

NCR Planning Board
Asian Development Bank

Capacity Development of the National Capital Region Planning Board (NCRPB) – Component B (TA No. 7055-IND)

Solid Waste Management Master Plan of Ghaziabad

January 2009



Abbreviations

ADB	:	Asian Development Bank
APWA	:	American Public Works Association
BOO	:	Built Own Operate
BOT	:	Built Own Transfer
BOOT	:	Built Own Operate and Transfer
C/N	:	Carbon /Nitrogen ratio
CBO	:	Community Based Organizations
CSS	:	Centrally Sponsored Scheme
CPCB	:	Central Pollution Control Board
DBOMT	:	Design, Build, Operate, Maintain and Transfer
DMA	:	Delhi Metropolitan Area
DP	:	Dumper Placer
DPR	:	Detailed Project Report
EA	:	Executing Agency
EIA	:	Environmental Impact Assessment
F&V	:	Fruit and Vegetable Yard
GCL	:	Geo Composite Layer
GDA	:	Ghaziabad Development Authority
GMC	:	Ghaziabad Municipal Corporation
GNN	:	Ghaziabad Nagar Nigam
GoUP	:	Government of Uttar Pradesh
Ha/ha	:	Hectare
HDPE	:	High Density Polyelthelene
HIG	:	High Income Group
IEC	:	Information Education and Communication
ISWM	:	Integrated Solid Waste Management
Km	:	Kilometer
LoI	:	Letter of Intent
LIG	:	Low Income Group
Mm	:	Millimeter
MSL	:	mean sea level
MIG	:	Middle Income Group
MPR	:	Master Plan Report
MOEF	:	Ministry of Environment and Forest, GOI
MSW	:	Municipal Solid Waste
MSW (M&H)	:	Municipal Solid Waste (Management and Handling) Rules,2000
MSWM	:	Municipal Solid Waste Management
MT	:	Metric Ton
NCR	:	National Capital Region
NCRPB	:	National Capital Region Planning Board
NEERI	:	National Environmental Engineering Research Institute

NGO	:	Non Government organization
O&M	:	Operation and Maintenance
POL	:	Petrol Oil Lubricants
PPP	:	Public Private Participation
PSP	:	Private Sector Participation
RWA	:	Resident Welfare Association
Sqkm	:	Square kilometer
SLF	:	Sanitary Landfill site
SPCB	:	State Pollution Control Board
SWM	:	Solid Waste Management
TA	:	Technical Assistance
ULB	:	Urban Local Body
UP	:	Uttar Pradesh
UPJN	:	Uttar Pradesh Jal Nigam
UPPCB	:	Uttar Pradesh Pollution Control Board
WSA	:	Wilbur Smith Associates

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I. INTRODUCTION

A. Background

1. The National Capital Region Planning Board, constituted in 1985 under the provisions of NCRPB Act, 1985, is a statutory body functioning under the Ministry of Urban Development, Government of India. NCRPB has a mandate to systematically develop the National Capital Region (NCR) of India. It is one of the functions of the Board to arrange and oversee the financing of selected development projects in the NCR through Central and State Plan funds and other sources of revenue.
2. On Government of India's request, Asian Development Bank (ADB) has formulated the technical assistance (TA) to enhance the capacities of National Capital Region Planning Board and its associated implementing agencies. The TA has been designed in three components: Component A relates to improving the business processes in NCRPB; Component B relates to improving the capacity of the implementing agencies in project identification, feasibility studies and preparing detailed engineering design; and Component C relates to urban planning and other activities.
3. ADB has appointed M/s Wilbur Smith Associates to perform consultancy services envisaged under Component B. In the context of this contract, the first deliverable – Inception Report, was submitted in October 2008.
4. This is the Interim Report prepared for the TA Component B, and is the second deliverable under the Contract. This was prepared by the WSA Team between October 2008 and January 2009.

B. Overview of this ADB TA

5. *Objectives.* The objective of this Technical Assistance (TA) is to strengthen the capacity at NCRPB, state-level NCR cells, and other implementing agencies in the area of planning for urban infrastructure and to impart necessary skills to conceive, design, develop, appraise and implement good quality infrastructure projects for planned development of NCR. The increased institutional capacity of the NCRPB and the implementing agencies will lead to effective and time scaling-up of urban infrastructure to (i) improve quality of basic urban services in the NCR; (ii) develop counter magnet towns; (iii) reduce in migration into Delhi and orderly development of NCR; and (iv) accelerate economic growth in the NCR.
6. The TA – Capacity Development of the NCRPB, Component B focuses on strengthening the capacities of NCRPB and implementing agencies relating to project feasibility studies and preparation, and detailed engineering design in the implementing agencies. Specifically this component B of the TA will support the project preparation efforts of the

implementing agencies by preparing demonstration feasibility studies that include all due diligence documentation required for processing of the project in accordance with best practices, including ADB's policies and guidelines.

7. *Scope of Work.* According to the terms of reference of the TA assignment, the following activities are envisaged in component B of the TA:
 - (i) Conduct technical, institutional, economic and financial feasibility analysis of identified subprojects in the six sample implementing agencies;
 - (ii) Conduct safeguards due diligence on the subprojects, including environmental assessment report and resettlement plan for all subprojects covered in the sample implementing agencies;
 - (iii) Prepare environmental assessment framework and resettlement framework; and
 - (iv) Develop a capacity building and policy reform program for the implementing agencies, including governance strengthening, institutional development and financial management.

8. Besides, this component of the TA will also:
 - (i) help in assessing the current practices and procedures of project identification and preparation of detailed project reports including technical, financial, economic and social safeguard due diligence;
 - (ii) support preparation of standard procedure manuals for project identification and preparation of detailed project reports including technical, financial, economic and social safeguard due diligence;
 - (iii) train the implementing agencies in the preparation of detailed project reports by using the sample subprojects, reports on deficiency of current practices and standard protocol manuals; and
 - (iv) help in developing a user-friendly web-page where different manuals and guidelines for preparation of DPRs will be made available for the implementing agencies.

C. About the Interim Report

9. The Interim Report is the second report/deliverable under the TA Component B, and was prepared between October 15, 2008 and January 16, 2009. During the Inception Stage, ADB/NCRPB in consultation with the implementing agencies and WSA Team has identified and finalized the sample implementing agencies and subprojects for preparation under this TA. Accordingly, it is proposed to produce model Detail Project Reports (DPR) in the following sectors: (i) Water Supply; (ii) Sewerage; (iii) Storm Water Drainage; (iv) Solid Waste Management, and (v) Traffic Planning

10. These model DPRs are proposed to be made available to the implementing agencies of the state governments so that they may replicate the methodology/approach in the future DPRs being prepared by them for obtaining finances from financial institutions including

NCRPB. It is also proposed to develop appropriate tool kits for each of these sectors to facilitate preparation of DPRs.

11. It is proposed to produce DPR for water supply for Panipat town, Sewerage for Hapur town, Storm Water Drainage for Hapur and Sonipat towns, Solid Waste Management for Ghaziabad town and Traffic Planning for Ghaziabad town.
12. Following the approach developed for the TA assignment as presented in the Inception Report, the Team at this stage focused on preparation of Master Plan as a base for preparation of sample DPRs. These Plans are prepared keeping in view of the long terms requirements of the sample towns. The existing infrastructure systems have been studied assessed and issues in service delivery have been identified. A long term plan has been developed with the projected service demands and targets to be achieved; and various interventions and subprojects required to achieve the sector plan targets have been identified. In the next phase of this study, DPRs will be prepared for selected subproject components from the above long-term plans.
13. The Interim Report is organized in Four Volumes:

Volume I is the main Interim Report; summarizes the entire output produced till date under the TA Component B; provides a brief of all Sector Master Plans;

Volume II. Infrastructure Master Plans: this is compiled in five parts, each dealing with a separate sector, as given below:

- A – Water Supply Master Plan of Panipat
- B – Sewerage Master Plan of Hapur
- C – Drainage Master Plan of Hapur
- D – Solid Waste Management Master Plan of Ghaziabad
- E – Existing Traffic & Transport Analysis of Ghaziabad

Volume III presents the results of the socio-economic base line survey conducted in three sample towns in three parts:

- A – Ghaziabad
- B – Panipat
- C – Hapur

Volume IV. The proceedings of the Introductory Workshop organized on December 10, 2008, as part of training/workshop component of the TA is presented in this Volume.

14. This is **Volume II D: Solid Waste Management Plan of Ghaziabad**, of the Interim Report. This report is the first step in the direction of producing DPR for solid waste management in Ghaziabad City. This report is organized into following ten (10) sections including this introductory section:

Section II presents an overview of municipal solid waste management in India;

Section III presents profile of Ghaziabad City

Section IV describes and assesses the existing solid waste management system in Ghaziabad;

Section V presents the solid waste quantification and characterization surveys conducted and analysis of the results;

Section VI presents planning for integrated solid waste management system of Ghaziabad, include projected population and estimated waste generation, and proposed improvement measures and recommendations;

Section VII presents design of ISWM system, and cost estimates;

Section VIII provides operation and management guidelines for operationalization of ISWM;

Section IX presents long term development plan of ISWM and its implementation aspects include a detailed review of private sector participation in SWM services

Section X provides institutional strengthening and staff training and capacity building aspects of ISWM.

II. SOLID WASTE MANAGEMENT – A COUNTRY OVERVIEW

A. Introduction

15. Solid waste is defined as discarded solid fractions, arising from domestic, trade, commercial, industrial, agricultural, institutional, public services and mining activities. The term waste refers to useless, unwanted or discarded material. This discarded material is very heterogeneous in nature and its characteristics vary from place to place and season to season. Refuse comprises of all the solid waste of the community.
16. American Public Works Association (APWA, 1975) has classified refuse materials in twelve categories. These include garbage, rubbish, ashes, street sweepings, dead animals, abandoned vehicles, construction/demolition waste, industrial refuse special waste such as hospital waste, bulky waste, animal and agricultural waste & sewage treatment residues.
17. Problem associated with solid waste began with the dawn of civilization when humans started congregating in communities. Prior to this period waste from primitive societies could be conventionally and unobtrusively disposed off by taking the advantage of the natural self-cleansing capacity of the environment. During this period the population density was low and plenty of land was available. Moreover, since the population was nomadic in habit, it was common for the tribe to move away from waste bodies. As villages grew into towns and gradually into cities, the waste was commonly thrown away into waterways, vacant lands and approach roads, where it was mixed with the other waste of the community and of the domestic animals.
18. The appalling conditions of the cities of ancient civilizations and during the middle ages are well documented. Such conditions resulted in epidemics like the Bubonic Plague, and then called the “Black Death” which in the 14th century destroyed half the population of Europe. During the last decade of the 19th century as well as during the five initial years of 20th century, millions of people died due to Bubonic Plague in India. In recent years, no city in the world with modern sanitation has reported a plague epidemic. Environmental impact due to gaseous and liquid discharges has received greater attention than that by solid waste. Progress in improving solid waste management is not yet satisfactory.
19. A study by the United States Public Health Service has demonstrated the relationship of 22 human diseases to improper solid waste management. With the advent of industrialization and urbanization the problem of waste disposal increased. High population density, intensive land use for residential, commercial and industrial activities led to adverse impact on the environment.

B. Status of Solid Waste Management in India

20. India is still considered to be a so-called developing country and an enormous gap exists between the rich elite and the poor masses. Over the years, there has been a continuous migration of people from rural and semi-urban areas to towns and cities. The number of class I cities has increased from 212 to 300 during 1981-1991 and further to 393, while class II cities have increased from 270 to 345 during 1981-1991 and to 401 now; as indicated in **Table 1**. The increase in the population in class I cities is very high as compared to that in class II cities. The uncontrolled growth in urban areas has left many Indian cities deficient in infrastructure services such as water supply, sewerage and municipal solid waste management. Urban sanitation and environmental issues are clearly contributors to basic health conditions in urban areas but Municipal Solid Waste (MSW) Management has a lower priority than water supply and sanitation. Although incidents such as the plague episode in *Surat* suggest that there are important health aspects to MSW, it is basically an environmental issue rather than a health one and certainly the recent pressures in India for improved MSW have had an environmental focus.
21. Solid Waste Management is a part of public health and sanitation, and according to the Indian Constitution, falls within the purview of the State List. Since this activity is non-exclusive, non-rivalled and essential, the responsibility for providing the service lies within the public domain. The activity being of a local nature is entrusted to the Urban Local Bodies (ULB). The Urban Local Body undertakes the task of solid waste service delivery with its own staff, equipment and funds. In this sector, very large numbers of people are involved, whether as “Scavengers” or “Rag pickers” or Municipal workers. Thus the numbers of people and their roles are important in any effort to improve the management of MSW. MSW is normally the single biggest activity that a municipality undertakes. Though there is widespread public concern about the poor level of MSW management in most urban centers but there are some good examples and some relatively well managed systems. A number of cities like *Surat*, *Ahmedabad*, *Bangalore*, *Hyderabad* and smaller towns like *Suryapet* have taken important initiatives and the State governments are giving this issue more attention and providing increased resources.

Table 1: Urban Local Bodies- Class and Numbers

Population	Class	Nos. of Cities
1,000,000 and above (metro only)		35
100,000 and above	Class I	393
50,000 – 99,999	Class II	401
20,000 – 49,999	Class III	1,115
10,000 – 19,999	Class IV	1,344
5,000 – 9,999	Class V	888
>5000	Class VI	191
Unclassified		10
Total		4,377

Source: Information from web site of CPCB

C. Waste Generation Quantities in India

22. There is no reliable national data on waste management, covering either the technical or the financial aspects and therefore any overview figures represent approximations. A background report prepared by NEERI summarizes the readily available information and provides an indication of the scale of problem. It is estimated that in year 2000, the major urban centers in India generated about 1, 00,000 tons per day of Municipal Solid Waste. On an annual level, therefore, approximately 35 million tons of MSW is generated. An analysis of data available with the CPCB shows that waste generation has been found to be a function of consumption and production activity and thus strongly affected by household income and local production of goods and services. Therefore, the scale of task at the level of individual cities is more relevant. For example Mumbai, generates about 7,000 MT per day, Delhi about 6,000 MT per day. Smaller cities tend to generate smaller per capita loads and therefore less waste. Ghaziabad produces about 600 MT per day. The average waste quantities vary between 250 gm to 500 gm/capita/day depending on the type of local body.

Table 2: Projected Municipal waste generations for urban population in India

Year	Projected population (in thousands)	Waste Generation Rate gm/ Capita/ Day	Total MSW Generation (million Tons)
2000	281,255	327	33.7
2005	315,276	391	45.0
2010	355,205	471	61.0
2015	401,898	571	83.8
2020	455,823	696	115.8
2025	517,178	848	160.1
2030	586,052	1,032	220.7

Source: Information from web site of CPCB

D. Problems Being Faced by Urban Local Bodies

23. In general all Indian cities face similar problems about their solid waste management. Amount and contents of generated solid waste may differ among different cities but problems related to collection, transport and disposal are same. Major parts of generated solid waste remain uncollected at the streets, road side, open places, etc. which pollute the environment. In many cities nearly 50% of generated solid waste remains unattended, giving rise to unsanitary conditions especially in thickly populated areas (slums etc.) which results in an increase in morbidity especially due to microbial and parasitic infections and infestations in all segments of population, with the urban slum dwellers and the waste handlers being the worst affected.
24. Solid waste is collected and transported in an inefficient way using outdated equipment and techniques. Collected municipal solid waste is indiscriminately dumped at the outskirts of the city and/or at road sides or at crude dumping sites. Availability of appropriate site for landfill is another crucial factor. Most of the urban local bodies including Ghaziabad Nagar Nigam are suffering with the acute problem of non-availability of suitable land.

25. The local bodies, which are fortunate to have got the land, are using these merely as crude dumping sites not even as controlled landfill site. The objective of maintaining a Sanitary landfill site is still like a distant dream for most of the ULB's. Personnel from sweeper to manager share a lack of motivation, working in an unpopular public sector with a dirty image.
26. It is estimated that 30% to 40% of the total budget of ULB's is allocated to solid waste management. Despite this, there has been a progressive decline in the standards of services with respect to collection and disposal of municipal solid waste, bio-medical waste and industrial wastes, as well as measures for ensuring adequacy of environmental, sanitation and public hygiene.
27. Little work is performed and little information is recorded and / or available. Municipal authorities do not have records of secondary data on solid waste management.
28. None of the Indian class – I/II cities has the details of the quantity of industrial waste generated and collected by them. Industries are supposed to take care of their own solid waste treatment and disposal. They are ordered to report how much waste they generate or what they do with it. How much of this is mixed with MSW is not known either.
29. In most Indian cities bio-medical waste is mixed with Municipal Solid Waste and disposed off along with it, without considering the implication of consequences of these activities. Now after, Bio medical waste (Management & Handling) rules, 1998 & 2000 and Municipal Solid Waste (Management & Handling) rules, 2000 have come to the force, it is expected that these rules will be followed strictly.
30. The local bodies generally do not get much financial support from State or central Government. They are supposed to generate their own financial resources. However, the elected bodies do not muster the courage to levy taxes under their powers, which may be commensurate with the level of services they wish to provide. Inadequate taxation and inefficient management both together render the municipal services far from satisfactory.
31. The smaller municipalities have hardly any funds to meet their day-to-day requirements and have no capabilities to take measures for improving the level of service. Growing costs, shortage of funds, indiscipline among the work force, etc. is making the situation worse with the passage of time. In large cities the situation is rather complicated and difficult. The infrastructural development is not in a position to keep pace with the population growth of such cities resulting in serious inadequacies in service.
32. Except for a few progressive Municipal Corporations in the country, all other local bodies suffer due to non-availability of adequate expertise, experience and resources. Hence the solid waste is not properly handled resulting in creation of environmental pollution and health hazards. These local bodies lack in technical, managerial, administrative, financial resources, adequate institutional arrangement and the technical know how of managing urban solid waste. The main reason of institutional deficiencies is that there is no system of accountability so the duties are not discharged efficiently. The institutional arrangement

for Solid Waste Management is extremely poor in most urban areas. Most of the city fathers and senior decision making officials do not consider this subject worth their personal attention. At some places unqualified and untrained persons are promoted from the post of sweepers to supervisor, which results in deterioration of services.

33. It is, therefore, very essential to provide proper guidance and training to the personnel in the Urban Local Bodies to make them efficient in managing the solid waste generated in their respective areas/cities/towns.
34. As will be seen in subsequent Chapters, Ghaziabad faces problems similar to the ones discussed above.

III. PROFILE OF GHAZIABAD CITY

A. Overview

35. Ghaziabad is located in the northeastern part of National Capital Region, about 20 km east of Delhi. Ghaziabad City is an important City in Uttar Pradesh State and it is headquarter of Ghaziabad District. The City is spread and developed on both the sides of River Hindon, an important tributary of River Yamuna. Location of Ghaziabad in NCR is presented in **Map 1**.
36. Ghaziabad, the headquarter of the district of the same name, lies on the Grand Trunk road about a mile east of the Hindon river at Latitude 28° 40' North and Longitude 77° 25' East. It is 20 km east of Delhi and 46 km southwest of Meerut which it is connected by a metallic road. Other roads lead northwest to Loni and Baghpat and east to Hapur and Garhmukteshwar. Buses run at frequent intervals from this town to Delhi, Meerut, Aligarh, Bulandshahar, Moradabad, Lucknow and other cities. It is an important station on the Northern Railway where railway lines from Delhi, Calcutta, Moradabad and Saharanpur meet, connecting it with many important cities of India. The City has a boundary adjacent to Delhi, acts as the main entrance of Uttar Pradesh and is also called the “Gateway of Uttar Pradesh”.
37. Ghaziabad town is situated adjacent to the National Capital, Delhi towards North East. Thus over the years, it has experienced very rapid development and urbanization. The town is spread on both the banks of the river Hindon, an important tributary of Yamuna, merging in to Yamuna at Gharbara in Bulandshahar district, after flowing for a distance of about 200 km through Saharanpur, Muzaffarnagar, Meerut, Ghaziabad and Bulandshahar districts. The confluence is located about 40 Km downstream of Okhla barrage. A short cut canal called the Hindon Cut joins the river Yamuna at Okhla barrage from where the Agra canal takes off. The Hindon Cut thus serves to make the Hindon river water, including the supplemental discharge from the upper Ganga canal, available for diversion to the Agra canal for irrigational use. The river stretch remains dry in winter and summer seasons from Dehradun to Saharanpur receiving the effluents of agro-based industries in the basin including distilleries, sugar mills, pulp and paper mills, vanaspati factories, textiles mills and domestic effluents of Saharanpur.







B. History of the Project Town

38. The City was founded in 1740 by the emperor, Ghazi-ud-din, who called it Ghaziuddin Nagar after himself and built a spacious structure consisting of 120 rooms of masonry with pointed arches. Only the gate, a few portions of the boundary wall and a massive pillar about fourteen feet high remain now, the precincts now being inhabited. His mausoleum still stands in the city but is in a bad state of preservation.

Capacity Development of the NCRPB: Component B (ADB TA 7055-IND)

Location of Ghaziabad in NCR

Legend

-  NCR
-  State Boundary
-  District Boundary
-  District Hq.
-  Counter Magnet Areas
-  River / Stream

Drawn: Asian Development Bank
National Capital Region Planning Board

Consultant:
Wilbur Smith Associates Pvt. Ltd.

Drawn: Pooja	Checked:
Date:	Approved:
Scale: Not to scale	

Map - 1 



39. The city was the scene of fighting during the Indian Freedom Struggle, 1857–58, a revolt that began with Indian soldiers in the Bengal army of the British East India Company but developed into a widespread uprising against British rule in India. In an encounter between the freedom fighters and a small British force, the former were defeated while trying to hold the Hindon. This was the first war of independence and it brought Ghaziabad much of its glory.
40. From historical, cultural, mythological and archaeological point of view, Ghaziabad has been a prosperous city. This has been proved from the research work and excavations undertaken in the district. The excavation work carried out at the mound of Kaseri situated on the bank of river Hindon, 2 km north from Mohan Nagar, shows that civilization existed here even in 2500 B.C.
41. On 14th November 1976, Ghaziabad became the district. From then Ghaziabad has moved forward leaps and bounds on the social, economic, agriculture and individual fronts.

C. Climatic Condition

42. The climate of the city is dry and healthy; intensely hot during summer and quite cold during winter. The temperature is highest in May – June. The minimum temperature generally ranges from 7 degree C (January) to 26 degree C (May) and the maximum temperature from around 23 degree C (January) to 42 degree C (May). Westerly hot winds blow with great intensity in these months. The average rainfall is 732 mm and is generally limited to the months during June to September. Dust and thunderstorms occur frequently in summer season while occasionally fog occurs in the winter. Geologically, the town forms a part of the Indo-Gangetic alluvium.

D. Urban Economy

43. The economy of the town has been bi-functional – industries cum services since 1971. Industries form an important component of the economic base of the city. Ghaziabad is one of the largest industrial cities, next to Kanpur, in Uttar Pradesh. It is also an important centre for trade and commerce in western UP sub-region. Various products and equipments are supplied to the regional, national and international markets. The workforce participation rate and percentage workers in secondary sector are marginally declining but the size of work force in the city has maintained its increasing trend.
44. In terms of occupational structure, the Ghaziabad Nagar Nigam area is dominated by the tertiary (services) sector (59% in 1991) in general and specifically the other services sector (30% in 1991). Less than one third of workers are engaged in the secondary sector of which 30% workers were engaged in manufacturing sector. The household industries showed a decline in 1991, but improved in 2001. The percentage of workers engaged in primary sector has declined across the Ghaziabad Nagar Nigam area.

45. A number of famous major industries like Bharat Electronics Limited (a public sector unit of Central Government), UPTRON (a public sector unit of Uttar Pradesh Government), Dabur, Mohan Meakins, Gagan Vanaspati, Sri Ram Piston, Bhushan Steel and Weston Television are located in Ghaziabad. According to the statistics of the District Industrial Centre, 106 units of medium and large industries employed 24,595 workers in 2001. In percentage terms factories in the chemical and allied distillery sections (33%) dominate the Ghaziabad industrial scene. While in terms of workers, the electrical and electronic goods industries employ 29% of workers.

E. Urban Development

46. The city is growing at a very high pace and the population base has increased from 0.5 to 1.0 million during 1991-2001. During the last twenty years the population concentration has been on the periphery of the municipal board boundary. The city is growing spatially. Private developers promoted by Public – Private Partnership policy (PPP) are now supporting the urban development. The quality and quantity of housing is improving and reflecting the contribution of the private sector. There is no single city level agency, which maintains the integrated picture of the city housing status.
47. The city development till 1995, undertaken by the Ghaziabad Authority had declined in terms of the quality of residential development when compared with that of Noida, Greater Noida and Gurgaon in the DMA towns. The shabby look of the housing built by GDA got face uplift and its aesthetic value improved once GDA entered into PPP with private developers. The Commonwealth Games 2010, to be held in East Delhi are leading to a great deal of action in infrastructure development, hospitality as well as in the retail segment, as a result of which the population has increased many fold. Indirapuram and Kaushambi have been witnessing a lot of development in the wake of the upcoming event. To compete in the housing market, the development effort has been shifted from the public sector to the private sector through a partnership approach. Shipra, Ansals, Omaxe, Parshvanath and similar real estate giants of the private sector in housing development, have contributed to the city development.

F. Administrative and Financial Aspects of SWM

48. As per 2001 census the population of Ghaziabad city is 9, 68,256. The Municipal administration has been decentralized in five zones and 80 administrative wards. City zone has 24 wards; Kabir Nagar has 17 wards; Vasundra zone has 11 wards; Mohan Nagar zone has 14 and Vijay Nagar Zone has 14 wards.
49. Overall in-charge of the city for sanitation and health is the Chief Health Officer, who is assisted by one Deputy Health officer, one Zonal Sanitation officer, one Chief Food Inspectors, three Sanitary and Food Inspectors, 130 Supervisor and over 4000 Sweepers. The Sanitary inspector through the staff deployed at the zone level looks after the cleaning work. Ward supervisors are responsible for sanitation at the ward level under overall

control of zonal inspectors. The health section is entirely responsible for road sweeping, collection of waste, transportation of waste, operation and maintenance of all vehicles of GNN and management of land fill site as a part of Sanitation and Solid waste management. In addition to this, health section is responsible for issuance of death and birth certificates, issuing of licenses under Municipal byelaws and for fogging.

50. The solid waste management activity has received scanty attention from the civic authorities, though the Ghaziabad Nagar Nigam (GNN) spends a large amount of money. As per available data; the annual budget of GNN for year (2008-09) is Rs. 1663.3 million. Out of this; Rs. 331.2 million is allowed towards health fund (related with Solid Waste Management activities), which is about 20 percent of the annual budget of the Corporation, Out of the above budget; Rs.45.0 million are earmarked for POL, Rs 25.0 million are for purchase and maintenance of vehicle / materials, Rs. 6.0 million for nallah cleaning, Rs 255.2 million are kept for salaries to workers etc (it includes Rs 130.0 million on regular workers+ 5.2 million on supervisors+ 120.0 million on daily wage workers). GNN is incurring about Rs.255.2 million or Rs 125.8 per MT on primary collection (mainly on account of salary of sanitation workers) & Rs.83.0 million or Rs. 409 per MT on transportation, *nallah* cleaning and vehicle maintenance, for 676 MT of waste collection and transportation by GNN every day for 300 working days in a year. Overall cost on SWM is Rs 1667 per MT.

IV. EXISTING SWM SYSTEM IN GHAZIABAD

A. Overview

51. As per 2001 census the population of Ghaziabad city is 9, 68,256. The Municipal administration has been decentralized in five zones and 80 administrative wards. City zone has 24 wards; Kabir Nagar has 17 wards; Vasundra zone has 11 wards; Mohan Nagar zone has 14 and Vijay Nagar Zone has 14 wards.

B. Waste Generation and Composition

52. The main solid waste generation sources are residential, commercial and market, slum, slaughterhouses, institutional organization like hospitals, hotels and restaurants, small and big scale industries, construction and demolition waste (debris) etc. but their quantity and quality data were not available with the Municipal authorities.
53. Some of the essential primary data has been generated by Quantification and Characterization (Q&C) survey undertaken by a private agency called M/s ECOPRO Environmental services during sample survey carried out during 27 to 29 th December 2008. To assess the waste quantity disposed at the disposal ground, all the transport vehicles carrying waste were weighed on 29th December prior to taking for disposal. Detail analysis is presented in Chapter 3.

C. Street Sweeping and Drain Cleaning

1. Existing System

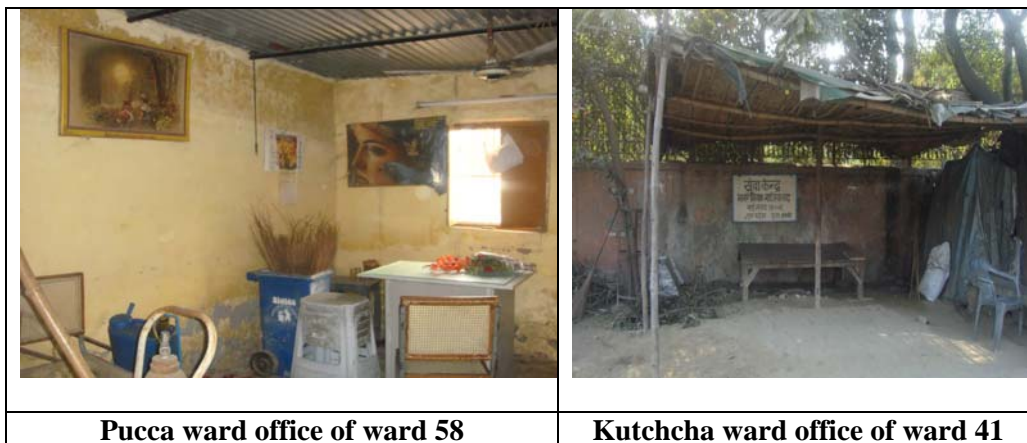
54. Entire Nagar Nigam area is divided in five zones, namely Mohan Nagar, Kabir Nagar, Vijay Nagar, Vasundhara and City zone.

Table 3: Details of Solid Waste Management Zones and Wards

Zone Name	Total Wards	Ward Numbers
Mohan Nagar	14	9,14,17,24,44,46,48,57,60,63,69,70,73,75
Kabir Nagar	17	16,20,21,22,33,34,35,38,42,53,59,64,65,67,68,71,79
Vijay Nagar	14	2,3,6,8,12,13,15,18,23,26,45,51,52,66
Vasundhara	11	25,28,29,36,37,40,41,49,58,72,78
City Zone	24	1,4,5,7,10,11,19,27,30,31,32,39,43,47,50,54,55,56,61,62,74,76,77,80

Source: Ghaziabad Nagar Nigam

55. Each zone is under charge of one sanitary and food inspector. The Zone office is the authorized place in every zone from where the sanitation activities are controlled. The tools and equipments are also stored here. The roll call of the sweepers/operators and their work allocation is done here. General public can interact with sanitary staff or can report a complaint for any deficiency at this office. Normally all works related to sanitation are handled at the zone office including parking of vehicle, allotment of duties, record keeping etc. every zone office has the facility of puncture repairing but for all other minor/major repairing, vehicle/equipment is sent to city garage which not only controls sanitation related activities of the city zone but controls all repairing, maintenance and fuel distribution to operators. In some zones, one-two room ward offices are also established which are manned by ward supervisors with staff for attending the ward level complaints.
56. Ward supervisors look after sanitation work at ward level but in most of the wards, pucca office/Seva Kendra does not exist. A picture view showing pucca and katchha ward office:



57. GNN has total strength of 4,072 including temporary workers. Few of them are also working as supervisors and drivers. The workers are working in three categories depending upon the length of service. 1037 are permanent workers; 458 are daily wages workers; 1421 are working through contractor and 1156 are on contract basis. On an average there are 3 sweepers for every 1000 population.
58. There are 165 supervisors for sanitation work; out of which; only 25 are regular and remaining 140 are officiating from the workers. The day to day responsibility of sanitation work of respective area is on the sanitary supervisor.
59. Normal working hours for sweepers and vehicle operators are 8 AM to 4 PM with a lunch period of 1 hour during 1-2 PM. Attendance of sweeping staff is taken two times in a day, in morning and after lunch. Normally, beats in morning shift are almost fixed but in afternoon shift, workers are made to sweep/clean specific area in collective manner as per the directions of supervisors.

60. The primary collection of solid waste is carried out through street and road sweeping because all kind of solid waste is thrown from windows/doors and put in open places. The sweeping and cleaning of city is done on the basis of a Single-tier system by forming “beats”. In each beat there is one sanitation worker. For waste collection from narrow roads, 24 number of three wheeler tempos are provided.
61. Every permanent worker is issued one uniform and gloves every year for summer seasons and one uniform for winter season once in three years but workers normally do not wear the uniform and gloves during work. Sanitation workers are using long coconut broom. Workers are also supplied spade, pick axe, shovel, pan, gumboot and other tools as per the requirement. The sanitation worker sweeps the stretch of street (beat) and heaps it on the road / street side with the help of coconut broom (Photo a). Drain cleaning is done by separate group of workers. Size of group depends upon nature and quantum of work. The sanitation worker after sweeping/drain cleaning collects these waste heaps in handcart and carries either to the nearby dust bin or to open collection point and unloads on the ground (Photo c, d, e, and f).
62. Total amount of Rs 255.2 million is spent on primary collection and road sweeping during year 2008-09 by GNN. Per MT expenditure comes out to be Rs 1258 per MT.
63. About 1,400 metallic un-containerized handcarts are distributed among 4,072 sanitation workers thus all the workers are not provided with equipment. The capacity of wheelbarrow is approximate 40-50 kg. Normally, each sanitation worker is making three-four trips per day. There is no fix norm for providing the carts. All the push carts are uncontainerized (Photo b).



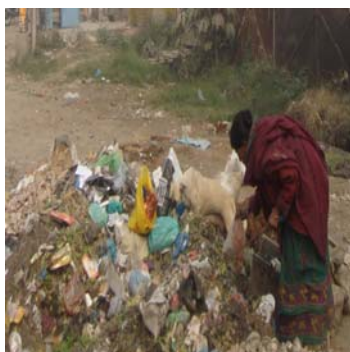
a (worker, sweeping)



b (worker with push cart)



c (waste unloading)



d (stray animal)



e (waste scattered near bin)



f (dumper placer bin)

64. The shops / markets and other establishments normally start business after 9:30 – 10:00 AM. These timing do not synchronize with the work schedule of the sweepers, as by this time most of the collection procedure is over. The waste from these business communities again accumulates on streets and road. The city does not appear clean. The same is true in the case of hotels, restaurants and vegetable market waste.
65. Ghaziabad city has a large number of Nursing homes, pathology centers and hospitals over 3000 bed facility. Expected generation is about 3 MT of biomedical waste daily; two agencies are available for collection, processing and disposal of hazardous medical waste in a common bio-medical waste processing facility centre. One called M/S Medicare incineration Private limited, Masuri has entered into agreement with 85 medical institutions and other agency called M/S Synergie Private limited, Noida has agreement with 118 medical institutions.
66. Industrial waste generated by Industries situated in Industrial areas/Estates is supposed to recycle/process within the industrial area and no waste from industries should be allowed to mix with Municipal Solid Waste; however waste generated by most of the industries is getting mixed with MSW, because - firstly, the industrial area is almost merging with residential and commercial areas of the city and secondly, there is no check or control over the industrial waste disposal system. There are 10 industrial areas but details about waste generation from various industries are not available. Waste from Industries is of hazardous nature hence suitable provision for disposal separately as per Hazardous Waste Rules 1989 amended in 2000 is required.

2. Deficiencies in the Existing System

67. The following are the deficiencies in SWM primary collection system in Ghaziabad:
 - (i) Amount spent per MT is much on higher side due to large work force.
 - (ii) Each of the zones is keeping records pertaining to respective activities but a written document pertaining to available resources and zone map showing boundaries is not readily available.
 - (iii) No work norm for the staff and vehicle movement is available. Area and number of beats in the area for each worker and vehicle is decided as per the practice. There is no system of sending the attendance to the senior officers on daily basis, thus ensuring the presence and taking the work from the sanitation workers is left entirely on to the supervisors.
 - (iv) In absence of the proper pucca ward offices there are no secure places to keep the sanitary implements after the days work in most of the wards.
 - (v) The handcart is left along the roadside or street side after the work is over, handcarts lying on the road give unpleasant sight, hindrance to the free flow of traffic and sense of insecurity in the mind of worker.
 - (vi) The solid waste is neither stored, neither segregated nor collected at source. It is thrown on streets, footpaths, open spaces, open drains or water bodies, back yard lanes etc. pushcart/tempo workers have to collect the street waste from the streets

and public places.

- (vii) Only few important roads and markets are swept on daily basis, while the other roads and markets are not swept regularly. Sweeping is not carried out on Sundays and worker's holidays.
- (viii) All type of solid waste generated is mixed with municipal solid waste including hazardous industrial waste, demolition waste, highly putrisciable waste and inert waste.
- (ix). Due to lot of encroachment on roads, covered drains, unauthorized parking, lot of traffic and kutchcha shoulders on both sides of streets; area looks unclean even after sweeping.
- (x) Large work force is available but productivity is very less.
- (xi) The workers have been deputed in each zone according to past practice without working out the need based requirement.
- (xii) Safai Karamchari's beats are not decided as per any work norms. They are working according to past practices.
- (xiii) Road sweepers only sweep the streets and transport the waste up to collection points but drains abutting streets are not cleaned by the sweeper. Separate group of workers are deployed for drain cleaning but work distribution is without any norms.
- (ix) The tools and equipment are insufficient and improper. The design of equipment mainly uncontainerized push carts and tempos are required to be unloaded near the bins on the ground, therefore one additional worker is needed to transfer the waste from the ground into the bin again ,this has reduced the manpower productivity and necessitated for additional workers.
- (xv) It is observed that workers are mentally prepared for only 3-4 trips per day, which makes efficiency level very low.
- (xvi) Handcarts are not properly distributed, nor are in sufficient numbers (only 1400 for 4072 workers), which is one of the main reasons for reduced efficiency and productivity.
- (xvii) Sweepers and supervisors are mostly unskilled and have not been provided training. They have no exposure of good practices, proper use of tools and are not aware about health and hygiene related issues.
- (xviii) Primary collection of solid waste in Ghaziabad city is primitive and inefficient.

D. Storage System

- 68. Zone/ ward Maps and list showing location of collection points is not available with Ghaziabad Nagar Nigam. Sanitation supervisors decide location of open/closed depot on their own without any norms in adhoc manner on the basis of availability of equipment and space. In some wards, number of collection points/bins is much more than required whereas many wards have only few collection points.
- 69. Out of total 675 collection points in entire area; 250 (35 % of total) are without containers and remaining has dumper placer bins. At 300 locations, 4.5 cum size bins; at 115 locations, 2 cum size bins and at 10 locations, refuse collector bins are provided in different wards.

70. All of 250 storage points which are on open land; develops unhygienic condition and cause of smell, odor, proliferation of flies, mosquitoes and other diseased vectors. These places are treated as receptacles of solid waste. In addition to regular points, many more number of irregular collection points exist for which no authentic information is available. The respective field staff collect the waste at temporary points and get the waste removed. At every closed collection point, one sanitation worker is deputed for transferring waste from the ground into the bin.
71. There are inadequate numbers of community dustbins of multiple size and design. These are not located and distributed properly. Positioning of the bins is decided on availability of space, past practice and personal preferences. There is lot of pressure against positioning of the bins as most of the bins are not cleared in time ; more waste remain scattered around the bin rather than inside the bin, attracting rag pickers and stray animals scurrying through the waste in search of recyclable/eatable.

E. Solid Waste Transport System

1. Existing System

72. Transportation is the second important stage of solid waste management system. This being very important element as it involves a large proportion of the capital and operating cost and cause an impact on both, primary collection and processing. Transportation stage can be defined as transportation of stored solid waste from various places in specially designed vehicles to the disposal site in the most hygienic way. The objective of the system is transportation of collected refuse from specific collection points to the disposal site at minimum cost and removal of the waste at regular intervals from all collection points. Transport of solid waste is carried out entirely by Ghaziabad Nagar Nigam from all 80 wards with no privatization.
73. It is estimated that Ghaziabad Nagar Nigam transports about 53-60 percent of total generated waste. The remaining waste is either left on streets, deposited in open plots, low lying areas and drains or burnt in open. Ghaziabad Nagar Nigam is carrying out transportation with its own fleet of equipment. Presently GNN is using Front end loader / Excavator cum loader with truck and tractor tippers for removal of waste from open collection points and dumper placer carriers for closed collection points (dumper placer containers).
74. GNN have five zones. Vehicle of each zone are parked in the respective zone office and moves to predecided route along with labour. Sanitary supervisors of zone are responsible for collecting the waste and ensuring that maximum waste gets lifted from their wards. Zonal officer fix the traveling routes of vehicles based on the basis of experience. Vehicle operation, management and fuel allotment of vehicles related to specific zone is under control of the zonal officer but the maintenance of vehicles is handled from city zone garage.

75. There is no record of with authorities on the route followed by collection vehicles and weight carried by each vehicle on each trip but fuel to each vehicle operator is issued as per past experience and assumed number of trips. Most of 125 vehicles (zone wise list given below) of Ghaziabad Nagar Nigam, like tempos, tippers and tractor trolleys are not covered though few of these are covered by tarpaulin sheet.

Table 4: Zone Wise Distribution of SWM Vehicles

Type	Name of Zones					Total
	City	Kabir Nagar	Vijay Nagar	Mohan Nagar	Vasundara	
Loader	4	2	1	1	2	10
Excavator Cum loader	2	2	1	2	2	9
Tractor trolley	13	5	5	5	1	29
Truck tipper	9	10	4	7	5	35
DP carrier 2 cum	-	2	1	-	1	4
DP container 2 cum	-	72	36	-	35	143
DP carrier 4.5 cum	6	3	1	2	3	15
DP container 4.5 cum	90	87	20	34	43	274
Tempo	6	5	7	3	3	24
RC	1	-	-	-	-	1
Tractor carrier	1	-	-	-	-	1

Source: Ghaziabad Nagar Nigam

76. GNN has 19 DP carriers for about 450 containers. The ratio of DP carrier to Container is 1: 24. Ratio of 1 excavator cum loader to tipper is 1:3 and 1 loader to tractor trolley is 1: 2.
77. Vehicles work in one shift but as per the understanding the drivers are expected to complete the minimum number of trips every day. Each Refuse collector is expected to make 1 trip; open tipper and tractor cum trolley 3-4 trips and DP carrier 5-6 trips each day per shift. Majority vehicles of Ghaziabad Nagar Nigam transport the waste to trenching ground at the banks of Sai Upvan *Nallah*. Vehicles of Vijay Nagar area go to other trenching ground of that area.
78. Trip record is maintained at the disposal yard. About 200 trips are made by all vehicles at the disposal place. Chief Health officer, GNN holds overall responsibility of management of operation and maintenance of about 130 vehicles. Each zone has puncture repairing and air filling arrangement but for any other maintenance work, vehicles are required to be sent to city garage which controls maintenance of entire fleet of vehicles of GNN. Financial power for minor repairing up to Rs 25,000 vests with Additional commissioner; up to Rs. 1 million with Commissioner; Rs. 1-1.5 million with Mayor; Rs. 1.5-2.0 million with the Executive committee; 2.0-3.0 with the Board and beyond Rs 3.0 million with the GoUP.
79. Total number of operators is 162 but regular operators is only 10. The deficiency is met out with sanitation workers /daily wage/contract workers holding driving license to run the vehicles. There are 152 temporary operators arranged for SWM operation work.

80. Following Table shows the expenditure incurred on solid waste transportation in Ghaziabad. Average cost of transportation per ton of waste transported is about Rs 409.

Table 5: Expenditure on Transport

S. No	Item	Cost (Rs. Million)
1	Amount sanctioned towards workshop head (transportation of waste) (2008-09)	83.00
i	Salaries of workshop and vehicle operator staff	7.00
ii	Vehicle repair and maintenance	25.00
iii	Fuel charges	45.00
iv	Drain cleaning	6.00
2	Population served (per ay) (year 2009)	1,359,383
3	Waste generated (ton/day) (expected)	748 MT
4	Waste transported(ton/day)(as per weighment on 29.12.08)	676 MT
5	Waste transported(ton/year)	202,800 MT
6	Cost of Transportation (per ton)	Rs 409 /MT

Source: Ghaziabad Nagar Nigam

2. Deficiencies in Existing System

81. The following are the deficiencies in the existing municipal solid waste transport system in Ghaziabad.
- (i) Number of major collection points in each ward is fixed by the supervisors in adhoc manner according to practice and convenience.
 - (ii) In some wards, population and generation of waste is less but the collection points are more whereas in many others, situation is just reverse. To set up a new point is very difficult for GNN. There is lot of pressure for shifting or abolishing of existing points.
 - (iii) In addition to identified points, several temporary points are also created for collection at the ward level for which no record is available.
 - (iv) In absence of any weigh bridge for weighment; exact information about actual waste transportation is not available. Only guess work prevails while giving account of waste removed on particular day.
 - (v) The milometer/hour meter of any vehicle is not in working condition. The quantity of waste transported as well as the operation hours of each vehicle can not be measured. Fuel distribution which ought to be on the basis of milometer reading is done on the basis of assumed number of trips.
 - (vi) Transport system is dependent on manual labour attached with each vehicle as well as on mechanized means.
 - (vii) Major drains are first filled with waste from the streets and later on are required to be cleaned under annual desilting programme.
 - (viii) Number of regular operators is much less than required. Most of the requirement is met from temporary staff from worker's category having driving license.

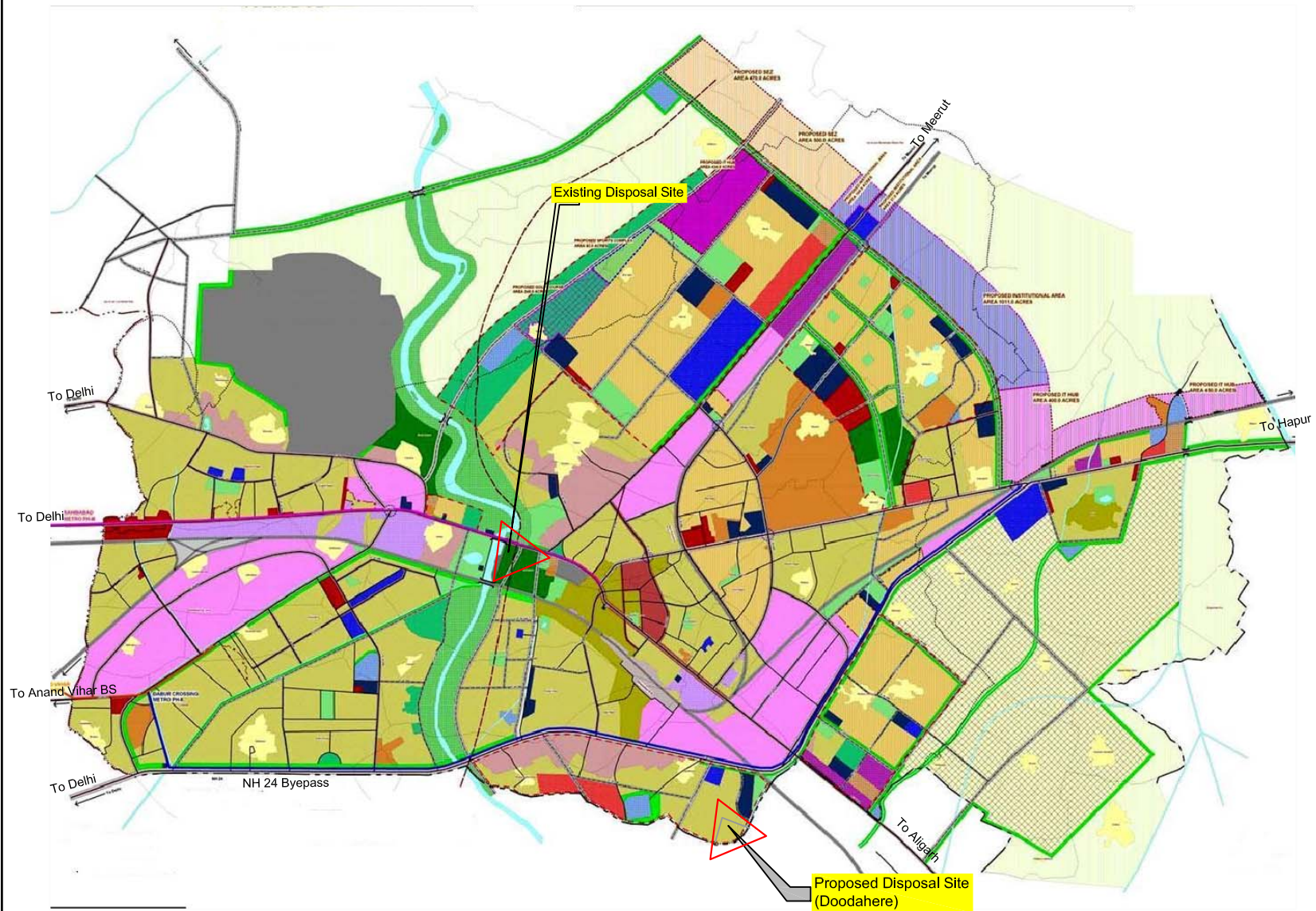
- (ix) Ratio of one dumper placer carrier to container is 1:24, which is on much higher side. The ideal ratio is 1:15 per day, depending upon the distance of disposal point.
- (x) Transport system is not fully synchronized with the system of community waste storage facility.
- (xi) Transport vehicles are not covered which is against the guidelines of Supreme Court.
- (xii) Vehicles of Ghaziabad Nagar Nigam are repaired regularly and no vehicles are grounded for want of minor maintenance work that is inspite of the fact that the garages do not have qualified mechanics and GNN is fully dependent on outside agencies for repairing of vehicles. Even minor repairs cannot be carried out by GNN.
- (xiii) GNN does not have own fuel pump and for daily needs, there is an arrangement with private fuel stations. The zonal officer is authorized to issue the fuel slip to each driver according to some assumptions, which are decided through past experience. Though record for fuel allotment is maintained but records for the exact distance traveled and the quantity transported are not maintained.
- (xiii) In the old city day time lifting of solid waste has always been problematic. The width of main lanes of old city not fit for two way traffic. Tempos are used to transfer waste from narrow areas up to community bins requiring for multiple handling and duplication of efforts.
- (xiii) Mostly transport vehicles have to travel on major highway which remains very much congested due to long route traffic passing through Ghaziabad. On going construction of the flyover is also causing obstruction in easy movement of the vehicles.
- (xiv) Encroachments across the lanes also pose a problem. Transportation from the inner lanes of the city is found very difficult. Though there exists a legal provision for removal of construction waste and onus of removal is on generator but the debris etc is being removed by the GNN.
- (xv) Condition of roads is not very good and shoulders are kutcha, causing lot of inconvenience to transport vehicles.
- (xvi) All types of mixed waste including hazardous and construction material are removed by transport vehicles.

F. Solid Waste Disposal System

82. At present, there is no processing plant and properly designed sanitary land fill site at Ghaziabad. Waste is disposed off at an existing site located near *Sai Upvan Nallah* by cured open dumping method. A proposal to set up a compost plant at new site at Dooda Hera on 14 acre site is at advance stage on DBOMT (Design, Build, Operate, Maintain and Transfer of land) basis under a centrally sponsored scheme approved by GOI. The UP Jal Nigam which is the executing agency for the project on behalf of GNN has already issued (Letter of Intent) LOI to the selected firm called as M/S Hollofix Urban infrastructure Private Limited, Noida which is expected to set up the integrated processing plant at the site once land use issue is resolved at the Government level.

Capacity Development of the NCRPB: Component B (ADB TA-7055)

Ghaziabad Existing and Proposed Disposal Site



Legend

- Rural Builtup
- Residential, Urban Builtup (High Density)
- Residential (Medium Density)
- Residential (Low Density)
- Main Commercial Area
- Commercial
- Whole Sale Commercial
- Industrial (Light & Small)
- Industry (Medium)
- Office
- Community Facilities
- Institutional Area
- Institutional Green
- Rregional / Local Recreations
- Park, Open Spaces, Sport Center
- City Forest
- Green Buffer, Belt
- Area Reserve for River /
- Transport Nagar / Bus Station
- Defence Land
- STP/WTP/SWD
- Agricultural Land
- River, Canal,Drains, Water Bodies
- Graveyard / Cremation Ground
- Railway Land
- Non Conforming Use (Unauthorised Settlements)
- Area for Proposed HI-Tech City Urban Expansion
- Industrial Dev. Authority Area
- Existing Road
- Proposed Expressway Tentative Alignment
- Proposed Road
- Railway Line
- Urban Expansion
- State Boundary
- Dev. Authority Boundary
- Nagar Nigam Boundary
- Village Boundary
- Area Upgraded From MP-2001

Client:
**Asian Development Bank
 National Capital Region Planning Board**

Consultant:
Wilbur Smith Associates Pvt Ltd

Drawn:SK
 Date: Jan, 2009
 Scale: NTS

Checked: SKG
 Approved: NSS

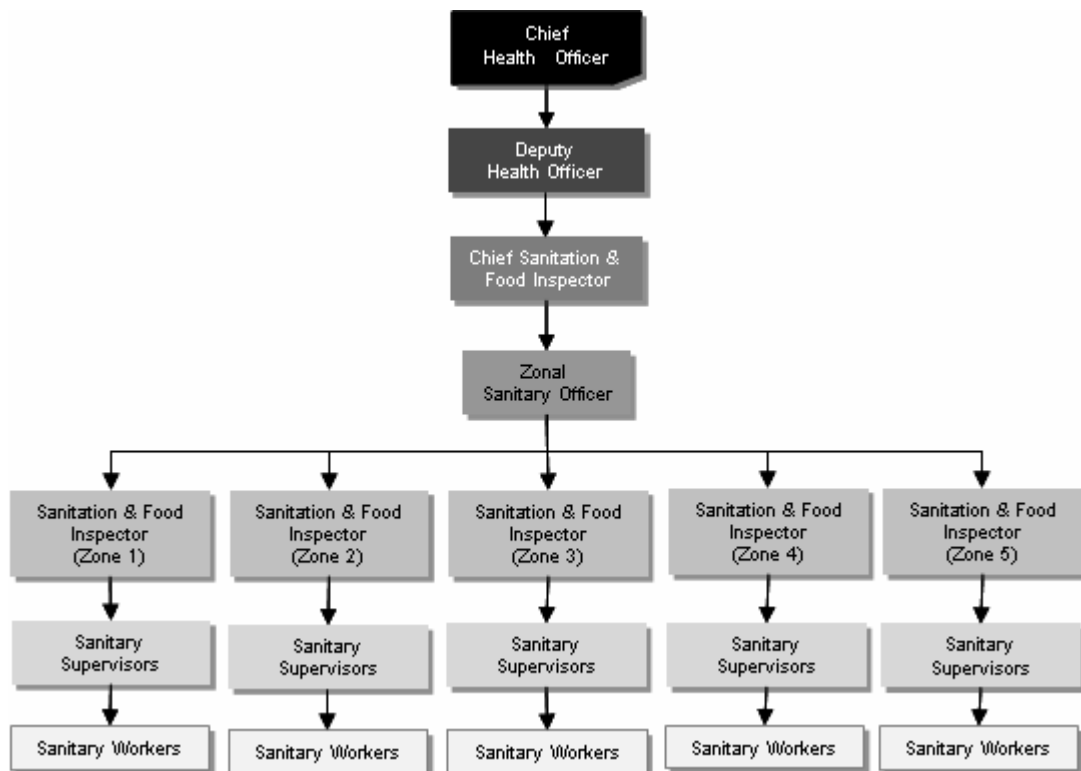
83. At present, most of the waste in mixed form is taken to Sai Upvan site with little quantity at Vijay Nagar site for disposal in crude open dumping method. The following are the deficiencies the observation of waste disposal practices in Ghaziabad:
- (i) The disposal sites are neither demarcated nor fenced.
 - (ii) Site is surrounded by Sai Upvan Nallah which ultimately connects to Hindon River at the down stream through RCC Hume pipes. The entire nallah remains choked and starts overflowing during monsoon season damaging the kutcha approach road and obstructing the smooth movement of the vehicles.
 - (iii) A large quantity of waste ultimately finds access to Hindon River through nallah thus acts as a major source of environmental pollution. During monsoon, leachate directly enters into nallah and Hindon River.
 - (iv) Present method of operation of the sanitary landfill is very crude and unscientific. The waste in mixed form is dumped without any processing and covering by daily cover.
 - (v) Waste is only spread and leveled that too not done on regular basis. One hired bulldozer, one poclain and one excavator cum loader are deployed at site for leveling and dozing but due to poor supervision and control, lot of waste heaps is visible on all corners of the site.
 - (vi) Rules regarding site safety, environment and health are not followed. There is no control at the existing sites on the entry of the rag pickers, who while attempting to recover useful recyclable material, spread the waste all around spoiling the site and in turn are exposed to serious diseases.
 - (vii) No studies have been carried out to determine the effect of the landfill operations on the environment and ground water. No EIA Studies have been carried out.
 - (viii) Hospital waste, industrial waste, construction waste and all kinds of waste are currently getting access along with other waste.
 - (ix) No weigh bridge exists at landfill sites. The record is kept by measuring the quantity on per trip basis. The total waste reaching at the dumping site is worked out by multiplying number of trips with average waste carrying capacity of vehicle. In absence of proper supervision and monitoring, this is handled by untrained workers/guards who do not understand the importance of this exercise and operators also consider this as a routine matter. Record of hired bulldozer is not kept by the guard.
 - (x) No attempts for leachate control or recovery of biogas is being made at the site. There is a tendency to burn the waste at the site
 - (xi) Condition of internal roads is very poor, due to which there is a tendency to dump at wrong places which either create obstruction or helps in deposition of waste in heaps at certain points.
 - (xii) The existing site does not fulfill requirements according to MSW (M&H) Rules, 2000.

G. Institutional and Policy Aspects

84. The establishment, roles and responsibilities of Municipal Corporations in Uttar Pradesh are mainly derived from (i) the UP Municipal Corporation Act, 1956 and (ii) 74th Constitutional Amendment. Municipal Solid Waste Management is one of the activities of the ULB and is defined as an obligatory function. Specifically, municipal solid waste management in India is guided by the national level legislation, the Municipal Solid Waste (Management and Handling) Rules, 2000.
85. *The Municipal Solid Wastes (Management and Handling) Rules, 2000.* Every municipal authority is responsible for the implementation of the provisions under these rules. The Rules outline the guidelines and principles for collection of wastes, segregation of wastes, storage of municipal wastes, transportation of municipal solid wastes, processing and disposal of wastes. The rules specify the criteria for selection of landfill sites and monitoring activities to be carried out before and after commissioning of the landfill sites. As per this legislation, the municipal authority is required to make an application for grant of authorization to set up waste processing and disposal facility from State Pollution Control Board (SPCB). The municipal authority shall also furnish its annual report to the SPCB on or before 30th June every year with respect to the solid waste management systems.
86. In Ghaziabad, the following institutions are involved in solid waste management.
- (i) Ghaziabad Nagar Nigam (GNN): GNN is responsible for solid waste management in Ghaziabad. Its Health Department is headed by Chief Health Officer is responsible for day-to-day solid waste management activities.
 - (ii) Uttar Pradesh Jal Nigam (UPJN): UPJN is a line department of the Government of Uttar Pradesh, mandated with provision of water supply and sewerage systems in the entire state. Although it is the responsibility of ULBs to prepare and execute the SWM projects, due to lack of its capacity, the preparation and execution of capital works is carried out by UPJN. In 2004, UPJN has prepared a project for SWM in Ghaziabad under a GoI Scheme. GoI approved this project with a cost of Rs. 135.1 million in 2004. The project comprised collection and transport equipment, construction of dhalaos (secondary waste storage depots) and platforms for bins, construction of processing plant and sanitary land fill site. UP Jal Nigam is the executing agency on behalf of GNN.
 - (iii) Uttar Pradesh State Pollution Control Board (UPPCB): As per the MSW Rules, 2000, UPPCB is the monitoring agency for implementation of MSW Rules, 2000 in UP. Its role is mainly to ensure implementation of MSW Rules, 2000, in terms of issuing consent for establishment and operation of waste treatment and landfill facility and also scrutinize the annual reports on SWM submitted by ULBs to ensure their compliance with the MSW Rules, 2000. The UPPCB also monitors the environmental compliance of the facilities during development, operation and closure as per the MSW Rules, 2000.

87. In GNN, overall in-charge of the city for sanitation and health is the Chief Health Officer, who is assisted by one Deputy Health officer, one Zonal Sanitation officer, one Chief Food Inspectors, three Sanitary and Food Inspectors, 130 Supervisors and over 4,000 Sweepers. The Sanitary inspector through the staff deployed at the zone level looks after the cleaning work. Ward supervisors are responsible for sanitation at the ward level under overall control of zonal inspectors. The health section is entirely responsible for road sweeping, collection of waste, transportation of waste, operation and maintenance of all vehicles of GNN and management of land fill site as a part of Sanitation and Solid waste management. In addition to this, health section is responsible for issuance of death and birth certificates, issuing of licenses under Municipal byelaws and for fogging. Organization set-up of the Health Department is shown in **Figure 1**.

Figure 1: Organizational Set-up GNN Health Department



88. The solid waste management activity has received scanty attention from the civic authorities, though the GNN spends a large amount of funds. As per available data; the annual budget of GNN for year (2008-09) is 1663.3 million, out of this Rs. 331.2 million is allowed to health fund (related with Solid Waste Management activities), which is about 20 percent of the annual budget of the Corporation. Out of the above budget; Rs.45.0 million are earmarked for fuel expenses, Rs 25.0 million for procurement and maintenance of vehicle/materials, Rs. 6.0 million for *nallah* cleaning, Rs 255.2 million are kept for salaries to workers etc - this includes Rs 130.0 million for regular workers, Rs. 5.2 million on supervisors, and 120.0 million on daily wage workers).

89. GNN is incurring about Rs.255.2 million or Rs 1,258 per MT on primary collection (mainly on account of salary of sanitation workers) and Rs.83.0 million or Rs. 409 per MT on transportation, nallah cleaning and vehicle maintenance, for 676 MT of waste collection and transportation by GNN every day for 300 working days in a year. Overall cost on SWM is Rs 1,667 per MT.

90. Following are the observation of institutional aspects of SWM in Ghaziabad:

- (i) Basic information is not available; each of the zones is keeping records pertaining to their activities; but there is no recorded information pertaining to available resources, and maps of zone/area of operation/beats/location of collection points etc.
- (ii) There are no work norms for the staff and vehicle movement; area and number of beats in the area for each worker and vehicle is decided as per the practice.
- (iii) There is no proper reporting mechanism followed from ward/zone level to GNN head quarters; there is no system of sending the attendance to the senior officers on daily basis, thus ensuring the presence and taking the work from the sanitation workers is left entirely on to the supervisors.
- (iv) The present scenario of SWM Ghaziabad is described in a picture gallery below:



(1) Solid waste lying in open



(2) Waste transport in open is common



(3) Worker sweeping the road



(4) Stray animals at open depot



(5) Inappropriate equipment



(6) Overfull Dumper placer container



(7) Overfull & broken container



(8) Manual loading of Solid Waste



(9) Burning of waste quite common



10) Rag pickers at land fill site



(11) Construction waste On roadside



(12) Crude dumping at disposal site

H. Initiatives for improvement of SWM in Ghaziabad

91. Solid waste management system has always been a serious concern for all urban local bodies. Being close to national capital and an important city of the State, Ghaziabad happens to be in limelight for sanitation and other infrastructure facilities. People often tend to compare the level of facilities of Ghaziabad city with Delhi. Due to poor financial situation, technical and managerial handicaps, it is not generally possible to keep the pace of infrastructure services with growth level but in case of SWM, GNN is fortunate to have got the funds from Government of India(GOI) under Centrally Sponsored Scheme.
92. Ghaziabad city is one of the 10 airfield towns, selected for SWM improvement scheme sanctioned by GOI with the objective to mitigate the bird hit menace for the aircraft's of *Hindon* Indian Air Force station situated at Ghaziabad. The solid waste management project of the city was approved by the Ministry of Urban Development, GOI for Rs 13.51 crores in year 2005. The scheme is 100% financed by the GOI and being implemented by UP Jal Nigam on actual + 10% administrative charge basis.
93. Few salient features of approved project are given below:
 - (i) The project report was prepared to cater the SWM related need of GNN for 5 years in general (2005-10) and 3 years for sanitary landfill site.
 - (ii) Equipment was proposed to augment the system for next 5 year period. Main focus was to provide supplementary number of equipment to meet the shortfall of equipment at particular time keeping consideration of financial limits.

- (iii) As sufficient land was not available at the time of project preparation, it was decided to develop SLF site for 3 year life period.
- (iv) MSW handling unit has been designed to handle up to 400 MT /day of MSW upto 2010 (5 years from design period). It has lately been decided to set up the plant on BOOT basis for 30 year period for which bidding process is already complete and firm called M/S Hollofix Urban infrastructure Pvt. Limited, Noida has been awarded the LOI. Agreement has not been signed as the proposed land was under legal dispute.
- (v) Eight components were identified in the project report about which brief description is shown in Table below.
- (vi) UP Jal Nigam is the executing agency on behalf of GNN.

94. The components of approved scheme and progress update are shown in following table:

Table 6: Cost Estimate of GoI Approved SWM Project (2005-10)

S. No.	Component	Approved Cost	Progress	Progress
		Rs. Crore	Financial	Physical
1	Solid waste collection	1.58	1.69	(i) 2000 bins of LLDPE of 50 litre (ii) 109 dumper placer containers of 4.5 cum capacity (iii) 143 dumper placer containers of 2 cum capacity (iv) 13 tractor container carriers (v) 11 Dhalaos and 192 platforms of two different sizes were constructed
2	Solid waste transportation and handling	0.53	0.48	(i) 298 heavy duty tricycles (ii) 1 servicing equipment with all accessories (iii) 4 DP carriers (iv) 1 tipper
3	Sanitary Landfill Unit (for 3 years)	3.66	0.37	*Only compound wall is constructed and some leveling work is executed as land issue is under litigation
4	Compost plant (100 TPD)	2.69	0.19	
5	Infrastructure facilities at solid waste disposal facility	1.78	0.88	
6	Vermi Compost unit (20 TPD)	0.58	-	
7	Sewerage/drainage facility near sensitive zone	2.05	2.20	
8	Public awareness, capacity building and training	0.25	0.25	
9	Contingency (3% on 1 to 7 above)	0.39		
10	Total basic cost	13.51	6.06	
11	UP Jal Nigam Project Management Charges	1.35		
12	Grand Total	14.87		

Source: SWM DPR

95. The picture gallery below shows some works executed/equipment supplied under CSS:

	
LLDPE bins	Tricycle
	
DP with 2 nos 2cum capacity bins	Tractor container carrier system
	
Platform for Dumper Placers	Dhalao

1. Critical Issues

96. It is obvious from the progress update given in table above that out of eight items, progress of four items is quite satisfactory but the progress related to compost plant and sanitary landfill site development is not satisfactory. The delay is caused due to land dispute and legal stricture of Honorable High Court on the identified land for Compost plant and sanitary landfill site at *Dooda Hera*. The progress was hampered in last two years due to legal interventions about which a brief narration is given below.

97. The site comprising of 14 Acre land in Dooda Hera (belonging to Ghaziabad Nagar Nigam) and adjoining land of 33 Acres in village Chipiyana (falling under jurisdiction of Gautam Buddha district), a total land of 47 Acre was selected for setting up of compost plant and sanitary land fill under the CSS of GOI. UP Jal Nigam constructed compound wall around the 14 acre land in year 2004, which was under possession of GNN at that time .No Objection Certificates were also granted by Air force station *Hindon* and UP state pollution control board, Lucknow for the proposed site in year 2004.
98. Real problem started when, the Master Plan, 2021 for Ghaziabad prepared by Ghaziabad Development Authority (GDA) became applicable from July, 2005. Unfortunately, the land under reference at Dooda Hera was shown as part of residential land use in the Master Plan which has become the bone of contention later on; as the Hon'ble High court, Allahabad granted Stay on carrying out any activity related to SWM on the petition of Mr Anil Tyagi in March, 2006.
99. Subsequently, after lot of persuasion and representations both at government and court level, it has now been decided by the Hon'ble High Court to allow to use the proposed site for SWM purpose provided land use is suitably amended by GDA. Since then, GDA have already recommended change of land use and matter has been sent to Government for final approval. It is expected that in couple of months from now, the change of land use would be effective and the work at the site could be started again by the UP Jal Nigam. The allotment of additional land of 29 acres (out of 33 acre) in village chipiyana is also at advance stage but even with this additional land, the requirement will not be fully met as pointed out in chapter 5.
100. Two more sites each of 20 Hectare area will be required by GNN in North/ North waste and East/ North-East of Ghaziabad for setting up processing plant and SLF site in consultation with GDA, Hindon Airport Authority and UP State Pollution Control Board.

V. SOLID WASTE QUANTIFICATION AND CHARACTERISTICS

A. Major Sources for Solid Waste Generation

101. The information on the quantity of waste generation and disposal, nature of wastes, its composition, physical and chemical characteristics are the basic needs for planning of MSWM system. Secondary data on Solid Waste Management of Ghaziabad is very scanty. Therefore, some of the essential primary data has been generated by Quantification and Characterization (Q&C) survey undertaken by a private agency called M/s ECOPRO Environmental services; which was confirmed by discussion with various line agencies.
102. The sample survey was carried out during 27 to 29 th December 2008. Samples from different category are collected to assess quantity at source and characteristics of generated waste. To assess the waste quantity disposed at the disposal ground, all the transport vehicles carrying waste were weighed on 29th December prior to disposal.
103. The various sources contributing Municipal Solid Waste are: Residential Areas; Bio Medical facilities; Commercial Areas; Hotels & Restaurants; Vegetable & Fruit Markets Construction & Demolition Activities; Road Swept Material, and Horticulture Waste, etc.

B. Quantities of Solid Waste Generated

1. *Need for Quantification*

104. The knowledge of existing quantity of solid waste generation is essential to judge the adequacy of existing fleet of vehicles. The quantity of waste also reflects whether available number of dustbins capacity is sufficient to store the solid waste. It is also necessary to know the quantity being disposed off at various disposal sites per day, so that their total life could be judged.
105. Once the present quantities were known, action could be initiated to estimate the future quantity for the plan period 2031. After knowing the present and future quantities, planning for acquisition of additional sites could be made. The knowledge of present and future quantity was essential for proper planning of the system.
106. Presently Ghaziabad Municipal Corporation does not have their own weighbridge facilities so the solid waste quantity was not known to the authorities. A detail weighment exercise was carried out on December 29, 2008 through a private agency. Total 677 MT waste was measured to be transported to the disposal place from 213 trips.

2. *Criterion for Collection of Samples*

107. It is very important to collect a reliable and representative composite sample, which should faithfully represent the conditions in the original mass and at the same time be of such volume & weight that can be easily and conveniently handled in the laboratory. While collecting the solid waste sample, it should also be kept in the mind that the characteristics of solid waste in the same city or town are going to be different, for different types of areas such as residential, commercial, market, industrial and institutional etc. Even for a residential area, the characteristics would differ for low, middle & high-income groups. For industries, the characteristics would change for different processing methodology.
108. Stratified random sampling is the best method for collecting the solid waste samples. For this type of sampling total population of that area, number of housing units and classification of houses on economical basis is necessary. However as this data is not available, using this method was not possible here because of time and money constraint, therefore a sample procedure giving good precision, accuracy and reliability was adopted. This is called the quartering method.
109. To verify the details, quantification and characterization survey for waste of Ghaziabad was got done by a private firm along with weighment of all transport vehicles for one day prior to final disposal and also the empty weight of the vehicle after disposal.
110. For the characterization & quantification study, 88 samples were collected from different categories after detailed discussions with the Ghaziabad Nagar Nigam authorities. 8 samples from LIG, 6 samples from MIG, 6 samples from HIG, 4 samples from slum areas, 8 samples from Commercial establishments, 8 samples from markets, 8 samples from fruit and Vegetable markets, 8 samples each from Horticulture and Hotels, 6 from Restaurants, 4 from Construction waste, 8 from road side bins and 4 samples from Trenching ground fresh waste and 4 samples from trenching ground old waste were selected for 3 consecutive days i.e. 27-29th December 2008.
111. On 29th December all waste transport vehicles were weighed at weigh Bridge prior to unloading at disposal place. The details of sample collection point and vehicle weighing data and results are attached at **Annexure 1** and **Annexure 2** respectively.
112. On the basis of sample collection and further analysis, it has been found out that per capita waste generation from Ghaziabad Nagar Nigam Area is 546.49 grams per capita per day or 0.55 kg per capital per day (**Annexure 3**).

Picture gallery showing sample collection from various sources

		
LIG	MIG	HIG
		
Hotel waste	Commercial waste	Fruit and Vegetable
		
Construction & Demolition waste	Restaurant	Dumping site



Waste from collection points



Horticulture waste



Weighment



Sample storage



Weighment



C. Density of Solid Waste

113. The knowledge of the density of a waste i.e. its mass per unit volume (kg/m^3) is essential for the design of all elements of the solid waste management system. As in high income countries, density of waste at the source is very less; therefore considerable benefit is derived through the use of compaction vehicles on collection routes, because the waste is typically of low density. A reduction of volume of 75% is frequently achieved in developed countries with normal compaction equipment so that an initial density of $200 \text{ kg}/\text{m}^3$ will readily be increased to $800 \text{ kg}/\text{m}^3$. In other words the vehicle would haul four times the weight of waste in the compacted state than when the waste is not compacted.
114. The situation in low – income countries is quite different, as in our country a high initial density of waste precludes the achievement of high compaction ratio. Consequently, compaction vehicles offer little or no advantage and are not cost- effective. So the refuse density estimation is very important. This data would also be useful for land filling as to how much waste can be compacted. From the Q & C survey, average density is calculated as $469.92 \text{ Kg}/\text{m}^3$ (**Annexure 4**). The high density is mainly attributed to the high percentage of inert material in the solid waste of Ghaziabad. Though the increase in density in India will not be in same proportion as in developed countries but, there is scope for increase in density by compaction. Normally, a density of $800 \text{ kg}/\text{m}^3$ may be achieved by using compactors, thus advantage of transporting 100 percent more waste by compactors.

D. Physico – Chemical Characteristic of Ghaziabad Municipal Solid Waste

1. Need for Analysis

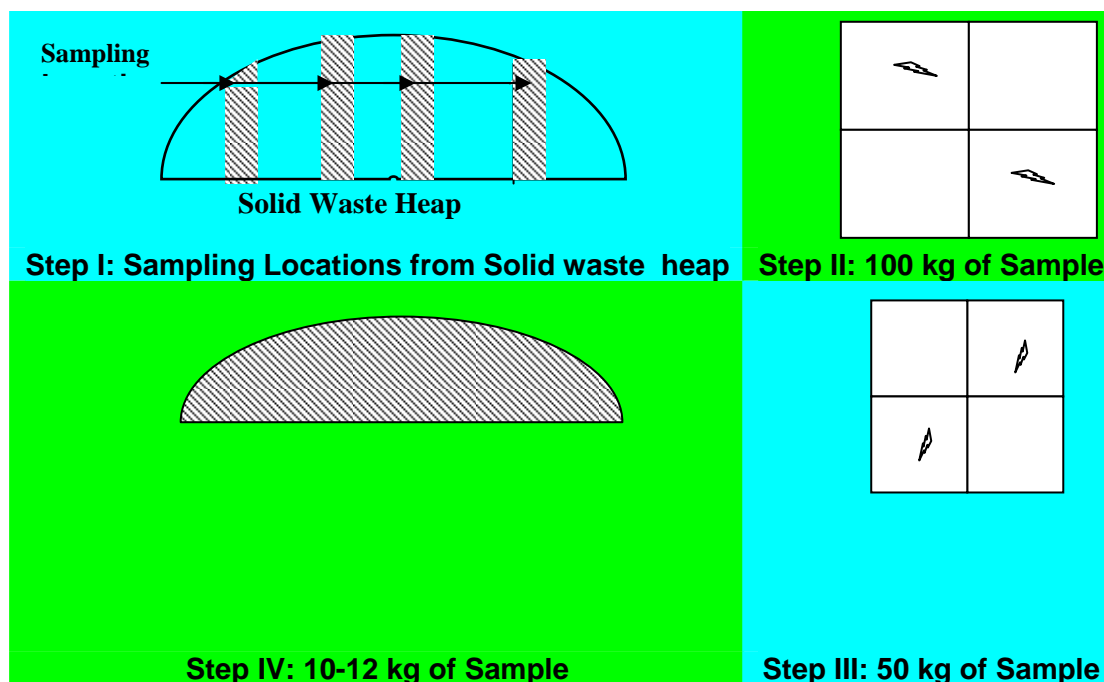
115. Knowing the physical and chemical characteristics and quantity of solid wastes is essential for the following reasons:
- (i) It provides the information for the selection of equipment and appropriate processing technology.
 - (ii) It provides the basic data on which the management system is planned, designed and operated.
 - (iii) After assessing the composition of analysis over time, the waste manager is able to detect changes in composition characteristics and quantities and the rates at which these changes take place, such knowledge facilitates forward planning.
 - (iv) It indicates the amount and type of material suitable for processing, recovery and recycling.

2. Sampling Criteria & Analysis for physical and chemical analysis

116. The method of quartering is also shown in the given **Figure 2** below. While collecting the solid waste sample, at a point, from 10 different points within the waste heap samples were grabbed each weighing approximately 10 kg. The grabbed sample was mixed together to obtain the composite sample of 100 kg. [STEP I] The 100 kg sample was then reduced to approximately 12-13 kg by the method of quartering. The material is spread in a rectangle heap and divided into four equal parts. The diagonally opposite portions are mixed together while other two diagonals are rejected. [STEP II] The collected portion is then mixed and spread in a rectangle heap. [STEP III] The opposite two diagonal parts, which are on the other diagonal side, are mixed together and remaining parts discarded. [STEP VI] The process is repeated till a sample of 10-12 kg remains. This representative sample is used for physical and chemical analysis.
117. The physical analysis of these samples was carried out by weighing the various constituents separately after manual separation and results expressed as a percentage of the total weight.
118. The mixed sample was first taken and subjected for moisture determination. The total weight of the sample was recorded initially. The whole sample was then screened through 20x20 mm sieve to separate the fine fraction of the refuse containing mainly the earth, small stones and some fine organic fraction. The coarse fraction of the refuse was further separated manually into different ingredients e.g. hay & straw, leaves, paper and cardboard, food & fruit waste (kitchen waste), plastic, metal, glass and ceramics, stores & bricks, inert fine (<20mm), wood, leather, textile & rubber etc. Each fraction was weighed separately and represented on percentage basis.

119. Part of the organic fraction of the sample was then oven dried at 100⁰C for 24 hours, pulverized, passed through 0.22 mm pore size sieve, and mixed thoroughly. This powder was subjected to detailed chemical analysis such as, moisture Content, volatile solids, ash, calorific value, carbon, hydrogen, nitrogen, sulfur, phosphorus, potash, C / N ratio.

Figure 2: Quartering Method of Solid Waste Sample Analysis



120. Conclusions of Physical Analysis

Table 7: Summarizes Physical Analysis at Source and at Trenching Ground in Wet Condition

Location	Moisture	Bio degradable	Recyclable			Non biodegradable and inert
			Fuel	Other	Total	
<i>Percent</i>						
At source	38.10	55.92	18.73	9.74	28.47	16.20
At trenching ground	41.63	58.09	4.71	7.41	12.12	29.79

Source: Quantity and Characterization Survey, 2009

121. **Conclusions on findings of physical analysis:**

- (i) High degree of biodegradable and low recyclable waste.
- (ii) Higher concentration of inert waste at the disposal ground as compared to generation point because of contamination of waste due to mixing with street sweep.
- (iii) Commercial waste (over 20%) is good source for recyclable waste.
- (iv) Higher concentration of inert waste with no scope for recycling.

- (v) High biodegradable waste with high moisture contents (38.10%) is unsuitable for incineration but suitable for composting.
- (v) Reduced percentage of recyclable matter at trenching ground indicates that most of the recyclable waste is picked up by rag-pickers during collection and transportation process.
- (vi) Ghaziabad City Solid Waste is having high percentage of biodegradable matter and therefore is suitable for composting.

122. *Inferences from Chemical Analysis.* Calorific value of waste at source is worked out as 1,097 Kcal/kg and at trenching ground as 796 kcal/kg (**Annexure 5**). Low calorific value of waste indicates that the waste is unsuitable for incineration and recovery of energy. C/N ratio at source and at trenching ground is analyzed as 28.63 and 22.57 respectively (**Annexure 6**).

VI. PLANNING FOR INTEGRATED SOLID WASTE MANAGEMENT SYSTEM

A. Introduction

123. Inadequately managed waste pose threat of environment pollution and epidemic disease, besides space constraint, odour and aesthetic problems. The situation is worse in case of urban solid waste where heterogeneous nature of waste is generated from various sources and composition with hardly any control over generation and the generator. Rapid urbanization has helped in increase of population, economic activity and the income. Changed habit and consumerism has further helped in more and more generation of waste of complex nature.
124. GNN is responsible for providing solid waste related services like arrangement for road sweeping, collection of waste, transportation facility; processing and disposal of waste but Nigam has limited technical, managerial and financial resources insufficient to manage the increased waste quantity.
125. Extension of Ghaziabad Nagar Nigam area in last 5 years has further aggravated the situation as resources have not increased in proportion to requirement. Nigam is not only administratively and technically weak but heavily dependent on the government for financial assistance and many policy matters. Moreover, it does not have land for establishing essential services for Transfer Station, Processing plant and Sanitary land fill site. The existing disposal site is functioning as open crude dumping place in complete violation of MSW (M& H) Rules, 2000.
126. Nagar Nigam would not able to run the system effectively if waste generators are indulged in littering, disposing of waste at unauthorized place and time, not practicing source storage and segregation ,therefore public participation is very crucial for effective system. It is needed to involve Non Government Organizations (NGOs), Community Based Organizations, Resident Welfare Associations (RWAs) not only for cooperation in system designed by GNN but also to help in waste minimizations and source segregation. A regular mass awareness drive for community and training for staff is required.
127. Evolutionary waste quantity and characteristics demand high cost, time and sophisticated technologies which could be available by involving private sector participation. At present Nagar Nigam is managing entire solid waste system without any private sector participation but in future, NGO/Private sector participation is must.
128. Thus, an integrated solid waste management system would be required association of all stakeholders.

B. Population Projection and Waste Generation Projections

129. The population of Ghaziabad Nagar Nigam Area as per the Census 2001 is 968,521. The projection of the future population is made for the purpose of Master Plan Report till 2031 and attached at **Annexure 7**. Population projections were carried out based on appropriate methods, considering the population growth from 1971-2001 and of 2011 and 2021 as projected in Ghaziabad Master Plan. Average of three methods (arithmetic increase, incremental increase and curve fitting) was considered. Population projections were made separately for Ghaziabad and other towns in the GDA area. As presented in the following Table, estimated population of GNN and GDA in 2041 is 4.4 million and 6.1 million respectively. The total estimated waste generation in GNN and GDA area is given below. The projection population for 2010, 2011, 2021, 2025 and 2031 are given in the Table below.

Table 8: Projected populations in GNN and GDA area up to 2041

Year	GNN	Dasna	Modi Nagar	Murad Nagar	Loni	Total GDA area
2001	968,521	24,428	139,642	74,080	120,659	1,327,330
2009	1,359,383	31,186	165,700	96,810	200,683	1,855,159
2011	1,479,619	33,150	172,941	103,508	227,902	2,017,120
2016	1,835,963	40,342	197,097	125,786	282,227	2,482,077
2021	2,278,126	49,095	224,628	152,859	349,501	3,054,209
2026	2,720,455	61,923	289,252	192,810	421,201	3,686,650
2031	3,248,668	78,103	372,468	243,202	507,610	4,450,051
2041	4,423,355	113,470	556,271	363,828	677,600	6,134,525

Source: up to 2021, as per Ghaziabad Master Plan 2021; and beyond that consultant's analysis

130. According to findings of the sample survey of solid waste, average per capita national waste generation is estimated as 0.55 kg/person/day. Earlier studies carried out by NEERI, Nagpur have shown that in the case of cities like Ghaziabad the per capita waste generation rate increases at 1.41 percent per year. Following Table shows projected population, increase in per capita generation rate. Thus, by following the above references, the per capita value at the end of 2031 (design period) from GNN and GDA areas is expected to be 0.75 kg/c/day
131. Projected waste generation from 2009 to 2041 in GNN area, outer area and total GDA area is given in the following Table. According to quantification analysis, per capita waste generation from GNN area was 0.57 kg/day (in base year of 2011).

Table 9: Projected Solid Waste Generation

Year	GNN	Other areas	Total GDA	Per capita waste /day	Waste From GNN Area	From Outer Areas	Total GDA
	<i>Nos.</i>			<i>Kg</i>	<i>MT/d</i>		
2001	968,521	358,809	1,327,330	-	-	-	-
2009	1,359,383	495,776	1,855,159	0.55	748	273	1020
2011	1,479,619	537,501	2,017,120	0.57	837	304	1141
2016	1,835,963	646,114	2,482,077	0.61	1,114	392	1506
2021	2,278,126	776,083	3,054,209	0.65	1,482	505	1987
2026	2,720,455	966,195	3,686,650	0.70	1898	674	2573
2031	3,248,668	1,201,383	4,450,051	0.75	2,431	899	3330
2041	4,423,355	1,711,170	6,134,525	0.86	3808	1473	5281

Source: Analysis; Population figures of 2011 and 2021 are from Ghaziabad Master Plan 2021

C. Proposed Improvement Measures and Recommendations

1. Storage of Waste at Source

132. Short Term:

- (i) Each of the existing community bins/pits should be surveyed and utility to be reassessed. If location of any bin is inappropriate or without any emptying arrangement, same should be changed.
- (ii) Proper storage community bins to be provided at suitable locations so that sweepers need not to travel long distance for depositing swept waste.
- (iii) Repairing system of community bin should be improved. Some authority should be given for ensuring emergency repairs immediately.
- (iv) Proper supervision mechanism should be in place. Daily reporting system showing number of containers cleared, number of pendency, and detail about damaged containers should be followed.

133. Medium Term:

- (i) New location, size and design of community bins should be decided, after assessing the expected waste receiving quantity, required frequency of collection and ensuring the emptying arrangement.
- (ii) New steel community bins of 4.5 cum capacity to be procured and suitably placed with provision of waste storage in segregated form.

- (iii) Every individual premise holder and bulk generators should be asked to store the waste in segregated form in suitable size of storage bin normally 100% more space than required for waste quantity expected to be generated in 24 hours.
- (iv) There should be separate arrangement for waste collection from societies, multiplexes and other bulk generators. Every society should devise internal collection system at own level which should be compatible with Municipal system from door step of the colony/society for which GNN should provide suitable size containers and proper transport system after consultation with representatives /RWAs.
- (v) GNN should actively associate resident associations, trade & street associations, Community based organizations, NGOs in the awareness campaign to motivate people for source segregation and deposition of waste at designated place.

134. Long Term:

- (i) More strict supervision on individual and bulk generator for ensuring waste storage arrangement in segregated form by keeping suitable size storage bins.
- (ii) Location for keeping storage bin with segregation arrangement should be made mandatory at the time of issuing building permission.
- (iii) Extensive mass awareness programme should be continued by associating NGOs, various associations, against littering and for encouraging source segregation and deposition of waste at designated places.

2. *Street Sweeping and Drain cleaning*

135. Short Term:

- (i) Work should be allotted according to the work norms. Sweepers should clean shallow drains abutting road/footpaths also.
- (ii) All workers should be provided with hand glove, mouth mask and gum boot (for drain cleaner).
- (iii) Tools should be immediately replaced if they are damaged or become useless. Some nominal amount, say 50 Rs per month to push cart holder could be given as an allowance for undertaking minor repairing work at their level.
- (iv) Few containerized pushcarts should be procured for pilot use.
- (v) Role of sweepers and supervisors should be appreciated. Good workers should be awarded with cash prize on special occasions.

- (vi) By changing sweeper's designation as "sanitation conservator" or "sanitation guards"; they could be made to feel more motivated.
- (vii) Suitable location should be identified for ward office in each ward with 1-2 room and storage facility as per availability of space.

136. Medium Term.

- (i) Pucca ward Office should be constructed and effectively operationalized in each ward.
- (ii) New containerized pushcart and other tools should be procured for all the workers. Few un-containerized pushcarts should continue to be in use for collection of debris/inert/drain muck/horticulture waste.
- (iii) Nagar Nigam should extend street sweeping and drain cleaning facility to un-serviced and new areas.
- (iv) Street sweeping on busy roads, congested areas is not possible in day time, therefore night sweeping should be taken up on such important roads.
- (v) Sweeper training is important, which should be arranged on periodical basis covering -work procedure and handling of tools, best practices of waste management, litter collection & removal, personal hygiene, health and safety issues and attitudinal & behavioral issues.
- (vi) Workers should be motivated by regularization of service, awarding cash prizes to best worker, promoting to supervisor position etc.

137. Long term

- (i) Sweeping and drain cleaning facility should be extended to entire Nagar Nigam area including more areas for night sweeping.
- (ii) Regular measures for worker's training and motivation.
- (iii) Ward offices should be strengthened. Majority of activities related to GNN should be attempted to be solved at the ward office.

3. *Waste Collection*

138. Short Term:

- (i) All collection points should be covered with collection system.
- (ii) Open collection points should gradually be replaced by covered bin of suitable size.

139. Medium Term:

- (i) Presently no door to door system is in practice but it is essential to introduce primary collection system, which means door step collection of waste from generating sources.
- (ii) Door to door collection should be done by using smaller vehicles preferably mini waste collector of 1.5 cum capacity with compartments for biodegradable, nonbiodegradable and recyclable waste with hydraulic system of unloading directly into community bins as well as inside the compactors by involving NGO/private entrepreneur.
- (iii) Initially door to door/ primary collection is proposed in 50% of area in base year which should gradually be increased to 60%; 70%; 80% and 100% level in year 2016; 2021; 2026 and 2031.
- (iv) In addition to door to door collection facilities, an additional facility by way of community bins of 4.5 cum capacity are proposed all along major streets/places of littering/bulk generators/unserved areas.
- (v) Awareness campaign should be carried out for best practices of solid waste and seeking cooperation for success of primary collection system.

140. Long Term Measures

- (i) Nagar Nigam should aim for increase in coverage area for primary collection in gradual manner by involving more NGOs and private sector entrepreneurs.
- (ii) Extensive awareness campaign should be carried out explaining source segregation, arrangement made by Nagar Nigam about primary collection, penalty provisions and about service charges.

4. *SWM Transport System*

141. Short Term

- (i) Minimum three trips daily to be made compulsory for every transport vehicle (other than dumper placer carrier).
- (ii) Minimum eight trips daily to be made compulsory for each dumper placer carrier.
- (iii) Fuel to be allotted after verification of actual milometer reading and verifying the trips at the trenching ground.
- (iv) Annual maintenance contract should be executed for timely repairing of vehicles.
- (v) At least one centrally located suitable place for Transfer Station cum recycling centre should be identified in each zone.

142. Medium Term

- (i) Heavy vehicles like compactors should be used for direct transportation only.
- (ii) Open and slow moving transport vehicle should be replaced by closed and fast moving vehicles. Some open vehicle could be used for transportation of construction waste/debris/horticulture waste.
- (iii) Old vehicles which have already outlived economic life should be replaced by new vehicles.
- (iv) In order to reduce number of vehicular movement carrying limited quantity of waste, it is suggested to use fast moving heavy vehicles which should ply between a common central location known as Transfer Station cum Recycling centre in each zone (approximately of 1 acre area) to the processing plant site.
- (v) Nigam should develop recycling centre cum transfer station either at centrally located place within zone or at the existing zone office. All the heavy vehicles (compactors) should be parked at this place. The mini garbage collectors should bring the waste at this place and unload into appropriate vehicle according to the category i.e. biodegradable/non-biodegradable, as the destination of each category of waste would be different. All recyclable products should be separated out and stored separately for further transportation for resale or for processing or for removal by rag pickers.
- (vi) Annual maintenance contract for repairing of vehicle should be executed.

143. Long Term

- (i) Private sector participation for part area for collection and transportation of solid waste should be considered.
- (ii) Transfer Station cum Recyclation centre should function effectively.

5. *Processing of Waste*

144. Short term

- (i) Work should be started on the proposed site at Dooda Hera selected for setting up of integrated processing plant.
- (ii) Two more sites as recommended in North and East of Ghaziabad should be identified for processing plant as well as SLF site for which 20 acre land space would be required.

145. Medium term

- (i) Dooda Hera should start operation.
- (ii) Possession of additional two sites for new plants and SLF site should be taken and secured by fencing/walled.
- (iii) Detail project report and bid document should be prepared for additional sites proposed to be developed on DBOMT basis.

146. Long term

- (i) Processing plant and SLF site at Dooda Hera continue to work smoothly.
- (ii) Setting up and operationalization of new processing plant and SLF sites at new sites.

6. *Disposal of waste*

147. Short term measures

- (i) As not much can be done on facility and structural aspects, therefore existing site at Sai Upvan cannot be used as sanitary landfill site but may be used as controlled dump site by implementing suitable operational and management guidelines.

- (ii) A controlled dump site is a non engineered disposal site where improvement is implemented on the basis of operational and management aspects rather than on facility and structural requirements, which would require substantial investment.
- (iii) Following measures could be implemented at Sai Upvan site :
 - Prohibit illegal entry
 - Diverting nallah
 - Keeping proper record of vehicles and manpower visiting the site
 - Ensuring dozing, pressing of waste in layers and covering with inert material layer
 - Repairing the approach road regularly
 - Reserving place for unloading and for stacking inert material
 - Arrangement of leachate collection and vent pipe
- (iv) Work order should be attempted to be issued for SLF site at Dooda Hera after resolving land issue.
- (v) Two more sites as recommended in North and East of Ghaziabad should be identified for processing plant as well as SLF site for which 20 acre land space would be required

148. Medium and long term measures - Same as mentioned under processing plant section.

7. *Institutional Arrangement*

149. Short Term

- (i) Importance should be given to SWM section and interdepartmental coordination should be improved.
- (ii) Work norms for workers, supervisors and operators should be finalized and implemented.
- (iii) Decentralization of duty and authority to be implemented.
- (iv) Identification of land for Transfer station cum Recyclation centers, processing plant and SLF sites and allotment of land for same.

150. Medium Term

- (i) SWM services should be provided on all seven days.
- (ii) Area, activities, terms and conditions to be finalized for private sector involvement.
- (iii) Initiating door to door collection and source segregation.
- (iv) Setting up of processing plant at Dooda Hera and Transfer Station cum Recyclation centre.
- (v) Initialing process for SLF site development at Dooda Hera.
- (vi) Possession of land for Transfer Stations and Processing plant cum SLF sites.
- (vii) Management information system should be implemented for effective monitoring and supervision of sanitation related activities.
- (viii) Operation and Management guidelines should be implemented.
- (ix) More area should be privatized.
- (x) As mostly workers and supervisors are on fixed monthly basis, so they do not have motivation and initiative towards work. Workers and supervisors should be given financial award for doing good work; by regularizing services on the basis of performance, giving more detailed responsibility and authority.
- (xi) For entire solid waste and sanitation management activities, health section should be strengthened by taking following steps:
- (xii) Public Health/Environmental Engineer in the grade of Executive Engineer should be made in charge of Solid Waste Management section with sufficient authority and responsibility. He would report directly to Commissioner.
- (xiii) To avoid the problem of coordination and passing of responsibility to others, overall control in relation to sweeping, drain cleaning, collection, transportation, processing and disposal of all wastes including vehicle maintenance facilities should lie with in charge of SWM section.
- (xiv) In charge should be assisted by two Assistant Engineers—one Civil Engineer and one Mechanical Engineer for technical matters and one Chief sanitary officer for supervision, monitoring, mass awareness and record keeping.

- (xv) The Assistant Engineer (Civil Engineer) should exclusively be made responsible for solid waste related activities like construction and maintenance of; buildings, storage points, processing plants and sanitary land fill sites.
- (xvi) The AEN Mechanical Engineer should be made responsible for entire transportation system, procurement & maintenance of vehicles, operation and maintenance of processing plant and sanitary land fill site.
- (xvii) The Chief sanitation officer should be responsible for supervision and monitoring of solid waste related activities, planning, record keeping and conducting mass cleaning drives and publishing IEC material.
- (xviii) Sanitary Inspectors to assist Chief Sanitation Officer in supervision of sweeping, drain cleaning, transportation, door to door collection, processing, disposal systems, planning and monitoring. Supervisors to assist in supervision work.

151. Long Term

- (i) Recycling cum Transfer Station, processing plant and SLF to be set up and start functioning smoothly.
- (ii) PPP to be in operation in many areas.
- (iii) 100% service charge recovery, strict monitoring and compliance of penalty provisions.

8. *Capacity Building and Training*

- (i) There is a dire need to develop the capacity of the Nagar Nigam in terms of training.
- (ii) It is suggested to provide adequate training to all levels of staff engaged in SWM section. The lower level staff such as sweepers and supervisors should be given training locally in various aspects like sweeping technique, proper use of tools, storage, source segregation, health & hygiene related issues and primary collection of waste.
- (iii) Inspectors and above should be given training in modern technologies of waste management, transportation, planning, personnel management programme within and outside the city.
- (iv) The senior officers of solid waste management department should be given adequate training through workshops and visit to various parts of the country and abroad.
- (v) Unqualified supervisory staff should be given in service training to qualify for supervising sanitation works/supervisors/operators.

- (vi) Refresher courses should be conducted for the supervisory staff at least every 5 years, or they should be sent for training to get an exposure of advancement in this field.

9. *Coordination Meeting*

152. Since the SWM department depends greatly upon the support of various departments of Corporation, mainly engineering and finance. The Commissioner should hold regular coordination meetings to sort out problems faced by solid waste management section, such as expeditious repairs of road, drains, footpaths, removal of debris/construction material. The procurement procedure for equipments and approval of pending files should also be decided expeditiously.

10. *Private Sector Participation*

- (i) Presently private sector participation in solid waste management sector is not in practice at Ghaziabad except repairing of vehicles by outsourcing.
- (ii) It is a known fact that the privatization proves to be cost effective as compared to public sector. The involvement of private sector would bring many advantages like-availability of new technology, improved efficiency, substantial financial investment , overall cost saving, increased level of accountability and citizens satisfaction.
- (iii) The selection of appropriate area for privatization depends on many factors. It should be based on the sound reasoning and technical & financial analysis. The population, type of area, quantity of generation and composition of waste should also be taken into consideration prior to decision about privatization.
- (iv) The shortage of manpower, equipment, high level of citizen's dissatisfaction and high cost of MSWM; normally cited as main reasons in favour of privatization. As the Nagar Nigam has less staff and resources; therefore in order to expand services to non-serviced areas it is considered essential to introduce private sector participation in SWM services.
- (v) In the newly developed areas and under-served areas the work of sweeping, collection, and transportation should be contracted out. Besides the facilities which are not provided by GNN so far; like operation and maintenance of new vehicles, setting up and operation of compost plant and sanitary land fill sites, door to door collection etc could also be entrusted to private sector for making it cost effective and efficient.

153. Following are some specific areas which could be considered for Private Sector Participation:
- (i) Sweeping and drain cleaning in part/full area.
 - (ii) Complete sanitation work from collection to transportation in unserved/new area.
 - (iii) Door to door collection of domestic, commercial and institutional waste and transportation up to secondary collection point/ transfer place/processing plant / land fill site by using corporation vehicles/ own vehicle.
 - (iv) Collection and disposal of construction waste on contractual basis.
 - (v) Vehicles on rate contract.
 - (vi) Transportation of waste on contractual basis.
 - (vii) Operation and Maintenance of Corporation vehicles
 - (viii) Setting up and/or operation and maintenance of waste processing and/ or disposal facility on tipping fee on quantity of raw waste/final product basis.
154. Although proposition of privatization sounds very attractive but this should not be considered as the only panacea for successful management of solid waste management services. Privatizing some aspects of the service or the entire system would neither reduce nor eliminate the responsibility nor should be interpreted as the weakening of GNN.
155. In order to effectively monitor the privatized services, GNN must be strengthened. The ill drafted document, ignorance, lack of supervision and mutual distrust may turn the conditions from bad to worse also. Privatization has both merit as well as demerits.

11. *Financial and Economic Aspects*

156. GNN should endeavor to provide the minimum level of services of SWM as per the recommendations and earmark the minimum budget on per capita basis. More investment would be required for purchase of new equipment and tools for providing/improving collection and transportation system in extended areas and for setting up of processing plant and SLF site. It is suggested to earmark fund on per capita per annum basis.
157. A large proportion of expenditure on solid waste is met from other revenue sources or from government grant but no direct tax is levied to meet SWM expenses .Attempt should be made to recover some revenue by imposing the tariff charges for solid waste facilities and also penalty provisions for defaulters.

12. *Community Awareness and Public Participation*

158. Though the GNN is primarily responsible for creation of adequate infrastructure facilities and planning a good system but even after setting up of a good system, there is no guarantee of success unless people and elected representative provide full cooperation to GNN. To ensure public participation, conducting mass awareness programmes for waste generators is a very important issue.

VII. DESIGN OF INTEGRATED SOLID WASTE MANAGEMENT SYSTEM

A. Introduction

159. Area of Ghaziabad Nagar Nigam was confined to the core area of the city i.e. only 63.94 sq km till 1991 with population of 5, 11,759 but by 2001, area increased to 171.43 sq km with population as 9, 68,521. Though, the GNN area has been extended by more than 2.5 times but resources for managing the services have not increased proportionately.
160. Master Plan report is prepared with the objective to design a suitable integrated solid waste management system (ISWM), to assess the resource requirement for next 20 years and to suggest suitable measures for improvement of solid waste management system.

B. Design Parameters

161. Solid waste is generated for all seven days of a week but services is provided only on working days, normally six days a week. There is always extra pressure on first day of the week and sight of uncleanliness on non working days. ISWM is designed with the objective to provide services available for all seven days, a week.
162. Primary collection is the backbone of efficient solid waste system. If majority of waste is collected from the source, several problems, like littering in open places, source segregation, collection from community bins, multiple handling of waste etc could be minimized.
163. Presently, primary collection is not in practice. Primary collection service is designed to cover 50% of population in base year i.e. 2011, with proposal to extend the services to 60% by 2016; 70% by 2021; 80% by 2026 and 100% by 2031.
164. Street sweeping and drain cleaning is proposed to be provided to entire population.
165. Waste would be generated by entire city population, even if primary collection services are provided or not; therefore community bins are proposed for expected waste quantity from entire population.
166. Design of processing plant and Sanitary land fill site is based on the expected waste quantity from entire projected population for the design period.
167. Presently there is hardly any pucca ward office in any ward of GNN area. It is proposed to construct one ward office in every ward with store for which the land has to be arranged by the GNN.

168. Transportation of waste by more number of vehicles cause lot of traffic congestion and proves to be uneconomical. It is suggested to use compactors for direct transportation from a centrally located place, commonly known as Transfer Station. The heavy transport vehicle should ply upto processing plant/ disposal site according to the type of waste after separating out recyclable product. It is proposed to construct one Transfer Station Cum Recyclation centre in every zone.

C. Work Norms for Workers for Primary Collection/ Street Sweeping

169. As per Government order; 28 workers per 10000 population has been prescribed. Normally, one sweeper should clean 1000 m of road length along with drains of shallow depth (up to 0.60 m) but in absence of road length information, government norms are adopted for preparation of the report.
170. One push cart worker should be associated with two sweepers, thus Number of pushcart holder will be half the Number of workers.
171. The Number of sweeper and push cart holder required for primary collection should be worked out on the basis of Number of beats as identified as per the criterion and by adding additional requirement of 17% staff for maintaining round the year service on Sunday and public holidays for giving rotational weekly off to the sanitation workers.

D. Norms for Primary Collection Equipment

172. Every out of two workers should be allotted one 4/6 containerized pushcart. Number of pushcarts should be worked out by adding 25% spare equipment.
173. Containerized mechanized four wheeler mini garbage collector is proposed for primary/door to door collection. These mini collectors should have separate compartments for biodegradable and non biodegradable waste with hydraulic unloading system and compatible with compactors as well as dumper placer containers thus avoiding the need for multiple handling. One fixed compartment is also provided for collection of recyclables. These vehicles should be used for door to door collection/primary collection and should ply upto Transfer station and unload the waste directly into compactors.
174. One mini garbage collector should be able to collect about 7 MT waste per day from 13000 persons. Number of vehicle should be worked out for assumed coverage area after adding 25% additional numbers required for maintenance.
175. One operator and one worker should be provided with every mini waste collector for primary collection.

176. Low capacity, slow moving mini garbage collectors should not be utilized for long distance transport. These should only be used for short distances up to Transfer station where compactors should be stationed.
177. City Corporation should enter into a rate contract, preferably for complete operation and maintenance of services or at least for maintenance of the vehicle to ensure that they are kept in good working condition.

E. Norms for Waste Storage Bins and Carrier Vehicle

1. General Criterion:

178. There would be no need to provide community bins, if the primary collection service could be provided to 100% population. In that situation, only littered bins would have been kept in busy areas and the city would have become “bin free city”.
179. Presently, primary collection system is not in practice, it is not possible to provide facility of primary collection for entire population of Ghaziabad in short time; therefore community bins would be required.
180. Community bins would also be required for collection of road swept material, littered material, bulk waste and waste from new areas where primary collection system would not be available.
181. As community bins of 4.5 cum are already in use, therefore it is suggested to procure similar type of bins to ensure compatibility with existing bins and carrier.
182. Number of containers provided should be 100% more than the actual requirement, as all of them are not going to be full. Normally, one bin of 4.5 cum size should be sufficient for a population of 4000 persons but Number of bins has been worked out @ one bin per 2000 persons.
183. One dumper carrier vehicle should make 8 trips in one shift or 15 trips in two shifts.
184. One dumper carrier should be sufficient for 15 containers as few of them may not be fully filled, therefore average 8 numbers of bins would be required to be removed in one shift. Total requirement of carriers should be worked out by adding 25% spare vehicles.
185. One Compactor of 14 cum size should be sufficient for 5 mini garbage collectors or 35 MT per day. Total requirement should be worked out by adding 25% spare Number of vehicles.

186. The compactors should be stationed at one common place within the central location of zone which should be developed as Transfer station. In case, the land for Transfer Station is not found, operation of compactor could be controlled from respective Zonal offices.
187. The containers should be grouped according to the likely frequency of their becoming full and no. of containers to be lifted each day should be worked out e.g. if a container is likely to be full twice a week it is required to lift the container once in 3 or 4 days only.
188. The route for lifting the containers should be worked out avoiding zigzag movement of the vehicles to the extent possible and depending on the containers to be cleared each day.
189. In market areas and congested areas, community bins should be avoided and door to door/shop to shop collection be emphasized by considering opening timings of the market. Normally, it should be after 9 AM.
190. Life of containers and mini waste collector is 5 years and life of transport vehicles like dumper placer carrier and compactors is assumed as 10 years.
191. Operation and maintenance cost for collection vehicle is considered as 10% and transport vehicle as 30% of capital cost per annum.
192. Nagar Nigam should enter into a rate contract for maintenance of vehicles and equipment and ensure that they are kept in a good working condition.

F. Norms for Processing Plant and SLF site

1. General Criterion for Processing Plant:

193. Selection of suitable processing technology should be based on physical and chemical composition of waste, availability of land, capital cost, operation and maintenance cost, financial & economic viability including marketability of final product and sustainability aspects.
194. Looking to high biodegradable fraction of Ghaziabad waste, it is most likely that aerobic compost should be a suitable option; but it is recommended to allow private entrepreneur to suggest for any better option depending upon chemical analysis.
195. Site for processing plant should be sufficient for 20 years and be designed for entire biodegradable waste quantity from the entire city. Ideally it should be near to SLF site, so that residual could be disposed off without requiring any additional transportation cost.
196. As per the design calculations, given in later section, a compost plant of 900 MT plant capacity per day should be sufficient till 2021; thereafter plant capacity might be upgraded

to 1200 MT .For Ghaziabad city, one compost plant is planned at *Dooda Hera site by UP Jal Nigam* under CSS project on DBOMT basis for which bids have been finalized and LOI is also issued to the selected firm.

197. It is observed that though the processing plant could be set up at Dooda Hera for 20 year design capacity but the land for sanitary land fill site is not sufficient at Dooda Hera for 20 years (even after considering additional land of 29 acre at *Chipyana* village adjoining to the site under reference), therefore it is suggested to set up processing plant and SLF site at three locations (including Dooda Hera). It is proposed to identify a suitable land of about 20 Hectares (GNN/GDA) in North and East side of Ghaziabad city for setting up processing plant and SLF site. At each site a processing plant of 300 MT could be set up with sufficient size of SLF site.
198. Work of processing plant should be executed on turn key basis i.e. Design, Built, Operate, Maintenance and Transfer (DBOMT). A suitable bid document containing qualification criteria, scope of work, employer's requirement, specifications and other contract conditions as per ADB procurement guidelines should be prepared by the consultant. A suitable entrepreneur should be selected on the basis of International Competitive Bidding (ICB) procedure of procurement guidelines.

2. *General Criteria for Selection of Sanitary Land Fill Site*

199. Land area should be large enough to last for minimum 20 years. If sufficient land is not available at one particular location, two-three locations in different sides of the city should be identified and developed which will save traveling cost and time.
200. The land fill site should be away from habitation clusters, forest areas, water bodies, National Parks, Wet lands, Monuments and places of important cultural, historically or religious interest.
201. A site accessible within 30 minutes travel time is suitable but for distance greater than 30 minutes travel time, large capacity collection vehicles or provision of transfer station should be made.
202. The site should be at least 20 KM away from Airfield or as decided by the Airport Authority. This aspect is very crucial for Ghaziabad city as NOC is required to be obtained for every new land fill site from Hindon Airport Authority.
203. None of the areas of landfill site should be part of the 10-year ground water recharge area for existing or pending water supply development.
204. The site should be free from any underlying underground mines that could adversely affect surface activity of land filling or minable resources.

205. The site should be free from any seismic risk. There should not be any fault lines or significantly fractured geological structure within 500 meters of the perimeter of the site that would allow unpredictable movement of gas or leachate.
206. There should not be any major issues related to social & settlement, environment and geotechnical matters.

3. *Design Criteria for SLF site*

207. The selected site should last for minimum 20 years.
208. Land area should be calculated assuming final solid waste density of 850 Kg/cum with a soil to refuse ratio of 16%.
209. Landfill site should be walled/fenced and provided with proper gate to monitor vehicle movement and to check entry of unauthorized persons and stray animals.
210. Approach road, other internal roads, drain, plantation and waste cell comprising of all necessary elements like bottom impervious layer, HDPE sheet, drainage layer, earthen bund, leachate collection and disposal arrangement, landfill gas emission system etc should be provided at SLF site.
211. The site should have waste inspection facility, dozing and compaction equipment, inert material storage, office facility for record keeping, shelter for equipment, pollution monitoring equipment; weigh bridge, fire protection equipment, drinking water, lighting arrangement, first aid arrangements and should be under supervision of an experienced supervisor.
212. The *Dooda Hera* site adjoining to proposed compost plant site has been found suitable for developing as a sanitary landfill site. The site is broadly suitable and should be finally selected after undertaking social & environmental survey and geotechnical analysis as per ADB guidelines.
213. It is suggested to execute the work of Processing plant and SLF site on turnkey i.e. Design, Built, Operate, Maintenance and Transfer (DBOMT) basis. A suitable bid document containing qualification criteria, scope of work, employer's requirement, specifications and other contract conditions as per ADB procurement guidelines should be prepared and suitable entrepreneur should be selected on the basis of International Competitive Bidding (ICB) procedure of procurement guidelines.

4. *Common Criteria for Processing Plant and SLF Site*

214. It is preferable to establish sanitary land fill site and processing plant near to each other so that transportation, maintenance and supervision cost would be least and cost of

infrastructure facilities such as- access road, fencing, gate control, weigh bridge, water supply, electricity and mobile equipment costs would be utilized for both the facility centers.

215. Processing plant and sanitary land fill site should be suitable for minimum 20 years of life. A land of about 60 hectares should be required for 900 MT per day plant capacity and for 20 year life of sanitary land fill site.
 216. Sufficient land is not available at Dooda Hera Area of Ghaziabad for both the facilities i.e processing plant and SLF site. It is therefore suggested to identify two more sites in North and East directions, each of about 20 Hectares area; so that waste could be diverted to three sites which would not only be economical but also help in increasing the life of proposed site.
 217. It is proposed to rehabilitate existing Sai Upvan disposal site by diverting the nallah, improving infrastructure facilities like road, drain and constructing watchman cabin, small office, parking place and practicing good practices of solid waste disposal i.e compacting waste daily in layers and by covering with inert material so that site could at least be converted into Controlled dumping site from open dump site at present.
 218. Operation and Maintenance cost should be considered as 20% of capital cost per annum.
 219. It is suggested to entrust setting and operation & maintenance work of compost plant and sanitary land fill site to any experienced firm on turnkey basis.
5. *A brief analysis report of prospective sites for new Landfill Site*
220. In the Master Plan report of Ghaziabad: 2021, prepared by GDA, ten sites have been indicated for STP/WTP/SWD, and are shown in Map 2. Copy of the master plan report showing all this site has been attached at **Annexure 8**. A brief analysis of all prospective sites is shown in the Table below:

Table 10: Brief Analysis about Prospective SLF Sites

Site number	Location	Present status	Remarks
	North of Ghaziabad near shahpura village	open site	NOC would not be issued by Hindon Airport authority as the site is within flying zone.
2.	East of Ghaziabad near Govindpura village	Existing STP	-
3 & 4	East of Ghaziabad in jurisdiction of Dasna nagar	(1)Proposed sites are beyond GNN jurisdiction (2)lot of habitation, shops and district jail nearby	(1)NOC by Hindon Airport is doubtful as the sites are within flying zone. (2)Social issues may be critical for SLF site

Site number	Location	Present status	Remarks
	panchayat		(3) Possibility of local residents of village against dumping of waste from Ghaziabad area.
5.	South East of Ghaziabad Near Dasna village	(1) Proposed site is within GNN jurisdiction (2) Site is open (3) Area is less	(1)Detail social, topographical analysis is required (2) Informal discussion with Hindon Airport authority is required about NOC.
6.	On GT road near Bhamheti village	Site is converted into market	-
7(a)	South of Ghaziabad near Dooda Hera village	(1) 14 acre open site is under possession of GNN. It is covered with a compound wall constructed by UP Jal Nigam under CSS project. (2) Land use under Master Plan is residential. (3) The site is already selected for setting up of a processing plant and SLF site for which NOC from Hindon airport authority has also been obtained. (4) NOC was also granted by UP State Pollution control Board which has been withdrawn recently in wake of court case and different master plan land use. (5) High court has granted stay for use of site for SWM activities till change of land use from residential to land fill site.	(1) Work of setting up of processing plant and SLF site under CSS project executed by UP Jal Nigam on behalf of GNN is stopped due to land use controversy and legal stay but now the matter is likely to be resolved soon as GDA has already initiated proceedings to change the land use on request of GNN. (2) Apart from 14 acre open land, about 29 acre of additional land is also available adjoining to the referred land. The adjoining site falls in the jurisdiction of Gautam Buddha district. An application for allotment of this land to GNN for SWM site is already under process. (3) NOC of Hindon Airport authority is a crucial issue for selecting land at Ghaziabad. The site could be considered after change of land use, additional land allotment and detail analysis of social, geo-technical and environmental aspects. (4) A fresh application for revalidating the NOC would also be required after change of land use.
7(b)	South of Ghaziabad near Doodahera	STP exist	STP is functioning at the site shown in the Master Plan 2021.
8.	South west of Ghaziabad near Pratap Vihar	WTP	WTP site
9.	West side of Ghaziabad near kanawani	WTP	WTP site
10.	North East of Ghaziabad Near Morti village	(1) Land is open under agriculture use. (2) no formal demarcation available	Being within range of flying zone area, Hindon Airport Authority has indicated possibility for NOC at this site.

Source: Ghaziabad Master Plan and Site Observations

Capacity Development of the NCRPB: Component B (ADB TA-7055)

Ghaziabad Locations of Prospective Disposal Sites

Legend

- Rural Builtup
- Residential, Urban Builtup (High Density)
- Residential (Medium Density)
- Residential (Low Density)
- Main Commercial Area
- Commercial
- Whole Sale Commercial
- Industrial (Light & Small)
- Industry (Medium)
- Office
- Community Facilities
- Institutional Area
- Institutional Green
- Regional / Local Recreations
- Park, Open Spaces, Sport Center
- City Forest
- Green Buffer, Belt
- Area Reserve for River /
- Transport Nagar / Bus Station
- Defence Land
- STP/WTP/SWD
- Agricultural Land
- River, Canal Drains, Water Bodies
- Graveyard / Cremation Ground
- Railway Land
- Non Conforming Use (Unauthorised Settlements)
- Area for Proposed HI-Tech City Urban Expansion
- Industrial Dev, Authority Area
- Existing Road
- Proposed Expressway Tentative Alignment
- Proposed Road
- Railway Line
- Urban Expansion
- State Boundary
- Dev. Authority Boundary
- Nagar Nigam Boundary
- Village Boundary
- Area Upgraded From MP-2001

Locations:

Sl.No	Area & Name
1.	Shahapura
2.	Govindapura
3.	Near Dasna Village
4.	do
5.	Near Indo German Hospital Near Dasana Village
6.	Market on GT Road Near Bamheli Village
7a.	Doodhara
7b.	do
8.	New Pratap Vihar
9.	Near Kanwant
10.	Morli Village

Client:

**Asian Development Bank
National Capital Region Planning Board**

Consultant:

Wilbur Smith Associates Pvt Ltd

Drawn: SK

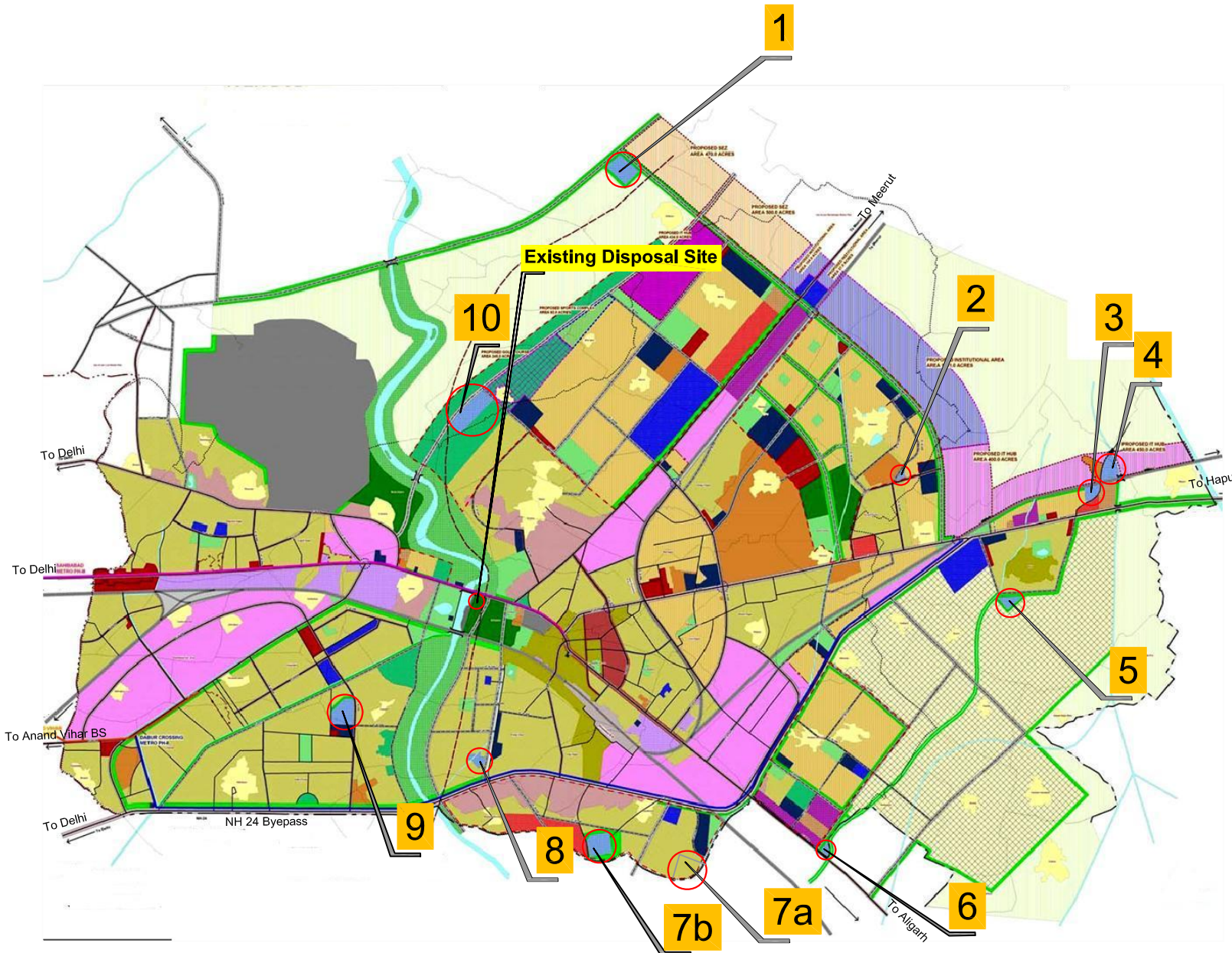
Checked: SKG

Date: Jan, 2009

Approved: NSS

Scale: NTS

Map. 3



Picture gallery showing few sites visited in connection of new SLF site:



221. Though the exact locations are not indicated but the proposed sites are indicated on the land use plan. Out of these, three most prospective sites have been visited. One site is in East of Ghaziabad in “Dasna” village; whereas other site, in North near “Morti” village. The third site south of Ghaziabad is near “Dooda Hera” site but not exactly on the indicated location of Master Plan. All these sites are at about 10 KM distance from GNN office. Out of above mentioned three sites, two sites as indicated in the Master plan are not found suitable as both the lands are under agriculture use and accessibility as well as acquisition of land is doubtful. The third site near “Dooda Hera” comprising of 14 Acres is in the possession of Ghaziabad Nagar Nigam.
222. Under New Centrally Sponsored Scheme, for Solid Waste Management and Drainage in 10 selected IAF airfield towns, a project worth Rs 135.2 million is approved by Government of India for Ghaziabad city as Hindon Airport is very close and there has

been instances of aircraft damages on account of bird hitting due to non availability of proper SWM system. The implementation of this project is being carried out by UP Jal Nigam. The project contains provision of setting up of processing plant and sanitary land fill site in addition to supply of collection and transport equipment etc.

223. Site at Dooda Hera (7a) was selected for processing plant and construction of new SLF site in consultation with GNN and after obtaining NOCs from Hindon Airport Authority and UP State Pollution Control Board.. Accordingly, a compound wall and some leveling work were carried out at the site. Bids were invited for setting up of compost plant on basis of DBOM (Design, Build, Operate and Maintain) basis for which a firm called M/S Hollofix has already been selected and LOI has also been issued. For setting up of SLF site, bids were invited by UP Jal Nigam separately for 3 year period on the proposed site. As the proposed site was not considered sufficient for 20 year design period, adjoining land of 29 acre falling in jurisdiction of Gautam Buddha district was also selected for meeting future requirement. The work at site is stopped by legal stay from High Court as the land use of the proposed land was shown as residential in Master Plan Report Ghaziabad, 2021. After the stay, attempts were also made to search for another site but alternative site could not be found either due to difficulty in getting NOC from Hindon airport authority or due to social and other reasons. The issue remained under limelight for last 2 years as GOI funds were involved and there was lot of pressure for setting up of a proper processing plant and SLF site for Ghaziabad city. Finally, it has been decided to use 14 acre site with additional land of 29 acre from Gautam Buddha Nagar district for the SWM purposes.
224. The identification and acquisition of a suitable site for SLF, processing plant and TS is most critical issue to be addressed by Government /GDA on priority. An area of about 80 hectares would be required for a site of life 20 years with processing plant, buffer zone etc for processing and disposal of waste from entire GDA area. Presently, Dooda Hera is only available site with about 16 hectare area (after including additional 29 acre area expected to be allotted to Ghaziabad Nagar Nigam by Gautam Buddha district administration for SWM activities. There is a huge shortfall of 66 Hectare area; hence at least two more sites each of about 30-35 hectares will be required, preferably in North of Ghaziabad around Meerut road and in East of Ghaziabad around Dasna/ Hapur road.
225. It is proposed to discuss with Hindon Airport Authority and UP state pollution control board authorities informally about prospective sites so that NOC could be obtained at the time of formal request.

6. *Design of MSWM System for Ghaziabad Nagar Nigam Area*

226. On the basis of design criterion, total requirement of equipment, vehicle and manpower is worked out for Ghaziabad Nagar Nigam area for next 20 years are decided as shown in **Table 11**. Requirement of waste processing (composting) plant and sanitary landfill (SLF) proposed to be developed at Dooda Hera site is given in **Table 12**. The total land requirement of GNN area for both compost plan and SLF is estimated as 44 ha.
227. Requirement of equipment and other facilities have been worked out according to the life of respective item. Life of containers, pushcart, and mechanized garbage collector is considered 5 years therefore all this equipment would have to be replaced after every 5 years as depicted in the Table. Life of carrier vehicles, loading vehicle, water tanker, tipper, tractor cum trolley is considered 10 years, thus replacement is needed after 10 years as shown in the table above. Life of bulldozer, land fill compactor and Weigh Bridge is 20 years, thus no need of replacement during design period.

:

Table 11: Collection & Transportation Equipment Requirement for SWM in GNN Area (2011-31)

S. No.	Item	Criterion/ Assumptions	2011	2016	2021	2026	2031
1	Population (no. s)	Master Plan & Analysis	1,479,619	1,835,963	2,278,126	2,720,455	3,248,668
2	Sanitation worker for sweeping and drain cleaning (no. s)	28 per 10000 population; additional 17% for leave reserve	4,847	6,015	7,463	8,912	10,643
3	Push cart for worker (no.s)	1 for 2 sweepers	2,071	2,570	3,189	3,809	4,548
4	Push cart 4 containerized (no.s)	1 for each worker; 25% more for repairs	2,589	3,213	3,987	4,761	5,685
5	Storage bin 4.5 cum capacity - for entire population and area (no.s)	1 for 2000 persons; add 25% more for repairs	925	1,147	1,424	1,700	2,030
6	Carriers - for entire population and area (no.s)	1 for 15 containers; add 25% more for repairs	77	96	119	142	169
7	Coverage for primary collection (% population)	Design criteria	50%	60%	70%	80%	100%
8	Population Covered (no. s)	--do--	739,810	1,101,578	1,594,688	2,176,364	3,248,668
9	Waste generation (MT/d)	--do--	419	668	1,037	1,518	2,431
10	Mini waste collector 1.5 cum for primary collection (no.s)	1 for 7 MT/d add 25% for repairs	75	120	188	276	441
11	Compactors (no.s)	1 for 35 MT waste per day; add for 25% more for repairs	15	24	38	55	88

Source:Analysis

Table 12: Waste Processing and Landfill Facilities for SWM in GNN Area (2011-31)

S. No.	Item	Criterion/ Assumptions	2011	2016	2021	2026	2031
I	Compost Plant (for GNN Area)						
<i>A</i>	<i>Size of Plant</i>						
1	Expected waste generated (MT)		837	1,114	1,482	1,898	2,431
2	Biodegradable waste quantity (MT)	56 %	469	624	830	1063	1361
3	Capacity of plant required (MT/day)	10 years/20 years		650		900	
4	Land requirement (ha)			6			
<i>B</i>	<i>Compost Plant Equipment (for 3 sites)</i>						
6	Unit & size to be provided (units, MT)			3x200		3x300	
7	Plant & machinery			3 sets		3 sets	
8	Loader backhoe		3	-	3	-	3
9	Tipper 8 cum		6	-	6	-	6
10	Tractor with tipper		3	-	3	-	3
11	Water tanker (3000 litre capacity)		3	-	3	-	3
12	Computerized Weigh bridge (30 MT)		3	-			
13	Other Infrastructure works	As per the site requirement		Yes		Yes	
B	Sanitary Land Fill						
1	Expected waste generation MT/d	As per sample survey	837	1114	1482	1898	2431
2	Net compostable quantity (MT/day)	56% biodegradable	469	624	830	1063	1361
3	Residual from compost plant and non biodegradable (MT/day)	10 % from compost plant + 16 % of total waste as inert and non-biodegradable	181	241	320	410	525
4	Capacity of SLF required for 20 years (MT/d)		335				
5	Total volume of landfill required, m ³	Assume density as 850 Kg/cum	2,879,793				
6	Total land area required for landfill include facilities, infrastructure & buffer (ha)		38				
7	Total land area required for compost+SLF (ha)		44				
8	SLF equipment (for 3 sites)						
	Loader backhoe		3		3		3
	Tipper		6	-	6	-	6
	Bull dozer		3	-	-	-	-
	Landfill Compactor		3	-	-	-	-
13	SLF infrastructure	-	As required	-	-	-	-

S. No.	Item	Criterion/ Assumptions	2011	2016	2021	2026	2031
14	Number of active years	20 years or more	-	-	-	-	-
15	Closure and post closure period	25 years	-	-	-	-	-
16	Operation and maintenance of primary collection equipment (per annum)	10% of capital cost	-	-	-	-	-
17	Operation and maintenance of transportation equipment with transfer station (per annum)	30% of capital cost	-	-	-	-	-

Source: Analysis

Plant & machinery of compost plant include trommel; elevator; vibro screen; gravity separator; magnetic separator; packaging sprout; drives; other accessories and tools

Compost plant civil works include: Internal road and side drain; parking shed; guard room; compost pad; other miscellaneous like water supply, electric line, leachate pond, storage tank, plantation, Buffer zone, tools etc

SLF infrastructure include: Internal road and drain; Plantation in buffer zone of 6/10 m width; U-shape drain; Miscellaneous; Cell construction shall comprise of : compacted natural soil at bottom; 90-100 cm compacted clay/amended soil or GCL sheet of 7 mm thick(if suitable clay is not available); 1.5 cm HDPE sheet; 30 cm protection silty soil/non woven geotextile sheet of 2 mm thickness; 30 cm drainage layer for leachate collection with suitable permeability ; net waste ht 10 m; 45 cm gas collection layer; 60 cm compacted clay/amended soil or GCL sheet of 7 mm thick; 45 cm vegetation layer; passive vent system; Leachate collection pond, and other miscellaneous facilities.

7. *Design of MSWM System for Other Towns in GDA Area*

228. On the basis of design criterion, total requirement of equipment, vehicle and manpower is worked out for the other towns of Dasna, Murad Nagar, Modi Nagar and Loni Nagar located in GDA area for the next 20 years (2011-2031), and given respectively **Table 13**, **Table 14**, **Table 15** and **Table 16**.

Table 13: Collection & Transportation Equipment Requirement for SWM in Dasna (2011-31)

S. No.	Item	2011	2016	2021	2026	2031
1.	Population (no. s)	33,150	40,342	49,095	61,923	78,103
2.	Sanitation worker for sweeping and drain cleaning (no. s)	109	132	161	203	256
3.	Push cart for worker (no.s)	46	56	69	87	109
4.	Push cart 4 containerized (no.s)	58	71	86	108	137
5.	Storage bin 4.5 cum capacity - for entire population and area (no.s)	21	25	31	39	49
6.	Carriers - for entire population and area (no.s)	1	2	2	3	3
7.	Coverage for primary collection (% population)	50%	60%	70%	80%	100%
8.	Population Covered (no. s)	16,575	24,205	34,367	49,538	78,103
9.	Waste generation (MT/d)	9	15	22	35	59
10.	Mini waste collector 1.5 cum for primary collection (no.s)	2	3	4	6	10
11.	Compactors (no.s)	-	1	1	1	2

Source: Analysis

Table 14: Collection & Transportation Equipment Requirement for Murad Nagar (2011-31)

S. No.	Item	2011	2016	2021	2026	2031
1.	Population (no. s)	172,941	197,097	224,628	289,252	372,468
2.	Sanitation worker for sweeping and drain cleaning (no. s)	567	646	736	948	1220
3.	Push cart for worker (no.s)	242	276	314	405	521
4.	Push cart 4 containerized (no.s)	303	345	393	506	652
5.	Storage bin 4.5 cum capacity - for entire population and area (no.s)	108	123	140	181	233
6.	Carriers - for entire population and area (no.s)	7	8	9	12	16
7.	Coverage for primary collection (% population)	50%	60%	70%	80%	100%
8.	Population Covered (no. s)	86,471	118,258	157,240	231,402	372,468
9.	Waste generation (MT/d)	49	72	102	162	279
10.	Mini waste collector 1.5 cum for primary collection (no.s)	9	13	18	29	50
11.	Compactors (no.s)	2	3	4	6	10

Source: Analysis

Table 15: Collection & Transportation Equipment Requirement for Modi Nagar (2011-31)

S. No.	Item	2011	2016	2021	2026	2031
1.	Population (no. s)	103,508	125,786	152,859	192,810	243,202
2.	Sanitation worker for sweeping and drain cleaning (no. s)	339	412	501	632	797
3.	Push cart for worker (no.s)	145	176	214	270	340
4.	Push cart 4 containerized (no.s)	181	220	268	337	426
5.	Storage bin 4.5 cum capacity - for entire population and area (no.s)	65	79	96	121	152
6.	Carriers - for entire population and area (no.s)	4	5	6	8	10
7.	Coverage for primary collection (% population)	50%	60%	70%	80%	100%
8.	Population Covered (no. s)	51,754	75,472	107,001	154,248	243,202
9.	Waste generation (MT/d)	29	46	70	108	182
10	Mini waste collector 1.5 cum for primary collection (no.s)	5	8	12	19	33
11	Compactors (no.s)	1	2	2	4	7

Source: Analysis

Table 16: Collection & Transportation Equipment Requirement for Loni Nagar (2011-31)

S. No.	Item	2011	2016	2021	2026	2031
1.	Population (no. s)	227,902	282,227	349,501	421,,201	507,610
2.	Sanitation worker for sweeping and drain cleaning (no. s)	747	925	1145	1380	1663
3.	Push cart for worker (no.s)	319	395	489	590	711
4.	Push cart 4 containerized (no.s)	426	494	612	737	888
5.	Storage bin 4.5 cum capacity - for entire population and area (no.s)	142	176	218	263	317
6.	Carriers - for entire population and area (no.s)	9	12	15	18	21
7.	Coverage for primary collection (% population)	50%	60%	70%	80%	100%
8.	Population Covered (no. s)	113,951	169,336	244,651	336,961	507,610
9.	Waste generation (MT/d)	65	103	159	236	381
10.	Mini waste collector 1.5 cum for primary collection (no.s)	12	18	28	42	68
11.	Compactors (no.s)	2	4	6	8	14

Source: Analysis

8. *Infrastructure requirement for GDA area*

229. On the basis of design criterion, total requirement of equipment, vehicle and manpower is worked out for the entire Ghaziabad Development Authority (GDA) area, which include GNN area and other towns of Dasna, Modi Nagar, Murad Nagar and Loni Nagar, for the next 20 years (2011-31) is worked and given in **Table 17**. Requirement of waste processing (composting) plant and sanitary landfill (SLF) proposed to be developed at Dooda Hera site is given in **Table 18**. The total land requirement of GDA area for both compost plan and SLF is estimated as 60 ha.

Table 17: Collection & Transport Equipment Requirement for SWM in GDA Area (2011-31)

S. No.	Item	Criterion/ Assumptions	2011	2016	2021	2026	2031
1	Population (no. s)	Master Plan & Analysis	2,017,120	2,482,077	3,054,209	3,686,650	4,450,051
2	Sanitation worker for sweeping and drain cleaning (no. s)	28 per 10000 population; additional 17% for leave reserve	6608	8131	10005	12079	14578
3	Push cart for worker (no.s)	1 for 2 sweepers	2824	3475	4276	5162	6230
4	Push cart 4 containerized (no.s)	1 for each worker; 25% more for repairs	3530	4344	5345	6452	7788
5	Storage bin 4.5 cum capacity - for entire population and area (no.s)	1 for 2000 persons; add 25% more for repairs	1261	1551	1909	2304	2781
6	Carriers - for entire population and area (no.s)	1 for 15 containers; add 25% more for repairs	105	129	159	192	232
7	Coverage for primary collection (% population)	Design criteria	50%	60%	70%	80%	100%
8	Population Covered (no. s)	--do--	1008060	1489246	2137946	2949320	4450051
9	Waste generation (MT/d)	--do--	571	904	1391	2058	3330
10	Mini waste collector 1.5 cum for primary collection (no.s)	1 for 7 MT/d add 25% for repairs	102	161	248	368	595
11	Compactors (no.s)	1 for 35 MT waste per day; add for 25% more for repairs	20	32	50	74	119

Source: Analysis

Table 18: Waste Processing and Landfill Facilities for SWM in GDA Area (2011-31)

S. No.	Item	Criterion/ Assumptions	2011	2016	2021	2026	2031
I	Compost Plant (for GNN Area)						
<i>A</i>	<i>Size of Plant</i>						
1	Expected waste generated (MT)		1,141	1,506	1,987	2,573	3,330
2	Biodegradable waste quantity (MT)	56 %	639	843	1,113	1,441	1,865
3	Capacity of plant required (MT/day)	10 years/20 years		650		900	
4	Land requirement (ha)			8			
<i>B</i>	<i>Compost Plant Equipment (for 3 sites)</i>						
6	Unit & size to be provided (units, MT)			3x300		3x400	
7	Plant & machinery			3 sets		3 sets	
8	Loader backhoe		3	-	3	-	3
9	Tipper 8 cum		6	-	6	-	6
10	Tractor with tipper		3	-	3	-	3
11	Water tanker (3000 litre capacity)		3	-	3	-	3
12	Computerized Weigh bridge (30 MT)		3	-	-	-	-
13	Other Infrastructure works	As per the site requirement		Yes		Yes	
B	Sanitary Land Fill						
1	Expected waste generation MT/d	As per sample survey	1,141	1,506	1,987	2,573	3,330
2	Net compostable quantity (MT/day)	56% biodegradable	639	843	1,113	1,441	1,865
3	Residual from compost plant and non biodegradable (MT/day)	10 % from compost plant + 16 % of total waste as inert and non-biodegradable	246	325	429	556	719
4	Capacity of SLF required for 20 years (MT/d)		455				
5	Total volume of landfill required, m ³	Assume density as 850 Kg/cum	3,909,351				
6	Total land area required for landfill include facilities, infrastructure & buffer (ha)		52				
7	Total land area required for compost+SLF (ha)		60				
8	SLF equipment						
	Loader backhoe		3	3	3	3	3
	Tipper		6	6	6	6	6

S. No.	Item	Criterion/ Assumptions	2011	2016	2021	2026	2031
	Bull dozer		3	3	3	3	3
	Landfill Compactor		3	3	3	3	3
13	SLF infrastructure	-	As required	-	-	-	-
14	Number of active years	20 years or more	-	-	-	-	-
15	Closure and post closure period	25 years	-	-	-	-	-
16	Operation and maintenance of primary collection equipment (per annum)	10% of capital cost	-	-	-	-	-
17	Operation and maintenance of transportation equipment with transfer station (per annum)	30% of capital cost	-	-	-	-	-

Source: Analysis

Plant & machinery of compost plant include trommel; elevator; vibro screen; gravity separator; magnetic separator; packaging sprout; drives; other accessories and tools

Compost plant civil works include: Internal road and side drain; parking shed; guard room; compost pad; other miscellaneous like water supply, electric line, leachate pond, storage tank, plantation, Buffer zone, tools etc

SLF infrastructure include: Internal road and drain; Plantation in buffer zone of 6/10 m width; U-shape drain; Miscellaneous; Cell construction shall comprise of : compacted natural soil at bottom; 90-100 cm compacted clay/amended soil or GCL sheet of 7 mm thick(if suitable clay is not available); 1.5 cm HDPE sheet; 30 cm protection silty soil/non woven geotextile sheet of 2 mm thickness; 30 cm drainage layer for leachate collection with suitable permeability ; net waste ht 10 m; 45 cm gas collection layer; 60 cm compacted clay/amended soil or GCL sheet of 7 mm thick; 45 cm vegetation layer; passive vent system; Leachate collection pond, and other miscellaneous facilities.

G. Capital Investment Requirement:

230. Total infrastructure requirement for 20 years with base as 2011 and design year as 2031 is shown in **Table 11, Table 12, Table 13, Table 14, Table 15, Table 16, Table 17, and Table 18**, respectively for GNN Area, Dasna, Murad Nagar, Modi Nagar, Loni Nagar and GDA area. Cost estimates (based on the block costs and subjected to change after detailed site surveys) are shown in the following **Table 19** for GNN area and **Table 20** for entire GDA Area. Cost of land has not been included presuming that land should be provided free of cost. The total requirement is estimated as Rs. 1926.9 million for GNN Area, and Rs. 2444.9 million for entire GDA Area including GNN. This is excluding contingencies.

Table 19: Capital Investment Requirement for GNN MSWM System (2011-31)

S. No.	Item	2011-15		2016-20		2021-25		2026-30		Total	
		No.	Amount (Rs million)	No	Amt. (Rs million)	No.	Amt. (Rs. million)	No.	Amt. (Rs. million)	No.	Total Amt. (Rs million)
A	Collection and Transport Equipment										
1	Containerized push carts with accessories @ Rs 7,000 each	2,589	18.1	3,213	22.5	3,987	27.9	4,761	33.3	14,550	101.8
2	Dumper placer containers 4.5 cum @ Rs 40,000 each	925	37.0	1147	45.9	1424	57.0	1,700	68.0	5,196	207.9
3	Dumper placer carriers @ Rs 1.2 million each	77	92.4	19	22.8	100	120.0	42	50.4	238	285.6
4	Mechanized mini garbage collectors @ Rs0. 5 million	75	37.5	120	60.0	188	94.0	276	138.0	659	329.5
5	Transport Compactor(14 cum) @ Rs 2.6 million	15	39.0	9	23.4	14	36.4	41	106.6	79	205.4
A	Total	3,681	224.0	4,508	174.6	5,713	335.3	6,820	396.3	20,722	1,130.2
B	Processing Plant										
B1	Equipment										
1	Loader Backhoe @ Rs 2.0 million	3	6.0	-	-	3	6.0	-	-	6	12.0
2	Tipper @ Rs 1.2 million	6	7.2			6	7.2	-	-	12	14.4
3	Tractor with tipper @ Rs 0.8 million	3	2.4	-	-	3	2.4	-	-	6	4.8
4	Water tanker 3000 litre @ Rs 0.3 million	3	0.9	-	-	3	0.9		-	6	1.8
5	Weigh bridge 30 MT @ Rs 1.5 million	3	4.5	-	-	-	-	-	-	3	4.5
6	Other plant and machinery related with compost plant for 3 units at three different sites	LS	60.0	-	-	-	-	-	-	-	60.0
B1	Total		81.0	-	-	15	16.5			33	97.5

S. No.	Item	2011-15		2016-20		2021-25		2026-30		Total	
		LS									
B2	Infrastructure works @ Rs 20.0 million for each of three sites	LS	60.0	-	-	-	-	-	-		60.0
B	Total (B1+B2)		141.0				16.5				157.5
C	Land Fill Site										
C1	Equipment										
1	Loader Backhoe	3	6.0			3	6.0			6	12.0
2	Bulldozer @ 6.0 million	3	18.0	-	-	-	-	-	-	3	18.0
3	Land Fill Compactor @ 3.5 million each	3	10.5	-	-	-	-	-	-	3	10.5
4	Tipper	6	7.2	-	-	6	7.2	-	-	12	14.4
C1	Total	15	41.7			9	13.2			24	54.9
C2	Land fill site development	(1) 334056 sqm cell area @ Rs 1300 (2) other LS Rs 20.0 mn for each site	494.3	-	-	-	-	-	-	-	494.3
C2	Total		494.3	-	-	-	-	-	-		494.3
C	Total(C1+C2)		536.0				13.2				549.2
D	Construction of ward offices @ Rs 0.5 million each for 80 wards	LS	40.0								40.0
E	Construction of Transfer station @ 0.1 million for each zone	LS	50.0								50.0
	Grand Total (A+B+C+D+E)		991.0		174.6		365.0		3963		1,926.9

Source: Analysis

Table 20: Capital Investment Requirement for MSWM System in GDA Area (2011-31)

S. No.	Item	2011-15		2016-20		2021-25		2026-30		Total	
		No.	Amount (Rs million)	No	Amt. (Rs million)	No.	Amt. (Rs million)	No.	Amt. (Rs million)	No.	Total Amt. (Rs million)
A	Collection and Transport Equipment										
1	Containerized push carts with accessories @ Rs 7,000 each	3,530	24.7	4,344	30.4	5,345	37.4	6452	45.2	19,671	137.7
2	Dumper placer containers 4.5 cum @ Rs 40,000 each	1,261	50.4	1551	62.0	1,909	76.4	2304	92.2	7,025	281.0
3	Dumper placer carriers @ Rs 1.2 million each	105	126.0	24	28.8	135	162.0	57	68.4	321	385.2
4	Mechanized mini garbage collectors @ Rs 0.5 million	102	51.0	161	80.5	248	124.0	368	184.0	879	439.5
5	Transport Compactor(14 cum) @ Rs 2.6 million	20	52.0	12	31.2	38	98.8	26	67.6	96	249.6
A	Total	5,018	304.1	6,092	232.9	7,675	498.6	9,207	457.4	27,992	1,493.0
B	Processing Plant										
B1	Equipment										
1	Loader Backhoe @ Rs 2.0 million	3	6.0	-	-	3	6.0	-	-	6	12.0
2	Tipper @ Rs 1.2 million	6	7.2			6	7.2	-	-	12	14.4
3	Tractor with tipper @ Rs 0.8 million	3	2.4	-	-	3	2.4	-	-	6	4.8
4	Water tanker 3000 litre @ Rs 0.3 million	3	0.9	-	-	3	0.9		-	6	1.8
5	Weigh bridge 30 MT @ Rs 1.5 million	3	4.5	-	-	-	-	-	-	3	4.5
6	Other plant and machinery related	LS	60.0	-	-	-	-	-	-	-	60.0

S. No.	Item	2011-15		2016-20		2021-25		2026-30		Total	
	with compost plant for 3 units at three different sites										
B1	Total		81.0	-	-	15	16.5			33	97.5
B2	Infrastructure works @ Rs 20.0 million for each of the three sites	LS	60.0	-	-	-	-	-	-		60.0
B	Total (B1+B2)		141.0				16.5				157.5
C	Land Fill Site										
C1	Equipment										
1	Loader Backhoe	3	6.0			3	6.0			6	12.0
2	Bulldozer @ 6.0 million	3	18.0	-	-	-	-	-	-	3	18.0
3	Land Fill Compactor @ 3.5 million each	3	10.5	-	-	-	-	-	-	3	10.5
4	Tipper	6	7.2	-	-	6	7.2	-	-	12	14.4
C1	Total	15	41.7			9	13.2			24	54.9
C2	Land fill site development	(1)453485 sqm cell area @ Rs 1300 (2) other LS Rs 20.0 mn for each site	649.5	-	-	-	-	-	-	-	649.5
C2	Total		649.5	-	-	-	-	-	-		649.5
C	Total(C1+C2)		691.2								704.4
	Grand Total (A+B+C)										
D	Construction of ward offices @ Rs 0.5 million each for 80 wards	LS	40.0								40.0
E	Construction of Transfer station @ 10.0 million for each zone	LS	50.0								50.0
	Grand Total (A+B+C+D+E)		1226.3		232.9		498.6		457.4		2444.9

Source: Analysis

VIII. OPERATION AND MANAGEMENT GUIDELINES

A. Guidelines for Quantification and Characterization Survey

231. The information on the quantity of waste generation and disposal, nature of wastes, its composition, physical and chemical characteristics are the basic needs for planning and designing of solid waste management system.
232. For quantification of waste, weighment exercise should be carried out by collecting representative samples from various waste generating sources such as residential -HIG, MIG, LIG, and slums, commercial -shops, hotels/restaurants and other bulk generating waste from horticulture, fruits and vegetable yards, markets etc.
233. For assessing the collection and transportation efficiency, weighing of waste reaching at the disposal point for seven consecutive days is another important field investigation. In case of well managed system, there should not be any significant difference in quantities of generation, collection, transportation and disposal but a huge difference could be found when the system is inefficient.
234. Characterization of waste is required to be carried out to know the physical and chemical characteristics of the waste. For correct assessment of Physical and chemical composition it is important to collect a reliable and representative composite sample by using quartering method. Waste collected from various similar types of locations will be mixed and then quartered. One sample per day for a particular type of location should be collected for physical and chemical parameters. The process should be repeated for seven consecutive days.
235. Following physical characteristics should be analyzed:
 - (i) Identification of individual components / constituents of the solid waste like food and fruit waste, paper and packaging material, plastic and polythene, textile and clothes, rubber and leather, wood, glass, metals , horticulture waste, inert etc.
 - (ii) Moisture content
 - (iii) Density of solid waste both at source and at disposal place
 - (iv) Source wise generation quantity on basis of representative sample surveys
 - (v) Actual weighment of waste quantity reaching at disposal place
236. Following chemical characteristics should be analyzed:
 - (i) Moisture (loss at 105 deg C for 1 hour)
 - (ii) Volatile matter (additional loss on ignition at 950 deg. C)

- (iii) Ash content
- (iv) Fixed carbon, Potassium, Phosphorous, Nitrogen
- (v) C/N ratio
- (vi) Calorific Value (Kcal/kg)
- (vii) The quantification and characterization survey should be carried out by some experienced agency under supervision of City Corporation.

B. Waste Storage System

- 237. The size of the storage bin and community bin should be adequate to hold the waste, generated in 24 hours with 100% spare capacity to meet any unforeseen delay in clearance or unanticipated extra waste.
- 238. The locations where the containers are placed should be grouped into four categories, such as (i) to be cleared more than once a day (ii) to be cleared once a day (iii) to be cleared on alternative days or twice a week (iv) to be cleared once a week. Suitable transport arrangement should be made for each category of containers.
- 239. Each premise holder should be asked, not to throw any solid waste in their neighborhood, on the streets, open space, vacant plots, drains etc.
- 240. Premise holders should be asked to (a) keep wet/biodegradable waste in covered containers and (b) dry/recyclable waste in another container/ bag.
- 241. Vegetable markets produce large volumes of solid waste. Depending on the size of the market, GNN should provide large containers with lids or skips for the storage of market waste at suitable location within or near the market.
- 242. Medical institutions should be asked to keep colour coded bins or bags for the storage of bio medical waste (body parts, soiled bandages, used injections, syringes) and disposed off at their level. The mouth of the polythene bags containing bio-medical bags should be removed from the wards, theatres, dressing rooms etc and stored in a safe place in a packed condition for safe disposal. Another container with a lid for storage of food waste and other waste fit to be disposed off into the municipal domestic stream should be separately kept and handed over to GNN waste collector or disposed off in the nearby community bin, as the case may be.
- 243. Construction waste should be stored until removed only within the premises of the building or into containers which should be provided by GNN on rent. In exceptional cases, where containers can not be provided, then such waste could be allowed to be stored on temporary basis on private or public land for specific period in a proper manner keeping environmental safety in mind and after obtaining written permission of the GNN and depositing requisite fees for some definite time period.

C. Collection

244. Every waste generator, (individual or bulk) should handover the waste to waste collector or deposit waste in nearby community bin, provided by the Nagar Nigam.
245. Each worker should be given a fixed area or beat from which to collect the domestic/commercial waste. The worker should ring the bell or blow the whistle announcing his arrival at the place of work. The people should be directed that on hearing the bell or whistle they should put their domestic biodegradable waste into the handcart of worker or handover the waste to him/her.
246. As there is shortage of workers and design of pushcart is also faulty, therefore door step collection of waste could be arranged either by arranging 4/6 containerized push cart or through mini waste collectors, which could carry up to 1.5 cum of waste in one trip. The mini waste collectors have compartments for segregated waste, use hydraulic system for direct unloading into truck/tipper/compactors and are able to cover areas with narrow roads. These vehicles should ply within the city and should unload the collected waste to heavy vehicles parked at recycling centre cum transfer station.
247. Mini waste collectors could either be operated by Nagar Nigam staff or given to NGO/Private entrepreneur for operation and maintenance on contract basis, for which proposals from experienced entrepreneurs should be invited.
248. Proposals should be invited in single stage two envelope open bid system (first envelope for earnest money and for technical bid and second for financial bid). Terms and conditions like qualification criteria; scope of work; area to be covered; unit rate for quotation; whether GNN resources are to be used or own; operation and management methodology; role of GNN; payment conditions; penalty provisions etc should be carefully decided and clearly mentioned in the bid document to ensure participation of experienced and resourceful firms. The selected person/firm should be authorized to buy all kind of recyclable components at minimum unit rate. He should also be allowed to recover service charges if any. The selected entrepreneur should be given some area on pilot basis, which should be extended if performance is found satisfactory, for which contract document should have specific reference.
249. Hospitals/primary health centers should be asked to make their own arrangement for collection and disposal of hazardous medical waste. Separate vehicles should be used for biomedical hazardous waste collection and transportation. Nagar Nigam is only required to accept non-hazardous waste from medical institutions in separately stored bins.
250. Nagar Nigam should actively associate Resident associations, trade & street associations, Community based organizations, NGOs like RSPN in the awareness campaign to motivate people for source segregation and handing over waste to designated collector or deposit in nearby community bin. City Corporation should arrange to collect from these community bins on day to day basis.

251. The shops and establishments normally open after 9 AM. These timings do not synchronize with the work schedule of workers. The shops/establishment occupiers should be asked to store waste in two bins and waste collectors should collect the waste after opening of the premises.
252. Nagar Nigam should use separate vehicles- open tippers, tractors for removal of construction waste on cost recovery basis. The charges should be fixed on per trip basis. The debris so collected should be used for reclaiming of areas, filling depression areas and also as daily cover at dumping sites for which advance planning should be made.

D. Street Sweeping and Drain Cleaning

253. Entire area of city should be divided into three categories- (i) Important areas having lot of habitation and commercial activities on both the sides or on either side of the street, requiring daily cleaning (ii) less important areas without any habitation which do not require daily sweeping and could be considered for periodical cleaning like on alternated day/ twice a week or weekly basis depending upon the requirement and (iii) Open spaces, drains, rivers and unserviced areas, which should be cleaned in a periodically manner to keep these areas clean from aesthetic and hygienic point of view.
254. Working norms for sweepers should be prescribed depending upon the road width and density of the area. For Ghaziabad, it is suggested to adopt as per government norms as 28 sweepers per 10000. A list of all roads, streets, to be cleaned should be prepared and each worker should be told about the road boundaries he/she has to clean according to the prescribed work norms.
255. Sweeping should be done on all seven days of a week. Rotational off should be implemented instead of weekly off or additional staff could be engaged in lieu of weekly holidays or workers could be given half day leave on two days in lieu of one additional working day.
256. Appropriate tools should be provided to sweepers to ensure that the sweepers are able to work conveniently. It is suggested to procure 4/6 containerized push carts and use on pilot basis. Further decision should be taken by the city corporation after reviewing the performance of the new equipment and acceptability by workers.
257. Drain abutting footpaths/lanes of shallow depth (up to 60 cm depth) should be cleaned by the sweepers but deeper drains should be cleaned by drain cleaners. Each drain cleaner should be given separate length of drain and work of every individual should be monitored. Drain cleaners should be given with all necessary tools like spade, shovels, hand gloves, mouth masks, gum boots, seamless push carts.
258. For the facility of the citizens to dispose off their waste in hand such as used cans of soft drinks, used wrappers etc litter bins should be provided in all the market places, places of public gathering and on all the important roads at reasonable distance. The litter bins

should be created at no cost to the City Corporation by involving the private sector and giving them advertisement rights on the bins or allowing them to use their firm's name for specified period.

259. The removal of waste from these litter bins should be done by the sweepers during their street cleaning operations. No litter bins should be provided without regular emptying arrangement.
260. Daily reporting about number of workers present, absent, area cleaned, remained unattended, specific complaints attended/ unattended etc should be prepared and submitted to division head.
261. Sweepers and supervisors are less in number, so strength need to be increased to cover unserviced and new areas. If more workers cannot be mobilized, City Corporation should consider entrusting the sweeping and drain cleaning work of some new areas to private entrepreneurs on contract basis. Contract conditions should be explicit and clear that the entrepreneur would be required to arrange necessary tools, mobilize required manpower and undertake the work for all seven days of week. The payment could be considered on per sqm area basis.

E. Transport System

262. Route chart showing route, location, time of arrival at spot and type of community bins and pits to be emptied by each vehicle in every trip should be prepared and followed by avoiding zigzag movement of the vehicle.
263. Old heavy transport vehicle should be operated and maintained by City Corporation till they outlive their life.
264. Reassessment of every old vehicle to analyze waste carrying capacity, fuel consumption and functionality of hydraulic system is required. If any vehicle has outlived economic life, same should be auctioned and replaced by new vehicle.
265. Annual service maintenance contract should be executed for all new vehicles for better operation and maintenance.
266. Recycling Centre cum Transfer station should be identified near the city. This place would be used for two purposes- (i) sorting and storing of recyclable products and (ii) as a transit point for receiving, transferring the waste to respective vehicle according to category of waste.
267. After sorting and removal of recyclable products at the recycling centre, remaining waste should be transported through heavy vehicles depending upon the category of waste. If the waste is of biodegradable nature, vehicle should be sent to processing plant site otherwise it should be sent to disposal point. Each heavy vehicle should ply between transfer station to disposal point and make minimum 3 trips per day.

268. Complete record should be kept at the recyclation cum transfer station and processing/disposal site, like vehicle number, time of arrival and departure, whether full/half empty/ empty, km readings.
269. Part of collection and transportation work could be entrusted to private entrepreneur. The private entrepreneur would be responsible for arranging suitable number of vehicles and mobilizing required manpower. Nagar Nigam should only supervise and monitor the performance of private entrepreneur.

F. Processing Plant

270. UP Jal Nigam has already identified a firm for setting up processing plant on DBOMT basis at Dooda Hera site. As the space availability at this site is not sufficient for entire waste of GDA area, therefore two more sites would be required in north and East side of the Ghaziabad. It is recommended to identify suitable sites and develop those sites also on DBOMT basis. Guidelines are given in following sections.
271. Production of quality product and marketing both are crucial aspects for success of the processing plant, therefore it is suggested to entrust the processing plant on turnkey basis to private entrepreneur for designing, building, operating and managing for minimum 10 years, thereafter the management of the plant could either be transferred to GNN or could be extended on mutually agreed terms.
272. Draft bid document should be prepared by professional consultant on the basis of three envelope open tendering system. Finalization of bid document and selection of suitable entrepreneur should be done by a committee in a transparent manner within a limited time frame. Bid should have complete information such as qualification criteria, scope of work, employer's requirement, specification, price bid form with clear offer terms (whether rates should be on raw quantity or on quantity of final product), payment conditions, verification mechanism, quality assurance guidelines, penalty provisions, operation and maintenance terms with any scope of extension, transferring mechanism, training schedule etc.
273. Private entrepreneur should be responsible for obtaining all required legal clearances from concerned government agencies with assistance from GNN.
274. Processing plants are not profit centers, therefore available useful information/facilities should be provided to entrepreneur to make the project attractive, such as:
- (i) Quantity of waste generation, composition, sources etc. (If some information is not available or some doubt on veracity, it should be clearly mentioned).
 - (ii) Information should be given about the availability of site, location, title, possible date of possession, land use details etc and also employer's expectations from the prospective agency.

- (iii) Provide information about supply of minimum waste quantity at the plant site free of cost on daily basis (If segregated waste is possible, mention it, otherwise mention clearly about mixed waste).
 - (iv) Decision of selection of appropriate processing technology should be left on the entrepreneur rather than suggesting for any specific technology.
 - (v) If possible buy back facility of certain quantity of final produce at pre-decided rate should be committed. This facility, if provided would attract more prospective entrepreneur.
275. The selected agency should operate and maintain the plant as per the guidelines given below:
- (i) Step I, Visual Inspection: Raw waste would be transported to plant site free of cost, which should be visually inspected and big objects such as tyres, cloths etc should be removed. After it is found suitable, it should be weighed in presence of authorized person. The weight taken and recorded should be used for making the payment to the plant operator if tipping fee is decided on raw waste basis.
 - (ii) Step II, Sanitization: Material should be sprayed with water and inoculums to fasten the digestion.
 - (iii) Step III, Digestion: Material should be taken to compost pad and piled up in form of windrows, where under Sun drying and turning after regular interval moisture loss and volume reduction shall take place. First phase of digestion should be over within 28 days
 - (iv) Step IV, Coarse segregation: Digested material should be taken to segregation plant for size wise separation i.e. 35/16 mm trowels. Rejects coming from plant should mostly be metals, plastics and other inorganic material, which should be removed.
 - (v) Step V, Curing section: Useful organic fraction should be kept in curing section for 10-15 days for further stabilizing of material.
 - (vi) Step VI, Refinement section: Material from curing section should be fed to refinement line to further segregate organic from inorganic material till heavy impurities are completely separated out and final useful product of proper size is available.
 - (vii) Step VII, Quality section: Final material free from any inorganic particle should be tested and quality assured. Admixture should be added for improving the quality of final product.

- (viii) Step VIII, Packaging: Tested material to be packaged as per demand of market. The weight of ready material should be taken if the tipping fee is decided on final product basis.

G. Controlled Dumping Site

276. Existing site at *Sai Upvan* is presently an open dump site but is proposed to be operated and managed as controlled dump site by following certain operation and management guidelines as given below:.
277. Only municipal solid waste should be accepted.
278. Operating hours should be according to collection schedules and operating hours of landfill equipment operators. Night operations should not be allowed.
279. All scattered waste should be brought over the existing heap. The existing waste heap should be covered with intermediate layer of 30 cm loose inert material available at the site and pressed with bulldozer (at least 6 passes in both directions by sprinkling water) to compress up to 20 cm compacted depth, thereafter site is ready for accepting fresh waste.
280. Vehicles entering to the facility should be visually inspected, registered, before proceeding to the working area. Waste should be unloaded only at the working area/face under supervision.
281. Waste should be spread and compacted in layers but should not be more than 1m after compaction before inert layer should be laid. Compaction of the waste should be on a slope of 20-30% and worked out from the bottom of the slope to the top.
282. A Soil cover of inert material of at least about 15 cm thick should be placed over the waste and compacted, preferably at the end of each day or after compacted waste of 1 m height. Daily cover material should be provided near the disposal area to facilitate covering of the waste.
283. Inactive areas should be covered with an intermediate cover of at least 1ft or 0.30 m.
284. Site personnel should record all pertinent information such as vehicle number, trip number, time of entering and exit, kilometre reading, name of the driver, number of personnel, visual remarks about filled/unfilled nature of the vehicle , occurrence of any special incident, such as fire, accident, spills, unauthorized loads etc.
285. Rag picking should be allowed only under control conditions so that routine operations are not disrupted.

286. Trained supervisors should supervise site operations. The operation guideline manual should be available to guide field personnel.

H. Sanitary Land Fill Site

287. It is proposed to develop a new disposal site as sanitary landfill site. Following operation and management guidelines should be followed:
- (i) The site should be designed and developed as per international standard for minimum design period of 20 years. The site should finally be selected and developed after it fulfils specific criteria and provisional no objection certificate is issued from regulatory agencies especially from Hindon Airport Authority and UP State Pollution Control Board.
 - (ii) Site specific data such as topographic, social and environment survey details, geotechnical analysis report, EIA and EMP reports, detail design, operation and management guidelines including daily reporting format should be available at the site.
 - (iii) Only residual from processing plants and non-biodegradable waste should be accepted. No toxic or hazardous waste should find access to the site.
 - (iv) Operating hours should be according to operating hours of landfill equipment operators. Night operations should not be allowed except in emergency situation.
 - (v) Vehicles entering to the facility should be visually inspected, registered, before proceeding to the working area. Waste should be unloaded only at the working area/face under supervision.
 - (vi) Waste should be spread and compacted in layers but should not be more than 1m after compaction before inert layer should be laid. Compaction of the waste should be on a slope of 20-30% and worked out from the bottom of the slope to the top.
 - (vii) A Soil cover of inert material of at least about 15 cm thick should be placed over the waste and compacted, preferably at the end of each day or after compacted waste of 1 m height. Daily cover material should be provided near the disposal area to facilitate covering of the waste.
 - (viii) Inactive areas should be covered with an intermediate cover of at least 1ft or 0.30 m.
 - (ix) Site personnel should record all pertinent information such as vehicle number, trip number, time of entering and exit, kilometer reading, name of the driver, number of personnel, weigh bridge record, visual remarks about filled/unfilled nature of the vehicle, visitor, any complaint, occurrence of any special incident, such as fire,

accident, spills, unauthorized loads etc.

- (x) Rag picking should not be allowed.
- (xi) Trained supervisors should supervise site operations. The operation guideline manual should be available to guide field personnel.
- (xii) All necessary quality control measures such as ground water quality, air quality and noise control should be periodically checked and properly recorded.

I. Monitoring Guidelines

288. For effective monitoring of solid waste management system, daily report format should be filled up, by literate supervisor:

- (i) Collection of waste:
 - Total number of (category wise) workers
 - Number of workers actually present
 - Number of workers absent
 - Areas left unattended
 - Arrangements prepared/ proposed for clearing the block log
- (ii) Inspection by supervisors for sweeping and primary collection
 - Number of persons required to supervise
 - Number of workers supervised
 - Number of cases, performance found satisfactory and not found satisfactory
 - Action taken or proposed to be taken
- (iii) Inspection of bulk community waste storage sites
 - Number of sites in the area under charge
 - Number of sites inspected
 - Number of sites well maintained
 - Number of sites found ill maintained
 - Action taken
 - Number of unauthorized sites or waste disposal sites identified during the field visits
 - Action taken

- (iv) Inspection of silt /construction waste sites
- Number of silt/construction waste site inspected
 - Number of sites where silt/construction waste was found unattended
 - Number of sites where construction waste was found unauthorizedly
 - Action taken
- (v) Transportation of waste
- Number and type of vehicle/equipment to report for duty
 - Number and type of vehicle/equipment actually reported for duty
 - Breakdown reported during the day
 - Number of trips made to transit point by each vehicle
 - Number of trips made to disposal point by each vehicle
 - Number and type of bins cleared during the day
 - Number and type of bins remain uncleared
 - Arrangement for clearing the backlog
- (vi) Quantities of waste transported
- Number of vehicles deployed during the day
 - Number of trips made by each vehicle up to transit point/disposal point
 - Quantity of waste transported by each vehicle
 - Number of vehicles which did not make adequate trips
 - Number of vehicles which carried less garbage
 - Action taken or proposed to be taken against defaulters
- (vii) Inspection of processing site
- Whether the plant is functioning properly
 - Whether it received the garbage as prescribed
 - Whether the site is properly maintained and waste stacked properly
 - Quantity of desired material produced during last week
 - Quantity of produce sold during the week
 - Quantity of end product in stock
 - Any irregularity noticed
 - Action taken
- (viii) Inspection of waste disposal site
- Name of the site inspected

- Whether all the staff is present on duty
- Whether the required machinery is available on site all the days
- Whether the approach road and internal roads are proper
- Whether the weigh bridge is functional and properly used
- What is the quantity of waste received at the site on the day and during last week
- Whether the entire waste was spread, compacted and covered on same day
- Number of vehicles and hours used for leveling and managing the site
- Deficiencies noticed
- Remedial action taken or proposed to be taken

(ix) Monitoring of the trips at the disposal site

- Vehicle number and name of the driver
- Arrival time of the vehicle
- Trips made including this trip
- Waste source and route number
- Weight of waste in MT
- Deficiencies noticed
- Action taken

(x) Monitoring of complaints: All complaints regarding SWM services should be registered at the relevant office and monitored daily.

- Recovery of additional cleaning service/ penalty charges
 1. Name of area
 2. Places visited
 3. Additional charges recovered – nos --- amount -----
 - From households
 - From shops
 - From other establishments
 - From road side vendors, eating joints
 - Others
 - Total

IX.. ISWM DEVELOPMENT – IMPLEMENTATION OPTIONS

A. Introduction

289. The previous chapters have all dealt with individual components in the SWM system viz; generation, collection, transportation & disposal. This chapter attempts to study an integrated SWM approach with a plan year 2031. To achieve an optimum solution, it is essential to build up a suitable system along with public participation. The extent of public involvement possible to achieve these goals should be gauged from the results of the Willingness to pay survey which should be undertaken by GNN. The broad possibility of private participation to achieve these goals has also been explored.

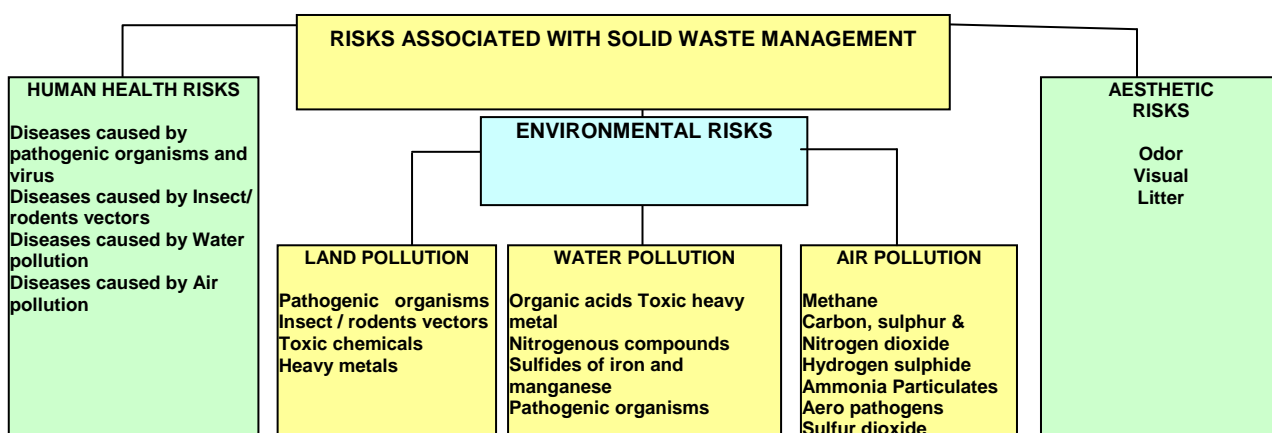
B. Optimal Design of System Elements

290. Situation analysis of the existing solid waste management system has elucidated the exigency in improvement and identification of an appropriate system through an integrated approach. Solid Waste Management System is an integral part of community life and the system takes its shape as per the need, available resources, technological development and recognition of its importance by the community. An inappropriate system poses significant risks and adverse impacts on health, environment and aesthetics. An overview of these impacts is depicted in **Figure 3**. The various system elements, viz. collection, storage, transportation, processing and disposal require formulation after adoption of an integrated approach. The system requires to be appropriately designed for collection, storage and transportation, the entire quantity of solid waste generated in the contributing area for its processing and disposal through sanitary land filling.

291. There can be several feasible alternatives for the various system elements. An assessment of the alternatives is, therefore, essential to arrive at the most appropriate technology to minimize adverse impacts and maximize social benefits through enhanced economic impacts.

292. Solid Waste Management system being an ongoing process, large material handling system requires long term designing in order to develop a resource allocation plan over a long range. A systems analytic approach is adopted to suit local conditions.

Figure 3: Risks Associated with Solid Waste Management



(Source: Policy Guidelines for Control of Environmental Pollution in Urban Areas of Developing Countries)

293. After the selection of an appropriate system alternative, the development of long term plan for the selected alternative is expounded.

C. Evaluation of Appropriate Methodology for Solid Waste Management

294. Feasible methodology have been developed and assessed in keeping with the “Policy Guidelines for the Control of Environmental Pollution in Urban Areas of Developing Countries” published by UNEP in 1985, Supreme Court Guidelines 1999 and MSW (M&H) Rules, 2000.

1. Development of methodology

295. The criteria suggested in the policy guidelines are adopted for developing methodology for collection, storage, transportation, and disposal. The following aspects have also been considered to account for the conditions specific to Ghaziabad Nagar Nigam. It is desirable to reduce the waste quantity requiring disposal thereby reducing the space requirement at the landfills. This can be achieved by recycling and processing of waste before its disposal.
296. Some special type of waste from Hotel/restaurant waste/ fruit and vegetable yard/horticulture/ marriage halls/ community centers/ bus stand/ railway stations/slaughter house which are by and large bio-degradable in nature can be collected separately and taken to the processing plant, especially compost plant. This waste need not to be allowed to get polluted by mixing with balance waste. Construction waste and debris can be used as filling material for depression areas/reclamation / inert material for covering of waste at the day end.

297. According to MSW (M&H) rule 2000, the biodegradable waste should be processed by composting, vermi composting or any other technology for stabilization of wastes.
298. Irrespective of the method and extent of resource recovery, sanitary land filling requires provision of compaction & cover material over the deposited waste. The cover material for the landfill can be conveniently obtained by blending soil. If sufficient quantity and suitable quality of soil is not available, then alternatively, any inert material such as construction and demolition waste may be used as cover material.
299. While identifying various alternatives, resources available with the existing system such as storage bins, vehicles, space available at the existing landfills and other future processing options especially compost plants have been considered. Past experience of use of various methods, equipments and procedures along with operating conditions have been considered.

Suitable criteria for Solid Waste Management

300. The suitable criteria are described as follow:

2. Health Risks

301. Solid waste management system is designed to handle non-hazardous, non-infectious wastes generated from residential and commercial establishments. However, the system handles all types of solid waste deposited in the community bins located at various places in the GNN area. The wastes may contain animal and poultry wastes. It is noticed that waste is mixed with biomedical waste, small scale industrial solid waste, slaughter house waste. It is also observed that night soil is mixed in areas with high population density, especially in slums area (due to the practice of defecation in the open). When solid waste is mixed with these ingredients it is likely to have an adverse effect on human health due to presence of pathogens & toxic ingredient. When this type of waste heaped on land is not removed regularly, flies, mosquitoes, rodents, etc. remain on these heaps and spread various type of disease health hazard. Pathogens can also be carried along with the leachate to surface water by run off. Airborne bacteria may be a risk to human health.

3. Environmental Risks

302. The existing practices of solid waste management are responsible for environmental pollution. The present dumping site near *Sai Upvan Nallah* that ultimately connects to Hindon River is not at all suitable and its situation near the drain/water body is a source of environmental pollution. The site is being used for crude dumping. The waste is spread with the help of bulldozer, poclain and excavator cum loader and not covered even with inert material. During the Monsoon season, the piled up waste gets washed away thus directly causing water and environmental pollution. There is a tendency to burn the waste at dumping site, which is responsible for air pollution. The air pollution is also caused due to fugitive emission because of wind blowing away the light particles of the waste material that remains in the air, exhaust from vehicles at the land fill and escape of gas generated

during decomposition of waste. The storage of solid waste in open spaces in the collection area or own dumping of solid wastes at the landfill is a source of air pollution and water pollution through leachate. Water pollution may occur due to organic acids, nitrogenous compounds and metal sulphide. The land environment gets polluted due to microbes and also due to toxic material in the Municipal Solid Waste. These factors pose risk to environment. So these parameters must be considered while evaluating the suitable methodology.

4. *Aesthetic Risks*

303. Uncontrolled handling of solid waste at various stages of the system results not only in ungainly appearance at the community bins, during transportation and at dumping yard site but also results into spreading of bad odour in the vicinity due to decomposition of putrescible organic matter. Open collection points in the city, littered garbage with stray animals, overfull collection bins and open waste carrying vehicles on the street all pose aesthetic as well as pollution risk. The waste Situation at the dumping yards is quite pathetic. Blowing of wind across the mass causes fine solid waste particles to be airborne resulting in poor vision. Therefore, odor, vision and litter pose aesthetic risks which require consideration while evaluating the alternatives.

5. *Costs*

304. Solid waste management involves capital investments and recurring expenditure. The possibility of revenue returns in the field of solid waste sector is not very encouraging in existing scenario, therefore while taking decision about setting up of a processing plant, a realistic approach should be followed, some concessions and user recovery charges should seriously be implemented. As the field is expanding, lot of big players are coming in this sector, who are willing to make initial capital investment but there should be clear understanding and written terms and conditions, so that there is no possibility of dispute in future. It is also observed that few local bodies try to enter into agreement with Private firms in haste without doing thorough exercise of financial capability for making timely payment to the operator due to which the work may get adversely affected. Few of the cost related considerations to be taken, have been elaborated below:
305. The annual expenditure includes payment of salary to staff, and operation and maintenance of equipment, machinery, vehicles, operation and maintenance of transfer station, processing plant and sanitary land fill site.
306. A capital investment is required for the purchase of equipment, machinery and vehicles, setting up of a processing plant, setting up of a transfer station, acquisition of appropriate site for development as sanitary landfills and construction of new sanitary landfills.
307. Additional haulage cost will be incurred when solid waste transportation network is changed. This would be different for various alternatives.

6. *Engineering features*

308. Various components of the system have different engineering features. The collection system is designed to achieve maximum labour productivity and prompt removal of solid waste under hygienic conditions. The storage devices and handling are designed for higher labour productivity with fully covered and containerized system, no need for multiple handling and ensuring compatibility with the transportation devices. The transportation vehicles are designed to facilitate fully mechanized loading and unloading of solid waste; full utilization of transportation capacity, fully covered and following the golden rule of route optimization. In case of privatization, well prepared document with complete check list, and control on contract will help in formulation of cost effective mechanism. The final disposal through sanitary land filling is oriented towards operation of the site to minimize the degradation of environmental quality.

7. *Land Requirement*

309. Solid waste management system requires land for the following purpose:

- Location of storage devices in different localities
- Reporting check posts, wards Offices, and zonal offices
- Workshop and garage facilities for maintenance and parking of vehicles.
- Transfer station at different location.
- Processing facilities and sanitary land fillings.

310. The land requirement for each of the system element is different and requires due consideration of various options.

8. *Skilled Labour Requirement*

311. The equipment, machinery and vehicles used in solid waste management are of specialized nature and demand skilled persons for their operation. The skilled labour requirement is different for each system element.

9. *Resource Recovery*

312. All treatment and disposal methods provide opportunities for resource recovery and recycling. Recycling could be carried out at the source of waste generation, at the collection point, in the collection and transport vehicle, at the transfer station but it should not be permitted at the final disposal site.

313. Solid waste contains several ingredients which can be recovered in its original or processed form. The constituents commonly retrieved for industrial use include paper, textiles, metals, glass, rubber and plastics. Usually the recyclable resources in the original form are recovered by the informal sector. The remaining portions are mainly organic and inert, out of which useful products can be recovered in the form of compost/Refused Derived Fuel pellets after processing of organic. It is desirable that maximum recovery is made to minimize the load on landfill. The resources can also be recovered in the form of biogas generated in the landfills. The biogas can be used as fuel for furnaces in the vicinity of landfills or generation of electricity at the site itself. The activity of waste pickers is proposed to be institutionalized by providing facilities and space for recovery of recyclable ingredients at specified places like landfills, transfer station, at the source segregation etc.

10. *Planning Horizon*

314. Solid waste management, being an ongoing, large and vital system, requires sizeable amount of resources in the form of manpower, implements, equipment, machinery, vehicles, and areas suitable for sanitary landfills. The system warrants strategic long term planning. The perspective plan for the Ghaziabad Nagar Nigam has been developed upto the year 2031. Therefore, the system of solid waste management is proposed to be planned for the period upto 2031.

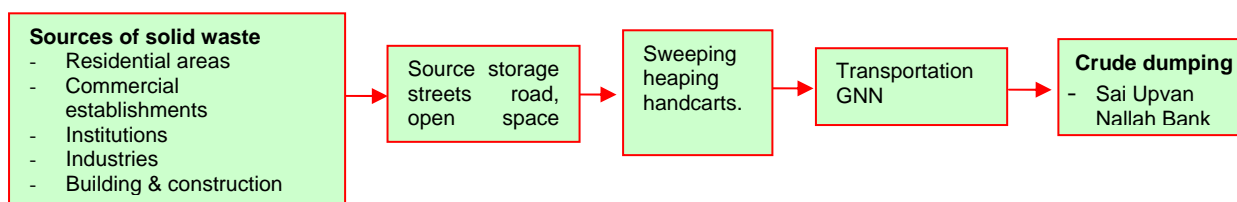
D. **System Components**

315. The selection of storage, collection and transportation methods is dependent on the baseline socio-economic conditions as well as the role and implications of informal sector involvement in the process of recycling as these affect the waste quantum and characteristics in Ghaziabad Nagar Nigam area. Since various steps in solid waste management are interlinked and the effectiveness and efficacy of one is intimately related to that of the other, the technologies for storage, collection and transportation and disposal must be compatible to each other.

1. *System Developed for the Planning Horizon (2011 – 2031)*

316. The system has been developed in keeping with the critical evaluation of the existing system and component systems identified in the earlier section.
317. Discussions were held with the authorities and following methodology is suggested. The existing system is presented in **Figure 4** by the model. This system should be evaluated and compared with the medium term and long term recommendations.

Figure 4: Existing System of Solid Waste Management



2. Proposed System – immediate measure

318. Solid waste generated in the residential localities and in the commercial establishments is proposed to be collected by following the existing procedure i.e. the residents and owners of the establishments would either deposit the solid waste in the nearest street, road, open place or to community dustbins. The SKs (Safari Karmacharies) would sweep the road & street and collect the waste in form of heap; finally the swept material would be transferred to the community bins by using a handcart. The vehicle fleet consisting of tippers or dumper placer machines would be used for transporting solid waste from existing heaps. This solid waste will be transported to dumping site. This system will only improve when the open heaps are replaced by the carrier containers/ community dustbins/ small containers and proper use of hand carts.

319. Following immediate administrative measures (should be implemented immediately in a year) are required to be taken:

- (i) Construction and strengthening of pucca ward office in each ward
- (ii) Proper work distribution of staff
- (iii) Decentralization of duty and authority
- (iv) Inter-departmental coordination
- (v) Giving due importance to SWM.
- (vi) More door to door collection
- (vii) Introduction of containerized push carts.
- (viii) Replacement of open collection points and vehicles in phases
- (ix) Identification and allotment of land for SLF, TS and processing plant
- (x) Regular monitoring and supervision
- (xi) Mass awareness and training programme

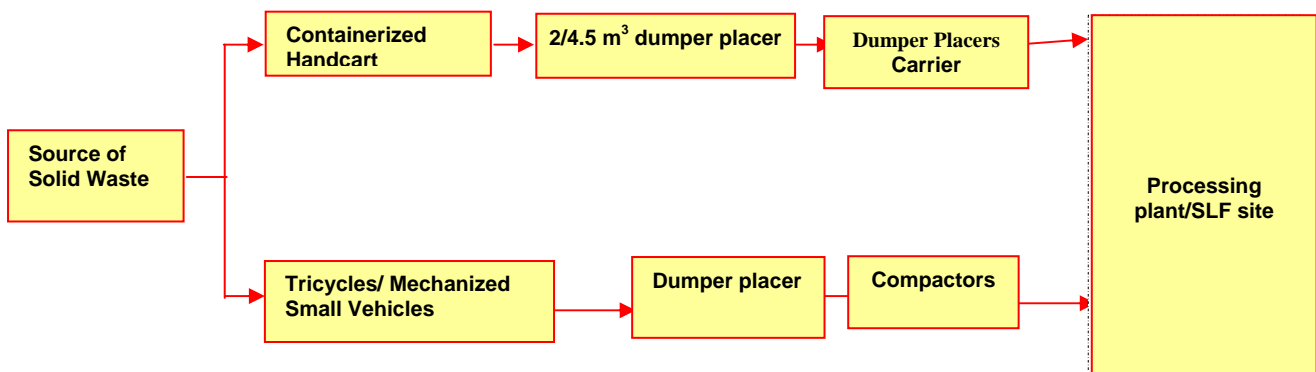
3. Proposed System – Medium term

320. Following Medium term measures (should be implemented between 1-3 years) may be taken:

- (i) Deciding areas and activities for Public Private Participation (PPP)

- (ii) Finalization of terms and conditions for PPP operations
- (iii) Use of Containerized push carts.
- (iv) Use of Compactors and Dumper placers in place of open tippers
- (v) More areas under door to door collection and segregation at source
- (vi) Setting and operation of small scale composting plant.
- (vii) Development of Transfer Station site
- (viii) Development of new SLF site
- (ix) Continuous mass awareness and training programme,
- (x) Beginning of imposition of User Charges

Figure 5: Proposed System of Solid Waste Management

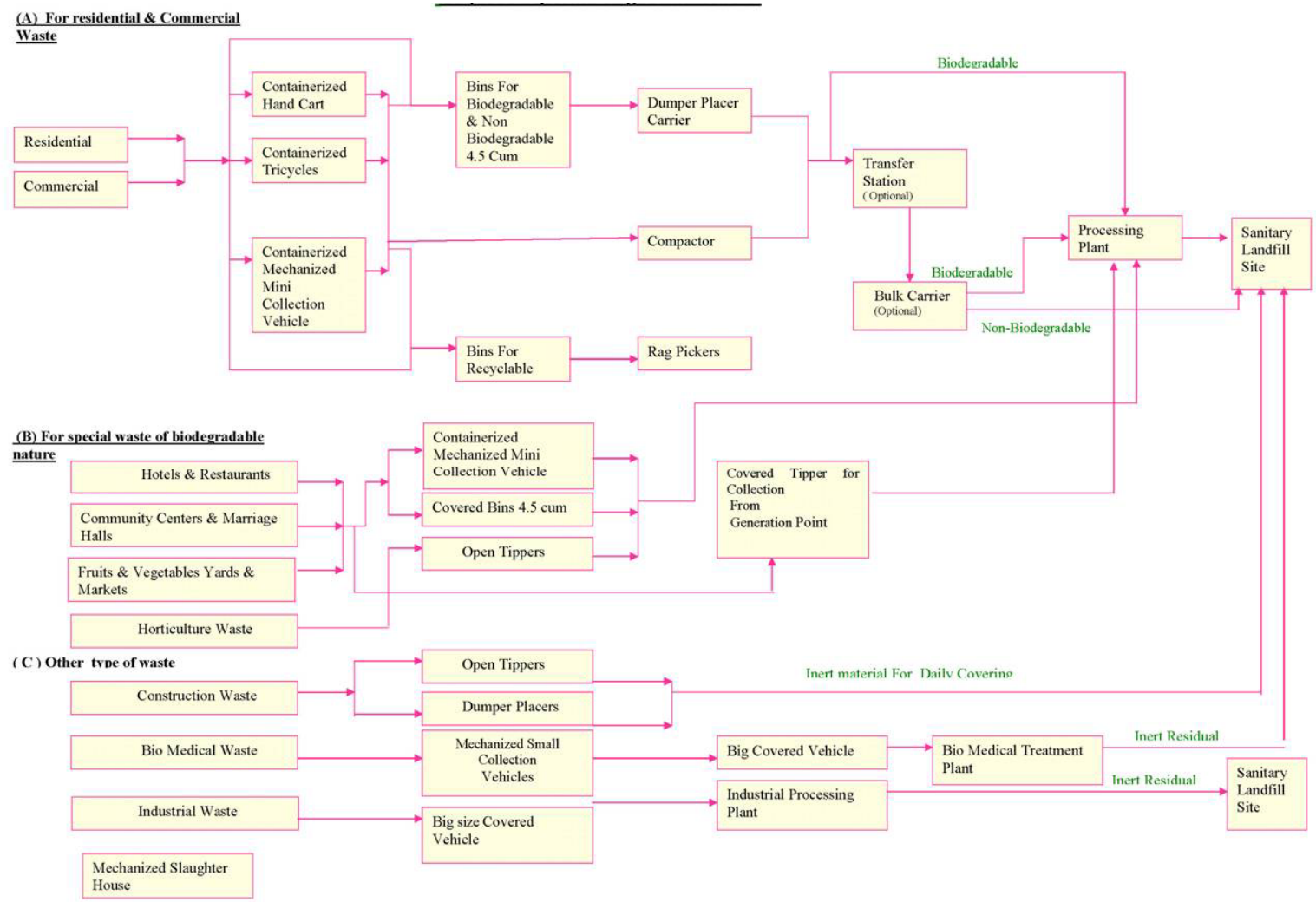


4. Proposed System – long term

321. Provision of a source specific collection system is proposed in this section. A house to house source segregation and collection system is proposed for residential localities and commercial places where the source segregation is also expected. The residents should store solid waste on their own premises in the bins of capacities ranging between 10-20 litres.
322. A Safai Karmachari (SK) with a **containerized handcart/tricycle** or **mini mechanized collection vehicle** would move along the streets, collect the waste from each house/commercial place till it is full and thereafter unload the waste in the community bin of 4.5 cum capacity or compactor. The collection should be in segregated form, therefore separate bins/vehicle are required for Biodegradable, Non-biodegradable and recyclable. The recyclable bin should be emptied by rag pickers and other two category waste should follow different route according to the type of waste. The biodegradable should be transported to processing plant and Non biodegradable to Sanitary landfill site as depicted.

323. For residential and commercial localities, it is proposed to place the community bins 500 m apart, provided road width permits and there is no obstruction to traffic during loading and unloading operations. These bins should be available at a maximum distance of 250 m from every house, the residents of these localities are expected to deposit the waste in these bins or keep their solid waste in their smaller bins or PVC bags and when SK with a containerized handcart/tricycle or mechanized smaller vehicle visit their areas, this should be handed over to him or he would collect the waste from specific location of houses. The SKs would unload solid wastes from hand cart containers into the nearest community bin.
324. For special waste of Biodegradable nature generated from places like hotels & restaurants, community halls, marriage halls, fruit & vegetable yards, markets and horticulture waste, there could be two types of arrangement- either bins of sufficient sizes should be provided at appropriate locations or by making arrangement for source collection. Both these arrangements should be done by GNN on Cost recovery basis by BOO operator appointed by GNN who should collect, transport and process the biodegradable waste on cost recovery basis from the generators, thus enabling the GNN in saving of waste quantity and cost. The waste of biodegradable nature should be taken to the Compost plant/processing plant.
325. For Construction waste, GNN should make the arrangement for collection and removal of waste on cost recovery basis. As the waste is of inert nature, therefore should be used for filling of depression areas/covering of waste at the land fill site.
326. For Bio Medical waste of hazardous nature, the generators are required to make proper arrangement for processing and disposal under respective Management and Handling rules. For Bio-Medical waste processing and disposal, two Common bio medical waste treatment facility plants are available for Ghaziabad area. One is run by M/s Synergie private at Noida and other called as M/s Medicare Private limited at Masuri.
327. For slaughtering, it is proposed to have Mechanized slaughter house for minimum 200 animals, extendable to 500 animals. GNN should get the suitable area reserved for the modern abattoir.
328. By this time Compost plant, Transfer Station and Sanitary land fill site should be in operation stage.
329. Regular Mass awareness programme and training programme should be continued even at this stage. GNN should get necessary amendments in Act for legal powers and action against defaulters.
330. **Figure 6** shows the proposed flow of ISWM system activities and components. The ideal time frame for implementation is 3-5 years.

Figure 6: Flow Diagram of Proposed ISWM System & Its Components



E. Advantages of Operation with the Private Sector

331. SWM services are highly labour intensive. On account of increased wage structure of the Government and Municipal employees, this service is becoming more and more expensive. Besides, the efficiency of the labour force employed in the urban local bodies is far from satisfactory. High wage structure and Inefficiency of the work force results into steep rise in the cost of service and yet the people at large are not satisfied with the level of service being provided by the urban local bodies. At the same time due to rapid urbanization, the cities are expanding at a very fast rate; the boundaries of cities are crumbling with addition of more and more new colonies in the city. With increase in the demand for infrastructure facilities in new colonies and areas, there is hardly any supply of services in commensurate to the requirement mainly due to restrictive government policies (there is hardly any new appointments) and poor financial condition of the departments. Efforts to increase the efficiency by Human Resource Development and institutional strengthening will, to some extent improve the performance but that may not be enough. It is, therefore, necessary that the local bodies seriously consider voluntary organizations / NGO / private sector participation in solid waste management.
332. Several factors play a role in the increasing interest of urban authorities in privatization of utilities such as:
- (i) Performance failure of their departments.
 - (ii) Rapid urban growth and escalating demands from citizens
 - (iii) Lack of resources & financial reorientation to private sector
 - (iv) Encouraging popular or individual participation in economic development
333. A few factors are mentioned below are the benefits and disadvantages of private participation (**Table 21**):

Table 21: Review of Private Sector Participation in SWM

Benefits	Disadvantages
<p>Brings technical and managerial expertise to the sector.</p> <p>Improves operating efficiency and reduce the needs for subsidies.</p> <p>For long term contracts it can result in large scale capital investments and greater efficiency in the use of that capital.</p> <p>The inhabitants can benefits by an increase in response to their needs and preferences.</p> <p>Privatization results in increased labor productivity & efficiency due to less job securities, incentives, flexible use of staff as per tasks, and linkages between productivity and salary. The entire process is guided by profits, while in government sector, apart from decision making delays, attempts are to avoid public</p>	<p>A government organization unlike private will provide services to as many citizens as possible, regardless of financial feasibility in a particular area.</p> <p>There is always a risk of failure because of different interests. The Private entrepreneur's main objective is of course to maximize profit and/ or acquire a bigger market share.</p> <p>Generally, private sector chooses activities with a specific objective ensuring certain return on investment therefore it is obvious that a private firm evaluates its ventures for the commercial viability and investment decisions are taken selectively ignoring less paying areas.</p> <p>Poor operation and maintenance of the facilities by the operators lead to failure of contract.</p>

criticism.	Unsustainable operations of the facilities owe to high capital and O& M expenses. Poor monitoring and supervision by the local bodies lead to inefficiencies. In case of some dispute, situation in area may deteriorate if work is discontinued and there is no alternative arrangement for tackling the situation. In such situation, there may be blackmailing or exploitation of management.
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334. Private Sector Participation or Public Private Partnerships may be considered by urban local bodies keeping merits and demerits into considerations. This will check growth in the establishment costs, bring in economy in expenditure and introduce an element of healthy competition between the private sector and the public sector in solid waste management services. There should be a right mix of private sector and public sector participation to ensure that there is no exploitation of labour as well as of the management.

335. **Areas where private sector participation can be considered are as under.**

- (i) Door to door collection of domestic waste/ collection and transportation up to transfer station or processing plant or to sanitary land fill site.
- (ii) Door to door collection of commercial waste/ collection and transportation up to transfer station or to processing plant or to sanitary land fill site.
- (iii) Collection, processing and disposal of hotel and restaurant waste on cost recovery basis or on (Built Own Operate) BOO basis.
- (iv) Door to door collection of hospital waste, processing and disposal on BOO basis.
- (v) Collection and disposal of construction waste on cost recovery basis.
- (vi) Setting up, operation and maintenance of waste treatment and/ or disposal facility on tipping fee basis or on BOO basis.
- (vii) Supplying vehicles on rent.
- (viii) Supplying vehicles on lease along with repairs and maintenance of vehicles at a private garage.
- (ix) Transportation of waste on contractual basis, etc.

F. Past Experiences in Private Sector Participation (PSP) in SWM

336. It has been observed that PSP has proved to be economical and efficient in several cases. Various successful models in the country are available, where different type of PSP is in practice. The PSP has brought in not only the technical and managerial expertise but helped in attaining operating efficiency and economy. Few of the successful examples are mentioned as under:

- (i) Review of case studies on PSP for Solid Waste Management for Rajkot and Surat show that these cities, which some years ago were regarded as extremely poor in environmental conditions are now much cleaner and have better environmental conditions. This was largely due to efforts with privatization made in these cities.
- (ii) In Mumbai certain wards are now being handed over to ALM's (Advance Local Managements) for maintaining all utilities including solid waste. This concept is now fast picking up and many areas are coming forwards to take control as this gives partial civil autonomy to approved areas.
- (iii) In Jaipur city, collection, transportation of more than half of the area is already with private contractors. Recently a contract has been signed for pelletization with Grasim industries, who will use the waste for manufacturing pellets(to be used as a fuel substitute to coal)
- (iv) In Surat city contracts for night cleaning of important roads are given to keep the major roads clean. Rate per square meter is fixed for making the roads dust free with tile help of brushes. The measurements of roads are taken keeping in view the portion of the road width to be cleaned and not tile entire road width. Giving contract of cleaning 0.75 meter road width on each side of the road is considered adequate for street cleaning to keep the roads clean and dust free.
- (v) Hyderabad city has introduced a contractual system of street cleaning as well as transportation of waste where the city is divided into operational groups and contract is given keeping in view the quantities of waste generating in that area under normal circumstances. The contractors are paid fixed monthly amount for the area allotted to them.
- (vi) City of Mumbai, Bhopal, Bangalore, Thane, Ahmedabad, etc., have entered into a contractual arrangement with private sector for setting up compost plants themselves or through a franchise where either the private sector or its franchisee invest money and the local body provides assured quantity of garbage at the processing plant without levying any charges. The private sector pays some royalty to local body and undertakes all the responsibility of managing the waste and its conversion into compost at its own cost. The land is given to the private sector on a nominal lease rent for a long term of 15 -30 years.

- (vii) The State Government of Tamil Nadu has exempted the Chennai Municipal Corporation from the purview of contract labour (Regulation & Abolition) Act 1970 vide its order No. 40 MS No. 99 dated 8th July 1999 allowing the said municipal corporation to engage contract labour for sweeping and scavenging activities. The private sector participation (M/s Onyx private company) has been operationalised in three zones of the city since 5th March, 2000.
- (viii) In Bangalore, M/S Ramky is maintaining and operating compost plant and a sanitary land fill site on BOO basis for which, tipping fees is paid by BMC on every Ton unloaded at the compost plant.
- (ix) State Government of Rajasthan has covered entire state by establishing 11 Common Bio Medical waste treatment facility plants at all major urban centers on BOO basis.

G. Existing Private sector Participation in Ghaziabad

1. Private Participation in Ghaziabad for Primary Collection of Solid Waste

337. Existing private participation level in Ghaziabad is almost nil except outsourcing of repairing of vehicles. Record of little private participation under practice is not available with GNN. The type of private participation is in form of customary services provided by sweepers as per the traditions and collection of waste from outer colonies, from where no arrangement is made by GNN.

2. Possibility of PSP to achieve long-term goals

338. There is no single, ideal and absolute solution for Solid Waste Management in all cities. Even within the city, different methodology are required be adopted. For example- some areas could be given to Private sector, whereas Ghaziabad Nagar Nigam could handle balance area. The selection of appropriate area would be based on the availability of manpower, equipment, and type of area, quantity of generation and type of waste etc. As per the normal practice, the privatization can begin with 1/3 of city area with ultimate objective to cover 1/2 to 2/3 of total city area but minimum 1/3 area should definitely be remained with Nagar Nigam staff to avoid any possible exploitation by the private entrepreneurs and to keep the staff and machinery of Nagar Nigam operational zed.
339. *Selection of executing agency for specific area:* Sanitation work on Public Private Participation (PPP) or Public Private People Participation (PPPP) basis (some nominal service charges say Rs.20/25 be contributed by each household) has been tried successfully in various parts of the country.
340. The PPP or PPPP model should be tried out in Ghaziabad. Some specific areas and modals could be as follows:

Table 22: Proposed SWM System and Recommendation for PSP

Proposed System	Recommendation for PSP
Collection System	
<p>SK should collect waste from different localities using different type of equipment as explained Separate collection system for various category of wastes such as commercial, Hotel and restaurants, marriage halls /community halls, horticulture, bio medical waste, etc.</p>	<ul style="list-style-type: none"> • Areas which do not have Municipal workers or have insufficient numbers should be considered for services by NGOs/privatization, which may include either complete sanitation work from source collection to transportation for totally unmanned area or comprehensive sanitation work for manned area (activities done by sanitation staff be excluded but all other activities be included). Precaution should be taken to keep the interest of existing sanitation staff intact; otherwise there may be resistance from the union. • House-to-House (HTH) collection by some NGO (Non Governmental Organization)/ RWA (Resident Welfare Organization) /CBO (Community Based Organization) by recovering service charges and sweeping, transportation by Corporation staff. • Source collection with phased segregation at source should definitely be the part of duty. • NGO should supervise work of their staff and try to train individual house holders for collection in two bins and for source segregation. • The work norms should be on the basis of standard yardsticks. • Provide implements along with O&M responsibility to NGOs or allow NGOs to deploy own equipments. • Well documented terms and conditions with timely payment schedule is the essence for success, hence should be followed in letter and spirit.
Transportation	
<p>Transportation through a fleet of dumper placers, & Compactor vehicles with transfer station</p>	<ul style="list-style-type: none"> • Stabilize transportation allocation to private contractors up to maximum ceiling of 50% of total transported waste quantity to prevent monopoly and cartelling. • Provide necessary vehicles as recommended to private contractors on a cost recoverable basis • Provide a contract period long enough to contractor to recover costs in purchasing own vehicles. • Provide necessary vehicles to private entrepreneurs for operation and maintenance on monthly payment basis. • Building & O&M of transfer stations, when decided, could be with private contractors on BOT basis against recovery of tipping fees.
Processing & Disposal	
<p>The waste of Ghaziabad is suitable for Composting, hence Compost Plant is proposed.</p>	<ul style="list-style-type: none"> • Encouragement should be given to small entrepreneurs for manual composting /vermiculture along with source segregation near their working areas. • Success of composting plant lies in economic design, source segregation and proper marketing. All this can be managed by some experienced private entrepreneur. Processing plant should be set up on BOOT basis but sometime the processing plants are not economically viable under BOOT basis but with gap funding /subsidy /tipping fee arrangement, the plant can be operated viably but in any case operation, maintenance and sale of compost should necessarily be in private hands.

Proposed System	Recommendation for PSP
Sanitary Landfill	<ul style="list-style-type: none"> The proposed SLF at Ghaziabad should be given out to private entrepreneur for operation and maintenance at some predecided tipping fees arrangement. In case, both compost plant and SLF are located at same place, it would be better if both the activities are entrusted to one operator.

341. After selection of suitable model for particular area of the city, terms and conditions of bid document could be prepared to get the work executed in true spirit of MSW (M&H) Rules 2000 with focus on people's satisfaction in true sense. The bidding system should be transparent and balanced in nature with provision of penalty and timely payment and prompt complaint redressal system. In order to attract resourceful and experienced firms, it is suggested to keep minimum period of operation as three years for collection and transportation and ten years for processing plant /SLF site with provision of termination and extension for another 2-3 years with mutual consent, as the case may be.

342. Privatization, however, is not the total solution for the successful provision of Solid Waste Management services. Privatizing some aspects of the service or the entire system does not reduce or eliminate the responsibility of Ghaziabad Nagar Nigam for the service. Furthermore, privatization of services should not be interpreted as the weakening of local government. On the contrary, in order for local government to effectively privatize some of its services, some of the government institutions must be strengthened. Only a local government institution having competent and qualified professional staff would be able to develop, negotiate, manage, monitor, and enforce a contract with a private entity.

343. It is essential that the GNN while giving a contract to private sector make an enabling provision in the contract to inspect the performance of the private contractor from time to time and as a matter of rule should inspect the performance of the private contractors to maintain the quality of the services, prevent corrupt practices and take remedial measures.

344. The formats should be prescribed for such inspections and results of inspections should be reported to the higher authorities at regular intervals. The contracts should carry a provision of penalty for failure to perform the contractual obligation.

3. *Method of Private Sector Involvement in Doorstep Collection of Variety of Wastes*

345. Tenders could be invited by the local body for private sector participation ~ doorstep collection of waste. The private entrepreneur getting contract should be allowed to select his own team of workers; give them containerized tricycles or handcarts or other vehicles, tools and equipments necessary for door step collection of waste. He may allot 200 to 300 houses, or adequate no. of shops, hotels, restaurants, etc., depending on the distances to be traveled and garbage/waste to be collected and manageable for day to day collection of waste from such premises. He may collect the user charge as per the rates fixed by the local body per unit per month for door step collection of waste in consultation with officials of Nagar Nigam. He should have his own supervisors to ensure that door to door collection service is given efficiently and Nagar Nigam officials should just over see by occasional inspection to see that services are adequately being provided in the given areas

through private sector and no over charging is done. The persons, engaged by the private sector for door step collection should be allowed to take away recyclable material and also be allowed to dispose of other waste into the municipal system/municipal bins in tile city in tile manner as may be prescribed by the GNN. The Nagar Nigam employees should provide all possible legal and administrative help to the private entrepreneur for making the activity successful. Mass awareness programme and publicity through Media should be regularly carried out by the Nagar Nigam. The Corporation should provide financial support to the private entrepreneur, as in beginning many people may be reluctant in giving user charges.

346. The local body may also encourage NGOs/ Community Based Organizations (CBOs)/ Neighborhood Committees (NCs) to enter into this field and organize the waste collectors in doorstep collection of waste and provide them an opportunity to earn their living. The local body can give incentive in cash or kind to NGOs in their effort of organizing waste collectors in primary collection of recyclable and/or organic waste.

X. INSTITUTIONAL STRENGTHENING AND TRAINING

A. Introduction

347. In order to make city's solid waste management successful, involvement & efforts of line agencies becomes very important. Institutional strengthening should be done by adequately decentralizing the administration, delegating adequate powers at the decentralized level, inducting professional into the administration and providing adequate training to the existing staff.
348. It is also necessary to fix work norms for the work force as well as for supervisory staff to maintain the manpower productivity and optimum output expected from the vehicles and machinery utilized. It is therefore, necessary that local body adopt adequate measures for institutional strengthening as mentioned above.

B. Existing Organization Structure

349. **Organization set up of GNN.** Mayor enjoys executive power of the house of 80 elected representatives. The administrative wing of Ghaziabad Nagar Nigam is headed by Municipal Commissioner responsible for the supervision and monitoring of day to day administration of the civic body. Municipal Commissioner is appointed by the State Government and assisted by Additional Municipal Commissioners (Administration and Solid Waste) and (works). Other officers are Chief Health Officer, Accounts officer, Chief Engineer, Executive Engineers, Law officer, Secretary council affairs along with their support staff.
350. **Organization set up involved in Solid Waste Management.** Overall in-charge is Additional Commissioner (Administration cum Solid Waste Management). Chief Health officer is responsible for general health and sanitation activities and other miscellaneous works. The main responsibilities are:
- (i) Road sweeping, waste collection at secondary collection point, transportation and disposal.
 - (ii) Operation and maintenance of all vehicles of GNN
 - (iii) Drain cleaning work of all drains
 - (iv) Procurement of new vehicles required for GNN
 - (v) Establishment and Monitoring of the sanitation workers.
 - (vi) Issuance of licenses under PF Act.
 - (vii) Issuance of Death and Birth certificate
 - (viii) Involved in policy making decisions.

351. Chief Health officer is assisted by 1 Deputy Health Officer, 1 Zonal sanitary officer, 1 Chief Sanitation and Food Inspector, 3 Sanitation and Food inspectors, 165 sanitary supervisors, and 4072 sanitation workers, which are deployed at the ward level. Following complaints are presently attended at the ward level:

- (i) All sanitation related works like street sweeping, collection and transportation of garbage
- (ii) Dead animal removal from the streets (complaints are noted here and conveyed to contractor)
- (iii) Fogging spraying , anti larva spraying
- (iv) Cleaning and maintaining of public toilets and urinals of the ward
- (v) Cleaning of drains
- (vi) Cleaning of septic tanks/ choke removal of sewage lines

352. Figure below shows the hierarchy and strength of Ghaziabad Nagar Nigam staff engaged for sanitation works.

Figure 7: Staff Set-up & Hierarchy for SWM in



353. *Ideal Organization Setup.* In Ghaziabad, the Solid Waste Management services are decentralized at the ward level, which is ideal practice for efficient management. However, the Solid Waste Management functions would be attended efficiently, if all functions of the city administration are decentralized at ward levels and senior officers are placed in-charge of each ward functioning independently with adequate delegated powers. The Solid Waste Management functions should be decentralized as under:

354. *Ward Level Administration.* Authority and responsibility should go hand in hand. For fixing accountability there should be adequate delegation of fiscal and disciplinary powers to the officers and the supervisory staff responsible for managing solid waste and carrying out all day-to-day functions smoothly. The ideal situation is one, in which most of the SWM related activities are dealt and disposed off at the ward level. To make the ward office self sufficient, the utmost requirement is to establish a pucca ward office in centrally located and convenient place in each ward with posting of an active ward officer. In Ghaziabad, ward offices are functioning from temporary huts or public places like park/water tank etc. The ward office should have sufficient space for minimum two to three rooms. One room for ward officer and other for storage is must. Following activities could be undertaken at the ward office:

- (i) All sanitation related works like street sweeping, collection and transportation of garbage
- (ii) Dead animal removal from the streets
- (iii) Nabbing of stray animals
- (iv) Fogging spraying , anti larva spraying
- (v) Cleaning and maintaining of public toilets and urinals of the ward
- (vi) Cleaning of drains
- (vii) Special sweeping and painting *Rangoly* on demand and special occasions
- (viii) Cleaning of septic tanks/ choke removal of sewage lines
- (ix) Maintenance of street lights
- (x) Maintenance of minor repairing works of street, drain, parks etc
- (xi) Deposition of license/registration fees
- (xii) Issuance of death and birth certificate
- (xiii) Arrangement of Public redressal system for all municipal related activities

355. **Essentialities for successful management:**

- (i) For efficient administration, there should be regular timings for opening and closing of ward offices.
- (ii) In each ward, communication system should be available with linking of the office with other offices, workshop and head office of GNN through Networking.
- (iii) One responsible officer with positive aptitude and tendency to solve the public grievances should always be available at the office for entire office hours.

- (iv) Strong monitoring at Zonal and City level should take place.
 - (v) Good inter-departmental coordination within each department of GNN should be ensured.
 - (vi) Top priority should be given to solving of public redressal
356. The Head of the Solid Waste Management department should also have the power to punish subordinates including supervisory staff. Adequate in-built checks may be introduced to ensure that the delegated powers are not misused.
357. The ward level administration should be fully responsible for ensuring primary collection of waste, street sweeping, storage of segregated waste at source and taking the waste to waste storage depots, clearing debris and cleaning surface drains and public space and should be regularly supervised by the ward-level supervisors. The presence of all Solid Waste Management officers in the field during morning hours is most essential. A grievance redressal system of the ward should be put in place in each ward.
358. *Involvement of Ward committees.* The 74th Constitutional amendment envisages formation of Ward Committees in each city above 0.3 million population. This is also applicable to Ghaziabad City. These Ward Committees, as and when formed, will be very useful in improving Solid Waste Management services at the ward level. These Committees should be motivated to help in the following areas:-
- (i) Creating public awareness regarding Solid Waste Management at the ward level;
 - (ii) Formation of Resident welfare Association / Neighborhood committees to ensure public participation in source segregation of recyclable waste and deposition of domestic waste in the handcarts at fixed time during primary collection;
 - (iii) Involving school children to be watch dogs in preventing littering of streets by the people;
 - (iv) Interfacing with the people and officials and help in reducing public grievances on Solid Waste Management at the ward level;
 - (v) Supporting the effort of cost recovery for the services rendered;
 - (vi) Encouraging NGO participation in Solid Waste Management.
359. *Exclusive SWM In charge from engineering background.* Although, there is exclusive Health officer to look after and coordinate the SWM activities in an exclusive manner but implementation is in traditional manner and not according to MSW (M&H) Rules, 2000. Normally, administrative officers and health officers are not experts in bidding procedures which compels them to continue with traditional style of working but for implementing good practices in SWM preparation of bid documents, tendering, formulation of specifications etc are required, which are related to engineering section but due to lack of coordination, lack of authority and personal conflict among officers most of the tender related activities have not been initiated.
360. A senior officer of XEN rank should be made the in charge of central SWM department. He should be responsible for entire implementation of SWM according to MSW (M&H)

rules, 2000. The central Solid Waste Management Department should be responsible for procurement and upkeep of vehicles, construction of transfer stations, setting up and maintenance of processing plants as well as for managing the disposal sites in an environmentally acceptable manner. It should make policy for House to House collection, decide the tax imposition, prepare a module for awareness and public private participation, contract document and suitable terms and conditions for various activities under SWM sector etc. It should monitor the manpower deployed, waste collection carried at ward level, waste quantity transported at the dumping sites, progress of complaint redressal, costs incurred on various activities on daily basis.

361. The central Solid Waste Management department should also be responsible for the procurement of land for processing and disposal of waste. As a Head Quarter in charge he should take policy decisions and co-ordinate the activities of all the wards and be answerable to the Municipal Commissioner and elected body for the efficient functioning of the department. He should look after the recruitment of manpower, human resources development, training etc. He should also coordinate for processing of waste, establishment of processing plant, transfer station, slaughter house, land fill site, carcass utility center, bio medical plant etc. He should be the officer in charge for all works related to SWM activities and have the complete authority and confidence of Commissioner.
362. **City Level Administration.** The city level administration should be directly under the control of Municipal commissioner. He should supervise and support the XEN (SWM) and should approve the policy and guidelines for successful implementation of SWM. He should delegate sufficient authority and powers to department head of the SWM section. The Municipal Commissioner should build up good rapport with State Government and arrange financial resources as well as physical resources such as land allotment, approval of policies requiring State Government approval.

C. Proposed Organizational Setup

363. The subject of solid waste management, so far being handled by Health Officers (with medical background) in most cities, now needs to be handled by Environmental engineers /public health engineers or civil engineer with the support of mechanical/automobile engineers to handle the workshop facilities and various processing plants. Qualified engineers should, therefore, be regularly inducted in handling Solid Waste Management.
 - (i) Public Health/Environmental Engineer in the grade of XEN should be made in charge of Solid Waste Management section with sufficient authority and responsibility. He would report directly to Commissioner.
 - (ii) To avoid the problem of coordination and passing of responsibility to others, overall control in relation to sweeping, drain cleaning, collection, transportation, processing and disposal of all wastes including vehicle maintenance facilities should lie with in charge of SWM section.
 - (iii) In charge should be assisted by two Assistant Engineers-one Civil Engineer and one

Mechanical Engineer for technical matters and one Chief sanitary officer for supervision, monitoring, mass awareness and record keeping.

- (iv) The AEN Civil Engineer should exclusively be made responsible for solid waste related activities like construction and maintenance of; buildings, storage points, processing plants and sanitary land fill sites.
- (v) The AEN Mechanical Engineer should be made responsible for entire transportation system, procurement & maintenance of vehicles, operation and maintenance of processing plant and sanitary land fill site.
- (vi) The Chief sanitation officer should be responsible for supervision and monitoring of solid waste related activities, planning, record keeping and conducting mass cleaning drives and publishing IEC material.
- (vii) Sanitary Inspectors to assist Chief Sanitation Officer in supervision of sweeping, drain cleaning, transportation, door to door collection, processing, disposal systems, planning and monitoring. Supervisors to assist in supervision work.

364. The sweepers should be given “Pin point” individual work assignments according to the density of the area to be swept. Following yardsticks should be adopted:-

Work Norms:

Norms of work for street sweepers	Length
High density area & Markets (Population above 60000 per sq. km.)	250 to 350 Running Meter
Medium density area (Population from 20000 to 60000 per sq. km.)	351 to 600 Running Meter
Low Density area (Population less than 20000 per sq. km.)	601 to 750 Running Meter

Note: Each sweeper should have an about 200 to 250 houses/ commercial/institutional wastes in the beats to the extent possible.

- 365. The sweepers may be directed to sweep the roads and footpaths in the area allotted to them as well as to collect the domestic, trade and institutional waste in their handcart from the households, shops and establishments situated on the road / street.
- 366. The above sweeping norms are for cleaning the streets in the first 4 hours of the working day. In the remaining hours of the day, if there is broken duty, the sweepers should be assigned pin point work for cleaning the streets in slums and unauthorized settlements to ensure hygienic conditions in the city and prevent the problems of health and sanitation arising in such areas.
- 367. The roads, which have a central verge or divider, should be considered as two roads. In such cases, the length of the road allotted for sweeping should be reduced to half or alternatively separate sweepers may be engaged for sweeping two sides of the road.

368. The yardstick for cleaning open spaces should be prescribed looking to the local situation. However, 30,000 sq.ft. of open space can be given to a sweeper for cleaning per day.
369. Similarly work norms can be prescribed for variety of vehicles used depending upon the distance to be traveled and the places to be covered. These norms may be prescribed after conducting time and motion study.
370. Normally one vehicle carrying containers could make 7-8 trips to the processing and disposal site depending on the distance to be traveled.
371. Norms of work for supervisors maybe prescribed and monitored by the local body for inspection of sweeping done, clearance of waste storage depots, transportation of waste carried out, etc. inspection of processing and disposal sites by various levels of supervisors may also be prescribed to ensure adequate output of all the supervisory staff.
372. The first level supervisors could be asked to inspect the work of all the sweepers every day. All temporary waste storage depots must also be inspected by the same level of supervisors with the same frequency.
373. All Supervisory Officers right from Sanitary Sub Inspector to in – charge of Solid Waste Management department must remain on the field for 4 hours in the morning during the time of street sweeping. The timings for the lower and middle level supervisor should extend beyond the duty hours of the sanitation workers in the afternoon/evening to verify whether work has been done properly. This supervision will have a direct impact on the quality of service.
374. For capacity building of the department, senior officials should be frequently exposed to developments taking place in various parts of the state / country by sending them out of city visits and for attending seminars, workshops and training courses. They should be also involved in all decision making processes.

D. Human Resources Development

375. Human resources development is very essential for internal capacity building for any organization. Training, motivation, incentives for outstanding service and disincentives for those who fail to perform are essential for human resources development. Concerted efforts should be made by the local body to inculcate among its officers and staff a sense of pride in the work they do and to motivate them to perform and give their optimum output to improve the level of services of the city and the image of the local body.

E. Training

376. Solid Waste Management has been a neglected subject for the past several decades. Systems have, therefore, not developed to improve the service. Knowledge of new technology and methods coupled with training at all levels is necessary. No specialized courses have so far been designed to meet need of different levels of staff. Short and medium term courses should therefore, be designed for the sanitation workers and supervisory staff. Special training and refresher courses may also be conducted as described below
377. *Special Training to Unqualified Staff.* Unqualified supervisory staff should be given service training to qualify for supervising sanitation works. They may be sent out for training to the All India Institute of Local Self-Government or such similar institutions with signs special course of sanitation supervisors.
378. *Refresher Courses for All Levels of Staff.* Refresher courses should be conducted for the sanitation workers as well as supervisory staff at least once in every 5 years, or they should be sent for training to get exposure to advance in this field. The course content could be as per the details given below:

1. Basic course content for Training to various levels of Staff/ Officers

(i) Training for Sanitation workers

- Importance of sanitation in urban areas
- Present scenario of solid waste management system in the urban areas, deficiency in the system etc.
- Impact of inefficient Solid Waste Management services on health and environment.
- Inefficiency of tools and equipments used and loss of manpower productivity.
- Need for modernization of solid waste management practices.
- Options available for improving the system
- Advantages of using improved tools and equipments for primary collection of waste and street sweepings
- Need for synchronization of storage of waste at source, primary collection of waste and waste storage depots
- Proper upkeep of tools and equipments and waste storage depots

(ii) Training to sanitation supervisors of various levels

- Need for synchronization of transportation of waste with waste storage depots
- Transportation of waste on day to day basis

- Waste processing and disposal options, advantages and disadvantages of various technologies.
- Sanitary land filling and related technologies
- Public and NGO participation in waste management
- Building public awareness
- Enforcement of the various rules

(iii) Training for officers looking after Solid Waste Management Department

- Solid Waste Management good practices prevalent in other parts of the country and in the developed countries
- Institutional strengthening, internal capacity building and human resource development
- Private sector participation in Solid Waste Management and cost benefits accrued on account of PSP.
- Management information systems
- Financial aspects
- Health Aspects
- Legal Aspects

379. *Exposure to Chief Executive Officer/ Municipal Commissioner.* It is necessary to give an orientation to the Chief Executive officer of the local bodies and make them aware of this important aspect of Urban Management. They may therefore be given exposure to Solid Waste Management through short training programs or seminars conducted by the departmental officers.
380. *Exposure to Elected Members.* Whereas the Municipal Commissioners or the Chief Executives are responsible for day-to-day affairs of the urban local bodies, the elected members are the policy makers and their sanctions are essential for any major investments or improvements in Solid Waste Management services. It is, therefore, necessary that the members of the elected wing such as the Mayors of the Corporation and other important office bearers, are given appropriate orientation towards the need of modernization of solid waste management practices in the urban areas and the importance of the same in terms of health and sanitation in the cities/towns. If these members are given an appropriate exposure, they would automatically support adequate financing for solid waste management services and strengthen the hands of chief executives in the implementation of modern methods of waste management and they would also help in getting public support through their network of field workers.
381. It is suggested to organize sponsored trip for officials of Municipal Corporations to places where considerable success has been achieved in the field of SWM. Few places for such visits could be-Chennai, Bangalore, Hyderabad, Surat or Ahmedabad.

F. Promotional Opportunities

382. Adequate promotional opportunities should be available in the decentralized Solid Waste Management hierarchy to maintain the interest of the supervisory staff to remain in the department.
383. *Inter Departmental Co-ordination.* Since the SWM department depends greatly upon the support of various departments of the local body, more particularly the Engineering department, the Chief Executive of the local body should hold regular monthly co-ordination meetings to Sort out problems faced by tile SWM department such as expeditious repairs of roads, drains, water-supply pipe-lines etc. which cause hindrance to street and city cleaning. The reinstatement of roads dug up by utility services should also be given priority. Apart from infrastructure works, the engineering department should give priority to specific works related to SWM section, such as- construction/repairing of ward offices, garage, store buildings, pucca floor under all collection points, identification of suitable land and construction of transfer station , SLF, Processing plant etc.
384. The procurement procedures for the SWM equipment also need to be expedited and simplified in such meetings. A Rate-contract system should replace time consuming tendering procedures. It should be ensured that none of SWM activity should get affected for want of repairing of equipment. Sanitary workers should have usable implements. About 25 % more equipment shall be purchased to take care of repairing and maintenance.
385. There should be an Apex Committee comprised of representatives of various utility services, headed by the Municipal Commissioner of the Corporation, to co-ordinate the laying of underground services in the city by various utilities and the reinstatement of the roads as soon as the underground services are laid. The Apex Committee should ensure that repeated digging of road is avoided for laying of services by various utilities at time. The works to be carried out by various utilities on a particular road should be coordinated to prevent frequent digging of roads, laying and maintaining of services in slums, provision of public health engineering services and water supply for public toilets and road construction in the slums to improve overall health and sanitation in the city may also be regularly reviewed in the co-ordination committee meetings.
386. *Encouragement to NGOS and Waste Collector Co-operatives.* NGOs should be fully involved in creating public awareness and encouraging public participation in SWM planning and practice. The local body may also encourage NGOs or co-operative of rag pickers to enter this field and organize rag pickers in doorstep collection of waste and, provide them an opportunity to improve their working conditions and income. The local body can give incentives to NGOs in their effort of organizing rag pickers in primary collection of recyclable and/or organic waste, and provide financial and logistic support to the extent possible.

387. *Suggestions on Campaign movement and mass awareness program.* For effective implementation of SWM practices, multi pronged action is required in association with all stake holders- Municipal corporation employees, Public representatives, State Government, NGOs and waste generators.
388. On one side, training & refresher courses are essential for Municipal employees; the other important side is conducting Mass awareness programmes for waste generators. It is experienced that even after setting up of a good system, it is not always necessary to obtain desired results, in absence of people's cooperation and awareness. No city can remain clean, if sanitation work is left entirely on civic body with no cooperation or very little cooperation of people. Thus Public Participation is key to the success for SWM.
389. People need to know about the duties of Nagar Nigam; rules and regulations / obligatory functions of GNN; as well as their participatory role towards city's cleanliness. Information, Education and Communication (IEC) mechanisms should be used to ensure effective public participation
390. Following methodology is suggested for carrying out community awareness and public participation in the sector of solid Waste management:
- (i) Objective: The overall objective is to achieve People's participation in SWM activities in collaboration with the Municipal Corporation. In order to achieve the objective, following steps has been suggested:
- Situational analysis for development of field based micro plan
 - i. no segregation and storage at source
 - ii. no house to house collection mechanism
 - iii. littering and open burning very common
 - iv. improper collection, transportation and disposal equipment and methodology
 - v. no cooperation to Nagar Nigam employees
 - vi. no payment of user charges
 - Dissemination of information to community regarding best practices of Solid Waste management through print, electronic media and unconventional media
 - Design and implement a suitable mechanism for source segregation, collection, transportation and proper disposal on pilot basis through NGO.
 - Capacity building of different stakeholders involved viz. NGOs, CBOs, Volunteers, line agencies, etc. for development of proper mechanism for adopting best practices of solid waste management
 - Production of relevant IEC for replication at their end
 - Strategies and approaches:
 - Identification of major issues of concern in respective area-such as,
 - i. Need and urgency of waste disposal
 - ii. Obligatory functions of ULB and legal provisions for People's

- participation
 - iii. Present scenario of SWM and need for active role of community participation
 - iv. Need of formation of Community Based Organizations (CBO), Neighborhood committees (NCs) for timely disposal and collection of waste; recycling, reusing and reduction of waste at source; segregated storage at source; deposition of waste at proper place in proper containers; no littering on streets and public places; paying user charges regularly and cooperation to Municipal corporation employees
 - v. Role of N.G.Os in city/Mohalla/ward cleanliness drive, street sweeping
 - vi. organizing awareness camps, skill enhancement of the people/communities as well as develop coordination with the ULB
- Development of IEC for replication and distribution
- Awareness generation through electronic media:
 - i. Scroll on message
 - ii. Ad spots
 - iii. Songs with drama
 - iv. Interactive sessions
 - v. Quiz competitions
- Awareness generation through print media:
 - i. Appeals
 - ii. Advertisements
 - iii. Articles
 - iv. Distribution of pamphlets
 - v. Stickers
 - vi. Posters
- Awareness generation through unconventional and traditional media:
 - i. Street plays
 - ii. Advertisement through UPSRTC buses/private buses
 - iii. Organization of workshops on 'best out of waste' during hobby classes and in schools
 - iv. Organization of public meetings, door to door campaigns etc.
 - v. Ensure facilitating awareness generation campaign in a series.
 - vi. Facilitate having associating partners, like NGOs, line agencies, media to implement joint venture for awareness generation campaign
 - vii. Capacity building of municipal personnel, NGOs, CBOs for development of effective mechanism for adopting best practices
 - viii. Formation of committees at local level to sustain the initiative undertaken and incorporating related capacity building initiatives
- Implementation through NGO on pilot basis: It would be better if a pilot project is implemented through NGO:
- Target group: House wives, members of selected commercial houses, grass root workers of GNN

- Number of camps: 20 (with recapitulation 3 times for each camp=80) for Ghaziabad city.
- Process of implementation
 - i. Coordination by NGO
 - ii. Involvement of CBOs/Mohalla Samities (where ever available), members of local small business enterprises, GNN grass root representatives, school teachers and the communities.
 - iii. Equipment input such as LPCD projector, video clippings
 - iv. Involving local media for publication of activities
 - v. Follow up activities

Expected outputs: Behavioral changes in practices

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