14.0 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 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 to meet the projected requirement is essential. GNCTD should prepare a detailed and integrated plan in coordination with concerned authorities, NGOs and community groups.

The Master Plan envisages an integrated approach 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 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 boost the performance, increasing community involvement 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.

14.1 PROJECTED REQUIREMENTS FOR THE YEAR 2021

The existing availability and projected requirement for physical infrastructure components is indicated in Table 14.1.

Table 14.1: Availability and Projections

	Availability*	Requirement**		
	2001	2001	Projected 2021	Additional 2001-2021
Water (mgd)	650	1096	1150	500
Sewerage (mgd)	512[2]	877	920	408
Power (mw)	2352	3265	8800	6448
Solid Waste (tons/day)	5543	7100	*15750*	10207

*Availability 2001 as per Perspective Plan of DJB, Transco and CSE (MCD)

** STP Capacity only. Actual sewerage is 652.4mgd (512.4 mgd from DJB supply,100 mgd from private generated & 40 MGD from industrial waste)

14.2 WATER

Delhi depends largely on river Yamuna and partially on river Ganga for its share of raw water. For sustainable development of water resources in Delhi, it is essential to ensure adequate supply of water in terms of reliability, quality and quantity. The water requirement @ 80 gpcd (360 lpcd) with break up of domestic and non-domestic as 50 gpcd (225 lpcd) and 30 gpcd (135 lpcd) respectively. However, minimum potable water supply of 50 gpcd has to be ensured for all areas. This may be provided at two levels-potable (for drinking, cooking etc.) and non-potable, as given in Table 14.2. In the existing areas till the arrangement of non-potable water is made, potable water shall be supplied. For urban extensions and areas under redevelopment schemes, these norms are recommended with necessary provisions. The potable 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 U.P, Uttranchal and H.P and conveyance system with 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. The non-potable requirement could be met through alternative sources referred in Table 14.2 and exchange of waste water from Delhi and Haryana. The recycling of waste water has to be based on techno-economic feasibility to be done by the concerned agencies.

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), production losses at existing plants. The existing 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:

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

ii) 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.

iii) 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.

iv) The planning should dovetail watershed management, and arrest the run-off. It should ensure the conservation of natural valleys, water bodies 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.

v) 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.

vi) One of the prime objectives of development should be 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.

vii) 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.

viii) 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.

ix) 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.

x) Where the hazard of pollution exists, the minimum charge for operating permits should cover the expenses of adequate policing and controls. Mandatory performance bonds and liability insurance should pay for all

damages plus any corrective measures, which might be needed. As a governing rule, no new development, manufacturing, process or operation of any polluting activity should be permitted, which may result in the significant degradation of any water resource.

xi) About half of the water that is treated and distributed at public expense is non-revenue water. This is due to unrecorded usage or illegal taps and water connections. Reducing water losses is cheaper than augmenting water capacity for such losses.

Table 14.2: Break-Up of Water Requirement upto 2021

Norm	Quantum (in gpcd)		
	Potable	Non-potable	Source for non-potable water
Domestic (@ 50 gpcd)*	**30**	**20**	
Residential	30	20	Recycling and permissible G.W extraction at community level
Non Domestic (@ 30 gpcd)	**5**	**25**	
Irrigation, Horticulture, Recreational, Construction, Fire (@ 6.75 lpcd)	-	10	Recycling from STP's and Permissible G.W extraction
Public-semi public, Industrial`, Commercial,	5	15	Recycling from CETP's
Total (@ 80 gpcd)	**35**	**45**	

To provide additional supply of potable water, augmentation of existing water treatment plants is proposed as given in Table 14.3. The actual provision of water treatment plants should be monitored depending on availability of raw water and need of potable water.

Table 14. 3 Water Augmentation Plan

S.No	Water Treatment Plants	Capacity 2001 (in mgd)	Capacity* 2021 (in mgd)
1.	Chandrawal I & II	90	100
2.	Wazirabad	120	130
3.	Haiderpur I & II	200	216
4.	Bhagirathi	100	110
5.	Dwarka	-	40
6.	Sonia Vihar	-	140
7.	Nangloi	40	40
8.	Bawana	-	20
9.	Okhla	-	20
10.	Ranney wells at Okhla	100	12
11.	Palla and other ground water sources	-	91
	Total	***650***	***919***

***** Capacity 2021 is as proposed by DJB.

In addition, new water treatment plants may be identified for potable water requirement.

14.3 SEWERAGE

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

By the year 2021 entire Delhi should be served by regular sewerage system 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 location for STP's, sewerage pumping stations, CETP's etc. Recycling plants of treated waste water and a plan for recycling of treated waste water to meet non-potable water needs. Common effluent treatment plants (CETP's) with supportive distributive infrastructure i.e. conveyance system has to be laid to carry treated wastewater from STP's to the areas for alternative uses. Decentralised STP's with smaller capacities are to be provided at the subcity level (10 lakh population). Possibility of recovering energy/ gas as fuel from sewerage 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 @ 80 % of the water supply, which has to cater to 1472 mgd (6625 mld) of waste water by the year 2021. This excludes commercial and industrial waste water handling which needs to be treated separately. The waste water is also generated due to the use of ground water drawn from the bore holes installed by the public. The needed capacity has to be monitored with provision of water recycling infrastructure and mini/decentralised treatments. The sewerage augmentation plan is given in Table 14.4.

Table 14. 4: Sewerage Augmentation Plan

S. No.	Treatment Plant	Capacity 2001 (in mgd)	Capacity* 2021 (in mgd)
1.	Okhla	140	170
2.	Keshav Pur	72	72
3.	Nilothi	40	70
4.	Coronation pillar	40	50
5.	Rithala	80	110
6.	Kondli	45	90
7.	Others		
	a) Sen Nursing Home Nalla STP	2.2	2
	b) Delhi Gate Nalla STP	2.2	17
	c) Yamuna Vihar	20	45
	d) Timarpur	6	6
	e) Mehrauli	5	5
8.	New plants in North Delhi		
	a) Narela / Alipur	10	50
	b) Rohini	15	55
9.	New plants in West Delhi		
	a) Dwarka/Pappankalan	20	40
	b) Najafgarh	5	5
10.	New plants in South Delhi		
	a) Vasant Kunj	5	5
	b) Ghitorni	5	5
	c) Badarpur	-	8
	Total	**512.4**	**805**

* Total sewerage treatment capacity based on 80% of water supply of 2011. Capacity 2021 is as proposed by DJB.

In addition, new sewerage treatment plants may be identified as per requirement.

14.4 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 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, NCT of Delhi has been divided into five drainage basins namely Najafgarh, Alipur, Shahdara, Khushak nallah and Mehrauli.

To improve the drainage system of Delhi, 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.

Other measures essential for proper drainage are the following:

1) Drainage to be integral part of Road Development Plans/ flyover/ Grade Separators.
2) GIS based drainage mapping and planning.
3) Subwells need to be developed under flyover for trapping rainwater. Pump houses in low-lying areas should be operational given back-up power.
4) Remodelling of selected drains may also be required considering the upstream flow in the region.

14.5 POWER

Delhi's requirement of power in the year 2021 as tentatively estimated by Delhi Transco Ltd, is 8800 mw based on 16th Electricity Power Survey of India, CEA. To meet this demand, the concerned agencies need to augment the power supply and improve the transmission and distribution system. A 400 kv ring is being set up around Delhi to draw power from northern regional grid. The additional power requirement would be met from local generation and allocated share from the grid system. The projected arrangement for both local generation and central allocation is given in Table 14.5. The actual requirement should be monitored and arranged as per seasonal demand.

Table 14.5: Proposed Power Plants

Plant	Capacity (in mw)	Type
A) Plants Proposed against Plan Funds.		
1. Pragati Power Project at the capacity of 600 mw	600	Combined cycle
2. Indraprastha Replacement Project (900 mw)	900	Liquid fuel / gas based high capacity cycle combined
3. Apollo Intergen	300	Eco-friendly fluidised bed boiler
B) Central Sector Power Project		
4. Parvati Hydel Power Plant (2051 mw) in HP	270	Hydro
5. Rihand (1000 mw)	-	Thermal
6. Narore (470 mw)	-	Nuclear
7. Dulhasti Hydro-Electric (390 mw) in J&K	-	Hydro
8. Uri-Hydro-Electric (450 mw) in J & K	-	Hydro
9. Tanakpur Hydro Electric (120 MW) in HP	-	Hydro
10. Others-Nathpa Jhankari (HP). Ballarpur Industries (MP), ISNI at Partappur etc.	-	Hydro

In the reform process for power sector in Delhi, the Delhi Vidyut Board has been formally unbundled into successor companies for managing the distribution, transmission and generation functions. After the privatisation of distribution system the power generation may also be privatised with regulatory controls on tariff structures. Load management techniques and energy accounting should be adopted. Schemes to minimise power thefts/losses by improved metering arrangements should be enforced. Low energy consuming gadgets and Non-conventional energy sources like recovering energy from sewerage, solar energy should be used for street lighting, lighting at public spaces, open areas, traffic signals, hoardings etc. For energy efficiency, the following critical areas need to be attended:

i) 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 symbosis, recycling and energy chains.

ii) Load management techniques and energy accounting should be adopted. Schemes to minimise power thefts/losses by improved metering arrangements should be enforced. Non-conventional energy sources like recovering energy from sewerage, solar energy should be used for street lighting, lighting at public spaces, open areas, traffic signals, hoardings, etc.

iii) To meet the part of the estimated requirement of 8800 Megawatts by Non-conventional sources/Solar Energy and other actions, the following stipulations are proposed:

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

iv) As per Asian Development Bank's report (1997), potential in saving due to better overall efficiency in domestic sector is about 20%.

There is strong case for replacing low efficiency incandescent lamp with high efficiency fluorescent tubes or CFL's without compromising with the lumens output. Similarly 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, which are known as light emitting diodes, or LED's have huge performance advantages in many mundane tasks (such as traffic lights). They consume 80 per cent less electricity than do the bulbs, and last up to 10 times as long. Moreover, they have the safety advantage of gradually fading instead of burning out. They eventual result will be huge savings in energy and maintenance costs.

14.6 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 @ 0.68 kg per capita per day and total quantum of solid waste is 15750 tons/day as given in Table 14.6.

Table 14.6: Quantum of Municipal Solid Waste (Tons/Day)

Local body area	Existing capacity 2001	Projected generation for 2021
MCD	5250	15100
NDMC	245	550
Cantonment	48	100
Total	**5543**	**15750**

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 at dalaos. For this, involvement of rag pickers with RWAs, CBOs and NGOs is to be encouraged.

The projected composition of municipal waste for the Plan period is estimated as given in table 14.7. For biodegradable and recyclable waste which is segregated at the source, decentralised treatment at neighbourhood level may be adopted, while for silt, centralised treatment may be followed.

Table 14.7: Projected Composition of Total Municipal Solid Waste for 2021

Constituents	Quantum (in tones)	Percentage to total waste
Bio-degradable	6000	38
Silt	6000	38
Recyclable	3750	24
Total	**15750**	**100**

Notes:

(i) Above figures are based on Report on Solid Waste Management in Delhi conducted by NEERI, Nagpur through DDA;

(ii) Figures of MCD are based on 'Feasibility study in Master Plan for Optimal Waste Treatment & Disposal for the entire State of Delhi' June, 2004 by COWI Consultants appointed by MCD.

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-medial 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 silt has to be disposed off in sanitary landfills. But wherever recycling is possible, it should be preferred than disposing off the waste in sanitary landfill sites. 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 sites, which are filled up or are in operation, are given in Table 14.8. 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.

Table 14.8: Existing Land fill sites for Waste Management

S.No.	Location	Area (in ha.)	Remarks
1.	Kailash Nagar, East Delhi	1.8	Filled up
2.	Tilak Nagar, West Delhi	16.0	Filled up
3.	Subroto Park	-	Filled up
4.	Purana Qila/Bharion Road	2.7	Filled up
5.	Timarpur	16.0	Filled up
6.	Sarai Kale Khan	24.0	Filled up
7.	Gopal pur	4.0	Filled up
8.	Chhaterpur	1.7	Filled up
9.	S.G.T. Nagar	14.4	Filled up
10.	I.P. Deoit	1.8	Filled up
11.	Sunder Nagar	2.8	Filled up
12.	Tuglakabad 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 in West Delhi	9.6	Filled up
17.	Site near Ghazipur Dairy Farm	28.0	In operation
18.	Site near Jhangipur / Bhalswa	16.0	In operation
19.	Okhla Phase I	12.8	In operation
20.	Crossing on G.T. Karnal Road	3.2	In operation
21.	Jaitpur / Tajpur	9.84	New
22.	Near Puthkhurd	55.0	New
23.	Bawan to Narela Road	28.0	New
24.	Sultanpur Dabas (Bawana)	16.0	New

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 vermiculture, fossilisation and composting.