals used it for transportation and for framing scenic views from their palaces (Sinha and Ruggles 2004) such as Taj Mahal, Mahtab Bagh, Humayun's Tomb and many more. The British turned away from the river and the developments that were framed around the river, causing the old town *Shahjahanabad* or now known as Old Delhi to suffer due to lack of infrastructure growth. The river has since then been suffering a huge ecological, social and economic loss. Although the old Mughal era and Colonial-era buildings remain as huge tourist attractions yet the river continues to face the brunt of industrialization.

The not so polluted water of the Yamuna River enters North Delhi from Haryana. After meandering in and out of Delhi for a stretch of 224 Km (Sharma and Kansal n.d.) it passes through Wazirabad Barrage. The 22 km stretch from Wazirabad to Okhla Barrage, is notably the most polluted part of Yamuna River ever. The city has already spent 1500 crore Rupees on cleaning the just 22 km, "1.6% of the entire stretch" (Khan and Bajpai 2014), of the Yamuna which flows through it. "This is possibly the highest amount spent on river cleaning in the country, if not the world" (Narain 2015). Presumably, the activities happening within this 22 km are the main contributing factors. Practices such as dumping untreated industrial effluents, agricultural practices on the floodplain, cattle bathing, throwing raw sewage etc. (Rai, et al. 2012).

So, does the problem lie in management issues? Is it the illegal settlements around and in the floodplain? Is it the lack of environmental impact assessment for the unhindered construction on wetlands? How can I as a designer turn this challenge into a solution? What if the very growth of infrastructure becomes a solution? Such as green infrastructures that cleanse the river? What if we let nature do its own role? Such as the wetlands cleaning the river.

In the light of current practices that occur near the river, it is socially, ecologically and economically not viable to restore the river to its very original state. So, what can we do in such a

scenario? Responding to the current functions and the future projected functions could be a better option. So, that designers can pave the way to broader thinking. Designing with the landscape not against it will pave the way for activities that might happen in the future and always will be prepared for it. This idea lies at the very core of ecological urbanism. We also cannot eliminate the fact that people's use of the river has dramatically shaped the river. So, eliminating the people out of the scenario will be out of the social bubble of sustainability. In fact, designers can address the carrying capacity of the area to respond to the increasing population of Delhi.

Tourism is one of the major economies of Delhi. According to a study done by The Ministry of Tourism with "Incredible India", Delhi receives 13 million domestic tourists and nearly 1 million foreign tourists each year (Incredible India 2010). This ties in well with the idea of integrating people with the landscape and the Yamuna River. Thus, creating ecotourism opportunities to be harnessed.

The systems involved

Clearly, the systems involved along the river corridor is the Floodplain, the heritage tourism, and activities, agricultural practices on the floodplain and the zoning and shaping of land around – landscape mosaic of Yamuna River (Figure 2.3). The system will further branch out to various elements affecting that system directly, such as soil conditions affects the quality of water and water storage capacity of the floodplain. These systems will be considered from the lens of reviving the Yamuna River corridor. It will also be later overlaid with the systems involved for bringing ecotourism, to test the possibility of cleansing the river and ecotourism going hand in hand.

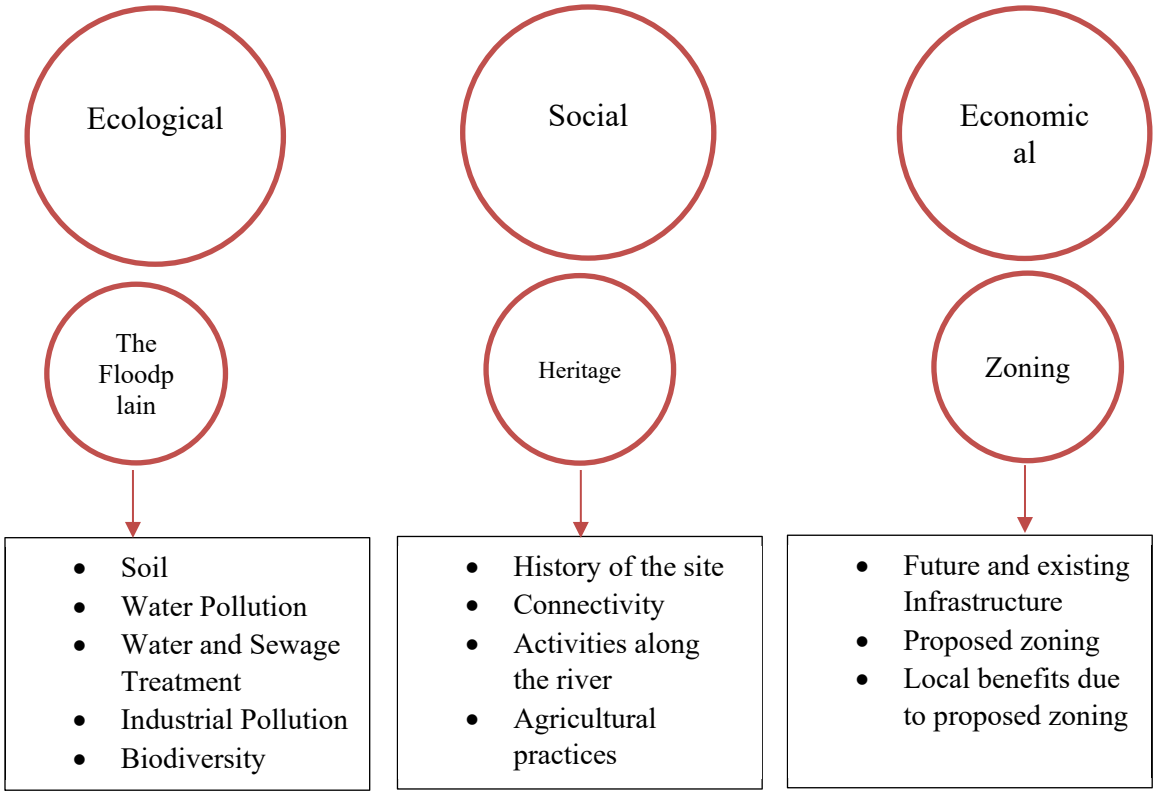


Figure 2.3: The structure of various systems at work near Yamuna River, Delhi, India

2.2 SOCIAL ASPECT

The history of River Yamuna is diverse and changes as the river changed its course. The river has flown from the very beginning of any civilization in Indian history. One of the most notable ones is mentioned in 'The Yamuna River Basin' by Rai, Upadhyay, Ojha and Singh, in 2012. The Yamuna River is the largest tributary of the Ganga River It is also considered as a sacred river in India. The Yamuna River is intimately connected to Lord Krishna's life. Lord Krishna sanctified the Yamuna River from the beginning of his avatar (incarnation) in the world. While his father Vasudeva was crossing the Yamuna with Lord Krishna for a safe place on the other bank of the river (Figure 2.4 and Figure 2.5). Legends say that the moment the rising water touched the feet of Lord Krishna, the flood receded (Rai, et al. 2012). The ancient city of Indraprastha, mentioned in Mahabharata, existed where the current complex of Purana Qila stands. There is no

solid evidence to prove or disprove the claim. But, “the fort rests on a site which marks an ancient settlement”. Excavation done in the 1950s have found Northern black polished ware and Painted gray wares, dating back to 1000 BC (Singh 2006).





Figure 2.4:Vasudeva crossing the Yamuna River with Lord Krishna.
Source: (The Birth of Krishna 2014)
Figure 2.5: Animated storytelling of the interaction of Yamuna River and Lord Krishna.
Photo credit: Vasudeva-Krishna Das, 2016

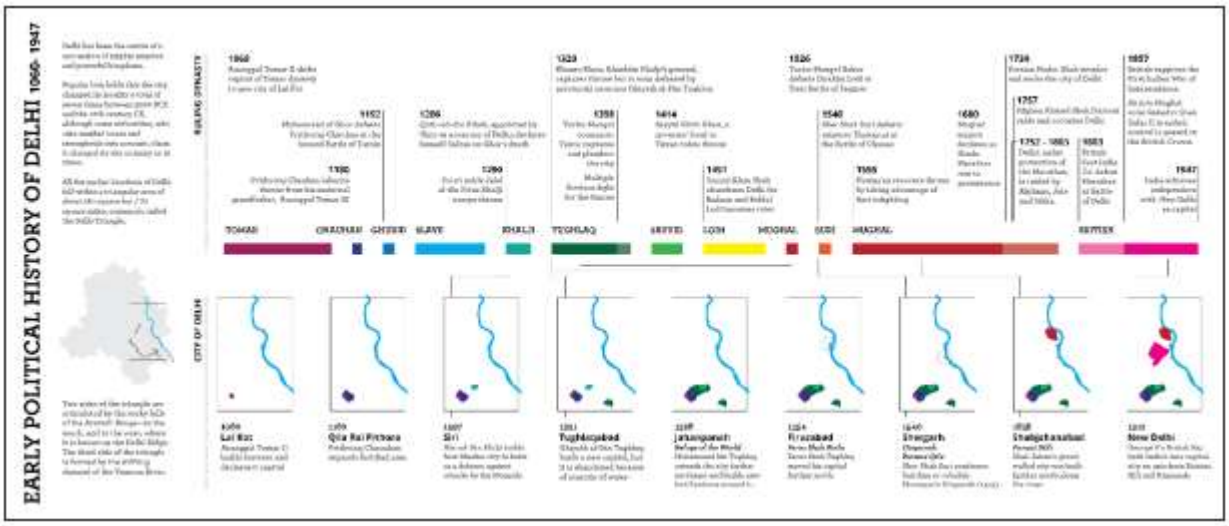


Figure 2.6: Map of construction of Delhi several times under various dynasties and rule
Photo credit: Bhavika Aggarwal, 2015

Delhi has been constantly demolished, constructed and revived seven times under the rule of various dynasties (Singh 2006) (Figure 2.6). Even though most physical evidences glorify the Islamic period of rule over the city, the story of Yamuna is incomplete without "the Hindu practices and perception of the Yamuna landscape" (Sinha and Ruggles 2004). While the Hindus "apprehended divinity in their daily life" and personified the landscape around as more animate, the Islamic practice emphasized the idea of "viewed and the viewer" (Jay 1988), (Sinha and Ruggles 2004). The importance of river for riverfront gardens and transportation of materials to create the former led to the development of *Shahjahanad* (Old Delhi). The play of hierarchy was more evident in their planning style as the kings and their family would reside on the higher ground, enjoying the views through kiosks, framed balconies, pavilions etc., examples of which can be seen in the architectural style of *Taj Mahal, Agra fort, Itmad-Ud-Daula* and so on (Figure 2.7, Figure 2.8 and Figure 2.9).



Figure 2.7: View of Yamuna River from Itmad-Ud-Daula, Agra, Uttar Pradesh, India.
Source: (Rogers 2014)
Figure 2.8: Architecture of Humayun's Tomb in Delhi.
Photo credit: Aditya Basrur, 2013





Figure 2.9: Artist's rendition aerial view of Jama Masjid, by Shah Jahan, at the banks of Yamuna River in Delhi, 1858 A.D.
Figure 2.10: Boats built for transportation near Red Fort, 1858 A.D.
Source: (Ebay 2006)

The visual and tactile engagement with River Yamuna has shaped the modes of experiencing the same landscape through shaping its architectural styles. The tactile engagement with the river in the Hindu practices such as taking a Holy dip in the river to cleanse one's sins led to formation of *ghats* where public access was facilitated. Semi engagement with water led to gated boat launches in the Mughal complexes (Figure 2.10). Visually enjoying the river formed the architectural typologies of *Jharokas*, *Char Bagh* gardens and *Chhatris.* Seeing has also been described as "metaphorical touch", where believers of Hinduism take pilgrimage to sites of mythical importance (Sinha and Ruggles 2004). Perhaps, the idea of meaning, significance, engagement, experience (Sinha and Ruggles 2004), perception and architectural typologies can be further developed in the landscape near the suggested site for both ecotourism and revival of the floodplain.





Figure 2.11: Washing of clothes by Yamuna River Bank. Photo credit: David Gilkey, 2016
Figure 2.12: Praying on the ghats to the Sun God. Source: (Hills 2012)





Figure 2.13: Immersion of Idols in the river. Photo credit: Vikas Choudhary, n.d
Figure 2.14: Cremation grounds by the river bank. Photo credit: David Gilkey, 2016

The significance of the Yamuna River stretch of interest in the thesis pivots around not only the river's ecological importance but also the heritage around it. The sites that developed around the river due to the mentioned importance, meaning and engagement with the river have managed to attract domestic and international tourists. The list of monuments, from the Islamic period in Delhi alone, is 200 or more. There are various other places such as a museum, cultural centers, and cultural landscapes, for the tourists to visit. The development of these sites falls along the sites of ecological importance. It is important to address these fragmented sites and systems through a well-connected design solution.

2.3 ECOLOGICAL ASPECT

Floodplains analysis

The 2-km wide floodplain of Yamuna River (Soni, et al. 2009) has been heavily encroached by settlements in the last decade, leaving very little space for the river to migrate naturally (Khan and Bajpai 2014). Delhi's water requirement to serve 18 million people is 1650 MCM out of which, Delhi Jal Board supplies 1100 MCM. Unused monsoon discharge from the Wazirabad barrage is 4000 MCM. The Yamuna floodplain can capture 160 times more water than all the other water bodies in NCT taken together. Total recharge from rooftops and all the water bodies is 52 MCM/year and 5.6 MCM/year respectively, which is negligible compared to the required level of water. The 97 SqKm floodplain of Yamuna can yield 510 – 1086 MCM per year and thus serves as the best water recharge zone as it is made of 40 m of permeable and porous sand, which has a 50% water holding capacity (Soni, et al. 2009). This floodplain can not only provide immediate source of water to the people in the city but also recharge the groundwater and aquifers. "Floodplain is the resort for the fresh groundwater within the shallow aquifers" (Khan and Bajpai 2014).

The floodplain comprises of older alluvial plain, the new alluvial floodplain deposit, alluvial basin and the quartzite ridge zone. The old alluvial plain consists of clay deposits, as well as silt and sand ranging from fine to course. The newer floodplain is the major source of fresh ground water, consisting of silty sand sediments. The quartzite zone has water only present in the fracture planes (Figure 2.15). The stretch from Palla to Wazirpur meanders its way in and out of Delhi and has experienced the most migration in its paths with sharp sinuous curves. This lead to the formation of paleochannels along the river (Khan and Bajpai 2014), (CGWB, Master Plan for Artificial Recharge to Ground Water in India 2002).

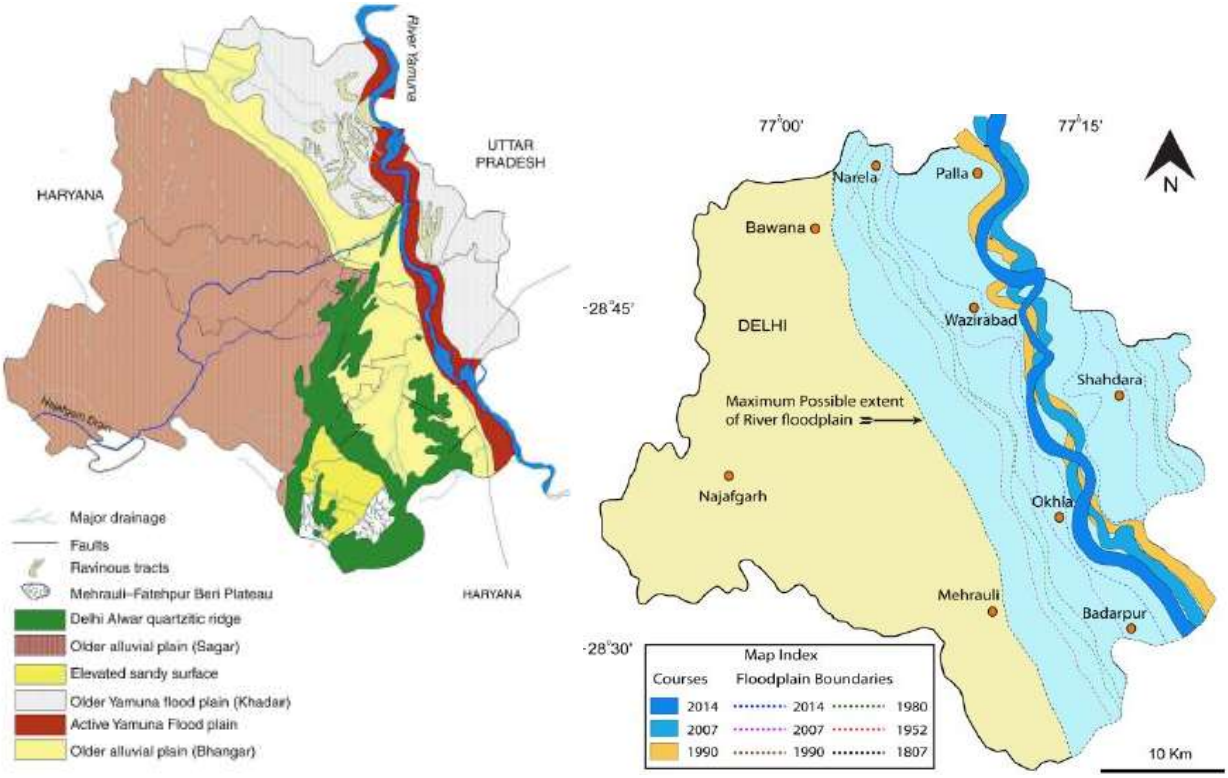


Figure 2.15: Geological Map of Delhi. Adapted from (Chatterjee, et al. 2009)

Figure 2.16: Paleochannels of Yamuna River in Delhi.
Source: (Khan and Bajpai 2014)

As the river flows further south, it experiences lesser changes in path and almost becomes too straight near the Okhla area. Due to heavy urbanization and constriction of flow, the river loses all its meandering and paleochannels. Marking the migration path of the river and its floodplain since 1807 to 2014, we see that the maximum possible extent of the river floodplain almost occupies 50% of the size of Delhi (Figure 2.16, Figure 2.17 and Figure 2.18) (Khan and Bajpai 2014).

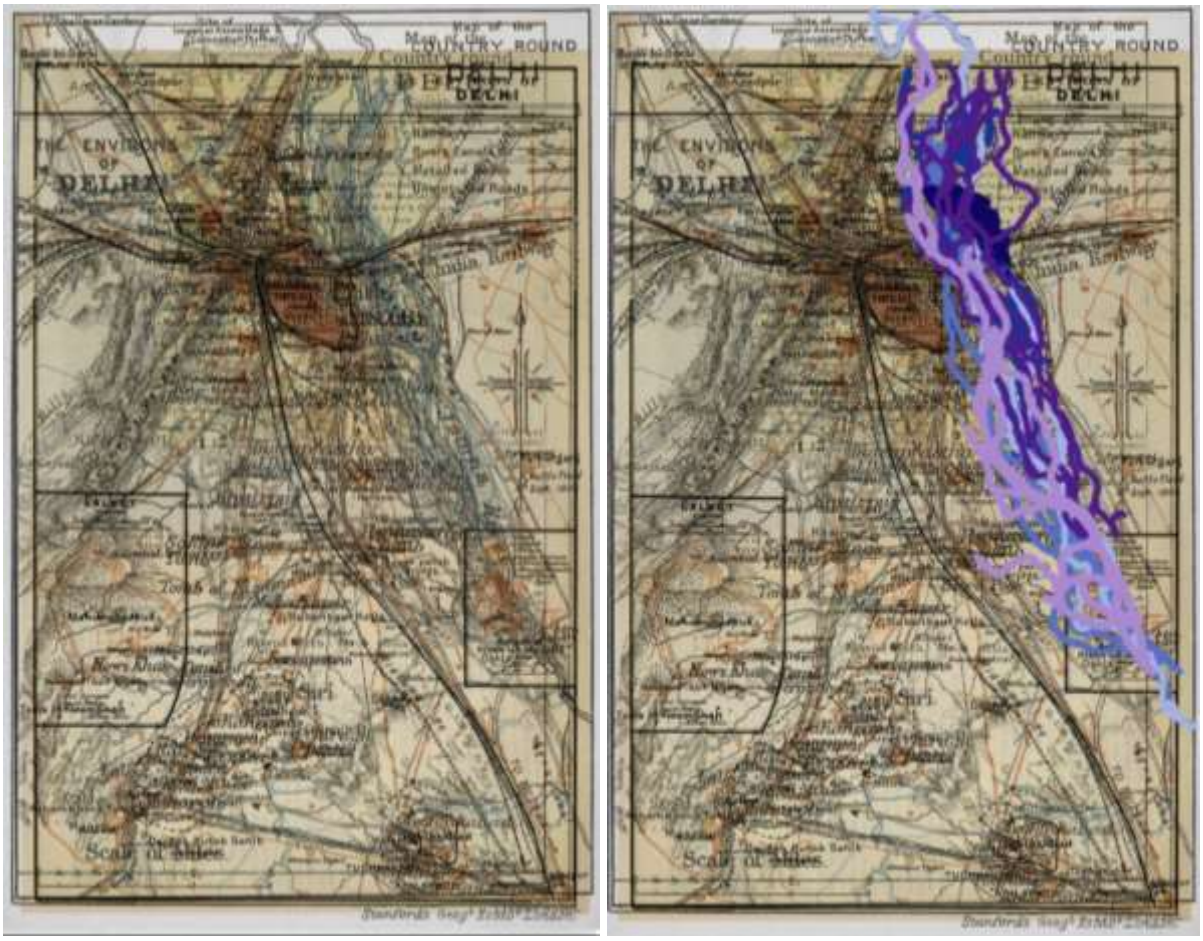


Figure 2.17: Overlay of historical maps (1893, 1901, 1906, 1909, 1912, 1914 and 1924) of Delhi.

Figure 2.18: Yamuna River from the construction of Mughal Delhi to Colonial Delhi. Maps compiled from Columbia University. Graphic compiled by author.

The level of pollution corresponds to the migration path of the river as well. Thicker alluvial soil and aquifer zones are found in the north and eastern part of the river, leading to more abstraction of water from tube wells dug in those areas, while the southern part receive discharge from all the canals and drains, leading to higher water pollution level in that region (CPCB 2006). The sections in the figure below (Figure 2.19, Figure 2.20 and Figure 2.21) show that the aquifers become shallower from north to south of the river. The floodplain in these regions can be used to recharge the aquifers and act as the sponge to collect water during the wet season.

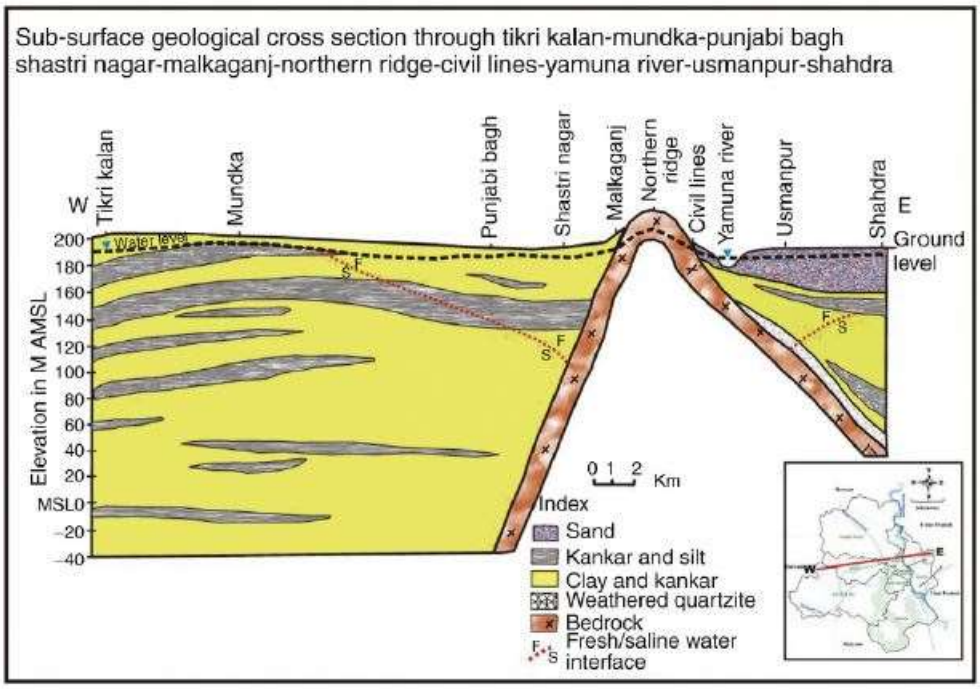


Figure 2.19: Subsurface cross section of Delhi. Source: (Sarkar, et al. 2016, CGWB 2006)

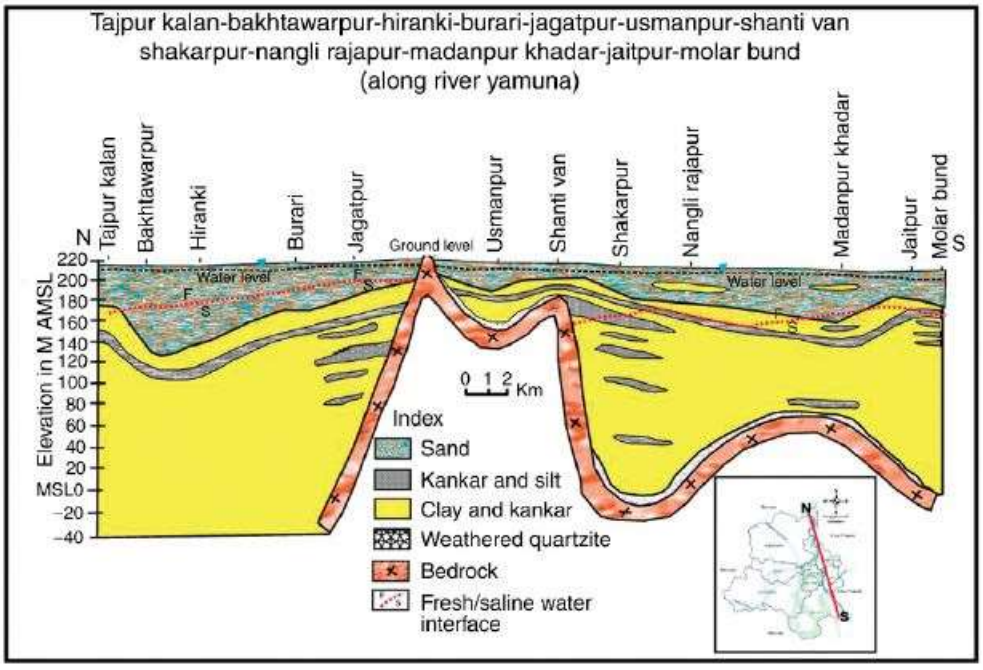


Figure 2.20: Subsurface section along Yamuna River. Source: (Sarkar, et al. 2016, CGWB 2006).

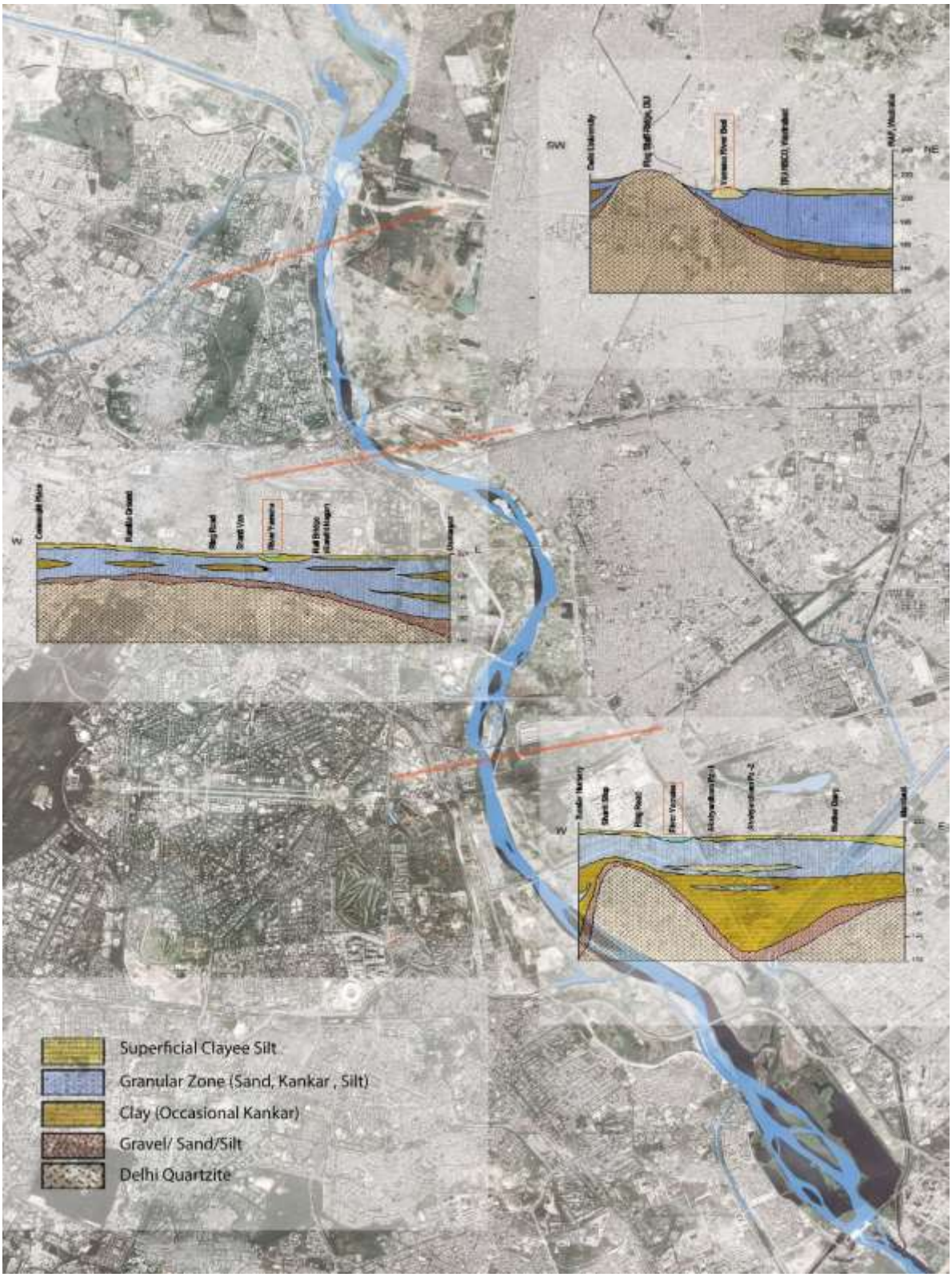


Figure 2.21: Cross sections of River Yamuna, *Source of inset sections*: *(CGWB, Master Plan for Artificial Recharge to Ground Water in India 2002) (Sarkar, et al. 2016)*

Sources of pollution

The sources of water pollution in any general case can be classified into 2 categories namely: point source pollution and diffused sources of pollution. The point sources are mainly domestic pollutants and industrial effluents. There are 5 sewerage zones in Okhla, Keshopur, Rithala, Coronation pillar, Shahdra. The table below shows the ratio of the sewage generated as per the population of the zone.

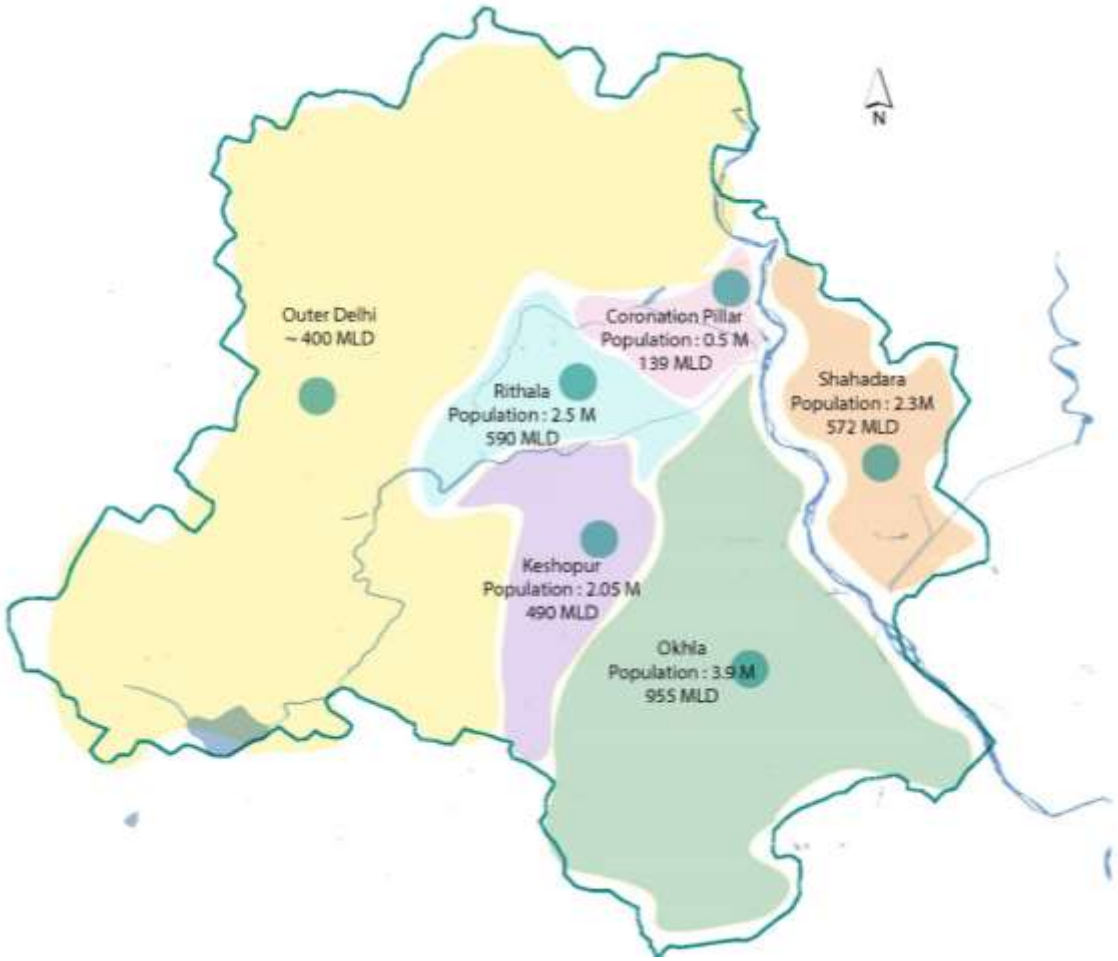


Figure 2.22: Sewerage zones of Delhi

The diffused sources are agricultural pollutants such as agricultural residue, fertilizers, pesticides, excess salts from irrigation water and animal husbandry. Immersion of idols, dumping of garbage, cattle bathing, washing clothes and other in-stream uses of the water are some of the

major sources of diffused pollution. Lack of proper sanitation facilities, in the rural and the slum areas of the basin, causes the unhealthy use of the water (Rai, et al. 2012).

There are 15 Common effluent Treatment Plants (CETP) for 28 industrial areas within those sewerage zones (Figure 2.22). Delhi contributes 18% to the pollution load due to industrial effluents, that is approximately 218 MLD (Rai, et al. 2012). Pulp and paper, sugar, distilleries, textiles, leather, chemical, oil refineries, pharmaceuticals, thermal power plants, food processing etc. are some of the industries that discharge effluents directly into the river (Figure 2.23) (Rai, et al. 2012). All the above-mentioned sources of pollution make the water unhealthy for drinking purposes and any other use, causing a cyclical process of ignoring the river.

It can be concluded that the major sources of pollution to the Yamuna River in the Delhi segment are domestic waste, industrial waste, garbage dumping, immersion of idols, pollution from cremation grounds, wastewater from agricultural fields and so on (CPCB 2006). This directs us to look at what is causing it. The partially functioning sewage treatment plants and waste water treatment plants discharge untreated sewer and water into the drains which finally flow out to the river. The parameters on which the level of pollution can be measured are pH level, Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO) and total Coliform count (MPN/100ml)

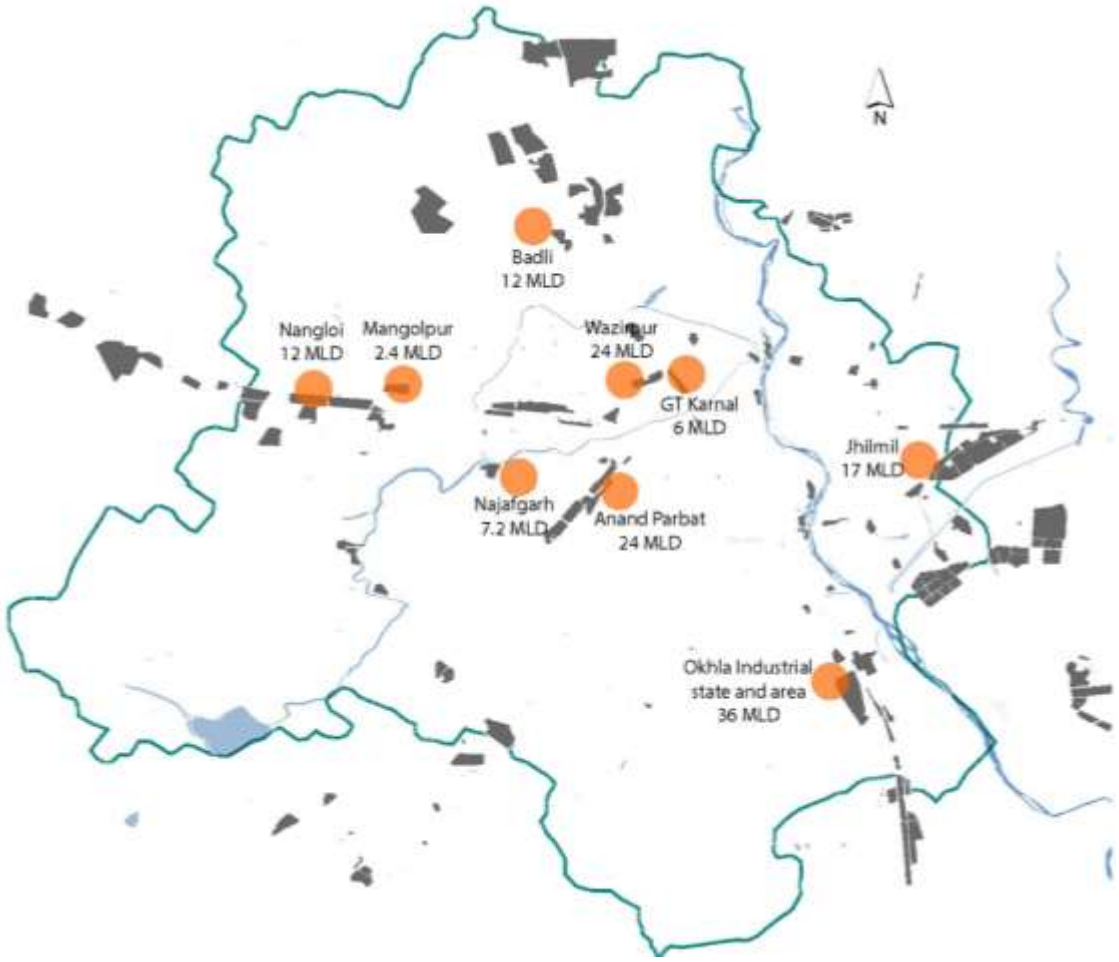


Figure 2.23: Location of industries in Delhi.

Waste water treatment

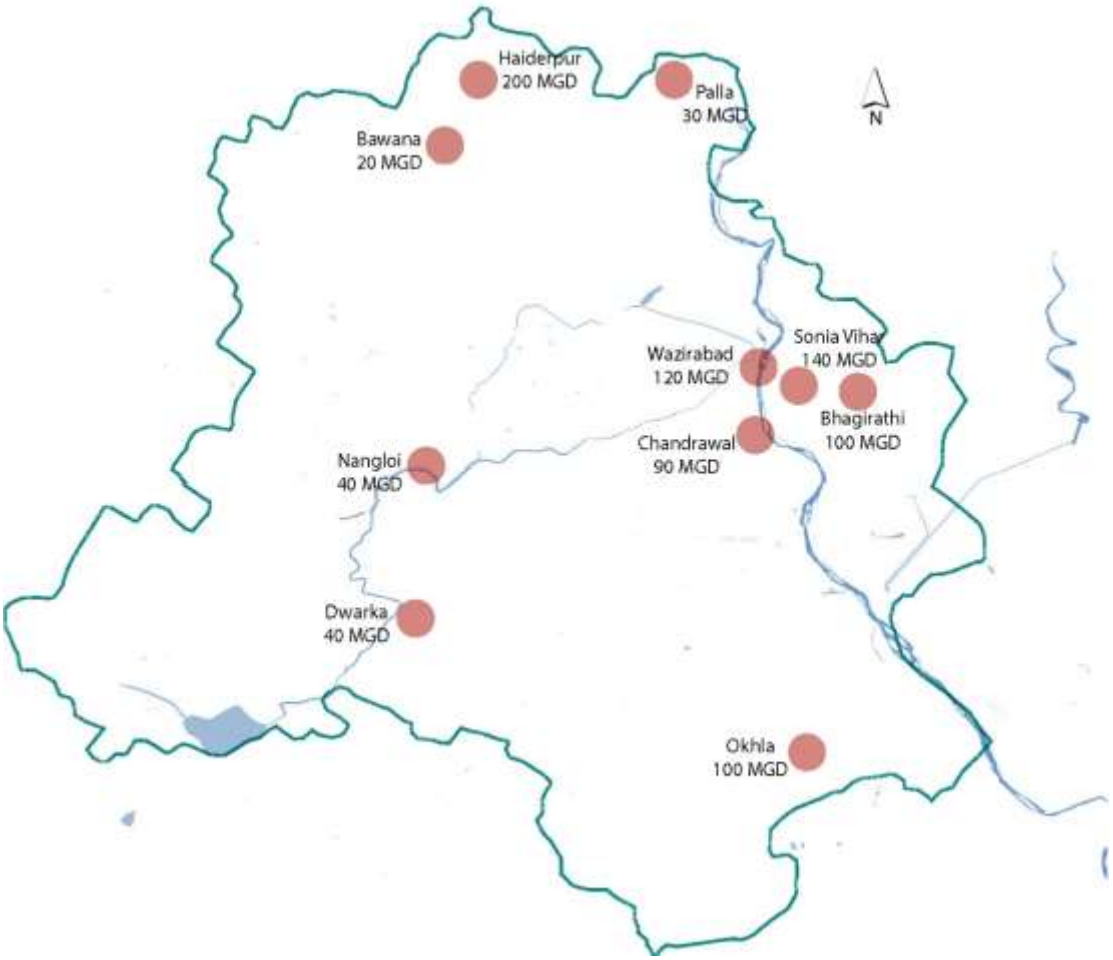


Figure 2.24: Location and capacity of waste water treatment plants in Delhi.

Delhi generates 3784 MLD of wastewater along the Yamuna River basin, thus contributing 84% of sewage generated in the river along its entire course (Figure 2.24) (Rai, et al. 2012). According to the same report: "Delhi has a sewage treatment capacity of 2330 MLD, hence there is a large gap between generation and treatment of wastewater." Out of that 84% of waste water discharged in the Yamuna, 25% is discharged downstream of Okhla Barrage. So why is the water not being treated?

Sewage treatment

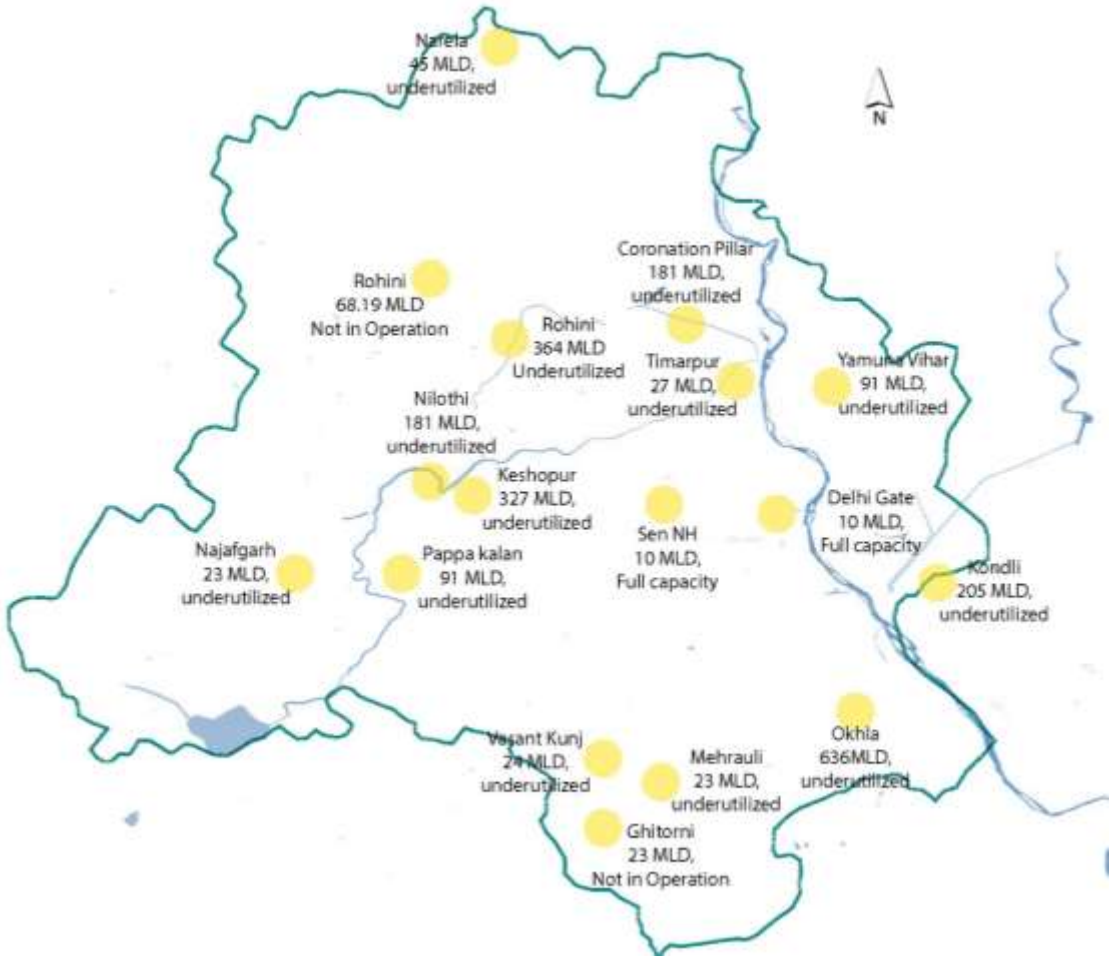


Figure 2.25: Location and capacity of sewage treatment plants in Delhi

Delhi has already got 17 sewage treatment plants (STPs), which together add up to 40 percent of the total installed sewage treatment capacity in India (Figure 2.25) (Narain 2015). But these plants remain grossly underutilized. Why? Because the city does not have the drainage to convey all its excreta to the treatment plants. One, we need to change the practice of pollution control. We must understand that rivers need water to assimilative our waste. Today, Delhi takes water from the river, upstream of Wazirabad and returns only sewage to it. Between the two

barrages — Wazirabad till Okhla — there is no water. There are only some 20 drains that bring sewage into the river (Narain 2015) (Khan and Bajpai 2014) (Bajpai and Prabhakar 1993).

Location of drains

There are around 20 drains in Delhi that contribute to the pollution load after receiving waste water from both sewered and unsewered areas (Rai, et al. 2012). The Najafgarh drain (Figure 2.27) and the Shahdara drain are two largest contributors of wastewater. An overlay of all the industries with the drains indicates that they are strategically located near the drains to discharge all the effluents into the drains (Figure 2.26 and Figure 2.28).

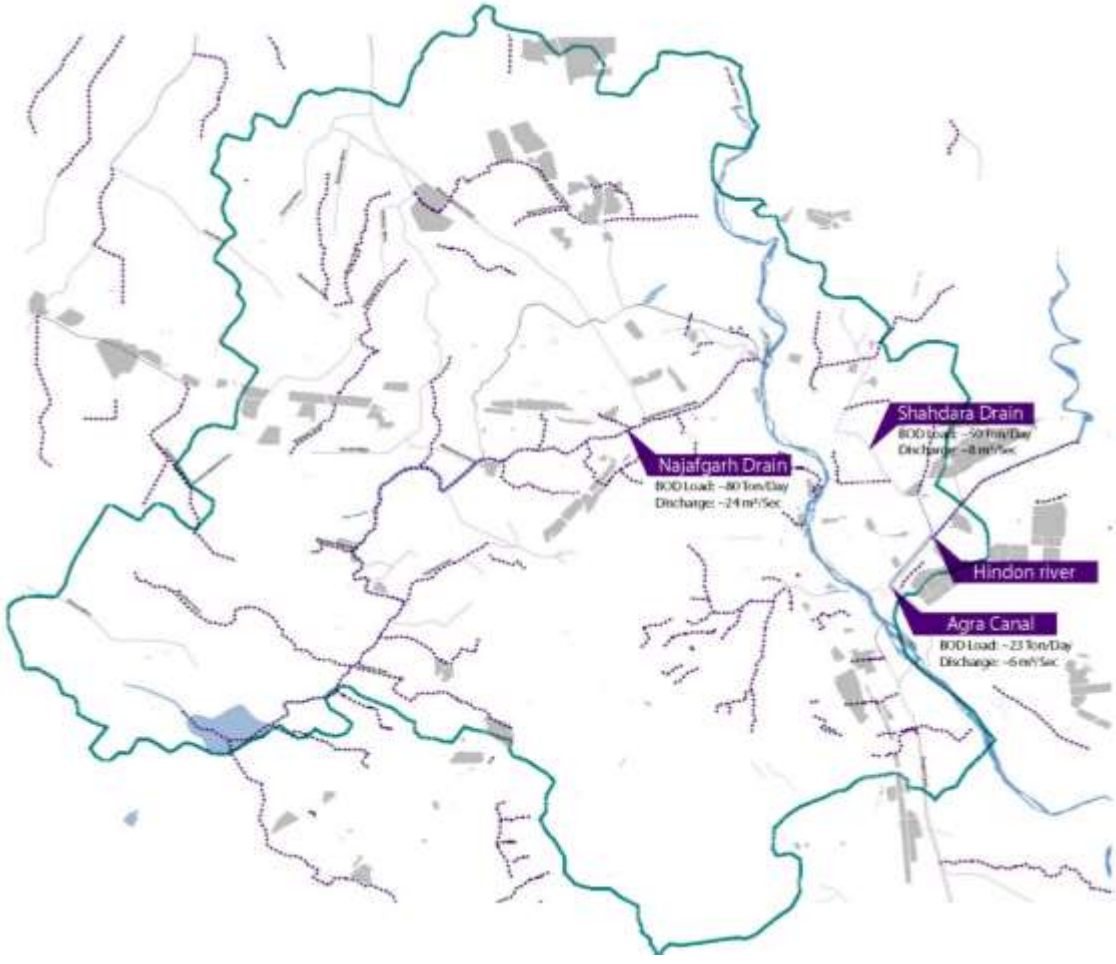


Figure 2.26: Location of drains with respect to industries in Delhi



Figure 2.27: Aerial view of Najfgarh drain
Photo credit: Alexander Savin, 2016



Figure 2.28: Drains empty into Hindon River to Yamuna River
Photo credit: Sunil Ghosh, n.d

Groundwater water quality

"Delhi region has no suitable groundwater resources in the current scenario". In the southwestern part of the region, where the subsurface strata mostly consist of clay and *kankar*, containing saline water. In last ten years, the heavy exploitation in the rocky tracts and upland areas has completely depleted the groundwater and fast and unending urbanization has limited the flow of rainwater down the drain instead of recharging the aquifers through floodplain (Khan and Bajpai 2014). "The depth of water table below ground level varies in general between 5 and 20 m. A number of groundwater structures by way of open wells and shallow tube wells (60–70 m deep) exist in this formation in different parts of NCR with varying degrees of discharge rates" (Rai, et al. 2012).

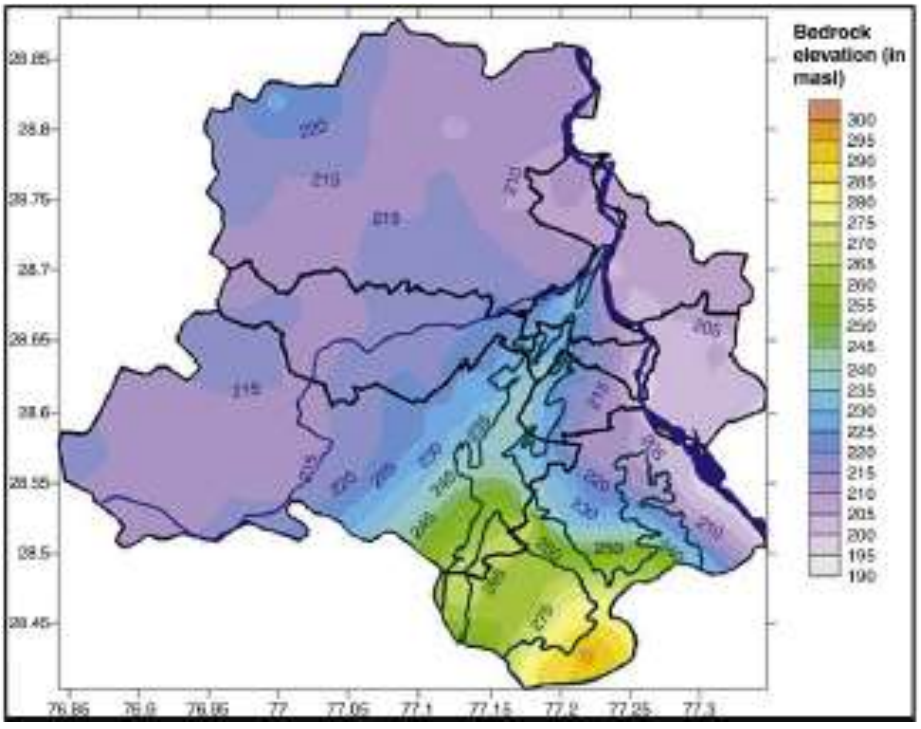


Figure 2.29: The bedrock elevation map of Delhi
Source: (Shekhar and Sarkar 2013) (Sarkar, et al. 2016)

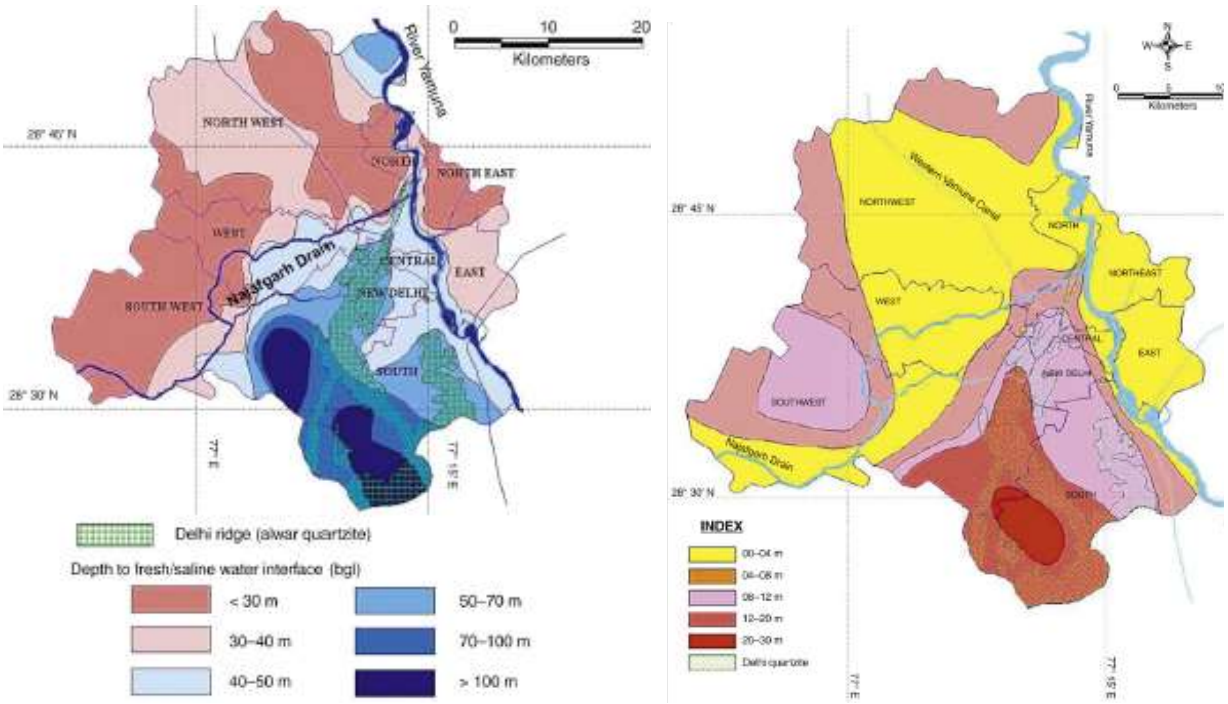


Figure 2.30: The depth of fresh/saline-water interface in Delhi.
Source: (Sarkar, et al. 2016, Shekhar, Purohit and Kaushik 2009)

Figure 2.31: Groundwater decline from 1960 to 2000 in Delhi.
Source: (Sarkar, et al. 2016, CGWB 2006)

Studying the above maps collectively, shows that bedrock elevation is higher in the south (Figure 2.27), depth of freshwater/saline-water is lower in the south and well depth is, therefore, deeper in the same regions too (Figure 2.28). The western and the south side of the Yamuna River consists of older alluvial plain and quartzite thus making the well depth deeper (Figure 2.29) – "Basement consists mainly of fractured and weathered quartzite hard rock (Bajpai 2011). Wells sunk in the weathered and fractured aquifers of hard rock generally penetrate down to 80 mbgl but in some places, they reach 150 mbgl" (CGWB 2012). The younger alluvial soil on the northeast and eastern side of the river has seen a considerably lesser decline in groundwater level. "The younger alluvial floodplains have unconfined aquifers with fresh water zones overlying saline water" (Rao, et al. 2007, S. Shekhar 2006).

A serious concern to the capital is that the groundwater level is depleting continuously in all the regions except along the Yamuna River basin. Groundwater level is depleting with rates varying between 1 to 4m per annum. Due to population growth exerting pressure on the water supply, leading to increased rate of water abstraction (Sarkar, et al. 2016), the rate of decline has been recorded to be 3 to 4m per annum in few districts. which is an alarming condition for Delhi (CGWB, Master Plan for Artificial Recharge to Ground Water in India 2002). "The three key drivers contributing to changes in the groundwater environment for the NCT of Delhi are population growth, urbanization, and climate" – All the three are interconnected. This thesis works to challenge the social, economic and ecological ills of the society to be used in a productive way. The system of groundwater is dependent on Ground water abstraction, groundwater level, and ground water quality.

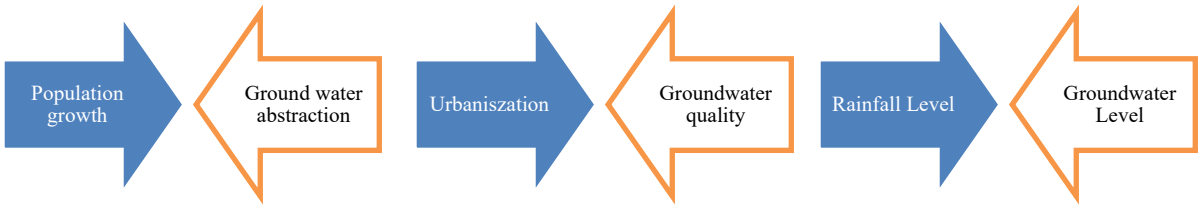


Figure 2.32: The interaction of various systems that affect groundwater quality

Level of water pollution

The dissolved oxygen level of Yamuna River is almost nil at Nizamuddin, with a biochemical oxygen demand of 23 mg/l and total coliform is 22516660 MPN/100ml. The BOD level has been steadily increasing two folds over the past decade due to the untreated waste water, sewage and effluents being dumped directly into the river. In fact, more astonishing levels of pollution can be found at the Okhla after meeting the Shahdara drain. The reason for the above level of pollution – 1.6% stretch of the river contributing to 80% of the pollution in the entire

stretch of Yamuna River (Khan and Bajpai 2014), (CPCB 2006) – could be blamed on the inefficient usage of STPs in Delhi. Out of the 2321 MLD capacity of the treatment plants, only 50% is treated (Sharma and Kansal n.d.).

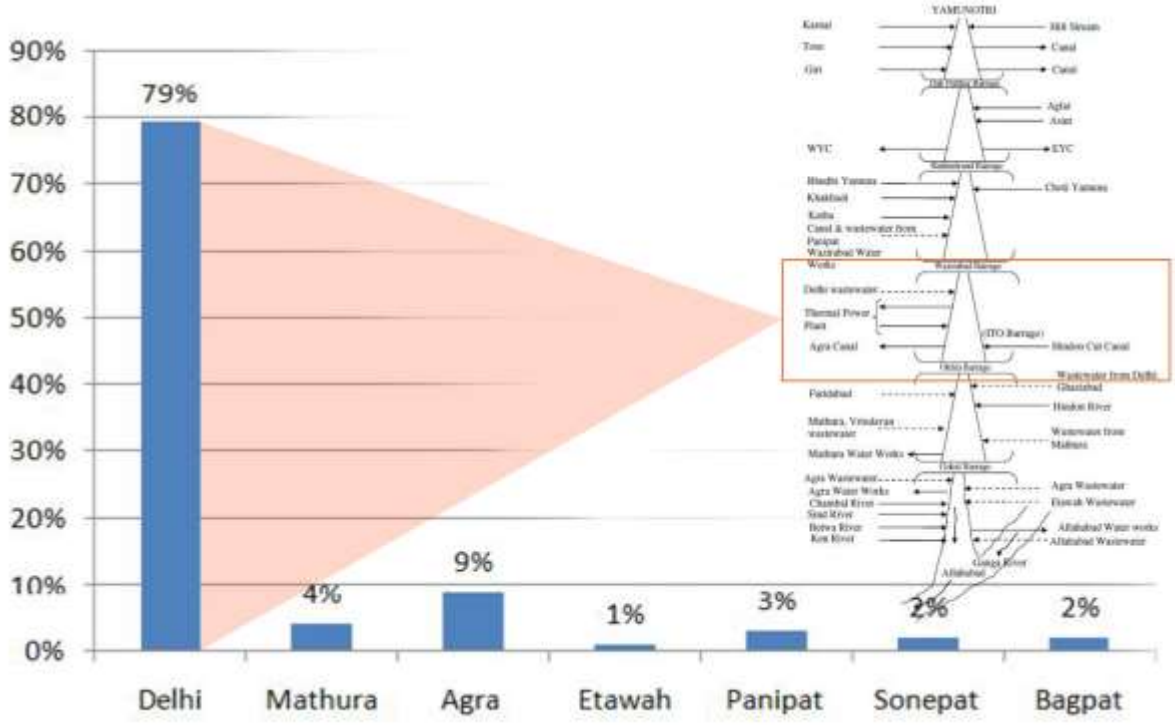


Figure 2.33: Delhi's pollution contribution to Yamuna River. Graph and map source: *(CPCB 2006) (Arya, Sultana and Das 2015). Graphic amended by Author.*

Agricultural practices

The cropping pattern in the region takes place in the same way as the rest of the northern plains in India. There are 3 cropping seasons: Kharif (July to October), Rabi (October to March) and Zaid (April to July). The requirement for these seasons are met by rainfall, canal irrigation or groundwater pumping (Rai, et al. 2012). "Agriculture is practiced throughout the floodplain encompassing 40% of the total floodplain area. Rice, wheat and vegetables are the main cultivated crops grown. With the increase in urbanization, the floodplains have been encroached upon for agriculture. There has been a tremendous increase in the intensity of chemical fertilizer and

pesticide use to enhance productivity. The runoff from these fields contribute high loads of pollution to the river" (Trisal, Tabassum and Kumar 2008).

- Kharif crops – Rice, *bajra*, maize, cotton, groundnut, *urad, moong, lobia*, sweet potato, sugarcane, lady's finger, soybean etc.
- Rabi crops – wheat, mustard, lentil, gram, potato, peas etc.
- Zaid crops – pumpkin, watermelon, bottle gourd, chili, tomato, *kheera, kakri, mung*, sunflower etc.

Flora and fauna

There are three Ridges in Delhi – northern, central and southern ridge – and the ring of scrubs, meadow land comprises most of the dense canopy cover in Delhi (Rai, et al. 2012). "These hills are a northernmost extension of the Aravalli range – oldest mountain range in India" (Singh 2006). To the north of Yamuna River, the maximum height of the hills is 2.5 m above the Yamuna floodplains, while to the south the elevation is 90 m above. The historic vegetation of the Delhi Ridge resembled the "dry, tropical forest species" of the Aravalli Range (Singh 2006).

The Delhi Zoo, Asola Bhati Wildlife Sanctuary in the southern Delhi Ridge and the Okhla Bird Sanctuary are some of the areas of ecological importance, lined around the Yamuna Floodplain and Delhi Ridge. Okhla Bird Sanctuary sits on a freshwater ecosystem – "a man modified floodplain wetland" – created due to the Okhla Barrage construction. The areas bring large species of waterbirds, reptiles, and mammals, amidst an urban setting (Manral, et al. 2012). Okhla area receives sufficient inflow of water from the drains and Hindon River, to support the growth of aquatic and semi-aquatic vegetation, while the limited lateral flow of the river in the north (Wazirabad Barrage - Yamuna Barrage), dictates the lower vegetation species there (Figure 2.34) (Tabasum, et al. 2009).



Figure 2.34: Okhla Bird Sanctuary
Photo credit: Abhishek Sohu, 2015

The vegetation of River Yamuna stretch in Delhi is under serious threat from the continuous encroachment of the floodplain resulting from the conversion of the land for agriculture, settlement, metro stations, housing etc. (Tabasum, et al. 2009, Chandra 1997). The clear connection between hydrology and rich vegetation has also proven that the water quality in the same areas are better than the areas where species richness is low (Tabasum, et al. 2009, Pamposh 2005).

The eastern part of Yamuna River (Figure 2.35) is the missing link that prevents the green belt from being completed. Yamuna River floodplain has the potential to complete this green belt if it is restored properly. The above points bring up a major need for restoring the floodplain ecologically and recognizing its value in future land use planning (Tabasum, et al. 2009). It is surprising that the economic potentials of these ecologically rich sites are the very reason for its fragility (Singh 2006).

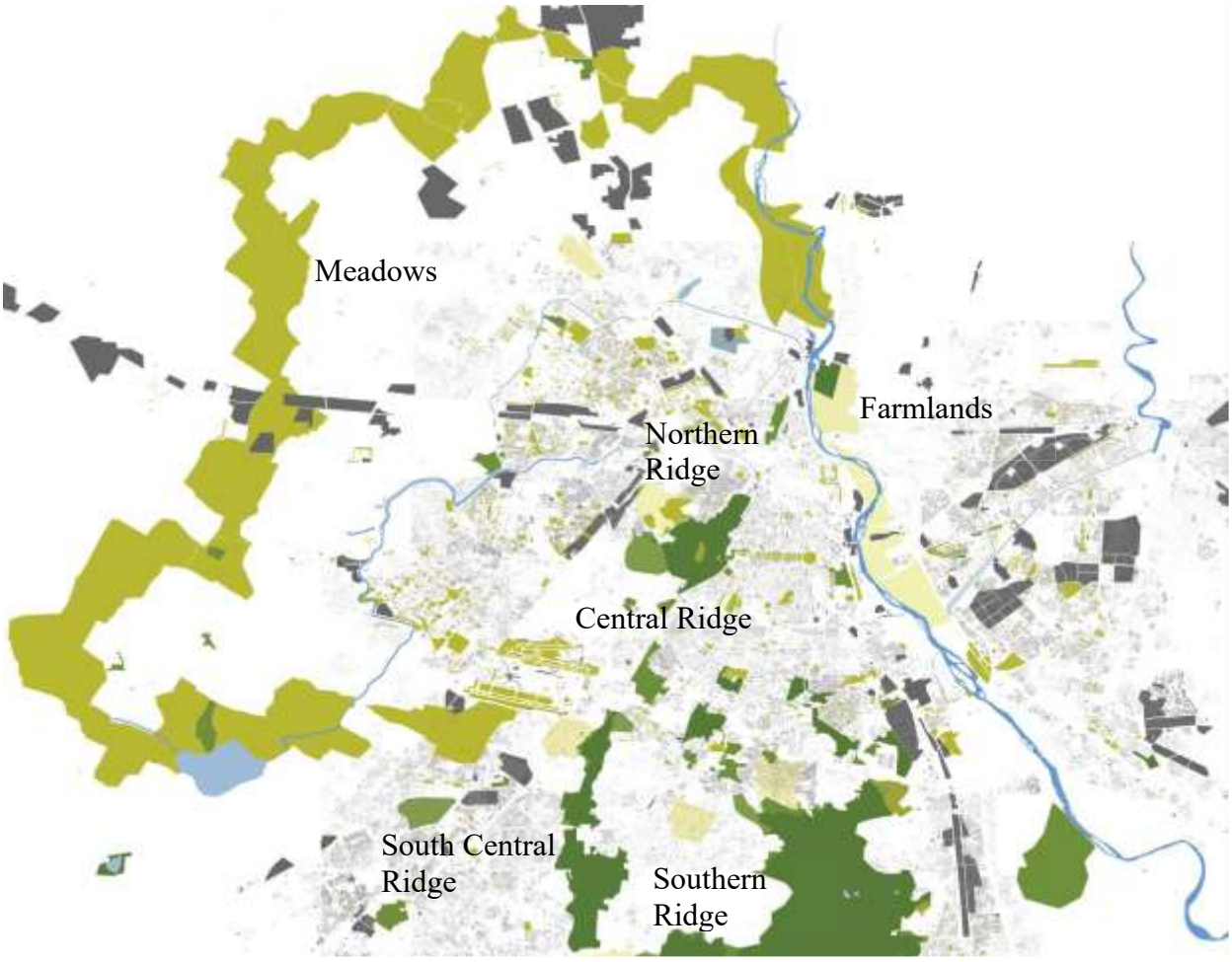


Figure 2.35: Natural areas in Delhi

2.4 CONCLUSION

The main aim of this chapter is to answer the question: *Why is ecotourism relevant to this setting?* The study of floodplain, soil, paleochannels, groundwater quality, agriculture and flora and fauna is done to understand the setting of Yamuna River in Delhi and what urbanism has brought to the city by far. The fundamentals of ecotourism lie in conservation of nature and culture of the host destination. The challenges and the opportunities of Yamuna River lies within the realm of what ecotourism seeks to solve and hence it is relevant to an urban setting like Yamuna River. It is not feasible to address each studied challenge of the city in this thesis, however, addressing

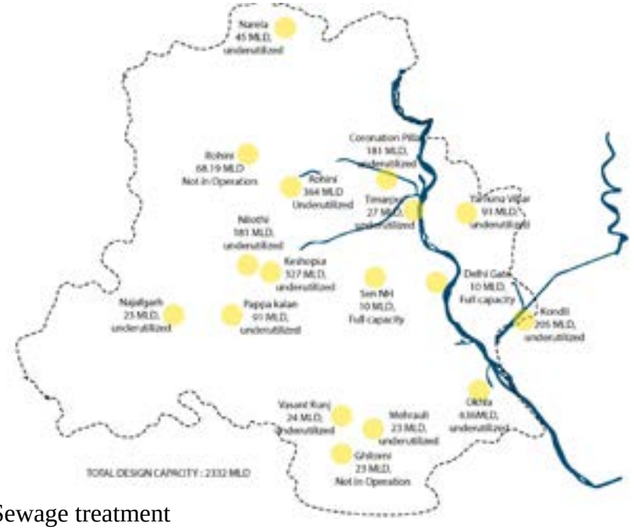
the challenges through the lens of ecotourism has help turn few into opportunities. Some of the challenges lie at a policy level and are beyond the scope of this thesis.



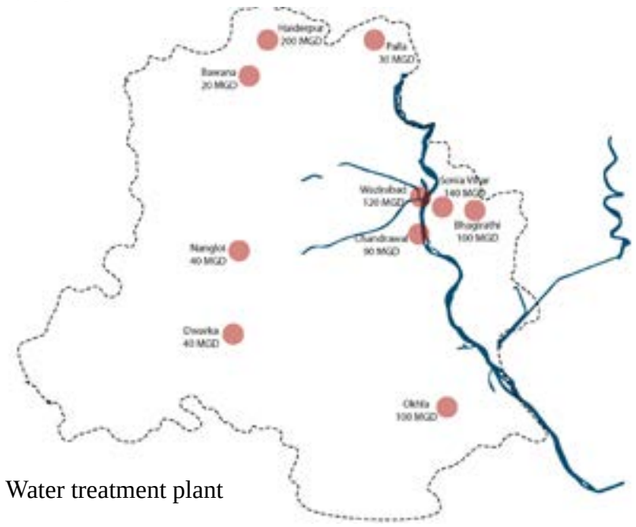
Drains



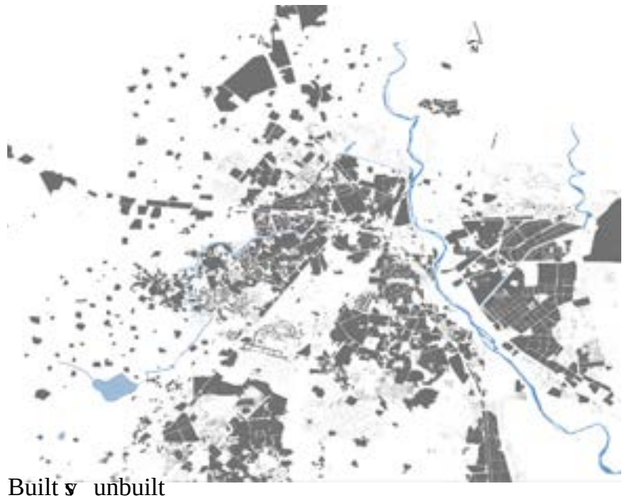
Industries



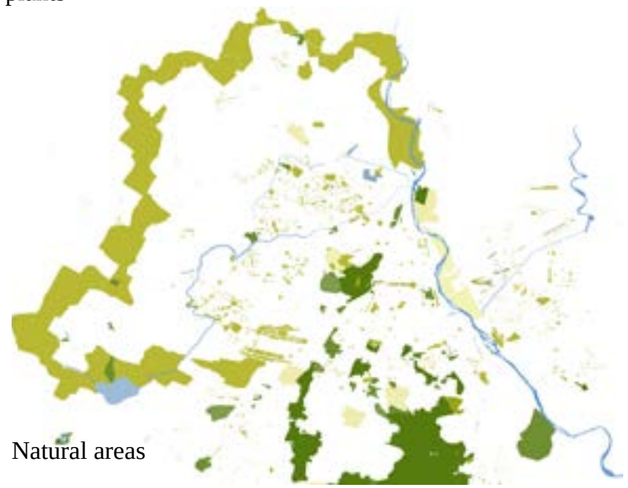
Sewage treatment plants



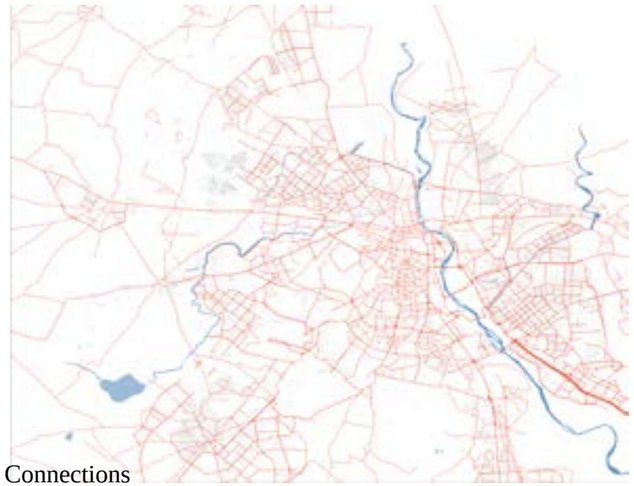
Water treatment plant



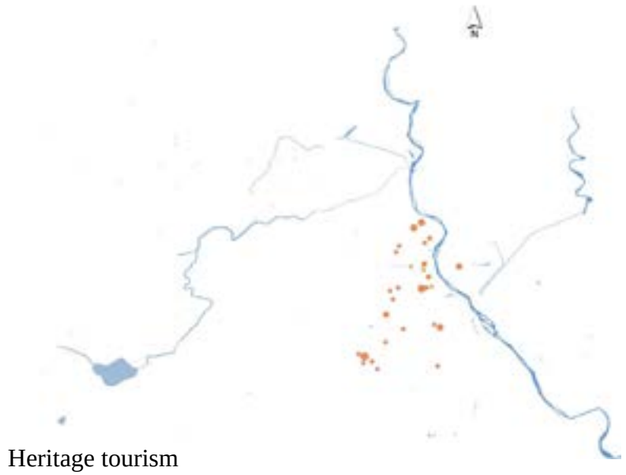
Built vs unbuilt



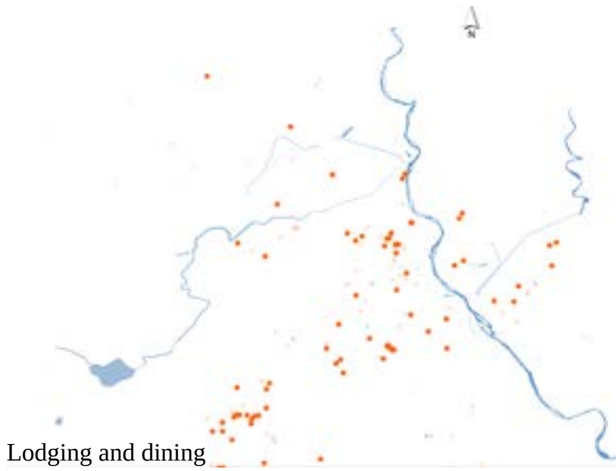
Natural areas



Connections



Heritage tourism



Lodging and dining

Figure 2.36: Inventory maps of Yamuna River, Delhi

CHAPTER 3

ECOTOURISM DISCOURSE.

3.1 DEFINITIONS, PRINCIPLES AND CONFLICTING IDEAS OF ECOTOURISM

What is ecotourism?

The first definition of ecotourism came from Hetzer in 1965 in Links magazine and in a reprint of Ecosphere as *"... to actively design, promote and implement responsible (alternative) tourism projects fulfilling four, main requirements."* Those requirements were: minimum environmental impact, respect and maintaining integrity of the host culture, economic benefits to the host country and recreational satisfaction to the *"participating tourist"* (Hetzer 1965) (Fennell, Ecotourism Programme Planning 2002). The definition evolved to "*tourism that involves travelling to relatively undisturbed or uncontaminated natural areas with the specific object of studying, admiring and enjoying the scenery and its wild plants and animals*" (H. Ceballos-Lascurain 1987). Ecotourism emerged as an *alternative* to mass tourism in the 1980s and 1990s (D. Diamantis 1999) (Hammond 2004). It gained attention due to its philosophy of experiencing natural areas, its conservation-oriented approach, minimizing the negative impact of tourism, economic empowerment of the local community, and ecological benefits to the destination (Hammond 2004).

Discourse about ecotourism has evolved to become more complex over the years, to the point where it is challenging to understand what is a "correct" definition. It started from the fundamental idea of "*economic development and conservation to walk hand in hand"* (H.

Ceballos-Lascurain 1987), (1991), (Highman 2007) and now encompasses various *indicators*[3] such as community empowerment, employment opportunities, (Hall and Boyd 2003), (Highman 2007), education and interpretation, wildlife based tourism, cultural tourism, adventure tourism sustainable development and so on (Graburn 1989), (Fennell 2002). The plethora of definitions that now exist face challenges of viability and operability. Even though ecotourism is intended to be small scaled and less stressful on nature, the result expected from ecotourism in terms of ecological and social benefits is massive in scale and may be *impossible* to achieve (Figure 3.1) (Orams 1995). Similarly, the idea of ecotourism taking place in a natural setting far removed from the human ecosystem (Boyd, et al. 1995) is a contradiction. Access to proper infrastructure enabling tourists to reach those natural areas is an important element in ecotourism discourse (Cooper, et al. 1998), giving rise to a paradoxical situation where connection is both undesirable and required (Highman 2007). The spectrum of ecotourism definitions in existing literature ranges from 'destination based' to 'ecotourism programming based' (R. Jaakson 1997), (D. Diamantis 1998), from a focus on "what ecotourists actually do" and "what ecotourists should do" to ecotourism as a conservation and development tool for the local community (Steward and Sekartjakrarini 1994) and "supply factors" to "demand factors"[4] (P. Wight 1993).

[3] Orams (1995) describes indicators as measuring tools to measure the effectiveness of ecotourism within his passive to active spectrum of ecotourism

[4] Supply factors include types of nature and resilience of resource, cultural and local community preferences, types of preferences, types of accommodation while demand factor includes types of activities and experiences, degree of physical effort, interest in natural or cultural resources (P. Wight 1993).

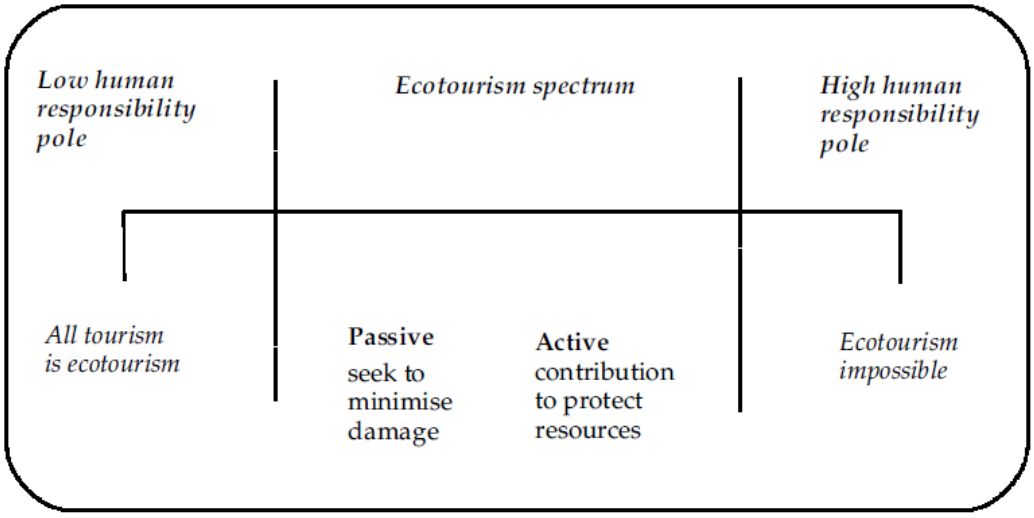


Figure 3.1: The continuum of ecotourism paradigm. Source: *(Orams 1995)*

Almost all definitions of ecotourism emphasize the "nature-based" component, making it ambiguous whether it is strictly nature tourism or also encompassing the social systems to fully embrace the concept of sustainability, which is also a repeated principle in the definitions (D. Diamantis 1999). "A variety of terms have been introduced to describe the same phenomenon which may be referred to as nature travel, nature-orientated tourism, nature tourism, nature–based tourism, sustainable tourism, alternative tourism and special interest tourism" (Laarman and Durst 1987) (Durst and Ingram 1988) (Wilson and Laarman 1988) (P. Valentine 1992) (Weiler and Hall 1992) (D. Diamantis 1998). As Ralf Buckley states "These boil down to nature-based product, minimal-impact management, environmental education, contribution to conservation and contribution to communities. But it is still difficult to define whether an individual product or project qualifies as ecotourism" (R. Buckley 2003).

"Ecotourism provides an intriguing and hitherto unresolved definitional conundrum. Numerous attempts of varied degrees of merit have been made to define ecotourism" (Highman

2007) (H. Ceballos-Lascurain 1987) (Ashton 1991) (R. Buckley 1994) (Ecotourism Association of Australia 1993) (D. Weaver 2001). Although ecotourism strives to achieve sustainable development goals, it is continually hindered by the participants in the tourism industry who do not have enough knowledge of the low impact philosophies of ecotourism. They take the quick and easy economic opportunity provided by the thriving "ecotourism" label to commodify the culture, experience and degrade natural resources (Clarkin and Kähler 2015). Places like Costa Rica and the Galapagos Islands have seen considerable negative impacts generated in the name of ecotourism – "Greenwashing" conventional tourism by claiming ecological protection. Rich untouched natural areas have been degraded in such areas (Wood 2002).

Ecotourism principles to take forward

The complexity, contradiction, ongoing debate and loose ends of ecotourism definitions suggest that there is a need to assess some of these definitions in the ecotourism literature and create a list of fixed principles based on which this thesis can proceed. The aim of this chapter is to search for repeated principles in the field and rearrange these ideas based on the number of times they appear in the ecotourism discourse. The sources of candidate principles are the direct quotes and thoughts of various experts such as Martha Honey, David Fennell, Deborah Mclaren, Ralf Buckley, R.W. Butler, Elizabeth Boo etc. and organizations such as The International Ecotourism Society (TIES), World Tourism Organization (WTO), Global Sustainable Tourism Council (GSTC) etc. (Table 1). *To sum up,* principles *are treated as equivalent to the* indicators *mentioned by Orams (1995) and* this thesis ranks the important indicators to make ecotourism move from passive evaluation of existing settings to active programming for new ones and to provide measures for the effectiveness of a proposed ecotourism model for the Yamuna River, New Delhi, India**.**

The collection of ecotourism definitions revealed similar results to Fennell (2002). The important keywords (in their ranked order) are (Table 2): *Conservation, appreciate host culture, natural areas, education and interpretation, community empowerment, low visitor impact, sustainable development strategies, interlink nature and culture, ecotourism programming, appreciate nature, evaluation, meeting visitors' need, and health & wellness***.** The words 'natural areas' occur in 34 (62.4%) of the times out of 55 definitions, in a study done by Fennell in 2001 as well (Fennell 2002). The "degree of naturalness" does not remain the same as places like tropical rainforests of Costa Rica, islands in Ecuador and jungles of Kenya are constantly changing as more and more 'ecotourists' visit and harm the ecosystem.

This chapter aimed to find an answer to the question: *What are the key principles of ecotourism and how can they be applied in an urban setting?* Although the key principles of ecotourism have been derived through content analysis of various ecotourism definitions (Table 1), yet to answer the second half of the question about its application on urban areas, few other questions need to be addressed first:

- *How is nature defined?*
- *Can the "nature" of ecotourism only occur in pristine sites such as Costa Rica, Guatemala, Ecuador, Kenya etc.?*
- Can *"nature" also apply to the urban areas that perform the ecological processes vital for the existence of the city*?
- *How is "nature" in pristine sites different from those in urban areas?*

Table 1 : Content analysis of ecotourism definitions

ORGANIZATIONS/BOOKS/AUTHORS	DEFINITIONS	KEYWORDS
The International Ecotourism Society (TIES), 1991	"Ecotourism is responsible travel to natural areas that conserves the environnment and sustains the well being of local people" and "purposeful travel to understand the culture and natural history of the environment; taking care not to alter the integrity of the of the ecosystem; producing economic opportunities that make the conservation of natural resources beneficial to local people".	Responsible travel, natural areas, conservation, health & wellness, education and interpretation, low visitor impact, community empowerment
IUCN (nOw World Conservation Union), 1996	"ecotourism is environmentally responsible travel and visitation to relatively undisturbed natural areas, in order to enjoy and appreciate nature, (and any accompanying cultural features-both past and present) that promotes conservation, has low negative visitor impact, and provides for beneficially active socio-economic involvement of local populations"	Natural areas, appreciate nature, appreciate culture and history, community empowerment, conservation, low visitor impact
Global Sustainable Tourism Council (GSTC), 2010	"use measurable indicators—such as electricity and energy consumption per serviced area, freshwater consumption and waste production per guest per night, and the quality of water discharged from onsite wastewater treatment facilities—to distinguish true ecotourism businesses from greenwashed enterprises." (Clarkin and Kahler, 2015)	Evaluation
Ralf Buckley	"the environmental input and the environmental output...The environmental input is the primary attraction: not the level of service or facilities provided as part of a product package, but the geographical factor which has led the tourist to a particular destination. The environmental output is the overall net global cost or benefit of the tour operation to the natural environment. This is an accounting question,which requires the identification, quantification and summation of all costs and benefits through all potential mechanisms, of which there are many." Emphasizing on triple bottom line (Human with nature, human with human and money) and geotourism. He also believes in 4 main dimension of ecotourism : nature base, support for conservation, sustainable management and environmental education (Fennell, 2002)	Evaluation
World Wide Fund for Nature (WWF), 2001	" careful planning and improved knowledge is needed. Ecotourism and responsible tourism should be part of wider sustainable development startegies, whether at a community or an international level"	Sustainable development strategies
Ecotourism and sustainable development, Martha Honey	1. travel to nature destinations 2. minimizing negative environmental impact 3. building environmental awareness 4. direct financial benefits for conservation 5. financial benefits and empowerment for local people 6. the respect of local culture 7. the support of human rights and democracy	Natural areas, low visitor impact, community empowerment, appreciate host culture , conservation, appreciate nature
World Tourism Organization	"Sustainable tourism development meets the needs of the present tourists and the host regions while protecting an enhancing opportunities for the future. It is envisaged a leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, biological diversity and life support system."	Conservation, appreciate host culture, meeting visitors' need
Fennell (Ecotourism Programme Planning, Fennell, 2002)	"An intrinsic, participatory and learning-based experience which is focused principally on the natural history of the region, along with other associated features of the man-land nexus. Its aim is to develop sustainably (conservation and human well being) through ethically based behaviour, programmes and models of tourism development which do not intentionally stress living and non-living elements of the environments in which it occurs."	Low visitor impact, education and interpretation, sustainable development strategies, interlink nature and culture, conservation, ecotourism programming, health & wellness
	Fennell stresses on the close interconnection between adventure tourism, cultural tourism and ecotourism, calling it ACE tourism as a whole. He believes that ecotourism in itself does not include cultural and adventure tourism but is more limited and is a part of nature based tourism which further includes wildlife tourism, indigenous tourism etc.	

Graburn (Ecotourism Programme Planning, Fennell, 2002)	He categorizes tourism into two categories: nature and cultural. Nature tourism includes ecological and environmental activities or programming such as hunting, fishing, safari etc. Cultural tourism includes historical tourism and ethnic tourism. It is the ethnic branch that bridges a connection between the two big categories.	Interlink nature and culture
Hetzer. 1965 (Links Magazine and reprint in Ecosphere)	"…. to actively design, promote and implement RESPONSIBLE (alternative) TOURISM projects fulfilling our four main requirements: 1. Minimum enviromental impact, 2. Minimum impact on - and maximum respect for- host cultures, 3. Maximum economic benefits to host country 'grassroots', 4. Maximum 'recreational' satisfaction to participating tourists. Tourism if it fulfills AT LEAST the above requirements can be a healthy and rewarding activity for the visiting tourists, an economically sound investment for the host area, and an environment - CONSERVING feature - an ecological tourism ('Eco-Tourism')."	Low visitor impact, appreciate host culture, empowerment of the community, meeting visitors' need, conservation
Hector Ceballos - Lascurain	"Ecotourism is that tourism that involves travelling to relatively undisturbed natural areas with the specific object of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any existing cultural aspects (both past and present) found in these areas. Ecotourism implies a scientific, aesthetic or philosophical approach, although the 'ecotourist' is not required to be a professional scientist, artist or philosopher. The main point is that the person who practices ecotourism has the opportunity of immersing him or herself in nature in a way that most people cannot enjoy in their routine, urban existences. This person will eventually acquire an awareness and knowledge of the natural environment, together with its cultural aspects, that will convert him into somebody keenly involved in conservation issues" (1983)	Natural areas, appreciate host culture, appreciate nature, education and interpretation, low visitor impact, conservation, community empowerment
	The revised definition : "Ecotourism is environmentally responsible travel and visitation to relatively undisturbed natural areas, in order to enjoy, study and appreciate nature (and any accompanying cultural features - both past and present), that promotes conservation, has low negative visitor impact, and provides for beneficially active socio- economic involvement of local populations".	
McLaren	Her definition of ecotourism is a contrast to those of Fennell and Burton. McLaren defines that ecotourism contains all forms of tourism : nature tourism, bird watching, archaeological digs, whale watching, adventure, and so on, all of which can occur in different settings of the environment. It is the programming of ecotourism that matters and provides for all types of experience ranging from luxury to 'bury your own poop style' travel.(Fennell, 2002)	Ecotourism programming
Boyd and Butler	"A responsible nature travel experience, that contributes to the conservation of the ecosystem while respecting the integrity of host communities and, where possible, ensuring that activities are complementary, or at least compatible, with existing resource-based uses present at the ecosystem." (Boyd & Butler, 1993: 13, 1996a: 386)(Diamantis 1999)	Conservation, natural areas, ecotourism programming, appreciate host culture
	"Ecotourism is a form of tourism which fosters environmental principles, with an emphasis on visiting and observing natural areas". (Boyd & Butler, 1996b: 558)	
Butler	1. It must be consistent with a positive environmental ethic, fostering preferred behaviour. 2. It does not denigrate the resource. There is no erosion of resource integrity. 3. It concentrates on intrinsic rather than extrinsic values. 4. It is biocentric rather than homocentric in philosophy, in that an ecotourist accepts nature largely on its terms, rather than significantly transforming the environment for personal convenience. 5. Ecotourism must benefit the resource. The environment must experience a net benefit from the activity, although there are often spin-offs of social, economic, political or scientific benefits. 6. It is first-hand experience with the natural environment. 7. There is, in ecotourism, an expectation of gratification measured in appreciation and education, not in thrill-seeking or physical achievement. These latter elements are consistent with adventure tourism, the other division of natural environment (wildland) tourism. 8. There are high cognitive (informational) and effective (emotional) dimensions to the experience, requiring a high level of preparation from both leaders and participants. Butler (1992), in Acott et al. (1998) (Highman 2007).	Conservation, natural areas, appreciate nature, appreciate host culture, education and interpretation, community empowerment, evaluation, ecotourism programming
Boo	"nature travel that advances conservation and sustainable development efforts",'Ecotourism is a nature tourism that contributes to conservation, through generating funds for protected areas, creating employment opportunities for local communities, and offering environmental education.' (Boo 1991b: 4) (Diamantis 1999)	Sustainable development strategies, conservation, education and interpretation, community empowerment

LIST OF ALL THE KEY IDEAS FROM THE LIST OF DEFINITION	Natural areas, Low visitor impact, Conservation, Education and interpretation, Appreciate nature, Appreciate host culture, Interlink nature and culture, Community empowerment, Health & wellness, Sustainable development strategies, Ecotourism programming, Evaluation, Meeting visitors' need

Table 2: Ranking of ecotourism principles

ECOTOURISM PRINCIPLES	AUTHORS/BOOKS/ORGANIZATIONS														
	The International Ecotourism Society (TIES), 1991	IUCN (nOw World Conservation Union), 1996	Global Sustainable Tourism Council (GSTC), 2010	Ralf Buckley	World Wide Fund for Nature (WWF), 2001	Martha Honey	World Tourism Organization	Fennel	Graburn	Hetzer	Hector Ceballos - Lascurain	Boo	Butler	Boyd & Butler	**RANKING**
Conservation	■	■				■	■			■	■	■	■	■	8
Natural areas	■	■	■			■					■		■	■	6
Appreciate host culture		■				■	■				■		■	■	6
Education and interpretation	■			■				■			■	■	■		5.5
Low visitor impact		■				■		■		■	■				5
Community empowerment						■				■	■	■	■		4.5
Sustainable development strategies			■	■	■			■				■			4
Appreciate nature		■						■			■		■		4
Ecotourism Programming			■	■		■							■	■	3.5
Evaluation			■	■									■		2.5
Meeting visitors' need							■			■					2
Interlink nature and culture								■	■						2
Health & wellness	■														1

3.2 URBAN ECOTOURISM

Does urban ecotourism exist?

Some consider the term "urban ecotourism" is an oxymoron (Higham and Lück 2002). The idea of ecotourism being practiced in an urban area is an emerging concept and is still being explored (Orams 1995) (Lawton and Weaver 2001) (Wu, Wang and Ho 2009). Urban ecotourism means travelling to natural areas with the perspective of conservation, appreciating nature, education and empowering the host community and respecting the host culture – it does not differ in contents from the definitions of traditional ecotourism, but simply overlaps with the traditional urban tourism (Wu, Wang and Ho 2009). Tourism has the potential to protect natural resources and conserve them, but most of the time it is used as a tool to advance economic benefits (P. Wight 1993) (Pearce 1995). Similarly, Gerardo Budowski, Governor General of IUCN in 1976 believes that "relationship between environmental conservation and tourism development is one of symbiosis, coexistence or conflict" (Budowski 1976). Ecotourism can harness funds to safeguard biodiversity and necessary ecological functions of the host destination (Gossling 1999). All these ideas of ecotourism can equally be applied to areas of ecological importance in an urban setting.

Urban Green Tourism practices in Toronto, Canada

Toronto, a rapidly growing city and the largest gateway to Canada. Toronto is both a riverfront and a lakefront city, leading to a very rich biodiversity. 12% of the city is municipal parks, conservation land, including 20,000 acres of green space, 75% of which (9% of the total) are ravines, valley lands, woodlots, waterfront areas, 50 environmentally sensitive areas (City of Toronto 2000). The city has a good mix of 'natural areas' as well as manmade areas. Tourism in Toronto is booming as well, receiving 8 visitors a year for every permanent resident, resulting in

considerable stress on the land and social carrying capacity of the city (Environmental Task Force 1999). In many ways, it is comparable to the conditions in New Delhi. Both are similar in their distribution of natural vs manmade areas and the social stress from tourism. Although Toronto belongs to a developed nation vs New Delhi to a developing one, each can learn and implement the good practices of the other.

The Green Tourism Association was established in Toronto as a nonprofit organization, in 1996, by a group of individuals consisting of several agencies and operators, to educate both tourists and the operators of best management practices for sustainable approach to tourism. The definition of urban green tourism comprised of four attributes: Environmental responsibility, local economic vitality, cultural sensitivity, experiential richness. Some of the major policies and programming undertaken by the city included the development of a website, bike rentals, "Go Green T.O.", workshops, and the *Other Map of Toronto* (Joppes and Dodds 1998). This map focuses on green space, outdoor activities, heritage sites, sustainable transportation. A major initiative undertaken is The Green Map System, showing all the areas of environmental significance in urban spaces (Figure 3.2). The idea is to highlight the interconnections between naturals areas, built environment, society, local community and for the tourist to get involved in urban ecology (Joppes and Dodds 1998).



Figure 3.2: The Other Map of Toronto by Green Map System. Source: *(Green Tourism Association 2005)*

Urban ecotourism vs traditional ecotourism

Tourists are more dispersed in cities as compared to small towns, but nevertheless have a significant impact on the existing infrastructure, natural resources, social and cultural environment (Joppes and Dodds 1998). However, unlike a small town, a metropolitan area the size of New Delhi or Toronto is not solely dependent on tourism. The job market is more diverse. The introduction of ecotourism will have less impact on the social structure and authenticity of the city since the likelihood of tourism commodifying the social behavior of the host culture is very slim. Unfortunately, natural areas are usually fragmented and susceptible to change due to new construction and urban growth (Figure 3.3). Nevertheless, it can be argued that 'natural areas' are of more importance for conservation, awareness and environmental education, all of which are fundamental to the practice of ecotourism. The overall social structure of the city may be resilient to the external forces of the tourism industry in a city while the exotic setting with its indigenous population that is the focus of tourism finds both its social and natural fabric under threat of commodification and disruption.

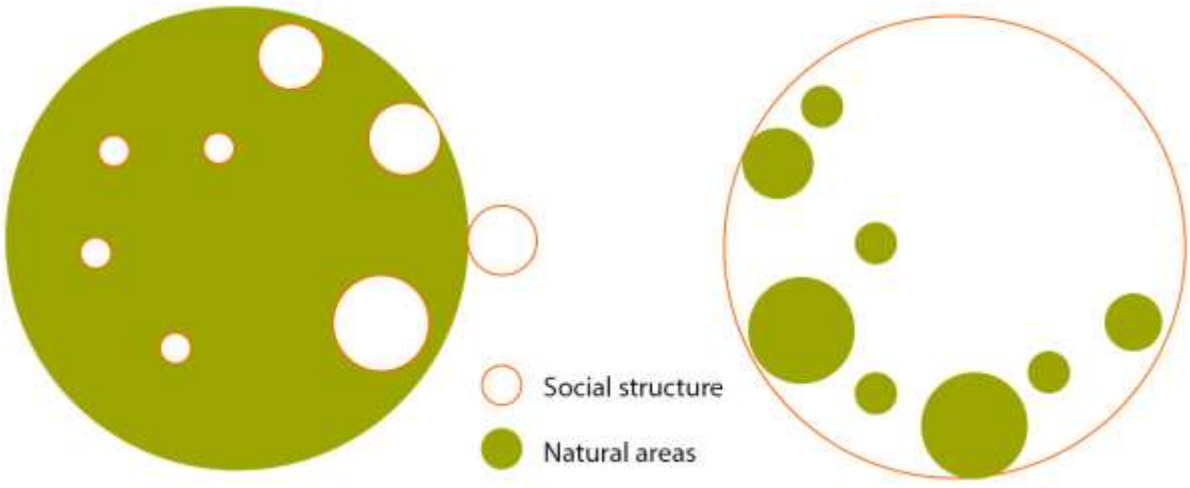


Figure 3.3: The patch and matrix in protected areas vs urban setting

3.3 NEW DELHI TOURISM STUDY AND ANALYSIS

Heritage tourism is the most important form of tourism in Delhi. The Delhi tourism website gives a quick snapshot of museums, crafts, food and heritage zones in Delhi. The places to visit and experience the capital city of India, are limited to heritage sites such as Humayun's tomb, Qutub Minar, the Gandhi memorial, and some tourist-oriented craft museums, ethnic markets and so on (Figure 3.4). It seems like somewhere the blended historical and contemporary essence of Delhi has been overpowered by its history.

Some of the important but overlooked environmentally sensitive zones in New Delhi are the 3 ridge areas, Yamuna River and its floodplain, the Okhla Bird Sanctuary and the farmlands and unbuilt areas of north-west Delhi. The city is also well connected by highways to other natural areas around its boundary. Perhaps, if one can create connections between the existing heritage hot spots utilizing the natural areas as linkages, with aspects of education, awareness, and local community empowerment for the tourism infrastructure, it might form the basic framework for ecotourism to happen in an urban context, using the Yamuna River floodplain as perfect spot to develop as a model.

January is the peak season for both domestic and foreign tourists. The hot and humid monsoon season - July to September – witnesses a decrease in the number of tourists. This creates the issue of seasonality that might affect jobs that are dependent solely on tourism. There has also been a significant shift as more 'domestic' tourists visit Delhi than 'foreign' tourists. The domestic tourist either stay with family and relatives or do not spend the night, thus not contributing much to the tourism industry. On the other hand, 84% of the foreign tourists that visit Delhi stay overnight and 60% of them are considered leisure tourist, staying at multiple-star hotels. The average duration of stay as per Tourism Survey of the state of Delhi is 1.2 days for both domestic and foreign tourists

(Incredible India 2010). A substantial percentage of foreign visitors visit Delhi for business purpose and same for the domestic day visitors.

Is there any way the programming of tourism in the region can pull in more visitors for leisure and social activities? How can ecological activities be integrated with the existing form of tourism and expand the scope of tourism beyond its current focus on heritage? *Where does Delhi's existing tourism scenario and culture stand in terms of enhancing authenticity, local businesses, job opportunities, diversification of job market, quality of tourism and empowerment?* A survey by Incredible India and The Ministry of Tourism (Incredible India 2010) underscored the focus of visitors on places of religious and historic importance (Figure 3.4). For instance, Qutub Minar was voted the most visited by both domestic and foreign tourists. Places of natural importance are at the bottom of the survey, suggesting either lack of knowledge, lack of advertisement or lack of accessibility to those places. These places include the Delhi Zoo, Asola Bhati Wildlife Sanctuary, Okhla Bird Sanctuary, Delhi Ridges and Yamuna Floodplain. The ridges and floodplains are places that have not yet been harnessed as opportunities for educational experiences. One may argue that it is for the good, but the element of awareness and education can help protect and care for these places. The lack of knowledge and care by the residents of Delhi is partly to be blamed for the constant degradation of ecological infrastructure in the city.



Figure 3.4: Major heritage tourism destination and tourist bus route in Delhi. Source: *(Hoho Delhi n.d.)*

CHAPTER 4

ECOLOGICAL URBANISM: DESIGN FRAMEWORK

4.1 ECOLOGIST'S PERSPECTIVE

Understanding ecology of urban areas

The previous chapter shed light on some important questions about apparent limitations on the scope of ecotourism that remain unanswered. Designer and planners taking an ecological perspective have assumed that natural areas do not exist in urban areas or they are not as important as the biodiverse hotspots of Costa Rica, Kenya or other nations' protected lands. The areas of ecological importance in cities have long been ignored with the result that they become suffocated by the unmanaged growth of urban infrastructure. It is important to understand that nature in *urban areas* are equally important as nature in biodiverse hotspots and more so, it is important to answer – *How do the natural areas in urban areas differ from pristine biodiverse sites?* Spirn believes that nature is neither a specific location nor an object such as mountain, river etc. (Spirn 1984) adding to the ubiquitous idea of "cities are an integral part of nature" (Ndubisi 2014). The term "urban" itself, has evolved beyond the traditional definition to encompass "networks of energy, food, infrastructure and living systems that support human settlement". The ecology of urban landscape comprises of relationships between and interactions between organism and their constructed environment, going beyond the limit of traditional ecology which exclusive of the human component (Orff 2016) (Revkin 2002).

Ecology is not just about the 'nature' but also encompasses the social and economic as well as "green" aspects of a city. Civilizations have always grown hand in hand with their natural resources, they were never completely disconnected. Such is the case with the Yamuna River. All the heritage sites were built along the river for enjoying the view, transportation of logs along river or drawn by the sanctity of the water during the Mahabharata times. It can be assumed that if the ecological areas in the cities are conserved and tapped into for their natural resources, engagement with nature can boost the social and economic side of the urbanism.

"Ecology above all sciences believes itself holistic, but it appears not to be the case if that knowledge lies outside of science" (Grose 2014). The city has always been divided into 'design perspective', 'ecological perspective', and 'social perspective', despite of the holistic nature of ecology. The city is a whole and these three perspectives are not independent (Bohm 1996). "Such thinking appears to be an extension of the binary of 'culture and nature' which has run its course in contemporary design" (Meyer 1997). While the necessity to weave green open space into cities for public health and well-being has been a theme of landscape architecture since its inception, it is only recently that "ecological urbanism" has emerged as an expression to formalize the applications of principles of ecological science to the creation of green remedies to urban challenges (cite Mostafavi, Waldheim.) The idea, driven by forceful and influential practitioners, has become a rallying-cry for designers wishing to adopt more defensible, sustainable design practices. Two leaders in the field, Chris Reed and Nina-Marie Lister (2014) quotes Felix Guattari's *'The Three Ecologies'* (1989):

> *"Ecology must stop being associated with the image of a small nature-loving minority or with qualified specialists. Ecology in my sense questions the whole of subjectivity"*

Grose (2014) states that many current dialogues in ecological science are increasingly concerned with the city, the garden, and messy nature and the idea that 'the world has changed' from that studied in more traditional 'pristine nature' because much of the world is now organized, altered, or constructed as novel ecologies. In short, ecological science has been shifting its focus from an almost sole concentration on the *measurement of natural phenomena and species in natural regions, towards the built environment and other constructed ecologies*. The move of ecologists into constructed ecologies is a reflection of snowballing changes this century where both disciplines of ecological science and landscape architecture are shifting their fields of interest, forging possibly unforeseen directions for their disciplines (Grose 2014). *A possibility for ecotourism to be updated to constitute urban ecotourism exists within this argument.*

The translation of human actions in the cities into ecological terms has been avoided due to complexities it brings with it – infrastructure, buildings, roadways and green spaces. The correct approach to studying the "*urban spatial mosaic*" is '*designed experiment*" that result from a partnership of ecologists and urban designers (Felson and Pickett 2005). The benefits that results from the overlap of research and design, and with the partnership of other disciplines – community involvement, cultural identity, maintenance and more opportunities for collaboration (Cook, et al. 2004) (Dickinson 1999) (Felson and Pickett 2005) – is like the outcomes expected out of traditional ecotourism – education, community empowerment, appreciation of nature, conservation, employment opportunities etc. "Cities are designed and managed ecosystem" (Felson and Pickett 2005) unlike the existing 'pristine natural' conditions in a non-urban location and therefore the questions asked and methods used to address ecotourism in an urban context require adjustments to the existing definitions.

Discourse of urban ecology to ecological urbanism

The above discussion on urban areas shed light on the fact that "unlike less human-dominated environments, cities are an outcome of many human processes" all permeated with cultural meaning and intention (Felson and Pickett 2005). To this one may ask:

How do 'designed experiments' approach in urban ecology and the road towards ecological urbanism provide a framework to address the complexity of "urban spatial mosaic"? What are the various components in the discourse of urban ecology and ecological urbanism?

Cities have always been portrayed as static and monumental architectural and exemplified as "cities of consumption rather than cities of production" (Pickett, et al. 2013). Urban ecology emphasizes on process rather than stasis, adaptation capacity to changes and integrating social sciences with the biophysical structure, to respond to the complexities of "urban spatial mosaic" (Pickett, et al. 2013). To quote a few extracts:

"An interest in questions of scale, as well as methodological diversification, is also evident in the recent emergence of 'ecological urbanism' rooted in the radical extension of ecological metaphors within urban design discourse" (Gandy 2015). An expanded conception of what constitutes 'the urban' now encompasses various types of 'ecological frontiers' or 'operational landscapes' within which cities represent concentrated nodes of global consumption. "If ecological urbanism is about an expanded presence of nature within cities, then its most obvious lineage to urban ecology as a scientific discourse lies in the field of 'ecosystem services' or other utilitarian responses to the biological sciences" (Gandy 2015). "There is a clear tension between new forms of ecological design and the emerging focus on '*urban ecological security*' as a systems-oriented response to future uncertainty" (Hodson and Marvin 2010). "The related concept of '*ecological resilience*' has also filtered through aspects of strategic planning and social policy as an extension

to earlier urban models now augmented through the enhanced possibilities for using ‘big data’ and other empirical tools” (Alberti and Marzluff 2004) (Pickett, Cadenasso and Grove 2004).

Urban ecology is a definite precursor to ecological urbanism in a sense that it sets the ground for a design framework to happen by addressing the concept of resilience, adaptive cycle, earth stewardship (Chapin, et al. 2009) (Chapin, et al. 2011), urban dynamics (McGrath and Pickett 2011). Using this as the background ecological urbanism sets forth with its own discourse amongst landscape architects to use ecology as both metaphor and design framework for operational models.

4.2 DESIGNER’S PERSPECTIVE

The theories in ecological urbanism are annular. There is no definite start or end. Even though the term was coined recently, the roots of ecological urbanism began as early as Ian McHarg’s “Design with Nature” (Figure 4.1). Since then there has been many theories, practices, and views supporting as criticizing the approach. The concept of ecological urbanism is still pursued philosophically and metaphorically by many designers. While theorists like Charles Waldheim, Mohsen Mostafavi, and Frederick Steiner are developing theories, practitioners like James Corner and Kongjian Yu are bridging the gap between practice and theory. Practice and theory complement each other, each pushes the limits of the other to move the discipline forward.

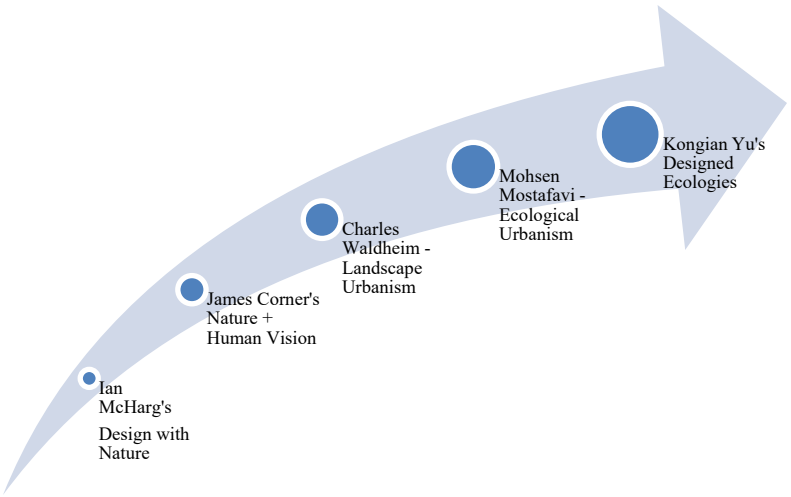


Figure 4.1: Timeline of development of the theory of ecological urbanism

Anne Spirn

Anne Spirn considers ecological urbanism to be a longstanding theory that started from the times of Olmsted. The works of Ian McHarg, Kevin Lynch, Patrick Geddes and Jane Jacob have shaped her thinking of ecological urbanism. Few of them advocated accepting that the processes of nature alone should shape the future. To quote a few: "We ought never to undertake any Thing that is not exactly agreeable to Nature" (L. B. Alberti 1988, 35-36), "things as they are and as they change...towards things as they may be" (Geddes 1915, 138-139), while Jane Jacobs, Ian McHarg and Kevin Lynch adhere to "human beings are... part of nature" (Jacobs 1961, 446), (Spirn 2011).

It is critical to interconnect the fundamentals of city design and planning with ecology, understand the relationships between biotic and abiotic factors in the city, and use this approach to create a framework for addressing the 'worst case scenarios' – and accommodating the trajectory of the city's growth (Spirn 2011). Humans are an integral part of the system and they should adapt, settle and shape the world around them acknowledging the natural factors, connections, and functions (Spirn 1998, 26), (Spirn 2011). Spirn's ideas of ecological urbanism ties right into the

argument that natural areas in urban areas are equally important as ones in pristine areas. Taking reference from her sources, she lists out fundamentals for an ecological approach to city design, in her book *The Granite Garden: Urban Nature and Human Design:*

- Cities are part of the natural world and design accordingly
- Cities are habitat
- Natural processes shape urban habitat, sustain life and reveal themselves as tangible and understandable
- Cities are ecosystem
- Design the city as a whole, as well as every park, building, and district within that larger whole, as ecosystems that require minimal inputs of energy and resources to build and sustain Identify and portray the interplay of natural and social processes that shape and structure the city
- Address social and environmental challenges within appropriate boundaries at the appropriate spatial and temporal scales
- Define multi-purpose solutions to comprehensively defined problems
- Take account of history
- Adapt the physical shape and structure of a city – the infrastructure of roads and sewers, the buildings and parks – to its deep structure
- Anticipate and exploit natural catastrophes
- Design resilient cities
- Act comprehensively and incrementally, (Spirn 1984), (Spirn 2011).

Charles Waldheim

Charles Waldheim coined the term 'landscape urbanism' (Steiner 2011) (Waldheim, The Landscape Urbanism Reader 2006) while integrating ecological advocacy of Ian McHarg with urban design vision of James Corner (Steiner 2011). Waldheim believes that McHarg's "Design with Nature" introduced large scale systems, embracing ecological and social systems and "brought people closer to nature". In his words "James Corner rejects the opposition of nature and city implied in McHarg's regionally scale environmental planning practice" (Waldheim 2006). In his opinion, cities have forever treated walls, concrete buildings, roads and highways as it fundamental building blocks and argues that landscape urbanism advocates the intermingling of nature and human at the same place and "to construct new urban ecologies that tap into social, cultural and environmental dynamics playing off one another" (Steiner 2011). Landscape serves as the medium through which various forms of urbanization could be tested and modeled on. Landscape is the primary element of urban order, not the architectonic model of city planning. (Waldheim 2016). Ecological urbanism is a continuation of landscape urbanism which seeks to make the latter better in terms of inclusivity of ecological functions, social issues, economic policies and more. The works of Chris Reed (Stoss LU), James Corner (James Corner Field Operations), Rem Koolhaas (OMA) and Andrian Geuze (West 8) are the most notably cited work (Waldheim 2006), (Waldheim 2016).

James Corner

James Corner in his article "Terra Fluxes" in *The Landscape Urbanism Reader* describes landscape urbanism as a "new hybrid" between landscape and urbanism (Corner 2006). Landscape, however, has often been seen as purely naturalistic, pastoral and scenic and this lens

for looking at landscape has often fogged the way we look at any such "scape". We created the wall between cities and existing nature by giving them names such as "cityscape", "technoscapes" etc. The separation is so big that we have associated cities with the fast-growing life, high population, offices and busy life and pushed away the so-called "nature" into the leftover spaces. The hybrid idea of "landscape urbanism" seems to be the perfect glue to restore today's urban fabric.

The idea of landscape lies not at looking at how it is but at how it functions, so that Central Park in New York is seen as a place of relief from the bustling city life but not for the effect it created. James Corner describes this effect as "catalytic". One idea of bringing the pastoral to the urban fabric trickled down many levels in the city. It had vast effect not only in the surrounding real estate development but also opened many doors of possibilities for future landscape designs to come.

Mohsen Mostafavi

"When addressing issues of sustainability, it is becoming increasingly more requisite that new approaches toward urbanism and planning consider cities as entities in their own right – this is where ecological urbanism takes form" (Mostafavi and Doherty 2016). Even though urban areas are growing in population day by day, traditional ecologists and environmentalist tend to neglect their research from these concrete jungles, "viewing urban setting negatively". "Ecology is the study of how living things interact with each other and their environment" yet the involvement of human beings in its environment is often ignored. Urbanism should be looked as the human's interaction with its environment by "working with the city" and its systems (Mostafavi and

Doherty 2016). "Ecological Urbanism considers the city with multiple instruments and with a worldview that is fluid in scale and disciplinary focus." (Mostafavi and Doherty 2016).

Ecological urbanism seeks to embrace various disciplines under its folds such as ecology, environmental science, design, sociology, urban design, geology and many more. Urbanism happens at multiple scales in a city and Mohsen Mostafavi sets the stage for urbanism as a "highly engaged, timely, integrated and innovative design practice; one rooted in the social, cultural and political condition of the present day, yet constantly recalibrating itself relative to the future" (Gattegno 2011). With this fundamental Mostafavi cites various theorists, designers and artists etc. to come up with the following sets of words to set the flow of ecological urbanism from theory to practical application (Mostafavi 2010), (Mostafavi and Doherty 2016).

- Anticipate – anticipating the present and the future, reflect on the unbuilt.
- Sense – embracing multiple ecologies to design better cities and addressing how technology will be used in the future and the consequential human senses of touch, sight, and smell.
- Curate – active engagement with design and stewardship of the designed ecologies.
- Collaborate – collaborating with other disciplines and professionals and students.
- Produce – Cities must produce its own needs energy rather than being just the consumption center.
- Interact – various interactions that a city has with its regions and beyond, within itself where organisms, environment, and humans interact daily.
- Mobilize – "mobility and social justice are intertwined", meaning that our interactions in the society shapes the infrastructure of the city.

- Measure – The idea of having a metrics to design a city is fundamental to ecological urbanism. It is important to have a framework that links policies to other developments and physical design.
- Adapt – resilience and adaptive capacity of a proposed design for the city is vital for it to thrive (Lister 2010).
- Incubate – "Incubating implies the idea of nurturing care over a period of time," both before and after birth. Urban ecologies need to be nurtured, cared for, and fostered over time. Incubation is an essential component of ecological urbanism".

4.4 OUTCOME AND DESIGN FRAMEWORK

Outcome

The underlying premise of the discourse of ecological urbanism and urban ecology is that one must appreciate nature no matter where. There is no fixed boundary or definition to nature. Appreciation of nature can take place at an urban, rural and in the biodiverse hotspots – *perception of nature is subjective*. "The manner in which we perceive the relationship between the city and its natural ecosystem informs and significantly determines the very praxis of urban territorial planning" (Mostafavi and Doherty 2016). The literature of ecological urbanism aims to practice the same. *Fundamentals of ecological urbanism* such as interdisciplinary, addressing natural processes, adaptiveness, addressing the social processes, flexibility in scale of solutions, collaboration, projecting the future of urbanism to act now, resilience and stewardship all seeks to create a framework for design.

Ecological urbanism comes back in full circle to its predecessor, urban ecology. Frederick Steiner elaborates on this to say that ecological urbanism pay shallow attention to the advances

made in urban ecology, such as the approach of constructed and designed ecologies, and should be incorporated with the implementable fundamentals of landscape urbanism to create "landscape ecological urbanism" (Steiner 2011). Enhancing ecosystem services and "deeper understanding of human agency in ecology" by "understanding the drivers, patterns, process, and outcomes associated with urban and urbanizing landscapes" are the main goals to be achieved (Steiner 2011). The challenge of addressing human ecology and ecosystem services which include waste water management, sanitation, clean water availability, transportation, mobility, urban heat island effect and overall urban health is a key component of an urban area, to which "ecological urbanism offers a promising framework" (Fajersztajn, et al. 2016).

The fundamentals learnt in the process were compiled and arranged varying from urban ecology to ecological urbanism. The main aim was to find the *opportunities of ecotourism* that might exists within the discourse of ecological urbanism (Table 3). Principles of ecotourism, such as sustainable development, community engagement and conservation finds a niche while health and wellness, meeting visitor needs and evaluating ecotourism scores poor within ecological urbanism.

Table 3: Ecotourism opportunity within ecological urbanism principles

		ECOLOGICAL URBANISM PRINCIPLES												
		Resilience	**Adaptive capacity**	**Traditional ecosystem services**	**Ecosystem stewardship**	**Cities as ecosystem**	**Celebrate natural processes in cities**	**Designed experiments**	**Mutiscalar and multipurpose**	**Interdisciplinary**	**Community engagement**	**Human ecosystem services**	**Social challenges and interactions**	**RANKING**
ECOTOURISM PRINCIPLES	**Conservation**	■	■	■	■		■							13
	Natural areas	■	■			■	■							10
	Appreciate host culture										■	■	■	9
	Education and interpretation			■				■				■		8.5
	Community empowerment										■	■	■	7.5
	Low visitor impact	■	■											7
	Appreciate nature			■	■		■							7
	Sustainable development strategies	■	■											6
	Ecotourism Programming								■	■				5.5
	Interlink nature and culture					■						■	■	5
	Evaluation							■						3.5
	Health & wellness			■								■		3
	Meeting visitors' need													2

Design Framework

The topic of ecological urbanism is new and full of possibilities yet also full of contradictions. Urban ecologist and designers who desire to shape communities through the framework of ecological urbanism are converging towards similar goals and objectives. Ecologists stress the idea of designed ecologies, the free flow of ideas between various disciplines and earth stewardship. The designers take the metaphorical route and stress the perception of ecology, the aesthetics of ecological urbanism and integration of natural and social ecologies through the existing urban fabric. They propose that the confluence of ecology and landscape in a city is not just about the picturesque but about understanding the natural processes and addressing the social interactions that occur due to those processes and ends up shaping the ecological aesthetic (Spirn 2011).

Ecotourism, on the other hand, can employ the frame of ecological urbanism to embrace the experience of "natur(e)(al)" areas within an urban platform and thus extend the scope of ecotourism beyond pristine and remote natural areas. The evolution of interest in urban ecology has shown that ecology has advanced and ecologists are refocusing their research on cities. The evolution from regional planning scale designing with nature towards ecological urbanism is taking root in cities as they adopt ecosystem management approaches to design and planning. Unfortunately, this evolution has not taken place in ecotourism. The late 1970s to 1990s were the thriving days for ecotourism research, travel, experiments, reports and declarations. If the disciplines shaping ecotourism are evolving and refocusing then it is also high time for ecotourism to be redefined. In doing so, opportunities of ecotourism can be found within the ecological urbanism framework, thus creating a platform for ecotourism in the city.

This thesis grows from an understanding of River Yamuna in the capital city of India and the major systems that are at intertwined with the river. In the previous chapter the principles of ecotourism were interpreted and then ranked per their occurrence in the literature. The framework of ecological urbanism is then used to take the principles of ecotourism to the urban scale and setting. The *major systems* identified within the *framework* of ecological urbanism that need to be addressed in considering ecotourism development are (Table 4):

1. Green patches of Delhi
2. Heritage tourism of Delhi
3. Urban metabolism of Delhi
4. Perception of River Yamuna
5. Floodplain Management
6. Agricultural practices
7. Meeting water treatment requirement, Groundwater recharge
8. Improving water quality
9. People, River Yamuna, and activities

The table points out the number of times certain ecotourism principles are addressed in by various systems of Yamuna River. The score at the bottom of the table shows the evaluation of site systems that *addresses* the principles of ecotourism the most. The score to the right is simply a reflection of what principles of ecotourism *can be addressed* the most in certain site systems. The systems of Yamuna River and Delhi are arranged in a spectrum of traditional green ecosystem services to human focused ecosystem services. The impact of site systems such as 'Green patches of Delhi', 'Heritage Tourism at Delhi' etc. are high. If these systems are addressed, ideally, in the design model, it will create a platform for ecotourism to happen at an 'urban scale'. The design

model helps create a platform for ecotourism principles to be practiced at Yamuna River and its surrounding urban areas.



Figure 4.2: Programming possibilities for the design lenses

Based on the evaluation of the table, three design lenses are created – 'the green lens', 'the human lens', and 'the balanced lens'.

- *The green lens*: Focusing design efforts on floodplain recharge, water quality improvement and conserving green spaces.
- *The human lens*: Addressing heritage and cultural conservation, job creation, neighborliness, happiness, security and environmental justice.
- *The balanced lens*: Addressing all the above with equal priority to green infrastructure and human ecology in New Delhi.

The table also indicates the major gaps in the green ecosystem services of a city which can be assumed to be a result of neglect of green infrastructure in a city. Most of the ecotourism

principles find its opportunity in the human-focused ecosystem services section of New Delhi and Yamuna River. Figure 4.2 graphically illustrates certain programming ideas that might fill the "major gaps" in Table 4 through the three design lenses.

Table 4: Design priority and ecotourism opportunity at the site

		YAMUNA RIVER, DELHI, INDIA									
		Floodplain management	**Improving water quality**	**Meeting water requirement**	**Groundwater recharge**	**Green patches of Delhi**	**Urban metabolism of Delhi**	**Agricultural practices**	**Heritage tourism of Delhi**	**People, River Yamuna & activities**	**Perception of River Yamuna**
ECOTOURISM PRINCIPLES	**Conservation**	13	13	13	13	13	13		13		
	Natural areas	10				10	10				
	Appreciate host culture							9	9		9
	Education and interpretation					8.5			8.5		
	Community empowerment							7.5		7.5	7.5
	Low visitor impact	7					7				
	Appreciate nature					7				7	7
	Sustainable development strategies	6	6	6	6		6	6			
	Ecotourism Programming					5.5		5.5	5.5	5.5	5.5
	Interlink nature and culture					5			5		5
	Evaluation	3.5	3.5	3.5	3.5		3.5				
	Health & wellness	3	3	3	3	3	3			3	3
	Meeting visitors' need			2	2						
		42.5	25.5	27.5	27.5	52	42.5	28	41	23	37

CHAPTER 5

THE THREE DESIGN LENSES

5.1 THE GREEN LENS

The natural areas and the most visited tourist spots in the city are fragmented and scattered. One cannot physically experience continuous natural sites while traversing from one destination to other. The major green infrastructure resources of Delhi were long ago overtaken by the challenges of this densely crowded city, such as water requirements, groundwater table decline, water pollution and its sources. The design process followed here highlights that some areas are necessary to protect and conserve while others form the platform for capturing and treating water.

An overall strategy for conserving natural resources and treating water where appropriate and connecting through Yamuna river and other possible ecological corridors could be comprised of the following design elements (see sections in Appendix).

- Protective biodiversity zones
- Interactive biodiversity zones – areas of ecological interests
- Programming of activities along River Yamuna and along tourism movement ways
- Wetland areas to treat water
- Areas designated to recharge aquifers
- Designate ecological corridors
- Visitor center

Conservation and protection

The existing areas of ecological importance identified are the Delhi Ridges, other open terrestrial green spaces, agricultural lands and the Yamuna Floodplain (see Appendix A). The flora and fauna vary from north ridge to the southern ridge. The northern ridge has trees with greater water demand due to thick soil structure and proximity to Yamuna Floodplains. Due to the close vicinity of the northern ridge to the urban development, it faces more pollution and damage. The southern ridge comprises of scrubby and drought tolerant planting. "The Southern Ridge portrays a better scenario as far as the faunal composition of the Ridge is concerned. Being comparatively isolated, it bears a greater sanctity in terms of the forest ecosystem" (Shukla, Basu and Singh 2014). The Flora and Fauna map (see Appendix A) shows the faunal abundance on the southern side of Delhi due to the presence of wetlands and its isolation from urban development. The Ridges are identified as major conservation and protection zones to promote the free flow of fauna within.

Capture and treat water

Surrounding these areas of ecological importance are fractured pieces of parks, leftover green spaces, wetlands, and street green alleyways, which are punctured within the dense urban development in the city. *"Typical conditions"* of these fractured pieces and built infrastructure are important areas for capturing and treating water (see Appendix A). Due to limited time, only three such typical conditions are considered in detail through section study (Figure 5.1). The fractured pieces also perform as edge ecosystem for the dense "green patches" of Delhi.

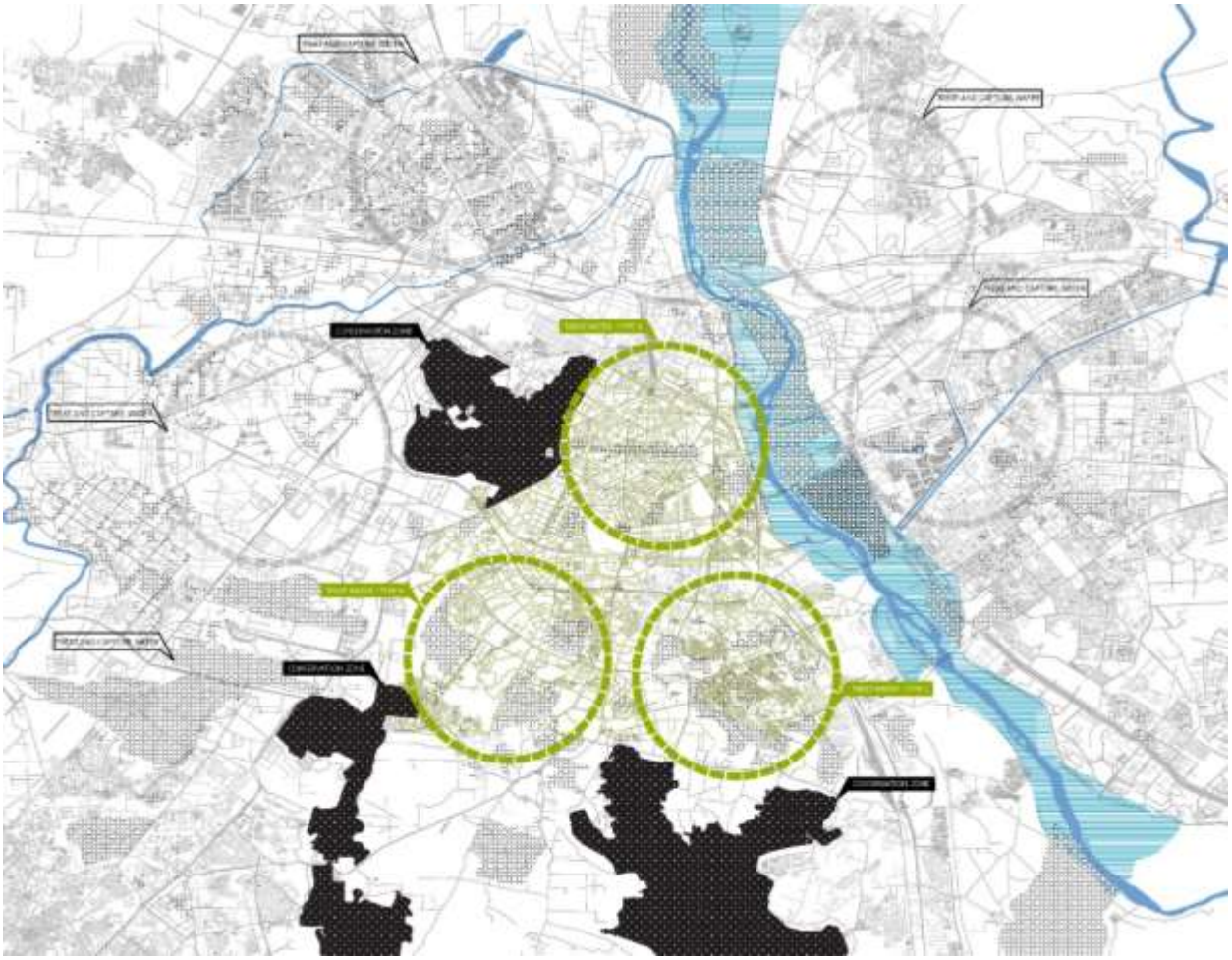


Figure 5.1: Typical conditions for capturing and treating water

Typical condition A (see Appendix A) is in the radially planned Lutyen's Delhi –. The streets and green alleyways provide ample space for creating green corridors and tourist as well as resident pathways to enjoy the opportunity of spotting native flora and fauna of the society. The green alleys provide the opportunity of functioning as water capturing zones during the monsoon season, to meet water requirement of the city during the dry seasons. Type B is like Type C (see Appendix A) but more focus is given to the slum development and its adjacency to a planned development. Typical condition C (see Appendix A) is in the area north of the southern ridge. The area comprises of attached residential buildings with rear leftover spaces, centrally located public parks and "green patches" at the edge of the housing communities. Due to more restricted green

space availability, the leftover back alleyways provide an opportunity for water collection from the residential building and green roof policy can create continuous corridors for avifauna.

The aim of focusing on typologies is not to propose fixed design ideas but a design experiment showing various opportunities, outcomes of flexible and multipurpose design ideas – *'What is, to what could be'*. The selected typologies simply serve as an example. These typologies can be repeated or modified in response to the locally unique urban matrix around the city.

Ecological corridors and hubs

The Yamuna River naturally serves as the ecological corridor "backbone" for Delhi by accommodating wetlands to cleanse the water, support fauna and flora, and serve as an interactive biodiversity education hub for the tourist as well as residents. The floodplain has the potential to store flood water during the monsoon season for later release but as per calculations, the storage available is not enough to suffice the year-around needs of the growing population. Extending the network of the Yamuna River, the Najafgarh drain connected to the Ring road of Delhi will serve as a continuous corridor for bird species as well as the attendant nature enthusiasts. The Najafgarh drain has great potential for water treatment and indulging with nature, given its approximately 300m wide right of way. The idea was to not just connect the green areas but also create an ecological corridor for flora and fauna of Delhi. The green infrastructure slowly seeps through the urbanism of Delhi by a process of conserving, treating of water and connecting the fragments (Figure 5.1).

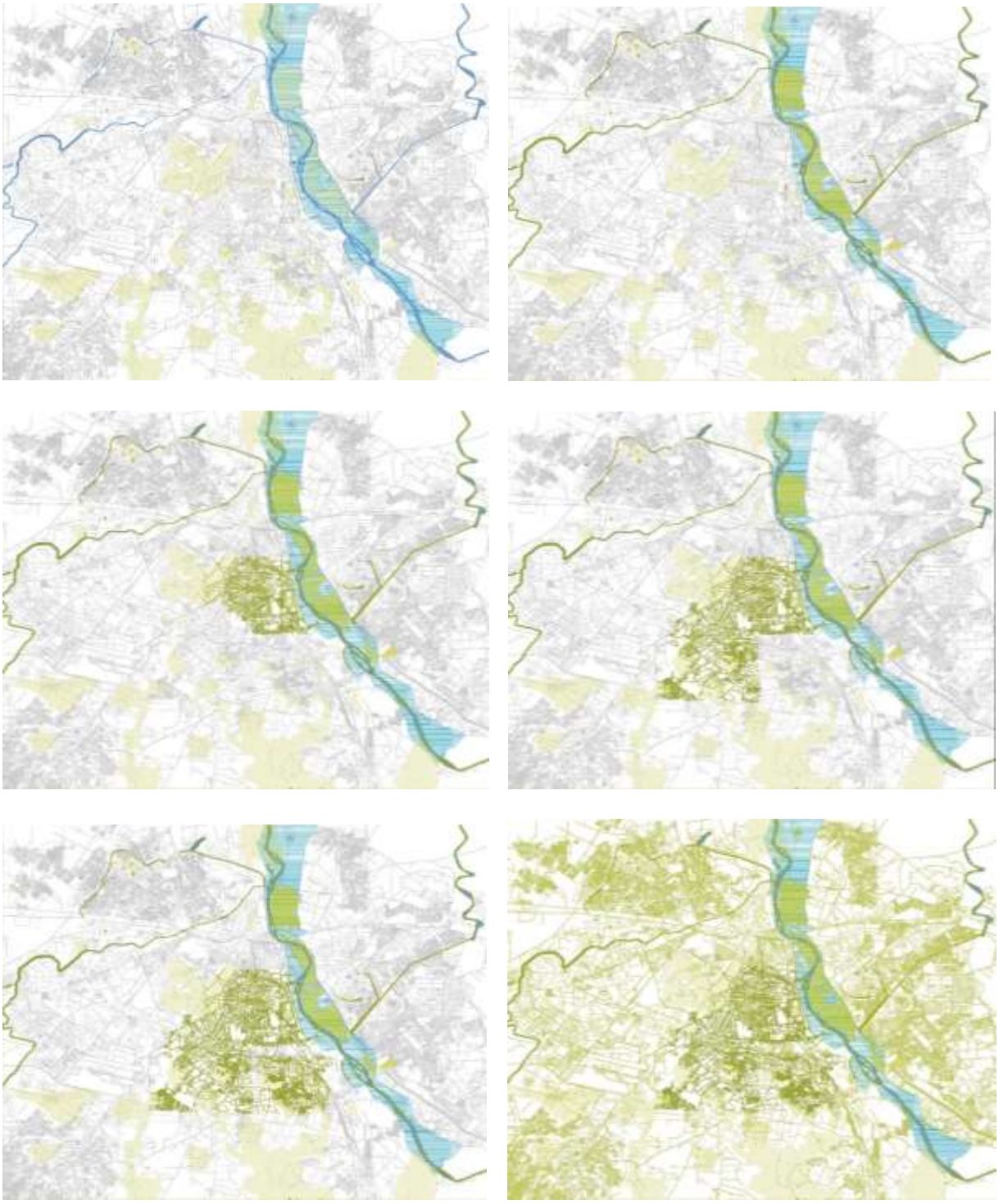


Figure 5.2: Imagined future of Yamuna River, the changing green infrastructure of Delhi through 'the green lens'

5.2 THE HUMAN LENS

The process

'The human lens' design identified 2 major catalysts for design. Firstly, the *existing spatial arrangement of public spaces* and secondly the *existing transit network* in the city. Study of the existing public space included the distribution of public parks, agriculture land – prospective agritourism space, retail spaces, lodgings, eating and dining areas, public leisure points such as theaters, cinema halls, shopping malls etc. (see Appendix B). The existing transit network included existing rail corridors, national highways, primary roads, the Ring Road of Delhi, bus stops, railway stations and metro stations (see Appendix B).

The next step involved understanding the spatial mosaic of public spaces and the overlap various types of public spaces. Each type of public space – retail, agricultural land, public parks and heritage tourism spots – was assigned a color per the previous map of *spatial arrangement of public spaces.* Colored rectangles like pixels were created wherever there is a cluster of public space belonging to respective category. For example, a green rectangle was drawn to circumscribe a concentration of patches of public parks in the North-West Delhi while a yellow rectangle gathered areas of agriculture lands on the floodplain of Yamuna River (Figure 5.3).

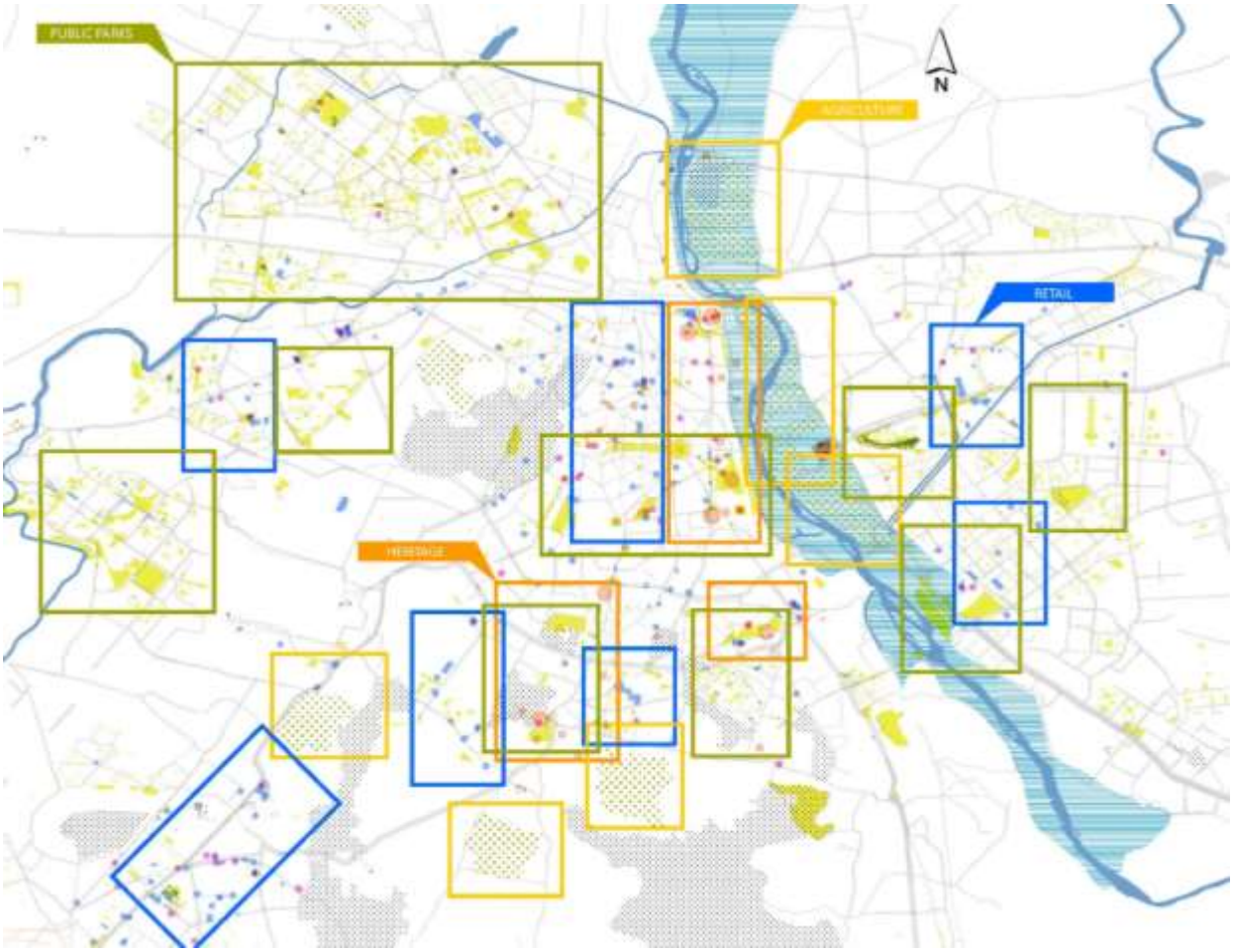


Figure 5.3: Spatial mosaic of public spaces

Outcomes and plausible solutions

The outcome of this map revealed a considerable range of spatial mosaic in the city. Certain areas, e.g., North-West Delhi, have one type of public space as a dominant recreation resource while some places like Central and South Delhi had overlap of all types, making those areas successful in terms of integrating human ecosystem services. The areas that appear completely empty in the map are either areas of no urban development or areas for which data is not available. The real question is *does the perfect overlap mean that it fulfills all components of human focused ecosystem services?*

One suitable solution in this scenario could be transit oriented development, where areas are both well connected to areas of diverse usage within a walking distance of transit stations. The Delhi government has already identified certain corridors for transit oriented development along metro existing stations. The map of *existing transit network* reveals that public spaces shown in the *existing spatial arrangement of public spaces* map are well connected via bus routes and metro station. The other suitable solution is to locate where possible growth of retail, transit, hotels, restaurants, and vendors would happen if Delhi becomes a major ecotourism destination.

Cross sections along Yamuna River was studied to analyze typical conditions along the river and possibility of building agritourism with public gathering spaces (Figure 5.4 and Figure 5.5). The proposed model also suggested maximization of public viewing, public access to the River as well as Restricted Forests on the banks of Yamuna River. The first section addresses industries and farmland on the floodplain. The proposed design model provides solutions such as buffer and treatment wetland area next to the industries. The farmland provides opportunity for agritourism and cabins for staying and participating in agritourism. The second typical section addresses a situation where the river channel is flanked by farmlands on both sides. The farmlands could be temporarily used as public gathering spaces when events like farmers' market, fares and vendors are set up, providing local business to participate. The third section addresses a residential frontage to the river and wetlands near Okhla Bird Sanctuary by providing viewing areas and pathways for the residents to enjoy and appreciate nature. The tourists would be restricted to the residential areas and allowed to have similar experience from the other side of the river, which is already accessible from the elevated flyover (see Appendix B).

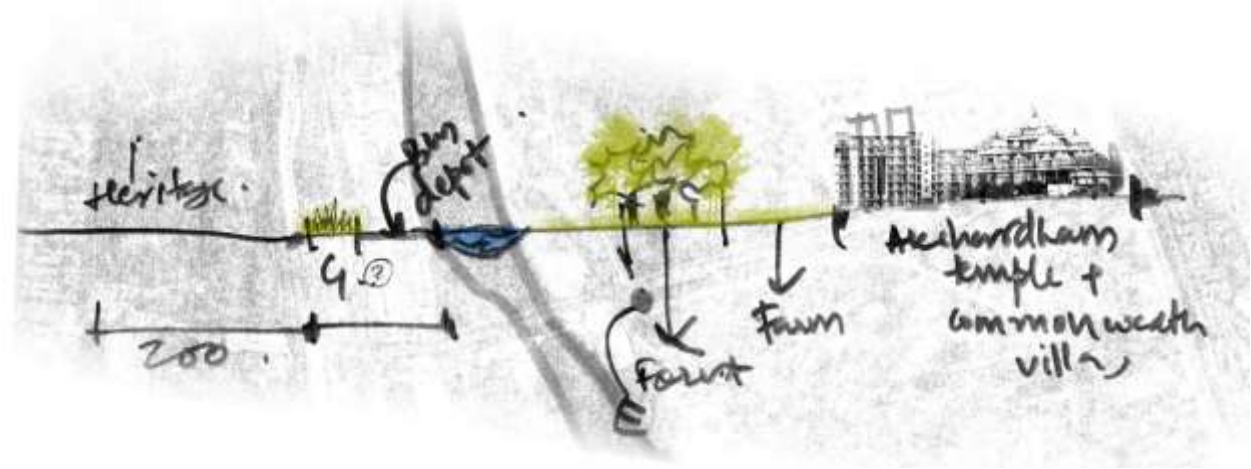


Figure 5.4: Yamuna floodplain existing condition - Heritage and farmland

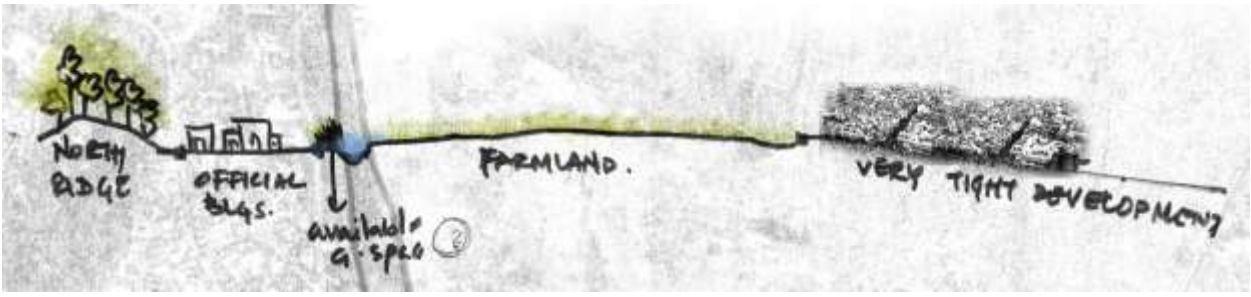


Figure 5.5: Yamuna floodplain existing condition – forest, farmland, and development

5.3 THE BALANCED LENS

'The balanced lens' focused on mitigating the negatives of both green and human lens. Imagining a scenario where natural systems and the social systems both find equal priority and justice as they grow in a city is the ideal situation we seek. The idea of mosaic was taken from 'the human lens' approach and applied again with the idea of sustainable development (Appendix C). 'The balanced lens' design approach is an extension of the previous lens put together Figure 5.2.



Figure 5.6: 'The balanced lens' design approach

'The human lens' identified spatial arrangement of public spaces and proposed new growth of public facilities along the major entry points and lodging areas of Delhi. 'The human lens' projects the same proposal over the comprehensive map of 'the green lens' design. This map shows how the natural areas and the urban matrix of the city might interact if development happens due to ecotourism. Another map delineates areas like the natural patches of Delhi that must be conserved for ecological processes to occur, zones for waste water treatment, limiting urban growth to certain extant, and Yamuna River corridor as the spine of the city, where all social activities and ecological processes converge.

The proposed design finds a midway between 'the green lens' and 'the human lens' by programming the Yamuna floodplain for both conservation and community benefits. Programming of the site includes dense riparian buffer on one side of the bank and agritourism practices on the other, treatment wetland zone for the industries on the floodplain, linking heritage tourism to interactive biodiversity zones on the floodplain, and temporary public spaces provision on the floodplain and other areas where tourist footprint is more. These design strategies aim to control existing practices of dumping of pollutants, flow of polluted water from agricultural lands and untreated sewage by keeping conservation in mind yet without disrupting the societies that rely on the floodplain for their livelihood – *conservation through benefiting the community*.

5.4 DESIGN EVALUATION

The aim of the design models was to achieve the ideal situation presented in the ecotourism and site table (Table 5), however, a few things were not attained or could not be measured in the design. The principle of *conservation*, *natural area* and *health and wellbeing* was achieved by all the site systems while *education and interpretation*, *community empowerment*, *evaluation* and *meeting visitor needs* was not achieved by any site systems. *Appreciation of nature* and *ecotourism programming* was made possible by adding viewing areas, pathways for residents along the River, and activities such as boating, fishing and kayaking on the water bodies (Table 6).

Table 5: Ecotourism vs site systems – 'the green lens' design evaluation

		YAMUNA RIVER, DELHI, INDIA									
		Floodplain management	Improving water quality	Meeting water requirement	Groundwater recharge	Green patches of Delhi	Urban metabolism of Delhi	Agricultural practices	Heritage tourism of Delhi	People, River Yamuna & activities	Perception of River Yamuna
ECOTOURISM PRINCIPLES	Conservation	13	13	13	13	13					
	Natural areas	10	10	8	8	10					
	Appreciate host culture										
	Education and interpretation										
	Community empowerment										
	Low visitor impact	7									
	Appreciate nature	7	7			5					
	Sustainable development strategies	6		6	6						
	Ecotourism Programming	5.5	5.5			5.5					
	Interlink nature and culture					5					
	Evaluation										
	Health & wellness	3	3	3	3	3					
	Meeting visitors' need										
		51.5	38.5	30	30	41.5					

'The human lens' design seeks to reach the middle ground between tradition ecosystem services and human focused ecosystem services. The comparison of the typical cross section of Yamuna river between 'the green lens' approach and 'the human lens' approach is noticeable. 'The green lens' achieves abundance of natural areas for conservation bringing better urban health and wellness while 'the human lens' approach seeks to achieve human interaction with the natural areas, thus fostering better ecosystem services (Figure 5.7 and Figure 5.8).

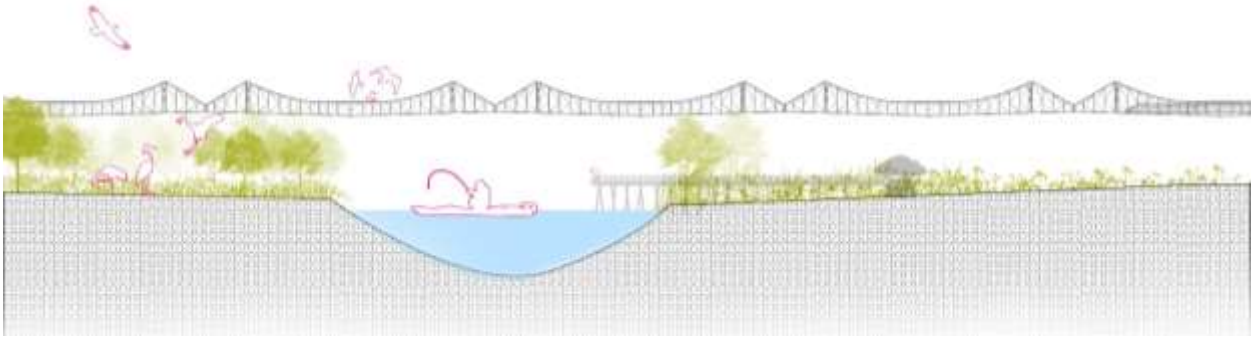


Figure 5.7: Cross section of Yamuna River from 'the green lens' approach

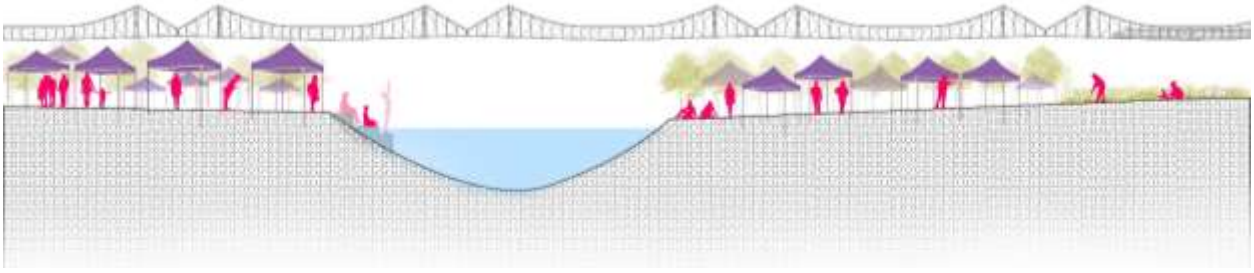


Figure 5.8: Cross section of Yamuna River from 'the human lens' approach

The prospect of agritourism could fulfill many principles of ecotourism including *education and interpretation, community empowerment, ecotourism programming* and *appreciation for nature*. Interlinkage of nature and culture was achieved by bringing people close to the River and making engage in activities such as walking, kayaking, relaxation on *ghats* and creating viewing areas (Table 6).

Table 6: Ecotourism vs site systems – 'the human lens' design evaluation

		YAMUNA RIVER, DELHI, INDIA									
		Floodplain management	Improving water quality	Meeting water requirement	Groundwater recharge	Green patches of Delhi	Urban metabolism of Delhi	Agricultural practices	Heritage tourism of Delhi	People, River Yamuna & activities	Perception of River Yamuna
ECOTOURISM PRINCIPLES	Conservation										
	Natural areas						10				
	Appreciate host culture							9	9		9
	Education and interpretation							8.5			
	Community empowerment							7.5		7.5	7.5
	Low visitor impact									7	
	Appreciate nature							7		7	7
	Sustainable development strategies						6				
	Ecotourism Programming							5.5	5.5	5.5	5.5
	Interlink nature and culture							5	5	5	5
	Evaluation										
	Health & wellness						3			3	3
	Meeting visitors' need										
							19	42.5	19.5	35	37

'The balanced lens' approach is almost the ideal situation every designer seeks to achieve yet this approach manages to not earn a perfect score on ecotourism. Floodplain management, Green patches of Delhi and Agricultural practice are the top three systems that can fulfill certain aspects of ecotourism and bring the practice of ecotourism to Delhi. On the other hand, Meeting water requirement, Groundwater recharge and Urban metabolism fails to score points from ecotourism perspective (Table 7).

Appreciation of host culture, *education and interpretation*, *community empowerment*, *evaluation* of ecotourism, and *meeting visitors' need* were not achieved through many of the site systems. Although *health and wellness* was achieved by most of the systems on site, yet it scored poor in the overall chart due to its low importance in the initial rubrics. An important question arises from the evaluation: *Is it necessary for all the site systems to achieve every principle of*

ecotourism? Some site systems may have indirect multiplier effect on the principles of ecotourism. In that case, how does one evaluate the indirect effects?

Table 7: Ecotourism vs site systems – 'the balanced lens' design evaluation

		YAMUNA RIVER, DELHI, INDIA									
		Floodplain management	Improving water quality	Meeting water requirement	Groundwater recharge	Green patches of Delhi	Urban metabolism of Delhi	Agricultural practices	Heritage tourism of Delhi	People, River Yamuna & activities	Perception of River Yamuna
ECOTOURISM PRINCIPLES	Conservation	13	13	13	13	13		13	13		
	Natural areas	10	10	10	10	10	10	10	10		
	Appreciate host culture							9	9		9
	Education and interpretation	8.5						8.5			
	Community empowerment	7.5						7.5	7.5	7.5	7.5
	Low visitor impact	7				7					
	Appreciate nature	7	7			7		7		7	7
	Sustainable development strategies	6		6	6		6				
	Ecotourism Programming	5.5	5.5			5.5		5.5	5.5	5.5	5.5
	Interlink nature and culture					5		5	5	5	5
	Evaluation										
	Health & wellness	3	3	3	3	3	3			3	3
	Meeting visitors' need										
		67.5	38.5	32	32	50.5	19	65.5	50	28	37

The opportunity for certain ecotourism principle to thrive in an urban setting is possible if the rubric developed to score the principles are made more complex and accurate in future research. The rubric created to measure ecotourism in this thesis is comprehensive rather than complex. Ideally to measure every component of ecotourism, ecological urbanism and the site systems, it would have been necessary to do a weighted overlay to get a coefficient for every component involved. The process of assigning weightage to every component is a thesis on its own and could be considered in future research, if a more rigorous analysis and accurate results are desired. However, to get the programming for the urban setting of the Yamuna River, Delhi, started, one

does not need an accurate result. Proficiency of the challenges and opportunities created by the ecotourism principles on the urban site and the gaps in the discourse of ecotourism that emerged during the evaluation (Table 7) are a good start to designing for the urban setting of the Yamuna River.

CHAPTER 6

CONCLUSION

The thesis began with an analysis of ecotourism practices in natural and biodiverse hotspots around the world leading to the argument that natural areas are equally important in an urban setting and the concept of ecotourism is not necessarily restricted to natural areas. The Yamuna River in Delhi, India – a river whose current state is unusable due to the same neglect of nature in urban areas – provided a suitable landscape for this argument to be tested. The argument was supported by examination of existing bodies of theory in ecology and landscape architecture – urban ecology and ecological urbanism. Both perspectives demand a rethinking of natural areas in urban setting while encouraging interdisciplinary approach to addressing the complexity of a city.

The thesis aimed to break the notion that nature is separate from the concept of urban life and that humans are a separate system from traditional ecological systems. In doing so, this thesis questioned the very basic ideas involved in shaping the ecotourism principles. The key fundamentals of ecotourism were identified after doing a content analysis of famous ecotourism definitions in its discourse. The process confirmed the assumption made in the discourse: *nature does not exist in the cities*.

The background study of Delhi provides enough evidence that natural areas do exist there and that the area is very rich in biodiversity. The challenges faced in developing ecotourism within an urban setting are different from those encountered in a naturally biodiverse hotspot. The idea of urban ecotourism is hence introduced with precedent study of Toronto's Green Tourism Association. Research on urban ecology and ecological urbanism further proves the point that even

though nature in city is considered an oxymoron, yet ecological systems in a city has the power to function as the very spine on which it can grow. Research shows that the focus of ecology has shifted towards an urban platform while the *definition of ecotourism remains unevolved and relatively unquestioned since its introduction*. These finding led to the investigation of *What would ecotourism look like in an urban setting like New Delhi?* Analysis of ecotourism discourse and ecological urbanism discourse provided design guidance for three design strategies: 'The green lens', 'the human lens' and the 'balanced lens'. Table 5 bring forward many design priorities and ecotourism opportunities that Yamuna River, Delhi can provide. The table highlights where one can put forward efforts for the three design strategies.

Evaluating ecotourism as a design strategy for the urban setting of Yamuna River with a focus on traditional ecosystem service over human ecosystem services indicate that better *floodplain management* and *conservation of existing green areas in Delhi* can satisfy some top ranked ecotourism principles: *conservation* and *travelling to natural areas*. 'The green lens' approach was not able to satisfy ecotourism principles that addressed the community such as: *appreciation of host culture, education and interpretation, and community empowerment*. 'The human lens' design focuses on human ecosystem services at the expense of natural areas. Addressing agricultural practices and people's perception of Yamuna River can satisfy ecotourism principles that 'the green lens' could not achieve while neglecting *sustainable development strategies*, when designing with human ecosystem services only in mind, stands an issue. 'The balanced lens' design approach brought out similar results as the other two approaches but also highlighted that systems like meeting water requirements, groundwater recharge and the urban metabolism of Delhi could not contribute much to ecotourism programming near Yamuna River, Delhi, India.

The theories of urban ecology and ecological urbanism to a large extent exist only on paper. Recognized projects such as the Highline in New York City and Freshkills Park in Staten Island, New York by Field Operations, Qunli storm water park in China by Turenscape, Buffalo Bayou in Texas by SWA and a handful more have been given the tag of landscape urbanist/ecological urbanist project. Current literature on those famous projects does not reveal any evaluation techniques like the one created for this thesis that would substantiate their adherence to a set of specific design principles. Analysis of how they achieve the fundamentals of ecological urbanism, and ecotourism, could reveal how theoretical programming shaped their design implementation but that was beyond the scope of this thesis.

There is a further challenge arising from consideration of ecotourism as a design generator. Ecotourism to date has been considered largely from a tourism programming perspective with relatively scant examination of the major players in ecotourism—the ecotourists. Defining how a *ecotourists should and should not behave* in a specific design setting is also beyond the scope of this thesis but is clearly a major issue if an appropriate appreciation of the natural setting is to be truly achieved. In today's technology driven world one can easily forget to appreciate nature while busy getting the perfect photograph or composing a clever caption for your experience when it emerges via social media. Similarly, defining the educational and interpretative components of ecotourism projects will be heavily dependent on the policy and structure set by authorities in Delhi. Interpretive, signage, mobile apps, workshops, educational tours etc. are not the sole measures on which *education and interpretation* of ecotourism can be developed but more creative approaches will require a supportive policy environment. A receptive audience who is to appreciate nature, learn from it and give back to the host community is a necessary component of developing *education and interpretation* as a strong ecotourism principle. A future take on this

research could lay out the interplay of the desired roles of the ecotourist, the host community and the derived ecotourism principles.

The design model also revealed that even though health and wellness could be achieved easily, it ranks very low in the realm of ecotourism and ecological urbanism to make significant impact on the overall structure of the design. Learning from all the study done and updating ecotourism to encompass urban areas, the context of ecotourism within in the tourism industry can be looked at in a different way. If all forms of tourism practiced the derived fundamentals of ecotourism, then the chances of it turning into mass tourism might be less (Figure 6.1).

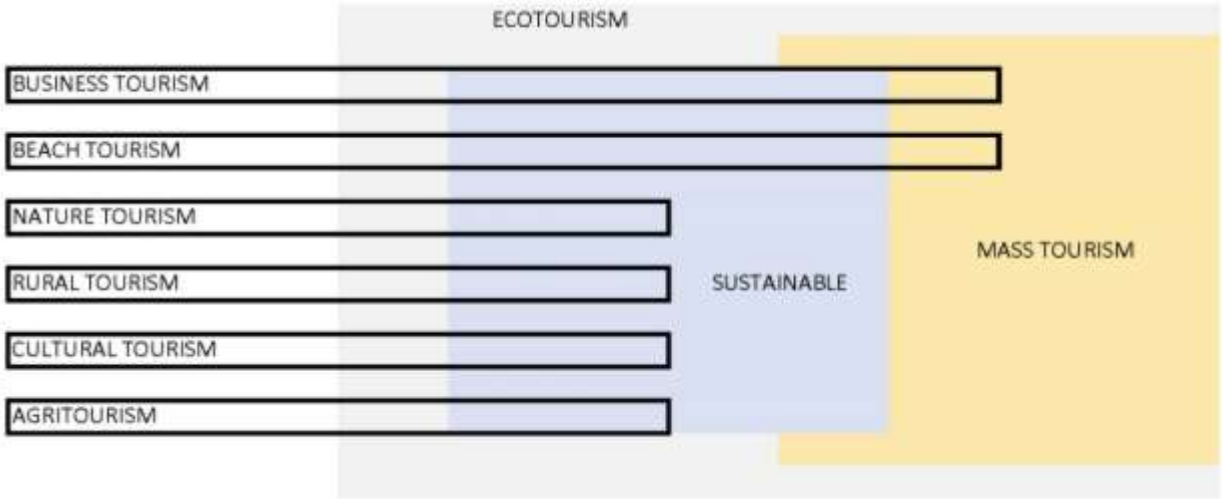


Figure 6.1: Mass tourism in the context of ecotourism

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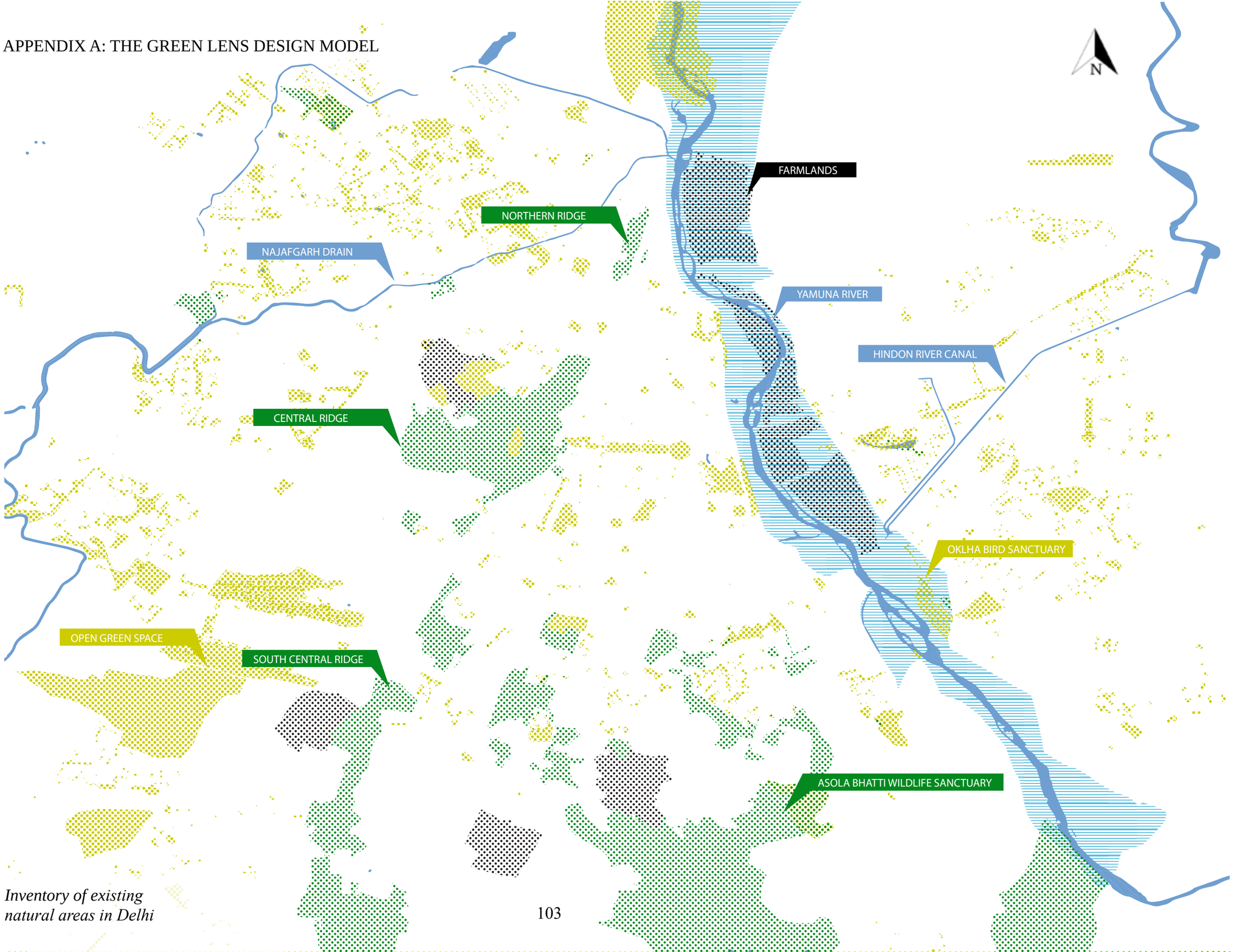
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Inventory of existing natural areas in Delhi

N

NORTHERN RIDGE

CENTRAL RIDGE

YAMUNA RIVER FLOODPLAIN

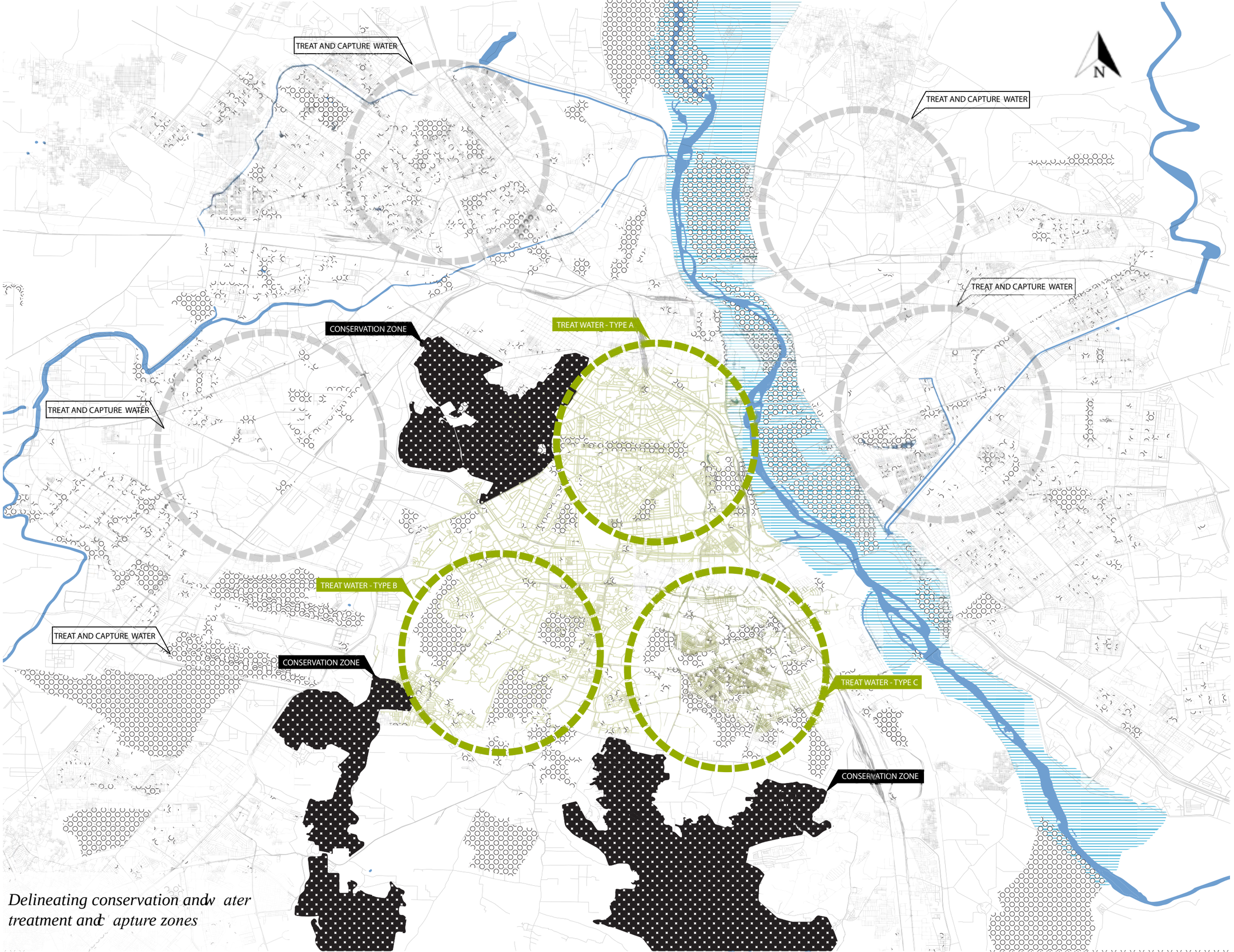
OKHLA BIRD SANCTUARY

ASOLA BHATI WILDLIFE SANCTUARY

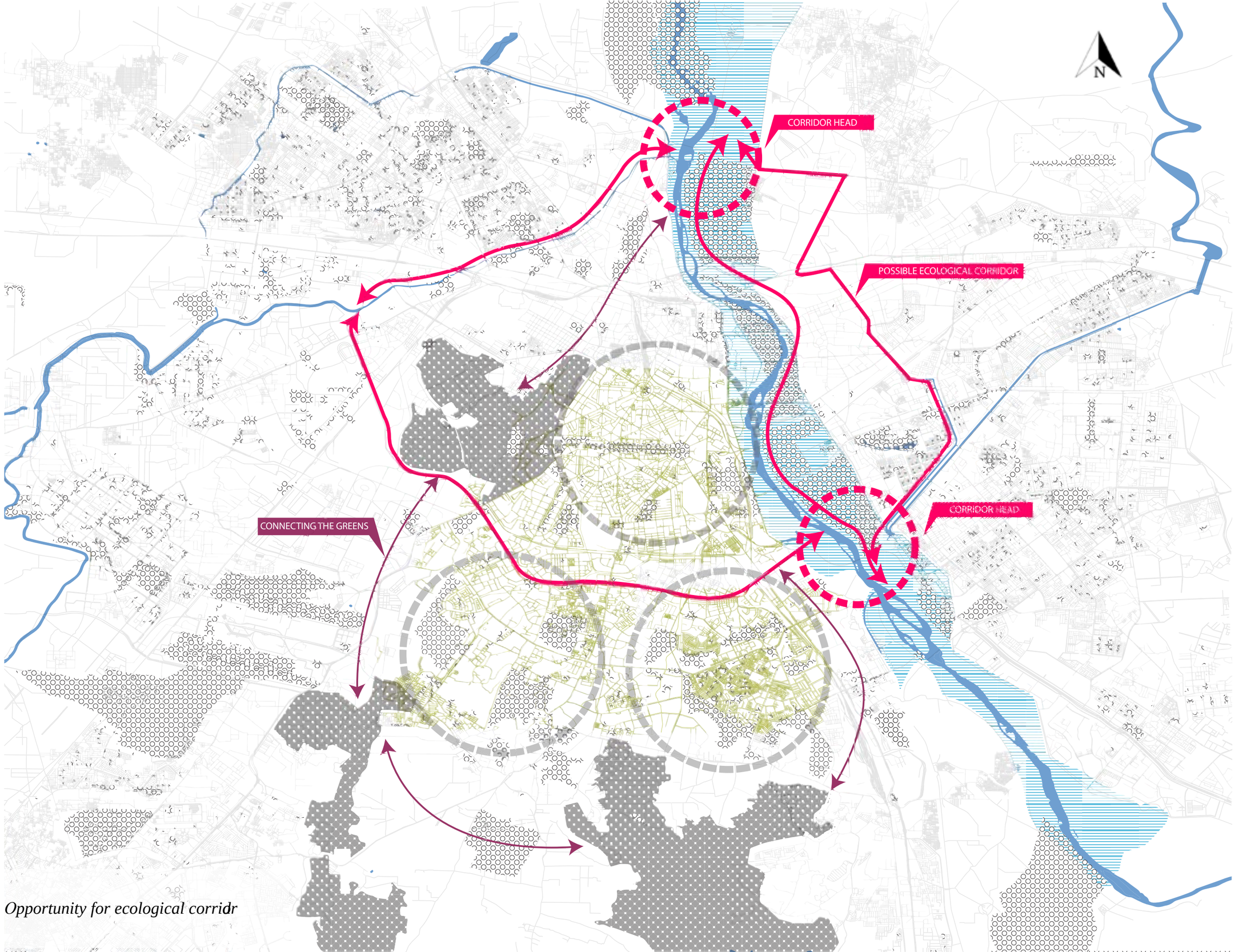
SOUTH CENTRAL RIDGE

SOUTHERN RIDGE

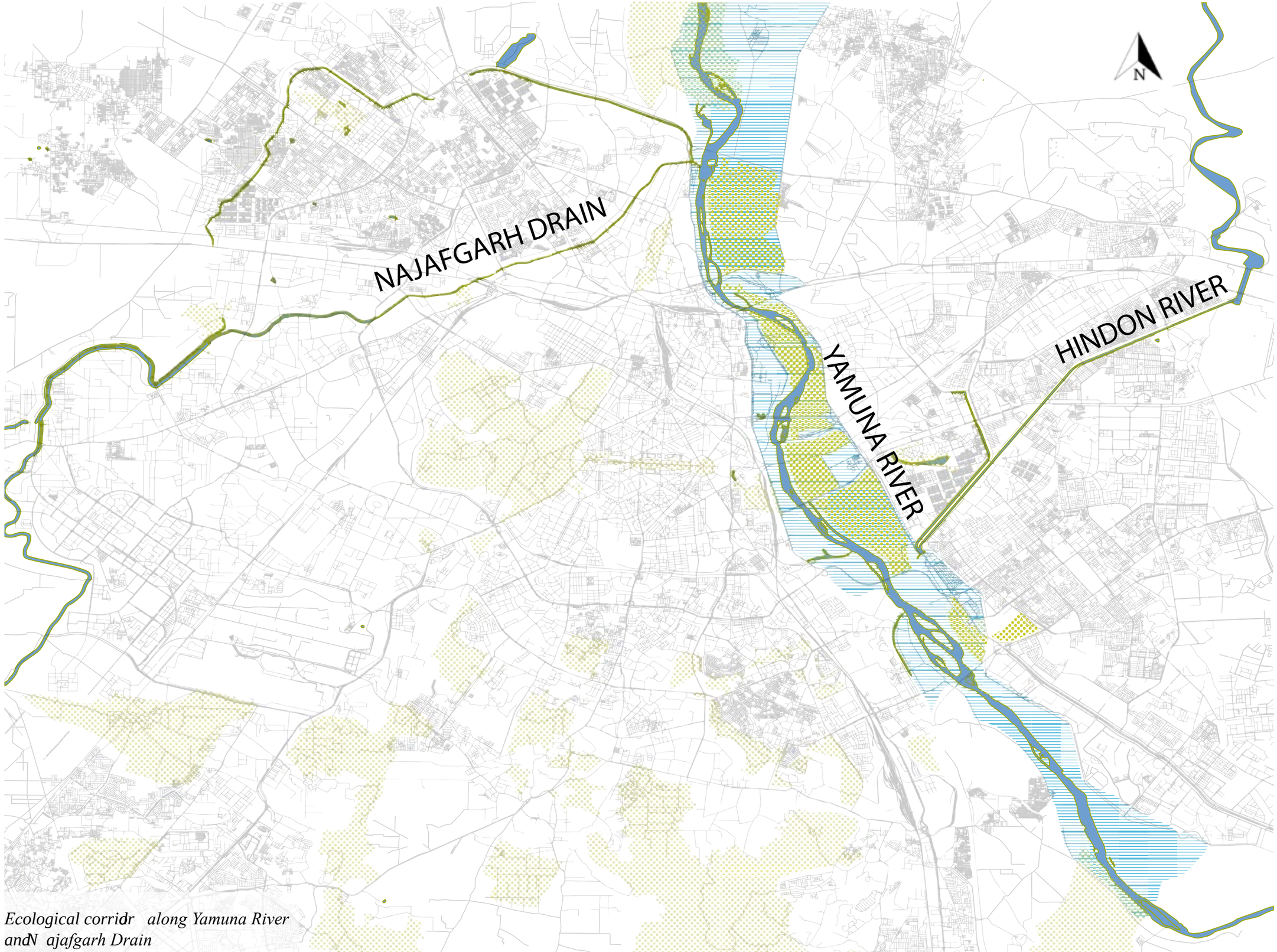
Flow of Fauna and Fauna



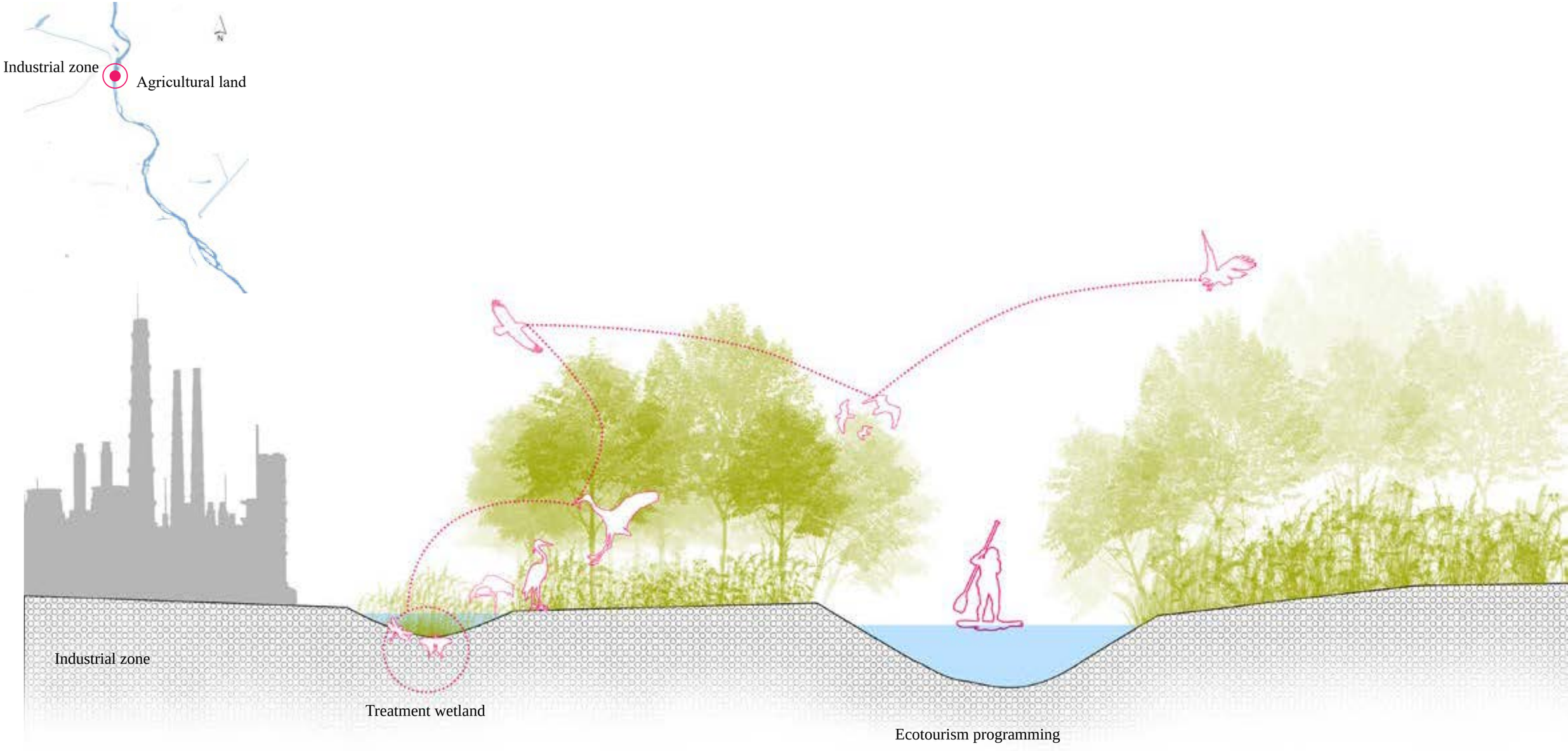
Delineating conservation and water treatment and capture zones



Opportunity for ecological corridr

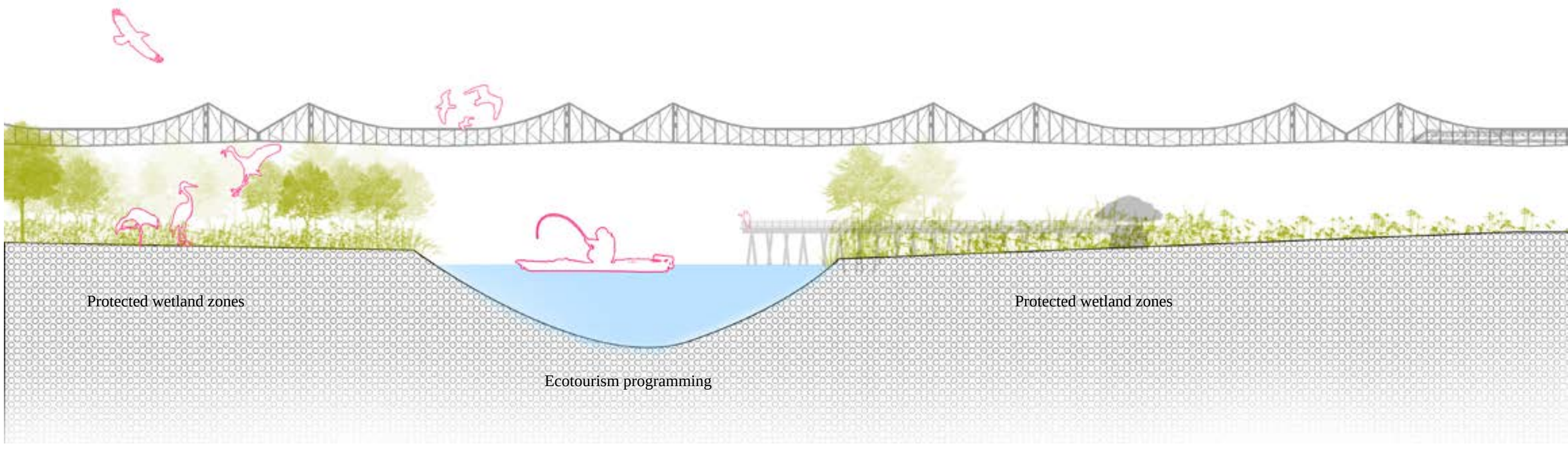


Ecological corridr along Yamuna River andN ajafgarh Drain

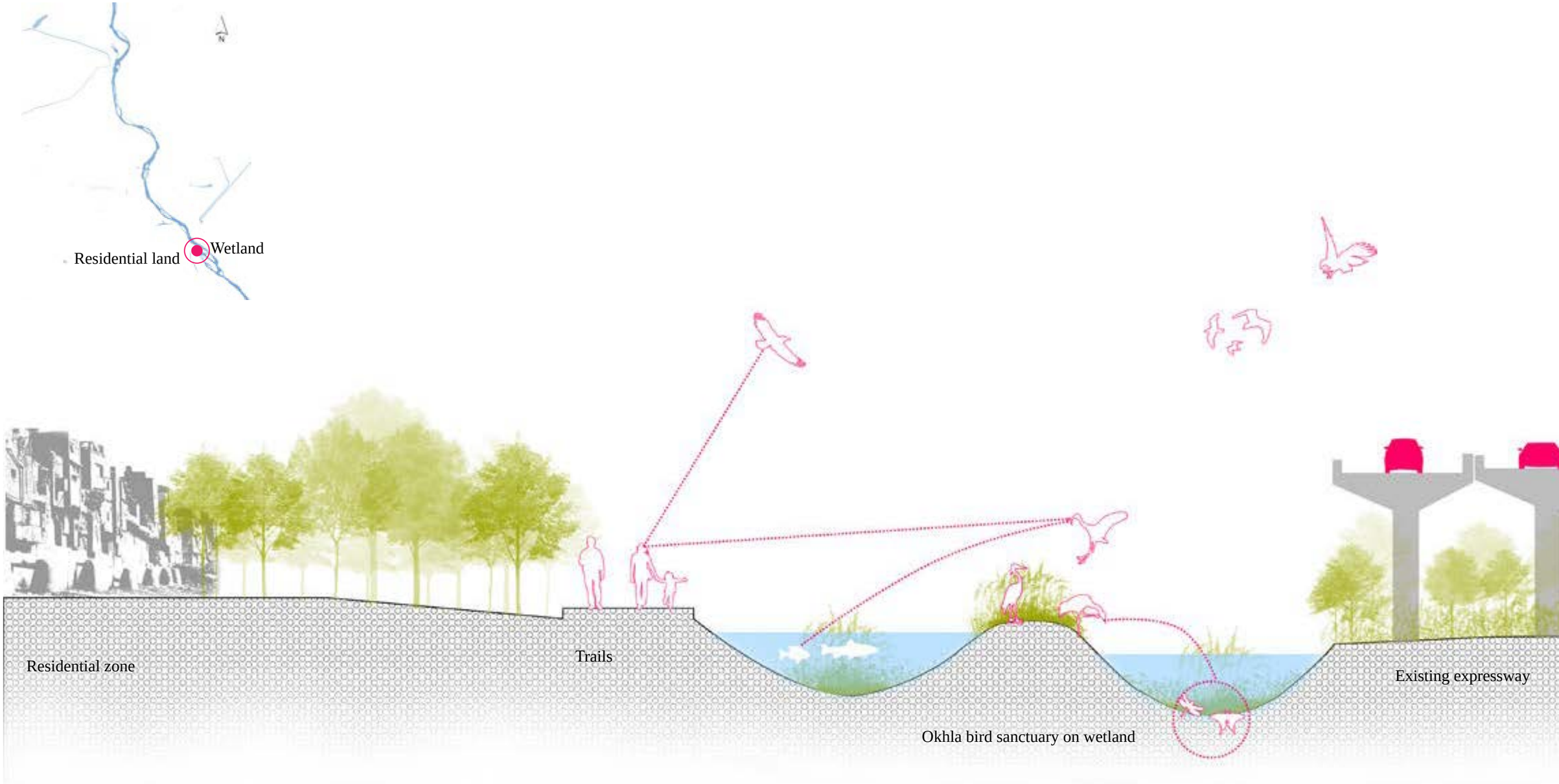


'The green lens' cross section of Yamuna River - Industrial and agriculture zone



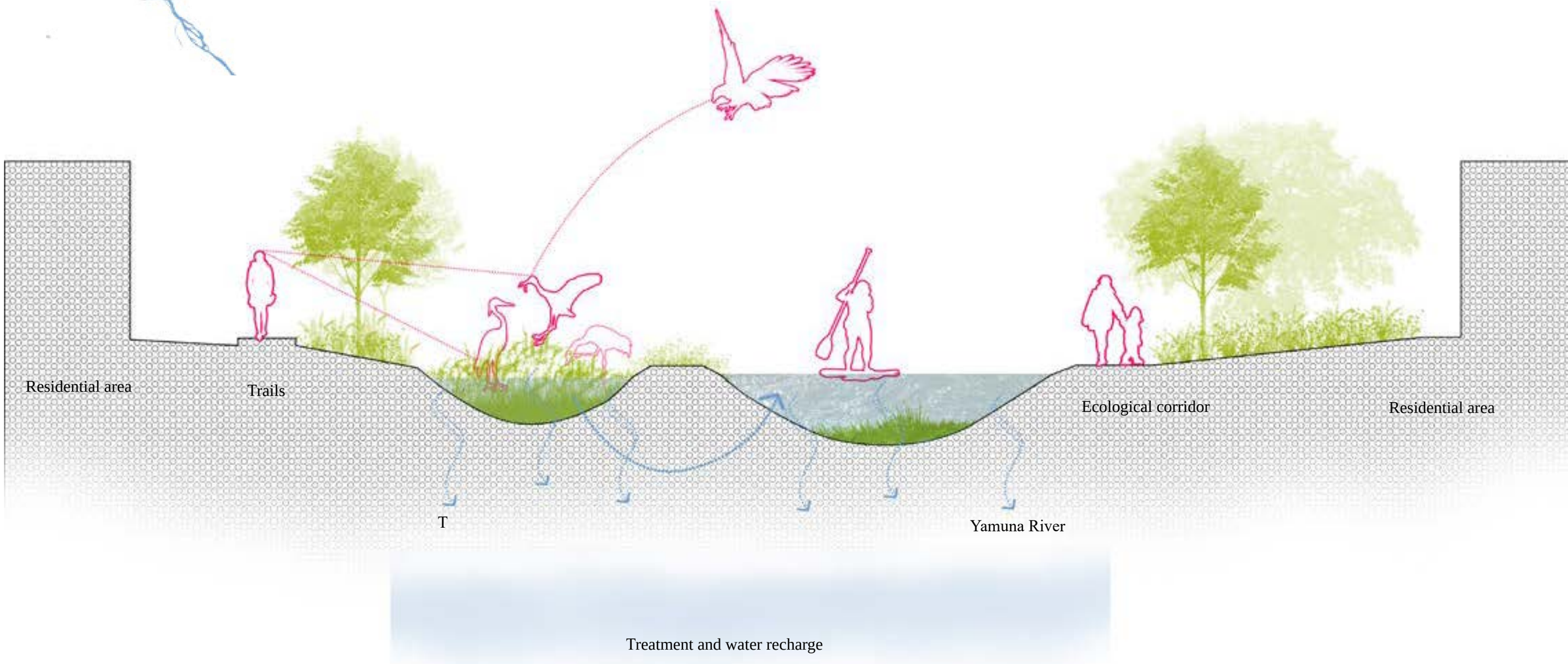


'The green lens' cross section of Yamuna River - Agriculture zone

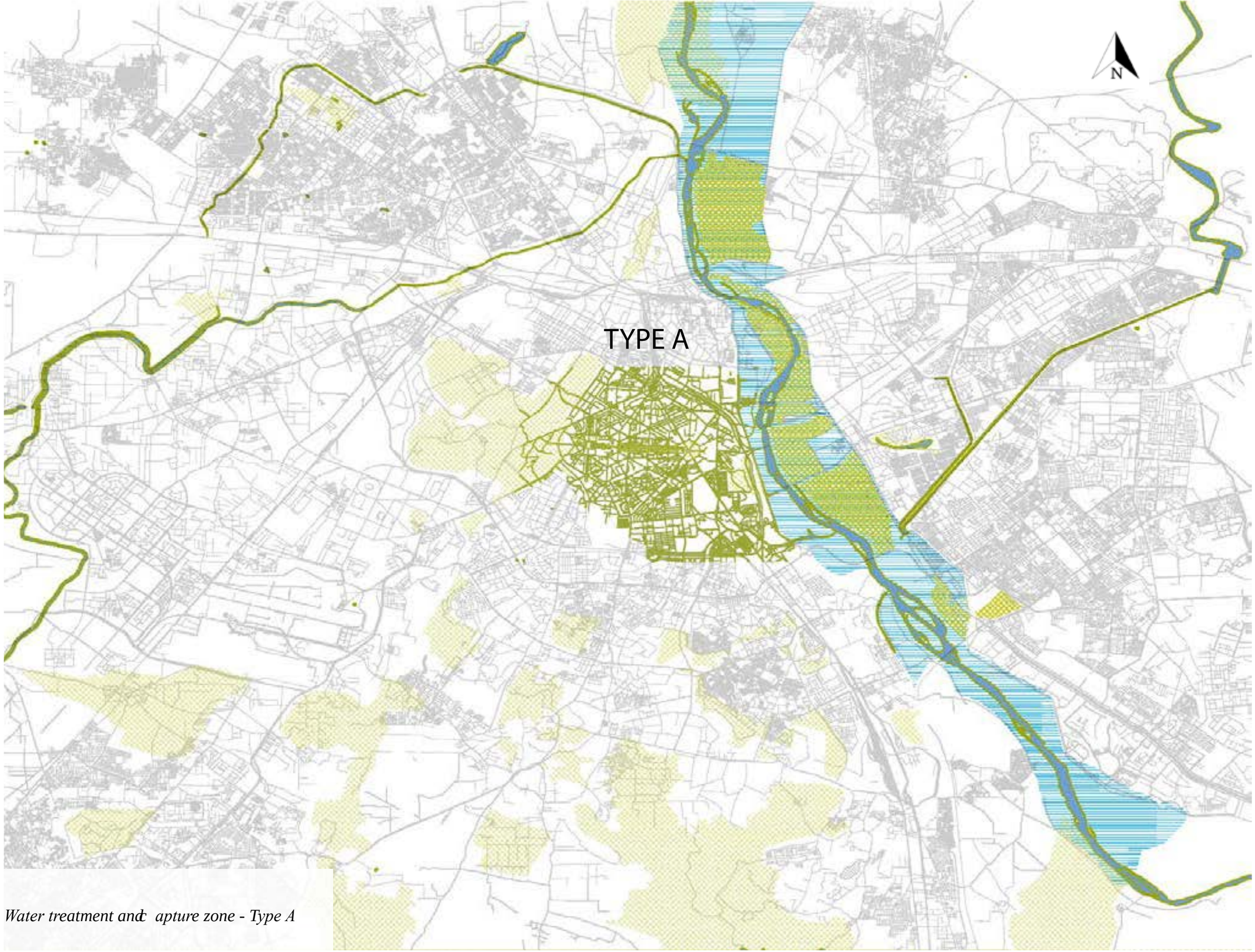


‘The green lens’ cross section of Yamuna River - Resid ntial zone

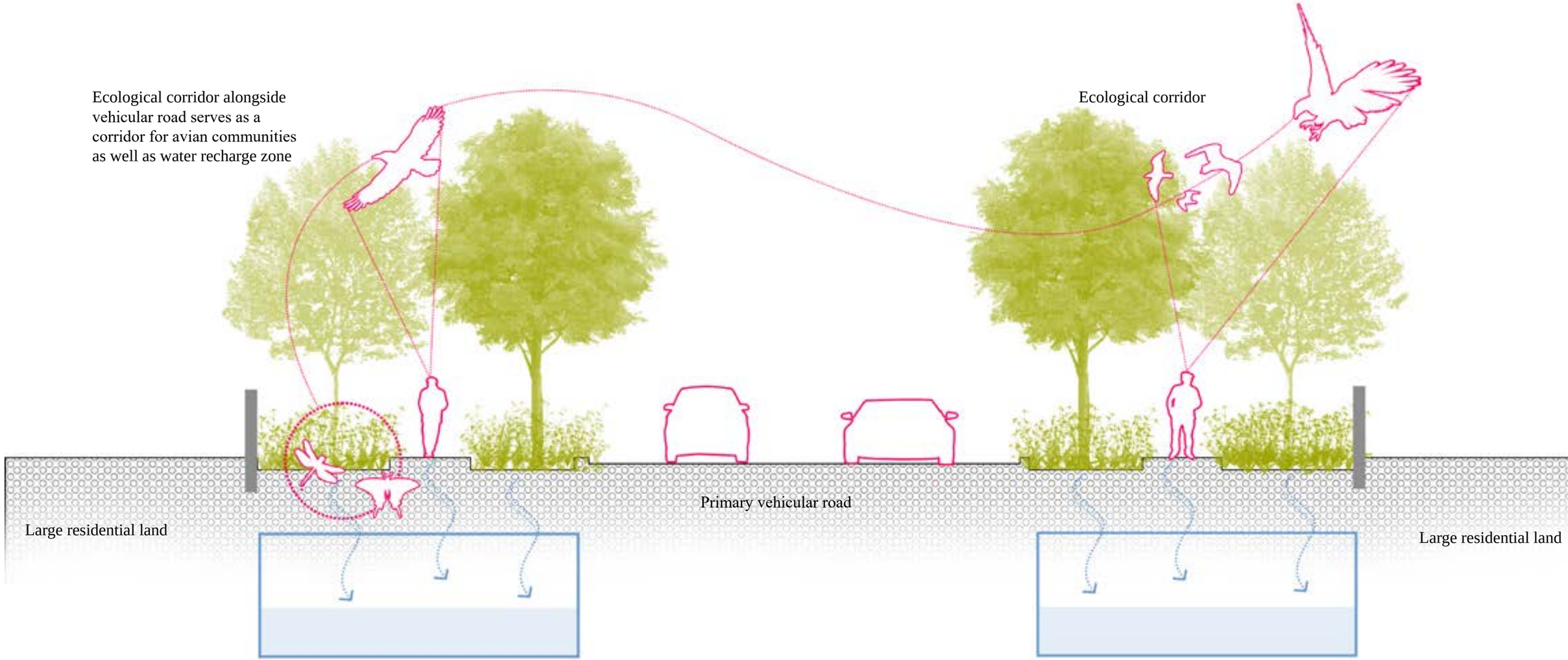




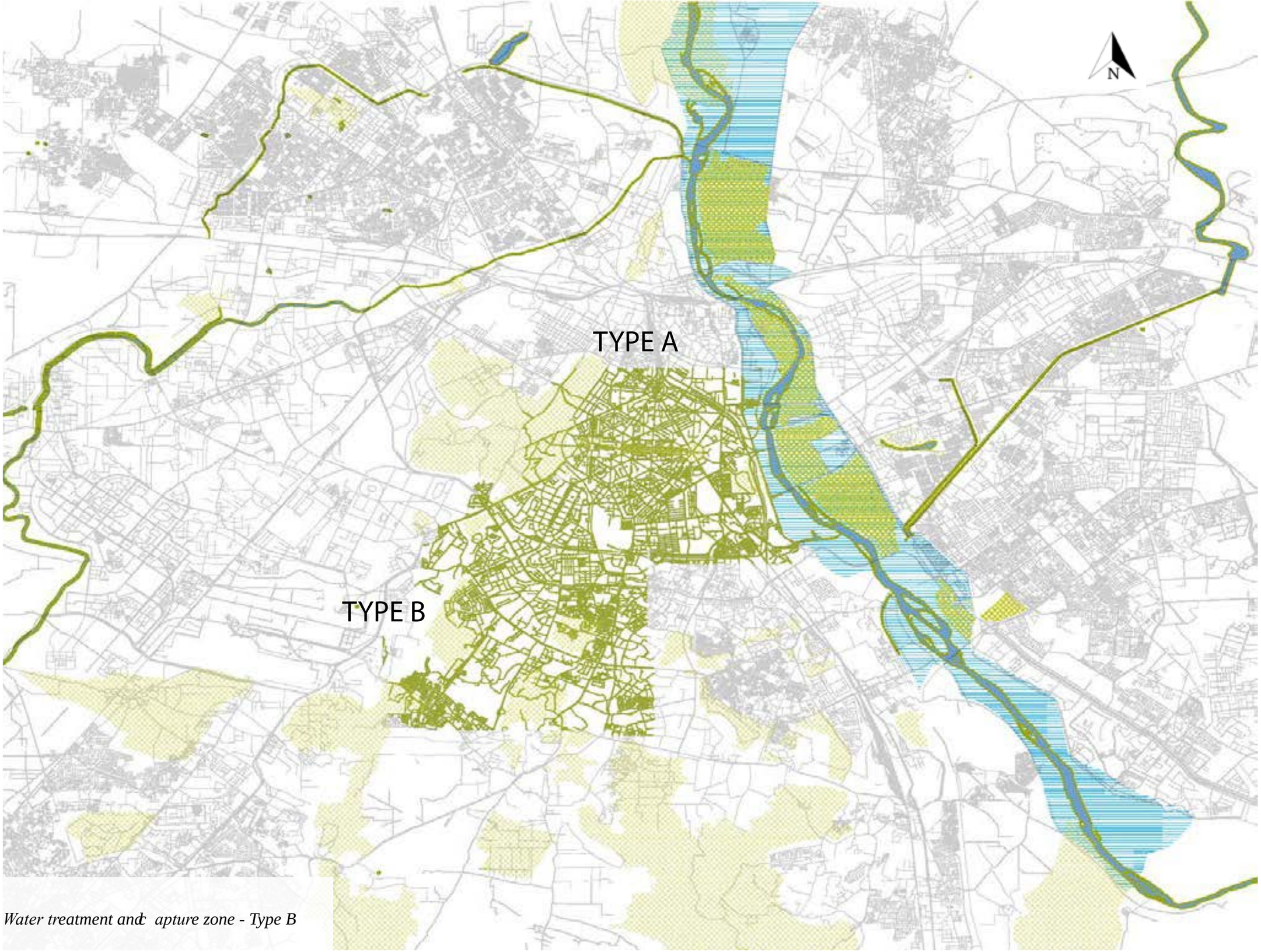
'The green lens' cross section of of Najafgarh d ain



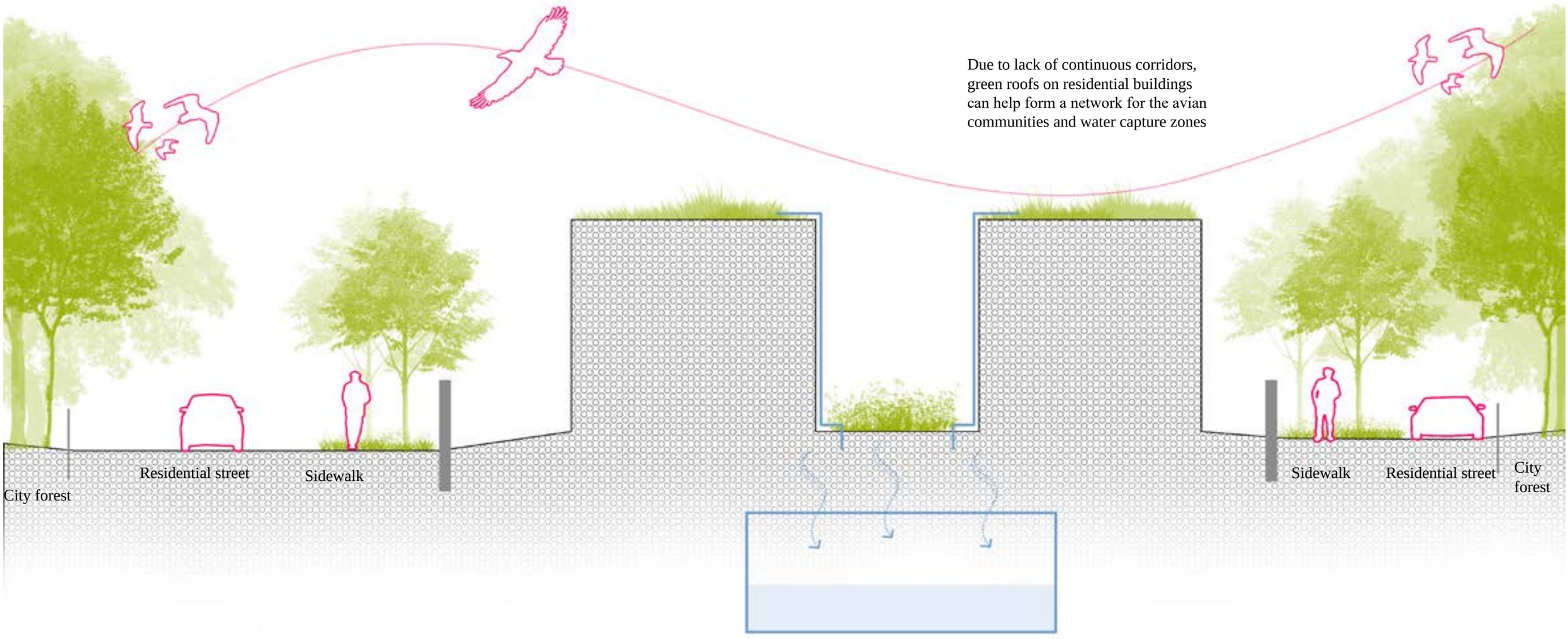
Water treatment and capture zone - Type A



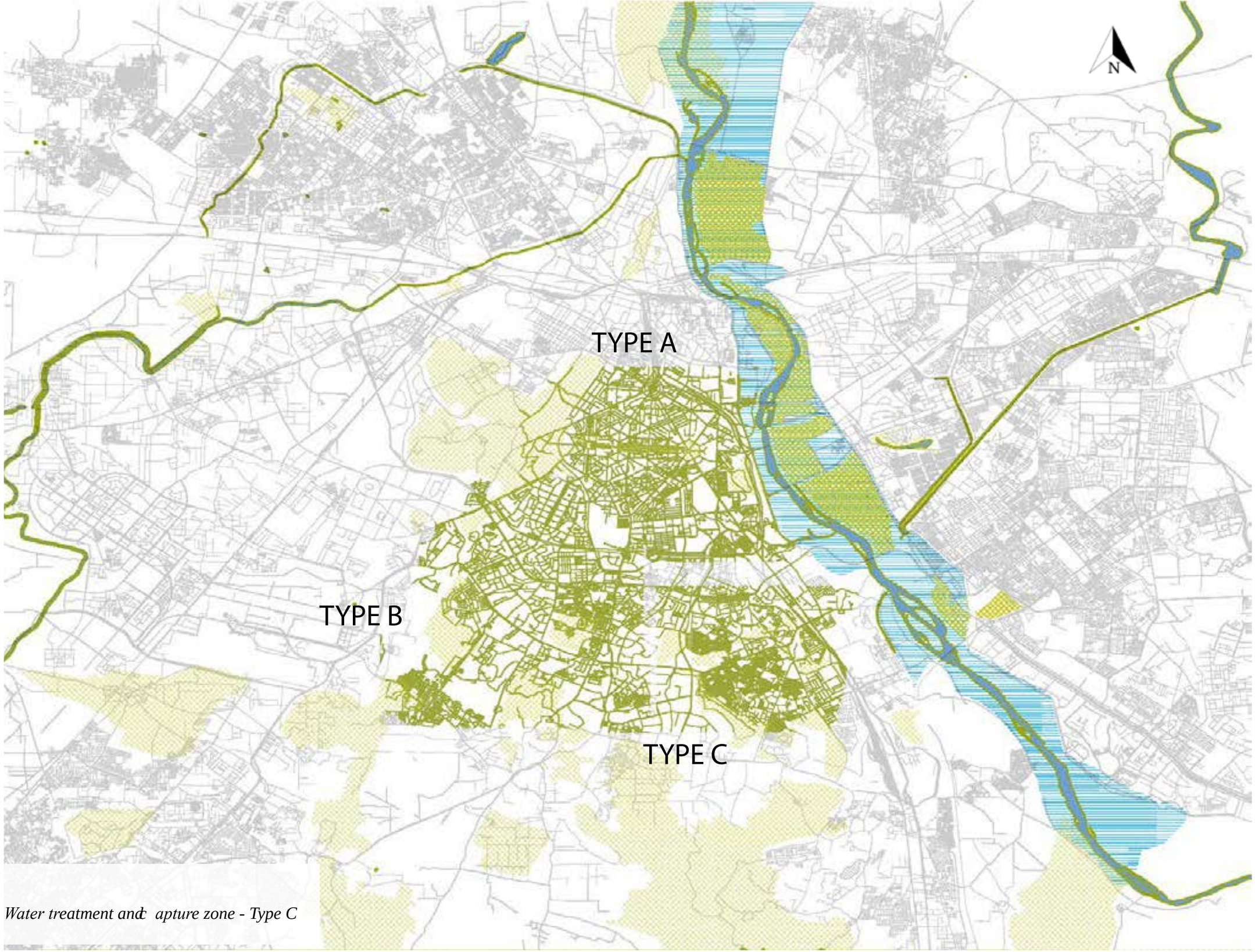
Proposed typical section of 'water treatment and capture zone - Type A'



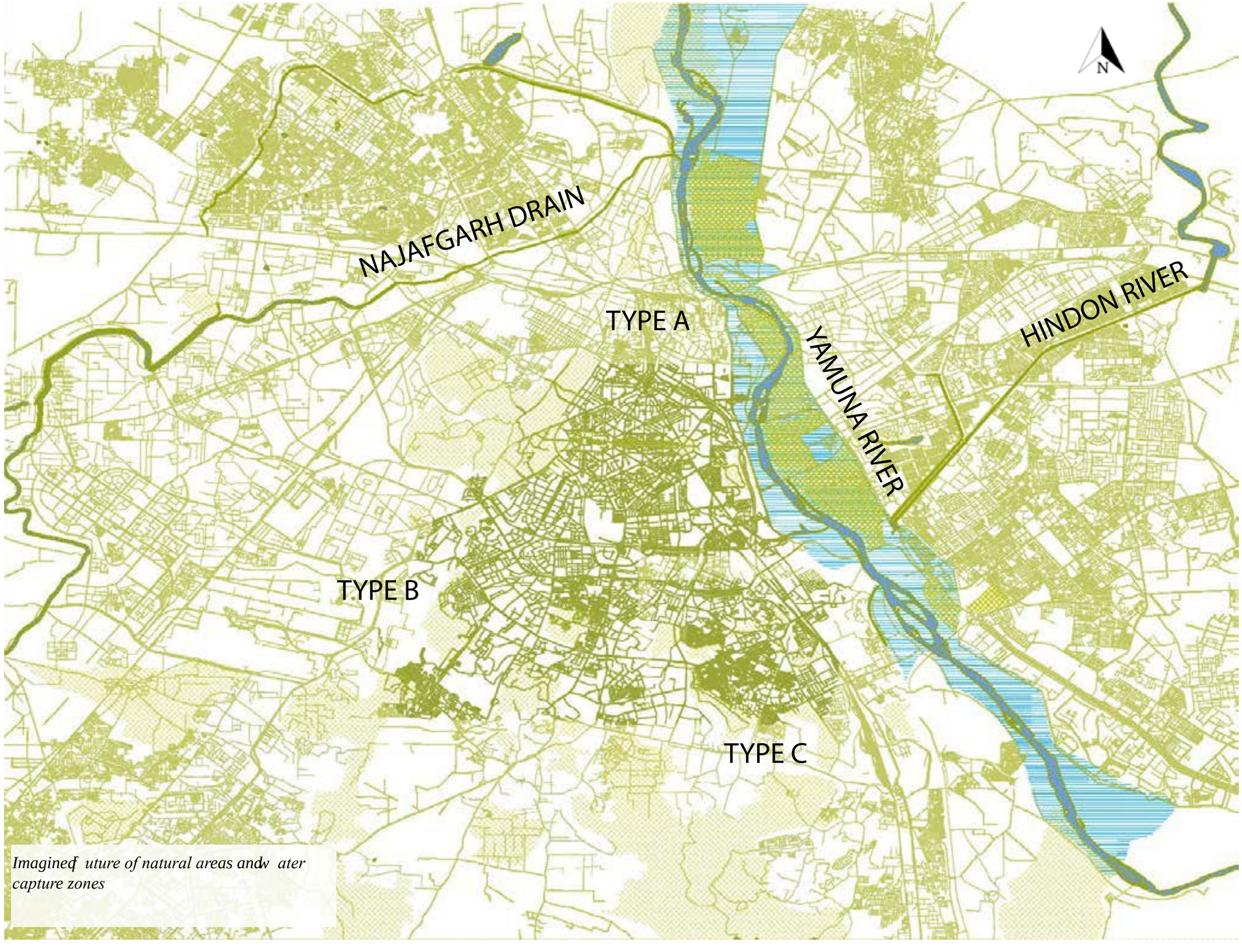
Water treatment and capture zone - Type B



Proposed typical section of 'water treatment and capture zone - Type B' and 'Type C'



Water treatment and capture zone - Type C



Imagined future of natural areas and water capture zones

EXISTING HERITAGE TOURISM ROUTE

ECOLOGICAL CORRIDOR OPPORTUNITY

CONSERVATION ZONES

OPEN GREEN/PARK SPACES

RIVER CHANNEL

FLOODPLAIN

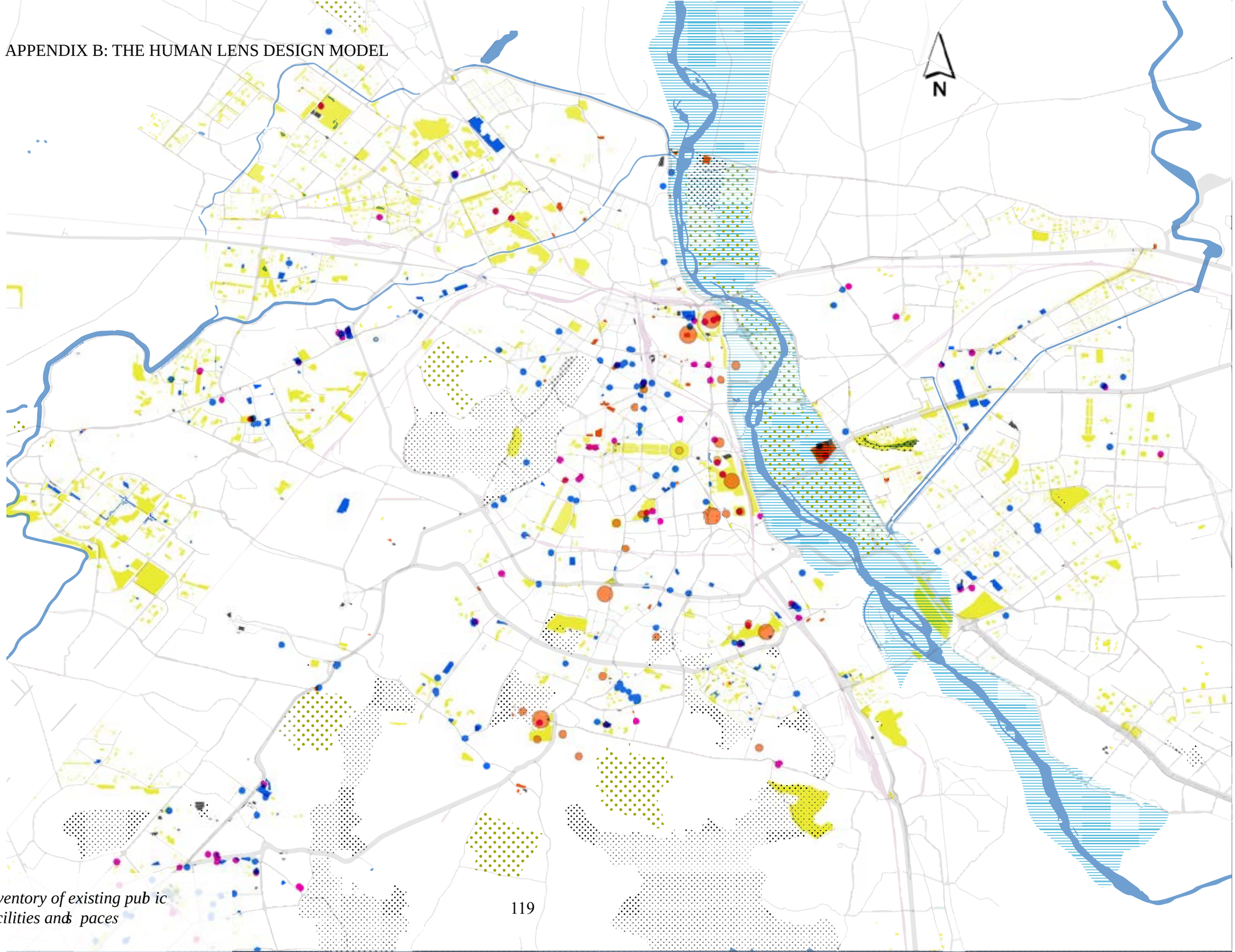
HERITAGE TOURISM SPOTS

N

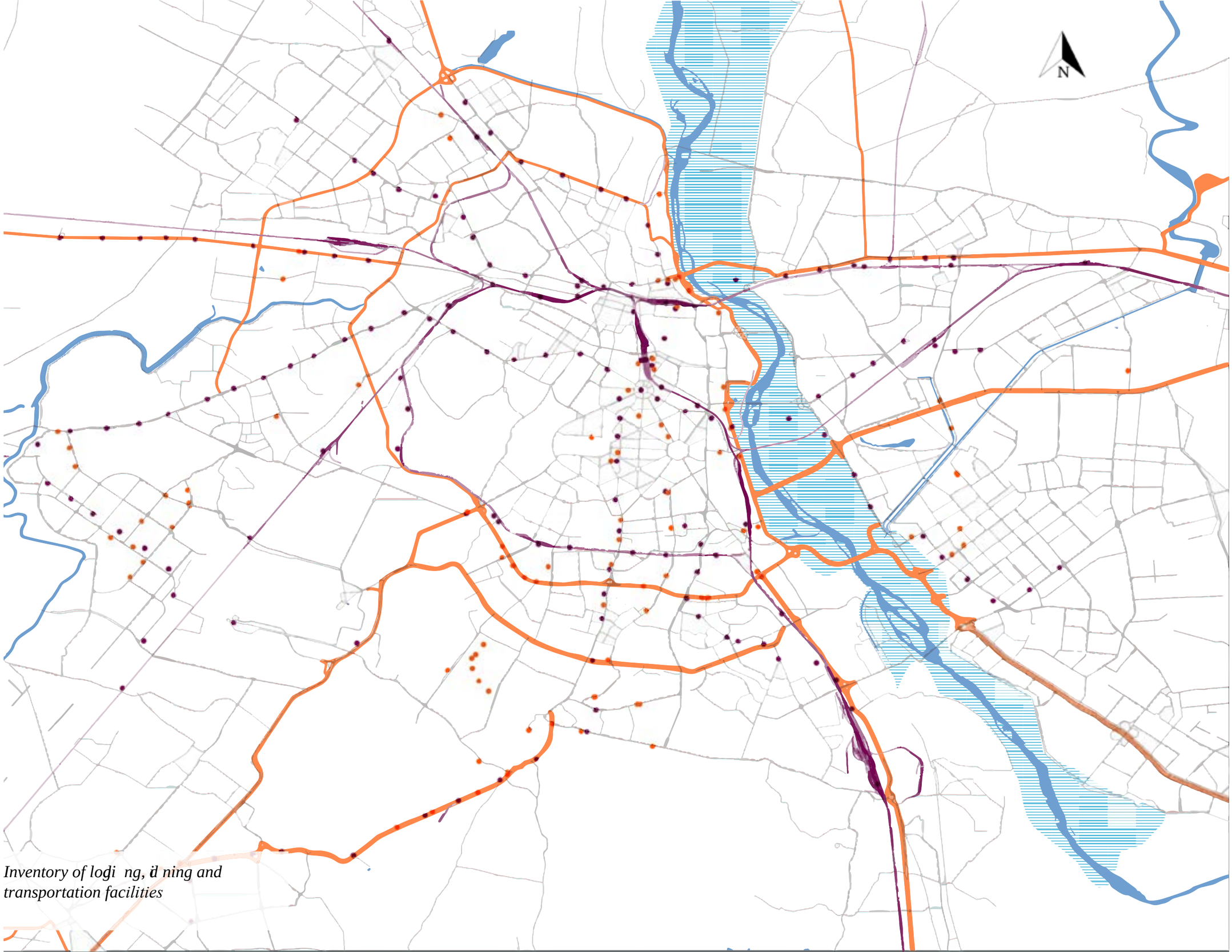
CORRIDOR HEAD

CORRIDOR HEAD

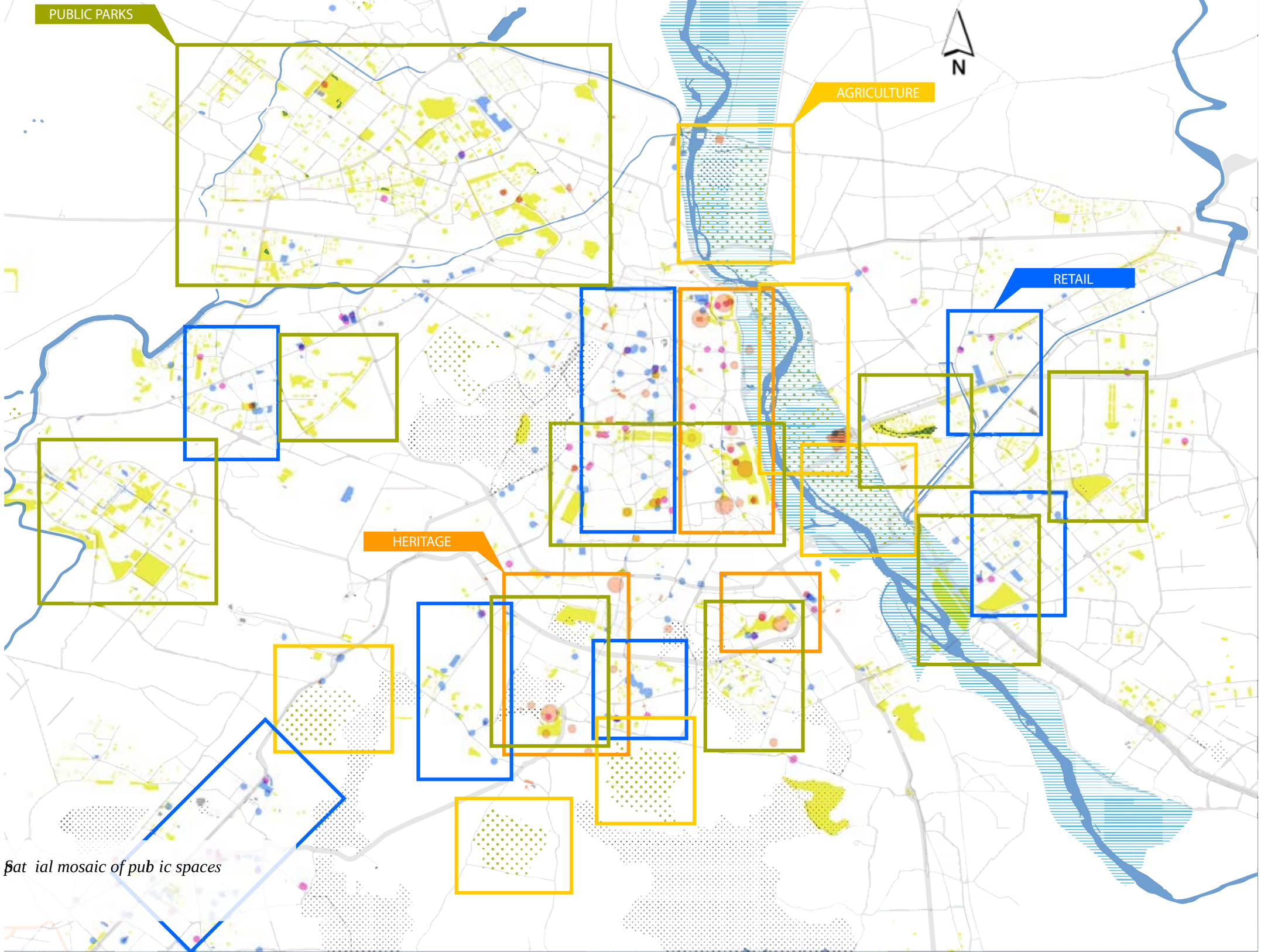
Comprehensive plan of 'the green lens'
design Model



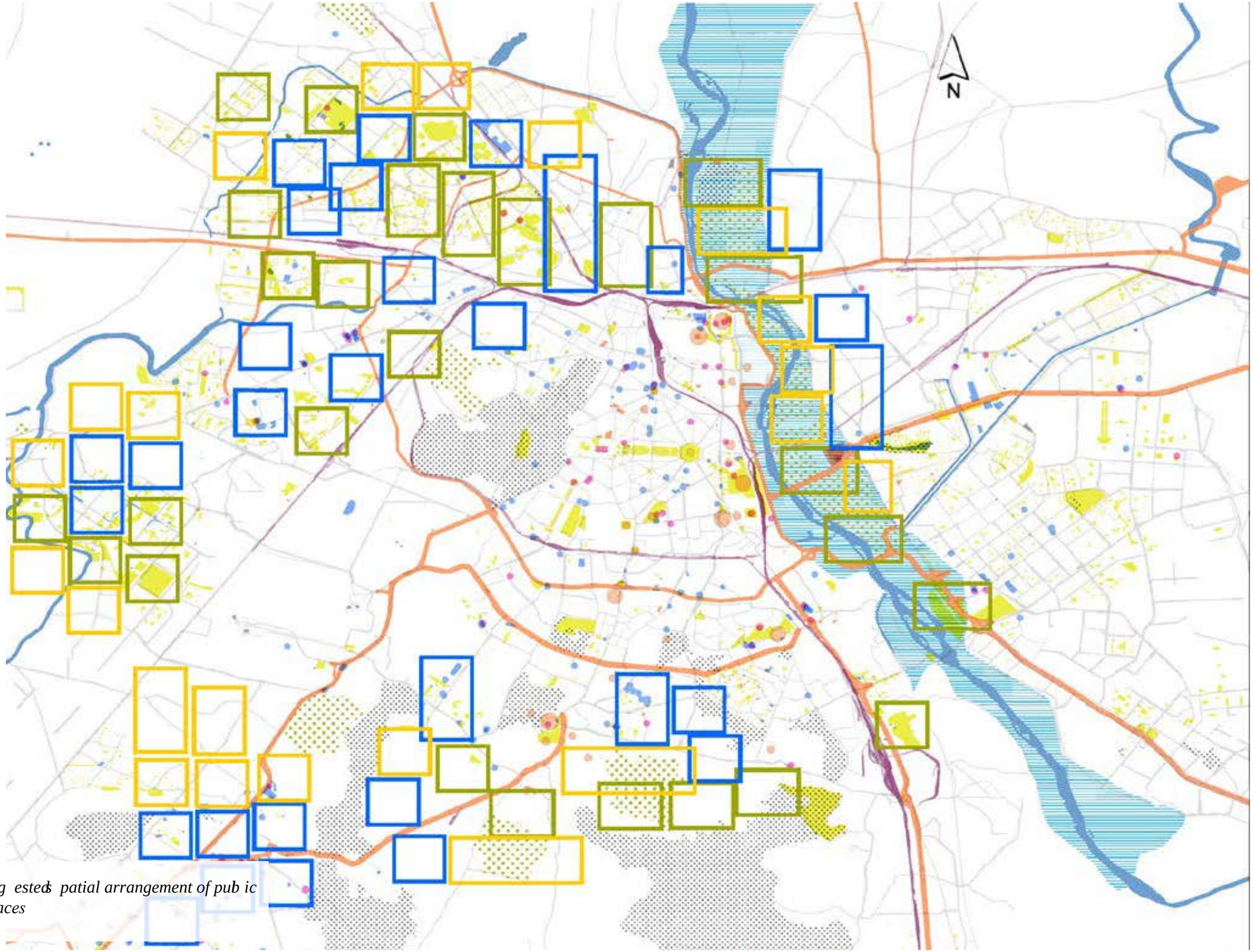
Inventory of existing pub ic facilities and s paces



Inventory of logi ng, i ning and transportation facilities

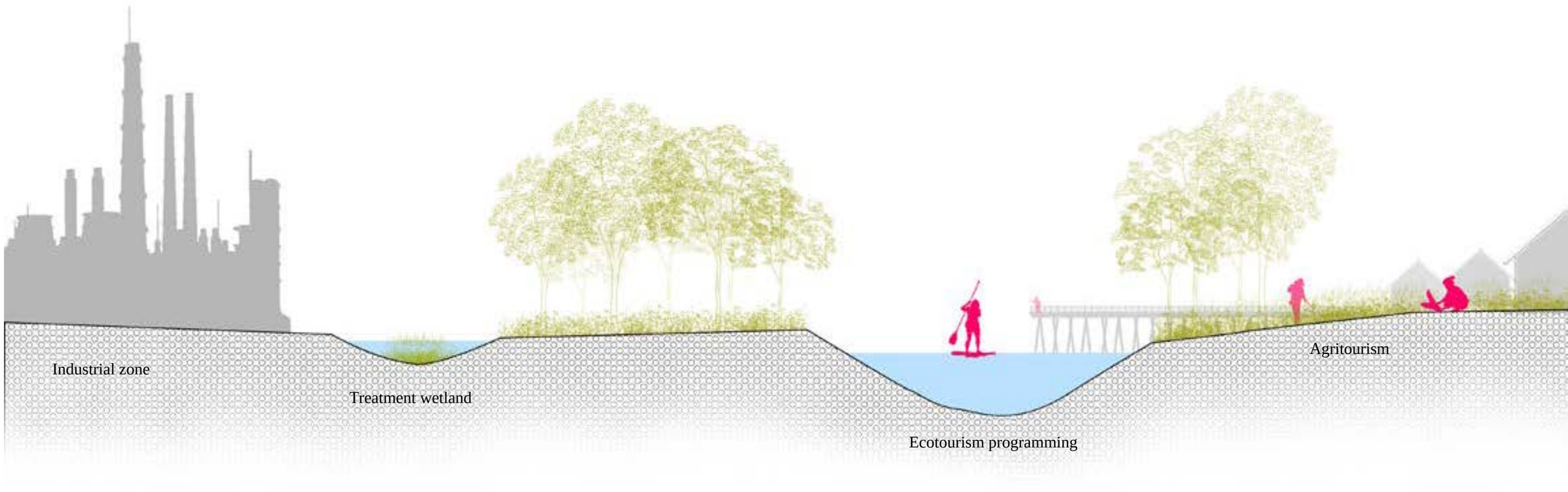


Spat ial mosaic of pub ic spaces



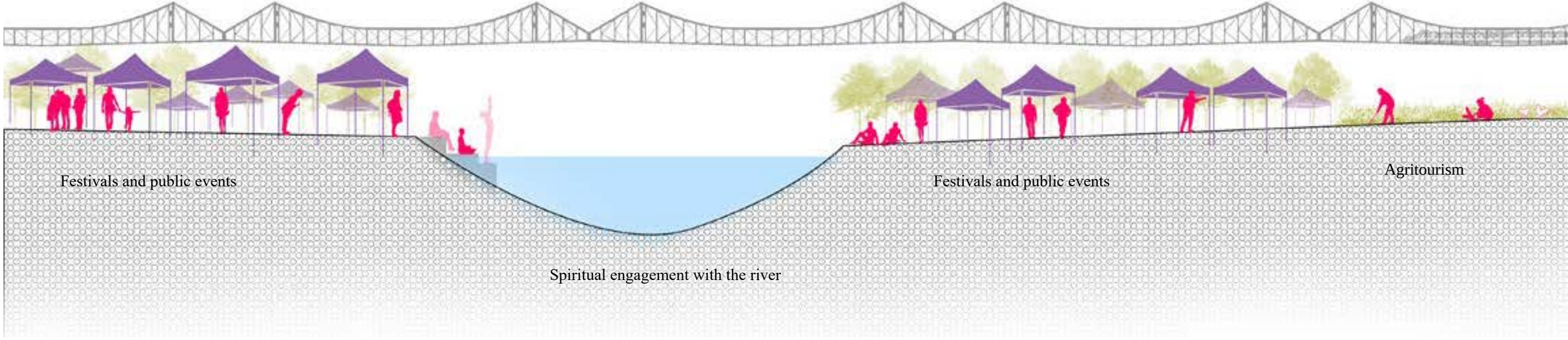
Suggested spatial arrangement of public spaces



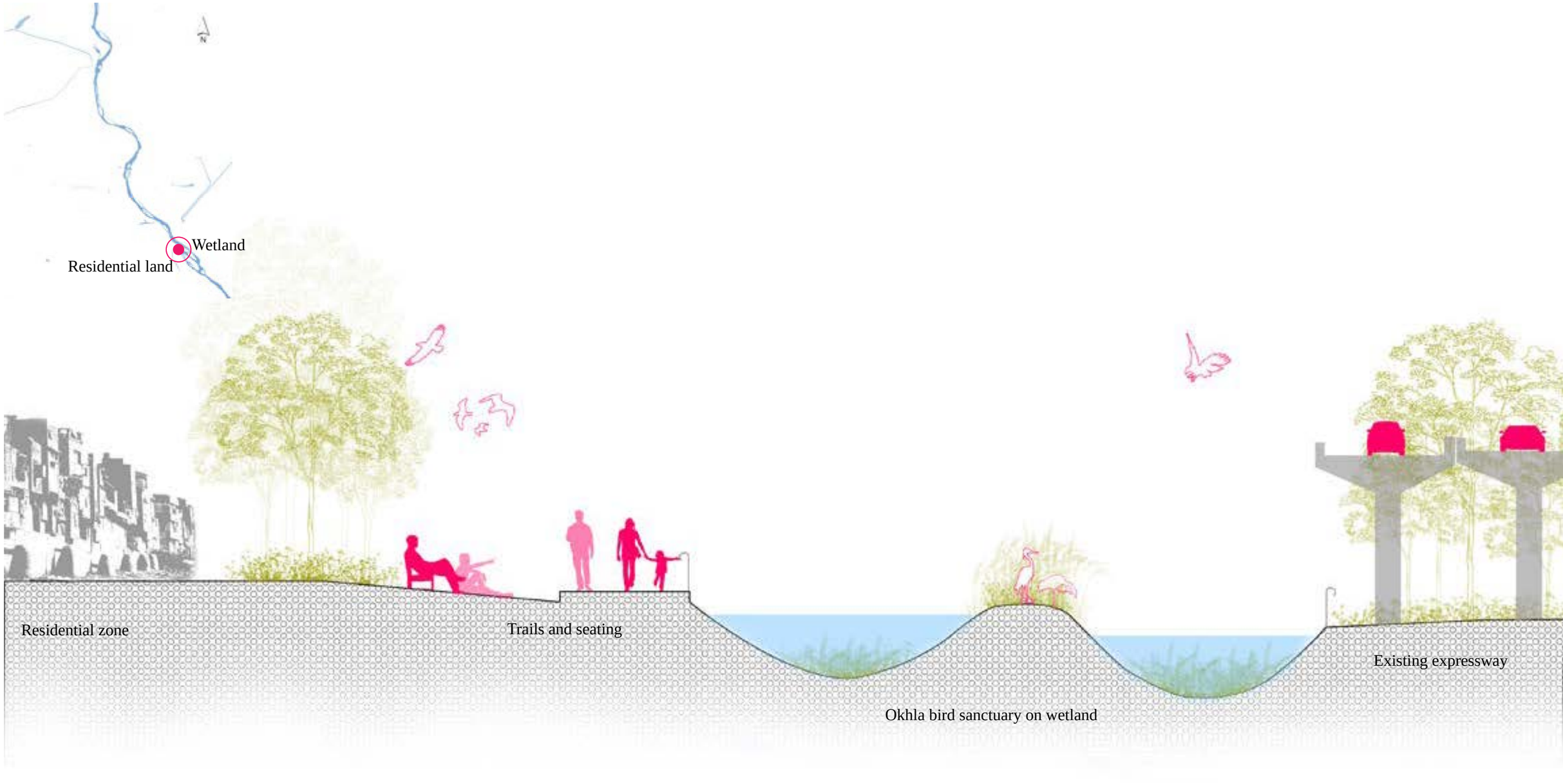


'The human lens' cross section of Yamuna River - Industrial and agriculture zone

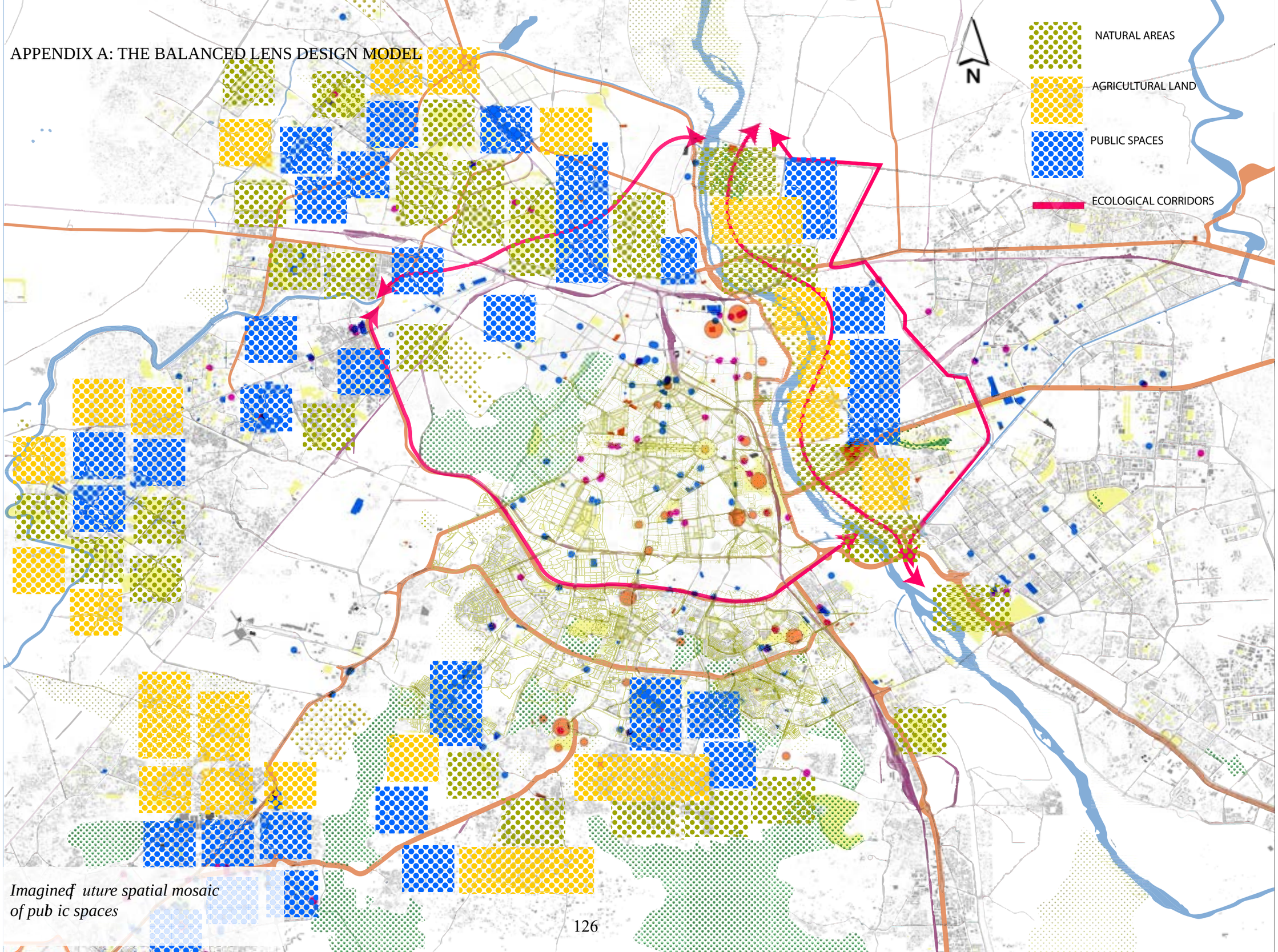




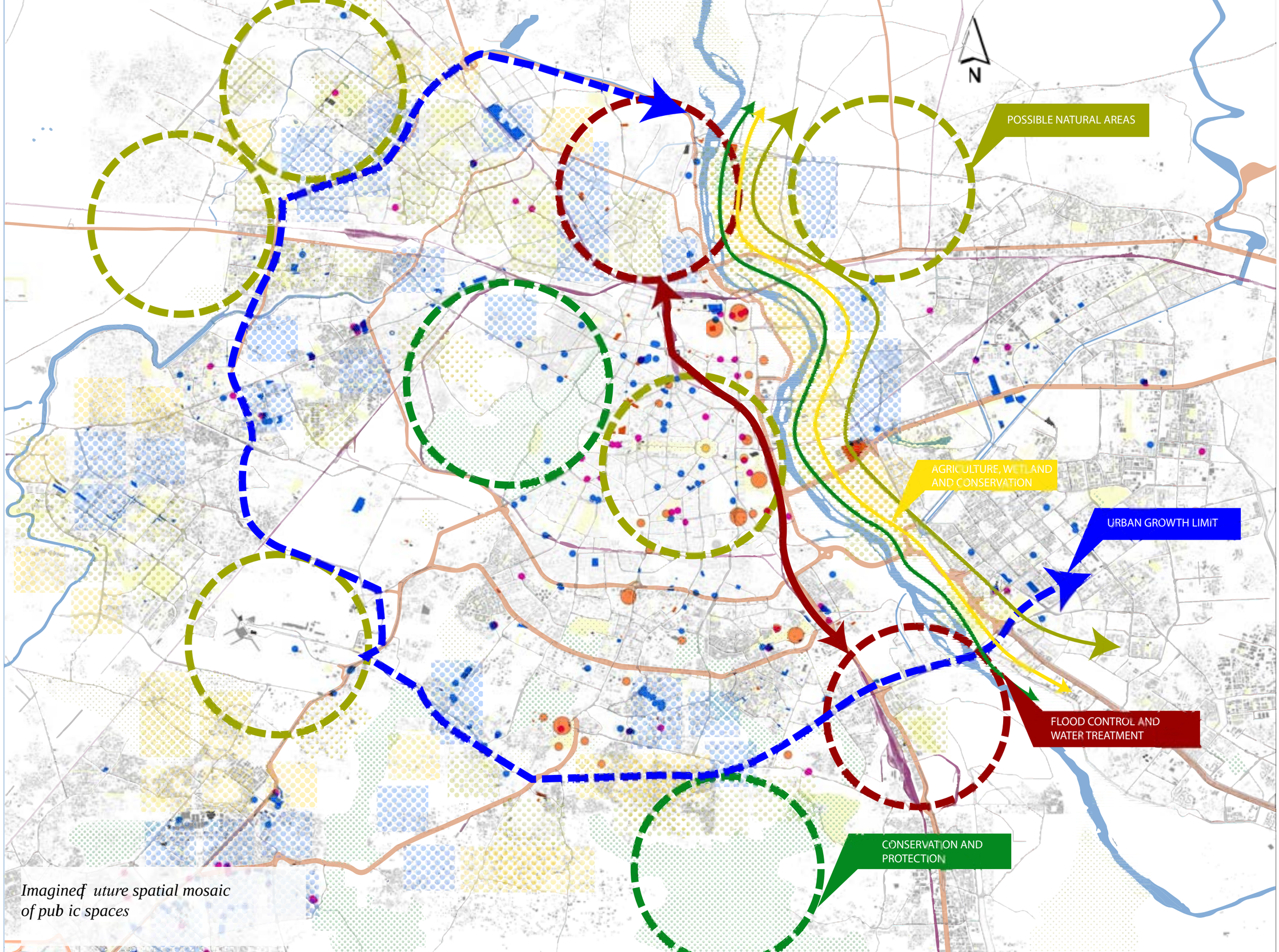
'The Human lens' cross section of Yamuna River - Agriculture zone



'The human lens' cross section of Yamuna River - Residential zone

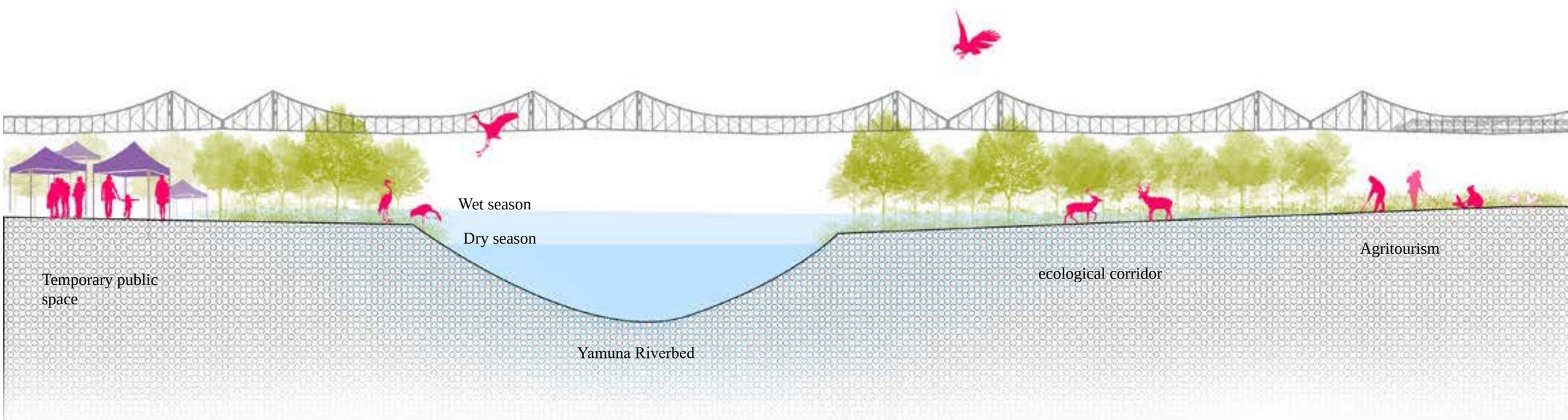


Imagined future spatial mosaic of public spaces



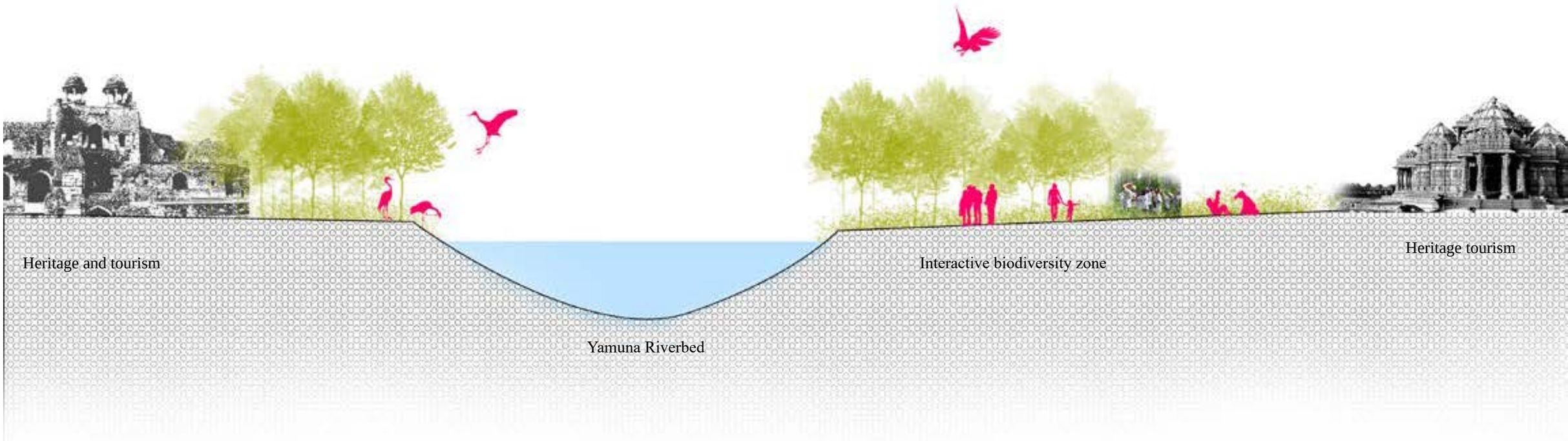
Imagined future spatial mosaic of public spaces



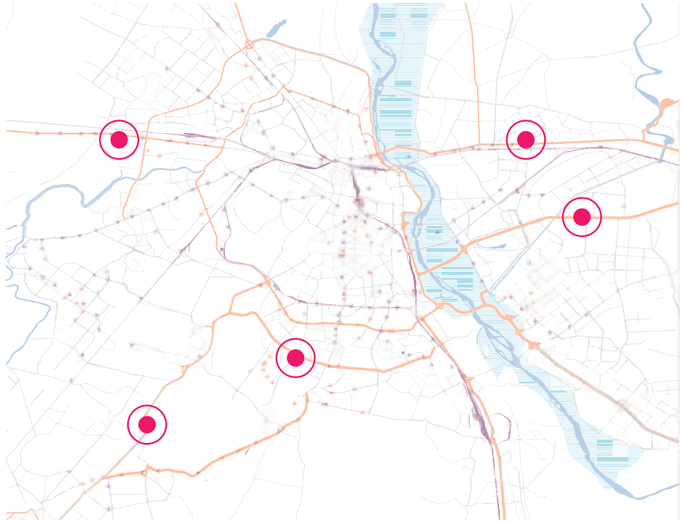


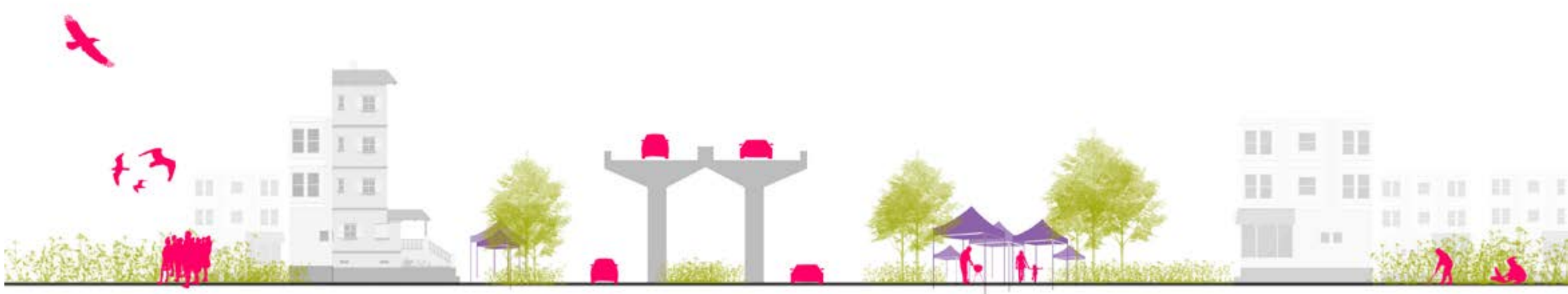
‘The ɓl anced ens’ cross section of Yamuna River - Agriculture zone





'The bl anced ens' cross section of Yamuna River - Heritage zone





'The bl anced ens' cross section of Yamuna River - National Highways to Delhi