CITY LEVEL PROJECTS

SOLID WASTE MANAGEMENT

Chittaranjan Park (Ward Number 190)

(An ISO 9001 : 2008 Certified Organisation)

Delhi Urban Art Commission

The Delhi Urban Art Commission was set up by an Act of Parliament in 1973 to "advise the Government of India in the matter of preserving, developing and maintaining the aesthetic quality of urban and environmental design within Delhi and to provide advice and guidance to any local body in respect of any project of building operations or engineering operations or any development proposal which affects or is like to affect the skyline or the aesthetic quality of the surroundings or any public amenity provided therein".

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Delhi Urban Art Commission

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BSES Yamuna Power Limited
RWA's and Area Councillors
Google Earth

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Preface

The city of Delhi, capital of this vast land of diversities, is a city laden with layers of history, a place where civilizations have lived, prospered and perished over centuries. The modern city today, built over and around a rich tapestry of heritage, presents an opportunity at every turn, to allow for co-existence of the past, present and the future. In order to understand this multidimensional urban spectrum and attempt to plan the future, various city level studies have been initiated by the DUAC. I hope that these studies will help the planners of modern day Delhi to carefully articulate urban space, structure, form and environment and sensitively address future requirements.

I convey my thanks to all the Consultants and Members of the Commission who have tirelessly worked on this research project to bring out this document. I also take this opportunity to place on record my sincere appreciation of the efforts of Secretary and other staff of DUAC for providing the necessary administrative support to make this happen.

I fondly hope that the authorities of the local, state and national government take these studies seriously and implement, in right earnest, the suggestions given herein.

October, 2017

Sd/-
Prof. Dr. P.S.N. Rao
Chairman, DUAC

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Summary

The problem of Municipal Solid Waste (MSW) management has acquired alarming dimensions in India, especially over the last few decades '*due to the changing lifestyles of people coupled with unplanned developmental activities, urbanization and industrialization' (Ogawa, 1989, Attarwalla, 1993, Vagale, 1997 and Development, 1999 quoted in Lecture1: Introduction to Municipal Solid Waste Management by National Programme on Technology Enhanced Learning*). Solid waste management includes the entire process of dealing with solid waste, starting from the generation, collection from the primary source to ultimate disposal, in a hygienic and scientific manner. If not handled in a scientific manner, MSW has adverse effects on health, environment, and pressure on land resources etc. Solid waste management involves management at various levels – segregation at source, storage and collection from primary source to temporary secondary source, transportation of the segregated recyclables for processing and resource recovery, and finally transportation of the remaining non- recyclable waste to the disposal/sanitary landfill site and scientific disposal. In the present scenario recovery and recycling of waste is done by rag pickers and scrap dealers alone.

As per the 12th Schedule of the Constitutional Amendment Act, 1992 as well as provisions in Municipal Solid Waste Management and Handling rules, 2000, Solid Waste Management (SWM) is an obligatory function of local urban bodies. However, in actual practice, due to lack of financial resources, inefficient institutional arrangement, inappropriate technology, weak legislative measures and public awareness has made the service most unsatisfactory and inefficient.

This report deals in detail with the MSW management in Chittaranjan Park (Ward No 190) that comprises the development of three colonies: Chittaranjan Park, Alaknanada and Kalkaji DDA Flats with typologies of plotted and group housing development. It is also interesting to understand the waste generation in Ward No 190, as the waste generation apart from typical annual activities varies during the peak festive season of Durga Puja, as the majority of residents in the area belong to the Bengali community. It also tends to attract a lot of people during the Puja Festival from all over Delhi and the NCR.

The major issues regarding nonsegregated waste, haphazard storage at secondary receptacles and finally dumping of the same in the landfill sites are analysed in detail. The scope of the study focuses on the analysis of issues, potentials and framing strategies for collection, segregation, storage, transportation, processing or resource recovery and disposal of municipal solid waste.

In light of the campaign 'Swachh Bharat Abhiyan' launched by the Government of India on 2nd October 2014, towards cleanliness and hygiene, the report attempts to improve cleanliness with respect to solid waste management in the municipal Ward No 190 by way of decentralized and inclusive waste management, resource generation, reducing pressure on land and social inclusion of informal rag pickers. The findings, recommendations and proposals made can be adopted as a pilot model which can be replicated in other Wards of Delhi as well.

1. Introduction

As per the twelfth Schedule of the 74th Constitutional Amendment Act, 1992, solid waste management is one of the basic essential services provided by municipal authorities in the country to keep urban areas clean. However, it is amongst the most poorly rendered services where the systems applied are unscientific, outdated and inefficient; population coverage is low and the poor are marginalized (Department of Economic affairs, Ministry of Finance, Government of India, 2009). It is estimated that the amount of solid waste generated per capita in India is 100 gms (in small towns) and 500 gms (in urban clusters). Globalization and the increase in purchasing power have further compounded the issue of waste management.

Per capita waste generation in Indian cities

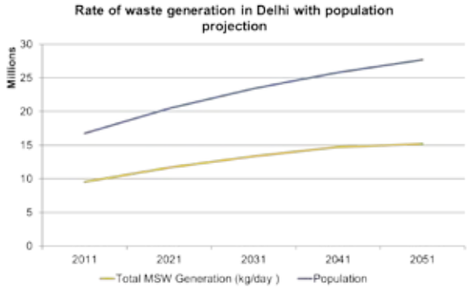
Population range (in million)	Average generation per capita in Indian cities (gms/capita/day)
0.1 to 0.5	210
0.5 to 1.0	250
1.0 to 2.0	270
2.0 to 5.0	350
5.0 plus	500

(Source: NEERI, 1995)

It is estimated that 500 g/capita/day of solid waste is generated in cities with more than a 5 million population. The major cities of India: Mumbai, Delhi, Bengaluru, Hyderabad, Chennai and Ahmedabad fall under this category.

1.1 Introduction to Solid Waste Management in Delhi

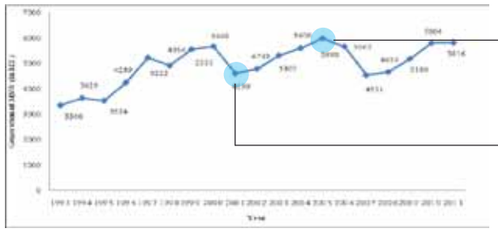
Delhi is a commercial and administrative hub, providing employment opportunities which has accelerated the pace of urbanization, resulting in a corresponding increase in Municipal Solid Waste (MSW) generation. MSW management has remained one of the most neglected areas of the municipal system in Delhi (Talyan, Dahiya, Sreekrishnan, 2007).



Projection of Population and Waste Generation in Delhi

Urbanization pattern of the city affecting SWM

- The decadal growth rate in the population of Delhi during the last decade (2001–2011) was 20.96%.
- About 70–80% of the generated MSW is collected, while the rest remains unattended to on streets or in small open dumps.
- Presently the inhabitants of Delhi generate about 7000 tonnes per day of MSW, which is projected to rise to 17,000–25,000 tonnes per day by the year 2021.



Construction activity during the Commonwealth Games resulted in an increase of C&D waste

Weigh bridge machines were introduced and therefore annual figures of waste generation came down due to the accuracy of weights

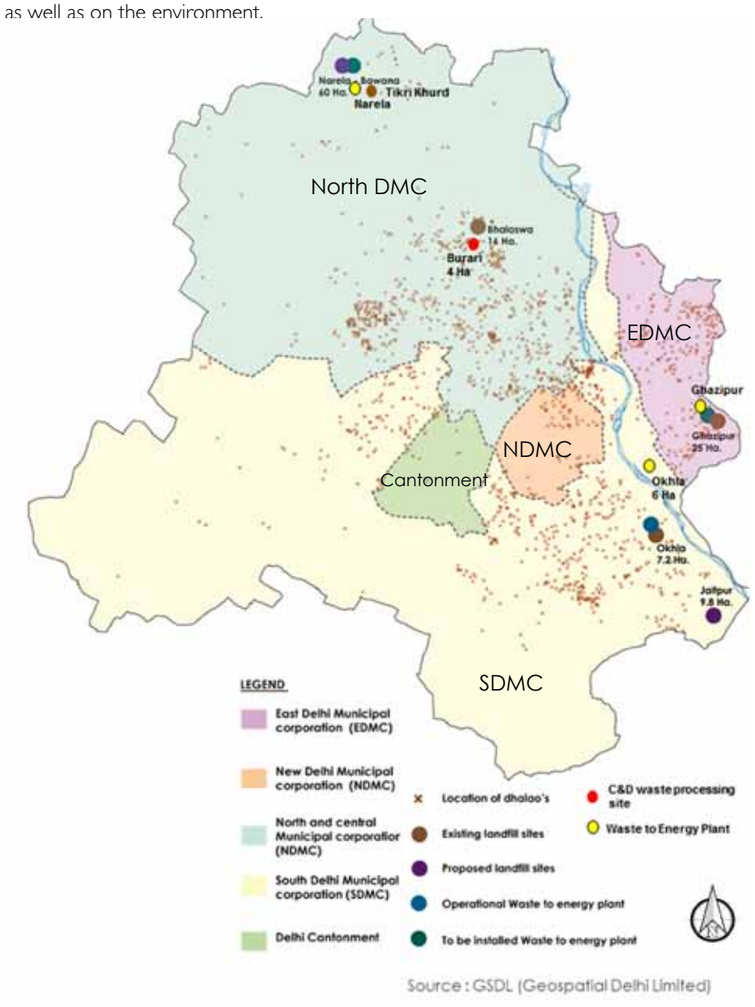
Growth of Municipal Solid Waste Generation in MCD, Delhi: 1993–2011

Souce : Kumar 2013, p. 09

1.2 Landfill and Waste Treatment Sites in Delhi

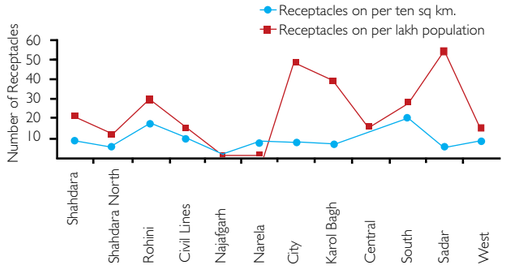
Twenty landfill sites have been developed in Delhi since 1975, out of which 15 have already been closed down and two have been suspended. At present there are three landfill sites in operation. The three operational landfill sites – Bhalswa, Ghazipur and Okhla have almost exhausted their capacity, but waste dumping still continues leading to overflowing.

Insanitary dumping on landfill sites causes contamination of soil and water, thereby having a negative impact on human health as well as on the environment.



Map Showing the Location of Sanitary Landfill Sites and Other Waste Treatment Sites in Delhi

(Source: Geospatial Delhi Limited)



Receptacles Serving Area and Population in MCD Zones

Source : Kumar 2013, p. 09

- MCD uses waste receptacles of two types i.e. neighbourhood dhalaos and street dustbins/community bins and sometimes open areas
- 1,00,000 rag pickers involved in the informal sector
- 20,000 scrap dealers are involved in recycling 16% of waste generated per day

Details of the Three Operational Landfill Sites in Delhi

S. No	Name of Site	Location	Area (ha)	Year started	Waste received (TPD	Zones covered	End of landfill life	Height [Permissible Height 20m]
1.	Bhalaswa	North Delhi	21.06	1993	2200	Civil Lines, Karol Bagh, Rohini, Narela, Najafgarh	2005	35–42 m [variation]
2.	Ghazipur	East Delhi	29.16	1984	2000	Shahdara (South and North), City, Sadar, Paharganj and NDMC	2008	25.5–35 m [variation]
3.	Okhla	South Delhi	16.20	1994	1200	Central, Najafgarh, South and Cantonment Board	2005	32.5–40 m [variation]

Landfill Sites Serving MCD Zones
Source : Department of Urban Development, Govt. of Delhi, 2007

Apart from the above, Delhi presently has four compost plants. 5.7% of the waste is being processed in three of the compost plants. Details of the compost plants, C&D waste processing plant and waste-to-energy processing plants are listed below.

Details of the Four Compost Plants in Delhi						
S No	Facility	Capacity (TPD)	Area (Ha)	Year started	Technology	Remarks
1.	Okhla (MCD) presently closed	150	3.2	1981	Aerobic window composting	Proposed to be upgraded to 200 TPD
2.	Okhla (NDMC)	200	3.4	1985	do	Operated below capacity
3.	Bhalaswa (Private Sector-NWMIL)	500	4.9	1999	do	Operating at 50% capacity
4.	Tikri Khurd, Narela (APMC and Private)	125	2.6	2001	do	Dedicated at 50% waste stream
Details of C&D Waste Processing Plants in Delhi						
1.	Burari C& D Waste Processing Plant (ILFS)	1200	4	2009	Treated effluent supplied from the Delhi Jal Board – reuse & recycled	Proposed to be upgraded to 2000 TPD 20%–30% of the Municipal Solid Waste
Details of Waste to Energy Processing Plants in Delhi						
1.	Timarpur – Okhla Waste to Energy Plant	1950	6	2007	Refuse-derived fuel technology	Energy generated 16 MW
2.	Ghazipur Waste to Energy Plant	1300	-	Under Installation	do	12 MW
3.	Narela Waste to Energy Plant	3000	-	Under Installation	do	24 MW

1.3 Concerned Local Bodies Responsible for SWM

The various agencies/organizations responsible for the management of Municipal Solid Waste in Delhi are:

Urban Local Bodies

Municipal Corporation of Delhi (MCD)
- North MCD
- East MCD
- South MCD

NDMC

Delhi Cantonment Board

Role: The Municipal Corporation of Delhi (MCD), New Delhi Municipal Corporation (NDMC) and Delhi Cantonment Board (DCB) are three local municipal bodies responsible for MSW management in their respective jurisdiction in Delhi.

Other Government Organizations

Delhi Development Authority (DDA)

Role: Delhi Development Authority (DDA) for siting and allotment of land for sanitary landfill sites and other waste processing sites as per requirement

Delhi Energy Development Agency (DEDA)

Role: Delhi Energy Development Agency (DEDA) for solid waste utilization projects aiming at biogas for energy generation

Department of Flood Control of Delhi (DFCD) Board

Role: Department of Flood Control of Delhi (DFCD) for supplying soil to be used as cover for landfills

Non-government Organizations

NGOs

Role: NGOs are responsible for mobilizing door-to-door collection, segregating and sorting waste and helping form street sweeping brigades.
They can provide capacity building and assist informal rag pickers for social inclusion and economic opportunity.

RWAs and Societies

Role: RWAs and societies propagate and carry out sustainable waste management practices in their respective complexes/areas.

Private Operators

Role: Private operators provide infrastructure and technical expertise in collaboration with the government to collect MSW at the ward level to landfill sites or waste-to-energy plants
They can also integrate informal scrap dealers into the mainstream for recycling.

1.4 Existing Policies and Recommendations for SWM in India

The existing policies for solid waste management in India are discussed under two categories as follows:
1 National Level Policies
2 State Level Policies

1.4.1 National Level – Existing policies and Recommendations for SWM in India

1.4.1.1 Twelfth Five Year Plan

Source : Planning Commission, Govt. of India, May 2013

Ministry of Urban Development to work with the States to explore the following strategies:

- The recovery of recyclables is presently unorganized and needs to be replaced with arrangements with rag pickers and NGOs/CBOs for effective door-to-door collection.
- Acquisition/earmarking of land required for the project should be facilitated by pro-active guidelines and direction from the State and it should be addressed in the Master Plan process.
- The concept of Regional Solid Waste Management solutions needs to be encouraged.
- Waste characterization has to be done properly, taking representative samples from the city for various types of waste and the treatment process should be selected accordingly.
- Appropriate technology options for the treatment of the organic content of the waste should be chosen based on the characteristics of the waste, local conditions and so on.
- IEC (Information, Education and Communication) in order to educate households, municipal staff, and other personnel engaged in the collection and management of waste.
- Polluter Pay Principle should be implemented in a calibrated manner in order to instill a sense of discipline in people who do not care about cleanliness and throw litter.
- In the area of solid waste management, concept of 'waste-to-wealth' to be pursued.
- PPP may also be explored for functions such as door-to-door collection, street sweeping, transportation, treatment, etc.

1.4.1.2 Guidelines for Swachh Bharat Mission

Source : Ministry of Urban Development, Govt. of India , December 2014

- Mission Objectives, para 2.1.3 provides for Modern and Scientific Municipal Solid Waste Management.
- Duration of the Mission – in force till 2nd October 2019.
- Municipal Solid Waste Management as a systematic process that comprises waste segregation and storage at source, primary collection, secondary storage, transportation, secondary segregation, resource recovery, processing, treatment, and final disposal of solid waste.

1.4.1.3 Manual on Municipal Solid Waste Management and Handling 2014

Source : Ministry of Urban Development through Central Public Health and Environmental Engineering Organization CPHEEO, 2014

- Dhalaos or masonry storage depots or area level waste collection centres, commonly used in cities like Delhi and others, are found to be unhygienic, environmentally unsafe and unsuitable for secondary waste collection. Where such systems exist, they are to be phased out as soon as possible.

1.4.1.4 MSW Management and Handling Rules 2000 and Revised Draft 2013

Source : Ministry of Environment and Forests , 2003 draft revised in 2013

- Designates urban local bodies responsible for MSWM and lays down mandatory functions to be performed by various stakeholders.
- The rules identify compliance criteria for various parameters for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes.
- Specifications for landfill sites are laid down for site selection, facilities at the site, specifications for landfilling, pollution prevention, water quality monitoring, ambient air quality monitoring, plantation at landfill site, closure of landfill site and post-care, etc.

1.4.1.5 National Urban Sanitation Policy (NUSP)

Source : Ministry of Urban Development , 2008

- Focus on re-orienting institutions for developing a city-wide approach to sanitation, covering all its aspects including solid waste management.

1.4.2 State Level – Existing Policies/Recommendations for SWM in Delhi

1.4.2.1 Master Plan for Delhi 2021

Delhi Development Authority, Revised 2017

- Table 4.2: Infrastructure requirement for layout at Residential Neighbourhood Level [Population of 10,000]: Area for segregation of waste and parking of utility vehicles.
- The word 'dhalao' has been replaced by 'area for segregation of waste and parking of utility vehicles' in order to discourage storage at secondary collection points and encourage sorting and segregation.
- The facility should include space for segregation of biodegradable and recyclable solid waste.
- Local bodies to ensure removal of existing dhalaos in phases.
- Waste to be segregated and collected in separate chambers at dhalaos. For this, the involvement of rag pickers with RWAs, CBOs and NGOs is to be encouraged.

1.4.2.2 Zonal Development Plan for Zone F

Source : Delhi Development Authority, Revised 1995

• Clause 10.4.2 states: The zone has large sanitary landfill sites in the vicinity along Ring Road. However, for the disposal of garbage, modern technology and methods which are environmentally safer, need to be adopted.

1.4.2.3 Unified Building Bye Laws for Delhi 2016

Source : Delhi Development Authority, Notification dated 16.03.2016

• Zero waste measures: All buildings to provide separate coloured bins to collect dry waste and wet waste.

• All nonbiodegradable waste shall be handed over to authorized recyclers.

• Organic waste compost/vermiculture pit with a minimum capacity of 0.3 kg/tenement/day, must be installed.

• Provide separate bins for safe disposal of hazardous waste batteries, e-waste, lamps, medical waste etc. as applicable at the centralized facility.

• Provision of Green Building: Additional FAR as an incentive for green buildings that includes waste management – segregation of waste and organic waste management.

1.4.3 SWACHH SARVEKSHAN: A Government of India Initiative for Clean India

The Ministry of Urban Development, Government of India carried out a survey to study the progress of the Swachh Bharat Mission for cleanliness based on 19 indicators called Swachh Sarvekshan.

Swachh Sarvekshan – Highlights:

Ranking of 75 cities in India based on levels of sanitation and cleanliness by the Quality Council of India (QCI).

Objectives related to Solid Waste Management – to ensure door-to-door garbage collection and proper disposal of municipal solid waste in all the selected 83,000 wards in urban areas by 2019.

Swachh Sarvekshan evaluated the work done in the following six measurable aspects of sanitation and hygiene:

• Strategy for Open Defecation-free town (ODF) and integrated solid waste management (SWM): 50 points

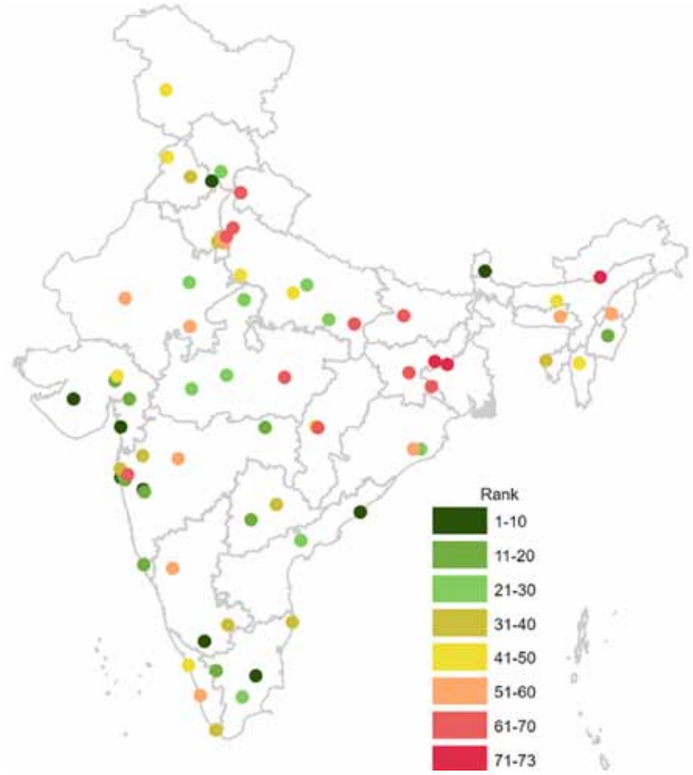
• Information, education and behaviour change communication (IEBC) activity: 50 points

• Sweeping, door-to-door collection and transportation (of solid waste): 400 points

• Processing and disposal (of solid waste): 200 points

• Provision of public and community toilets: 150 points

• Construction of individual toilets in households: 150 points



Location of Indian Cities Surveyed for Swachh Sarvekshan 2016

Source : https://gramener.com/swachhbharat/

As per the Swachh Sarvekshan 2016 Survey, the following are the top ten Indian cities:

Rank	Cities
1.	Mysuru
2.	Chandigarh
3.	Tiruchirappalli
4.	Delhi – NDMC
5.	Visakhapatnam
6.	Surat
7.	Rajkot
8.	Gangtok
9.	Pimpri Chinchwad
10.	Greater Mumbai

The following are the all India ranking of Delhi Municipal Corporations:

Rank	Cities
4 / 75	Delhi – NDMC
39 / 75	Delhi – SDMC
43 / 75	Delhi – North DMC
52 / 75	Delhi – EDMC

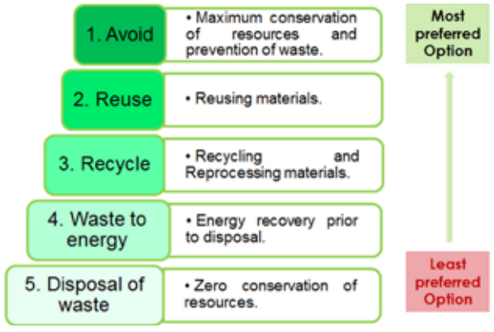
Based on the indicator of Solid Waste Management (SWM) and public toilet (PT) facilities, the following are the scores obtained by respective local bodies of Delhi:

1. TNDMC – 348/400 (SWM) & 141/150 (PT)
2. SDMC – 272/400 (SWM) & 99/150 (PT)
3. North DMC – 163/400 (SWM) & 49/150 (PT)
4. East DMC – 193/400 (SWM) & 57/ 150 (PT)

If the parameters of SWM and Public Toilets are improved in the concerned local bodies the following scenario is projected:

Cities/ Local Body	Present Ranking	Ranking if SWM improved	Ranking if SWM and Public Toilet are improved	Remarks
Delhi – NDMC	4 / 75	1 / 75	1 / 75	Moves 3 ranks up
Delhi – SDMC	39 / 75	23 / 75	23 / 75	Moves 6 ranks up
Delhi – North DMC	43 / 75	17 / 75	14 / 75	Moves 29 ranks up
Delhi – EDMC	52 / 75	33 / 75	23 / 75	Moves 29 ranks up

2.1 Waste Management Hierarchy



The approach to waste management should be an integrated system of technology and socioeconomic activity aimed towards maximizing practical benefits from products and to generate the minimum amount of waste. Hence, the waste management hierarchy indicates an order of preference for action to reduce and manage waste.

The proper application of the waste hierarchy can have several benefits. It can help prevent emission of greenhouse gases, reduce pollutants, save energy, conserve resources, create jobs and stimulate the development of green technologies.

The Waste Management Hierarchy

The proposed Solid Waste Management strategy will be based on **5 Rs:** Rethink, Reduce, Reuse, Recycle, Recover – which would ensure zero waste.

- **Waste Avoidance** – "Rethink" – not producing waste in the first instance and aim at waste prevention at source by avoiding the use of unnecessary packaging materials or avoid using disposables etc.

- **Waste Reduction** – minimizing production of waste.

- **Waste Reuse** – continuing the use products in their original form and re-purposing for other uses.

- **Waste Recycling** – resources contained in waste items are recovered and reprocessed to make similar materials or provide feedstock for another process.

- **Waste Recovery** – use the energy embodied in waste to create heat or electricity, or by gas recovery to be used as a fuel.

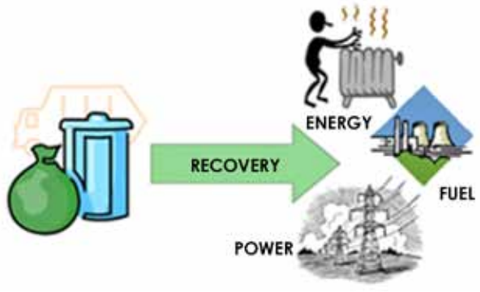
- **Waste Disposal** – when no other opportunity currently exists for the product, then responsible disposal.

Avoidance of waste: Without packaging

Waste reduction: Use reusable shopping bags

Waste reuse: Reuse glass/plastic containers

Waste recycling : Glass bottles used as decorative items



Waste Recovery: Different types of energies harnessed to be used as alternative sustainable fuels

2.2 Best Practices: Global

2.2.1 The Loading Dock Reuse Programme in Baltimore, Maryland

Source : NIUA PEARL Initiatives – Compendium of good practices: Urban solid waste management

An Example of Construction Waste Resource Recovery

The Loading Dock warehouse with a variety of fittings – ranging from plumbing, sanitary ware, wood etc.

Features of the initiative:

- An NGO 'The Loading Dock' created a scheme to reuse discarded and surplus building and construction material waste to be made available at subsidized rates for the construction of affordable housing. These would otherwise be redirected to a landfill.

- It is the recipient of two prestigious national awards: the Presidential Award for Sustainable Development and the United Nations Habitat II "Building Communities of Opportunity" National Excellence Award.

Key Findings :

- The project rescued tons of building material that would have been diverted to landfills.

- It helped moderate income housing and alleviating sub-standard housing by supplying used or unused building materials at subsidized rates.

- It brought about solid waste reduction, employment, and community development goals achieved through reuse.

Learnings:

- In India, construction and demolition waste makes up to 25% of total waste generation. This resource, if recovered and reused, can help reduce the cost of low budget housing by approximately 30–35%.

- It would also help reduce a substantial amount of waste being diverted to landfills which are already saturated and follow unscientific methods of filling.

2.2.2 The Zero Waste Framework, Cochrane, Canada

Source : https://www.cochrane.ca/199/Waste-Recycling

An Example of Waste Segregation – Composting – Recycling

Separate bins for organic and recyclable waste: Rolled out on to the roadside in the morning for collection; timeline for the recycling of different wastes; specific rules for the disposal of organic waste.

Features of the Initiative:

- Roll with it! Cochrane, is an initiative towards Cochrane Zero Waste Framework, in harmony with the Cochrane Sustainability Plan.

Key Findings :

- Organic Waste: Food waste composting in the Cochrane Eco Centre, where it will be turned into high-quality garden and landscape compost. Organic waste is not accepted if it contains any recyclable waste.
- Pay-As-You-Throw program allows residents to dispose off extra bagged household waste for a small fee and a penalty for noncompliance.
- Establish a benchmark and time line for recycling different recyclable wastes, such as: residential, industrial, commercial and institutional.
- Engage the whole community in segregation, rolling out waste in the morning and in proper storage until collection.

Learnings:

- Proper treatment of waste through composting of organic waste, recycling of recyclables and disposal of nonrecyclables.
- Incentives and disincentives for compliance to segregation rules.
- Ban on disposal of organic waste and recyclable waste in landfill sites.
- Establishment of benchmarks and practical timeline for phases of the project with appropriate institutional arrangements.

2.2.3 Waste Management Initiatives in Curitiba, Brazil

Source : http://wwf.panda.org/wwf_news/?204414/Curitiba-waste-as-resource

An Example of Incentivizing Waste Segregation and Recycling

Exchanging recyclable waste brought to waste stations for bus tickets, food, and school books.

Features of the Initiative:

- Curitiba's two programmes initiated by the government:

1. Garbage that is not garbage and,

2. Green exchange aimed at involving the entire society by incentivizing locals to segregate waste and handling it at waste stations.

Key Findings:

- In Curitiba, Brazil, the city did not have a budget for waste management or for a standard recycling plant, so it found a way to turn the negative spiral into a positive one through two important programmes.
- The city created a system to reward people for separating their organic and non-organic recyclable waste and bringing them to waste stations, by exchanging the waste for bus tickets, food, and school books.
- Participation among Curitiba households reached 70% in the 1990s and 20% of waste was recycled by its citizens. Employment was created in various ways.

Learnings:

- In India, recyclable waste makes up to 30-40% of total waste generation. This resource if recovered and reused can help reduce the pressure of dumping the same in landfill sites.
- This type of resource recovery will help in revenue generation, employment generation, social inclusion, encourage public transport, improve health and environment.
- The residents and visitors, can be made actively aware of their own responsibilities to achieve their sustainability goals, eg. through recycling or choosing public transport.

2.2.4 Waste Diversion from Landfill to Wealth in Mexico City

Source : http://edition.cnn.com/2012/06/19/world/americas/mexico-city-barter-scheme/

An Example of Reduce, Reuse, Recycle, Barter

Features of the Initiative:
The legislature in Mexico, passed the Solid Waste Act of 1990, which set a goal of diverting 25% of New Mexico's municipal solid waste from landfills by 1995 and 50% by July 1, 2000. In order to manage waste. The Environmental Protection Agency (EPA) and the Solid Waste Act in favour of an integrated solid waste management strategy – Reduce, Reuse and Recycle.

Key Findings :
- Mexico City held an inorganic domestic waste exchange market – a Barter Market promoted by the Environment Ministry.
- Barter Markets are organized monthly where recyclable waste is exchanged for agricultural produce.
- Stakeholders involved include: The Environment Ministry, farmers cooperatives, Barter Market workers (public employees and volunteers), market traders, chefs (who offer weekly free public cooking lessons), citizens and companies involved in recycling.
- Land preservation, habitability and public space; create and promote opportunities for exploitation of recycled materials, create job opportunities and income generation.

Learnings:
- Weekly or monthly Barter Markets can be encouraged as an effective initiative for recycling and spreading awareness that waste can be converted to wealth.
- Involve locals in waste recycling and reduce pressure on dumping waste in landfill sites.
- Revenue generation, employment generation, social integration, improved health and environment.

Barter Markets at various locations in which more than 2,000 people participate monthly; open from 8.00 am to 2:00 pm


Recyclables are weighed and green points are issued, which are used for purchasing agricultural produce with these points

2.3 Best Practices: India

2.3.1 Vrindavan Kuda Prabandhan Pariyojna: A Programme by Friends of Vrindavan

Source : NIUA PEARL Initiatives – Compendium of good practices: Urban solid waste management

An Example of a Community-led Recycling Initiative

Features of the Initiative:
An NGO, 'Friends of Vrindavan' manages solid waste management in the town of Vrindavan, with the purpose of preserving the ecological heritage of the city (Vrindavan being a heritage city, receives lakhs of devotees every year, which adds to waste generation).

Key Findings :
- Door-to-door waste collection of segregated waste (in two wards) based on user charges. (About 25% of waste generated in the town is collected under the programme).
- Capacity building of waste pickers (Safai Mitras) who were trained to collect segregated garbage from door-to-door. Dry waste is sold to collectors and wet waste is deposited in community bins. (Recyclables worth Rs 100,000 have been retrieved and sold in the market).
- Waste from temples (floral and prasad) is collected and composted by vermi-composting at the local level.
- A paper recycling unit set up which receives waste from local schools, institutions etc.

Learnings:
- In the absence of an efficient municipal waste management system, community led initiatives play an important role in conjunction with the approval of municipal authorities.
- An issue as big as solid waste management can be handled at a decentralized level and turn into a sustainable initiative where waste is used as a resource.

Safai Mitras collecting segregated waste and sweeping streets

Upgraded vehicles funded by various donors

2.3.2 CHINTAN: Material Recovery Facility at Bhopura, Ghaziabad

An Example of Segregation of Waste and Resource Recovery

Features of the Initiative:
Material Recovery Facility (MRF) by Chintan is a sorting and storage facility which hyper-segregates waste into different categories eg. organic, recyclable, combustible etc. and sells these various types of waste to respective collectors and dealers.

Key Findings:
- Around 0.73% of Delhi's waste is managed by Chintan, thereby reducing the burden on municipal authorities of the city.

- The segregated waste is then sold in the market by the workers (from which they get their earnings). This is then further processed by various collectors and dealers. It trains workers with the required skills and this improves their earning capacity.



Chintan: Works with informal doorstep waste collectors (Safai Sena) to help them formalize their work through legal contracts with RWAs.

Composting of organic waste


Segregation: Training workers to earn minimum wages, work safely and legally and how not be exposed to toxins. This is apart form training in recycling of waste and resource recovery.

Learnings and Replicability :
- Smaller such material recovery facilities can be set up at the ward level with space allocation for segregation by workers. These facilities can hold segregated waste for further collection or reuse by different dealers of paper, textiles, metal, glass, plastics etc.

- These facilities can be mini-utility complexes with facilities like public toilets and drinking water facilities for workers and local people to improve sanitation standards.

- These facilities can be utilized to generate revenue by providing space for advertisements and information (as part of the design intervention).

- Other features could include composting and a biodigester plant (where space permits).

2.3.3 Delhi – Toxics Link and RWA Defence Colony: Community Level Composting

An Example of Waste-to-Manure

Features of the initiative:
The RWA and an NGO Toxics Link collaborated to provide composting pits that convert organic waste to organic manure.

Key Findings:
- A model of decentralized solid waste management, with the resident community as the key stakeholder.

- The RWA took up the task of constructing the pits and coordinating with waste collectors.

- The practice of segregation at the household level was pursued by pushing residents to handover separated dry and wet waste. Later, the workers further segregated the waste to recover recyclable and reusable waste for sale.

Learnings:
- Composting pits are a low budget, practical solution to convert large amounts of organic waste produced by residents through kitchens and gardens (about 40% of the total waste generated is organic) into rich organic manure/fertilizer which can be then be sold into the open market or utilized in terrace gardens or local parks for horticulture.



Community level composting plant in parks: organic waste being composted to produce organic fertilizer.

2.3.4 Pune – Greenleaf Renewable Energy Pvt Ltd: Bio Gas Energy Park

Source : http://knowhowledge.com/website/staticpages/Featureidea/Featureideaavail/Biogaslight/biogaslight1p.asp

An Example of Waste to Energy

Features of the Initiative:
A biogas plant installed in a park to generate energy from food waste generated from hotels and restaurants.

Key Findings :
- The plant at Peshwe Energy Park treats five tons of food waste generated from hotels and restaurants in Pune.
- Five tons of food waste per day generates 350 cu m of gas (equivalent to 400 kw/h electricity) – illuminating 700 tube lights (50 watts) for 10 hours per day.
- The residue is used in the park as organic manure and the excess is sold.

Learnings:
- Similar installations can be replicated in parks for lighting from biodegradable waste.
- The residue can be utilised as fertilizer for the flora planted in the park and excess manure can be sold for revenue generation.

Organic waste processed and sent to a biogas plant to produce energy.

2.3.4 Delhi – Pom Pom Recycling Pvt. Ltd

Source: http://www.pompom.in/about-us.php

An Example of Recycling Waste – Pick Up from Home or Work Place

Features of the Initiative:
POM POM is a web based recycling company that helps in the disposal of recyclable waste with door-to-door service, and pays the best possible price for the same.

Key Findings:
- Use of technology: An app-based, user friendly initiative for recycling reusable waste – helps by serving the entire metropolitan city of Delhi.
- A doorstep pick service for all recyclables: from any place and at any given time that is convenient to the waste donor.
- Deals in all kinds of recyclables: paper, cardboard, plastic, glass, metal, e-waste etc.
- POM POM is also involved in training school students and spreading awareness.

Learnings:
- POM POM is already serving the study area of Ward No 190. However, more awareness is necessary for mass participation in recycling.
- Such web-based application services and start ups should be encouraged by the government by giving incentives.

Door-to-door pick up service

Workshop on recycling waste at a school organized by POM POM

2.4 Summary of Key Findings

S No	Location	Initiative	Key Findings
		Global Case Studies	
1.	Baltimore, Maryland	Loading Dock – reuse and recycling of construction materials	• Rescue and recover building materials • Supply building materials at subsidized rates • Reduce solid waste, generate employment
2.	Cochrane, Canada	The Zero Waste Framework	• Strict compliance on segregation • Composting of organic waste • Establishing a benchmark and timeline for recycling • Engaging the entire community • Providing institutional achievable targets
3.	Curitiba, Brazil	Waste Management Initiatives	• Incentivizing exchange of recyclable wastes • Helping reduce the pressure of dumping in landfill sites. • Resource recovery; helping in revenue generation, employment generation, social inclusion, encouraging the use of public transport, improving health and environment
4.	Mexico City	Waste Diversion from Landfill to Wealth	• Organizing waste exchange through Barter Markets • Exchanging recyclable waste for agricultural products. • Preserving land; creating and promoting opportunities for exploitation of recycled materials, creating job opportunities and generating income
		Indian Case Studies	
5.	Vrindavan	Vrindavan Kuda Prabandhan Pariyojna	• Community led waste management – door-to-door waste collection of segregated waste • Capacity building of waste pickers and inclusion of scrap dealers in an organized way
6.	Ghaziabad	Toxics Link & RWA Defence Colony	• Sorting and storage facility for segregated waste • Composting of organic waste at local level • Training workers in the required skills and improving their earning capacity
7.	Delhi	Toxics Link & RWA Defence Colony	• Neighbourhood level initiative involving residents for composting organic waste at low cost • Segregating and decentralizing solid waste management
8	Pune	Greenleaf Renewable Energy Pvt Ltd	• Installing a biogas plant in a park to generate energy-from-food waste from hotels and restaurants in Pune • Five tons waste used to light around 700 tube lights in the Peshwe Energy Park and the residue used as organic manure.
9.	Delhi	Pom Pom Recycling Pvt. Ltd.	• Providing a doorstep pick up service for recyclable waste at the convenience of residents through a web-based application. • Dealing in all kinds of recyclables including e-waste. • Workshops and training at schools.

Conclusions

1. There should be strict compliance on segregation of waste – incentivize segregation and penalize non-segregation.

2. Reduce, Reuse and Recycle (3 Rs) to help reduce pressure on land and preservation/optimum utilization of urban land.

3. Resource recovery helps in revenue generation, social inclusion, employment generation, improves health and the environment.

4. Innovative and alternative treatment/processing techniques can be implemented – exchange of recyclables in monthly Barter Markets, door-to-door pick up services for recyclables, composting of biodegradable waste, waste-to-energy facilities, reuse of inert waste to usable construction materials etc.

5. RWAs, NGOs, school students and volunteers can help in training, organizing workshops, spreading awareness programmes towards zero waste management.

6. The whole community should be made aware and be engaged in community led initiatives with institutional support.

3.1 Aim, Scope and Objectives of the Study

Aim:

Zero waste management through decentralised waste management in Ward No 190.

Scope of the Study

The study includes understanding and management of solid waste in Chittaranjan Park (CR Park), Ward No 190 of NCT of Delhi. The scope of the study focuses on analysis of issues, potentials and framing strategies for collection, segregation, storage, transportation, processing and disposal of municipal solid waste in the study area.

Objectives of the Study

1. To understand the existing cycle of municipal solid waste management in CR Park Ward No 190.
2. To identify issues and potential areas with respect to Municipal Solid Waste Management in the study area.
3. To set up guidelines for localized and decentralized management of municipal solid waste.
4. To locate dhalao/segregated area for solid waste, and redesign the same to create efficient hi-tech recycling depots, and prepare guidelines for their effective management.
5. To achieve an efficient solid waste management plan and efficient resource management for the next 20 years which involves minimum human intervention and provides a hygienic working environment for users i.e. staff involved in the collection and transportation of waste, rag pickers etc.
6. To formulate strategies for alternative solutions – by working out spatial standards for placing community bins and to recycle materials through mechanisms such as a monthly barter system.
7. To convert discarded waste into useful resources, generate revenue and reduce waste to reduce the pressure on land required for landfills.

3.2 Introduction to CR Park

Map showing location of Ward No 190 in Ward Map of Delhi

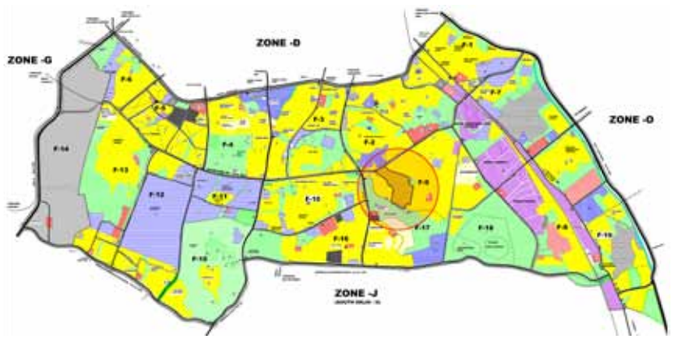
Map showing location of Ward No 190 in Planning Zone: Delhi

Location of Study Area:

The study area: Chittaranjan Park falls in Ward No 190 under the South Delhi Municipal Corporation.

Planning Zone as per MPD-2021: Zone F and further in Sub Zone: F-9

The population of Ward No 190 is 78,000 approximately (Census of India, 2011).



Map showing location of Ward No 190 in Zonal Map of MPD-2021

MPD 2021 and the Zonal Plan, demarcate the predominant land use of the study area as residential, but over time Kalkaji has grown into a major retail market.

Map showing surrounding area of CR Park
Source : Base Map - Google Earth , 2014

Surrounding Area:

The study area covers an area of 175 ha between Govindpuri and Nehru Place.

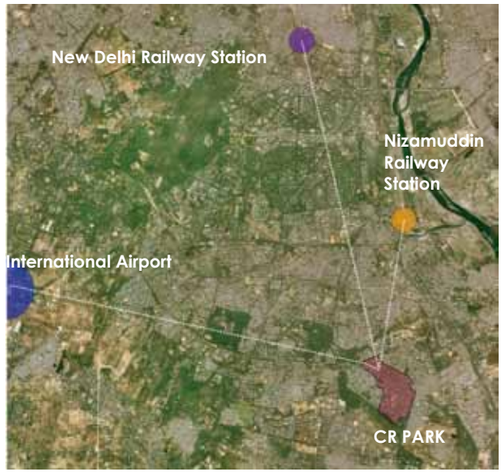
CR Park is well connected and is adjacent to the District Centre of Nehru Place.

It is located in the posh area of South Delhi and is surrounded by a mixed urban fabric such as planned areas (Kalkaji, GK, Nehru Place), unplanned areas (Govindpuri) and green areas (Jahanpanah Forest).

Connectivity:

Railway Station: 11 km
International Airport: 25 km

CR Park: Existing and proposed MRTS corridor
Source: Base Map – Google Earth, 2014



CR Park: Existing Major Network Nodes
Source: Base Map – Google Earth, 2014

Nehru Place

Kalkaji Colony

Govindpuri Colony

Jahapanah Park

Greater Kailash I

Giri Nagar

Development Pattern:

Map indicating divisions of CR Park Ward into Colonies

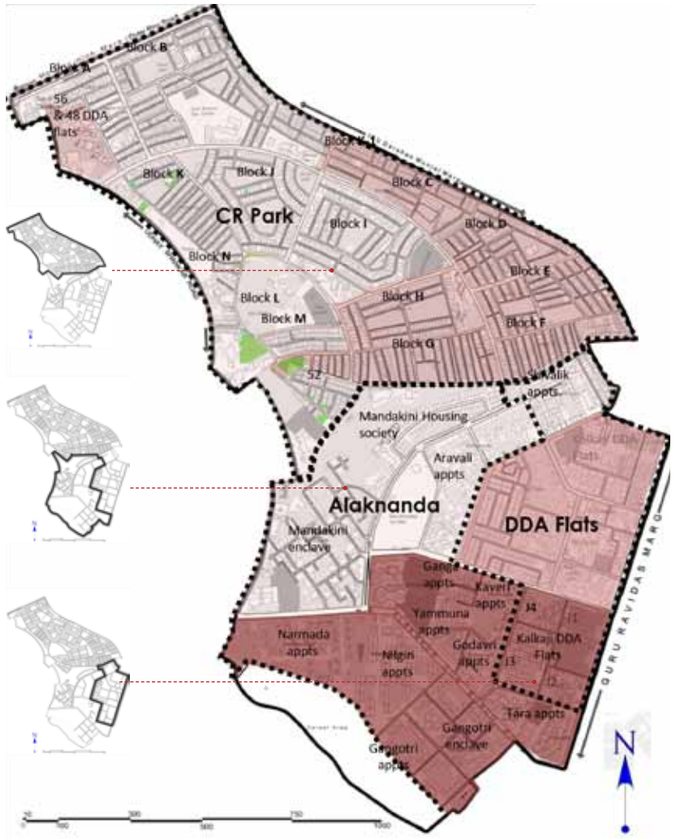
Development Pattern:

CR Park (Ward No 190) is divided into three colonies:

- CR Park
- DDA Flats
- Alaknanda

The above colonies development pattern can be categorized as:

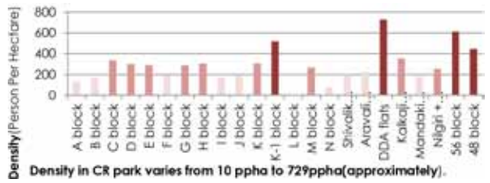
- Plotted: 61.2 ha
- Flatted: 113.3 ha



Map indicating densities in CR park ward

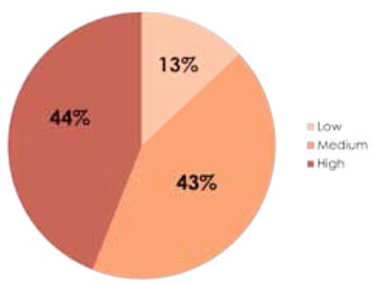
Source: Delhi Urban Art Commission, CR Park , 2014

Parameter	Unit
Total Population	78000
Area of Ward	174.5 ha
Average Density	447 PPH
Total Waste Generated @.5kg/capita/day	39 tonnes per day



Distribution of densities in CR Park Ward

CR Park ward has a diverse typology of housing, institutional, religious, commercial, mixed use and seasonal activities during the festive period, particularly Durga Puja which are various sources of waste generation.



Density Distribution in CR Park

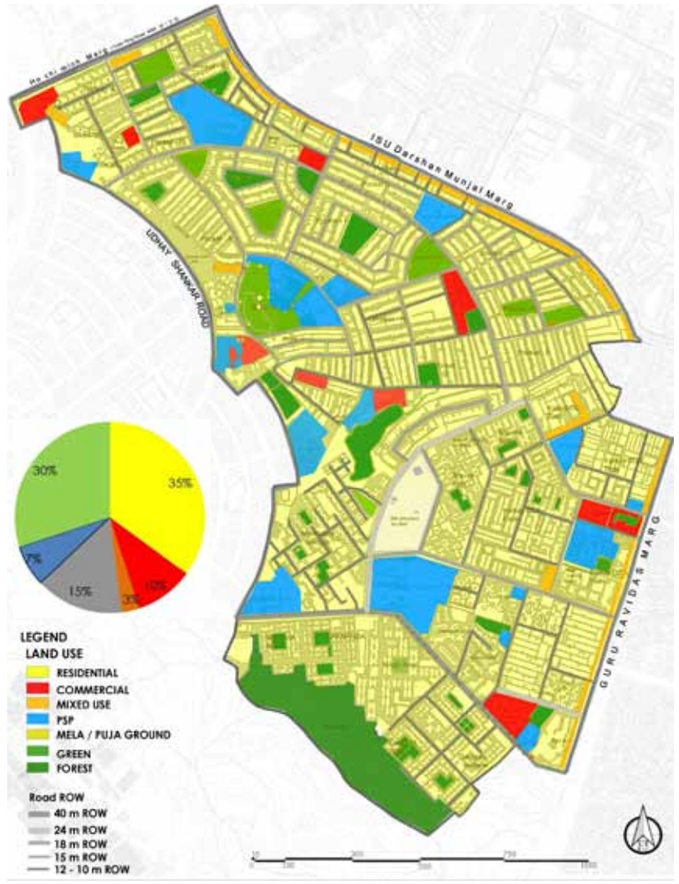
As per the pie-chart shown:

1. 13% of the Ward has low density (0–250 ppha)
2. 43% has medium density (250–550 ppha)
3. 44% has high density(500–750 ppha)

High density areas are observed in the southern part of Ward No 190 where existing developments are group housing/ flatted development – Kalkaji DDA flats and apartments.

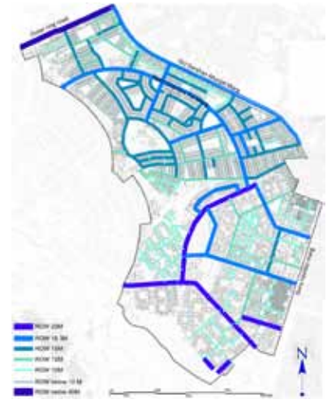
The CR Park colony plotted development has low density areas in the northern part of the ward.

3.3 Land Use and Existing Infrastructure



Existing Land Use Plan of CR Park Ward No 190 (2016)

Source : Delhi Urban Art Commission , CR Park , 2014



Map showing Road ROW

Map showing Markets and Commercial Streets

The land use of ward 190 is predominantly residential. It has a balanced 30% area under green cover. Every pocket has planned development with a park or a tot lot. There are mela/ puja grounds located in CR Park colony which serve as city level festive grounds during the Durga Puja season. Many cultural activities are observed during this festive season, especially for Bengalis in Delhi NCR.

Map showing Social Infrastructure

Source: Delhi Urban Art Commission, CR Park, 2014

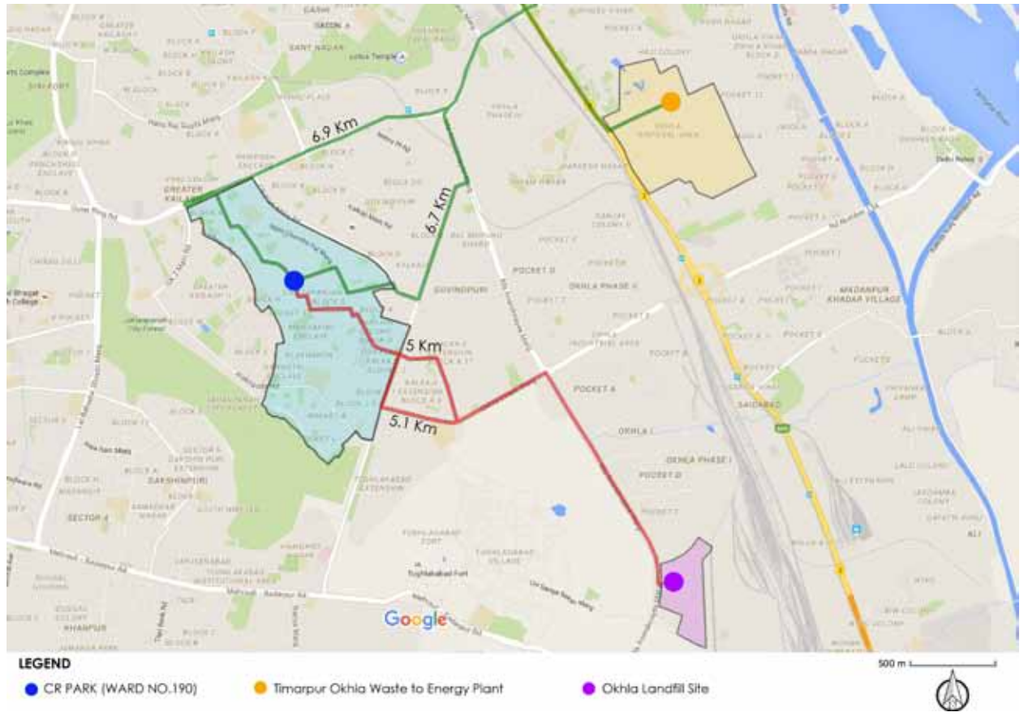
Map showing Public Utilities

Source: Delhi Urban Art Commission, CR Park, 2014

There are six local shopping centres in Ward 190: Market 1,2, 3, 4 in Chittaranjan Park Colony; Alaknanda Market in Alaknanda; a fish market in DDA Flat Colony. In Ward 190, the right of way (ROW) ranges from 6.6 m to 40 m. Public utilities and public/semi-public facilities are evenly distributed in ward 190.

The study area is a planned colony developed around the 1960s after land was allotted to refugees from East Bengal.

3.4 Solid Waste Management: Treatment and Disposal Sites



Location of Landfill Sites and Waste to Energy Plant with respect to CR Park

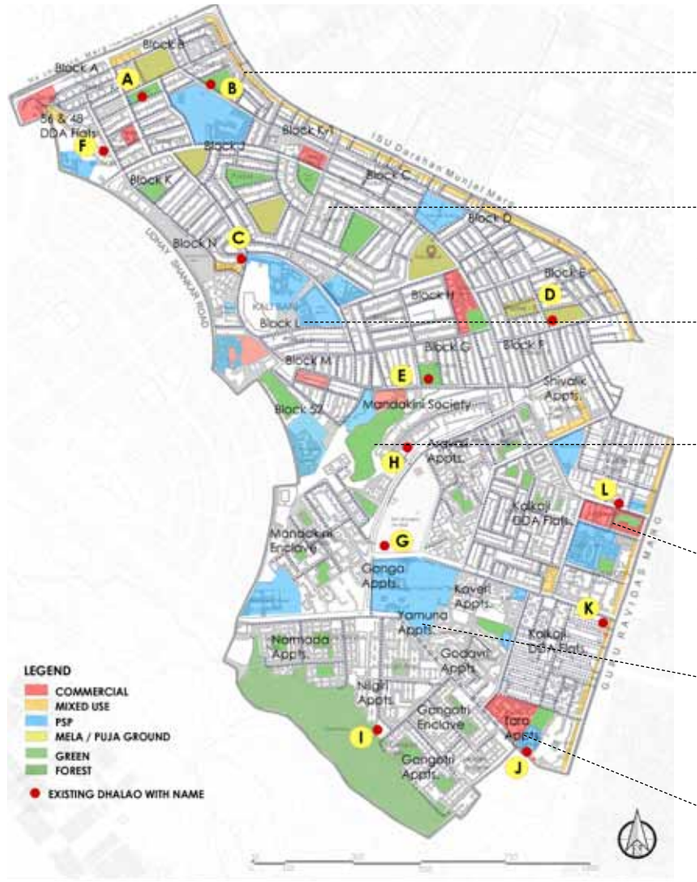
Particulars of solid waste management in CR Park:

- CR Park is managed by DWM – SPML for transportation of waste from various waste receptacles to Okhla landfill sites.
- DWM – SPML has 2 trucks for ward No. 190 which carries the waste in 5 trips each morning and evening i.e. a total 10 trips.
- Each trip takes approximately four tonnes in each dumper truck and comes back with an empty truck.
- Total waste collected from CR Park ward each day is approximately 40 tonnes.
- Monthly expenditure on transportation of solid waste from Ward No 190 to the sanitary landfill site is approximately Rs 9,00,000/-

Transportation Cost of Solid Waste Management:

S No	Description	Quantity	Units
1.	Total Solid Waste generated per day in CR Park (approx.)	40	Ton
2.	Distance from CR Park to landfill site/composting plant (approx. distance)	7	km
3.	One to and fro trip cost (the dumper is empty on the return trip)	3000	Rs
4.	Total No. of trips made by 2 trucks in a day (5X2)	10	No
5.	Total cost of transportation of waste from ward to landfill sites (approx.) per day	30000	Rs.
6.	Total cost of transportation of waste from ward to landfill sites (approx.) per month	9,00,000	Rs.

4.1 Existing Facilities and Typologies of Waste Generated



Location of Existing Facilities: Land Use in CR Park

Typology of Waste Generated

Mixed Use: Commercial and Mixed Use Streets:
Biodegradable waste, plastic, paper, textile, glass, sanitary, biomedical, inert and e-waste

Residential:
Biodegradable waste, paper, plastic, textile, glass, sanitary and e-waste

PSP- Cultural:
Biodegradable waste, organic waste, flower and prasad waste, recyclable

Greens:
Horticulture/organic waste, paper plastic, etc.

Commercial:
Biodegradable waste, plastic, paper, textile, glass, sanitary, inert and e-waste

PSP – Institutions:
Biodegradable waste, paper, biomedical, e-waste and inert waste

PSP- Religious:
Biodegradable waste, flower and prasad waste.

Typology of Waste Generation from Various Land Use Categories in CR Park

Various uses/ facilities	Duration	Issues/Problems
Residential – Domestic waste	All year round	• Waste generated getting mixed and eventually dumped at secondary collection points (dhalaos). • Unhygienic conditions in dhalaos due to unattended dumping for days and finally dumping of the garbage in landfill sites without segregation, processing and recovery of recyclable materials • Contamination of soil, ground water, air, etc. due to leachate from the landfill • SWM related health hazards and chances of catching fire due to methane content in the dumped garbage
Commercial	All year round	• In addition to issues mentioned above, large waste in the form of paper, plastic bottles etc. being dumped adding to the overflowing of dhalaos/bins • These causes flash floods during the monsoon and waterlogging

Typology of Waste Generation from Various Land Use Categories in CR Park

Various uses / facilities	Duration	Issues / Problems
Mixed Use – Commercial & Mixed Use Streets	All year round	• Waste generated getting mixed and eventually dumped at secondary collection points (dhalaos). • Unhygienic conditions in dhalaos. • Contamination of soil, ground water, air, etc. • SWM related health hazards and chances of catching fire due to methane content in the dumped garbage. • Large waste in form of paper, plastic bottles etc. being dumped adding to the overflowing of dhalaos/bins. • Flash floods during the monsoon and waterlogging.
Greens: Gardens and Parks	All year round	• Large amount of horticulture waste i.e. dried leaves are burnt causing air pollution. Toxic wastes like pesticides and fertilizers get mixed into the MSW finally getting dumped in the landfills.
Public & Semi Public (PSP): Institutions, Hospital, Schools and Offices	All year round	• All categories of waste are not properly handled and potentially lead to the spread of infectious disease to the vulnerable community exposed to such areas.
PSP: Cultural & Recreational Puja Pandals and Mela ground	Seasonal	• Durga Puja/seasonal festivals attracting thousands of people from Delhi. • No facilities for garbage disposal like community bins etc. • No amenities such as public toilets. • Lack of additional human resource for cleaning during the peak season.
PSP: Religious: temples/ other religious activities etc.	All year round	• Waste in the form of flower and prasad being mixed with municipal waste adding to overflowing dhalaos and bins.

Note: In the study, the scope of the work does not cover biomedical and hazardous waste. These shall be treated as per norms.

Fish market
Source: https://urchintmatters.wordpress.com/2016/03/

Street vending during Durga Puja
Source: https://banglakonnection.com/Pujo_Must_Dos

Biodegradable Waste
Source: http://blog.mydala.com/dussehra-special-10-evils-that-indians-need-to-get-rid-of/

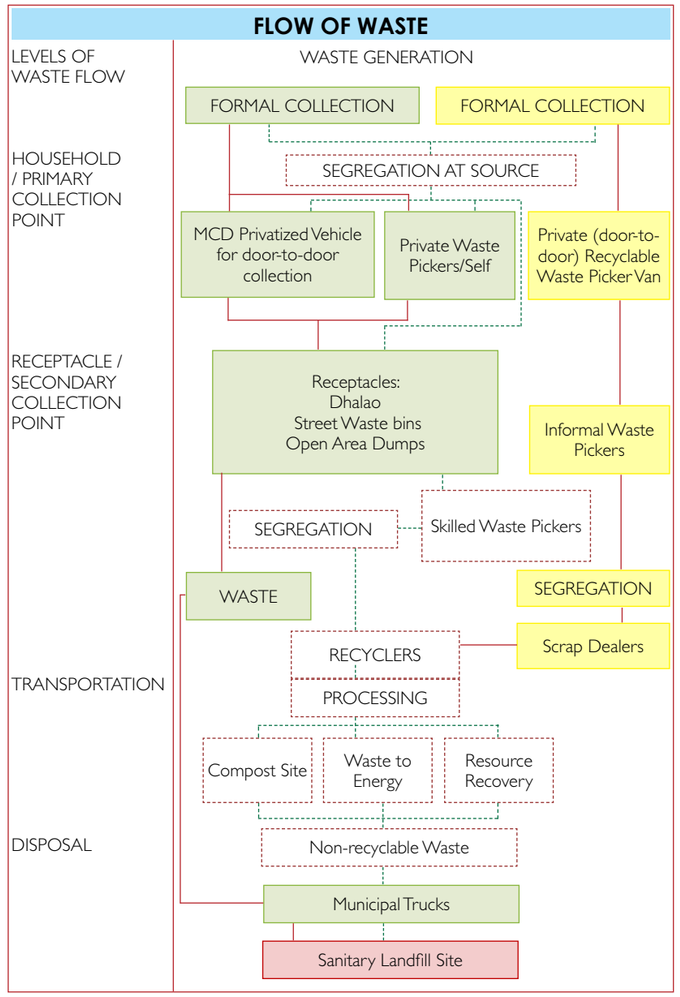
Pandals under construction for Durga Puja
Source: https://mytravelnama.com/2015/08/09/a-bengal-filled-evening-at-the-cr-park-market-new-delhi/

Grocery shops in CR Park Market
Source: https://mytravelnama.com/2015/08/09/a-bengal-filled-evening-at-the-cr-park-market-new-delhi/

4.2 Waste Flow in the Formal and Informal System

Formal Collection of Waste:
At present the flow of waste in the formal system has the following steps:

1. Waste generation at source – primary collection at the household level.
2. Collection of waste and depositing at secondary collection point/ receptacles(dhalaos, municipal bins and open dumping sites) by various means – self, private waste pickers, municipal vehicle via door-to-door collection, street sweepers etc.
3. The waste is stored temporarily for 1-2 days in the dhalaos.
4. Municipal trucks load the waste/ garbage and finally deposit it in the nearest sanitary landfill site.



Existing formal waste management system
Existing Informal waste management system
Gaps required to be integral part of system
Existing flow
Recommended flow

Informal Collection of Waste:
1. Waste generation at source – household level.
2. Waste collection by private waste pickers and dumped in secondary collection points/receptacles.
3. Recyclable waste is sorted and picked up by rag pickers scavenging in the dhalaos.
4. Segregated waste like metals, cardboard etc. are taken to local scrap dealers and sold to them at marginal rates.
5. Lastly, scrap dealers recycle the recyclable materials via recyclers.

Mode of Waste Collection:
1. Self disposal
2. Hired private waste pickers
3. Door-to-door collection by municipal vehicles.
4. Municipal street sweepers.

Note: If a zero waste management system is achieved, up to 90-95per cent of waste can be recycled and only 5-10 per cent of waste will be taken to landfills.

Role of Rag Pickers:
It is estimated that 350 rag pickers are directly or indirectly involved in segregation of solid waste in CR Park. They help in recycling about 16% i.e. 6 tonnes of scrap from the receptacles.

Location of existing receptacles and typology of waste collection system

4.3 Existing Process of Solid Waste Disposal

The existing process of solid waste disposal by various facilities as per different land use are as follows:

Sources (land use)	Primary storage	Collection methods	Mode of collection	Receptacle facility	Issues
Domestic waste (residential) Plots Flats	Dustbins at household level	Door-to-door collection	Conventional rickshaws	Dhalao	• Door-to-door collection is not available in the entire ward • No proper vehicles for primary collection • No daily collection of garbage leading to overflowing dhalaos • Overflowing garbage leading to encroachment on pavements and ROW • No space for sorting and segregation
Public Facilities (PSP) Schools Healthcare facilities Temples/Kali Bari	Community level bins	Door-to-door collection	Conventional rickshaws	Dhalao	• Community level bins are often overflowing • At times waste is burnt in them leading to burning of the bins and pollution • Not uniformly placed in the ward, thus leading to random littering on roads • Overflowing garbage leading to encroachment on pavements and ROW • No space for sorting and segregation

Conventional rickshaw and municipal bins

A dhalao with municipal bins outside it

Municipal bins and waste dumping near it

Non-segregated waste in a conventional rickshaw

Sources (Land use)	Primary storage	Collection methods	Mode of collection	Receptacle facility	Issues
Transportation: Streets and Roads	No provision	Street sweeping	Hand / push cart	No provision	• Street sweeping does not cover the entire ward • The collected waste is often burnt on the roadside causing air pollution and destroying the organic and biodegradable resource • Encroachment on ROW • No space for sorting and segregation
Commercial: Markets Commercial streets	Community level bins	Street Sweeping & Collected by informal waste pickers and dump in the nearby dhalaos.	Conventional rickshaws	Dhalao	• The bins are not distributed uniformly along markets • The waste is not collected on a daily basis, thus leading to overflow of bins • There are no segregated bins for different wastes leading to mixing of dry and wet waste • Encroachment on pedestrian & Road ROW • No space for sorting and segregation

Street sweeping by a municipal sweeper

Municipal bins with no separate compartments

Overflowing garbage

Conventional handcarts

ANALYSIS

Existing Dhalaos and Catchment Area

Dhalao A: Inset in park

Dhalao B: Inset in Park

Dhalao E: Inset in park

Dhalao D: Inset in park

Dhalao F: Mini dhalao inset in park

Dhalao H: On pedestrian pathway

Dhalao C: Inset in park

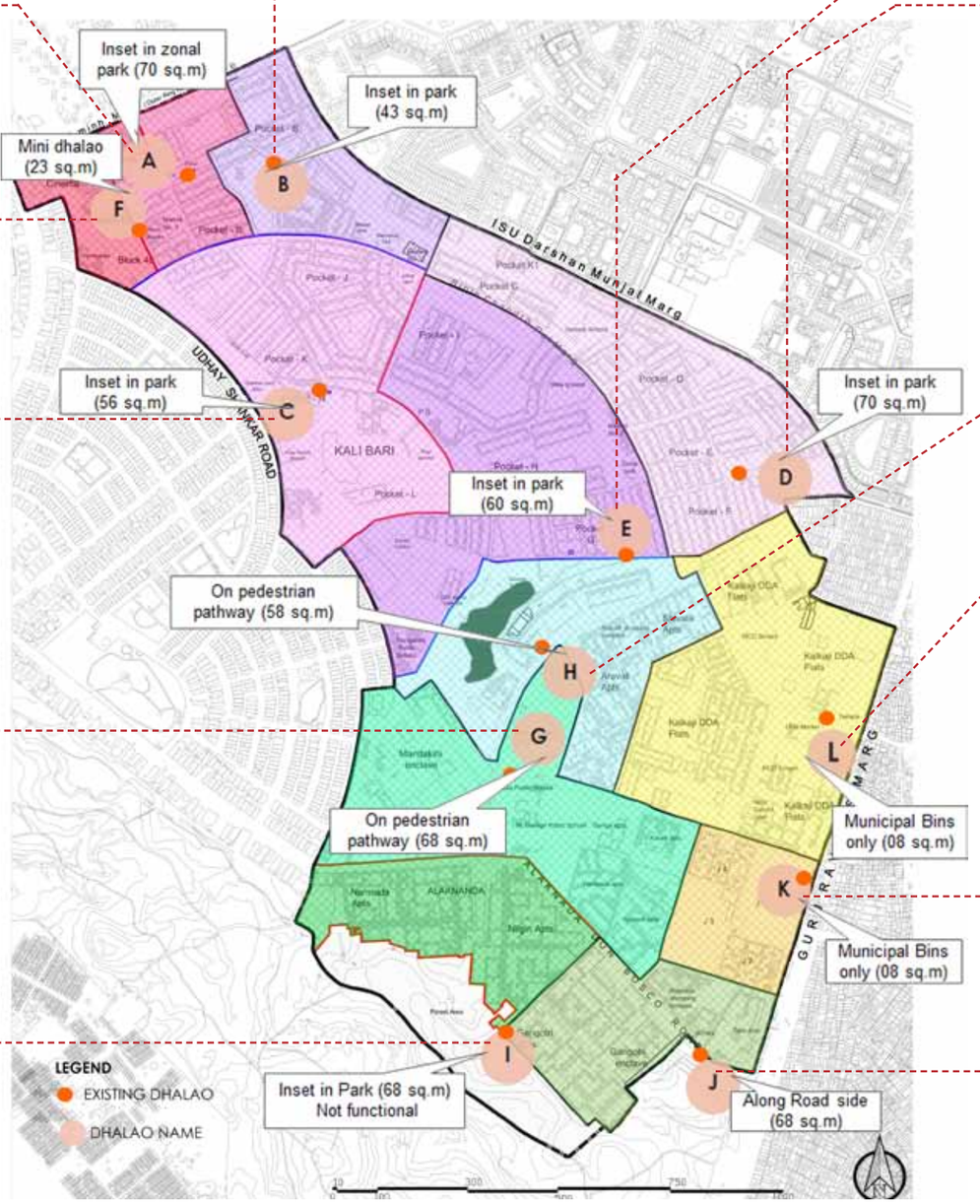
Receptacle L: Municipal bin in the fish market

Dhalao G: On pedestrian pathway

Recptacle K: Municipal bin

Dhalao I: Non-functional dhalao, inset in a park

Dhalao J: On pedestrian pathway along roadside



Location map of existing receptacles and catchment area of each

4.4 Existing Dhalaos, Catchment Area and Related Issues

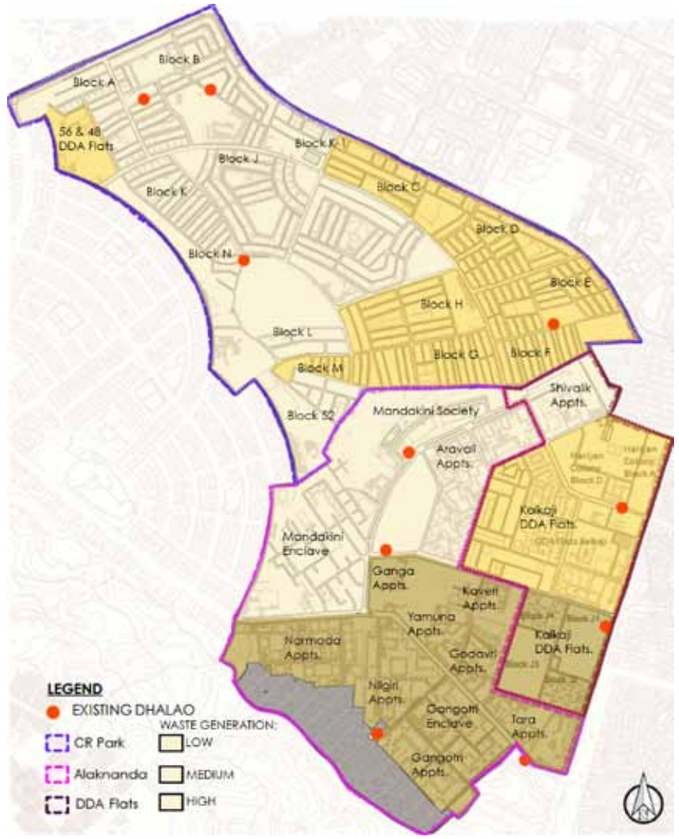
Table: Existing dhalaos, catchment area and related issues

Dhalao Name	Location and Description	Size (sq m)	Capacity (tons/day)	Catchment area	Issues
CR PARK					
A	Block B (Zonal Park) Inset in the park	70	2.5	A and B Block	Overflowing garbage, not cleaned daily
B	Block B Inset in the park	35 + 8 (MB)- 43	3.0	K1 and B Block	Overflowing garbage
C	Kali Bari Mandir Inset in the park	48 + 8 (MB)- 56	4.0	I, J and N Block, Kali Mandir	Overflowing garbage, not cleaned daily
D	Block E & F Inset in the park	62 + 8 (MB)- 70	4.0	Part Govindpuri , E Block Market No.2	Overflowing garbage, not cleaned daily
E	Opposite Jahanpanah Park Inset in the park	60	3.0	F, G and H Block	Overflowing garbage
F	Near B Block Mini dhalao	15+ 2X4(MB) 23	1.0	Block 56, Pocket B	Small dhalao with overflowing municipal bins
ALAKNANADA					
G	Opposite Kalka Public School –encroached on pedestrian way	60+ 8 (MB)- 68	7.0	Mandakini Enclave	Overflowing garbage, encroached on the pedestrian pathway
H	Opposite Aravalli Market – encroached on the pedestrian pathway	50 + 8 (MB)- 58	5.0	Aravalli, Shivalik, NRI Colony, Bundagarhi	Overflowing garbage, encroached on the pedestrian pathway
I	Gangotri Not functional	60 + 8 (MB)- 68	0.0 (if functional 6,0)	Gangotri Enclave & Apartments	Not functional
J	Near Tara Apartments along roadside	60 + 8 (MB)- 68	6.0	Tara Apartments, Alaknanda Shopping Complex	Overflowing garbage, Encroached on the pedestrian pathway
DDA FLATS					
K	J1 Colony No dhalao	Municipal bins 8 sq m	1.0	J1, J2, J3 and J4	No dhalao, overflowing municipal bins
L	Harijan Colony – No dhalao	Municipal bins 8 sq m	1.0	Harijan Colony and Part of DDA Flats Kalkaji	No dhalao, overflowing municipal bins
TOTAL	12 RECEPTACLES	600 sq m	37.5	174.5 ha	

MB – MUNICIPAL BINS

At present there are 12 Receptacles (Dhalaos) existing in Ward No. 190 distributed uniformly in the colonies of CR Park and Alaknanda. However there are shortage of receptacles in DDA Flats colonies and only Municipal bins are accessible. The total area covered by the receptacles in the whole ward is 600 sq m

4.5 Detail Composition of Solid Waste Generated

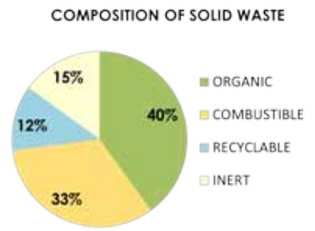


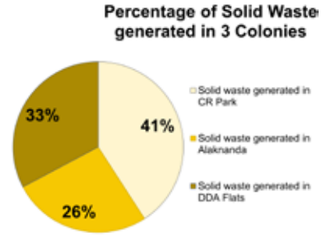
Map showing the rate of solid waste generated in different colonies of Ward No 190

Municipal solid waste generated in Ward No 190 has four major compositions:

- Organic
- Combustible
- Recyclable
- Inert

In addition to these there is also nonbiodegradable waste like medical waste which requires scientific treatment before disposal.





The comparative waste generation trend in the three colonies in Ward No 190 shows that the rate of waste generation is directly proportional to the density of the area. Higher density shows higher rate of waste generation per unit area. The total solid waste generated in Ward No 190 is 40 tons per day. The following table shows the amount of waste generated and its composition in Ward No 190.

Table showing the composition of solid waste generated in different colonies of Ward No. 190

S No	Colony	Total Popu-lation	Solid waste generated @ 0.5 kg per capita per day (in Kg)	Organic Waste (40%)	Recyclable Waste (39%)				Combustible Waste (6%)	Inert Waste
				Biodegra-dable	Glass + Ceramic (5%)	Metal (3%)	Plastic (4%)	Paper (27%)	Textile and Wood(6%)	Inert (15%)
1.	CR Park	31866	15933	6373	797	478	637	4302	956	2390
2.	Kalkaji DDA Flats	25559	12780	5112	639	383	511	3450	767	1917
3.	Alaknanda	20574	10287	4115	514	309	411	2778	617	1543
4.	Total	78000	39000 kg ~40 Tons	15600 kg	1950	1170	1560	10530	2340	5850 kg
					15210 kg				2340 kg	

4.6 Projections of Solid Waste Generation

Table showing projected density for the year 2041 taking the base as the 2011 population census

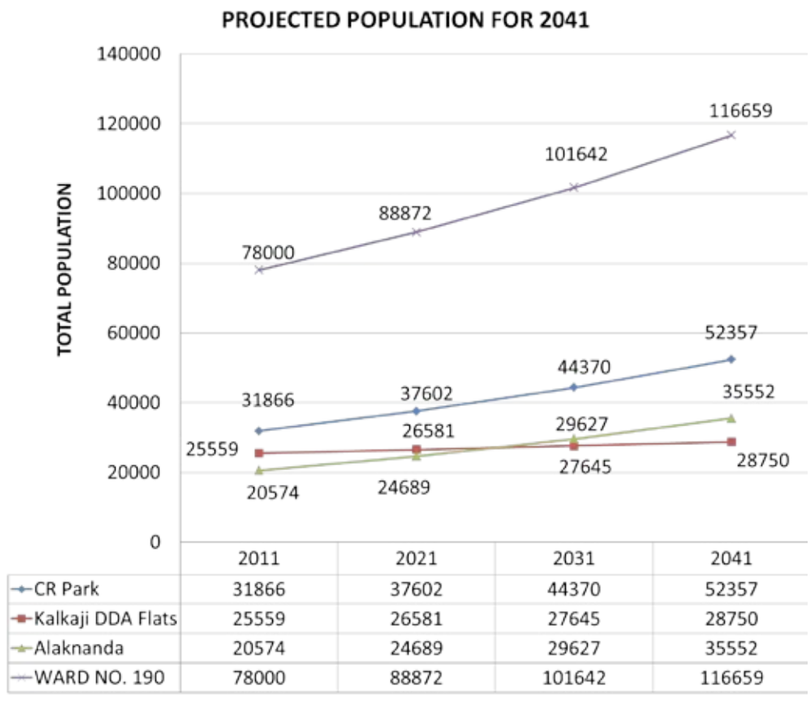
S No	Name of Area	Area in ha	Population 2011	Density 2011	Projected Density		
					2021	2031	2041
1.	CR Park	82.5	31866	386.25	**455.78**	**537.82**	**634.63**
2.	Kalkaji DDA Flats	20.6	25559	1240.73	1290.36	1341.97	1395.65
3.	Alaknanda	71.4	20574	288.15	345.78	414.94	497.93
4.	**WARD No 190**	**174.5**	**78000**	**446.99**	**536.39**	**643.67**	**772.40**

Table showing projected population for the year 2041 taking base as 2011 population census

S No	Name of Area	Projected Population		
		2021	2031	2041
1.	CR Park	37602	44370	52357
2.	Kalkaji DDA Flats	26581	27645	28750
3.	Alaknanda	24689	29627	35552
4.	WARD No 190	88872	101642	116659

Projection of solid waste generation in Ward No 190 based on projected population 2041

1	2	3	4	5	6	7	8	9	10	11		12
Year	Area Name	Total Population	Solid waste generated @ 0.5 kg per capita per day (kg)	Organic Waste (40%)	Recyclable Waste (39%)				Combustible Waste (33%)	Inert (15%) (Kg)		Non-recyclable/ other waste after processing disposed to land fill site (5–10%) discarded from Col 5 to 11 (Kg)
				Biodegra-dable	Glass + Ceramic (5%)(kg)	Metal (3%)(kg)	Plastic (4%) (kg)	Paper (27%) (kg)	Textile and Wood(6%) (kg)			
2011	CR Park	31866	15933	6373	797	478	637	4302	956	2390		1594
	DDA Flats	25559	12780	5112	639	383	511	3450	767	1917		1278
	Alaknanda	20574	10287	4115	514	309	411	2778	617	1543		1029
	WARD No 190 (Total)	78000	39000	15600	1950	1170	1560	10530	2340	5850		3900
			~ 40 Tons		15210							~ 4 Tons
2021	CR Park	37602	18801	7520	940	564	752	5076	1128	2820		1880
	DDA Flats	26581	13291	5316	665	399	532	3588	797	1994		1329
	Alaknanda	24689	12345	4938	617	370	494	3333	741	1852		1235
	WARD No 190 (Total)	88872	44436	17774	2222	1333	1777	11998	2666	6665		4444
			~ 45 Tons		17330							~ 4.5 Tons
2031	CR Park	44370	22185	8874	1109	666	887	5990	1331	3328		2219
	DDA Flats	27645	13823	5529	691	415	553	3732	829	2073		1383
	Alaknanda	29627	14814	5925	741	444	593	4000	889	2222		1482
	WARD No 190 (Total)	101642	50821	20328	2541	1525	2033	13722	3049	7623		5082
			~ 51 Tons		19821							~ 5 Tons
2041	CR Park	52357	26178.5	10471	1309	785	1047	7068	1571	3937		2618
	DDA Flats	28750	14375	5750	719	431	575	3881	863	2156		1438
	Alaknanda	35552	27776	7110	889	533	711	4800	1067	2666		1778
	WARD No 190 (Total)	116659	58330	23332	2916	1750	2333	15749	3500	8749		5833
			~ 59 Tons		22749							~ 6 Tons



The projected population in different colonies of Ward No. 190

Inference:

- If zero waste management is followed, only 15% of the waste will end up at landfill sites and 85% of the waste can be recovered as valuables which will reduce the pressure and requirement on landfill sites.
- For the projected year 2041, as per existing solid waste management practices a waste of 59 tons per capita per day of solid waste is expected to end up in landfill sites. However, if zero waste management is adopted the waste ending up at the landfill is merely 9 tons per capita per day.

Considerations/Assumptions

There were only 134 wards in Delhi in the year 2001. Ward No 190 was bifurcated from existing wards in the year 2007. Hence, for projection of population by the conventional method, which requires two decadal census population, could not be adopted for the study area. So taking the base year as 2011 census, the projection of population is calculated based on the growth of population on existing density. The percentage of decadal growth increase ranges from -2 to +1.45. The table (Assumed Ward Growth) shows the decadal growth increase.

Assumed Ward Growth

Population Density	% Decadal Increase
0-100	20.0%
100-200	18.0%
200-300	15.0%
300-400	12.0%
400-500	9.0%
500-600	6.0%
600-700	4.0%
700-800	2.0%

4.7 Summary of Solid Waste Management Related Issues

S No	Aspect	Issues/Problems
1.	Household generation	• Waste generated at the household level is not segregated at source. Hence, it leads to the mixing of all types of waste – biodegradable, recyclable, batteries, sanitary, medical, construction and demolition waste.
2.	Conventional ways of primary collection	• Door-to-door collection takes place with conventional handcarts/ rickshaws which do not have segregated compartments and are usually overflowing with garbage spilling on to the road. • Door-to-door-collection of waste is privatized as it is cheaper and more convenient for the residents of CR Park. However, the waste pickers are not recognized in the formal system. • Some residents also self dispose unsegregated waste into the dhalao/ municipal bins • Municipal collector tempos are also deployed for door-to-door collectionin the morning, but unsegregated waste collected in such a vehicle is again stored in dhalaos/municipal bins until it is picked up by JCB trucks. • Waste stored in the dhalao creates unhygienic conditions and is a health hazard, encroachment on the pathway due to overflowing causes foul odour in the neighbourhood.

Mixing of waste destroys reusable resources due the inability to separate and decompose

Till date, manual handling of waste with no safety standards is followed

Source: http://www.downtoearth.org.in/news/trashing-the-ragpicker-53516

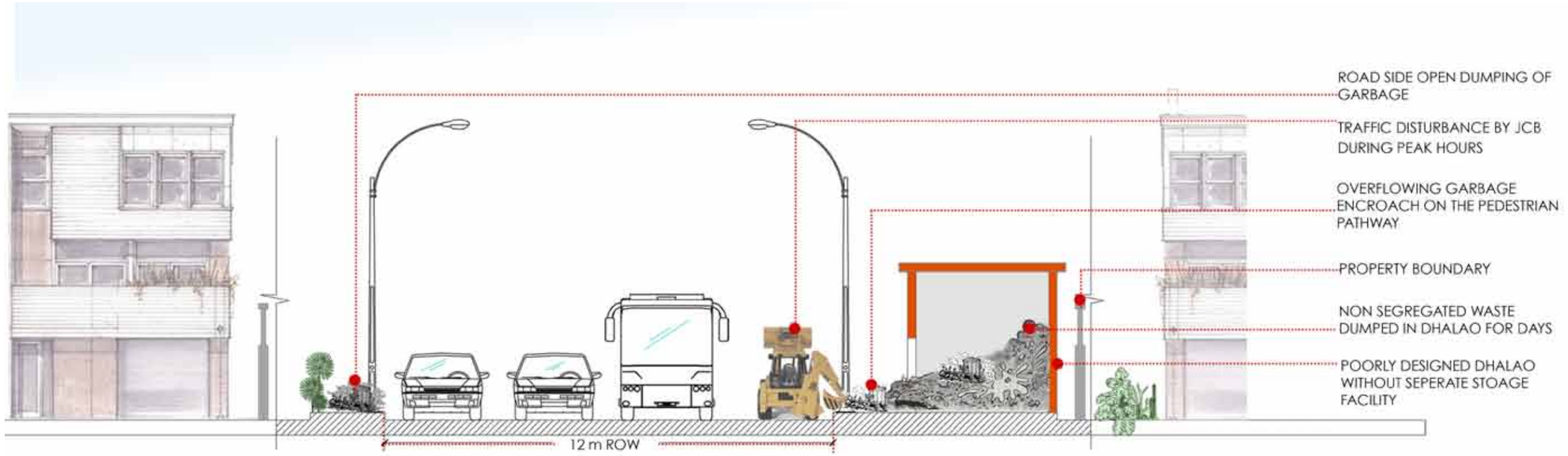
Condition of young rag pickers operating as primary recyclers in the neighbourhood

Source: http://citydirectorysite.info/hivecrelated-child-labour.html

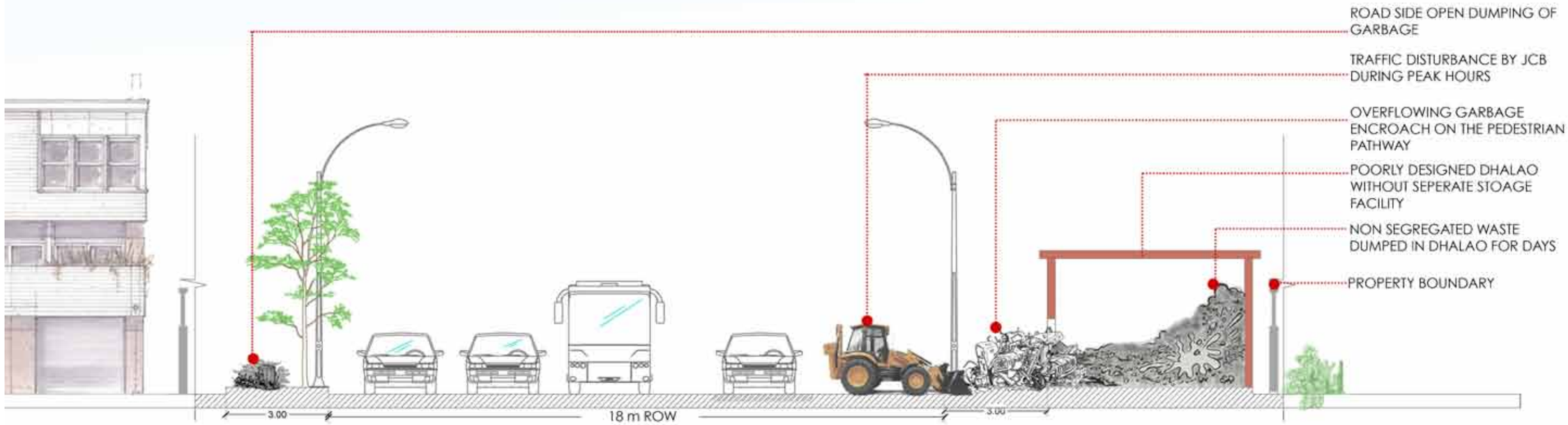
Open garbage trucks spill waste during transportation to landfill sites or treatment plants

S No	Aspect	Issues/Problems
3.	Dhalao and its surrounding areas	• Existing dhalaos often encroach on pedestrian pathways with garbage overflowing on to the road with filthy conditions around them. • These structures being open and poorly designed, often become ground for stray animals and breed disease. • During the long storage period in the dhalaos/municipal bins, most of the value related to resource recovery is lowered and thus valuable recyclable materials are wasted. • All the unsegregated solid waste generated is dumped in dhalaos/receptacles, and because the amount is huge, waste segregation is labour intensive.
4.	Role of rag pickers	• About 350 rag pickers are directly or indirectly involved in the segregation of solid waste in CR Park. They help in recycling about 16% i.e. 6 tons of the scrap from the receptacles. • 40% of the rag pickers are under the age of 14. Each rag pickers collects an average of 10 kg of waste and earns approximately Rs 80 to 100 per day. • No social security for rag pickers who are poor, illiterate immigrants with no formal education, who join this profession at the young age of 4 years and are subject to disease and harassment from local authorities and scrap dealers. • The scrap collected by rag pickers is sold to the local scrap dealer. However, neither the rag pickers nor the scrap dealers are integrated into the Solid Waste Management System.
5.	Improper waste handling	• The waste is handled several times before transported and no norms are followed for safety standards of waste handlers i.e. collecting, sorting, transferring etc. thus making it an inhumane activity. • Soil and water and air are contaminated with toxic waste, causing pollution and disease. • Segregation, which happens at a later stages involves human resource, time and money.
6.	Transportation	• Waste is transported from the dhalaos to waste-to-energy plants or landfill sites in open trucks, which spread foul smell and drop garbage on the way. Vehicles are poorly maintained. • There are no strict norms for timing related to transportation of the waste to landfill sites creating traffic congestion during peak hours of the day.
7.	Unscientific disposal methods	• It is invariably done by land filling without observing scientific norms. These create health hazards in the areas near the landfill site. Sometimes, by-products of the waste like methane can become a fire hazard at the landfill site causing fatal accidents and environmental pollution. • Also, resource recovery from organic waste is seldom done as the waste is contaminated at source and it is difficult to segregate dry from wet later.
8.	Norms	• The Municipal Corporation of Delhi has no spatial standard norms for the placement of these receptacles i.e. distance between receptacles or number of receptacles per unit area.

4.8 Typical Dhalao Location and Problems



TYPICAL SECTION OF 12 M ROW CARRIAGE WAY ROAD IN WARD NO. 190



TYPICAL SECTION OF 18 M ROW CARRIAGE WAY ROAD IN WARD NO. 190

4.9 Conclusions

1. Non-segregated and mixing of wet and dry waste reduces the reusable value of recyclable waste.

2. Door-to-door collection of waste is done in non-segregated conventional handcarts, rickshaws and municipal trucks. Segregation at a later stage is labour intensive.

3. Storage of such waste in poorly designed dhalaos creates unhygienic conditions, health hazards, encroachments on footpaths/pedestrian pathways.

4. The condition of rag pickers is vulnerable in terms of social security, health hazards, child labour and harassment.

5. There is no scientific method adopted for waste handling at present.

6. Transportation of the waste takes place in open trucks during peak hours creating nuisance and traffic congestion.

7. There are no spatial standard norms for placement of receptacles adopted by concerned local bodies.

5.1 Decentralized Process of Solid Waste Management at the Community Level

1. • Avoid waste generation – **Prevention of waste generation.**
   • **Segregation** at source of **Generation.**
   • **Colour coded bins** used for biodegradable and nondegradable waste at household level.
2. • **Door-to-door collection** (Primary collection) by trained Safai Karamcharis in covered manual rickshas/auto tippers.
   • **Colour coded bins** used to collect different types of waste from **households to receptacles.**
3. • Transfer to **Secondary Storage** i.e. dhalao/ **Hi-tech recycling depot/ Colour Coded Community Bins.**
   • Further **sorting and segregation** of the nondegradable waste into combustible/inert/recyclable waste etc.
   • **Temporary storage** of the segregated waste till **transportation to Material Recovery Facility** – Composting Plant, Biodigester Plant, Energy-to-Waste Treatment Plant, C&D Recycle Plant, Metal Recycle Plant, etc.
4. • **Resource recovery** of segregated waste at different **Material Recovery Facility Units** like conversion of C&D: into construction materials, combustible: into waste-to-energy, biodegradable: into manure, metals: recycled metals etc.
5. • **Reuse/Recycling** of segregated waste at Recovery Centre and revenue/energy generation.
6. • **Transportation** of rejected waste from the receptacles to landfill using covered vehicles (manual/mechanical loading)

Segregated waste at source
Source: https://eastcoastkitchens.co.uk/vauth-sagel/3778-oeko-centre-swing-waste-bin-39l-min-500mm-cabinets-four-container.html

Colour coded bins (Door-to–door) collection)
Source: http://www.richmondgov.com/PublicWorksRefuseCollection.aspx

Dhalao as mini material recovery facility

Resource recovery at dhalaos /material recovery facilities

Resource recovery of recyclable waste to reusable items

Covered transport vehicles to landfill site
Source: http://www.flickriver.com/photos/51819203@N06/sets/72157625759941707/

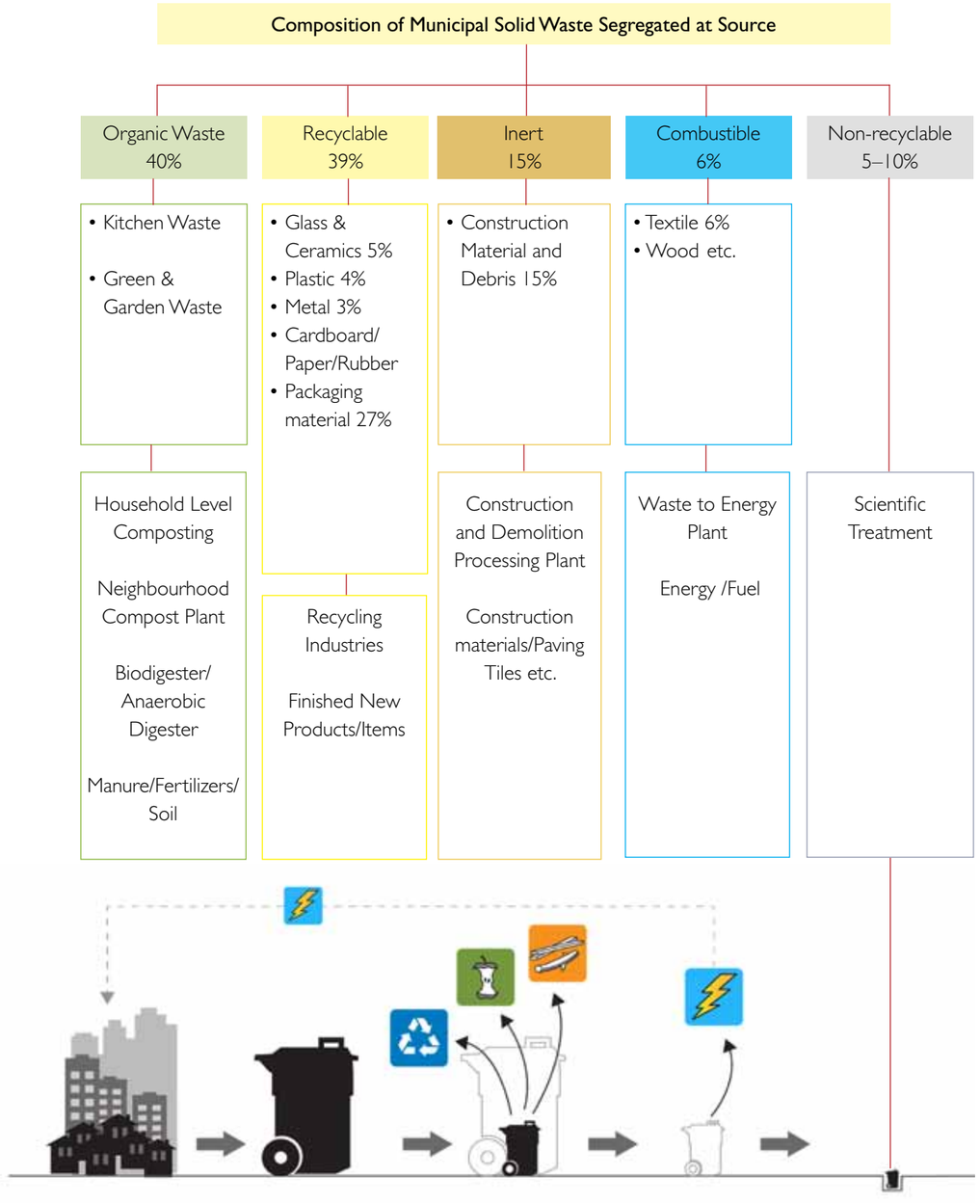
The specific proposal for the Ward No 190 can be identified as follows

Proposal For Zero Waste Management

- **Hi-Tech Recycling Depots:** To replace existing dhalaos. Redesigned with provision of area for segregation.
- **Neighbourhood Bins:** Colour coded community bins to be installed within walking distance in neighbourhoods.
- **Barter Market:** Monthly Barter Market space identification for exchange of recyclables with usable items.
- **Biogas Plant:** To convert waste to energy in parks.

5.2 Proposal for Hi-Tech Recycling Depots

5.2.1 Composition of Municipal Solid Waste – Ward No 190



Segregated waste is transferred from primary source to receptacles. (Hi-tech recycling depot)

Different composition of waste is stored in separate bins until taken for recycling and the remaining non-recyclables transferred to landfill sites.

Waste is recycled and composted, returning nutrients to the soil and reclaiming energy used to produce these goods.

The garbage that remains is diverted from the landfill and goes to a waste-to-energy facility where it is converted into energy.

The remaining material goes to landfill sites.

5.2.2 Proposed Typologies of Receptacles as Per Site Conditions

For achieving zero waste management the following typologies of waste handling facilities are proposed in Ward No 190 with facilities described in details as shown below:

Type of Depot/ Receptacle	Facilities Proposed			
	Recycling Depot	Composting Pits	Biodigester	Public Toilet
I				
II				
III				
IV	Colour Coded Community/Municipal Bins			
V	Biogas Plant for Ward Level Biodegradable waste-to-energy processing			

Facilities incorporated in the design of depot

Facilities not added in the design of depot

5.2.3 Location – Existing Dhalao and Proposed Typologies of Hi Tech Recycling Depot

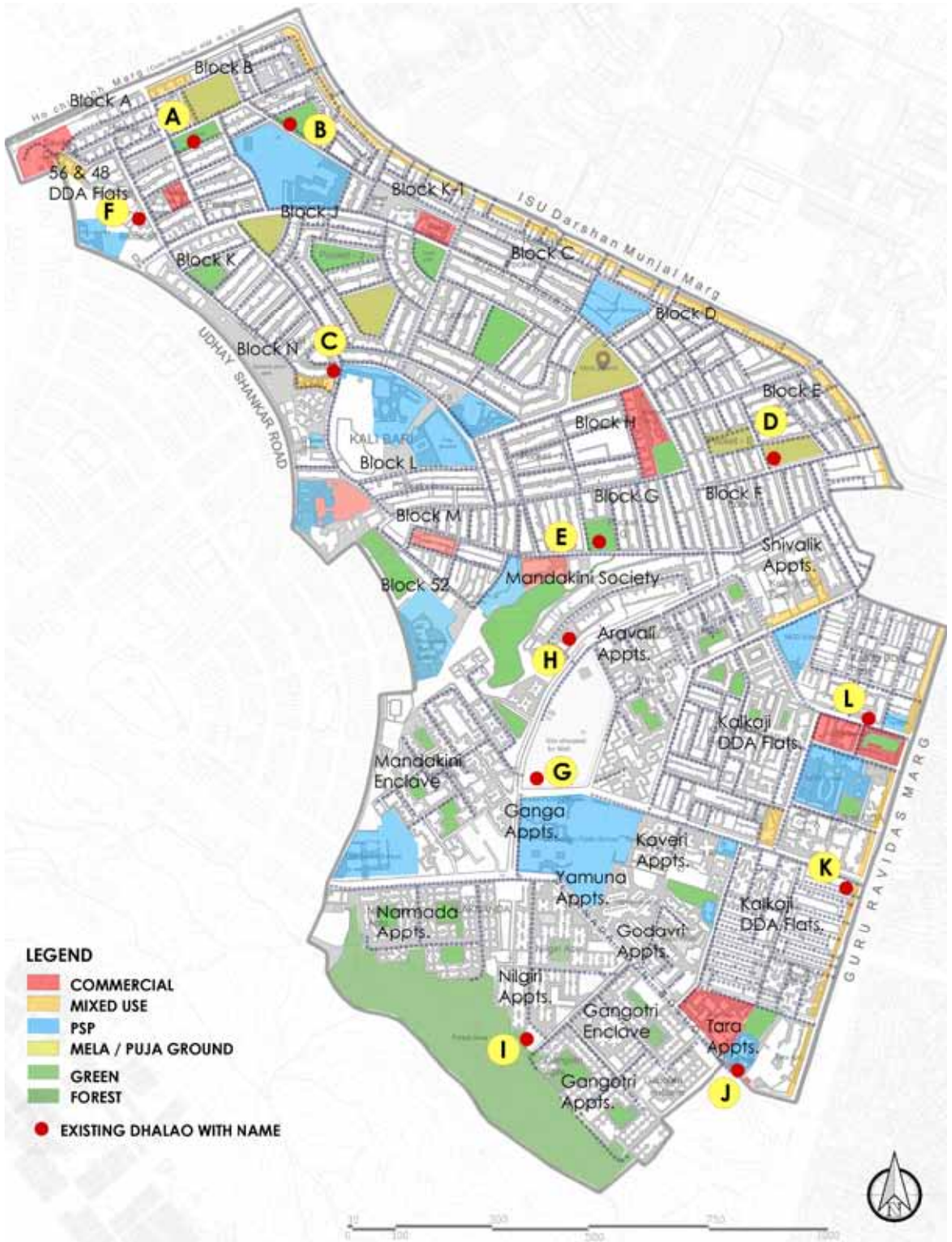
DHALAO NO.	EXISTING LAYOUT	LOCATION	NO. OF HH CATERED	SIZE (sq.m.)	CAPACITY (TPD)	COLLECTION FREQUENCY	ISSUES	SEASONAL ACTIVITIES	PROPOSED LAYOUT
COLONY: CHITTARANJAN PARK (CR PARK)									
A		Block B (Zonal park): Dhalao inset in the park	200-250 HH (900-1150 Persons) (Waste generated: 0.575 TPD)	70	2.5	2-3 times a week in the evening	• No daily collection -overflowing garbage on the road. • Dhalao opens on the road - truck causes traffic congestion while operation. • Bad odor around the vicinity. • No space for sorting and segregation. • Lack of public toilets in the vicinity. • Unhygenic condition for both public and waste collectors/ rag pickers	• Durga Puja Pandal built during festive season (Oct./ Nov.) • Additional garbage generated during peak seasons/ festivals. • No provision of public toilets, thus turning dhalaos into urinals.	 TYPE I 1. PUBLIC TOILET FACILITIES 2. COMPOSTING PLANT 3. HI TECH RECYCLING DEPOT - AREA FOR SEGREGATION, TEMPORARY STORAGE 4. BIO DIGESTER (CAPACITY 28 CU.M) 5. SPACE FOR ADVERTISMENT TOTAL AREA 130 SQ.M
C		Kali Bari Mandir: Dhalao inset in the park boundary.	650-750 HH 2950-3350 Persons) (Waste generated: 1.675 TPD)	56	4.0	Daily or alternate day in evening			
D		Pocket E & F, Market No. 2 Dhalao on the pedestrian pathway	600-700 HH 2700-3150 Persons) (Waste generated: 1.575 TPD)	70	4.0	2-3 times a week in the evening	• Dhalao encroached on pedestrian pathway. • No daily collection: overflowing garbage on the road/ pathway • No space for sorting and segregation. • Lack of public toilets in the vicinity. • Unhygenic condition		 TYPE I 1. PUBLIC TOILET FACILITIES 2. COMPOSTING PLANT 3. HI TECH RECYCLING DEPOT - AREA FOR SEGREGATION, TEMPORARY STORAGE 4. SPACE FOR ADVERTISMENT TOTAL AREA 96 SQ.M
E		Opposite Jahapanah Park, near NRI Colony, Mandakini enclave Dhalao inset in the park boundary.	800-900 HH (3600-4050 Persons) (Waste generated: 2.025 TPD)	60	3.0	Daily or alternate day in evening	• No daily collection: overflowing garbage on the road. • Dhalao opens on the road: truck causes traffic congestion while operation. • Bad odor around the vicinity. • Lack of public toilets in the vicinity. • Unhygenic condition		 TYPE II 1. PUBLIC TOILET FACILITIES 2. COMPOSTING PLANT 3. HI TECH RECYCLING DEPOT - AREA FOR SEGREGATION, TEMPORARY STORAGE 4. BIO DIGESTER (CAPACITY 28 CU.M) 5. SPACE FOR ADVERTISMENT TOTAL AREA 130 SQ.M
COLONY: ALAKNANDA COLONY									
G		Opposite Kalka Public school near Mandakini Enclave Dhalao on the pedestrian pathway	300-400 HH (1350-1800 Persons) (Waste generated: 0.9 TPD)	68	7.0	Daily or alternate day in evening	• Dhalao encroached on pedestrian pathway. • No daily collection: overflowing garbage on the road. • No space for sorting and segregation. • Lack of public toilets		 TYPE III 1. PUBLIC TOILET FACILITIES 2. HI TECH RECYCLING DEPOT - AREA FOR SEGREGATION, TEMPORARY STORAGE 3. SPACE FOR ADVERTISMENT TOTAL AREA 54 SQ.M
H		Opposite Aravalli shopping complex Dhalao built on the pedestrian pathway.	3000-4000 (1350-1800 Persons) (Waste generated: 9.0 TPD)	58	5.0	Daily or alternate day in evening	• Dhalao encroached on pedestrian pathway. • No daily collection: overflowing garbage on the road. • No space for sorting and segregation. • Lack of public toilets		 TYPE III 1. PUBLIC TOILET FACILITIES 2. HI TECH RECYCLING DEPOT - AREA FOR SEGREGATION, TEMPORARY STORAGE 3. SPACE FOR ADVERTISMENT TOTAL AREA 54 SQ.M

5.2.4 Location – Existing Dhalaos and Proposed Typologies of Hi-Tech Recycling Depot

In this section the first four types of depot/receptacles will be described in detail. These depots – **Hi-tech Recycling Depots** are proposed to replace the existing 12 dhalaos in Ward No 190.

The existing dhalaos are redesigned with facilities listed below:

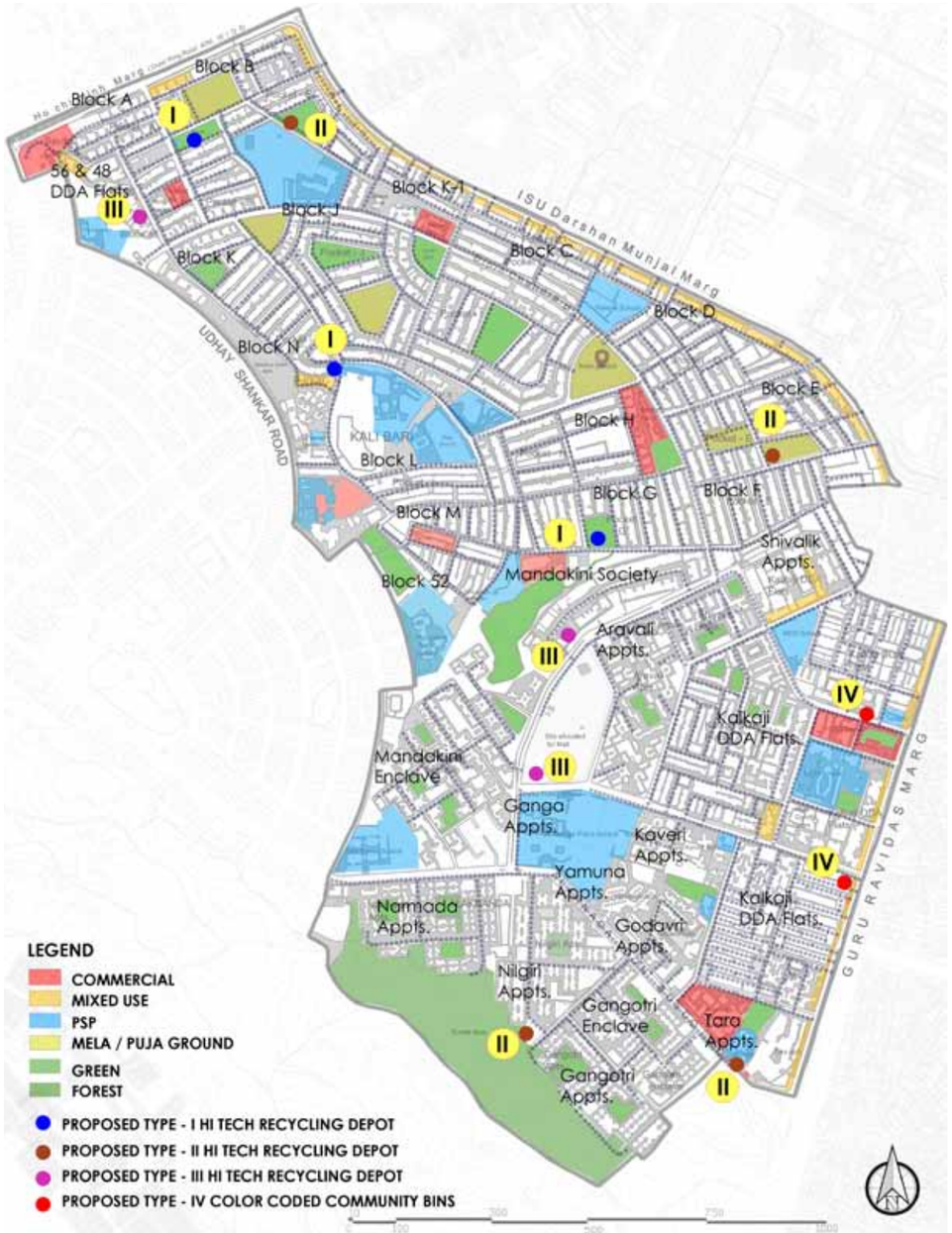
1. Area for segregation (Recycling Depot)
2. Composting pits for composting biodegradables at neighbourhood level
3. Biodigester for conversion of waste-to-energy at neighbourhood level
4. Public toilet facilities for public sanitation



Map showing location of existing dhalaos in Ward No 190

Advantages of the HI TECH RECYCLING DEPOTS are:

- Public Toilet facility and Drinking Water.
- Hygienic/ organized space for the sorting- segregation and temporary storage facilities for solid waste.
- Recycling of waste and reduce pressure on landfill site.
- Community level decentralized Composting of the 40% waste (biodegradable).
- Regulate problems associated with stray animals littering the areas around the dhalaos.
- Improved work space for the workers associated with picking, segregating, transporting, handling, and recycling of waste.
- Resource recovery, economic opportunity and revenue generation.



Map showing location of proposed Hi-tech depots/community bins to replace the existing dhalaos in Ward No 190

5.2.5 Study Area with the Four Typologies of Hi-Tech Recycling Depots

Dhalao E: Inset in Park (60 sq m) – replaced by proposed Type I

Dhalao E: Inset in Park (60 sq m)

Dhalao D: Inset in Park (70 sq m)

Dhalao D: Inset in Park (70 sq m) – replaced by proposed Type II

Map showing location of dhalaos/receptacles in the study area

Key Plan

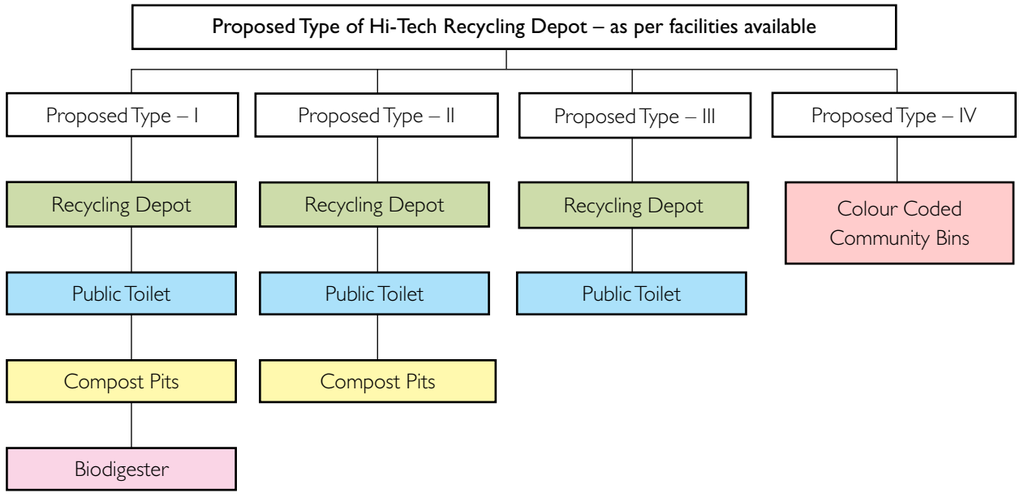
Dhalao H: On pedestrian pathway (58 sq m) – replaced by Type III

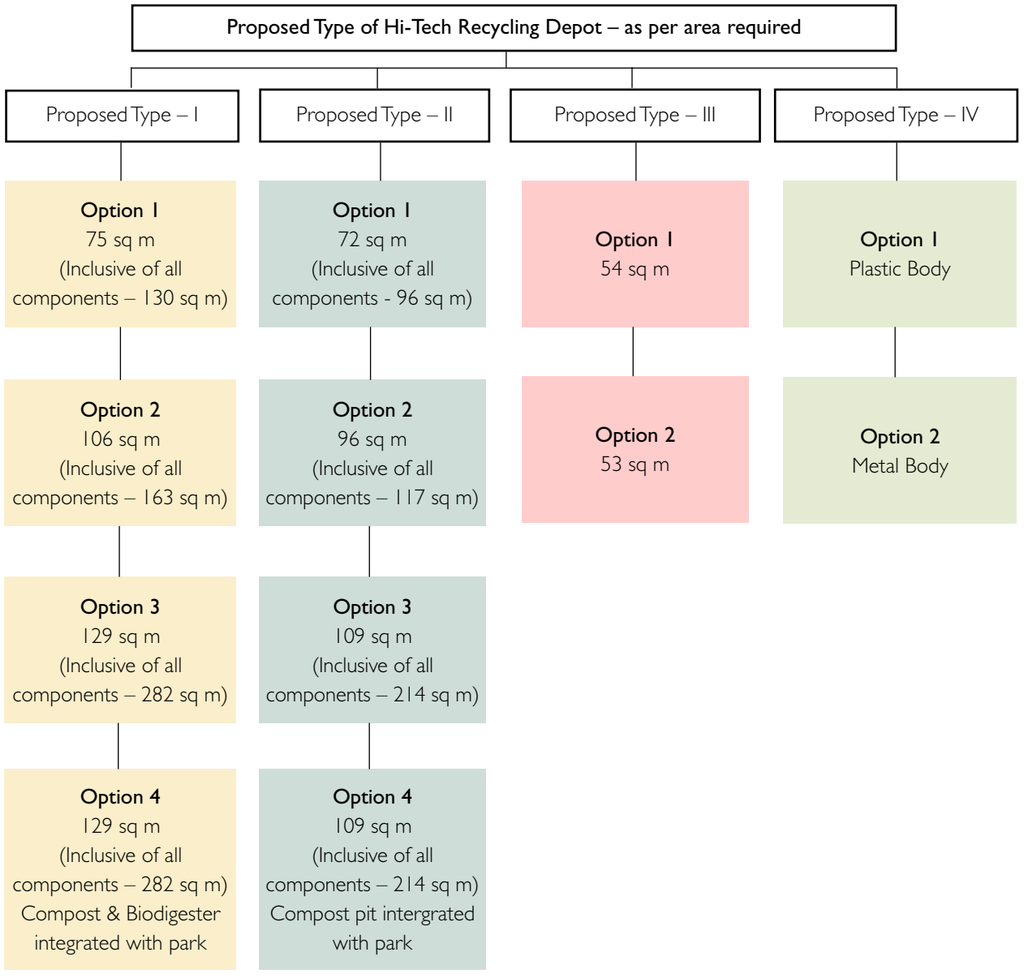
Dhalao H: On pedestrian pathway

L: Municipal bin in market

Receptacle L: Municipal bins only (08 sq m) – replaced by proposed Type IV

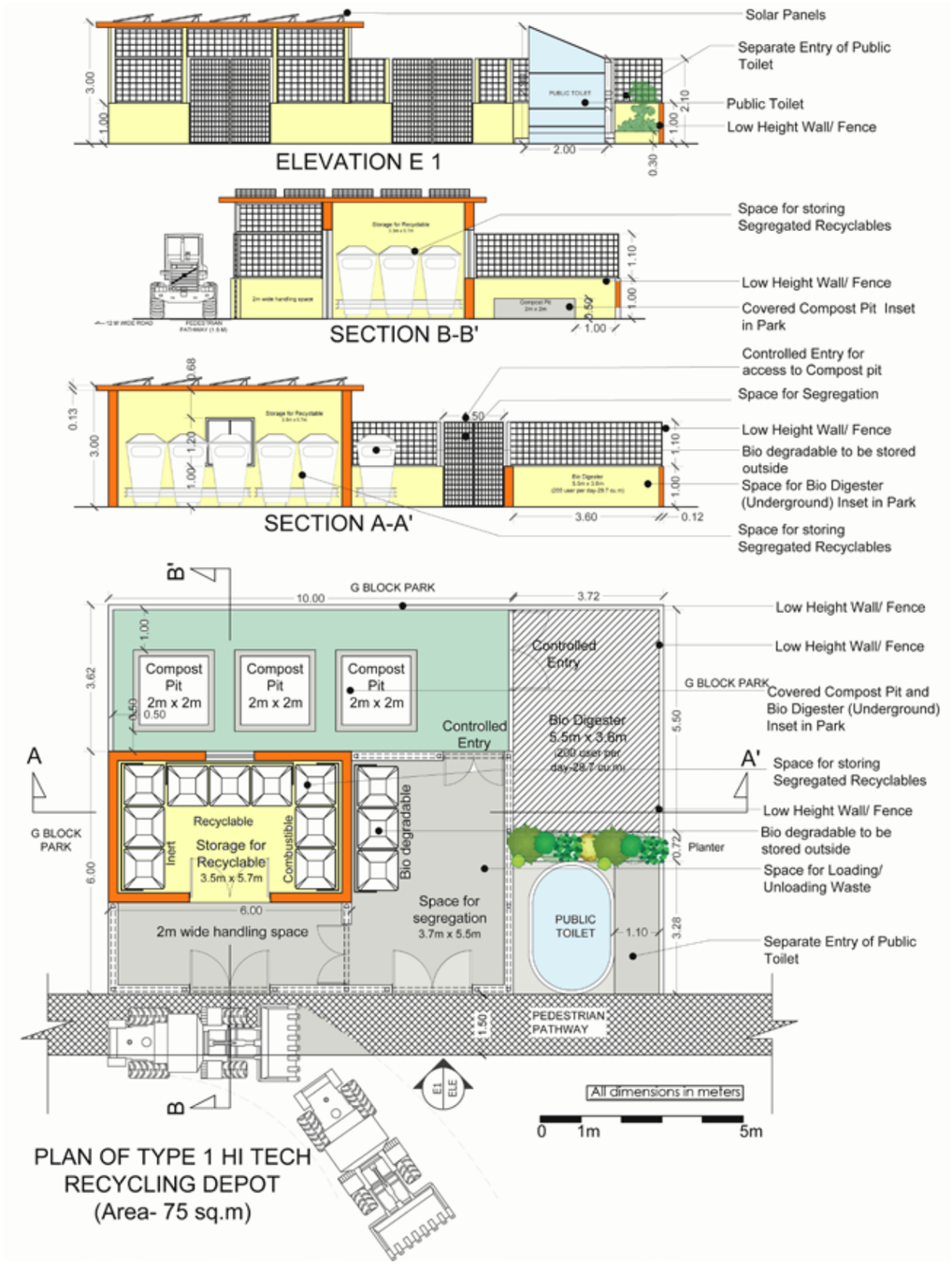
5.2.6 Details of Hi-Tech Recycling Depots



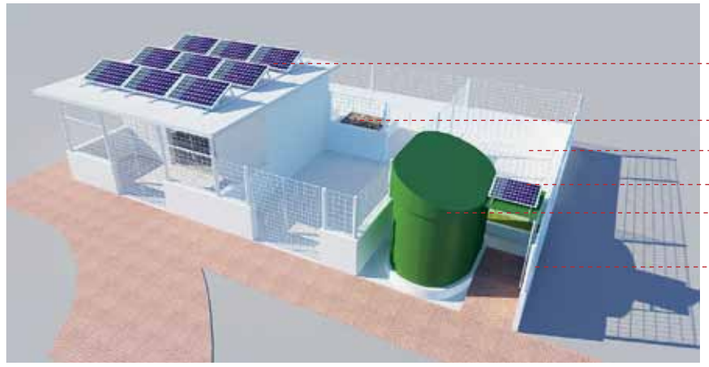


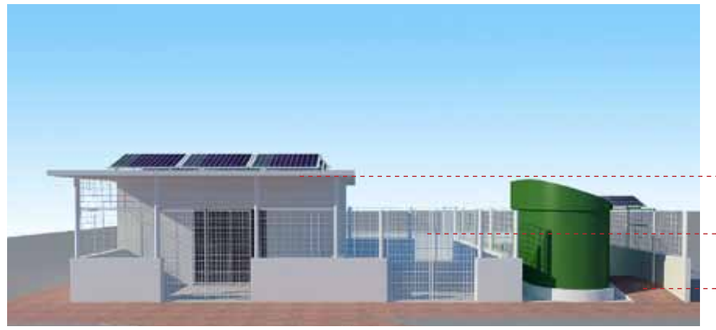
The Hi-tech Recycling Depots are designed conceptually with possible alternate options as per space availability and flexibility in design choices. The details are discussed in the following section.

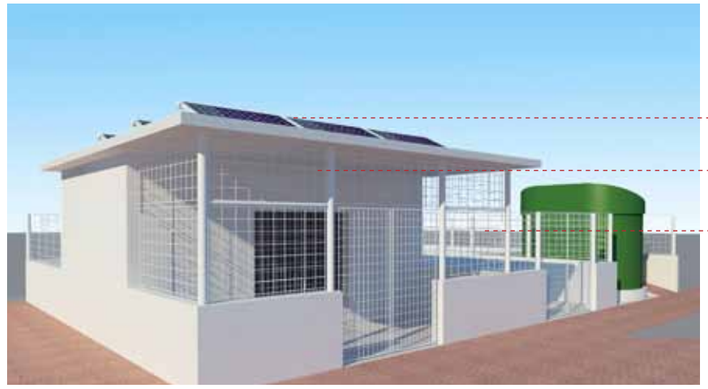
5.2.7 Hi-Tech Recycling Depots – TYPE I – OPTION I

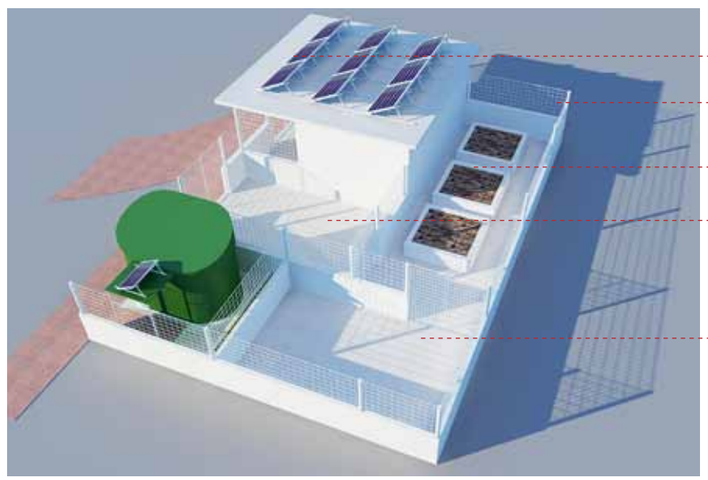


Hi Tech Recycling Depot: Type I – Option I – Plan, Sections and Elevation



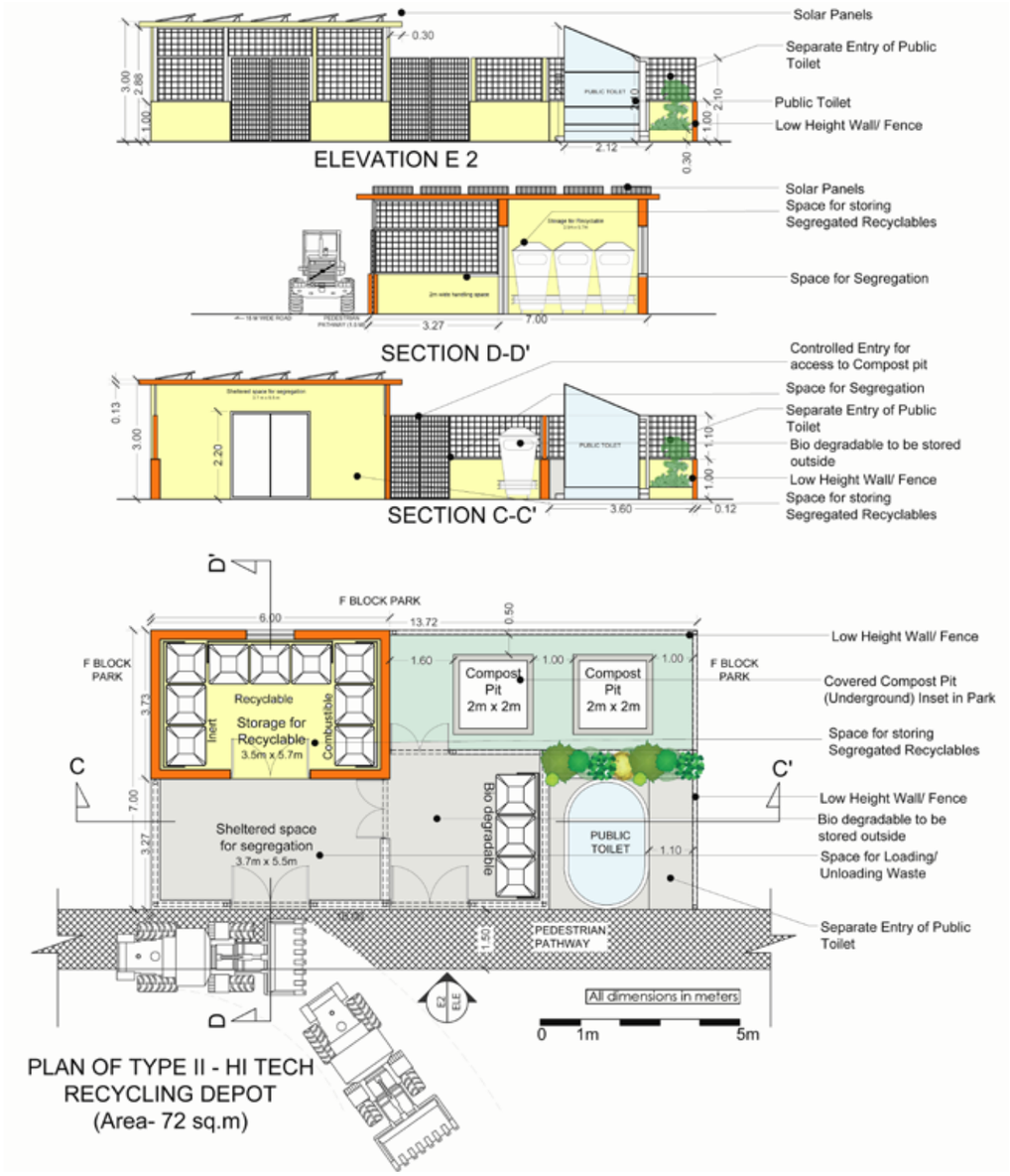




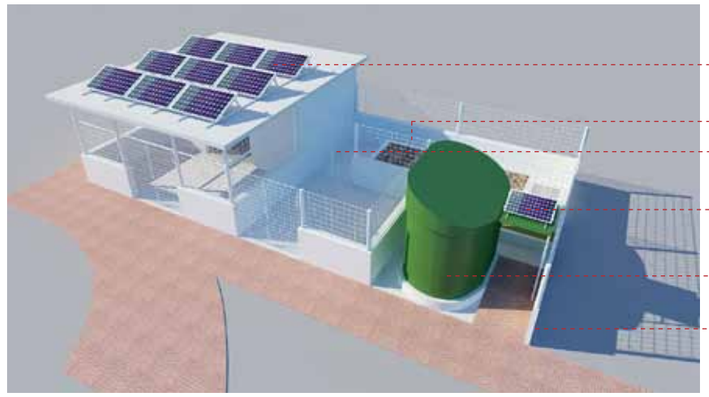


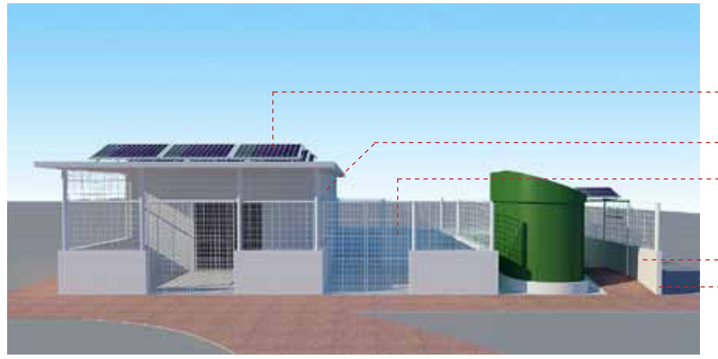
Hi Tech Recycling Depot: Type I – Option I – 3D Views

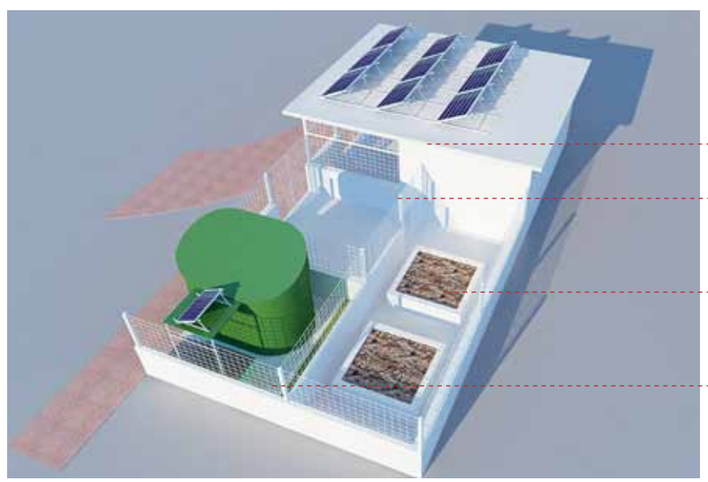
5.2.8 Hi Tech Recycling Depots – TYPE II – OPTION 1



Hi Tech Recycling Depot: Type II – Option 1 – Plan, Sections and Elevation

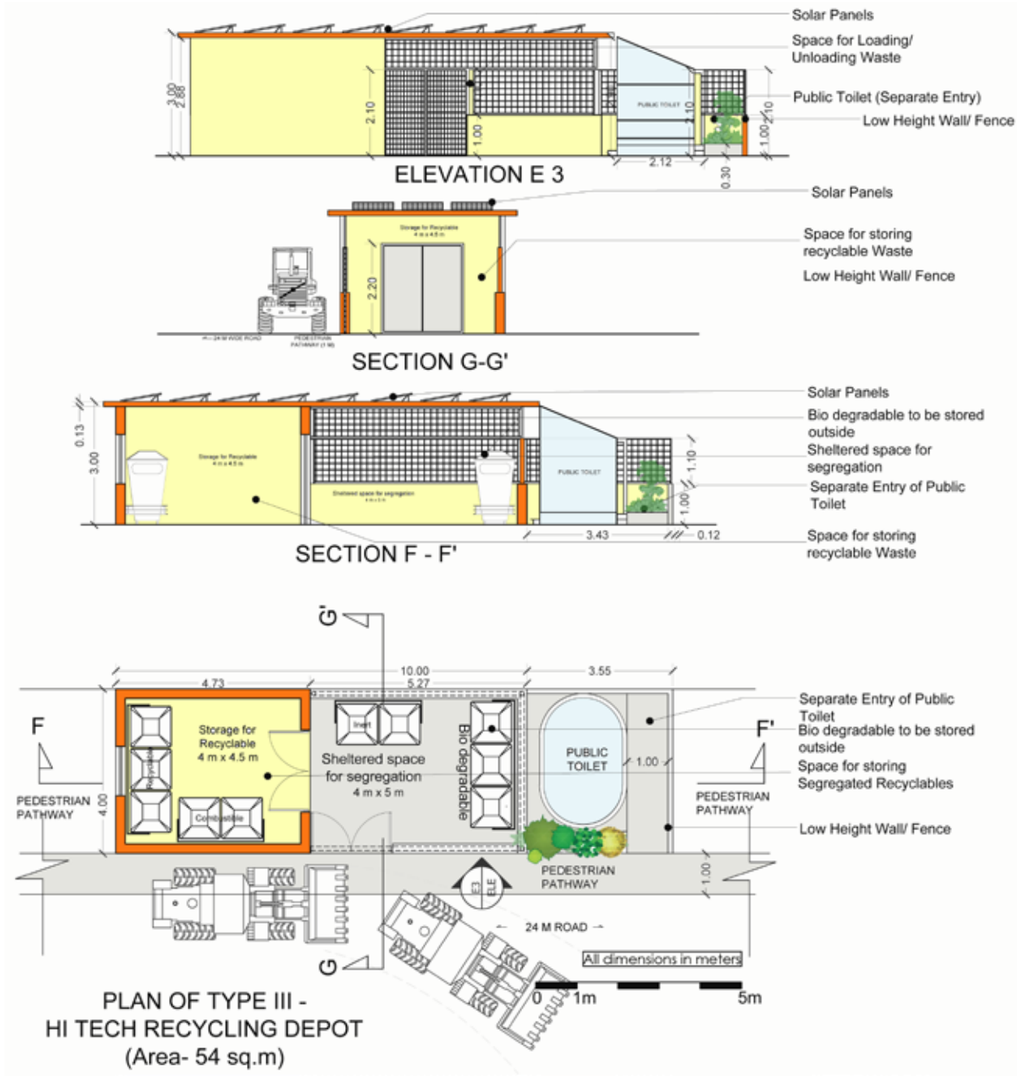




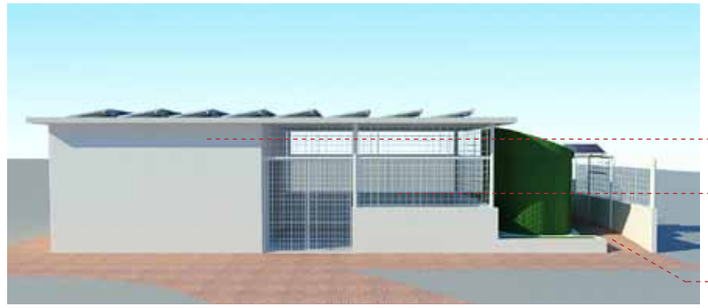


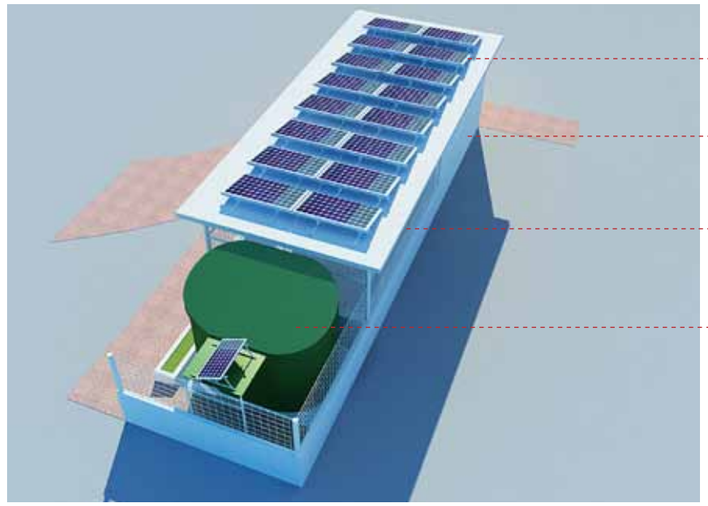
Hi Tech Recycling Depot: Type II – Option 1 – 3D Views

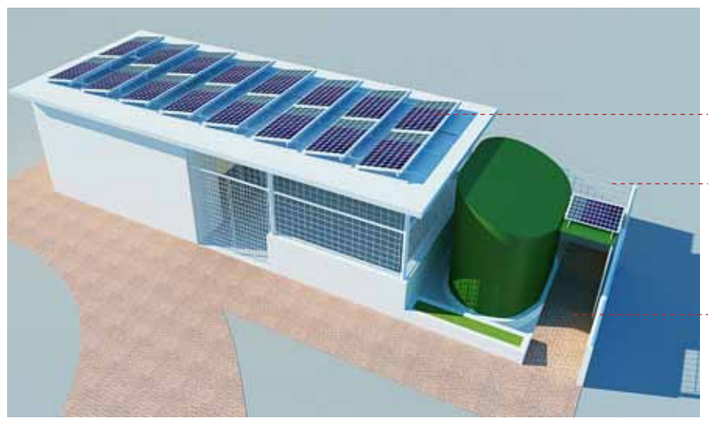
5.2.9 Hi Tech Recycling Depots – TYPE III – OPTION 1



Hi Tech Recycling Depot: Type III – Option 1 – Plan, Sections and Elevation

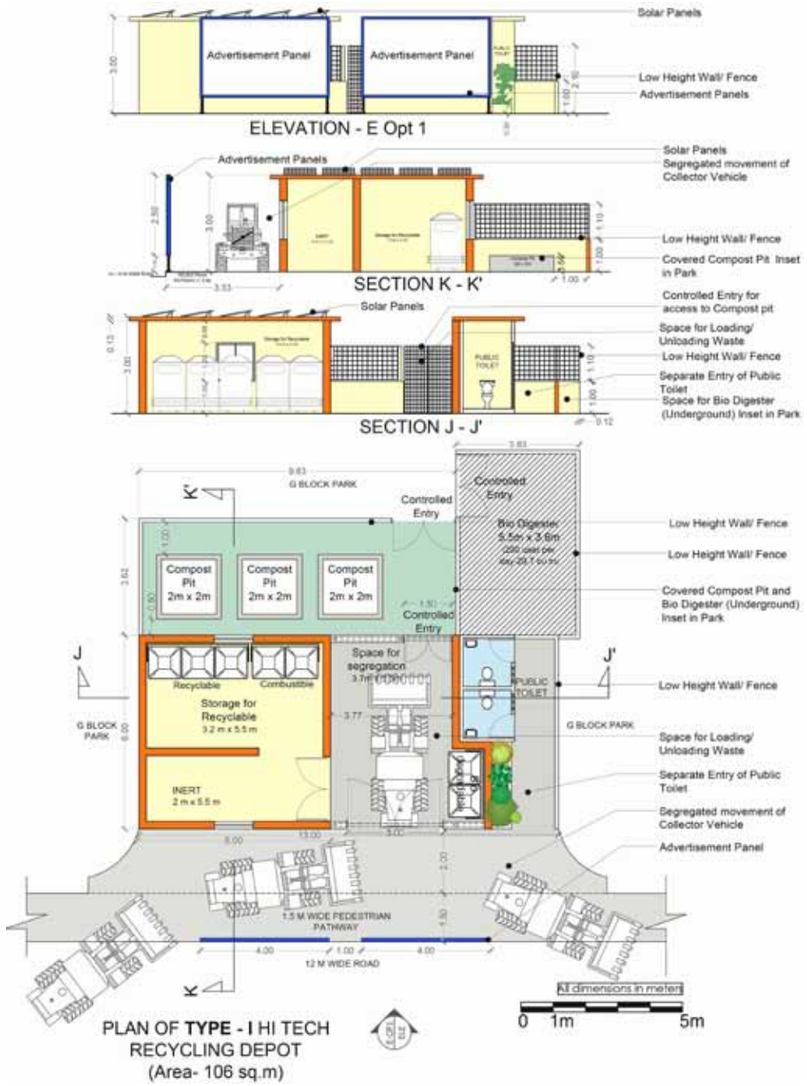




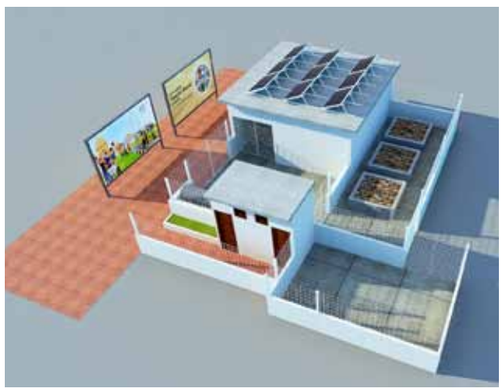


Hi Tech Recycling Depot: Type III – Option 1 – 3D Views

5.2.10 Hi Tech Recycling Depots – TYPE I – OPTION 2

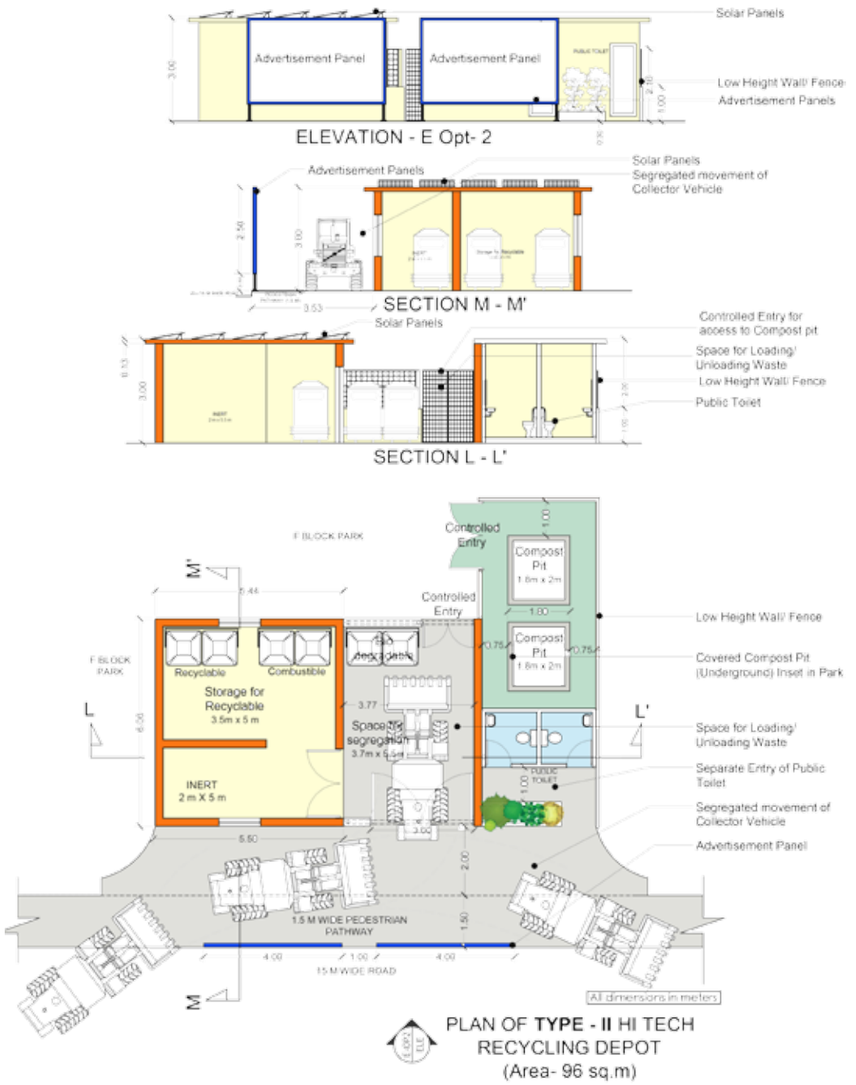


Hi Tech Recycling Depot: Type I – Option 2 – Plan, Sections and Elevation

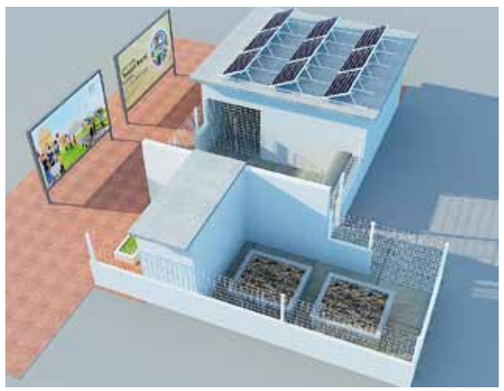


Hi Tech Recycling Depot: Type I – Option 2 – 3D Views

5.2.11 Hi Tech Recycling Depots – TYPE II – OPTION 2

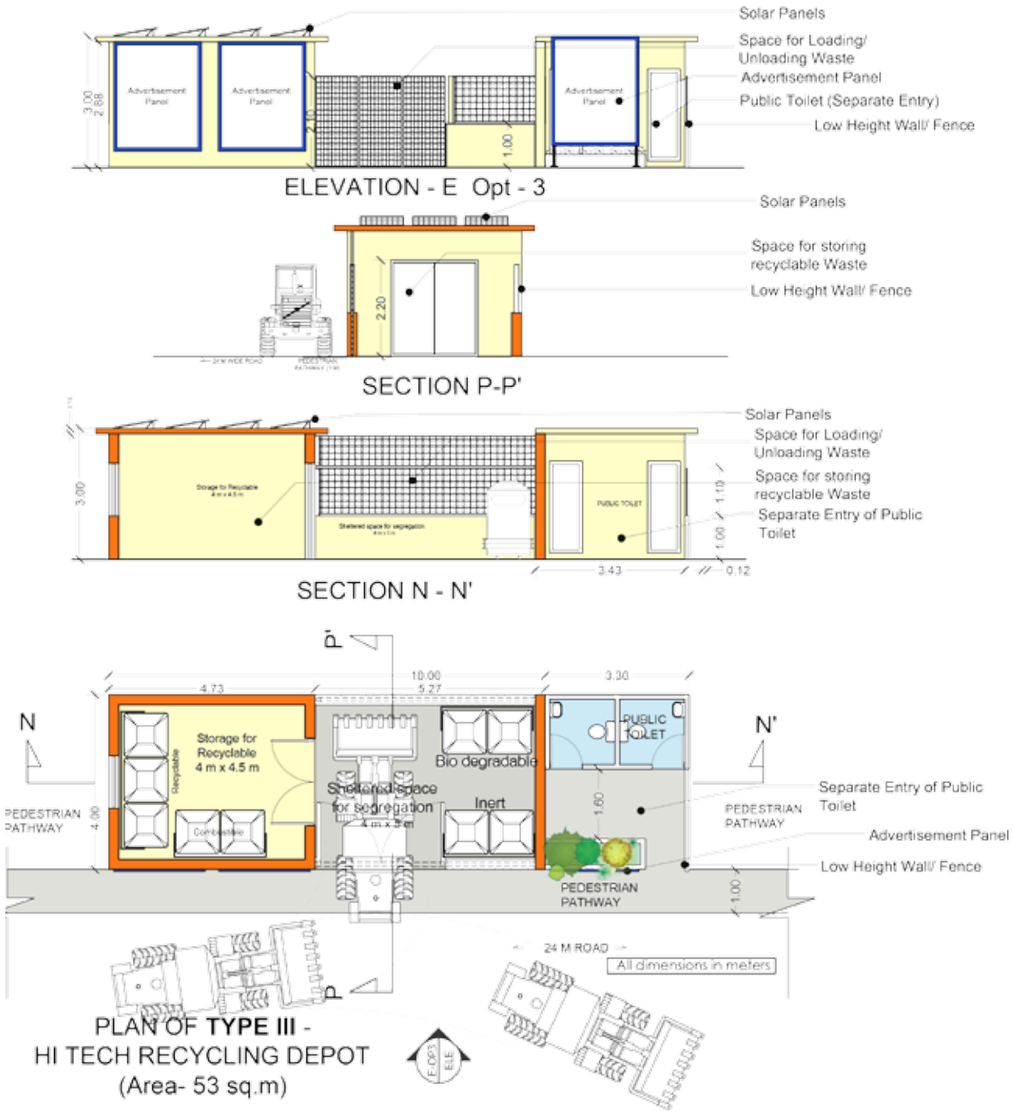


Hi Tech Recycling Depot: Type II – Option 2 – Plan, Sections and Elevation

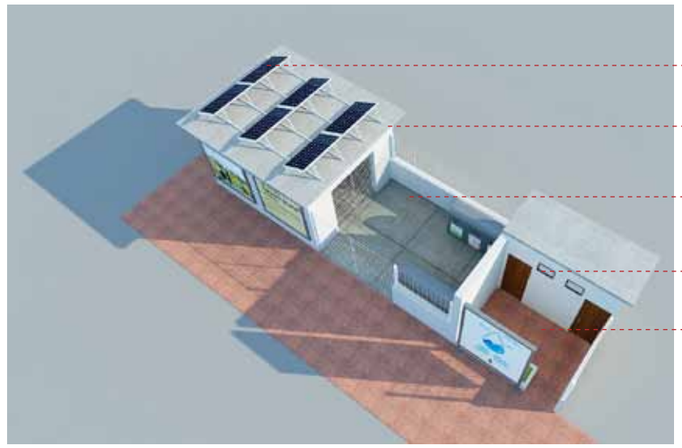


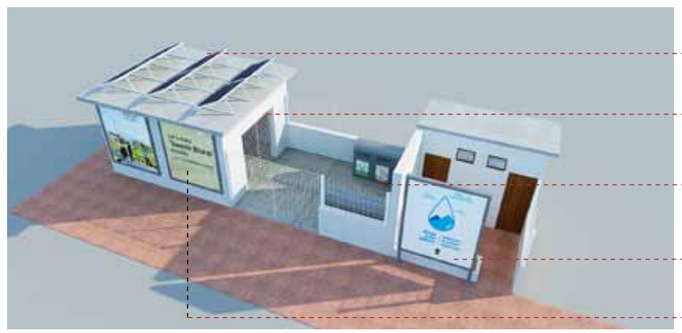
Hi Tech Recycling Depot: Type II – Option 2 – 3D Views

5.2.12 Hi Tech Recycling Depots – TYPE III – OPTION 2



Hi Tech Recycling Depot: Type III – Option 2 – Plan, Sections and Elevation

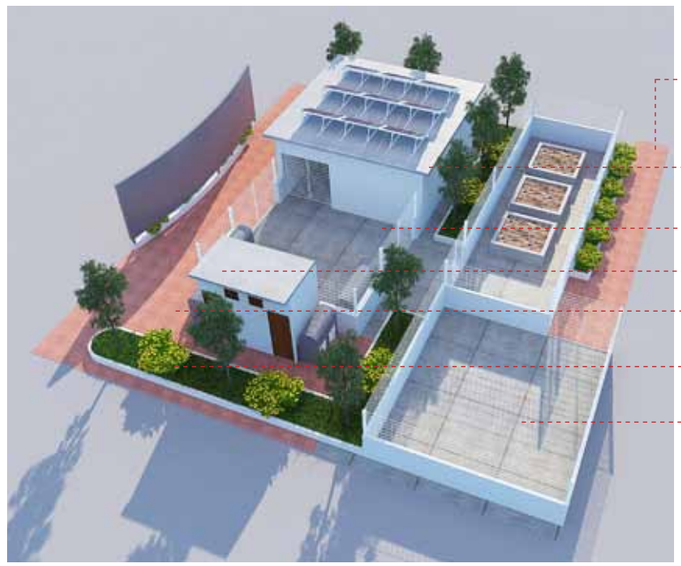




Hi Tech Recycling Depot: Type III – Option 2 – 3D Views

5.2.13 Hi Tech Recycling Depots – TYPE I – OPTION 3

Hi Tech Recycling Depot: Type I – Option 3 – Plan, Sections and Elevation



Hi Tech Recycling Depot: Type I – Option 3 – 3D Views

5.2.14 Hi Tech Recycling Depots – TYPE II – OPTION 3

Hi Tech Recycling Depot: Type II – Option 3 – Plan, Sections and Elevation

Hi Tech Recycling Depot: Type II – Option 3 – 3D Views

5.2.15 Hi Tech Recycling Depots – TYPE I – OPTION 4

Hi Tech Recycling Depot: Type I – Option 4 – Plan, Sections and Elevation

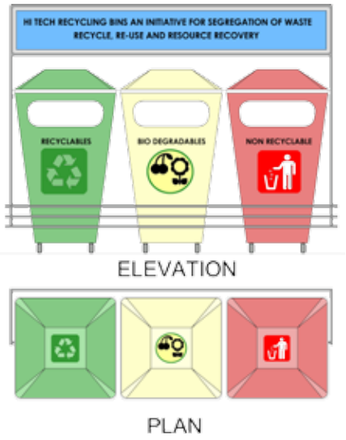
Hi Tech Recycling Depot: Type I – Option 4 – 3D Views

5.2.16 Hi Tech Recycling Depots – TYPE II – OPTION 4

Hi Tech Recycling Depot: Type II – Option 4 – Plan, Sections and Elevation

Hi Tech Recycling Depot: Type II – Option 4 – 3D Views

5.3 Proposal for Colour Coded Community/Municipal Bins



OPTION 1: Colour Coded Community/Municipality Bins with plastic body. Three separate compartments for recyclable, biodegradable and non-recyclable waste. Removable lid for cleaning.

OPTION 2: Colour Coded Community/Municipality Bins with durable metal body. Three separate compartments for recyclable, biodegradable and non-recyclable waste.

Conceptual design showing different options for opening and cleaning.

5.4 Proposal for Spatial Pattern Layout for Additional Community Bins

For maintaining a clean neighbourhood, colour coded community bins are proposed at walking distances for each of the neighbourhoods. For this purpose, the spatial pattern and standard spacing has to be considered based on the population, density and development pattern. The detailed study on spatial pattern layout for placing community bins is based on Indian Standard – Solid Waste Management System – Collection Equipment – Guidelines; Bureau of Indian Standards; IS 12647: 1989.

The governing factors for spacing of community bins/dustbins can be detailed as follows:

1. Availability of space for installing community bins/dustbins – intersections of roads, near community garden or public utilities/market areas and other similar places.
2. Capacity of community bin/ dustbin,
3. Population density and
4. Average distance convenient for residents and sweepers to take the refuse to the community bin/dustbin.

Calculation for Spacing of the Community Bins as per Population Density

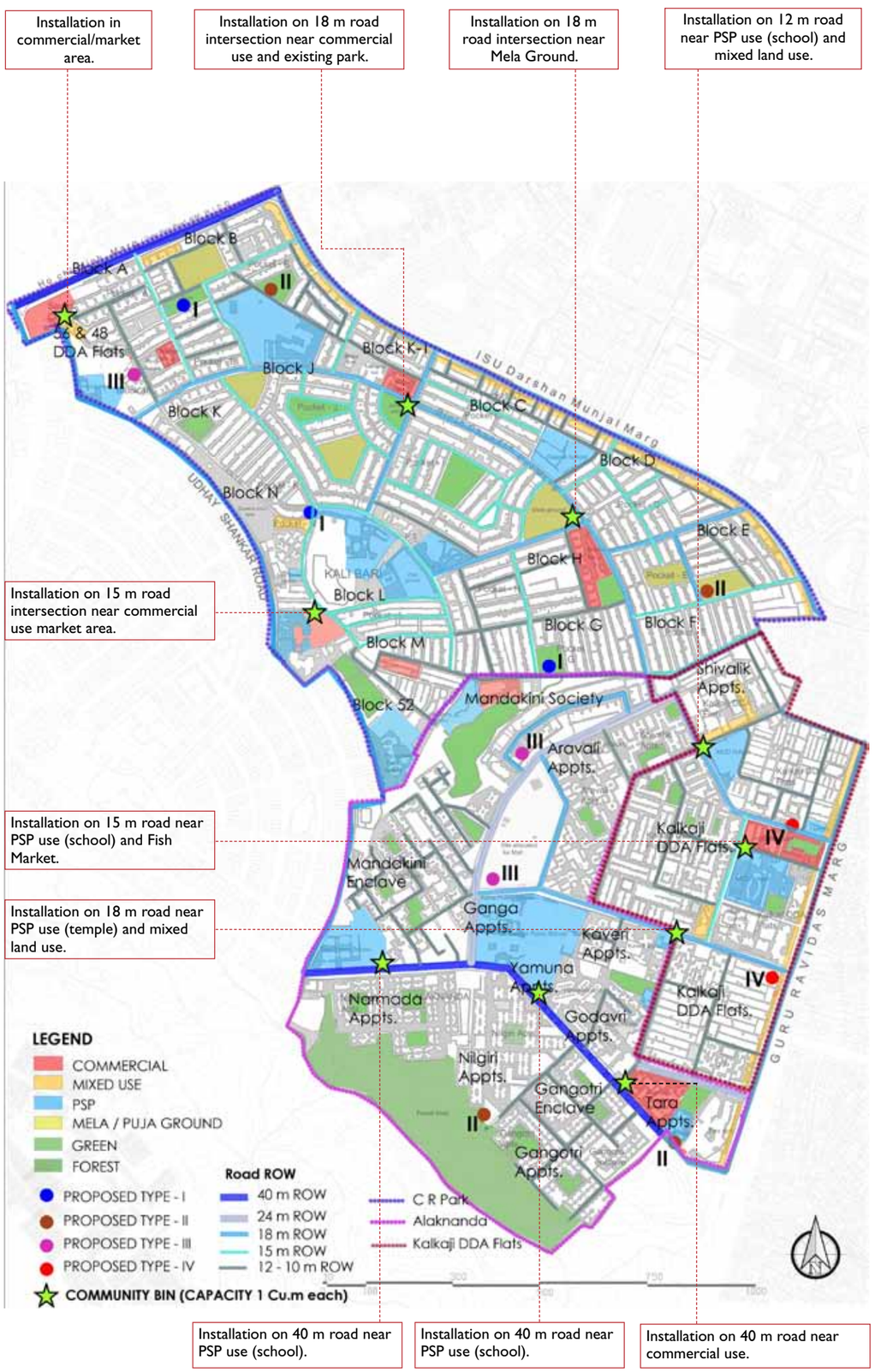
S No	AREA	Area in ha	Pop. 2011	Density 2011	Waste gen. per ha/day	Min. spacing between 2 bins	No. reqd	Waste cap. per day
1.	CR Park	82.5	31866	386	193 kg	750 m	4	2 TPD
2.	Kalkaji DDA Flats	20.6	25559	1241	620 kg	900 m	3	1.5 TPD
3.	Alaknanda	71.4	20574	288	144 kg	900 m	3	1.5 TPD
4.	WARD No 190	174.5	78000	447	224 kg		10	5 TPD

Note:

1. *Considering that the community bins are cleaned on alternate days.*
2. *Community bins/dustbin of 1 cu.m can accommodate 500 kg of waste.*
3. *Community bins of volume 1 cu.m are considered in calculation.*

Conclusions:

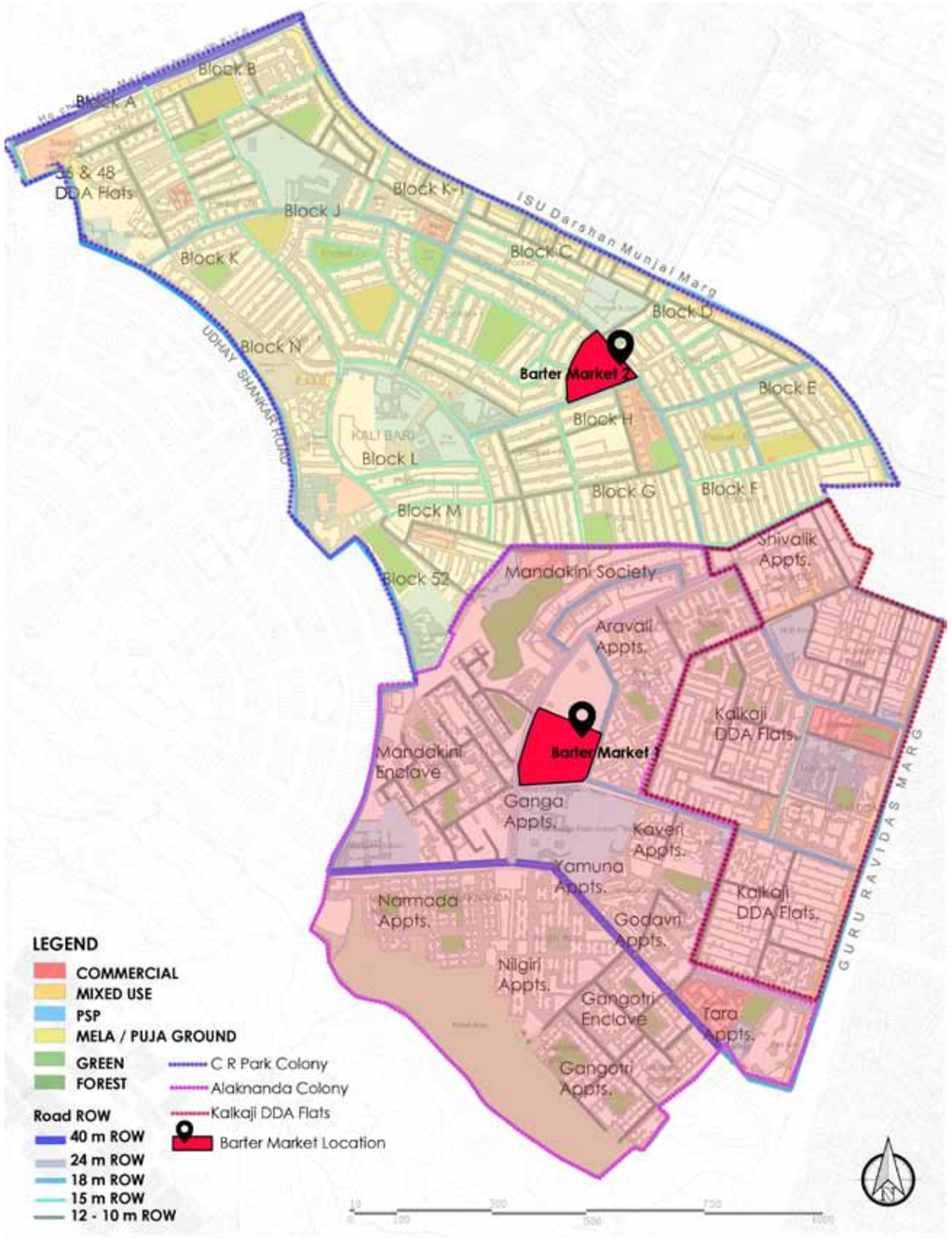
- Installation of 10 community bins will add capacity to handle solid waste @ 5 TPD in Ward No 190.
- The spacing of the community bin/dustbin is based taking into consideration the existing secondary receptacles, existing land use/ existing utilities, population density etc.
- The walking distance of the layout for secondary receptacles (community bins and hi tech recycling depot) for waste disposal from residence/work place/cultural activity centre is average 300 m or less.



Map showing location: spatial pattern layout for additional community bins.

5.5 Proposal for Barter Market – Exchange of Recyclable Waste to Usable Items

Recyclable items at the household level are encouraged to be segregated and stored for exchange with valuables during the Monthly Barter Market. The proposal for Monthly Barter Market consists of two markets proposed at CR Park Mela Ground (to cater to CR Park Colony) and at the open area near Jahapanah Park (to cater to Alaknanda Colony and Kalkaji DDA flats).



Map showing location: Monthly Barter Market in Ward No 190.

PROPOSALS: Monthly Barter Market

- Identify parks/public open places for organizing the Monthly Barter Market in exchange for recyclable items to usable items.

- Include awareness programmes as part of training/workshops in schools for waste reduction, segregation, storage of recyclable waste and final exchange.

- Awareness programmes on waste reduction ,segregation , storage of recyclable waste and final exchange to be aired on TV for a wider audience viewing.

- Train volunteers for public awareness: NGOs/school students/residents to give demonstrations on waste reduction, segregation, storage of recyclable waste and final exchange of the same in barter markets for vegetables/ complimentary currency coupons for online or off-line shopping/recharge for common mobility card etc.

- Provision of colour coded household bins at subsidized rates.

- Organize Monthly Barter Market with a recreational environment by involving:
  - Vegetable vendors.
  - Street vendors selling household items and food.
  - Resident volunteers providing cooking classes, handicraft classes etc.
  - NGOs providing training on re-use of recyclable materials.

5.6 Proposal for Biogas Plant in Jahanpanah Park – Waste-to-Energy Plant

The proposed biogas plant of capacity 5 tons per day requires about 500 sq m area in Jahanpanah Park. The plant is estimated to produce energy to light about 700 tube lights in public open spaces.

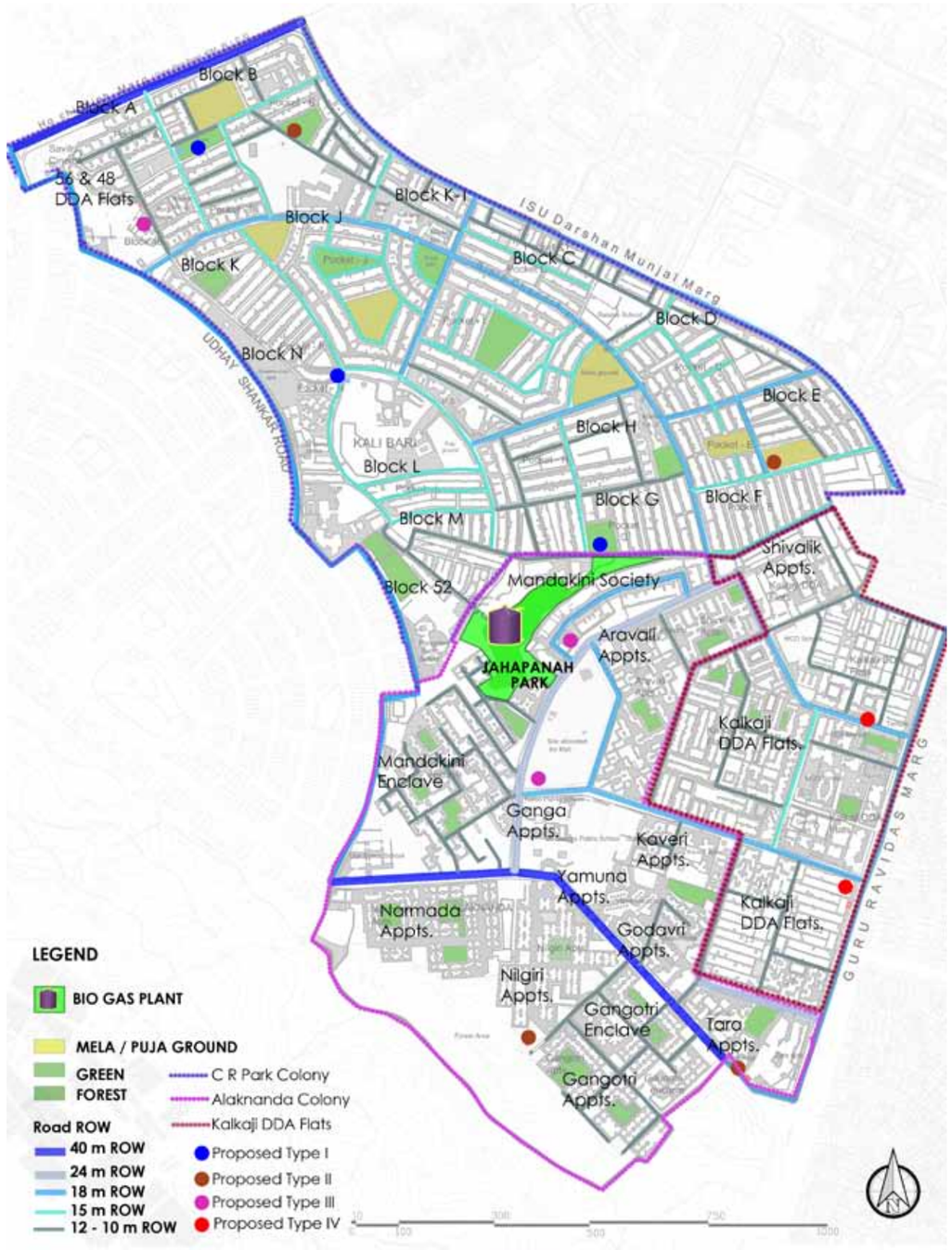
The following are the standard calculation for a 5 ton Biogas Plant utilized for electricity generation:

Project: Biogas Utilized for Electricity Generation*

1.	Plant Cost	Rs 120.00 Lakhs
2.	Biogas Generated	300 Cum./day
3.	Electricity Generated	400 kwh /day
4.	Auxiliary Consumption	@ 50 kwh/day
5.	Annual Savings due to Biogas (Considering 330 operating days)	Rs 7.50 Lakhs (350 kwh/day X Rs 6.50 /kwh X 330 days)
6.	Annual Savings due to Manure	Rs 1.80 Lakhs (150 Ton Per Annum X Rs1200 / MT)
7.	Savings to ULB in Transportation of Waste to Landfill Site	Rs 11.50 Lakhs (5 TPD X Rs 700/- / Tone X 330 Days)
8.	Savings (Electricity + Manure + Transportation)	Rs 20.80 Lakhs
9.	O & M Cost	Rs 20.80 Lakhs
10.	**Net Savings**	**Rs 9.50 Lakhs / Year**
11	**Simple pay-back period**	**8 Years**

* Source: Ghatge, Dr. Ketaki, Divisional Medical Officer, Pune Municipal Corporation - Waste to Energy (Energy Revolution from Municipal Solid Waste)

Accessed from : http://icrier.org/Urbanisation/events/30-5-14/Waste_Energy_Ketaki%20Ghatge.pdf



Conclusion:

- The proposed biogas plant for waste-to-energy of 5 tons capacity in Ward No.190 will require an area of approximately 500 sq m (5,000 sq ft).
- The capital cost of the plant at the existing market value is approximately Rs 120 lakhs and the annual saving after installation per annum is Rs 9.50 lakhs.
- Considering operation and maintenance cost and other auxiliary consumptions, the pay back period of the project is estimated to be 8 years.

5.7 Land Requirement and Waste Handling Capacity for 2041

Land Required and Total Capacity of Waste Handling

1	2	3	4	5			6	7
Dhalao Name	Proposed Type	Location and Description	Size sq m	Proposed size (sq m) of Hi tech Recycling Depot			Existing Capacity TPD	Proposed Capacity TPD
				OP - 1	OP - 2	OP - 3		
CR PARK – 31866 population								
A	I	Block B (Zonal Park) Inset in the park	70	75	106	129	2.5	7
B	II	Block B Inset in the park	43	72	96	109	3.0	5.5
C	I	Kali Bari Mandir Inset in the park	56	75	106	129	4.0	7
D	II	Block E & F Inset in the park	70	72	96	109	4.0	5.5
E	I	Opposite Jahpanah Park Inset in the park	60	75	106	129	3.0	7
F	III	Near B Block Mini dhalao	23	54	53	53	1.0	4.5
ALAKNANDA- 20574 population								
G	III	Opposite Kalka Public School – encroached on pedestrian way	68	54	53	53	7.0	4.5
H	III	Opposite Aravalli Market – encroached on pedestrian pathway	58	54	53	53	5.0	4.5
I	III	Gangotri – not functional	68	54	53	53	0.0	4.5
J	III	Near Tara Apartments – along roadside	68	54	53	53	6.0	4.5
DDA FLATS – 25559 population								
K	IV	J1 Colony – no dhalao	8 (MB)	10	10	10	1.0	3
L	IV	Harijan Colony – no dhalao	8 (MB)	10	10	10	1.0	3
TOTAL	12 Receptacles		600 sq m	659 sq m	689 sq m	890 sq m	37.5 TPD	60.5 TPD

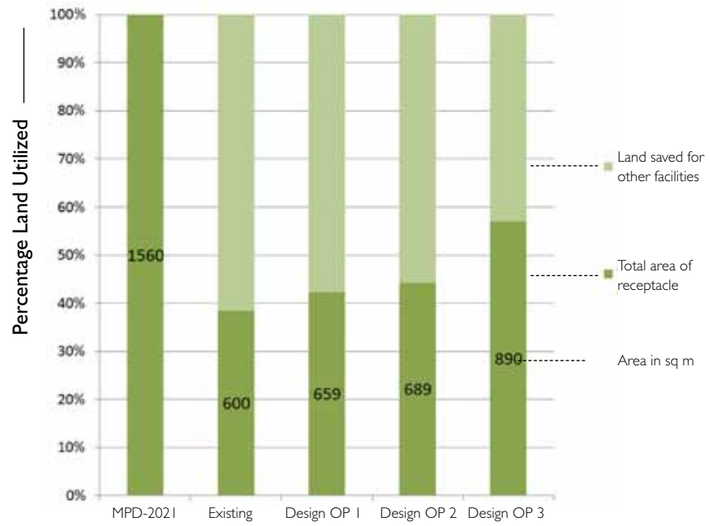
The existing land under dhalaos/secondary collection points is 600 sq m and the total existing capacity for handling waste is 37.5 TPD. As per the proposed Hi Tech Recycling Depot the total handing capacity will be approximately 60.5 TPD and the total land required will range from 659 to 890 sq m, depending on the design of the depot.

Calculation of Land Required for Secondary Collection Point/Receptacles

AREA	Popln. 2011	Projected Population			Area reqd. for Secondary collection point				No. of reqd. Receptacles			
		2021	2031	2041	2011	2021	2031	2041	2011	2021	2031	2041
CR Park	31866	37602	44370	52357	637.3	752.0	887.4	1047.1	3.2	3.8	4.4	5.2
Kalkaji DDA Flats	25559	26581	27645	28750	511.2	531.6	552.9	575.0	2.6	2.7	2.8	2.9
Alaknanda	20574	24689	29627	35552	411.5	493.8	592.5	711.0	2.1	2.5	3.0	3.6
WARD No 190	78000	88872	101642	116659	1560	1777	2032	2333	7.8	8.9	10.2	11.7

Provision as per Master Plan for Delhi 2021

- One area for segregation/secondary collection point for each neighbourhood.
- One per neighbourhood – 10,000 population
- Standard norm for an area for segregation – 200 sq m



Land required by various parameters

Land required for Secondary Collection Point/ Hi Tech Recycling Depot

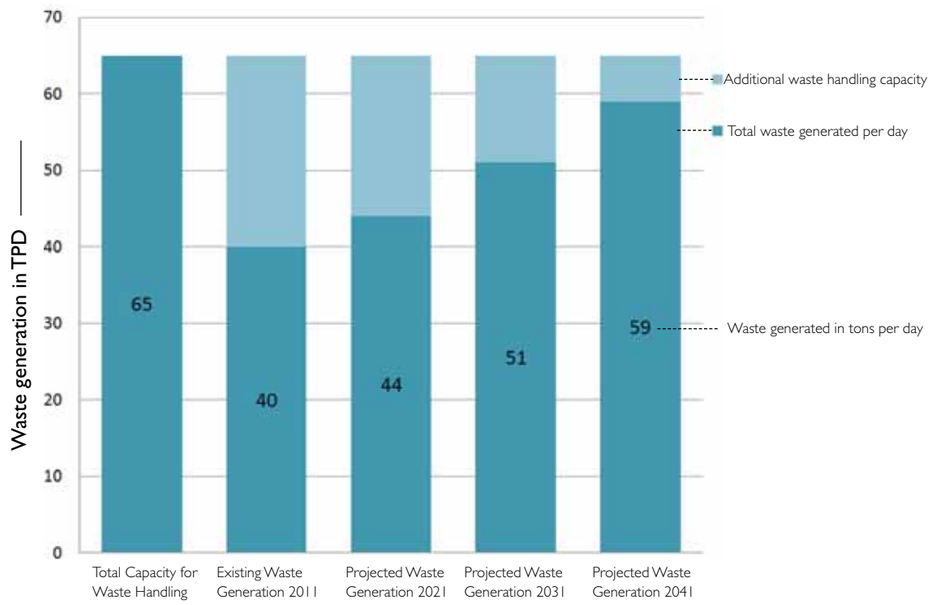
Inferences:

Land Requirement:

- The total area required for secondary collection point in Ward No 190 as per MPD-2021 is 1560 sq m
- Existing area under dhalao/secondary collection point is 600 sq m
- As per the design options of Hi Tech Recycling Depots the areas required are:
  - Option 1: 659 sq m
  - Option 2: 689 sq m
  - Option 3: 890 sq m

Calculation of Capacity for Waste Handling as per the Proposed Hi Tech Recycling Depot

AREA	Popln. 2011	Projected Population			Waste generated per day (TPD)			
		2021	2031	2041	2011	2021	2031	2041
CR Park	31866	37602	44370	52357	16	19	22	26
Kalkaji DDA Flats	25559	26581	27645	28750	13	13	14	15
Alaknanda	20574	24689	29627	35552	10	12	15	18
Ward No190	78000	88872	101642	116659	**40 TPD**	44 TPD	51 TPD	**59 TPD**



Projected Waste Generation and Handling Capacity in Ward No 190

Capacity for Waste Handling:

- The total waste handling capacity of the secondary collection points existing in Ward No 190 is 37.5 TPD which is less than the total waste generated at present i.e. 40 TPD by 2.5 TPD.
- It is proposed that when the hi tech recycle bins are deployed, the waste handling capacity will be 60 TPD which can handle the total waste projected in 2041 i.e. 59 TPD.
- In addition to above the proposed, 10 colour coded community bins will have a waste handling capacity of 5 TPD. Hence, the total waste handling capacity after their installation increases. The total waste handling capacity for 2041 will be 65 TPD.

5.8 Approach for Policy Interventions

1. Central/State Intervention and Strategies:

- Promote and frame policies for the avoidance and minimization of waste generation.
- Segregation to be incentivized to encourage public participation in terms of rebate in municipality service charges and also disincentivize or penalize non-segregated waste.
- Incorporate standard norms of spatial pattern for placement of receptacles/community bins/dustbins i.e. distance between receptacles or number of receptacles per unit area.
- Ban on the landfilling of biodegradable wastes.
- Ban on use of non-recyclable plastics.
- Provision of financial support and technical know how to local people interested in start up business models for recycling waste.
- Incentivizing the private sector to start waste recycling businesses.

Education programmes/workshops on waste management for the public, schools, colleges and institutes to be organized. Training of officers and staff for the implementation of proposed Zero Waste Management System.

- PPP Models for collection – sorting – segregation and transport to involve and train existing rag pickers and provide economic and social security to them by giving them formal training and income for the same.
- Inclusion of provision for the informal workforce involved in recycling and formal space provision for kabadis/ scrap dealers. Facility in all use zones in the Master Plan for Delhi-2021 (at present only provision of junk yards and godowns are given and these are permitted only in wholesale commercial and manufacturing zones.)
- Setting up a committee to ensure basic education and healthcare for rag pickers below the age of 14 years.
- Monitoring committees to be set up which are empowered to hold the service provider accountable for any action.
- Development authorities and service providing agencies to take urgent action for setting up efficient landfill sites to replace the already exhausted and operational landfill sites.

2. Citizen-centric Interventions:

- Mandatory segregation of waste at source – household level.
- Penalty for not segregating to discourage mixing of waste. Incentives for exchange of recyclable waste to productive items. Avoid disposal of recyclable waste and dispose only wet/organic waste that goes to the neighbourhood compost plants.
- Citizens to be encouraged to take ownership of a decentralized waste management system at the neighbourhood level – composting (biodegradable waste) and recycling (recyclable waste).

3. Effective Knowledge Based Solutions

Setting up of Research Centres for identifying latest and efficient technologies for various type of Waste Treatment/ Processing/Recycling:

- Biodegradable Waste
- Recyclable Waste
- C&D Waste
- Combustible Waste
- Hazardous Waste

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