STUDY OF TRAPPING AND INTERMIXING OF DELHI DRAINS FOR REJUVENATION OF THE RIVER YAMUNA

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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OF

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ENVIRONMENTAL ENGINEERING

Submitted by:

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CANDIDATE'S DECLARATION

I, Prateek Shukla (2K18/ENE/08), student of M.Tech (Environmental Engineering), hereby declare that the project Dissertation titled '**STUDY OF TRAPPING AND INTERMIXING OF DELHI DRAINS FOR REJUVENATION OF THE RIVER YAMUNA'** which is submitted by me to the Department of Environmental Engineering, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the degree of Master of Technology, is original and not copied from any source without proper citation. This work has not previously formed the basis for the award of and Degree, Diploma Associateship, Fellowship or other similar title or recognition.

Place: Delhi Prateek Shukla

Date:

CERTIFICATE

I hereby certify that the Project Dissertation '**STUDY OF TRAPPING AND INTERMIXING OF DELHI DRAINS FOR REJUVENATION OF THE RIVER YAMUNA**' which is submitted by Prateek Shukla (2K18/ENE/08) to the Department of Environmental Engineering, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the degree of Master of Technology, is a record of the project work carried out by the students under my supervision. To the best of my knowledge this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

Place: Delhi

Prof. S.K. Singh

Date:

(Head of Department)

ACKNOWLEDGEMENT

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I express my heartfelt gratitude to my project guide **Prof. S.K. Singh** for giving me an opportunity to do my Major 1 project work under his guidance. His constant support and encouragement has made me realize that it is the process of learning which weighs more than the end result. I am highly indebted to the panel faculties during all the progress evaluations for their guidance, constant supervision and for motivating me to complete my work. They helped me throughout by giving new ideas, providing necessary information and pushing me forward to complete the work.

I also reveal my thanks to all my classmates and my family for constant support.

Prateek Shukla

ABSTRACT

This investigation looks at the nearness of contamination of Yamuna in the city of Delhi, from two viewpoints: (i) understanding the idea of catching channels and (ii) setting up little scope Sewage Treatment plants at the purpose of outfall. Getting channel alludes to the catching of 22 depletes legitimately streaming into the waterway Yamuna while setting up of little extension sewage treatment plants would prompt reduction in contamination in the stream. With occasions happening throughout the only remaining century making stream Yamuna dirtied, the investigation centers around the most recent techniques and advancements accessible to abstain from intermixing of sewage and tempest water channels to lessen contamination. Because of blending of tempest water and sewage, the ideal characteristics of the waterway water get corrupted and the measure of broke down oxygen decline impressively. In the event that this water is permitted to go through a sewage treatment plant, at that point it will prompt increment in time of treatment because of increment in release. The investigation likewise incorporates the hypothesis of tributaries of stream Yamuna, Major Drainage issues in the locale, Quality of River water, Water quality issues in Yamuna River and main sources of pollution in River Yamuna. The examination remembers the investigation of fourteen significant channels for the territory of Delhi where channels were legitimately streaming into the waterway Yamuna. Out of the fourteen channels, three primary channels are key supporters of contamination which are Najafgarh channel, Supplementary channel and Shahdara channel. The examination likewise incorporates the investigation of the particular areas where sewage was getting blended in with storm water. The sewage was being siphoned to storm water channel which arrives at waterway Yamuna along these lines expanding the poison fixation in the waterway. The sewage was being siphoned with the assistance of streetcar into the tempest water channel and there were for the most part 39 such areas. After the review of all the individual areas it was reasoned that the work for the restoration of waterway Yamuna is still in running stage and a great deal of

work despite everything should be done. Proper catching of the sewage was not being done

because of inappropriate/helpless activity and support and furthermore checking of stream was not done. It is prescribed that it will be smarter to give decentralized treatment of sewage at the outfall itself in this manner diminishing contamination level in the waterway stream. Despite the fact that the advancement has expanded quickly with the expanding time however there's still parcel to be checked and worked.

LIST OF FIGURES

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LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE

1. MGD: Millions of gallons per day
2.MLD: Millions of liters per day.
3. CN: Commercial and Neighborhood
4. STP: Sewage Treatment Plant
5. BOD: Biochemical Oxygen Demand
6. SBR: Sequencing Batch Reactor

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CHAPTER 1

INTRODUCTION

1.1 Brief

The Yamuna is one of the most significant streams of northern India. It goes through Uttarakhand, Haryana, Delhi, and Uttar Pradesh. It converges with the Ganga at Allahabad in Uttar Pradesh. At once, it was the help for the individuals of the zone, yet today it is one of the most contaminated streams of the nation. In spite of the fact that the Yamuna begins getting contaminated by pesticides and manures as it enters Haryana, the greater part of the contamination happens in Delhi. In excess of 18 million individuals live in Delhi. However it doesn't have an appropriate sewage removal framework.

Nineteen channels from Delhi open into the Yamuna. At once, these conveyed water. But since of the helpless sewage removal framework, water conveying sewage is released into these channels, from where it discovers its way to the stream.

In Delhi, along a stretch, the Yamuna is stifled by water hyacinth—a weed. This is a case of eutrophication. Dead fish are likewise found in the waterway when the rainstorm starts. This is because of the abrupt increment in pesticide and other contamination levels.

Mechanical squanders additionally discover their way into the waterway from huge modern units (22 in Haryana, 42 in Delhi and 17 in Uttar Pradesh) and numerous little mechanical units. Shockingly, however Delhi comprises just 2% of the catchment zone; it is liable for 80% of the contamination of the waterway.

1.2Tributaries of River Yamuna

In the upper spans of River Yamuna, there are a few slope streams consolidating to shape the standard. There are four primary streams that joins Yamuna in the higher Himalayan reaches, these are Rishi Ganga, which joins on the correct bank of Yamuna, where as Unta and Hanuman Ganga joins on left bank. In the lower Himalayan extents the Yamuna River gets Kamal, Tons, Giri and Bata on its correct bank and on left banks gets Aglag and Asan. The Chambal, Betwa,

Sindh and Ken are the significant tributaries joining Yamuna on right bank in plain and on left bank Hindon stream joins River Yamuna. Among every one of these tributaries, Tons at slopes and Chambal at fields are the most significant tributaries as far as their releases. The Tons is the chief wellspring of water in uneven range and by and large conveys more water than standard. In fields, during non-storm period, River Chambal contributes around 5-10 times more water to the Yamuna than its own stream. Notwithstanding, since the year 2003, there is a critical decrease in the water amount that River Chambal releases into the Yamuna River.

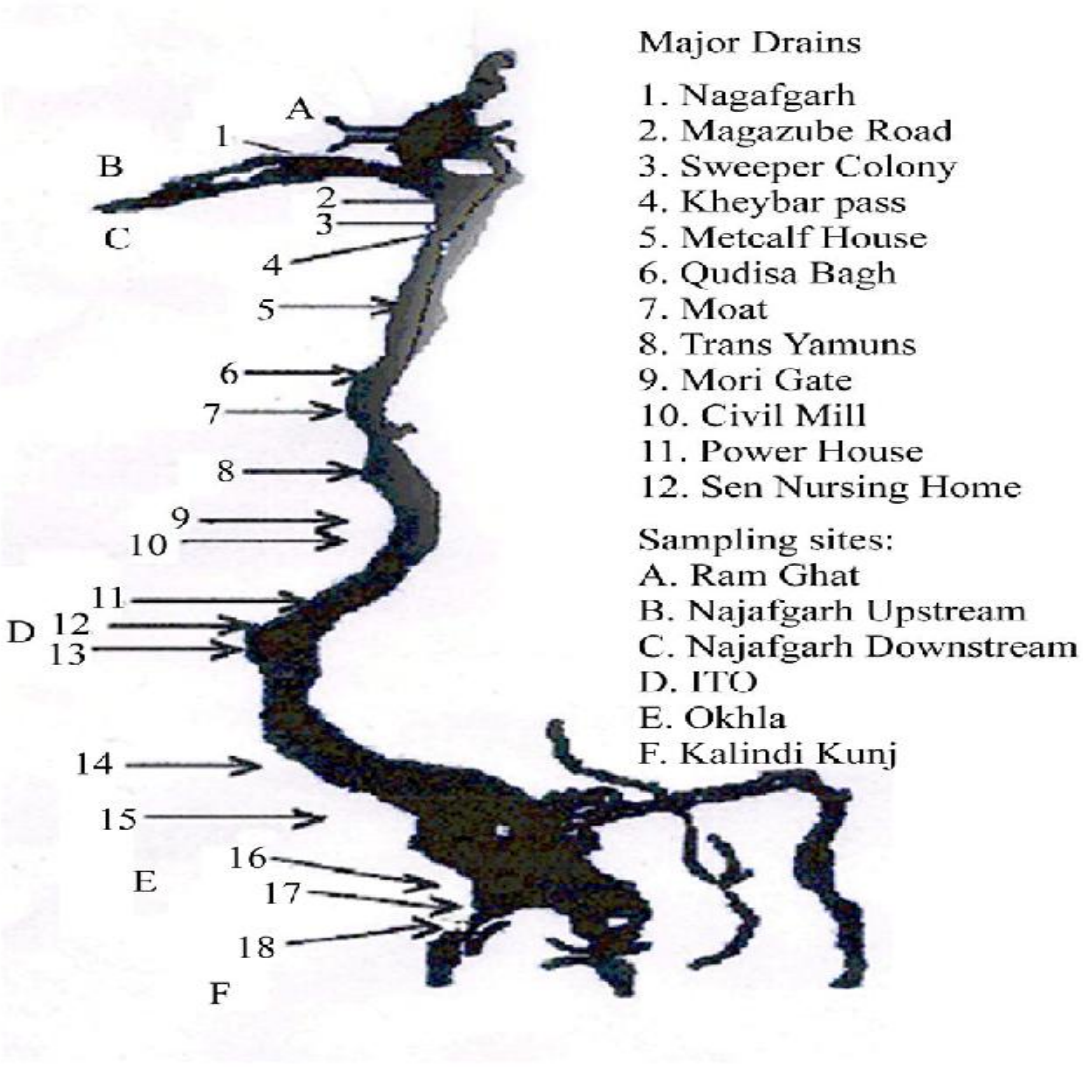


Figure 1: Map showing major drains of Delhi

1.3 Major drainage problems in the region

Fast impromptu urbanization, shallow groundwater level, low to medium rise have brought about incessant flooding issues in the area. The serious issues are featured underneath.

•Increasing cleared surface, diminishing water permeation and expanding spillover.
•Reversal of stream course and lacking/disappointment in siphoning.
•Often the development flotsam and jetsam in the new deplete isn't cleared; trash is dumped out and about side channels. No isolation among sewerage and tempest water framework.
•Low lying zones experience intense seepage clog.
•Encroachment by covering the channel and utilizing the space for stopping.

1.4 Quality of River water

In spite of the fact that the Yamuna River streams just for 54 KM from Palla to Badarpur through Delhi, the 22 KM stretch from Wazirabad to Okhla, which is under 2% of the waterway length of 1370 Km from Yamnotri to Allahabad, represents about 76% of the contamination in the waterway. During the dry season, spreading over about multi month of the year, the stream has no new water downstream of Wazirabad and the main stream accessible is sewage, both rewarded and untreated, coursing through 22 depletes that join the waterway Yamuna every single through it venture from start to finish inside Delhi. The setting up of Sewage Treatment Plants (STPs) and Common Effluent Treatment Plants (CETPs) is done to guarantee that the sewage/modern profluent doesn't discover its approach to channels which in the end joins the stream, other than a few different measures.

1.5 Water Quality Issues in Yamuna River

The majority of the streams including River Yamuna are profoundly viewed as mother. Individuals from everywhere throughout the nation visit different stretches of this stream particularly at Yamunotri, Paonta Sahib, Mathura-Vrindavan and Bateshwar to take heavenly dunk in waterway water to cleanse away their transgressions. Hence, the stream depicts Indian

culture and conventions.. The issues related with water nature of Yamuna are amassing of contaminations in the catchment zone, stylish worth, deforestation in the catchment territory, decrease in the amount of water and expansion of sewage release into the stream.

1.6 Main sources of pollution in River Yamuna

The Yamuna River enters Delhi close Palla and navigates around 48 kilometers.The stretch of Yamuna in Delhi is around 22 kilometers beginning from Wazirabad and consummation at Okhla. In spite of the fact that Yamuna has just 2% of its all out length streaming in Delhi yet at the same time 70 % of the all out contamination stacked in Yamuna is from Delhi. The stretch of River Yamuna is demonstrated as follows.

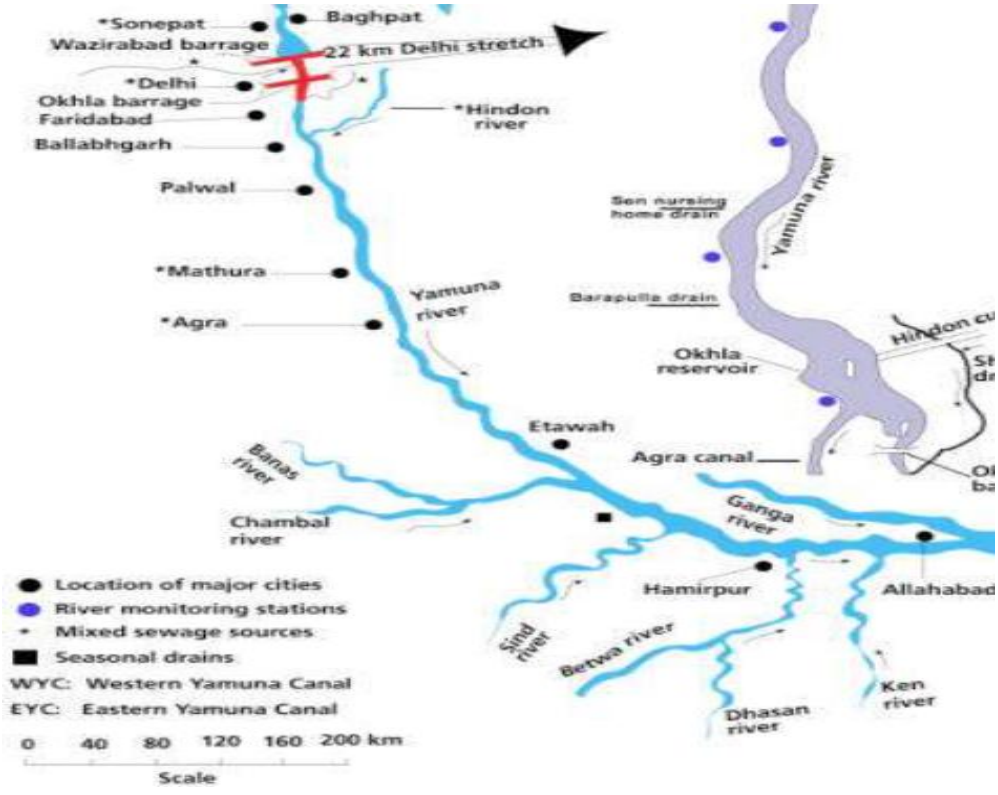


Figure 2: Map showing stretch of River Yamuna

The significant purpose behind the occurrence of contamination in the River Yamuna is because of the progression of 22 depletes straightforwardly into the stream without giving any treatment. Out of the 22 channels, three channels are the key supporters of the contamination which are Najafgarh channel, Supplementary channel and Shahdara channel.

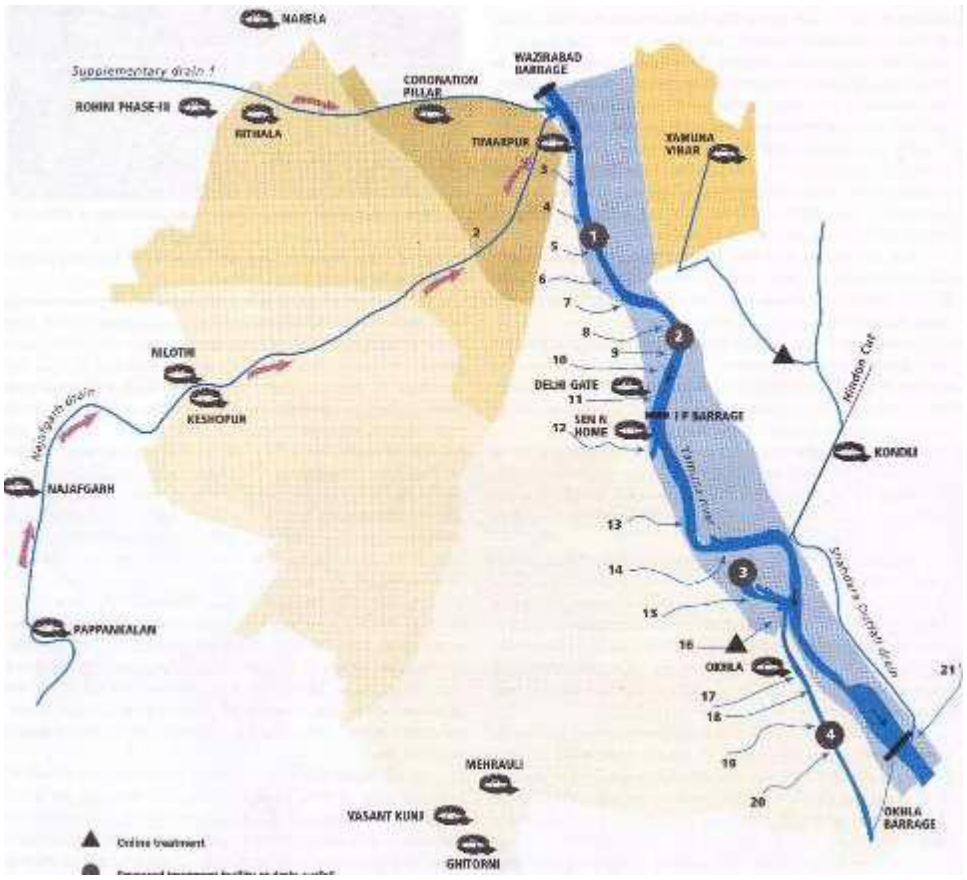


Figure 3: Three key contributory drains

The significant purpose behind the occurrence of contamination in the River Yamuna is because of the progression of 22 depletes straightforwardly into the stream without giving any treatment. Out of the 22 channels, three channels are the key supporters of the contamination which are Najafgarh channel, Supplementary channel and Shahdara channel.

1.7 Organization of Thesis

Chapter 1 'INTRODUCTION' presented the brief of the details of River Yamuna and its tributaries. It also includes the current water quality issues of the river along with the major sources causing pollution in it.

Chapter 2 'LITERATURE REVIEW' shows the background studies of the river, drainage conditions of the city and design of small scale sewage treatment plants by reviewing the research papers presented by various students and professors.

Chapter 3 'METHODOLOGY' shows the theory of the approach carried out during inspection

and various locations that were inspected.

Chapter 4 ‘OBSERVATIONS AND RECOMMENDATIONS’ illustrates the various details of the carried out inspection of drains and the recommendations that can be applied.

Chapter 5 ‘CONCLUSIONS’ basically shows the summary of this study and its future scope as well.

CHAPTER 2

REVIEW OF LITERATURE

2.1 General

The literature survey related to River Yamuna, Drainage conditions of the city and design of small scale sewage treatment plants was gathered and shown in upcoming section.

2.2 A river and the riverfront: Delhi's Yamuna as an in-between Space, Awadhendra Sharan

The wandering stream couldn't proceed with over the top for long. Neither could city specialists stay energetic about the degree to which the stream was being influenced by the regularly expanding measure of waste streaming into it. Another stage in the urbanization of the Yamuna had started in the wake of freedom/parcel in August 1947, even as the stylish creative mind, had stayed a lot of the equivalent. Inside a month, the waterway was dependent upon an enormous flood with neighborhood papers giving an account of the marooned individuals and steers between the Yamuna and the Hindon streams on the eastern side, crops harmed and kutcha (made of reeds) houses completely washed away.

This exposition has inspected the verifiable changes in and around Yamuna in Delhi, with a specific accentuation on changes that have happened over the recent decades. In this activity we have attempted to look at the changed manners by which the stream has worked an in the middle of room, not simply geologically (being arranged inside the city limits) yet in addition thoughtfully. While from one viewpoint, the recurrence and force of expulsions has expanded as the waterway has tried to be 'cleaned', on the other, the state's forces to make 'special cases' has prompted advancements of megaprojects, regardless of whether on the floodplains. The article has additionally underlined the significance of the waterway as an envirotechnical framework, while referencing the long history of innovative improvements as bunds and sewage treatment plants, through which the morphology of stream and nature of the stream water have been affected in Delhi.

2.3 Drainage Master Plan for NCT of Delhi, A. K. Gosain R. Khosa

The suggestions that can make a tempest waste framework to work in an effective way are referenced underneath:

A) No infringements on storm channels

• Storm channels ought to be treated as key open resources and no infringement ought to be permitted. Any infringement of the channel ought to be quickly expelled and announced back.

B) No sewage in storm channels

• No characteristic or counterfeit tempest channel ought to be permitted to convey any sewage. Just regarded sewage of adequate quality according to CPCB standards ought to be permitted in storm channels.

• No sewage ought to be permitted to enter the tempest empties even out of unapproved settlements; interceptor sewers ought to be set-up any place required.

C) No Solid Waste or C&D squander be permitted into storm channels

• No sediment from the street (previously or after street clearing – manual or something else) ought to be permitted to be dumped into ringer mouths/channels. Street clearing procedure ought to be totally redesignd. • No strong waste ought to be permitted to be dumped into storm channels.

• Construction and Demolition (C&D) waste ought not be permitted to be dumped in storm channels or melancholies. Measure of waste liable to be produced from a development or destruction site ought to be surveyed by the temporary worker ahead of time.

Suggestions :

1. No tempest water ought to be depleted into sewer frameworks:

• No tempest channel ought to ever outfall into sewer framework at any expense since they are never intended for such circumstance and will consequently bring about extra charge of sewerage organize and may flood a portion of the regions with sewage. Every single such case ought to be recognized and quickly tended to. No such cases (transitory or changeless) ought to ever be permitted.

• Practice of opening sewer man-gaps to release neighborhood storm water ought to be restricted. Satisfactory framework to release storm water ought to be set up and open mindfulness ought to be expanded towards sick impacts of redirecting storm water into sewer lines.

• Similarly, house-holds depleting storm water into the sewer lines ought to be punished.

2. No development ought to be permitted inside any tempest channels.

No such action ought to be permitted. Likewise, in the areas such trade off of the segment has occurred, sufficient measures ought to be taken promptly to reestablish the first conveying limit of the tempest channel.

3. Structure of new tempest channels ought not be done in disconnection

• Overall effect of any new channel on the current tempest seepage framework ought to be considered.

• Data gathered and displaying framework conveyed as a feature of this examination ought to be utilized for checking structure plausibility of any new depletes.

• Different situations have been conceived and introduced in this report to recreate the overall conditions just as the mediations required to mitigate the flooding conditions in different pieces of the city. In the wake of executing the suggested rehearses, more situations can be later presented, further improving the productivity of the seepage system of the city.

4. Revival of water bodies

• Dumping of waste into water bodies ought to be precluded to keep up encompassing water quality.

• Regular desilting ought to be embraced to stay away from decrease away limit of the water bodies.

• No infringement or unapproved development in wetlands ought to be allowed.

5. Low Impact Development (LID) Options

So as to investigate extra choices for removal of the staying abundance water, it is prudent to investigate the nearby conditions in a far reaching way and any place attainable, distinguish different Low Impact Development (LID) choices, for example, invasion channels, downpour gardens, bio-maintenance lakes, bio-swales, and so on in particular contributing zones of every one of the channels.

6. Successful authoritative administration

There ought to be a solitary organization that bears a general duty of the administration of the absolute tempest water seepage framework inside NCT of Delhi.

2.4 Monitoring Committee Reports, Rejuvenation of the river Yamuna, The Interceptor Sewer Project Issues

Out of the considerable number of channels falling into the waterway Yamuna, 75% of

contamination is contributed by three significant channels for example Najafgarh, Supplementary and Shahdara. Untreated sewage which originates from littler depletes all streams into these three significant channels. This sewage is coming from1800 unapproved provinces with a populace of 68.40 lakhs according to DJB Report. The greater parts of these settlements are unsewered. Since laying sewer lines and giving availability of every family to sewage treatment plants is a drawn out objective, in a short and medium term, the Interceptor Sewer Project tries to trap sewage at the purpose of conjunction of the littler channel and a bigger channel, similar to the Najafgarh channel, and to pass on the sewage through a trunk sewer line. The building plan is to trap the sewage by developing Intercepting Chambers and laying Interceptor Sewers along the banks of the channels. Around 57 kilometers of sewer lines are to be laid by Micro Tunneling and Pipe Jacking technique.

Fix and Maintenance of Drains:

There are 22 depletes that join Yamuna in Delhi, including Shahdara outfall channel which joins downstream of Okhla. These channels convey 3911 MLD of waste water, both rewarded and untreated, (CPCB report for the year 2017) which is discharged into the waterway Yamuna. Despite the fact that the Report had expressed that there are 210 common tempest water channels of which 157 must be situated, according to the data currently got from DJB, the quantity of channels (characteristic and counterfeit) in the catchment of Najafgarh, Supplementary and Shahdara channel is 376 NGT had given point by point headings which are related underneath as they are on the whole monitorable.

i. Real number of channels which are associated with STPs either straightforwardly or in a roundabout way ought to be mapped and no sewage or mechanical gushing be permitted to course through the channels and depletes joining bigger channels ought to be caught at the outfall point and passed on through Interceptor sewer line to STPs.

ii. Sewage stream from eleven channels out falling into Yamuna which have been caught and sewage passed on to STPs ought to be without sewage as six of these channels on review, were found having sewage in them.

iii. Six channels, specifically, Shadara, Qudasia bagh (Mori entryway), Barapulla,, Maharani Bagh, Kalkaji and Tekhand channels must be caught.

2.5 Storm water audit

Numerous schools have huge territories of hard surfaces like vehicle leaves, b-ball courts, get together regions or solid quadrangles. These hard surfaces increment the measure of pursue off downpour. This run-off, called stormwater, can convey soil and trash with it to the closest stormwater channel. These channels structure some portion of a nearby stormwater arrange, which lead to the closest conduit.

By doing a storm water review, we can:

• discover what toxins get into channels from the school

• work out the wellspring of these contaminations

• make a Stormwater Management Plan to lessen contamination in the channels.

• help to lessen stormwater contamination in nearby conduits.

Prior to the review

• Get an ethereal guide of the neighborhood network, fixated on the school and demonstrating the nearest conduit (maps are accessible from Google Earth or your nearby chamber). Take a gander at the guide to discover where stormwater from your school goes. This will generally be the nearest conduit like a stream, waterway or sea. In the event that the guide has forms (lines demonstrating regions of equivalent tallness above ocean level), this will help show which heading the water streams.

• Talk about how clean the nearby conduit is and any undeniable connects to the stormwater channels in the school and neighborhood network.

• Talk about the distinction among stormwater and wastewater (sewage).

• Divide into gatherings of five or six understudies with a copyist for each gathering. Each gathering ought to have a review sheet and an A3 guide of the school grounds indicating all structures. A few schools might have the option to get a stormwater map from school resource directors.

• Make sure everybody thinks about being protected around stormwater channels.

2.6 Small Scale Sewage Treatment Plant

Accomplices may discover accessing and deciphering data for little scope STPs in India risky. Earlier challenges have included:

• Obtaining information for advances at an applicable scale—a great part of the information

accessible will in general be for bigger city scale sewage treatment frameworks. In any case, this scale isn't as significant for RT (i.e., cost information doesn't interpret).

• Understanding the specific design/set-up of genuine little scope frameworks and absence of regular definitions and wording used to depict them—a considerable lot of the frameworks are gotten from a couple of base innovations, yet are equipped with a blend of highlights and segments that lead to an expansive exhibit of complete frameworks. These frameworks frequently have differing highlights, input necessities, and emanating measures.

• Understanding the quality degree of the profluent created by explicit little scope frameworks so as to draw correlations dependent on execution.

• Understanding what precisely is remembered for capital expenses for these little scope frameworks; accomplices of the Foundation will explicitly need to comprehend value bends (CAPEX of frameworks over treatment limit) with regards to various framework types.

The point of this focused on task was to get definite data on decentralized, little scope sewage treatment frameworks in India, with an emphasis on setup, execution, and capital/activities expenses of explicit frameworks. STeP verified that the accompanying three STP types were most noteworthy need for this undertaking:

• Moving Bed Biofilm Reactor (MBBR)

• Sequencing Batch Reactor (SBR)

• Membrane Bioreactor (MBR)

2.7 Small Scale Waste Water Treatment Plant, **SOPAC Technical Report 288, July 1999**

The starter standards of the little scope wastewater venture, given its destinations, was controlled via cautious thought of what was significant when making wastewater mechanical decisions. Standards were then organized, after which a table was set up rating every innovation against these standards for better assessment. General suppositions should be made to maintain a reasonable spotlight on the venture targets. In the event that these suppositions were not settled on, at that point the decision of innovation would be confined to a chose not many. The supposition that will be that there is sufficient economical water gracefully for the utilization of waste removal. The innovation picked should deliver emanating quality that is up to standard with respect to the different quality estimations: BOD, suspended solids, nitrogen, phosphates and so forth. Various advances give various degrees of waste treatment, expelling contaminants by different techniques. All choices must be deliberately considered concerning the treatment

quality that is accommodated by the various advances. This is a significant measure and is the deciding element in the adequacy of the various innovations picked As far as emanating quality created the evaluations are as per the following:

Low Effluent Quality, Moderate Effluent Quality, High Effluent Quality.

Water is utilized in squander removal fundamentally for the transportation of sewage from one spot to the next despite the fact that it is utilized in the natural debasement of natural issue in a specific way as well. The supposition made was that there is sufficient water provided for this utilization also as supported for proceeding with future use for either reason. Water is set here in the standards since it is a key perspective in separating innovations. Without water, it is hard to transport the sewerage to another site to be dealt with. This permits just a single alternative for on location treatment, by the utilization of fertilizing the soil latrines. Areas that are not fit for giving this water prerequisite would then be restricted to location treatment choices. To support water flexibly, a moderate sum must be utilized for this. The purpose behind a constrained land space prerequisite is that land issues are consistently an issue and must be taken care of cautiously. In a town, land might be possessed by numerous families each guaranteeing their own piece. This family possession doesn't just incorporate the close family, however incorporates the more distant family also, bringing about numerous individuals claiming a real estate parcel.

Land made sure about for squander treatment would be hard to get. This is additionally positioned high on the list in light of the fact that regularly there is constrained land accessible and this should be considered while picking an innovation. Despite the fact that this would confine our alternatives, constrained land accessibility regularly can't be survived. It was expected that a specific level of upkeep is required and furthermore a talented workforce to perform support and operational obligations when required. The upkeep of a wastewater treatment framework is then surrendered over to the townspeople themselves after usage where it is expected that at any rate one resident has the capacity to manage the activity and upkeep of the framework. Despite the fact that the activity and upkeep of the framework might be looked into every now and then by the important gatherings it is frequently left to the residents themselves over the long haul. The best possible upkeep of the picked framework would be a restricting component as far as the maintainability of the undertaking at the town level, as it has been seen from past encounters that regularly upkeep has not been agreeable. To defeat this, appropriate

support and activity preparing ought to be made accessible to certain individuals who are answerable for this obligation. At times mechanical hardware is imported and when parts need fix or substitution they are not accessible locally so the framework becomes non-operational for a while. This standards is put here in light of the fact that support and activity are significant and need to be viewed as when settling on an innovative decision in light of the fact that the manageability of picked innovation depend on the correct activities of the two. Some expertise would be required for any innovation, decision made as there is no innovation that doesn't require upkeep by any stretch of the imagination. Decisions ought to maybe be coordinated towards generally low upkeep frameworks. Monetary help might be provided by numerous sources. On a town level, financing might be furnished by the residents themselves with the help of nearby government divisions for example Branch of Health and so on. Aside from this, budgetary help may likewise be given from different sources like outside guide programs, etc. At first there would be cost of development after which the running expenses may become effective for example cost of support etc. Cost isn't to be set first on the rundown in light of the fact that inside the extent of this undertaking it ought to not be the deciding component in the sort of treatment framework picked. Be that as it may, individuals now and again take the alternative of a not exactly sufficient framework that doesn't perform agreeably giving out low quality profluent for reducing expenses. The money related assets of the neighborhood thought may not be a lot, however there may frequently be remote contributor support for attractive undertakings and so forth. Electrical force might be utilized from various perspectives in the waste treatment framework for example it might be utilized for siphons to ship the sewerage starting with one spot then onto the next and furthermore may be utilized in advancements including air circulation and so forth. Those advances that are reliant on electrical force for activity can once in a while become non-operational because of intensity cuts. The supposition made is that the prerequisite of electrical force for activity isn't basic in light of the fact that there are advancements that can be picked which needn't bother with power to work. In the event that power can be given this equitable expands the choices of mechanical decisions. This measure isn't put high on the rundown as there are mechanical alternatives accessible that try not to require power and it is frequently not fundamental in the decisions made. It is remembered for the rundown of measures on the grounds that frequently the utilization of bundle plant type alternatives requires electrical force for activity.

Geological conditions for example the slant of a region and so on have an impact over the sort of innovation picked and these conditions change starting with one site then onto the next. A few zones have a geography that permits simpler usage of wastewater advancements then others. The kinds of wastewater advancements picked with thought of geographical conditions work all the more proficiently likewise with these specialized contemplations as a primary concern they become progressively viable, delivering better quality gushing. Geographical conditions ought to be considered as a measure anyway is excluded from the rating sheet as it is very site explicit.

2.8 Cost Effective Treatment Technology for small Size Sewage Treatment Plants in India, S Gautam, December 2016

The paper talked about financially savvy wastewater treatment innovations for little estimated sewage treatment plants in India. Wastewater treatment advancements picked up significance for a goal of strategy creators and businesses for meeting the necessary contamination control rules as set somewhere near the controllers of the nations and to make the wastewater fit for wanted utilizations bringing about protection of water resources. The article gave an examination of advances usually utilized in the segment as far as cost appraisal and impression prerequisite for choosing its reasonableness in Indian climate. Various vigorous treatment advances, for example, moving bed biofilm reactor (MBBR), membrane bioreactor (MBR), sequencing batch reactor(SBR), extended aeration(EA), submerged aerobic fixed film(SAFF) appropriate for rewarding wastewater have been considered for similar investigation which incorporates activity and support and cost also. The study recommended that SBR is the most practical treatment innovation and MBR as the most costly among the different accessible treatment alternatives.

2.9 Action Plan for cleaning the River Yamuna, Delhi Jal Board, February 2016

The action plan for cleaning the river Yamuna included the following major 7 steps to be carried out:

1.Cleaning 3 major drains Najafgarh, Supplementary & Shahadra

These three drains are the key contributors causing pollution in the river Yamuna. This step includes tapping water entering the Primary Drain through Tributary Drain. The tapped water will be allowed to go through newly constructed STPs after utilization of Existing STPs. The Interceptor Sewer Project (ISP) would be used to tap water and divert it to nearest STP for

primary treatment. The following figure shows the pictorial representation of the process.

Figure 4: Cleaning of 3 Major Drains

2. Cleaning all tributary drains of Najafgarh, Supplementary & Shahadra drains

After the cleaning of primary drains, the action involves cleaning of all the tributary drains of Najafgarh, Supplementary & Shahadra drains. This involves setting up of decentralized Sewage Treatment plant (STP) to treat sub drains.

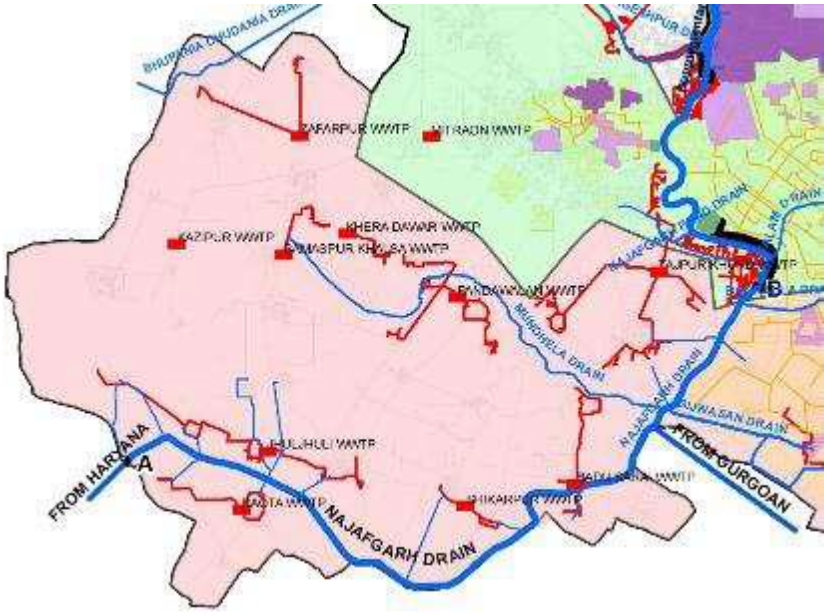


Figure 5: Plan for segment Dhansa to Goyla

3. Trapping/ cleaning of remaining 15 drains directly falling into River Yamuna- Bela Road, Ring Road sewer Project

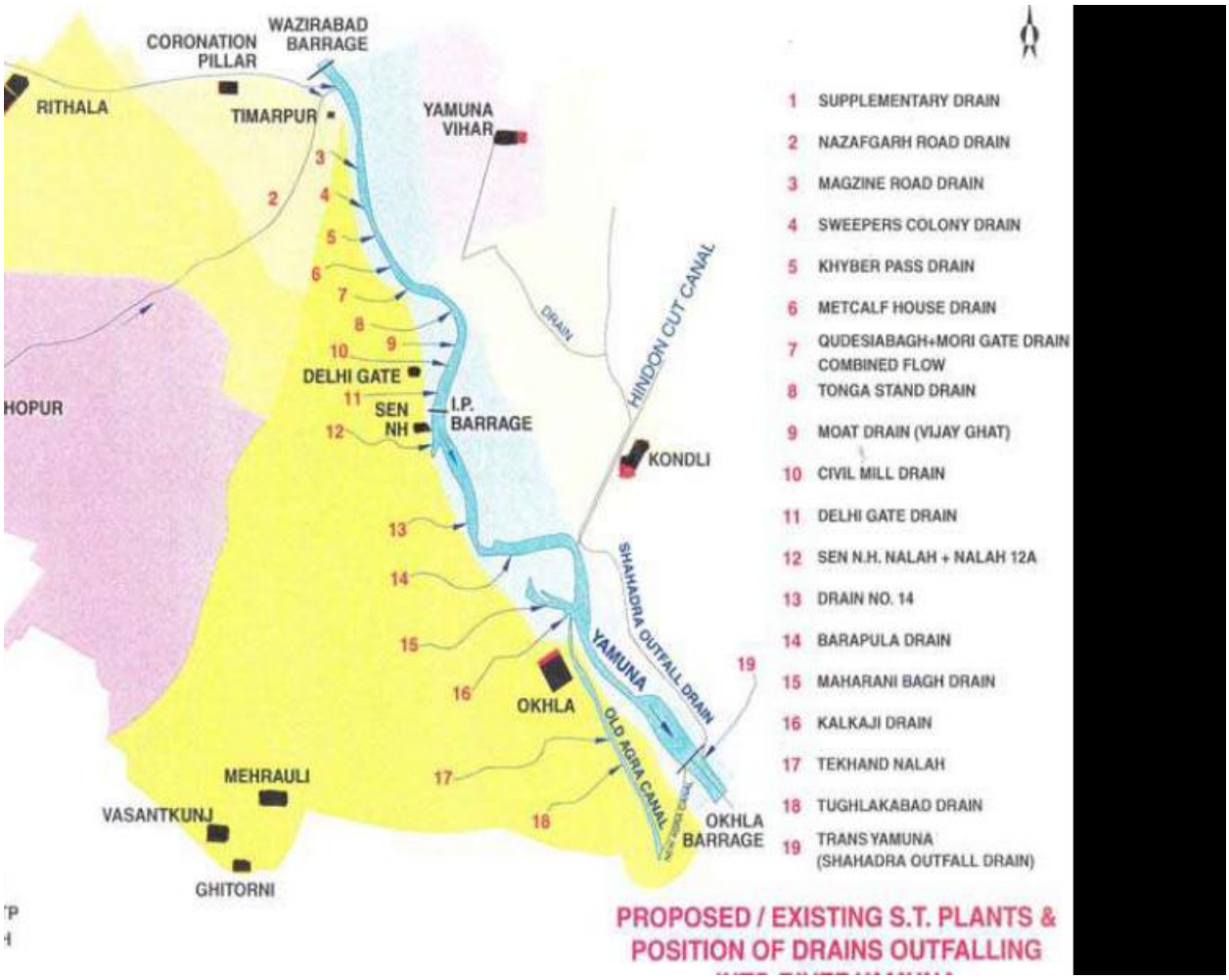


Figure 6: Map showing all major drains of Delhi

4. Dredging of major drains and 22 Km stretch of Yamuna bed

Digging includes the expulsion of residue from the base and sides of stream channels and can likewise incorporate fixing of channels and developing of the base. These dug channels require long haul support and proceeded with function as new sediment will collect inside the waterway bed after some time.

5. Laying of sewerage system in unsewered areas- Master Plan 2031.

The sewerage Master Plan 2031 has been finalized for un-sewered areas of Delhi. The salient features are:

i. The Plan is for horizon year 2031 and to be implemented in four phases
ii. 2. Total length of sewer line to be laid : 9800 Km
iii. 3. Number of decentralized Sewage Treatment Plants : 75
iv. 4. Total Capacity of the STPs: 375 MGD
v. 5. Cost of projects under SMP-2031 if implemented by 2027: Rs.19500 Cr. ($ 2879 MILLION)

6. Rehabilitation & up-gradation of old sewerage infrastructure- Yamuna Action Plan- III

This Action plan involves the rehabilitation of following catchments.

i. Sewers (Rehabilitation)

• Kondli Catchment - Total Length for rehabilitation– 15 Km
• Rithala Catchment - Total Length for rehabilitation – 5 Km

ii. 2. Rising Mains (Rehabilitation)

• Kondli Catchment - Total Length – 9.3 Km
• Rithala Catchment - Total Length – 12.4 Km

iii. 3. Tertiary Treatment Plants

Kondli Catchment – 204 MLD (45MGD)

Okhla Catchment – 428 MLD (95MGD)

Rithala Catchment – 182 MLD (40 MGD)

7. Immediate action for Bio remediation & development of public space along all three major drains

Cleaning of River can be done by using biological system of channel floating wetlands and wetland parks along and around Sahibi and Najafgarh Nalla. People and Places can be reconnected through alternative movement system with non polluting NMV, Cycle tracks and pedestrian pathways. Another method of cleaning involved Urban Waste Management which reduces and cleans urban solid waste that feeds into river Sahibi and Najafgarh Nalla from the adjoining neighborhoods.

Figure 7: Bio remediation & development of public space

Figure 8: Wetland

CHAPTER 3

METHODOLOGY

3.1 STUDY AREA

This study includes the inspection of 14 major drains of Delhi (Arunanagar Drain/ Magazine Road Drain, Sweeper's Colony Drain, Khyber Pass Drain, Metcalf House Drain (Bela Road), Mori Gate Drain & Quadasia Drain, Tonga Stand Drain, Civil Military Drain, Delhi Gate Drain, Dr. Sen Nursing Home Drain, Drain No. 14, Barapullah Drain, Taimoor Nagar Drain, Tughlakabad Drain, Tekhand Drain). Inspection of other 39 drains was also done for the prevention of pollution in the river Yamuna due to intermixing of sewage in storm water drains. For the inspection purpose, whole area of Delhi was divided into four zones (North, South, East and West). Each site was inspected under the supervision of Engineer provided by Delhi Jal Board. The prevailing conditions of the various drains of Delhi are shown along with the relevant photographs in observations.

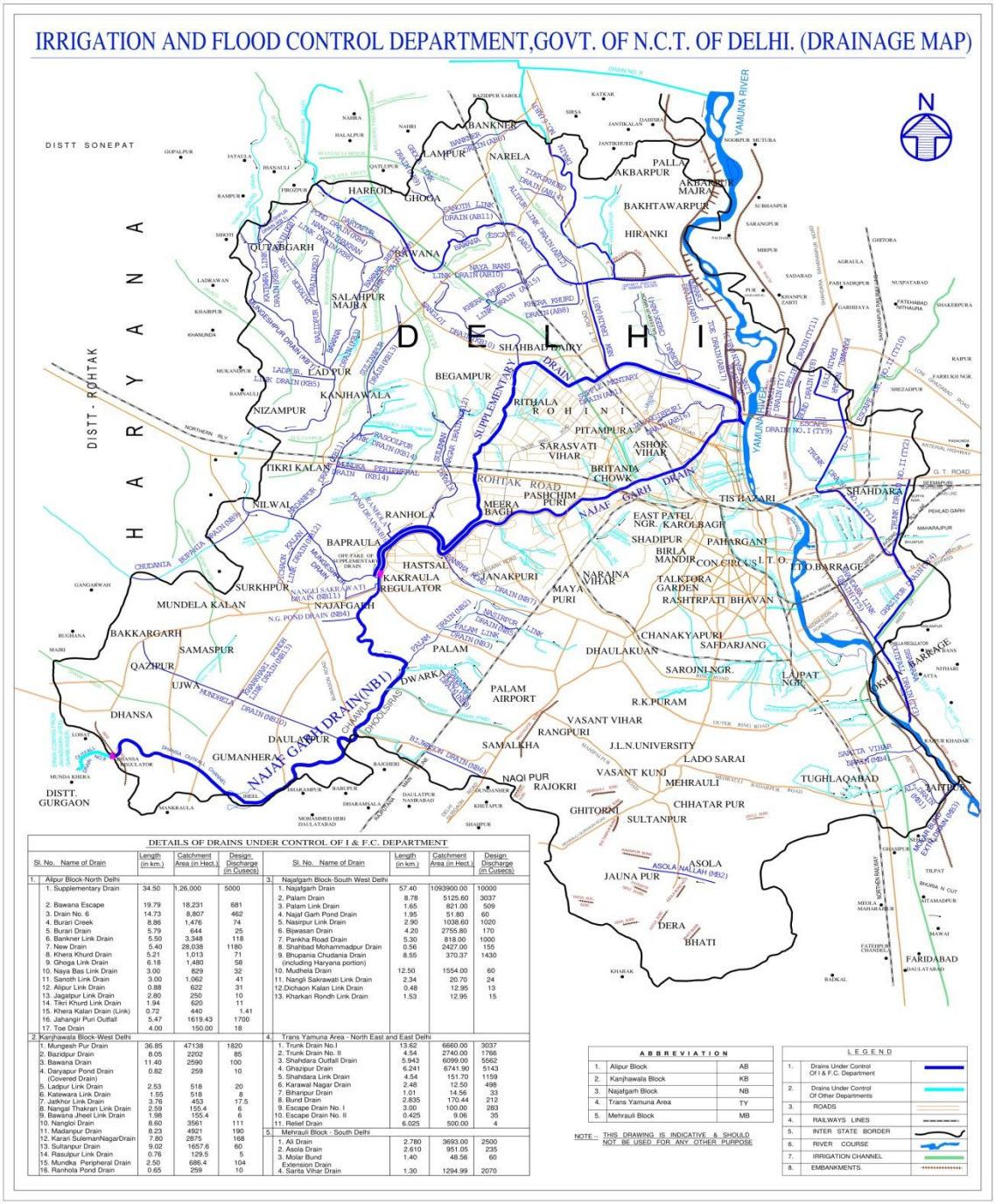
3.2 PROCESS OF INSPECTION

- The Superintending Engineer of the respective zone was informed about the inspection prior to the day of visit.
- The role of Superintending Engineer was to appoint the Junior Engineer or Assistant Engineer of that locality as per the availability.
- The Engineer appointed by the Superintending Engineer used to take me to the respective location.
- The condition of the drain was observed, noted and was compared with the remedial action proposed at that particular location.
- The Remarks were noted along with latitude and longitude of that particular location.
- At last, the filled Google form was sent to professor of Delhi Technological University and then the final report was sent to hon'ble National Green Tribunal.

3.3 LOCATIONS

The locations covered all the four zones of Delhi. The locations included the 14 major drains of

Delhi and other 39 locations.



DETAILS OF DRAINS UNDER CONTROL OF I & F.C. DEPARTMENT

Sl. No.	Name of Drain	Length (in km.)	Catchment Area (in Hect.)	Design Discharge (in Cusecs)
1.	Alipur Block-North Delhi			
1.	Supplementary Drain	34.50	1,26,000	5000
2.	Bawana Escape	19.79	18,231	681
3.	Drain No. 6	14.73	8,807	462
4.	Burari Creek	8.86	1,476	74
5.	Burari Drain	5.79	644	25
6.	Bankner Link Drain	5.50	3,348	118
7.	New Drain	5.40	28,038	1180
8.	Khera Khurd Drain	5.21	1,013	71
9.	Ghoga Link Drain	6.18	1,480	58
10.	Naya Bas Link Drain	3.00	629	32
11.	Saneth Link Drain	3.00	1,062	41
12.	Alipur Link Drain	0.88	622	31
13.	Jagatpur Link Drain	2.80	250	10
14.	Tikri Khurd Link Drain	1.94	620	11
15.	Khera Kalan Drain (Link)	0.72	440	1.41
16.	Jahangir Puri Outfall	5.47	1619.43	1700
17.	Toe Drain	4.00	150.00	18
2.	Kanjhawala Block-West Delhi			
1.	Mungesh Pur Drain	36.85	47138	1820
2.	Bazidpur Drain	8.05	2202	85
3.	Bawana Drain	11.40	2590	100
4.	Daryapur Pond Drain (Covered Drain)	0.82	259	10
5.	Ladpur Link Drain	2.53	518	20
6.	Katewara Link Drain	1.55	518	8
7.	Jaikhor Link Drain	3.76	453	17.5
8.	Nangal Thakran Link Drain	2.59	155.4	6
9.	Bawana Jheel Link Drain	1.98	155.4	6
10.	Nangloi Drain	8.60	3561	111
11.	Madanpur Drain	8.23	4921	190
12.	Karari SulemanNagarDrain	7.80	2875	168
13.	Sultanpur Drain	9.02	1657.6	60
14.	Rasulpur Link Drain	0.76	129.5	5
15.	Mundka Peripheral Drain	2.50	686.4	104
16.	Ranhola Pond Drain	0.65	259	10
3.	Najafgarh Block-South West Delhi			
1.	Najafgarh Drain	57.40	1093900.00	10000
2.	Palam Drain	8.78	5125.60	3037
3.	Palam Link Drain	1.65	821.00	509
4.	Najaf Garh Pond Drain	1.95	51.80	60
5.	Nasirpur Link Drain	2.90	1038.60	1020
6.	Bijwasan Drain	4.20	2755.80	170
7.	Pankha Road Drain	5.30	818.00	1000
8.	Shahbad Mohammadpur Drain	0.56	2427.00	155
9.	Bhupania Chudania Drain (including Haryana portion)	8.55	370.37	1430
10.	Mudhela Drain	12.50	1554.00	60
11.	Nangli Sakrawati Link Drain	2.34	20.70	24
12.	Dichaon Kalan Link Drain	0.48	12.95	13
13.	Kharkari Rondh Link Drain	1.53	12.95	15
4.	Trans Yamuna Area - North East and East Delhi			
1.	Trunk Drain No.I	13.62	6660.00	3037
2.	Trunk Drain No. II	4.54	2740.00	1766
3.	Shahdara Outfall Drain	5.943	6099.00	5562
4.	Ghazipur Drain	6.241	6741.90	5143
5.	Shahdara Link Drain	4.54	151.70	1159
6.	Karawal Nagar Drain	2.48	12.50	498
7.	Bihanpur Drain	1.01	14.56	33
8.	Bund Drain	2.835	170.44	212
9.	Escape Drain No. I	3.00	100.00	283
10.	Escape Drain No. II	0.425	9.06	35
11.	Relief Drain	6.025	500.00	4
5.	Mehrauli Block - South Delhi			
1.	Ali Drain	2.780	3693.00	2500
2.	Asola Drain	2.610	951.05	235
3.	Molar Bund	1.40	48.56	60
	Extension Drain			
4.	Sarita Vihar Drain	1.30	1294.99	2070

Figure 9: Map shows drainage zones of Delhi as defined by I&FC.

3.4 INTERCEPTORS SEWER STRATEGY

The Delhi government has cleared Rs 1,950-crore venture to tap channels conveying sewage from states not associated with the city sewers. Interceptor sewers to be utilized for tapping is seen by the legislature as a transitory answer for the issue of untreated water arriving at the Yamuna. The administration intends to lay sewers all through the city over the long haul.

The task is a restrained rendition of a Rs 3,150-crore proposition originally mooted by the Delhi Jal Board in 2006. It includes laying 50 km of interceptors, 2-3 meters in breadth, to capture 150 little depletes releasing into three significant channels in the capital- - Najafgarh, Supplementary and Shahadra. The three channels contribute 70 percent of the release of 3,600 million liters every day (MLD) of sewage into the Yamuna. Another 13 channels will be taken advantage of sewers under restoration. Four channels including one close to the Sarita Vihar connect conveying around 690 MLD finds no notice in the arrangement, which has been cleared without undertaking reviews coordinated by the preeminent court. The blocked waste will be taken to a siphoning station and afterward to a sewage treatment plant (STP). At places, the course is winding. For instance, sewage from a channel close to the Yamuna Vihar stp would be sent to an inaccessible siphoning station, while siphoning straightforwardly to the plant would have been reasonable since, every kilometer of sewer costs nearly Rs 20 crore. Likewise in rainstorm the wastewater will sidestep the interceptors into the Yamuna.

Delhi's stps can lessen sewage's natural oxygen request to just 20mg/l (in the event that they work); 3 mg/l will make the waterway fit for washing. So the rewarded water will require in excess of multiple times weakening.

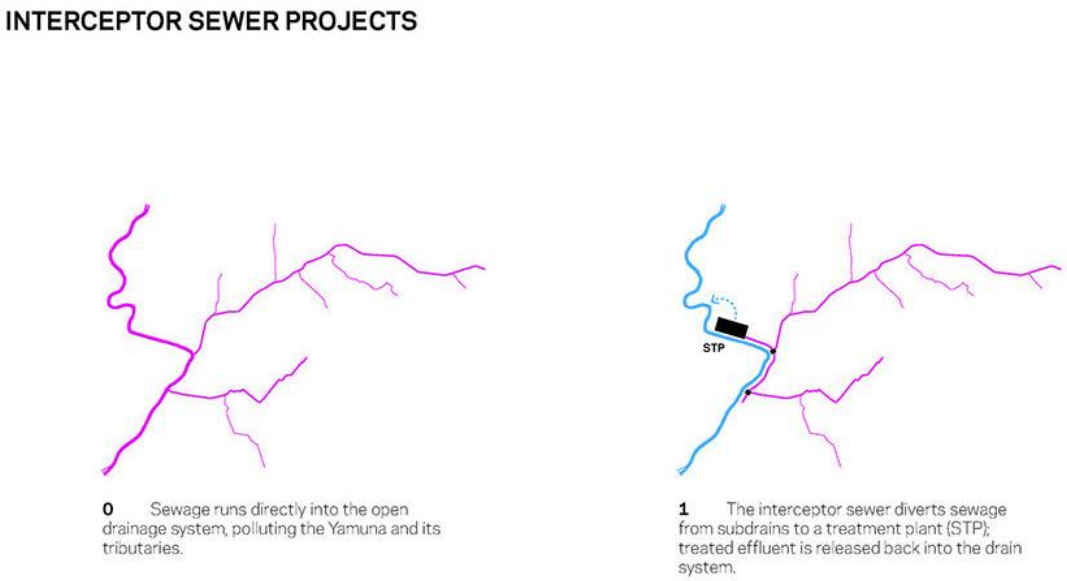


Figure 10: Interceptor Sewer Project

The Jal Board is venturing out, a progression of "interceptor sewers" which will catch dark water in the channel framework and occupy it to close by sewage treatment plants. In the primary stage, significant tributary channels are caught.

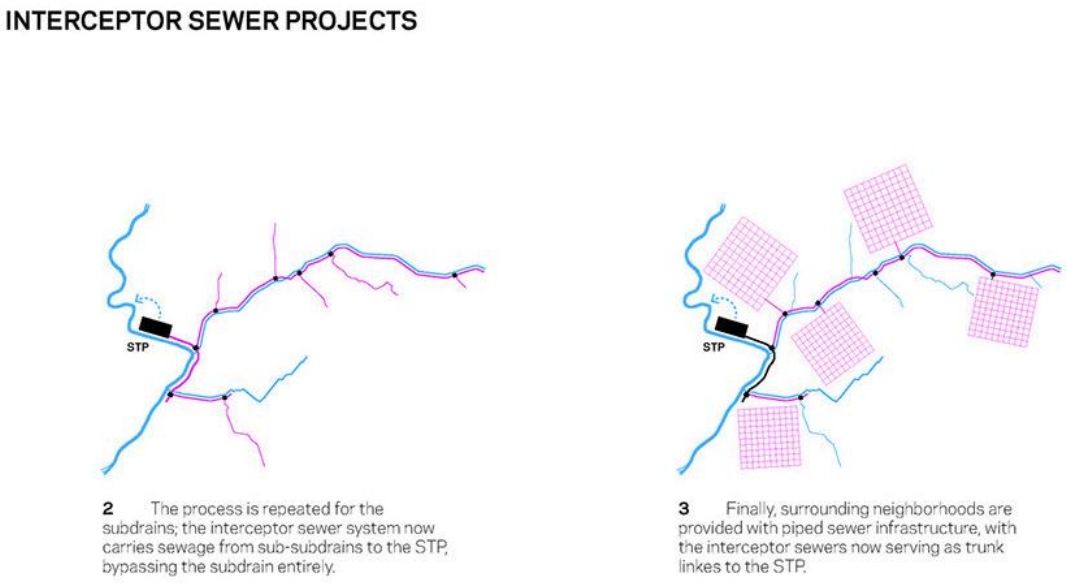


Figure 11: Modification of Interceptor Sewer Project

A future stage will catch the tributaries of those tributaries. Eventually channeled sewage

foundation will be introduced in as of now unsewered regions, and the interceptor sewers will fill in as trunk lines, transmitting waste straightforwardly from structures to treatment plants.

3.5 SEQUENCING BATCH REACTOR

After going through all the wastewater technologies it was concluded that sequencing batch reactor (SBR) was the best technology that could be adopted for the establishment of small scale Sewage Treatment Plants (STPs). The SBR treatment method is described below.

SBR: The sequencing batch reactor (SBR) is a fill-and draw enacted slop framework for wastewater treatment. In this framework, wastewater is added to a solitary "cluster" reactor, rewarded to evacuate bothersome segments, and afterward released. Adjustment, air circulation, and explanation would all be able to be accomplished utilizing a solitary cluster reactor. To improve the exhibition of the framework, at least two bunch reactors are utilized in a foreordained grouping of tasks. SBR frameworks have been effectively used to treat both metropolitan and mechanical wastewater. They are particularly appropriate for wastewater treatment applications portrayed by low or discontinuous stream conditions.

Description of a Wastewater Treatment Plant Using an SBR

An ordinary procedure stream schematic for a metropolitan wastewater treatment plant utilizing a SBR is appeared in Figure 1. Influent wastewater for the most part goes through screens and coarseness expulsion before the SBR. The wastewater at that point enters a somewhat filled reactor, containing biomass, which is accustomed to the wastewater constituents during going before cycles. When the reactor is full, it acts like an ordinary initiated slime framework, however without a constant influent or emanating stream. The air circulation and blending is suspended after the organic responses are finished, the biomass settles, and the rewarded supernatant is expelled. Abundance biomass is burnt through whenever during the cycle. Visit squandering brings about holding the mass proportion of influent substrate to biomass almost steady from cycle to cycle. Consistent stream frameworks hold the mass proportion of influent substrate to biomass steady by changing return initiated slop stream rates ceaselessly as influent stream rates, attributes, and settling tank sub-current focuses fluctuate. After the SBR, the "cluster" of wastewater may stream to a balance bowl

where the wastewater stream rate to extra unit prepared can be is controlled at a decided rate. Now and again the wastewater is sifted to evacuate extra solids and afterward purified. As outlined in following figure, the solids taking care of framework may comprise of a thickener and an oxygen consuming digester. With SBRs there is no requirement for return enacted ooze (RAS) siphons and essential slop (PS) siphons like those related with ordinary initiated muck frameworks.

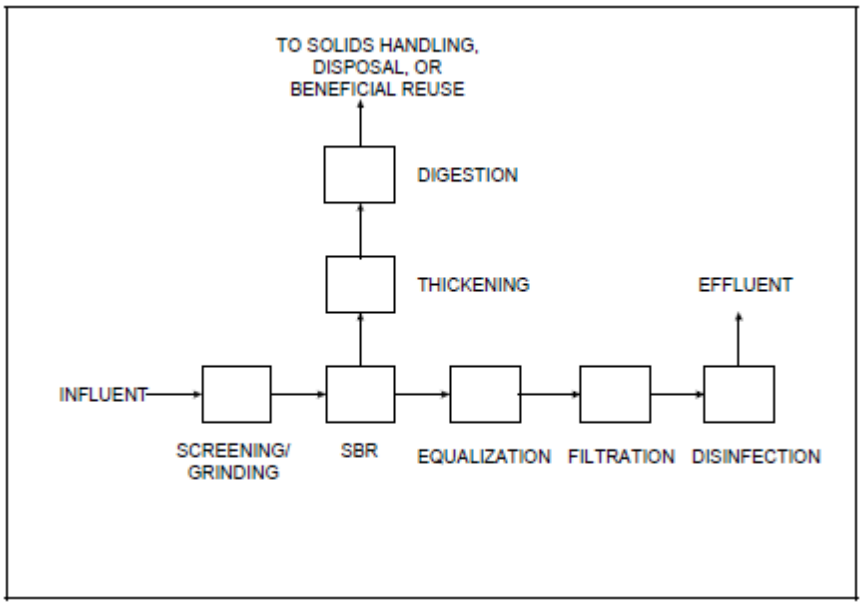


Figure 12: Process flow diagram for a typical SBR

With the SBR, there is normally just a single slop to deal with. The requirement for gravity thickeners before absorption is resolved dependent upon the situation relying upon the attributes of the ooze. A SBR fills in as an adjustment bowl when the vessel is loading up with wastewater, empowering the framework to endure top streams or pinnacle loads in the influent and to even out them in the clump reactor. In numerous traditional actuated slop frameworks, separate balance is expected to shields the natural framework from top streams, which may clean out the biomass, or pinnacle loads, which may disturb the treatment procedure. It ought to likewise be noticed that essential clarifiers are commonly not required for city wastewater applications before a SBR. In most customary actuated muck wastewater treatment plants,primary clarifiers are utilized before the organic framework. Be that as it may, essential clarifiers might be suggested by the SBR maker if the all out suspended solids (TSS) or biochemical oxygen request (BOD) are more noteworthy than 400 to 500 mg/L. Memorable

information ought to be assessed and the SBR maker counseled to decide if essential clarifiers or evening out are suggested preceding a SBR for city and mechanical applications. Leveling might be required after the SBR, contingent upon the downstream procedure. On the off chance that leveling isn't utilized preceding filtration, the channels should be estimated so as to get the clump of wastewater from the SBR, bringing about a huge surface zone required for filtration. Estimating channels to acknowledge these "group" streams is typically not plausible, which is the reason evening out is utilized between a SBR and downstream filtration. Separate adjustment following the natural framework is commonly not required for most traditional enacted ooze frameworks, in light of the fact that the stream is on a nonstop and progressively steady premise.

CHAPTER 4

OBSERVATIONS AND RECOMMENDATIONS

4.1 LIST OF DRAINS MONITORED

The following list contains the 14 major drains of Delhi which are contributing heavily in polluting the river Yamuna. The observations include the name of the drain with their approximate discharge in MGD. It also includes the identified problems during the inspection along with their relevant photograph(s).

Sr. No.	Name of Drain
1.	Arunanagar Drain /Magazine Road Drain
2.	Sweeper's Colony Drain
3.	Khyber Pass Drain
4.	Metcalf House Drain (Bela Road)
5.	Mori Gate Drain & Quadasia Drain
6.	Tonga Stand Drain
7.	Civil Military Drain
8.	Delhi Gate Drain
9.	Dr. Sen Nursing Home Drain
10.	Drain No. 14
11.	Barapullah Drain
12.	Taimoor Nagar Drain

13.	Tughlakabad Drain
14.	Tekhand Drain

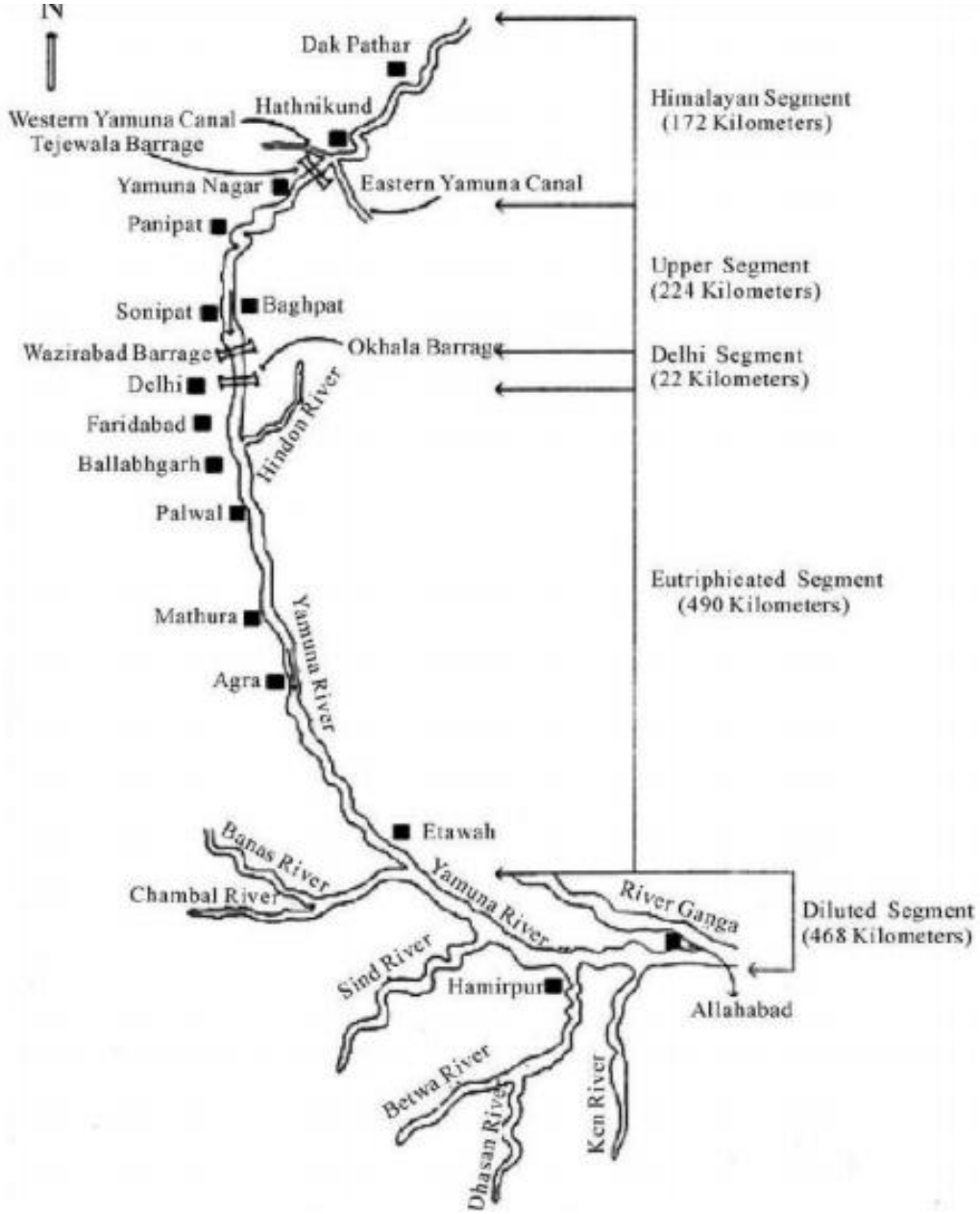


Figure 13: Map of River Yamuna showing the Delhi segment

Table 4.1: OBSERVATIONS OF ARUNANAGAR DRAIN / MAGAZINE ROAD DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
26.04.2019	Arunanagar Drain / Magazine Road Drain	4.5 MLD	Sewerage system from Arunanagar, old Chandrawal Village and Tibetan Camp doesn't have a sewage outfall. Maintenance of point of interception is poor. Leakage/overflow of sewage was observed. Solid waste accumulation was observed.

TABLE 4.2: OBSERVATIONS OF SWEEPER'S COLONY DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
26.04.2019	Sweeper's Colony Drain	4 MLD	Sewage outfall from sweeper's colony Leakage from interceptor sewer (Gate open) Freshwater outfall from Chandrawal WTP (Backwash) Solid waste accumulation at interception point

TABLE 4.3: OBSERVATIONS OF KHYBER PASS DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
26.04.2019	Khyber Pass Drain	1MLD	Sewage from Arunanagar, old Chandrawal Village, Chandrawal JJ cluster, and Tibetan Camp etc. Maintenance of point of interception is poor Leakage/overflow of sewage .Leakage of freshwater Solid waste accumulation at interception point

TABLE 4.4: OBSERVATIONS OF METCALF HOUSE DRAIN (BELA ROAD)

Date of Visit	Name of the Drain	Discharge	Identified Problems
26.04.2019	Metcalf House Drain	5 MLD	Solid Waste accumulation. Leakage of freshwater Faulty gate (open during inspection)

TABLE 4.5: OBSERVATIONS OF MORI GATE DRAIN

Date	Name of the Drain	Discharge	Identified Problems
26.04.2019	Mori Gate Drain	9-10 MLD	Leakage/overflow of sewage from Old Delhi and Mori Gate area (Leakage from sewered area) Leakage from ISBT and area around Solid waste accumulation at

			interception point

TABLE 4.6: OBSERVATIONS OF TONGA STAND DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
26.04.2019	Tonga Stand Drain	-	Solid Waste accumulation Leakage of sewage from Old Delhi Railway station area Sewage and solid waste from unauthorised colony immediately before outfall Open defecation near the point of outfall

TABLE 4.7: OBSERVATIONS OF CIVIL MILITARY DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
26.04.2019	Civil Military Drain	2.5 MLD	Leakage and overflow of sewage from Chandni Chowk area Leakage of sewage from the gate of regulator Open defecation near the point of outfall

TABLE 4.8: OBSERVATIONS OF DELHI GATE DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
29.04.2019	Delhi Gate Drain	15 MGD	Sewage from Chawri Bazaar and Darya Ganj area Leakage of sewage Accumulation of some solid waste Proper management

TABLE 4.9: OBSERVATIONS OF DR. SEN NURSING HOME DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
29.04.2019	Dr. Sen Nursing Home Drain	2.2 MGD	Sewage from railway colony area Leakage of sewage from NDMC area Accumulation of solid waste Overflow from the regulator gate

TABLE 4.10: OBSERVATIONS OF DRAIN NO. 14

Date of Visit	Name of the Drain	Discharge	Identified Problems
29.04.2019	Drain No. 14	1 MLD	Accumulation of solid waste Overflow of sub-soil water (freshwater) from construction activity at Pragati Maidan

TABLE 4.11 OBSERVATIONS OF BARAPULLAH DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
19.11.2019	Barapullah Drain	20 MGD	Sewage from Sangam Vihar colony Leakage of sewage from NDMC area Accumulation of some solid waste

TABLE 4.12: OBSERVATIONS OF TAIMOOR NAGAR DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
29.04.2019	Taimoor Nagar Drain	6 MGD	Leakage of sewage from adjoining colonies Sewage from Taimoor Nagar colony (Non-sewered) Accumulation of solid waste

TABLE 4.13: OBSERVATIONS OF TUGHLAQABAD DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
29.04.2019	Tughlaqabad Drain	4-5 MGD	Partially trapped 10%, Sewer coming from sewered area, sewage system not working properly, from Tughlaqabad Govindpur

TABLE 4.14: OBSERVATIONS OF TEKHAND DRAIN

Date of Visit	Name of the Drain	Discharge	Identified Problems
29.04.2019	Tekhand Drain	6 MGD	Sewerage system does not exist 10 MGD plant proposed From Tejpur group of unauthorised colonies Tehkhand Village

RECOMMENDATIONS

SERIAL NUMBER	DRAIN	DISCHARGE	RECOMMENDATIONS
1.	**Arunanagar Drain / Magazine Road Drain**	4.5 MLD	Proper maintenance of outfall system of drain so that entire sewage is diverted into Arunanagar Sewage Pumping Station Providing proper outfall of sewage system of Arunanagar Provision for measurement of flow shall be made available.
2.	**Sweeper's Colony Drain**	4 MLD	Proper maintenance of tapping point so that entire sewage diverts to Arunanagar SPS. Interception/collection of sewage from Sweeper's colony Provision for measurement of flow shall be made available.
3.	**Khyber Pass Drain**	1 MLD	Proper maintenance Providing sewage system and outfall for JJ cluster Setting up constructed wetland system for treatment of sewage at

			source i.e. Chandrawal water works itself Provision for measurement of flow shall be made available.
4.	**Metcalf House Drain (Bela Road)**	5 MLD	Proper operation and maintenance Providing proper baffle for overflow Provision for measurement of flow shall be made available.
5.	**Mori Gate Drain**	9-10MLD	Diversion of sewage to sewer line at source in the respective areas Providing root zone treatment before outfall to treat waste water Provision for measurement of flow shall be made available.
6.	**Tonga Stand Drain**	No measurement	Proper operation and maintenance of existing sewers Interception of sewage before outfall Provision for measurement of flow shall be made available.
7.	**Civil Military Drain**	2.5 MLD	Proper operation and maintenance of existing sewers Providing root zone treatment before outfall or trap this sewage into trunk sewer line near Red fort Provision for measurement of flow shall be made available.
8.	**Delhi Gate Drain**	15 MGD	Proper cleaning of drain operation and maintenance of existing treatment systems Provision for measurement of flow shall be made available.
9.	**Dr. Sen Nursing Home Drain**	2.2 MGD	NDMC must divert sewage to sewer lines at source. Railway department must trap sewage into DJB sewer line near Tilak Marg or Deen Dayal Upadhyay Marg. Proper operation and maintenance of existing treatment system at STP Providing root zone treatment

			before outfall Provision for measurement of flow shall be made available.
10.	**Drain No. 14 Drain**	1 MLD	Sewage is being trapped into Ring Road Trunk sewer Provision for measurement of flow shall be made available.
11.	**Barapullah Drain**	20 MGD	Proposed STP of 20 MGD (as per information from DJB) Trapping of sewage into sewer lines at source to reduce flow of sewage into drains. Proper Maintenance of trapping points at Krishi Vihar, Andrews Ganj and Nizamuddin. Root zone treatment before outfall Provision for measurement of flow shall be made available.
12.	**Taimoor Nagar Drain**	6 MGD	Taimoor Nagar colony to be sewered Trap out-flowing sewage to CV Raman Trunk sewer should be made functional. Diverting sewage into sewer lines in sewered areas at source. Provision for measurement of flow shall be made available.
13.	**Tughlakabad Drain**	4-5 MGD	O&M to be done properly, sump at zero level Provision for measurement of flow shall be made available. Coffer Dam for diversion of sewage to maintain minimum flow into Sarita Vihar SPS to Okhla STP, Flow meter not present, Weir type dam. Provision for measurement of flow shall be made available.
14.	**Tekhand Drain**	6 MGD	Online or decentralised plant Sewerage system for unauthorised colony to be sent to decentralised plant Provision for measurement of flow

			shall be made available.

LIST OF MINOR DRAINS MONITORED FOR THE PURPOSE OF TROLLEY REMOVAL

The following list contains the specific locations where sewage was getting mixed with storm water. The sewage was being pumped to storm water drain which reaches river Yamuna thereby increasing the pollutant concentration in the river. The sewage was being pumped with the help of trolley into the storm water drain. Relevant pictures are also shown below the table.

IMAGES OF INSPECTION OF ABOVE 39 LOCATIONS

Figure 14: Ram Kishore Marg, Railway Colony, Civil Lines, Delhi

Figure 15: Gagan Vihar, Krishna Nagar, Delhi

Figure 16: Ram Krishna Puram, New Delhi

Figure 17: Nishad Raj Marg, Lal Qila, Chandini Chowk, New Delhi

Figure 18: Vikas Puri

Figure 19: Mahatma Gandhi Marg, Gas Turbine Power Station, New Delhi

Figure 20: Maharana Pratap ISBT Kashmiri Gate, Old Delhi

Figure 21: Pocket 32, Sector 3H, Rohini, Delhi

Figure 22: Bhairon Marg, Pragati Maidan, New Delhi

Figure 23: Gali Number 2, Shalimar Park Extension, Shahdara, Delhi

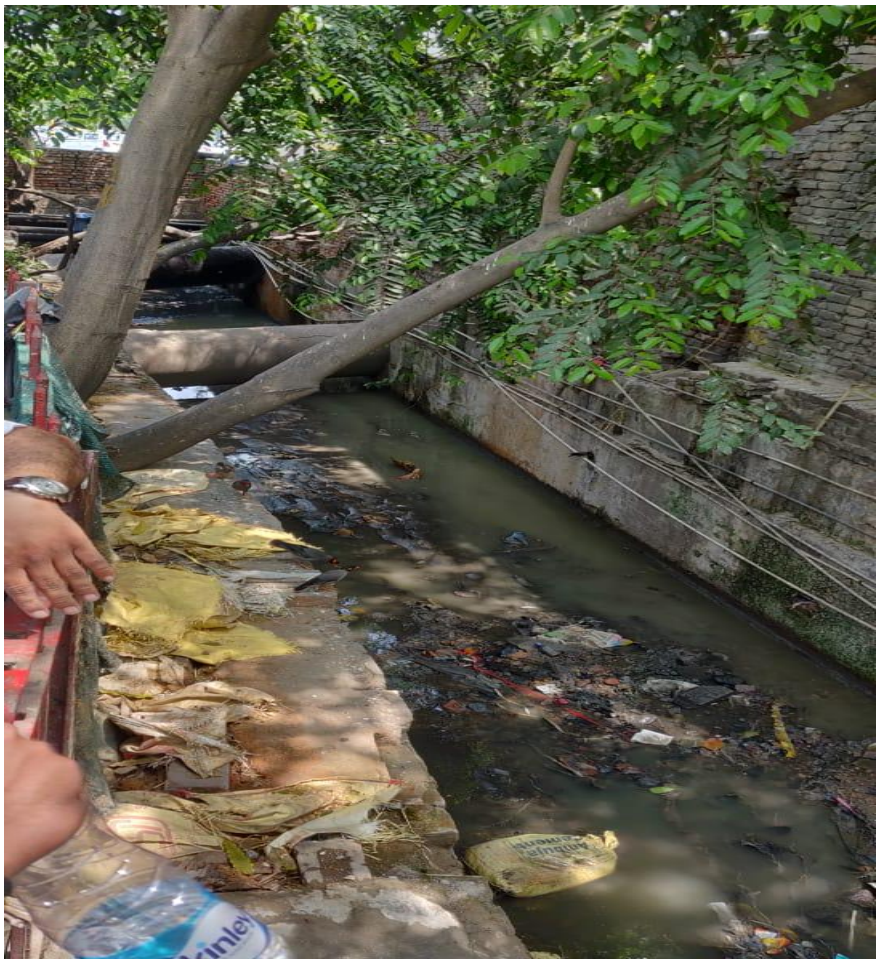


Figure 24: Nishad Raj Qila, Chandini Chowk, New Delhi

Figure 25: Mahatma Gandhi Marg, RPS Complex, Raj Ghat

CHAPTER 5

CONCLUSIONS

After the review of all the individual areas it was reasoned that the work for the restoration of waterway Yamuna is still in running stage and a great deal of work despite everything should be done. Proper catching of the sewage was not being done because of inappropriate/helpless activity and support and furthermore checking of stream was not done. It is prescribed that it will be smarter to give decentralized treatment of sewage at the outfall itself in this manner diminishing contamination level in the waterway stream. Despite the fact that the advancement has expanded quickly with the expanding time however there's still parcel to be checked and worked. The major conclusions of the work done are as follows:

1. It was observed that most of the drains which were reports as plugged, actually, there was sufficient discharge going downstream except at Delhi Gate Drain. This shows that still there’s a possibility of discharging of sewage into storm water drains at various other locations thereby polluting the river Yamuna. This results that there could be more such locations which are still not under an authorized area.
2. It was observed that proper trapping of the sewage is not being done due to improper/poor operation & maintenance. This is the main reason for mixing of sewage in storm water drains. Although the trolleys have been removed from all the 39 locations but the operation and maintenance work needs to be focused. There should be a check to inspect that trolleys are not being placed at any new or old stations.
3. It was observed that most of the places a large amount of the solid waste was found in the drain which was causing obstruction of flow and un-aesthetic view. The Tonga Stand Drain is the best example showcasing the accumulation of solid waste in the drain. The solid waste accumulation further leads to clogging of drains due to which the water gets stagnated leading to fly nuisance and bad odour.
4. It is recommended that it will be better to provide decentralized treatment of sewage at the outfall itself. Providing small scale sewage treatment plants at the outfall still remains the best method to minimize this pollution occurrence in the river due to sewage disposal occurring in it.

5. Monitoring of flow has not been done. Discharges given above are approximate and are subjected to verification.

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