Toxics Link
for a toxics-free world

On the edge

Potential Hotspots in Delhi

About Toxics Link:

Toxics Link emerged from a need to establish a mechanism for disseminating credible information about toxics in India, and for raising the level of the debate on these issues. The goal was to develop an information exchange and support organisation that would use research and advocacy in strengthening campaigns against toxics pollution, help push industries towards cleaner production and link groups working on toxics and waste issues.

Toxics Link has unique experience in the areas of hazardous, medical and municipal wastes, as well as in specific issues such as the international waste trade and the emerging issues of pesticides and POP's. It has implemented various best practices models based on pilot projects in some of these areas. It is responding to demands upon it to share the experiences of these projects, upscale some of them and to apply past experience to larger and more significant campaigns.

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A Report by

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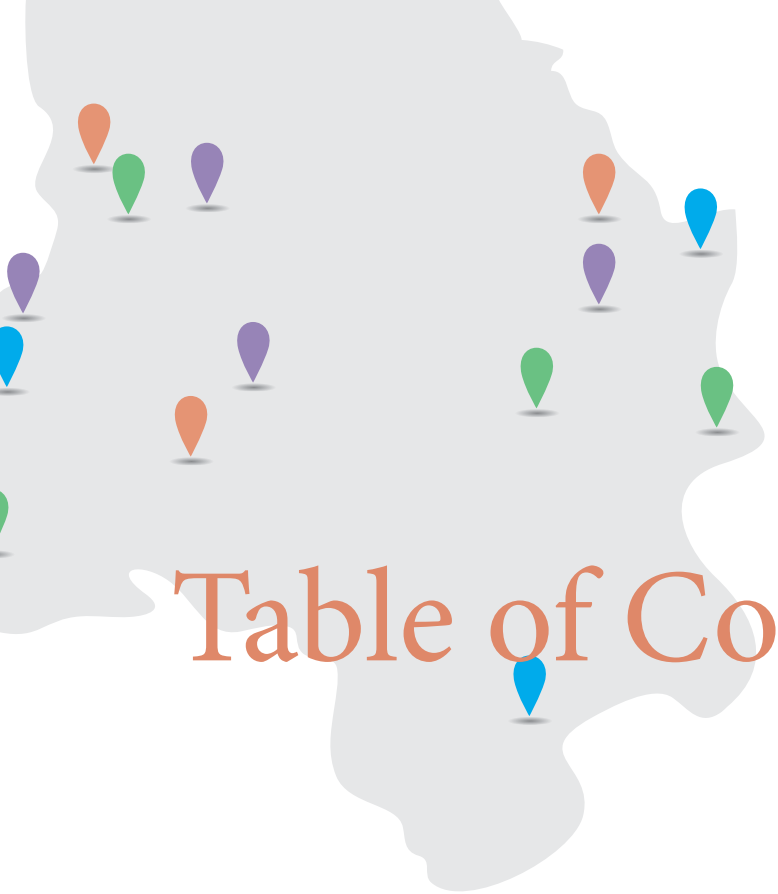

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Abbreviations

BFR	Brominated Flame Retardant
BOD	Biochemical Oxygen Demand
CFL	Compact Fluorescent Lighting
CNG	Compressed Natural Gas
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CRT	Cathode Ray Tube
DDA	Delhi Development Authority
DJB	Delhi Jal Board
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DPCC	Delhi Pollution Control Committee
DSIIDC	Delhi State Industrial and Infrastructure Development Corporation Ltd
EPPCA	Environmental Pollution (Prevention and Control) Authority
ETP	Effluent Treatment Plant
GAIL	Gas Authority of India Limited
GOI	Government of India
HA	Hectare
JNU	Jawaharlal Nehru University
LDPE	Low Density Polyethylene
LFG	Landfill Gas

MCD	Municipal Corporation of Delhi
MLD	Million Litres per Day
MoEF	Ministry of Environment and Forests
MPD	Master Plan Delhi
MSW	Municipal Solid Waste
MT	Metric Tonne
MW	Mega Watt
NCR	National Capital Region
NCT	National Capital Territory
NDMC	New Delhi Municipal Council
NEAMA	National Environmental Assessment and Monitoring Authority
NGT	National Green Tribunal
OH&S	Occupational Health and Safety
PIL	Public Interest Litigation
PM	Particulate Matters
POP	Persistent Organic Pollutant
PVC	Polyvinyl Chloride
PWD	Public Works Department
RSPM	Respirable Suspended Particulate Matter
SC	Supreme Court
SLF	Sanitary Landfill
SSI	Small-scale Industries
TDS	Total Dissolved Solid
TPD	Tonnes per Day
TSDF	Treatment Storage Disposal Facility
U.P.	Uttar Pradesh
WEEE	Waste Electrical and Electronic Equipment
WHO	World Health Organisation
WTE	Waste to Energy

Foreword

Delhi, like many cities globally, has experienced rapid development and population growth in the last few decades. Being the capital of the country the city has many different hues. In addition to providing employment and shelter, it is a centre of culture and learning, a link to the rest of the world and a place for millions for earning their livelihood. The unique characteristics of the city have attracted an eclectic mix of people including a high number of inhabitants whose lifestyles demand high energy consumption, more land for the built environment, and increasing consumption of natural resources. In order to mitigate the negative impact of such growth, especially on the environment, there is a need for strategic planning which goes in tandem with the pace of development. This can only be achieved through a sound information base to support decision-making.

Delhi has been a seat of various industrial and semi-industrial activities which take place within the city boundary. Delhi has 29 industrial estates maintained by the Delhi State Industrial and Infrastructure Development Corporation Ltd (DSIIDC), Municipal Corporation of Delhi (MCD), Public Works Department (PWD) and other agencies. These areas cater to many kinds of industries, including plastic, metal, textile, etc. The city also has one of the largest recycling markets in the world catering to all sorts of wastes and material, with a vast population engaged in formal and informal processing of a mix of toxic and non-toxic waste.

Years of such activities have had an impact on the environment of the city, contaminating the soil, water and air. Poor implementation of environmental norms has made many of these locations probable hotspots of pollution. The general public in Delhi has little knowledge of the existence of environmental hotpots, and even less knowledge of their effects on public health and the surrounding environment. This study focuses on identifying these sites as well as gathering and compiling information related to these sites. The report will enable us to take stock of the city's environmental condition, to look into the future and assess the various policy options for consideration. It would also help in ascertaining if there is an urgent need to look at the current activities in any of these sites and plan remediation. We believe that a well-planned city is the foundation of a strong and adaptable economy and for that we need to sustain our natural resources and retain ecological balance. A study of this nature will help us understand and plan it in a better manner.

Introduction

Environmental pollution is a widespread problem that knows no boundaries. Contamination of water, soil, and air in many parts of the world is a serious environmental problem, and a permanent risk to public health. Industrial development that does not comply with environmental standards has been a major source of pollution all over the globe. Contaminants can range from solvents, acids, effluents and heavy metals, to radioactive substances. The sources of contaminants are not just restricted to industrial processes; other sources may include agricultural activities, inadequate waste disposal, activities like plastic recycling, e-waste dismantling, etc.

Contaminants can take a variety of forms and may impact human beings, flora and fauna, property, etc., in different ways. Leaching of contaminants into the water through runoff not only affects the aquatic system but also pollutes drinking water. Some contaminants may also create explosion hazards or be corrosive to building material. The mode of exposure to contaminants may vary in different sites: inhalation of volatile fumes, drinking groundwater contaminated with effluents discharged from industries, etc.

Over the last three decades there has been increasing global concern over the public health impacts attributed to environmental pollution, in particular, the global burden of disease and body burdens. The World Health Organisation (WHO) estimates that about a quarter of the diseases facing mankind today occur due to prolonged exposure to environmental pollution. Most of these environment-related diseases are, however, not easily detected and may be acquired during childhood, though symptoms may show only in adulthood. The impact of this exposure takes a long time to manifest itself and in developing countries like India, where there is little work and focus on these issues, the links are often ignored.

Industrial growth in India saw the expansion of industries like chemical, steel, automobile, etc., over the past three decades. With this revolution came huge economic and social growth. But during that time, as development and growth were a priority, the environment took a back seat. The consequences of industrial growth for the environment were not fully understood due to a lack of knowledge, and expertise and hence it was difficult to plan sustainable growth. Small-scale industries (SSI) that exist and operate without permissions in the country often defy the prescribed environmental standards, making this a critical issue. Further to this, industrial pollution in India significantly impacts the health of the poorest communities, especially women and children.

To add to this industrial pollution is the huge waste burden and its impact on the environment and people. The growing population and consumerism in the past few decades have made waste a serious issue in the country. India has not just been struggling with industrial waste, but also hazardous and non-hazardous household waste. With informal recycling operations, for which there are no checks, taking care of the majority of waste, recycling processes and standards are big concerns.

Over time, this negligence and the resulting contamination end up creating hotspots. Hotspots are considered delicate areas not only for the environment but also for public health. Therefore, they require identification, periodic remediation and continuous monitoring.

Over the years capacities have been built and there is better understanding and recognition of the environmental impacts, however, huge gaps remain. Going by the lax implementation of environmental standards and huge non-licensed operations (production and recycling), there is a great possibility of high-risk areas and hotspots developing in India but very few studies have been done to identify and manage them in a proper way. To identify and assess the threat, it is important to identify the sites and document the activities in the area, from the past and in present times.

Delhi (also known as the National Capital Territory [NCT] of India) is a metropolitan region in India, located on the banks of the river Yamuna, which includes the national capital city, New Delhi. With a population of 22 million in 2012, it is the world's second most populous city and the largest city in India in terms of area. Being the capital and a commercial hub, the city attracts people from all parts of the country and a sizable portion of New Delhi's population is formed by migrants. Estimated figures indicate that 200,000 to 300,000 people from other states in India settle in Delhi permanently every year.[1] These people come in search of employment and education opportunities and become permanent resident of Delhi. Thus the city is facing unsustainable migration; a consequence of this is poverty which is pushing many unemployed people to turn to informal businesses, some of which are detrimental to health and the environment. Due to the increasing number of rural migrants (who end up as a cheaper labour force) and availability of land in neighbouring states, small - and household-based businesses have mushroomed in recent times. They are unaccounted in industry data and as a consequence of inadequate surveillance, have no environmental standards in place.

As per the Master Plan Delhi (MPD) 2021, all polluting industries need to be shifted out of Delhi by 2021. Though a lot of efforts have been made to shift polluting industries the problem persists. In 2011, the MCD was supposed to close down around 22,000 industrial units operating from residential and non-conforming areas in the city.[2] These areas were mainly Anand Parbat, Shahdara, Sultanpur Majra, Dabri, Shalimar Bagh, Jawahar Nagar, New Mandoli, Rithala, Karawal Nagar, Naresh Park Extension, etc. It took the MCD three months just to identify those units and it is still uncertain if they were closed down. Many of the polluting industries are either located in unauthorised or residential or village areas which are very difficult to track down.

1 http://www.indiaonlinepages.com/population/delhi-population.html.

2 http://articles.timesofindia.indiatimes.com/keyword/yogender-chandolia/featured/3.

Objective & Methodology

2.1 Objective

Delhi is a mix of high technology industrial development along with a wide presence of the informal sector. These burgeoning industries and non-licensed units have made Delhi one of the most polluted cities in the world. Not only that, with open boundaries and no proper land demarcation for industrial areas in spite of the MPD 2021, banned industries still exist and function in Delhi, especially in the border areas. It is, therefore, important to understand and document such operations and the affected areas. Though there have been studies to document water or air pollution in the city, there have hardly been any studies to identify pockets which have hazardous activities or activities which may lead to contamination. This study focuses on identifying such high-risk areas or hotspots.

For the purpose of this study, hotspots are defined as areas with a long history of industrial production or activities which might lead to contamination of the soil, air and water of the site in the near future.

The aim of this report is to identify potential environmental hotspots in Delhi, provide basic information about the processes there, and provide information which could be used to initiate projects for developing more detailed studies and help address this issue in the future.

The main objectives of the study are as follows:

- Identifying the possible high-risk areas or hotspots in Delhi.
- Preliminary assessment of these sites, identifying needs and setting the priorities for future policy.

2.2 Methodology

Delhi has 29 identified industrial areas in which various kinds of industries are given space to operate. Apart from these, there are myriads of villages and unauthorised areas in Delhi where industries, including polluting ones, still persist and operations continue without hindrance. The informal sector accounts for 66.7 per cent of total employment in Delhi.[3] Industries in this sector are scattered and hidden, so getting information about them is very difficult.

Some of these informal units are also located in the notified industrial areas. But the industrial area associations were not always forthcoming about giving information regarding these operations. Hence, a systematic methodology had to be followed to identify the high-risk areas in Delhi as part of this study. The methodology comprises of the following steps:

- Literature review
- Field Study

3 http://infochangeindia.org/urban-india/backgrounder/the-informal-sector-and-urban-poverty.html.

2.2.1 Literature Review

A literature review is the most important part of any research. It helps to identify the issues related to the study, which can be validated by collection of data. Hence, a review was done of existing studies on high-risk areas or contaminated sites, industrial processes that can lead to contamination, etc., to understand problems associated with it.

Though we looked at various studies related to Delhi, there was hardly any historical data on risk areas or studies to identify such areas in Delhi.

2.2.2 Field Study

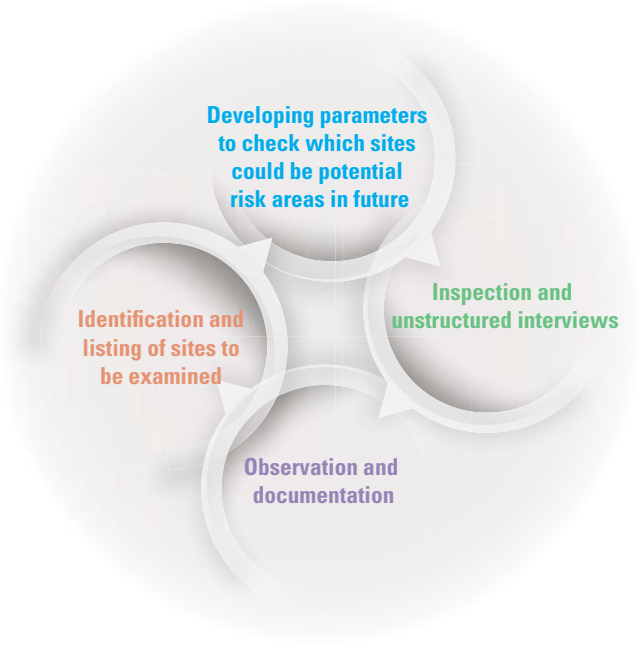
To explore the possible risk areas, it is very important to conduct field visits to the sites and organise unstructured interviews with the industrial units and local residents of the place. Data for preparation of the report was collected from site visits, meetings, and contact with various government and non-government institutions; from the projects carried out in this area, as well as from public enterprises that manage these areas. In addition to providing a realistic picture of the state of these areas, by providing recommendations, the report aims to identify high-priority needs in order to take action for rehabilitation. Our field visit had the following components.

- **Site Identification:** High-risk areas can have major economic, legal, social and planning implications for the community. Contamination of soil and groundwater can limit land use potential or increase costs for developers, property owners and local authorities. For this particular study, 51 sites were identified as prospective hotspots based on the kind of activities/operations happening there currently or historically. Identification was done with the help of local experts, data obtained from the DSIIDC and MPD 2021. These sites were then divided into four zones: North, East, South and West, and were evaluated according to the parameters identified by the team.
- **Development of Parameters to Assess the Quantum of Risk:** Industrial activity significantly contributes to development and economic growth, however, such activity also has the potential to degrade the environment. Environmental degradation occurs not only due to large industries and factories but also small-scale, home-based units, which exist in abundance. Such units are largely unmonitored by the government, and they do not follow any safety norms, thus causing tremendous damage to the environment. Often, these units are unauthorised. Low awareness and poor financial conditions are major reasons for the poor conditions.

  It was very difficult to decide parameters to understand the possibility of contamination for the study. After much discussion, the following parameters were identified:

  - **Industrial Process:** To identify different types of industrial activities or processes happening in different industrial clusters, so that we can get an idea about the possible environmental and health issues that may arise.
  - **Use of Chemicals:** Different processes use different kinds of chemicals. Some may be toxic and

Figure 1: Steps in Field Visit



hazardous in nature. Hence, it is essential to identify such chemicals and their end disposal in these areas.

- **Discharge and Emissions (Air/Water/Soil):** This is a vital parameter which would decide the contamination level of an industrial cluster or areas with industrial activity. Understanding the possible emissions or discharges during the process is important when we are looking at high-risk areas and also helps to determine if there are any measures taken to mitigate these.
- **Disposal Technique:** Waste and chemical disposal remains a big cause for contamination in India. Hence it is important to look at this as a parameter to identify possible hotspots.
- **Occupational Health and Safety (OH&S):** Occupational safety is a neglected area in India, not just in the unorganised but also in the organised industry, especially in small- and medium-scale industries. Workers in factories and small units are in direct contact with chemicals and contaminants on a daily basis and at a great risk of exposure.

- **Unstructured Interviews:** A site inspection plan was made and visits were made to these sites. One-to-one interviews with local workers and residents helped us find information and build knowledge about the area. We followed the leads from the interviews which helped us identify various units and areas. Some units in each area were visited to understand industrial practices and processes.
- **Observation and Documentation:** It was quite difficult to get information from people at the sites as they were not very forthcoming. Photography was not allowed in most of the areas. We gathered information mostly by talking to workers, people living around the area and residents.

2.3 Limitations of the Study

There were various challenges faced during the study. Of these, the most prominent one was to study operations and activities with no licenses or permissions. As these operations are illegal and unauthorised, even finding their location is difficult. Moreover, collecting information from people at the units regarding their operations and material channels is difficult as they are not very cooperative.

Even formal industrial plants and units were not very keen to share information or allow us to see their operations.

Also, there were limitations to the number of sites which could be visited during the study. The team shortlisted the sites based on secondary research and prior experience and hence it is possible that some sites may have been missed.

This study also did not have provisions for testing air, water and soil for possible contamination.

Delhi: Profile

3.1 The Area and Location

Delhi is located in North India at a latitude of 28'-53'-17" to 28'-53'-00" and east longitude of 76'-50'-24" to 77'-20'-3". From one end to another, the greatest length of the city is nearly 52 kilometres and greatest width is 48.48 kilometres. Delhi has 209 villages and 9 districts. It is the second most populous metropolis in India, with a population of 22 million and coverage area of 1487 square kilometres (MPD 2021). Bordered by Haryana in the north, south and west and Uttar Pradesh (U.P.) across the river Yamuna, Delhi is located approximately 213 to 305 metres above sea level.

3.2 Geology

The city of Delhi lies in the fertile northern plains of India. The main features of Delhi are the Aravalli hill ranges and the Yamuna River. Land use in Delhi has undergone significant changes during the last two decades due to ever increasing population, rapid industrialisation and urbanisation. Delhi's soil is alluvial, which is usually formed due to soil degradation, flooding and salinity. Delhi has 12 per cent land under agriculture and is suitable for growing wheat, maize, tomato, cabbage, etc.

The major source of drinking water in the state are the rivers Ganga and Yamuna, Bhakra Beas Management Board and ground water from Ranney wells and tube wells of the DJB. The groundwater availability is controlled by characteristics of the soil and rocks. The majority of the land is covered by fine to coarse loamy soil with different levels of moisture-retention capacity.

3.3 Climate

Delhi has a semi-arid climate, with hot summers, average rainfall and moderate winters. The temperatures go up to 40–45° Celsius in summers and down to 4–5° Celsius in winters. The annual precipitation is about 711 millimetres, falling largely during the monsoon months (July–September). Dust storms are frequent during the summer months leading to an immense build-up of particulate matter in the atmosphere.

3.4 History of Environmental Pollution

Delhi, which was known as a centre for trade and governance, has emerged as a multi-functional city adding SSIs as well as a wide range of commercial and service-oriented industries to its range of economic activities. However, this change has been unplanned and unregulated. The rapid growth of Delhi in recent times has resulted in a sig-

Figure 2: Map of Delhi

Delhi is the capital of India and its third-largest city. The city consists of two parts: Old Delhi was the capital of Mughal India, and New Delhi, the imperial city was built as the capital of India by the British.

nificant increase in environmental pollution. A study funded by the Ministry of Science & Technology, Government of India (GOI) in 2013 has identified the metropolis as a 'high health risk' zone, stating there is an alarming rise in the level of outdoor particulate matters (PM) in the city.[4] In a previous study by Jawaharlal Nehru University (JNU) in 2012, it was revealed that the air in Delhi was full of carcinogenic particles. This toxicological risk assessment report pointed out alarming levels of aerosol and heavy metals (cadmium, chromium and nickel) in the city's air.[5]

The rise in population and growth in economic activity has contributed hugely to the increasing pollution in Delhi. Most areas in Delhi are plagued by acute problems related to municipal solid waste (MSW) resulting in unhygienic living conditions for inhabitants. But the concern is more critical due to polluting industries and hazardous activities in the city, especially in residential areas and those that are not identified as industrial areas.

A white paper on pollution in Delhi, which contained an action plan was published by the Ministry of Environment and Forests (MoEF) in 1997.[6] It identified three major kinds of pollution in Delhi:

- **Air Pollution:** This was a major issue in Delhi. Air quality data of the government's pollution watchdog, Central Pollution Control Board (CPCB) for 2010 shows that Delhi is among the worst affected cities in terms of air pollution. In 1975, vehicular population in Delhi and Mumbai was same. But by 1997, Delhi had three times more vehicles than Mumbai. Vehicular pollution contributed 67 per cent of the total air pollution load in Delhi. Another 25 per cent was generated by industries and coal-based thermal power plants. The three power plants in Delhi generated 6,000 metric tonnes (MT) of fly ash per day.
- **Water Pollution:** The river Yamuna, once the reason for Delhi's very existence, has now turned into nothing more than a drain. In 1997, 17 drains were discharging about 1,900 million litres per day (MLD) of municipal sewage and wastewater into the river Yamuna. The industrial effluent load discharged into the Yamuna was 320 MLD. The Najafgarh drain contributes to 60 per

4 http://indiatoday.intoday.in/story/delhi-still-the-most-polluted-city/1/298028.html.

5 Khillare and Sarkar, *Airborne Inhalable Metals in Residential Areas of Delhi, India: Distribution, Source Apportionment and Health Risks*, 2012.

6 http://moef.nic.in/divisions/cpoll/delpolln.html.

> Pollution levels in residential areas of Delhi are known to be dangerously high and that is one of the reasons why polluting manufacturing units were moved out of Delhi. In spite of that, the city, including the heart of the capital, remains critically polluted.

cent of the total wastewater. Treatment plants are all underutilised and not efficient enough to treat the entire wastewater.

- **Industrial Pollution:** Delhi was the hub for all kinds of small-, medium- and large-scale industries. Small- and medium-scale industries were mostly located in unauthorised areas or villages as per the MPD. In 1995, M.C. Mehta filed a public interest litigation (PIL) regarding industries located in residential area. The Supreme Court (SC), after considering the report from the CPCB and Delhi Pollution Control Committee (DPCC) in 1996, ordered all the polluting industries to either shut down or shift out of Delhi.

3.5 Existing Legal Framework in India

Despite the absence of a concise environmental regulatory framework with respect to contamination sites in India, progress in protecting the environment has been made through the application and expansion of existing environmental laws, use of proactive concepts including the 'polluter pays principle' and the precautionary principle and aggressive use of PILs.

Although India does not have specific standards for contaminated sites, there have been many instances where companies or industries have been penalised and held liable for soil and groundwater contamination. Applicable environmental laws include the Water (Prevention and Control of Pollution) Act, 1974 and Environmental (Protection) Act (EPA), 1986. Hazardous Waste (Management and Handling) Rules, 1989, notified under EPA, is the framework for managing the industrial waste and follows the polluter pays principle. It imposes liability on property owners and operators and the penalties imposed have included site closure and recovery of the cost of remediation from the responsible companies.

Public interest litigation has given the judiciary enormous scope for intervening in environmental matters and passing severe penalties against companies that have been found guilty. However, much needs to be done by the government in this area. As a result, the government has launched special courts for environmental issues, such as the National Green Tribunal (NGT) under the National Green Tribunal Act, 2010, and is soliciting comments for setting up a National Environmental Assessment and Monitoring Authority (NEAMA).

Table 1 mentions all the agencies concerned with activities directly dealing with environmental services, environmental infrastructure investment and environmental planning at the project and sectoral levels. Only two agencies, DPCC for Delhi and Environmental Pollution (Prevention and Control) Authority (EPPCA) for the National Capital Region (NCR) are responsible for regulating, monitoring and enforcing environmental concerns.

3.6 Industrial Units in Delhi

As per the economic survey of Delhi 2001–02, there were about 129,000 industrial units in Delhi in 1998, against 85,050 units in 1991. An average unit employed nine workers while 30 per cent of units employed less than four workers. Units related to textile products constitute the largest number followed by repair services and electrical machinery.

Table 1: Agencies in Environmental Management and their Role

Agency	Role
Delhi Pollution Control Committee (DPCC)	Compliance of water, air, noise parameters at Delhi level
Central Pollution Control Board (CPCB)	Compliance at national level, monitoring of water quality of the Yamuna and discharging drains at various locations
Delhi Jal Board (DJB)	Ensuring water supply and managing raw water in Delhi, discharges in Yamuna
Municipal Corporation of Delhi (MCD)	Solid waste management, drainage and sewerage, street cleaning
Environmental Pollution (Prevention and Control) Authority (EPPCA)	Enforcement of environmental regulation in NCR, hazardous substances
Department of Industry – Delhi State Industrial Development Corporation (DSIDC)	Relocation of polluting and non-conforming industries

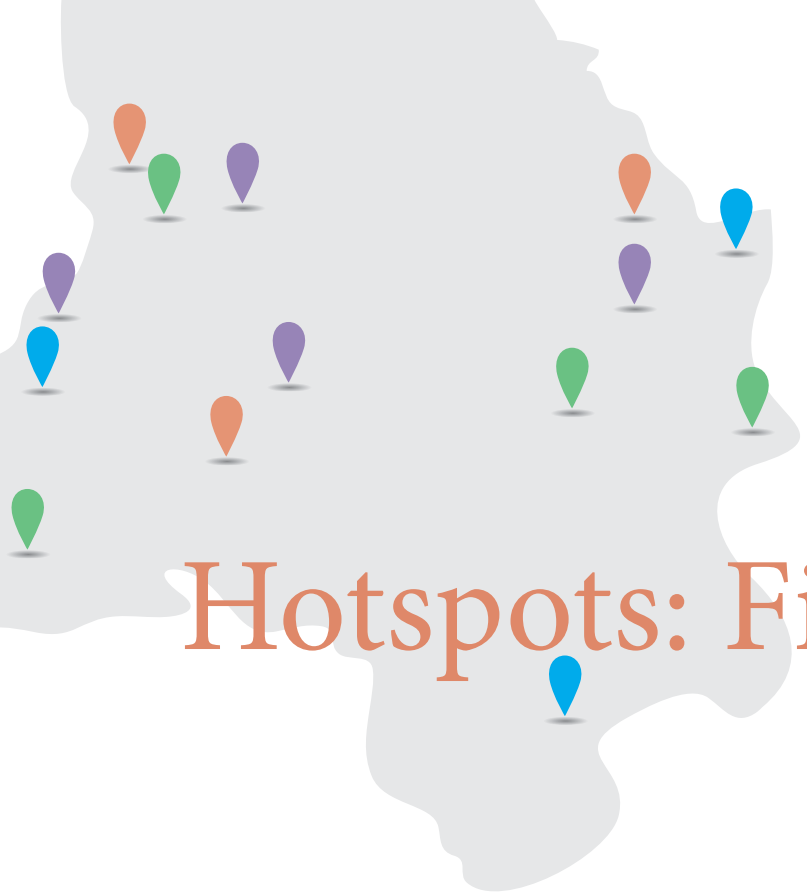
Delhi has 29 identified industrial areas. The industrial estates of Bawana, Narela, Badali, Mangolpuri, Okhla, Patparganj and Shahdara were developed in the 1970s and over the years have deteriorated considerably in terms of physical infrastructure. The industrial estates in the city are owned by three agencies: DSIIDC, Delhi Government Industries Department and Delhi Development Authority (DDA). These industrial estates have various problems such as pot-holed roads, overflowing garbage bins, lack of water supply, improper electrical installations, absence of banks and common facility centres.

It has been more than two decades since the SC ordered the shifting of polluting industries from Delhi, yet the implementation of this order is a big question mark. Accepting the order of the SC, the CPCB categorised various industries as green, orange or red, based upon varying levels of air pollution potential from low to high, respectively (MoEF, 1989). Highly polluting industries (categorised as red) and brick kilns were not permitted to operate within the jurisdiction of the NCT of Delhi. However, even now, thousands of small and medium polluting enterprises, recycling units, unorganised markets and villages exist in the state. The major difficulty in taking action against them is that relative invisibility, as they are either home-based or operate out of narrow lanes in residential colonies or villages or located in border areas that are difficult for the government to monitor.

Table 2: Growth of Industrial Units and Employment

Year	Number of Industries	Number of Employees	Employees per Industry
1981	42,000	568,910	14
1991	85,050	730,951	9
2001	129,000	1,440,000	11

Source: MPD 2021



Hotspots: Findings

The term hotspot is now becoming a common definition in the field of environmental protection. It is increasingly used to draw attention to specific situations or certain environmental concerns. The term is used to describe areas with high pollution potential and related environmental and public health impacts. Environmentalists usually use the term hotspot when referring to negative change and environmental deterioration in a particular area, or to describe contaminated areas that remained uncontrolled or unmonitored over a period of time, and have a harmful effect on the environment and humans. Though the term may also be used positively, in this report, the term hotspot should be understood in the negative sense, as it has been used to denote polluted areas which are created as a result of various economic activities.

This report looks at industrial and other activities in the city and identifies areas that are likely to develop into hotspots.

4.1 Priority Industries and Activities

Industrial activities like plastic moulding and extrusion, e-waste recycling, jeans dyeing, compact fluorescent lighting (CFL) recycling, etc., are commonly found in both authorised and unauthorised industrial areas of Delhi. Based on initial research, certain industries were identified as critical and contributing significantly to the damage. This damage was caused either by the hazardous material they were using or due to their presence in residential areas, among other reasons, that included the scale of the units and the area they covered. Most of these operations are carried out in the unorganised sector where safety norms are not followed. However, many a time even formal units in industrial areas do not follow the norms laid down by the authorities and end up raising health and environmental concerns.

- Lead Acid Battery Recycling: Recycling of used lead acid batteries is banned in Delhi, yet such operations continue to flourish near the border areas of the capital. Due to lack of proper state boundary demarcation, most of these units are said to be located in the NCR even though they draw their electricity and water connections from Delhi.

  Operating practices and working conditions vary tremendously in each unit, but on the whole:

  - There are few or no facilities for the neutralisation and safe disposal of battery electrolyte, hence acidic effluents percolate into the water table, rivers and sanitary system.
  - There are few furnace exhaust control systems to prevent atmospheric pollution.

- Furnace residues are unstable and leachable, and tend to have a high lead content. The residues are dumped indiscriminately either around the premises of non-licensed smelters or sent to landfills.
- Occupational hygiene is poor and few operators wear masks to protect themselves from lead fumes.
- These are located close to shops and homes, increasing the risk of lead exposure for the general population.

- CFL Recycling: In India, used and discarded CFLs from households are collected by *kabadiwalas* and handed over to traders. The traders separate CFLs that can be refurbished or reassembled and sell the remainder to recyclers for the recovery of glass material and circuit boards. These operations are completely in the unorganised sector. Workers with no knowledge of the hazards associated with mercury reassemble CFLs, which contain mercury, with their bare hands. Sometimes CFL's break during assembling and transportation exposing workers to mercury vapours.
- E-waste Dismantling: Dismantling of e-waste is not allowed without proper authorisation in India under the E-waste Rules, 2011. Further, dismantling is not an authorised activity in Delhi as per the MPD. In spite of this, the hazardous practice of dismantling continues in many areas in the unorganised setups. E-waste containing toxic materials like lead, mercury, cadmium, etc., is broken and separated in the informal sector in a very crude manner. Units that operate in residential colonies in Delhi pose a threat to the environment and human health. Women and child labourers are often employed in the dismantling process.
- Pickling: When stainless steel is manufactured, it goes through a unit process called pickling. The aim of this operation is to remove oxide layers from the steel surface as well as a chromium depleted zone underneath. The pickling solution normally consists of a mixture of nitric and hydrofluoric acid. During this treatment, metals such as iron, chromium, nickel and molybdenum are also released in the bath where they form different complexes with the acids. Spent acid liquor is a highly hazardous chemical and should be treated before being discharged. The traditional method for treatment of spent pickling liquor before discharging to the recipient is neutralisation where a rise in pH leads to chemical precipitation of metals as hydroxides.

  The output from neutralisation is sludge with high metal content. For an optimal process management it is important to have a good measure of the acid concentrations and the amount of added chemicals. Since nitric acid is used, pickling gives a discharge of nitrates which are not captured in the neutralisation process. It is difficult and expensive to reduce them. As a consequence, nitrates will follow the wastewater into our natural waters where they act as excessive fertilisers.

  The pickling process is considered hazardous under the Hazardous Waste Rules, 2008. Though there were appeals by the pickling industry to continue operations in Delhi, the NGT in 2013 restrained such units from carrying out any manufacturing activity in Delhi without the consent of the DPCC. However, various units are still operating in different parts of the city.
- Dyeing: Though the process of textile dyeing is not hazardous per se, the wastewater that is generated contains myriads of toxic chemicals. The process deals with various chemical dyes with a high content of chromium, lead, etc. Jeans dyeing is a widespread activity in unauthorised areas of Delhi, hidden from the authorities. As per the rules, wastewater from textile industries needs to be treated by the respective industries before it is released into the drainage system. Most of the units release it directly into nearby drains. Workers handle the dyes with bare hands without knowing the subsequent consequences.

Table 3: Chemicals Used in Different Industrial Processes

Industrial Process	Chemicals/Materials of Concern
E-waste Processing	Lead, Mercury, Cadmium, Brominated Flame Retardant (BFRs)
Jeans Dyeing	Dyes containing lead, cadmium, etc., caustic soda
Lead Acid Battery Recycling	Lead oxide
CFL Assembling	Mercury
Pickling and Polishing	Acids: HCL, HF, H_2SO_4, polishing bars

Apart from these industrial activities, the two areas of concern reviewed during this study are:

- Chemicals Market: There is an open chemicals market in Delhi, near Chandni Chowk. All types of chemicals ranging from ordinary to banned chemicals are found in this market. It is a small, congested market with hundreds of people living in nearby areas.
- Landfills: Delhi has three active landfill sites: Okhla, Ghazipur and Bhalswa. A large number of informal workers earn their living from waste segregation and recycling in these landfills.

4.2 Hotspots in Delhi

Delhi is reported to have 130,000 industrial units, of which only 25,000–30,000 are located in the planned industrial areas or comprise permissible household industries.[7] The remaining industries are located in residential areas and are not considered as 'safe' units to be operated in such areas. The uncontrolled industrial development began in the villages surrounding the Lal Dora area of Delhi. Since it became profitable to install SSIs in such non-conforming areas, this has been on the rise. There is certainly concern over these units, but there is also concern about the permissible industries in the planned areas not conforming to prescribed norms and rules. Fifty-one sites were identified for evaluation and were visited during the study period. The sites included in the list were in the industrial areas as well as small, unauthorised villages or housing colonies.

These sites, many dominated by informal sector workers and operations, had a mix of processes and activities, with some sites specialising in a particular process or industry and some home to different types. South Delhi had the least number of such industries on the list. Plastic appeared to be a dominant industry, spread in almost all parts in Delhi.

In these sites, as discussed earlier, the following elements were looked at to analyse the risks or to categorise them as possible or future hotspots:

- Location (proximity to water body, residential area, etc.)
- Use of chemicals in processes (toxicity, storage, etc.)
- Contamination (of air/water/soil from releases during processes)
- Waste Disposal
- OH&S (use of protective equipment)
- Workers profile (employment of women and children)
- Knowledge about risks among workers

In most areas we found that environmental norms were flouted and the units functioned without proper environmental standards. The worker safety and occupational safety equipment were not in use, thereby exposing people to the risk of accidents and exposure. Waste disposal also remained a major concern in both industrial areas and residential areas from which the units operated.

Based on these criteria, out of 51 sites visited and evaluated during the study, the areas mentioned in the section below were recognised as possible 'high risk areas' or potential hotspots.

Table 4: Areas Visited During the Study

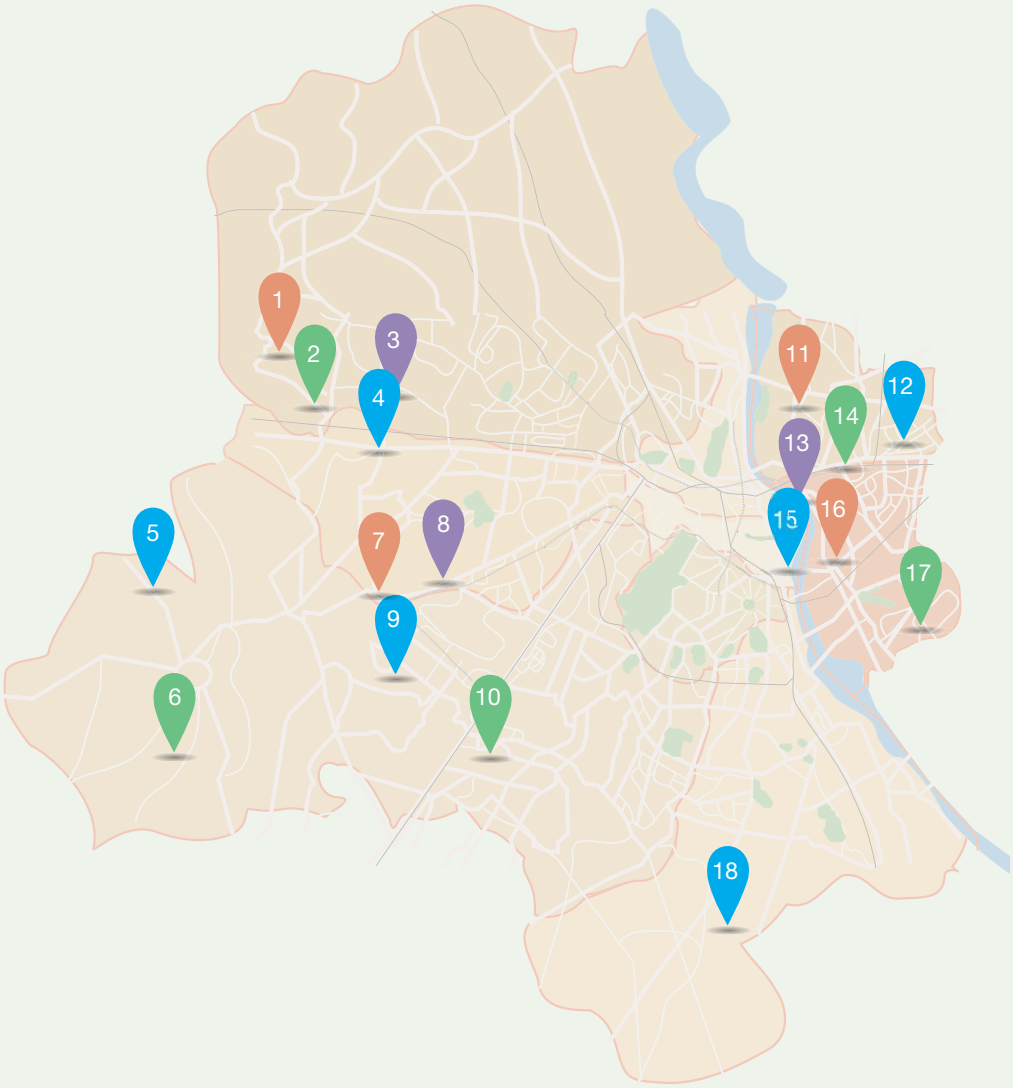
S. No.	Site	Processes/Operations
1	Alipur	Storage: food items like wheat, cereals; kabaadiwalas; glass separation
2	Anand Parvat	Plastic moulding, metal work, engineering
3	Badli	Manufacturing: plastic crockery, steel plates and utensils; plastic moulding; engineering goods
4	Bawana Industrial Area	Manufacturing: rubber belts; Storage: cardboard and paper; plastic moulding and extrusion; food processing
5	Bhalswa Landfill Site	Dumping of MSW, medical waste and construction debris
6	BudhVihar	Storage: cardboard and paper; plastic grinding units
7	Ghazipur Landfill Site	Dumping of MSW, butcher waste from the nearby fish and meat market
8	Gokulpuri	Cathode ray tube (CRT) regunning and refurbishing, automobile repairing
9	Inderlok	Plastic extrusion, moulding, grinding
10	Jhilmil Industrial Area, A & B Block	Manufacturing: Polyvinyl Chloride (PVC) cables, Low Density Polyethylene (LDPE) sheets, non-stick cookers; metal work; utensil polishing
11	Johripur	Plastic pelletisation and moulding, chain casting
12	Kamruddin Nagar	Plastic pelletisation
13	Karawal Nagar	Manufacturing: Aluminium utensils; plastic pelletisation and moulding, chain casting, zinc polishing, etc.
14	Khyala	Engineering goods, plastic moulding, metal works
15	Kirti Nagar	Plastic extrusion

7 http:/9/www.ccs.in/ccsindia/pdf/Ch04_City%20Environment%20Profile.pdf.

S. No.	Site	Processes/Operations
16	Lawrence Road	Food processing: cereals, flour, spices; plastic moulding
17	Madanpur Khadar	Melting of thermocol, large scrap dealer shops
18	Mandoli	Metal works: Copper, Zinc, Aluminium, Brass; plastic extrusion; e-waste processing; lead acid battery recycling
19	Mangolpuri Phase I + DSIIDC	Manufacturing: cosmetics; storage: cardboard and engineering goods; plastic moulding; utensil polishing; battery plating
20	Mangolpuri Phase II	Storage: cardboard and industrial goods; plastic moulding; printing
21	Mayapuri	Dye casting, textiles, printing, engineering goods, plastic moulding, pellets making, automobiles
22	Moti Nagar	CFL trading and assembly
23	Mundka	All type of plastic work including storage, segregation, trading, grinding, and moulding
24	Mustafabad	E-waste dismantling, CFL repairing, plastic grinding, CRT refurbishing
25	Najafgarh (Nagli Sakrawati)	Jeans dyeing, printing, engineering goods, pharmaceutical industry, food processing, plastic moulding and extrusion, metal work
26	Nangloi	Plastic recycling
27	Naraina Phase I (A, B, C & Z blocks)	Plastic extrusion from resin and waste, plastic moulding, nickel polishing, engineering, printing
28	Naraina Phase II	Printing press
29	Narela Industrial Area	PVC footwear, plastic extrusion, PVC cables, PET, disposable cups, food packaging, engineering, injection moulding, pharmaceutical, printing, etc.
30	New Seelampur	PVC wire recycling
31	New FC Industrial Area	Plastic recycling and moulding, engineering goods, cosmetics, pharmaceutical industry, metal works: copper and aluminium
32	Okhla Landfill Site	Dumping of ash and construction debris, medical waste and MSW
33	Okhla Phase I	Textile dying, plastic moulding and granules, printing press
34	Okhla Phase II	Plastic moulding and granules, printing press
35	Okhla Phase III	Printing press
36	Old Seelampur	Waste Electrical and Electronic Equipment (WEEE) dismantling and dyeing
37	Patparganj A, B & C block	Plastic extrusion, moulding, metal works: copper and aluminium
38	Pooth Kalan	Plastic pellet, rubber grinding, chain casting, utensil polishing; storage: plastic & rexin
39	Prem Nagar (UP)	Lead acid battery
40	Punjabi Bagh	Engineering goods, automobile repairing
41	Rampura	Kabaadiwala, textile cutting, paper, oil-soaked clothes, bakelite powder
42	Ranhola Gaon	Plastic grinding, washing, extrusion, jeans dyeing, textile waxing
43	Samaypur and Lebaspur	Plastic moulding and extrusion, jeans dyeing, engineering goods, steel utensils, lead acid battery
44	Shastri Park	E-waste dismantling
45	Sultanpur Mazra	Lead acid battery assembling, plastic pelletisation and grinding, engineering goods
46	Tikri Kalan	PVC sole segregation and plastic market
47	Tilak Bazar	Open sale of chemicals, including toxic material like mercury
48	Udyog Nagar + DSIIDC	Plastic pellet, moulding of footwear, etc., textile, cardboard making and engineering goods
49	Vishwas Nagar	Plastic pellet making and moulding, cardboard and electrical goods assembling
50	Wazirpur	Steel work: heating plate, utensil manufacturing, polishing
51	Yamuna Vihar	CRT regunning and refurbishing

Figure 3 : Potential Hotsopots

Lead Acid Battery	Pickling	Dyeing	Landfill
E-waste	CFL Recycling	Metal Scrap	
CRT	Furnace Operation	Automobile Scrap	



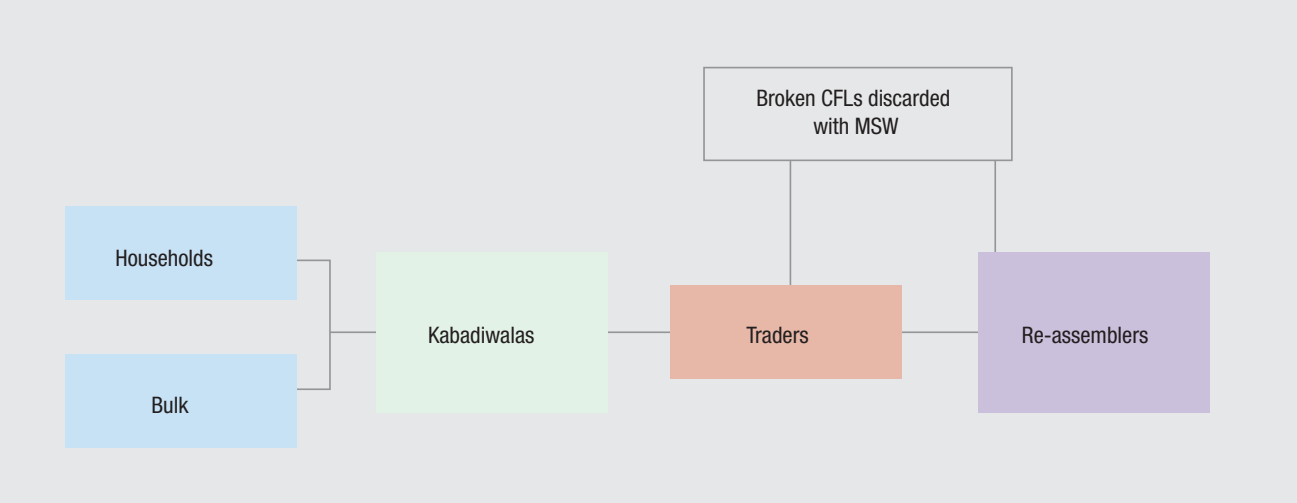
1. Samaypur
2. Badli
3. Lebaspur
4. Bhalswa
5. Ranhola Village
6. Najafgarh
7. Moti Nagar
8. Anand Parbat
9. Wazirpur
10. Mayapuri
11. Mustafabad
12. Mandoli
13. Yamuna Vihar
14. Gokulpuri
15. Shastri Park
16. Old Seelampur
17. Ghazipur
18. Okhla

Moti Nagar

Compact fluorescent lamps, once considered a boon for the environment for their energy-saving properties, are now a cause for concern because of the presence of mercury. The concern is mainly for the manufacturing stage when there is occupational exposure, and end-of-life disposal as mercury, if not disposed properly, has the potential to cause damage to public health.

Moti Nagar in West Delhi specialises in dealing with end-of-life CFL bulbs. The bulbs, discarded by households as well as bulk consumers through small and big kabadiwalas, reach the traders operating in this area. The area is well known for trading and assembling of discarded CFLs, with assembling units located in residential colonies. There are thousands of households engaged in this hazardous work, each unit with 3–4 workers employed for assembling work. Mostly male workers are hired as this is considered to be technical work.

Figure 5: End-of-life CFL Flow



The traders dealing with CFL lights source the material from large scarp dealers or kabadiwalas. There is lot of breakage during transportation and broken bulbs are segregated and discarded, as they can't be sold to re-assemblers. Discarded bulbs are thrown along with other waste and picked up by the municipal waste collector. The waste collectors charge for collecting this waste, as they are aware that this is hazardous material. This lands up in the nearby dhalaos or local waste collection centres, to ultimately be transported to landfill sites.

Unbroken CFL bulbs are sold by traders to re-assemblers who then take out the faulty components and replace them with new or working components (sourced from other bulbs as well as new ones). Most new components are sourced from China. Though no one was willing to tell us the exact costs of individual parts, an approximation was done based on the information provided by the workers. Reassembling costs including labour range from Rs 23–30 per piece depending on the quality of the CFL, and assembled CFLs are sold at Rs 26–37 per piece. Workers in the units are experts and very deft; each one can reassemble 100–300 pieces within eight hours. Most of them are salaried workers earning Rs 6,000–10,000 per month depending on their quality of work.

During reassembling, various components are fixed together using acid and soldering. Lead soldering is used to join the components. Workers carry out the assembly work with bare hands without any knowledge about the hazards associated with the product or material used. Though metallic mercury is not used during the process, there is a lot of breakage during the assembly, increasing the risk of exposure to mercury vapours for the workers. These broken CFLs are discarded along with the MSW and picked up by the waste collectors. According to the waste collectors, they often get cuts because of the broken glass in the bins.

The working conditions in these assembling units are appalling, with small non-ventilated rooms and no safety measures. The workers have no safety equipment. Though most unit owners were aware of the mercury hazard, they chose to ignore this and carry on working in the residential colonies. The presence of such units in residential areas does not just pose a serious threat to the health and safety of the workers, but also puts the residents living in the area at the risk of exposure to hazardous material.


Xipol

Risks

- Illegal units: not recognised as industrial area.
- Units operating in residential colonies and hence risk of exposure to the residents.
- Emission due to breakage in transportation and assembling.
- Lead soldering being used without any precaution.
- Occupational exposure to the workers.
- Hazardous waste disposed off in the municipal bin.
- Hazard to waste collectors.

Mandoli

Delhi's fluid boundaries with its adjoining areas at times cause problems in environmental monitoring and compliance. This is probably one of the reasons why Delhi still has some polluting industries operating in the state, especially in the border areas. One such area is Mandoli, located in the eastern part of Delhi and sharing its boundary with Ghaziabad, U.P.

Various kinds of industrial activities happen in and around this area, among which metal work, extrusion and pelletisation of plastic from e-waste and lead acid battery recycling are very common. There are almost 150 small-scale units in this area with 2–5 workers per unit. The working environment in the units is very poor and unhygienic. The plastic units in particular are poorly ventilated with people working without any protective gear. The waste plastic pieces from the processes are burnt openly instead of being properly disposed, releasing toxic fumes into the air.

Prem Nagar, one of the pockets in Mandoli is a hub of hazardous activities, with close to 110 lead acid battery

recycling units. Geographically, Prem Nagar falls under U.P. state . But the interesting fact found during the study was that all these units get their electricity and water supply from Delhi. These units do not have knowledge about pollution control devices, nor can they afford to invest in them, hence they become hubs of hazardous activities and possible hotspots.

Most units in this area relied on coal to fuel crude furnaces and recovered lead in a very crude manner. During the recycling process, battery acid is haphazardly dumped on the ground, waste pile or into the nearest water body. There is a high possibility of this spent acid containing lead particulates. As the lead plates are melted, lead ash falls into the surrounding environment, collects on clothing or is directly inhaled by workers in close proximity. Not only the workers, but even the local communities are at a high risk of exposure to toxic lead.

Risks

- Presence of units with hazardous activities.
- Burning of plastic waste in the plastic units.
- Spent acid with lead particles disposed off in nearby drains or open fields.
- Occupational exposure to the workers, especially working in the lead acid battery recycling units.
- Lead fumes emitted during the process.

Old Seelampur and Shastri Park

Approximately 15 kilometres from the centre of Delhi is the area of Old Seelampur, the biggest e-waste dismantling and trading market in the country. This residential area in east Delhi, with narrow lanes, is lined on both sides with shops filled with the debris of electronic equipment: computers, cellular phones, televisions, etc. Truckloads of e-waste, including end-of-life cathode ray tubes (CRT), printers, etc., land here every day from all over the country. Going through the lanes and by lanes of Old Seelampur, one finds godowns full of dismantled circuit boards strewn around; computer parts like hard disks, CD drives and keyboards stacked in heaps; and mounds of CRTs lined up on the sides. The houses in the area are spilling over to the streets and are filled with entangled wires, broken computers, keyboards and other waste with youngsters, women and children rifling through the scrap piles. They break down the equipment, hunting and separating components with value, for instance, those containing precious metals like silver, copper, etc.

The traders in Seelampur source electronic scrap from small kabadiwalas, who collect it from individual households and also through auctions from large corporations

In India, Battery (Management & Handling) Rules, 2001 were notified more than a decade back and the producers or the battery manufacturers were made responsible for taking back and recycling end-of-life batteries. Even now, most end-of-life batteries end up in the informal market and are recycled in unregulated units.

Prem Nagar near Mandoli is one such centre.

or public sector units. But a large chunk of their waste also comes from developed countries like the U.S. and European countries. The traders employ some labour to segregate the working equipment, which can fetch a better price. The non-working equipment is sold to dismantling shops in the area.

The shops operating out of sections of homes are a bed of hazardous activity. In small rooms, workers continuously dismantle different electronic and electrical equipment manually, using hammers and other tools. Some of the hazardous activities are also done on the roofs of houses to avoid the public eye. In most of the rooftops and in the little rooms, the circuit boards are heated on stoves or through blowtorches to desolder them, melting away the lead soldering to retrieve the Integrated Chips (ICs), capacitors, etc. The lead fumes emitted engulf these workspaces, exposing the workers to this deadly metal and poisoning the air. The melted lead solder is often swept away to the streets or nearby drains.

The workers in the areas handle circuit boards, leaded glass, brominated flame retardant (BFR)-laded plastic, and PVC-coated wires without any precautionary measures to control unwanted emissions and discharges. Some of the shops in this area are also involved in CRT regunning. On an average, they work for about 10 hours a day, sitting in the midst of piles of computer or other electronic waste, in a small, unventilated room. Depending on the type of work, they earn Rs 60 to 200 per day, the female workforce earning lower daily wages. The conditions in these units are extremely precarious and unhygienic. The workers deal with toxic e-waste without any protective clothing or gear, exposing themselves to the risk of physical injuries and hazardous chemicals. Children and

women are the more susceptible part of the workforce and are found working in most units in the area. The non-recyclables are often burned or disposed off in the nearby drain, causing further damage.

The unit owners as well as workers are aware that they are dealing with something illegal and are not forthcoming in showing their work to outsiders or being photographed. Most workers, though, are unaware of the health risks that they are exposing themselves to.

Shastri Park, which was once an e-waste trading and dismantling area, is now drying up with only 50–60 odd shops as compared to 200–250 units in Seelampur. But the hazardous dismantling continues in these shops as well, causing health and environmental risks.

Old Seelampur, in addition to the e-waste units, also has 7–10 shops involved in textile dyeing.

Risks

- Presence of units in residential colonies.
- E-waste dismantling units in abundance.
- Lead fumes and remains poisoning the area.
- Employment of teenagers, women and children in large numbers.
- Non-recyclables being burnt or thrown carelessly in the area.
- Dyeing units without effluent treatment plant (ETP).
- Occupational exposure.

Mustafabad

Located in the north-eastern part of Delhi, Mustafabad is known for e-waste dismantling and CRT regunning. There are around 40–50 non-licensed units in this area, working within residential colonies. Each of these units employs 3–4 workers, especially young boys.

The operations or processes in Mustafabad are similar to Old Seelampur, with similar risks of emissions and discharges. The major difference is the scale of operations, which are smaller in Mustafabad. The number of units focusing on CRTs is larger here.

This area is known for the CRT regunning process in which the necks of old CRTs are cut and new necks joined by glass welding. The new electron gun and gas input pipe is fixed and gas is then filled in enclosed chambers. These units don't have proper technology for regunning and use methods that are very crude and rudimentary. Gas chambers, which are supposed to be enclosed, have chances of leakages. Workers involved in the processes don't use proper protective gears like masks or gloves, exposing them to fumes and gases. During neck-cutting and polishing, there are chances of release of glass dust into the environment as well.

Apart from the risk of exposure to toxic chemicals, the workers in the units are at constant risk of exposure to high levels of noise on account of manual dismantling of the scrap with hammers, which in the long run impairs their hearing.

Risks

- Presence of units in residential colonies.
- Lead fumes and remains poisoning the area.
- Employment of young boys in the dismantling units.
- Risk of leaks in CRT regunning.

Mayapuri

In the news for a radiation leak in the market in 2010, Mayapuri is one of the biggest scrap markets of Delhi. One of the main businesses at the west Delhi junkyard is the recycling of metal scraps and processing of plastic. It is also the biggest market for used automotive and industrial spare parts in India. This area has more than 1,000 metal-scrap and automotive-spare-parts shops and around 800 units dealing with plastic moluding and pelletisation, and dye casting.

The Mayapuri radiation leak can be taken as an example to understand what could happen if illegal markets and non-licensed activities are not regulated in the state. India's first case of radiation exposure killed one person and injured many at the scrap market in April 2010. The NGT in May 2013 said the situation has not changed much and the threat of radiation leaks could not be ruled out in Mayapuri because of poor management and handling of waste and scrap. Most units involved in different commercial activities in Mayapuri do not have trading licenses or requisite permissions from the municipal corporation. Expressing concern over the health of the people who work there without any protective gear and safety measures, the NGT banned burning of plastic, tyres, wires and other such material in and outside the shops in Mayapuri in 2013. The Tribunal banned the use of gas or electronic cutters to dismantle heavy machinery such as generators, tankers and transformers. Now nobody in the market is allowed to store e-waste or materials which are likely to generate radioactivity and pose a hazard to life and the environment. However, many of these activities continue, making this area a probable candidate for becoming a hotspot.

Risks

- Dealing with all kinds of scrap and a history of dealing with radioactive waste.
- No safety measures and open work areas.
- Oil spills and used oil discharge.
- Hazardous material from vehicles.
- Waste disposal.

Yamuna Vihar and Gokulpuri

Yamuna Vihar is a locality in north-east Delhi and has emerged as an affluent residential colony in this part of the city. Despite this, there are pockets in Yamuna Vihar which are hubs for CRT dismantling and processing.

CRT monitors collected from different parts of Delhi are brought to Yamuna Vihar and a small village area close by known as Gokulpuri. Though there are only 5–7 units in these areas, the work carried out is very hazardous in nature. Once the monitors are bought from the kabadiwala network, the workers remove the plastic casing and electron gun and smash the CRT glass. Workers involved in the process don't wear any form of protective gear and are directly exposed to the glass dust. Parts of the CRT glass contain large quantities of lead which can get released during the crude method of hammering the monitors to break the glass. The lead dust released from these CRT glasses flies all around the place and can, in the long run, have serious health impacts on the workers and the people residing nearby.

The broken glass is sold further to the glass dealers. These processes are carried out in the residential colonies of Yamuna Vihar and Gokulpuri. Each unit has approximately 3–4 workers, with one large unit employing close to 20 people. Workers are paid around Rs 250–300 per day. A study done on the occupational risks associated

with CRT operations[8] revealed that significant quantities of heavy metals are released during the process. Continuous exposure might lead to various health impacts. Also, the processes involved in the CRT operations like crushing and grinding are noise intensive, causing hearing impairment among the workers.

Another area of concern with CRTs is that of implosion. A high vacuum exists within all CRTs. If the outer glass envelope is damaged a dangerous implosion may occur. Due to the power of the implosion, glass pieces may explode outwards at high velocity. Hence CRTs, when removed from equipment, must be handled carefully to avoid personal injury. The workers have very limited knowledge of the technical aspects. Various accidents can happen at the workplace if the equipment is not handled with care.

8 Katers, Barry, et al, 'Occupational Risks Associated with Electronics Demanufacturing and CRT Glass Processing Operations and the Impact of Mitigation Activities on Employee Safety and Health', 2010.

Risks

- Hazardous activity in residential area.
- Lead dust and exposure.
- Physical injuries due to broken glass.
- No safety measures.

Delhi Landfill Sites

The population of Delhi has increased rapidly in the last couple of decades, leading to higher consumption of goods and materials resulting in a corresponding increase in MSW generation. Presently the inhabitants of Delhi generate about 7,000 tonnes per day (TPD) of MSW, which is projected to rise to 17,000–25,000 TPD by the year 2021. Management of MSW has remained one of the most neglected areas of the municipal system in Delhi. Only nine per cent of the collected MSW is

treated through composting, the majority of MSW is disposed in landfills. In the absence of leachate and landfill gas collection systems, these landfills are a major source of groundwater contamination and air pollution (including generation of greenhouse gases).

Since 1975, 20 such landfills have been created in Delhi. Of these, 16 have already been exhausted and 2 have been suspended. Since their closure, many of the landfill sites have been, filled up and residential colonies have come up in these locations. Some of these have been bordered and pipes have been installed to let the methane gas escape. A prominent example is Indraprastha Park, which came up on a closed landfill site. These may also be sites of concern as no proper remediation was done.

At present, three landfills sites are operational, namely Ghazipur, Bhalswa and Okhla, spread over a total area of

60 hectares. The details of the existing landfills are given in Table 5. All types of waste—household, industrial, medical, hazardous and from slaughterhouses—is disposed together. To save landfill space, the dumped waste is leveled and compressed with four to five passes of hydraulic bulldozers. The MSW is deposited in layers of 2–5 metres and a covering is provided at the end of the day. Generally, construction and demolition waste and inert material are used for daily covering.

In Delhi, landfills are not provided with a base liner or with a leachate collection, treatment, and disposal system. Leachate generated from these landfills (active and closed), therefore percolates to the groundwater or flows to nearby drains. A study revealed that concentration of total dissolved solid (TDS), turbidity, sulphate, chlorides, fluorides, iron, cadmium, lead, and copper are above the acceptable standards for drinking in all the landfills.[9] Around Okhla sanitary landfill (SLF) pH is found to be below 6.5, indicating that the underground water has turned acidic. Underground water samples near the landfill sites at Okhla, Ghazipur and Bhalswa have been checked and found to be unfit for drinking purposes. Groundwater near the landfill sites is unfit for human consumption mainly due to contamination by leachate. Any contamination of the soil and groundwater sources due to ill managed landfills may result in long-term liability as the cost of remediation may be quite high.

Ghazipur Landfill

The Ghazipur landfill site is spread over an area of 29 hectares and has been in operation since 1984. On an average, the landfill site receives about 2,000 TPD of MSW from north and south Shahdara. The landfill has already matured but continues to receive MSW in its overloaded capacity.

The vegetable, poultry and fish wholesale market is located very close to this landfill. Most of the waste piling up in Ghazipur landfill comprises of household municipal waste, waste from the nearby butcher shops and, to some extent, biomedical waste like expired medicine, syringes, etc. The condition of the landfill site is poor. There is no leachate collection or treatment system in place in the landfill due to which there is a high risk of the hazardous contents of waste percolating into the soil, polluting both soil and groundwater. Untreated leachate is diverted directly into nearby drains, which in turn are released into the Yamuna. During the study the occupants of the residential colonies located nearby expressed their concerns related to the landfill, especially with regard to the overflowing waste and smell emanating from the dumpsite. Though there are hardly any studies to look at the health impact on these residents, the proximity of the residential colony to the landfill raises huge concerns. Global studies have shown that living near a landfill increases the risk of cancer, birth defects and asthma. Most residents use groundwater, in spite of the landfill contamination risk.

Table 5: Closed Landfill Sites

S. No.	Location	Area (in HA)	Remarks
1.	Kailash Nagar	1.8	Filled up
2.	Tilak Nagar	16.0	Filled up
3.	Subroto Park	Not Available	Filled up
4.	Purana Qila/Bhairon Road	2.7	Filled up
5.	Timarpur	16.0	Filled up
6.	Sarai Kale Khan	24.0	Filled up
7.	Gopalpur	4.0	Filled up
8	Chhatarpur	1.7	Filled up
9.	S.G.T. Nagar	14.4	Filled up
10.	I.P. Depot	1.8	Filled up
11.	Sunder Nagar	2.8	Filled up
12.	Tughlakabad Extension	2.4	Filled up
13.	Haider Pur	1.6	Filled up
14.	Mandawali Fazilpur	2.8	Filled up
15.	Rohini Phase III	4.8	Filled up
16.	Near Hastal Village	9.6	Filled up

9 Singhal, Study of Ground Water Contamination due to Landfill in Delhi, 2012.

Table 6: Landfills in Delhi

Name of site	Location	Area (in HA)	Year started	Waste received (TPD)	Zones supplying waste
Bhalswa	North Delhi	21.06	1993	2,200	Civil Lines, Karol Bagh, Rohini, Narela, Najafgarh and West Delhi
Ghazipur	East Delhi	29.16	1984	2,000	Shahdara (south and north), Sadar, Paharganj and New Delhi Municipal Council (NDMC) area
Okhla	South Delhi	16.20	1994	1,200	Central Delhi, Najafgarh, South Delhi and Cantonment

City Development Plan, October 2006

There are about 200 rag picker families who depend on Delhi's Ghazipur landfill for a living. The community comprises mostly of migrants who live in jhuggis (shanties) at the edge of the landfill. The rag pickers sort through this garbage and pick out recyclable materials like plastic, glass, metal, hair, etc., and earn around Rs 100–150 daily. Men, women and children of all ages live and work amongst waste in subhuman conditions. Small children can often be spotted running after the trucks carrying waste to be the first one to lay hands on the waste and find valuables. The workers are at a major risk, as there is no safety equipment used during the waste picking.

In recent times, an initiative has been taken by the Gas Authority of India Limited (GAIL) to harness landfill gas (LFG) and convert it into fuel to be used for other purposes. The project involves closure and capping of the landfill, installation of gas extraction wells, extraction of LFG, LFG cleaning and conversion to Compressed Natural Gas (CNG). Creating a waste-to-energy (WTE) plant is another option that is being considered for managing the waste in this landfill area.

Okhla Landfill

The site opened in 1994 and received 461,200 tonnes of waste in 2009. Currently, the site is estimated to have more than 7 million tonnes of waste. About 90 per cent of the landfill is covered with waste, with a maximum height of about 40 metres at a few places and average height of about 27 metres above ground level. The landfill does not have any system to manage surface water drainage; therefore, rainfall run-off from the landfill flows directly to the adjoining surface water drains.

A study done by Indian Institute of Technology Delhi in 2009 found heavy metals in the leachate tests done and clearly showed the potential risk of environmental pollution through the toxicity levels of the Okhla leachate. Groundwater in the area also has a high risk of being polluted by leachate from the waste. Untreated leachate is diverted to the drains which in turn affects the water quality of the Yamuna.

Leachate is defined as liquid that has percolated through solid waste and has extracted dissolved constituents of waste, soluble products of waste degradation process and suspended materials from waste.

Studies have shown that leachate from MSW landfill can be more toxic than hazardous waste landfill leachate.

Adding to the concerns related to this landfill site is the presence of the ESI hospital in its vicinity. The ashes from the site disperse all around the area, probably also reaching the patients in the hospital whose immune systems are already compromised.

Most of waste earlier dumped in the Okhla landfill is now being diverted to the Okhla WTE and compost plant. Currently only construction debris and ashes from construction sites or the WTE plant are brought to the dumpsite. There were around 450 rag pickers engaged on this site earlier, but the number is much less now. During the study, 100–150 rag pickers were found collecting ferrous metals from the dumpsite using a magnetic device. Workers were not wearing gloves or masks while collecting waste items exposing them to tremendous health hazards. The surveyors found it difficult to even breathe at the landfill due to flowing ashes all around and it is not difficult to imagine what these workers might be going through routinely.

Bhalswa Landfill

Bhalswa SLF is located in the north-western corner of Delhi near the Bhalswa Lake, which is a fresh water oxbow lake on the Yamuna flood plain. The Bhalswa landfill site occupies 21.06 hectares of land out of which about six hectares are devoted to a compost plant. The landfill is not scientifically lined as the pit is only used as a dumpsite. It has only got a layer of malba topped with soil, instead of having a layer of plastic or a special type of clay layer required for a secure landfill. At present it receives about 2,200 TPD of waste, out of which about 700 TPD goes to the compost plant. The landfill has already reached a height of about 22 metres, and was supposed to be closed in November 2009. It is surrounded by localities such as Bhalswa and Jehangirpuri. The site opened in 1992 and had approximately 6.9 million tonnes of accumulated waste by 2008. Mixed municipal waste comes on a daily basis from north and west Delhi to this dumpsite.

The view at Bhalswa landfill site is shocking, with heaps of waste strewn about and more than 200–250 men, women and children working with bare hands to separate sellable waste from the pile of garbage. The rag pickers have no equipment to protect themselves. Not only that, they even eat their meals in the landfill with dirt all around. The working environment is extremely unhygienic and unhealthy.

A critical danger to human health from landfills such as Bhalswa is the use of groundwater that has been contaminated by leachate. Contaminants are leached from the solid waste as water percolates through the landfill and mixes with groundwater. In a study done at the Bhalswa landfill site in 2009[10], it was expected to become a cause of serious groundwater pollution in its vicinity. The leachate from Bhalswa landfill was found to contain a high concentration of chlorides, as well as Dissolved Organic Carbon (DOC) and chemical oxygen demand (COD). This study was undertaken to determine the likely concentration of principle contaminants in the groundwater over a period of time due to the discharge of such contaminants from landfill leachates to the underlying groundwater. The average concentration of chlorides and heavy metals in leachate, and in the groundwater samples collected at varying radial distances from the landfill indicated the landfill as the point source for all the contaminants because the groundwater flow is outward, away from the Bhalswa landfill, and the concentration of pollutants decreased radically as one moved away from the landfill along the groundwater flow.

The Bhalswa resettlement colony located right next to the landfill is surrounded by sewage ponds and has a perpetual foul smell. Hand pumps are the main source of water in the area. The groundwater obtained is usually used for domestic purposes, and in some cases, for drinking. According to a study report from 2012[11], the groundwater from the hand pumps located in the vicinity of the landfill show increased concentration of contaminants. The water samples had high levels of TDS, COD as well as specific contaminants such as lead and zinc. Some of the water samples were contaminated with faeces. This indicates that there is a possibility of contamination occurring due to the landfill. The study also found that residents suffer from a number of illnesses, especially gastro-intestinal diseases, musculoskeletal pain, skin and eye irritation, and respiratory problems. Water-related problems are not restricted to Bhalswa. Residents of Shraddhanand Colony, located directly at the base of the landfill, and Mukundpur, have similar complaints.

- **Landfill Fires:** Landfill gases and the sheer amount of landfill waste can easily ignite a fire. Fires can be difficult to put out and contribute to pollution of air and water. They can also potentially destroy habitats nearby if not controlled soon enough. The most flammable gas that is commonly produced by landfills is methane, which is highly combustible.
- **Decomposition:** Landfill sites are transformed into recreational parks in many parts of the country. However, the maintenance of such parks involves ongoing expenditure as most of the landfill waste is biodegradable and decomposes over time. Therefore, continuous earth fillings are required to preserve these parks.

10 Bharat Jhamnani and SK Singh, *Groundwater Contamination due to Bhalaswa Landfill Site in New Delhi*, https://www.waset.org/journals/ijcee/v1/v1-3-22.pdf.

11 *Ground Water Quality and Health Impacts in Bhalaswa*, New Delhi, Bhalaswa Lok Shakti Manch, and Hazards Center, New Delhi, 2012.

Risks

- Proximity to resettlement colony and residential area.
- Anthropogenic emissions.
- Groundwater contamination due to leachate.
- Risk of fire and uncontrolled emissions.
- Occupational risk to rag pickers engaged in the area.

Najafgarh Basin

In a nationwide study in 2009, the CPCB in consultation with the MoEF identified 88 critically polluted industrial clusters. The Najafgarh Drain Basin—which includes Wazirpur, Naraina, Anand Parbat and Okhla industrial areas—in the NCT was one of them. It is the largest among the surface drains joining the river Yamuna in the NCT and contributes to more than 50 per cent of the total wastewater being discharged into the river. The Najafgarh drain is considered to be the largest sewage-carrying drain of the capital. This drain passes through important industrial complexes such as Najafgarh Road, Lawrence Road, Wazirpur Industrial Area, Mayapuri, Kirti Nagar, Naraina and Anand Parbat. These areas are chiefly clusters of SSIs which generate significant quantities of effluent discharges.

There are more than 3,000 industrial units in this industrial cluster mainly comprising of dyeing, pickling, polishing, plastic moulding and extrusion, electroplating, metal work, etc.

Anand Parbat

Anand Parbat has a designated industrial area, which is in close proximity to the residential colonies. There are both small- and medium-scale industries in this area. The medium-scale industries are mainly engaged in manufacturing of engineering goods, with 10–20 workers in each unit. This area is also known for plastic moulding and metal work, usually done on a small scale. These units employ four to six workers each. Most of the workers, both in the medium- and small-scale units are salaried workers and paid around Rs 5,000–7,000 per month.

Most of the small-scale units in Anand Parbat are in residential areas and operated by unorganised sector players. The plastic moluding and the metal work in usually carried out in one-room units, with no ventilation or safety norms being followed. During the study, it was found that coal-based chimneys were used in some of the units for extracting metals like iron, aluminum, nickel, etc. The two types of chimney found were Kupla and Kothala: Kupla

is a small chimney which is used almost daily to extract metal in small quantities, whereas Kothala is used once a week for larger extraction. Coal-based chimneys are not allowed within Delhi because of the pollution they cause. These units have no pollution control device to regulate or treat the smoke coming out from the chimneys. Hence, smoke is released into the atmosphere directly without any treatment.

Workers in the units work with bare hands even though they have to deal with the hot chimneys and melted metals. The waste from the units is either openly burnt (plastic) or mixed with the municipal waste which ends up in landfills. These units not only compromise the health and safety of workers but also the surrounding environment and people residing nearby.

According to reports,[12] the Delhi government has identified many units in Anand Parbat as illegal, hazardous units and made several efforts to close them down. But these units were found to be in operation during the study.

Najafgarh

This area has more than 1,000 industrial units comprising of jeans dyeing, plastic moulding, engineering, printing, etc. It has a combination of small-, medium- and large-scale industries with numbers of workers varying from 5–20 per unit. Like other industrial clusters, units here are also poorly ventilated and workers work without bare minimum protective gear. Out of 1,000 units, 75 per cent comprised of plastic moulding or extrusion units. The conditions in these units were of concern, as plastic was heated during the process with no temperature control. The plastic particles or dust could be found flying around in the units, which had little or no ventilation.

Textile or jeans dyeing units were also identified in Najafgarh. During the study visits, it was observed that the workers in these units deal with dyes and chemicals bare-handed and most of them had permanent colour stains on their hands. Dyeing is a water-intensive process and the untreated water from these units is directly released into the drain or thrown openly on the ground nearby. The owners of these units were well aware that having an ETP was compulsory for textile units but had not installed it, violating the law and causing environmental damage. The water and soil quality of this area would worsen over time with regular discharges.

Wazirpur

During this study, Wazirpur Industrial Area was one of the dirtiest areas we saw in Delhi. The units as well as the nearby residential area are full of filth and dirt. The presence of industries is one of the reasons, however, the problem is escalated due to overflowing municipal bins which stray animals rummage through, and open butcher shops that throw their waste products indiscriminately.
There are around 1,200 units in this area comprising of pickling units, utensil polishing and a few plastic units. Depending on the size of the unit, there are 40–100 workers in each. In the polishing units, five to ten per cent of the workers are women who are engaged in washing the polished utensils.

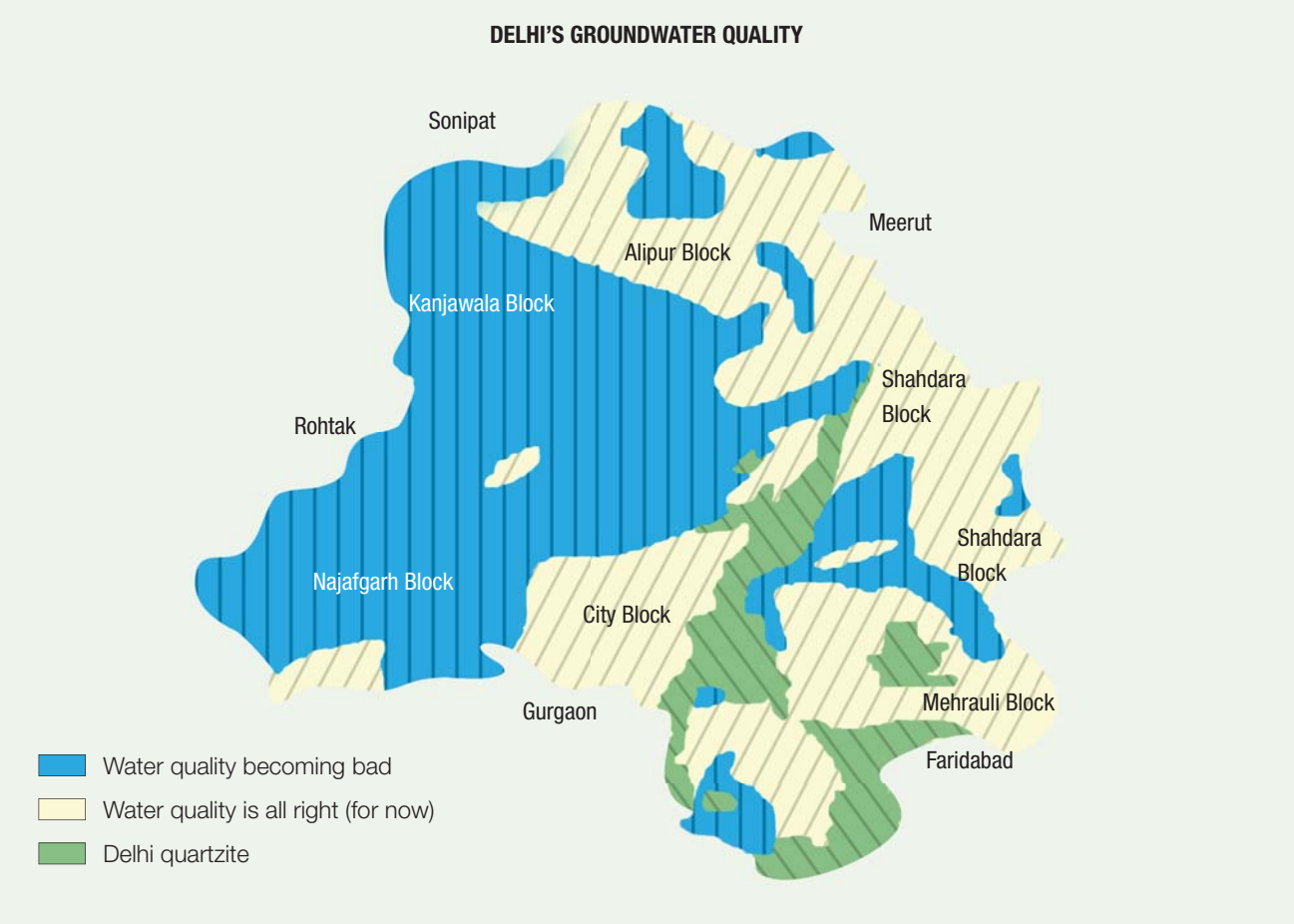
> Pickling is a treatment for metal surfaces used to remove impurities such as stains, inorganic contaminants, rust or scale from ferrous metals, copper, and aluminum alloys.
>
> A solution called pickle liquor, which contains strong acids, is used to remove the surface impurities.

The primary concern in this area is from the picking industry. Workers in the pickling units deal with concentrated forms of acids like sulphuric acid and hydrochloric acid for more than eight hours at a time, for the length of one work shift. In the absence of proper ventilation, these units get filled with acid fumes, causing uncomfortable working spaces and also increasing the risk of respiratory illness among workers. The protective gear worn by the labour force is of very low quality making them vulnerable to acid burns especially if there is a spillage or some other accident. Workers in the polishing units work without even wearing gloves, resulting in their fingers getting swollen. The steel dust they are exposed to forms a black layer on their faces.

During the pickling process, especially in the informal units, acid is used multiple times till its potency is low and it cannot be used further for this activity. This acid should ideally be neutralised and then disposed off safely, but these units just throw it on the open ground to save the disposal cost. Also, during polishing, a lot of steel dust is generated which is either thrown in the dump or burnt along with poly bags and rubber gloves. Though there was no air sampling or testing done during the study, it was obvious that the air quality of this area was very poor.

12 http://articles.timesofindia.indiatimes.com/2011-09-04/delhi/30112096_1_industrial-units-mcd-officials-residential-areas.

Figure 6: Water Quality in Najafgarh Basin, Source: CGWB and CPCB 2002



As per a study done by the DPCC in 2011, it was found that the water, air and soil quality of the Najafgarh basin is deteriorating day by day due to the unregulated industrial activities in the area. The ambient air quality monitoring analysis of 12 years (1997–2010) reveals that the annual average concentration of Respirable Suspended Particulate Matter (RSPM) in the Najafgarh Basin is in the range of 160 to 301 µg/m^3 against the annual average prescribed standard of 120 µg/m^3 for industrial areas, 60 µg/m^3 for residential, rural and other areas and 50 µg/m^3 for sensitive areas.

Risks

- Illegal units.
- Units operating in the residential colony.
- Emissions from plastic units.
- Lack of ETP plants in the dyeing industry.
- Occupational exposure to the workers.
- Spent acid discarded without neutralisation or any precaution.
- Residents at risk of exposure.

Thermal Power Plants

There are three coal-based thermal power plants in Delhi at Indraprastha, Rajghat and Badarpur. These three plants, which have a total generation capacity of 1,087 mega watts (MW), were responsible for approximately 10 per cent of the air pollution load in 2001.[13] Threats to the environment and health from thermal power plants are due to the air pollution they cause. The main pollutants are stack emissions, fly ash generation and fugitive emission in coal handling. The total quantity of fly ash from the three power plants is about 6,000 TPD (Badarpur: 3,500–4,000 TPD; Indraprastha: 1,200–1,500 TPD; and Rajghat: 600–800 TPD). While Badarpur and Rajghat have dry fly ash collection facilities, they do not have adequate storage facilities. By and large the fly ash generated is disposed off in ash ponds. The ash ponds are located close to the river Yamuna in the case of Rajghat and Indraprastha power plants. The river Yamuna is vulnerable to overflows from the ash ponds, particularly during the monsoon. Besides, ground water contamination may take place due to leaching of heavy metals present in the fly ash. The coal used in these plants is of low quality, raising concerns of emission and pollution.

13 Department of Environment, *Government of NCT of Delhi & Delhi Pollution Control Committee, A Case Study of Delhi.*

RIVER YAMUNA

River Yamuna, with a total length of around 1,370 kilometres is the largest tributary of the Ganges. It flows through the state of Uttaranchal, Haryana, Delhi and Uttar Pradesh before merging with the Ganges in Allahabad. For the past few decades it has turned into one of the most polluted rivers in the world, especially in the Delhi stretch, as the city dumps about 57 per cent of its waste into the river. The Yamuna's 22 kilometre stretch in Delhi is barely two per cent of the length of the river, but contributes to over 70 per cent of the pollution load. The water in the stretch is severely polluted owing to heavy industrial and domestic wastewater discharge.

Delhi discharges about 3,684 MLD of sewage through its 18 drains into the Yamuna and, along with Agra, it accounts for 90 per cent of the pollution in the river. The Najafgarh drain contributes to 60 per cent of the total wastewater and 45 per cent of the total Biochemical Oxygen Demand (BOD) load being discharged from Delhi into the Yamuna. A CPCB study on river water quality at the upstream of Wazirabad shows dissolved oxygen (DO) levels at 7.5 milligrams per litre and BOD level at 2.3 milligrams per litre. At downstream Okhla, the DO level declined to 1.3 milligrams per litre with the BOD at 16 milligrams per litre, indicating considerable deterioration in water quality due to discharge of sewage and industrial effluents. The coliform count at Wazirabad is 8,506/100 millilitres whereas at Okhla, it increases to 329,312/100 millilitres, as against the prescribed standard of 500/100 millilitres.

In a study done by The Energy and Resources Institute (TERI) in 2012, concentration of heavy metals in the waters of the Yamuna and in the soil of agricultural fields along its course in Delhi were reported from 13 sites, spread through the Delhi stretch of Yamuna, starting from the Wazirabad barrage till the Okhla barrage. Water samples from the river showed high levels of nickel, manganese, lead and mercury. At one particular location, lead levels were found to be 10 times more than elsewhere in the river.

At another point near a thermal power plant, the mercury concentration was 200 times higher than the levels determined by the United States Environmental Protection Agency (USEPA). Peaks were observed in samples collected downstream of Wazirabad and Okhla barrage, indicating the anthropogenic nature of the contamination.

Levels of nickel, manganese, lead, and mercury (Hg) were above the permissible international standards in agricultural soil along the river. Moderately high levels of contamination were recorded in urban areas. High level of pollutants in the flood plains can be associated with treated and untreated effluents or with sewage flowing into the river. Two hotspots for soil contamination were identified around Wazirabad and at Okhla barrage.

Higher levels of analysed heavy metals contaminants were found here. A possible reason for this is the industrial effluents. While the Wazirabad section of the river receives wastewater from Najafgarh and its supplementary drains, the Shahdara drain releases its load downstream at the Okhla barrage. Vegetables grown in the flood plains of the Yamuna area showed high levels of heavy metals contamination.

The waste pumped into the river also includes waste from dairies, unauthorised slaughter houses, flowers and other material used during worships, and carcasses of animals. Human and animal bodies are sometimes dumped in the Yamuna. Bodies of infants are also disposed in the Yamuna.

Fly ash dumping was regulated by the Delhi High Court in 1999, and now it is being increasingly used to make bricks. But, prior to that there were large fly ash dumping areas in the city like Buradi and Sarai Kale Khan. The Millennium Park Bus Depot has come up on a fly ash pond that used to be the dumping site for waste generated by the nearby thermal power stations. Though there is no data available on these, the sites could be potential hotspots because of contaminants in the fly ash.

Unauthorised Operations in Villages

The major crisis faced by Delhi today is identifying industrial units operating in unauthorised areas, villages and residential areas, which are difficult for the authorities to track. During our survey, we found many villages engaged in activities that may be a risk to health and the environment.

Ranhola Village

Situated in the western part of Delhi, locating the units here was very tedious as local people were secretive and not forthcoming. There are around 200 non-licensed units operating in this area of which plastic grinding and moulding units comprise 80 per cent, jeans dyeing units comprise 10 per cent and the remaining industries comprise 10 per cent. All types of plastics including electronic plastics like ABS are grinded here. Though units have proper machinery for dyeing of jeans, wastewater is released directly into drains without treatment. The dyeing process uses myriads of chemicals which are drained into the river system directly causing severe damage to water. Each unit has around 10–15 workers, each putting their lives at risk to earn their daily wage. The knowledge level of these workers is poor and they are unaware of the impact of the chemicals they are using on their health.

Badli, Samaypur and Lebaspur

These three villages had extremely narrow lanes and each lane had at least 10 illegal units. Units ranged from plastic moulding, grinding and extrusion, to jeans dyeing, manufacture of utensils and lead acid battery recyclers. More than 1,500 units mushroomed in these small, congested lanes. Each of these units had around 8–10 workers. Working conditions were extremely unhygienic and poor. Most were small, family-run units within houses as they couldn't afford to lease out space.

Historical or Legacy Sites

The issue of industries in Delhi has been the subject of extensive debate, controversy and concern over the past few decades. Master Plan Delhi 2001 served as the basis for the SC's judgement on a public interest petition filed by activist-lawyer M.C. Mehta seeking a directive to relocate polluting industries away from Delhi. With regard to preventing pollution, the court's orders required that 168 hazardous industries be moved from Delhi to suitable locations in the NCR, or closed down by November 30, 1996. Forty-six hot mix plants and 243 brick kilns were also to be closed down or relocated outside Delhi. Though many of these changes were put into effect, there are no studies to understand the contamination these industries may have caused in these areas during their operations. Stone crushing in Badarpur and Lal Kuan or chemical manufacturing units in Zakhira, cloth mills at Bara Hindu Rao and Kishan Ganj, cement factories in Okhla—many of these may have contaminated the habitat around their operations. No study or remediation has been done in these sites, raising concerns regarding the existence of historical hotspots.

TILAK BAZAAR

Chandni Chowk is one of the oldest and busiest markets in Delhi. It is well known for its delicious cuisine and flamboyant clothing. In the midst of all this lies Tilak Bazar, the biggest chemical market of Delhi.

In Old Delhi, most shops operate out of homes. In Tilak Bazar too, ground floors are converted to shops and owners live on the first or second floor. The place has many congested lanes and streets, all stuffed with shops selling chemicals. Currently, more than 1,000 chemical shops are located in this area. These shops traditionally dealt with all sorts of chemicals, including many hazardous ones. Each shop has three to six workers who work for around eight hours daily. They are mostly salaried workers earning Rs 6,000–9,000 per month. During our visit, no worker seemed to have been using any kind of protective gear in the shops even when dealing with acids and dyes.

In 2001, there was a fire accident in the market, leading to people getting hurt and damage to property. Since then the Delhi High Court has ordered all the hazardous chemicals to be shifted outside the city. At present, cleansing chemicals, dyes and intermediates and acids are believed to be available in the market. Some of the shops sell chemicals like mercury only for commercial purposes in limited quantities.

Conclusion and Recommendations

5.1 Conclusion

The environment is of great importance for the welfare of human society. Environmental degradation through air pollution, noise, chemicals, water quality, and loss of natural areas, combined with changes in lifestyle, greatly effects the quality of human health and overall development.

Industrialisation is considered the foundation of development strategies due to its significant contribution to economic growth and human welfare but it carries inevitable costs and problems in terms of pollution. Industries emit large amounts of toxic pollutants during production processes polluting the air, water and soil. Waste disposal from industries causes extensive water and soil contamination too. The damage is deeper in a developing country like India, where many of these industrial activities are carried out without any safety norms or monitoring, often in the informal sector. Research and studies in this field are scarce.

Delhi, the capital city of India, is a hub of various activities. It attracts people from all over the country who come here in search of a livelihood. Being a centre for trade, the city has seen thousands of small- and medium-scale manufacturing and recycling enterprises come up, including home-grown units in the unorganised sector. It is important to understand the impact of such widespread activity, since many of them flout environmental and occupational safety norms and end up creating hotspots. This study has made an attempt to identify such areas of high risk in Delhi.

Though most areas visited during the study had issues related to environmental safeguards, some clusters have been identified as potential hotspots because of the prevailing risks and severe conditions related to the environment and health. The areas are hotbeds of industrial activity with most dealing with hazardous chemicals and processes. There are innumerable hazards in almost all these workplaces caused by obviously unsafe working conditions such as unguarded machinery, slippery floors, inadequate fire precautions or poor ventilation. Almost all units had issues related to storage, use and disposal of chemicals or hazardous materials, high temperature processes with no controls on emissions and, last but not the least, waste disposal.

	Site/ Parameter	Industrial Process	Use of Chemicals	Discharge and Emissions	Working Class	Number of Workers/Unit	Number of Units	Proximity to Water Body	Proximity to Residential areas	OH&S	Disposal Technique	Knowledge of Workers
South	Okhla Landfill Site	Dumping of ashes and construction debris, medical waste and MSW	No	Yes	Men, women, children (6–15 yrs)	100–150	NA	No	Next to ESIC Hospital and close to residential area	No protective measures	Open dumping	Nil
East	Mustafabad	E-waste dismantling and CRT regunning	No	Yes	Men, children (12–17 yrs)	3–4	40–50	No	Within the residential colony	No protective measures	Open dumping	Nil
	Mandoli-Prem Nagar (U.P.)	Lead acid battery recycling	Acid and lead	Yes	Men	9–10	110	No	Yes	No protective measures	Open burning and dumping	Nil
	Ghazipur Landfill Site	Dumping of MSW from the fish and meat market nearby	No	Yes	Men, women, children (6–15yrs)	100	NA	No	Yes	Few workers wearing gloves	Open burning and dumping	Nil
	Old Seelampur	WEEE- dismantling and dyeing	Yes	Yes	Men and 1% women	2-5	200-250	Near to Nalla	Yes	No protective measures	Open dumping	<10%
	Shastri Park	E-waste dismantling	No	Yes	Men	2-4	50-60	No	Yes	No protective measures	Open burning & dumping	Zero
	Yamuna Vihar & Gokulpuri	CRT regunning and refurbishing	No	Yes	Men	3-4	5-7	No	yes	No protective measures	Open burning & dumping	Zero
West	Moti Nagar	CFL trading and reassembly	Mercury, lead and acid	Yes	Men	3–4	1,000	No	Within the residential colony	No protective measures	Open dumping	Nil
	Najafgarh	Jeans dyeing, plastic moulding and extrusion	Dyes, inks, calcium powder and PVC resins	Yes	Men	5–15	1,000	No	Within the residential colony	No protective measures	Open burning and dumping	Nil
	Ranhola Gaon	Plastic grinding, washing, extrusion, jeans dyeing	Dyes, inks, calcium powder, and PVC resins	Yes	Men	5–15	125	No	Within the residential colony	No protective measures	Open burning and dumping	Nil

Table cont...

	Site/ Parameter	Industrial Process	Use of Chemicals	Discharge and Emissions	Working Class	Number of Workers/Unit	Number of Units	Proximity to Water Body	Proximity to Residential areas	OH&S	Disposal Technique	Knowledge of Workers
	Mayapuri	E-waste, automobile dismantling, dye casting, plastic moulding and pelletisation	Oil, dye and inks	Yes	Men	4–10	1,800	No	Yes	No protective measures	Open burning and dumping	Nil
North	Wazirpur	Pickling	Hydrochloric acid, Sulphuric acid and Hydrofluoric acid	Yes	Men, women	40–100	1,200	Yes	Yes	Low quality of protective gear	Open burning and dumping	Nil
	Bhalswa Landfill Site	Dumping of MSW, medical waste and constructi-on debris	No	Yes	Men, women, children (6–15yrs)	300–400	NA	No	Yes	No protective measures	Open burning and dumping	Nil
	Anand Parvat	Plastic moulding, metal work	PVC resins	Yes	Men	4–20	>500	No	Yes	Low quality of protective gear	Open burning and dumping	Nil
	Badli	Jeans dyeing, plastic moulding	Dyes and PVC resins	Yes	Men	8–10	300	No	Within the residential colony	No protective measures	Open burning and dumping	Nil
	Samaypur and Lebaspur	Plastic moulding and extrusion, jeans dyeing	Dyes and PVC resins	Yes	Men	8–10	>1,000	No	Within the residential colony	No protective measures	Open burning and dumping	Nil

Most units, especially those working on plastic processing, pickling or lead acid battery recycling, had very poor ventilation and the work areas were full of fumes, making it uncomfortable for the workers. None of the workers were wearing appropriate protective gear and none of the units had any OH&S instructions in their unit for workers safety. The workplace environment was also very unhygienic. Many units, especially of e-waste, and the landfills, had children, young boys and women workers. Sometimes women carry their small children along with them to the workplace exposing them to the precarious conditions and hazards.

Metal and textile industries are in a majority in the industrial areas, according to the *State of Environment Report for Delhi,* 2010 by the Government of Delhi. These are known to cause pollution. But most of these units claim to be connected to ETPs. In some of the industrial areas, units were generating hazardous waste which they claimed was being disposed off in a proper way by giving it to the Treatment Storage Disposal Facility (TSDF). But they could not provide us with any documentary evidence supporting the fact. Non-hazardous waste was either being picked up by the MCD trucks or thrown on open grounds. Industries and factories were least bothered about the environment. For them, reducing costs is the main motive.

Most of these areas have industrial units close to or within residential area. Toxic smoke and dust from the units, open dumping, burning and spilling of chemicals affects the health and safety of workers and residents. These areas are mainly inhabited by low-income groups or marginalised communities, and hence the impact on them is grave.

Though this study is limited in nature, it is evident that these areas in Delhi need immediate attention.

5.2 Future Scope

Hotspots represent a serious problem for the environment. These problems require detailed analysis, identification of remedial options, implementation of remedial measures, and long-term monitoring, in order to avoid further risks to human health and the environment.

The study suggests the need to conduct more extensive studies to understand the issue of contamination in the unauthorised industrial areas in Delhi. There is also a need to do a technical study on the issue where proper sampling of air, water and soil is undertaken to understand the extent of risk and damage.

Every site has its own unique challenges and issues that may initially appear complex and daunting. These issues need to be correctly addressed within a framework of local, state and central legislative requirements. Customised solutions need to be developed depending on various factors that prevail in a particular region. Case studies of various countries need to be undertaken for best practices so that these can be replicated in India.

For Delhi, addressing trans-boundary pollution will play a crucial role in reducing air pollution in the city.

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Annexure

Status of CETP's in Delhi's industrial areas:

S. No.	Name of CETP	Present Status
1.	Wazirpur	Plant has been completed and handed over to CETP Society, Wazirpur on 31.10.2005 for further operation and maintenance.
2.	Mangolpuri	Plant has been completed and handed over to CETP Society, Mangolpuri on 27.10.2005 for further operation and maintenance.
3.	Mayapuri	Plant has been completed and handed over to CETP Society, Mayapuri on 27.10.2005 for further operation and maintenance.
4.	Lawrence Road	Plant has been completed and is being run by DSIIDC.
5.	Jhilmil	Plant has been completed and handed over to CETP Society, Jhilmil on 02.01.2006 for further operation and maintenance.
6.	Badli	Plant has been completed and handed over to CETP Society, Badli on 16.03.2006 for further operation and maintenance.
7.	Okhla Industrial Area	Plant has been completed and handed over to CETP Society, Okhla Industrial Area on 01.03.2006 for further operation and maintenance.
8.	G.T.K. Road	Plant has been completed and handed over to CETP Society, G.T. K. Road on 20.10.2005 for further operation and maintenance.
9.	S.M.A. Industrial Area	Plant has been completed and handed over to CETP Society, S.M.A. Industrial Area on 17.02.2007 for further operation and maintenance.
10.	Nangloi	Plant has been completed and handed over to CETP Society, Nangloi on 21.10.2005 for further operation and maintenance.
11.	Naraina	The Plant is under construction and likely to be completed soon.
	The status of CETP Narela & Bawana, not a part of the above scheme, is given below.	
1.	Narela	This CETP has been constructed to treat wastewater being generated by industries situated in Narela Industrial area. CETP at Narela is being operated and maintained by DSIIDC.
2.	Bawana	The CETP is under construction and likely to be completed soon.

Regular Industrial Areas in Delhi

NORTH ZONE	
1.	G.T. Karnal Road Industrial Area
2.	Rajasthani Udyog Nagar Industrial Area
3.	S.M.A. Industrial Area
4.	S.S.I. Industrial Area
5.	Wazirpur Industrial Area
6.	Lawrance Road Industrial Area
7.	Udyog Nagar Industrial Area
8.	D.S.I.D.C. - Sheds Nagloi
9.	Mangol Puri Industrial Area (Both DDA & DSIDC)
10.	Badli Industrial Area
11.	Narela Industrial Area
12	Bawana Industrial Area

SOUTH ZONE	
1.	Okhla Industrial Area, Ph-I & Ph-II
2.	Okhla Industrial Estate
3.	Flatted Factory Complex Okhla
4.	Mohan Cooperative Industrial Estate
5.	Flatted Factory Complex, Jhandewalan
6.	Rani Jhansi Road
7.	Shahzeda Bagh Industrial Area

WEST ZONE	
1.	Naraina Industrial Area Ph-I & Ph-II
2.	Mayapuri Industrial Area Ph-I & Ph-II
3.	Tilak Nagar Industrial Area
4.	Kirti Nagar Industrial Area
5.	D.F.L. Industrial Area, Moti Nagar
6.	Najafgarh Road Industrial Area

EAST ZONE	
1.	Jhilmil Industrial Area
2.	Friends Colony Industrial Area, Shahdara
3.	Patpar Ganj Industrial Area
4.	Shahdara Industrial Area.

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