Indirapuram STP, Ghaziabad
Co-treatment Case Study

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A. City Profile

Ghaziabad is a rapidly growing city in the National Capital Region (NCR). Geographically located in the Upper Gangetic Plain, it is bisected into two almost equal halves by River Hindon.

The Ghaziabad Nagar Nigam (GNN) is spread over an area of 210 km^2. The city had a population of 1.73 million in 2011 and it is estimated that its current population is around 1.81 million. The GNN is divided into five administrative zones namely, City, Kavi Nagar, Vijay Nagar, Mohan Nagar and Vasundhara.

Access to toilets: As per Census 2011, 97.1 percent of the households in Ghaziabad had access to Individual Household Toilets (IHHLs) while only 0.4 percent were using public toilets. (Figure 1) Further, around 2.5 percent of households lacked access to any kind of sanitation facilities and were defecating in the open. (For further details refer Annex 1)

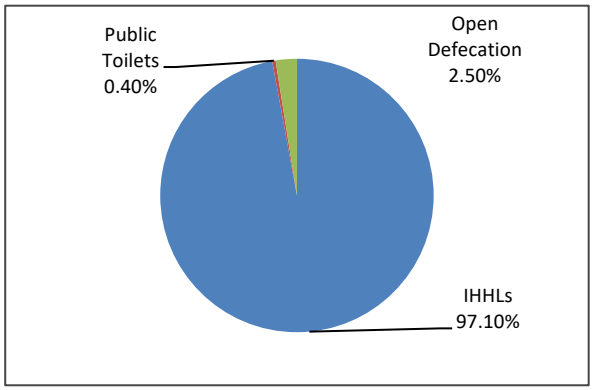


Figure 1: Access to toilets in Ghaziabad (Census 2011)

As per Service Level Improvement Plan (SLIP) 2017 submitted by GNN to the Government of India (GoI) for AMRUT, 95 percent of households[2] had access to IHHLs or community toilets located within walking distance of their house. Approximately 14,580 households (5 percent) lacked access to sanitation facilities and were defecating in the open. The city was declared Open Defecation Free (ODF) in October 2017 post the construction of public / community toilets by GNN.

Sewage collection and conveyance system: In 2011, ~68 percent of households with IHHLs were connected to Under Ground Sewerage System (UGSS) while 29 percent (~94,000 households) were connected to septic tanks (For details refer Annex 1). The proportion of households connected to UGSS has increased over the years and in 2017 ~76[3] percent of households were connected[4]. In terms of geographical area, approximately 16 percent of the city's area was covered with UGSS in 2015 which has increased to 24 percent in 2017.

In 2017, around one fourth[5] of the households with IHHLs were connected to on-site sanitation systems, mostly, septic tanks and soak pits[6].

Sewage treatment facilities: As per SLIP 2017, there are five STPs in Ghaziabad with a total installed capacity of 312 MLD of which only 227 MLD (73 percent) is being utilised at present. (**Error! Reference source not found.**) Discussions with officials revealed that there are a few STPs which are planned and/or under construction but the details of the same were not available. All STPs are based on Sequential Batch Reactor (SBR) technology. The treated waste water is discharged into River Hindon.

[1] 3.07 lakh households
[2] 2,92,620 households out of 3,07,200 households had access to IHHLs or community toilets within walking distance of their house
[3] 2,32,530 households out of 3,07,200 households are connected to underground sewerage system
[4] Source: Service Level Improvement Plan (SLIP), 2017 submitted by GMC to GoI for AMRUT; available at http://www.nagarnigamghaziabad.in/downloads/SLIP%202017-18%20_AMRUT_WATER%20SUPPLY_%20GZB.pdf
[5] 74,670 households out of 3,07,200 households are connected to septic tanks
[6] Source: Service Level Improvement Plan (SLIP), 2017 submitted by GMC to GoI for AMRUT; available at http://www.nagarnigamghaziabad.in/downloads/SLIP%202017-18%20_AMRUT_WATER%20SUPPLY_%20GZB.pdf

Table 1: Details of Sewage Treatment Plants in Ghaziabad

	Location	Capacity (in MLD)	Waste Water Flows (in MLD)	Technology	Operated and Maintained by which agency
A 1	Indirapuram	74	40	SBR	UP Jal Nigam
A 2	Indirapuram	56	51	SBR	Ghaziabad Development Authority
A 3	Indirapuram	56	40	SBR	Ghaziabad Nagar Nigam
B 1	Dundahera	70	52	SBR	Ghaziabad Nagar Nigam
B 2	Dundahera	56	44	SBR	Ghaziabad Nagar Nigam
	Total	**312**	**227**		

Septage Management: Even though one fourth[7] of households with IHHLs are connected to on-site sanitation systems, till very recently there was no organised system for collection and treatment of septage. Private operators were involved in emptying septic tanks and they were rampantly disposing the collected septage in open areas / field / drains. Private desludging operators were operating unregulated by the local body and / or the pollution control agencies.

Since August 2017, GNN has permitted decanting of septage collected by private desludging operators at Indirapuram STP (56 MLD plant which is operated and maintained by GNN). In addition, GNN has started registration and licensing of private desludging trucks operating in the area under its jurisdiction. The local body has also fixed charges for emptying and transportation of septage which private operators can charge households and commercial establishments (refer Table 3).

Institutional Arrangements: There are multiple organizations involved in managing sewage infrastructure in Ghaziabad. As per the provision laid down in the Uttar Pradesh Water Supply and Sewerage Act, 1975 planning and implementation of sewerage works in the state is the responsibility of Uttar Pradesh Jal Nigam (UPJN) while the operation and maintenance of UGSS is being carried out by the Water Works Department (*Jal Kal Vibhag*) of GNN. The GNN has super suction machines (2 nos.) and jetting machines (15 nos.) for cleaning and maintenance of the sewerage network. In addition, the Ghaziabad Development Authority (GDA) is also responsible for installing sewerage infrastructure in the areas developed by it; these are handed over to the GNN in due course.

City's Vision for Sanitation: The city is committed to ensuring universal access to sanitation facilities and for covering the entire geographical area under the jurisdiction of the GNN with UGSS. Under AMRUT, UGSS projects worth INR 3070 million for the FY 2015-16 and INR 6840 million for the entire mission period 2015-20 have been planned and are being implemented in a phased manner.

[7] 74,670 households out of 3,07,200 households are connected to septic tanks

B. Co-treatment – Genesis

Ghaziabad initiated co-treatment of septage in August 2017 at Indirapuram STP. The Indirapuram STP complex has three STPs of 74 MLD, 56 MLD and 56 MLD being operated and maintained by UPJN, GDA and GNN respectively. All three STPs are based on Sequential Batch Reactor (SBR) technology. This paper presents the details of the co-treatment of septage being undertaken at the 56 MLD STP being operated and maintained by GNN. The STP receives waste water flow of ~40 MLD[8] and at present there is spare treatment capacity of ~16 MLD.

The main driver for initiating co-treatment was the fact that private desludging operators were dumping septage into the city's open areas / drains and GNN wanted to put an end to this unauthorised dumping and the resultant pollution. Directive of the National Green Tribunal (NGT), regarding the need to arrest pollution of the region's water bodies, was another factor which prompted definitive action from the local body. Further, the inclusion of co-treatment as one of the parameter in the *Swachh Sarvekshan* was an incentive for GNN to implement co-treatment in order to improve the city's overall score and the resultant national ranking.

Simultaneous to the initiation of co-treatment facility, GNN undertook strict enforcement of the NGT's directives and provisions of the Swachh Bharat Mission. Fines *(challans*) amounting to INR 20,000 were imposed on private desludging trucks found disposing septage in the open. This twin strategy of strict enforcement of environmental pollution control laws along with making provision of decanting facility helped GNN ensure that private desludging operators operating in the city got registered with the local body. The process of registration of private desludging trucks was initiated on October 12, 2017 and at present, 23 trucks are registered with GNN. Vehicles used for desludging are trucks mounted with suction pumps and tanker with capacities ranging from $3m^3$ – $8m^3$. The GNN is committed to ensuring that all private desludging trucks operating within the area of its jurisdiction are registered.

Contractual arrangements with private desludging operators

Only private desludging operators who are registered and licensed by the GNN are authorised to desludge septic tanks and decant the collected septage at the decanting points identified by the GNN. All private operators are required to sign an undertaking on a Non Judicial Stamp Paper (value of INR 100) agreeing to comply with the rules set out by GNN for emptying, transportation and co-treatment of septage. (Refer

[8] Source: Staff of STP

Table 2 for a list of rules set by GNN). The undertaking applies to a single truck (although some operators have more than one truck) and is to be renewed annually on payment of INR 2,000 (for each truck annually).

A notification was published by the GNN in all leading newspapers about making it mandatory for all private desludging operators to register with GNN. The registration forms priced at INR 200 were made available at the Water Works Department's office both at the GNN Headquarters and its zonal offices. The private desludging operators were given a week from the publication of the notification to get registered with the local body, failing which they would become liable for penalties and legal proceedings for non-compliance.

Table 2: List of Rules for private desludging operators partnering in co-treatment

1	Only private desludging operators who are registered and licensed by the GNN are authorised to desludge septic tanks and transport the collected septage to the decanting points specified by GNN.
2	The private desludging operators are responsible for ensuring that the septage is safely transported and there is no leakage of septage while transporting the same from the place where it is collected to the decanting point specified by the GNN.
3	The private desludging operators have to make necessary provisions to prevent any kind of pollution while transporting the septage from the place where it is collected to the decanting point specified by the GNN.
4	The private desludging operators are to be fully responsible for any damage caused to any person, vehicle or property while collecting and transporting septage.
5	The private desludging operators will ensure that safety equipment is available on the vehicle to ensure safety of the staff (driver and helper) manning the desludging vehicle. The safety equipment must include gas detector, gas mask, safety gear, oxygen mask, oxygen cylinder, first aid box, etc.
6	The private desludging operators need to ensure that the collected septage is disposed only at the decanting points identified by the GNN.
7	The private desludging operators are to be responsible for training its staff on how to use safety equipment during any accident which may occur during the process of desludging of septic tanks, transportation and decanting of septage.
8	The private desludging operators will be responsible for ensuring a regular health check-up (frequency of health check-up isn't specified) for their staff (both driver and helper)
9	The private desludging operators will be responsible for insuring their staff for any accident that may occur during the process of desludging of septic tanks, transportation and decanting of septage.
10	In case the private desludging operators do not comply with any of the rules stated above (point 1-9) their license will be revoked with immediate effect, the security deposit will be forfeited and they will become liable to pay other fines as applicable
11	The decanting is permitted only between 7 am and 7 pm at the decanting points identified by the GNN.
12	The decanting of industrial waste is not permitted at any of the decanting points.
13.	All private desludging vehicles need to be registered with the Transport Department. The operators need to ensure that they adhere to all rules and regulations of the Transport Department. All tankers must display the following text in red on both sides of the tanker "Licensed by the GNN for the transportation of septage"

Fixing fee for emptying septic tanks and transportation of septage

The GNN has also fixed charges which private desludging operators can charge households and institutions for emptying the septic tanks and transporting the septage to the decanting station. The fee has two components, a fixed charge for emptying a tanker load and a transportation charge which depends on the distance between the place from where the septage is collected to the nearest decanting point. (Refer Table 3)

Table 3: Charges for emptying septic tank and transporting septage to decanting stations

Type of user	**Fee per Tanker load (INR)**	**Transportation charge, per km (INR)**
Individual House	250	20
Multi storeyed Apartment	300	20
Institutions	500	20

C. Co-treatment at Indirapuram

Plant Background

Indirapuram STP serves the south western part of Ghaziabad including major residential complexes located in the Trans-Hindon area along with sewage intercepted and diverted from Sahibabad drain.

The Indirapuram STP has an installed capacity of 56 MLD and is based on "Sequential Batch Reactor" (SBR) technology. The STP is being operated and maintained by the GNN. The STP receives waste water flow of ~40 MLD[9] and at present there is spare treatment capacity of ~16 MLD, thus enabling co-treatment due to this spare capacity.

Planning and Implementation of Septage Co-treatment

Co-treatment of septage at Indirapuram STP was initiated in August 2017. The non-sewered areas in Trans-Hindon are served by this co-treatment facility. As mentioned above, private operators are involved in desludging septic tanks on payment of a fee, which has recently been fixed by GNN (refer Table 3).

Twenty three private desludging vehicles, trucks mounted with suction pumps and tanker, with capacities ranging from $3m^3$ – $8m^3$ are registered with GNN. Each truck makes multiple (2 – 3) trips every day and about 46[10]- 69[11] truckloads of septage are discharged at Indirapuram on a daily basis. Decanting is permitted at two points, namely, Mohan Nagar Sewage Pumping Station (SPS) and Indirapuram STP.

Decanting Station at Mohan Nagar SPS

Decanting in progress

Volume and Quality of Septage

The facility receives about ~58[12] truckloads of septage on a daily basis or about 0.32 MLD[13] of septage which is blended with ~40 MLD of sewage (therefore septage is less than 1 percent of the current sewage flows). Due to absence of data, comparison of characteristics of raw sewage and septage is not possible. The city does not undertake quality testing of septage prior to its addition to the raw sewage at the decanting points.

[9] Source: Staff of STP
[10] Assuming 2 trips are made by every truck each day
[11] Assuming 3 trips are made by every truck each day
[12] Average figure, arrived after adding the total trips assumed at 2 trips per truck (46) and three trips per day (69) per day
[13] Calculated at 58 truckloads with an average capacity of 5.5 m^3 (average of $3m^3$ – $8\ m^3$)

Infrastructure Investments and Operational Changes for Co-treatment

Decanting Station: Septage decanting is permitted at two points, namely, Mohan Nagar SPS and at Indirapuram STP. At the Mohan Nagar SPS there is a receiving well into which the trucks decant the septage. At the STP the tankers are required to decant at the main inlet point. No additional infrastructure requiring capital investment has been created at either the SPS or the STP for decanting.

Retrofits or additions to the treatment process: Discussions with staff at the STP revealed that there have been no retrofits or additions made to the treatment process after mixing of septage with sewage prior to treatment.

Sampling, Monitoring and Record Keeping Protocols: While the GNN doesn't permit decanting of industrial waste at the decanting points there is no regular testing of input quality of septage in order to identify metals or traces of industrial waste. Our visit to the decanting stations revealed that there is no supervisory staff present for monitoring the movement of trucks and for collecting samples of septage prior to decanting / addition to sewage. There are no records available on the number of trucks using the facility.

Safety protocols: As per the agreement with GNN, private desludging operators are supposed to ensure that the following safety equipment is available on the vehicle and is used by the driver and helper – gas detector, gas mask, safety gear, oxygen mask, oxygen cylinder, first aid box, etc. During our visit, we did not find staff using any protective gear.

Financial Details

Capital Cost: No additional retrofits or modifications requiring capital investment have been made at the STP to enable co-treatment. Further, no additional infrastructure has been created at the decanting stations.

Registration Charge and Security Deposit: GNN will have annual collections of INR 46,000 as registration charge for 23 trucks that are registered with the local body. A one-time security deposit of INR 2000 per truck is also to be deposited by the private operators on a truck wise basis.

Table 4: Co-treatment – Capital Costs Incurred and Revenue Generated

Category	*Details*	*Amounts (in INR)*
Capital Cost	None incurred	-
O&M Cost	None made so far	-
Revenue Generated	Registration charge (@ INR 2,000 per truck per year)	46,000
	Security Deposit (@ INR 2,000 per truck; one time charge)	46,000
	Tipping Fee (no tipping fee)	0

Performance Details

The Indirapuram STP receives a very small amount of septage (less than 1 percent by volume of the current flows received at the STP). Data on wastewater quality at inlet and outlet is available for some days across June, July, August, October 2017 and January, February and March 2018. While there hasn't been any significant change in pH and BOD at the inlet point pre and post co-treatment (August 2017) there has been a slight increase in TSS values at inlet point from August 2017. While inlet BOD increased dramatically in August 2017 (935 mg/L) it has subsequently reduced to 195 mg/L in October 2017 and 215 mg/L in March 2018. The data shows no significant impact on the final effluent quality on all parameters. It appears that the plant is able to handle and treat the additional load from septage without impacting unit operations. However, the data available isn't enough to make a clear deduction and there is thus a need for more stringent quality testing of septage, sewage at inlet and treated effluent at outlet point.

Table 5: Performance Indicators (PH, DO, TSS, BOD and COD) at Inlet and outlet Points[14]

	Dates of Sampling													
	16.06.2017		19.07.2017		26.08.17		28.10.2017		11.01.2018		20.02.2018		28.03.2018	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
PH	7.35	7.63	7.45	7.75	7.35	7.78	7.29	7.71	-	7.49	-	7.35	7.32	7.74
DO (mg/L)	0.38	5.52	0.15	5.56	0.58	5.56	0.09	5.58	-		-		-	4.85
TSS (mg/L)	430	8.75	438	11	465	6	460	9	-	13	-	15	475	8
BOD (mg/L)	398	9	460	-	935	8	195	9	-	9.5	-	8.5	215	8
COD (mg/L)					438	38	438	42	-	42	-	38	469	36

D. Impact of co-treatment

City population being served by co-treatment: The initiative has been successful in serving the un-sewered parts of Trans Hindon area. Given that there are approximately 58 trips per day to the Indirapuram STP, it is estimated that the co-treatment facility is able to provide septage treatment solution for between 40,000 to 1.6 Lakhs households with septic tanks per year[15].

Regularisation of private desludging operators: The 23 private trucks that are registered with the GNN have been provided with a safe and economical option for discharging septage.

Environmental Impact: The initiative has ensured that unauthorised dumping of septage in the city's open areas and water bodies has reduced substantially.

Source of Revenue for the STP: The registration charges collected from private desludging trucks (@ INR 2000 / truck / year) is generating additional revenue of 46,000 per year.

E. Key lessons and practices

- The fact that there is no tipping cost has ensured that the private desludging trucks are making full use of the decanting facility. With the payment of the registration fee of INR 2000 per truck they can use the facility for one year. The co-treatment initiative has ensured that the private operators have a dedicated place to discharge the septage rather than trying to dump septage in open areas / waterways while trying to evade enforcement authorities.
- The fact that GNN undertook rigorous enforcement of environmental protection and pollution control provisions in tandem with initiation of co-treatment has proved critical to move private desludging operators towards a regulated regime and dissuade illegal dumping of septage.
- The STP at Indirapuram receives a very small amount of septage (less than 1 percent by volume of the current flows received at the STP). Data on treated wastewater available for the period pre and post initiation of co-treatment (August 2017) indicates that there has been no significant impact on the final effluent quality and that the plant is able to handle and treat the additional load from septage without impacting unit operations.
- Record keeping protocol needs to be put in place to record the movement of trucks in and out of the decanting points and the volumes of septage decanted at the decanting stations.

[14] Source: Chemist, Indirapuram STP

[15] Estimated based on number of households that can be serviced when septic tank sizes varies from 4 to 10 m^3 and when desludging is done once every 3 or 5 years.

- Safety protocol should be put in place to identify and eliminate industrial waste from being disposed of at co-treatment facilities; this must include random testing of the septage arriving at the STP. Also protocols to ensure safety of the staff involved in decanting needs to be put in place.

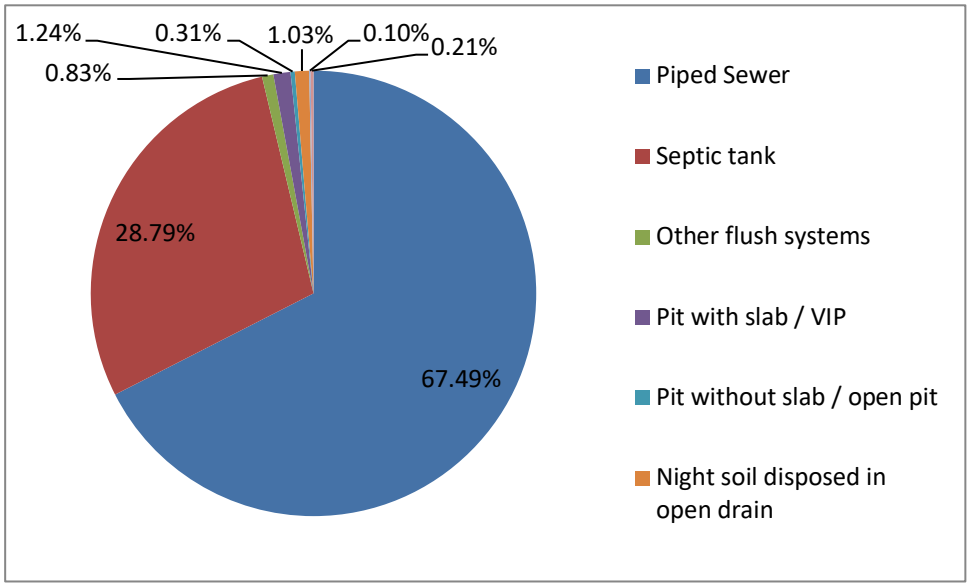
Annex 1: Status of access to sanitation and collection and conveyance systems in Ghaziabad

Table 1: Access to toilet facilities (Census 2011)

Access to Sanitation Facilities	Number of households	%
Individual Toilets	3,25,986	97.10
Public Toilets	1,344	0.40
Open defecation	8,401	2.50
Total households	**3,35,731**	**100.00**

Table 2: Collection and Conveyance systems (Census 2011)

	Number of households	%
Piped sewer	2,19,789	67.49
Septic Tank	93,763	28.79
Other Flush System	2,688	0.83
Pit with slab / VIP	4,032	1.24
Without slab/ open pit	1,008	0.31
Night soil disposed into open drain	3,360	1.03
Night soil serviced by human	336	0.10
Night soil serviced by animal	672	0.21
Total	**3,25,648**	**100.00**



Collection and Conveyance systems in Ghaziabad (Census 2011)

Annex 2: List of officials met at Ghaziabad

S. No.	Name, designation, organisation	Mobile	Email
1.	Chandra Prakash Singh Commissioner, GNN		
2.	Mr. Anand Tripathi Executive Engineer, GNN	8178016814	
3.	Mr. Akanshu Singh Junior Engineer, UP Jal Nigam	8447776044	akanshu.singh1@gmail.com
4.	Mr. Umshankar, PMU-GNN supported by KPMG	9999358033	
5.	Mr. Bhitush Luthra Centre for Science and Environment		