

Delhi – Towards a Green City

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1 INTRODUCTION

Delhi, the fast growing Capital City of India has presently a population of about 17 million persons and is estimated to grow in a 23 million population Mega City by the year 2021, further, as per the projections, the trend is expected to continue beyond the year 2021 also. Despite a land locked situation and with such a big concentration of population, it is a liveable city with natural landscape and with very high percentage of landuse under green/open spaces.

The administrative area of the National Capital Territory of Delhi is 1483 sq. kms i.e. 148300 ha. The adjoining land areas to this National Capital Territory belongs to other States of Republic of India with independent State Governments (some times of different political parties) and the land issues are in their purview. Therefore, the adjoining lands areas are not under the Administrative control of City Development Authority / Municipal Delhi – Green City. Corporation/ Delhi State Govt. A Federal Government Body i.e. the National Capital Region Planning Board (NCRPB) is an Advisory Agency who makes the Plan of the National Capital Region (NCR) in consultation with State Govts., but apparently there is no much control of NCRPB on the landuse in these adjoining areas and the State Governments are mostly using the land to their benefit hence Delhi has to be almost self dependant and Delhi Master Plan mostly provides for almost every aspect leaving minimal on NCR.

Out of total area of 1483 sqkm in NCT Delhi, about 150 skm has been proposed as Green Belt at the peripheral area of the city to act as lung space for City as across the boundary there is again concentration of State population. In addition to this lung space about 100 skm land is in River Zone as Green Space to facilitate ground water recharge and about 90 skm as Ridge / Regional Park (part of Aravali ranges) and water bodies with biodiversity parks for enriching the environment and natural flora and fauna in its original style in the city. The built up areas also contain more than 15% area in form of city and neighbourhood level parks allocating about 5 skm open space per person at city level. The open space in form of tot-lots, small parks, incidental open spaces are in addition to this. Hence more than 40% land is under green. Efforts like water harvesting, recycling of liquid and solid waste, use of non-conventional energy, differential pricing policy, energy audit, and state of the art technology etc. for minimal energy consumption are adopted to give a sustained life to the city of Delhi.

2 ENVIRONMENT – PROVISION OF MASTER PLAN FOR DELHI 2021

Creation of a sustainable physical and social environment for improving quality of life is one of the major objectives of the plan. The almost unprecedented scale and speed of urbanisation in Delhi has resulted in enormous pressures on the physical environment with a severe adverse impact in terms of pollution, and today Delhi is considered to be among the most polluted cities in the world.

The city's environment can essentially be seen in terms of two components of urban management- the environment per se, or the habitat, and services management. The former pertains to the natural features and resources including: the elements of air and noise, water (water bodies-river, lakes, drains and ponds and ground water) and land with reference to open spaces, green areas and other surface and sub-surface conditions. The latter is related to the built environment and includes the environmental infrastructure - water supply, sewerage, solid waste disposal, and the transportation network.

A clear approach towards management of 4 types of wastes generated in Delhi, namely Solid Waste, Hazardous Waste, Bio-Medical Waste and Electronic Waste, should be adopted. The approach should take into account the need for adopting the Clean Development Mechanism (CDM) and the awareness of the carbon credits that can be earned and encashed through a planned and organized mechanism, to be developed for this purpose.

2.1 Natural Resources

Natural Resource Conservation includes management of water (surface and ground), air and noise.

2.1.1 Water (Surface and Ground)

(a) The surface water resources in Delhi are basically comprised of the river Yamuna, drains and the lakes/ponds. The ground water in Delhi occurs in confined and semi-confined conditions, with depths varying from 1 m to 10 m below the ground level and in the alluvial terrain, several sandy aquifers occur at different levels upto a depth of 70 m. Based on studies and statistics, some of the striking features that are revealed about the surface water resources in Delhi are:

- The Yamuna river and the drains are highly polluted;
- The supply of water for human use is too much in absolute terms, but is characterized by iniquitous distribution in per capita terms in different areas, and significant wastage;
- Assuming that 80 percent of the water is converted into waste water, the capacity to treat waste water is grossly deficient; Various options for the re-use of treated waste water must be explored and implemented.
- The actual quantity of waste water treated is much below the installed capacity on account of missing links in sewer connectivity between the generation points and treatment plants and choking/silting of sewer lines, etc. The missing links in sewer connectivity must be covered for its continuity from the generation point to the treatment plant.
- The planned re-use of treated waste water is minuscule;
- The treated wastewater is being largely put back into the drains and gets polluted again before flowing into the river Yamuna, which receives 70 percent of its waste from the 22 kms. of its flow through urban Delhi which, in turn, constitutes only 2 percent of the total length of the river basin stretching from its point of origin till its merger into the Ganga at Allahabad;
- A large number of the traditional water bodies in the form of ponds, etc. (excluding areas of unintended water logging along railway tracks, highways and canals etc.) have been encroached or have otherwise become defunct.
- The standards for STP/CETP developed by Central Pollution Control Board/Delhi Pollution Control Committee should be adhered to.
- The public participation and education programmes must be encouraged so that the sensitivity of the water resource is understood by the consumers, students and Resident Welfare Associations.

(b) Groundwater is one of the major sources for water supply in many parts of the country. In Delhi too, ground water contributes a substantial quantity of water supply. Especially in new development areas, groundwater is largely being used as drinking water resources.

The average annual rainfall in Delhi is 611 mm. However, recharge of ground water gets limited due to decreased availability of permeable surfaces owing to urbanisation, and the runoff getting diverted into the sewers or storm water drains that convey the water into the river Yamuna. The annual rainwater harvesting potential has been assessed at 900 billion litres or 2500 million litres per day. If even 25% of this could be harvested it would imply availability of 625 mld, which would be nearly equivalent to the presently estimated deficiency. This is in addition to the potential for roof water harvesting assessed at 27 mld.

The existing drainage basins shall have to be made self-sustainable in water management by integrating water-sewerage-drainage systems. New projects and upgradation of present infrastructure should be taken up in addition to promotion of water conservation through an integrated and a community driven model. Complimentary short term and long-term strategies as mentioned above will need to be initiated.

(c) Development of parks and green corridors along the drains should incorporate conservation of ground water and water bodies. to recharge the ground water, conservation of water bodies and rainwater shall be essential.

(d) To increase sub-surface soil water through seepage of rain water, porous paving tiles should be used in the pavements and soft parking areas. all the new bridges/flyovers must have the provision for rain water harvesting.

Water bodies, having a minimum size of surface area of 1 ha., shall be preserved by the concerned authorities. Further efforts shall be made at the local level to retain smaller water bodies.

2.1.2 Air

Despite various initiatives and measures taken over the past few years, like introduction of CNG and EURO II norms etc., the air quality in the city, in terms of pollution levels, has continued to be a matter of concern, and has been responsible for a number of respiratory diseases, heart ailments, eye irritation, asthma, etc. The three main sources of air pollution in Delhi are vehicular emission (around 70 percent) industrial emissions (around 20 percent) with a major element of this coming from the three thermal power plants, and from other sources such as diesel generator sets and domestic cooking, burning of biomass, etc.

Apart from the issue of pollution on account of industries, the major area of planning and intervention would relate to transportation planning. With the phenomenal growth in the number of vehicles, almost 8-10 times in the last two decades in absolute terms, the most significant aspect in the context of congestion and pollution, relates to the growth in personalised transport as compared to the availability of public transport. It has been estimated that buses, which constitute barely 1.2 percent of the total number of vehicles, cater to around 60 percent of the total transport load, while personal vehicles –cars and scooters, though almost 93 percent of the total number of vehicles, cater to around only 30 percent of the travel demand. Such a huge share of private vehicles in Delhi, while serving a relatively limited purpose in terms of the transportation modal split, obviously creates tremendous pressure on road space, parking, and pollution directly and through congestion.

Public transportation planning must, therefore, drive the future policy. So far public transport is largely seen as the transport mode for the not so well off and poorer sections of the community, who cannot afford to own/use personal transport. An important element of policy would now also have to aim to make public transport a mode for personal vehicle owners and users through a mix of incentives and disincentives. Apart from aspects like frequency, inter-modal integration, a possible single ticketing system, use of parking policy as a means to influence vehicle use, etc., the quality of public transport, particularly buses, would need to be significantly upgraded, inter-alia, keeping the element of clean transport in view.

Another issue which has been raised in the context of vehicular congestion and pollution relates to the policy of mixed land use.

The other elements which would need carefully thought out policy measures would relate to the operation of existing Power plants to significantly reduce the pollution arising from them, and industries, both in terms of pollution control in designated industrial areas, and relocation of non-conforming industries.

As per the Government of India Notification, it is mandatory for all construction agencies to use Fly Ash bricks or tiles or clay fly ash bricks along with pond ash in the construction of roads/flyovers embankments and reclamation of low-lying areas. To control the ambient air quality of Delhi, it may be made mandatory that all commercial vehicles (like trucks and tempos) are converted into CNG. All Thermal Power plants located in Delhi should be gradually converted to gas based plants.

2.1.3 Noise

Noise is emerging as a major pollutant and irritant as well as a constant source of disturbance and health hazards. Against a permissible level of 50-60 dB, the sound level in Indian cities often exceeds 80 dB. Faulty and leaking silencers, over-use of horns and vehicles plying on roads accentuate noise level, besides the noise from commercial and industrial activities, unabated use of sound amplifiers, generator sets and fire-crackers etc.

The Noise Pollution (Regulation & Control) Rules 2000 specify the noise levels in the industrial area, commercial area, residential area and silence zone. It also specifies banning of all noise creating activities between 10 PM to 6 AM, which may be adhered to by the concerned agencies.

By proper land use planning, such as location of public, semi-public and commercial activities along major transport arteries, a buffer can be created for residential zones. Green buffer through thin leaved trees, land formations, mounds embankments, etc. along major roads could also provide effective barriers to transmission of noise. It is also necessary to improve monitoring and effective implementation of the Noise Pollution (Level) Rules 2000 and, to notify certain areas as 'No Horn Zones'. The design and surface material of roads and pavements should also ensure reduction of noise. The concerned authorities should prepare area wise traffic calming schemes and a Noise Monitoring and Control Plan.

Working in night shifts for household industries or non-conforming industries in the residential areas should be prohibited. Areas located within the air funnel should be planned with due consideration of noise generated from the aeroplanes.

Environmentally stressed zones in Delhi should be identified and local area environment management plans should be prepared for such areas, together with regular monitoring.

2.2 Natural Features

The major natural features and eco-systems of Delhi are the river Yamuna, together with a network of streams/drains that empty into the river, and the Aravalli Range. Both of these are in a state of considerable degradation, and it is of vital importance to conserve and rejuvenate these ecosystems. This has regional bearing, therefore, surrounding states also have to contribute towards their conservation and rejuvenation.

2.2.1 River Yamuna

Once the lifeline, which spawned the many civilisations and Cities that grew in the area of the present NCT of Delhi, the River Yamuna today suffers from inadequate flow and quantum of water and an extremely high degree of pollution. The length of the river in the NCT of Delhi is 48 km from Palla in the North to Okhla in the South, with a total river bed/flood plane area of around 97 km² which is about 7 percent of the total area of Delhi. A little over 50 percent of the river lies North of Wazirabad and the rest, around 22 km, to its South, in the Urban area of Delhi. Apart from being the main sources of water supply for Delhi, it is one of the major sources of ground water recharge. However, over the years, rapid urbanisation, encroachments on the river banks, over exploitation of natural resources/water, and serious deficiencies and backlog in sanitation and waste water management services, have resulted in the dwindling of water flow in the river and extremely high levels of pollution in the form of BOD and Coliforms, etc. As against the stipulated 3 mg/l, the designated water quality for bathing purposes, the water quality data for 2003-04 suggests that the BOD values range from 1-3 mg/l at Palla, 5.56 mg/l at Nizamuddin and nearly 7 mg/l at Okhla. Similarly, at all locations, except Palla, the total coliform levels are many times higher than the minimum tolerable standards for drinking and bathing purposes.

The major source of pollution in the river to the extent of about 80%, is the the discharge of treated and untreated water through the 22 major drains, which flow into the river. Six of these drains viz. the Najafgarh and the Supplementary Drain, the Shahdara Drain, the Drain near Sarita Vihar, the Maharani Bagh Drain, the Barapulla drain and the Sen Nursing Home Drain contribute almost 90 percent of the flow and 80 percent BOD load levels respectively.

Through public awareness campaigns, people are to be discouraged from throwing garbage into the river or the drains and measures are taken to prevent throwing of garbage by the habitations along side. Regular desilting of the drains should also be undertaken.

Measures for Rejuvenation of River Yamuna

(1) The issue of pollution in the river Yamuna has engaged the attention of the Supreme Court for the last several years, and it constituted a Committee under the chairmanship of Secretary, Ministry of Urban Development to draw up an Action plan for the cleaning/rejuvenation of the Yamuna River.

- Minimum flow in river Yamuna to be ensured by Riparian states by releasing adequate water.
- Refurbishment of Trunk Sewerage System

DJB has a network of approx. 130 km. length of trunk sewerage system to convey the collected sewage to different STPs for treatment. Nearly 91 km of sewer lines are in highly dilapidated condition and have been silted to the extent of 50 % to 70 % at different stretches.

- Treatment of the flows in Najafgarh and Shahdara drains.
- Laying of Sewer Lines in the un-sewered areas of Delhi
- Removal of Slum Cluster and Yamuna River Bed
- Treatment of Industrial Effluent

(2) Apart from the above measures, steps would also need to be taken to augment ground recharge from the river and decentralised wastewater treatment system. The creation of 'regulated flood plane reservoirs', for

storing the excess monsoon overflow at suitable locations would augment the water retention capacity of the riverbed.

(3) At another level, a strategy for the conservation/development of the Yamuna River Bed area needs to be developed and implemented in a systematic manner. This issue is sensitive both in terms of the environment and public perceptions. Any such strategy will need to take into account the cycle of flood occurrences and flood zones, the ground water recharge potentials and requirements, potential for reclamation derived from the foregoing considerations, designation and delineation of appropriate land uses and aesthetics of the River Front which should be more fully integrated with the city and made more accessible- physically, functionally and visually.

(4) Environmental study of the existing major drains should be conducted before their covering.

2.2.2 Regional Park

The Aravalli Range in the NCT of Delhi comprises of the rocky outcrop stretching from the University in the North to the NCT Border in the South and beyond, and sizeable areas of the same have been designated as the Ridge. This is not a continuum as various intervening stretches have, over a period of time, been brought under urbanisation - for example the Central Ridge area was planned as an integral part of New Delhi, at the time of the development of New Delhi as the Capital in the early part of the twentieth century. The Master Plan of Delhi – 2001 identified the Regional Park into four parts as below:

- Northern Ridge 87 ha.
- Central Ridge 864 ha.
- South Central Ridge 626 ha. (Mehrauli)
- Southern Ridge 6200 ha.

The area of Regional Park is 7777 hectares. Part of this has been notified as Reserve Forest.

2.2.3 Green and Recreational Area

Delhi has a much larger green cover than any of the other metropolitan city in the country, and could well be called a “Green City”. The green/recreational use constitutes 8,722 ha of land as per MPD 2001, which is around 19 % of the total urban land area of 44,777 ha. This includes 1577 ha under the Northern, Central and South Central Ridge (the remaining area of the Ridge is in the rural area). The balance area under recreational/ green use i.e. 7145 ha is in the form of District Parks, City Parks, Community Parks etc. comprising around 15 % of the total urban land area. In addition to this, a large chunk of green area is provided in the form of Neighbourhood Parks/Tot lots in the gross residential use zones, plantations/greens in large campuses like President’s Estate, JNU, IARI, Delhi University, plantations along drains and roadside plantations. In addition to above, two Bio-diversity parks are under development.

In the Urban Extension the green cover is to be provided at the rate of 15 % of the total land, excluding the Ridge Regional Park. Out of this, some area shall be developed in the form of formal parks for the community and the rest shall be developed as woodlands and incidental greens for balancing the environment. This will be in addition to the development of specialized parks like Bio-Diversity Parks, plantation along the roads, drains, riverbank, etc.

S.No	Category	Planning Norms & Standards	
		Population/Unit (Approx.)	Plot Area (Ha)
1.	City Park	10 lakh	100
2.	District Park	5 lakh	25
3.	Community Park	1 lakh	5
4.	Neighbourhood Park	10000	1.0
5.	Housing Area Park	5000	0.5
6.	Tot lot at Housing Cluster Level	250	0.0125

Tab. 1: Planning Norms, Standards for Recreational Areas/ Parks at Sub-City Level.

2.2.4 Amusement Park

Amusement Park up to 10 ha may be permitted in District Park. Following development controls shall be applicable:

- Max Ground Coverage- 5 %
- Max. FAR- 7.5
- Max. Height- 8 mt
- Parking- 3 ECS/100 m² of floor area with the stipulation to provide min. parking for 100 cars.

2.2.5 Green Belt

The Plan provides for agricultural land as Green Belt along the border of NCT of Delhi, in synergy with the provisions of Regional Plan 2021 of NCR. The belt extends from the NCTD boundary up to a depth of one peripheral revenue village boundary.

2.3 Physical Infrastructure

A key issue related to the sustainable development of Delhi, and a minimum quality and standard of living pertains to the availability of, and accessibility to basic physical infrastructure facilities viz. water, power, sewerage, drainage and solid waste management. The rapid and almost uncontrolled growth of population has put these facilities under severe pressure, and there are significant deficiencies. Even a cursory analysis of the present state of affairs, infrastructure problems could become a cause of crisis. Sewerage and solid waste management are State affairs but water supply, power and drainage are Inter-State issues. Thus critical need of advance action and arrangement is required for the adequate provision of physical infrastructure. For each component a broad augmentation plan is essential to meet the projected requirement. The State Government to prepare a detailed and integrated plan in coordination with concerned authorities, NGOs and community groups.

An integrated approach is envisaged that packages mutually supportive infrastructure components i.e. water-sewerage-drainage for recycling, harvesting and optimal use of water; solid waste-sewerage-power for power generation, etc. Innovative techniques for the use of alternative technologies like solar energy, recycling, etc., are also to be encouraged. The Master Plan accepts the need for institutional capacity building, “User Pays” approach and public private partnership as tools for institutional strengthening. To improve the efficiency and to boost the performance, more community participation and decentralised management is required. Technical feasibility of rehabilitation/ augmentation network of sewerage, water supply and drainage is required on priority for old built up areas and the areas identified for redevelopment.

2.3.1 Water

Delhi depends largely on river Yamuna and partially on river Ganga for its share of raw water. For sustainable development of Delhi, it is essential to ensure adequate supply of water in terms of reliability, quality and quantity. However, Delhi has an average water availability of 225 lpcd, the distribution of the same is not uniform. Some areas get 24 hrs water supply, whereas some get hardly 1-2 hr water in a day. The minimum water supply @ 270 lpcd will have to be ensured for the projected population. The water requirement has to be made from river water allocation and ranney wells in Yamuna flood plains. The supply crucially depends on the progress of the proposed dams in adjoining States, Satluj Yamuna link canal and Sharda Yamuna link canal. Further it will also depend upon the conveyance system, which should be in place before the release of allocated water to Delhi. However to some extent localised ground water extraction and its supply after treatment to prescribed level of quality may also be required to meet up the demands. In addition, promotion of recycled wastewater based on techno economic feasibility is also to be done by the concerned agencies for water augmentation.

To improve the water supply in accordance with the projected requirement upto the year 2021 Inter-State river water allocation is required to be worked out. All measures are to be taken to reduce unaccounted flow of water (UFW) and production losses at existing water treatment plants. The drainage basins shall be made self-sustainable in water management by integrating water-sewerage-drainage systems. It is imperative to not

only initiate new projects and upgrade present infrastructure, but also to promote water conservation through an integrated and a community driven model, comprising of complimentary short term and long term measures as given below:

(1) Towns/cities have so far been planned by their respective authorities for their individual needs. There has been total lack of regional approach for sustainable use of available water and its conveyance from areas of plenty to scarcity. The raw water augmentation should not be territory specific but it should be on regional basis irrespective of State boundaries.

(2) Recycling of treated wastewater with separate lines for potable water and recycled water. For this, dual pipeline system has to be introduced in a phased manner in all the areas.

(3) Ground water recharging through rain water harvesting, conserving water bodies and controlling groundwater extraction:

- Groundwater extraction is to be controlled through registering boreholes and recharging according to test yields. Ground water management is to be enforced by concerned agency.
- Focused planning and action will be required to be taken to prepare and implement rain water as roof water harvesting schemes both with the aim of optimizing water use and ground water recharge. For this suitable mandatory provision to be made for planning and construction of various schemes.
- Blue print is required to be prepared for Integrated Water Management of all the water resources in the NCR as well as potential for water reservoirs in Himachal Pradesh and Uttaranchal. Further it is vital to identify all the potential surface water sources, ground water aquifers and inter-basin opportunities for transfer of water to the region. This should include water mapping, desilting of existing lakes/depressions for augmentation of storage of rain/flood water, capturing the monsoon run off, rain water harvesting, reuse and recycling of waste water and measures for conservation of water, inter-basin transfer of water. It should also ensure the conservation of natural depressions, water bodies, flood plains and aquifers. The concepts of 'zero run-off drainage', with retention ponds, sediments traps and balancing lakes should be adopted, with a segregated wastewater disposal system. A green network overlapping the blue network would protect the ecology of aquifers, and also provide a pleasant environment. Simple methods of site planning, which incorporate porous/semi permeable paving, drop inlet/down pipe, sediment trap, retention ponds, etc. will contribute in maintaining ground water table.
- Yamuna River, major drains and canals, with indiscriminate dumping of wastes, have become polluted and foul. These need strict pollution control measures and eco-sensitive land use controls. Water flow needs to be controlled and stabilized and marked at each kilometer station. The valleys should be zoned as water portals, so that these are flanked with greenery, farmlands and forests.
- One of the prime objectives of development should be to live in harmony with the environment. Efforts should be made to improve the quality of river-water, to secure its continuous flow and to encourage the return of aquatic life. This needs improvement of drainage, waste water treatment and pollution abatement by sewerage improvement. The surplus water during the monsoons should be retained in balancing ponds along the riverbed rather than allowing it to the downstream areas.
- The drains and waterfront can be landscaped in the form of interconnected parkways. There is no need for elaborate gardening of the greenways, but wild, simple and natural stretch by itself would be ecologically important. Such trails could be one of the cheapest forms of drainage and recreation.
- Water supply in new areas should incorporate separate lines – one for washing, water coolers and garden taps, the second for supplying potable water. All non-residential buildings having a discharge of over 10,000 litres a day should incorporate a wastewater recycling. The capacity of the sewage treatment plants/recycling plants would be equal to or more than the water inflow requirements so that it may be possible to treat major part of the discharge excepting toilets and kitchen discharge. Keeping in view the uses of recycled water, a policy shall be formulated for determining the optimum water requirements for various uses.
- The wasteful practice of 'drill, pump, and spill' has to be replaced by efficient methods of water conservation, use, and recycling as standard and mandatory procedures. There is a need to

incorporate the mandatory stipulation of water saving/waterless flushing system in the Building Bye-laws.

2.3.2 Sewerage

The existing capacity of sewerage system in Delhi is grossly inadequate, as only about 55% of the population is covered under organised sewerage system and about 15% under on-site sanitation systems. Rest of the population does not have proper access to sanitation facilities. The sewage treatment facility is also inadequate. The increasing pollution in the river Yamuna is a major indicator of lack of sewage treatment facilities.

By the year 2021 entire Delhi should be served by regular sewerage system. It should be developed in a phased manner. The areas where immediate regular sewerage system is not available, low cost sanitation system by individual families could be adopted as a short-range provision. These should be planned in such a way that in the long term regular sewerage could be provided. To improve the sewerage and sanitation, the surface drainage and sewerage systems would have to be developed in an integrated manner.

Planning of the city must incorporate land at appropriate locations for sewage treatment plants (STPs), sewage pumping stations, recycling plants for waste water, sewage treatment plants, common effluent treatment plants (CETPs) with supportive distributive infrastructure i.e. conveyance system to be laid to carry treated wastewater from STPs to the areas for alternative uses. Decentralised STPs with smaller capacities are to be provided at the community/subcity level. Possibility of recovering energy/ gas as fuel from sewage shall be explored.

The liquid waste would be taken care of by augmenting the capacity of existing treatment plants as well as through new sewerage treatment plants. The sewerage system is designed to handle domestic liquid waste at 80 % of the water supply, which has to cater to 1100 mgd (4950 mld) of waste water by the year 2021. The wastewater is also generated due to the use of ground water drawn from the boreholes installed by the public. The needed capacity has to be monitored with provision of water recycling infrastructure and mini/decentralised treatments. The treated sewage effluent should be recycled for non-potable uses like gardening, cooling towers, etc.

2.3.3 Drainage

Drainage has two aspects: flood protection and storm water discharge, which are interrelated. The storm water and flood protection in Delhi are not local but have regional bearing including areas of State of Haryana and Rajasthan. The main drainage system of Delhi is such that all water collected through main drains, link drains and small rivulets is discharged into Yamuna. On the basis of topographical characteristics and existing drainage network of Delhi has been divided into five drainage basins namely Najafgarh, Alipur, Shahdara, Khushak nallah and Mehrauli. The blockage of natural channel is a matter of concern. It is mainly because of the encroachment by slum dwellers along the drains which causes choking of drains and flooding in the upstream areas due to reduced carrying capacity. The other major reason is dumping of solid waste in the drains causing blockage. The blockage of natural depressions and drainage channels must be prohibited.

To improve the drainage system, effluent treatment plants should be provided at outfall of drains and aeration units at interceptions with advanced techniques for maintenance of drains. A time bound action program for augmentation and capacity revision of existing and new drains (due to increase in run off from urban extensions) is also vital. Check dams and depression/ lakes may be designed for increasing ground water table and as storm water holding points wherever needed. The design shall preserve the natural drainage pattern after the development of an area.

Drainage should be linked with the ecology and green networks, by adopting the concept of “bio-drainage”.

Regular desilting of drains and control of dumping of solid waste/malba into the drains should be taken up. Public awareness program need to be taken up in association with NGOs and RWAs to make the people aware about the consequences of dumping garbage in the drains.

2.3.4 Power

The present total availability of power is 3170 MW. Based on the 17th Electricity Power Survey of India, Central Electricity Authority, requirement of power for Delhi in the year 2021, as tentatively estimated by

the Delhi Transco Ltd. is 11000 MW. To meet the additional requirement of 7830 MW, the concerned agencies need to augment the power supply and improve the transmission and distribution system. The additional power requirement would be met from allocated share from the grid system and local generation for which required land component will be identified.

Following critical areas need to be attended for energy efficiency:

(1) The concept of energy efficiency should begin with the idea of Zero-fossil Energy Development (ZED) which envisages an urban form and design of passive building envelope that reduce the demand for power to the point where it becomes economically viable to use energy from renewable resources. This involves a holistic approach combining the issues and actions at various levels of planning, design, construction and maintenance leading to a sustainable and energy efficient regime. The city geometry, restructuring and zoning with self-contained neighbourhoods could minimise the need to travel and substantial saving of recurring energy/ fuel consumption. Integrated mass transport system, traffic and transit operation and management, better tele-communications, promoting bicycles and NMV transport, is another major area of energy efficient habitat. The introduction of energy audit and design of energy efficient buildings by site planning, heights, form, construction and materials and reducing energy demand by passive micro-climatic design approach, intelligent energy controls, heat recovery, landscape, opening design, furnishings, etc., are the critical considerations. The key to future is a cybernetic form of sustainable energy, which integrates symbiosis, recycling and energy chains.

(2) Load management techniques and energy accounting should be adopted. Schemes to minimise power thefts/ losses by improved metering arrangements should be enforced.

(3) Non-conventional energy sources like recovering energy from sewerage, solar energy, etc. should be used for street lighting, lighting at public spaces, open areas, traffic signals, hoardings, etc.

(4) To supplement part of the estimated growing power requirement, non-conventional sources/solar energy and other actions proposed are as follows:

- Solar energy should be encouraged for all units with floor area of more than 300 sqm.
- Compulsory Solar Panels for public advertising, lighting in open areas, public utilities, streets, etc.
- As alternate mandatory arrangement during power cuts to replace generators/inverters etc.
- Adoption of Load Management Technique.
- Tariff restructuring and improved metering arrangement to minimize power thefts/losses.
- Interim solutions of single point connection in unauthorized colonies and jhuggies.
- Private Sector Participation in different stages of Power generation, transmission and distribution.
- Incentivising energy savings and use of energy efficient gadgets.
- Public awareness, capacity building and training.

(5) v) As per Asian Development Bank's report (1997) potential in saving due to better overall efficiency in domestic sector is about 20% by adopting following measures:

- Replacement of low efficiency incandescent lamp with high efficiency fluorescent tubes (CFLs) without compromising with the lumens output.
- Similarly for refrigerators, which account for 30% of total electricity consumed, measures like increased thickness of foam insulation, use of high coefficient compressors increased evaporator surfaces, use of tighter door seals and through technical improvements can reduce consumption from 540 KWH/year to 300 KWH/year (for a 165 litre refrigerator).
- Incandescent bulbs, neon tubes and fluorescent lamps are giving way to light-emitting microchips that work longer, use less power and allow the use of light in new ways. The chips, known as light emitting diodes, or LEDs have huge performance advantages in many mundane tasks (such as traffic lights). These consume 80 per cent less electricity than the bulbs and have longer life. Moreover, they have the safety advantage of gradually fading instead of burning out. This eventually results in huge savings in terms of energy and maintenance costs.

2.3.5 Solid Waste

The problem of solid waste management in Delhi is assuming serious proportions due to increasing population, urbanisation, changing lifestyles and consumption patterns. The garbage from unauthorised developments, slums, JJ settlements, etc is not collected which further adds to the environmental degradation. The projected average garbage generation upto the year 2021 is at 0.68 kg per capita per day and total quantum of solid waste is 15750 tons/day.

Management of solid waste involves waste generation, segregation and storage; waste collection; waste transfer/ transportation; treatment, recycle, reuse, recovery; and disposal. For effective waste management, its segregation at the community and neighbourhood level is imperative. The waste shall be segregated and collected, in separate chambers. For this, involvement of rag pickers is to be encouraged.

The municipal biodegradable and recyclable waste, which is segregated at the source, decentralised treatment at neighbourhood level may be adopted, while for non-biodegradable, centralised treatment may be followed.

The other type of specialised waste includes biomedical waste; hazardous waste from industries; construction debris and fly ash; meat processing centre etc. Disposal of bio-medical waste is to be as per bio-medical waste rules and hazardous waste requires special handling according to hazardous waste handling rules. Proper dumping, recycling and reuse of construction debris and fly ash have to be linked. Meat processing centre waste is to be recycled for chicken feed etc.

Considering the nature of solid waste and the economic aspects of its disposal, major part of solid waste especially non bio-degradable has to be disposed off in sanitary landfills. Recycling should be preferred than disposing off the waste in sanitary landfill sites' wherever possible. The segregation of solid waste should start at the point of generation of the waste. It should be collected in two separate bags of green and black colour. The involvement of RWAs and Rag pickers association will reduce the quantum of waste drastically. And it will also result in the reduction of area required for landfill sites.

Further, some more viable alternatives to landfills are vermiculture, fossilisation, composting etc. Waste Minimisation Circles (WMCs) should be constituted and made effective. Implementation and monitoring & Bio-Medical Wastes (Handling & Management) Rules, 1998, for hospitals, nursing homes, and clinics should be taken up. The filled up sites may be reused for plantation or as recreational area. The proposed sites for sanitary landfill and compost plants are to be finalised by the MCD.

This shall also include buffer zone of 'no development' around landfill sites. Keeping in view the fact that finding new sanitary landfill sites in Delhi is becoming extremely difficult, there is no option, but to resort to alternative and decentralised methods of waste treatment, reduction, recycle and use, which include composting. Pilot projects in this regard have been taken up by the MCD with the consultants. vermiculture, fossilisation and composting. Pilot projects in this regard have been taken up by the MCD with consultants.

2.4 Mixed Use Regulations

The policy acknowledges the need for permitting use of land for purposes other than that for which it was originally envisaged and lays down the conditions under which this may be applied in different situations.

- Mixed use means the provision for non-residential activity in residential premises.
- The policy aims to balance the socio-economic need for such activity and the environmental impact of the said activity in residential areas.
- Mixed use allows access to commercial activities in the proximity of the residences and reduces the need for commuting across zones in the city. However, at the same time, it needs to be regulated in order to manage and mitigate the associated adverse impact related to congestion, increased traffic and increased pressure on civic amenities.
- The over-riding principles for permitting mixed use are the need to acknowledge and make adequate provision for meeting community needs, mitigating environmental impact and providing for safe and convenient circulation and parking.
- The extent of non-residential activity seen as being necessary or desirable by the residents themselves varies from area to area based on the socio-economic status of the residents as well as the past pattern of development in that area. While certain colonies may need non-residential activity as

an integral part of their livelihood, some others may wish to preserve the residential character of their colonies and neighbourhood.

The following three broad types of mixed use are permissible, in residential premises:

- Commercial activity in the form of retail shops in plots abutting notified mixed use streets.
- “Other activity” broadly in the nature of ‘Public and Semi-Public’ facilities and as per conditions specified, in plots abutting roads of minimum ROW.
- Professional activity as per conditions specified.

3 CONCLUSION

Despite that the city is growing at a rapid pace and is deficient in many ways which affects environment, however, the concerned Agencies are fully aware of their role to make Delhi a Green City and are in process of making provisions, preparing action plans, setting system to get equipped for the new challenge etc. The concerned agencies have also started taking up the works which are of initial stages and do not require elaborate system and huge expenditure. However, it will be a challenge to them and their endeavour to work in this direction and bridge the existing gap as well as to achieve targets towards fulfilment of the goals to make the City Green in real sense.