

criteria for delineating the Planning Regions are presented below but list can be expanded based on requirements on planning approach and region's specifications:

Table 4.3: Criteria for Delineation of Region

S. No.	Parameters	Indicators
1	Environment and land suitability	▪ Soil cover & fertility, ▪ Topography, Geology, Geomorphology, Lithology & Drainage ▪ Surface water body & Ground water table, ▪ Green & forest cover, ▪ Buffer areas, ▪ Agriculture cover and intensity of production ▪ Hazardous zone ▪ Other environmentally sensitive areas
2	Demographic, Quality of Life	▪ Population growth rate: percentage increase in population, ▪ Urbanism: percentage of urban population to total population ▪ Migration: number of persons migrating to nodal point, ▪ Density: population per Ha, ▪ Aspect of literacy, ▪ Other socio economic aspects,
3	Flows	▪ Goods: Volume of goods traffic: – Supply of raw materials, – Sale of finished goods, – Supply of perishable goods like vegetables, milk, egg, meat, etc. ▪ People: Passenger traffic: – Floating population – Labour supply – Cultural affinity: shopping, major recreational, ▪ Finance: banking facilities ▪ Infrastructure links: Supply and management of services such as water supply, waste water and solid waste treatment with focus on recycling and re-use. ▪ Drainage channels, irrigation channels, power house etc. ▪ Information: location of institutes, movement of students and scholars, Telephone calls etc.
4	Economic and investments	▪ Economic: – Local economic activity, – Wholesale trade, – Major existing developments, ▪ Large investment proposals for developments ▪ Workers: Percentage of non-agricultural workers to total workers, ▪ Land ownership and land uses
5	Others	▪ Contiguity of areas, ▪ Integrated development, ▪ Adjustment of boundaries with other planning areas, ▪ Manageable size of the region from planning point of view.

Source: Various Sources including Reading Material on Planning Techniques by JH Ansari and Mahavir.

It is recommended that the planning region should have a nodal point, either developed or developable to satisfy the organisational needs of the region. The homogeneous region identified should be adjusted to the nearest administrative boundary, such as village boundary, taluka or district.

4.5.2.1. Techniques for delineation

The criteria mentioned above are to be analysed by the following suggested techniques for area delineation:

1. **Weighted Index Number Method:** This method helps to determine a homogeneous region within certain variations/ deviation limits. For example, delineation of a region based on literacy rate may be limited within the area having specific mean literacy rate with not more than one a standard deviation. The approach used in this method is:
 - i. Identification of the criteria such as literacy rate, unemployment rate, watershed, contours etc.
 - ii. Determination of weights to the respective criteria
 - iii. Determination of homogeneity limits such as standard deviation.
2. **Flow Analysis:** The flow analysis identifies the direction and intensity of flows and builds up functional relationship between the dominant centre and the surrounding satellite towns. The flows show decreasing intensity as it becomes more distant from the main centre, hence identifying the sphere of influence of the main centre. The flows can be plotted on linear graphs from which following information can be obtained:
 - i. Most intense (Primary) and less intense (Secondary) flows into and out of each centre
 - ii. Hierarchy of nodes providing the form and extent of functional relationships within an area.
 The flow analysis involves grouping together of local units which displays a considerable degree of inter dependence.
3. **Gravitational Analysis:** This technique identifies the potential flows between centres rather than the actual flows. This model suggests that the interaction between the two centres is directly proportional to the 'mass' of the centres and inversely proportional to the 'distance' between the centres. The variables used to measure 'mass' and 'distance' depend upon the problem and data availability. The 'mass' can be represented by variables such as population, employment, income, expenditure etc. and 'distance' can be represented by distance in physical terms i.e. km, time, price etc. Mathematically this can be represented as:

$$T_{ij} = [p_i p_j / d_{ij}^2]$$

Where T_{ij} is the gravitational force between towns i and j and P_i and P_j are the masses of the two centres and d_{ij} is the distance between them.

By calculating the potential for the centres in a study area, contour lines of equal potential can be plotted on a map, illustrating the relative attractiveness and sphere of influence of various centres.

4.6. Special Area Planning Regions

Special area development planning implies prudent use of all the available resources to ensure optimum and sustained development of the region, towards improving quality of life of the people and to meet growing demands of increasing population. It is also imperative to maintain the fragile balance between development and conservation practices through identification of the problem areas and preparation of location specific development plans.

The special areas requiring conservation- development approach could be:

4.6.1. Eco-sensitive areas

Eco-sensitive area is a designation provided to area which has very diverse yet fragile ecosystem. Western Ghats is one of the ecologically sensitive areas in the country. The Government of India had taken a step to conserve and develop this region sustainably.

For this GoI constituted **Western Ghats Ecology Expert Panel** which submitted its report in year 2011. Western Ghats is a region which is defined by its geological characteristics, biological landscape, richness in flora-fauna species, spatial heterogeneity, high conservation value and ecological sensitivity. Human activities had deteriorating ecological impacts on the region due to which the committee was constituted to give recommendations for its conservation. The committee has given recommendations for protection of Western Ghats, few of which have been shared below:

- River basin-level planning and decentralised management of water resources
- Sustainable strategy of livestock development for the Western Ghats
- Convert tea estates to organic production with the integration of animal husbandry
- Promote systems of providing incentives to local people for conservation efforts
- Strengthening the Rural Development department on issues related to non-timber forest produce
- Promote industries and services that involve dematerialization e.g. e-commerce, tele-conferencing
- Promote education hubs and special incentives should be given to agro-based fruit and food processing industries
- The Zoning Atlas for siting of Industries should be used as a tool for decision-making at various levels for industry, regulatory authorities and the general public
- Exclusion of mining from ecologically sensitive areas/zones etc

The basic unit of development of eco-sensitive areas can be a watershed, which is a manageable hydrological unit and covers the entire area starting from the highest point of the area to the outlet of the stream. The efficient development planning requires an overlay of various thematic layers of the spatial and non-spatial data. The watershed management approach is a suitable planning platform for conservation and sustainable development of all the resources specially land and water.

The development approach shall consist of the following steps:

- a. Identification and acquisition of the spatial and non-spatial data
- b. Identification of the 'formal region' on the basis of homogeneity of demographic and economic characteristics and sharing of natural resources
- c. Creation of the thematic layers, overlay and interpretation for developing an integrated approach for conservation and development

4.6.2. Socio economic sensitive areas

These are areas which lack amenities due to an imbalance in the economic development of the region/ nearby region and standard of living of the residing population. Such areas also encounter high rate of social stresses.

There are culturally sensitive areas like tribal areas which lack even the basic social amenities of health and education as mostly they are not covered in the jurisdictional areas of the administrative offices. Schedule 6 of Constitution of India gives the provision for the tribal areas in the north-east states of India. This schedule gives provisions for the administration of tribal areas in the States of Assam, Meghalaya, Tripura and Mizoram. In such cases, planning and land development is not directly under the control of the State, but rests with the Autonomous District Councils, formed in the districts as per the constitution.

However, the Regional Council of an autonomous region or District Council for an autonomous district of these states have the power to make laws with respect to 'the allotment, occupation or use, or the setting apart, of land, other than any land which is a reserved forest for the purposes of agriculture or grazing or for residential or other non-agricultural purposes or for any other purpose likely to promote the interests of the inhabitants of any village or town.

4.7. Land use classification for Regional Planning

1. **Urbanisable Zone:** In Regional Plan, the areas under existing development and those earmarked for future development shall be termed as 'U Zone'. This zone is envisaged at three levels U-1, U-2 & U-3.
 - 'U-1' zone shall primarily cover the existing areas where more intensive urban development and economic activity are expected in future.
 - 'U-2' zone shall cover the new town areas/ satellite towns/counter magnet/growth centres where urban development and economic activity is expected or proposed.
 - 'U-3' zone shall be zone outside the existing or proposed urban zones, which have potential for urban development such as lands around major roads and corridors, railway stations etc. No formal development plan may be prepared for U-3 zone but the development shall be regulated on the basis of road widths and development promotion regulations.
In U Zone all residential, commercial, light and service industry, public and semi-public buildings, transport zones and recreational area may be permitted depending upon the compatibility of the uses.
2. **Industrial Zone:** The areas earmarked for industrial use – service and light industry, extensive and heavy industry, special industrial zone or development of SIR, IT zones etc. shall be termed as 'I Zone'.
3. **Transport and Communication Zone:** The areas earmarked for transport and communication use shall be termed as 'T Zone'. This zone can be sub divided into Roads/ BRTS: T-1, Railway/ MRTS: T-2, Airport: T-3, Seaports/ Dockyard/ Dry ports: T-4, Bus depots/ truck terminals and freight complexes: T-5 and Transmission and Communication T-6.
4. **Primary Activity Zone:** The areas earmarked for primary activity use shall be termed as 'PA Zone'. This zone can be sub divided into Agriculture: PA-1, Forest: PA-2, Poultry and dairy farming: PA-3, and Brick kiln and extractive areas: PA-4.
5. **Open Area Zone:** The areas earmarked for leaving open shall be termed as 'O Zone'. This zone can be subdivided into Recreation Area: O-1, Green Buffer Zone: O-2. Green buffer zone shall be provided, so as to restrict the peri-urban areas from unauthorised development. For peri urban

areas special regulations and development control regulations shall be determined in the development plans.

- 6. Protective and Eco Sensitive Zone:** The areas earmarked as Protective and Eco-sensitive Areas shall be termed as 'E Zone'. This zone may comprise of Water bodies: E-1, Special recreation zone/ protective areas such as sanctuaries/ reserve forests: E-2, Forest Zone: E-3, Coastal Zone: E-4 and Undevelopable use zone: E-5. Undevelopable use zone shall be identified as Earthquake/ landslide prone, cliffs and environmentally hazardous area, areas adjacent to fault lines, areas with slope higher than 45°, areas adjacent to major drainage lines and other areas identified by State Disaster Management Authority and all environmentally sensitive areas.
- 7. Special Area Zone:** In addition to the above listed zones, zones may also be specified keeping in view the special characteristic of such areas/pockets. Such areas shall be termed as 'S Zone'. This zone may comprise of old built-up areas with architectural or historical importance : S-1, areas of scenic value: S-2 which need to be preserved without spoiling the character by putting up various kinds of structures, the area restricted for development by Government: S-3, or it may be area under other uses/ spot zones: S-4. Therefore, it is necessary that use/activity permissibility in special areas should be carefully thought of in the development plan when it is being formulated.

Table 4.4: Simplified Regional Land use Classification

Level I			Level II		
N	A-N	Use Zone	N	A-N	Use Zone
1.	U	Urbanisable Zone	11	U-1	Existing Zone
			12	U-2	New Area Zone
			13	U-3	Potential for Urban Development Zones
2.	I	Industrial Zone			
3.	T	Transportation & Communication Zone	31	T-1	Roads/ BRTS
			32	T-2	Railways/ MRTS
			33	T-3	Airport
			34	T-4	Seaports, Dockyards and Dry ports
			35	T-5	Bus Depots/ Truck Terminals and freight Complexes
			36	T-6	Transmission and Communication
4.	PA	Primary Activity Zone	41	PA-1	Agriculture
			42	PA-2	Poultry and Dairy Farming
			43	PA-3	Rural Settlements
			44	PA-4	Brick Kiln and Extractive Areas
5.	O	Open Area Zone	51	O-1	Recreation Area
			52	O-2	Green buffer zone
6.	E	Protective and Eco sensitive Zone	61	E-1	Water Bodies
			62	E-2	Special recreation Zone / Protective Areas such as sanctuaries/ reserve forests
			63	E-3	Forest Zone
			64	E-4	Coastal Zone
			65	E-5	Undevelopable Use Zone
7.	S	Special Area Zone	71	S-1	Heritage and Conservation Areas
			72	S-2	Scenic Value Areas& Tourism Zone
			73	S-3	Government Restricted Area (such as Defence)
			74	S-4	Other Uses/ Spot Zone*

Source: Various Regional Plans (NCRPB, MMRDA, HMDA). N= Numeric Code ; A-N= Alpha Numeric Code

Note: *The process of changing/relaxing/modifying land use of part or "Spot" of a "zone" in a particular land use is termed as "**Spot Zoning**". Spot Zoning can be done for comparatively smaller area in a particular land use zone in such a way that it does not affect the overall Plan.

4.8. Composition of the Planning Committees

Traditionally, the planning bodies in India have remained nominated, starting with the Chairperson and including the members. At times, in the name of democratisation, a serving or former Legislator is made the Chairperson. Also, the technical expertise available with the Planning Bodies needs to be augmented, in view of the flooding of the environment with technological tools and techniques that can make spatial planning far more realistic, speedy and transparent. Accordingly, in the changing socio-economic environment, it would be desirable to consider introducing greater

democracy as well as subject matter expertise in the composition of the Planning Authorities at all levels.

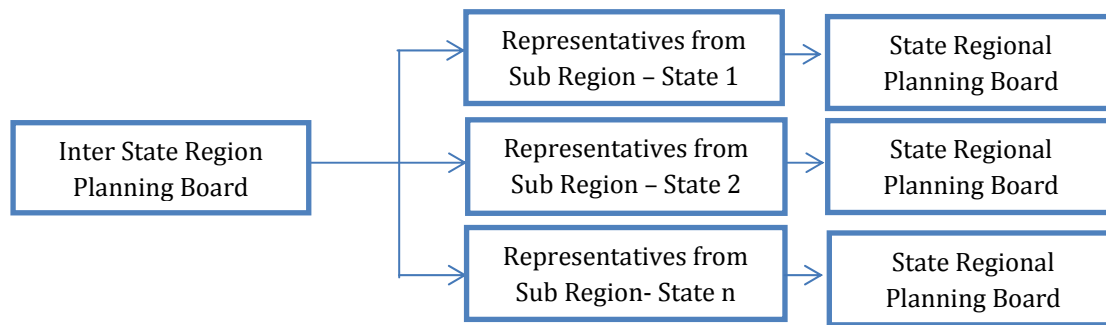
There is also this perception that Planning bodies are increasingly doubling up as Development Authorities and, in the process, they suffer from conflict of interest and besides, the development functions get overwhelming attention to the detriment of the planning functions. The Municipalities and *Panchayats* falling in the jurisdiction of the Development Authorities (DAs) have been complaining of all the financial and regulatory 'cream' being skimmed off by the DAs, leaving only the rubbish removal task and unpleasant authority (like property tax collection) with the Municipalities and Panchayats.

To address such concerns, some broad suggestions are given below.

District/Metropolitan Planning Committees and Regional Planning Boards: The DPCs and MPCs may be constituted as per the broad framework indicated in the 74th CAA. However, it is suggested that the DPC/MPC should not be unwieldy in size and the total number of members, including the Chairperson and the nominated members, *should not exceed 30. Subject matter experts* (3 to 4), from the fields of spatial planning, agriculture, climate issues, and finance should be nominated as members. The members should be authorised to elect among themselves a Chairman, Vice Chairmen and Chairmen of Subject Committees. Wherever the District/Region include cantonment areas, the Head of the Cantonment Board may also be made a member. The State level Heads of relevant Central and State Government organisations may be invited from time to time, as per felt need.

For interstate regions, such as the NCR, Parliament would have to make a law, in consultation with the States concerned, for constitution of the Regional Planning Board (RPB). Concomitantly, the State Laws, including the T&CP Acts, would need to be amended suitably, to mandate the alignment of the Local Area Plans with the Regional Plans. The onus of such alignment should remain with the State Government concerned by way of self- certification and there should be no need for mandating formal approval of the Local Area Plans by the RPB. The Chief Ministers of the participating States should, by rotation, be made the Chairperson of the RPB. This would be in line with the federal principles. In the alternative, a Minister of the Union may be the Chairman of the Inter State RPB. For the area of region falling in the respective States, there should be State Regional Planning Board, to carry out the regional plan in finer details in the sub-regions.

Figure 4.6: Planning Board for Inter State Regions



Regional Development Authorities and Improvement Trusts: The broad principles for composition and functioning indicated above for the DPCs and MPCs may be suitably adopted for the Regional Development Authorities and Improvement Trusts as well. The Development Authorities should preferably not be combining the planning, regulatory and development functions all in one. All the resources generated by way of fees etc. in approval of layouts should be sharable with the local bodies (*Panchayats* and Municipalities) besides using it partly for development of regional infrastructure.

5 Urban Planning Approach

5.1. Introduction

The location, site and situation significantly contribute to growth and function of a settlement. Location and surroundings could have positive and negative impact on settlement development. However, careful planning should be able to use well the advantages that the location of a town provides. Particularly location in the context of waterfront of sea, river and large lakes provides special resources, which can be effectively used for development of the town. Similarly, the town located on the hills provide other special opportunities for development. Any appraisal of the value and importance of a particular site must involve a knowledge of its historical past, evolution and landmarks of change.

The growth of clusters of urban settlements is more frequently found around large metropolises and results in what are sometimes called “city regions”. Often these are made up of small towns and villages, which have been enormously expanded as a result of national policy on dispersal of economic activities away from the metropolises. The small and medium towns in these city regions are related to one another by the functions, which they perform. Site condition in the hilly and mountainous regions may occupy site in Ridges, Valleys, River terraces, Confluences, Rolling Meadows and in cases linear settlement growth along the major transportation routes or at the entrance to specific hill region.

5.2. Guidelines for Study on Location, Site and situation of Settlement

5.2.1. Location

Location attributes to be considered in a planning exercise:

- a) Location in terms of latitude and longitude, population size and area and connectivity with other settlements etc.
- b) Nodal significance in the national or regional transport and communication network, power network and industrial development etc.
- c) Location in terms of agricultural produce collection and distribution centre, agro-industries linked to local markets, irrigation network, agricultural extension services etc.
- d) Significance of the location in ecological terms, related to important ecological networks
- e) Status that the settlement in hierarchy in the State or the Region
- f) Role and status of the city/ town in the national delivery systems of social services;
- g) Relative significance of locations of city/ town in proximity to a Metropolitan/Megapolis:
 - i. Nodal significance
 - ii. Presence of high productive economic activities
 - iii. Presence of large scale market

5.2.2. Site

Site attributes to be studied for planning exercise:

- a) Conditions of site: low-lying, swamp, or dry land, ridge, on a riverbank or canal side. Within the town-flat, slopping (in which direction), undulating-gentle slope, moderate slope, steep slope.
- b) Value and importance of the site and its historical past, that is, when the nucleus was established.
- c) Analyse the factors responsible for determining the site:
 - i. In alluvial plains
 - ii. In hilly and mountainous regions
 - iii. In arid regions
 - iv. In the areas of territorial ruler ship
 - v. In the areas around some localised physical resources, mining settlements, manufacturing towns, resort towns
 - vi. Around large metropolis
- d) Climate and its influence on daily life, construction, range of crops and how the city activities have modified the natural climate, particularly in the built-up area.
- e) Analysis of climate type, variations in temperature, wind velocity and wind directions in different parts of the city; study of the climate with reference to summer, rainy and winter seasons.
- f) Limiting and the favourable factors of site in the spread and growth of the city/town.

5.2.3. Situation

The following to be considered for situation analysis:

- a) The endowment of the situation (wider setting) for the subsequent growth in size of the city/town and for the enhancement of its functions
- b) The important and interrelated aspects of situation, namely,
 - i. Physical configuration
 - ii. Route patterns
 - iii. The extent of the territory to which the urban functions are related
- c) Suggest measures to retard or even overcome the weakening of the original value of the site and situation.

5.2.4. Hinterland

The endowment of the hinterland is another factor on which growth of an urban centre rests. An urban centre, for example, can establish a mutually interacting relationship with its hinterland if the hinterland has a variety and extent of natural resources in terms of both agriculture and economic potentials. A city's growth may be consistent and stable mainly because its economic base is closely linked with that of its hinterland. It is also conceivable that the city can be an instrument not merely for effectively utilising the existing potential of its hinterland but also of increasing the hinterland's potential itself. The development of the regional economy helps the growth of small towns, which in the process become the main service centres for their hinterlands.

Therefore, considerable attention should be given to the delimitation, functionality, social and economic link to a particular urban settlement. The area linked socially and

economically to an urban settlement has been given various names, such as “Hinterland”, “Upland”, “Urban Field”, “Sphere of Influence”, “Zones of Influence”, “Tributary Area”, or “Catchment Area”. The immediate hinterland of a large city, which is directly under the influence of the agglomeration, is the ‘peri-urban area’.

Location, Site, Situation and Hinterland may be studied using Geospatial techniques on the aspects like Hydro-Geological analysis, Temperature Change analysis, Network analysis, Proximity analysis, Land Suitability analysis, Urban Growth analysis, etc.

5.2.4.1. Peri-urban area

The area influenced by a town is not a two-dimensional feature, not a sphere, nor does it necessarily form a continuous zone. Flow of goods, services and information into and out of a town/city, most modern urban settlements and their immediate hinterlands are economically interdependent, rather than one being a tributary to the other. An analysis of the rural area served by a city/town gives some indication of the relation between city and the urban-rural mix (the peri-urban area), which is of practical application in examining the provision of goods and services in an urban centre. However, as mentioned in the Regional planning chapter, ***Peri-urban is the zone which is within the planning area limits but outside the limit of the municipal corporation / authority or metropolitan planning committee or authority.***

As smaller towns fall within the areas served by larger metropolitan regions, the delimitation of urban zones of influence also sheds light on the manner in which a city at a particular level in the urban hierarchy provides specialist services for the surrounding population and settlements (such as service towns, satellite towns or service villages). Finally, very large cities extend a particularly intensive influence over the areas around them; so much so that these can be well defined peri-urban areas. Delimitation of peri-urban areas is directly influenced by accessibility as of highways and/or prime economic investments. With rapid urbanisation conditions, the peri-urban zone is dynamic. Hence peri-urban limits undergo alterations subject to high stress for urban growth and therefore always in fast transition.

In examining zone of influence, one commonly adopted method is to establish on a map the areas served by employment, shopping, entertainment, education, health services and so on. This method of analysis is applicable to cities and towns at all level in urban hierarchy. At a higher level in urban hierarchy the criteria used reflect the distinctive functions of larger settlements and employ information like:

- The area served by the city's services and amenities like water supply, electricity, gas supply and telephone, health services, educational, cultural, recreational elements, security services such as police and fire brigades, postal services, mainly the local delivery areas and postal zones; banking and insurance facilities, the circulation of its daily newspapers.

- Flow of wholesale products, trip generation, intensity and speed of movement should be taken into consideration.
- Other reflective elements, which may be considered, are land use ratio of non-agricultural to agricultural population, density trends in population growth, settlement pattern, growth of built-up areas and pattern of communication.

In respect to a typical industrial town, its peri-urban area may be much more restricted than that of the other types of town. An intrusive industrial town may well not have the full range of urban services appropriate of its size. These missing functions will be supplied from other centres, thus making its zone of influence less clearly defined.

Temporal data provided by Satellite imageries may be used for the delineation of Urban Zones of influence. All maps for urban areas like utility maps, infrastructure maps, growth maps, vegetation maps, transport maps, etc. may be prepared using high resolution satellite data. It will be clear that the analysis of urban zones of influence is most appropriate for those cities whose dominant role is that of serving as a central place, although most settlements of any reasonable size will have this among their various functions.

5.2.4.2. Leapfrog Development and Urban Sprawl

Leapfrog development refers to the occurrence of urban settlement in places separated from denser areas by open space and land under agricultural production. This development has “jumped” land unavailable for such development because it is held by the state, by other private owners, or because it is under the control of traditional authorities. This type of development may take the form of upmarket residential and business park development, or it may take the form of low-cost housing projects or informal settlements which may be implemented, or which may occur as a consequence of rapid urbanization³².

Urban sprawl refers to urban growth; along transportation routes in linear form with one or a few property depth as width on both sides of the road, taking advantage of accessibility, flow of goods and services. These urban developments have higher infrastructure systems cost such as water supply, power supply, which often have to be long extended from the nearest serving areas. Land Assembly/Land Management Techniques using geospatial techniques may be used for effective utilization of land and thus check the urban sprawl.

Municipal Planning & Management should apply careful control over change of agricultural land for non-agricultural uses. These conversions are commonly seen in peri-urban areas and are neither covered under Municipal laws nor under any planning regulations as the location is outside the limits of municipality or even a planning authority.

Often, sporadic and scattered conversions create problems for future planned urban development, where many of these are done for speculation purposes to gain high

³²Sustainable Urbanization: Guidelines to Manage Urban Growth, Volume 2: Tools and Guidelines, McIntosh Xaba & Associates.

capital returns from land lots. Though the laws require the land revenue authorities to take the advice of State Town Planning Department about viability before permitting conversions, but due to absence of any approved land use plan and weak structure of Town Planning Department, this step is rarely taken or even if taken it is hardly effective from planning perspective. Such haphazard urban sprawl needs to be curbed and regulations should be in place to discourage unplanned growth, which can be achieved through the Regional Planning Approach (see **Chapter 4**).

5.2.5. Accessibility

Accessibility is the dominant factor influencing the location, growth and functions of urban centres. It is to combine at least three elements: the location of a place within a region (in general, centrally located places are more accessible); the form of the transport system; and accessibility within the area of the activities: access to employment opportunities, access to population, access to educational or health facilities, etc. Green mobility and TOD demand a focus on better accessibility by non-motorised mobility and public transport.

Urban settlements tend to grow on transport routes only at specific places, particularly at junctions and break-of-bulk points, where one form of the transport is changed for another. Hence settlements whose locations are guided by transport routes are found not only at the end of these routes, but also along them. The number of routes, which come together at a particular point, is important, but the degree to which passengers and goods are interchanged is more important.

The guidelines for the study of accessibility are as under –

Establish the role of:

- i. Long-distance regional/inter-regional transportation in determining the locations of the city/town;
- ii. Both the long distance as well as local and intra-urban transportation in the growth of size of the city/town;
- iii. Inter-urban and intra-urban transportation in affecting urban structure.
- iv. Non-Motorised Transport and Transit Oriented Development in defining intra-urban transportation and urban structure.
- v. Inter-regional easy access by different modes;
- vi. Good mobility within city/town due to construction of tunnel results in the development of new areas with commercial, industrial and residential activities, which leads to population increase in the entire urban area.

5.2.6. Socio-Economic Profile

City is not alone a characteristic of its physical or locational forms; its population and its characteristics determine the social processes that set the City culture. Socio-economic class-wise distribution of the population is a key indicator of the social parameters in a settlement. In case of existing settlement, the pattern of population on the basis of socio-economic levels can be studied for planning to understand the services and facilities. On the contrary, it is useful for the greenfield sites, where

zoning can be proposed based on the income of the settling population class, higher, middle or low. Spatial plan is usually influenced by living and work places of different of population classes.

This principle of Urban Strategic Planning³³ should in consonance with the income distribution structure of the city region with the urban poor located near public transport nodes/links and specially providing space for the urban poor in master/development plans for living, selling and working - at city, zone and local levels.

Overall, the social indicators allow the planner to understand the city, link it with the city spatial form and its behaviour pattern. In short, unlike the traditional approach to zoning, social parameters can be used for creating zones and its functions. This can directly point at the urban facilities such as bus services, dedicated transportation corridors, facilities of social infrastructure and physical infrastructure.

5.3. Distribution of Land Use

5.3.1. Developed Area Average Densities

For the purpose of these guidelines, the densities mentioned in this section are the Gross Population Densities defined as person per unit area (in hectares) for developed area only. The calculation includes population of the settlement on the developed land of the settlement.

Fixation of density norms should be based on carrying capacity analysis focusing on parameters - space per person, access to facilities, available piped water per capita, mobility and safety factors. The task should be settlement specific. However, for overall planning approach density ranges are suggested in **Table 5.1**.

Table 5.1: Developed Area Average Densities

Settlement Type	Persons per Hectare(pph) in	
	Plain Areas	Hill Areas
Small Towns	75-125	45-75
Medium Town	100-150	60-90
Large Cities	125-175	60-90
Metropolitan Cities	125-175	100-150
Megapolis	More than 200	--

Source: Revised based on UDPFI Guidelines.

These are suggestive population densities as per the settlement size. However, while planning for compact and TOD development, these densities should be modified to suit the requirement and should be based on carrying capacity analysis. Developed area densities suggested above is useful to calculate total developed area requirement

³³Report of the Working Group on Urban Strategic Planning, 12th Five-year Plan'

at city level, when the target population for the city is given. When used along with the suggested norms for different land use, area can also be calculated.

5.3.2. Proposed Land use Structure of Urban Centres

The proposed land use structure for urban centres is indicated in **Table 5.2**:

Table 5.2: Land use Structure for Developable Area in Urban Centres

S.No.	Land use Category*	Percentage of Developed Area			
		Small	Medium	Large Cities	Metropolitan Cities & Megapolis
1	Residential	45-50	43-48	36-39	36-38
2	Commercial	2-3	4-6	5-6	5-6
3	Industrial	8-10	7-9	7-8	7-8
4	Pub. & Semi Public	6-8	6-8	10-12	10-12
5	Recreational	12-14	12-14	14-16	14-16
6	Transport & Communication	10-12	10-12	12-14	12-14
7	Agriculture, Water bodies and Special areas	Balance	Balance	Balance	Balance
8	Total Developed Area	100	100	100	100

Source: Revised based on UDPFI Guidelines, 1996

Note:

1. It would be desirable to fix the recommended Landuse share for essential uses (Residential, Transportation and Recreational) while the proportion for other uses may be flexible. Actual land use percentage in a given city case should be calculated based on local conditions and needs.
2. Zoning regulations given in Table 9.1 – ‘Simplified land use classification’ to be followed in consistency with the land use structure given in the table above.
3. *Land occupied under Special Areas (refer Table 9.1 for uses) to be included in the land use categories 1-6 given in the table above, unless large special areas to be considered as a separate entity for planning, such as cantonment areas.
4. *However, to propose the mixed land use of a city –percentage share of residential, commercial and industrial land use to be adjusted proportionally as planned by the local authority. Mixed land use should be either non-industrial oriented or industrial mix oriented (refer Table 9.1 for uses).
5. The adjustment in the residential, commercial and industrial land use (dominant use) to be based on the land area proposed for mixed land use zone and reduction of respective proposed mixed land use(s). Appropriate reduction in residential, commercial or industrial uses and adjustments in other uses to be made so that the total land use becomes 100%. The mixed use of land to be envisaged at vision development stage of the plan formulation.
6. Detailed study is to be undertaken on the co-relation of and effects of FAR/Densities in our towns (both small towns and metropolitan cities) and guidelines to be adopted for the optimal use of land.

Specific attention needed on areas in section 5.4 - Urban planning approach.

5.4. Urban Planning Approach

Though urban development increasingly accounts for a large share in the National economy, huge gap between the need of infrastructure services and available resource still remains unbridged as a major concern. It adversely effects provision of employment, mobility and lifestyle of large sections of city's population. Challenges like environmental sustainability, changing but stressed lifestyle put pressure on mobility and health. In order to reduce pressure on land and response to climate change impact, alternative approaches of city planning and building is the need of the hour.

Such solutions lay in keeping the city compact by mixing uses of land to an optimum level, decreasing trip generation and high population density making mass rapid transit systems technically and economically viable. Aspect to be encouraged by urban planners are walk to work best designed pedestrian safety, protection of natural features and environmentally sensitive areas, along with finding new source of financial resources for city development.

To moderate and eventually curb the environmental impacts of urbanisation, sustainable ways of planning are required. Urban centres by its conventional form play a significant role in mounting urban heat island. Green city modules such as street orientation in lines with sun direction, prevailing wind direction and use of heat repelling material not only help reduce the impact, but also slow down the gas emissions from artificial cooling systems. Further green spaces within the urban set-up ensure cooling effect and better public interaction spaces, apart from psychological supports in reducing human stress levels.

Both compact city and green city approach should help to release land for open space and recreational use purposes, reducing pollution levels, decentralising waste handling, encouraging public transportation and simplifying land use segregation.

To technically meet the demand of the urban centres in making it cost effective and in optimum utilisation of available resources to any of the urban planning approaches, Information Communication Technology (ICT) has emerged as a solution. Smart city concept facilities better living experience for human kind, declining dependency on contingencies by using ICT enable development of smart communities, providing a communication web that connects buildings, energy and mobility devices such as Electric Vehicles (EV) by using bi-directional information exchange. 3D City Models may be used to facilitate orientation of views in terms of scale and spatial position and planning other urban utilities. Digital modelling can also be used to create decision support tools that help to reduce the environmental impact of planning decisions, for flood risk prevention and for cost benefit analysis.

The following sections cover the key benefits of compact city, green city and smart city approaches and its aspects in planning.

5.4.1. Green City

Green cities are those where economic growth and development is fostering, that reduce negative environmental externalities, the impact on natural resources and the pressure on ecosystem services. These cities have significant synergies between environmental and economic objectives. A clean or effective production and consumption of facilities related to movement of people and goods, waste management and recycling, pollution prevention, treatment, energy, abatement, design, construction, maintenance, resource extraction, agriculture, natural resource management and other environmental services, are the prime component of a green city.

5.4.1.1. Key Benefits of Green city

- **Effective Land Use:** Green cities promote effective land use and get rid of urban sprawl by encouraging compact mixed-use developments. Higher urban densities are promoted without affecting the quality of life.
- **Habitat Prevention and Restoration:** These cities aim to prevent damage to the natural landscape, productivity of agricultural land, biodiversity and natural habitat. Such green spaces improve the quality of air and canopy covers reduces noise level.
- **Efficient Transportation Management:** Green city increases opportunities for non-motorised movement, bicycling, pedestrian friendly network, reduction in the number of automobile trips, promoting public transportation and use of vehicles with alternative fuels.
- **Effective Use of Resources:** Limits the usage of resources by incorporating efficient systems, like:
 - Water Efficiency:** Green city includes “R3” (reduce-recycle-reuse) strategies and can save potable water to an extent of 30-40% including water harvesting.
 - Energy Efficiency:** On-site power generation using various renewable energy technologies and other clean fuels can significantly reduce the load on grid power supply. There can be energy saving to the tune of 20-30%.
 - Waste Management:** Waste management in Green Cities are well planned which takes into account waste reduction initiatives by planning and implementation of efficient and effective systems for collection, transportation, treatment, recycling and reuse or disposal of municipal solid waste. Also, Waste-to-energy is a key component of green city.
- **Other Benefits:** Reduced maintenance costs, resource consumption, waste generation along with higher marketability and speedy environmental clearance approvals.

5.4.1.2. Green city Planning Components

Site Selection and Planning

Green city development in India is a new effort. West Bengal Government and Maharashtra Government have recently taken initiatives. Green city initiatives should on publically owned land with minimum site disturbance should be preferred during site selection in case of a Greenfield township. Priority should be given to the already developed land in order to achieve green redevelopment.

Land Use & Transportation Planning guidelines for green cities

1. Urban sprawl is controlled by practicing higher density development
2. Green cities should majorly use public transportation to reduce fossil fuel consumption & vehicular emissions. The proximities of basic transportation mode should be in walk-able distance.
 - a. Eco- friendly transportation services should be preferred which runs on CNG, bio-fuels, solar battery etc. Thus, Non-Motorised Transport (NMT) and Intelligent Transport System (ITS)³⁴ should be encouraged.
 - b. Requirements:
 - i. **Rail Station Proximity:** Locate a city project within 1/2-mile (800-meter) walking distance as far as possible (measured from a station building entrance) of an existing or planned commuter rail, light rail or subway station.
 - ii. **Bus Stop Proximity:** Locate a city project within 1/4-mile (400-meter) walking distance as far as possible (measured from a main building entrance) of 1 or more stops for 2 or more public, campus, or private bus lines usable by building occupants.
 - iii. **Public Transportation Proximity:** Locate the project within ¼-mile (400-meter) walking distance as far as possible from the bus stop. Rideshare options should be promoted which include passenger ferry terminals, vans and IPT, such as rickshaws, that are authorized by the local transit authority and that meet the definition of public transportation.
3. About 25-35 % of total area should be earmarked as recreational and open spaces within the Green City in addition to environmental sensitive areas, which must be protected.
4. Locate basic amenities within walk-able distances to reduce dependency on automobiles
 - a. Basic amenities like ATM, Parking, Convenience shopping, religious facilities, crèche etc. should be within 600-800 meters.
 - b. Amenities such as School, Medical Clinic, Community hall with sports facilities, Restaurant etc. within 1.6 - 2 km.
5. Provide a non-industrial mixed land use by including at least 3-4 developments like Offices, Hospitals, Retail, Recreational areas, etc.
6. Economic sustainability and resilience are important aspects of green cities. Provide good connectivity and accessibility by *green mobility*. Provision of TOD to create economic opportunities and facilities around multimodal nodes of infrastructure.
7. The need of differently abled / physically challenged / disabled people should also be adequately addressed.

Infrastructure Resource Management

Green cities are required to be developed as a self-sustained entity i.e. the place where the resources can be utilized in a recycled and reusable approach, so that the dependency over the civic bodies can be minimized.

Addressing water supply: It should be mandatory for a green city to practice the rainwater harvesting to enhance groundwater table through recharging and reduce municipal water demand. As a whole, water supply should comply with the R3 (*Reduce-Recycle-Reuse*)³⁵ concept in order to address the water related issues. Grey water reuse shall be built in the infrastructure set-up (refer Chapter 8 for details).

Efficient energy: Green cities shall majorly emphasize on non-conventional sources of energy, at least 10% of city's peak electricity load³⁶. Solar energy, Waste-to-energy, Landfill Gas Energy and Wind energy are some of the alternative sources that can be integrated with the green city development to reduce the load on grid power. Further attempts should be made to guide and channel prevailing wind

³⁴Green Module, A study of West Bengal.

³⁵Ibid.

³⁶Pasadena Green City Report.

through sensitive design of roads, related plantation and maintenance of building lines. This should reduce heat island formation and also make mobility including cycling and walking easier.

Waste reduction: The aim should be to achieve “Zero Waste” to landfills. “User-friendly” recycling and composting programs should be implemented with the goal to reduce at least 20% per capita solid waste disposal to landfill. Use of eco-friendly materials (e.g. heat repellent material) are recommended including use of hollow AAC Blocks for better insulations.

Case study: Vancouver, the Greenest City

Vancouver is the world's most liveable city as per the Economist magazine. It's proved to be not only the most liveable, but also Canada's model for using renewable energy sources.

- 93% of Vancouver's electricity is generated from renewable sources.
- The City has implemented the greenest building code in North America.
- The City has shifted investment to walking, cycling and transit infrastructure instead of building new roads.
- Vancouver has the smallest per capita carbon footprint of any city in North America.
- By 2020, reduce waste heading to landfills or incinerator by 40% and over 50% of commuter by walking, biking or public transport.



Source: Greenest City Action Plan, City of Vancouver

Microclimate change³⁷

Green cities can be planned in accordance with the microclimate. Conditions of wind, sun, radiation and humidity experienced at a particular location around the built mass contribute to microclimate and understanding of these can create energy efficient landscapes for buildings and comfortable dwelling units.

Proper practices that affect microclimate can reduce pressure on artificial temperature reducing power consumption and ultimately GHG emissions, which is explained below:

1. **Street Orientation:** Street geometry and orientation influences the amount of solar radiation received by street surfaces, as well as the potential for cooling of the whole urban system. The streets can be oriented (as mentioned earlier) parallel to prevailing wind direction for free airflow in warm climates. Preferably, the street orientation in Indian context should be E-W, as the buildings will be oriented N-S, thus there will be easier seasonal solar control as the walls are protected in the summer and exposed in the winter.

³⁷MNRE, Solar Energy, Chapter 2

2. **Water bodies:** Since water has a relatively high latent heat of vaporisation, it absorbs a large amount of heat from the surrounding air for evaporation, which cools the air. The wind pattern at a site is also influenced by the presence of water body. Therefore, water bodies such as lakes, ponds or fountains should be provided.
3. **Open spaces & Vegetation:** Open spaces such as courtyards can be designed, that can act as heat sinks. Grass cover and shading which gives cooling effect. Plants adsorb radiations and cool the environment. Planting a deciduous plant (e.g. Mulberry, Champa) on East and West side provides shade from intense and glazing morning and evening sun in summers, cut off hot breeze, and also allow solar radiations in winter as they shed the leaves in that period.
4. **Semi-pervious ground cover:** Semi-pervious paving which allow percolation of water into the underground water table.
5. **Green Buildings:** A green building is one, which uses less water, optimises energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building. As an added benefit, green design measures reduce operating costs, enhance building marketability, increase worker productivity and reduce potential health impacts resulting from indoor air quality problems.
6. **Solar Passive Design³⁸:** Passive solar design refers to the use of the sun's energy for heating and cooling of living spaces. In this approach, the building itself or some element of it takes advantage of natural energy characteristics in materials and air created by exposure to the sun. The key features lies with solar passive design are: Orientation of building, Sunshades, Window design, double glazed windows, Building insulation, Roof treatment, Evaporative cooling, Landscaping, Surface to volume ratio, Passive heating, Earth air tunnel, Solar chimney, and Wind tower.
7. **Green Roof:** Green roofs are roofs that have a layer of living plants on top of the standard structure and waterproofing elements. It helps in reducing Urban Heat Island Effect and also delays storm-water runoff. It also reduced energy consumption. Thus, adaption of this technology throughout the city will increase the green area; hence areas with construction can also be converted to green area.

For development of green buildings, the norms as suggested by MoE&F and various bodies such as LEED, IGBC or GRIHA may be applicable depending upon the requirements.

An effective design of green city for its various components can even reduce crime. Green cities promote features that maximize visibility of people, open spaces in and around the campuses and building entrances looking over the streets and parking areas, pedestrian-friendly sidewalks, which allows natural surveillance.

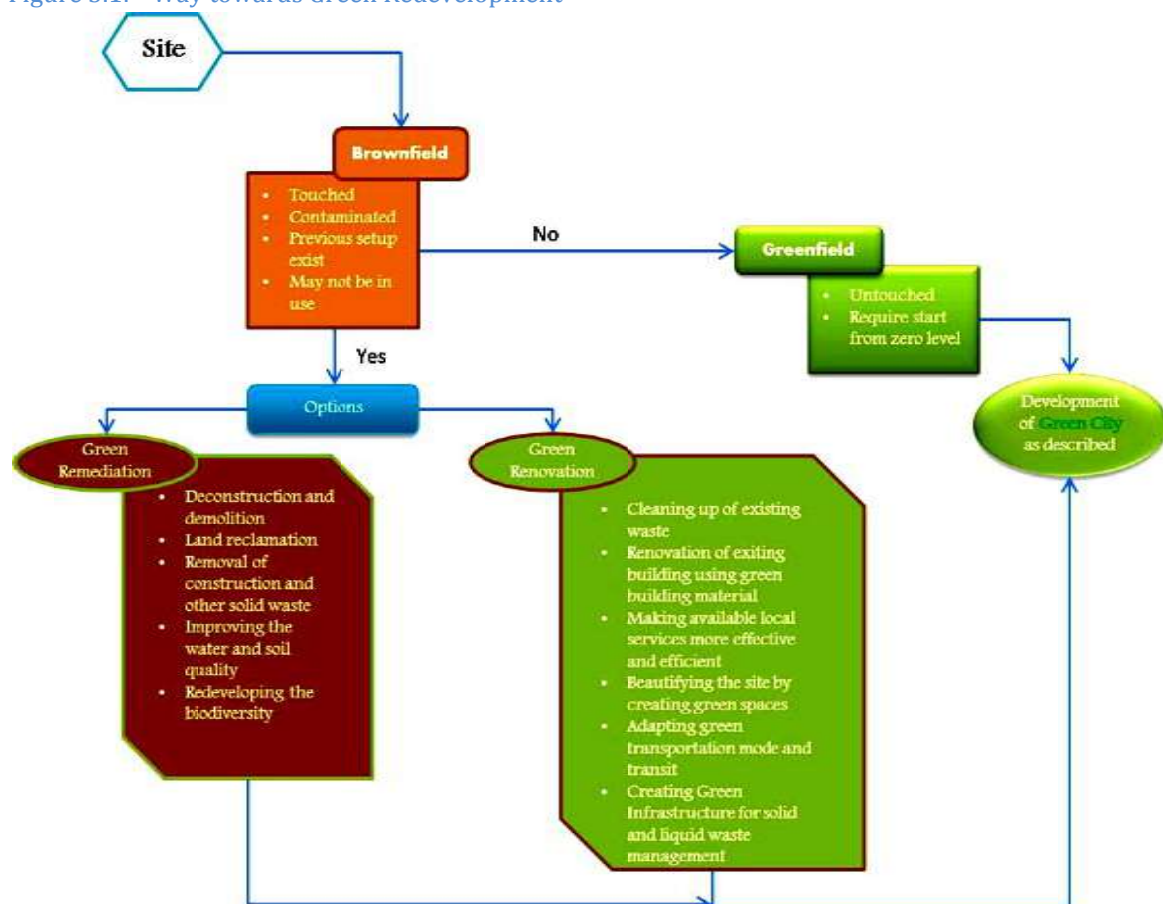
5.4.1.3. Redevelopment of brownfield sites

Priority shall be given to redevelopment of contaminated and dense sites, which are environmentally degraded or demographically saturated. Focus should be on green redevelopment of such site, which can improve the overall condition of existing sites. Thus, it is advisable to prefer redevelopment on brownfield sites than fresh development on a greenfield site until absolutely essential. In such a case, brownfield

³⁸TERI with support of MNRE

redevelopment makes efficient use of existing infrastructure. The process for the decision and actions is given in the figure below:

Figure 5.1: Way towards Green Redevelopment

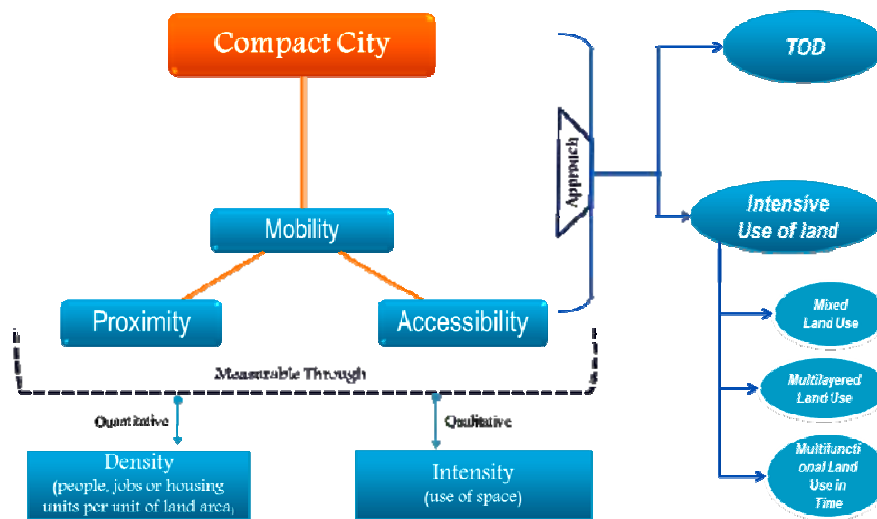


5.4.2. Compact city

Urban sprawl is a resultant of an ever-expanding city jurisdiction due to absence of compact development practices. This has resulted in undesirable extension of urban infrastructure, encroachment of valuable agricultural land, raising cost of development and also increasing carbon, water and energy footprints.

Concept of Compact City revolves around high-density development without compromising the quality of life of the people. Cities based on compact approach may or may not incorporate all dimensions of a green city approach, stated under **section 5.4.1**. This approach largely solves the problem of externalities such as friction on space (congestion), travel time delays and losses in economic productivity, air and water pollution, solid waste collection and disposal. The optimum density reduces the capital and operating costs of providing public infrastructure and services and improves overall accessibility.

Figure 5.2: Compact City's Concept and Approach



Source: Various sources including Fact Sheet, UNESCAP, MILUNET, Practitioner's Guide, 2006 etc.

As shown in the figure above, the efficient densification and effective intensification needs to be balanced in order to maintain the liveability of people.

5.4.2.1. Key Benefits of Compact city

The benefits of the compact city approach are:

- Efficient use of land and urban containment
- Increase in the number of ridership for economically viable MRTS
- Environment protection by lowering the climatic change emissions
- Protection of ecological diversity, countryside and land for agriculture
- Efficient delivery of utility services in more densely populated areas. Due to the economies of scale in supplying energy, water and treating waste, it is less costly to deliver urban utility service in compact cities than in suburban areas³⁹
- Increased social interaction leading to safety against crime
- Less travelling distances that saves time, money and fuel consumption per capita
- Improved public health by better water and air quality, and by walking and jogging

The approach of compact city development is given below:

5.4.2.2. Transit Oriented Development

Transit Oriented Development is a compact & integrated transportation development, which should be incorporated in Compact Cities. It is defined as, “any development, macro or micro that is focused around a transit node, and facilitates and complete ease of access to the transit facility, thereby inducing people to prefer to walk and use public transportation over personal modes of transport.⁴⁰”

TOD provides opportunities by access to high-quality public transportation by enhancing connectivity and contributing to attractive and walkable distances through

³⁹Fact Sheet, UNESCAP.

⁴⁰ Draft UTTIPEC Guidelines, 2012.

densification. TOD Ideal land use mix and mixed land use development (with Density) and the Transit mode function at various city destinations are indicatively explained in the Table 5.3. High density, mixed-use and interconnected street networks reduce per capita vehicular trips. This can be achieved through a balanced mix of job, housing and markets along MRTS corridors.

Table 5.3: Transit Oriented Development Matrix

TOD	Ideal Land use mix and mixed land use development (with Density)	Transit mode function
Core Area	- Residential: High Intensity - Commercial/ Office: Medium Intensity - Mixed Use - Supporting retails & services	- Bicycle Lanes - Pedestrian Networks - Intermediate transportation supported by non-motorised vehicles - Limited Parking Lots
Commercial Zones	- Employment (commercial, office, industrial, institutional): High Intensity - Supporting retail & services: Medium Density - Residential: Minimal	- Parking Lots, if required - Pedestrian Networks - Bicycle Lanes - BRT and Bus Stops - Intermediate transportation supported by motorised vehicles
Neighbourhood	- Residential: Medium Intensity - Employment (commercial, office, industrial, institutional): Medium Intensity - Supporting retails & services	- Pedestrian Networks - Bicycle Lanes - Considerable Multi-level Parking Areas - Intermediate transportation support by non-motorised vehicles
Peri-urban Area	- Commercial: High Intensity along TOD - Residential: Medium Intensity in inner region - Mixed Use including compatible institutional use	- Transition to higher density and greater mix of uses close to the transit source - BRT and Bus Stops - Green Interconnected Pedestrian Network - Considerable Multi-level Parking Areas

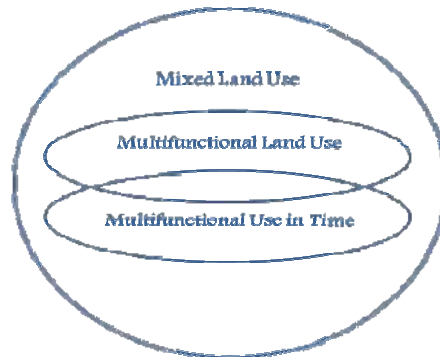
Source: *Transit Oriented Development Policy Guideline, Calgary, 2004.*

As a whole, TOD encourages use of non-motorized transportation, directs compact high-density developments, intensifies under-utilized urban areas through redevelopment, leads to lower infrastructure costs and increases public safety, mobility options and health benefits.

5.4.2.3. Intensive Use of land

The intensive land use offers cities the possibility of (re)development of urban areas for a number of functions that, in combination, can offer residents, workers and visitors high quality services. This concept can be sub-divided into three types with combinations as shown in **Figure 5.3**.

Figure 5.3: Types of Intense Land Use



Source: MILUNET, Practitioner's Guide, 2006

Mixed Land Use: Mixed-use development is the practice of allowing more than one type of use in a building or set of buildings which can be a combination of residential, commercial, industrial, office, institutional or other land uses. It is presumed that mixed land uses yields socio-economic benefits and therefore has a positive effect on housing and commercial values.

Good mixed-use can be defined as a finely grained mix of primary land uses, namely a variety of housing and workplaces with housing predominant, closely integrated with all other support services, within convenient walking distance of the majority of the homes. (Murrain 1993:86). It is also referred as cellular development. Mixed use is to be carefully allowed along with the compatible use only. The mixed use of land and the dominant use thereof should be referred from Chapter 9 on Simplified Development Promotion Regulations.

The approaches for promoting mixed-use development can be by increasing intensity of land use, increasing diversity of land use or integrating segregated uses. The key parameters for integration of different uses can be:

- The functional and physical integration of different uses such as Residential, Commercial – Retail & service and Public Semi Public.
- Integration of three or more significant revenue producing uses – Industrial, Commercial – Wholesale, Retail & service and Public Semi Public – offices

In an urban space, mixed use development can be planned at selected locations with ideal mix, such as a) City or town centres comprising the commercial and civic core of town and cities, b) Inner city areas and c) Peri-urban locations and greenfield sites in urban fringes as also indicated in **Table 5.3. Mixed layer development/ Multifunctional land use:**

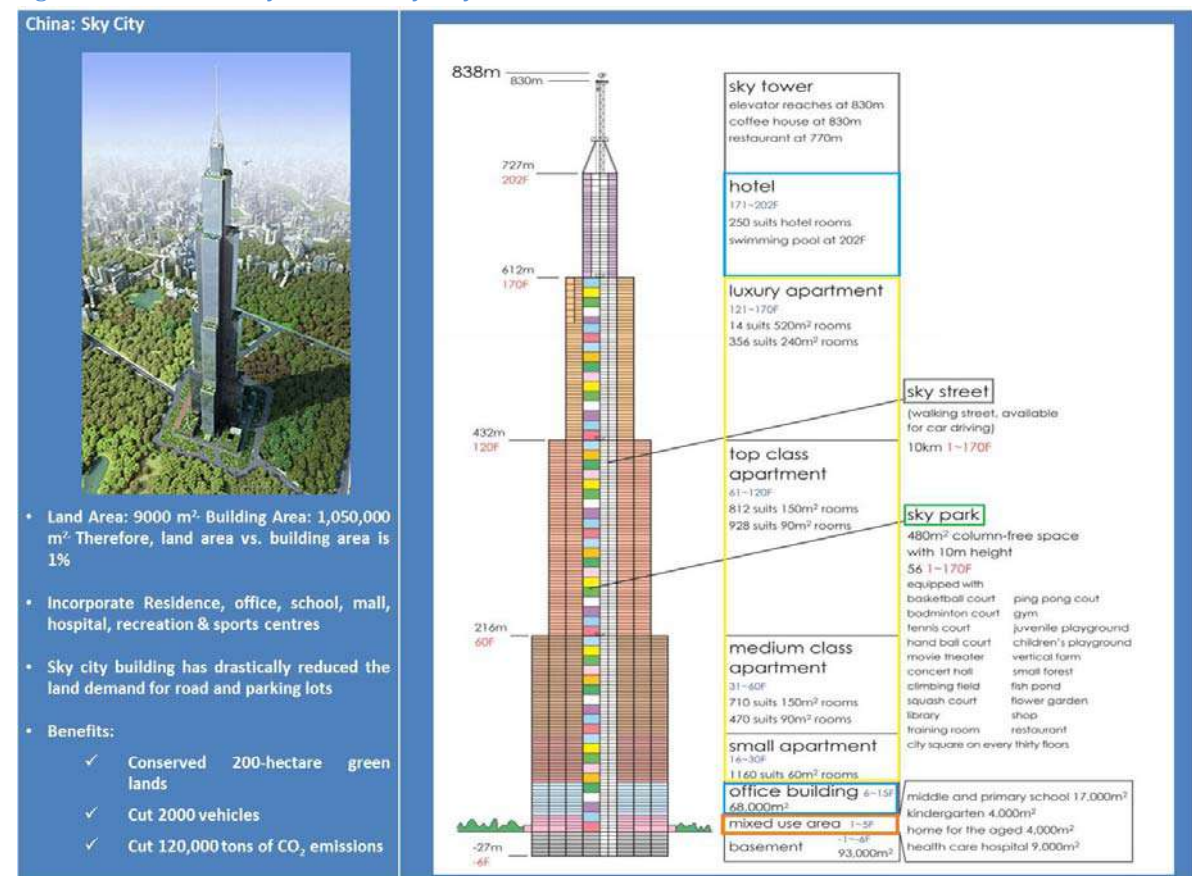
Mixed layer development is based on the principal of high intensity with vertical integration. It is under the category of multifunctional land use and also termed as “Layering Development”.

Vertical integration has many benefits to offer to cities as a whole. Benefits include energy-saving potential, reduction in unnecessary journeys, improves overall accessibility and social inclusion possibilities offered by combining housing, shopping, work, transport, recreation, culture and social functions within one area. This

combination also helps to utilize the full potential of an urban site, leaving sufficient open spaces for a greener surrounding. A mixed-use high-rise development diversifies the use of space within a single building structure, which in turn saves horizontal travelling, and hence additional land requirement.

Mixed layer development provides (re)development opportunities that ease the way towards Compact Cities. This concept should be preferred for abandoned sites within the city instead of building on greenfield sites on the edge of town. Therefore, brownfield sites can be redeveloped to offer a higher building density by layering different functions on top of each other. The land use structure and densities given earlier in this chapter is not applicable for mixed layer development. Such planned areas are proposed to have high average density up to 800-1000 pph, with large open spaces and inter-block margins. Typically, this form of vertical integration land use development has commercial/retail on the street level with offices and recreational commercial on the top levels, while the intermediate levels are for residential, well developed open spaces, institutional. Case study of Sky City, China, is a world-class example, which is explained below.

Figure 5.4: Case Study of China Sky City



Source: Sky City, China.

High-rise development may limit the access of light to the lower storeys and therefore demands slender buildings or appropriate setbacks from the boundary wall. The

recommendations of the Expert Advisory Committee (EAC) for high-rise buildings are:

- The height of the building should be linked with the width of the road on which the proposed building is to be located;
- Also the distance of Fire Station from the building so that in case of emergency, the Fire Tender may reach in the shortest possible time.

The EAC also recommended that the provisions and the guidelines, as applicable, of the State Departments and National/State Disaster Management Authority should be strictly followed⁴¹.

Multi-functional use in time:

A public space or a building can have different functions at different time periods. For example use of spaces even buildings can be used in shifts in a day allowing different types of uses in different shifts.

School playground, which can be utilized by the students during school hours and later in evening wherever possible, can be used for sports training and practice purposes or public stadium which can be seasonally used as fair grounds. Such areas can be considered especially in small size towns where infrastructure and funds are limited.

5.4.3. Smart City

A smart city uses information, communication and technology to enhance its liveability, workability and sustainability. A smart city is build-up by key basic functions: Information collection, communicating, and crunching (analysing). The two basic steps towards Smart city are:

1. **DATA-** Created by the already implemented information technology. Some of the Indian cities have created a cornucopia of data in past few decades, which can form the basis for the development of a Smart city.
2. **DIGITAL DNA (BUILT ENVIRONMENT DATA)-**Data collected by building departments, engineering departments, land department, planning department, tax department and department of postal services. India is still finding its footprints in this regard.

In view of rapid urbanisation and high congregation of population in large cities, it is imperative to make use of advances in technology, capability to make cities safer and protect cities from cyber-crime and also augment the quality of governance with higher levels of transparency and accountability. Such cities, which take advantage of advanced technology, are called as Smart Cities.

⁴¹MoEF Office Memorandum, Guidelines for High Rise Buildings, 2012.

5.4.3.1. Important Insights

The following figure provides the important insights of Smart City application globally.

Figure 5.5: Important insights of SMART city application globally

NEED	DRIVERS	ELEMENTS
• Growing urbanization • Growing stress • Inadequate infrastructure • Growing economic competition • Growing expectation • Growing environmental challenges • Rapidly improving technology capabilities • Protection from Cyber Crime • Revolutionize people's relationship with Govt.	• Legal provisions and Insurance • Planning and design • Construction Commission and handover • Facility operations- • Space planning, Asset Management, Maintenance, Environment Health and Safety security	• Energy • Water • Waste • Infrastructure • Public Safety • Education • Health Care • Green Buildings • Transportation • Citizen Services
BENEFITS	BARRIERS	INITIATIVES TAKEN
• Enhanced Livability-Better living conditions • Enhanced Workability-Better working conditions(broadband connectivity, clean, reliable, inexpensive energy, efficient transportation • Enhanced Sustainability	• Siloed, piecemeal implementations • Lack of Financing • Lack of ICT know-how • Lack of Integrated Services • Lack of citizen Engagement • Lack of a Smart City Vision	• Installation of smart meters and sensors • Smart thermostats and Building management system • Healthcare consultation via computer • Installation of intelligent transportation management software, roadway sensors, smart parking apps. • Setting up of Smart Grids

Source: Various sources including Smart Cities Readiness Guide, RICS-Smart Cities.

5.4.3.2. Universal Targets to achieve Smart city development

There are mandatory targets that must be accomplished in order to propel on the smart city path, these are termed as “Universal” as each of them applies to every city responsibility. **The Check Sheet (Implementation Progress)** reflects the strong and the weak points in the existing city infrastructure. Status of this matrix reflects the preparedness of the city to be a Smart city and helps in prioritizing the points on the basis of the status (progress) in order to drive on the path of development towards being a Smart city.

Figure 5.6: The Universal Targets

Enabler	Universal Targets	Implementation Progress			
		None	Partial	Over 50%	Complete
	How Smart Cities Deploy and Use ICT				
Instrumentation and control	Implement optimal instrumentation				
Connectivity	Connect devices with multi-service communications				
Interoperability	Adhere to open standards				
	Use open integration architecture and loosely coupled interfaces				
	Prioritize use of legacy investments				
Security & Privacy	Publish Privacy Rules				
	Create a security framework				
	Implement cyber security				
Data Management	Create a citywide data management transparency and sharing policy				
Computing Resource	Consider a cloud computing framework				
	Use an open innovation platform				
	Have access to a central GIS				
	Have access to comprehensive device management				
Analytics	Achieve full situational awareness				
	Achieve operational optimization				
	Achieve asset optimization				
	Pursue predictive analytics				

Source: Smart Cities Readiness Guide.

The essential elements of focus in a Smart city include:

5.4.3.3. Smart grid concept

A **smart grid** is a modernized electrical grid that uses analogue or digital information and communications technology to gather and act on information, such as information about the behaviours of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity. Metering and Smart power generations are the two basic steps taken in the direction of handling power in cities.

- Smart meter-** Smart meters help utilities to better detect and manage outages. Smart meters coupled with advanced metering infrastructure (AMI) helps to pinpoint problems in the grid, allowing determination of faults and failures in no time⁴².
- Smart power generator-** Smart power generation is a concept of matching electricity production with demand using multiple generators, alternatively to buffer the peak and high demand for load balancing. These generators are designed on smart technologies to operate efficiently at chosen load⁴³.

5.4.3.4. Smart Transportation Concept

The smart transportation refers to the integration of information and communication technologies with transport infrastructure to improve economic performance, safety,

⁴²A U.S. Department of Energy study showed that real-time pricing information provided by the smart meter helped consumers reduce their electricity costs 10% on average and their peak consumption by 15%.

⁴³Source: GE: Smart grid technology guide.

mobility and time saving of the citizens. The above can be accomplished by incorporating the following technologies in the existing structure:

- a. **Digital view terminals**-These terminals provide users with an intelligent navigation system that optimizes the best routes, alternative destinations, efficient movement by a well-informed guidance from the terminal. For example, the entire city's bus lines, their stops, and drop-off and pick-up times are displayed on the terminals along with satellite street views of locations, such as of restaurants and other tourist attractions. Coordinates for banks, schools, hospitals, and real estate are also featured for the citizens to determine best-suited route between destinations.
- b. **Intelligent roads**- It includes setting up of sensor technologies in the pavements and over the bridges, which can be combined with the data collected from moving vehicles to provide operators, maintenance authorities and road users with rapid warning of emerging problems.
- c. **Traffic Prediction Tool**-It predicts traffic flows over pre-set durations (10, 15, 30, 45 and 60 minutes) by stimulations. With these predictions, traffic controllers can anticipate and better manage the flow of traffic to prevent congestion and save time.

Other smart applications in the intelligent Transportation system may consist of:

- Optimised dynamic signalling
- Automatic parking system,
- Advanced Driver Assistance Systems (ADAS),
- Satellite application for emergency handling, traffic alerts, road safety and incident prevention
- Automated transport systems.

Case Study: Malta, World's first Smart Island

Malta is a group of small islands 50 miles to the south of Sicily. Smart meters are installed in the island for both electric and water customers. These smart meters records the data automatically and sends the data back to the office for billing. Smart meters also act as the analysis instrument that locate problems and determine when and whether to expand the grid. The new smart water grid has increased theft detection, and has also introduced **new pricing options for customers that reward conservation**.

Figure 5.7: Malta: World's first Smart Island



Source: Smart Cities Council-Readiness Guide

The goal of Smart City Malta is to put everything a high-tech company needs to succeed in one place, including state-of-the-art ICT infrastructure along with a host of IT, media and production services.

5.4.3.5. Application of Built Environment Data

The built environment data of the city is captured by the different departments to develop a blue print of the city and its attributes for virtual representation of the physical city. This data forms the DNA for the smart city. It includes:

- Demographic distribution
- Land uses
- Transportation and other infrastructure framework
- Forests and parks
- General urban plan
- **Space and organization plan:** This data when linked with the Information communication and technology develops the digital DNA, which forms the basis for the Smart city. The software and service layers for the built environment data can contain the following layers⁴⁴:
- **Data layer:** that presents all the information, which is required, produced and collected in the smart city.
- **Service layer:** This incorporates all the particular e-services being offered by the smart city.
- **Infrastructure layer:** that contains network, information systems and other facilities, which contribute to e-Service deployment.
- **User layer:** that concerns all e-service end-users and the stakeholders of a smart city for dialoguing and in decision-making. The participation includes:

The local *stakeholders* –who supervise the smart city, and design

Those who offer e-services- and

The *end-users* –who “consume” the smart city’s services

5.4.3.6. Urban planning and smart city interrelations

On the attributes discussed in the preceding section, various e-service portfolios can be offered in a modern smart city, some of which have been mentioned below:

Table 5.4: e-Services of a Smart city

e-Services	
e-Government	Public complaints, showing administrative procedure, bringing transparency in governance.
e-democracy	Performing dialogue, consultation, polling and voting of issues of city.
e-Business	Supports business installation.
e-health and Tele-care	Distant support and services to elderly, civilians with diseases, disabled
e-learning	Distant learning opportunities, training material to the students.
e-Security	Supports public safety via amber-alert notifications, school monitoring and natural hazard management
Environmental services	Information about recycling, guide households and enterprises in waste/energy/water management
Intelligent Transportation	Offers tools for traffic monitoring, measurement and optimization.
Communication services	Broadband connectivity, digital TV

Source: Compiled from *Urban Planning & Smart Cities: Interrelations and Reciprocities*, Leonidas G. Anthopoulos.

⁴⁴Source: *Urban Planning and Smart Cities: Interrelations and Reciprocities*, Leonidas G. Anthopoulos.

5.5. City Typology

Urbanisation over centuries and evolving city morphology has given shape to the present day cities in India. Most post-independence cities have emerged from planned directions and yet have experienced population explosion. Cities also have benefited from planning based on Government schemes and programmes. However, the functions of the urban centres have taken natural course to its maturity, without or with intended interventions. These are the consequences of response of human settlement and interaction of societies. Focus on planning even application of land use standards and development controls could vary depending upon the typology of the cities.

Situation of the city: Situation of the city is the prime factor to be considered while planning. City situation is established on its growth in size, physical configuration or route pattern and largely with its function. Cities, besides multi-functional, can be also defined on the basis of the prime economic activity and/or evolution of the city. Such cities with typical location, situation and functions need focused approach while planning, to address the associated issues. Some of such kinds are:

- Hill cities,
- Inner cities/ walled cities,
- Industrial cities,
- Religious cities,
- Tourism cities,
- Heritage cities,
- Port cities,
- Medi-cities (townships),
- Sports cities (townships)

Site and situation specific solutions: These cities, owing to its nature of development and population, and either permanent, new settlers or floating population, have specific functions and therefore have associated issues. Some of the generic ones are:

- Lack of alternative economic activities,
- Stagnation of city growth,
- Strict segregation of classes by profession and income,
- High crime rate,
- Lack of public spaces,
- Lack of recreational activities,
- Lack of educational facilities for low income class/ poor,
- Significant ratio of bachelor population,
- Lack of gender specific health facilities and other facilities,
- Investment oriented land/property ownership,
- Others: pressure on public utilities, lack of social guidance in case of exposure to cultural variation etc.

Such as, in case of industrial cities or township, specific drawbacks are observed like lack of recreational activities, lack of alternative economic opportunities, and social activities. These townships are limited to work - home relationship and lack

recreational activities and therefore, there is a need to focus on providing dedicated public spaces for population to interact in such cities/towns.

Similarly, other city typologies also have specific issues to be addressed for which approach can be defined while preparing plans. Mix of economic activities such as service industries and social activities should be promoted to encourage the avenues for wholesome development.

Increased rate of crime as observed in some industrial and port town is primarily due to segregation of population income classes, lack of recreational activities, lack of educational facilities for low income class, and to some extent due to high proportion male workers living without families and also large number of bachelor population.

Therefore to promote sustainability of cities, its situation in terms of its function and its social behaviour shall be addressed. Such cases need emphasis on complimentary requirements of the city, besides its prime economic activity and physical infrastructure for holistic development of the city. Some of the complementary activities are suggested below-

- Promotion of service industries,
- Educational facilities with emphasis on technical institutes
- TOD mix of institutional and administrative land use,
- Social infrastructure, targeting needs of specific strata of population
- Recreational facilities, also theme based facilities
- Heritage and religious activities to be promoted for mixing of economic base and population
- Earmarked spaces for the urban poor / informal sector residents or their activities⁴⁵.

5.5.1. Hill city

The National Building Code defines hilly areas as “Any area above 600 m in height from mean sea level, or any area with average slope of 30°, considering the sensitive and fragile eco-system of hills and mountains.” However, the State Governments may identify and notify areas to be covered under ‘Hilly Area’, which need to be dealt with special consideration, when developmental activities are taking up.

Hilly areas have fragile ecosystems, which need to be conserved. Therefore planning and development strategies for hilly areas shall have to be designed with added sensitivity and sound land use planning and settlement planning.

5.5.1.1. Associated Issues

Hilly areas have a sensitive ecosystem consisting of mountains, rivers and valleys, several lineaments and some of them even experience extreme weather conditions. These varied natural features also make hilly areas a suitable place for tourist destination, thus creating a pull for commercial development and urbanisation. Also, many rivers originate from the Northern Himalayan range, thus the areas attract

⁴⁵ Also Suggested in ‘Strategy paper on master plan formulation, inclusive planning, prioritization for housing and pedestrian movement, 2010’

development of hydro power plants, which directly or indirectly have shown great impact on the river hydrology and bio-diversity.

The common issues associated with planning in Hilly areas are:

- Hilly areas in Himalayas and Northeast experience heavy rainfall, which makes the shallow soil, cover highly susceptible to erosion (such as in Darjeeling)⁴⁶. These conditions necessitate conserving the precious soil cover during monsoons and harvesting irrigation water for dry months. In other areas heavy rainfall causes deep weathering of sedimentary rock and rapid and active erosion of weathered materials from steep slopes.
- There are issues with respect to mobility and connectivity due to steep slopes and difficult terrain.
- Also geographically younger hill areas with high seismic activities make settlements vulnerable to disaster risks. In such areas regulating construction activity is of prime importance in planning. Adherence to seismic code specific to seismic design of buildings is to be made mandatory for plan approval in hill areas.
- In hilly areas, remarkable variations in culture and practices (including in many places tribal culture and rich craft skill) exists between the settlements even within short distances as compared to those in plain areas⁴⁷
- As terrain plays a crucial role in the hilly areas, settlements are to be on definite habitable lands only and thus, its carrying capacity needs to be determined for adequate planning.
- The planning status of hilly areas, in the present state, is uncontrolled creating haphazard growth due to need for urbanisation, industrialisation (such as quarrying and hydro power generation) and intrusion of commercial activities (such as tourism industry) on the limited land cover, typically along hill routes. These trends has led to encroachment on forest land and precious green cover, construction on unsuitable lands and development at higher level of ridges, thereby disturbing the natural ecosystem and making the areas more vulnerable to disasters.

The impacts on infrastructure are - traffic chaos, inefficient service infrastructure and congestion in prime locations, inadequate social infrastructure.

The impacts on the environment are loss of hill and forests, degradation of stream system, landslide and erosion, increase in natural hazard as earthquake, landslide and manmade hazards such as air pollution and roadway noise.

5.5.1.2. Strategies for Development

Hilly areas have various factors, which necessitate a thrust on adoption of an integrated planning approach for conservation, preservation and planned development.

Strategy 1: Land Conservation and Optimisation:

- 1) **Environment Inventory/ Impact Assessment:** For planning of the new settlements or working out the strategies for the growth of the existing settlements, it is necessary to conduct detailed environmental inventory/ impact assessment. The inventory would involve geological investigations, slope analysis, soil, flora and fauna analysis, climatic inventories, vulnerability to natural disasters (such as earthquakes, landslides, floods etc.), etc. In addition to this the aesthetic factors, cultural, architectural and historical heritage, scenic/ landscape value shall also be taken into consideration.

⁴⁶Planning Commission Report of Task Group on Problems in Hilly habitations.

⁴⁷Report of the Evaluation Study on Hill area Development programme in Assam and West Bengal", Planning Commission, June 2010.

- 2) **Identification of Developable Area:** Identification of developed area is calculated by deducting the natural ecological area from the entire township jurisdiction. Jurisdiction may be large to control the surrounding areas. The classification of land uses should be given only for developed area, while the rest of the ecological area shall be for conservation or restoration.

$$\text{Hill Town Developable Area} = \text{Hill town jurisdiction area} - \text{Natural Ecological Area.}$$

- 3) **Land use optimisation:** Keeping in view the scarcity of good buildable land and also the high cost of the construction, it is necessary to optimize the use of land by calculation of carrying capacity and land suitability analysis. Green building approach should be adopted such as use of cost effective and appropriate building materials and technologies.

Strategy 2: Sustainable development based on Watershed Management:

A watershed, also called a drainage basin or catchment area, is defined as an area in which all water flowing into it goes to a common outlet. People and livestock are the integral part of watershed and their activities affect the productive status of watersheds and vice versa. From the hydrological point of view, the different phases of hydrological cycle in a watershed are dependent on the various natural features and human activities. In hilly areas or where intensive agriculture development is planned, the size of watershed relatively preferred is small.⁴⁸ Watershed managements, i.e. river basin management also is important in the context of regional planning both in terms of as a source of water and sources of disaster risk like flood etc.

During the Tenth Five Year Plan of Government of India, emphasis was on watershed development and ecological restoration/preservation for the hill areas of Assam and West Bengal. In the sixth Five Year Plan, the Planning Commission had suggested achieving a balance between beneficiary-oriented and infrastructural development programmes, keeping in view the vital importance of ecological restoration and conservation. This can be achieved through⁴⁹:

- Better water and land-use and control of soil erosion through watershed management,
- Afforestation, silvi-pasture development and replacement of annual crops with perennial shrubs and trees and plantation crops in steep slopes and development of other high value-low volume crops linked with processing and marketing.
- Rural and small industries and electronic and precision instruments industries can also be promoted taking advantage of favourable weather conditions.

To understand watershed system data from latest and authentic sources to be collected (details provided in **Chapter 7**), simulation models may be used to analyse (drainage pattern modification) scenarios before Development Plan Preparation and building regulations.

⁴⁸<http://oar.icrisat.org/3914/1/1. Watershed Management Concept.pdf>.

⁴⁹<http://planningcommission.nic.in/plans/planrel/fiveyr/6th/6planch25.html>.

5.5.1.3. Proposed Land use Structure of Hill Towns

The proposed land use structure for hill towns are:

Table 5.5: Land use structure for hill towns

Land use Category	Percentage of Developed Area		
	Small	Medium	Large & Metropolitan Cities
Residential	50-55	48-52	45-48
Commercial	2-3	2-3	4-5
Industrial	3-4	4-5	4-6
Pub. & Semi Public	8-10	8-10	12-14
Recreational	15-18	15-18	16-18
Transport & Communication	5-6	5-6	6-8
Ecological	Balance	Balance	Balance

Source: UDPFI Guidelines, 1996.

The ecological area (non-developable area) given in the table above for Hill towns is applicable for the hill town jurisdiction developable area only. Hill town developable area shall be considered as area hill town jurisdiction minus natural ecological area. Where, non-developable area is defined as- Earthquake/landslide prone, cliffs and environmentally hazardous area, areas adjacent to fault lines, areas with slope higher than 45°, flood plain and areas adjacent to major drainage lines for general guidance and all environmentally sensitive areas. Land suitability analysis should be an important tool in first principal approach for deciding on land use proportions.

5.5.1.4. Aspects of planning⁵⁰

The important aspects to be considered in planning for the hilly areas are suggested as below:

1. The hillside with less than 30° slope are in general stable. Therefore, building sites (temporary or permanent) should in general be located on hillside with not more than 30°- 45° slope. In areas where most of the land is above 30° degree slope, spatial regulations should control construction activity on slopes above 30° degree with maximum of 45° provided that appropriate technology is used.
2. The maximum height of the building to be fixed, such as in States of Meghalaya maximum building height permitted is 15 meters on hills.
3. Flat land is normally not available in hilly regions. The houses are required to be constructed on partially sloping land made available by cut and fill. It shall be necessary to protect the house by building retaining walls/breast walls to avoid landslides occurring at time of earthquakes or heavy rains.
4. Cut slopes with height less than 5 m or two to three storey heights of residential buildings are in general stable. For higher cut slopes special investigation should be carried out and details of protection works should be worked out and implemented.
5. Site development in hilly regions consumes about 30 to 40 per cent of total cost of building complex, therefore the following investigations shall be done to obtain the following geotechnical parameters:

⁵⁰NBC, 2005 & IS 14243, 1995 b.

- a. Type of Soil Rock: Weathered or intact, dip of bedding planes, drainage conditions, shear planes, material between the joints, tension cracks, type of plantation, verticality of trunks of the trees etc. Cliff sides and spur faces need to be protected with appropriate technology including where netting with tables and/or blowing of RCC along the walls.
 - b. Thickness of overburden, nature of soil strata, details of soil matrix etc.
 - c. Estimation of shear-parameters of the in situ soil mass, which will govern the failure.
 - d. Drainage pattern of the area and permeability tests in the area to see the Drainage conditions.
 - e. Specific slip zones in the area, if any.
6. Roads and paths: Street orientation shall preferably be East-West to allow for maximum South sun to enter the buildings. The street shall be wide enough to ensure that the buildings on one side do not shade those on the other side. Hill Road Manual (IRC: SP: 48-1998) should be referred to for detailed guidelines for planning roads in Hilly Areas.
 7. Provisions for Landslide Hazard Mitigation, Seismic Micro-zonation and mitigation of Liquefaction hazard should be integrated.

Specific aspects for New Hill Towns:

1. The new hill towns will have to follow the basic principles of hill architecture including use of local building materials, slanting roofs, seismic bands in structures etc. so that they merge in cultural landscape of their regions.
2. Travelling time from nearest town to the new township should be at least one hour or 20 Km.
3. The new town should be self-sufficient in infrastructure and its area should ideally not be less than 40 hectares.
4. Provision of facilities for additional (and /or floating) population should be made.

Specific aspects for Buildings in Hilly area:

1. A minimum clearance of 1.5 m should be provided between toe of boundary wall and building wall.
2. On the uphill side of the building on a sloping site, the natural flow of the water shall be diverted away from the foundations.
3. The slope of ground all around building should be not less than 1: 50 built in such a way that rain water does not find way to ingress in ground excessively and moves away quickly to surface drains or away on adjoining hill surface towards natural streams.
4. A minimum of 0.75 m wide apron should be provided all around the building to prevent entry of water into foundation.
5. Stepped terrace development and stepped storeyed building construction may be adopted for offices, schools and other building complexes⁵¹ because of following advantages:
 - a. It results in least hill cutting, disturbance to hill stability and also in least deforestation.
 - b. Cost of site development works, slope protection and other protection works is reduced considerably.
 - c. Least load comes on valley side, so danger of foundation failures is avoided.
6. Buildings to be provided with good drainage facilities to prevent excessive saturation of sub surface formations. Construction should not obstruct existing surface drainage courses.
7. Buildings shall be located on the south slope of a hill or mountain for better exposure to solar radiation. At the same time, locating the building on the leeward side may minimize exposure to cold winds.
8. Appropriate solar passive methods, such as orientation, double-glazing, trombe walls and solar collectors, to be adopted to achieve climatic comfort with little use of conventional energy.

⁵¹(Refer conditions of development from IS 14243 Part 2: 1995 for details)

5.5.2. Planning for Inner city

Walled cities, old city, often central zones, which are also generally the core area of the settlements, are referred as inner cities. These city parts have been the melting pot for cultures with a history. Some of the old cities have been historically an important trading centre, owing to its regional prominence, strategic location and trade links. However, owing to its prosperity, some of the cities were under the threat of plunder and loot, which reshaped the city form over the centuries (as also walled cities). These cities are marked by key features, such as, narrow roads (gullies), dense built-up, often mixed use of land, small plot sizes occupying 100% ground for built-up, social homogeneity, limited public spaces, which are usually congested developments, in comparison to the modern day cities.

5.5.2.1. Associated Issues

Common issues associated with the inner cities:

- Out migration of local residents and release of residential spaces for commercial use,
- Dilapidated buildings (as building owners only repair their buildings, while little or no reconstruction is takes place) and vacant properties,
- Narrow roads- not planned for vehicular movement,
- Unorganized on-street parking at various locations,
- No prominent public transport system present in the city,
- Presence of cottage or household industries and polluting industries
- Prominence of on-street encroachments for informal markets & hawkers,
- Due to shift from residential to commercial land use, emergence of warehouses, go-downs, workshops or other non-compatible activities,
- Old water supply distribution network and in non-metric sizes, difficult to maintain
- Repeated excavation of roads damaging the underground utilities and disturbed road levels
- Overall lack of social infrastructure facilities compared to the density of the inner cities
- Outcrop of Slum like conditions in the open areas surrounding historical properties or on old recreational open spaces

5.5.2.2. Alternative strategies for Redevelopment and Regeneration

Redevelopment and regeneration are the prime planning aspects of inner cities. The space norms and development control rules that are generally applicable to other city areas are normally not applicable to inner cities. The two alternatives for the redevelopment of an inner city/ old city are based on the strategy of revival or in-situ development. These are:

Alternative 1- Modification in Built-up: In this approach, the residential built up is adjusted with the plot size and height from urban renewal point of view. The building density is redefined, usually by increasing the permissible FAR/FSI as permissible by the available infrastructure. It allows the market forces to reconstruct and redevelop the core city areas. The urban local authority may provide supporting infrastructure through betterment levy or charges. This tool of redevelopment is in practise in major cities like, Hyderabad and in some parts of the old Delhi (Shahajahanabad). Abutting road width, plot sizes, accessibility and land use regulates the increased building height. This entails amalgamation of plots.

This alternative can be applied for the entire inner city or it could be limited to an identified area such as along the transport corridors as in the case of Old Delhi (Shahajahanabad) wherein a 500 meter influence zone of metro rail is permitted with a suitable enhanced FAR.⁵²

An added advantage of this alternative is amalgamation of residential units. To improve the morphology of the core city, increase in unit size of the residential plots is also often necessary, especially where very small units are present. Higher FSI, for medium size plots, even marginally will lead to amalgamation of small and very small plots by market forces. This will improve the urban design and density of residential areas. However amalgamation of plots is to be carried out in lines with regulations, which is to be defined based on the study of the area by the local authority. The redevelopment project of east Kidwai Nagar, New Delhi is among the first initiatives as a vision project of Ministry of Urban Development.

Alternative 2- In-situ Development: In order to conserve the characteristics of the inner city, this alternative is adopted to maintain and revive the old city by different mechanisms. Unlike the alternative 1, in-situ development maintains the height and the building foot print, by carefully using Transferable Development Rights (TDR). This alternative is used where the redevelopment strategy is to maintain and encourage the heritage of the city and its housing morphology, as in the case of Ahmedabad, where Tradable Development Rights are provided for the notified Structures, Buildings and Precincts in the form of Tradable Right Certificate by competent authority. However the authority controls other activities such as:

- The Permissible Uses for the Heritage Areas and other buildings on the basis of its plot size and floor.
- Amalgamation and/or Sub-division not be permitted in the Zone,
- The owners of these heritage structures and buildings are required to conserve the following original aspects of their Buildings:

All Façades

Building Footprint

Character of Open Spaces such as courtyards, khadki, streets, etc.

The in-situ development also does not encourage road widening until necessary, as it aims to preserve the building façade. Therefore parking spaces are created through community initiatives and by consultative process. In case if it is not feasible to provide the required parking within the existing building as per Regulations, the Competent Authority may recover fees for deficit parking to develop on-street parking/parking lots/parking structures as a part of Parking Management Plan.

The concept of Accommodation Reservation may be introduced for social infrastructure whereby for the provision of essential public facilities to be handed over to the local body / government, the owner of property is given full permissible FAR on the component of public facility. Vacant properties should be preferred for this purpose.

The two alternatives of redevelopment to be chosen carefully and a combination of the two may be used for suitable sub-zones in an inner city. However the redevelopment strategy is to cover the key aspect i.e. positive growth for the city to be a liveable area and also as a work space. Therefore in most of the Indian inner cities, mixed land use is to be recognised as permissible and thereafter organised, as the city is planned on the concept of work & live with inherited benefit of reduced travel trips. The land use structure given in Table 5.2 could be modified and adjusted for mixed land use as planned by the local authority. To achieve this, regeneration is to be a part of the redevelopment, including socio-economic development, maintaining and encouraging commercial lifeline of the inner city for its revival.

⁵²Source: ITPI article by A.K. Jain, Commissioner (Planning), Delhi Development Authority.

5.5.2.3. Aspects of Revival

While planning, planners face the problems associated with road levels, laying of new pipelines, parking in residential areas, decongestion, fire safety issues, requirement of road widening and loss of heritage façade, provision of land for social infrastructure and sometimes re-planning underground infrastructure. Core city revival is based on conservation, promotion and solution. These can be:

1. Out-Shifting of polluting, noxious and hazardous trades / industries and de-limitation of non-residential non-compatible activity with priority,
2. To decongest the inner city, proposal can be to develop counter centres in the form of Integrated Freight Complexes at the peripheral location or new industrial area,
3. Iconic developments along the historically valuable areas and if space allows - encourage city level recreational areas to create a pull factor towards the old city,
4. A new set of development controls for Mixed Use, enhanced FAR and TDR applicability. Mixed use to be maintained with regulations on the road width, plot sizes and density,
5. Conservation and restoration of historical buildings. Provisions for FAR and Tax incentives for those who have to maintain the architectural controls,
6. Revival of cities by alternative public transport system technically modified for the road network and as per the trip generation,
7. For parking, multi-level parking is one of the solutions for identified residential pedestrian,
8. In case of new development or redevelopment, stilt parking to be mandatory,
9. Adding street furniture can enhance street design. This is to facilitate public space for community interaction and promote pedestrian movement,
10. In congested and bottle neck areas, solutions such as one ways and multi-level parking to be adopted,
11. Alternative solutions of use of smaller fire hydrants for very narrow roads for the fire safety,
12. To meet the social infrastructure requirement, reducing space norms up to 50-60% in case of space non-availability in the core city. In order to compensate for the shortfall in various types and levels of facilities in the existing built-up area, such facilities may be provided in contiguous / proximity to sectors of new development.
13. Multi-functional uses should be proposed to encourage optimum utilisation of existing built-up infrastructure.
14. ULBs to initiate developing database of the buildings, with attributes such as its age, height, heritage value, revenue collection and other points as desirable.

5.5.3. Industrial city

Cities with major thrust in manufacturing and production are industrial cities. Such a focus on manufacturing was initially in the beginning five year plans after independence, when the focus was on heavy iron and steel manufacturing. Industrialisation again boosted after liberalisation in 1991 and encouraged developing clusters for export in 2005 by the SEZ Act, 2005, which provides for the establishment, development and management of the Special Economic Zones for the promotion of exports. There were also schemes proposed for promotion of cluster/park development by respective Ministries, while Small Scale Industry (SSI) was defined under Micro, Small & Medium Enterprises (MSMED) Act, 2006.

Lately, Government of India has also announced the National Manufacturing Policy in year 2011 with the objective to enhance the share of manufacturing in GDP and

increasing employment. Under the National Manufacturing Policy, the New Investment and Manufacturing Zones (NIMZ) guidelines was cleared by the Cabinet in 2011.

5.5.3.1. Associated issues

The following are the key concerns for industrial area planning:

- Industrial cities are marked by high intensity of noise levels and air pollution levels, which makes unsuitable for residential. Also, improper discharges of liquid and solid industrial waste/effluents are concerns for health. These hazard prone activities have a direct impact on residential areas,
- Movement of heavy traffic for transportation of raw material and finished goods, large share of the traffic load on the roads (highways) & rail,
- Lack of supporting infrastructure such as logistics, warehousing,
- Industries face power problems with respect to unscheduled cuts, which affects the productivity, especially in the continuous process plants. In order to make up for production loss, industries have to operate DG sets which eventually increase the overall production cost and air pollution,
- Lack of emergency facilities for fire safety and accidents, including medical infrastructure and health care,
- Absence of integration with research and development and ICT infrastructure in Indian industrial cities,
- Unplanned infrastructure provisions for various utilities, both underground and on surface,
- Limited space for industrial plots, allowing no expansion in future.

Other issues associated with industrial township are:

- Issues of compatibility between processing and non-processing areas,
- Lack of alternative economic activities leading to stagnation of city growth,
- Some of the industrial towns also show high rate of crime. This is primarily due to segregation of classes, lack of recreational activities, lack of educational facilities for labour class, and to some extent due to a portion of the population is bachelor,
- Ignorance on the public transportation in the industrial areas for labour and managerial labour,
- Lack of housing for construction labour, who continue to live within and adjacent to the industrial cities for years and lack of housing requirements for low income labour and informal employment.

5.5.3.2. Planning strategies

Site location of the industrial city is the prime aspect of its planning. The siting criteria shall satisfy the environmental requirements mentioned by Ministry of Environment and Forest, which is with sufficient buffers, distance from a large size town and agricultural land (refer Chapter 6 for specifics).

Land suitability analysis to be done for identifying zones for placing hazardous industrial (uses including air polluting units and wind directions), other manufacturing industrial, compatible uses along surface water bodies, hamlets and settlements and placing of non-processing areas. For locating industrial zone, preference to areas with easy connectivity, provision for logistics and areas with existing industries to be given, also wind directions to be considered.

Zoning for processing and non-processing areas is recommended in the ratio of 40:60 (especially in SEZ). The land use regulations have to keep in view the requirements of both these areas according to the activities envisaged. Due to the health concerns and safeguards, provision of green buffers of minimum of 500 meters between compatible and non-compatible shall be well defined while zoning(as given in **Chapter 6**).

Processing area: may be comprise of the following activities:

- Industries / manufacturing;
- Ancillary & MSMEs;
- Retail Trade and commerce;
- Go-downs and warehousing;
- Utility corridor;
- Port and port related activities;
- Airport and related uses, rail, road and inland waterway and spaces for parking etc.;
- Public utilities and any other essential services;
- Incidental and other activities for safety and security; and essential residential for the same;
- Governmental use / activities to manage the proper functioning of such processing areas.
- Information Technology and Enabled Services;

Within the processing areas, space for informal commercial, service industries and parking as per industrial requirement to be paid attention. For development of various types of parks – like IT parks, Plastic parks, Bio-technology parks, Food parks, Agro park, etc. the policy and norms issued by respective departments and guidelines available to be considered for planning. In absence of such handholding provisions, case studies of the specific industrial sector to be referred.

Cluster development: A cluster approach may be taken to optimise use or resources and minimise cost of production. For example, all work related to computers, IT, Communication can be housed in a cluster at the outskirts of processing area to minimise heavy transportation within the city. Small clusters related to IT and communication can also be accommodated within the non-processing area at uniform distance for easy reach of availability of all services in time.

Non-processing areas: Areas other than processing area are to be planned for various uses and activities, mainly as an industrial township including residential, commercial, recreational and activities related to social infrastructure like education, health care, and socio-cultural facilities.

Social infrastructure: The overall quantum of social infrastructure to be provided in the industrial township may be divided into two levels of facilities, including - Industrial city level Facilities and Local Level Facilities.

Land use: An industrial township should provide for a judicious mix of land uses / activities in such a way that it is not dependant on the neighbouring or other city. The norms and standards for distribution of land use may be as under⁵³.

5.5.3.3. Proposed Land use Structure of Industrial towns

Table 5.6: Land use structure for Industrial towns⁵⁴

Sl. No.	Land use Category	Percentage of Developable Area
1	Residential	20-25
2	Commercial	3-4
3	Industrial	30-35
4	Public and Semi-Public	6 -8
5	Recreational	12-15
6	Transport and Communication (including logistics)	10-12
7	Water bodies & Special areas	Balance
Total		100

Note: The above landuse distribution is indicative, and may vary as per the size of SEZ, industrial town, cluster development.

⁵³Draft SEZ Guidelines study by TCPO presented to the Parliament Standing Committee.

⁵⁴ Ibid.

5.5.3.4. Aspects of planning

The industrial town should primarily be a modern state-of-the-art township having **world-class infrastructure**⁵⁵, high quality living, working and entertainment provisions, which are particularly suited to the flexible uses and space demands of modern technology and knowledge based activities.

Infrastructure:

- a. All industries to be responsible for treating the effluent generated as per the CPCB regulations, for small and medium size industries infrastructure of Common Effluent Treatment Plants (CETP) to be planned. Special care to be taken in cases where the effluent after treatment is discharged into a water body.
- b. Solid waste disposal to be as per CPCB/SPCB regulation, specifically for hazardous waste disposal,
- c. To meet the power supply pressure, alternative source of energy to be explored in the site and situation to meet the domestic and commercial demand within the region.
- d. Logistics and Parking requirement of industrial area as per the industrial area demand. The transportation infrastructure, including RoW and speed design to be as per the norms given in the transportation section of this guideline.
- e. To ensure safety from high-tension power line, reduce disruption and for increasing life, infrastructure lines are to be well designed within the Row for infrastructure corridors, by allocating Right of Use as per regulations of each facility.

Non-processing areas:

- a. To bring harmony in the society, integration of residential sectors (informal/low income group/managerial staff/ pockets of high income group) shall be planned to reduce friction and encourage interaction socially and economically. The locations of low income group to be in proximity to the industrial and commercial areas to facilitate easy movement and reduce pressure on public transportation.
- b. Public transportation shall primarily target integration of residential areas with industrial zone.
- c. In case of greenfield industrial sites, for the expansion of existing hamlets and small settlement, a buffer to be governed by respective authority (to be marked on the development plan after calculating the induced growth rate). Such buffers shall be established for recreational, livestock support and social infrastructure for the developments of the hamlets. Similarly buffers along rivers in the industrial areas shall be well protected from any water pollution by allowing river front developments with recreational activities but without permanent developments.

Space norms:

After liberalisation in 1991, several changes have taken place in the manufacturing and service industries. Among which the key shift is from labour intensive to capital intensive. Hence the space for industrial allocation is shrinking, while in service sector the work space norms are altering with the FDI in IT/BPO sector. Workers space norms are to be proposed based on the latest technologies used, scale of development and investment planned. The work force ratio is as given below⁵⁶:

- 1) Work force participation can be considered more than 75% of the total population in industrial towns, in case the Work Force Participation Rate (WFPR) is not available.
- 2) The Industrial workers density can be: 100 pph to 125 pph

⁵⁵ "World class infrastructure" would consist of 24X7 hour water supply, uninterrupted power supply, efficient and pollution-free transport and modern solid waste management, sewerage treatment and communication systems.

⁵⁶Source: Based on UDPI Guidelines, 1996

The ratio of employment to land allocation should be case to case specifically for the sector of investment. With the advancing technology, the investment intensive developments will be altering the employment and space ratio.

Safeguards:

- a. Disaster management Plan for the industrial towns to be prepared at initial stages of planning and integrated with the Development Plan. In case of hazardous industrial, an evaluation plan shall be designed within the transportation network, to ensure evaluation by high speed designed roads.
- b. Health care facilities and emergency services to be decentralised and located in the processing and non-processing areas both.
- c. Specifically fire stations to be located on the corner plot giving direct access to sub-arterial roads.
- d. Local water holes and rainwater harvesting tanks to be linked with pressured hoses as a back-up to fire extinguisher.

5.5.4. Heritage/ Religious/ Tourism city

Heritage areas and cities with historical and tangible / intangible cultural values; preserved, conserved and evolved by social interactions and changing economic factors have given shape to tourism in these cities. The World Heritage Organisation, Ministry of Culture, Ministry of Tourism have laid focus on the conservation, restoration and promotion of cultural heritage. Among these historical cities, pilgrim destinations and centres of religious values have emerged with broad base economic activity of tourism. Close observation of these cities reveals that these cities were not designed for large population influx. Many of the religious towns with pilgrim destination in India are located on the fronts of water bodies or in the fragile ecosystems, (such as in the Himalayan ranges) where the balance between human activities and the nature is sensitive issue. It is crucial to include the eco-sensitive area mapping, evaluation of carrying capacity (refer **Chapter 7** for details) and provision of eco-tourism in planning for such towns.

Planned tourism is a major contributor to cities' economy. Tourism sector provides a high multiplier in employment generation. Tourist cities' economy may almost be totally based on tourism.

As evolved from the Tourism 2020 Vision, UNWTO 2002, 'cities or places of high population density where trips are taken by travellers for leisure and recreation can be referred as tourism cities'. Besides, the heritage and religious cities, as mentioned before, tourism cities/regions have developed from natural tourism, sports tourism, adventure tourism, rural tourism, and wellness tourism, among others. The National Tourism Policy, 2002, Ministry of Tourism rests on the principle of:

- Institutional framework may be based on participation between Government and the private sector. Government to provide legislative framework to regulate tourism trade and private sector to tourism related activities,
- The deep rooted relationship of tourism and culture to be realised, and promotion of cultural tourism should be encouraged focusing culture related (craft, art, performing art, living style as) saleable products for tourist.
- Greater emphasis on Eco-tourism, focusing on natural landscapes and other environmental features and also virgin traditional rural environment etc.

- Special thrust may be imparted to rural tourism and tourism in small settlements, where sizable assets of our cultural and natural wealth exist.

Linking heritage, build and nature with tourism is important. Heritage sites both global (world heritage sites) and natural are to be identified and protected. Such areas should be integrated with rest of the development based on rules and regulations specified by World Heritage Centre, Archaeological Survey of India and State Governments. Protection of sites of historical value other than officially designated at local area level may be identified and integrated in the Regional/ Development / LAPs.

5.5.4.1. Associated issue

Some of the issues associated with heritage cities, religious cities and cities of tourism potential are:

- Influx of the floating population or tourists,
- Assessment of areas of influence of tourism/ pilgrimage,
- Pressure on fragile/sensitive tourism zones and on eco-tourism sites in the tourist circuits,
- Seasonal variation of the local economic base,
- Unclear infrastructure estimations & planning estimations for the tourism towns due to fluctuation in the population to be served,
- Transport planning issues associated with terrain, slopes and undulated systems,
- Priority for non-motorised transport and public transport.
- Conservation and improvement of land profile, areas of scenic value and utilization of site features for strengthening the ambience,
- Issues in solid waste management especially in religious/pilgrim towns,
- Street vending activities in the popular religious and tourist sites and measures for their rehabilitation,
- Lack of documentation of heritage buildings and areas and application of general architectural control in historical areas,
- Supporting investment in heritage assets and generating returns by ULBs or by private sector,
- Lack of social guidance in case of exposure to cultural variation, specifically in international tourism destination, et al.

5.5.4.2. Planning Strategy

A tourism city planning strategy is to be broadly based on the understanding -

- For 'Nature' in its many forms, its mountains, streams, sylvan surroundings;
- Its 'Culture' as manifest in the art, architecture, temples and pilgrim towns;
- Its 'History' as seen in the archaeology of the tangible and intangible outputs of an earlier era.

On 10th November 2011, UNESCO's General Conference adopted the new recommendation on the Historic Urban Landscape by acclamation, as an additional tool to integrate policies and practices of conservation of the built environment into the wider goals of urban development in respect of the inherited values and traditions of different cultural contexts. The UNESCO General Conference recommended its Member States to take the appropriate steps to facilitate its implementation and further recommended that Member States and relevant local authorities identify

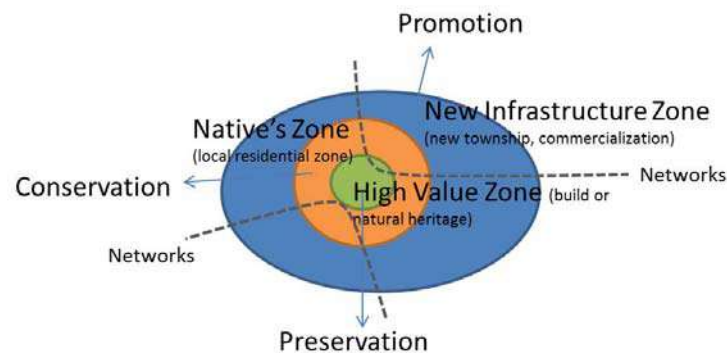
within their specific contexts the critical steps to implement the Historic Urban Landscape approach, which may include the following:

- To undertake comprehensive surveys and mapping of the city's natural, cultural and human resources;
- To reach consensus using participatory planning and stakeholder consultations on what values to protect for transmission to future generations and to determine the attributes that carry these values;
- To assess vulnerability of these attributes to socio-economic stresses and impacts of climate change;
- To integrate urban heritage values and their vulnerability status into a wider framework of city development, which shall provide indications of areas of heritage sensitivity that require careful attention to planning, design and implementation of development projects;
- To prioritize actions for conservation and development;
- To establish the appropriate partnerships and local management frameworks for each of the identified projects for conservation and development, as well as to develop mechanisms for the coordination of the various activities between different actors, both public and private.

Through adopted strategies, such as of UNESCO's new Recommendation on the Historic Urban Landscape, the local conservation approach is to be defined by the local authority in lines with the broader prevailing policies in India. However application of conservation, preservation and promotion is not to be equally treated. With detailed mapping, documentation and analysis, zones of treatment and extend of tourism may be identified for sustainable development. Figure 5.8 explains the integrated approach to tourism city/region planning.

High Value zone: The core zone of heritage, religious or of tourism value is the high value zone. This may consist of Natural Heritage or Built Heritage or both. Ethnic value of the zone is of the highest level and is meant for preservation. The carrying capacity of this value zone is the key to the tourism potential of the city.

Figure 5.8: Integrated approach to Tourism City/Region Planning



Native's Zone: This can be called as the residential zone of the locals or the settlement. This zone usually overlaps with the high value zone, as mentioned earlier, due to social interactions and economic relationships. The economic benefits of tourism are measurable in the native zone and improvement in the quality of life of the local population can be achieved through planned development. This zone is for conservation of the culture, valuable architecture, and for promotion of local economy. This zone is suggested for innovative strategies to provide the city with a

consistent image and therefore provide significant revenue and added value to its residents.

New infrastructure zone: The city periphery or outer zone is the new development zone. This outer zone is for the new development to come-up to meet the tourism requirements for the promotion of tourism and for city growth. By understanding market trends through market analysis, demand and needs of the tourist is to be assessed for the Tourism Product Development⁵⁷ such as experiential-shopping, festivals, emotional-cultural and historic resources, hospitality, physical-infrastructure, natural resources, restaurants, accommodation. In doing so, tourist attraction spots and areas should be first made easily accessible. Depending on the quality of such tourist area, certain experience based tourist trails can be planned with adequate support of logistics. These new developments should be integrated with the inner two zones.

The investment in this zone can draw from the various tourism infrastructure development schemes by the State. Promotion of tourism as an economic activity, alternative economic base including thrust in institutional & commercial developments is to be adopted in this zone & if allowable in Native's Zone too.

In case of tourism regions/circuits, the new infrastructure zone may be wide spread and can be considered as the rest of the area of the region/circuit outside high value zone and native's zone. A tourism circuit will have various nucleus of high value zone bedded by the thread of connectivity.

Networks: The integration of the zones is to be strong with networks. Networks to connect zones for accessibility between the two outer zones i.e. new infrastructure zone and native's zone shall have strong linkages, while from eco-sensitive approach; the High Value zone shall have limited access (if possible pedestrian). For the protection of the (built and natural) heritage from the adverse impacts of tourism, adoption of greener tourism in this zone is the key. For improving external connectivity up to the tourist city/ nodes in the tourist circuit, alternative modes of transportation should be promoted.

Simple practical steps to reduce adverse impact on the environment and promote the benefits of tourism are through zoning. Local consultative approach to be taken for tourism based livelihood development, physical infrastructure, transport and tourists, heritage and tourism conservation, environment and tourism, any other. However, a generalised land use structure is proposed below.

⁵⁷Tourism Product Development is a key factor in the overall experience demanded by tourists visiting cities or other types of destinations. Understanding market trends through market analysis will help create a strategy that will match tourists' needs and demands.

5.5.4.3. Proposed Land use Structure of Heritage/ Religious/ Tourism city

Table 5.7: Land use structure for Heritage/ Religious/ Tourism City

Sl. No.	Land use Category	Percentage of Developable Area
1	Residential	35-40
2	Commercial	5-7
3	Industrial	4-5
4	Public and Semi-Public	10-12
5	Transport and Communication	12-14
6	Recreational & water bodies	10-12
7	Special areas (including heritage and religious areas)	7-10
Total		100

Source: Modified based on the Proposed Land use Structure for Urban Centers and analysis of various case studies (including Agra, Puri, Rameshwar, Hampi, Bodhgaya etc.)

Note: The above land use distribution is indicative, which may vary as per the size of city and the economic base.

5.5.4.4. Aspects of preservation, conservation & promotion

- In line, with the objectives of the Ministry of Culture, (RFD 2013-14), planning for heritage cities to include- 'safeguard of various forms of Intangible Cultural Heritage and promote research through financial support to artistes, scholars and cultural organizations and Manage national monuments (Tangible Heritage) of India through Archaeological Survey of India, State Governments, Universities, Local Bodies'.
- Special attention to be paid while planning for religious settlements along the river fronts and water bodies, where emphasis is to be laid on conservation of water bodies, reduction of pollution (due to incompatible activities), improper solid waste management and no alteration of the watershed system of the area.
- For the application of the conservation, preservation and promotion in various zones of treatment and flow of tourist, the various planning aspects can be adopted:
 - Development plan should include historic & religious zones as special zones where all Development should be permitted by the competent authority.
 - Development controls to be based on ground realities with a separate section on urban design approach (such as façade controls) for improving aesthetics of the town at large,
 - Standardisation of Urban Design in the preservation and conservation zone including: Typical elevation of the houses, Building height, Elevation colour theme, Building material (Maintain and encouraging local building material use), Typical styles for column, bracket, balcony, motifs. While the usable area inside should be free from regulation.
 - Visibility of historical monuments and façade of the core zone to be maintained and implementation of the Ancient Monuments and Archaeological Sites & Remains Act, 2010 (AMASR).
 - Signages to be specified and preferably aesthetically fitted, (as given in Shimla Master Plan)
- Formation of a Heritage Conservation Committee within the Municipality/Development Authority for the heritage cities is suggested as an implementation agency for Heritage related policies and plans. The cell to essentially consist of Planners, Conservation architects, Archaeologist, Structure (retrofitting) engineer, urban designer, Property evaluator, representative from ASI, members from revenue department, town planning department and local representatives (councillor). Its roles & responsibility may include:
 - Strict implementation of Central & State Government policies
 - Carry out Heritage related studies & surveys, categorising heritage properties and mapping

- c. Formulate special heritage guidelines
 - d. Formulate & implement Heritage related Development Control regulations and make revisions for the 'regulated zone' as per the AMASR Act, 2010
 - e. Any heritage related notification and fines
 - f. Equipment and infrastructure for maintenance of the heritage buildings to be acquired and maintained
 - g. Conducting workshops, awareness programs and cultural activities
 - h. Support heritage property owners in repair and maintenance and suggestions for retrofitting of old structures
5. The tourism plan may also include:
- a. Promotion of Heritage walkway and River front walkway,
 - b. Landscaping & Up-gradation of available open spaces
 - c. Revival of urban water bodies
 - d. Seasonal tourism events such as Fair and Festivals to be organised as per the approved 'Guidelines for Financial Assistance to State Government / Union Territory Administrations for Organizing Fair and Festivals and Tourism related Events'.
 - e. Alternative modes of transportation to be encouraged in the tourism plan. Key nodes on transportation networks to have Tourist Information Centre/kiosk.
 - f. Marketing strategies of the tourism destinations to be well-defined including generating revenue to the local population, apart from employment generation estimations. On average, Employment generation by tourism industry as direct and indirect is suggested for hotel industry (per room) by the Tourism Policy is:
 - i. Direct employment: 2 persons
 - ii. Indirect employment: 3 persons

5.5.5. Port city

A coastal city whose seafront is dominated by port and which has come into existence primarily due to port activities is referred to as a Port City. Such cities represent exceptional developmental potential due to their maritime identity. Coastal features remarkably notable within the high-low tide line mark are mudflats, salt pans, estuaries, creeks, mangroves, coral reefs, geomorphological features with patches under sand and beaches; scrubs, plantations, forests and sometimes horticulture. On the other hand, easy access to large water body of the port leads to development of coastal infrastructure, fishing activities, salt manufacturing, presence of industries and even power plants, which provide an advantage to the City development by means of bearing the benefits of its location. Besides the coastal advantages, these sites are connected to the hinterland by rail and roads.

5.5.5.1. Associated issue

The challenge in the management of such a city lies in the balanced development of port activities, environmental protection and urbanisation. Key issues associated with port city planning are:

- Challenge to sustain the port city's activities while transforming into major economic centres. Some of the ports have intensified port activities, which have resulted in increasing pressure on land for urbanisation.
- Development of compatible land uses, activity areas and integration of port, industries, logistics facilities and the residential zones, with the provision of adequate green buffer and connectivity.

- Decentralised development through provision of self-contained zones within the Port City region.
- Preservation of ecologically fragile areas, water bodies and their basins, CRZ and forests.
- Identification and planning for the Coastal Regulations Zone and land under the High Tide lines per the CRZ regulations and major use of the available waterfront.
- Attempts along the port land to reclaim land impacting the marine ecology.
- Lack of alternative economic activities leading to stagnation of city growth.
- Some of the port towns also show high rate of crime. This is primarily due to segregation of classes; lack of recreational activities, lack of educational facilities for labour class, and to some extent due to a considerable percentage of the population is bachelor.

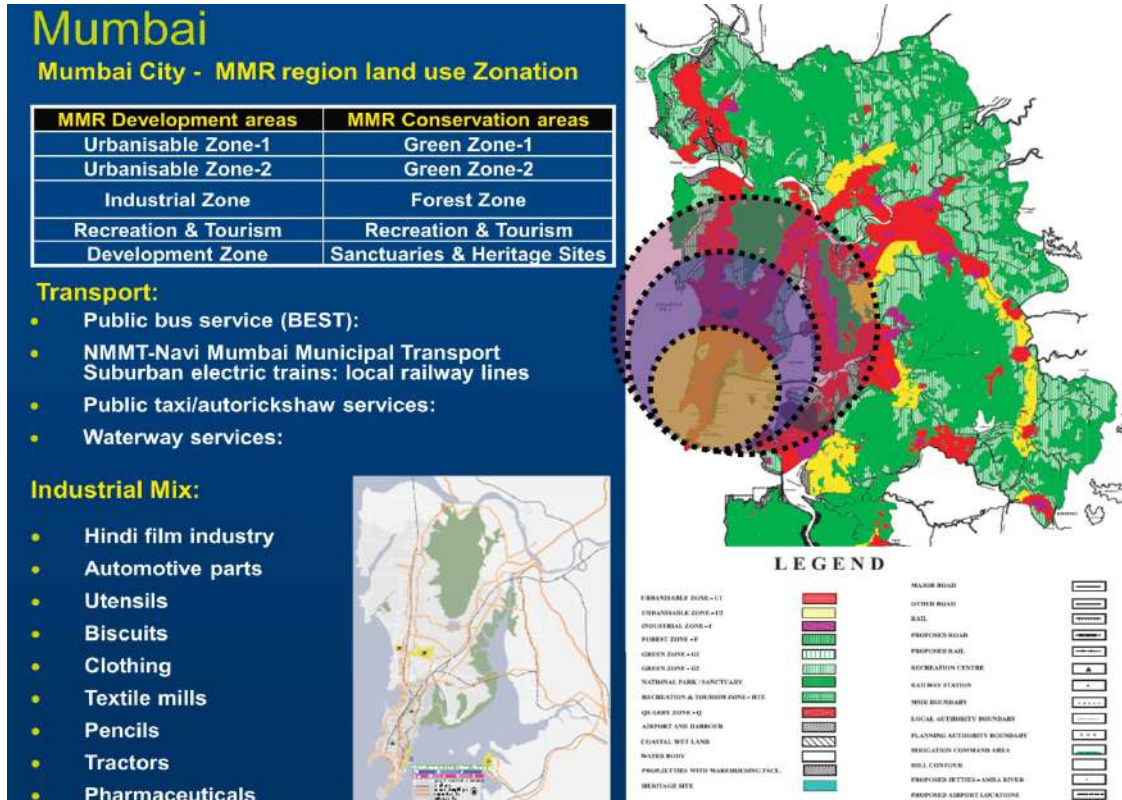
5.5.5.2. Planning strategy

A port and a city usually have two distinct entities, the port operational area and the civil city. These two entities may be differently administered and managed, however, under the Indian Port Act (IPA), 1908; the Port Trust is the nodal agency for the port operational area and, at times the civil city too. In some cases port city may have the administration under the municipal law, hence planning for port city must take into account the conditions of IPA 1908. Planning for the port for which the jurisdictional area is well defined is to be done by the Port Trust. While planning for the civil city may be done by the Port Trust or by the Town and Country Planning Department/ relevant body of the State.

A growth model in general is observed for port city, which evolves from harbour to a heavy manufacturing base, eventually leading to a commercial growth centre. The pressure on land impacts its demographic profile and land values. Also, industrial development requires supporting residential development. Often ancillary and service industries, warehousing facilities, logistic sector, truck and heavy vehicle parking areas begin cropping up around the industrial development. This is the stage where the unplanned proliferation of developmental activities start and a strong need for planning intervention is felt. Slowly the surrounding land's real estate value rises and commercial development intensifies. As a result worker population increases and forward linkages are established as services like institutional development, development of financial institutions, corporate offices, BPO amongst others. As the quality of infrastructure and service improves, eventually the tourism sector also grows.

International and Indian port cities, viz, Mumbai, Vishakhapatnam, Shanghai and Singapore reflect presence of industrial manufacturing base and other key components such as city size and population density. Land use pattern of Los Angeles and Vishakhapatnam, amongst others have inspired the planning for the non-industrial components of institutional support system and commercial economic base.

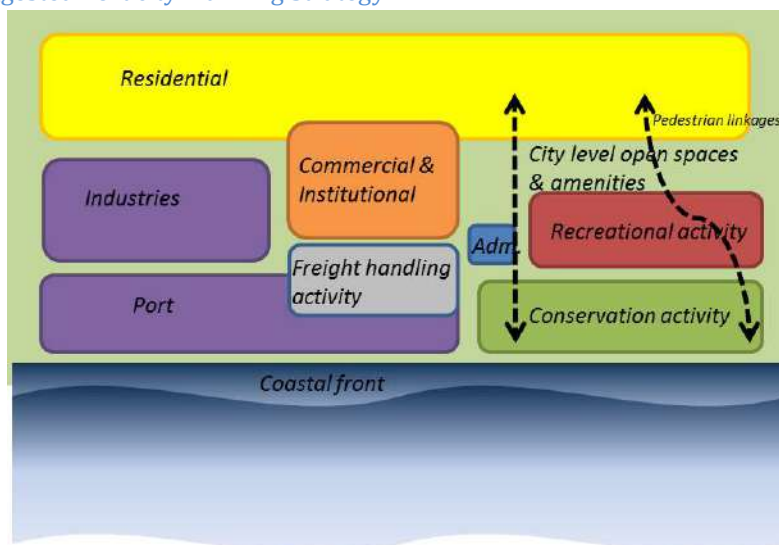
Figure 5.9: Mumbai Port City Analysis



Source: MMRDA.

The strategy to accommodate all the self-contained zones within the Port City region is largely dependent on the geographical and topographical patterns of each port city. However there are some fundamental similarities in the arrangements in their land use pattern, which have been depicted in the following diagram.

Figure 5.10: Suggested Port city Planning Strategy



Source: Various Port city case studies referred.

Port & Industries: Ports bring in a variety of trade and their ancillary activities to the immediate hinterland. Freight handling and industrial activities have inseparable linkages with the port.

The industrial and residential zones generally form two distinct parts of the port cities with industries and manufacturing units clustering together in the area immediately surrounding ports. Within the industrial region, the heavy and the light industries tend to be separated as well with the light industries being set up away from the port but well connected with transport lines. In many situations SEZs come up right around the port to attract industry and form the main urban centre of these port cities. However, shipbuilding and saltpans are economic activities, which come up along the waterfront.

Residential & Support: Port Trust can allow the development of residential building for the employees of the Board, within or outside the limits of port as the board may consider necessary⁵⁸. Migratory population increases the demand for housing in the port vicinity, which creates a large portion of the land use share to be residential and commercial activities.

Residences are generally planned in the port hinterland with strong connectivity. Along with residences, planned educational/institutional and commercial areas come up with a view to cater the urban population. Here it is important to note that the commercial and institutional developments are as a complimentary requirement of the thrust economic sectors and thus need to be integrated with the port & industries.

To avoid stagnation of port city growth, alternative avenues and economic opportunities shall be adopted as key strategy taking advantage of the agglomeration economy and access to basic logistics, like transport, power and water. Institutional infrastructure base provides skilled and semi-skilled labour as per the demand and as a consequence, share of institutional requirement in port cities is slightly on the higher side. With higher end services being provided, an institutional framework is established that provides a highly educated and motivated workforce.

Transportation: There would be two aspects for the development of transport infrastructure in port cities. Firstly, the aspect of infrastructure development is the establishment of interstate rail lines and airports that are created to accommodate the easy movement of cargo as the capability of port increase with the setting up of more industries.

Second is development of a public transport network, which in most cases consists of rail lines as well as mass rapid transit service. This comes up to cater the movement of the residential population to the commercial and industrial zones and forms the backbone of the expansion and growth of the city. Also, the areas around these Transport Corridors gain in land values and various kinds of mixed use developments develop around it including commercial, institutional, theme developments, investment areas, and hospitality and tourism activities amongst others.

A seamless transport infrastructure network should be developed throughout port trust and local authority area. Works for roads, railways, bridges, and tunnels can be

⁵⁸Major Port Trust Act, 1963.

executed within or without the limits of the port by the sanction of the Board of Trustees.⁵⁹

Environment and Sustainability: Marine ecosystems of the coast are very rich in species diversity and abundance. It is seen in many of the port cities across the world that once industry and residence has been established, port cities set up environmental reserves and forest regions and fish culture areas begin focussing on sustainable development even attracting tourism. Economic activities requiring water front and conservation of this front under coastal regulation zones have a combating demand for the sensitive land. However, port trusts have power to carry out the activities like reclaiming, excavating, enclosing, and raising any part of the foreshore of the port or port approaches to carry the port activities properly.⁶⁰

This zone can be regulated through provision of buffers and protected areas surrounded with compatible land uses of recreational, institutional and sparse residential areas. Recreational zone can be developed with beaches, creek development, parks, street shopping etc. to accommodate urban leisure activities by carefully integrating the sea edge with the city by well-developed pedestrian paths.

Quality of life: As more workers begin to settle, an urban, cosmopolitan environment is generated which attracts the commercial and service sectors to these port as well as recreational areas. The development of these service sectors attracts a different population of workers, service providers, henceforth emphasising on the need of educational facilities with technical institutes.

For interaction of the various classes of the society, the living and recreational areas are to be integrated and hence the open spaces and amenities to be decentralised and inclusively planned for public integration. Here, social infrastructure can target needs of specific strata of population to ensure improved quality of life and eventually social security.

Maritime boards of the country in respective States are making effort to plan these cities as multi-functional and sustainable. The idea is to provide for infrastructure to attract & accommodate urban population and to regulate development in and around these ports.

⁵⁹Ibid.

⁶⁰Ibid.

5.5.5.3. Proposed Land use Structure of Port city

Table 5.8 summarises the land use structure for a typical port city

Table 5.8: Land use structure for Port City

Sl. No.	Land use Category	Percentage of Developable Area
1	Residential	20-24
2	Commercial	3-4
3	Industrial (including Port)	20-25
4	Public and Semi-Public	6-8
5	Recreational (including waterfront activities)	15-20
6	Transport and Communication (including logistics)	15-18
7	Primary activities & Water bodies	Balance
Total		100

Source: Modified based on the Proposed Land use Structure for Urban Centers and analysis of various case studies, including Singapore, Shanghai, Los Angeles, Vishakhapatnam, Chennai, Mumbai, Surat, Rotterdam etc.

Note: The above land use distribution is indicative and including green, open spaces, water front activities area, but excluding CRZ areas and non-developable areas.

5.5.5.4. Aspects of Planning

- Planning of the port and its surrounding area to be based on the harbour structure, port infrastructure, cargo capacity, facilities including jetties & wharfs, Godown facilities and on the understanding of its backward & forward linkages of the commodities of import and export. The following port supporting infrastructure could be considered in a port city as per requirement:
 - Encourage logistics infrastructure development by private or by the ULBs to generate revenue. Logistics as a backward linkage benefits from port & other industries and generates direct and indirect employment.
 - Separate rail lines and cargo/freight handling junctions to be situated along the port and its industries.
 - Aerodrome, if existing, can be extended to commercial operations as well.
 - During planning, provision for pipelines infrastructure in and around port city to be given attention
 - Innovative and feasible alternatives of water supply infrastructure, using techniques such as desalination, reverse osmosis to be considered.
 - Appropriate disposal system for industrial effluents, sewerage and solid waste.
 - Area identification for Cyclone Shelters in view of cyclone proneness and Hazard Line demarcation.
- Sectors with focus on local raw material available from the natural resource base have due advantage to bring benefit to the local economy. The areas marked as high cropping intensity should be left as green/agriculture. Also, Ship building industry to be allowed/considered along the coastal front.
- Institutional development is complementary and key support to port city industrial development for sectors such as port & logistics. Skilled labour is

required and crucial in light engineering for technical inputs. Similarly semi-skilled manpower is prime logistics requirement. Development centres for skilled and semi-skill labour shall be developed as a part of institutional facility. Office spaces and Information Technology is a support system required for high end and value addition in the entire industrial zone. Besides this, Marine mining & biotechnology may benefit from research & development. R& D can be diverted to add value to agriculture, pharmaceuticals etc. also.

4. The National Environmental Policy, 2006 suggests actions to conserve coastal resources - explicitly consider sea-level rise and vulnerability of coastal areas to climate change and geological events, in coastal management plans, as well as infrastructure planning and construction norms.

Adopt a comprehensive approach to Integrated Coastal Management by addressing linkages between coastal areas, wetlands, and river systems, in relevant policies, regulation, and programs.

Environment risks and mitigation plan to be taken into consideration while planning the port city development.

Sustainability of the port is reflected from its planning as per local weather conditions and for Ecologically Sensitive Areas & Protected areas such as CRZ, Marine National park and sanctuaries, specifically taking into consideration the climate change.

Port city design is generally in grid formation. This is due to alignment with the wind flow directions in the coastal areas as sea breezes and helps to reduce pressure of cyclonic winds, apart from the influence of mangroves on the cyclone.

5. In case of older cities where ports were set up many years ago, the aim is to attain sustainable growth of the city by decongesting city centres while at the same time allowing greater growth in the commercial and industrial sectors by connecting these cities to smaller towns, suburbs and decentralized hubs of activity.

Apart from coastal ports, India also has Dry ports- Inland Container Depots (ICD) and Container freight Stations (CFS) are alternatively called Dry Ports. ICD and CFS provide warehousing space, temporary storage and handling equipment for import and export load, as well as empty containers. Rail network should be provided for strong connectivity between the port cities and dry ports.

5.5.6. Integrated Township

Integrated Township can be defined as clusters of planned housing and commercial businesses with associated infrastructure such as roads, schools, hospitals, convenience shopping, water treatment plants and drainage & sewage facilities. Integrated townships majorly emphasise on creating self-contained settlements with work-live-play concept by integrating selected economic activities in manufacturing/service/business categories.

Integrated townships have more open areas with suitable economic size capable of supporting businesses and homes, with adequate physical and social infrastructure. Yet, these should be compact enough to enable high quality living environments where it is possible to walk-to-work / school or take public transport for other activities. Such townships are expected to offer the same or more comforts and facilities as available in main city. Over that, it provides relief from congestion and traffic bottlenecks.

Strategically, integrated townships should be designed to have zero impact in terms of waste management and be adequately self-sufficient in terms of facilities for education, health and other aspects of social welfare. Therefore, for sustainable infrastructure and continued operation and maintenance, new service sectors such as facilities management and integrated waste management shall be promoted in Integrated Townships.

States like Maharashtra and Rajasthan have policy (township policy) under which new townships are being developed by private developers within the city limits on Urbanisable land under the Development plan/ Master plan of the city. The minimum area of such townships is 100 acres in Maharashtra and 10 hectares in Rajasthan.

Government of India has permitted Foreign Direct Investment up to 100% for development of integrated townships including housing, commercial premises, hotels, resorts, city and regional level urban infrastructure facilities such as roads and bridges, mass rapid transit systems and manufacture of building materials. Development of land and providing allied infrastructure will form an integrated part of township's development.⁶¹ Many States in India, following initiatives by Maharashtra and Rajasthan, have made attempt to prepare policies or schemes for the development of integrated townships. The brief based on study of relevant policy/schemes of three States' is being presented below.

5.5.6.1. State Integrated Township Policies

To provide a framework for the development of townships and to regulate the functions of the participants in such developments, the Government should formulate an Integrated Township policy / scheme, as has been done by the Governments of Gujarat⁶², Himachal Pradesh⁶³, Rajasthan⁶⁴ and Uttar Pradesh⁶⁵. Such policies institutionalise the role of the state government, developers and other state level agencies in the process of developing Integrated Townships.

Rajasthan:

⁶¹Guidelines for FDI in Development of Integrated Township, DIPP Press Note, 2002.

⁶²Gujarat Integrated Township Policy, 2008 (GUDC).

⁶³Himachal Pradesh Integrated Township Scheme (Draft).

⁶⁴Rajasthan Township Policy, 2010.

⁶⁵Integrated Township Policy, Housing & Urban Planning Department, Government of Uttar Pradesh.

The salient features of the Guidelines for developing Integrated Township provided by State of Rajasthan⁶⁶ has been listed below:

- Minimum area for integrated township shall be 10 hectares,
- The local authority shall acquire land and may allot for township projects to developers,
- Local authorities would develop sector parks on the lines of sector roads as per zonal plans,
- Road connectivity shall be ensured by the developer and no road shall be less than 40 ft.,
- FAR for the entire gross area of scheme shall be 1.2,⁶⁷
- Industrial Township shall have Facilities/Services/Open/Road area as 35%, further breakup of which is facilities area -10%, open area- 5%, area under roads – 20%
- Street Lights: The distance between poles should not be more than 30 meters,
- It is mandatory for the developer to establish and operate STP in the township along with recycling of treated waste water,
- Horticulture & Plantation: Trees of heights more than five feet should be planted with minimum of 30 trees per acre of the gross area,
- In township schemes local authority will construct “community water harvesting structures” and all water outlets and drainages will be connected to this structure. This shall be strictly enforced by the Local Authority,
- The design of the township shall aim at water and energy conservation.

Rajasthan Township Policy, 2010 has provided following categories of schemes for developing different type of townships:

Table 5.9: Rajasthan Township Policy: Types of Townships

Types of Townships	Area requirement
Township Scheme	More than 20 hectares.
Mini-Township Scheme	More than 10 hectares and up-to 20 hectares
Special Townships (like Educational Township, Industrial Township, I.T. Township)	Special Townships (like Educational Township, Industrial Township, I.T. Township)
Mixed land use on land of closed /sick units in small towns	Minimum area of 10 hectares in RIICO68 industrial areas in small towns.
Affordable housing projects on land of sick or unviable units in industrial areas of RIICO or elsewhere.	

Source: Rajasthan Township Policy, 2010.

Himachal Pradesh:

The salient features of Himachal Pradesh Integrated Township Scheme⁶⁹ are:

- More than 40 hectare of land in hilly terrain and above in 50 hectare in plains mandatory for developing Integrated Townships,
- Special Townships (like Educational Township, Industrial Township, I.T. Township etc.), with more than 40 hectares of land,
- The Township shall not include land under the forest, water bodies, land falling within 100m from (having the level the HFL) the HFL (High Flood Level) of the major lakes, dams land falling within 200m from the official boundary of historical monuments and places of archaeological importance, archaeological monuments, heritage precincts, other restricted areas.
- The Township scheme shall have a minimum of 15 meter approach road from any National Highway, State Highway, Major District Road, Other District Road or any other road area network/sector roads/master plan roads.

⁶⁶Notification, 2007, Government of Rajasthan.

⁶⁷ However, the individual plots can be allowed maximum FAR as per Building Regulation but not exceeding 2.4.

⁶⁸Rajasthan State Industrial Development and Investment Corporation.

⁶⁹Himachal Pradesh Integrated Township Scheme.

- For global township, FAR for the entire gross area of scheme shall be 1.75.⁷⁰

Policies at national level also provided guidelines for the Integrated Townships, as National Urban Housing and Habitat Policy states that, Integrated Townships should generally be located on comparatively degraded land excluding prime agricultural areas growing more than one crop with the help of assured irrigation. Also, these should be located at a reasonable distance from medium or large towns.⁷¹ Hence, mass rapid transport corridors shall be developed between existing medium and large towns and new green-field towns so that the relationship between industry and commerce is developed to an optimum level.

Gujarat:

Government of Gujarat has proposed to provide primarily five types of support activities through the Gujarat Integrated Township Policy, 2008 (GUDC) for facilitating to develop Integrated Townships in the State, which are as follows:

- Provision of trunk infrastructure and procurement of land,
- Establishment of a Green Channel for statutory clearances related to land, development permissions, environmental clearances,
- Special benefits (tourism, education, health projects) under the policy,
- Rating of developers and projects to be mandated by the government.

Gujarat Integrated Township Policy has provided detailed town planning norms on land use classification. Broad percentages of land area under each use sub category in the proposed township are defined in the policy document. The land use categories prescribed in table below may be the predominant use of the land, thus, the document also specifies land uses which are permitted and those which are not permitted in the land use zone. The colour coding differentiates the mandatory from the recommended norms.

⁷⁰ However, the individual plots can be allowed maximum FAR as per Building Regulation but not exceeding 2.4.

⁷¹ National Urban Housing and Habitat Policy, 2007.

Table 5.10: Space Allocation/Land Use Mix: Permitted under Gujarat Integrated Township Policy, 2008

NO	Use Category Name	Description	Measurable Parameter	Value	What does the value include?	Minimum Land Area by Use Sub-Category					Institutional (Social infrastructure)	Industrial	Road	Functional Open Spaces
						Residential	Residential for EWS	Commercial	Commercial for EWS	Institutional				
1	Technology Parks	Such as Parks of IT ITES, Biotechnology, Apparel, Gems & Jewellery and other R & D Institutions with Ancillary Housing	Proportion of total Built Up Area used for Economic Activity	70% or more	Residential, Commercial, Institutional and Industrial area as specified	30% of the developed land area	10% of land under residential development to be allocated	-	5% of land under commercial development to be allocated	-	1% of developed land area	-	10% of the developed land area	10% of the developed land area
2	Education Based Townships	Such complexes of schools/colleges/ Universities/research centres with Hostels and Ancillary Housing	-	60% or more	Residential and Institutional	15% of the developed land area	10% of land under residential development to be allocated	5% of the developed land area	5% of land under commercial development to be allocated	-	1% of developed land area	-	10% of the developed land area	10% of the developed land area
3	Medical/Health care Townships	Such as complexes of hospitals/ health resorts/ medical colleges/ medical research facilities with Hostels and Ancillary Housing	Proportion of total Built Up Area used for health Care facilities	60% or more	Residential and Institutional	15% of the developed land area	10% of land under residential development to be allocated	5% of the developed land area	5% of land under commercial development to be allocated	-	1% of developed land area	-	10% of the developed land area	10% of the developed land area
4	Tourism Related Infrastructure		Proportion of total Built Up Area used for Economic Activity	70% or more	Commercial, Institutional, Residential	20% of the developed land area	10% of land under residential development to be allocated		5% of land under commercial development to be allocated	-	1% of developed land area	-	10% of the developed land area	10% of the developed land area
5	Logistics Parks	Includes all large scale logistics (freight handling) and trading activities (wholesale or retail) with ancillary activities such as office complexes.	Proportion of total Built Up Area used for commercial activity	70% or more	Commercial, Industrial, Residential	20% of the developed land area	10% of land under residential development to be allocated	-	5% of land under commercial development to be allocated	5% of the developed land area	1% of the developed land area	-	10% of the developed land area	10% of the developed land area

NO	Use Category Name	Description	Measurable Parameter	Value	What does the value include?	Minimum Land Area by Use Sub-Category							Functional Open Spaces	
						Residential	Residential for EWS	Commercial	Commercial for EWS	Institutional	Institutional (Social Infrastructure)	Industrial		Road
		entertainment complexes and Ancillary Housing												
6	Residential	Where Housing is developed as serviced plots or constructed Dwelling Units and is contiguous to an accessible economic activity	Proportion of total Built Up Area used for Dwelling Units	80% or more	Residential	-	10% of land under residential development to be allocated	10% of the developed land area	5% of land under commercial development to be allocated	5% of the developed land area	5% of the developed land area	-	10% of the developed land area	10% of the developed land area
7	Mixed Use Townships	Are also eligible				-	10% of land under residential development to be allocated	10% of the developed land area	5% of land under commercial development to be allocated	-	1% of the developed land area	-	10% of the developed land area	10% of the developed land area

Source: Gujarat Integrated Township Policy, 2008.

5.5.7. Planning for Affordable Housing

Provision for affordable housing is a critical provision in the context of sustainable development. Affordable housing implies that the cost of the housing should be affordable to the disposal income of low income group, EWS and the poor. The cost of housing has two major components- land and construction of houses. Invariably in large cities land cost undesirably is boosted making housing cost unaffordable for the majority. Therefore, the critical policy in planning has to relate to adequate supply of land, commensurate to the needs of the majority, not for demand of the minority. This requires strong policy interventions to control rise of land price, speculation and more importantly to increase supply of land for buildings in the market. Some State initiatives have made efforts in policy and planning and prevention in order to affordable housing and this involves enacting regulations of reservation in housing supply for EWS and the poor.

Case Study: Affordable Housing Norms, Rajasthan

Sustainable human development cannot be achieved without adequate & affordable housing to the vulnerable population residing in the ever-growing urban settlements currently. Affordable shelter for the masses or creation of productive and responsive housing is a complex amalgam of a host of factors, which need to be tackled at all levels and in a synchronized manner. Department of Urban Development, Housing and Local Self Government, Government of Rajasthan has developed Affordable Housing Policy, 2009 after studying and dovetailing various housing schemes of Government of India. With the help of the policy framework and the in-built incentives it is aimed to motivate various agencies, including private developers to take up construction of affordable housing for EWS/LIG categories in various urban centres of Rajasthan. Under the said Policy, five models for developing Affordable Housing have been advanced.

Model No-1: Mandatory Provisions

Table 5.11: Proportion of Plots/Houses/Flats in Townships/Group Housing Schemes

S.No.	EWS/LIG	MIG-A category
Rajasthan Housing Board	50%	20%
All Urban Local Bodies	25%	20%
Private developers	15%	-

Source: Affordable Housing Policy, 2009, Rajasthan Government

Model No-2: Private developers on land owned by them

- Developers to take up construction of EWS/LIG flats on minimum 40% of the total land.
- The built up EWS/LIG flats to be handed over to Avas Vikas Limited at pre-determined prices.
- Several incentives are offered like double of the normal FAR, TDR facility, waiver of EDC, Building plan approval fee, conversion charges, 10% of the total land allowed for commercial use, fast track approval

Model No-3: Private developers on acquired land

- The land would be made available to the developer on payment of compensation (Land Acquisition cost + 10% Administration charges). All other parameters as per Model No. 2.

Model No-4: Private developers on Government land

- Earmarked Government land to be offered free of cost to the developer selected through an open bidding process. The developer offering the maximum number of EWS/LIG flats free of cost to the ULB would be awarded the project. At least 50% houses should be of EWS category.
- The developer shall be free to use the remaining land as per his choice for residential purpose with 10% for commercial use. All other parameters as per Model No. 2.

Model No-5: Slum Housing

- The model is based on various schemes approved by Government of India and also on the lines of "Mumbai Model" of slum redevelopment with private sector participation.

The Policy document also provides for the tentative land use breakup, ground coverage, time period for finishing project, additional FAR and Use of TDR as a result of additional FAR.

Integrated Townships developing in the periphery of cities lead to formation of enclaves once city grows and once peripheral area is accommodated in city planning area. These enclaves can be assimilated with the city character and structure by realising needs of the main city, promoting required activities in the townships and developing policies to accommodate needs of development.

5.5.8. Medi-City

The concept of modern medical cities or special health care facilities as been in place for some time, but has gained renewed interest, particularly in rapidly developing economies. The concept of a medi-city or health city defines a cluster of hospitals, a holistic healthcare centre; a large hospital sprawled across acres of land. Medi-city can be a new township or a zone of a city, where medical facilities are provided releasing pressure from the main city or to promote medical tourism attracting new sources of economic growth.

Medi-cities have been designed to be comprehensive in scope and incorporate advanced technologies and medical practices. The scale and scope of medical cities usually demands an advanced level of care, both in technology and approaches to create an attractive destination for care to ensure the high level of patient volumes required to support such a large setup.

5.5.8.1. Pre-requisites

In certain circumstances, Medi-cities evolve in metropolitan cities. There are many pre-requisites for the development of Medi-cities, as:

- **Volume and demand:** Medi-cities will always require a significant amount of patient volume from the local population in addition to the human resources and community infrastructure that a city setting provides.
- **Special infrastructure:** Medical care and associated infrastructure is to be provided in a planned manner. Medi-cities require highly specialised provisions for medical waste handling especially hazardous bio-waste, accessibility, special care systems, area reservations and infrastructure.

- **Accessibility:** Well-connected site is required for Medi-city development to provide ease in accessibility. Parking provisions in a medi-city is need based demand, focusing on institutional set-ups. Accessibility into and around the medi-city should be highly focused on the accessibility of differently abled / physically challenged / disabled.
- **Attractiveness:** Medical cities need to offer several attractive attributes to attract foreign or 'non-local' patients to overcome the competition, having special care, area reservation, and infrastructure facilities. Hotels, beautiful landscaping and country club, in order to attract and promote medical tourism, should complement the medi-city.
- **Multiple functions:** Medi-cities developing in isolation do not reach the maturity stage. Medical cities should also incorporate substantial non-medical services to support the staff, patients and visitors. Clear approach and effective forecasting may not be easy in such a case.
- **Poor management of health care waste** potentially exposes health care workers, waste handlers, patients and the community at large to infection, toxic effects and injuries, and risks polluting the environment. It is essential that all medical waste materials generated from medical city are segregated at the point of generation, appropriately treated and disposed of safely. Bio-Medical Waste (Management and Handling) Rules, 2011 of MoEF or latest such guidelines, must be followed in Medi-cities (to be monitored by CPCB/SPCB as per their regulations).

5.5.8.2. Planning strategy

Medi cities have the ability to support services that are highly specialized, services that often struggle to see sufficient volume to support a business case. Medi-cities need to have a strong higher and medical educational system and complete and stable infrastructure to become an ideal location for specialisation. Due to the interplay of economies of scale, the Medi-city creates an interesting and opportunistic intersection with medical tourism as mentioned earlier. For those organizations providing medical tourism services, this integration extends beyond the immediate community into the global healthcare delivery system.

5.5.8.3. Aspects of Planning

Since the most critical issue in Medi-city is handling of hazardous medical waste, essential facilities for the maintenance of Medi-city has been prescribed by WHO, these are:

- Effective waste reduction and waste segregation, ensuring that only appropriate wastes are incinerated;
- Siting incinerators away from populated areas or areas where food is grown, thus minimizing exposures and thereby risks;
- A properly engineered design, ensuring that combustion conditions are appropriate, e.g., sufficient residence time and temperatures to minimize products of incomplete combustion;
- Construction following detailed dimensional plans, thus avoiding flaws that can lead to incomplete destruction of waste, higher emissions, and premature failure of the incinerator.

Apart from the waste handling of the Medi-city, the key aspects of planning are:

1. **Access:** One of the primary success factors for proper healthcare design is convenient and easy access to and from the facility. This includes simple way-finding, safe and weather-protected vehicular drop-offs, and convenient access to parking. Such access is often at odds with urban planning trends, which attempt to minimize the impact of vehicular transportation in favour of more pedestrian-oriented buildings.

2. **Transportation facilities** like bus routes, metro rail, bicycling, and heliports are substantial non-medical services to support the staff, patients and visitors.
3. **Parking Demands:** Access to public transportation and housing within walking distance creates opportunities for staff and certain patients and visitors to avoid vehicular commuting altogether. This reduces the polluting impact of automobiles and can minimize the size of required parking facilities. It should be noted, however, that even with these reductions, hospitals would still generally create a much higher parking demand per square foot than a typical urban office building.⁷²
4. **Natural Environment:** Environment Studies have concluded that a natural environment is essential to create a genuine state-of-the-art healing environment and reducing stress. Key sustainable design elements such as roof-gardens, courtyard spaces can minimize the building's heat-island effect, reduce demand on storm water systems, improve surrounding air quality, and reduce noise pollution.
5. **Institutional:** Integration of Medi-city with research and development centres for bio-medical research, medical colleges, training centres are necessary. Also, financial support units should be created such as banks, ATM facilities, information centres, money transfers and exchange and insurance company outlets.
6. **Commercial Space:** A mixed use community is desirable in this area because of its proximity to the emerging Medical City. Therefore, Planned Development shall be encouraged, including a mixture of residential use types, hotel, retail/commercial, office and airport support, commerce, conservation and recreational uses.

Medical city should encompass the concept of self-sustainable cities/townships, in a way as an eco-city is designed with consideration of environmental impact. They should have clean disposal of waste, waste-to-energy, renewable energy, sustainable transportation and drainage system, zero-energy building, green roof, etc.

5.5.9. Sports city

Sports City defines a large developed area with all kind of sports infrastructure facility to support organising and hosting different sports activities in a city. Basically it is a concept of "City within City" which provides a regular series of sports venues, sports academies, providing a platform for youth development, recreational sports facilities, residential and commercial developments, together with all the related amenities. The purpose-built city is supported by service facilities like schools, medical facilities for sportsmen and residents, hotels, community centres and entertainment venue. And eventually all the events of sports city translate their activity into economic generation for an economically sustainable sport city.

5.5.9.1. Associated issue

As sports city emerges as a newly developed city on the fringe or near to the existing or old city so the associated issues are different from the parent city. Following are some of the issues associated with sports city:

- Large vacant land is required for developing sports city for development of sports infrastructure and supporting services. This required land is only available near to the parent city, if planned in advance.

⁷² Case Studies in Design Excellence for Mid-Sized Urban / Inner Suburban Medical Centers, by AIA Potomac Valley

- Huge and regular investment for infrastructure development is a big challenge to sustain sports cities. Major sports events are not held on a high frequency so maintenance and sustainability during lean time is a challenge
- World class modern infrastructure and equipment only can act as a pull factor of sports persons to come, participate and stay for long. Apart from development of sports complexes other development including residential, commercial and logistic facilities (store houses) are to be integrated.
- As sports cities lies on outskirts of the city, lack of connectivity leads to isolation of the sport city.
- Further, if the sports city lacks alternative economic activities, apart from sport event, it leads to stagnation of city growth.

Apart from sports city, it has been widely accepted that availability of facilities for sports and games and recreation is an essential part of healthy social life. Now it has been considered as an important parameter in determining the quality of human development. Sports play a vital role in overall development of youth. As per the latest All India Educational Survey conducted by the National Council for Educational Research and Training (NCERT) more than 50 per cent of one million plus schools in the country lack playground facility. This problem is more acute in the urban areas where playing fields are facing serious threat from competing demands on open spaces due to the low priority attached to it.

5.5.9.2. Planning strategy

The various factors associated with Sports city planning are strategic location, sports infrastructure, supporting institutional infrastructure and most importantly, skilled man power in the sector.

In India, cities and townships like Greater Noida Sports City, Mohali Sports Complex has emerged as a sports city. Now, New Raipur, almost 20 km from Raipur city is developing as a new sports city by the Naya Raipur Development Authority in eastern part of India.

Initial development of the sports city are to focus on infrastructure development, specific to sports, recreation and connectivity to national level urban centres and also international. Success of the city lies in the institutional backing to provide for highly specialised skill development, research and development and application of evolving technologies in the field. To overcome the challenge of huge investments, sports tourism, is among the alternative sources to sustain sports cities. The management of such cities/townships shall strategies these with hospitality, commercials, recreational and entertainment venues and proportion of its land use up to 15-20% to be dedicated for such uses⁷³.

⁷³Evolved from Gujarat Integrated Township Policy, 2008.

Case Study: Naya Raipur Sports City

Total area: Proposed development is on 130 acres, with its prime use divided into recreational and residential zone as mentioned in the Master Plan of Naya Raipur, 2031.

Land use & Infrastructure: The project is conceived as an integrated development featuring residential and commercial real estate components of the Greenfield capital city, complemented by various sports facilities of international standards. Core activities of the two areas is proposed to be well segregated, however, the supporting infrastructure and amenities to facilitate all the prerequisites for luxury lifestyle and a well-equipped base for sports requirements are integrated.

Inclusive planning: As per the stipulations of NRDA, 10% of the total housing units need to be developed as LIG and 15% of the total number of housing units need to be developed as EWS housing.

Residential Zone: The core concept of this component is to be an integrated neighbourhood development with easy access to social amenities and facilities like healthcare, education, shopping, leisure and entertainment, sports.

Sports Zone: It is the prime focus area for development of sports city for providing sports complex for organising games, training centre, practice venue and competition based environment of sports at both national and international level. The sports zone would offer a wide range of indoor and outdoor sports facilities, mainly comprising an aquatic centre and indoor stadium to be development components. Sports centre, accommodation facilities for players along with other support infrastructure such as food courts, restaurants, and open spaces form optional sports components.

Other facilities would be parking space, public utilities and amenities, hospital and primary health centre and shopping centre for local residents.

5.5.9.3. Aspects of Planning

The major planning aspects of the sports city are development of sports complexes, training centres, medical facilities, good connectivity, residential and commercial zones. The following supporting infrastructure should be considered for sport city:

- Good connectivity with the existing cities by road and rail facilities.
- Provisions for all basic infrastructures like water supply, storm water drainage and sewerage, and if location allows, integrate with the parent city, in order to draw benefits from the common infrastructure.
- Share of open spaces and recreational land use to be significantly high and hence provision of water harvesting system for available large open spaces in the sports city to be mandatory.
- Alternative uses of the open space to generate revenue during lean period.
- To regulate the development activity of sports city an integrated institutional development is required with local bodies and the sports authority.
- To promote Sports Tourism, Sports City to boast major entertainment venues, community centres, hotels and all the related amenities expected

It should be noted that the projections and allocation of infrastructure provisions and space standards of a Sports city are different. Such as the per capita water supply requirement should be planned for higher amount compared to the other cities. Since it is a “City within City”, the building regulations in the development plan for these areas to be individually prepared. The large land requirement in these cities must be compensated by sustainable development and green infrastructure.

Government of India (GoI) has taken into consideration, the importance of sports in day to day life and have made policies for development of sports at the level of Gram Panchayat, Urban Local Body and schools. Initiatives taken by the GoI are as follows:

- The National Sports Policy, 2001 of Government of India, ensures the provision of land and development of sports for the educational institutions, Schools and Colleges in **both rural and urban areas**, where existing play fields and stadium, both in rural and urban areas, will be maintained for sports purposes. The introduction of suitable legislation may be considered for providing open areas to promote sports activities. Steps would be taken to evolve low cost functional and environment-friendly designs in this regard, so that maximum benefits could be derived through relatively low levels of investment.
- The revised Twenty Point Programme, 2006 of Ministry of Youth Affairs & Sports provide for substantially enhanced public investments as a fundamental requirement for the time-bound establishment of basic but extensive sports infrastructure along with trained supervisors and organized sports management arrangements. This will include trained supervisors, **in all rural Panchayats and urban neighbourhoods throughout the country, leading to the establishment of a National Sports Infrastructure Grid extending from the community level in Panchayats and Municipalities to Block, District, State, Metropolitan and National levels, backed by sports medicine and sports sciences.**
- Apart from Sports city, the Comprehensive Sports Policy, 2007 of Ministry of Youth Affairs and Sports urges State Governments and Local Governments to engage physical instructors in schools and make available at least **1 acre of land for a primary school and 2.5 acres of land for an upper primary school for use as playgrounds.** In addition, it is also introducing and thus, implementing major programme in urban areas, to financially support the *Nagarpalikas* and other Urban Local Institutions to provide basic safe places to play in poorer areas in convergence with the Jawaharlal Nehru National Urban Renewal Mission. The *Nagarpalikas* will need to provide the minimum prescribed extent of land on a realistic basis. For this, financial assistance from GoI should be used as seed money to raise other contributions from the public and private entities for the creation of the basic sports infrastructure.

5.5.10. Development by the Private Sector

Multiple urban planning approaches that are available today pave way for the development of planned settlements in greenfield and brownfield sites. The information provided in this chapter about different cities and townships, state policies and development approaches can be realised on the ground of State backing. Easy adoption of these opportunities by developers for developing planned and better cities is possible once State Governments legislate and bring out township policies.

5.6. Special Area Planning (cantonment area, restricted area etc.)

5.6.1. Cantonment Area

Cantonment area is a place or places along with boundaries in which any part of the Armed Forces is quartered in a region amidst civil population. The overall municipal administration of the notified cantonments is the function of the Cantonment Boards which are local bodies comprising democratically elected representatives of the residents of the Cantonment as well as official members on a 50:50 basis.

As per “*The Cantonments Act, 2006*”, the Central Government may, by notification in the Official Gazette, declare any place or places along with boundaries in which any part of the Forces is quartered or which, being in the vicinity of any such place or places, is or are required for the service of such forces to be a cantonment for the purposes of this Act and of all other enactments for the time being in force, and may, by a like notification, declare that any cantonment shall cease to be a cantonment. Also, section 10(2)⁷⁴ states that, “Every Board shall be deemed to be a municipality under clause of article 243P of the Constitution for the purposes of-

- a. Receiving grants and allocations; or
- b. Implementing the Central Government schemes of social welfare, public health, hygiene, safety, water supply, sanitation, urban renewal and education.

Thus, the Cantonment Board provides municipal services, community facilities and civic utilities including Water Supply, Sanitation, Street-lighting, roads, medical, educational, and recreational facilities. The Board also strives, as per the National Policy, for the environmental up-gradation by planting trees, bushes, decorative plants, etc. The cantonment board also act as a municipality for taxation purposes⁷⁵.

The structure of Cantonment Boards is being maintained keeping in view the fact that the Cantonment areas were and are primarily meant to accommodate the military population and their installations. The Cantonment is an area, which comprise of both military and civil population. Thus, it needs to be covered under the guidelines of area development plan, so that the civic services can be integrated for the benefit of the ultimate user.

5.6.1.1. Categorises of Cantonments

As per the Cantonments Act, 2006, the cantonments are categorised into four types based on the population residing within the cantonment limit. The categories are mentioned in table below.

⁷⁴The Cantonments Act, 2006.

⁷⁵Section 108⁷⁵, states that, “A Board shall be deemed to be a municipal committee for the purposes of taxation as per the Municipal Taxation Act, 1881 (11 of 1881).”

Table 5.12: Cantonment Categories

Sr. No.	Cantonment Categories	Population Limit
i	Category I	More than 50, 000
ii	Category II	10,001 - 50,000
iii	Category III	2,501 – 10,000
iv	Category IV	Up to 2,500

5.6.1.2. Land Use in Cantonment

Land in cantonments is classified under the following major categories for the purpose of development:

- **Class A:** Reserved for specific military purpose and is managed by military authorities.
- **Class B:** Reserved for military administration for central government departments, railways; state government and agricultural land; used by private persons on lease; Vacant land, managed by the defence estate officer.
- **Class C:** Occupied or used for municipal purposes such as markets, roads, ranges, gardens, etc. it is managed by the cantonment board.

Case Study of Cantonment areas

1. Delhi Cantonment Area

Delhi Cantonment Area is spread over an area of 42.97sq.km and municipal administration is provided by the Delhi Cantonment Board (DCB), which works under the administrative control of the Central Government (Ministry of Defence).

Role in Infrastructure: The Board (DCB) is responsible for solid waste management, drainage and sewerage, street cleaning of the Delhi Cantonment area. While bulk water is supplied by Delhi Jal Board, which is 100%, metered, water is being metered in the distribution side at the pump houses for bulk consumers but not at individual houses. The Delhi Jal Board receives in bulk all sewerage from Delhi Cantonment Board for treatment and disposal.

Land features:DCB regulates development in the Cantonment Area, located between the airport and the NDMC area, within which features such as the Cantonment low density bungalow layout with extensive gardens, heritage buildings associated with the Armed Forces, and components such as Gopinath Bazaar and St. Martins Garrison church are considered to be of significance. Some locations in the Cantonment Area have been proposed as a Conservation Area by INTACH in the 2000 List. However, total number of Jhuggies has been increased from 1570 in 1990 to 1700 in 1994 in Delhi Cantonment Board area.

(Source: CDP Delhi, Dept. of Urban Development, Govt. of Delhi

(http://jinnurm.nic.in/wp-content/uploads/2010/12/CDP_Delhi.pdf)

2. Pune Cantonment Board (PCB)

The Pune Cantonment Board (PCB) is considering levying the Local Body Tax (LBT) in future, only after the Pune Municipal Corporation abolishes octroi. They have also studied the implementation of LBT in Aurangabad and have found there is a hike in their revenue and they believe LBT is far more feasible than octroi. Specific rule under Cantonments Act states that if the State abolishes a particular tax, the Cantonment Board situated in that State cannot levy that particular tax, limiting PCB to impose it.

5.6.1.3. Associated issues

Some major and minor issues associated with Cantonment areas and their developments are:

- Cantonments were always considered as high-security areas. The Cantonment Land Administration Rules permitted lease option for civilian population, who initially settled within the limit of Cantonment for the purpose of residential and commercial activity. These settlements are support systems such as for commercial activities, manpower support as formal or informal and to fulfil some of the institutional requirements. Within the cantonment areas, military based development and civilian based development takes place. But the management of this development faces the similar issues as those by the ULBs and development authorities. They are:

Lack of sufficient funding due to dependency on the Central and State government policies and permitted or abolished finance revenues;

Lack of consolidated and appropriate planning norms to guide the development of the civilian areas;

- The administration of Cantonments is a Union Subject, placed in List I of VII Schedule of the Constitution. The municipal administration of Cantonments is regulated under the provisions of the Cantonments Act, 2006. Cantonments cannot access development funds because the Ministry of Defence and the army are in the non-plan sector. This isolation is the fundamental reason for

Lack of integration with the city as a whole, due to paucity of funds and non-implementation of Central and State Sponsored Schemes is the Cantonments.

However, as per the Cantonments Act, 2006 the Board may join with any other local authority and appoint a joint committee for any purpose in which they are jointly interested.

In most cases, cantonments draw services from the city municipality especially water and power, this creates a dependence on city municipality which needs to be planned carefully and with higher standards than that set for the city.

Therefore, from the planning perspective, the integration of planning between cantonment areas and the urban settlements around it, is weak or absent.

- Another important planning issue is urban sprawl/ out growths. Cantonment areas which were originally located at a distance from the city are now within its limits or on its fringe which creates planning problems related to security and planned urban development of the city. The rapid urbanisation along urban settlements has engulfed the buffer zone between the two, leading to⁷⁶ :

Haphazard development in the surrounding areas of cantonment due to lack of Master Plan / Development Plan, and lack of land use specifications, resulting into unplanned formal and informal commercial establishments.

High waste generation in the surroundings of the Cantonment areas due to uncontrolled and undeveloped open spaces. Such a case is of Ahmedabad Cantonment area (due to untreated disposal methods and lack of proper waste management system).

Illegal occupancy on defence land due to uncertain General Land Records (GLR). Cases of occupants questioning the preparation of GLR particularly in the case of Secunderabad Cantonment have arrived.

5.6.1.4. Planning Strategies

The Cantonment Board has to execute a variety of duties and functions with the limited availability of funds. The board is responsible to make provisions for physical as well as social infrastructure. Construction, conservation and

⁷⁶The Times of India

maintenance of public service infrastructure, historical monuments, public places, etc. are also under the purview of the board.

In the given circumstances, where the duties and functions of the cantonment board and the municipality are similar, the integrated planning efforts shall address the associated issues of the cantonment area planning

Strategy 1: To control the overall area, in absence of land use specifications, which results into shopping and commercial establishments in Cantonment residential areas calls for the need for preparation of Development Plans/ Master Plan. Here, efforts shall be made by the Cantonment Board or by Joint Committee for formulation of a detailed Development plan. The norms and standards given in this Guideline may be adopted with modifications for planning (specifically) the civilian areas of the cantonment. Some specific planning aspects to include:

- a. Public utilities such as water supply, sewage systems and treatment plants, telecommunication, transportation networks and modes, power etc. can be integrated for ULB's and Cantonment Board for an effective output by the powers vested in the Joint Committee.
- b. Social infrastructure such as stadium and sports complex, working women hostel can be built within the Cantonment area for civilians. Recreational facilities shall be integrated with the cantonment areas.
- c. Commercial space development with proper guidelines will result in increment of the land value, which will be beneficial for Cantonment Board.
- d. Integration of the external infrastructure with the city level infrastructure facilities.
- e. More importantly, cantonment boards should make provision to include all sprawls or outgrowths within their jurisdiction areas for control (building) and land use managements⁷⁷.

Strategy 2⁷⁸: Another approach for planning exercise is by JNNURM scheme, where Comprehensive Development Plan and Comprehensive Mobility Plan shall be prepared by the Local authorities in consultation with Cantonment Board and approved by Ministry of Defence for raising the funds under the scheme. As per norms, a city development plan projecting future development of roads, water, sewerage and storm water drains and an indent of existing land use and a future land use plan is mandatory to obtain grants under all Central scheme such as Jawaharlal Nehru National Urban Renewal Mission (JnNURM), Rajiv Awas Yojana (RAY) and other Central government schemes.

This approach of planning the cantonment is to ensure:

- Integration in terms of connectivity as well as mass rapid transportation system,
- Suitably chosen locations of city level infrastructure for cantonment and civilians
- Well planned economic/commercial base in the cantonment area,
- Giving city a direction to its future growth towards or away from cantonment as strategized.
- Another advantage is that the natural systems management such as rivers and flood control measures can be clubbed for both the Cantonment areas and City area, which will minimise the losses, as, witnessed for Ambala Cantonment.
- City zonal plans on areas adjacent to cantonment board area should be finalised by the Competent City Authority (Municipalities/ Development Authority) in consultation with Cantonment Board Administration.
- Control on the surrounding or immediate zonal plans to cater to the requirements of the cantonment area.

⁷⁷In case of requirement buffer zones are created for specific defence land pockets under Works of Defence Act, 1903.

⁷⁸Ministry of Urban Development (MoUD) had introduced JnNURM in selected 76 cities of the country to provide funds on Central/ State/ Local Body sharing basis to develop basic infrastructure of the cities keeping in view the modern day requirements of urban governance. Among these cities, there are 28 Cantonments which are co-located within these Mission cities in the first phase of JnNURM. However, the issue of sharing funds with cantonment boards is still under consideration of Government of India.

Case Study for CDP preparation in Cantonment area

The Khadki Cantonment Board (KCB), Pune is preparing City Development Plan (CDP) to strengthen urban infrastructure and integrate it with that of the Pune Municipal Corporation with focus on traffic management for better connectivity, improvement in water supply, better garbage disposal system, developing sewerage system in bungalow areas and implementing projects in slum areas. The concept arises to get more funds from the state and Union governments under the JnNURM as cantonment board is looking for more funds. The first step for getting the funds is to prepare a CDP, which has to be approved by the state government and sent to the Union government for final approval

(Source: *The Times of India*.)

Revenue generation for Implementation of the plan:

The Cantonment Board generates revenue through meagre octroi, taxes and other fees, as explained in above sections. There are alternatives to increase this revenue. Cantonment area should incorporate shopping plaza/complex, which will encourage the shopkeepers to pay more rent to the board. The board can also organise weekly markets, which will also encourage higher shop rents⁷⁹. Proper planning strategy as recommended above shall ease the establishment of paid parking, theatres, cinemas, community hall, stadiums, gymnasias etc. that will also generate revenue. As per “The Cantonment Act, 2006”, these establishments are the responsibilities of Cantonment Board.

5.6.1.5. Recommendations

As per the Study of the National Commission to Review the Working of the Constitution, recommendation on “Empowering and Strengthening Local Self-Government in Cantonments” suggest the following reforms:

1. As Cantonments come within the legislative competence of the GoI under Article 246 read with entry-3 of List I of the Seventh Schedule, the solution appears to bring the Cantonments under the administrative control of the Ministry which has something to do with the local self-government and can access plan finance and developmental grants and loans. It may be worthwhile considering that the Ministry of Urban Development and Poverty Alleviation as the most suitable Ministry for Cantonments. The Cantonments could be brought under the Ministry of Urban Development and Poverty Alleviation (now MoUD) for planning and budget purposes and the mechanism may be worked out as in the case of border roads and coastal guards which are not under the administrative control of Ministry of Defence but still function in the interest of Defence forces with the Ministry of Defence and army having their say.
2. The Cantonments may also be brought under the Part IX-A of the Constitution so that they can take the advantage of the benefits of district planning, metropolitan planning, the finance commission, assignment of taxes, duties, tolls and grants and aids from the State Government, prepare plans for economic development and social justice, etc.
3. Structural constraints prevent the Cantonment Boards to access plan finance and development funds available for municipal necessities merely because the Cantonments come under the Ministry of Defence, a non-plan area.

⁷⁹The Deolali Cantonment Board (DCB), *The Times of India*.

6 Sustainability Guidelines

One of the early definitions of sustainable development was provided by Brundtland Commission (1987) as: ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’⁸⁰. The Commission’s report also states that “in essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development; and institutional changes are all in harmony and enhance both current and future potential to meet human needs and aspirations. Applied to the context of planning and development, the most fundamental element of sustainability is the utilization of natural resources in a city region most efficiently, most equitably across sections of society and in such a manner that the resources are conserved and renewed for future generations to meet their needs and aspirations. Integrating sustainability principles in planning process and development in today’s scenario has been explained in this chapter.

6.1. Sustainable Development

6.1.1. Sustainable Planning

Sustainable habitat development means achieving a balance between the economic and social development of human habitat together with the protection of environment, equity in employment, shelter, basic services, social infrastructure and transportation. Some of these parameters, which can be considered in Planning and Development, are:

1. **Regional Planning:** Regional development to control mushrooming unplanned and un-organized growth outside Master Plans/Development Plans along with integration of land use and transport resulting in sustainable development.
2. **Compact city/ High Density Development:** The National Mission on Sustainable Habitat⁸¹ (NMSH) recommends Low Rise and Higher Density Development to improve overall energy efficiency of the area; such forms are less expensive and reduce pressure on travel demand. Therefore for planning for high-density development and for increase in FAR in existing built up area, rationality for the increase in FAR should be worked out apart from carrying capacity analysis for the area.
3. **Re-development / re-densification:** Approaches shall be developed for Re-development / re-densification of existing urban habitat. Mixed land use, integrated and shared social space and multiple transport options can be considered and implemented to reduce trip generation and create efficient transport system.
4. **Open Spaces:** Emphasis should be given on vegetation/Green Belt in urban areas to reduce “heat island” effects.

⁸⁰ World Commission on Environment and Development’s (The Brundtland Commission) Report Our Common Future (Oxford: Oxford University Press, 1987).

⁸¹ National Mission on Sustainable Habitat, MoUD.

Apart from the key parameters, the National Mission on Sustainable Habitat has identified the components, which have major role to play in bringing environmental sustainability. These basic norms are detailed out below:

6.1.2. Energy Efficiency

The Generic Energy Efficiency Guidelines are given below. These guidelines are applicable for various categories of the building irrespective of their climate location.

- **Non-Conventional /Renewal Energy:** As per NMSH⁸², for residential buildings 15% of the total external lighting load should be met through renewable energy and for commercial / institutional / industrial / mixed use buildings, 5% of the total lighting load should be met through renewable energy sources (solar, wind, biomass, fuel-cells and so on). Also, there should be development of city level Energy Efficiency (EE) and Renewal Energy (RE) policy actions for e.g. Nagpur and Bhubaneswar have developed and adopted city level EE and RE.
- **Energy Efficient Design:** Efficient development control regulations and building byelaws from the point of view of energy efficient design should be considered. The Government of India has developed the Energy Conservation Building Code (ECBC), which provides minimum energy performance standards for energy efficient buildings, which can to be referred while designing private and public buildings. The ECBC is currently a voluntary programme, with a number of States adopting it as a mandatory requirement.
- **Building Performance Certification and Rating System:** After the introduction of ECBC, MoEF suggested ECBC compliance while undertaking EIA for all building and construction projects falling under their purview. Apart from EIA, in 2008, the Ministry of New and Renewable Energy, the Government of India have launched Green Rating for Integrated Habitat Assessment (GRIHA). GRIHA rating standards have been incorporated the provisions of the NBC 2005, ECBC, and other Indian Standard codes.

Similar to the Leadership in Energy & Environmental Design (LEED) rating system (practiced globally), the LEED-India promotes a whole-building approach to sustainability by addressing performance in the following five areas: (1) sustainable site development, (2) water savings, (3) energy efficiency, (4) materials selection and (5) indoor environmental quality. It also meets the specifications of ECBC 2007, NBC 2005, MoEF Guidelines, and CPCB norms.

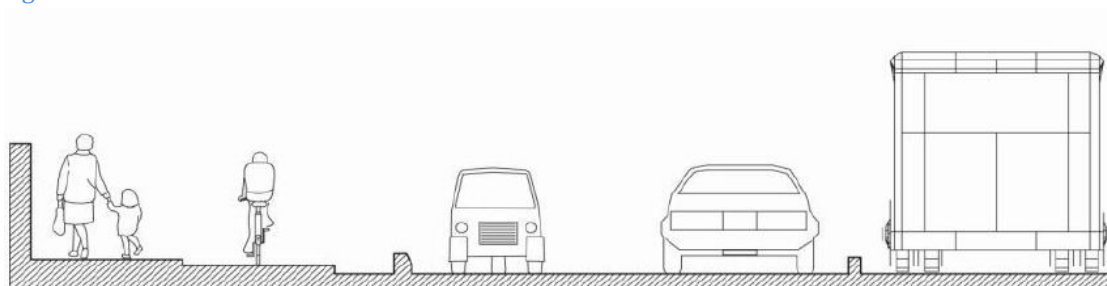
6.1.3. Urban Transport

- **Transit Orient Development (TOD):** Provision for TOD in cities should be considered, as it encourages high density and mixed-use development, overall reducing the travel demand and in turn reducing the carbon footprints. The details on TOD are elaborated in Physical Infrastructure section.
- **Strengthening of Public Transport System:** It can be done through a Combination of Promotional, Regulatory and Fiscal Measures adopting green transport models. Report of the Sub-Committee on Urban Transport (NMSH) can be referred for strengthening Public Transport.

⁸² Report of the sub-committee for development of NMSH parameters for energy efficiency in Residential and Commercial Buildings.

- **Reducing Fuel Consumption per passenger:** Significant GHG mitigation can be achieved through modal shift by providing all arterial roads more than 25 m Right of Way to have minimum of 2.5 m pedestrian path (with trees) and proper street furniture and 2.5m bicycle path preferably in each direction as a mandatory measure. Where it is not possible to provide a dedicated cycle path because of right of way being narrow, traffic calming measures to reduce the speed of traffic to 30 kmph need to be adopted.

Figure 6.1: Schematic cross-section of Arterial Roads



Source: Code of Practice Part-1, MoUD

- **Road Passenger with Urban Transport systems:** Long-distance passenger travel needs to be closely integrated into the urban environment, facilitating fast traveller-friendly mass-transport access to well-located terminals and airports. Carefully planned highway system improvements are required to reduce travel times for goods and passengers while improving road safety, congestion, fuel consumption and emissions.
- **Non-Motorised Transport (NMT) and Intelligent Transport System (ITS):** NMT and ITS should be encouraged. Provision of NMT is described in Physical Infrastructure section of this guideline, which aims to reduce carbon footprint. Moreover, ITS should be implemented for demand management and efficient implementation/enforcement of Public Transport. Provision of Mixed-use along the streets to ensure public safety and attractiveness for pedestrians and cyclists and hence accommodate large numbers of pedestrians and street vendors.
- **Non-Conventional source of Energy:** Changing to fuels that have a lower carbon footprint in sufficient quantities would have a major impact on GHG emissions from urban transport. Also alternative fuel base in cities to be promoted to reduce dependency. To achieve a good quality of public space, trees need to be planted to prevent *Heat island* effects.
- **Accessibility:** Accessibility of public transport to be improved in order to reduce travel distance.

Table 6.1: Accessibility of Public Transport at Neighbourhood Level

S. No.	Transport infrastructure	Distance from Neighbourhood
1	Rail Station including metros, monorail, light rail	800 meters or 5 minutes walking distance
2	Bus stops	400 meters
3	Intermediate Public Transport	400 meters

Source: LEED for India, 2011, IGBC 2011.

6.1.4. Urban Infrastructure

- **Zero Waste and Waste Recycling:** The urban waste should be recognised with a significant proportion of organic constituents, which has emerged as a resource for energy generation in an environmentally sustainable manner. Energy in the form of biogas, heat or power should be seen as a bonus, which improves the viability of such projects.

Bio-methanation, refuse derived fuel and incineration are the most common technologies,

Pyrolysis and gasification are also emerging as preferred options,

In case of existing landfills, bioremediation of waste is recommended with a view to reclaim the land and convert organic waste into useful products, which will result in reduction or elimination of GHG emission.

- **GHG mitigation measures for wastewater:** GHG mitigation measures includes - collection, conveyance and treatment of wastewater, reuse and recycling of treated effluent and gas recovery from sludge as well as use of treated wastewater for artificial recharge of aquifers to improve the ground water potential.
- **Decentralised Wastewater Management** – Decentralized wastewater management systems for community, housing complexes, and commercial buildings to be introduced for efficient wastewater management. Institutional capacity of all (ULBs) should be strengthened for effective implementation and O&M of sewerage system.
- **Low Water use and Ecological Sanitation** - It should be ensured that systems for the management of human excreta incorporate conservation principles. Low-water use toilets (3-5 litre) and ecological sanitation approaches (including ecological toilets), where nutrients are safely recycled into agricultural manure can be promoted.
- **Recovery of Energy** - The major benefits of recovery of energy from urban wastes is to bring about reduction in the quantity of waste by 60 per cent to 90 per cent; reduction in demand for land as well as cost for transportation of wastes to faraway landfill sites; and net reduction in environmental pollution besides generation of substantial quantity of energy.
- **Reducing need for pumping** - It would reduce the demand for energy, reduction of Non-Revenue Water (NRW), energy audit of all the water utilities, rationalization of water tariff to reduce wasteful use of water, minimization of leakages, metering of all water taps and water audit, etc.

6.2. Climate Change Mitigation and Adaptation

Climate change and its recent trends have a direct impact on all types of the development. Numerous agencies including National and International agencies are carrying out studies and are supporting cities to develop, adopt and implement sustainable and climate safe practices as per the National Action Plan on Climate Change, Government of India.

The International Panel on Climate Change (IPCC) Working Group-II's most recent report (2013) paints a grim picture for India. Focus of the report is on food and water supply and the urgent need for our cities to be resilient. Considering this, the Regional Plans and Development Plans must incorporate the possible impact of climate change on development. The focus should be on water security, use of heat reflecting materials in construction and minimising concrete surfaces. Aspects such as urban agriculture, vertical farming, water harvesting and preservation of all environmentally fragile ecosystems including water, landscapes etcetera should be incorporated. Specific actions should be included to address, among the other mentioned components. It may be desirable to develop appropriate policies and bring about effective legal and administrative control systems to deal with the problem.

City-Level Action Plans, for e.g. Kanpur and Meerut have already initiated the effort, which is supported by WWF. Green building is also one of the approaches for effectively reducing impact of climate change. It is combination of all the best practise principle. A brief on Green Building is given in subsection below.

6.2.1. Green Building

Green building concept recognises sustainable development by effective performance in the following key areas:

1. **Sustainable site development:** the sustainable site development shall include the following:
 - a. Efficient land use
 - b. Habitat preservation and restoration
 - c. Efficient transportation management
 - d. Efficient use of locally available materials and resources
2. **Water Efficiency:** It shall encourage use of water in a self-sustainable manner through reducing, recycling and reusing strategies. The methods of rainwater harvesting can be integrated to reduce load of water requirement on the urban water supply system.
3. **Energy Efficiency:** It shall reduce energy consumption of infrastructural equipment through energy efficient street lighting, motor pumps etc. On site power generation using various renewable energy technologies and other clean fuels can also be integrated in the planning system.
4. **Waste Management:** It shall encourage effective waste management strategies by facilitating the segregating of waste at source and promoting re-use of products and materials.
5. **Indoor Environment Quality:** For development of green buildings, the norms as suggested by Ministry of Environment and Forest and various bodies such as LEED, GRIHA or IGBC may be applicable depending upon the requirements.

6.2.2. Climate Proofing Guwahati, Assam: City Resilience Strategy and Mainstreaming Plan

Housing and urban planning, urban infrastructure and services, informal settlements and slums, poverty and livelihood, ecosystems and land-use and emergency response capacity are the key sectors which are considered to understand the present and future vulnerability of the city in context of climate change impacts.

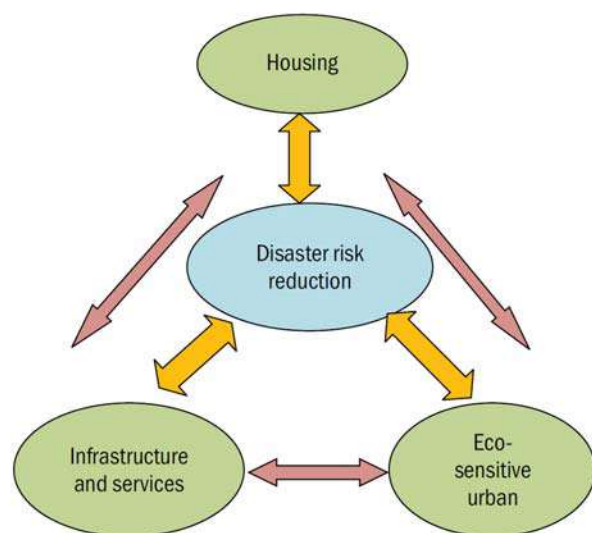
Table 6.2 Disaster Management strategies for different sectors

Parameters	Strategy
Housing	- Guidelines for construction of buildings on slopes - Structural stability of buildings in hills and for the entire GMA - Soil erosion and sedimentation control for construction in non-hill areas
Ecologically sensitive urban planning	- Demarcate eco-sensitive areas in the city as low/ no built up areas - Bring in principles of climate resilient urban development based on environmental parameters like conservation of natural ecosystems, natural drainage patterns
Urban infrastructure and services	- Augment the piped water supply network in the city - Augment the water treatment capacity of the city - Water Conservation and Rainwater harvesting - Development of a sewerage system - Monitoring water quality at disposal points - Integrated natural drainage plan for the city - Prepare and implement a storm water drainage plan
Disaster Resilience	- Preventive health measures - Public health management and surveillance system - Emergency medical response

Source: Climate Proofing Guwahati, Assam City resilience strategy and Mainstreaming Plan, Synthesis Report, TERI, 2013

Based on sectorial analysis, recommendations have been provided for each sector, which was focused on ecologically sensitive urban planning, management and conservation of natural resources and efficient and eco-friendly urban infrastructure and services.

Figure 6.2: Components of Guwahati Climate Resilience Strategy



Source: Climate Proofing Guwahati, Assam City resilience strategy and Mainstreaming Plan, Synthesis Report, TERI, 2013.

6.3. City Bio Diversity Index

City Biodiversity Index (CBI) is a dynamic process, being prepared for depicting the urban biodiversity status. This helps in evaluation, planning, improving and reviewing the city conditions in biodiversity perspective. The UNEP and UN Habitat

states that cities occupy 2 % of the Earth's surface, their inhabitants use 75 per cent of the planet's natural resources.

Recognising the importance of biodiversity and healthy ecosystems for their survival, cities should undertake initiatives to utilize and conserve their surroundings efficiently. These actions can reach far beyond the boundaries of the city, affecting biodiversity on a global scale. At the City level, High-resolution satellite images may be used for identifying Bio-diversity areas.

As adopted by Greater Hyderabad City for formulating Greater Hyderabad Biodiversity Index, the city biodiversity index system has 92 score system with 23 indicators. These indicators are given in Appendix E of Volume II B.

International convention (Convention on Biological Diversity) and national policies/plans (National Biodiversity Action Plan (NBAP), 2008) and documents have identified Invasive Alien Species as threat to biodiversity⁸³. The 12th Five Year Plan (2012-2017) has emphasised the need for a national invasive species monitoring system to track the introduction and spread of invasive species and advised that such a system should be linked to the State Forest Departments, and field staff should be trained to collect information on invasive species. Invasive species identification should not be limited to invasion in forests— it should also include invasion in aquatic and marine ecosystems, grasslands, wetlands and so on⁸⁴. It is suggested that while implementing a plan or project and developing green areas or green buffers, local species be used and the State Forest Departments to be made stakeholders in such projects.

6.4. Environment Policies and Statutory Obligation

Key environmental policies and obligations to be observed while planning are enlisted and detailed in this section, for reference. However, the latest and updated versions shall be referred from respective sources during planning and compliance.

6.4.1. National Environmental Policy (NEP), 2006

The NEP, 2006 encompasses an integrated approach to reduce the impact on environment degradation on human life by taking proactive measures at various fronts. These include regulatory reforms, process related reforms, substantive reforms, enhancing and conserving environmental resources, prevention of land degradation, desert ecosystem, and also various other factors that influences the environment. The policy primarily focuses on ensuring that people who are dependent on natural resources for securing their livelihoods from the act of degradation should realize that a greater purpose will be served from the

⁸³India's Fifth National Report to the Convention on Biological Diversity, 2014

⁸⁴Twelfth Five Year Plan (2012-17), Volume I

conservation of resources which includes land, desert ecosystem, water, wildlife, forests, wetlands etc.

The National Environment Policy (NEP, 2004) is a response to our National Commitment to a clean environment, mandated in the Constitution in Articles 48 A and 51 A (g), strengthened by judicial interpretation of Article 21. The NEP, 2004 has been motivated by the above considerations and is intended to mainstream environmental concerns in all development activities.

6.4.1.1. Reforms suggested through the policy

The statements of policy objectives are to be realized by concrete actions in different areas relating to key environmental challenges. Therefore the key reforms suggested through this policy, which impact planning directly or indirectly are:

- Environmental and Forest clearance
- Economic principles for environmental decision making by costing the resources
- Coastal areas: development activities in the coastal areas are regulated by means of the coastal regulation zone notification.
- **Environmentally sensitive zones:** *environmental sensitive zones may be defined as areas with identified environmental resource with 'incomparable values' which require special attention for their conservation.*
- Monitoring & enforcement of environmental compliance.
- Use of economic principles in environmental decision making so that costs are associated with the degradation and depletion of natural resources.
- Enhancing and conserving environmental resources through production and consumption practices with focus on regulatory and institutional reforms. Land degradation, forests and wildlife, biodiversity, freshwater resources; ground water and wetlands are the thrust resources of concern.
- Pollution abatement: ecosystems have some natural capacities to assimilate pollution; however these vary considerably with the nature of the pollutant and the ecosystem.
- Climate change issues

6.4.1.2. Strategic actions suggested

There is requirement of evolving a flexible policy framework with a built-in system for monitoring and review, and where necessary, revise the same for further use.

Table 6.3 Strategic Actions suggested

Actions	Strategy
Environmental standards	Environmental Standards refer both to the acceptable levels of specified environmental quality parameters at different categories of locations ("ambient standards"), as well as permissible levels of discharges of specified waste streams by different classes of activities ("emission standards").
Environmental Management Systems, Eco-labelling and Certification	Environmental Management Systems (EMS), such as ISO 14000, by requiring the adoption of standardized environmental management practices, documenting their actual use, and third party verification of the fact may significantly ease the public burden of monitoring and enforcement of prescribed emissions standards.
Clean Technologies and Innovation	Clean technologies, as distinct from "end-of-pipe" abatement technologies minimize the generation of waste streams in the production processes themselves, rather than treating the waste after generation. In general, clean technologies are less intensive in use of raw materials and energy, than conventional technologies, which rely on pollution abatement after generation. For this reason, they may also offer significant cost advantages to the producer.
Environmental Awareness, Education, and Information	Enhancing environmental awareness is essential to harmonize patterns of individual behaviour with the requirements of environmental conservation. This would minimize the demands placed on the monitoring and enforcement regimes; in fact, large-scale non-compliance would simply overwhelm any feasible regulatory machinery.
Partnership and stakeholder involvement	Conservation of the environment requires the participation of multiple Stakeholders, who may bring to bear their respective resources, competencies, and perspectives, so that the outcomes of partnerships are superior to those of each acting alone. Implementing and policy making agencies of the Government, at Central, State, Municipal, and Panchayat levels; the legislatures and judiciary; the public and private corporate sectors; financial institutions; industry associations; academic and research institutions; independent professionals and experts.

Source: The National Environment Policy (NEP, 2004).

6.4.2. EIA Notification, 2006

To ensure that the economic growth and development in our country is in conformity with regulations for environmental conservation, the Ministry of Environment & Forests (MoEF) has notified the Environmental Impact Assessment (EIA) Notification, 2006. The EIA Notification 2006 has notified 39 developmental sectors, which require prior EC.

MoEF has prepared EIA guidelines on each sector as identified by EIA notification 2006, which elaborates the procedure and mandatory requirements of EIA with respect to the sector. For e.g. Manual on norms and standards for environment clearance of large construction projects has been issued by MoEF to assist developers to measure and quantify environmental impacts of proposed construction, and derive mitigation options to minimise impacts. The manual also enables evaluation of construction projects by the expert appraisal committee. The proponent may use mitigation options, other than the ones described in the manual, to mitigate environmental impacts of respective projects.

6.4.3. Environment Protection Act, 1986

The Environment Protection Act, 1986 (EPA) has notified various rules under EPA for protecting the environment which are chronologically mentioned below:

- The Manufacture, Use, Import, Export and Storage of Hazardous Micro-Organism Genetically Engineered Organism or Cells Rules, 1989
- The Hazardous Wastes (Management and Handling) Rules, 1989
- The Manufacture, Storage and Import of Hazardous Chemicals Rule, 1989
- Scheme of Labelling of Environment Friendly Products (ECO-MARK)
- Restricting certain activities in special Specified area of Aravalli Range
- The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996
- The Bio -Medical Waste (Management and Handling) Rules, 1998, as amended to date
- The Recycled Plastics Manufacture and Usage Rules, 1999
- The Municipal Solid Wastes (Management and Handling) Rules, 2000
- The Noise Pollution (Regulation and Control) Rules, 2000
- The Ozone Depleting Substances (Regulation) Rules, 2000
- The Batteries (Management and Handling) Rules, 2001

Along with the above rules as identified in EPA 1986, The Air (Prevention and Control of Pollution) Act, 1981 and the Noise-Pollution (Regulation and Control) Rules, 2000 should also be referred to formulate norms and standards while preparing development plan for a city. The various statutory obligations for different clearances are mentioned in table below:

Table 6.4 Statutory Obligations of Environment Clearances

Type of Clearances	Statutory obligations
Environment Clearances	As per EIA notification, 2006
Forest Clearances	As per Forest Conservation Act, 1980
GEAC Clearances	Rules for Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/Genetically Engineered Organisms or Cells 1989, under EPA 1986

Source: MoEF and other sources.

6.4.4. Forest Conservation Act, 1980

Due to rising rate of deforestation and the resulting environmental degradation, the Central Government enacted the Forest (conservation) Act in 1980. The Act prohibits the deletion of a reserved forest or the diversion of forestland for any non-forest purpose, and prevents the cutting of trees in a forest without prior approval of Central government. The salient features of the Act are given below:

- This Act has five Sections, which deal with conservation of forests.
- The Act was enacted with the twin objectives under Section 2 of restricting the use of forestland for non-forest purposes, and preventing the de-reservation of forests that have been reserved under the Indian Forest Act, 1927. However, in 1988 the Act was further amended to include two new provisions under Section 2, where it sought to restrict leasing of forest land to private individuals, authority, corporations not owned by the Government, and to prevent clear felling of naturally grown trees.
- The Act empowers Central Government to constitute a committee to advise the Government with a grant of approval under Section 2, as also on any other matter connected with the conservation of forest and referred to it by the Central Government.
- The Act provides for punishment of offenders from the Government Departments, including Head of the Departments and Authorities.

6.4.5. Strategic plan for new and renewable energy sector for the period 2011-17, Ministry of New and Renewable Energy

India's substantial and sustained economic growth is placing enormous demand on its energy resources. The demand and supply imbalance in energy sources is pervasive requiring serious efforts by GoI to augment energy supplies. India imports about 80% of its oil. There is a threat of its increasing further, creating serious problems for India's future energy security.

The Vision of Ministry of New and Renewable Energy (MNRE) is to upscale and mainstream the use of new and renewable energy sources in furtherance of the national aim of energy security and energy independence, with attendant positive impact on local, national and global environment.

6.4.5.1. Objectives

The key objectives are:

- To promote deployment of grid-interactive renewable power generation projects
- To promote renewable energy initiatives for:
 - Meeting energy/ lighting needs in rural areas
 - Supplementing energy needs in urban areas
 - Supplementing energy needs in industry and commercial establishments, and
- To promote research, design and development activities at premier national institutions and industries on different aspects of new and renewable energy technologies and help development of new products
- To encourage development of a Robust Manufacturing Industry in Renewable Energy Sector

Table 6.5 Thrust areas of solar thermal sector

Cost reduction in:	
Incubating technologies	Industrial process heat systems
Development of silicon and other materials	Technology improvement for various low temperature applications
Efficient solar cells	Solar cooling
Thin film materials	Concentrating PV technology

Source: Strategic Plan for new and renewable energy sector for the period 2011-17

6.5. Environmental Guidelines

6.5.1. Environmental Guidelines for Industries

6.5.1.1. Areas to be avoided⁸⁵

In siting industries, care should be taken to minimise the adverse impact of the industries on the immediate neighbourhood as well as distant places. Some of the natural life sustaining systems and some specific land uses are sensitive to industrial impacts because of the nature and extent of fragility. With a view of protection such an industrial site shall maintain the following distances from the areas listed:

⁸⁵<http://moef.gov.in/citizen/specinfo/enguin.html>

Table 6.6 Distance of Different Areas from Industrial Site

S. No.	Areas	Distance
1	Ecologically and/or otherwise sensitive areas	At least 25 km, depending on the geo-climatic conditions the requisite distance have to be increased by the appropriate agency.
2	Coastal areas	At least 1/2 km from High Tide Line.
3	Flood Plain of the Riverine Systems	At least 1/2 km from flood plain or modified flood plain affected by dam in the upstream or by flood control systems.
4	Transport/Communication System	At least 1/2 km from highway and railway.
5	Major settlements (3,00,000 population)	Distance from settlements is difficult to maintain because of urban sprawl. At the time of siting of the industry if any major settlement's notified limit is within 50 km, the spatial direction of growth of the settlement for at least a decade must be assessed and the industry shall be sited at least 25 km from the projected growth boundary of the settlement.

Source: Environmental Guidelines for Industries, MoEF.

6.5.1.2. Siting criteria⁸⁶

Economic and social factors are recognized and assessed while siting an industry. Environmental factors must be taken into consideration in industrial siting. Proximity of water sources, highway, major settlements, markets for products and raw material resources is desired for economy of production, but all the above listed systems must be away for environmental protection. In such a selected site, the following factors must be recognized:

- No forestland shall be converted into non-forest activity for the sustenance of the industry (as per the Forest Conservation Act, 1980).
- No prime agricultural land shall be converted into industrial site.
- Within the acquired site the industry must locate itself at the lowest location to remain obscured from general sight.
- Land acquired shall be sufficiently large to provide space for appropriate treatment of wastewater still left for treatment after maximum possible reuse and recycle. Reclaimed (treated) wastewater shall be used to raise green belt and to create water body for aesthetics, recreation and if possible, for aquaculture. The green belt shall be 1/2 km wide around the battery limit of the industry. For industry having odour problem it shall be a kilometre wide.
- The green belt between two adjoining large-scale industries shall be one kilometre.
- Enough space should be provided for storage of solid wastes so that these could be available for possible reuse.
- Layout and form of the industry that may come up in the area must confirm with the landscape of the area without affecting the scenic features of that place.
- Associated township of the industry must be created at a space having physiographic barrier between the industry and the township.
- Each industry is required to maintain three ambient air quality-measuring stations within 120-degree angle between stations.

6.5.2. Guidelines for Rain Water Harvesting

Rainwater harvesting is the technique of collection and storage of rainwater at surface or in sub-surface aquifers, before it is lost as surface run-off. The augmented

⁸⁶ Ibid.

resource can be harvested in the time of need. Artificial recharge to ground water is a process by which the ground water reservoir is augmented at rate exceeding that under natural conditions of replenishment.

The functioning of ground water recharge units, various methods and techniques have already been elaborated in Infrastructure Planning section. Ministry of Water Resources, Central Ground Water Board (CGWB) has issued the 'Manual on Artificial Recharge of Ground Water⁸⁷', which can be referred for development of such projects.

6.5.3. Guidelines for Buffer Zones

Buffer zones are areas created around the conservation area, often peripheral to it, inside or outside to enhance its protection. Within Buffer zones, certain legal and/or customary restrictions are placed upon resource use and/or is managed to reduce the negative impacts of restrictions on the neighbouring communities. Based on various activities, important buffer zones have been identified in **Table 6.7**.

Table 6.7: List of Buffers for various activities

S.No.	Activities	Recommended Buffer
1	Eco-sensitive zones ⁸⁸	- As per National Wildlife Action Plan (NWAP) 2002-2016, "All identified areas around Protected Areas and wildlife corridors are to be declared as ecologically fragile under the Environment (Protection) Act, 1986." - As general principle the width of the eco-sensitive zone could go up to 10kms around a Protected area as provided in the Wildlife Conservation Strategy, 2002. In case where sensitive corridors, connectivity and ecologically important patches, crucial for landscape linkage, are even beyond 10 kms width; these should be included in the Eco-sensitive zones. - Further, even in context of a particular Protected Area, the distribution of an area of Eco-sensitive Zone and the extent of regulation may not be uniform all around and it could be of variable width and extent.
2	Railway land	RoW includes no development zone in itself.
3	Aviation related infrastructure	- As per Airport Authority of India (AAI), the buffer zone is applicable within 20 km radius of Airport on the height of the buildings, for which NOC is required from AAI for any construction activity. - Aviation imposes height restrictions only. Other DCR norms such as ground coverage, setbacks etc. of the local municipality are applicable. - The airport should be 20 km away from green area such as wildlife sanctuaries/ zoos/ bird sanctuaries and should not have restricted activities such as butcheries, sewage and no garbage storage around airports.
4	Communication and Transmission facilities such as satellite towers ⁸⁹	Installation of telecom towers should not be allowed on and around (100 Meters) the buildings where educational, religious and health care institutions are functioning.
5	Industrial area / SEZ ⁹⁰	- No SEZs may be planned in the sensitive areas such as the forests, mangroves, coral reefs, archeologically important sites, sensitive ecosystems, etc. A buffer zone of 1000 m shall be maintained from such sensitive areas and a greenbelt with tree density of 1000 trees/ acre shall be developed in the said buffer zone. - Major settlements (of 3,00,000 population) to maintain a buffer of 50-25 kms from the settlement's notified limit and projected growth boundary

⁸⁷Available at www.cgwb.gov.in

⁸⁸ Guidelines for declaration of Eco-Sensitive Zones around national parks and wild life sanctuaries, MoEF, 2011

⁸⁹Draft Special Regulation For Installation Of Telecom Towers In Urban Areas, Government of Orissa, 2013

⁹⁰SEZ guidelines, Industries Commissionerate, Government of Gujarat

S.No.	Activities	Recommended Buffer respectively.
6	Mining and quarrying⁹¹	Buffer zone in case of Mining Lease (ML) area up to 25 ha is to be considered as 5 km all around the periphery of the core zone and for ML area above 25 ha - an area 10 km all around the periphery of the core zone.
7	Petrochemical and Gas industries⁹²	- No Gas pipeline should be located within 15.0 meters of any private dwelling or any industrial building or place of public assembly in which persons work, congregate or assemble, unless it is provided with at least 300 mm of cover over and minimum cover as specified Petroleum And Natural Gas Regulatory Board Notification, 2009. - No Gas or Oil well shall be drilled at any point, within a minimum distance, to be prescribed by the Central Government, of any railway, pipeline or other right of way, surveyed road, dwellings, industrial plant, air-craft runway, buildings used for military or public purposes, or within three kilometres of any mine, whether active or abandoned, unless the special permission of the Central Government is obtained in advance. - About 90m x 90m buffer to be maintained along the active oil wells, petroleum storage tanks, encompassing all the safety norms for precautions against fire⁹³.
8	Heritage related areas^{94,95}	Every area, beginning from the limit of the protected area/monument, extending to a distance of 100 meters in all directions shall be the 'protected areas' and extending up to a distance of 200 meters in all directions shall be 'regulated area'. The protected zone is a no construction zone. The building regulations in the regulated zone to be prepared by the Heritage Conservation Committee in consultation with ASI.
9	Natural hazard zones such River flood plains and water bodies including wetlands⁹⁶	- The basic concept of flood plain zoning is to regulate land use in the flood plains to restrict the damage caused by floods. Flood plain can be identified based on last 50 or 100 year flooded area of water bodies or river. There can be different considerations for regulations. For example, the area likely to be affected by floods up to a 10-year frequency should be kept reserved only for gardens, parks, playgrounds, etc. Residential or public buildings, or any commercial buildings, industries, and public utilities should be prohibited in this zone. - In area liable to flooding in a 25-year frequency flood, residential buildings could be permitted with certain stipulation of construction on stilts (columns), minimum plinth levels, prohibition for construction of basements and minimum levels of approach roads, etc. In urban areas there should be double storeyed buildings. Ground floors could be utilised for schools and other non-residential purposes.
10	Coastal Regulation Zone	Coastal land up to 500 m from the High Tide Line (HTL) landward side and a stage of 100 m along banks of creeks, estuaries, backwater and rivers subject to tidal fluctuations is called the Coastal Regulation Zone, which is regulated for developmental activities.
11	Manmade hazard zones such as radioactive, chemical and gas treatment / processing / distribution lines⁹⁷	Chemical Industry - The development of buffer zones all around the industry in an effective manner and establish Off-Site responding agencies at an appropriate distance from the new installations. Nuclear Plants⁹⁸ 500 Ha is needed to be in the control of power station as an exclusion zone. This is maintained as a vacant space and developed as a green belt area. - Sterilised Zone: the plant as sterilized zone maintains Area of 5 km radius. No restriction is imposed by the plant on organic development activities of

⁹¹Proforma For Environmental Appraisal Of Mining Projects, MOEF

⁹²The Petroleum and Natural Gas Rules, 1959

⁹³Oil Mines Regulations, 1984

⁹⁴ Model Building Byelaws, TCPO

⁹⁵Ancient Monuments and Archaeological Sites and Remains Act, 2010 (AMASR)

⁹⁶ National Disaster Management Guidelines Management of Floods, NDMA

⁹⁷ National Disaster Management Guidelines Chemical Disasters (Industrial), NDMA

⁹⁸http://www.npcil.nic.in/pdf/news_12oct2011_01.pdf (National Power Corporation of India Limited)

S.No.	Activities	Recommended Buffer
		population in the annulus between 1.5 and 5 kms. Administrative actions ensure that there is no influx of large population in this area • Population Restriction: – Population density within 10 km radius: Less than two-third of state average; – Population within sterilised zone (5Km radius) Less than 20,000; – Population centres with more than 10,000 persons more than 10 km away; – Population centres with more than 100,000 person) more than 30 km away;
12	High density/ high activity zones	Areas around high density, mixed land use or residential areas along dense commuter's zones/ arterial and sub-arterial roads to be buffered with trees and plantations, flexible building material for attenuation/reflection.

Sources: As given

6.6. Environmental Guidelines for Planning Eco-fragile zones ⁹⁹

6.6.1. Coastal Area

As per the CRZ notification, 2011, coastal land up to 500 m from the High Tide Line (HTL) landward side and a stage of 100 m along banks of creeks, estuaries, backwater and rivers subject to tidal fluctuations is called the Coastal Regulation Zone (CRZ). For regulation of developmental activities, the coastal stretches within 500 m of HTL on the landward side are classified into four categories and restrictions have been imposed on construction activities in these zones. The following activities are prohibited within the CRZ: -

1. Setting up of new industries and expansion of existing industries, except those directly related to waterfront or directly needing foreshore facilities.
2. Manufacture or handling or disposal of hazardous substances.
3. Setting up and expansion of fish processing units including warehousing (excluding hatchery and natural fish drying in permitted areas).
4. Setting up and expansion of units/mechanism for disposal of waste and effluents into the watercourse.
5. Discharging of city untreated waters and effluents from industries, cities or towns and other human settlements.
6. Dumping of city or town waste for the purposes of land filling or otherwise, the existing practice, if any, shall be phased out within a reasonable time not exceeding 3 years from the date of notification.

6.6.2. Eco-Sensitive zones

Due to rapid urbanisation and its impact on protected zone, there is a need to conserve protected areas. The MoEF has developed guidelines for declaration of eco-sensitive zones around protected areas, national parks and wildlife sanctuaries. These guidelines provide the framework to states/UTs to develop specific buffer zones around National Parks, Wildlife Sanctuaries, Sanctuaries, important migratory

⁹⁹ Eco fragile zone s are Fragile Ecosystems such as Coastal eco-system, Desert eco-system, Mountain eco-system, Aquatic eco-system, Rain forest eco-system.

corridors, etc. with a view of minimizing and preferably eliminating any negative impact on protected areas and sanctuaries. The recommended procedure to be adopted by states is mentioned below:

- Prepare an inventory of the different land use patterns and the different types of activities, types and number of industries operating around each of the Protected Area (National Parks/Sanctuaries) as well as important Corridors be made with the help of range officers.
- A small committee comprising the concerned Wildlife Warden, Warden, an Ecologist and an official of the Revenue Department of the concerned area, could be formed whose function is to provide recommendation on requirement and extent of eco sensitive zone. Further, the committee can also suggest the methods of management of zone and thematic activities, which can be included in the Development Plan/ Master Plan of the region.

6.6.3. Water bodies in Urban Areas

Water Bodies play multi-functional role in urban area. It can be the source of water for supply, landscaping, irrigation, fishing and eco-tourism, which add values to social benefits. They can also be used to prevent heat island effects and to improve the micro-climate in cities. For conserving the same, it is necessary to analyse the hydrological system with reference to catchment basins for the water bodies. MoEF has prepared 'Advisory Report for Conservation and Restoration of Water Bodies in Urban Areas' which recommends State and ULBs to take initiatives in order to conserve water bodies. While formulating Development Plan at city levels, steps suggested by MoUD & MoEF in the above mentioned report could be adopted to conserve and restore the water bodies in cities. One of the finest examples of restoration of lakes in the fast growing urban environment is the Kankaria Lake in Ahmedabad.

Case Study: Kankaria Lake, Ahmedabad

Restoration of lake in a fast growing urban environment - Kankaria Lake in Ahmedabad

Key Highlights:

1. Source of water: Surface and recharge of groundwater, for drinking and irrigation
2. Supports livelihoods
3. Food and nutrition
4. Act as flood control measures
5. Recreation Spot
6. Lake as a 'natural infrastructure' for climate change adaptation

Transformations of Ghats: Kankaria Lake, Ahmadabad



Before



After



After

Source: MoUD presentation.

MoEF has also suggested to integrate identified projects on water bodies with Programmes such as National Lake Conservation Programme and National Wetland Conservation Programme, JnNURM/ UIDSSMT, Ministry of Water Resources programme for Repair, Renovation & Restoration (RRR) of Water Bodies with Domestic/External Assistance which are undertaken by Government of India (GoI).

For conserving rivers, MoEF has taken up the initiative and formed National River Conservation Directorate (NRCD). Initiatives have been taken through various River Action Plans such as - Ganga Action Plan and Yamuna Action Plan

6.6.4. Desert areas¹⁰⁰

India is a party to the UN Convention to Combat Desertification (UNCCD) and MoEF is the National Coordinating Agency for the implementation of the UNCCD in the country¹⁰¹, under the 'National Action Programme to Combat Desertification' with objectives:

- Community based approach to development,
- Activities to improve the quality of life of the local communities,
- Awareness raising,
- Drought management preparedness and mitigation,
- R&D initiatives and interventions which are locally suited,
- Strengthening self-governance leading to empowerment of local communities.

Desert ecosystem sensitive planning is crucial at Regional planning stage including mapping of land degradation, drought monitoring and indicating components for the State and District Disaster Management Plan for drought preparedness and warning system groups.

At Development Plan and local area planning level the key actions suggested in NEP, 2006 as given below to be considered:

- Intensive water and moisture conservation through practices based on traditional and science-based knowledge, and relying on traditional infrastructure.
- Enhancing and expanding green cover based on local species.
- Reviewing the agronomic practices in these areas, and promoting agricultural practices and varieties, which are well adapted to the desert eco-system.

6.6.5. Wetlands¹⁰²

Wetlands, natural and manmade, freshwater or brackish, provide numerous ecological services. They provide habitat to aquatic flora and fauna, as well as numerous species of birds, including migratory species. Several wetlands have sufficiently unique ecological character as to merit international recognition as Ramsar Sites¹⁰³.

Wetlands also provide freshwater for agriculture, animal husbandry, and domestic use, drainage services, and provide livelihoods to fisher folk. Larger wetlands may also comprise an important resource for sustainable tourism and recreation.

¹⁰⁰National Environmental Policy 2006, MOEF.

¹⁰¹Source: http://moef.nic.in/sites/default/files/Document1_0.pdf.

¹⁰²National Environmental Policy 2006, MOEF.

¹⁰³The Ramsar Convention defines wetlands as, 'areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres', thereby giving a wide scope to the term.

Wetlands are under threat from drainage and conversion for agriculture and human settlements, besides pollution. This happens because public authorities or individuals having jurisdiction over wetlands derive little revenues from them, while the alternative use may result into financial gains to them.

A holistic view of wetlands is necessary, which looks at each identified wetland in terms of its causal linkages with other natural entities, human needs, and its own attributes.

Key actions suggested in NEP 2006 at state or local level are as follows:

- Integrate wetland conservation, including conservation of village ponds and tanks, into sectoral development plans for poverty alleviation and livelihood improvement, and link efforts for conservation and sustainable use of wetlands with the ongoing rural infrastructure development and employment generation programmes.
- Formulate conservation and prudent use strategies for each significant catalogued wetland, with participation of local communities, and other relevant stakeholders.
- Formulate and implement eco-tourism strategies for identified wetlands through multi stakeholder partnerships involving public agencies, local communities, and investors.
- Take explicit account of impacts on wetlands of significant development projects during the environmental appraisal of such projects; in particular, the reduction in economic value of wetland environmental services should be explicitly factored into cost-benefit analyses.
- Consider particular unique wetlands as entities with “Incomparable Values”, in developing strategies for their protection.
- Promote traditional techniques and practices for conserving village ponds.

6.6.6. Hilly areas (further to section 5.5.1)

Hilly areas have one of the most fragile ecosystems, which need to be conserved. Therefore planning and development strategies for hilly areas shall be designed with added sensitivity and stress on integrated development. The development approach shall comprise judicious land use planning and settlement planning. In hill areas, the space standards are affected by the following and therefore these factors should be considered while setting norms in such areas:

- Exposure to sunlight, degree of slopes and accessibility in the form of distance travelled.
- Minimum needs of the people and the conservation principle.
- Flexibility in norms and standards to accommodate conditions guided by difficult hill terrain and its geology.
- Work place and residence relationship.
- Energy needs.
- Alternative mode of transportation communication network.
- Communication network.
- Mobile and emergency facilities.

On the same line, TCPD of Government of Himachal Pradesh has formulated the Norms and Standards for their state, which can be adopted by other states for hilly areas. Some of the infrastructure norms and standards are detailed in Infrastructure planning chapter. For vision development of Himalayan cities, ‘National Mission for

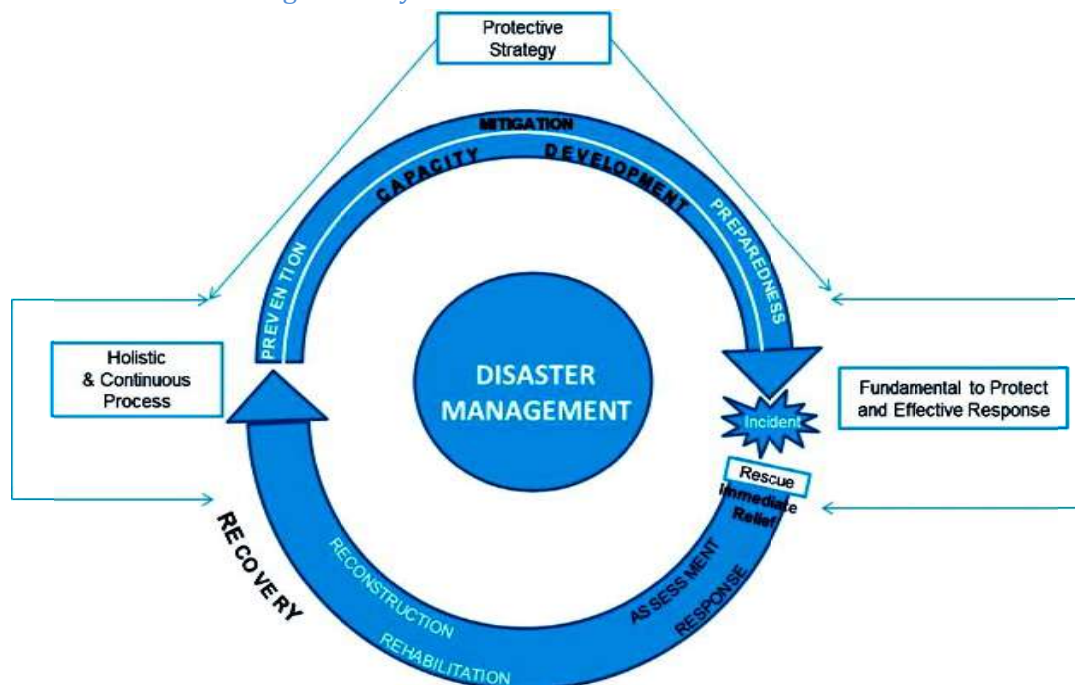
Sustaining Himalayan Ecosystem' should be referred from the National Action Plan on Climate Change, Government of India.

6.7. Disaster Management

Disaster means a catastrophe, mishap, calamity or grave occurrence affecting any area from natural and manmade causes, or by accident or negligence, which results in substantial loss of life or human suffering or damage to, and destruction of property, or damage to, or degradation of environment and is of such a nature and magnitude as to be beyond coping capacity of the community of the affected areas. As it is clear from the definition disaster may impact human habitat in a severe manner. Hence it is evident to manage these disasters at appropriate level so that impact can be minimised.

As per Section 2 (e) of Disaster Management Act, 2005, disaster management means a continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary or expedient for - (i) prevention of danger or threat of any disaster; (ii) mitigation or reduction of risk of any disaster or its severity or consequences; (iii) capacity-building; (iv) preparedness to deal with any disaster; (v) prompt response to any threatening disaster situation or disaster; (vi) assessing the severity or magnitude of effects of any disaster; (vii) evacuation, rescue and relief; (viii) rehabilitation and reconstruction" as shown in **Figure 6.3**.

Figure 6.3: Disaster Management Cycle



Source: National Disaster Management Hand Book for Training and Capacity Building of Civil Defence and Sister Organisations.

6.7.1. Institutional set-up

The institutionalized approach for disaster management initiated when 4th Finance Commission (FC) proposed the concept of “Margin Money”. Subsequently, 9th FC suggested ‘Calamity Relief Fund’ (CRF) now termed as State Disaster Relief Force (SDRF). Further, 11th FC recommended establishment of ‘National Calamity Contingency Fund’ (NCCF) now termed as ‘National Disaster Relief Force’ (NDRF). The institutional and policy mechanisms for disaster to carry out response, relief and rehabilitation have been well established since independence. NDMA has prepared various Guidelines for the Management of different types of disasters including, natural and manmade, to assist the GoI Ministries and Departments, State Governments and other agencies to prepare Disaster Management (DM) Plans. The Central Relief Commissioner (CRC) in the Ministry of Home Affairs is the nodal officer to coordinate the relief operations for natural disasters. The CRC in the Ministry of Home Affairs is the Chairman of the Crisis Management Group (CMG) whose primary function is to review the contingency plans formulated by various Ministries / Departments / Organizations in their respective sectors; provide measures and coordinate among central and state ministries.

Post Disaster Management: The National Crisis Management Committee (NCMC) set up by Ministry of Home Affairs, Government of India that gives direction to the CMG. NCMC can give directions to any Ministry/Department/Organization for specific action needed for meeting the crisis situation. These mechanisms are based on post-disaster relief and rehabilitation and have proved to be robust and effective mechanisms in addressing its requirements.

However, in order to further institutionalize the new approach, the Government of India have decided to enunciate a National Policy on Disaster Management (2009), whose broad objectives are to minimize the loss of lives and social, private and community assets because of natural or manmade disasters and contribute to sustainable development and better standards of living for all, more specifically for the poor and vulnerable sections by ensuring that the development gains are not lost through natural calamities/disasters.

Disaster Prevention, Preparedness & Mitigation: Apart from above, the Disaster Management Act, 2005 (DM Act, 53 of 2005) lays down institutional and coordination mechanisms for effective disaster management (DM) at the national, state, and district levels. As mandated by this Act, the Government of India (GoI) created a multi-tiered institutional system consisting of:

- National Disaster Management Authority (NDMA), headed by the Prime Minister,
- State Disaster Management Authorities (SDMAs) by the Chief Ministers and
- District Disaster Management Authorities (DDMAs) by the District Collectors and co-chaired by elected representatives of the local authorities of the respective districts.

Others organisations: The Act further provides for constitution of National Executive Committee (NEC), National Institute of Disaster Management (NIDM) and National Disaster Response Force (NDRF).

6.7.2. National Disaster Management Guidelines

The salient features of the NDMA guidelines with respect to the formulation of DM plans have been briefed, along with integration of the recommended planning system for the urban and regional planning in **Table 6.8** and **Table 6.9**. The detailed NDMA guidelines for following disasters can be referred separately while formulating the Plans¹⁰⁴.

Table 6.8: Salient Features of NDMA Guidelines for Management of Natural Hazards

Sr. No.	Types of Natural Hazards	Salient Features on Prevention, Preparedness and Mitigation of respective Disasters
1	Flood Management	Prevention and Preparedness ■ Set up River Basin Organisations to deal with the management of water resources at river basin level. ■ Preparation of Flood Management Plan by joint effort of States and concerned department of Central. This plan should be integrated with plans at city region or district level. Mitigation ■ Identification and marking of flood prone areas on maps, preparation of close contour and flood vulnerability maps, formulating plans for expansion and modernisation of flood can also be included in Development Plans. ■ Implementation of the schemes for expansion and modernisation of the flood forecasting and warning network, execution of flood protection and drainage improvement scheme and identification of reservoirs. ■ Implementation of activities, which include construction of dams and catchment area treatment (CAT) works in India as well as neighbouring countries for flood mitigation.
2	Earthquake Management	Prevention and Preparedness ■ Facilitate selective strengthening and seismic retrofitting of existing priority and lifeline structures in earthquake-prone areas ■ Prioritise the enforcement of earthquake resistant design features and strengthen the existing structures. ■ Improve the compliance regime through appropriate regulation and enforcement. Mitigation ■ Incorporation of earthquake resistant design features for the construction of new structures. The same should be reflected in building byelaws in development planning. ■ Sensitive earthquake seismic zones should be identified at city

¹⁰⁴For details NDMA guidelines are available at www.ndma.gov.in website.

		or region or district level. Priority to be given in Earthquake Seismic Zones 3, 4 and 5.
3	Drought Management	Prevention and Preparedness ■ Preparation of Drought Management Plan at district and State level in integration with Disaster management Plan and development plans. Plan to be prepared in advance based on the long season forecast issued by India Meteorological Department (IMD) in April and also the previous season rainfall. Mitigation ■ Measures for integration of soil, water and forest management and form part of soil conservation, watershed development and forestry programmes. ■ Drought proofing measures are taken before the crop is planted and drought management measures are taken during the crop-growing period.
4	Cyclones Management	Prevention and Preparedness ■ Coastal bio-shields spread, preservation and restoration/regeneration plans to be prepared by the Coastal Area Development, and Irrigation and Command Area Development Authorities ■ Developing Integrated Coastal Zone Management (ICZM) frameworks for addressing the sustainability and optimal utilisation of coastal resources, which shall also serve as cyclone impact minimisation plans. ■ Evolving eco-system restoration plans for degraded ecological zones. Mitigation ■ Mapping and delineation (coastal wetlands, patches of mangroves and shelterbelts), identification of potential zones for expanding bio-shield spread based on remote sensing tools, which can be integrated with DM Plan and Development Plan formulation. ■ Regulating infrastructure and development activities in coastal zones. Ensuring cyclone resistant design standards are incorporated in the rural/ urban housing schemes in coastal areas. ■ Implementing coastal flood zoning, flood inundation management and regulatory plans. ■ Groundwater development (recharge) and augmentation of freshwater requirement in coastal urban centres. ■ Development of Aquaculture Parks in the identified potential zones.
5	Tsunami Management	Prevention and Preparedness ■ Preparation of State and District Disaster Management Plans (also at city and village level), with specific reference to the management of tsunami. ■ Integration of coastal and tsunami risk into community planning. Mitigation

			■ Revision of town planning byelaws and adoption of model byelaws, wide dissemination of earthquake and tsunami-safe building codes, the National Building Code 2005, and other safety codes. ■ Development of tsunami safety standards and guidelines for existing critical lifeline structures in coastal areas. ■ Emphasis on Early Warning System. ■ Mapping contour levels up to which Tsunami impacted on the last incident of disaster.
6	Landslides/ Avalanches Management	Snow	Prevention and Preparedness ■ Integrating landslide concerns in the development of disaster management plans at all levels (especially for hilly areas and the Master plans of these areas to integrate the DMP provisions). ■ Landslide hazard zonation mapping in macro and meso scales. ■ Setting up of institutional mechanisms for generating awareness and preparedness about landslide hazard among various stakeholders. ■ Strengthening Post disaster management by respective DMAs and it should be considered as an integral component of mitigation effort. Mitigation ■ Taking up pilot projects to carry out detailed studies and monitoring of selected landslides to assess their stability status and estimate risk and the output of these studies can be utilised in planning process at all levels. ■ Development of model landuse / town planning byelaws and revision of existing ones. ■ Strengthening of building / heritage structures and safety of critical facilities against landslides and snow avalanches in hazard prone areas. ■ Enforcing and monitoring the compliance of land use and town planning byelaws, and other safety regulations in hilly areas.
7	Urban Management	Flooding	Prevention and Preparedness ■ Contour Mapping will be prepared at 0.2 - 0.5 m contour interval. ■ Inventory of the existing storm water drainage system will be prepared on a GIS platform. ■ Catchment will be the basis for planning and designing the storm water drainage systems in all ULBs. ■ Storm water drainage systems for coastal cities have to be designed taking into account the tidal variations. ■ Risk assessment will be carried out with a multi-hazard concept leading to fool proof land use planning. ■ Involvement of the Residents' Welfare Associations & Community Based Organisations in monitoring this and in all Urban Flood Disaster Management actions. Mitigation ■ Future Storm water drainage systems will be designed with a

	Runoff Coefficient of up to 0.95 in using Rational Method taking into account the approved Land-use Plan. ■ Rainwater Harvesting as an integral component of the building. ■ Encroachments on Drains and in Floodplains will be removed by providing alternative accommodation to the poor people. ■ Low-lying areas should be reserved for parks and other low-impact human activities. ■ Storm water drainage concerns will be made a part of all Environmental Impact Assessment norms.
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Table 6.9: Salient Features of NDMA guidelines for Man-made Hazards

S. No.	Types of Man-made Hazards	Salient Features on Prevention, Preparedness and Mitigation of respective Disasters
1	Chemical Terrorism Disasters(CTD) Management	Prevention and Preparedness ■ Preparedness for an emergency response at the incident site requires protection, detection, and decontamination. The Chief Medical Officer will be the main coordinator for the management of CTD. Preparedness for emergency medical response includes prompt establishment of medical posts as part of the ICS. ■ The nodal ministry for CTD and for chemical accidents will organise necessary activities to develop a common information platform for a sufficiently robust networking system, as part of the DM plans. Nodal and line ministries at the central level and departments of health, SDMAs and DDMAAs at the state or district level will identify the various requirements of critical infrastructure to be developed with PPP models to mitigate the impact of CTD. Mitigation ■ Counter-terrorism strategies, risk and vulnerability assessment, chemo-surveillance, and environmental monitoring are required for the mitigation of CTD by authorities recommended by NDMA. ■ A buffer zone to be defined to such industries, which are vulnerable for CTD. Development in such zones should be restricted, which should be covered in development planning.
2	Chemical (industrial) Disaster Management	Prevention and Preparedness ■ Strengthening of the present regulatory framework to meet the defined national policies and aspirations; augmentation of technical support functions, a supportive and technology neutral regulation framework. ■ Specific roles and responsibilities of MAH units, transporters, drivers, authorities and aspects related to emergency communication systems and training of various stakeholders. ■ Preparation of Crisis Management Plan by the hospitals, concept of mobile hospital and mobile teams, planning for and regular testing of emergency plan, establishing post-disaster documentation procedures, epidemiological surveys and minimum criteria for relief and rehabilitation. Mitigation ■ Legislation on land-use policy (buffer zone around chemical industry), Standardisation of national codes and practises, Preparation of On-Site

S. No.	Types of Man-made Hazards	Salient Features on Prevention, Preparedness and Mitigation of respective Disasters
		and Off-Site, Preparation of a highway DM plan for the transportation of hazardous chemical, Establishing a risk management framework criterion for chemical assessment. Hazard identification, risk assessment, incorporation of GIS technology, risk mapping, and development and improvement of database.
3	Nuclear & Radiological Disaster Management	Prevention and Preparedness - The plans for DM of nuclear/radiological emergencies / disasters from all levels of administration must be mainstreamed, allocation of funds from the Planning Commission as well as the concerned ministry. - Off-site emergency preparedness and response plans to be prepared by the collectors/ magistrates of the districts. - The SDMAs are required to identify and enlist officers with total responsibility of issues related to nuclear/radiological disaster management, the collector/magistrate of the district affected by nuclear emergency from nuclear power plant/facility will be in-charge of the off-site emergency programme and for radiological emergencies in the metropolitans/large cities, wherein more than one district is involved. The state authorities will nominate an incident commander; NDRF personnel must always be made available on emergency basis by NDMA at the affected site. Mitigation - Engineering safety features and accident management procedures that should be in place in a nuclear plant as accident mitigation measures for minimising the impact of a nuclear emergency by keeping the radioactivity release in the environment to levels as low as possible. - Controlling the power, cooling the fuel and confining the radioactive material should be used as three basic safety functions in Nuclear Plant. - The inbuilt safety measures, including biological shields, safety systems and interlocks, safety audits, operations strictly following safety procedures, etc., mitigate the consequences of accidents should be adopted.
4	Fire Services Management	Prevention and Preparedness - Preparation of Fire Hazard Response Mitigation Plan (FHRMP) - The plan should incorporate activities for mass awareness and inspection of fire-fighting facilities and equipment especially in schools, busy shopping malls, high-rise buildings and residential clusters. - Integration of FHRMP with 13th Finance Commission report and state five year plans for mobilisation of funds.

Source: NDMA guidelines for each of the Man-made Hazards.

Moreover, in addition to above points, there is a need to identify infrastructural needs for preparing mitigation plans, Implementing a financial strategy for the allocation of funds for different national and state/district level mitigation projects.

Capacity Building: In addition to above-mentioned salient features, the capacity development for managing the disaster is an important criterion, which should be considered as a part of preparedness. There should be availability of skilled and

adequately trained manpower like rescue and relief teams, Civil Defence, Home Guards, and other emergency service providers having basic knowledge of relevant disasters. In Disaster Management Plan, the role of NGOs, other voluntary organisations, and the community is required to be defined. Capacity development should be undertaken at the district, state, and national levels by the Ministries and departments concerned as a part of their respective DM plans.

Response Mechanisms: A mechanism for coordinated approach and efforts is required for effective response after the incident. Role of communities, NGO and National Disaster Response Force (NDRF)¹⁰⁵ should be considered while formulating incident response strategy.

Response & Relief: To provide Psycho Social Support after the incident as a part of relief is an important aspect. NDMA has also issued detailed guidelines which describes the following features:

- Implementation of Psycho-Social Support and Mental Health Services (PSSMHS) in National Mental Health Programme (NMHP) and in District Mental Health Programme (DMHP);
- Integration of the PSSMHS in DMHP and General Health Programme as a part of hospital and District health plan;
- Formation of a National Sub-Committee on PSSMHS;
- Training of National Disaster Response Force (NDRF), Quick Reaction Teams (QRTs)
- Disaster Management Teams (DMTs) in all basic psycho-social support skills;
- Integration of PSSMHS and NMHP with Disaster Management (DM) Plan and Health/Hospital DM Plans.

In terms of medical preparedness¹⁰⁶, the prevention measure and the preparedness measure is separately highlighted by NDMA.

- Preventive measure: Integrated Disease Surveillance Programme (IDSP)
- Preparedness for the management of mass casualties: Emergency Medical Response (EMR) at the incident site and their quick and safe evacuation by ambulance, are two important steps.

6.7.3. State Disaster Management Plan

The Section 23 of Disaster Management (DM) Act 2005 states that there shall be a DM plan for every state. The NDMA has also issued guidelines on preparation of State Disaster Management Plan (SDMP), which outlines the broad coverage of the plan as well as the requirements of consultation in its preparation. It also provides provision for annual review and updating of the State DM Plan, and enjoins upon the state governments to make provisions for financing the activities to be carried out under the state plans. The SDMP shall be prepared in consultation with the State Perspective Plans and/or State Urbanisation Policies.

The Act provides for the departments of the State Governments to draw up their own plans in accordance with the state DM plan. The SDMP should be prepared by the State Executive Committee (SEC) in conformity with the guidelines to be issued

¹⁰⁵A separate guideline has been issued by NDMA on Incident Response System and National Disaster Management Information and Communication System, which is available at www.ndma.gov.in.

¹⁰⁶The NDMA guideline on Medical Preparedness available at www.ndma.gov.in can be referred.

on related matters by the SDMA having regard to the NDMA guidelines. The SDMP prepared by SEC should be approved by the SDMA. The approach to the preparation of the SDMP should be holistic and address all the hazards the state is vulnerable to.

The SDMP may also adopt the generic categorisation of disasters with respect to specific plans at the state level by various departments to handle different disasters. These categories could be L0, L1, L2, and L3.

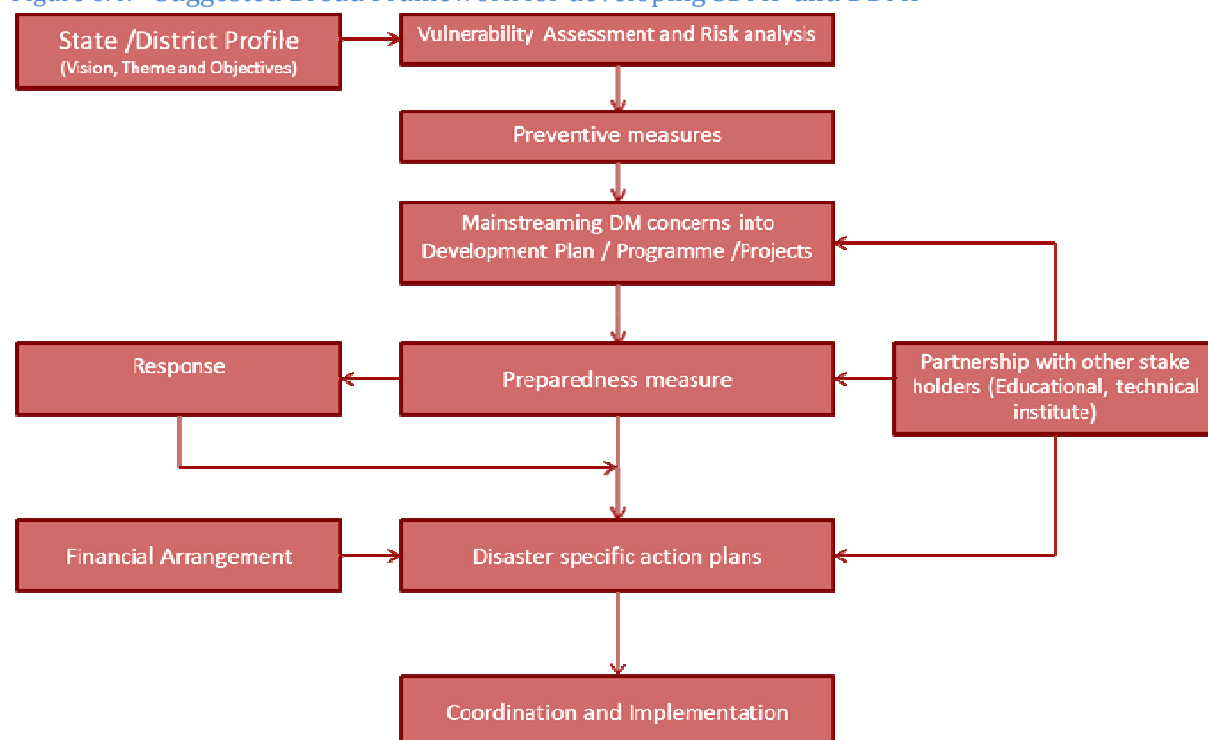
- L0 denotes normal times, which are expected to be utilised for close monitoring, documentation, prevention, mitigation and preparatory activities. This is the planning stage where plans at all levels from community to the State should be put in place. Training on search and rescue, rehearsals, evaluation and inventory updating for response activities should be carried out during this time.
- L1 specifies disasters that can be managed at the district level, however, the state and centre will remain in readiness to provide assistance if needed.
- L2 specifies disaster situations that may require assistance and active participation of the state, and the mobilisation of resources at the state level.
- L3 disaster situations arise from large-scale disasters where districts and the state may not have the capacity to respond adequately and require assistance from the central government for reinstating the state and district machinery.

The following features should be considered while preparing the SDMP

- Hazard Risk and Vulnerability Atlas (HRVA) assessment of different parts of the state to different kinds of disasters.
- The vulnerability of different parts of the state to different kinds of disasters.
- The SDMP should be developed in line with DDMPs.
- The measures to be adopted for prevention and mitigation of disasters.
- The manner in which mitigation measures shall be integrated with development plans and projects.
- The capacity building and preparedness measures to be taken.
- The roles and responsibilities of each department of the government of the state in relation to the measures specified above.
- The roles and responsibilities of different Departments of the government of the state in responding to any threatening disaster situation or disaster.
- The state plan will be reviewed and updated annually.

The suggested framework for developing SDMP & DDMP is shown in the **Figure 6.4**.

Figure 6.4: Suggested Broad Framework for developing SDMP and DDMP



Source: National Disaster Management Guidelines, Preparation of State Disaster Management Plans.

6.7.4. District Disaster Management Plan (DDMP)¹⁰⁷

Section 31 of the DM Act, 2005 makes mandatory to formulate District Disaster Management Plan (DDMP) by District Authority in consultation with local authorities. DDMP shall include Hazard Risk and Vulnerability Analysis (HRVA), prevention, mitigation, preparedness measures, response plan and procedures. An indicative list with possible plan objectives is given below:

- To identify the areas vulnerable to major types of the hazards in the district.
- To adopt proactive measures at district level by all the Government departments to prevent/ know disaster and mitigate its effects.
- To define and assign the different tasks and responsibilities to stakeholders during the pre-disaster and post-disaster phases.
- To adopt disaster resilient construction mechanism in the district by way of using Information, Education and Communication for making the community aware of the need of disaster resilient future development.
- To enhance disaster resilience of the people in the district by way of capacity building.
- Reduce the loss of public and private property, especially critical facilities and infrastructure, through proper disaster management planning
- Manage future development to mitigate the effect of natural hazards in the district.
- To set up the early warning system so as to prepare the community to deal with the disaster and responsive communication system based upon fail-proof proven technology.
- To develop the standardized mechanism to respond to disaster situation to manage the disaster efficiently.

¹⁰⁷ Source: Explanatory Notes for Preparation of District Disaster Management Plan (DDMP), NDMA

- To set up an Emergency Operations Centre at the District level to function effectively in search, rescue, response.
- To prepare the response plan based upon the guidelines issued in the State Disaster Management Plan so as to provide prompt relief, rescue and search support in the disaster affected areas.
- To make the use of media in disaster management.
- Rehabilitation plan of the affected people and reconstruction measures to be taken by different govt. departments at district level and local authority.
- Integration of DM initiatives into development plan and projects.
- To coordinate with Centre & State agencies concerned for effective and efficient DM.

The District Disaster Management Plan (DDMP) is the guide for achieving the objective mitigation, preparedness, response and recovery. It should be noted that Development Plan for the District/City should also integrate with DDMPs and city planning or town planning should be in compliance with the DDMPs and SDMP of the concerned District.

7. Simplified Planning Techniques

Town planners use variety of techniques at different stages of the planning process. These techniques may relate to surveys for collection of data, assessment of existing conditions in a settlement, as well as analysis and projections of future requirements in respect of various activities.

Substantial proportions of these techniques are highly elaborate and demand intensive data inputs. Considerable time is lost in collecting the required data causing delays occur in the plan preparation process. Further, with rapid urbanisation, planners need simplified techniques for analysis and plan preparation. The chapter describes some of the useful and simplified techniques for data collection, survey, analysis, projections and mapping. Most of these exercises can be take up as a separate research/ survey before plan preparation to provide processed data inputs.

7.1. Identifying Data Needs and Data Collection List

The basic presumption of simplified information gathering methodologies is that there is always a certain amount of uncertainty attached to any set of data, and that the available data may or may not be complete as compared to what is required for ensuring perfectness in decision making. This presumption implies that decision-making most often involves an element of imperfect data and good decision maker makes good use of extrapolation of the collected data though the application of simplified survey techniques.

The methods of rapid information collection institutionalise existing good practices and even common sense. They rely mostly on direct observation, seek several views of any one “fact” (cross checking) and make use of checklists and semi-structured dialogues instead of lengthy and often costly questionnaire-based surveys. Due to difficulties of measuring much of socio-economic information directly, rapid survey techniques make liberal use of proxy indicators to trace ranking, trends and shifts. These rapid methods must not be considered as substitutes to specialist investigations and should be used for quick access to information for rapid decision-making.

7.1.1. Data Checklist

The data collection checklist is a precise and exhaustive listing of topics/issues and sub-topics/issues related to the information need. The process begins with the preparation of an initial checklist. The next stage is to define the method of acquiring information about each sub-topic in the list. The checklist is flexible and allows the surveyor to adapt and improvise in the field. The steps involved in the preparation of the checklist are as follow:

- List major topics with its priority.
- List of major information needs and how each will be used for analysis.
- Break down each topic into sub-topics.
- Indicate the likely information sources such as
 - Document from Government departments, organisations, private agencies, publications etc.
 - Observation in the study area and inspection
 - Dialogue, interviews
 - Self-completion surveys etc.

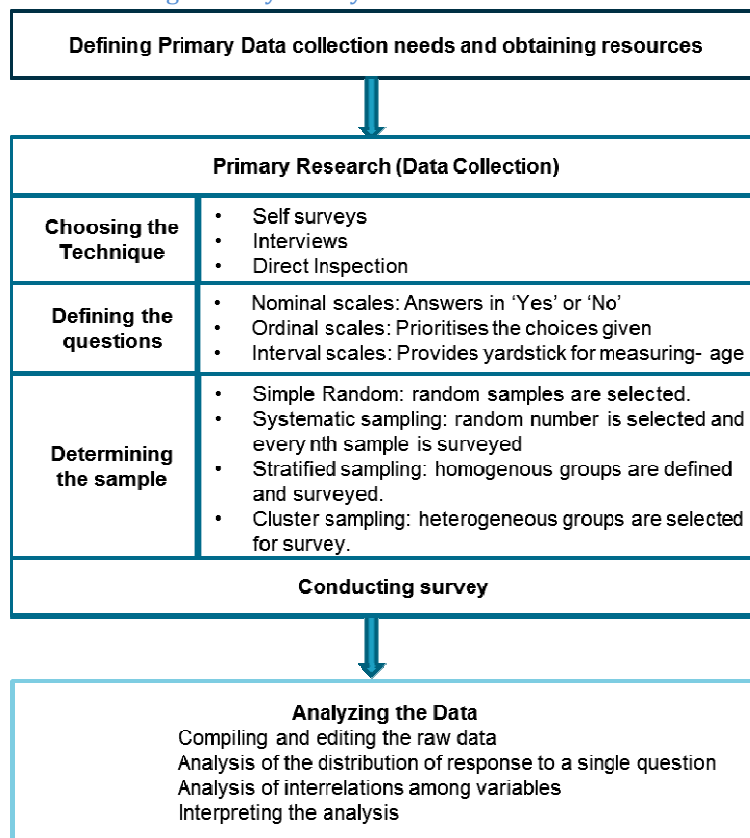
7.2. Data Collection Techniques

Information or data can be divided into two types, i.e. Primary data and Secondary data. Primary data is collected first hand by investigator, thus through Primary survey. Secondary data is second hand data, initially collected by some other investigator for other purpose but later on used by an investigator for his/her own purpose.

7.2.1. Primary Data Collection techniques

Primary data are those, which are collected for the first time and are always given in the form of raw material and original in character. Before beginning the primary data collection process, the technique of data collection, the questionnaire thereof and the survey sample selection technique is to be finalised. To process, analysis and interpret primary data, suitable statistical methods are needed.

Figure 7.1: Stages of conducting Primary Survey



Source: Reading Material on Planning Techniques by JH Ansari and Shri Mahavir.

This section discusses four types of primary surveys, which are listed in the order of passive to active respondents. Following are the broad categories of primary surveys:

- **Visual survey / Reconnaissance survey:** This survey does not require direct contact with population of the study area. It is quick overview of the area.
- **Inspection:** It involves direct inspection of area by surveyor for extracting information.
- **Personal Interview / Dialogue:** This survey is more personal and could be either face-to-face or telephonic. In such type of surveys some initial topics are investigated to gain insight in the area of interest.
- **Self-survey:** In this type of survey indirect contact is made with the respondent by sending questionnaire through mail or handed out but the response is not collected on the spot.

7.2.1.1. Visual surveys / Reconnaissance survey

Visual surveys are direct inspection surveys, which are performed by survey teams moving in a vehicle or walking. This type of survey can be used in the initial stages of the investigation, often after preparing initial checklist. It performs variety of functions, such as:

- Familiarise with study area.
- Give initial impressions of the physical and social state of an area.
- Identify selected areas for further investigation.
- Generate ideas for development of checklist.

7.2.1.2. Inspection

Direct Inspection: The direct inspection of conditions or activities is employed in many kinds of surveys where human communication is not required to elicit the information (*Source: Reading Material on Planning Techniques by JH Ansari and Shri Mahavir*). It can be used for observing traffic counts, recreation area use surveys, housing quality studies and proxy observations where required.

Indirect Inspection: The findings of the initial survey can be substantiated with the help of Key Indicator Survey, which are specific to the objectives of the analysis. Often, instead of getting direct information on the variable, surveyors rely on observing approximations known as proxies. A proxy is used to inform about a variable without direct investigation, instead investigating its key indicators. Such as: instead of enquiring about the income range, the surveyor can observe the housing condition, number of vehicles and other consumer goods. Table 7.1 lists proxy indicators to be generated through checklist, relating to the sub-topics, which are identified as important.

Table 7.1: Possible Proxy Indicators

Topic	Possible Proxy	Add your own proxies
Economic growth	Housing construction & condition Dwelling extensions Electricity consumption Sale of new vehicles	
Prosperity	Number of Petrol pumps Sale of Furnishings types Types of commercial stores	
Service levels	Number of standpipes Private water carriers Electricity supply Use of public urinals On-street garbage	
Wealth distribution	Differing new houses construction Private car ownership Imported goods consumption	
Women's participation	Hand portage of water Ratio of girls in higher education	
Municipal efficiency	Frequency of garbage removal Condition of road Street lights	

Source: UDPFI Guidelines, 1996

Such methods are to be adopted if the documentary statistics is aggregative or out-dated or both. Good proxies are those which can be easily investigated, however, proxies can often be misleading and must be used with care. Therefore generating proxies require knowledge about the relationship between the proxy and the variable it is trying to assess and its relationship in the study area.

7.2.1.3. Personal Interview/Dialogue

A number of types of surveys are undertaken face to face or by telephonic conversation. In case of quantitative survey, the structured dialogue is one-way where precise questioning takes place. Semi-structured dialogue is a flexible two-way process where only some initial topics are investigated. These topics can be revised as the practitioner gains insight in the area as information flows-in from the respondents. The semi-structured dialogue is thus an informal process but it needs to be managed expertly, particularly in the aspects listed below:

- Behavioural factors of the surveyors and respondents
- Questions not to be ambiguous or long
- Managing the conversation & careful probing to seek answers
- Judging responses without biases
- Cross-checking with other respondents
- Recording the interview (audio/video)
- Avoiding errors

7.2.1.4. Focussed Group Discussion (FGD)

Focussed group discussion is a qualitative data collection and research technique. Questions about opinions, perceptions, beliefs, attitude of people towards planning aims, services are probed in these discussions. FGD can be used for learning about stakeholders, their interrelationship and to know about a range of issues on the topic. This method costs fairly low compared to surveys, as one can get results relatively quickly and increase the sample size. FGDs can either be used to explore meaning of survey findings that cannot be explained statically as well as before designing questionnaires.

Homogenous group of people are selected for FGD so that they are comfortable and have free flow of discussion. Main objective and key questions of the meeting should be pre-decided. Group of 10 to 12 people and questions should be selected for a single FGD¹⁰⁸. More than one, mostly three to four FGDs to be done before legitimate results can be reached on an issue. FGD in rural settings can make use of interactive diagrammatic data collection techniques such as mapping, Venn diagram etc.

7.2.1.5. Participatory Rapid Appraisal

PRA is an intensive, systematic but semi-structured learning experience carried out in a community by a multi-disciplinary team, which includes community members¹⁰⁹ using various tools given below. Participatory appraisal methods and tools can be used across all age groups and cultures and do not rely on literacy skills. Methods of PRA are highly visual and comprise a myriad of activities to elicit and triangulate the same information¹¹⁰. Tools used in participatory interviews or group meetings include brainstorming, mapping, ranking and diagramming and can be broadly put in four categories¹¹¹:

- Group dynamics, e.g. learning contracts, role reversals, feedback sessions
- Sampling, e.g. transect walks, wealth ranking, social mapping
- Interviewing, e.g. focus group discussions, semi-structured interviews, triangulation
- Visualization e.g. Venn diagrams, matrix scoring, timelines

Participation usually takes place in familiar surroundings in the street, public places or through community-based activities¹¹².

7.2.1.6. Self-Survey

These are often in the questionnaires sent to respondents through mail or survey forms handed out or inserted in the newspapers and the filled questionnaires are

¹⁰⁸Source: Overseas Development Institute, UK; Wikipedia.

¹⁰⁹<http://www.slideshare.net/ronelcana/participatory-rapid-appraisal>.

¹¹⁰http://shortwork.org.uk/?page_id=210.

¹¹¹Source: Wikipedia.

¹¹²http://shortwork.org.uk/?page_id=210

mailed back to the surveyor. It has various limitations, like; responses can be low and unsatisfactory.

Primary data collection techniques can be costly and very time consuming thus methods of rapid information collection, which rely mostly on direct observation, is an alternative. This method seeks several views of any one “fact” (cross checking), makes use of checklists and semi-structured dialogue. However, rapid methods must not be considered as substitutes to specialist investigations and should be used for quick access to information for rapid decision making only.

7.2.2. Secondary Data Collection techniques

Secondary data are those, which have already been collected by someone other than the investigator himself. These are usually compiled and processed information but may be relatively less accurate than the primary data. However, the problems associated with the primary data collection such as time consumption, skilled manpower requirement do not arise here. Secondary data can be collected from a number of sources, which can be broadly classified, into two categories.

7.2.2.1. Published Sources

Mostly secondary data is collected from published sources, which makes it reliable. Some important sources of published sources and statistical data are as follow:

- Published reports of Central and State Governments and local bodies.
- Statistical abstracts, census reports and other reports published by different Ministries of the Government.
- Official publications of the foreign Governments.
- Reports and Publications of trade associations, chambers of commerce, financial institutions etc.
- Journals, Magazines and periodicals.
- Periodic Publications of Government organizations like Central Statistical Organization (CSO), National Sample Survey Organization (NSSO).
- Reports submitted by Economists, Research Scholars, Bureaus,
- Published works of research institutions and Universities

7.2.2.2. Unpublished Sources

Statistical and non-statistical data can also be collected from various unpublished sources. Some of the important unpublished sources from which secondary data can be collected are:

- The research works carried out by scholars, research associates and professionals.
- The records maintained by private firms and business enterprises, which may not have been published due to business discretion.
- Records and statistics maintained by various departments and offices of the Central and State Governments, Corporations, Undertakings among others.

For assisting planning and development efforts of local bodies, **Central Statistical Organisation (CSO) of Ministry of Statistics and Programme Implementation (MoSPI)** has published a document ‘Basic Statistics for Local Level Development’ for

Rural-village schedule, Urban- ward schedule and Metropolitan city/ city/ town schedule. At village level, the *gram Panchayat* will consolidate, maintain and own village level data. It is suggested that District Statistical Office (DSO) will coordinate with respective local body and different departments for getting the information compiled at respective schedule.

7.3. Types of Surveys

While planning regional or urban area, diverse studies are done which use various sets of information to analyse existing situation and make future projections. Thus, keeping in mind the range of data required in planning, following survey types have been undertaken.

7.3.1. Socio-Economic Survey

Demographic survey is concerned with collection of socio-economic data regarding characteristics of human populations, such as size, growth, density, distribution, and vital statistics. This survey forms base for not only understanding current socio-demographic characteristics of specific area but also projections of future population and related infrastructure. However this survey is to be done in rare cases only as Census of India provides detailed information of demography.

7.3.2. Land use/utilisation Surveys

Land use survey is commonly undertaken with the purpose to identify developed and undeveloped areas for analysis of physical distribution and condition of existing development for future projections. In case of ground verification of the land use map prepared by remote access or by various secondary sources, land use of a defined land parcel can be observed by undertaking a well-planned exercise.

The developed and undeveloped area can then be further classified into major categories depending upon the use to which major portions of land are put to. The categories are to be in line with Urban or Regional Plan (s) (as given in Table 4.4 and Table 9.1). In case of multiple use of a land parcel, the dominating land use should be marked, if mixed land use is not considered in the plan.

7.3.3. Density Surveys

Density surveys are done to understand the relationship between built-up area and population density. It is taken up for assessment of infrastructure requirements, to reduce congestion, appropriate availability of land for specific activities and services required by residents for good quality of life.

7.3.3.1. Residential Density¹¹³

Residential density surveys are undertaken with the objective to understand the accommodation density, built-up area density (built-up area per land area) and the residing population density. Based on the analysis from this survey, the decisions on the control and promotional measures can be taken.

There are two separate aspects of this objective, first is less congestion within dwelling unit and second is low- high density in a neighbourhood or the study area. Another reason for such surveys is to control number of people residing in an area so as to provide appropriate/sustainable or decentralised services and utilities for the area.

Residential density is normally expressed in terms of:

- Houses per unit land (dwelling units/hectare),
- Habitable rooms per unit land (rooms/hectare) (Accommodation density) and
- Persons per unit land (persons/hectare) (Population Density).

For comparison at later stages and analysis of the residential areas, the study area can be further divided into zones/sub-divisions of similar housing types/conditions and tentative observation of density or based on similar pattern for survey within the study area.

As accommodation density and population density are calculated for same unit of area, these can be compared to reach at number of persons (occupancy rate) per habitable room. Thus it is used to determine whether particular area is under-utilized or over-utilised. This information can be used in future planning to decide which areas are to be decongested and in which areas density can be increased. The following formulas are used for the calculation:

$$\text{Accommodation density} = \frac{\text{Number of habitable rooms in the study area/sub-division}}{\text{Net area of the study area/sub-division}}$$

$$\text{Population density} = \frac{\text{Total population of the study area}}{\text{Total area of the study area}}$$

$$\text{Occupancy rates} = \frac{\text{Population density}}{\text{Accommodation density}}$$

7.3.3.2. Non-Residential Density

Density in non-residential areas is carried out for assessment and provision of appropriate quantity and quality of services to the users of study area. Measurement of density in non-residential area in terms of room or occupant per acre does not

¹¹³ Source: Reading Material on Planning Techniques by Sh.JH Ansari and Sh. Mahavir; and Keeble Lewis, Principles and Practices of Town & Country Planning, 1968.

provide useful information, thus a method based upon the floor space index (FSI) is used to calculate non-residential density.

This survey seeks to obtain twofold information about study area; first, a statement of the total area devoted to different classes of land use within the non-residential area, distinguishing only between quite distinct kinds of use, e.g. shop, office, place of assembly. Second, the intensity of use of each street blocks in the non-residential area in terms of its overall FSI. The FSI survey gives some idea whether the amount of land requires be increasing or reducing for different land uses.

Table 7.2: Field sheet for non-residential survey

Sub-division No.	Floor area in square meters				Total floor area	Total Size	F.S.I.
	Shop	Residence	Office	Industry			
1							
2							
3							
4							
5							

Source: Reading Material on Planning Techniques by JH Ansari and Shri Mahavir.

7.3.4. Infrastructure Surveys

Infrastructure survey includes the survey of existing infrastructure within and surrounding the study area in terms of its population. The result of infrastructure survey is compared to benchmarks and parameters provided by National/Government authorities. Such survey includes physical as well social infrastructure. This survey is commonly integrated with the land use survey to cohesively understand the use of land and to save on time and manpower.

- Physical infrastructure indicators: transportation, water supply, wastewater, sewerage, and solid waste management infrastructure.
- Social infrastructure indicators: educational, civic and utilities, health care, recreation infrastructure etcetera.

Key parameters to be assessed in the survey are capacity, utilisation, gap assessment, issues associated as well as technology. The following table indicates the various infrastructure indicators that can be used and the benchmark providing agencies for the same.

Table 7.3: Infrastructure indicators and benchmark providing agencies

Indicators	Benchmarks providing Authority
Transportation	Urban Road – Code of Practice
Water supply	CPHEEO, Service level benchmarking-Ministry of Urban Development (MoUD)
Waste water management	CPHEEO, Service level benchmarking-MoUD
Solid waste management	CPHEEO, Service level benchmarking-MoUD
Storm water Drainage	CPHEEO, Service level benchmarking-MoUD
Sewerage	CPHEEO, Service level benchmarking-MoUD
Industrial Effluent	As per CPCB / SPCB norms

Sources: As given.

Transportation infrastructure survey is undertaken to comprehend the transport network and the movement of commuters in the city. It comprises survey of traffic volume, commuter load of different forms of commutation, parking survey and others. **Table 7.4** covers this in detail.

7.3.5. Transportation Surveys

Types of surveys, their objectives and methods, sampling size and expected output are given in the table below:

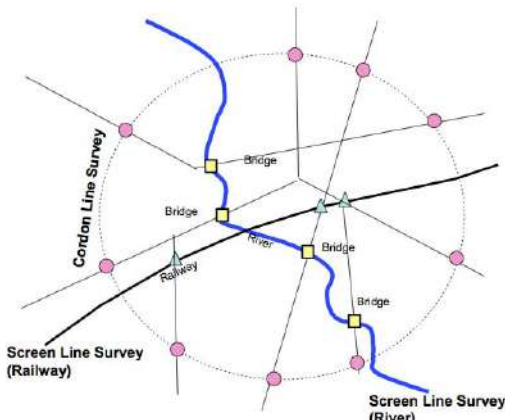
Table 7.4: Comprehensive Table of Transportation Surveys (Transport Survey forms Refer Appendix F of Volume II B)

S. No.	Survey Name	Objectives	Survey Methods	Sampling Size	Expected Output
1.	Inventory of road network system Review of existing transport infrastructure and facilities, including: ▪ Flyovers/ underpasses, ▪ Major intersections, ▪ Parking facilities, ▪ Traffic control facilities ▪ Pedestrian facilities ▪ NMV facilities, ▪ Level Railway Crossings ▪ Public Transport and Para transit Facilities	▪ To appreciate the physical characteristics of the identified road network in terms of right-of-way, carriage way, number of access points, surface type, abutting land use, etc. ▪ To identify physical constraints and bottleneck points along the identified road network. ▪ To assess the capacity potential of the identified road network ▪ To appreciate traffic management measures presently adopted along the identified road network ▪ To understand the existing transport situation in order to develop a rational land use and transport plan and mobility improvement measures in a CMP	Manual	▪ Two sections for a road section with similar land uses ▪ Two samples for a road section with similar land use ▪ Samples to be collected where ever section has variation	Physical characteristics and physical constraints of road network and transport infrastructure
2.	Speed and delay studies	▪ To elicit the journey and running speed along the road network ▪ To identify the bottleneck point ▪ To obtain the travel time matrix for all the O-D pairs ▪ To quantify delays and identify factors causing delay	▪ Moving Observer method ▪ Floating Car Method ▪ Registration Number Method ▪ Elevated observer Method	The average of around six runs ¹¹⁴	Journey and running speed, travel time, delay causing factors
3.	Classified traffic volume counts	▪ To appreciate traffic characteristics in terms of size composition and variation – directional and temporal. ▪ To appreciate the spatial distribution of traffic ▪ To establish the level of service on the road network system	▪ Manual Method ▪ Using automatic devices like Sensors ▪ Video Photography	As even day count will then give the Average Daily Traffic (ADT) ¹¹⁵	▪ Traffic Characteristic of the study area ▪ Traffic volume ▪ Spatial distribution of traffic ▪ Circulation of traffic

¹¹⁴ IRC:SP:19-2001.

¹¹⁵ Ibid.

Simplified Planning Techniques

S. No.	Survey Name	Objectives	Survey Methods	Sampling Size	Expected Output												
4.	Road Side Origin and destination surveys at - Cordon and - Screen lines 	- To appreciate the traffic characteristics - To appreciate the desired patterns of passenger and goods traffic - To assess the intensity of through and destined traffic - To use in model validation	- Road Side Interview Method - Registration Number Plate survey - Tags on vehicles	The survey should normally be conducted for three consecutive days, on sample basis, if possible during a representative week in the year and must encompass the weekly market day and one working day ¹¹⁶	- Travel pattern - O-D matrix to calibrate a transport demand model												
5.	Mobility survey (Household Survey)	- To elicit socio-economic characteristics of the household - To elicit travel characteristics of the household (total trips, purpose of trips, mode used, trip length, trip origin and destination etc.) - To appreciate desired pattern of traffic - To elicit opinion (of the residents of the study area) regarding general transport problems of the city and the probable areas of improvement.	Household interviews	<table><tr><th>Population</th><th>Sampling rate</th></tr><tr><td><50,000</td><td>1 in 5</td></tr><tr><td>50,000-1,50,000</td><td>1 in 8</td></tr><tr><td>1,50,000 – 3,00,000</td><td>1 in 15</td></tr><tr><td>3,00,000-5,00,000</td><td>1 in 20</td></tr><tr><td>>10,00,000</td><td>1 in 25</td></tr></table>	Population	Sampling rate	<50,000	1 in 5	50,000-1,50,000	1 in 8	1,50,000 – 3,00,000	1 in 15	3,00,000-5,00,000	1 in 20	>10,00,000	1 in 25	Socio-economic profile of the study area, number of trips, purpose of trips, mode used, trip length, trip origin and destination, vehicle ownership
Population	Sampling rate																
<50,000	1 in 5																
50,000-1,50,000	1 in 8																
1,50,000 – 3,00,000	1 in 15																
3,00,000-5,00,000	1 in 20																
>10,00,000	1 in 25																
6.	Parking Demand Characteristics	- To assess the parking characteristics in terms of parking duration and accumulation by mode - To assess future levels of demand	- Parking Space Inventory - Parking usage Survey by patrol	Each typology to be covered / representative sample to be collected	Parking duration, load, volume, index, turn-over												

¹¹⁶ Ibid.

S. No.	Survey Name	Objectives	Survey Methods	Sampling Size	Expected Output
		To develop a parking policy	- Cordon count - Questionnaire type parking survey		
7.	Parking Supply	To assess the Parking Supply	Parking Space Inventory	Each typology to be covered / representative sample to be collected	Determine availability of existing parking
8.	Activity place study	- To appreciate the activity pattern in terms of type and intensity - To appreciate the employment levels by type of activity - To develop relationship between floor space and employment - To appreciate the trip and other characteristics of employees - To develop trip production and attraction rates by type and intensity of activities.	Primary survey	100 % of land use survey and Sample size of trip rate to be decided based on the size of study area.	Identify trip generation rates
9.	Public transport system study	- To appreciate system and operational characteristics - To appreciate the performance and economic characteristics	- Inventory - User surveys - Operator Surveys	Sample size to be decided based on the size and characteristic of study area	System and operational characteristics
10.	Para transit study	- To appreciate role and function of Para transit - To appreciate the system characteristics of Para transit - To appreciate characteristics Para transit users	- Inventory - User surveys - Operator Surveys	Sample size to be decided based on the size and characteristic of study area	System and operational characteristics
11.	Terminal studies	- To appreciate physical characteristics of the terminal regarding size, space usage etc. - To appreciate the operational characteristics in terms of flow of vehicles/good/people to and from the terminal - To appreciate the user characteristics (in case of passenger terminal) regarding their origin, destination, mode used, trip length etc. - To appreciate the parking characteristics in the terminal - To appreciate the problems, constraints and potentials for expansion of the terminal activity	- Inventory - User surveys - Operator Surveys	Sample size to be decided based on the size and characteristics of study area and availability of users	Physical characteristics of the terminal, operational characteristics in terms of flow of vehicles/good/people, parking characteristics in the terminal

Simplified Planning Techniques

S. No.	Survey Name	Objectives	Survey Methods	Sampling Size	Expected Output
12.	Safety studies (accident studies, including collision & traffic incidences)	- To appreciate the trends of accidents in the study area - To appreciate the temporal and spatial variation of accidents - To identify the accident prone areas - To identify planning and management measures for improvement of traffic safety	Secondary data collection from police stations	Accident record for last 2 years	Identification of accident prone areas
13.	Pedestrian Survey - Volume Counts - Along - Across	- To appreciate pedestrian characteristics in terms of size composition and variation – directional and temporal. - To appreciate the spatial distribution - To establish the level of service on the road network system - Safety: Continuity of street lighting for carriageway and pavements - Comfort: Continuity of shade, provision of access ramps - Convenience: Presence of pedestrian path-finding signage, street furniture such as garbage bins, seating, drinking water	- Manual Counts - Video - Attitude	As even day count will then give the Average Daily Traffic (ADT) ¹¹⁷	Level of service of the pedestrian system and need for additional pedestrian facilities
14.	Intersection Survey - Intersection Turning Movement Survey - Queue length Survey	- Measures turning movements at key intersections during the morning and evening peak hours. - A queue length survey at major bottlenecks can show the severity of traffic congestion quantitatively.	Manual counts	- Directional movement of traffic in the peak hour - Counts for 2 hours each in the morning and evening peak periods unless there exist extended peak hours.	Performance characteristics of an Intersection

Source: As given

Notes:

1) In 'Inventory of Road Network System' inclusion of 'City, ward and neighbourhood level NMT routes' & 'NMT priority zones, public bicycle sharing schemes, NMV parking facilities' may be considered.

2) Special emphasis must be paid to understand the differences in travel between men and women (especially in 'Mobility survey' 'Public Transport System Study', 'Para transit Study' and 'Terminal Study'; assess their met and unmet requirements for incorporating the results to improve transport system towards providing gender sensitive transport system.

¹¹⁷ Ibid.

7.4. Analytical Techniques

Analysis breaks down complex phenomena into simple elements by organising, correlating, classifying, displaying and resolving. Based on the understanding of existing conditions, analysis and trends of change, the planners propose short-term and long-term scenarios of future and design schedules of inter connected interventions to steer development towards a desired future state.

These analysis techniques shall be carefully chosen keeping in view the objective of the study and the extent of data collected. The techniques with following characterised shall be preferred:

- Consideration of multiple parameters
- Handling mass data base
- Analysis output in visual form

Simplified Reporting: A report can be a summarized or detailed description of studied phenomenon. It helps in performing the tasks of putting information in an ordered format, identifying patterns, classifying, observing trends, correlating and inferring with a view to arrive at insights, conclusions, policy guidelines or design directions related to issues under investigation.

The report should introduce the contents at the very beginning, stating the objectives, scope and limitation of the study, describing the methodology used in collecting information and conducting analyses for arriving at alternatives, evaluating alternatives and deriving conclusions and recommendations.

Trend Analysis: This is a simple technique to study changes in a system over a period of time. Availability of time series data at least for three points of time is a basic requirement for its application. The analysis can be displayed in the form of tables, graphs, maps or diagrams. This technique is popularly used in study and analysis of change in urban economy, demographic pattern and physical form. Analytical tools for Trend Analysis may be used to predict the result of specific measures in the context of Traffic and Transportation strategies as decision support tools.

Data Compilation & Analysis Techniques: With advancement, data analysis can be executed more exhaustively and extensively through various software platforms. Complex analysis involving multiple variables and scenario building for various cases require advanced analytical software. These are carefully chosen to meet the requirement of the data compilation and analysis.

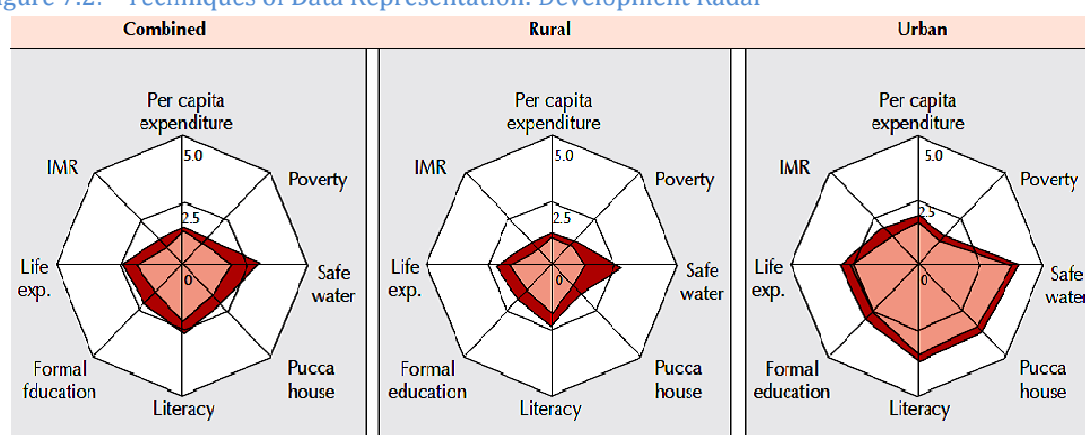
Software like Statistical Package for the Social Sciences (SPSS), Statistical Analysis System (SAS), STATA, Microsoft Excel files and others assist in data analysis for multiple variables, the output of which could be presented visually with graphs, trend charts and diagrams. Various other software, which aid in decision making like Pan Plus, which supports in preparation of participatory plans by enabling recording of

preferences and priorities of people and slotting them into schemes and programmes that form part of the budget envelope of planning unit is useful as an analysis technique.

Innovative data analysis techniques

Development radars are pictorial depictions of performance of planning unit with coordinates plotted around at 360 degrees, with each axis depicting one parameter of development. Development radars can also be a report card, because it can be re-drawn over a time sequence and the difference in attainment measured. These can be used in respect of various sectors such as health, education, poverty alleviation, drinking water, and housing.

Figure 7.2: Techniques of Data Representation: Development Radar



Source: Integrated District Planning, Planning Commission

Figure 7.3: Tabular presentation of Smiley face

Item	Unit	National norm	District position	
Drinking water	lpcd	50	30	☹️
Literacy	percent	85	85	😊
IMR	per 1000	50	20	😊

Source: Integrated District Planning, Planning Commission.

Data representation can add value to stock taking and visioning exercises through interfacing numerical data with spatial information and making it more communicative – one of such method is smiley face which describes the deviation from norm/average through smileys, greater the gap, sadder the face.

Map Analysis Techniques: Map related software contains maps from official sources such as NRSC; NIC having locations of infrastructure and services and boundaries of urban/rural centres plotted on them through GIS overlays. They also contain an interface between numerical data and display of data on map. Some initiatives of such software applications are by Gram +++ (which converts numerical data into visual

outputs) and Ridhisoft's Whizmap (GIS platform for local planning)¹¹⁸. These and other platforms of GIS can be used for the preparation of different plans. The method of planning through GIS platform has been elaborated later in this chapter in the section: GIS application in plan formulation.

The above mentioned data collection, analytical and mapping techniques are comprehensive in nature and can be appropriately adopted during the course of the project. Land availability for development is declining with accompanying competition amid various activities. With this scenario land suitability analysis plays important role wherein land for particular use is selected after considering range of factors. Land selected thereupon is most suitable and tend to reduce wastage of this limited resource.

With the expanding city areas, threshold analysis for limiting its boundaries is evaluated on the basis of viability. These techniques have significant impact on decision-making.

7.4.1. Carrying Capacity

Carrying capacity of an area can be defined as the maximum number of population that can be supported by the environment of that area through optimum utilization of the available resources. The pattern and extent of resource usage serves to be the primary factor that affects the carrying capacity. This indeed depends highly on the:

- Socio-economic status of the people
- Use of technology

If technology is used in a positive manner then the carrying capacity is measured to increase manifold.

Planners usually define carrying capacity as the ability of the natural or artificial system that can absorb the population growth or physical development without considerable degradation or damage (*Schneider et al., 1978*).

(Source: *Schneider, D.M., D.R. Godschalk, and N. Axler. 1978. The Carrying Capacity Concept as a Planning Tool. Chicago, IL: American Planning Association, Planning Advisory Service Report 338*).

The techniques can be translated into policies, strategies and action plans at the local level towards augmentation and sustenance of urban environment resources in terms of their supportive and assimilative capacities on one hand and size, nature and distribution of urban-economic activities and their concomitant demands on environment, on another.

(Source: *Carrying Capacity based Regional Planning by National Institute of Urban Affairs, New Delhi; IHS, Rotterdam*)

The evaluation of urban carrying capacity is a complex process as it is determined from basic needs such as food requirements, various kinds of resources consumed

¹¹⁸Source: Integrated District Planning Manual by Planning Commission

and the many kinds of wastes generated, different kinds of land use conversions leading to ecological imbalance and the great variability in technology, institutions and lifestyles created. There are 6 types of carrying capacities that can be evaluated -

- Infrastructure capacity level,
- Institutional capacity level,
- Perceptual carrying capacity,
- Environmental capacity level,
- Sustainable capacity level and
- Bio-centric capacity level.

Among these six types, the profound ones are infrastructure capacity level, environmental capacity level, and sustainable capacity level, which are more relevant to urban planning.

Table 7.5: Levels of evaluating carrying capacity for the urban areas

Level of Evaluation	Infrastructure Capacity Level	Environmental Capacity Level	Sustainable Capacity Level
Definition	<i>"The degree of human activity that facilities and services within an area can support without causing serious degradation of or damage to the maintenance of quality of life."</i>	<i>"The degree of human activity that environment and ecosystems within an area can support without causing serious degradation or damage to quality of life."</i>	<i>"Sustainable carrying capacity is the number of a species that can be supported in a particular area indefinitely, given that area's endowment of water, food, and other necessities."</i>
Concept	At this capacity level, the major factor of evaluation is the infrastructure development .	This level basically reflects the present state of the environment with respect to productivity.	The basic resource flow through the urban area to its ultimate sink is evaluated. These are long term-based factors.
Indicator	Here the intensity and pattern of resource usage is estimated for the development of infrastructure like, water supply system, sewage system, transportation system, waste disposal system, etc.	The state of productivity of the environment , e.g. agricultural productivity by evaluating the past data or the availability of clean air & water, low pollution.	Indicators of particular resource: how long it will be available . If a resource is getting scarce then efficient steps could be taken to sustain it for long term.

Source: Urban Carrying Capacity: Concept and calculation; IIT Guwahati; 2011-12, Determining Sustainable Development Density using the Urban Carrying Capacity Assessment System Kyushik Oh, YeunwooJeong, Dongkun Lee, Wangkey Lee; UCL, Working Paper Series, 2004 & The sustainable carrying capacity of New Zealand; The royal society of New Zealand.

7.4.2. Applying Carrying Capacity for Urban and Regional planning:

Carrying capacity based approach to planning is a concept as well as tool towards sustainable development of cities and region. It is still in nascent stages in India. Planning based on carrying capacity deals with the management of human activities, supportive resources and assimilative capacities of the environment (**Figure 7.4**) and general process of carrying capacity based planning is depicted (**Figure 7.5**).

Carrying Capacity analysis tool is useful to rationalise fixation of FAR including increase in given FAR. Two major determining factors should be considered:

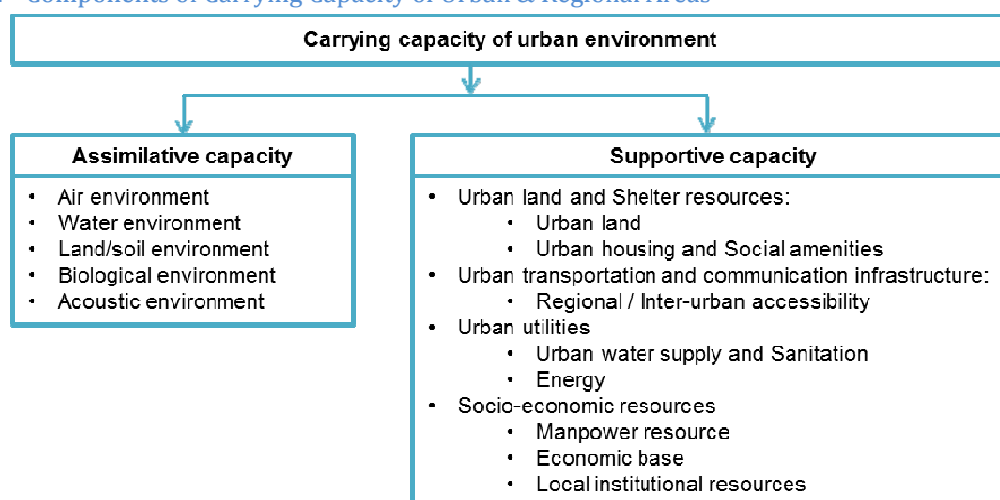
1. V/C (V = volume, C = capacity)

V/C: optimum level is 0.8; it can be relaxed up-to 0.9. Above 0.9 is dysfunctional and 1.0 is not desirable.

2. LPCD of piped water supply

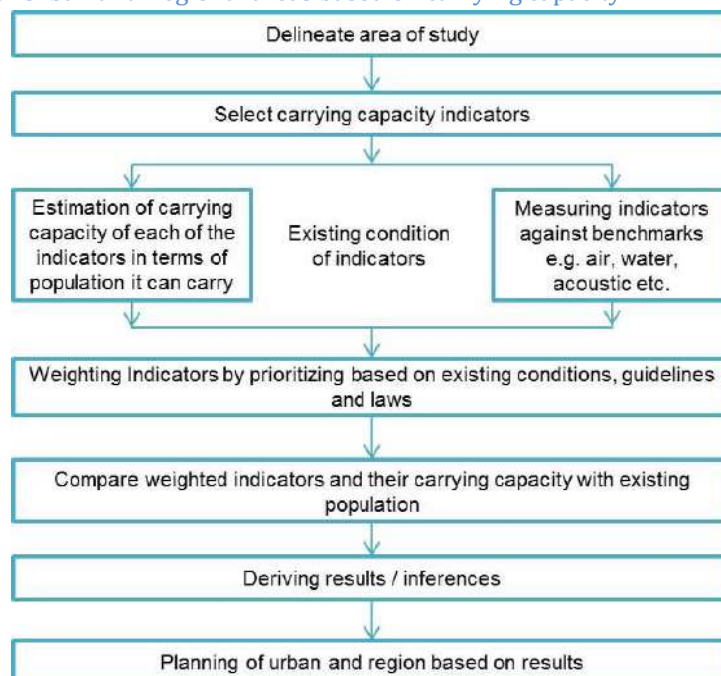
Litres per capita per day (LPCD): the planned LPCD should be as per the minimum of norm is 135 LPCD set. However, the density is to be capped by the Development/ Master Plan as per the threshold.

Figure 7.4: Components of Carrying Capacity of Urban & Regional Areas¹¹⁹



Source: Project paper on Carrying Capacity based Regional Planning by NIUA.

Figure 7.5: Planning of Urban and Regional areas based on carrying capacity



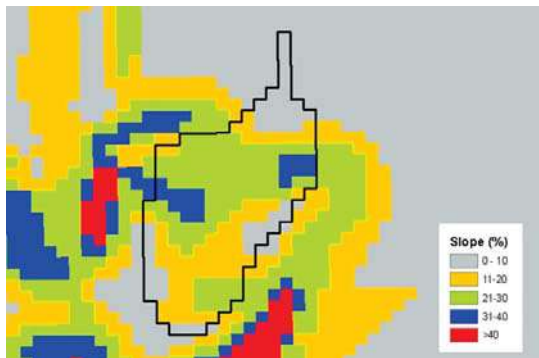
Source: Modified based on Project paper on Carrying Capacity based Regional Planning by NIUA.

¹¹⁹Supportive capacity means the capacity of the environment to support the lives of the people and other living organism. Assimilative capacity is the capacity of the environment to absorb/re-cycle matter, energy and/or other components, which come into the environment either by themselves or through human intervention, for sustenance of environmental quality.

Case Study1: Urban Carrying Capacity, Guwahati

A new method of calculating carrying capacity was developed by IIT, Guwahati called Sustainable Accommodation through Feedback Evaluation (SAFE). This method was developed for hilly urban area to ensure hazard free sustainable urban development. The Steps is as follow:

- Step 1: Delineation of the urban watershed.
- Step 2: Demarcation of the developable & non-developable area.
- Step 3: Determination of area required for different infrastructure and facilities.
- Step 4: Calculation of the available residential area.
- Step 5: Socio economic survey of the urban region and calculation of the floor area requirement of the people.
- Step 6: Determination of the Floor Area Ratio.
- Step 7: Calculation of population carrying capacity.
- Step 8: Check adequacy of other indicators not analysed earlier.

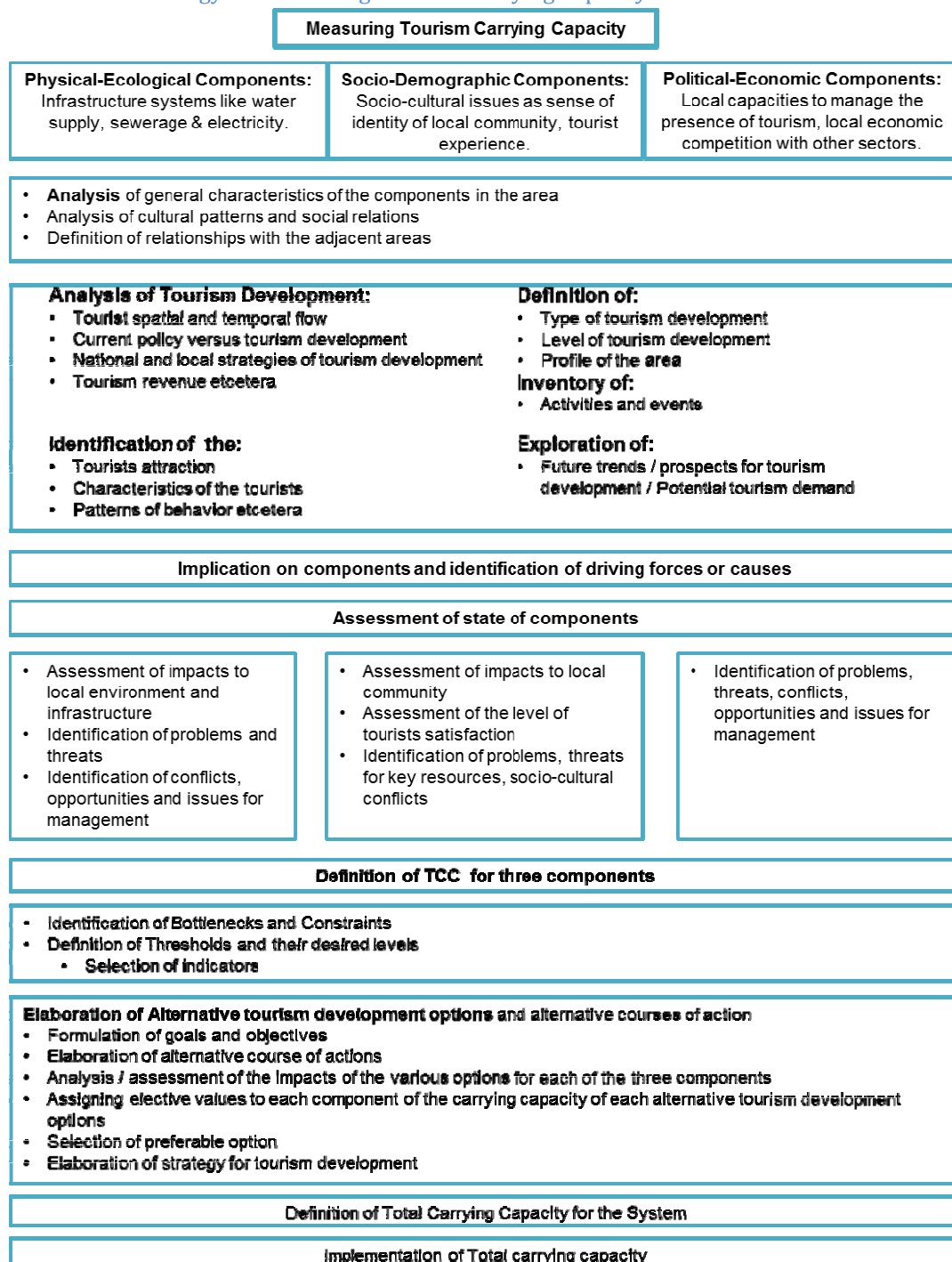


Case Study 2: Tourism Carrying Capacity in European Tourism Destinations

The study was undertaken to elaborate comprehensive methodological framework to understand the concept of Tourism Carrying Capacity (TCC) and applying this methodology for sustainable tourism activities in the European tourist destinations.

The basic elements of the concept of carrying capacity from tourism point of view, i.e. the need for a limit/ a threshold in the tourist activities, were charted. For measuring TCC different components and subsequent indicator swere weighted based on the (a) characteristics of the locality, (b) the type of tourism and environment interface and (c) the type of tourism. Sample of different type of tourism destinations were studied for calculating TCC. Such as coastal areas, islands, protected areas, mountain resorts etcetera. The methodology of measuring TCC has been shown in **Figure 7.6**.

Figure 7.6: Methodology for measuring Tourism Carrying Capacity



Source: Defining, Meaning & Evaluating Carrying Capacity in European Tourism Destinations by University of Aegean, Greece.

7.4.3. Threshold Analysis

The threshold theory is based on the observation that any urban centre encounters limitations to their expansion due to physiographic features, existing land use and technology of infrastructure. An important inference from this observation is that physical growth of town is not smoothly continuous but proceeds in stages marked by successive limitations which have been called development threshold. These

thresholds are not insurmountable and can be overcome but only at additional (often very high) development investments known as threshold costs.

This technique is used to determine influence zones, urban extents and regions, attempts to rationalize and control the process of urban growth and provides a quantitative tool to help decision-making. Thresholds based on physical limitations are comparatively easy to determine using mapping techniques. Thresholds can be tangible or intangible.

Tangible thresholds are those, which can be measured, quantified and represented. These are physical, technological and structural limitations such as land available for development, current technology of water treatment or electricity production. Physical limitations or threshold are restrictions imposed by physiography and topography and get physically identified in the form of natural features such as rivers to be crossed, hilly areas and steep slopes etc. Technological thresholds are limitations imposed on physical growth of city, by constraints in expansion of infrastructure system. Some of these thresholds can be identified spatially and some numerically for instance, watershed line is generally the limit of extension of sewerage system, whereas, the capacity of a sewage treatment plant can be expressed in terms of number of inhabitants that can be served (numerically) identified threshold. Intangible thresholds can only be understood and indirectly measured such as, socio economic limitations.

7.4.3.1. The Process of Threshold Analysis

Part One: Analysis

- **Stage I:** Delineation of area to be surveyed by drawing the boundaries of area as closely as possible to a homogenous pattern of settlement.
- **Stage II:** Analysis of factors affecting town/urban development such as physiographic suitability of land and possible extension of public utilities.
- **Stage III:** Tracing the threshold lines, delimiting areas suitable for urban development and new development areas from fundamental land development.
- **Stage IV:** Synthesis – The information can now be correlated to form a synthesis of all factors considered on basis of which, the lines of urban development thresholds can be defined. Physical thresholds are shown spatially on base map and quantitative thresholds such as population figures, investment, power or water supply requirement can be expressed.
- **Stage V:** Land is subdivided for main functions of city within the successive physical threshold areas. This is done generally for two main functions, suitable area for industry and suitable area for other urban uses, priority being given based on vision of development.
- **Stage VI:** The calculation of capacity of residential areas within the first and successive threshold lines in relation to quantitative threshold figures in order to define the approximate number of inhabitants, which may be accommodated.
- **Stage VII:** The calculation of averages of industrial areas within the first and successive threshold lines to define their potential for industrial location after considering the quantitative threshold figures.

Part Two: Outline of Economic Assessment

- Stage VIII: Calculating the approximate capital investment costs necessary to overcome each threshold within the examined area.
- Stage IX: Calculating the following efficiency indices for each successive threshold area:
 - Cost of each new inhabitant
 - Cost per acre of land suitable for development

In regional planning indirect use of quantified results can be used in decision making among alternative locations for some significant investment within the region, while preparing a comprehensive regional policy for the distribution of the expected influx of population.

7.4.3.2. Land Suitability Analysis

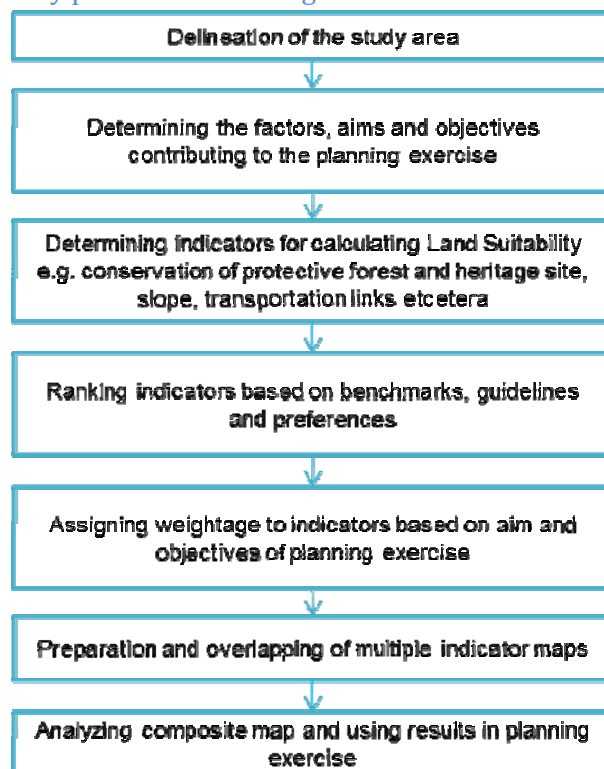
Land suitability refers to the ability of a particular type of land to support a specific use. The process of land suitability classification involves; evaluation and grouping of particular land areas based on their suitability for a defined use¹²⁰. Land use suitability analysis aims at identifying the most appropriate spatial pattern for future land uses according to specific requirements, preferences, or predictors of some activity¹²¹.

Applications of suitability analysis can be found in many fields, such as site selection for cropland, agriculture suitability, graze suitability, forestry suitability (natural resource management field), flooding control, sustainable development (environment field), suitability for urban expansion, site selection for specific land use etcetera. Land suitability can be used in planning process to finalise most appropriate land for particular land use or activity by following the process presented in **Figure 7.7**.

¹²⁰Land suitability analysis for agriculture crops: a fuzzy multi-criteria decision making approach; 2003; Prakash T N.

¹²¹Hopkins, L., 1977. Methods for generating land suitability maps: a comparative evaluation. *Journal for American Institute of Planners* 34 (1), 19–29.) (Collins, M.G., Steiner, F.R., Rushman, M.J., 2001. Land-use suitability analysis in the United States: historical development and promising technological achievements. *Environmental Management* 28 (5), 611–621.

Figure 7.7: Land suitability process in Planning



Source: Various source on land suitability analysis.

Factors taken into consideration to bring out most suitable land will vary according to the desired land use for which this technique is undertaken. A few examples of factors are given in the Figure 7.8. However, list of the factors can be broadly gauged according to the scope of project and availability of data.

Figure 7.8: Factors taken into consideration to assess the most suitable land use



Source: Land suitability Analysis, Rohtak, Land suitability Analysis for urban planning environmental assessment in an ecologically sensitive coastal area of eastern China based upon multi-criteria mechanism; Xiang S, Dong Z X, Fan L Y, Li Z, Yan Z; 2008.

7.4.3.3. Method

Suitability analysis is the process to assign weightage and overlay the factors to identify the land parcels on the pre-defined scales. There are various advanced mapping and statistical techniques that can be used for calculating land suitability. **Grey tone method**, also known as **map overlay method**, makes use of gradual colours to represent the suitability levels in the same scale, and overlay all the factor maps in a certain order. GIS techniques are used to transfer the suitability level into

numerical value, and assign weightage to each factor according to their relative importance. Three simplified steps for suitability analysis model include:

- **Selecting Suitability Factor:** Each factor is represented by a thematic map in GIS,
- **Single Factor Analysis:** According to single factor evaluation standard, score is given to the map unit of each factor and then the single factor suitability is generated,
- **Multiple Factors Overlay:** Weights are accorded to suitability factors according to their relative importance. The weights are determined by statistic integration and hierarchic analysis in this research from which the composite score is calculated.

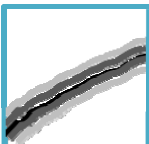
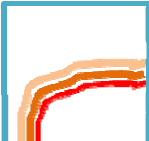
Computer methods were developed to solve the inherent shortcomings of the traditional land suitability methods.

In case, specific data is not available or indicative study is to be undertaken or in case of cross checking, **sieve mapping** can be used. In this method, a series of 'sieves' (factors) are overlaid to exclude the areas, which are not suitable for the specific land use, thereof, the left over area is considered as- suitable for some specific uses¹²². Weighted overlay method of land suitability is presented in **Figure7.9**.

¹²²Mnalun Y, Suitability Analysis of Urban Green Space System Based on GIS, 2003.

Figure 7.9: Weighted Overlay of Land Suitability

Parameters / Indicators	Preferences 1 > 2 > 3	Weight
Rivers	River body > Buffer 500m > 1000m	1
Forest	Forest Area > Buffer 500m > 1000m	3
Slope	Slope 15% above > 10-15% > 5-10%	2
National Highway	Proximity 3km > 2km > 1km	5
City Boundary	City Boundary 3km > 2km > 1km	4

Indicators	Rate	Weightage	Weighted	Suitability																																																
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Source: http://www.urban.uiuc.edu/courses/up503/Lectures/3_UP503SuitabilityAnalysis11.pdf.

Case Study: Hyderabad Metropolitan Development Region

For calculating land suitability of Hyderabad region two broad categories of indicators were made:

- Environment suitability (ten features)
- Land potential analysis (twelve features)

Total twenty-two features were studied and land was divided into 5 classes after conducting land suitability / potential analysis. Based on land suitability study alternative concepts for future development of city were proposed.

Features studied for Environment suitability:

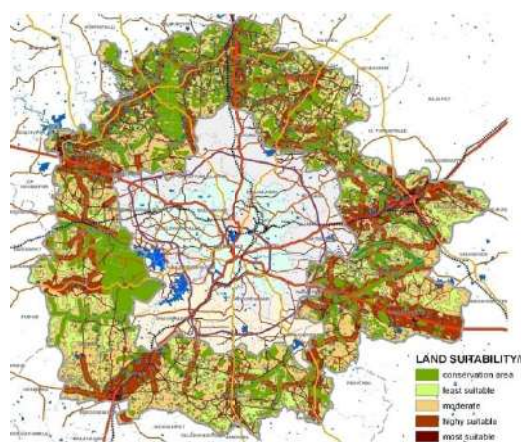
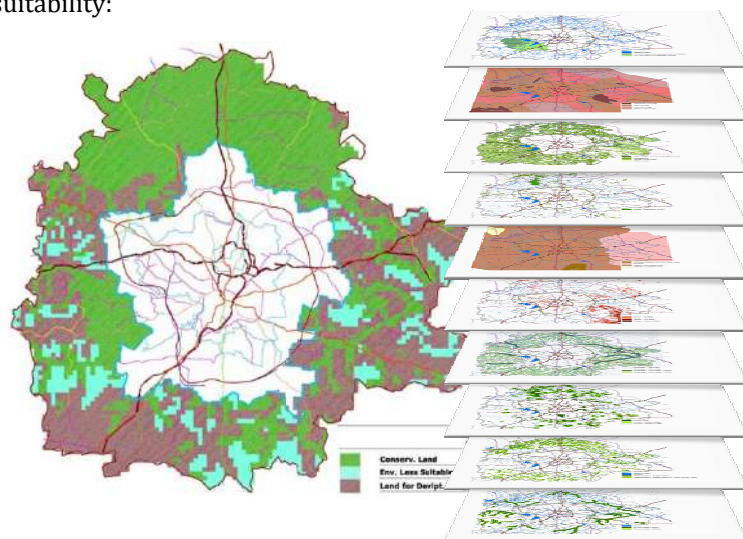
- River, Water bodies
- Forest
- Drainage
- Slope, Soil
- Vegetation
- Agriculture
- Govt. Order (GO)
- Ground water

Features studied for Land potential analysis

- Airport and railway stations
- Workplace and industrial locations
- Urban area
- Urban village 1,2 &3
- National Highway
- State Highway
- Ring road
- District road
- Proposed road
- Hyderabad City boundary

Five classes decided upon, through land suitability study:

- Conservation area (as environmentally sensitive areas)
- Least suitable area
- Moderate suitable area
- Highly suitable area
- Most suitable area



7.5. Projection Techniques

In the process of plan formulation, projection techniques are used for anticipating future, which is a necessary step. Here, two types of projection techniques, Simple (1, 2 and 3) and Analytical (4, 5 and 6) are available to planners for making projections, have been discussed.

The distinction between simple projections and analytical projections is that simple projections operate on limited data directly and usually extrapolate a series of

observations in a direct manner. Analytical projections depend on more detailed information in which the projected value is often the dependent variable derived from projections of independent variables. Generally speaking, analytical methods are to be preferred over simple ones since it allows accounting for or assuming differing patterns of change in the components of a situation; this usually leads to more accurate results than is the case with simple projections.

7.5.1. Population Projection

Planners are concerned with population projections which form the basic framework for setting targets expected to be achieved within a specified time-frame, be it for land use, services or facilities. Most of the important decisions about land uses and services are derived from population estimates: the demand for water, power and waste disposal facilities; housing, open spaces and schools; the supply of labour; spending power available for the retail trade, the numbers of private cars to be expected, possible recreational demands -all can be estimated from the projected population.

The section describes six methods of population projections viz.

1. **Mathematical and Direct Methods:** These are simple or direct methods of estimations based on the past population records. Arithmetic progression is involved when, past data suggests that, population is changing by a constant rate. The figures are plotted on plain paper (conventionally with y = population and x = time), which results in a straight line. This straight line is extrapolated for projecting the future population.

However, mostly population changes according to geometric progression, in such a case semi-logarithmic paper is to be used to yield a straight line for extrapolation. If the past data does not follow a definite progression, then a 'best fit' equation can be derived by method of least square and this may be extended to provide projection.

Graphical methods are most useful for short-term projections, particularly when demographic changes show stable trends. Hence, these methods should be used for projecting up to 10 years in stable situations and 5 years where population change is more volatile.

2. **Employment Method:** This method assumes that there is a very strong inter-relationship between population and employment and indicators such as worker's population can be correlated with total population to yield extrapolated information.

This method's reliability is low and should not be used for long range population forecasting.

3. **Ratio Methods:** These methods rests on the assumption that changes in any geographical area is a function of those experienced in wider area. Thus population of a city is held to be a function of the region and region itself is a result of the function of that nation.

In ratio methods the population of the second largest area (e.g. the region) is plotted against that of the parent area (the nation). A curve is obtained by fitting it on the two points. Thereafter it is extrapolated, by least square/ graphical/other method, to estimate the projected value for the parent area for the target year.

4. The requirements of such projections are time-series of populations for the areas to be used in the analysis and a forecast or sets of forecast for the larger area. These methods are weaker for longer periods and smaller areas, but are useful for quick and cheap forecasting for middle range (10-15 years) for areas not less than a whole metropolitan area or a city region.

Migration and Natural increase Method: As the name implies, this method enables natural and migratory changes to be handled separately. By examining past data on net migration rates and by attempting to relate these to economic conditions, particularly to the demand for employment in the study area, it is possible to adopt varying assumptions about the pattern of future migration. Next, a set of programmes of future natural change would be developed either by subjective projection of past maximum and minimum migration rates or by using migration data from projections produced nationally or regionally. The essence of the method is to begin with the starting date population, add the estimated migratory population figure to produce the next figure (A). Natural change in population is then added to the projected figure (A), thus completing one cycle of the projection giving a figure (B). The process is then repeated until the end of the projection period giving a figure (C). Cycle of projection could be any convenient period e.g. 5 years, 10 years or more.

This projection method uses total population, but age & sex structure is not considered. Thus changes in death and birth rates, which might result from changing age/sex structure cannot be seen and acted upon. Neither future estimates of school-age population and numbers of women of working age can be made. Still migration and natural increase method does reveal the possible sequence and the main elements of change.

- 5. The Cohort-Survival Methods:** The Cohort-Survival projection is a method for forecasting what the future population will be, based upon the survival of the existing population and the births that will occur¹²³. This method can be applied for any period of time but typically it involves five-year steps.

Cohort-component models are so-called because they divide the population into cohorts and model on the demographic components of change such as fertility, mortality and migration – affecting each of the cohorts. Cohort indicates the generational group e.g. 0- 9, 10-19 and so forth¹²⁴.

The cohort component method is used when population projections by age and sex are needed for 5 years, 10 years or longer periods of time. This projection tool allows planners to examine the future needs of different segments of the population including the needs of children, women in their reproductive years, persons in the labour force and the elderly. It also allows planners to project the total size of the population. The results can be used in all aspects of local and regional development plans¹²⁵.

- 6. Matrix Methods:** These methods follow the logic of the cohort-survival technique. The initial age and sex distribution is similarly represented as a column sector but the incidence of births and deaths is handled by means of a 'survivor-ship matrix' which operates on the original population to age the population through successive time periods, simultaneously performing the calculations of births and deaths.

7.5.2. Economic Projection

The likely demands of land development rest on various types of economic activities, its scale, its possible location within a city or a city region and broad relationships between these activities. The key concerns are addressed by economic projections, which are ultimately relevant for calculating demand for housing, hospitals, schools and other social facilities. Seven methods of economic projections are described, viz.

¹²³<http://www.sjsu.edu/faculty/watkins/cohort.htm>.

¹²⁴ Tom Wilson, A Review of Sub-Regional Population Projection Methods, 2011.

¹²⁵ <https://training.measureevaluation.org/non-certificate-courses/pap/lesson-8>.

- **Simple Extrapolation:** Measures of economic activity such as employment, volume or value of production, value added by manufacturer etc. may be arranged in time series and extrapolated in a variety of ways.

These methods have advantage of simplicity, relying on readily available data and do not require high level of skills. But since these do not attempt to examine the factors of the phenomenon (e.g. employment) to reveal the possible reasons of its occurrence or influences upon it, these are likely to be unreliable and are only referred as a general guide. Also, simple extrapolation method is suitable for small planning areas only.

- **Productivity Method:** The variables of 'production' or 'output' on one hand and 'employment' on the other are linked by the variable 'productivity'. This is simply measured as 'output per worker'. This simple form is suitable for planners for whom employment is the most useful measure. The projection is accomplished by obtaining estimate of future production or output and productivity from some reliable source. Hence,

$$\frac{\text{Output}}{\text{Workers}} = \text{Productivity}$$

Or, in other words, output divided by productivity yields an estimate of workers.

This method has advantages over the simple manipulations of employment data since it enables user to examine the projected employment with the trends of production, separately and therefore more clearly.

- **Projections by Sectors of Economy:** It is more valuable to have estimates of the future levels of output or employment in the various sectors of the economy separately. For example, to estimate the possible amount of secondary activity, the land requirement for different kinds of manufacturing is estimated (such as the floor-space needed by wholesaling and retailing and office-type employment).

In the simplest case, the forecaster simply extrapolates the past trend in each sector of the economy e.g. through productivity method. The estimates from different sector forecasts then have to be summed. Such figure arrived should be cross-checked with a forecast of total employment derived from some other source or calculation.

- **Economic Base Method:** This method is based on the postulate that growth in an area's economy comes from the expansion of economic base which is defined as all those 'basic' activities which are produced for export beyond boundaries of local area and which increases its wealth and ability to pay for imports. The remaining activities, which do not produce for 'export' but which exist to satisfy local needs are referred to as the 'service' or 'non-basic' activities.

The projection of basic activities (produce for export only) of the economy is made by using ratio method of comparing local to national trends (for each sector of economy separately). Once the projection of basic activities of each sector of economy has been made in the basic/non-basic ratios, the forecasts of basic employment are projected in comparison to total employment estimate.

The problems associated with the method are, definition of the 'local area' and identification of the basic sector of the economy itself. The shortcomings of the economic base method are: reliance on employment as the measure ignores the possible effects of changes in productivity; and the basic/non-basic ratio is a suspect measure at any given point of time.

Ratio Method: The method makes use of a similar rational as described in the population projection studies i.e. local levels of economic activity (either in total or sector wise) bear proportional relationships to levels of economic activity in successively larger geographical areas. The ratio method also implies that these relationships may be studied as they change over time and are extrapolated so that, estimates for the local area may be derived based on the given set of forecasts for the larger geographical unit (e.g. the nation).

Input-Output Methods: This method is based on the assumption that if the total output of particular industry is distributed among all other sectors of economy (including consumers and export) in a known proportion, it should be possible to calculate a 'table of co-efficiency' which would show effects of a given increase of output of one industry on the purchase of all others. This kind of definable relationship spelled out in input-output grid can be helpful for economic projections for a particular region/city.

The results are valid for short-term projections only, as it cannot be assumed that relationships between sectors will be stable through time. But to use this method, first, the relationship between different sectors of economy for a given date has to be obtained by some reliable source.

- **Social or Regional Accounts Method:** These methods employ the same logic as input-output method but by using money (rather than production or employment) as the measure. It can be fully comprehensive in its analysis of the inter-relations within an economic system by inclusion of capital formation, investment and trade as well as industrial production. In this way the matrix is a record of the income-and-expenditure relationships between all sectors of the economy. This matrix may be used to obtain projections of the expected income of each sector for the future. To do so, it is necessary that the coefficients expressing the inter-sector relationships (each cell in the matrix) is set. Then, the level of employment and income per worker of different sectors of economy is estimated¹²⁶.

7.5.2.1. Estimation of City level GDP

National product is a measure in monetary terms of the volume of all goods and services produced by an economy during a given period of time, accounted without duplication. It is measured by three approaches, namely the production, income, and expenditure. In India Gross Domestic Product (GDP) is calculated through production and expenditure approach¹²⁷.

Production approach (of GDP calculation) = the sum of value added of all economic activities within the country's territory (sum of output minus intermediate consumption) + indirect taxes - subsidies on products¹²⁸.

Expenditure approach (GDP at market price) = Household final consumption expenditure + Non-profit Institutions' final consumption expenditure + Government final consumption expenditure + Gross fixed capital formation + Acquisition less disposals of valuables + Changes in inventories + Exports – Imports.

GDP - Depreciation = **Net Domestic Product (NDP) of the country.**

The state accounts statistics are an extension of the system of national accounts at the regional level.

The most important aggregate of the state & district accounts is the **State Domestic Product (SDP) and District Domestic Product (District DP)** respectively, compiled by State Directorates of Economics and Statistics. For estimating the Domestic Product, the economy is divided into various economic activities like agriculture, forestry, fishing, mining, manufacturing, construction, electricity, transport, communication, trade etc.

The Central Statistical Organisation (CSO) estimates Rural and Urban share of the GDP at National level for few years¹²⁹. From the National Urban GDP, the following method could be considered for estimating urban share of District GDP¹³⁰:

¹²⁶Urban & Regional Planning-A systems Approach by J.BrianMcLoughlin.

¹²⁷ Quarterly Estimates of Gross Domestic Product for the Third Quarter (October-December) of 2013-14.

¹²⁸National Accounts Statistics: Manual on Estimation of State and District Income, 2008.

- Fundamental equation estimated at all India level for urban GDP calculated by CSO.
- Simplify the fundamental equation by making urban share of GDP a function of urbanization rate and non-agriculture share of GDP to estimate State's Share of Urban GDP.
- Apply the estimated coefficients on district level urbanization rate and non-agriculture GDP to estimate District share of Urban GDP.

Once the urban share of District GDP is derived, City GDP could be calculated by following steps:



The approach and methodology for estimating the Rural and Urban income sector wise, is discussed in the National Accounts Statistics Sources and Methods, 2007.

For calculating city level GDP, CSO may develop a city level inventory. The following table provides sector wise tentative items, the monetary value of which can be considered in the inventory, to calculate city GDP.

Table 7.6: Items for consideration in the inventory for City GDP calculation

S. No.	Sector	Items
1	Manufacturing	Index of Industrial Production (Manufacturing) Manufacturing registered (unorganised sector) Production and income
2	Financing, Insurance, Real estate and business services	Banking Insurance Real estate Ownership of dwellings Legal services Accounting Computer related services Renting of machinery Research and development
3	Electricity, Gas and Water supply	Electricity: Index of Industrial Production (Electricity) Gas Water Supply: public and private
4	Railways	Goods (Net tonne Kms.) and Passenger (Net passenger Kms.) The two indicators are combined using the weights of respective earnings
5	Transport by other means	Public: road, water transport, air transport, Private: road transport, water transport, air transport Service incidental to transport Warehousing Storage Cold storage
6	Communication	Public services and infrastructure cost Private-courier services, cable operators, other communication

¹²⁹http://planningcommission.nic.in/hackathon/Urban_Development.pdf.

¹³⁰McKinsey & Company's note to MoUD, 17th April 2014.

S. No.	Sector	Items
7	Construction	<i>Pucca</i> construction: House hold sector, Public sector, Private corporate sector <i>Kutch</i> a construction
8	Trade, Hotels and Restaurants	Trade: public sector dealing in wholesale and retail trade; private organised trade, private unorganised trade, Hotel and restaurants: public, private
9	Public administration	Public administration Quasi-government bodies
10	Mining and Quarrying	Coal and crude petroleum Other major minerals Other minor minerals
11	Agriculture	Major and Minor crops Commercial crops Miscellaneous crops By-products
12	Livestock	Milk & milk products Egg, Meat Other products (wool)
13	Forestry	Fuel wood Industrial wood Minor forest products, if any
14	Fishing	Inland and marine fish, prawns Subsistence fish
15	Other services	Public: education, medical, coaching centres etc. Private: coaching centres, medical and health, sewage and refuse disposal, recreational activities, washing and cleaning, hair dressing, funeral related services, tailoring services etc.

Sources: National Accounts Statistics Sources and Methods, 2007. Respective source of data collection of the above mentioned items could be referred from National Accounts Statistics: Manual on Estimation of State and District income, 2008.

7.5.3. Assessment of Requirement of Housing

Based on the projection of population and economic activities, town planners' major pre-occupation is to determine the demand for housing and other facilities in a town. While dealing with housing, it is necessary to clearly distinguish between housing need and its demand. 'Need' refers to inadequacy of existing provisions when compared with socially acceptable norms, while 'demand' is an economic concept wherein standard and amount of housing demand is related to household's income and ability to pay. Both housing need and demand are affected by factors such as housing shortage and rate of obsolescence, whereas demand would be additionally affected by affordability and future housing needs.

Present housing need: By subtracting the number of unsuitable dwellings from the existing housing stock the present housing need can be estimated.

Future housing need: Further, the future housing need can be estimated from the projected number of additional households in the city. A simple way of doing this is to estimate the future population of the city and divide it by the expected household size. The household size is to be referred from National average family size.

Demand estimation requires careful analysis of the affordability criterion. For this initial capital cost of the housing units, total annual household income and annual

economic rent¹³¹ have to be looked into simultaneously. The annual economic rent can be further analysed based on the information on amortisation rates, interest rates, and cost of maintenance, repair and management.

7.6. Mapping

A map can be defined as representation of earth's pattern as a whole or part of it on a plane surface with conventional signs, drawn to a scale and projection so that each and every point on it corresponds to the actual terrestrial position.

No matter how large or small a community is; a planner has to deal with spatial information required for planning such as land parcels, zoning, land use, transportation networks, housing stock among others. As well, to monitor multiple urban and regional indicators, forecast community needs, and plan accordingly to improve quality of life of the community; mapping activities are valuable in understanding and communicating planning issues.

7.6.1. Scale of Map

The scale of map used depends upon the size of the planning area and the coverage and extent of the information to be shown. The scale of maps for different types of planning exercises at various levels may be selected out of the range indicated in the following table.

Table 7.7: Scale of Maps for Planning

Sr. No.	Type of map/Planning Exercise	Size of Planning Area
1	Perspective Plan	1:2,50,000 - 1:1,00,000 (for larger regions) 1:1,00,000 - 1:50,000 (for smaller regions)
2	Regional Plan	1:50,000- 1:25,000 (District Development Plan) 1:25,000 - 1:10,000 (Metropolitan Region Plan)
3	Development Plan	1:10,000 – 1:8,000 (as per State Provision)
4	Local Area Plan/ Special Purpose Plan	1:5,000-1:1,000 (as per the requirement of the project)

Source: Based on scale of SoI Toposheet, Bhuvan data availability and UDPFI Guidelines, 1996, NUIS 2006, Scale of various Plans as per State provisions.

7.6.2. Map Information Checklist

Maps contain lots of spatial data for the planning of urban and regional areas. Depending upon the requirement of study and availability of data, features can be selected and presented through map.

This data is collected from various sources and in diverse fields to make a comprehensive and working plan. A map information checklist with sources of information is given below to save time and expedite planning process. This data is broadly divided into 17 categories and these categories are further divided into detailed data list.

¹³¹ Considering the fast rising land prices in almost all towns and cities, it is necessary to promote rental housing. This requires augmenting access to reasonable housing by the low income and fresher in the employment. Requiring higher residential density over and above the owned housing stock.

Table 7.8: Map Data Checklist

S.No.	Features	Sub-categories		Sources
1	Physical	Physiography	Undulating plain with mounds	SoI Toposheets, Satellite Image Photo mosaic from NRSC & Bhuvan (Resolution 30m Height accuracy 8m), Aerial Photographs
		Plains	Flood plain, Alluvial plain, Coastal plain, Lacustrine plain,	SoI Toposheets, Satellite Image Photo mosaic from NRSC & Bhuvan (1:50,000), Aerial Photographs
		Valleys	'U' shape, 'V' shape, Hill valley, River valley, Plateau valley	SoI Toposheets, Satellite Image Photo mosaic from NRSC & Bhuvan (joint project of NRSC/ISRO and GSI), Aerial Photographs
		Water bodies/ Drainage	River, Canal, Lakes/ Ponds, Reservoirs, Tanks, Cooling ponds / cooling reservoir, Abandoned quarries with water, Hot springs	SoI Toposheets, Satellite Image Photo mosaic from NRSC & Bhuvan (1:50,000; for 2005, 2012), Aerial Photographs
		Ground water	Aquifers, Depth of water table, Fluctuation of water table	SoI Toposheets, Bhuvan Ground water prospects maps (1:50,000), Centre Ground Water Commission
		Lithology	Un-consolidated sediments, Residual Capping, Volcanic Flows and Inter-trapeans, Semi-Consolidated Sediments, Consolidated sediments, Intrusive Rocks, Crystalline / Metamorphic rocks, Fault and sheer zones,	Geological Survey of India, Bhuvan Under Rajiv Gandhi Drinking Water Mission (RGDW) Joint project of NRSC/ISRO and Ministry of Rural development (1:50,000),

S.No.	Features	Sub-categories		Sources
		Geological Structure	Lineament, Fracture / Fault line valley, Folds, Geomorphology, Fault lines, Fractures, Folds	SoI Toposheets, Satellite Image Photo mosaic from NRSC & Bhuvan (1:50,000), Geological Survey of India
		Soil	Types of Soils	Red Soil, Black Soil, Mixed Red and Black Soil, Laterite and Lateritic Soils, Alluvial Soil (river/deltaic/costal), Peaty and Marshy Soils, Desert Soils, Saline and Alkaline Soil, Forest and Hill Soil
		Soil depth	Very deep (>150 cms), Deep (100-150 cms), Deep to moderately deep (50-100 cms), Shallow (25-50 cms), Very shallow (<25 cms)	Satellite Image Photo mosaic from NRSC & Bhuvan, Photo mosaic from NRSC & Bhuvan,
2	Planning and Administrative	Administrative Boundaries	State Boundary*, District Boundary*, Taluka / Tehsil Boundary*, Mandal / block Boundaries*, Village Boundary*, UDA Boundary, Municipal Boundary, Cantonment Boundary, Zone Boundary, Block Boundary, Locality Boundary, Municipal / Census wards,	SoI Toposheets, Census Atlas Maps, Maps / Drawings from ULB, Revenue records, Municipal maps, State Remote Sensing Application Centre (SRSAC), Satellite Image Photo mosaic from NRSC & Bhuvan* (1:50,000),

S.No.	Features	Sub-categories	Survey no. Boundary, City survey no. Boundary	Sources
3	Locational and regional settings	Location of town in regional setting, Urban/rural settlements		SoI Toposheets, Satellite Image Photo mosaic from NRSC & Bhuvan (Cities and Towns locations), Census Atlas maps, National Atlas and Thematic Mapping Organisation (NATMO), State Remote Sensing Application Centre (SRSAC)
4	History of development	Settlement morphology		Municipal maps Maps and Drawings from ULBs Departmental maps
5	Climate	Temperature, Rainfall, Humidity, Wind direction		Bhuvan (Point information Can be registered and data can be downloaded, SAC/ISRO web site provides these parameters by AWF station
6	Land use assessment	Existing land use / cover, Proposed land use / cover	Residential, Industrial, Mixed land use, Recreational, Public and semi-public, Communications, Public utilities and facility, Commercial, Transportation, Reclaimed land Vacant land, Vegetated area	SoI Toposheets Maps and Drawings from ULBs Satellite Image Photo mosaic from NRSC & Bhuvan(1:50,000; 2005-06, 2011-12), Aerial Photographs State Remote Sensing Application Centre (SRSAC), NUIS maps
		Agricultural land	Cropland, Fallow land, Plantation, Double cropped area, Irrigated land: Canal irrigated,	SoI Toposheets Departmental maps Revenue records Satellite Imageries Aerial Photographs, Satellite Image Photo mosaic from NRSC & Bhuvan (1:50,000; 2005-06, 2011-12),

S.No.	Features	Sub-categories	Sources
			Well irrigated, Tank irrigated
		Waste land	Salt affected Gullied / ravenous Land with / without scrub, Barren / rocky / unculturable land, Culturable waste land, Sandy area
			Sol Toposheets Satellite Image Photo mosaic from NRSC & Bhuvan (1:50,000; 2005-06, 2011-12), Revenue maps Aerial Photographs
		Grazing land	Permanent pastures, Other grazing land, Miscellaneous tree crops and groves
			Sol Toposheets Satellite Image Photo mosaic from NRSC & Bhuvan (1:50,000; 2005-06, 2011-12), Revenue maps Aerial Photographs
7	Environmentally and ecologically sensitive area	Air, water and noise pollution, Location of pollution generating industries, Map depicting the location of slums, squatters and other blighted area	Departmental Maps Maps and Drawings from ULBs Aerial Photographs CPCB (Zoning Atlas of Industries)
8	Conservation of environment	Hazards zone	National Disaster Management Authority (NDMA), Geological Survey of India
		Polluting activities	Central Pollution Control Board (CPCB), State Pollution Control Board (SPCB), Major project EIA reports
		Environmentally sensitive / Conservation area	Forest boundary
			Notified / Reserved / Protected Forest Boundary, National Park Boundary, Sanctuary Boundary
		World heritage sites	Cultural and Natural heritage
		RAMSAR sites	UNESCO
		Other Wetlands	Salt pans, Marshy / swampy
			Sol Toposheets Satellite Image Photo mosaic from NRSC & Bhuvan,

S.No.	Features	Sub-categories	Sources
		Mudflats, Waterlogged	
9	Heritage site, building and areas	ASI sites, Location of heritage site, building and areas	SoI Toposheets, Archaeological Survey of India
10	Tourism	Tourism development Map	Ministry of Tourism, State Tourism Departments
11	Hazard prone	Earthquake prone, Flood Prone, Cyclone Prone, Deforestation Prone, Desertification Prone	Building Material and Technology Promotion Council, CWC (Flood Atlas of India), Bhuvan(1:50,000; only Bihar and Assam)
12	Demography	Distribution of existing and proposed population, Migration trends, Population growth, Population Density, Sex ratio, Child sex ratio, Gender gap in Literacy, Workforce Main workers, Marginal workers, Non-workers, Cultivation, Agricultural labourers, Household industry workers, Other workers Slum population	Census Atlas maps, National Atlas and Thematic Mapping Organisation (NATMO)
13	Economic and social development	City ward/ district map, Location of informal sector's area Type of street vendors Stationary, Mobile, Nature of street vendors Perishable, Non-perishable goods.	Departmental Maps, Maps and Drawings from ULBs, Census Maps Ground survey

S.No.	Features	Sub-categories		Sources
14	Housing and shelter	Built-up area Distribution of residential land use, Base map containing building / property boundaries, Building material map, Building age map, Land value map		Revenue department of the local authority Departmental Maps, Maps and Drawings from ULBs
15	Transportation	Road network, Existing and Proposed road network map	National highway, State highway, District roads, Village roads, City roads, Ward and neighbourhood level non-motorized routes Existing, Proposed non-motorized transport priority zones, Bus Transport Chowkies or Resting areas, Existing street lighting, Ring road, Bye-pass, Expressway, Bus terminus, Truck terminal	Sol Toposheets, NHAI, Departmental Maps, Maps and Drawings from ULBs, Detailed Project Reports, Road and Building Department, Public Work Department, Satellite Image Photo mosaic from NRSC & Bhuvan (110,000; existing road network), Ground survey
		Railway network, Existing and Proposed rail network map	Broad gauge, Narrow gauge, Railway stations, Railway terminals,	Sol Toposheets, Minister of Railways
		Airports Location of airports and airdromes, Air funnel maps	International airports, Domestic airports, Customs airports	Sol Toposheets, Airport Authority of India, Satellite Image Photo mosaic from NRSC & Bhuvan,

S.No.	Features	Sub-categories		Sources
		Water ways, Sea Ports, Land use maps of jetties and ports	Major ports, Minor ports	SoI Toposheets, Departmental Maps
16	Infrastructure	Water supply network, Drainage Network, Sewerage and solid waste management,	Water treatment plants, Water pumping stations, Public toilets for men and women. Sewerage treatment plants, Sewerage pumping stations, Outlets in water bodies / low lying areas, Community garbage bins, Waste treatment site, Waste dumping site,	SoI Toposheets, Departmental Maps, Maps and Drawings from ULBs, City Guide Maps, Aerial Photographs, Detailed Project Reports, Public Work Department Ground survey.
		Power supply line network,	Electricity line, Electricity sub stations, Power stations,	
		Telecommunication network,	Mobile Towers,	
		Health centres,	Including day-care centres, health posts, de-addiction centres,	
		Educational institutes, Fire station, Post office, Police stations, Banks / ATMs, Community centres,	Including street schools and <i>balwadis</i> , Police field offices.	

S.No.	Features	Sub-categories	Sources
		Socio-cultural and religious centres All social infrastructures within informal settlements.	
17	Review, Revise	Updated base map, Existing land use map, Proposed plan of various sectors	Maps and Drawings from ULBs

Source: As given.

7.6.3. Procedure of Collecting Data

Procedure to retrieve data by permissions, which is not available in the public forum are given below:

7.6.3.1. Topo sheets

Unrestricted topographical/ city guide maps published by Survey of India are available for sale. The standard topographical maps on scale 1:25000, 1:50000 and 1:250,000 and city guide maps published for selected towns/cities are useful for urban development plan purpose.

All the topographical maps along the external boundary/coastline of India, as indicated in the Topo Index map of Survey of India are categorised as restricted maps. The restricted category maps can be procured by State and Central Governments / Private Individuals / Organisations/commercial firms by filling a separate form. Private individuals and organizations / commercial firms can also obtain restricted maps with prior approval from Ministry of Defence through the State Government to whom they should apply.

7.6.3.2. Aerial photography

Information regarding area of interest for aerial photography, its scale and cost rates can be obtained from Surveyor General's Office, Dehradun or the Directorate of Survey (Air), New Delhi. Survey of India (SoI) has a dedicated web portal for presenting the meta-data information available with SoI from various aerial photography tasks commenced. Web Aerial Photography Transaction Registry (APTR) provides transparent indenting process based on instructions issued by Ministry of Defence.

Indentor can obtain the existing photography by marking the area of interest on 1:250,000 scale topographical map, indicating purpose, identifying the type (B&W, colour, colour infrared), scale and the photographic product required (contact prints, enlargements, mosaic, etc.). If the existing photography does not cater to the requirements of indentor, process for fresh aerial photography can be initiated. The National Government agencies, which provide fresh aerial photography, are:

- Indian Air Force (through Survey of India)
- National Remote Sensing Centre, Hyderabad
- Air Survey Company, Calcutta.

For indenting fresh aerial photography the indentor may approach any of the flying agencies with specific information. The indentor may mark the limit of the area to be photographed on 1:250,000 scale top sheet if photography is required on scale smaller than 1:20,000 and 1:50,000 scale top sheet if photography is required on

scale 1:20,000 and larger and apply with the specific requirements mentioned for the procurement of the existing aerial photography.

7.6.3.3. Satellite Images

National Remote Sensing Centre (NRSC) is the important segment of Indian Space Research Organization (ISRO) with the mandate of providing Earth Observation (EO) data from space and aerial platforms to users, develop technologies for the management of natural resources, support disaster monitoring and management and capacity building for utilization of EO data. It is vested with the authority to acquire and disseminate all satellite remote sensing data in India, both from Indian and foreign satellites.

Table 7.9: IRS Satellite Data Products relevant for Urban Applications

S.No	Satellite / Sensor	Spatial Resolution	Spectral Resolution	Scale of Base & Thematic mapping (Possible)	Remarks
1	Cartosat-2	1m	PAN	1:5,000	Merging PAN+ LISS-IV Images can generate 1m multi-spectral images.
2	Cartosat-1	2.5m Stereo	PAN	1:10,000	2.5m multi-spectral image can generated by merging PAN+ LISS-IV Images
3	Resourcesat-1/2	LISS-IV (5.8m)	Multi-spectral	1:25,000	Capable of imaging in cloud conditions, hence Useful in especially during monsoon
4		LISS-III (23.5m)	Multi-spectral	1:50,000	
5		Awifs (56m)	Multi-spectral	1:25,000	
6	RISAT	Capable of imaging 50m to 3 m in different modes	Microwave sensor		
7	Near Future Satellite	Proposed sensors			
	Cartosat-3	25 cm PAN		1:2,000 or better	24cm multi-spectral image can be generated by merging PAN+ LISS-IV Images.
		1M Multi-spectral			

Source: National Remote Sensing Centre¹³²

In addition to the IRS satellite data products, very High Resolution foreign satellite data may procure through NRSC, as per the Remote Sensing Data Policy 2011.

1. All data of resolutions up to 1 m shall be distributed on a non-discriminatory basis and on “as requested basis”
2. With a view to protect national security interests, all data of better than 1 m resolution shall be screened and cleared by the appropriate agency prior to distribution.

Apart from the responsibilities stated above, NRSC proactively disseminates the information derived from its various national level projects through its Bhuvan Geoportal. The free satellite data download facility is also available for registered users to facilitate research, formulate projects and plan development activities.

¹³²Details on data products, price and necessary data order forms are available www.nrsc.gov.in. Apart from the responsibilities stated above, NRSC proactively disseminates the information derived from its various national level projects through its Bhuvan Geoportal. The free satellite data download facility is also available for registered users to facilitate research, formulate projects and plan development activities.

7.6.3.4. Geological Survey of India

To assess the meta-database of Geo-environmental studies for various cities in India, with interpretation of geomorphology, hydrology, geological structures and tectonic data from Geological Survey of India, Urban Local Bodies and its representatives can approach Ministry of Mines and GSI with their specific requirements.

7.7. Base Map & Development Plan Preparation

7.7.1. Base map features

Before taking up any urban development plan exercise the first task, both from planning point of view and as statutory requirement, is to prepare or obtain reliable, accurate and up-to-date base map for the respective town or city for which the plan is being prepared. The amount of information to be represented on the map varies from map to map because information depiction depends on:

- Purpose of map
- Scale
- Projection
- Method of map-making
- Draughting skill

Uniformity of base map with regard to presentation of features, scale, size and notations, facilitates the readability of these maps and comparison of one map with another. Mapping software of Remote Sensing and Geographical Information System are capable of generating maps with uniformity as well as processing data from different platform. The standard layout of map is given in **Appendix G of Volume IIB**.

7.7.2. Plan formulation through Remote Sensing & Geographic Information System

Geographical Information System (GIS) in planning is increasingly being applied for plan formulation, analysis as well as for proposal. As a powerful tool, GIS helps the planners to view different scenarios and their outcome so that an optimal strategy can be chosen for planning and development. Besides this ***Plan formulation using Remote Sensing and in GIS platform have the following advantages:***

- Benefits of Analytical techniques in GIS platform
- Ground points and geo-referenced data base for proposals preparation
- Dynamic features can be incorporated from RS data
- Regular Database updating and Plan Revision without hassle
- Provide decision making support
- Promote collaboration among public agencies.
- Automated tasks -reduce human errors
- Long Term Investment
- In addition, for *Bhuvan* - Enhance public participation
- In addition, for *Bhuvan*- Increase access to government & efficient approval procedures

Once the spatial and attribute data are generated in GIS frame, their applications are wide and varied. These include resource inventory and management, planning and monitoring, land records for taxation and ownership controls, facilities and services management, environment impact assessment. GIS is being used for planning of various cities in India lately. Development Plan is a level of plan for which GIS could be used very successfully. Preparation of Development Plan using RS & GIS can be classified under following parts for easier understanding and implementation.

- Base map preparation process
- Preparation of existing land use map
- Analysis of the study area
- Proposed land use plan
- Revision of the plan

7.7.2.1. Base Map preparation process

Preparation of Master Plan starts with base map preparation before which relevant data of all the necessary information, which is to be presented via base, map is collected. For base map preparation, National Urban Information System (NUIS) Scheme has prepared maps on 1:10,000 scale and made available on NRSC/ISRO Geoportal *Bhuvan* (www.bhuvan.nrsc.gov.in) for Urban Local Bodies for 152 towns.

Bhuvan NUIS GIS database comprises **Base layers**: Road, Rail, Canal, Transportation nodes, Drainage, Surface water Bodies and **Thematic layers**: Urban Land use / Cover, Geomorphology*, Lithology, Geological structures*, Physiography* and **Administrative Layers**: State, District, Village, City/Town boundaries and Ward Boundaries (*outside core area also). Attribute data has spatial layers as, administrative boundaries, forest boundary, settlement and village locations / names and city / town boundaries and non-spatial data. Other sources of licenced/authentic versions of interpreted satellite imageries can also be used for preparation of base map.

Alternatively, for detailed base map preparation high spatial resolution panchromatic image and medium resolution multi-spectral image can be merged to provide a high-resolution multispectral image at appropriate large-scale urban information. For preparing thematic maps, under NUIS, Cartosat-1 (panchromatic) with 2.5m spatial resolution and Resourcesat-1 (LISS-IV/ multispectral data) 5.8m spatial resolution satellite imageries were fused, to produce colour images at 2.5m spatial resolution for analysis, mapping and product generation.

At this stage, scale of the map should be decided. The Thematic GIS databases available on *Bhuvan* range from 1:10,000, to 1:250,000. The important Satellite data and thematic GIS data resources available for utilization for various planning and development are listed below.

Table 7.10: Bhuvan Satellite data and thematic GIS data resources available

S.No	Description	Scale of data	Coverage
Satellite Data Resources			
1	High Resolution satellite image	2.5m spatial resolution Natural Colour Composite (NCC)	Entire India
2	Very High Resolution satellite Image	1 m spatial resolution Natural Colour Composite (NCC)	Major Cities/Towns
Base and Thematic GIS data services			
1	NUIS Scheme Base and Urban Thematic GIS database	1:10,000	152 Towns
2	SIS-DP Base and Land Use/Cover GIS data	1:10,000	Entire India- State wise
3	Land use / Cover GIS data	1:50,000	Entire Indian 2005 -2006 2011-2012
4	Geomorphology GIS data	1:50,000	Entire India (Collaboration with GSI)
5	Geological structures GIS data	1:50,000	Entire India (Collaboration with GSI)
6	Wasteland GIS data	1:50,000	Entire India
7	Ground Water Prospects GIS data	1:50,000	Entire India
8	Land use / Cover Raster data	1:250,000	Entire India 9 Cycles of data from 2004 to 2013

Source: National Remote Sensing Centre. This list of satellite data and Thematic GIS data availability gets updated, regularly as per the ISRO/DOS policies.

Once the base and thematic layers from the Satellite Imagery are prepared, other city/town specific information such as, cadastral maps, revenue records, and plans of government agencies and attribute information from Industrial Development Corporations, Public Work Department, Railways, National Highway Authority could be integrated for preparation comprehensive GIS database as required for Development Plan/ Master Plan preparation.

The process to overlay Satellite images over cadastral maps for preparing base map is explained in the **Manual: Space based Information System for Decentralised Planning, ISRO**¹³³. The satellite imageries, Resourcesat LISS-4 and Cartosat PAN, can be overlaid on cadastral maps to prepare base map. These satellite images depict field bunds, cart tracks, small *nullahs*, settlements, tanks and other cultural features like roads, railway network and canals. These features facilitate identification of Ground Control Points (GCP) for tie down satellite image and cadastral map.

For overlaying cadastral map with satellite image it is required that cadastral map be generated in vector mode. In this process the main tasks are acquisition of cadastral maps, scanning and digitisation of cadastral maps and generation of vector data. Once the cadastral maps in vector mode are available, the geo-referencing of these maps

¹³³ Appendix G of Volume II B and Manual also available at: <http://www.bhuvan-panchayat.nrsr.gov.in/assets/Manual-Part2.pdf>

can be done. The geo-referencing of digital cadastral maps and overlaying with satellite image consists of the following steps:

- Acquisition of GCP's
- Transformation model development and assessment
- Geo-referencing of cadastral maps
- Validation of Geo-referenced map, in Isolation
- Validation of Geo-referenced map, with neighbourhood
- Mosaic generation at revenue inspector (RI), *taluka* and district level

These steps are detailed in Appendix H of Volume II B.

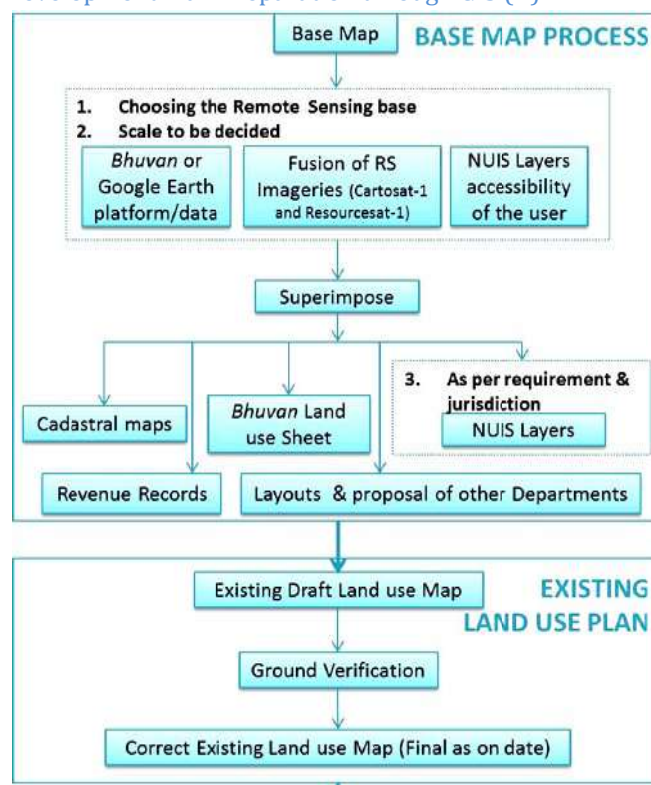
Further, the process of preparation of Existing land use plan can be initiated as the logical step of data preparation.

7.7.2.2. Preparation of Existing Land Use Map

The draft of the existing land use map, incorporating the land use features from the satellite interpretation and revenue records are taken up for ground verification. The amount of information or area verified under this stage varies from settlement to settlement. In rural areas 15-20% of ground verification should be appropriate, given the predominance of agriculture, wasteland or forestland cover. While, in urban areas ground verification could be 20-50% or even up to 100%, if settlement is very dense.

Once ground verification is over and incorporated in the existing draft land use map, final land use map is produced. In the final existing land use map, the date on which map was approved should be mentioned.

Figure 7.10: Process of Development Plan Preparation through GIS (A)



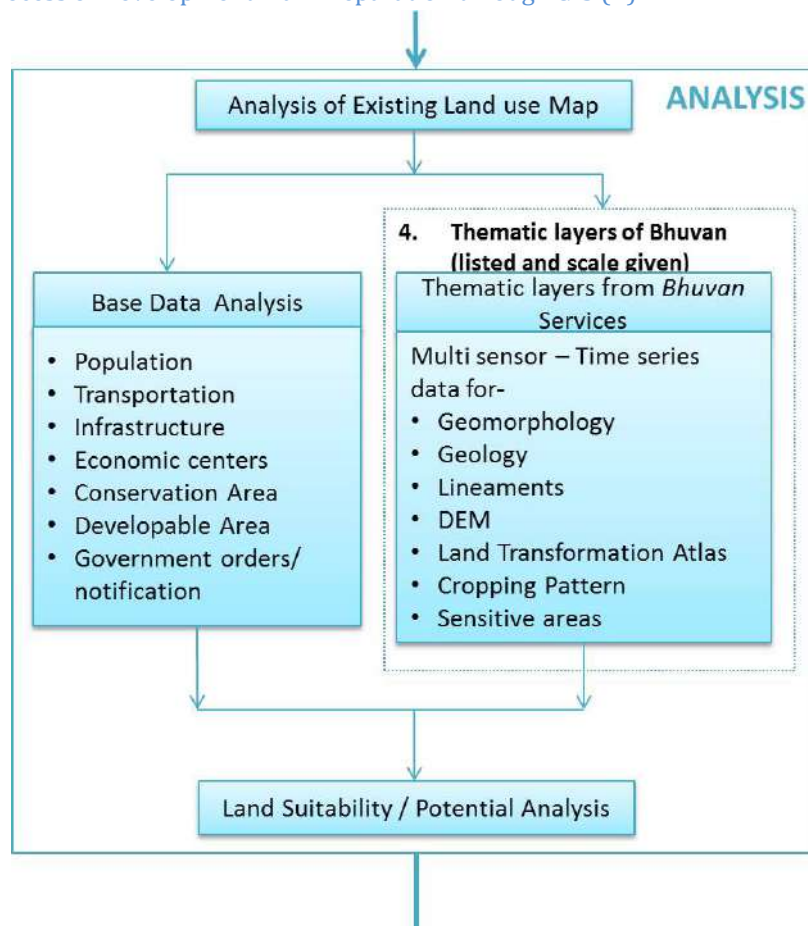
Source: Consultations with NRSC, NUIS, HMDA and various sources.

7.7.2.3. Analysis of Existing Land Use Map

Base data, such as population, transportation, infrastructure, area under conservation/preservation, ecologically sensitive area, developable area etc., can be taken. Thematic layers from Bhuvan series providing data of geomorphology, geology, lineaments, DEM, land transformation Atlas etc., can be selected. After giving weightage to the chosen indicators, these layers can be superimposed to generate maps showing land suitability or its potential for development or conservation. Here the parameters for selection are to be carefully chosen to suit the planning requirements of the region. Through the weightage given for analysis, the resulted map can be categorised into suitability layers, such as:

- Land most suitable for development
- Land suitable for development
- Land moderately suitable for development
- Land non-suitable for development

Figure 7.11: Process of Development Plan Preparation through GIS (B)



Source: Consultations with NRSC, NUIS, HMDA and various sources.

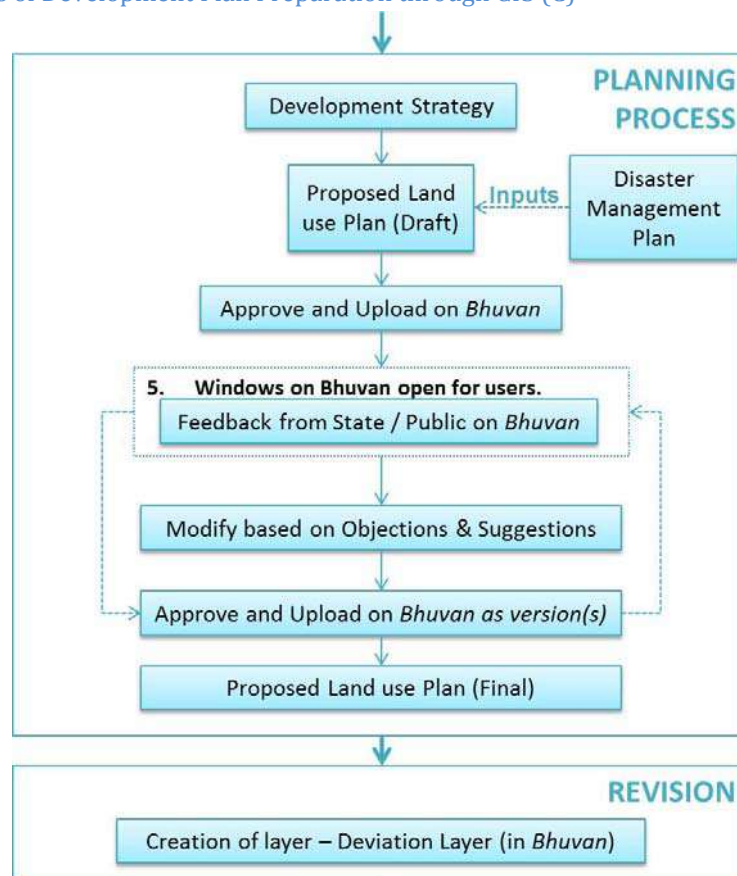
7.7.2.4. Proposed Land use Plan

Development strategy can be prepared from the analysis of the situation after superimposing it on the existing land use map. Development strategy could be

focussed on urban nodes, key infrastructure, transport links or industrial development. The development strategy and land suitability analysis is to suggest the land use zoning and the proposed plan. However, these zones and specifications of the existing land use map are overlaid and refined for bringing out details on the proposed plan. Analysis on GIS also allows planners to integrate inputs from Disaster Management Plan into the Proposed Draft Land Use Plan.

Through efforts of the State and Local Government, Master Plan formulation using web based GIS software application on *Bhuvan* can be utilised for public participation on Geospatial platform. The approved proposed land use plan could be uploaded on *Bhuvan* Geoportal. Feedback can be given on such plans on *Bhuvan* Geoportal by the public or by State officials. Based on the objections and suggestions received in earlier stage, the proposed land use plan can be modified and uploaded on *Bhuvan* Geoportal again as a new version. The process of objections & suggestions and approvals and uploading of the Plan can be repeated for a number of times as per the State's statutory provisions until the Final Plan version is not approved.

Figure 7.12: Process of Development Plan Preparation through GIS (C)



Source: Consultations with NRSC, NUIS, HMDA and various sources.

7.7.2.5. Use of GIS in Plan Revision

For monitoring and revision of the Development Plan, deviation from the proposed land use can be determined in GIS. The ULB and the State governments having utilised

the *Bhuvan* portal can create new data layers for the non-conforming land uses to assess the deviation between the previous approved Proposed Land use plan and the existing situation. And since the mapping has been done on GIS, temporal variation from the latest remote sensing imagery can also be earmarked. This deviation can be addressed in the revision of the plan.

7.7.3. *Bhuvan* GeoPortal for Planning

Bhuvan is a geoportal of Indian Space Research Organisation (ISRO), which is for Indian Earth Observation data products and services. *Bhuvan* provides interpreted satellite imageries, thematic data and other services to all, apart from base for urban and regional planning for the authorised Government agencies. Some of its salient features are:

- Provide access to all *Bhuvan* GIS databases as well as any other relevant data from other websites like Survey of India (SOI), Forest Survey of India, National Highways Authority of India, Indian Railways etc., Can used through the WMS service for effective utilization of available data. This helps in avoiding the duplication and redundancy.
- Respective ULB can upload the town specific spatial data like cadastral maps and attribute data to *Bhuvan* and comprehensive database required can be organised and used for formulation of Master Plan.
- Open source freely available WebGIS software package for example QGIS
- Use *Bhuvan* WMS service for data creation.

7.7.3.1. *Bhuvan* GeoPortal User Access

Bhuvan provides access to ULBs¹³⁴, development authorities for government administration for urban and regional planning, to work on the available information, create new database as layers; prepare, approve and upload plan. At ULB, the three tier system of *Bhuvan* data mangement provides login to draughtman, Town Planning Officer and Commissioner level officers.

Each level has different powers to access *Bhuvan* database, which is described below (and can be customized as per ULBs procedures/methods being followed):

- Draughtsman can work on Town database and have rights to read and control write in the portal database. Draughtsman have access control for all database for ready, edit, process and write to temporary folder. At this level personnel can create new spatial files or edit the existing files and upload data for approval.
- Town planning officer (TPO) can work on Town database and have rights to read and write. TPO have full control on the database. The maps, analysis on existing data, uploaded data and reports by draughtsmen are posted in temporary folder and requires TPO approval to move these files to the database.
- Commissioner level officer can work on Town database and have rights to self-controlled read and write access.
- State level authorities (Director's office of State town & Country Planning Department) have rights for accessing respective sate all towns.

¹³⁴ ULBs can access *Bhuvan* through MoUD and State Town & Country Planning Department for authorisation and facilitation of *Bhuvan* username and password.

- National level authorities (Ministry of Urban Development, TCPO, Delhi) have the rights of all accessing state wise all towns status of India.

7.7.3.2. Portal User Interface

After Planning activity is over, such data can be uploaded on *Bhuvan* portal for public viewing. *Bhuvan* portal has user interface in three levels such as:

- Viewing: Citizens and government departments can view the spatial plan that is uploaded on *Bhuvan* portal
- Data creation: *Bhuvan* accessed town level Urban Planning authorities can create and upload data on the Portal.
- Feedback on the uploaded Plans: Citizens, Government departments and *Bhuvan* accessed Town level Urban Planning authorities can give feedback on uploaded data/plans.

7.7.3.3. *Bhuvan* Mobile applications

Bhuvan provides varieties of solutions on Mobile and Smart-phone platform in addition to field data collection and upload, which can be used for urban and regional planning exercise. '*BhuvanApp*' can be downloaded on compatible mobile software. Both attribute data and pictorial data can be collection from the field through the app, and uploaded on *Bhuvan* to develop a centralized database and thereafter can be viewed by all for decision-making.

Other applications are also available as a part of *Bhuvan* mobile app, such as emergency services/responses at the event of hazard. Such applications can be used for Smart city concepts and can be modified or customized for the need to the ULBs/DA. For the State of Uttarakhand, a post disaster initiative was taken using *Bhuvan*. *Bhuvan* has developed customized applications called, Mapping the Neighbourhood in Uttarakhand (MANU), for collecting information from the field on mobile by assigned team and updating it on the *Bhuvan* for enabling reconstructs and rehabilitation exercise that could be used by local Govt. effectively.

8 Infrastructure Planning

Millennium Development Goals (MDG), directly or indirectly, are linked to status physical infrastructure. MDGs were adopted by UN in 2000 keeping in mind to raise the quality of life of vulnerable population of the world. India is falling behind the goals and time frame to achieve goal will get over in 2015. In this scenario it is prudent that local bodies focus on improving physical infrastructure. Many policies and schemes of Central government are also providing for improvement of physical infrastructure in India.

The planning of infrastructure shall be based on the hierarchy of urban development. This chapter of URDPFI guidelines suggest the infrastructure planning norms for an Urban/ Regional space; the norms are suggested under five categories, namely:

1. Transportation Planning
2. Physical Infrastructure
3. Social Infrastructure
4. Commercial Infrastructure
5. Miscellaneous Infrastructure

8.1. Hierarchy of Urban Development

A planned city for an environment of convenience should have a hierarchical structure; with each unit planned for basic self-sufficiency. The smallest planning unit is conceived as Housing Area for 5000 population with convenience shopping, open area, Anganwadi and milk booth as minimum infrastructure provision. The higher level of additional facilities is to be provided at Neighbourhood, Community, District, Zonal, Sub-city and Regional levels. The hierarchy of development on the basis of population is given in **Table 8.1**.

Table 8.1: Hierarchy of Infrastructure Development

Sr.No.	Planning Unit	Population
1	Housing Cluster/ Neighbourhood	5000
2	Neighbourhood	5000-15,000
3	Community	Up to 100,000
4	District*	5 Lakh
5	Zonal	10 lakh
6	Sub city centre	25 Lakh – 50 Lakh
7	City	50 Lakh +

Source: UDPFI Guidelines, 1996; MPD, 2021, Jaipur Master Plan. * Ward at 3-lakh population.

8.2. Transportation Planning

Besides the National Urban Transport Policy (2006), the National Transport Development Policy Committee (NTDPC)¹³⁵ was constituted by the Government of India in 2010 to formulate a long-term transport policy having an aim to set up the conditions for a coherent transport strategy for India in the long term for the horizon year 2032, with a vision to arrive well-developed and competent institutional system for planning, management and execution of transport projects. Indian cities are expanding and therefore urban transport has gained regional importance. The public transport needs to improve by an integrated road and rail base transport, expansion of BRTS/MRTS, etc through formulation of Master/Development/Mobility Plan which may help to integrate transport and urban development. Similarly, bus priority ways, connectivity of MRTS with CBD and residential areas, improvement of intermediate public transport and priority in planning for NMT, etc should be developed along with other facilities such as parking, street furniture, etc.

The report recommends that State Governments should also enact “Comprehensive Urban Transport Law” to define the roles and responsibilities of the city authorities and State level entities related to public transport, landuse and transport integration, multi-modal integration, transport infrastructure for pedestrians, bicycle, cycle rickshaws, etc. Further, priority in planning for various modes should focus on improving mobility through NMT, Public Transport, Para-Transit and Personal vehicles in order. There is a need to set up Metropolitan Urban Transport Authorities as holistic and integrated decision making and coordinating bodies. The dedicated non-lapsable and non-fungible urban transport funds should be set-up at the National, State and City levels.

Each Municipality and Development Authority could have a Transportation and Traffic cell/division to comprehensively prepare CMP in lines with the Development Plan, implement the transportation plan and coordinate with Traffic Police. The role of such a cell/division is also to include application of smart technologies to improve transportation in the city. It is necessary for Transportation and Traffic cell/division to employ transport planners and urban planners for technical inputs.

8.2.1. Classification of Urban road

1. **Urban Expressway:** Expressways are divided highways for through traffic with full or partial control of access and generally with grade separations at major crossroads.¹³⁶
2. **Arterial road**¹³⁷: They are the primary roads for ensuring mobility function. They carry the largest volumes of traffic and longest trips in a city. These

¹³⁵ NTDPC India Transport Report- *Moving Indian to 2032*, Jan 2014.

¹³⁶ Highway Design Manual, Department of Transportation, New York State (USA).

roads are characterized by mobility and cater to through traffic with restricted access from carriageway to the side. In such cases, special provisions should be introduced to reduce conflict with the through traffic.

3. **Sub Arterial Road:** This category of road follows all the functions of an Arterial Urban road and is characterized by mobility, and caters to through traffic with restricted access from carriageway to the side. It carries same traffic volumes as the arterial roads. Due to its overlapping nature, Sub arterial roads can act as arterials. This is context specific and is based on the function and the land use development it passes through.
4. **Distributor/Collector Roads:** As the name suggests, these are connector roads, which distribute the traffic from access streets to arterial and sub arterial roads. They are characterized by mobility and access equally. It carries moderate traffic volumes compared to the arterial roads. Due to its overlapping nature, distributor roads can act as sub arterial and as access streets, depending upon the function and the land use of the surroundings.
5. **Local Street**¹³⁸: These are intended for neighbourhood (or local) use on which through traffic is to be discouraged. These roads should be made pedestrian and bicycle friendly by using modern traffic calming designs to keep the speeds within limits as per design.
6. **Access Street:** These are used for access functions to adjoining properties and areas. A majority of trips in urban areas usually originate or terminate on these streets.

8.2.2. Design Consideration of Urban Roads

8.2.2.1. Design Speed and Space Standard

The design speed and carriageway width for different types of road, as recommended recently by MoUD may be seen in **Table 8.2 & 8.3**:

Table 8.2: Design consideration of urban roads

S.No.	Road Types	Design Speed (kmph)	Space Standards (m)
1	Urban Expressway ¹³⁹	80	50-60
2	Arterial Road	50	50-80
3	Sub Arterial Road	50	30-50
4	Distributor/Collector Roads	30	12-30
5	Local Street ¹⁴⁰	10-20	12-20
6	Access Street	15	6-15

Source: Urban Road, Code of Practice Part-1, MoUD.

¹³⁷Urban Road Code of Practice, MoUD.

¹³⁸Urban Street Design Guidelines, UTTIPEC.

¹³⁹The Urban expressway design standards have not been developed in India, However for urban context, it is assumed as Main Arterial road and IRC: 86-1983 recommends design speed of such road is 80 KPH and Space standard of 50-60m width.

¹⁴⁰ Urban Street Design Guidelines, UTTIPEC.

8.2.2.2. Carriageway Width

Table 8.3: Carriageway Width for each type of road

S.No.	Types of Roads	Characteristics	Width of each car lane (m)	Width of each Bus lane (m)
1	Urban Expressway ¹⁴¹	Minimum 6 lanes divided (using a median)	3.0 to 3.5m width each	3.5m -(segregated)
2	Arterial Road	Minimum 6 lanes divided (using a median)	3.0 to 3.5m width each	3.5m -(segregated)
3	Sub Arterial Road	Minimum 4 lanes divided (using a median)	3.0 to 3.5m width each	3.5m (segregated) or Painted lane
4	Distributor/Collector Roads	Maximum 4 lanes of 3.0m width each (excluding marking) or 2 lanes of 3.0 to 3.3m width each (excluding marking) with or without an intermittent median	2 lanes of 3.0 to 3.5m width each	Mixed traffic
5	Local Street ¹⁴²	1 to 2 lanes, (undivided);traffic calming is required	2.75 to 3.0m width each	Not required
6	Access Street	1 to 2 lanes, (undivided); of 2.75 to 3.0m width each,	2.75 to 3.0m width each	Not required

Source: Code of Practice Part-1, MoUD, (refer Appendix I of Volume II B for the Cross Sections).

Notes:

1. Footpath, NMT provisions and Right of Use (RoU) of the various infrastructure shall also be assigned in the RoW at the stage of finalisation of road network and hierarchy.
2. RoW shall also include a well-planned utility corridor.
3. Road levels to be defined at the Local Area Plan level to ensure integrated road levels with drainage system and slope.
4. No roads to have two different road levels without a proper median or a separator.

8.2.3. Footpath

Footpath should be normally designed for a pedestrian Level of Service (LOS) B, thereby providing wide pedestrian facilities for pleasant and comfortable walking. Under resource constraint LOS C can be adopted for deciding the width of footpath mentioned in Table 8.4. The width of footpaths depends upon the expected pedestrian traffic and may be fixed with the help of the following norms subject to not being less than 1.8m

¹⁴¹ The Urban expressway design standards have not been developed in India, However for urban context, it is assumed as Main Arterial road, and hence the lane of width is assumed to be the same as arterial road which is referred from Code of Practice Part-1, MoUD.

¹⁴² Urban Street Design Guidelines, UTTIPEC.

Table 8.4: Capacity of Footpath& Design

Width of sidewalk (m)	Design Flow in Number of Persons per hour			
	In Both Directions		All in one direction	
	LOS B	LOS C	LOS B	LOS C
1.8	1350	1890	2025	2835
2	1800	2520	2700	3780
2.5	2250	3150	3375	4725
3	2700	3780	4050	5670
3.5	3150	4410	4725	6615
4	3600	5040	5400	7560

Source: IRC 103-2012.

The land use adjacent to road significantly influences generation of pedestrian traffic. Recommended width of footpath along various landuses are given in Table 8.5

Table 8.5: Required width of footpath as per adjacent land use

S.No.	Description	Width
1	Minimum free walkway width and residential/mixed use areas	1.8
2	Commercial/Mixed Use Areas	2.5
3	Shopping Frontages	3.5 to 4.5
4	Bus Stops	3
5	High Intensity Commercial Areas	4

Source: IRC 103-2012.

8.2.4. Cycle Tracks

Cycle infrastructure width requirements are based on vehicle dimensions, volume and clearance requirements of moving vehicles (cycle rickshaw, freight rickshaw). These requirements vary for straight riding cyclists and those manoeuvring a bend at a cruising speed.

Exclusive lanes for slow moving vehicles-bicycles and rickshaws and pedestrians along with spaces for street vendors are also essential. Hawkers and roadside vendors provide services to bus commuters and pedestrians therefore designed spaces would discourage them from occupying the carriageway. This improves the capacity of the lanes designed for motorized vehicles and increases safety of bicyclists and pedestrians.

Table 8.6: Cycle / NMT track

Sl No.	Arterial Roads	Sub Arterial Roads	Distributary Roads	Access Roads
Non-Motorised Vehicle	Segregated Cycle Track	Segregated Cycle Track	Cycle Lane	Mixed \traffic
Location	Between Carriageway or street parking and footpath on either edge of the carriageway	Between Carriageway or street parking and footpath on either edge of the carriageway	On the edge of the carriageway, adjacent to the footpath or parking.	Not Applicable
Gradient	1:12 – 1:20	1:12 – 1:20	1:12 – 1:20	1:12 – 1:20
Lane width	2.2 to 5.0m	2.2 to 5.0m	1.5 to 2.5m	Mixed with motorized vehicular traffic
Minimum Width	2.5 for a two lane cycle track and 1.9m for a common cycle track and footpath	2.0 for a two lane cycle track and 1.7m for a common cycle track and footpath	1.5m	1m (painted)

Source: Code of Practice Part-1, MoUD, 2012.

8.2.5. For Hilly Areas

Width of roads in hilly areas is given below which can be adopted as per requirement and adjoining land uses.

Table 8.7: Carriageway width in Hilly areas

S.No.	Description	Width(metre)
1.	Single lane without kerbs	05.00
2.	2-lane without kerbs	08.80
3.	2-lane with kerbs	10.00
4.	3-lane with /without kerbs	13.00 / 11.80

Source: TCPO, Government of Himachal Pradesh.

8.2.6. Passenger Car Units (PCU)

The PCU standards as per the vehicle type for planning the area requirement are given in **Table 8.8** below:

Table 8.8: PCU standards

S.No.	Vehicle Type	Equivalency factor
1	Passenger car, tempo, auto, jeep, vans, or agricultural tractor	1.0
2	Truck, bus, agricultural tractor-trailer	3.0
3	Motor-cycle, scooter and cycle	0.5
4	Cycle-rickshaw	1.5
5	Horse drawn vehicle	4.0
6	Bullock cart	5.0
7	Hand-cart	6.0

Source: JnNURM - Rapid Training Programme, Preparation of DPRs, UDPFI guidelines and in IRC 106-1990.

8.2.7. Design Service Volume

The Design Service Volume standards as given in IRC Code 106-1990, which recommends LOS C while designing road capacity, are given in **Table 8.9** below:

Table 8.9: Design Service Volume Standards

S.No.	Type of Carriageway	Total Design Service Volume for different road category		
		Arterial	Sub-Arterial	Collector
1.	2-Lane (one way)	2400	1900	1400
2.	2-lane (two way)	1500	1200	900
3.	3-lane (one way)	3600	2900	2200
4.	4-lane undivided (two way)	3000	2400	1800
5.	4-lane divided (two way)	3600	2900	--
6.	6-lane undivided (two way)	4800	3800	--
7.	6-lane divided (two way)	5400	4300	--
8.	8-lane divided (two way)	7200	--	--

Source: IRC Code 106-1990.

8.2.8. Parking

8.2.8.1. Equivalent Car Space (ECS) for different vehicles

The recommended ECS required for different type of vehicles are given in Table 8.10

Table 8.10: Recommended ECS for various types of vehicles

S.No.	Vehicle Type	ECS
1	Car/taxi	1.00
2	Two Wheeler	0.25
3	Auto Rickshaw	0.50
4	Bicycle	0.10
5	Trucks/Buses*	2.5
6	Emergency Vehicles*	2.5
7	Rickshaw*	0.8

*Source: Volume V-D1: DPR for Multi-level Parking Facility at Ghaziabad Main Report, NCRPB and ADB, 2010.

8.2.8.2. Recommended ECS based on land use type

The recommended ECS required for different type of land use, as recommended by the NBC, are given in **Table 8.11**.

Table 8.11: Parking Standards

S.No.	Land use	Parking Standards	Remark
1	Residential		
	Residential Plot-Plotted Housing	2 Equivalent Car Space (ECS) in plots of size 250-300 sqm and 1ECS for every 100 sqm. built up area, in plots exceeding 300 sqm.	--
	Residential Plot - Group Housing	2.0 ECS/100 sqm built up area	--
	Cluster Court Housing	2.0 ECS/100 sqm built up area	--
	Guest House / Lodging & Boarding House / Dharamshala	2 ECS per 100 sqm. of built up area	--
2	Commercial Centres		
	Convenience Shopping Centre/Local Shopping Centre / Local Level Commercial areas	2 ECS / 100 sqm of floor area	--
	Service Market	2 ECS / 100 sqm of floor area	--
	Community Centre / Non- hierarchical Commercial Centre	3 ECS / 100 sqm of floor area	--
	District Centre/ Sub-Central Business District/Sub-City Level Commercial areas	3 ECS / 100 sqm of floor area	--
	Commercial Plot: Retail & Commerce Metropolitan City Centre	3 ECS / 100 sqm of floor area	--
	Hotel	3 ECS / 100 sqm of floor area	For Population between 2- 10 lakh – 1 car parking space for every 4 guest room. For Population between 10-50 lakh – 1 car parking space for every 3 guest room. For Population more than 50 lakh – 1 car parking space for every 2 guest room ¹⁴³ .
	Service Apartments	3 ECS / 100 sqm of floor area	--
	Any other commercial centre including commercial component along with Railway/MRTS and ISBT	3 ECS / 100 sqm of floor area	--
	Integrated Freight Complex/ Wholesale Market	3 ECS / 100 sqm of floor area	In case of plots up to 300 sqm. common parking is to be provided

¹⁴³ National Building Code, 2005.

S.No.	Land use	Parking Standards	Remark
3	Socio-Cultural Facilities		
	Community Hall	Parking standard @ 3.0 ECS / 100 sqm	--
	Recreational Club	Parking standard @ 2 ECS / 100 sqm of floor area	--
	Socio-cultural activities such as auditorium, music, dance & drama, centre / meditation, spiritual centre etc.	Parking standard @ 2 ECS / 100 sqm of floor area	--
	Science Centre	Parking standard @ 2 ECS	--
	International Convention centre	Parking standard @2 ECS	--
	Old Age Home / Care Centre for Physically / Mentally challenged / Working women / men hostel /Adult Education Centre / Orphanage / Children's Centre / Night Shelter	Parking standard @ 1.8 ECS of floor area.	--
	Sport facility for international sports event	2 ECS / 100 sqm of floor area.	--
4	Public-Semi Public		
	Integrated Office Complex	1.8 ECS / 100 sq m of floor area	The norms for Local Government offices / Public Sector Undertakings under Government Land use shall be as per Integrated office complex
	District Court	1.8 ECS / 100 sqm of floor area	--
	Head Post Office with Administrative office & with / without delivery office	1.33 ECS per 100 sqm. of floor area	--
	Amusement Park	3 ECS / 100 sqm. of floor area	--
	ISBT/Metro	2 ECS per 100 sqm. of floor area	--
	Hospitals	2 ECS per 100 sqm. of floor area	--
	Veterinary Hospital	1.33 ECS per 100 sqm. of floor area	--
	Veterinary Dispensary	1.33 ECS per 100 sqm. of floor area	--
	Nursing and Paramedic institute	2 ECS per 100 sqm. of floor area	--
	Medical College	As per norms of Medical Council of India / Regulatory Body	--
5	Industry		
	Industrial Plot up to 50 sqm area	2 ECS / 100 sqm of floor area	--
	Industrial Plot 51sqm -400 sqm area	2 ECS / 100 sqm of floor area	--
	Industrial Plot 401 sqm and above	2 ECS / 100 sqm of floor area	--
	Flatted group Industry (Min Plot size 400 sqm)	2 ECS / 100 sqm of floor area	--

S.No.	Land use	Parking Standards	Remark
6	Mixed Land use	Parking @ 2.0 ECS per 100 sqm built up area shall be provided within the premises.	Where this is not available, cost of development of parking, shall be payable by the plot allottee / owner to the local body concerned or Multi-level parking to be provided as an option. This condition shall apply even if residential premises are used only for professional activity.

Source: Master Plan of Delhi (MPD) 2021.

Parking standards are prescribed in above table, however, where it is not prescribed; it could be followed as given in **Table 8.12**.

Table 8.12: Permissible ECS for different land uses

S.No.	Use Premises	Permissible Equivalent Car Spaces (ECS) Per 100 sqm. of floor area
1	Residential	2.0
2	Commercial	3.0
3	Manufacturing	2.0
4	Government	1.8
5	Public and Semi-Public Facilities	2.0

Source: MPD 2021.

8.2.8.3. Space Standards for Parking

For the provision of car parking space, the space standards shall be given as per the **Table 8.13**.

Table 8.13: Space standards for Parking

S.No.	Type of Parking	Area in sqm per ECS
1	Open	23
2	Ground Floor covered	28
3	Basement	32
4	Multi-Level with Ramps	30
5	Automated Multilevel with lifts	16

Source: MPD 2021.

8.2.8.4. Parking for Hilly Areas¹⁴⁴

Apart from the above given parking norms, one car parking space / garage for each dwelling unit should be provided in residential buildings. For institutional buildings, one floor exclusively for parking of vehicles should be compulsory.

¹⁴⁴ TCPD, Government of Himachal Pradesh.

8.2.9. Bus Terminals

8.2.9.1. Functions

The functions of bus terminal primarily includes processing of vehicles, passengers etc. with provision of necessary facilities for their smooth flow. The terminal serves as a point and unit where necessary information to user is made available for processing. To create seamless multimodal connectivity, the bus terminal should be integrated with other modes of transport (train, metro, bicycle, pedestrian, private car)

A bus terminal also functions as the centre of a neighbourhood with high density mixed use activities in its vicinity. To provide a safe and attractive place at all times, the presence of residential housing, shopping complexes, offices and other commercial activities are to be encouraged around the terminal.

A passenger bus terminal broadly needs to perform the functions to meet requirements of the following:

- a. Passengers and Vehicles
- b. Passengers only
- c. Vehicles only
- d. Crew
- e. Management

The functions related to both passengers and vehicles include:

- Concentration
- Loading
- Dispersal
- Unloading

Passenger only oriented functions of the terminal include provision of:

- Passenger platforms to board and alight (with ramps for disabled & elderly)
- Ticketing facilities
- Waiting lounges
- Rest houses/ rooms
- Baggage Storage Facilities
- Commercial: Basic Shopping and retail facilities
- Utilities, Services and Amenities (including public toilets, ATM, drinking water etc.)
- Information System
- Shelter from weather
- Communication and postal facilities
- Eating places

8.2.9.2. Components

The components related to vehicles (bus) only include provision of:

- Bays for loading and unloading
- Idle bus parking spaces
- Facilities related to maintenance

- Information system for movement with terminal

The terminal components to meet the needs of crew are:

- Rest rooms
- Information system
- Communication facilities
- Eating places

The terminal facilities for the management in terms of:

- Demand management on account of concentration
- Incurring minimum expenditure
- Development of centralised information
- Ensuring better control

8.2.9.3. Design Criteria

The design criteria of terminal studies determining the size of terminal and factors to be taken into consideration in planning the facilities and activities is primarily governed by the following factors:

- Traffic Demand
- Traffic Characteristics
- Function of Terminal
- Type and Sophistication of Facilities

The other factors to be considered in terminal design by appreciating activity and facility inter-relationship are:

- a. Segregation of terminal and non-terminal traffic
- b. Segregation of vehicular and pedestrians traffic and movement
- c. Segregation of traffic by type, function and direction
- d. Coordination of different activities in terms of functional and spatial inter-relationship
- e. Provision of good user and vehicular information
- f. Provision of necessary and identified facilities to meet requirement of all user groups achieving minimum passenger and vehicular processing time
- g. Achieving overall functional and spatial efficiency
- h. Achieving smooth flow of all types of traffic to and from terminal.

8.2.9.4. Planning Norms and Space Standards

Norms

- | | |
|--|-------------------------------|
| a. Capacity of an intra-city bus terminal | : 1.5 lakh passengers/day |
| b. One bus bay for 5000 passengers per day | : Loading |
| c. One bus bay for 10,000 passengers per day | : Unloading |
| d. Peak hour load | : 10% of daily passenger load |
| e. Occupancy/bus: | : 50 ideal |
| f. Time taken for loading | : 6 min; 12 min |
| g. Time taken for unloading | : 3 min; 6 min |

Space standards for Parking Facilities

The parking standards for bus bays, as mooted by UDPFI Guidelines 1996, continue to remain valid and are given in **Table 8.14** below:

Table 8.14: Bus Bays – Parking Standards

Type of parking	Area/vehicle
Idle Parking	145 sqm
Angular	76 sqm
Parallel	104 sqm

Source: UDPFI Guidelines, 1996.

8.2.10. Truck Terminal

A truck terminal is highly specialised facility, designed for a specific function and operating plan in terms of service standards it must meet, the area it serves and the volumes to be handled. It provides interface between intercity and local transportation facilities and which handle the distribution and collection of goods within the city.

The major objectives of a truck terminal are:

- a. To reorganise office and go-down space of transport companies
- b. To provide for expansion of companies
- c. To reduce parking, loading/unloading instances in CBD (Central Business District)
- d. To locate the facilities for vehicle repairs, servicing, rest places, shops etc.
- e. To cater to intercity movements destined to operator's godown and provide for idle parking for trucks waiting for return load.
- f. To function as a rest and halting place for through traffic.

8.2.10.1. Facilities in Transport Nagar

The main facilities for which area allocation needs to be made in Transport Nagar are:

- i. Transport Agencies
- ii. Circulation
- iii. Parking
- iv. Open Space
- v. Petrol Pump
- vi. Service Centre
- vii. Toilets
- viii. Police Station
- ix. Restaurant
- x. Shops
- xi. Godowns
- xii. Weigh Bridge
- xiii. Stalls/Dhabas
- xiv. Administrative Office
- xv. Fire Station, Post Office, Dispensary
- xvi. Bank, Bus Station, Electric Sub station
- xvii. Cold Storage
- xviii. Spare Parts Shops
- xix. Body Building Shops
- xx. Cinema

8.2.10.2. Locational Factors

The following factors are generally considered while locating a truck terminal/Transport Nagar:

- a. They should be located on main corridor of goods movement.
- b. Multimodal connectivity with train corridors and waterways
- c. They are generally located on fringe of developed lands
- d. They should have proper linkage with other freight generating activities as well as developed areas.
- e. Consideration for intra city goods movement pattern in terms of desire of movement, modes used and distances over which movement is made should also be kept in view.

8.2.10.3. Broad Land Use Break Up

The broad land use breakup in a truck terminal (Transport Nagar) is as follows:

Table 8.15: Broad Land Use break-up

S.No.	Use	Percentage Area
1	Transport operators - Office, Godown, Loading/Unloading	30.0
2	Service Industry - Petrol Pump, Service Area, Weigh Bridge, etc.	6.0
3	Public/Semi Public - Police Post, Post office, Telephone, First Aid etc.	3.0
4	Commercial	3.0
5	Parking - Idle, Transit, Other Vehicles	18.0

Source: UDPI Guidelines, 1996.

8.2.11. Integrated Freight Complex¹⁴⁵

8.2.11.1. Functions

The basic functions of an integrated freight complex are:

- a. To provide facilities for regional and intra – urban freight movement.
- b. To provide facilities for freight in transit as well as interchange of mode.
- c. To provide warehousing and storage facilities and link-link these sites with specialised markets.
- d. To provide servicing, loading and boarding, idle parking, restaurants and other related functions in the complex.

8.2.11.2. Objectives

The functional objectives of wholesale complex-cum-truck terminal should be:

- a. To provide adequate facilities for wholesale trade activities, these include:
 - i. Auction areas
 - ii. Wholesale shops and subsidiary storage capacity
 - iii. Parking facilities
 - iv. Wholesales godowns, cold storage, etc. together with handling facilities and equipment, etc.

¹⁴⁵These norms may be modified to be used for Dry Ports, Container Freight Station (CFS), Logistics Hub.

- b. To provide adequate parking space and facilities for trucks expected to utilise the terminal. These facilities include:
 - i. Service/repair facilities
 - ii. Rest/recreation for drivers
 - iii. Weighing of trucks etc.
- c. To provide adequate facilities for office/storage activities of trucks operating at terminal. These include :
 - i. Godown space
 - ii. Office space
 - iii. Loading/unloading facilities
 - iv. Weighing of goods vehicle etc.

Apart from the above mentioned objectives, the complex must provide for a number of associated/ancillary facilities and services, some of which are:

- d. Provision for goods movement within the complex in terms of truck movement and loading unloading / stacking of goods.
- e. Building and amenities for administration and security measures necessary for complex.
 - i. Facilities like banking, postal truckers, etc. required for business transactions
 - ii. Amenities for wholesales, truckers and their employees
 - iii. Areas for shops, eating houses and other service establishment
 - iv. Provision of lighting, water supply and garbage, sewerage disposal.

8.2.11.3. Space Norms

The Space norms in terms of quantum handled (kilograms) per square meter area for selected commodities as per Central Warehousing Corporation (CWC) is given below:

Table 8.16: Space Norms

Commodity	Wt./Area (Kg./s q.m.)
Food grains	1054
Fruits and Vegetables	721
Hardware and Building Material	1054
Iron and Steel	904
Timber	968
Machinery	968
Auto Parts	968
Textile	968
Chemicals and fertilisers	968

Source: Central Warehousing Corporation.

8.2.11.4. Broad Land Use Break-up

The broad land use break-up of an integrated freight complex recommended in UDPFI Guidelines 1996 continue to be relevant and are as follows:

Table 8.17: Broad Land Use Break Up

Use Type	Percentage of Area
1. Wholesale Market	35.0
2. Warehousing	8.0
3. Booking Agencies	2.0
4. Commercial & Public/Semi-Public	5.0
5. Utilities and Services	3.0
6. Service Industry	4.0
7. Parking	12.0
8. Circulation	25.0
9. Others	6.0
Total	100.0

Source: UDPFI Guidelines, 1996.

8.2.11.5. Area Requirements

As a general guideline, the area required for a truck terminal (Transport Nagar) should be reserved at the rate of one hectare per 300 tonnes of daily goods inflow into the complex. In case of integrated freight complex, the area necessary would be one hectare per 400 tonnes of daily goods inflow into the complex.

8.2.12. Travel Demand Modelling Process¹⁴⁶

A travel model is a simplified representation of travel behaviour through the use of mathematical equations and data analysis. Models are based on the theory that an individual's travel choices are a function of his or her socioeconomic characteristics (household size, income, and vehicle ownership), geographic location (distance to work, shops, etc.) and modal choices (road, rail, bus, NMT) available to them. Modelling is an attempt to replicate this behaviour using statistical analysis. The process is complex and requires large amount of data.

The accuracy of a travel model depends on many factors: land use and demographic data, quality of travel survey data, technical expertise of the developer, and assumptions used. Therefore, a model should be evaluated as a whole and never as a function of the forecasts produced. A model should always be calibrated well so that it can replicate current year conditions within reason before using it to produce forecasts. Model calibration and validation should be done at every step of the process to ensure quality of forecasts.

¹⁴⁶ Development of Training Material under Sustainable Urban Transport Project, Reference Guide Volume 2 Demand Assessment, MoUD.

Models are a simplified simulation of travel behaviour producing rational travel choices based on the controlled variables within a model. In the real world, variables are constantly changing and individuals don't always make the most rational decisions. Therefore model forecasts should only be used as one element in transport planning.

The most commonly used method of forecasting is 4 step Aggregate Model; this model includes trip generation, distribution, modal split, and assignment.

An individual decides whether to make a trip, where and when to go, which mode to select, and which route to take based on his needs, income, occupation, vehicle ownership, etc. and the choices available to them. The choices could be different modes of transportation (car, 2 wheeler, public transport, bicycle etc.), different times of day travel (peak, off-peak) or competing destinations (shopping mall, downtown). As mentioned above, this method involves 4 major components, which are detailed in **Appendix J of Volume II B**.

8.2.12.1. Recommended Modal Split by Public Transport Modes

The recommended share of public transport modes based on city size, which is mentioned in **Table 8.18**.

Table 8.18: Recommended derived Modal Split

City Size	Recommended Modal Split
Below 1 Million	30%
Around 1 Million	35%
1.5 Million	40% plus
3.0 Million	50% plus
6.0 Million	70% plus
9.0 Million	75% plus (85% with a mass transit system)

Source: UDPFI Guidelines, 1996.

8.2.13. MRT options for the City

Every city is different and requires its own study of the potentially realistic options. The guidelines shown in Table 8.19 and Table 8.20 are to assist decision makers in narrowing down the applicable options. As can be seen in the table, population density is an important criterion. City shape/form (linear or circular) also influences the concentration of demand; therefore, this factor may be incorporated when selecting appropriate MRT options.

Table 8.19: MRT options for the City

S.No.	MRTS Options	City Requirements
1	Bus Rapid Transit (BRT)	- When more than about 100 buses per hour per direction (bphpd) use the busway¹⁴⁷ - Cities with a medium- to high-density urban area - BRT should be one of the first considerations in MRT system development in any city. - BRT system can be developed as trunk systems as well as feeders to an existing (or planned) MRT system - Suitable for cities where an MRT system needs to be developed quickly and incrementally as conditions and funding allow - A well-developed traffic planning/management capability should be available (this may be brought in initially) - Existing bus and paratransit operations can be regulated/restructured - Road space is available for BRT development (2-4 lanes from existing roads) - Bus Only Lane (BOL) can be recommended in the following two cases: - One lane busway (4 meters for a single lane) is available and the passenger demand is below 6,000 bphpd; and - Multiple lane busways (7 meters for two lanes, or 10.5 meters for three lanes) are available and the passenger demand exceeds 6,000, but is below 12,500 bphpd
2	Light Rail Transport (LRT) including monorail, tramways	- Cities with a medium- to high-density urban area - Cities where environmental issues are critical and there is a need to attract car users to use public transport systems; however, if the core requirements are operational effectiveness, - LRT system should be developed that is more flexible and costs less - Appropriate for cities with an existing tram operation, which may be cost-effectively enhanced. - A well-developed traffic planning/management capability should be available - Existing bus and para-transit operations can be regulated/restructured - Road space is available for LRT development (2-3 lanes from existing road) or existing tram track can be converted to an LRT route
3	Metro Rail	- Existing public transport flows on the main corridor of the order of 10,000-15,000 passengers per hour per direction with more than 15km trip length - City incomes that are not low (typically at least US\$1,800 per person) - Prospects for sustained economic growth and an expanding centre (in case of metropolitan regions) - Existence of a low-cost metro alignment - Fares policy – a fares policy on metro and bus systems to encourage ridership yet limit the need for financial support - A well-developed traffic planning/management capability should be available - Existing bus and para-transit operations can be regulated/restructured - Strong and largely autonomous management of metropolitan region, with clear objectives

Source: Guidelines and Toolkits for Urban Transport Development Module 1 Comprehensive Mobility Plan.

Personal rapid transit system is also emerging as an alternative mode of transportation in many Nations. This system is capital intensive and has long payback period, besides, the system is feasible where passenger flow in the main corridor is higher than the demand for the metro rail and the paying capacity is higher.

¹⁴⁷ Guidelines and Toolkits for Urban Transport Development in Medium Sized Cities in India Module 2: Bus Rapid Transit (BRT): Toolkit for Feasibility Studies, MoUD.

Table 8.20: Technical Parameters of Public Transport Options

	Metro Rail	LRT	Tramways	HCBRT	BRT	Bus Priority Lanes	City Bus
Line Capacity (PAX/hr/dir.)	40,000-75,000	15,000-45,000	5,000-15,000	20,000-35,000	7,500-15,000	5,000-7,500	Below 1,000
Cost per km (Infrastructure, vehicles, OCC, Maintenance)	Very high	High	Medium/high	Medium/high	Medium	Low	Very Low, only bus stops and maintenance stop required
Alignment	Double-track railway	Double-track railway, elevated, at grade or in tunnels	Double-track tramway, at-grade	4 Bus Lanes (2 per direction)	2 to 3 Bus Lanes	2 Bus Lanes	Use public roads
Segregation	100% segregated in tunnels, elevated or at-grade	High degree of segregation preferred, but sections with shared right of way possible	Uses public roads, but may have reserved right of way on sections with higher demand	All Bus Lanes must be segregated to achieve high capacity	Bus Lanes must be in general segregated, exceptions possible, reduce capacity and speed	Bus Priority Lanes must be exclusively for buses	None
Road space required	None	None in case of elevated and tunnel alignment, 2 lanes at- grade, additional space required for stations and terminals	2 Lanes, additional space may be required for stations and terminals, tracks can be shared with public roads or pedestrian roads	4 Lanes; more linear space for Interchanges and Terminals	2 Lanes, possibly 3 or 4 at Stations and Interchanges, space for major Interchanges and Terminals	2 to 3 Lanes (3 to 4 Lanes at Bus Stops)	Shared with cars and pedestrian
Vehicles	High capacity EMU	Medium to high capacity EMU's (upgraded trams as an option)	Trams, articulated and/or with wagons as an option	Special articulated bus with at-floor boarding and wide doors	Articulated buses; pre- paid boarding required	Standard City Bus, articulated as option	Standard City Bus
Passengers per Vehicle/Train	1,200-2,500	250-1,500	Depends on length	180-240	150-180	75-100	75
Traction	Electric	Electric	Electric	Diesel	Diesel (Electric as an option)	Diesel	Diesel
Feeder System	Necessary	Necessary	Not necessary	Necessary	Desired	Not necessary	Not necessary
Flexibility of route changes	Very low	Low	Low	Very low	Medium	Medium	Very high
Ticketing System	Closed	Closed	Open	Closed	Closed or open	Open	Open

Source: Guidelines and Toolkits for Urban Transport Development Module 1 Comprehensive Mobility Plan.

8.2.14. Urban Buses and characteristics

MoUD¹⁴⁸ has established different types of buses for urban services. The following table defines the characteristics and floor height of different urban buses.

Table 8.21: Types of urban buses and their characteristics

S.No.	Bus Types	Bus Characteristics	Low floor definition
1	Standard size urban bus (AC/Non-AC)	Maximum floor height: 400/650/900 mm	Low floor area shall not be less than 50% of the total saloon area (excluding front wheel boxes and driver's cab) and shall not be ramped in the longitudinal plane.
2	Mini and Midi urban buses (AC/Non-AC)	Maximum floor height 900 mm with inclusion of variants of having floor height of 400 mm and 650mm	Low floor area shall not be less than 50% of the total saloon area (excluding front wheel boxes and driver's cab) and shall not be ramped in the longitudinal plane.
3	Standard BRTS bus (AC/Non-AC)	Maximum floor height:400/650/900 mm	Floor height of 400, 650 or 900 mm shall be uniform inside the vehicle.
4	Mini BRT Bus	Floor height of 400, 650 or 900 mm shall be uniform inside the vehicle	Low floor area shall not be less than 50% of the total saloon area (excluding front wheel boxes and driver's cab) and shall not be ramped in the longitudinal plane.
5	Midi BRT Bus	Floor height of 400, 650 and 900 mm shall be uniform inside the vehicle	Low floor area shall not be less than 50% of the total saloon area (excluding front wheel boxes and driver's cab) and shall not be ramped in the longitudinal plane.
6	Standard Bus of Premium Segment (Air conditioned)	Maximum floor height:900 mm	Low floor area shall not be less than 50% of the total saloon area (excluding front wheel boxes and driver's cab) and shall not be ramped in the longitudinal plane.
7	Midi Bus of Premium Segment (Air conditioned)	Maximum floor height:900 mm	Low floor area shall not be less than 50% of the total saloon area (excluding front wheel boxes and driver's cab) and shall not be ramped in the longitudinal plane.
8	Articulated BRTS Bus (AC /Non -AC)	Maximum floor height: 900 mm	Floor height shall be uniform inside the vehicle
9	Bi-articulated BRTS Bus (AC/Non -AC)	Maximum floor height:900 mm	Floor height shall be uniform inside the vehicle

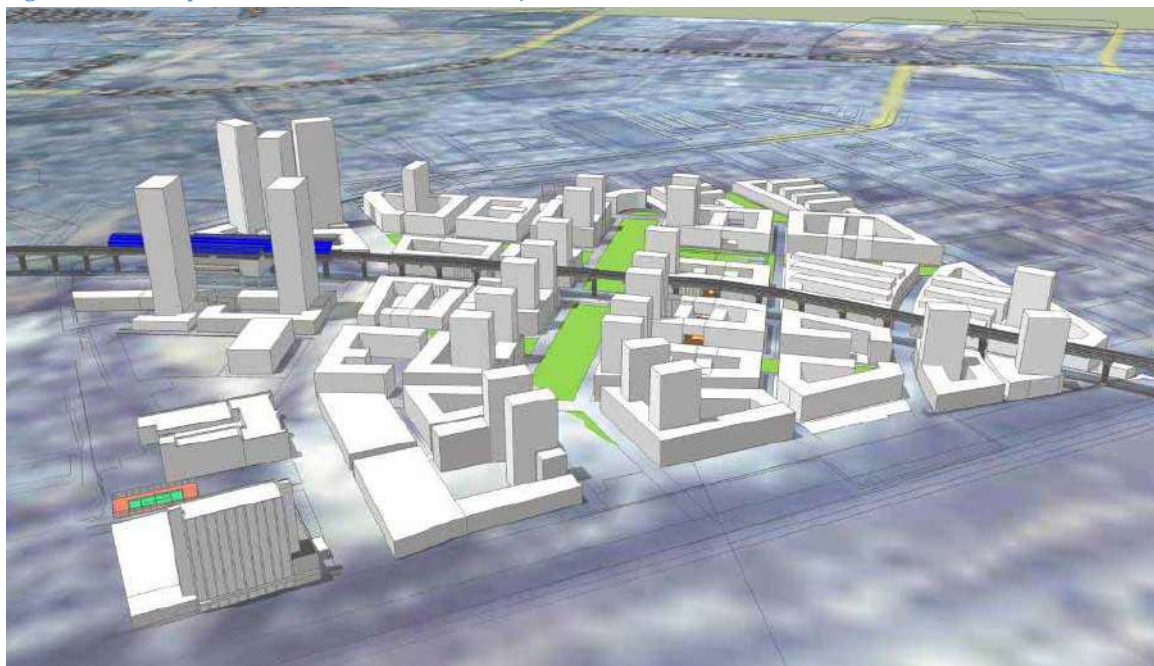
8.2.15. TOD Norms

Transit Oriented Development is a development, macro or micro that is focused around a transit node, and facilitates complete ease of access to the transit facility thereby inducing people to prefer to walk and use public transportation over personal modes of transport¹⁴⁹.

¹⁴⁸ Recommendatory Urban Bus Specifications, MoUD 2013.

¹⁴⁹As per Draft UTTIPEC Guidelines of DDA.

Figure 8.1: Proposed Karkardooma TOD Project



Source: <http://uttipec.nic.in/writereaddata/linkimages/6080492270.pdf>

Region and Transit-Oriented Development arises from investment in infrastructure that guides the urban growth of the city and is suggested as one of the approaches in the regional & urban planning approach Chapter 4 and 5 respectively of the guidelines. Typically, TOD involves implementing or strengthening a mass transit system with development focused on major transport nodes (which can be planned at regional level or city level). This strategy supports the objective of achieving a desirable modal split of 50-70% as advised¹⁵⁰.

Mass transit can be strengthened by:

- Enhancing the public transport network by careful and robust selection of an optimum mass transit system, including bus service improvements, bus rapid transit (BRT), and/or rail-based solutions; and
- Developing an integrated public transport system that combines modes and services through interchanges and feeder services, rationalises existing services, and improves passenger dispersal at terminals

Cities with strong Central Business Districts (CBDs) are generally good candidates for transit-oriented development. Trips can take place along radial axes between the CBD and suburban communities, with concentrated mixed use development around the suburban nodes. TOD can be facilitated by identifying major corridors and investing in them as primary mass transit corridors. This can be undertaken with reference to analysis of travel demand and desire line patterns from the modelling exercise.

¹⁵⁰“Traffic and Transportation Policies and Strategies in Urban Areas in India”, 1998, MoUD, GoI.

8.2.15.1. Demarcation of the TOD Influence Zone¹⁵¹

TOD is a new concept introduced in India. Currently UTTIPEC (a subdivision of Delhi Development Authority DDA) has developed draft policy norms and guidelines for TOD. Some of the key aspects related to demarcate TOD zone is given below:

1. A maximum up to 2000 m. wide belt on both sides of centre line of the MRTS Corridor is designated as TOD Influence Zone, which should also be identified in Development Plan of a city.
2. The entire influence zone shall be considered as “white zone”. Application of Development Control Norms in the White Zone shall be compliant with TOD norms as stated in TOD guidelines (approved by competent Authority). Final boundaries of Influence Zones shall be demarcated as per the Influence Zone Plans.
3. The overall Influence Zone further consists of three sub zones – Zone 1: Intense TOD Zone, Zone 2: Standard TOD Zone, and Zone 3: TOD Transition Zone.
4. Development Control Norms as per UTTIPEC TOD norms apply to all three TOD zones.
5. Development Control Norms of High Density Mixed Income Development shall not be applicable to the TOD Transition Zone.
6. All properties public or private shall be able to avail the norms and benefits of TOD while complying to an approved Influence Zone Plan, However exception can be identified where:

Height restriction has already made.

Flight funnel zones shall follow the height restrictions as per regulations of Airport Authority of India.

Environmentally sensitive zones for protection (Environment Protection Zones)

Seismic Zones such as fault lines.

Table 8.22: TOD Influence Zones

Zone 1: Intense TOD Zone	Zone 2: Standard TOD Zone	Zone 3: TOD Transition Zone
300m influence zone of all MRTS Stations	800m* (10-min walking)influence zone of all MRTS Stations.	2000m** (10-minute cycling distance) influence zone of all MRTS Stations.
800m* (10-min walking)influence zone of Regional Interchange Station (i.e. Rail-MRTS, or two MRTS lines.)		300m influence zone of BRT corridors.
		Zones within Intense (zone 1) or Standard TOD Zones which are not permitted for redevelopment but need enhancements in public realm and network connectivity.

Source: Draft Transit Orient Development – Policy, Norms, Guidelines, UTTIPEC

8.2.15.2. Development Types within Influence Zones¹⁵²

Broadly the types of planned and unplanned development which may fall within the Zone 1: Intense TOD influence zones and Zone 2: Standard TOD may be categorized into three broad categories:

Redevelopment/ Infill – Sites within the Intense/ Standard TOD Zones are those within Existing Urban Area and suitable for development/ redevelopment.

7. Infill Sites are empty sites within Existing Urban Area, which may have opened up for development.
8. Redevelopment sites could be any of the following:
 - i. Low density areas
 - ii. Shopping/ Commercial centres
 - iii. Industrial areas/ clusters

¹⁵¹ Draft Transit Orient Development – Policy, Norms, Guidelines, UTTIPEC.

¹⁵² Ibid.

- iv. Resettlement Colonies
- v. Unauthorized colonies
- vi. Urban Villages
- vii. JJ clusters

Greenfield – Sites within the Intense/ Standard TOD Zones which are in the Urban Extension Area where provision of road networks, services and social facilities has not yet taken place.

Retrofit – In addition to TOD Transition Zones, sites within Intense/ Standard Zones which have existing gross density higher than 250 du/ha may not be suitable for redevelopment, but may need retrofitting to meet TOD Zone requirements. The following criteria may be used as benchmarks for selecting such dense sites for need for retrofitting:

1. Lack of street network and connectivity
2. Lack of fire access to buildings.
3. Lack of adequate physical and social infrastructure facilities.

Hence, depending upon the requirement of the area, to which TOD is applied, the influence zone plan is to be prepared.

8.2.15.3. Influence Zone Plan

A Detailed Influence Zone Plan is a document that provides a framework and vision for future TOD development for MRTS. Any public or private development within the Influence Zone Plan Areas must adhere to the overall strategies, framework and benchmarks provided by the Plan. The Plan shall be prepared or be approved by the competent Planning Authority for each influence zone area in a phased manner, customized to site characteristics and context. The plan shall include the following components:

- 1. Urban Design Framework** – This would include:
 - Street Network Plan indicating street hierarchy and character
 - Landscape and Open Space Structure indicating type of open spaces and distribution of play areas. To include planting strategy for all street trees.
 - Net FAR and residential densities for each block within the Influence Zone
 - Vertical mix of uses for each TOD parcel indicating location of civic amenities within mixed –use blocks (refer Chapter 9 for mixed zone use). To include location of ‘unbundled’ parking sites for shared use.
 - Three-dimensional site briefs for each block within the Influence Zone indicating recommended massing and organisation of uses.
 - Location and numbers of short and long term parking spaces
- 2. Transport Impact Assessment& Mitigation Strategies** – This would include strategies for:
 - Achieving the desired modal shift, in particular mode shift for short trips
 - Street network improvement through assessment of existing capacity and augmentation of network as required through new linkages, alternate routes, junction designs etc. for all modes with priority for intermediate public transport, pedestrians, cyclists / NMT.
 - Integrated strategy for Public transport, Pedestrian and Cycle access
 - Determining the optimum mix of uses to mitigate negative impact on surrounding land uses and transport networks
 - Parking Strategy as a Demand Management Tool
 - Mitigation strategies for traffic noise and vibration

The Draft TOD Guidelines and Norms of UTTIPEC are under finalization. In the context of MPD-2021 provisions which spell out that a 500 m wide belt from the centreline of MRTS corridors/major transport axis shall be designated as the “influence zone”. The Guidelines and Norms have been included under the Chapter on **Transportation**, which is under revision as part of MPD-2021 review exercise.

It is important to appreciate that TOD is a value-addition over and above mixed-use streets and the Land-Pooling policy in the sense that provides for multiple uses within the same building along with higher FAR provisions so as to promote intensive development along MRTS corridors/major transport axis which will induce people to use Public Transport and do away with personalized vehicular modes. However, TOD has to be designed case-to-case basis and cannot be a default function.

Figure 8.2: Proposed Karkardooma TOD Project



Source: <http://uttipec.nic.in/writereaddata/linkimages/6080492270.pdf>

3. Decentralized Infrastructure and Sustainability Plan – This would include:

Water and Waste Water management strategy including recycling and re-use of waste water. To include strategy for both potable and non-potable water.

Rain water strategy, to be integrated with the Landscape and Public Open Space Strategy

Solid Waste Management Strategy

Energy Strategy maximising use of renewable sources

Integrated Infrastructure and Services Systems Plan indicating space requirements for all infrastructure

4. Economic Viability and Implementation Model – This would include:

Determining a financially profitable mix of uses based on the current demand and supply, coupled with the projected land values for the TOD zone. To include cost delivering of Social and Physical infrastructure

Determining a financial model and delivery mechanism for affordable housing, public infrastructure and public transport facilities through mechanisms of cross subsidy, FAR benefits or any other possible benefit that the TOD authority can give.

Strategy for revenue collection from the TOD zone based on the benefits enjoyed by a piece of land lying within the TOD zone. To determine total profit generated from the TOD Zone in a phased manner for individual owners, consortiums and TOD administration.

Determining appropriate mechanisms for land-pooling by individual plot holders to avail the benefits of TOD based on the specific characteristics of the site.

Determining the structure of the administrative body of the TOD zone and the cost of operation of the body.

Strategy for implementing the TOD policy in the TOD zone through the principle of award and penalty.

Note: After preparation of Influence Zone Plans for Urban Extension areas, the TOD Zones shall accommodate substantially greater proportion of the population of planned areas of Zonal Plans, which may therefore require subsequent modification.

8.2.15.4. Redevelopment Criteria and Minimum Project Size Criteria¹⁵³

Policy:

- Redevelopment within developed areas of the city would be permitted only when an overall Influence Zone Plan has been prepared for the Station. This is to ensure that local street networks, physical and social infrastructure and shared parking facilities have been planned for the area, before densification commences.
- For achieving higher FAR it would be desirable to incentivize amalgamation of plots as well as make appropriate amendments in the bye laws, as per TOD norms. However, though amalgamation is desirable but it may not be a pre-requisite. Densification should be allowed in all plot sizes subject to the project complying with the approved Influence Zone Plan, so that incremental development and densification can start taking place.
- It is highly inappropriate to allow land banking in TOD zones. Penalties such as vacant land tax, etc. on underutilized land and/or underutilized FAR could be levied, in order to ensure time bound densification along with MRTS corridor. Such penalties should apply to all developers as well as Govt. bodies, to even inefficient use of valuable land.

Norms:

1. If Influence Zone layout plan for the station area does not exist, no individual developments with TOD norms shall be permitted.
2. If Influence Zone Plan for the station area exists:
 - i. Any projects size of equal or more than 50 Ha may be taken up for development/ infill or redevelopment, if in adherence to the influence zone plan prepared by the Planning Authority.
 - ii. Individual buildings shall be given sanction by the concerned authority within the framework of the overall influence zone plan.
 - iii. For projects accommodating more than 5000 residential population, the residents/ cooperative societies/private developers should get the detailed layout and services plan prepared in consultation with the concerned authority for final approval.

¹⁵³Draft Transit Orient Development – Policy, Norms & Guidelines, UTTIPEC.

8.2.15.5. TOD Development Control Norms¹⁵⁴

The TOD mainly has 6 components for which the DCR is to be developed by development authorities. These components are as following:

1. Pedestrian & Cycle/ Cycle-Rickshaw Friendly Environment
2. Connectivity: Create dense networks of streets and paths for all modes.
3. Multi-modal Interchange: Mass transportation modes servicing the area should be well integrated to afford rapid and comfortable modal transfers.
4. Modal Shift Measures: Shift to Sustainable Modes by using Design, Technology, Road Use Regulation, Mixed-Use, Parking Policy and Fiscal Measures
5. Placemaking and Safety: Urban places should be designed for enjoyment, relaxation and equity.
6. High Density, Mixed-Income Development: Compact Neighbourhoods for Shorter Commutes and equity for all sections of society.

Policy details and development norms for each of the above components are provided in Draft Transit Orient Development – Policy, Norms, Guidelines issued by UTTIPEC¹⁵⁵, which is the only guideline available in India at present and can be referred for TOD projects. In addition, ITDP mentions principal and objectives of TOD in its version 2.0 of ‘TOD Standards’ and provides project eligibility criteria and its scoring. However, any latest and more comprehensive document and case studies can also be referred for this exercise.

8.2.16. Non-Motorised Vehicles (NMV)

As per Guidelines and Toolkits for Urban Transport Development in Medium Sized Cities in India prepared by MoUD and ADB, Non-Motorised Transport (NMT) measures proposed by an Indian city should conform to existing policy at National, State and City level. National Urban Transport Policy has also encouraged using NMVs by offering Central financial assistance for this purpose. As per MoUD guidelines, NMVs can be promoted through the following initiatives:

- Providing better facilities to accommodate existing NMV use and encourage more NMVs through visible infrastructure;
- Developing a strategic NMV plan including a network of routes available to NMVs throughout the city;
- Segregating NMVs/MVs to improve safety and smooth passage of NMVs;
- Promoting freight NMVs for the transport and delivery of small goods to markets and shopping areas;
- Identifying sub-projects which make positive, pro-active provision for NMVs as part of a balanced approach to traffic planning;
- Giving NMVs priority over MVs on selected routes and in selected areas;
- Strengthening Road User Education (RUE) programmes for NMV users to improve behaviour and road safety;
- Rationalising and improving NMV registration, licensing for use as a Public Transport or freight vehicle, regulation and enforcement
- Encourage NMV by improving women’s access.

¹⁵⁴ Ibid.

¹⁵⁵ The document is available at www.uttipee.nic.in.

Various initiatives and programmes taken-up by Ministry of Road Transport and Highways in this direction.

It has also been suggested by MoUD that NMV measures can be implemented either as mandatory or advisory. Mandatory measures are 'formal' and require to be backed up by appropriate traffic regulations. For example, part of the highway may be designated for NMVs only. Advisory measures are usually designed to encourage NMV use, or where mandatory measures are difficult to implement due to the requirement of traffic regulations or the practicalities of accommodating motorized vehicles within limited road space. For example, part of the highway may be allocated for NMVs, but MVs would be allowed to encroach for side accesses or when traffic volume is high. Even advisory measures can incur costs such improved road surfacing or removal of physical obstructions to ensure that NMV passage is smooth and comfortable.

MoUD has also recommended that segregation of NMVs and Motor Vehicles (MV) is well suited for Indian scenario. Segregated NMV measures can take the form of dedicated lanes within the highway (with physical dividers or simple line demarcation) either with-flow or contra-flow, and streets that prohibit motor vehicles. Mixed flow measures allow all types of traffic to mix within the highway and are typically a do-nothing or minimum case, though some treatments can be implemented to improve the comfort level of NMVs or provide priority, e.g. at intersections. It also offers safe and efficient network for NMVs.

8.2.17. Road Safety

Road safety is to include design strategies for elements that make up the urban environment at various scales must be clearly articulated, and must be integrated with relevant development regulations (Development Plan, Local Area Plans, Urban Design Guidelines, etc.)¹⁵⁶. A checklist of road safety indicators is provided in Appendix K of Volume II B for ready reference. The principle of road safety to be included at Regional planning level (Mobility 1), Development Plan Preparation level with CMP (Mobility 2) and local area plan level to create safe infrastructure.

8.2.18. Special Requirements for Barrier Free Built Environment for Differently abled and Elderly Persons¹⁵⁷

Barrier free environment is one, which enables people with disabilities to move about safely and freely and to use the facilities within the built environment. The goal of barrier free design is to provide an environment that supports independent functioning of individuals so that they can get to and participate without assistance

¹⁵⁶ Working Paper on 'Urban Development and Road Safety', Embarq, India.

¹⁵⁷ Guidelines, NBC, pg 47-48.

in everyday activities such as procurement of goods and services, community living, employment and leisure.

- Public walks should be minimum 1.2 m wide with a maximum gradient of 1 in 20
- Parking spaces for individuals with physical disabilities when placed between two conventional diagonal or head on parking spaces should be 3.6 m to 3.8 m wide and the length of the aisle should 7.3m, 6.3m and 6.5 m for head on, 90° and 60° parking respectively.
- Buildings- Ramps with gradients: A ramp should have a maximum slope of 1 in 20 or maximum of 1 in 12 for short distance up to 9 m. Other details of ramp shall be referred from NBC 2005.
- Use of Tactile paving and ensuring continuous pavement

For designing elements within the building premises, the norms as given in the Guidelines for Barrier Free Built Environment shall be applicable.

8.2.19. Inland Water Transportation

Water based transport is effective as operating costs of fuel are lower and environmental pollution is lower than for corresponding volumes of movement by road, rail or air. A major advantage is that the main infrastructure, i.e. the waterway is often naturally available¹⁵⁸.

In India, a number of central and state agencies play crucial role in the regulation, operation and sustenance of Inland Water Transport (IWT). Their smooth functioning is required for IWT to be viable. Some of the actors in this sector are given below.

- Inland Waterways Authority of India (IWAI)
- Central Inland Water Transport Corporation (CIWTC)
- State governments
- Port authorities
- Transport development agencies
- Customers

As per constitutional provisions, only those waterways, which are declared as National Waterways, come under the purview of Central Government while rest of waterways remain in the purview of respective State Government. Since formation of IWAI, waterways namely:

1. Ganga
2. Brahmaputra
3. West Coast Canal with Udyogmandal and Champakara Canals
4. Kakinada-Puducherry Canals system along with Godavari and Krishna rivers
5. East Coast Canal with Brahmani River and Mahanadi delta
6. Barak river

The National Transport Policy Committee (1980) recommended the following principles for declaration of a National Waterway.

- It should possess capability of navigation by mechanically propelled vessels of a reasonable size.

¹⁵⁸ Rangaraj N and Raghuram G, Viability of Inland Water Transport in India, <http://www.ieor.iitb.ac.in/files/faculty/narayan/transport/iwt-tec-rep-oct-05.pdf>.

- It should have about 45 m wide channel and minimum 1.5m depth.
- It should be a continuous stretch of 50 km. The only exception to be made to waterway length is for urban conglomerations and intra-port traffic.
- It should pass through and serve the interest of more than one State (or).
- It should connect a vast and prosperous hinterland and Major Ports (or).
- It should pass through a strategic region where development of navigation is considered necessary to provide logistic support for national security (or).
- It should connect places not served by any other modes of transport.

As per IWAI, the waterways shall be classified in the following categories for safe plying of self-propelled vessels up to 2000 Tonnes dead weight tonnage and tug barge formation in push-type units of carrying capacity up to 8000 tonnes.

Table 8.23: Waterways Classification

S.No.	Class	River	Canal
1	Class-I	Minimum 1.2 metre depth, 30 metre bottom width, 300 metre bend radius, 4 metre vertical clearance and 30 metre horizontal clearance between piers	Minimum of 1.5 metre depth, 20 metre bottom width, 300 metre bend radius, 4 metre vertical clearance and 20 metre horizontal clearance between piers
2	Class-II	Minimum 1.4 metre depth, 40 metre bottom width, 500 metre bend radius, 5 metre vertical clearance and 40 metre horizontal clearance between piers	Minimum of 1.8 metre depth, 30 metre bottom width, 500 metre bend radius, 5 metre vertical clearance and 30 metre horizontal clearance between piers
3	Class-III	Minimum 1.7 metre depth, 50 metre bottom width, 700 metre bend radius, 7 metre vertical clearance and 30 metre horizontal clearance between piers	Minimum of 2.2 metre depth, 40 metre bottom width, 700 metre bend radius, 7 metre vertical clearance and 40 metre horizontal clearance between piers
4	Class-IV	Minimum 2.0 metre depth, 50 metre bottom width, 800 metre bend radius, 10 metre vertical clearance and 50 metre horizontal clearance between piers	Minimum of 2.5 metre depth, 50 metre bottom width, 800 metre bend radius, 10 metre vertical clearance and 50 metre horizontal clearance between piers
5	Class-V	Minimum 2.0 metre depth, 50 metre bottom width, 800 metre bend radius, 10 metre vertical clearance and 80 metre horizontal clearance between piers in case of rivers only.	NA
6	Class-VI	Minimum 2.75 metre depth, 80 metre bottom width, 900 metre bend radius, 10 metre vertical clearance and 80 metre horizontal clearance between piers	Minimum of 3.5 metre depth, 60 metre bottom width, 900 metre bend radius, 10 metre vertical clearance and 60 metre horizontal clearance between piers
7	Class-VII	Minimum 2.75 metre and above depth, 100 metre and above bottom width, 900 metre bend radius, 10 metre vertical clearance and 100 metre horizontal clearance between piers in case of rivers only	NA

Source: The Inland Waterways Authority of India Act, 1985.

There are only few states, which have undertaken the initiatives to develop waterways as transport medium. Such states are Assam, Goa, Kerala, Maharashtra (Mumbai), West Bengal, and some other coastal areas (where it has natural advantage and no developmental intervention is needed).

8.2.20. Airport Planning

Airport planning is a systematic process used to establish guidelines for the efficient development of airports that is consistent with local, state and national goals. A key objective of airport planning is to assure the effective use of airport resources in order to satisfy aviation demand in a financially feasible manner. An airport has different elements, which required space; however it may vary (depending on the passenger traffic which is the essential parameter to determine the size of airport). Such overall required space should be integrated with development plan in order to minimise the effect at later stages of planning. Airport consist of different elements, such elements are:

1. Runway
2. Taxiway
3. Terminal Building
4. Ancillary buildings which include Cargo Terminal, Fire fighting Station, Fuel farm
5. Aprons
6. Hanger
7. Air Traffic Control Tower etc.
8. Road infrastructure which includes Airside road and land side road, and
9. Other Infrastructural facilities such STPs, WTPs.

8.2.20.1. Airport Land Requirement

The following table assembled by International Air Transport Association (IATA)¹⁵⁹ provides the approximate land requirement based on passenger movement, number of runways, cargo movement etc. in order for airport planners and airport authorities (could be used for development planning as well) to understand the scale of the site required for airport infrastructure development. These cover the above mentioned elements and should be used for rough estimation purposes only. However these figures may vary depending upon the local topography, type of aircraft for which airfield is to be designed etc.

Table 8.24: Approximate Land Requirement for Airport infrastructure

Airport (Asia & Pacific)	No. of Runways	Total Annual Mvts.	Total Annual Passengers (mppa)	Total Annual Cargo.	Land Area (ha)
Sydney (SYD)	3	307,058	25.7	573,880	887
Hong Kong (HKG)	2	193,895	32.7	2,240,585	1,255
Singapore Changi Airport (SIN)	2	184,533	28.6	1,680,000	1,300
Narita International Airport (NRT)	2	133,396	27.3	1,932,694	1,084
Kansai International Airport (KIX)	1	122,916	19.4	999,692	510

Source: Airport Development Reference Manual, 9th edition, IATA.

¹⁵⁹Airport Development Reference Manual, IATA.

8.2.20.2. Unit area norms for Airport Terminal¹⁶⁰

Overall space/area norm should be such as to provide a reasonable level of service for all components required in a Terminal Building. Commercial or Retail area providing amenities like food & beverages, book shops, counters for car rental, vending machines, public rest rooms etc., normally require 8-12 per cent of the overall area, and should be planned and provided accordingly. This shall be considered as the built-up area by the planners while providing indoor infrastructure facilities and trunk infrastructure capacity.

In bigger airports, i.e., with annual passenger traffic exceeding 10 million, commercial area could be up to 20 per cent of overall area.

Table 8.25: Norms for Airport Terminals

Sl. No.	Nature of Terminal	Area Norm – Sqm/ peak hour passenger (php)
1	Domestic Terminals	
	Traffic up to 100 php	12
	Traffic between 100-150 php	15
	Traffic between 150-1000 php	18
	Traffic above 1000 php	20
2	Integrated terminal for handling both domestic and international	25
3	International Terminals	27.5

8.3. Physical Infrastructure

8.3.1. Water Supply

The objective of a public protected water supply system is to supply safe and clean water in adequate quantity, conveniently and as economically as possible. Rising demand of water due to rapid urbanisation is putting enormous stress. While planning the water supply system for an area, it is evident to consider water conservation aspects, which may be possible through optimal use of available water resources, prevention and control of wastage of water and effective demand management.

¹⁶⁰ Norms & Standards for Capacity of Airport Terminals, Planning Commission, Government of India.

8.3.1.1. Water Supply Standards

The water supply standards as indicated by the CPHEEO are detailed in Table 8.26.

Table 8.26: Water Supply Standards

S.No.	Classification of town/cities	Recommended maximum water supply levels (lpcd)
1	Towns provided with piped water supply but without sewerage system	70
2	Cities provided with piped water supply where sewerage system is existing / contemplated	135
3	Metropolitan and Mega cities provided with piped water supply where sewerage system is existing/contemplated	150

Source: CPHEEO Manual, 1999.

Notes:

- i. In urban areas, where water is provided through public stand posts, 40 lpcd should be considered
- ii. Unaccounted-for Water (UFW) is the difference between the quantity of water supplied to a city's network and the metered quantity of water used by the customers. UFW has two components: (a) physical losses due to leakage from pipes, and (b) administrative losses due to illegal connections and under registration of water meters. The above figures exclude UFW, which should be limited to 15% for new proposed systems.
- iii. Water requirement for the town/city will be 135 to 150 lpcd. However, water requirement for institutional buildings should be as specified in Table 8.27.
- iv. The water needs of the town will be partially met by making provision of Rain Harvesting Structures in all the buildings.
- v. Figures include requirements of water for commercial, institutional and minor industries. However the bulk supply to each establishment should be assessed separately with proper justification.
- vi. Piped water supplies should be designed on continuous 24 hours basis to distribute water to consumers at adequate pressure at all points (using grid supply system of a Smart city).
- vii. For towns where one storeyed building is common and for supply to the ground level storage tanks in multi-storeyed buildings, the minimum residual pressure at ferrule point should be 7m for direct supply. Where two storeyed buildings are common, it may be 12m and where three storeyed buildings are prevalent 17m or as stipulated by local byelaws.
- viii. The consumption of water when supply is metred is less compared to that when the water charges on flat rate basis. Hence in order to achieve optimal utilisation of water, metering is recommended.
- ix. CPHEEO manual specifies design period for various components, broadly 30 years for civil works and 15 years for electro-mechanical works. In fixing a design period, the useful life of structures and equipment employed, taking into account obsolescence as well as wear and tear, design constraints, rate of population growth etc. should be incorporated and integrated with overall planning of the city.
- x. PPP should be encouraged and could be introduced in phases, either on Build, Operate and Own (BOO) or Build, Operate, Own and Transfer (BOOT) basis. Primarily, it is possible in two ways i.e. privatization of the existing water supply systems and secondly, privatization of systems in newly developed townships, housing colonies, business and commercial complexes, etc.

8.3.1.2. Fire fighting

The CPHEEO Manual recommends fire-fighting water demand as a function of population, i.e. water demand for fire-fighting purpose = $100\sqrt{P}$, where P stands for forecasted population may be adopted for communities larger than 50,000. It is desirable that one-third of fire-fighting requirements from part of the service storage. The balance requirement may be distributed in several static tanks at strategic points. These static tanks may be filled from nearby ponds, streams or canals by water tankers wherever feasible. The pressure required for fire-fighting would have to be boosted by fire engines.

8.3.1.3. Institutional Buildings

Table 8.27: Water requirements for Institutional Buildings – CPHEEO, 1999

S. No.	Institutions	Litres per head per day
1	Hospital (including laundry) a. no of beds exceeding 100 b. no. of beds not exceeding 100	a. 450 (per bed) b. 340 (per bed)
2	Hotels	180 (per bed)
3	Hostels	135
4	Nurses homes and medical quarters	135
5	Boarding schools/colleges	135
6	Restaurants	70 (per seat)
7	Airport and seaports	70
8	Junction stations and intermediate station where mail or express stoppage (both railway and bus stations) is provided	70
9	Terminal stations	45
10	Intermediate stations (excluding mail and express stops)	45 (could be reduced to 25 where bathing facilities are not provided)
11	Day Schools/colleges	45
12	Offices	45
13	Factories	45 (could be reduced to 30 where no bathing rooms are required to be provided)
14	Cinema, concert halls and theatres	15

Source: CPHEEO Manual, 1999.

8.3.1.4. Industrial Units

Table 8.28: Water requirement for Industrial Units

Industry	Unit of Production	Water Requirement in Kilolitres per unit
Automobile	Vehicle	40
Distillery	Kilolitre (proof alcohol)	122-170
Fertilisers	Tonne	80-200
Leather	100 kg (tanned)	4
Paper	Tonne	200-400
Special Quality paper	Tonne	400-1000
Straw board	Tonne	75-100

Industry	Unit of Production	Water Requirement in Kilolitres per unit
Petroleum refinery	Tonne (crude)	1-2
Steel	Tonne	200-250
Sugar	Tonne	1-2
Textile	100 kg (goods)	8-14

Source: CPHEEO Manual, 1999.

8.3.1.5. Station water requirements

Water requirement for the Station for various uses (per day):

- 15 litres per passengers (Metcalf Eddy)
- 455 litres per employee (ref: CPHEEO Manuals)
- Apron washing – 10 litres per sq meters as per Indian Railways Work Manual (IRWM)
- Cleaning/ mopping of platform and floor – 5 litres per sqm.
- Meters and greeters – 5 litres per visitor
- Catering – 45 litres per passengers
- Gardening/ Horticulture – 22500 litres per hectares (IRWM)
- Cleaning of trains on platform – 500 litres per coach (IRWM)
- Cleaning of trains in washing lanes – 3600 litres per coach (IRWM)
- Watering of trains – 1800 litres/ coach (IRWM)
- Fire-fighting (CPHEEO Norms)
- Commercial -45000 litres per hectares per day (IRWM)
- UFW – 15% of total demand for new system (CPHEEO)
- 75% of total capacity shall be filled at the station for long haul trains (passing trains)

Water requirement for metro station could be calculated based on the type of station (underground or elevated). In absence of any specific norms to calculate water demand for metro station, the water estimations can be calculated from the above mentioned information for stations. Parameters such as staff requirement, HVAC requirement if station is underground, toilet requirement and passenger requirement to be considered based on the facilities provided at metro stations.

8.3.1.6. District Meter Area Planning (Bulk metering)

The term ‘district metering’ is used to describe the method whereby flow meters are installed on all major supply lines and strategic points within the distribution system. The meters should be used to monitor the overall performance of the system establishing average daily flows into various districts. District meter areas ideally consist of 2000 to 5000 properties.

Size of the district meter should be such that it is capable of recording night flow without loss of accuracy and also must be capable of supplying peak flow without introducing serious head loss.

The District Meters should be read at weekly intervals at the same time of day as previous readings of the meter.

8.3.1.7. Billing and Collection

Revenue management system is an important aspect of any Water supply System as it governs the financial aspect. Besides fixing a tariff structure, billing and collection of revenue play an important part.

The water charges to be fixed taking into account the ability of the system to meet the expenditure on the following heads.

- Operating Cost (excluding establishment cost),
- Establishment Cost,
- Depreciation,
- Debt Services & Doubtful Charges,
- Asset replacement fund.

Tariff structure should be fixed and revised periodically. Automatic increase of tariff periodically on index basis can also be adopted. Where the same authority also provides sewerage system, charges for this can also supply through Public stand post, may be charged and also be included as a percentage of the water charges.

There are various methods by which Water Billing can be done. The user is advised to refer 'Manual on Operation and Maintenance of Water Supply Systems' of CPHEEO while fixing the tariff, billing process and collection system.

8.3.1.8. Leakage Control

The overall objective of leakage control is to diagnose how water loss is caused and to formulate and implement action to reduce it, to technically and economically acceptable minimal.

The water losses can be termed into two categories i.e. Physical losses and Non-Physical Losses. The Physical Losses is mainly due to leakage of water in the network and comprises of physical losses from pipes, joints & fittings, reservoirs & overflows of reservoirs & sumps. The Non-Physical Losses is due to theft of water through illegal, already disconnected connections, under-billing either deliberately or through defective meters, water wasted by consumer through open or leaky taps, errors in estimating flat rate consumption, public stand posts and hydrants.

The major activities which should be taken up for efficient monitoring and leakage control are:

- **Preliminary data collection and planning** – The water distribution drawings are to be studied and updated. The number of service connections is to be obtained and in the drawings of the roads the exact locations of service connections marked. The district and sub-district boundaries are suitably fixed taking into consideration the number of service connections, length of mains, and pressure points in the main. The exact locations of valves, hydrants with their sizes should be noted on the drawings.
- **Pipe location and survey** – Electronic pipe locators can be used during survey. These instruments work on the principle of Electromagnetic signal propagation. It consists of a battery

operated transmitter and a cordless receiver unit to pick up the signals of pre-set frequency. There are various models to choose from.

- **Assessment of pressure and flows** – Data loggers are used to record the pressure and flows. It is an instrument which stores the raw data electronically so as to be able to transfer it to the computer with a data cable link. Two types of portable data loggers are used either with a single channel or dual channel. In the absence of electronic equipment, the pressures can be ascertained by tapping and providing a pressure gauge. Flows can be assessed by using meters on a bypass line.
- **Locating the leaks** – Walking and sounding are the two general methods or their combination can be used to detect possible location of leakages. Leakage can be detected by walking over the main looking for tell-tale signs of presence of water. Whereas sounding is the cheapest and an effective method of detecting leaks in a medium - sized water supply system. The equipment used for detecting leakages is described in in 'Manual on Operation and Maintenance of Water Supply Systems' of CPHEEO.
- **Assessment of leakage** – To conduct tests for assessment of leak the following equipment are needed :
 - Road measurer
 - Pipe locator
 - Valve locator
 - Listening sticks or sounding rods
 - Electronic sounding rods

Each method mentioned above is described in 'Manual on Operation and Maintenance of Water Supply Systems' of CPHEEO and can be referred during formulation of the strategy.

8.3.1.9. Water Quality Standards

The water quality standards as prescribed by the Indian Standard Organisation are tabulated below:

Table 8.29: Organoleptic and Physical Parameters of Drinking Water

S. No.	Characteristics	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source	Method of Test, ref. to part of IS 3025	Remarks
1	Colour, Hazen units, Max	5	15	Part 4	Extended to 15 only, if toxic substances are not suspected in absence of alternate sources
2	Odour	Agreeable	Agreeable	Part 5	Test cold and when heated Test at several dilutions
3	pH Value	6.5-8.5	No relaxation	Part II	-
4	Taste	Agreeable	Agreeable	Parts 7 and 8	Test to be conducted only after safety has been established
5	Turbidity, NTU, Max	1	5	Part 10	-
6	Total dissolved solids, mg/l, Max	500	2000	Part 16	-

Source: IS 10500: 2012.

Note: It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under 'acceptable' render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source' in col.4, above which the sources will have to be rejected.

Table 8.30: General parameters concerning substances undesirable in excessive amounts in drinking water

S No.	Characteristics	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source	Method of test, Ref. No.	Remarks
1	Aluminium (as Al), mg/l, Max	0.03	0.2	IS 3025 (Part 55)	-
2	Ammonia (as total ammonia-N), mg/l, Max.	0.5	No relaxation	IS 3025 (Part 34)	-
3	Anionic, detergents (as MBAS) mg/l, Max.	0.2	1.0	Annex K of IS 13428	-
4	Barium (as Ba), mg/l, Max.	0.7	No relaxation	Annex F of IS 13428 or IS 15302	-
5	Boron (as B), mg/l, Max	0.5	1.0	IS 3025 (Part 57)	-
6	Calcium (as Ca), mg/l, Max.	75	200	IS 3025 (Part 40)	-
7	Chloramines (as Cl ₂), mg/l, Max.	4.0	No relaxation	IS 3025 (Part 26) or APHA 4500-Cl.G	-
8	Chloride as (Cl)/mg/l, Max.	250	1000	IS 3025 (Part 32)	-
9	Copper (As Cu), mg/l, Max	0.05	1.5	IS 3025 (Part 42)	-
10	Fluoride (as F) mg/l, Max	1.0	1.5	IS 3025 (Part 60)	-
11	Free residual chlorine, mg/l, Min	0.2	1	IS 3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/l.
12	Iron (as Fe), mg/l, Max	0.3	No relaxation	IS 3025 (Part 53)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l)
13	Magnesium (as Mg.), mg/l, Max	30	100	IS 3025 (Part 46)	-
14	Manganese (as Ms), mg/l, Max	0.1	0.3	IS 3025 (Part 59)	Total concentration of Manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
15	Mineral Oil, Mg/l, Max	0.5	No relaxation	Clause 6 of IS 3025 (Part 39) Infrared partition method	-
16	Nitrate (as NO ₂), mg/l, Max	45	No relaxation	IS 3025 (Part 34)	-

S No.	Characteristics	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source	Method of test, Ref. No.	Remarks
17	Phenolic compounds (as C ₆ H ₃ OH)	0.001	0.002	IS 3025 (Part 43)	-
18	Selenium (as Se), mg/l, Max	0.01	No relaxation	IS 3025 (Part 56) or IS 15303	-
19	Silver (as Ag), mg/l, Max.	0.1	No relaxation	Annex J of IS 13428	-
20	Sulphate (as SO ₄), mg/l, Max	200	400	IS 3025 (Part 24)	May be extended to 400 provided that Magnesium does not exceed 30
21	Sulphide (as H ₂ S), mg/l, Max	0.05	No relaxation	IS 3025 (Part 29)	-
22	Total alkalinity as Calcium, Carbonate, mg/l, Max.	200	600	IS 3025 (Part 21)	-
23	Total hardness (as CaCO ₃), mg/l, Max	200	600	IS 3025 (Part 21)	-
24	Zinc (as Zn), mg/lr, Max	5	15	IS 3025 (Part 49)	-

Source: IS 10500: 2012.

Table 8.31: Permissible limits of Toxic Substances

S No.	Characteristics	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source	Method of test, Ref. No.	Remarks
1	Calcium (as Ca) mg/l, Max	0.003	No relaxation	IS 3025 (Part 41)	-
2	Cyanide (as CN), mg/l, Max.	0.05	No relaxation	IS 3025 (Part 27)	-
3	Lead (as Pb), mg/l, Max	0.01	No relaxation	IS 3025 (Part 47)	-
4	Mercury (as Hg), mg/l, Max.	0.001	No relaxation	IS 3025 (Part 47) Mercury analyser	-
5	Molybdenum (as Mo), mg/l, Max	0.02	No relaxation	IS 3025 (Part 2)	-
6	Nickel (as Ni), mg/l, Max	0.07	No relaxation	IS 3025 (Part 54)	-
7	Pesticides, mg/l, Max.	As given above	No relaxation	As given above	-
8	Polychlorinated biphenyls, mg/l, Max	0.0005	No relaxation	ASTM 5175	-
9	Polynuclear aromatic hydro-carbons (as PAH), mg/l, Max	0.0001	No relaxation	APHA 6440	-
10	Total arsenic (as As), mg/l, Max.	0.01	0.05	IS 3025 (Part 37)	-
11	Tribalomethane:				
(a)	Bromoform, mg/l Max	0.1	No relaxation	ASTM D 3973.85 or APHA 6232	-

S No.	Characteristics	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source	Method of test, Ref. No.	Remarks
(b)	Dibromochloromethane, mg/l Max				
(c)	Bromodichloron ethane, mg/l, Max	0.06	No relaxation	ASTM D 3973-85 or APHA 6232	-
(d)	Chloroform, mg/l, Max.	0.2	No relaxation	ASTM D 3973-85 or APHA 6232	-

Source: IS 10500: 2012.

Table 8.32: Permissible Limits of Radioactive Substances

S. No.	Characteristics	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source	Method of test, Ref. No.	Remarks
1	Alpha emitters Bq/l, Max	0.1	No relaxation	Part 2	-
2	Beta emitters Bq/l, Max	1.0	No relaxation	Part 1	-

Source: IS 10500: 2012.

Table 8.33: Pesticide Residues Limits of Drinking Water

S. No.	Pesticide	Limit ug/l	USEPA	AOAC/ISO
1	Alachlor	20	525.2.507	-
2	Atrazine	2	525.1.8141 A	-
3	Aldrin / Dieldrin	0.03	508	-
4	Alpha HCH	0.01	508	-
5	Beta HCH	0.04	508	-
6	Butachlor	125	525.1.8141 A	-
7	Chlorpyrifos	30	525.2.8141 A	-
8	Delta HCH	0.04	508	-
9	24-Dichlorophenoxyacetic acid	30	515.1	-
10	DDT (o,p and pp – Isomers of DDT, DDE and DDD)	1	508	AOAC 990.06
11	Endosulfan (alpha, beta and sulphate)	0.4	508	AOAC 990.06
12	Ethion	3	1657 A	-
13	Gamma – HCH (Lindane)	2	508	AOAC 900.06
14	Isoproturon	2	508	-
15	Malathion	190	532	-
16	Methyl parathion	0.3	8141 A	-
17	Monocrotophos	1	8141 A	-
18	Phorate	2		-

Source: IS 10500: 2012.

Table 8.34: Bacteriological Quality of Drinking Water

S. No.	Organisms	Requirements
1	All water intended for drinking:	
(a)	E. Coli or thermotolerant coliform bacteria	Shall not be detectable in any 100 ml. sample
2	Treated water entering the distribution system	
(a)	E-Coli or thermotolerant coliform bacteria	Shall not be detectable in any 100 ml. sample
(b)	Total coliform bacteria	Shall not be detectable in any 100 ml. sample
3	Treated water in the distribution system	
(a)	E-Coli or thermotolerant coliform bacteria	Shall not be detectable in any 100 ml. sample
(b)	Total Coliform bacteria	Shall not be detectable in any 100 ml. sample

Source: IS 10500: 2012.

8.3.1.10. Land requirement for Water Supply System

Identification of land for water infrastructure is an essential parameter. It is necessary to earmark land for Water Treatment Plant (WTP) in Development Plans. Also land for overhead reservoirs, pumping stations should be marked at the zonal level or local area plan level. However land requirement may vary based on the capacity of WTPs and up-gradation of technology. Below is the table, which recommends land requirement based on different capacity.

Table 8.35: Recommended land Requirement based on capacities

S.No.	Identified Capacities	Land Requirement (Hectares)
1	5 MLD	0.10
2	10 MLD	0.19
3	50 MLD	0.93
4	100 MLD	1.87
5	200 MLD	3.73
6	500 MLD	9.34

Source: CPHEEO.

Note: Additional 0.63 ha of land can also be considered for staff quarters

8.3.1.11. Design Period for Water Supply Components

Table 8.36: Design Period for Water Supply Components

S.No.	Components	Design period (in years)
1	Storage by Dams	50
2	Infiltration works	30
3	Pumping	
i	Pump house (civil works)	30
ii	Electric motors and pumps	15
4	Water treatment units	15
5	Pipe connection to several treatment units and other small appurtenances	30
6	Raw water and clear water conveying mains	30
7	Clear water reservoirs at the head works, balancing tanks and service reservoirs (overhead or ground level)	15
8	Distribution system	30

Source: Manuals on Water Supply and Treatment, 1999, CPHEEO.

National Water Policy, 2012 by Ministry of Water Resources was formulated to govern the water resource's planning and development along with its optimum utilisation. The Policy provides following recommendations regarding urban settlements:

- Urban water supply and sewage treatment must be integrated along with its billing,
- Least water intensive sanitation and sewerage systems with decentralized sewage treatment plants should be incentivized.
- Water reuse must be encouraged in urban settlements,
- Urban domestic water systems need to collect and publish water accounts and water audit reports indicating leakages and pilferages, which should be reduced.
- In urban and industrial areas, rain water harvesting and desalinisation where techno-economically feasible, should be encouraged to increase availability of utilizable water.

State Governments shall draft State Water Policy for decentralised or micro level water management to yield better results.

8.3.2. Sewerage & Sanitation

8.3.2.1. National Urban Sanitation Policy

The aim of the National Urban Sanitation Policy (NUSP), 2008 is to transform Urban India into community-driven, totally sanitized, healthy, and liveable cities and towns.

Basic features laid down in NUSP given below should be adhered for planning of the cities

- Cities must be open defecation free
- Must eliminate the practice of manual scavenging and provide adequate personnel protection equipment that addresses the safety of sanitation workers
- Municipal sewage and storm water drainage must be safely managed
- Recycle and reuse of treated sewage for non-potable applications should be implemented wherever possible
- Solid waste collected and disposed-off fully and safely
- Services to the poor and systems for sustaining results
- Improved public health outcomes and environmental standards.

The objective of public waste water collection and disposal system is to ensure that sewage or excreta and sullage discharged from community is properly discharged, collected, transported, treated to the required level of degree and finally disposed-off without causing any health or environmental problems¹⁶¹.

As per CPHEEO manual, 80% of water supply may be expected to reach the sewers however it recommends designing the system by considering minimum wastewater flow of 100 litres per capita per day.

¹⁶¹Further details are also available in National Mission on sustainable Habitat, Adaptation & Mitigation Measures in the field of Water supply & Sanitation, CPHEEO, MoUD

Table 8.37: Recommended Design Period for Sewerage Systems Components

S.No	Component	Recommended Design Period (Years)	Clarification
1	Collection system i.e. Sewer Network	30	The system should be designed for the prospective population of 30 years, as its replacement is not possible during its use.
2	Pumping Stations (Civil Works)	30	Duplicating machinery within pumping station would be easier/cost of civil works will be economical for full design period.
3	Pumping Machinery	15	Life of pumping machinery generally 15 years
4	Sewerage Treatment Plant	30	The construction may be in a phased manner as initially the flows may not reach the designed levels and it will be uneconomical to build the full capacity plant initially.
5	Effluent Disposal and Utilisation	30	Provision of design capacities in the initial stages itself is economical.

Source: Manual on Sewerage and Sewage Treatment, CPHEEO.

8.3.2.2. Decentralised Wastewater Management System (DWMS)

DWWM has emerged over the period of time, which reduces the load of centralised wastewater treatment unit. As per MoUD¹⁶², Decentralized wastewater management may be defined as “the collection, treatment, and disposal/reuse of wastewater from individual homes, clusters of homes, isolated communities, industries, or institutional facilities, as well as from portions of existing communities at or near the point of waste generation”. In case of decentralized systems, both solid and liquid fractions of the wastewater are utilized near the point of its origin, except in some cases when a portion of liquid and residual solids may be transported to a centralized point for further treatment and reuse.

MoUD (Guidelines for Decentralised Waste Water Management, MoUD 2012) in association with Indian Institution of Technology (IIT) Madras has developed guidelines on DWWM, which recommends 15 years of design period for DWWM, if possible. Another way to design a DWWM is to estimate the present day capacity and plan the system for an additional 20% capacity. Further, the detailed guidelines as mentioned in Draft Manual on Sewerage and Sewage Treatment of CPHEEO (December 2013) can be referred while developing DWWM units in a city which elaborates siting criteria, components and other design consideration including wastewater characteristics and waste water treatment.

8.3.2.3. Centralized vis-a-vis Decentralized Sewage Treatment Systems

While the conventional sewerage may be a comprehensive system for sewage collection and transport, it also remains as a highly resource-intensive technology. Consequently, high capital cost, and significant O&M cost of this system inhibits its

¹⁶²Guidelines for Decentralized Wastewater Management.

widespread adoption in all sizes of urban areas. The implementation of Centralized Wastewater Management System (CWMS) should not be considered as the only option available for collection, transportation and treatment of sewage. There are certain factors, which govern the selection of options between CWMS and DWMS.

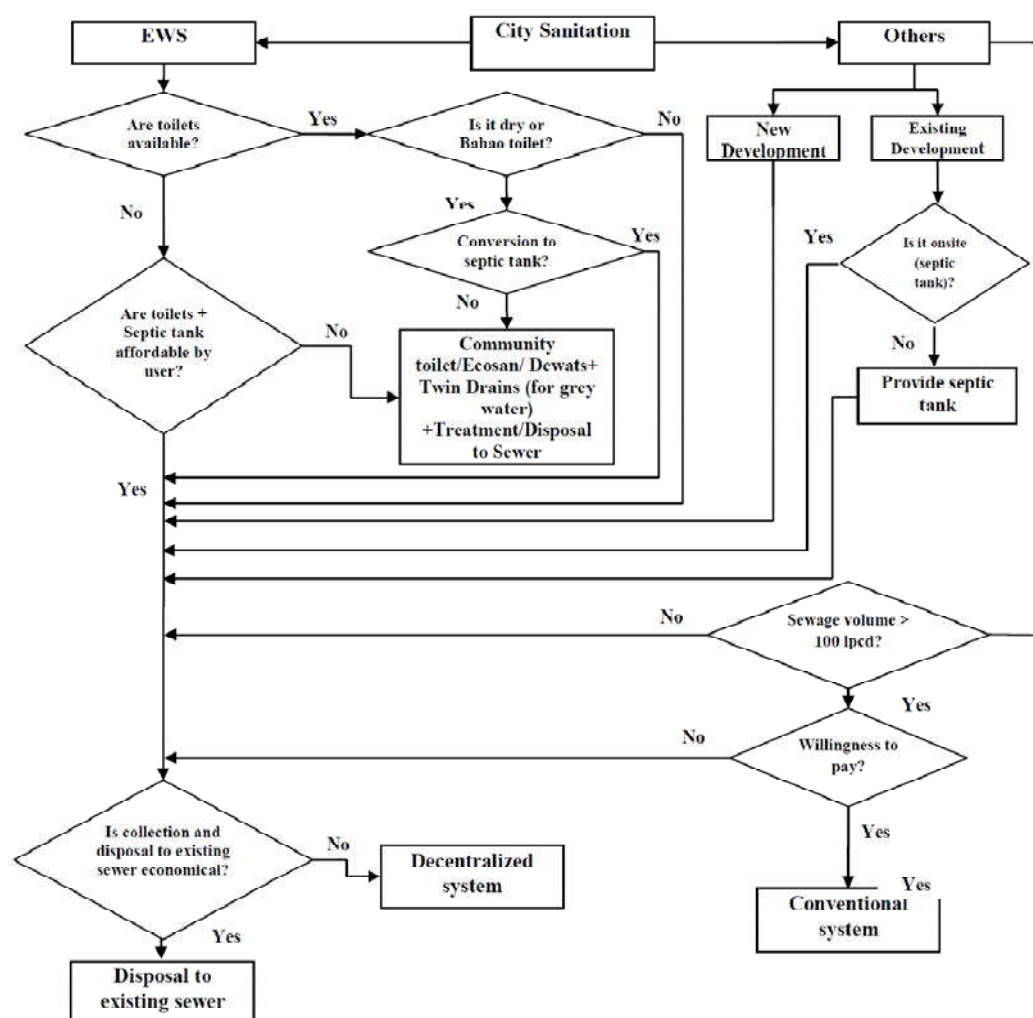
Recognizing the many applications and benefits of sewage reuse, some important points may be kept in view such as;

- (i) Review of the impact of the population growth rate
- (ii) Review of potential water reuse applications and water quality requirements
- (iii) Review of appropriate technologies for sewage treatment and reuse
- (iv) Considering the type of management structure that will be required in the future and
- (v) Identification of issues that must be solved to bring about water reuse for sustainable development on a broad scale.

It has been emphasized that if sewage from the urban and semi urban areas were reused for a variety of non-potable uses, the demand on the potable water supply would be reduced.

The choice of appropriate technology also depends on several factors such as composition of sewage, availability of land, funds and expertise. Different operation and maintenance options have to be considered with respect to sustainable plant operation, the use of local resources, knowledge and manpower. A flow diagram showing the decision making steps is given in figure 8.3.

Figure 8.3: Decision Tree: Selecting the wastewater management system (Onsite, Decentralized or Conventional)



Source: Guidelines for Decentralized Wastewater Management, MoUD.

8.3.2.4. Effluent Standards

As per MoEF, the general effluent standards for discharging the waste water are given in table below:

Table 8.38: General Effluent Standards for Discharge

S No.	Parameter	Standards			
		Inland surface water	Public Sewers	Land for Irrigation	Marine Coastal areas
1	Colour and Odour	All efforts should be made to remove colour and unpleasant odour as far as practicable			
2	Suspended Solids mg/g, Max.	100	600	200	For process waste water 100
					For cooling water effluent 10 per cent above total suspended matter of influent.

S No.	Parameter	Standards			
		Inland surface water	Public Sewers	Land for Irrigation	Marine Coastal areas
3	Particulate size of suspended solids	Shall pass 850 micron IS Sieve	-	-	(a) Floatable solids, max. 3 mm (b) Settle-ablesolids, max. 850 microns
4	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
5	Temperature	Shall not exceed 50C above the receiving water temperature	-	-	Shall not exceed 50C above the receiving water temperature.
6	Oil and grease mg/l, Max.	10	20	10	20
7	Total residual chlorine mg/m, Max	1.0	-	-	1.0
8	Ammonical nitrogen (as N), mg/l, Max.	50	50	-	50
9	Total Kjeldahl Nitrogen (as NH ₃), mg/l, Max	100	-	-	100
10	Free Ammonia (as NH ₃), mg/l, Max.	5.0	-	-	5.0
11	Biochemical Oxygen demand (3 days at 270C), mg/l, Max.	30	350	100	100
12	Chemical Oxygen Demand, mg/l, Max.	250	-	-	250
13	Arsenic (as As), mg/l, Max.	0.2	0.2	0.2	0.2
14	Mercury (as Hg), mg/l, Max.	0.01	0.01	-	0.01
15	Lead (as Pb), mg/l, Max	0.1	1.0	-	2.0
16	Cadmium (as Cd), mg/l, Max	2.0	10	-	2.0
17	Hexavalent Chromium (as Cr+6), mg/l, Max.	0.1	2.0	-	1.0
18	Total Chromium (as Cr.), mg/l, Max.	2.0	2.0	-	2.0
19	Copper (as Cu), mg/l, Max.	3.0	3.0	-	3.0
20	Zinc (as Zn.), mg/l, Max	5.0	15	-	15
21	Selenium (as Se) mg/l, Max	0.05	0.05	-	0.05

S No.	Parameter	Standards			
		Inland surface water	Public Sewers	Land for Irrigation	Marine Coastal areas
22	Nickel (as Ni), mg/l, Max	3.0	3.0	-	5.0
23	Cyanide (as CN), mg/l, Max	0/2	2.0	0.2	0.2
24	Fluoride (as F), mg/l, Max	2.0	15	-	15
25	Dissolved Phosphates (as P), mg/l, Max	5.0	-	-	-
26	Sulphide (as S), mg/l, Max	2.0	-	-	5.0
27	Phenolic compounds (as CSHS OH, mg/l, Max	1.0	5.0	-	5.0
28	Radioactive materials:				
a	Alpha emitter micro curie/ml	10-7	10-7	10-8	10-7
b	Beta emitter micro curie/ml	10-6	10-6	10-7	10-6
29	Bio-assay test	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
30	Manganese (as Mn)	2 mg/l	2 mg/l	-	2 mg/l
31	Iron (as Fe)	3 mg/l	3 mg/l	-	3 mg/l
32	Vanadium (as V)	0.2 mg/l	0.2 mg/l	-	0.2 mg/l
33	Nitrate Nitrogen	10 mg/l	-	-	20 mg/l

Source: Environment Protection Act, 1986.

8.3.2.5. Recommended norms for Sewage and its uses

The recommended treated sewage quality is proposed to be achieved for the stated reuse as given in the table below:

Table 8.39: Recommended upper limits of treated Sewage quality for specified activities at point of use

S.No.	Parameter	Toilet flushing	Fire Protection	Vehicle Exterior washing	Non-contact impoundments	Landscaping, Horticulture & Agriculture			
						Crops which are eaten			
						Horticulture, Golf Course	Non edible crops	Raw	Cooked
1	Turbidity (NTU)	<2	<2	<2	<2	<2	AA	<2	AA
2	SS	Nil	Nil	Nil	Nil	Nil	Nil	Nil	30
3	TDS	2100							
4	pH	6.5 to 8.3							
5	Temperature °C	Ambient							
6	Oil & Grease	10	Nil	Nil	Nil	10	10	Nil	Nil
7	Minimum Residual Chlorine	1	1	1	0.5	1	Nil	Nil	Nil
8	Total Kjeldahl Nitrogen as N	10	10	10	10	10	10	10	10
9	BOD	10	10	10	10	10	20	10	20
10	COD	AA	AA	AA	AA	AA	AA	AA	30
11	Dissolved Phosphorous as P	1	1	1	1	2	5	2	5
12	Nitrate Nitrogen as N	10	10	10	5	10	10	10	10
13	Faecal Coliform in 100 ml	Nil	Nil	Nil	Nil	Nil	230	Nil	230
14	Helminthic Eggs/litre	AA	AA	AA	AA	AA	<1	<1	<1
15	Colour	Colourless	Colourless	Colourless	Colourless	Colourless	AA	Colourless	Colourless
16	Odour	Aseptic which means not septic and no foul odour							

Source: Draft Manual on Sewerage and Sewage Treatment Systems, CPHEEO 2013.

In order to achieve desired water quality, excess chlorination, granular activated carbon adsorption / Ozonation and/ or various kind of filtration including membrane are recommended. For recreational impoundments for non-human contact, residual chlorine is not required so as to protect aquatic species of flora and fauna.

As per the Manual of Sewerage and Sewage Treatment, the following provisions are to be followed for usage of treated sewage, sludge and biogas utilization:

- a. Reuse of treated sewage should be taken up after discussions between ULB, water boards, PHEDs / Jal Nigams and the public, as the case may be. Various possible reuse methods such as farm forestry, greenbelt development and lawns in road medians.
- b. Utilization of sludge in public areas is not possible due to issues of public acceptance and hence it is best to focus on farm forestry.
- c. Utilization of alternative energy, like in plant energy to be harnessed from bio-methanation and to evaluate the ambient temperature suitability or hearing of sludge vs economics.
- d. Reuse of treated sewage to a minimum extent of 20% by volume shall be mandatorily explored and the proposed use for achieving this 20% target shall mandatorily form part of the CSP.
- e. Utilization of sludge as a construction material (as porous pavement, bricks etc.)

8.3.2.6. Recycling of Waste Water

Various sewage treatment technologies, given below, are adopted in sewerage system to treat wastewater up to secondary level, as per the effluent standards in India as well as in other parts of the world. These technologies are:

1. Activated Sludge Process (ASP)
2. Waste Stabilisation Pond Systems (WSPS)
3. Upflow Anaerobic Sludge Blanket Process (UASB)
4. Duckweed Pond System (DPS)
5. Facultative Aerated Lagoon (FAL)
6. Trickling Filter (TF)
7. Biological Filtration and Oxygenated reactor (BIOFOR) Technology
8. High rate Activated Sludge Biofor-F Technology
9. Fluidized Aerated Bed (FAB)
10. Submerged Aeration Fixed Film (SAFF) Technology
11. Cyclic Activated Sludge Process (CASP)

The salient features and comparison of these technologies in terms of their applicability, land requirement, capital cost and operation and maintenance (O&M) cost are given in table below.

Table 8.40: Fact Sheet for Various Treatment Process

S.No.	Recycling Technique	Applicability	Land Requirement (Per MLD in Hectares)	Capital Cost (per MLD in INR)	O&M Cost (Million/Year/MLD)
1	Activated Sludge Process (ASP)	The most widely used option for treatment of domestic wastewater for medium to large towns where land is scarce.	0.15-0.25	2 – 4	0.3 – 0.5
2	Waste Stabilisation Pond Systems (WSPS)	- In warm conditions - Easy land availability - Where power supply is expensive, low or unreliable. - Where social preference for aquaculture	0.8-2.3	1.5 – 4.5	0.06 – 0.1
3	Upflow Anaerobic Sludge Blanket Process (UASB)	The suitability of this technology may be doubtful as a standalone secondary treatment option	0.2-0.3	2.5 – 3.6	0.08 – 0.17
4	Duckweed Pond System (DPS)	Low strength domestic wastewater after sedimentation with influent BOD < 80 mg/L	2-6	1.5 – 4.5	0.18

S.No.	Recycling Technique	Applicability	Land Requirement (Per MLD in Hectares)	Capital Cost (per MLD in INR)	O&M Cost (Million/Year/MLD)
		- In combination with existing WSP - Easy land availability - As a polishing pond for an existing activated sludge plant or other technology based STPs.			
5	Facultative Aerate Lagoon (FAL)	- Standalone system - As a pre-treatment unit for WSP - As an upgradation option for overloaded WSPs.	0.27-0.4	2.2 – 2.9	0.15 – 0.2
6	Trickling Filter (TF)	- Standalone system if operated at slow rates - As a high rate roughing filter for high BOD waste water - In combination with ASP	0.25-0.65	Not available, but slightly lower than ASP	
7	Biological Filtration and Oxygenated reactor (BIOFOR) Technology	-	0.04	6.5 – 8.1	0.86
8	High rate Activated Sludge Biofor –F Technology	-	0.08	5.2	0.18
9	Fluidized Aerated Bed (FAB)	- Small to medium flows in congested locations - Sensitive locations - Decentralised approach - Reliving existing overloaded STPs.	0.06	3 – 5	0.6 – 0.75
10	Submerged Aeration Fixed Film (SAFF) Technology	- Small to medium flows in congested locations - Sensitive locations - Decentralised approach - Reliving existing overloaded trickling filters	0.05	7	1.14
11	Cyclic Activated Sludge Process (CASP)	- Small to medium flows in congested locations - Sensitive locations - Decentralised approach - Reliving existing overloaded trickling filters	0.1-0.15	Not Available	Expected to be higher than ASP

Source: Compendium of Sewage Treatment Technologies, National River Conservation Directorate, MOEF, 2009.

Land availability plays an important role in providing such facilities. Land requirement may vary based on the technology adopted for sewage treatment. However, it is evident to mark the required land on development plan. It is recommended to decide the most suitable technology in advance based on the various parameters as given in Appendix L of Volume II B.

8.3.2.7. Septage Management – Planning and Implementation¹⁶³

For effective septage management plan, robust data on septage arrangements, their quantity and locations of its generation etc. are required. The ULBs would need to make arrangements to collect baseline data, like type of latrine disposal, effluent disposal arrangement, size, age, when it was last cleaned, access to the on-site

¹⁶³ Advisory Note – Septage Management in Urban India, 2013, MoUD.

system, arrangement for disposal of effluent, if any of existing installations, to plan for workable de-sludging schedules. It is advisable to divide the city into different sanitary zones (if not already done) and carry out the baseline survey in one or a few of these zones, pilot de-sludging area wise schedules to learn operational issues and devise solutions, before up-scaling to the entire ULB can be taken up. The selection of zone could be based on availability of septage disposal sites – existing STPs could be potential septage disposal/application sites or trenches provided in solid waste landfill sites or suitable urban forestry sites where the septage trenches would serve to fertilize the plants. In order to be economical and financially competitive, it is suggested that households in demarcated septage management zone should be within 20 to 30 km travel distance from the identified treatment and disposal sites.

Further a two-step process is to be followed for selection of the treatment system:

1. To determine the appropriate treatment option on the basis of size of town, land availability, proximity/availability of sewage treatment plants and proximity to residential areas; and
2. To conduct a techno-economic feasibility to choose the most appropriate technology on the basis of capital, operations and maintenance costs.

The steps in planning and implementing septage management are given below:

3. Collect data on the households and other properties with on-site arrangements in the city.
4. List out the municipal, private and other septic tank/pit cleaning services active in the city
5. Identify catchment-wise land for septage treatment facility such as use existing STP where available; or acquire land if not available for construction of septage treatment facility
6. Formulate draft regulations for septage management
7. Choose technology for septage treatment: prepare design of Septage Treatment and Disposal Facility (STDF) along with operations and maintenance costs
8. Conduct techno-economic feasibility of the STDF
9. Implement construction of septage management and disposal facility
10. Purchase vehicles and vacuum trucks etc.
11. Launch awareness campaign
12. Initiate training and capacity building
13. Provide cleaning services incrementally in areas completing surveys of tanks and pits.

Further, the guidelines for selection of Septage management disposal system are summarized in **Table 8.41**.

Table 8.41: Guidelines for the selection of Septage disposal system

Town / Category	Conditions	Recommended Technologies	Capital Cost	O&M Cost	Management
Unsewered Class-III, IV and V towns and rural communities	Remote land area available with suitable site and soil condition	Sludge drying beds and waste stabilization pond	Low	Low. User fees to recover O&M costs	Municipality or private (if implemented by private sector through a management contract)
	Land available but close to settlements	Lime stabilization, sludge drying beds and waste stabilization pond	Low to medium	Low to medium. User fees to recover O&M costs	Municipality or private (if implemented by private sector through a management contract)

Town / Category	Conditions	Recommended Technologies	Capital Cost	O&M Cost	Management
	Inadequate land area with unsuitable site and soil condition, but available STP capacity within 20-30 km distance	Disposal at STP	Low to medium	Low to medium. User fees to recover O&M costs	Municipality
Partially sewered medium size (Class-II Towns)	Land area available with suitable site and soil condition but close to settlements	Lime, stabilization, sludge drying beds and waste stabilization pond	Low to medium	Low to medium. User fees to recover O&M costs	Municipality or private (if implemented by private sector through a management contract)
	Inadequate land area, but available STP capacity	Disposal at STP	Medium	Medium. User fees to recover O&M costs	Municipality or private (if implemented by private sector through a management contract)
	Inadequate land area; no available STP capacity	Disposal at independent mechanical treatment facility	High	High. User fees to recover O&M costs	Municipality or private (if implemented by private sector through a management contract)
Class-I and metro cities	Available STP capacity	Disposal at STP	Medium	Medium. User fees to recover O&M costs	Municipality or private (if implemented by private sector through a management contract).
	No available STP capacity	Disposal at independent mechanical treatment facility	High	High. User fees to recover O&M costs	Municipality or private (if implemented by private sector through a management contract).

Source: Advisory Note – Septage Management in Urban India, MoUD 2013.

8.3.2.8. Recommended Norms for Public Toilets in Public Area

The general standard/guidelines for public toilets in public area and modified norms for public toilets in public places and roads recommended in the draft CPHEEO manual are given below.

Table 8.42: Norms for Public Toilets in Public Area

TYPE	Norms for Toilets
Public Toilet	On roads and for open areas: @ every 1 Km, including in parks, plaza, open air theatre, swimming area, car parks, and fuel stations. Toilets shall be disabled-friendly and in 50-50 ratio (M/F). Provision may be made as for Public Rooms.
Signage	Signboards on main streets shall give directions and mention the distance to reach the nearest public convenience of visitors. Helpline number shall be pasted on all toilets for complaints/queries.
Modes	Pay and use or free. In pay and use toilets entry is allowed on payment to the attendant or by inserting coin and user gets 15-20 minutes.
Maintenance/Cleaning	The toilet should have both men and women attendants. Alternatively automatic cleaning cycle covering flush, toilet bowl, seat, hand wash basin, disinfecting of floor and complete drying after each use can be adopted, which takes 40 seconds. Public toilets shall be open 24 hours.

Source: Draft Manual on Sewerage and Sewage Treatment Systems, CPHEEO 2013.

8.3.3. Drainage

As per CPHEEO manual on Sewerage and Sewage Treatment System, sanitary sewers are not expected to receive storm water. Strict inspection, vigilance, proper design and construction of sewers and manholes should eliminate this flow or bring it down to a very insignificant quantity. Therefore, it is evident to plan a separate system to carry storm water.

8.3.3.1. Estimation of Storm water runoff

During rainfall periods there can be a considerable amount of storm water that does not infiltrate into the ground surface and most of this becomes the excess overland flow or direct surface runoff. There are many contributing factors for analysing the quantity and temporal variations of this flow; these include geology of the land, topography, geography, rainfall intensity and pattern and the land use type.

Estimation of such runoff reaching the storm sewers, is dependent on the intensity and duration of precipitation, characteristics of the tributary area and the time required for such flow to reach the sewer. There are various methods available to calculate the runoff, the two of the below mentioned methods can be adopted to calculate runoff:

1. Rational Method
2. Kirpich Equation Method

Rational Method

It is based on the assumption that the entire precipitation over the drainage district does not reach the sewer. The characteristics of the drainage district, such as, imperviousness, topography including depressions and water pockets, shape of the drainage basin and duration of the precipitation determine the fraction of the total precipitation which will reach the sewer. This fraction known as the ***coefficient of run-off*** needs to be determined for each drainage district.

The National Disaster Management Authority (NDMA) guidelines on urban flood management has prescribed that “all future storm water drainage systems for peak flow for any city should be designed after taking into consideration a runoff Coefficient of up to 0.95¹⁶⁴ using the rational method. The runoff reaching the sewer is given by the expression,

$$Q = 10 C i A$$

- Where Q is the runoff in m³/hr;
- C is the coefficient of runoff
- i is the intensity of in mm/hr and
- A is the area drainage district in hectares.

¹⁶⁴Source: National Disaster Management Guidelines- Urban Flood management, 2010.

It may be reiterated that Q represents only the maximum discharge caused by a particular storm.

The portion of rainfall, which finds its way to the sewer is dependent on the imperviousness and the shape of the drainage area apart from the duration of storm. The percentage of imperviousness of the drainage area can be obtained from the records of a particular district. In the absence of such data, the table below may serve as a guide.

Table 8.43: Runoff coefficients for stated surfaces

S. No.	Type of Area	Percentage of Imperviousness
1	Commercial and Industrial Area	70-90
2	Residential Area	
	- High Density	61-75
	- Low Density	35-60
3	Parks and undeveloped areas	10-20

Source: NDMA.

When several different surface types or land use which comprise the drainage area, a composite or weighted average value of the imperviousness runoff coefficient can be computed, such as:

$$I = 1/A \times (A_1 \times I_1 + A_2 \times I_2 + A_3 \times I_3 + \dots + A_n \times I_n)$$

Where, the subscripts refer to respective sub-drainage area types, and 'A' is the total drainage area.

Kirpich Equation Method¹⁶⁵

The time of concentration is defined as the time it takes for a drop of water in the remotest point in a drainage basin to travel to the outlet. As calculation methods go, the Kirpich formula is one of the most widely used methods.

$$T_c = 0.01947 \times L^{0.77} \times S^{-0.385}$$

Where:

- T_c = Time of concentration (hours)
- L = Maximum length of water travel (m)
- S = surface slope, given by H/L (m/m)
- H = difference in elevation between the remotest point in the drainage basin and the outlet (m)

The Kirpich equation is normally used for natural basins with well-defined channels. If there are many undefined channels that are grassed or vegetated throughout, the Kirpich formula will likely underestimate the time of concentration, and so a factor of 1.3 – 1.5 should be added. If most of the drainage basins are non-natural (in urban system) with concrete or other smooth channels, the result should be decreased about 40 – 60%.

8.3.4. Rain Water Harvesting

Rain water harvesting and conservation is the activity of direct collection of rain water. The conservation of rain water so collected can be stored for direct use or can be recharged into the ground water. The main goal is to minimise flow of rain water

¹⁶⁵K Subramanyapg 247,45.

through drains / *nallahs* to the rivers. It is a known fact that the ground water level is depleting and has gone down in the last decades. Thus the rain water harvesting and conservation aims at optimum utilisation of the natural resource i.e. rain water¹⁶⁶. *Many states such as Tamil Nadu¹⁶⁷, Kerala¹⁶⁸, and Delhi¹⁶⁹ etc. have made mandatory the adoption of rainwater harvesting in new constructions. It is suggested to all the other States to mandate rainwater harvesting in all their new construction works. Also, continuous monitoring of the performance of the rainwater harvesting structures is also recommended.*

8.3.4.1. Basic requirement of artificial recharge¹⁷⁰

- A. Availability of non-committed runoff in space and time;**
- B. Identification of suitable hydrogeological environment and sites for augmenting subsurface reservoir through cost effective artificial recharge techniques.**

If the above mentioned criteria are satisfied, the following criteria need to be evaluated for planning the artificial recharge scheme:

- C. Identification of Area**
 - Areas where ground water levels are declining on regular basis.
 - Areas where substantial amount of aquifer has already been desaturated.
 - Areas where availability of ground water is inadequate in lean months.
 - Areas where salinity ingress is taking place.
 - Urban Area where decline in water level is observed.
- D. Hydrometeorological studies**
 - Rainfall pattern in the area.
 - Evaporation losses from the area.
 - Climatological features that effect the planning of artificial recharge.
- E. Hydrological studies**
 - In-situ precipitation on the watershed.
 - Surface (canal) supplies from large reservoirs located within basin.
 - Surface supplies through trans-basin water transfer.
 - Treated municipal and industrial wastewaters.
 - Hydrological investigations are to be carried out in the Watershed/Sub-basin/basin for determining the source water availability.
- F. Soil infiltration studies**
 - Control the rate of infiltration.
 - Prerequisite study in cases of artificial recharge through water spreading methods.
 - Infiltration rates can be estimated by soils infiltration tests using Cylinder or flood infiltro-meters instruments.
- G. Hydrogeological studies**
 - Firstly, to synthesize all the available data on hydrogeology from different agencies.
 - Study of satellite imagery for identification of geomorphic units.
 - Regional Hydrogeological maps indicating hydrogeological units, both at shallow and deeper levels.
 - Water table contours to determine the form of the water table and the hydraulic connection of ground water with rivers, canals etc.

¹⁶⁶ Manual on Rain Water harvesting and Conservation, CPWD.

¹⁶⁷Tamil Nadu Municipal Laws Ordinance, 2003.

¹⁶⁸The Kerala Municipality Building Rules, 1999.

¹⁶⁹Central Ground Water Board.

¹⁷⁰ Guide on Artificial Recharge to Ground Water, CGWB.

- Depths to the water table (DTW) for the periods of the maximum, minimum and mean annual position of water table.
- Ground water potential of different hydrogeological units and the level of ground water development.

H. Aquifer Geometry

- Data on the sub-surface hydrogeological units, their thickness and depth of occurrence
- Disposition and hydraulic properties of unconfined, semi-confined and confined aquifers in the area

I. Chemical Quality of Source Water

- Quality of raw waters available for recharge is determine
- Treatment before being used for recharge
- Relation to the changes in the soil structure and the biological phenomena which take place when infiltration begins
- Changes expected to the environmental conditions.

8.3.4.2. Artificial Recharge Techniques¹⁷¹

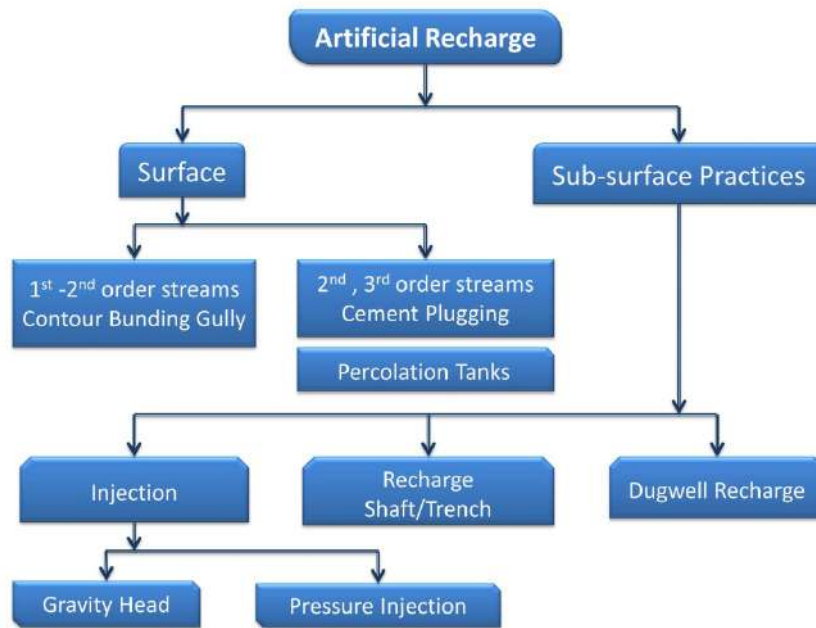
A variety of methods have been developed to recharge ground water. Most of the artificial recharge techniques are briefly described below:

1. Direct surface techniques, by -
 - Flooding
 - Basins or percolation tanks
 - Stream augmentation
 - Ditch and furrow system
 - Over irrigation
2. Direct sub surface techniques, by -
 - Injection wells or recharge wells
 - Recharge pits and shafts
 - Dug well recharge
 - Bore hole flooding
 - Natural openings, cavity fillings.
3. Combination surface – sub-surface techniques, by -
 - Basin or percolation tanks with pit shaft or wells.
4. Indirect Techniques, by -
 - Induced recharge from surface water source.
 - Aquifer modification

Although no two projects are identical, most use variation or combination of direct method, direct sub-surface, or indirect techniques. A schematic diagram of the artificial recharge methods used is given as flowchart below.

¹⁷¹ Select Case Studies Rain Water Harvesting and Artificial Recharge, Central Ground Water Board

Figure 8.4: Flowchart showing the various Artificial Recharge Practices



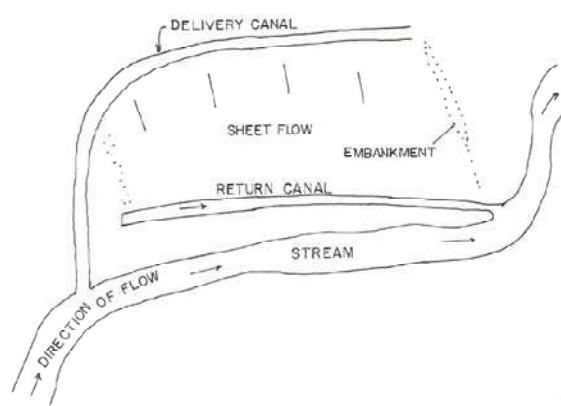
Source: Manual on Artificial Recharge of Groundwater, Ministry of Water Resources, CGWB.

The brief on artificial recharge methods has been given below. These methods and detailed methodology has been explained in 'Manual on Artificial Recharge of Groundwater'¹⁷², prepared by Ministry of Water Resources, Central Ground Water Board (CGWB).

1. Ditch and Furrow Method
2. Lateral Ditch Pattern
3. Dendritic Pattern
4. Contour Pattern
5. Spreading Basin or Percolation Tanks
6. Gully Plug / Check Dam / Nala Bund / Gabbion Structures
7. Dug Well Recharge
8. Recharge Shafts / Pits / Trenches
9. Artificial Recharge through Injection Well
10. Induced Recharge from Surface Water Sources
11. Subsurface Dykes / Underground Bandharas

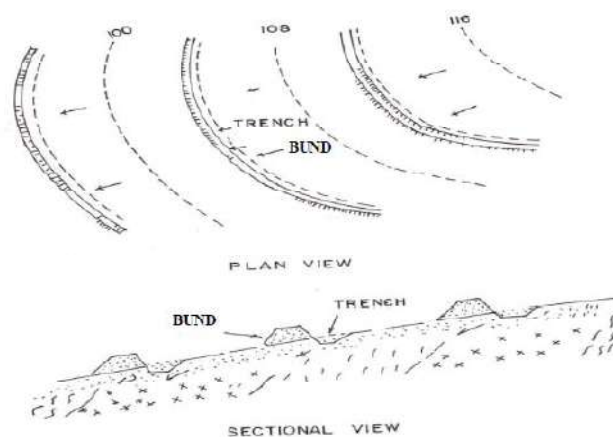
¹⁷²www.cgwb.gov.in

Figure 8.5: Ditch and Furrow Method



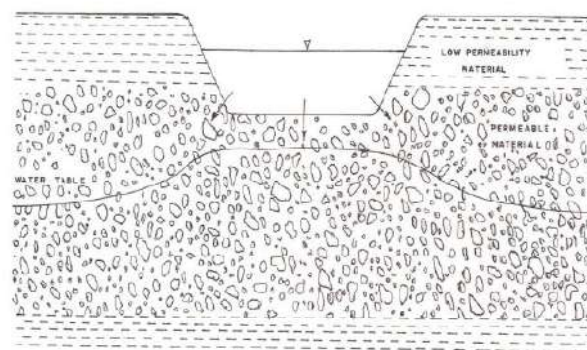
Source: Manual on Artificial Recharge of Ground Water

Figure 8.7: Contour Pattern



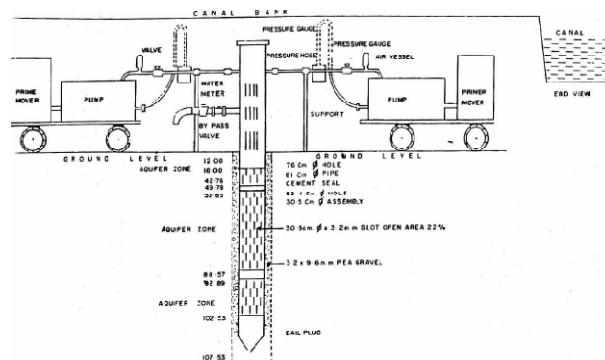
Source: Manual on Artificial Recharge of Ground Water

Figure 8.6: Recharge Pit:



Source: Manual on Artificial Recharge of Ground Water

Figure 8.8: Injection well:



Source: Manual on Artificial Recharge of Ground Water

8.3.5. Electricity

Based on the estimated requirements of power supply as per the National Electricity Policy published in 2005, the recommended consumption is 1000 units per Capita per year or 2.74 kWh per capita per day demand which included domestic, commercial, industrial and other requirements.

The actual estimation of power can be made based on the industrial development (type and extent), commercial development, domestic and other requirements. The provision of one electric substation of 11KV for a population of 15,000 can be considered as general standard for electricity distribution.

Ministry of New and Renewable Energy has come out with strategic plan for new and renewable energy sector for the period 2011-17. Ministry has identified local bodies as one of the main users who can be encouraged to utilise energy from biomass and urban waste etc. A National Rating System - GRIHA has been developed, to promote green buildings, which is suitable for all types of buildings in different climatic zones of the country. A green building designed through solar passive concepts and including active renewable energy systems can save substantial

conventional energy apart from generating energy for meeting various requirements in different seasons.

8.3.6. Solid Waste Management

Municipal Solid Waste (MSW) is the trash or garbage that is discarded day to day in a human settlement. According to MSW Rules 2000 MSW includes commercial and residential wastes generated in a municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. Waste generation encompasses activities in which materials are identified as no longer being of value (being in the present form) and are either thrown away or gathered together for disposal. The following table indicates the waste generation per capita per day for estimation and forecast of waste generation for future for planning purposes:

Table 8.44: Waste Generation Per Capita per Day

S.No.	Land use type	Estimated waste generation
1	Residential refuse	0.3 to 0.6 kg/cap/day
2	Commercial refuse	0.1 to 0.2 kg/cap/day
3	Street sweepings	0.05 to 0.2 kg/cap/day
4	Institutional refuse	0.05 to 0.2 kg/cap/day

Source: Manual on Solid Waste Management, CPHEEO – 2000

8.3.6.1. Systematic process

Municipal Solid Waste Management (MSWM) refers to a systematic process that comprises of waste segregation and storage at source, primary collection, secondary storage, transportation, secondary segregation, resource recovery, processing, treatment, and final disposal of solid waste. For effective MSWM following steps should be followed, hence appropriate considerations should be made at planning stage. To meet zero waste / landfill site, the complete SWM systematic process could be followed to reduce waste disposal at landfill site or no disposal at all. Some of the best practices of solid waste management are given in Appendix M of Volume II B for reference. GIS/GPS/ICT techniques for Solid Waste Management need to be used for Landfill site selection, site assessment of illegal dump-sites, routing efficiency for solid waste collection and monitoring waste collection performance.

8.3.6.2. Storage of waste

Storage of waste at source is the first essential step of Solid Waste Management. Every household, shop and establishment generates solid waste on day-to-day basis. The waste should normally be stored at the source of waste generation till collected for its disposal.

Biodegradable waste and non-bio-degradable waste should be collected in separate bins from the source.

- Green coloured bins – Waste bins for biodegradable waste

- White coloured bins – storage of recyclable wastes
- Black coloured bins – storage of other wastes

8.3.6.3. Primary collection of waste

Primary collection of waste is the second essential step of Solid Waste Management activity. Primary collection system is necessary to ensure that waste stored at source is collected regularly and it is not disposed of on the streets, drains, water bodies, etc.

Local bodies should arrange for the primary collection of waste stored at various sources of waste generation by any of the following methods or combination of more than one method:

- Doorstep collection of waste through non-motorised and motorised vehicles with active community participation.
- Collection through community bins
- Doorstep or lane-wise collection of waste from authorised/unauthorised slums or collection from the community bins to be provided in the slums by local bodies

8.3.6.4. Waste Storage Depots

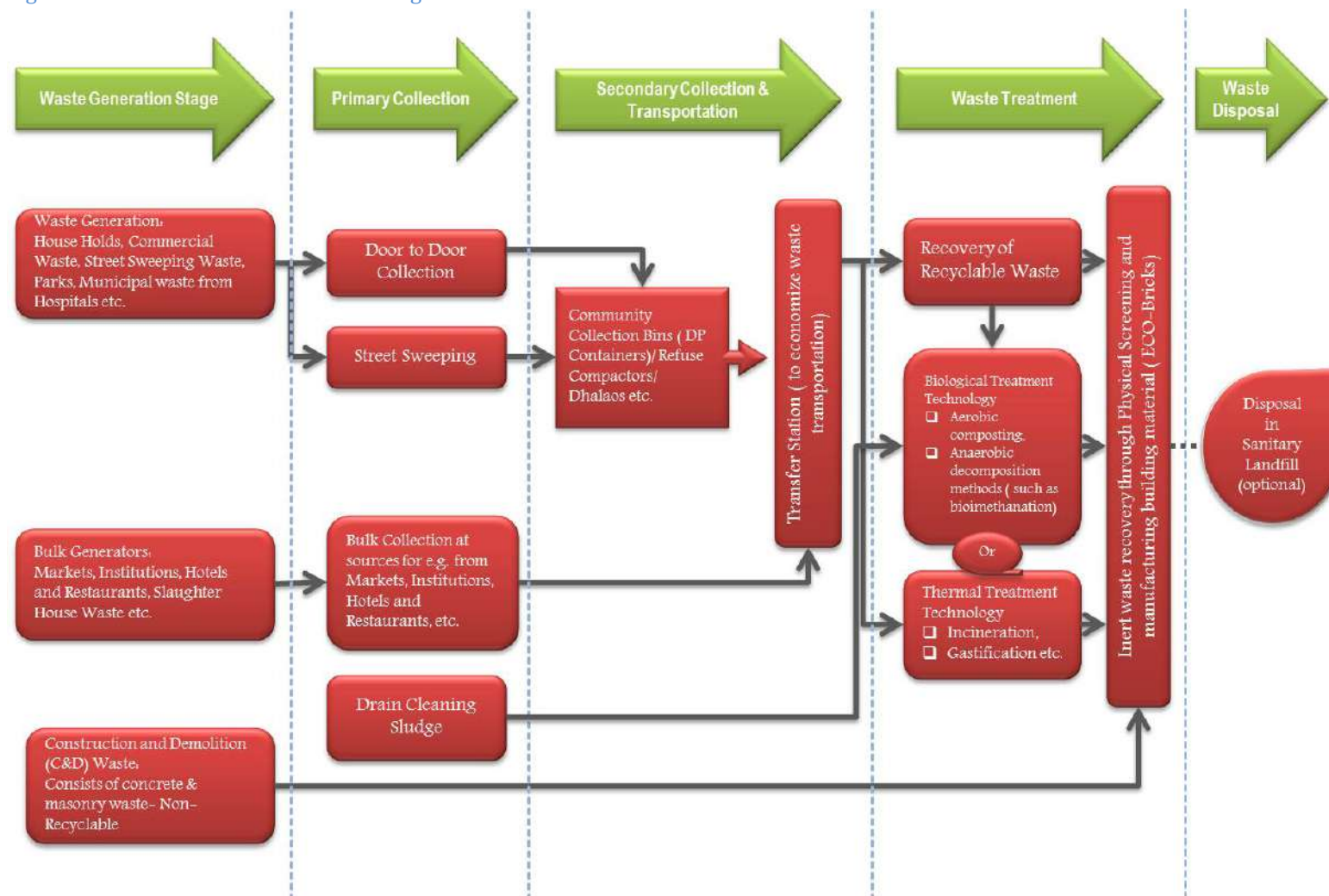
This is the third essential step for an appropriate Solid Waste Management System. All the waste collected through Primary Collection System, from the households, shops and establishments has to be taken to the processing or disposal site either directly necessitating a large fleet of vehicles and manpower or through cost effective systems which are designed to ensure that all the waste collected from the sources of waste generation is temporarily stored at a common place called "Waste Storage Depots" and then transported in bulk to the processing or disposal sites. Such temporary arrangement for storage of waste is popularly known as dust bin, dhalavs, etc. This facility has to be so designed that the system synchronizes with the system of primary collection as well as transportation of waste. Locations for bins/depots of appropriate size should be identified at planning stage.

8.3.6.5. Transportation of the waste

Transportation of the waste stored at waste storage depots at regular intervals is essential to ensure that no garbage bins/containers overflow and waste does not litter on the streets. Hygienic conditions can be maintained in cities/towns only if regular clearance of waste from temporary waste storage depots (bins) is ensured. Transportation system has to be so designed that it is efficient, yet cost effective. The system should synchronize with the system of waste storage depot and should be easily maintainable.

The schematic diagram of SWM process is shown in Figure 8.9. The detailed description of above mentioned stages are given in Manual on Municipal Solid Waste Management, CPHEEO.

Figure 8.9: Schematic Solid Waste Management Process



Source: Modified from the Toolkit for Solid Waste Management Jawaharlal Nehru National Urban Renewal Mission, MoUD.

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8.3.6.6. Solid Waste Treatment¹⁷³ Technologies

There are various technologies available for treatment and processing of waste in an environmentally sound manner. However, a technology suitable for one may not be appropriate for others. The comparison of these technologies is shown in table below:

Table 8.45: Comparison of Different Solid Waste Treatment Technologies

Element	Composting	Refuse derived fuel	Biomethanation	Gasification / Pyrolysis	Incineration
Technically and economically feasible size of operation per day fresh waste	50 TPD and above	100 TPD and above	1 TPD at small scale and above 50 TPD at larger scales of pure organic waste	500 TPD and above. Due to high moisture in our waste, suitable only for segregated dry waste.	500 TPD and above due to high moisture in our waste. Suitable only for segregated waste. However, sizes as small as 10-50 TPD of waste are available for commercial sale but not advisable due to high running costs.
Adopted Capacity for study	500 TPD	500 TPD	500 TPD	500 TPD Plant	500 TPD
Land required for adopted capacities	6 Ha	3 Ha	4 Ha	10 Ha	4 Ha
Waste Characteristics	Moisture Content >50%	Moisture Content <45%	Moisture Content >50%	Moisture content <45%	Moisture Content <45%
	Organic Matter >40%	Volatile Matter >40%	Organic Matter >40%	Net Calorific Value >1200 Kcal/Kg	Net Calorific Value >1200 Kcal/kg
	C/N Ratio between 25-30		C/N Ratio between 25-30		
Waste Suitability	Suitable for MSW Characteristics of India	Not suitable for MSW characteristics in India but workable with use of Auxiliary Fuel	Suitable for MSW characteristics of organic waste in India	Not suitable for MSW characteristic in India but workable with use of Auxiliary Fuel	Not suitable, due to high moisture in our waste.
Typical investment for assumed capacities (excluding cost of land)	INR 17-20 Cr. For a 500 TPD Plant	INR 17-20 Cr. For a 500 TPD Plant	Approximately INR 75-80 Cr for a 500 TPD Plant	INR 80-90 Cr. For 500 TPD Plant	NA
Recurring cost	INR 300 per ton of input waste	INR 290 per ton of input waste	INR 100 per ton input waste	NA	-
Recoverable	250 Kgs of compost per ton of waste	200 Kgs pellets per ton of waste	80 cum of bio gas / ton of waste plus 200 Kgs of manure / ton	NA	-

¹⁷³Toolkit for Solid Waste Management Jawaharlal Nehru National Urban Renewal Mission, MoUD.

Element	Composting	Refuse derived fuel	Biomethanation	Gasification / Pyrolysis	Incineration
Volume reduction	45-55%	55-65%	55-65%	>80%	>80%
Environmental issue	Impurities in compost due to mixed waste, traces of heavy metals, leachate runoff	Problems in burning exhaust	Problems if mixed feed stock	Ash handling and Air Pollution	Ash handling and Air Pollution (emission of particular matter, chlorinated compounds dioxins / furans)
Technology Reliability	Running successfully in India	Running successfully in integrated facilities	Small scale organic treatment plant operational but mixed waste large scale plants failed in India	Insufficient operational experience for MSW	Only Plant in India failed due to mismatch in waste quality. MSW 2000 has recommended for incineration of waste only after doing a waste suitability analysis and providing adequate flue gas management methods.
Limitation	Large Land Requirement, Non acceptance of compost as soil enrichener in some areas of the Country Process depends highly on factors such as waste quality & climatic conditions	Fluff / Pellets can be used a fuel in large industries, e.g. In cement kilns with necessary permissions from the PCBs and required pollution control measures.	The technology requires pre-segregated homogenous biodegradable waste as mixed waste retards efficiency of the process. Hence applicability is limited to highly organic and homogenous waste streams like market wastes.	Requires waste with high calorific value. Expensive flue gas remediation methods to attain achievable outputs.	Expensive technology, waste criteria must have low moisture content and high calorific value, which is not found in Indian Waste. Costly flue gas remediation methods to attain achievable outputs.

Source: Toolkit for Solid Waste Management Jawaharlal Nehru National Urban Renewal Mission, MoUD.

8.3.6.7. Disposal of Waste¹⁷⁴

Waste after treatment must be disposed in a manner that does not create any instance of environmental pollution and public nuisance. The MSW Rule 2000 defines waste disposal as an activity, which involves “final disposal of municipal solid wastes in terms of the specified measures to prevent contamination of ground-water, surface water and ambient air quality”.

The landfill design shall be aimed to minimize the following:

- The ingress of water into the landfill,
- The production of leachate, its subsequent outflow and uncontrolled dispersions into surrounding aquatic environment,
- The accumulation, migration and uncontrolled release of landfill gas into the atmosphere.

¹⁷⁴Toolkit for Solid Waste Management Jawaharlal Nehru National Urban Renewal Mission, MoUD.

The detailed description of disposal of waste can be referred from Toolkit for Solid Waste Management Jawaharlal Nehru National Urban Renewal Mission, MoUD.

8.3.6.8. Landfill Gas Extraction (LFG)^{175,176}

The waste deposited in a landfill gets subjected, over a period of time, to anaerobic conditions¹⁷⁷. This leads to landfill gas production containing about 45-55% methane. This methane can be recovered through a network of pipes and utilised as a source of energy. Landfill gas extraction systems adds to efforts to reduce Climate Change initiatives as it helps reduce Green House Gas emissions through avoidance of landfill gas (mainly comprising of methane) into the atmosphere.

Waste composition is the most important factor in assessing the LFG generation potential and total yield at a site. Inorganic and inert wastes will produce little or no LFG; more organic wastes will produce greater amounts of LFG on a per unit mass basis. Similarly moisture content in waste also impacts the LFG generation from waste. For e.g. highly organic wastes such as food wastes are able to produce LFG, but comprises of large water, which inherently does not produce LFG but will aid the rate of LFG evolution.

While planning for LFG, pH and Nutrient content of the waste should also be considered. The generation of methane in landfills is greatest when neutral pH conditions exist. Numerous toxic materials, such as heavy metals, can retard bacterial growth in portions of a site and consequently slow gas generation. Another parameter that influences the LFG generation rate is the particle size and density, which may affect the transport of nutrients and moisture throughout the landfill.

8.3.6.9. Regional Solid Waste Management¹⁷⁸

A 'Regional MSW Project' means a project to either:

1. Develop and/or construct and/or operate, maintain and/or manage any type of new Regional MSW Facility; or
2. Convert and/or redevelop an existing MSW facility or system from being a facility used by a single Authority into a Regional MSW Facility. A Regional MSW Project can cover, within its scope, any existing MSW management facilities or systems within the jurisdiction of an Authority.

Thus, Regional MSW Facilities or Regional MSW Projects would help the Authorities to share technical expertise, costs of development and management of infrastructure.

For the implementation of the Regional MSW Projects, state governments may incorporate a public limited company or state-level utility (which may be called the

¹⁷⁵Toolkit for Solid Waste Management Jawaharlal Nehru National Urban Renewal Mission, MoUD

¹⁷⁶ Landfill Gas Management Facilities Design Guidelines, Ministry of Environment, British Columbia

¹⁷⁷Organic Compounds are transformed into methane (CH₄), CO₂, and Water in an atmosphere devoid of oxygen.

¹⁷⁸ Guidance Note on Municipal Solid Waste Management on a Regional Basis, MoUD

State MSW Management Company Limited/Utility—the ‘Company/Utility’) for the purposes of identifying and enabling the development of Regional MSW Projects within the state. The Company/Utility may create a body of expertise in the development, implementation and financing of Regional MSW Projects for the benefit of the state. The utility may be backed by appropriate legislation.

The Company/Utility would have to be supported by the state government through issuance of adequate administrative instructions/ directions/policies. The state government may facilitate the process where Authorities are unable to provide for adequate services in a consultative manner.

In order to ensure a balanced framework for the implementation of a Regional MSW Project through such a Company/Utility, a framework should be established whereby a Project Coordination Committee for each project is constituted which comprises representatives of each participating Authority and the Company/ Utility; and important project decisions during the project development, implementation and operational stages are taken through this committee.

In the event that the Regional MSW Project is implemented through the PPP route, the Board of the Project Company (SPV) so constituted with a private sector participant, will have nominees of the participating Authorities, state government as well as the Company/Utility. The Project Coordination Committee, overseeing project implementation, would also have a nominee of the selected private sector participant.

8.3.6.10. Special provisions for hilly areas¹⁷⁹

Cities and towns located on hills shall have location-specific methods evolved for final disposal of solid wastes by the municipal authority with the approval of the concerned State Board or the Committee.

- The municipal authority shall set up processing facilities for utilization of biodegradable organic wastes.
- The inert and non-biodegradable waste shall be used for building roads or filling-up of appropriate areas on hills.
- Because of constraints in finding adequate land in hilly areas, wastes not suitable for road laying or filling up shall be disposed of in specially designed landfills.

¹⁷⁹Toolkit for Solid Waste Management Jawaharlal Nehru National Urban Renewal Mission, MoUD

Case study Solid Waste Management in Bruhat Bangalore Mahanagar Palike (BBMP)¹⁸⁰

The Bruhat Bangalore Mahanagar Palike has area of 800 sq. km, which accommodates the population of 78 Lakh. Estimated MSW generation projection for 2009, from all the BBMP zones is 3000 tpd. BBMP aims to adopt zero waste management or reducing the quantity of inerts that goes to landfills by less than 10% by recycling wherever possible.

Waste Collection System

About 70% of the MSW (Municipal Solid Waste) activity starting from primary collection to disposal has been outsourced & 30% is managed by BBMP. A combination of alternatives is adopted, such as:

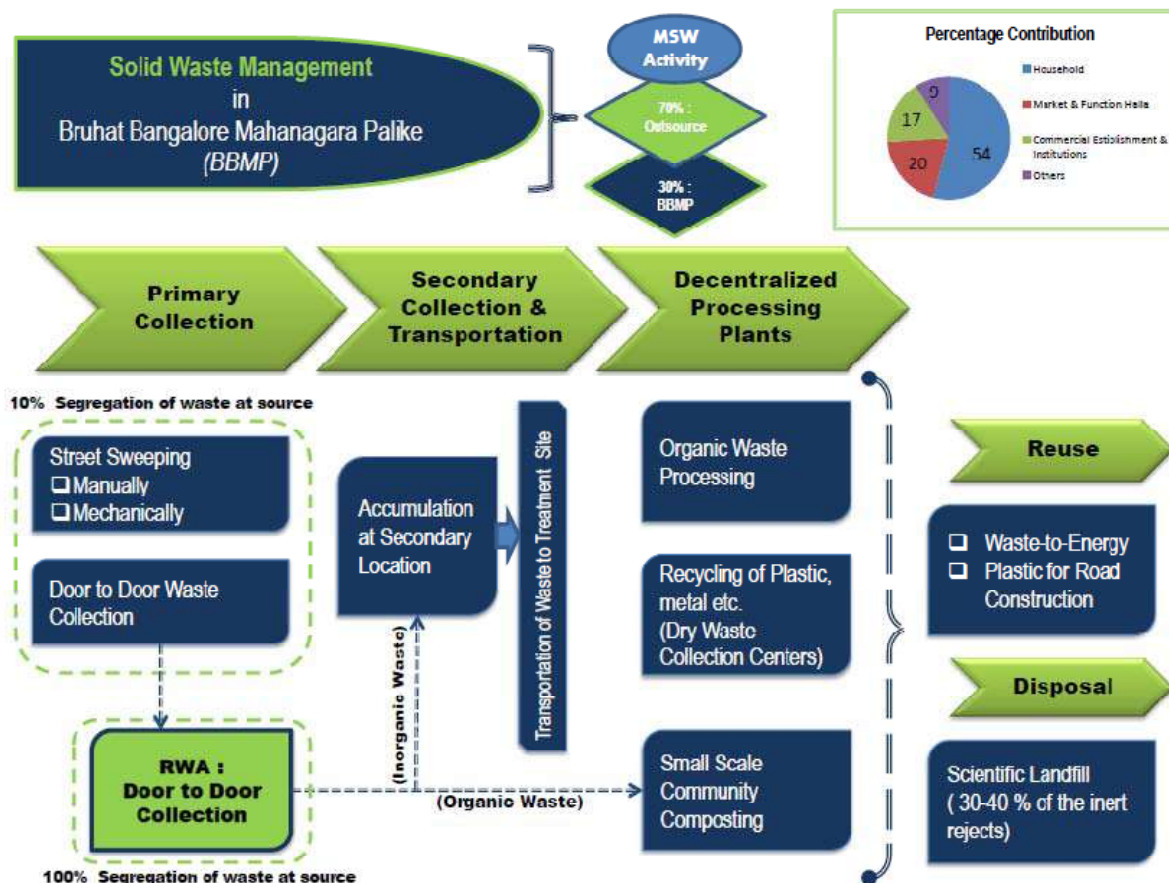
- There are about 4300 Pourakarmikas (Sweepers) of BBMP & 10000 Pourakarmikas (Sweepers) from contractor who performs Door-to-Door collection & sweeping activities.
- In some of the new zones the Door-to-Door collection activity is entrusted to Self Help Groups (SHG's), which are basically below poverty women's groups.
- In some of the residential areas the Residential Welfare Associations (RWA's) are involved in Door-to-Door collection & decentralization of composting the waste.

Decentralized Processing Plants

- Some of the areas where RWA's are performing Door to Door collection, the waste is segregated at source & the organic waste is composted in the community in a small scale.
- BBMP has setup a 15 ton capacity decentralized plant to process organic waste as well as recycle the plastic, metal etc.
- BBMP has established a decentralised one-ton capacity aerobic composting unit at Malleshwaram market (West Zone) using organic waste convertor.
- Dry waste collection centres has been set up for recycling the dry materials like plastic, paper, glass, metals etc.

¹⁸⁰ www.bbmp.gov.in

Figure 8.10: BBMP model of SWM



Source: www.bbmp.gov.in.

Processing & Disposal sites

In order to comply with MSW rules, BBMP has setup processing & disposal facilities on PPP model. Following are the processing & disposing facilities:

Table 8.46: Disposal and Processing Site

S.no.	Name of the project	Capacity of the plant	Technology adopted
1	M/s Ramky	600 MTPD	Aerobic Composting & scientific land fill
2	M/s S.G.R.R.L	1000 MTPD	Waste to energy (Presently composting & land filling the inert & combustible. material are stored for RDF)
3	M/s Terraforma	1000 MTPD	Integrated system where composting, vermi composting, biometanization is followed
4	M/s Organic Waste India pvt ltd (yet to start)	1000 MTPD	Integrated system (yet to commission)

Source: BBMP.

Construction Waste¹⁸¹

As per Central Pollution Control Board (CPCB), India's construction industry generates around 14 million tonnes of waste every year. A recycling unit makes imminent sense as it could solve two problems: dispose tons of debris dumped illegally every day and will make a sound replacement to river sand, which causes ecological degradation.

The Karnataka State Pollution Control Board (KSPCB) has directed the Bruhat Bengaluru Mahanagara Palike (BBMP) to set up a unit at a site in Mallasandra (on Hessarghatta road), which is already designated as a municipality dump yard for construction waste. A unit is developed to crush and process 50 lorry-loads of debris every day. Some of the salient features of this effort are shown in picture below:

Figure 8.11: Processing of Construction Waste at Mallasandra, Bangalore



Source: The Hindu, Bangalore edition, Date: 19-Jan-2014

Approach adopted & actions taken:

- The combination of technologies for processing of MSW attempted for sustenance & viability.
- Generally around 30 to 40 per cent of inert rejects, which includes recyclables, are going to the scientific landfill.
- Attempt is being made to utilize all the recyclables.
- Small quantity of Waste Plastic are segregated and used in the construction of pavement roads. About 8% of Poly blend is mixed in the asphalt
- There is an exposure of converting the plastics into diesel by following de-polymerisation technology, which is yet to be implemented in large scale.
- To bring in accountability for the distance travelled by the vehicles GPS/GPRS Based Tracking system is implemented.
- CCTV cameras have been installed at all the processing sites at the entry and exit points to view the vehicles reached.
- Also a ticketing system using Hand Held Device, which collect the data and send it to the central server for monitoring and analysis is in place,
- The entire truck numbers and operation schedule is automatically downloaded to the Hand Held device through GPRS.

¹⁸¹<http://www.thehindu.com/news/cities/bangalore/debris-is-preciousdont-just-dump-it/article5590977.ece>

8.3.6.11. Construction & Demolition (C&D) Waste

As per the (draft) Construction and Demolition Waste Rules, large waste generators of 500 MT are to process (recycle and reuse) construction and demolition waste at the site- minimum 20% of process waste at the site for reconstruction purposes meeting structural requirements. Recent initiatives of MoUD at the Redevelopment of East Kidwai Nagar (Delhi) Government Residential Complex have shown that it is possible to provide for 100 per cent recycling and reuse of C&D Waste at the construction/ demolition site itself in a decentralised mode. Such models obviate the need for transporting the C&D waste to a centralised unit and also for transporting the reuse material such as bricks, to the construction sites. This would be cost-effective, besides environment friendly and would also avoid movement of the waste related transport vehicles through the city.

8.3.6.12. Municipal Solid Waste (Household)

While regional and centralised waste processing has been tried out over the years, the availability of landfill sites is becoming a growing problem, as residents do not like a land fill site in their vicinity. Many cities had set up landfill sites and plants on the outskirts, but such outskirts have gradually become part of the city, owing to natural outgrowth, and the residents have started agitating for removal of the landfill. A viable solution has been tried out in the *New Moti Bagh Government Residential Complex* in Delhi, wherein a small plant of 3 to 5 tonne capacity set up in less than a quarter of hectare recycles the household and green waste into fuel cake and manure. Small plants make sorting easy and avoid the need for any collection point. Carefully planned, the recycling process can do away with the need for land fill altogether. The financial viability of any waste recycling system would depend on (a) reuse of the recycled material and (b) levy of some user fee on those who generate the waste.

8.3.6.13. Nuclear or Radioactive Waste

Nuclear or radioactive waste means any waste material containing radio-nuclides in quantities or concentrations. The disposal of such waste include the release of radioactive material to the environment in a manner leading to loss of control over the future disposition of the radio-nuclides contained therein and includes emplacement of waste materials in a repository beings or animals or in research activities in these fields or in the production or testing of biological waste. Such waste must be managed through “Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987”.

8.3.6.14. E-Waste

E-waste or electronic waste means waste Electrical and Electronic Equipment (EEE), whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded. “The E-waste (Management and Handling) Rules 2011” should be followed for disposal of E Waste.

8.3.6.15. Bio Medical Waste

Hospital waste/Bio-medical waste is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities in these fields or in the production or testing of biological waste. Hospital/Bio-medical waste must be handled and disposed-off as per guidelines laid in “Bio-Medical Waste (Management and Handling) Rules, 1998”.

8.3.7. Domestic Gas Supply Pipelines

8.3.7.1. Criteria for Technically Feasible Domestic PNG Connection¹⁸²

A technically feasible area/locality/ society / building shall have provision to lay Medium-Density Polyethylene (MDPE) pipelines and its lanes shall have free accessibility for fire tender in case of any emergency. The under-developed slum areas, water-logging areas, places with soak pits, narrow lanes that do not have room for excavation and/or the narrow and/ or crowded lanes which prevent accessing the area in case of emergency and structurally unstable buildings shall be considered technically not feasible.

A technically feasible domestic PNG connection shall have provision for connecting the customer’s premises with the service MDPE pipeline with the riser for the customers building. The connectivity service pipeline to customers building from the mainline should be possible without posing any hindrance or safety hazard.

8.3.7.2. Provisions

The provision of the domestic and trans-country pipelines shall be as per the PNGRB Technical & Quality Standards and specifications, which ensures overall safety, quality, and convenience. The last updated PNGRB rules and regulations shall be followed for:

- Design, Layout, Construction, & Maintenance of City Gas Distribution Infrastructure
- Pressure Standards & Maintenance
- Material of Construction
- Selection of Location for City Gate Stations (CGS)

The municipalities and development authorities to make provisions for:

¹⁸²Indraprastha Gas Limited (IGL)

- Right of Usage (RoU) to be pre-defined in the Right of Way (RoW) of the city roads, as per the norms of PNGRB to be compatible with the other utilities,
- The safety norms prescribed by PNGRB to be included in the Development Control Regulations by the development authorities,
- Land for City gas stations to be provisioned in the urban extensions, avoiding congested areas. Land requirement for the CGS of an area of minimum 2000 sq. mtrs.

8.3.8. Telecom Services

Utility corridor: The telecom services including broadband are to be integrated with the utility corridor and Right of Way (RoW) permission should be made available to telecom services, similar to tower installation with buffers and distances prescribed by the State Governments (refer table number 6.7).

Building regulations: modifications in the building regulation of the dense cities may be allowed for accessing telecom and broadband services to the end users.

Large facility installation: municipalities and local authorities to provide large facility installation of telecom and broadband services in the peri-urban areas.

8.3.9. Service Level Benchmarking for Infrastructure

In recent development, MoUD has initiated an exercise to define Service Level Benchmarking (SLBs). Measuring service levels of civic agencies implies measuring outcomes, and indirectly reflects on institutional capacity, financial performance and other parameters. The Handbook of Service level benchmarking prepared by MoUD can be referred while providing basic infrastructure facility such as water supply, sewerage, drainage and solid waste management for efficient functioning.

Considering the importance of SLBs to measure the performance of above mentioned infrastructure facilities it is suggested that SLB should be considered as benchmark for measuring, reporting and monitoring the performance and comparing inter and intra city level infrastructure. The MoUD (Advisory note on Improving Urban Water Supply and Sanitation Services, MoUD, 2012) has suggested SLBs for different utility services in an urban area, which are mentioned in table below:

Table 8.47: Service Level Benchmarks

Sr. No.	Indicators	Benchmark Levels
Water Supply		
1	Coverage of WS connections (Population)	100%
2	Per capita availability of WS at consumer end	135 Lpcd
3	Extent of metering of WS connections	100%
4	Extent of Non-Revenue Water	20%
5	Continuity of Water Supply	24x7
6	Efficiency of redress of Customer Complaints	80%
7	Quality of Water Supplied	100%
8	Cost recovery of in Water Supply Service	100%
9	Efficiency in collection of Water Supply Charge	90%
Sewerage		
1	Coverage of Wastewater network service	100%
2	Collection efficiency of Wastewater network	100%
3	Adequacy of Wastewater treatment capacity	100%
4	Quality of Wastewater treatment	100%
5	Extent of reuse & recycling of treated Wastewater	20%
6	Extent of cost recovery in Wastewater management	100%
7	Efficiency of redress of Customer Complaints	80%
8	Efficiency in collection of sewerage charges	90%
9	Coverage of toilets	100%
Storm Water Drainage		
1	Coverage of storm Water Drainage network	100%
2	Incidence of water logging / flooding	0
Solid Waste Management		
1	Household level Coverage of Solid Waste Management service	100%
2	Efficiency of Collection of Municipal Solid Waste	100%
3	Extent of segregation of Municipal Solid Waste	100%
4	Extent of Municipal Solid Waste recovered / recycled	80%
5	Extent of scientific disposal of Municipal Solid Waste	100%
6	Extent of cost recovery in Solid Waste management service	100%
7	Efficiency of redress of Customer Complaints	80%
8	Efficiency in collection of user charges	90%

Source: Advisory note on Improving Urban Water Supply and Sanitation Services, MoUD, 2012.

8.4. Social Infrastructure

The quality of life in any urban centre depends upon the availability of and accessibility to quality social infrastructure. These include the following infrastructure:

- a) Education facilities
- b) Healthcare facilities
- c) Socio Cultural facilities
- d) Recreational facilities
- e) Sports Facilities
- f) Distribution Services
- g) Police Safety

8.4.1. Provision of Infrastructure

Hierarchy: The provision of social amenities in any urban area shall consider the regional bearings; as small towns cater to the requirements (especially of higher level facilities) of surrounding villages, medium size towns cater to small towns and villages and so on. However, in case of large and metro cities, certain apex level facilities significantly cater to regional requirements in addition to the city demand. In order to efficiently plan for cities & regions, alternatives, which could be considered, may be to provide:

- a) Amenities for 25% additional population overall as a cushion, or
- b) Exclude such apex level facilities from the total estimated needs provision.

In distribution of infrastructure, population plays the guiding role and therefore, indication of population served by a facility or service is given. In some cases depending upon the regional requirements, a higher order facility becomes necessary in a lower order settlement. A comprehensive list of facilities at each hierarchy is given in **Appendix N of Volume II B**.

Location of social infrastructure should be decided by local authority taking into account walkable distances. Maintenance of such micro-level facilities should be, as far as possible, handed over to RWA / housing co-operative societies with the provisions of direct involvement of women.

Proximity: The local community participation shall be encouraged, especially women, in management of the local level facility units to promote efficient utilization and upkeep of the facilities. These local level facilities shall be provided at a preferable 300 m to 800 m walkable distance (located within 5-15 minutes) to promote pedestrianisation and reduction in vehicular use.

It is observed that a number of lower level social amenities particularly in regard to education and health infrastructure operate in private residential premises due to their proximity to the area of demand. The potential of such practices shall be assessed to find out the actual needs, which shall be reliable input for arriving at realistic norms as well as for providing adequate number of sites for such facilities.

Multiple uses: The possibilities for multiple uses of social amenities may be considered depending upon the compatibility of the activities and acceptance of the society, such as the school auditoriums can be utilised for public seminars in off working hours. The multiple uses can be for private and public owned land/properties. The possibility of multiple activities in public facilities may also be considered such as in case of bus terminal, the above floors can be provided for use of staff residential, post office, courier services, ticket booking offices, retail markets etc.

Utilisation threshold: It is observed that the built up facilities for social amenities are often underutilised and lie vacant. A consideration of 80% utilization of existing facilities can be made mandatory before approving plan of new facility for similar use in a particular area.

In case of vacated properties, for efficient utilisation of the built up spaces; change in use permission can be considered.

Self-sufficiency: In planning of social infrastructure the provisions given in 'National Mission on Sustainable Habitat' shall be considered such as utilisation of renewable sources of energy like solar roof top panels, rain water harvesting etc. The facilities can be designed for self-sufficiency and can also generate revenue by selling of surplus resources.

The planning norms for social infrastructure as suggested below are based on the provisions given in National Building Code 2005 and the current guidelines from respective departments. It is suggested that the latest guidelines shall be referred at the time of urban and regional plan preparation. The plot area requirement given herein is suggestive and may vary depending upon the size, geography and land availability of an urban centre.

8.4.2. Education Facilities

8.4.2.1. Pre-primary to Secondary Education

Table 8.48: Norms for Pre Primary to Secondary Education

Sr. No.	Category	Student Strength	Population Served per unit	Area Requirement	Other Controls
1.	Pre Primary, Nursery School	--	2500	0.08 ha	To be located near a park
2.	Primary School (class I to V)	500	5000 (NBC, 2005)	Area per School = 0.40 Ha a) School building area = 0.20 Ha b) Playfield Area = 0.20 Ha	Playfield area with a minimum of 18 m x 36 m to be ensured for effective play
3.	Senior Secondary School (VI to XII)	1000	7500	Area per School = 1.80 Ha (NBC, 2005) a) School building area = 0.60 Ha b) Playfield Area = 1.00 Ha c) Parking Area = 0.20 Ha	Playfield area with a minimum of 68 m x 126 m to be ensured for effective play

Sr. No.	Category	Student Strength	Population Served per unit	Area Requirement	Other Controls
4.	Integrated School without hostel facility (Class I-XII)	1500	90,000 – 1 lakh	Area per School = 3.50 Ha a) School building area = 0.70 Ha b) Playfield Area = 2.50 Ha c) Parking Area = 0.30 Ha	To be located near a sport facility
5.	Integrated School with hostel facility (Class I-XII)	1500 (NBC, 2005)	90,000 – 1 lakh	Area per School = 3.90 Ha a) School building area = 0.70 Ha b) Playfield Area = 2.50 Ha c) Residential Hostel Area = 0.40 Ha d) Parking Area = 0.30 Ha	To be located near a sport facility
6.	School for Physically Challenged	400	45,000	Area per School = 0.70 Ha a) School Building Area = 0.20 Ha b) Playfield Area = 0.30 Ha c) Parking Area = 0.20 Ha (NBC, 2005)	To be located near a park or sport facilities
7.	School for Mentally Challenged		10 lakh (MPD, pg 137)	0.20 Ha	To be located near a park and non-noise polluting zone
Other Controls: The schools should preferably face service roads and roads with less traffic intensity.					

Source: NBC, 2005 Part 3 and MPD 2021.

8.4.2.2. Higher Education

Table 8.49: Norms for Higher Education Facilities

Sr. No.	Category	Student Strength	Population Served per unit	Area Requirement
General				
1.	College	1000 - 1500	1.25 lakh	Area per college = 5.00 Ha a) College Building Area = 1.80 Ha b) Playfield Area = 2.50 Ha c) Residential including Hostel Area = 0.30 Ha d) Parking Area = 0.30 Ha
2.	University Campus	--	--	10.00 to 60.00 Ha area a) Residential (if included) = 25% of total land area b) Sports and Cultural Activities = 15% of total land area c) Parks and landscape including green belt= 15% of total land area. (MPD)
Technical Education				
3.	Technical Education Centre (A) – To include 1 Industrial Training Institute (ITI) and 1 Polytechnic	ITI = 400 Polytechnic = 500	10 lakh	Area per Technical Education Centre = 4.00 Ha a) Area for ITI = 1.60 Ha b) Area for Polytechnic = 2.40 Ha
4.	Technical Education Centre (B) – To include 1 ITI, 1	--	10 lakh	Area per Technical Education Centre = 4.00 Ha a) Area for ITI = 1.40 Ha b) Area for Technical Centre = 2.10 Ha

Sr. No.	Category	Student Strength	Population Served per unit	Area Requirement
	Technical Centre and 1 Coaching Centre			c) Area for Coaching Centre = 0.30 Ha
Professional Education				
5.	Engineering College	1500	10 lakh	Area per College = 6.00 Ha
6.	Medical College	--	10 Lakh	Area per College = 15.00 Ha Area of site including space for general hospital
7.	Other Professional Colleges	250 to 1500	10 Lakh	a) Area of site for student strength up to 250 students = 2.00 Ha b) Additional area of site for every additional 100 students or part thereof up to total strength of 1000 students = 0.50 Ha c) Area of site for strength of college from 1000 to 1500 students = 6.00 Ha
8.	Nursing and Paramedical Institute (MPD, pg 135)	--	10 lakh	Institute Plot area = 2000 sqm (subject to Nursing Council of India/ Ministry of Health Norms)
9.	Veterinary Institute (MPD, pg 135)	--	-	As per Veterinary Council of India/ Ministry Norms (subject to availability of land)

Source: NBC, 2005 MPD 2021.

Threshold population of each of education facilities should not only to depend on the number of population, but also on the characteristics of the population. Considering that there is a wide variation in the levels of literacy and increasing rate of entry into the school, the variations based on the areas are to be respected. Further to the table above, it is recommended that the threshold population shall be determined based on the characters of the population, along with the number of population in order to determine social infrastructure provision at varying regions.

8.4.3. Healthcare Facilities

The size of a hospital depends upon the hospital bed requirement, which in turn is a function of the size of the population it serves. As per the Indian Public Health Standards (IPHS), 2012, the calculation of number of beds is based on-

- annual rate of admission as 1 per 50 population
- average length of stay in a hospital as 5 days

For example: In India the population size of a district varies from 50,000 to 15,00,000. For the purpose of convenience the average size of the district is taken as one million population. Based on the assumptions the number of beds required for 10,00,000 population is :

- No. of bed days per year : $(10,00,000 \times 1/50) \times 5 = 1,00,000$
- No. of beds required with 100% occupancy : $1,00,000 / 365 = 275$
- No. of beds required with 80% occupancy : $(1,00,000 / 365) \times 80\% = 220$

The classification of health care facilities is given in Table 8.50.

Table 8.50: Health Care Facilities

Sr. No.	Category	No. of beds	Population served per unit	Area requirement
1.	Dispensary	--	15000	0.08 to 0.12 Ha
2.	Nursing home, child welfare and maternity centre	25 to 30 beds	45000 to 1 lakh	0.20 to 0.30 Ha
3.	Polyclinic	Some observation beds	1 lakh	0.20 to 0.30 Ha
4.	Intermediate Hospital (Category B)	80 beds Initially maybe for 50 beds including 20 maternity beds	1 lakh	Total Area = 1.00 Ha a) Area for Hospital = 0.60 Ha b) Area for residential Accommodation = 0.40 Ha
5.	Intermediate Hospital (Category A)	200 beds Initially the provision maybe for 100 beds	1 lakh	Total Area = 3.70 Ha a) Area for hospital = 2.70 Ha b) Area for residential Accommodation = 1.00 Ha
6.	Multi-Speciality Hospital (NBC)	200 beds Initially the provision may be for 100 beds	1 Lakh	Total Area = 9.00 Ha a) Area for hospital = 6.00 Ha b) Area for residential accommodation = 3.00 Ha
7.	Speciality Hospital (NBC)	200 beds Initially the provision may be for 100 beds	1 Lakh	Total Area = 3.70 Ha a) Area for hospital = 2.70 Ha b) Area for residential accommodation = 1.00 Ha
8.	General Hospital (NBC)	500 Initially the provision maybe for 300 beds	2.5 lakh	Total Area = 6.00 Ha a) Area for hospital = 4.00 Ha b) Area for residential Accommodation = 2.00 Ha
9.	Family Welfare Centre (MPD, pg 134)	As per requirement	50,000	Total area = 500 sqm 800 sqm
10.	Diagnostic centre (MPD, pg 134)	--	50,000	Total area = 500 sqm to 800 sqm
11.	Veterinary Hospital for pets and animals (MPD, pg 134)	--	5 lakh	Total area = 2000 sqm
12.	Dispensary for pet animals and birds (MPD, pg 134)	--	1 lakh	Total area = 300 sqm
13.	Rehabilitation centres			As per requirement

Source: UDPFI Guidelines, 1996, NBC, 2005 Part 3 and MPD, 2021.

The Department of Health and Family welfare suggests incorporation of **Trauma Centres** in the highways cutting across urban local authority jurisdiction. The trauma care centres should be suitably positioned along the highways with doctors trained in emergency medicine and trauma care, with adequate emergency management technicians, supported by efficient and efficient ambulance system.

8.4.4. Socio-cultural

The provision of socio cultural facilities shall correspond to the changing urban demography and work lifestyle.

Table 8.51: Norms for Socio – Cultural Facilities

Sr. No.	Category	Population Served per unit	Land Area Requirement
1.	Anganwadi - Housing area/ cluster	5000	200-300 sqm
2.	Community Room	5000	750 sqm (NBC)
3.	Community hall, mangalkaryayala, barat ghar/ library	15000	2000 sqm
4.	Music, dance and drama centre	1 lakh	1000 sqm
5.	Meditation and spiritual Centre	1 lakh	5000 sqm
6.	Recreational Club	1 lakh	10,000 sqm
7.	Old age home	5 lakh	Max. 1000 sqm, subject to availability of land
8.	Religious Facilities (MPD, pg 149)		
8a.	At neighbourhood / housing cluster level	5000	400 sqm
8b.	At sub city level in urban extension	10 lakh	4.00 Ha
9.	Other Facilities (MPD)		
9a.	Orphanage/ Children's Centre (One each)	10 lakh	Max. 1000 sqm, subject to availability of land
9b.	Care centre for physically /mentally challenged	10 lakh	Max.1000 sqm, subject to availability of land
9c.	Working women – men hostel	10 lakh	Max. 1000 sqm, subject to availability of land
9d.	Adult education centre	10 lakh	Max.1000 sqm, subject to availability of land
9e.	Night Shelter	10 lakh	Max. 1000 sqm, subject to availability of land
10.	Socio – Cultural centre/ Exhibition cum fair ground	10 lakh	15 Ha (NBC)
11.	Science Centre (MPD, pg 148)	10 Lakh	As per requirement
12.	International Convention Centre (MPD, pg 148)	City level	As per requirement

Source: UDPFI Guidelines, 1996 and MPD 2021.

Notes:

1. For lower income group population, the maintenance and management of formal community buildings is a challenging task. Thus to ensure optimum utilisation and maintenance and management of formal community buildings, the use of such facilities shall be planned and designated for multipurpose activities. Activities such as adult education, training programmes for economic generation activities, child and family welfare programmes etc. can be organised in such spaces.

2. Orphanage and Old age homes can be co-developed with appropriate green spaces to promote social relations between the two dependent age groups. The facility could include the following apart from living space:
 - a) Common recreational facilities such as sports facilities, walking tracks, reading rooms etc.
 - b) Opportunity for part time work for old people. This shall promote their active involvement with other social groups.
 - c) Adequate barriers in living spaces between the two groups to address social security of orphanages.
3. It has generally been observed that the religious buildings come up on encroached sites and especially those meant for open spaces. Effort should be made by the development agencies with the assistance of NGO's in the area to ensure that the places of worship come up as planned with the participation and preferences of the community itself. As a general basis, separate religious sites (2 for 15,000 populations) may be provided so that places of worship do not get established on encroached sites.

8.4.5. Open Spaces

The open spaces can include the following three categories, namely:

- a) Recreational space
- b) Organised green
- c) Other common open spaces (such as vacant lands/ open spaces including flood plains, forest cover etc. in plain areas.

Considering open spaces, including all the above-mentioned categories, provision be 10-12 sqm per person may be desirable. However, in hilly areas the protected zones and ecological conservation areas shall be considered to be over and above this open space requirement. In the built up area (excluding recreational space, vacant land, flood plain, forest) the NBC suggests 3 sqm/ person as minimum norm.

The hierarchy for organised green such as parks, play fields and other open spaces like specified park, amusement park, maidan, a multipurpose open space, botanical garden and zoological parks, traffic parks etc. are as under:

Table 8.52: Hierarchy of Organised Green

S. No.	Planning Unit	Number of Organised green spaces
1	Housing Cluster	3 - 4 local parks and playgrounds
2	Neighbourhood	3 - 4 local parks and playgrounds
3	Community	2-3 community level park and open space
4	District/ Zone	1 district level park and sports centre, maidan
5	Sub city centre	1 city level park, sports complex, botanical / zoological garden, maidan

Source: UDPFI Guidelines, 1996.

8.4.5.1. Organised Green for Plain Areas

Table 8.53: Norms for Organised Green for Plain Areas

S. No.	Category	Population served per unit	Area Requirement (Ha)
1.	Housing Area Park	5000	0.50
2.	Neighbourhood park	15000	1.00
3.	Community park	1 lakh	5.00
4.	District park	5 lakh	25.00
5.	Sub city park	10 lakh	100.00

Source: MPD, 2021.

8.4.5.2. Other Controls (NBC):

- 1) Open spaces/ maidans should be spatially distributed and multiple function in time to be promoted
- 2) In any layout or sub-division of land measuring 0.3 Ha or more in residential and commercial zones, the community open space shall be reserved for recreational purposes which shall as far as possible be provided in one place.
 - a) The minimum recreational space provided shall be 450 sqm.
 - b) The minimum average dimension of the recreational space shall not be less than 7.5 m and the length shall not exceed 2.5 times the average width.
- 3) Each recreational area and the structure on it shall have an independent means of access.
- 4) Any building line to be at least 3 m away from the boundary of recreational open space.
- 5) Zoological garden to be as per Central Zoo Authority provisions

Notes:

Green areas and other associated non-economic activities to be preferably proposed on Government reserved land. In case the open/green spaces which do not generate income are proposed on privately owned land, the local authority preparing the plan shall part with a fair compensation as per 'The Right to Fair Compensation and Transparency in LARR Act, 2013' to the land owner.

8.4.5.3. Organised Green for Hilly Areas

Table 8.54: Norms for Organised Green for Hilly Areas

S. No.	Category	Population served per unit	Area Requirement (Ha)
1.	Housing Area Park	5000	0.50 to 1.00
2.	Neighbourhood park	10000	1.20 to 2.00
3.	City Parks/ playgrounds/ maidan/ exhibition grounds/ cultural gathering grounds	For entire town at one or more sites, depending upon design and space availability	--
4.	Botanical Garden	1 for every town	10.00 to 20.00
5.	Recreational complex including zoo	1 for every settlement with tourist potential	10.00 to 12.00

Source: NBC, 2005.

8.4.5.4. Norms for Multipurpose Grounds

Table 8.55: Norms for Multipurpose grounds

S.No	Category	Population served per unit	Area Requirement (Ha)
1	Sub city level multipurpose ground	10 lakh	8
2	District level multipurpose ground	5 lakh	4
3	Community level Multipurpose ground	1 lakh	2

Source: MPD, 2021.

Variation by size of settlement

A. Small Towns

- 1) In light of the standards recommended by various bodies, it is suggested to provide 1.0 to 1.2 ha per 1000 persons for town level open spaces (excluding the open spaces in residential pockets), which can be distributed for different residential pockets uniformly for a population of 8000 to 10,000. (Calculation based on the 10-12 mts / person for the entire planned areas).
- 2) As already mentioned, the open spaces are to be developed with other socio cultural and commercial facilities so that they can serve multiple purposes.

B. Medium Towns

- 1) The open spaces shall be provided at the rate of 1.4 to 1.6 ha per 1000 persons. The lower income areas shall be provided with more open spaces and the area under facilities like community halls etc. can be merged with the open spaces to suit their social requirements.

C. Large City, Metropolitan and Megapolis

- 1) The suggested standards for open spaces in large and metropolitan cities are 1.2 to 1.4 ha per 1000 persons, depending upon the land availability.
- 2) The older parts of the large cities have normally been found highly deficient with respect to the availability of open spaces, thus additional provisions in the new development may also take care of the existing deficiencies. For large and metro cities, provisions shall also be made for city level special parks such as botanical and zoological parks, picnic huts, children parks, amusement parks, etc.

8.4.6. Sports Facilities

Table 8.56: Norms for Sports Facilities

Sr. No.	Category	Population Served per unit	Land Area Requirement
1.	Residential unit play area	5,000	5000 sqm
2.	Neighbourhood Play area	15,000	1.50 ha
3.	District Sports Centre	1 lakh	8.00 ha
4.	Divisional Sports Centre	10 lakh	20.00 ha

Source: NBC, 2005, part 3.

8.4.7. Distribution services

Table 8.57: Norms for Distribution Services

Sr. No.	Category	Populati on served per unit	Land Area Requirement		Other Controls
			Type of Facility	Area requirement	
1.	Petrol/ Diesel filling and Service Centre				
	Permitted in:		i. Only filling station	30 m x 17 m	• Shall not be located on road having Right of Way less than 30m. • Special cases in old city areas may be considered based on the approval by statutory authorities. • Shall be approved by the explosive/ fire department.
	a) Central District		ii. Filling cum service station	36 m x 30 m	
	b) Sub central District		iii. Filling cum service station cum workshop	45 m x 36m	
	c) District Centres		iv. Filling station only for two and three wheelers	18m x 15m	
	d) Community Centres (Only Filling Station)				
	e) Residential & Industrial Use Zone in Urban Areas				
	f) Along National and State Highways				
	g) Villages identified as growth centres				
	h) Freight Complex				
	i) Proposed major roads				
	j) Police/ security force services (for captive use only) (MPD, pg 125)				
2.	Compressed Natural Gas (CNG)/ filling centre				
	Permitted in:		CNG mother station	1080 sqm	• Shall not be located on road having Right of Way less than 30m. • Shall be approved by the explosive/ fire department.
	a) All use zones (except in Regional Parks and Developed District Parks)		(Including building component – control room/ office/ dispensing room/ store, pantry and W.C.)	(36m x 30m)	
	b) Along National and State Highways				
	c) Villages identified as growth centres				
	d) Freight Complex				
	e) Proposed major roads				
3.	LPG Godown/ Gas godown	40,000 to 50,000	Capacity = 500 cylinders or 8000 kg of LPG Area (inclusive of guard room)	520 sqm (26m x 20m)	The major concern for its storage and distribution is the location, which shall be away from the residential areas and shall have open spaces all around as per the Explosive Rules.
4.	Milk Distribution	5000	Area inclusive of service area	150 sqm	--

Source: NBC, 2005.

Notes:

- 1) Super Kerosene Oil/ Light Diesel Oil for industrial activity shall be given separately.
- 2) Large petrol/diesel storage centres to be located outside city jurisdiction.

8.4.8. Police, Civil Defence and Home Guards

Table 8.58: Norms for Police Facilities

Sr. No.	Category	Population Served per unit	Land Area Requirement
1.	Police Post	40,000 – 50,000 (Area not served by Police Station)	0.16 Ha (Area inclusive of residential accommodation)
2.	Police Station	90,000	1.50 Ha (Area inclusive of essential residential accommodation) 0.05 Ha additional to be provided for civil defence and home guards.
3.	Traffic and Police Control Room (MPD, pg 143)	--	As per requirement
4.	District office and battalion	10 lakh	Total area = 4.80 Ha a) Area for district office = 0.80 Ha b) Area for battalion = 4.00 Ha
5.	Police line	20 lakh	4.00 to 6.00 Ha
6.	District Jail	10 lakh	10.00 Ha
7.	Civil defence and home guards	10 lakh	2.00 Ha
8.	Police Training Institute/ College (MPD, pg 143)	City level (to be located in fringe areas)	5 Ha
9.	Police Firing Range (MPD, pg 143)	City level (to be located in fringe areas)	Up to 10 Ha
10.	Police camp including Central Police Organisation/ Security Forces (Including Central Security Forces) (MPD, pg 143)		Up to 10 Ha
11.	Police Booth (at major road intersections)	--	10-12 sqm (to be provided by transport planners)

Source: NBC 2005 and MPD 2021.

8.4.9. Safety Management

Table 8.59: Norms for Safety Facilities

Sr. No.	Category	Distribution or Population Served per unit	Area Requirement
1.	Sub fire station/ Fire Post	Within 3-4 km radius	0.6 Ha (with essential residential accommodation)
2.	Fire Station	2 lakh population or 5-7 km radius	1 Ha with residential accommodation
3.	Disaster Management Centre	One in each administrative zone	1 Ha along with suitable open area 2 Ha if soft parking, temporary shelter, parade ground etc. included
4.	Fire Training Institute/ College	City level (one site in Urban extension)	3 Ha

Source: MPD 2021.

Guidelines for locating fire stations and other fire fighting facilities (As per MPD)

- Fire stations should be located so that the fire tenders are able to reach any disaster site within 3-5 minutes
- Fire stations should be located on corner plots as far as possible and on main roads with minimum two entries.
- In the new layouts, concept of underground pipelines for fire hydrants on the periphery exclusively for fire fighting services should be considered.
- Necessary provisions for laying underground/ over ground fire fighting measures, water lines, hydrants etc. may be kept wherever provision of fire station is not possible.
- The concerned agencies shall take approval from Fire Department for fire fighting measures while laying the services for an area.

8.4.10. Special Requirements for Gender Sensitive Planning¹⁸³

Women's travel is characterized by trip chaining i.e. combining multiple destinations within one trip. Given women's higher domestic and caretaking responsibilities, they tend to seek employment opportunities closer to home with more flexible hours than their male counterparts. This translates into a higher sensitivity to distance.¹⁸⁴

- At the regional and city levels, decentralized economic opportunities should be considered to reduce travel distances.
- At the neighbourhood or planning sector levels, single land use zones should be discouraged, as they tend to be "dead" or inactive as with business districts in the night or residential areas. Mixed land uses (such as mixed residential and mixed commercial uses) should be encouraged which will generate street activity throughout the day and also reduce walking distances.
- Women are disproportionately affected by poor quality pedestrian infrastructure and increased walking distances. Walkable blocks should be promoted by limiting block sizes, providing direct, shortest non-motorized transport routes or pedestrian public right of ways.
- The height of compound walls can restrict street visibility. Therefore porous or semi-porous compound walls are recommended to allow street visibility.

Figure 8.12: Compound walls Restricting Street Visibility



High compound walls limit street visibility. Semi-porous and porous compound walls attract people.

Source: Working Paper on 'Incorporating a Gender Perspective in Urban Planning and Regulations', Embarq, India.

¹⁸³ Working Paper on 'Incorporating a Gender Perspective in Urban Planning and Regulations', Embarq, India.

¹⁸⁴ Camstra, 1996.

8.4.10.1. Housing

- Any project, which involves relocation of households, economic links or networks, should be preserved by considering relocation within the same ward or local area.
- The design of housing schemes for poor women should consider their lower incomes, work in the informal sector¹⁸⁵ and that the house and the open space adjoining it is also used for economic activity.¹⁸⁶

8.4.10.2. Amenities

- Where land is not reserved for amenities like police stations, public toilets, reading areas, community bins, they are constructed on pavements or informally provided thereby obstructing pedestrian movement.
- Due to women's higher domestic and care-taking facilities, amenities like day care centres, pre-primary and primary schools, primary health facilities, local markets are recommended to be provided within 5-15 minutes walking distance (300-800m).
- Similarly adequate space and access should be provided for women in these public amenities, considering their needs. For example, it is recommended that public toilets should be provided within 15 minutes walking distance with special emphasis on areas with high volumes of people i.e. railway stations, markets, bus terminals, public buildings, public open spaces etc. Public toilets should ensure sufficient seats for women, space for childcare and include toilet seats for dependents.

8.4.10.3. Street Design

- There needs to be an effort to increase cycling modal shares of women by improving women and girls' access to cycles, especially load carrying cycles.
- Crowded streets, station entrances or exits are perceived as unsafe for women. Therefore a level of service approach should be used to plan pedestrian infrastructure. As per IRC Guidelines 103-2012: Guidelines for Pedestrian Facilities, a level of service B or C is recommended. All footpaths should include and specify a dead zone, an uninterrupted walking zone and a multi-utility zone for street furniture etc.
- Streets, including carriageway and pavements should be consistently and continuously lit.
- The role of street vendors in creating street eyes is acknowledged¹⁸⁷ and therefore must be planned for in neighbourhood layout or local area plans and in street design.

¹⁸⁵ Khosla, Renu. Addressing Gender Concerns in India's Urban Renewal Mission. UNDP.

¹⁸⁶ SPARC and KRVIA. 2010. Re-Dharavi. <http://www.sdinet.org/media/upload/documents/ReDharavi.pdf> (Accessed on 25th February 2014).

¹⁸⁷ Cross, John and Morales, Alfonso (Ed). 2007. Street Entrepreneurs: People, Place and Politics in Local and Global Perspective, Routledge.

8.4.10.4. Public Transport

Such provision include - Prioritizing safe access to transit, rethinking transit fare structures to minimize cost for multi-stop journeys and in off-peak hours, introducing flexible services – such as halting buses in-between stops to drop women closer to their destination in the night, women only buses/trains/coaches or reserved seats for women in buses, ensuring sufficient toilet seats for women at stations and terminals, ensuring bus shelters and train stations have safety and comfort features (lighting, benches, emergency call options) etc.

8.5. Commercial Activities

8.5.1. Hierarchy of Commercial Centres

Hierarchy of commercial centres is a function of the hierarchy of planning units in an urban centre. Normally an urban centre shall have some or all of the following, depending upon its size:

Table 8.60: Hierarchy of Commercial Centres (NBC)

Sr. No.	Planning Unit	Class of Settlement			Population served	Hierarchy of Commercial Centre
		S	M	L		
1	Housing Cluster	✓	✓	✓	5000	Convenience Shopping
2	Neighbourhood	✓	✓	✓	15000	Local shopping centre
3	Community	✓	✓	✓	100000	Community Centre
4	District	-	✓	✓	500000	District Centre
5	Sub city	-	-	✓	25 lakh - 50 lakh	Sub city Centre
6	City	-	-	✓	50 lakh +	City Centre

S: Small Town
M: Medium Town
L: Large City, Metropolitan City and Megapolis

8.5.2. Norms for Commercial Centres

The norms for planning of commercial centres are as given in table below:

Table 8.61: Norms for Commercial Centres

Sr. No.	Category	Population Served per unit	Land Area Requirement
1.	Convenience Shopping	5,000	1,500 sqm
2.	Local shopping including service centre	15,000	4,600 sqm
3.	Community Centre with service centre	1,00,000	5 Ha
4.	District Centre	1 at District level / 5,00,000 population	40 Ha
5.	Sub-city Centre (UDPFI)	25 lakh to 50 lakh	As per requirement
6.	City Centre (UDPFI)	50 lakh +	As per requirement
7.	Local Wholesale Market/ <i>Mandi</i>	10 lakh	10.00 Ha
8.	Weekly Markets	1 to 2 locations for every 1 lakh	Area per location = 0.40 Ha

Sr. No.	Category	Population Served per unit	Land Area Requirement
	1) Parking and other open spaces within the commercial centres could be so designed that weekly markets can operate in these areas during non-working hours. 2) The area of informal sector should have suitable public conveniences and solid waste disposal arrangements.	population with 300 to 400 units per location	
10.	Organised Informal eating spaces	1 lakh	2000 sqm

Source: NBC, 2005.

Note:

- Small and medium towns to give emphasis on the weekly markets from promoting local economic activities,
- *Mandis* and wholesale markets to be given emphasis in regional planning. Integration of the rural and small and medium towns to be developed through the provision of *Mandis*.

The area of commercial centres and the number of shops is given below:

Table 8.62: Area of Commercial Centres

Sr. No.	Category	Area per 1000 persons (sqm)	Number of shops
1.	Convenience Shopping	220	1 for 110 persons
2.	Local shopping including service centre	300	1 for 200 persons
3.	Community Centre with service centre	500	1 for 200 persons
4.	District Centre	880	1 for 300 persons

Source: UDPFI Guidelines, 1996 updated.

8.5.3. Distribution of Activities

The following activities allowed in the hierarchy of Commercial Centres.

Table 8.63: Distribution on Activities

Hierarchy of Commercial Centres						
Sr. No.	Activities	City an Sub city centre	District centre	Community centre	Neighbourhood Centre	Cluster Centre
1.	Shopping (retail services, repair)	✓	✓	✓	✓	✓
2.	Limited wholesale & <i>Mandi</i>	✓	✓	-	-	-
3.	Informal shopping	✓	✓	✓	✓	✓
4.	Commercial Offices	✓	✓	✓	✓	-
5.	Cinema	✓	✓	✓	-	-
6.	Hotel	✓	✓	✓	-	-
7.	Guest House	✓	✓	✓	-	-
8.	Bank/ ATM	✓	✓	✓	✓	✓
9.	Nursing Home	✓	✓	✓	-	-
10.	Service Industries	✓	✓	✓	✓	✓
11.	Auditorium	✓	✓	✓	-	-
12.	Museum	✓	✓	-	-	-

Hierarchy of Commercial Centres						
Sr. No.	Activities	City an Sub city centre	District centre	Community centre	Neighbourhood Centre	Cluster Centre
13.	Library	✓	✓	✓	-	-
14.	Reading room	✓	✓	✓	✓	-
15.	Science Centres, Art/ Craft/ Music/ Dance School	✓	✓	-	-	-
16.	Weekly markets (on close days)	✓	✓	✓	✓	-
17.	Local Government Offices	✓	✓	✓	-	-
18.	Bus Terminal	✓	✓	-	-	-
19.	Fire Station	✓	✓	-	-	-
20.	Police post/ station	✓	✓	-	-	-
21.	Telephone Exchange	✓	✓	-	-	-
22.	Electric sub station	✓	✓	✓	✓	✓
23.	Post office	✓	✓	✓	-	-
24.	Petrol pump	✓	✓	✓	-	-
25.	Conveniences shopping centre	✓	✓	✓	✓	✓
26.	Essential Residential	✓	✓	-	-	-

Source: UDPFI Guidelines, 1996 updated.

8.5.4. Urban Street Vendors

Street vendors¹⁸⁸ form a very important segment of the unorganised sector in the country and it is estimated that in several cities street vendors account for about 2% of the population. The planning of the urban street vending zones shall be so done so as to provide for and promote a supportive environment for the vast mass of urban street vendors to carry out their vocation while at the same time ensuring that their vending activities do not lead to overcrowding and unsanitary conditions in public spaces and streets.

The Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act, 2014 has come into force since March 2014. The Act provides for Town Vending Committee (TVC), which shall conduct a survey of all existing street vendors every five years. According to the Act every local authority shall prepare a plan to promote the vocation of street vendors in consultation with the planning authority and on the

¹⁸⁸The National Policy on Urban Street Vendors, 2009 defines Street Vendors as 'a person who offers goods or services for sale to the public in a street without having a permanent built up structure'. The three basic categories of street vendors are a) Stationary, b) Peripatetic and c) Mobile.

Street Vending Act, 2014: "Street Vendor" means a person engaged in vending of articles, goods, wares, food items or merchandise of everyday use or offering services to the general public, in a street, lane, side walk, footpath, pavement, public park or any other public place or private area, from a temporary built up structure or by moving from place to place and includes hawker, peddler, squatter and all other synonyms terms which may be local or region specific; and the words "street vending" with their grammatical variations and cognate expressions, shall be construed accordingly.

recommendations of the Town Vending Committee once in every five years. Local authority can also make byelaws, under the Act, to provide vending zones, regulation of civic services in the vending zones and other matters.

8.5.4.1. Planning norms for Urban Street Vendors

Master/ Zonal/ Local/ Layout development plans to be 'inclusive' and address the requirements of space for street vending through reservation of space. With the growth of cities/ towns in response to urbanisation, the statutory plans of every new area should have adequate provision for Vending¹⁸⁹/ Hawking zones and 'Vendor Markets'.

The provision for number of informal units for urban street vendors for different types of land use categories is given below. It is observed that the informal eating places mushroom at a faster rate. It is suggested to make provision for 1 informal eating-place per 1 lakh population with a space allocation of 2000 sqm (NBC, 2005 part 3)

Table 8.64: Norms for Informal Units for Urban Street Vendors

Sr. No.	Category	No. of Informal Units
1.	Retail Trade	3 to 4 units per 10 formal shops as specified in the norms
1a	Central Business District	
1b	Sub central Business District	
1c	District Centre	
1d	Community Centre	
1e	Convenience Shopping Centre	
2.	Government and Commercial Offices	5 to 6 units per 1000 employees
3.	Wholesale Trade and Freight Complexes	3-4 units per 10 formal shops
4.	Hospital	3-4 units per 100 beds
5.	Bus Terminal	1 unit per 2 bus bays
6.	Schools	
6a.	Primary	3-4 units
6b	Secondary/ Senior Secondary/ Integrated	5-6 units
7.	Parks	
7a.	Regional/ District Parks	8-10 units at each major entry
7b.	Neighbourhood Parks	2-3 units
8.	Residential	1 unit/ 1000 population
9.	Industrial	5-6 units per 1000 employees
10.	Railway terminal	To be based on surveys at the time of preparation of the project

Source: UDPFI Guidelines, 1996.

¹⁸⁹"Vending zone" means an area or a place or a location designated as such by the local authority, on the recommendations of the town vending committee, for the specific use by street vending and includes footpaths, side walk, pavement, embankment, portions of a street, waiting area for public or any such place considered suitable for vending activities and providing services to the general public.

Quantitative Space Norms: Every land use has a carrying capacity ceiling and the same is true of vendors operating in a clearly demarcated area. Overuse can cause congestion and reduction of public hygiene. Every city/ town shall evolve its own quantitative norms after conducting proper surveys and evaluating actual needs. The principle of 'Natural markets' should be followed in designating areas as Vending Zones and their maximum holding capacity should be determined based on this principle.

8.5.4.2. Demarcation of Vending Zones

City/ Town Development Plan shall demarcate the zones as 'Restriction free vending zones', 'Restricted Vending Zones' and 'No-vending zones'. Guidelines for locating zones:

- a) Spatial planning should take into account the natural prosperity of street vendors by providing locations in response to the patterns of demand for their goods/ services. For this, competent institutions recommend photographic digitised surveys of street vendors and their locations.
- b) A policy for regulating entry of street vendors into the identified street vending zones on time-sharing basis shall be formulated by Municipal Authorities.
- c) The 'vendor markets' may be established at suitable locations keeping in view demand for the wares/ services of street vendors. Time restrictions on vending should be in accordance with the need for ensuring non-congestion of public spaces/ maintaining public hygiene without being ad hoc, arbitrary or discriminatory. Attempts should be made to provide ample parking areas for mobile vendors for security of their vehicles and wares at night on payment of suitable fees.
- d) Mobile vending should be permitted in all areas even outside the 'Vendors Markets', unless designated as 'No- vending zone' in the zonal, local area or layout plans. 'Restricted Vending zones' may be notified in terms of both location and time. Locations designated as 'No vending zones' shall be fully justified.

8.5.4.3. Provision of Civic facilities

The following basic civic facilities shall be provided in Vending Zones/ Vendor's markets:

- a) Solid waste disposal
- b) Public toilets to maintain cleanliness
- c) Aesthetic design of mobile stalls/ push carts
- d) Electricity
- e) Drinking water
- f) Protective covers to protect wares of street vendors as well as themselves from heat, rain, dust etc.
- g) Storage facilities including cold storage for specific goods like fish, meat and poultry, and
- h) Parking areas

The vendor markets should to the extent possible, also provide for crèches, toilets and restrooms for female and male members.

For other aspects of the street vending norms such as organisation and participative processes, promotional measures, action plan for stakeholders, monitoring and

review etc., the provisions of the policy shall be referred to as updated from time to time.

8.5.4.4. Small Towns

- 1) For the general retail shopping requirements, the concept of street/ road side commercial activity shall be accepted as a policy with certain specific controls such as:
 - a) No commercial activity along the NH/ SH or any major district road
 - b) The minimum width of the street to be 12 m, where vehicular movement is permitted to a limited extent (i.e. only up to 2 wheelers or rickshaw) and the streets with a minimum width of 4.5 m without vehicular movement may be permitted for road/ street side commercial activity.
- 2) It has been generally observed that the service and retail shops emerge along the major roads and the activities are extended up to the roads in most cases, thereby affecting the smooth flow of traffic and increasing probability accidents. Thus us, it is suggested that the service centres shall be provided as a planned component and the sites near the petrol pumps shall be considered. The exact requirement of the area for service centre will be guided by the following factors:
 - a) Vehicular population
 - b) Villages falling in the influence zone of the towns or, in other words, the service requirements of the villages in the surrounding areas.
- 3) The function based commercial requirements such as *mandi* (vegetables/ grains/ fruits), cattle markets or any other such specialised markets are to be planned as per the case specific requirements based on the study of the area.
- 4) The quantum of commercial activities to be proposed shall be restricted based on locational attributes and the local need based emergence in its natural growth be permitted.
- 5) For the newly planned schemes in small towns also, the policy of mixed land use can be adopted suiting the behaviour pattern of the society.
- 6) As already dealt in the previous section, the area requirements for commercial activities in small sized towns works out to be about 0.2 to 0.25 Ha/ 1000 persons on an average, based on the proposed land use which is governed by the functional character of the town.

8.5.4.5. Medium Town

- 1) The growth of towns from small to medium sized town through transition phases (50,000 to 100,000) changes the requirements for commercial activities gradually and for a town exceeding a population of 1 lakh, the extensions start developing in pockets of well-defined economic strata of the people and thus it is suggested that the areas predominantly planned for upper middle groups shall be provided with the planned commercial centres (with adequate inbuilt provision for informal commercial activities with the commercial centres) at the rate of 4-5 formal shops and 2-3 informal shops per 1000 persons.
- 2) The requirements for the wholesale trade will be governed by the following factors:
 - a) Location of the town with respect to large/ metro cities
 - b) Small towns and villages falling in the direct influence zone of the town for which it has to act as a distribution centre.
- 3) As already dealt in the previous section on land use, the area requirements for commercial activities in medium sized towns works out to be about 0.24 to 0.32 Ha/ 1000 persons on an average, based on the proposed land use which is governed by the functional character of the town and the regional imperatives mentioned above.

8.5.4.6. Large City, Metropolitan City and Megapolis

The average land requirements for commercial activities work out to be 0.4 Ha per 1000 persons in a range of 0.2 to 0.6 Ha/ 1000 persons depending on the location of these large cities with respect to metropolitan. Similar requirements have also been observed in case of metropolitan which are located in the influence zone of Megapolis; the average land requirement for commercial activities under this category works out to be about 0.3 Ha/ 1000 persons.

8.5.4.7. Variations for Hill Towns

- 1) The requirements of commercial activities in hilly areas are mainly limited to retail activities that are mainly catered by small shops in the residence in non-tourist centres. The provision of commercial facilities in tourist centres is to be reviewed for two major aspects. First, the boarding and lodging requirements of the tourists and second the informal activities near tourist spots.
- 2) The requirements for hotels and restaurants can be worked out on the basis of data on tourist and their growth trends. The informal activities at the tourist spots are mainly informal eating-places and other general shops selling local specialities.

8.6. Miscellaneous Facilities

8.6.1. Cremation/Burial Ground

Table 8.65: Norms for Cremation/ Burial Ground

Sr. No.	Category	Population served per unit	Min. Land Area Requirement
1.	Electric Crematorium	1 for large size towns	2.00 Ha
2.	Cremation Ground	5 lakh	2.50 Ha
3.	Burial Ground	5 lakh	4.00 Ha

Source: NBC, 2005.

Other Controls:

- 1) The site not to be in proximity to residential areas and preferably in urban extension.

8.6.2. Dhobi Ghat

Table 8.66: Norms for Dhobi Ghat

Sr. No.	Category	Population served per unit	Min. Land Area Requirement
1.	Dhobi Ghat with appropriate arrangements for water and drainage facilities. It may be ensured that the water bodies are not polluted as a result of such activities.	1 Lakh	5000 sqm

Source: NBC, 2005.

8.6.3. Mandis and whole-sale agricultural produce markets

According to the recommendations by National Farmers Commission (2004)¹⁹⁰, availability of regulated Markets should be within 5 km radius (area served approx. 80 sq km) The agricultural produce can be categorised under two heads (a) Perishable produce consisting of fruits, vegetables and flowers and (b) Non-perishable produce consisting of grains and pulses. The planning for the *mandis* shall depend upon the following parameters:

- Number of food items
- Perishability of food items
- Volume to be handled
- Type of storage/ cool chain facilities.
- The *mandis* shall be preferably adjacent to arterial roads.

The government initiatives for promoting regulated markets are:

3. **Direct marketing** by promoting farmers' markets in various forms, such as *Apni Mandis* in Punjab, *Rythu Bazaars* in Andhra Pradesh, *UzhavarSanthai* in Tamil Nadu, and *Shetkari Bazaar* in Maharashtra, promoted by state agencies.
4. **e-trading**: Various states have adopted the Model APMC Act, which provides for e-trading. (Pg 16)
5. **Terminal market complex**: proposed to be implemented through Public Private Partnership (PPP) mode by establishing the Hub (Main Market) and Spokes (Collection Centres) in the States who have amended their APMC Act.

8.6.4. Provisions for Livestock Management/ Animal Management Centre

In order to ensure primary economic activities and food security, in urban areas and region, sustainable development of agricultural sector and associated activities is interdependent. Livestock management and addressing the urban problem of street animals calls for a dedicated space for its management.

The National Livestock Policy, 2013 provides a policy framework for improving productivity of the livestock sector in a sustainable manner, taking into account the provisions of the National Policy of Farmers, 2007 and the recommendations of the stakeholders, including the States.

The policy recommends the following with respect to urban and regional planning:

1. Inclusive planning of livestock management services such as veterinary institutions, vaccine and diagnostic production units, semen stations and artificial insemination breeding farms, feed and fodder production units etc. at regional and community level for generation and delivery of these services in rural and urban areas.
2. Integrated land use planning with livestock as a component should be encouraged through *Panchayati Raj* Institutions to ensure production potential of pastures and grazing community lands

¹⁹⁰Working group on Agriculture Marketing Infrastructure, Planning Commission, 12th Five Year Plan, pg 8.

Along with the livestock management, adequate provisions for street animals shall also be planned for by provision of animal management centres in urban and regional areas. The other facilities to be provided here are:

- Veterinary facilities & hospitals as mentioned before
- Gaushala with primary milk packaging facilities
- Bio-degradable solid waste disposal and decomposition facilities
- Bio-gas plants
- Open green spaces and nurseries
- Essential residential spaces

8.6.5. Norms for Telephone, Postal and Banking facilities

Table 8.67: Norms for Communication facilities

Sr. No	Category	Population served per unit	Area Requirement
1.	Telephone & communications		
1 a	Telephone exchange of 40,000 lines	4 Lakh	4 Ha
1b	Radio/ TV Station	5 -8 lakh	1,700 sqm
1c	Remote subscriber unit (MPD, pg 142)	1 for 3 km radius	300 sqm
2.	Postal		
2a.	Post office counter without delivery (Floor area to be provided in local shopping centre)	15,000	85 sqm
2b.	Head post office with delivery office	2.5 Lakh	750 sqm
2c.	Head post office and administrative office	5 Lakh	2500 sqm
3.	Banking		
3a.	Bank with extension counters with ATM facility	15000	
i)	Floor area for counters		75 sqm
ii)	Floor area for ATM		6 sqm
3b.	Bank with locker, ATM and other banking facilities	1 lakh	2500 sqm

Source: NBC, 2005 & Study on Zoning Regulations, TCPD, 2004.

8.7. Provisions for Hilly Areas

The provision of Social infrastructure; Police, Civil defence and home guards; Safety; Commercial Activity and other Miscellaneous Activities for hilly areas shall be general as given above. However, the following minimum norms shall also be ensured:

Table 8.68: Norms for Hilly Areas

Sr. No.	Category	Population served per unit	Distance between two facilities (km)	Area Range (Ha)
1.	Education Facilities			
1a	Primary School	4000	1 to 2	0.20 to 0.30
1b	Secondary School (10+2)	15,000	5 to 7	0.30 to 0.50
1c	Industrial Training Centre	--	8 to 12	0.30 to 0.60

Sr. No.	Category	Population served per unit	Distance between two facilities (km)	Area Range (Ha)
1d	College	30,000	8 to 12	2.00 to 3.00
1e	Professional College	30,000	8 to 12	1.00 to 1.50
1f	University	50,000	8 to 12	2.00 to 3.00
2.	Healthcare Facilities			
2a	Dispensary	2500	2 to 4	0.015 to 0.020
2b	Health sub centre	3000	2 to 4	0.025 to 0.067
2c	Family Welfare Centre	5,000	5 to 10	0.025 to 0.050
2d	Maternity Home	15,000	5 to 10	0.025 to 0.050
2e	Nursing Home	15,000	5 to 10	0.050 to 0.075
2f	Primary Health Centre (25 to 50 beds)	20,000	16 to 20	0.105 to 0.210
2g	Hospital (200 to 250 beds)	80,000	16 to 20	0.840 to 2.100
2h	Veterinary Centre	1000	16 to 20	0.050 to 0.100
3.	Other Facilities			
3a	Local Convenience Shopping	10,000	2 to 4	0.50 to 0.10
3b	Milk Booth	10,000	2 to 4	0.04
3c	Banquet Hall	10,000	5 to 10	0.10
3d	Religious Buildings	10,000	5 to 10	0.10
3e	Cremation Ground	10,000	5 to 10	0.20
3f	Informal Bazaar	15,000	5 to 10	0.10 to 0.20
3g	Community Welfare Centre	16,000	5 to 7	0.10 to 0.15
4.	Services			
4a	Rural post office	1000	1 to 2	--
4b	Rural post office	2000	2 to 4	0.025 to 0.050
4c	Post Office	10,000	5 to 7	0.10 to 0.15
4d	General Post Office	50,000	10 to 15	0.20 to 0.40
4e	Telephone exchange	50,000	10 to 15	0.20 to 0.40
4f	Bank (tribal areas)	10000	16 to 20	0.100 to 0.150
4g	Police Chowki	5000	2 to 4	0.10
4h	Police Station	15000	5 to 10	0.50
4i	Fire Station	50,000	--	0.30 to 0.80
4j	Disaster Management Centre	20,000	5 to 10	1.00
4k	Electric substation (66 kv)	--	--	1.00
4l	Electric substation (11 kv)	--	--	0.05
4m	LPG godown	As per requirement	--	0.15

Source: NBC 2005, TCPO Draft Indian Standard for Development Planning in Hilly Areas.

8.8. Access Provisions for the “Differently abled”

The minimum access provisions shall be provided as per ‘Guidelines and Space Standards for barrier free built environment for disabled and elderly persons’, 1998. The following provisions shall be provided in various types of buildings:

Table 8.69: Minimum Access provisions for Barrier Free Built Environment

Sr. No.	Type of Building	Minimum Provisions
1.	Single detached, single dwelling units	A minimum of 2% of the total number of units to be constructed with barrier free features (adoptable units)
2.	Staff housing, multiple dwelling and high rise residential units and tenements	Minimum of 1 unit for every 25 units to be designed for barrier free built environment Plus 1 additional unit for every 100 units thereafter. Entrances and exits to be designed for barrier free accessibility.
3.	Tenement houses, row houses, apartments and town houses	A minimum of 1 unit for up to 150 units Plus minimum of 1 additional unit for every 100 units thereafter Entrances and exits to be designed for barrier free accessibility
4.	Post offices, banks and financial service institutions	a) A minimum of 1 lowered service counter on the premises. b) A minimum of 1 lowered ATM/ cash dispersal point on the premises.
5.	Shop houses and single storey shops	Barrier free access to/within shopping area.
6.	Places of worship	Entrances and exits and main area of the worship to be accessible.
7.	Food centres	a) A minimum of 1 table without stools or seats attached to the floor for every 10 tables. b) A minimum of 2 tables without stools or seats attached to the floor for the whole premises. c) Accessible entrance.
8.	Community centres, village halls, auditoria, concert halls, assembly halls, cinemas, theatres and other places of public assembly	a) Accessible entrances, exits, aisles and main community or public gathering areas. b) Accessible toilet facilities should be nearby c) Seating for persons with disabilities to be accessible from main entrances and lobbies. d) Various seating/ viewing choice to be provided for persons in wheelchairs throughout the main seating area. e) A minimum of 2 wheelchair spaces for seating capacity up to 100 seats. f) A minimum of 4 wheelchair spaces for seating capacity from over 100 to 400 seats.

Source: Guidelines and Space Standards for barrier free built environment for disabled and elderly persons, Central Public Works Department, Ministry of Urban Affairs & Employment, India, 1998.

9 Simplified Development Promotion Regulations

The purpose of the Simplified Development Promotion Regulations is to guide the formation of zonal and building regulations by State Departments and by Local Urban Bodies. These regulations, besides prescribing the various provisions, also allow freedom to adopt appropriate practices in lines with the approach to the human settlement, both urban and regional. These can be:

- Development plans for its zonal planning and building design,
- Fire safety provisions,
- Environmental and geographical variation,
- Protection and improvement of local environment,
- Socio-economic considerations,
- Towards the creation of sustainable human settlements.

As per the National Building Codes, 2005, ‘Technological and socio-economic developments in recent times have led to remarkable increase in demand for more and more sophistication in buildings resulting in ever increasing complexities. These perforce demand high levels of inputs from professionals of different disciplines such as architecture, civil engineering, structural engineering, functional and life safety services including special aspects relating to utilities, landscaping, etc in conceptualization, spatial planning, design and construction of buildings of various material and technology streams, with due regard to various services including operation, maintenance, repairs and rehabilitation aspects throughout the service life of the building.

Apart from the given general regulations, energy efficiency in the building bye-laws to be adopted as per Energy Conservation Building Code (ECBC) was launched by Ministry of Power in May 2007. It sets minimum performance standards for buildings to promote energy efficiency. The National Building Code – 2005 focuses on energy efficiency in the following:

- Use of Pozzolona in concrete production
- Daylight integration (indoor lighting levels to be met via day lighting)
- Artificial lighting requirements for indoor spaces
- Ventilation standards (natural and mechanical) for optimal human health and well-being.
- Electrical standards (minimum power factor, allowances for diversity etc)
- Select HVAC design norms.

India being a large country with variations from region to region, these regulations may be followed for the regulating development in the settlement which under no jurisdiction or in case of absence of any statutory plan to meet the requirements of different regions of the country.

9.1. Simplified Urban Land use Classification

Table 9.1: Simplified Urban Land use Classification

Level I			Level II		
N	A-N	Use Category	N	A-N	Use Zone
1.	R	Residential	11	R-1	Primary Residential Zone
			12	R-2	Unplanned/ Informal Residential Zone
2.	C	Commercial	21	C-1	Retail Shopping Zone
			22	C-2	General Business and Commercial District/ Centres
			23	C-3	Wholesale, Godowns, Warehousing/ Regulated Markets
			24	C-4	Service Sector
			25	C-5	Regulated/ Informal/ Weekly Markets (TCPO Study on Zoning Regulations)
3.	I	Industry	31	I-1	Service and Light Industry
			32	I-2	Extensive and Heavy Industry
			33	I-3	Special Industrial Zone - Hazardous, Noxious and Chemical
4.	PS	Public and Semi-Public	41	PS-1	Govt./ Semi Govt./ Public Offices
			42	PS-2	Govt. Land (use undetermined)
			43	PS-3	Police Headquarter/ Station, Police Line
			44	PS-4	Educational and Research
			45	PS-5	Medical and Health
			46	PS-6	Social Cultural and Religious (inc. Cremation and Burial Grounds)
			47	PS-7	Utilities and Services
5.	M	Mixed Use	51	M-1	Mixed Industrial use Zone
			52	M-2	Mixed Residential Zone
			53	M-3	Mixed Commercial Zone
6.	P	Recreational	61	P-1	Playgrounds/ Stadium/ Sports Complex
			62	P-2	Parks & Gardens – Public open spaces
			63	P-3	Multi-open space (Maidan)
7.	T	Transportation and Communication	71	T-1	Roads/ BRTS
			72	T-2	Railways/ MRTS/
			73	T-3	Airport
			74	T-4	Seaports and Dockyards

Level I			Level II		
N	A-N	Use Category	N	A-N	Use Zone
			75	T-5	Bus Depots/ Truck Terminals and freight Complexes
			76	T-6	Transmission and Communication
8.	A	Primary Activity	81	PA-1	Agriculture
			82	PA-2	Forest& Horticulture
			83	PA-3	Poultry and Dairy Farming
			84	PA-4	Rural Settlements
			85	PA-5	Brick Kiln and Extractive Areas
			86	PA-6	Others (fishing, pottery etc.)
9.	E	Protective and Undevelopable Use Zone	91	E-1	Water Bodies
			92	E-2	Special Recreation Zone / Protective Areas such as sanctuaries/ reserve forests and Eco-sensitive zone
			93	E-3	Undevelopable Use Zone
10.	S	Special Area	101	S-1	Old Built-up (Core) Area
			102	S-2	Heritage and Conservation Areas
			103	S-3	Scenic Value Areas
			104	S-4	Government Restricted Area (such as Defence)
			105	S-5	Other Uses/ Spot Zone*

N: Numeric Code

A-N: Alpha Numeric Code

Source: UDPFI Guidelines, 1996 & various sources including Study on Zoning Regulation, TCPO, 2004.

Notes:

- Overall, there could be 43 use zones at the Development Plan level within 10 land use categories at the Perspective Plan level as given in the above table.
- Areas of informal activities may be identified in the above land use categories at Level II for 1 to 7 Level I Use Zones only.
- Mixed use zone shall be identified at the Development Plan level, having dominant use and mixed use.
- Use permissions for different activities, as specified in the next section on Simplified Use Zone Regulations can be provided at the project/action plan level or with the approval of the Statutory Authority as the case may be.
- *The process of changing/relaxing/modifying land use of part or "Spot" of a "zone" in a particular land use is termed as "Spot Zoning". Spot Zoning can be done for comparatively smaller area in a particular land use zone in such a way that it does not affect the overall Development Plan.
- Use zone regulations for the use permissibility (from the suggestive list) could be decided by the town planner depending upon the requirement/ feasibility.
- Appropriate code in terms of both numerical and alphabetic (letter) are provided to facilitate the reference and to have a simplified procedure to follow.

9.2. Simplified Urban Land use Zoning Regulations

Buildings and premises listed below are 'Permitted' normally on specific sites/locations forming part of the Regional Plan, Development plan, LAPs, Annual plan and Projects. However, this is a suggested list which could be further enhanced or reduced, as the case may be, depending on the size of the city/town, characteristics and other relevant factors. The list also contains the buildings/premises which could be allowed on an application to the Competent Authority if such sites do not form part of the Regional Plan, Development plan, LAPs, Annual plan and Projects. Such use/activity is termed as 'Restricted'. The uses/activities which are otherwise not allowed in a particular use zone are termed as 'Prohibited'. The activities shall be proposed in the land use based on its compatibility with surrounding land uses and width of the approach road as the case may be.

1) RESIDENTIAL (R)

The Residential Use Zone can be subdivided into

1. Primary Residential Zone: R1
2. Unplanned/ Informal residential Zone: R2

The activities Permitted, Restricted and Prohibited in Residential land use zone shall be as given below:

Residence – plotted, (detached, semi-detached and row housing) group housing houses, residential flat, residential-cum-work, hostels, boarding and lodging (accommodation for transit employees of Govt./ Local Bodies) houses, barat ghar/ marriage hall, community hall, old age home, police post, guest houses, crèches, day care centre, convenience shopping centres, local (retail shopping), medical clinic, dispensaries, nursing home and health centres (20 bed), dispensary for pets and animals, professional offices, educational buildings: (nursery, primary, high school, college), school for mentally/ physically challenged, research institutes, community centres, religious premises , library, gymnasium, park/tot-lots, plant nursery, technical training centre, yoga centres/health clinics, exhibition and art gallery, clubs, banks/ ATM, police stations, taxi stand/three wheeler stands, bus stops, electrical distribution depot, water pumping station, post offices, hostels of non-commercial nature, kindergartens, public utilities and buildings except service and storage yards.

Restricted Uses/Activities

Dharamshala, foreign missions, night shelters, petrol pumps, motor vehicle repairing workshop/garages, household industry, bakeries and confectionaries, storage of LPG gas cylinders, burial-grounds, restaurants and hotels, printing press, go-downs/warehousing, bus depots without workshop, cinema hall, auditoriums, markets for retail goods, weekly markets (if not obstructing traffic circulation and open during non-working hours), informal markets, multipurpose or junior technical shops, transient visitors camp, municipal, state and central government offices.

Uses/Activities Prohibited

Heavy, large and extensive industries : noxious, obnoxious and hazardous industries, warehousing, storage go-downs of perishables, hazardous, inflammable goods, workshops for buses etc., slaughter-housing wholesale *mandis*, hospitals treating contagious diseases, sewage treatment plant/disposal work, water treatment plant, solid waste dumping yards, outdoor games stadium, indoor games stadium, shooting range, zoological garden, botanical garden, bird sanctuary, picnic hut, international conference centre, courts, sports training centre, reformatory, district battalion office, forensic science laboratory.

2) COMMERCIAL USE (C)

The Commercial zone can be subdivided into

1. Retail Shopping Zone: C1
2. General Business and Commercial District/ Centres: C2
3. Wholesale, Go-downs, Warehousing/ Regulated markets: C3
4. Service Sector: C4 and
5. Regulated/ Informal/ Weekly markets: C5

The activities Permitted, Restricted and Prohibited in Commercial land use zone shall be as given below:

Permitted Use/Activity

Shops, convenience/neighbourhood shopping centre, local shopping centres, professional offices, work places/offices, banks, stock exchange/financial institution, bakeries and confectionaries, cinema hall/theatre, malls, banquet halls, guest houses, restaurants, hotels, weekly market, petrol pumps, go-downs and warehousing, general business, wholesale, residential plot-group housing, hostel/boarding housing, hostel, banks/ ATM, restaurants, auditoriums, colleges, nursing homes/medical clinics, pet clinics, religious places, offices/work places, commercial centres, research/training institute, commercial service centres/garages/workshop, *baratghar*/night shelter, weekly/formal markets, library, parks/open space, museum, police stations/post, taxi stand/three wheeler stands, parking site, post offices, government/ institutional offices, telephone exchange/centres, warehousing and covered storage, research institutions.

Restricted Uses/Activities

Non-pollution, non-obnoxious light industries, warehousing/storage go-downs of perishable, inflammable goods, coal, wood, timber yards, bus and truck depots, gas installation and gas works, poly-techniques and higher technical institutes, junk yards, water treatment plant, railway yards/stations, sports/stadium and public utility installation, hotel and transient visitor's homes, religious buildings, hospitals and nursing homes.

Uses/Activities Prohibited

Dwellings except those of service apartment, essential operational, watch and ward personnel, heavy, extensive, noxious, obnoxious, hazardous and extractive industrial units, hospitals/research laboratories treating contagious diseases, poultry farms/dairy farms, slaughter-houses, sewage treatment/disposal sites, agricultural uses, storage of perishable and inflammable commodities, quarrying of gravel, sand, clay and stone, zoological garden, botanical garden, bird sanctuary, picnic hut, international conference centre, courts, sports training centre, reformatory, district battalion office, forensic science laboratory and all other activities which may cause nuisance and are noxious and obnoxious in nature.

3) INDUSTRIAL USE ZONE

The Industrial Use Zone can be subdivided into

1. Service and Light Industry: I 1
2. Extensive and Heavy Industry: I 2
3. Special Industrial Zone – Hazardous, Noxious and Chemical: I 3

The activities Permitted, Restricted and Prohibited in Industrial land use zone shall be as given below:

Permitted Use/Activity

Residential building for essential staff and for watch and ward personnel, all kind of industries, public utilities, parking, loading, unloading spaces, warehousing, storage and depot of non-perishable and non-inflammable commodities and incidental use, cold storage and ice factory, gas go-downs, cinema, bus terminal, bus depot and workshop, wholesale business establishments, petrol filling stations with garage and service stations, parks and playgrounds, medical centres, restaurants.

Restricted Uses/Activities

Noxious, obnoxious and hazardous industries except storage of perishable and inflammable goods, junkyards, sports/stadium/playgrounds, sewage disposal works, electric power plants, service stations, cemeteries, government/semi-government/private business offices, bank and financial institutions, helipads, hospitals/medical centres, religious buildings, taxi stands, gas installations and gas works, animal racing or riding stables, workshops/garages, dairy and farming, quarrying of gravel, sand, clay or stone.

Prohibited Uses/Activities

Residential dwellings other than those essential operational, service and watch and ward staff, schools and colleges, hotels, motels and caravan parks, recreational sports or centres, other non-industrial related activities, religious buildings, irrigated and sewage farms, major oil depot and LPG refilling plants, commercial office, educational institutions, social buildings.

4) PUBLIC AND SEMI-PUBLIC USE ZONE (PS)

The Public and Semi Public use zone can be sub divided into

1. Govt./ Semi Govt. / Public Offices: PS 1
2. Govt. land use: PS 2
3. Police Headquarter/ Station. Police line: PS 3
4. Educational and Research: PS 4
5. Medical and Health: PS 5
6. Socio Cultural and Religious (incl. Cremation and Burial Grounds: PS 6 and
7. Utilities and Services: PS 7

The activities Permitted, Restricted and Prohibited in Public and Semi Public use zone shall be as given below:

Permitted Uses/Activities

Government offices, central, state, local and semi government, public undertaking offices, defence court, universities and specialised educational institute, polytechnic, colleges, schools, nursery and kindergarten (not to be located near hospital or health care facility), research and development centres, social and welfare centres, libraries, social and cultural institutes, religious buildings/centres, conference halls, community halls, *barat ghar*, *dharamshala*, guest house, museum/art galleries, exhibition centres, auditoriums, open air theatre, recreational club, playground, banks, police station/police posts, police lines, police headquarters, jails, fire stations/fire posts, post and telegraph, public utilities and buildings, solid waste dumping grounds/sites, post offices, local state and central government offices and use for defence purposes, bus and railway passenger terminals, public utility and buildings, local municipal facilities, uses incidental to government offices and for their use, monuments, radio transmitter and wireless stations, telecommunication centre, telephone exchange, hospitals, health centres, nursing homes, dispensaries and clinic.

Restricted Activities/Uses

Residential flat and residential plot for group housing for staff employees, hostels, water supply installations, sewage disposal works, service stations, railway stations/yards, bus/truck terminals, burial grounds, cremation grounds and cemeteries/graveyards, warehouse/storage godowns, helipads, commercial uses/centres, other uses/ activities.

5) Prohibited Uses/Activities

Heavy, extensive and other obnoxious, hazardous industries, slaughter-houses, junk yards, wholesale *mandis*, dairy and poultry farms, farm-houses, workshop for servicing and repairs, processing and sale of farm product and uses not specifically permitted herein.

6) MIXED USE ZONE (M)

The Mixed-use Zone can be subdivided into

1. Mixed Industrial use: M1
2. Mixed Residential use: M2
3. Mixed Commercial use: M3

The activities permissible, restricted and prohibited shall as given below.

Permitted Uses/Activities

In M1 Zone activities falling within non- polluting industry/ service industry (dominant landuse) categories can coexist with maximum up to 20-30% of commercial, institutional, recreational and residential land use.

In M2 Zone all activities falling within permitted residential land use (dominant landuse) shall be minimum 60% and to coexist with commercial, institutional, recreational.

In M3 Zone all activities falling within permitted commercial, institutional land use (dominant landuse) shall be minimum 60% and to coexist with residential, recreational and non- polluting and household industry.

Restricted Uses/Activities

Activities related to commercial, institutional and residential landuse in M1 Zone and non-polluting industrial landuse in M2 Zone can be increased to between 20-50% depending on the contextual and locational feasibility of the area.

Prohibited Uses/Activities

All other activities especially industrial which are polluting in nature and which will have an adverse impact on the overall activities of this zone

Note: Mixed landuse to be well defined by the Development control body by prescribing the limits on the use of activity based on the abutting road width, compatible uses, plots size, ground coverage, FAR/FSI, density, any other urban design guideline.

7) RECREATIONAL USE ZONE (P)

The Recreational Use Zone can be subdivided into

1. Playgrounds/ Stadium/ Sports Complex: P1
2. Parks and Gardens – Public open spaces: P2 and
3. Multi-open space (Maidan): P3

The activities Permitted, Restricted and Prohibited in Recreational Use Zone shall be as given below:

Permitted Uses/Activities

Regional parks, district parks, playgrounds, children traffic parks, botanical/zoological garden, bird sanctuary, clubs, stadiums (indoor), outdoor stadiums with/ without health centre for players and staff, picnic huts, holiday

resorts, shooting range, sports training centres, specialized parks/*maidans* for multiuse, swimming pool, special recreation and special educational areas, , library, public utilities.

Restricted Uses/Activities

Building and structures ancillary to use permitted in open spaces and parks such as stand for vehicles on hire, taxis and scooters, bus and railway passenger terminals, facilities such as police post, fire post, post and telegraph office, commercial use of transit nature like cinema, circus and other shows, public assembly halls, restaurants and caravan parks, sports stadium, open air cinemas.

Prohibited Uses/Activities

Any building or structure which is not required for open air recreation, dwelling unit except for watch and ward personnel and uses not specifically permitted therein.

8) TRANSPORT AND COMMUNICATION USE ZONE (T)

The transport and communication use zone can be sub divided into

1. Roads/ BRTS: T 1
2. Railway/ MRTS: T 2
3. Airport: T 3
4. Seaports/ Dockyard: T4
5. Bus depots/ truck terminals and freight complexes: T5
6. Transmission and Communication T 6

The activities Permitted, Restricted and Prohibited in Transport and Communication use zone shall be as given below:

Permitted Uses/Activities

Road transport terminals (bus terminals and depots), goods terminals, parking areas, circulations, airports-building and infrastructure, truck terminal, motor garage, workshop, repair and repair shop and facilities such as night shelter, boarding house, banks, restaurants, booking offices, transmission centre, wireless station, radio and television station, observatory and weather office.

Restricted Uses/Activities

Any other use/activity incidental to transport and communication, residential dwelling units for essential staff and watch and ward personnel.

Prohibited Uses/Activities

Use/activity not specifically permitted herein. In vicinity of airports: butcheries, tanneries and solid waste disposal sites shall be prohibited within 10 km from the Aerodrome Reference Point (ARP)

9) PRIMARY ACTIVITY USE ZONE

Primary Activity can be sub divided into

1. Agriculture: PA 1
2. Forest: PA 2
3. Poultry and dairy farming: PA 3
4. Rural settlements: PA 4
5. Brick kiln and extractive areas: PA 5
6. Others (fishing, pottery etc.): PA 6

The activities Permitted, Restricted and Prohibited in Primary Activity zone shall be as given below:

Permitted Uses/Activities

Dwelling for the people engaged in the farm (rural settlement), farm-houses and accessory buildings, agriculture, horticulture and forestry, poultry, piggeries and dairy farm, cottage industries, storage, processing and sale of farm produce, petrol and other fuel filling stations, fishing, public utility and facility buildings.

Restricted Uses/Activities

Farm houses, extensive industry, brick kilns, sewage disposal works, electric power plant, quarrying of gravel, sand, clay or stone, service industries accessory to obnoxious and hazardous industries, school and library, temple, churches, mosques and other religious buildings, milk chilling stations and pasteurisation plants.

Prohibited Uses/Activities

Residential use except those ancillary uses permitted in agricultural use zone, heavy extensive, noxious, obnoxious and hazardous industries, any activity which is creating nuisance and is obnoxious in nature.

10) PROTECTED AND UNDEVELOPABLE USE ZONE

The protective and undevelopable use zone shall be sub divided into

1. Water bodies: E1
2. Special Recreation Zone / Protective Areas such as sanctuaries/ reserve forests and Eco-sensitive zone: E2
3. Undevelopable use zone: E3

Undevelopable use zone shall be identified as all earthquake/landslide prone, cliffs and environmentally hazardous area, areas adjacent to fault lines, areas with slope higher than 45 degree (NBC), flood plain and areas adjacent to major drainage lines¹⁹¹ for general guidance, other areas identified by State Disaster Management Authority and all the environmentally sensitive areas.

¹⁹¹Aizawl Master Plan

Eco-Sensitive Zones: Guidelines for declaration of Eco-sensitive zones around National Parks and Wildlife Sanctuaries, has provided the extent of eco-sensitive zones as following:

- Many of the existing protected areas have already undergone tremendous development in close vicinity to their boundaries. Some of the protected areas actually lying in the urban setup (Eg. Guindy National Park, Tamil Naidu, Sanjay Gandhi National Park, Maharashtra, etc.). Therefore, defining the extent of the eco-sensitive zones around protected areas will have to be kept flexible and protected area specific. The width of the eco-sensitive zone and type of regulations will differ from protected area to protected area. However, as a general principle the width of the eco-sensitive zone could go up-to 10 Kms around a protected area as provided in the Wildlife Conservation Strategy-2002.
- In case where sensitive corridors, connectivity and ecologically important patches, crucial for landscape linkages, are even beyond 10 Kms width, these should be included in the eco-sensitive zone.
- Further, even in context of a particular protected area, the distribution of an area of eco-sensitive zone and the extent of regulation may not be uniform all around and it could be of variable width and extent.

11) SPECIAL AREAS (S)

In addition to the various uses/activities, permitted, restricted on application to the Competent Authority and prohibited, listed under various use zones, zone may also be specified keeping in view the special characteristic of such areas/pockets. This may comprise of old built-up areas having mixed land use: S1, areas of historical or archaeological importance having historical monuments and architecturally important buildings: S2, areas of scenic value: S3, which need to be preserved without spoiling the character by putting up various kinds of structures, the area restricted for development by Government: S4, or it may be area under other uses/ spot zones: S5. Therefore, it is necessary that use/activity permissibility in special areas should be carefully thought of in the development plan while formulated, keeping in view the predominant and compatible activities of a specific use, of which such a special area is a part of.

9.3. Plot Requirement Regulations in Land use zones

9.3.1. Means of Access¹⁹²

Every building/plot shall abut on a public/private means of access like streets /roads.

A. Residential Buildings

Plots which do not abut on street /road shall be provided with minimum width corresponding to the length of the means of access as given in table below:

Table 9.2: Width and Length of Means of Access for Residential Plots

Sr. No.	Width of Means of Access (m)	Length of Means of Access (m)	Other Controls
1.	6.0	75	➤ Development on plot shall not be permitted without a minimum 6m width of access road. ➤ If development is only on one side of the means of access, the prescribed widths may be reduced by 1m in each case.
2.	7.5	150	
3.	9.0	250	
4.	12.0	400	
5.	18.0	1000	
6.	24.0	Above 1000	

Source: NBC, 2005.

B. Other Buildings

For plot development of uses other than residential, the following minimum width corresponding to the length of the means of access shall be followed:

Table 9.3: Width and Length of Means of Access for plots other than residential

Sr. No.	Width of Means of Access (m)	Length of Means of Access (m)	Other Controls
1.	12.0	200	➤ The width of the means of access shall not be less than the internal access ways in layouts and subdivision.
2.	15.0	400	
3.	18.0	600	
4.	24.0	above 600	

Source: NBC, 2005.

Other Controls:

- 1) Pathway: Approach to a building from Public Street/ road/ means of access shall be through a paved pathway of minimum width 1.5 m, provided its length is not more than 30 m.
- 2) No premises other than highway amenities like petrol pumps, motels etc. shall have direct access from highways and other roads minimum width of 52 m.
- 3) For high rise buildings and buildings other than residential, the following additional provisions shall be ensured:
 - a) The width of the abutting main street shall not be less than 12 m and one end of this street shall join another street not less than 12 m in width.
 - b) The approach to the building and open spaces on all sides upto 6 m width and the layout shall be done in consultation with Chief Fire Officer of the city.
 - c) The main entrance to the plot shall be of minimum 6 m width to allow easy access to fire engine.

¹⁹² NBC 2005 Part 3, Pg 13.

9.3.2. Area and Height Limitations¹⁹³

The limitation of area and height of buildings shall be specified in terms of Floor Area Ratio (FAR). The FAR shall take into account the following aspects:

- 1) Population Density
- 2) Occupancy Class
- 3) Types of construction
- 4) Width of street fronting the building and the traffic load
- 5) Locality where the building is proposed and the density
- 6) Parking facilities
- 7) Local firefighting facilities
- 8) Water supply and drainage facilities
- 9) Earth prone zone
- 10) Land use zone
- 11) Carrying capacity (estimated population on above based inputs)

9.3.2.1. Model for Flexible FAR¹⁹⁴

Normally maximum permissible FAR's are specified for various use premises in the Master Plan. No construction beyond permissible FAR is allowed except additional 5% which may be compounded i.e. permitted with penalties generally to accommodate construction deficiency. Since the allotment is based on FAR's and it is generally revised upwards over a period of time as part of extensive modification to the Master Plan, the concept of "additional FAR charges" is provided for (for the difference between the FAR at the time of allotment and the permissible FAR) with a view to recover part of the cost for augmentation of essential services.

With a view to provide flexibility and also to utilize the scarce urban land optimally additional FAR, as provided in the Master Plan may also be examined on a site based upon its Additional FAR Factor which is a product of 'creativity' and 'context'. **Creativity can be defined by design parameters such as urban form, parking provision, pedestrian safety, concern for the poor through induced informal activities, and provisions for evacuation during an emergency due to disaster (for example, Delhi falls in the Zone 5).** It also includes the impact of the design on essential services and environment. As a principle, the additional FAR should not result in a negative impact on the essential services and environment.

Locational attributes, of the site being assigned additional FAR, refer to its location with respect to land use as given in the approved Master/Zonal/Layout Plan (as the case may be), accessibility, level of congestion on the approach road, and nearness to a heritage building (if any).

¹⁹³ NBC 2005 part 3 Pg 26.

¹⁹⁴ Source: An Innovative Approach to Structured Spatial Transformation: Case- Delhi, Dr. S.P. Bansal, Journal Spatio-economic Development Record (SDR) Volume-19, No. 1, Jan-Feb., 2012.

Taking into account the creativity and context the Additional FAR Factor of a site can be expressed as:

$$\begin{aligned} \text{Additional FAR Factor} &= \text{Creativity} \times \text{context} \\ &= \text{design parameters} \times \text{locational attributes} \\ &= \left(\frac{a+b+c+d+e}{x+y} \right) m.n.o.p. \dots\dots\dots (1) \end{aligned}$$

Where:

- a = Parking provision value
- b = Disaster emergency provision value
- c = Urban Form value
- d = Pedestrian Safety value
- e = Induced informal activities value
- x = Impact on essential services value
- y = Impact on environment value
- m = Land Use value
- n = Accessibility (Right of way of the approach road) value
- o = Congestion (Mobility index in terms of travel speed) value
- p = Heritage Value

Assignment of Values

For finding the Additional FAR Factor, the various values are assigned in the Equation (1) on the following basis:

a = Parking provision: Based on design efficiency of parking provisions made. If parking provisions are made over and above the norms then it could be **0.2**; if as per norms **0.1** & if less than norms it would be **0**.

b = Disaster emergency provision value: For disaster emergency evacuation arrangements made in the design. The value may be given as **0.2** if all the considerations for safety & disaster management in terms of fire, seismic, cyclone etc. incorporated. If partially incorporated than value could be **0.1** & if not incorporated it would be **0**.

c = Urban Form value: Based on height and urban form. The value depending upon the location & expenditure on work of art @ at least 2% of the project cost and fulfillment of all the social corporate responsibility it could be **0.2**, if partially fulfilled it could be **0.1** & if not addressed it may be **0**.

d = Pedestrian Safety value: Depending on the pedestrian safety considerations made in the design. If the design has made all the provisions for conflict free pedestrian movement as well as barrier free movement for physically challenged the value could be **0.2**; if partial provisions are made **0.1** and if no provisions made it could be **0**.

e = Induced informal activities value: Depending on the induced informal activity and design considerations made. If spaces for various informal sector activities e.g. taxi stand, petty trades, servicing etc. are provided the value could be **0.2**; if partial provisions are made it could be **0.1** & if no provisions are made it would be **0**.

x = Impact on essential services value: (e.g. water, waste water, power, waste management etc.): If the design offers positive impacts the value could be between **0.4** to **0.5**; if there are no impacts (i.e. business as usual) the value be **0.5** and if the impacts are negative the value would be **between 0.5 to 0.6**.

y = Impact on environment value: (In terms of carbon credits and green building design concepts): If the impacts are positive the value could be **between 0.4 to 0.5**; if there are no impacts (i.e. business as usual) the value be **0.5**; and if there are negative impacts it would be between **0.5 to 0.6**.

m = Land Use value: For 'river bed', 'regional park/ridge' & 'LBZ area' the value may be **0**, for other conforming land uses it could be **1**; and in case of 'redevelopment', 'facility corridor' and 'TOD area' with conforming land use the value could be **1.5**.

n = Accessibility (Right of way of the approach road) value: For roads less than 18 mts. the value could be considered at **0**, for roads between 18 to 30 mtr. it is to be **0.5**; and for roads above 30 mtr. the value could be as **1**.

o = Congestion (Mobility index in terms of travel speed on the approach road) value: If it is less than 10 km/h. it may be taken as **0**, if the speed is between 10 to 15 km/h it may be **0.5** and if it is 25 km/h or more it may be considered as **1**.

p = Heritage Value: If the distance between the location and the protected monument is less than 100 mtr. the value is **0**, if the distance between plot and protected monument is between 100-300 mtr. it is **0.5** and if it more than 300 mtr. the value is **1**.

Example

As per MPD-2021 for '**hospital - B (201-500 bed)**' Master Plan provides coverage of 30% + additional **5%** for multi level parking (not to be included in FAR), FAR 200 and height of 37 mtr., parking standard @ 2 ECS/ sqmt. of floor area. In view of repeated request of hospital industry for grant of higher FAR to cope up with the rising cost of providing specialized health care and to make the construction and operation of hospitals viable; location specific request for additional FAR could be examined using the above formula. If the hospital plot is located in River Bed, Regional Park or LBZ area or it faces road less than 18 mtr. in any other area, where the travel speed is less than 10 km/h and the plot is at a distance less than 100 mtr. from notified protected monument; the request for additional FAR can be rejected as the value of **m, n, o** and **p** would be zero and the net additional FAR factor would be zero too. However, in other circumstances based on the location where the value of is not zero and the design parameters are worked out in such a way that the maximum permissible value of **m, n, o** and **p** are scored i.e. **a, b, c, d** and **e** each has a value of **0.2** and the value of **x** and **y** are **0.4** each, the additional FAR factor could be maximum i.e. and the value of **x & y** are **0.4** each could be **1.25 (1÷0.8)** at any location or **1.87 (1.25×1.5)** at location forming part of 'redevelopment', 'TOD' & facility corridor', thereby with the permissible FAR could be raised to **250** or **374**, instead of **200** as assigned in the Master Plan. This, however, would be subject to seeking all mandatory clearances from the concerned statutory bodies, NOC from local service providing agencies and depositing an additional FAR charge as per rules.

Source: Dr. S.P. Bansal

9.3.2.2. Model for Purchaseable FAR¹⁹⁵

Provision of purchasable FAR in Group Housing, Commercial, Institutional, Industrial, Sport and amusement complex, recreational greens and Low Density Sports plot may be considered, where:

- (i) The Plots exist on '24mtrs. and above' wide road.
- (ii) The construction has not started, or
- (iii) The allottee wants to construct a new additional building within the limits of permissible ground coverage, or
- (iv) The allottee wants to construct new building on the vacant plot, or

¹⁹⁵ Source: The Greater Noida Industrial Area Development Regulations, 2010

- (v) The allottee has already constructed building within purchasable F.A.R limits, or
- (vi) Purchaseable F.A.R may be allowed on minimum 18.0mtrs. road width and above road width for institutional and industrial use.

Explanation: The Purchasable FAR shall be allowed up to the maximum limit of the applicable FAR in the Building Regulations.

Purchasable FAR shall be allowed with the following provision/ conditions:-

- (i) No construction shall be allowed beyond the limit of maximum permissible ground Coverage.
- (ii) Parking facilities shall be provided within the plot as per the provisions of the building bylaws.
- (iii) No objection certificate from the Airport Authority of India/ Competent Authority shall be obtained for the height of the building.
- (iv) Structure design duly checked and verified by the I.I.T/ N.I.T./ Government Engineering College shall be submitted along with the proposal in case where additional floors are being proposed.
- (v) No objection certificate from Fire Safety and Environmental Clearance shall be obtained from the Competent Authorities.
- (vi) Purchasable FAR shall be applicable only on the basis of assessment of planned and available physical infrastructure.
- (vii) Use of purchaseable FAR shall be governed by the terms and conditions of lease deed.
- (viii) In case where purchasable FAR is allowed, the Authority shall permit increase in the height of building as per requirement.
- (ix) Additional Proportionate residential units shall be allowed on the purchaseable FAR for Group Housing.

Note:-

- (i) Purchasable FAR is an enabling provision. It shall not be allowed to any Allottee as a matter of right.
- (ii) With the consideration of Traffic density, conditions of approach road, availability of physical infrastructure, distance from the protected area and heritage sites or in the light of planning the Authority may identify the zones/ areas where purchasable FAR shall not be allowed.
- (iii) In case of mixed land use permitted in any pocket/plot:
 - (a) Permissible FAR for various uses shall be as applicable for respective use including the purchasable FAR
 - (b) The total FAR in the pocket/plot shall be subject to the overall permissible FAR for the pocket/plot.
 - (c) Purchasable FAR shall be calculated on the basis of the FAR of the individual uses within that pocket/plot.

Calculation Method for the rate of charges of Purchasable FAR:-

Rate assessment for purchasable FAR shall be calculated in proportion to the land requirement for additional built up area. The Fraction of land value shall be charged from the allottee on the basis of following formula:-

$$C = Le \times Rc \times P$$

C=Charge

Le=Proportionate Land required against purchasable FAR , i.e. $F_p \times 100 / FAR$

F_p = Allowed Additional covered area (sq.mt.) as per purchasable FAR.

FAR=Permissible Floor Area Ratio as per Building Regulations.

Rc= Prevailing sector rate or allotment rate of related plot (on the basis of auction/sealed bid) whichever is higher.

P=Value of purchasable Factor is as follows:-

Group Housing =0.40

Commercial =0.60

Institutional /Institutional green* =0.30

Industrial =0.30

Green/sport/recreational Areas =0.20

Note:-

**(i) The purchasable FAR in institutional green plot shall only be permissible for the institutional use in the plot.*

(ii) The purchaseable FAR shall be allowed to a maximum permissible FAR allowed for the particular use above the constructed building. If the allottee has done the construction before sanctioning, the compounding charges of un-sanctioned area shall be payable at the rate of Rs. 200/-per sqmts. These compounding charges shall be over and above the fee charged for purchaseable FAR. In case of the construction is beyond the limit of purchasable F.A.R the allottee will have to first remove the extra construction beyond permitted F.A.R., then allottee may be allowed the extra purchasable F.A.R.

(iii) The Authority may also allow additional ground coverage with purchaseable F.A.R upto the maximum limit of 40% in commercial plots of more than 5000 sq. mtr. area on the basis of additional charges.

Additional Charges for Purchasable Ground Coverage shall be calculated as follows:

$$C = L \times 0.30 \times R$$

C= Cost of additional purchasable ground coverage

L= Land required under ground cover for additional ground coverage

R= Rate of land per sq.mt.(current reserve price or auction/ bid/allotment rate whichever is higher)

0.30 is a constant factor for purchasable ground coverage.

However, additional coverage will not considered in the setback area

9.3.2.3. Model for Floating FAR:

The state of Andhra Pradesh has adopted floating FAR concept. The method is to allow development by restricting/ regulating height of the building width of abutting road and plot sizes. This method is based on the carrying capacity analysis of the infrastructure planned. In keeping with the norm in the provision of infrastructure adjusted to the percentage, plot owners are permitted to use the additional FAR on payment basis.

Basis for increasing FAR: Carrying Capacity analysis tool is useful to rationalise fixation of FAR including increase in given FAR. Two major determining factors should be considered:

4. V/C (V= volume, C= capacity)

V/C: optimum level is 0.8; it can be relaxed up-to 0.9. Above 0.9 is dysfunctional and 1.0 is not desirable.

5. LPCD of piped water supply

Litres per capita per day (LPCD): the planned LPCD should be as per the minimum of norm is 135 LPCD set. However, the density to be capped by the Development/ Master Plan as per the threshold.

9.3.3. Minimum Setbacks

The setbacks in a building layout are provided subject to requirements of building height, the ventilation and fire safety requirements. Setbacks can be provided in two ways, i.e;

- 1) Based on plot sizes
- 2) Based on abutting road widths.

These two methods as described below may be adopted for providing setbacks. However, the provisions shall also confirm to the local building bye-laws.

9.3.3.1. Setbacks based on Plot Sizes

The following table may be referred for deciding the minimum setbacks for different size plots in various use zones. The size of plots should be decided after taking into account the provisions of National Housing Policy and Urban Land (Ceiling and regulation) Act. The setbacks, if necessary, may be changed depending upon the local situations and specified in the Development Plans and Building byelaws. Details indicated in UDPFI Guidelines 1996 continue to be valid and are presented in the table below.

Table 9.4: Minimum Setbacks

Sr. No.	Plot Size (in sqm)	Front (m)	Rear (m)		Side (m)	
			Plains	Hill Towns	Plains	Hill Towns
1.	Upto 60	0	0	2	0	1.5
2.	Above 60 and upto 150	3	0	2	0	1.5
3.	Above 150 & upto 300	3	3	3	0	1.5
4.	Above 300 & upto 500	3	3	3	3	3
5.	Above 500 & upto 1000	6	3	3	3	3
6.	Above 1000 & upto 2000	9	3	3	3	3
7.	Above 2000 & upto 4000	9	6	6	6	6
8.	Above 4000 & upto 10000	9	6	6	6	6
9.	Above 10000	15	9	9	9	9

Source: UDPFI Guidelines 1996.

Notes:

- 1) In case the permitted coverage is not achieved with setbacks, the setbacks of the preceding category may be followed.
- 2) In case a layout is sanctioned with more than the minimum prescribed setbacks, the same shall be followed in the sanction of the building plans.
- 3) The building plan sanctioning authority may relax setbacks in special circumstances.
- 4) In case of Compact city planning, the margins to be altered upto at least 50%.

9.3.3.2. Setbacks with respect to Abutting Road Width¹⁹⁶

The norms for setback, as per National Building Code, are indicated in the following tables:

A. Front Setback

Table 9.5: Front Setbacks with respect to Abutting Road Width

Sr. No.	Front Setback (m)	Width of street fronting the plot (m)	Remarks
1.	1.5	Upto 7.5	For buildings upto a maximum height of 7 m
2.	3.0	7.5 to 18	
3.	4.5	18 to 30	
4.	6.0	Above 30	

Source: NBC 2005.

Note: For streets less than 7.5 m in width, the distance of the building (building line) shall be at least 5m from the centre line of the street.

B. Rear and Side setback for building height upto 10 m

Rear setback: the rear setback shall be minimum 1.8 m

Side setback: the side setback shall be as follows:

- For detached buildings: Minimum 3m on both sides,
- For semi-detached buildings: Minimum 3 m on one side,
- For row type buildings: No side setback is required.

C. Rear and Side setback for building heights above 10 m

Table 9.6: Rear and side setback with respect to abutting road width

Sr. No.	Height of Buildings (m)	Side and rear setbacks (m)	Other Controls
1.	10	3	➤ For buildings above 24 m in height, the minimum front setback shall be 6 m. ➤ Where rooms do not derive light and ventilation from the exterior open space, the width of such space shall be reduced by 1 m subject to a minimum of 3 m and maximum of 8m.
2.	15	5	
3.	18	6	
4.	21	7	
5.	24	8	➤ Alternative setbacks for tower like structures - o Upto height of 24 m with one setback: Minimum 6m - o Between 24 m and 37.5 m with one setback: Minimum 9 m - o Above 37.5 m with two setbacks: Minimum 12 m
6.	27	9	
7.	30	10	
8.	35	11	
9.	40	12	
10.	45	13	
11.	50	14	
12.	55 and above	16	

Source: NBC, 2005.

Note: The building plan sanctioning authority may relax setbacks in special circumstances and increase in case of compact city and TOD development.

¹⁹⁶NBC 2005 part 3 Pg 23.

9.3.4. Activities permissible in open area¹⁹⁷

The open areas provided in the buildings can be used for the following permissible activities:

- a. Garden, rockery, water well and well structures, plant nursery, water pool, swimming pool (if uncovered), platform around a tree, landscaping, tank, fountain, bench, *chabutra* with open top and unenclosed on sides by walls and the like.
- b. Drainage culvert, conduit, catch pit, gully pit, chamber, gutter and the like.
- c. Compound wall, gate, un-storeyed porch and potico, canopy, slide, swing, uncovered staircase, ramps areas covered by *chhajja* and the like.
- d. Watchmen's booth, suction tank and pump-house, garbage shaft, sanitary block, parking lock up garages, electric cabin or substations and such other utility structures meant for the services of the building under consideration.

9.3.5. Distance from Electric Lines¹⁹⁸

Following clearances shall be maintained between the building and overhead electric supply line in accordance with the current Indian Electricity Rules as amended from time to time:

Table 9.7: Distances from Electric Lines

Sr. No.	Description	Vertical Distance (m)	Horizontal Distance (m)
1.	Low and medium voltage lines and service lines	2.5	1.2
2.	High voltage lines upto and including 11 kV	3.7	1.2
3.	High voltage lines above 11 kV and upto and including 33 kV	3.7	2.0
4.	Extra high voltage line beyond 33 kV	3.7 (plus 0.3 m for every additional 33 kV or part thereof)	2.0 (plus 0.3 m for every additional 33 kV or part thereof)

Source: NBC, 2005.

¹⁹⁷ NBC 2005.

¹⁹⁸ NBC 2005, Part 3 Pg 22.

9.4. Simplified Development Promotion Regulations for Specific land Use Zones

9.4.1. Residential Use Zone

9.4.1.1. Indicative Dwelling unit Sizes

The minimum dwelling units size could vary from State to State and region to regions, owing to various factors, including the terrain and soil type etc. However, a thumb rule could be noted from the following table.

Table 9.8: Indicative Minimum Dwelling Unit Sizes

Number of rooms	Dwelling unit size (sqm)
1 BHK	60-80
2 BHK	80-120
3 BHK	120-160
4 BHK	160-200
5 BHK	200-260

Source: Naya Raipur Master Plan.

The residential areas are developed either as (a) plotted development or (b) group housing/ flatted development. The density pattern i.e. (high density, high medium density, low medium density or low density) are followed for working out the pattern of development with respect to the size of plot to number of dwelling units on each plot, setbacks, FAR and the number of storeys/ height of the building.

9.4.1.2. Plotted Development

The layout plans for residential scheme are formulated keeping in view the following:

- 1) That there would be sufficient light and air in the buildings when constructed
- 2) That there would be protection against noise, dust and local hazards
- 3) That there would be sufficient open space for various family needs
- 4) That the circulation and access is easy and is safe from accident point of view
- 5) That, as far as possible, the plots are of regular shape and size and
- 6) These are logically arranged in a systematic manner so as to give a regular pattern of development in the form of row houses, detached and semidetached houses and if necessary the regular bungalow type sites.

The size of the plot would depend upon the number of dwelling units to be permitted on each plot and the type of the housing needed for a particular city based on general affordability of the people. The following table is suggested for different size of plots applicable, ground coverage, FAR, height and number of dwelling units for a residential area:

Table 9.9: Plotted Housing

S. No.	Plot Area (Sqm)	Maximum Ground Coverage (%)	FAR	Maximum Height (m)
1.	30	75	150 (350, MPD)	8 (15, NBC)
2.	Above 30 upto 50	75	150	8 (15, NBC)
3.	Above 50 upto 100	65	180	12
4.	Above 100 to 250	65	180	12
5.	Above 250 to 500	55	165	15
6.	Above 500 to 1000	45	120	15
7.	Above 1000 to 1500	40	100	15
8.	Above 1500 to 3000	33 1/3	100 (120, MPD)	15

Source: UDPFI Guidelines, 1996.

Note:

- 1) In the already approved/developed plots the pattern of development should confirm to the existing regulations.
- 2) Basement, if constructed, may be used for incidental use such as parking, servicing and household storage. It is not to be used as a dwelling unit.
- 3) The area of the basement should not be more than the ground coverage.
- 4) Parking as per the prescribed norms should be provided with the plot or provision should be made in the layout plan without affecting the circulation pattern.
- 5) 50% of the open area of the plot should be used for proper landscaping and for plantation.

A. Low Income Housing¹⁹⁹

For low income housing, the minimum plot size should not be less than 30 sqm.

The guidelines as given below shall be adopted for low income group housing:

- 1) It is recommended to provide cluster housing instead of single room dwelling.
- 2) The minimum plot size with ground coverage not exceeding 75%, shall be minimum 40 sqm in small and medium towns and minimum 30 sqm in metropolitan cities.
- 3) Plot sizes below 30 sqm and not less than 15 sqm may be permitted in case of cluster planning. In such a case the ground coverage and FAR can be 100 and 200 respectively.
- 4) Size of room: Every dwelling unit should have at least two habitable rooms, first room of minimum 9 sqm and width of 2.5 m. Other room shall be min 6.5 sqm with minimum width of 2.1 m provided the total area of both the rooms shall not be less than 15.5 sqm.
- 5) In case of single room tenements, the single multipurpose room shall be minimum 12.5 sqm carpet area.
- 6) The recommended density of dwelling units for low income housing may be as given below:

Table 9.10: Density norms for low income housing

S. No.	Type of Development	Range of Densities	Population Density (PPH)*
1.	Plotted Development	65-120 plots per Ha	--
2.	Mixed Development		--
2a)	Small Towns	75-100 DUs per Ha	335 - 450
2b)	Cities	100-125 DUs per Ha	450 - 560
2c)	Metropolitan Cities	125-150 DUs per Ha	560 - 675

Source: NBC: Special Requirement for Low Income Housing in Urban Areas.

* calculated @ 4.5 persons per dwelling

¹⁹⁹Annexure C, NBC 2005, pg 43.

The above dwelling unit and population density as suggested can be modified in view of development of Greenfield cities which should be based on compactness. The range of density may be applicable with slight modification to suit the local condition in brownfield cities, especially in case of redevelopment.

9.4.1.3. Group Housing

The number of dwelling units is calculated on the basis of the density pattern given in the development plan, taking into consideration a population of 4.5 persons per dwelling unit, as in the table below:

Table 9.11: Group Housing

S. No.	Minimum plot size (sq.m)	Maximum Ground Coverage (%)	FAR	No. of DUs	Maximum Height (m)
Plains					
1.	3000	25 to 35	50-175/ (Higher FAR may be given depending on the pattern of development. DUAC study, 2013 suggest FAR 400 in order to meet the requirements)	To be calculated on the basis of the net plot area of a particular neighbourhood. This may vary between 25 DUs to 175 DUs per Ha (if the FAR is raised beyond 175 the number of DUs will vary accordingly).	15 for plot sizes upto 4000 sqm 26 m for plot sizes above 4000 sqm
Hill Towns					
1.	5000	25 to 35	50 (Higher FAR may be given depending on the pattern of development and should not exceed 175)	To be calculated on the basis of the net plot area of a particular neighbourhood. This may vary between 25 DUs to 175 DUs per Ha.	15 (for all plot sizes)

Source: UDPFI Guidelines, 1996.

Note:

- 1) Basement, if constructed, is to be used for parking, servicing and for essential household storage and for providing facilities without counting in FAR.
- 2) The quantum of basement may vary between 33% to 50% of the plot area.

FAR and Ground Coverage for Group Housing based on density in DU's / Ha:

Table 9.12: FAR and Ground Coverage for Group Housing

Sr. No.	Net Residential Density Average (in DU's / Ha)	Maximum Ground Coverage (%)	FAR
1.	25	25	0.50
2.	50	30	0.75
3.	75	33	0.90
4.	100	35	1.00
5.	125	35	1.25
6.	150	35	1.50
7.	175	35	1.75

Source: NBC, 2005.

Other Controls²⁰⁰:

- a) The size of the habitable room should be minimum of 9.5 sqm, where there is only one room with a minimum width of 2.4m. Where there are two rooms, one of these shall be minimum of 9.5 sqm and other 7.5 sqm, with a minimum width of 2.1 m.

²⁰⁰NBC 2005 Part 3 page 30.

9.4.2. Commercial

Table 9.13: Norms for Commercial Centres

Sr. No.	Hierarchy of Commercial Centre	Maximum Ground Coverage (%)		Maximum FAR		Maximum Height (m)		Other Controls
		Plains	Hills	Plains	Hills	Plains	Hills	
1.	Cluster Centre Convenience Shopping	40	40	60	60	15	6	
2.	Neighbourhood Centre	30	35	100	100	15	9	
3.	Community Centre	25	30	100	100	26	15	
4.	District Centre	25	25	125	125	37	15	Some of the buildings in Plains could be permitted upto 50 m height with the approval of the Government for achieving an urban form.
5.	Sub city centre	--	--	--	--	--	--	Controls to be as per requirement
6.	City Centre	25 (MPD, pg 59)	--	150 (MPD, pg 59)	--	--	--	Other controls to be as per requirement
7.	Hotel	40 (MPD, pg 59)	--	225	--	--	--	Other controls to be as per requirement
8.	Service Apartment	30	--	150	--	--	--	Other controls to be as per requirement
9.	Any other commercial centre	25%	--	100	--	--	--	Other controls to be as per requirement

Source: UDPFI Guidelines 1996, MPD.

9.4.3. Public and Semi-public

The norms for public and semi public uses as indicated in the UDPFI Guidelines 1996 have been compared with those proposed for MPD-2021 by the DDA and are suggested in the **Tables 9.14, 9.15& 9.16** below.

Table 9.14: Norms for Public and Semi Public uses

Sr. No.	Uses	Maximum Ground Coverage (%)		Maximum FAR		Maximum Height (m)		Other Controls
		Plains	Hills	Plains	Hills	Plains	Hills	
1.	General (in cases where specific regulations are not given)	30 (MPD)	25	120 (MPD, pg 150)	100	26	15	➤ 15% of the total floor shall be allowed for residential purpose. ➤ Basement upto envelope line and to the maximum extent of 50% of the plot area shall be allowed and if used for parking and services should not be counted in FAR.
2.	Government Offices	30 (MPD)	25	200 (MPD, pg 87)	100	37	15	➤ The integrated office complex shall include Central Government

Sr. No.	Uses	Maximum Ground Coverage (%)		Maximum FAR		Maximum Height (m)		Other Controls
		Plains	Hills	Plains	Hills	Plains	Hills	
								office, local government office, public undertaking offices and courts. ➤ Basement upto envelope line and to the maximum extent of plot area shall be allowed and if used for parking and services should not be counted in FAR.
3.	Nursery School	33 1/3	33 1/3	100 (MPD, pg 137)	66 2/3	8	6	➤ Basement below the ground floor and to the maximum extent of ground coverage, and if constructed shall be counted in FAR.
4.	Primary School	33	33	120 (MPD)	100	15	15	➤ School for handicapped shall have same norms as the Primary School.
5.	Higher Secondary School	35 (MPD)	30	150 (MPD)	100	15	15	
6.	College	35 (MPD)	25	150 (MPD, pg 139)	75	15	15	The total area of the plot shall be divided in: a) School/ college building area b) Play field area c) Parking area d) Residential and hostel area
7.	Education and Research Centres (Large campus i.e above 8 Ha) Large campuses of universities, medical and engineering colleges and other education and research institutes shall be covered under these regulations. The campus will be divided into three parts and the regulations shall apply, as given below:							
7a)	Academic, including administration 45% of the total land area	30 (30, MPD)	20	120 (MPD, pg 139)	80	37 (MPD)	15	Basement below the ground floor and to the maximum extent of ground coverage shall be allowed and if used for parking and services should not be counted in FAR.
7b)	Residential 25% of the total land area							This will be developed at a density of 400 pph gross. The land shall be reserved for residential facilities @ 9.2 sq.m per person. Sub division regulations as given for group housing shall apply.
7c)	Sports and Cultural activities	10	10	15	15	--	--	

Sr. No.	Uses	Maximum Ground Coverage (%)		Maximum FAR		Maximum Height (m)		Other Controls
		Plains	Hills	Plains	Hills	Plains	Hills	
	15% of the total land area							
7d)	Parks and Landscapes 15% of the total land area	--	--	--	--	--	--	Suitable landscape plan to be prepared for this area.
8.	Religious Premises	33 1/3	33 1/3	66 2/3	66 2/3	11 (excluding minarets, shikhars and domes)	11 (excluding minarets, shikhars and domes)	Basement below the ground floor and to the maximum extent of ground coverage, if constructed, shall be counted in FAR.

Source: UDPFI Guidelines, 1996 and MPD, 2021.

Table 9.15: Socio Cultural Use Zone

Sr. No.	Category	Ground Coverage (%)	FAR	Maximum Height (m)
1.	Multipurpose Community hall, Banquet hall	30	120	26
2.	Recreational Club	25	100	26
3.	Socio cultural facilities such as auditorium, music, dance and drama centre/ meditation centre etc.	35	120	26
4.	Exhibition cum fair ground	20	20	--
5.	Science centre	30	120	26
6.	International Convention centre	30	120	--
7.	Old age home/ care centre for physically / mentally challenged/ working women/ men hostel/ adult education centre/ orphanage/ children's centre/ night shelter	30	120	26
8.	Aanganwari	30	60	15
9.	Sports Facilities	20	40	--

Source: MPD, 2021.

Norms for socio cultural use zone & security and safety facilities use zone is given for application in plains and hilly areas both.

Table 9.16: Security and Safety Facilities Use Zone

Sr. No.	Category	Ground Coverage (%)	FAR	Maximum Height (m)
Security Facilities				
1.	Police Post	35	150	15
2.	Police Station	30	150	26
3.	District office and Battalion	30	120	26
4.	Police Lines			
	- Administration	20		
	- Residential	30		
	- Sports and Facilities	10		
	- Open Spaces	40		
5.	District Jail	30	120	26
6.	Police Training Institute/ College	30	120	26
7.	Police Firing Range	12.5	25	9
8.	Police camp including Central Police	12.5	25	9

Sr. No.	Category	Ground Coverage (%)	FAR	Maximum Height (m)
	Organisation/ Security Forces			
	Fire Facilities			
1.	Fire Post/ Fire Station/ Disaster Management Centre/ Fire Training Institute	30	120	26

Source: MPD, 2021

9.4.4. Industrial use Zone

Table 9.17: Industrial Use Zone

Sr. No.	Plot Size (sq m)	Maximum Ground Coverage (%)		Maximum FAR		Maximum Height (m)		Other Controls
		Plains	Hills	Plains	Hills	Plains	Hills	
1.	Flattened Group Industry							
	Minimum 2000	30	30	120	100	15	15	Basement upto the building envelope line to the maximum extent of 50% of plot area shall be allowed and if used for parking and services should not be counted in FAR.
2.	Light and Service Industry							
2a)	Less than 400	60	60	125	100	12	9	➤ Maximum floors allowed shall be basement, ground floor and first floor. Basement should be below ground floor and to the maximum extent of ground coverage shall be counted in FAR. In case the basement is not constructed, the permissible FAR can be achieved on the second floor. ➤ In case of roof truss, height of buildings should be adjusted/ relaxed.
2b)	Above 400 upto 4000	50	50	125	100	12	12	
2c)	Above 4000 upto 12000	45	45	125	100	12	12	
2d)	Above 12000	40	40	100	75	12	9	
3.	Extensive Industry							
3a)	400 to 4000	50	50	100	75	9	9	➤ Single storey building with basement is allowed. Basement shall be below the ground floor and the maximum extent of ground coverage and shall be counted in FAR. ➤ In case of roof truss, height of buildings should be adjusted/ relaxed.
3b)	Above 4000 upto 12000	45	45	90	60	9	9	
3c)	Above 12000 upto 28000	40	40	80	50	9	9	
3d)	Above 28000	30	30	60	45	9	9	

Source: UDPFI Guidelines, 1996

Note:

- 1) A new planned industrial area to have minimum 100- 300 sqm size of plot and its width shall not be less than 15 m.
- 2) For industrial plots upto 1000 sq.m, 5% of the total area shall be reserved as amenity open space which shall also serve as general parking space. When such amenity open space exceeds 1500 sq.m, the excess area could be utilised for construction of buildings for banks, canteen, welfare centre and such other common purposes.
- 3) For industrial plots more than 1000 sq m, 10% of the total area shall be reserved as amenity open space to a maximum of 25 sq m.

9.4.5. Transportation & Communication Use Zone

For transportation use zone the following norms may be applicable:

Table 9.18: Norms for Transportation Zone

Sr. No.	Category	Area under operation (%)	Area under building (%)	FAR	Floor area that can be utilised for passenger accommodation (%)
1.	Rail Terminal	70	30	100	15
2.	Bus Terminal	50	50	100	25
3.	ISBT	25	Max 50 (as per requirement)	100	as per requirement
4.	Metro Yards	80	20	100	15

Source: MPD, 2021.

Other Controls:

- 1) The space on first and second floor shall be essentially used for public services like post office, police-post and other essential services.
- 1) Bus queue shelters are not to be included in the coverage and FAR.
- 2) In order to integrate the supporting commercial uses around the transportation zone, FAR can be more for promoting mixed use.

9.4.5.1. Aerodromes

The following restrictions in vicinity of aerodromes shall be applicable²⁰¹:

- 2) The buildings or structures which rise to 30 m or more in height and are to be located within 20 km of the aerodrome reference point shall require No Objection Certificate from the Directorate General of Civil Aviation.
- 3) In case of buildings to be located in the vicinity of defence aerodromes, the maximum height of such buildings shall be decided by the Defence Authority.
- 4) No new chimneys or smoke producing factories shall be constructed within a radius of 8 km from the Aerodrome Reference Point (ARP).
- 5) Overhead high voltage/ medium voltage lines or telephone & other communication lines shall not be permitted in the approach/ take off climb areas (funnel zone) within 3000 m of the inner edge of these areas.
- 6) A 3 m margin shall be allowed in new constructions for wireless/ TV antennas, cooling towers and munties.
- 7) For height Restrictions with respect to Approach Funnels and Transitional areas NBC 2005 or the latest revised version shall be followed.

²⁰¹NBC, 2005, part 3, pg 27.

9.4.6. Primary Activity

Table 9.19: Norms for Farm Houses

Sr. No.	Size of Farm	Maximum FAR	Maximum Height	Other Controls
1.	Above 1.0 Ha and upto 2.0 Ha	100 (including mezzanine floor)	Single storeyed maximum height 6m	➤ Setback in dwelling house should be 15 m away from any boundary line of the property.
2.	2.0 Ha and above	150 (including mezzanine floor)	Single storeyed maximum height 6m	➤ Where the property abuts an urban road, the dwelling house building should be setback from the centre line of that road by 60m. Where the property abuts a village road, the building setback from the centre line of that road should be by 30 m. ➤ No dwelling unit should be built within 400 m of the right of way of any National Highway.

Source: UDPFI Guidelines, 1996

Table 9.20: Norms for Primary Activity

Type	FAR	Ground Coverage	Max. Building Ht.
Agro based uses	5	5%	15 m
Poultry Farm	25	25%	10 m
Religious, Educational, Hospital, Slaughter house, cold storage, transport related activities and truck terminal, Govt/ semi govt / FCI go-downs and warehouses	45	15%	15 m

Source: Ahmedabad Development Plan (part III, page 103).

9.5. Special Requirement

9.5.1. Building Norms for Natural Habitat

The land uses identified as Natural Habitat covering water bodies, forest & vegetation, green open spaces, coastal zone, wetlands etc., shall be protected and adequate buffer shall be provided from the planned establishments. For planning around these areas, the building norms and regulations as stipulated by the respective statutory bodies such as MoEF and State Environment and Forest Department shall be applicable.

9.5.2. Historical or Archaeological areas

The special areas shall be identified as old built-up areas, areas of historical or archaeological importance, areas of scenic value, area restricted for development by Government or area under other uses/ spot zone during preparation of Development plan. For protection of these areas the norms as stipulated by the respective statutory bodies such as Archaeological Survey of India and respective departments shall be applicable.

As per the Model Building Bye-laws, buildings within heritage precincts or in the vicinity of heritage sites shall maintain the skyline in the precinct and follow the architectural style (without any high-rise or multi-storeyed development) as may be existing in the surrounding area, so as not to diminish or destroy the value and beauty

of or the view from the said heritage sites. The distance is prescribed as 200 meters Regulation zone by AMASR Act, 2010. The development within the precinct or in the vicinity of heritage sites shall be in accordance with the guidelines framed by the Commissioner, Municipal Corporation / Vice- Chairman, Development Authority on the advice of the Heritage Conservation Committee or separate regulations / guidelines, if any, prescribed for respective zones by Municipal Corporation / Development Authority.

9.5.3. Industrial Regions

For planning of Industrial Regions the guidelines development by State Authorities such as Special Investment Region (SIR) guidelines within Delhi Mumbai Industrial Corridor (DMIC) or by National Authorities such as guidelines for National Investment & Manufacturing Zones (NIMZ's), Special Economic Zone (SEZ) should be referred to. Refer Chapter 6 for environmental aspects and annexures of Volume II for various Acts and Policies.

9.5.4. Introduce Use of Form Based Codes

In view of current urban form of Indian city, an approach may be adopted to the form the image of city through Form-Based Code in addition to the development promotion regulation. This can act as a technique for regulating development to achieve a specific urban form, and it creates a predictable public realm by the regulation of the physical form primarily. The different parameters used to zone the city into different transects are land use intensity, density, building disposition, building configuration, building function, standards, mixed use and neighbourhood.

10 General Recommendations

10.1. Adoption of URDPFI Guidelines, 2014

Spatial planning for development is an envisioning process which requires a sound assessment of the ground issues and provides options for sustainable development within the bound constraints of the demographic, physical, socio-economic, jurisdictional and financial aspects. The focus is on spatial dimension as all development efforts have direct impact on the use of land and different development projects need to be coordinated and integrated within a desirable spatial frame. The process of planning must always be continuous to address the evolving issues of the human settlements. The formulation of the URDPFI guidelines as a revision of the UDPFI guidelines, 1996 addresses the present challenges of urban and regional development, plan preparation process and implementation and attempts to standardise and also simplify the guidelines required for planning in the country. Considering the rapid pace of urbanisation, it is suggested that the Ministry of Urban Development should revisit the guidelines in a periodic time frame.

The norms and standards prescribed by URDPFI Guidelines are in a form of a suggested model, which may be adopted by the respective State Governments in accordance to the local conditions. State Town and Country Planning Departments have been preparing Development plans with reference to UDPFI Guidelines of 1996. The recommendations provided in the 2014 guidelines are specific and aim at facilitating and quacking the processes of plan preparation and implementation of plans. Specifically, some of the key points that require immediate attention of the State Town & Country Planning Departments, planners and practitioners have been detailed. Along with suggestions for further actions to be taken up by the Ministries, Organisations and Agencies at the National level, those for the governments, organisations and agencies at State level and Development Authorities are also provided.

These Guidelines are generic in nature and the title starts with the word 'Urban', these are applicable for all settlements, urban or rural. Some States such as Orissa and Rajasthan have moved ahead to prepare formal spatial plans for rural areas having population of 10,000 or more. The URDPFI Guidelines endorse such policies. More significantly, these Guidelines highlight the concept of regional planning, by recommending treating the rural areas that are contiguous to the urban areas as a continuum. This continuum is termed as 'RURBAN' in Gujarat and is profusely used for notifying 'Development Authorities' in many States.

10.2. Key Recommendations in the Guidelines

Based on the extensive consultations & deliberations with various stakeholders and experts, it can be summed up and recommended that following parameters are a

prerequisite for the developments to be taken up in India. The guidelines, focuses on the following:

- Integrated regional and urban development with focus on spatial planning
- Regional spatial development frame to provide the backdrop within which settlement planning (urban, rural, peri-urban) and local area planning should be taken up,
- Adapting a paradigm shift towards planning and development for compact, green, smart cities and safer cities,
- Ensuring that the task of urban and regional planning must be only carried out or must ONLY be the responsibility of certified planner.

India is not only one of the oldest civilizations but also the largest democracy and is extremely diverse geographically, culturally, socially, economically, administratively & historically. Hence, no single approach can work uniformly. The approaches to development need to be tailored contextually, which needs to be done by the individual State Governments and City Municipalities.

Also during the implementation process as seen while comparing cases like Delhi, Ahmedabad, Hyderabad and Mumbai, there are various limitations seen in terms of diversity in the mix of activities, population concentration, nature of existing developments and dynamic changes in the peri-urban areas. Urban design approach based projects need to be taken up at micro area level so that the cross cutting development themes can be tailored/modified to suit as per contextual realities while implementing plans in various regions/cities/areas.

Therefore contextual approach becomes important consideration specially at local area planning level. However, a uniform frame of spatial planning considerations must guide all development within an integrated frame of regional and urban perspective. At local area level, it is essential that approach to planning and design has to be mainly guided by urban design approach. For this purpose, urban planners and urban designers should work together as unified team.

Table 10.1: Key Aspects of the Guidelines

Sector	Key Aspects
Transportation planning	• The streets, roads, mass rapid transit systems, other public transportation systems provide the back bone structure for urban and regional development. Transportation including mobility should therefore be given a prime importance. • Transportation planning not only to be efficient, but also needs to be designed and integrated into other systems in such a way that it facilitates mobility for all genders, age groups and citizens with disabilities (differently abled citizens).
Sustainable Land development	• Selecting the right density of development taking into consideration the environment, provision and cost of infrastructure and mobility. • High & medium density zones as appropriate to contextual situation in planning to include mixed use development/ Compact city development.
Sustainable Resource Management	• Realizing the pressure on the natural resources, all infrastructure planning should be done with a strong emphasis on sustainability like green cities approach. • Also, it is important that based on the suitability of the land and availability of resources, States should prepare Perspective (Strategic) Plan in order to guide development at regional and city level.
Efficient Urban Development Management	• Application of GIS, Bhuvan in planning process • 73rd&74th Amendment to be adopted in the given planning system and

Sector	Key Aspects
	- formulation of DPC & MPC. • Transparency and integration in various planning & non-planning department in terms of the processes related to planning and development works. • Smart cities application
Participatory Planning approach	• Direct involvement of the citizens as appropriate in planning processes and mechanisms. • Pre and post planning people's participation and consultation to be promoted, which has been successfully practised in Goa and Rajasthan. • Citizens' charter to bring transparency and accountability.
Regional Planning Approach	• Planning regions can be identified as Administrative Regions such as District and Metropolitan Regions, Investment Regions and Special Regions. • Preparation of a State Perspective Plan with planning for Districts and Metropolitans as Regions • The planning for investment regions should be under a National level policy, like DMIC, NMIZ policy.

Source: URDPFI Guidelines, 2014

10.3. Key aspects of Guidelines for local area/ site specific development

- Local area/ site specific development planning should be based on urban design approach focusing on mobility, accessibility and connectivity, street furniture including street plantation, pedestrian & cycle paths, signage and parking, provision of site level facilities, etc.
- Special attention is required on authenticity of property boundaries and land tenure on the basis of the revenue records
- Special development incentives such as increased FAR should be adopted in the designated TOD influence zone (approx. 500 meters) along the major transportation corridors.
- Special attention to be given to conservation of archaeological, architectural and historic buildings and sites as per the prevailing rules.

10.4. Suggestions for future Development in Planning

MoUD as the nodal ministry has taken the initiative to prepare the Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines, now it is recommended that the following specific tasks be reviewed by the relevant Central and State Government Ministries/ Departments/ Organisations/ Agencies/ Authorities and if found suitable and necessary, adapt in their own policy, legal and administrative procedures. In doing so, States are urged to review respective policies and Acts which are relevant to operationalize the URDPFI Guidelines and bring changes wherever necessary and appropriate. The URDPFI Guidelines are to be circulated to all the State Town and Country Planning Departments, Urban Development Authorities, Urban Local Bodies, relevant Ministries and other agencies which are involved in preparation of Master Plans/ Development

Plans/Metropolitan Plans /District Development Plans for their appropriate adoption.

Land development and Urban Development are State subject, therefore URDPFI Guidelines need to be integrated with the State level legal and policy measures. In the process of preparing the Master Plans/ Development Plans /District Development Plans, it would be desirable that all the State Town and Country Planning Acts, Urban Development Authority Acts, Municipal Acts, Industrial Development Corporation Acts may be aligned with the URDPFI Guidelines.

10.4.1. Recommendations for the National Organisation(s)

1. The current policy for primary categorisation of Land under the **Draft National Land Utilisation Policy** (2013), should be followed by State during the preparation of State Perspective Plans.
2. The prevailing Model law(s) needs to be reviewed and revised to simplify & suggest State Departments to come to a unified legal and operational framework.
 - i. The **Model Regional and Town Planning and Development Law** was prepared in 1985, almost 30 years ago, since then many legislative and ideological changes have taken place in the developmental approach of Government of India. Also to incorporate the provisions of 73rd&74th CAA, the Model Regional and Town Planning and Development Law, 1985 requires appropriate revision and restructuring. Accordingly, an independent exercise for changes in the Model law in light to the suggestions made in the URDPFI Guidelines, 2014, Volume – II could be undertaken.
 - ii. The **Model Municipal Law (MML), 2003** was introduced more than a decade back; it is pertinent that the provisions of MML need to be updated to bring it in harmony with the recent developments in the Municipal Law. The MoUD study undertaken by NIUA (2013) to review the MML, suggested various points for revision of the provisions given in MML, based on their status of implementation. There are various provisions in the current scenario that are vital for MML to bring it in line with the new developments in municipal governance. Provisions like reservations of seats for Women/SC/ST/BC in Municipality, Local Bodies/Municipal Ombudsman, functions and duties of *Area Sabha* Representative, disclosure of various documents relating to municipal affairs, accrual based double entry system of accounts, defining functions and responsibilities of DPCs and MPCs are suggested to be detailed out under the MML. Such changes and more are suggested to be considered for the revision of the Model Municipal Law.

3. **Draft Town and Country Planners Registration Bill, 2012** is being prepared by Town and Country Planning Organisation identifies the need for establishment of Council of Town and Country Planning. Such Council is suggested to be body corporate, having continuous succession and a common seal. The purpose of such Council is to control and regulate the quality of education institutions of Town and Country Planning and qualified professionals from such institutes, in the country. It is suggested, that the bill to be reviewed, be given a legal status and adopted at the earliest. It could be explored that the certified planners by the council are empowered to take decision on financial expenditure as appropriate for the administrative position. Also, the Council could ensure that the task of urban and regional planning must be only carried out by certified planners.
4. It is suggested that the nomenclature of JnNURM's 'Comprehensive Development Plan' be changed to as '**City Investment Plan**' to avoid confusion between the recommended statutory Development Plan (the nomenclature) as per the State provision and 'Comprehensive Development Plan' as per JnNURM and also the fact that City Development Plan is essentially a resource mobilisation plan on specific schemes and projects .
5. For integration of planning systems, both statutory and non-statutory plans, JnNURM to accept City Investment Plan (named as City Development Plan under JnNURM) and Comprehensive Sanitation Plan as sub-plans of Development plan/ Master plan or Statutory Plans as per the State Government provision and provide funding of such plans after official approval of the Development Plan.
6. While adopting the URDPFI Guidelines, it is necessary to develop **Planning Information System (PIS)** on the lines of Management Information System (MIS). This will be essential as numbers of agencies are involved in collection of different attribute and spatial data, which often leads to duplicity of work and ambiguity in terms of analysis and interpretation. Hence, it becomes necessary to streamline the data collection, analysis and interpretation for preparing the Master Plans/ Development Plans/Metropolitan Plans /District Development Plans. This will enable hastening the process of preparation of Plans. It has been observed that the process of Plan Preparation often gets delayed due to lack of availability of relevant and comparable both in content and time scale spatial/attribute data.
7. National Remote Sensing Centre (NRSC) to take necessary actions for easy access and wider popularity of *Bhuvan* and making it faster and more user friendly. Ministry of Urban Development to extend the necessary support for it. For **compatibility of geo-spatial database other Ministries' geospatial data** could be incorporated with the *Bhuvan* database, like Ministry of Drinking Water & Sanitation, Ministry of Road Transport & Highways MoRTH, NIC. Already

database from Geological Survey of India has been integrated at appropriate scale with *Bhuvan*.

8. Lack of cadastral maps limits the use of *Bhuvan* land use base for preparation of development plan/ Master plan, and therefore, integration of the cadastral records at appropriate scale with **National Land Record Modernisation Programme** is suggested which could provide ready to use geo-spatial and revenue database pan India.
9. For preparation of local area plan, authentic and reliable data at 1:2000 or 1:1000 scale is required specially on plot boundaries and area of plots. In reality there exists lot of discrepancies between the plot boundaries and area as recorded in the revenue records and what actually is the ground reality. This problem is a serious one and greatly hampers implementation of local area schemes. MoUD in assistance with NRSC and in collaboration with representatives revenue departments of the States should evolve mechanisms to improve the situation. The crucial aspect in helping implementation of the local area plans will be access to digitised and authentic data on plot boundaries and plot areas, and also on land tenure by planners.
10. The centrally sponsored National Urban Information System (NUIS) Scheme approved by GoI with two major components (i) Urban Spatial Information System (USIS) to meet the spatial data requirements of urban planning & management (ii) National Urban Data Bank & Indicators (NUDB&I) to develop town level urban database to support development of indices through a network of Local Urban Observatories (LUO) under the National Urban Observatory (NUO) programme. These schemes and programmes are suggested to be expedited for completion.
11. With the experience of the practitioners in the North eastern hilly states, it is suggested to review at the Service Level Benchmarks (SLBs), which should be flexible on such certain items, for example: extent non-revenue water source may be additional 5%. MoUD to review and assess the **SLBs in hilly and North-Eastern areas** to redefine the SLBs. Apart from this, SLB's to include extent of **Municipal Construction waste reuse/ recycled benchmark**²⁰².
12. **E-governance, techniques and methods:** Under the E-Governance, it has to be seen that how the entire planning process gets expedited in a short period of time, wherein use of digital technology should be maximized by way of preparing spatial database and integration of attribute data periodically. It is recommended that the plans should be updated /revised through mid- term review, so as to ascertain the efficacy of implementation, preferably every five years, which may be co-terminus with the five year plans. Under E-governance, various processes related to planning like change of land uses, building plan

²⁰² For cities about 20% as per the (draft) Construction and Demolition Waste Rules

sanctions, issuance of completion certificate and other clearances required for any project needs to be streamlined, so that all the urban infrastructure projects gets completed within the stipulated time.

13. For this purpose, URDPFI suggests that '**citizen's charter**' should be enacted at the state level to bring transparency and accountability.

14. Promotion of the network, viz, "City Net": "City Net" could be recommended for encouraging the networking between various cities with a view to ensure balanced development in a region. This will require exchanging /sharing of information and data among the cities. This will ensure effective integration of trunk infrastructure in a region connecting all urban settlements. The benefit of "City Net" network will ensure efficient delivery of the services and will also be helpful in achieving the balanced development and redistribution of population, thereby reducing urban primacy. City Net will also facilitate formulation of Inter – State Regional Plans

15. Independent research is suggested to be initiated by the Ministry of Urban Development for the following:

- i. **Mixed landuse and compact city norms** observing the international scenario and national resource availability, to identify norms for sustainable density norms (range) for different scales of cities.
- ii. In case of inadequacy in the manpower capacity with the Government bodies for planning, outsourcing to non-governmental and private organisation could be considered as an option. A standard **Terms of Reference (ToR) for such consultancy services** is suggested to be prepared and made available to the State Governments.

It is recommended that all the human settlement planning, infrastructure and administrative related departments could use the URDPFI Guidelines, 2014 and not merely only the State Town and Country Planning Departments.

10.4.2. Recommendations to State Governments/ State Town and Country Planning Departments/ Local Bodies/ Development Authorities

1. State Governments could review and where necessary amend the **respective State Town and Country Planning Acts and related laws of the State Government** to minimise inconsistencies and contradictions, if any. The State T&CP Acts could direct the public participation at pre-planning and post draft plan formulation stage and the time period for approval of development plans. The amendments are suggested to be referred from the Model Town and Country Planning Law and Model Municipal Law by the Central Government revision.

Table 10.2: Relevant State Level Acts to be considered for revision

S.No.	Name of State	T & CP Act	Urban Development Authority Act	Industrial Development Act
1	Andhra Pradesh	Andhra Pradesh Town and Country Planning Act, 1920	Andhra Pradesh Urban Areas (Development) Act, 1975	-
2	Arunachal Pradesh	Arunachal Pradesh Urban and Country Planning Act, 2007	The Arunachal Pradesh Urban and Country Planning Act, 2007	-
3	Assam	Assam Town and Country Planning Act, 1959	Guwahati Metropolitan Development Authority Act, 1985	-
4	Bihar	Bihar Urban and Regional Planning and Development Act, 2011	-	The Bihar Industrial Area Development Authority, Act -1974
5	Chhattisgarh	Chhattisgarh Town and Country Planning Act, 1973	-	-
6	Goa	Goa Town and Country Planning Act, 1974	-	The Goa Industrial Development Act 2013
7	Gujarat	Gujarat Town Planning & Urban Development Act, 1976	Gujarat Town Planning and Urban Development Act, 1976	The. Gujarat Special Investment Region. Act-2009
8	Haryana	Haryana Development & Regulation of Urban Areas Act, 1975.	Haryana Urban Development Authority Act, 1977	-
9	Himachal Pradesh	Himachal Pradesh Town and Country Planning Act, 1970	Himachal Pradesh Housing & Urban Development Authority Act, 2004	-
10	Jammu & Kashmir	Jammu & Kashmir Development Act, 1970	J&K Development Act 1970	-
11	Jharkhand	Jharkhand Town Planning and Improvement Trust Act, 1954 (adopted from Bihar)	Jharkhand Regional Development Authority Act, 2001	Jharkhand Industries (Facilitation) Act - 2012
12	Karnataka	Karnataka Town and Country Planning Act, 1961	Karnataka Urban Development Authorities Act, 1987	The Karnataka Industrial Areas Development Act, 1966
13	Kerala	Kerala Town Planning Act, 1939	-	Kerala Industrial Township Development Area Act, 1999
14	Madhya Pradesh	Madhya Pradesh Nagar Thatha Gram NiveshNiyam, 1975	Madhya Pradesh Municipalities Act, 1961	The Madhya Pradesh Investment Region Development And Management Act, 2013,
15	Maharashtra	Maharashtra Regional and Town Planning Act, 1966	Mumbai Metropolitan Region Development Authority Act, 1974 Maharashtra Regional and Town Planning Act, 1966	The Maharashtra Industrial Development Act, 1961
16	Manipur	Manipur Town and Country Planning Act, 1975	Manipur Municipalities Act, 1994	-
17	Meghalaya	Meghalaya Town and Country Planning Act, 1973	Meghalaya Urban Development Authority, Shillong Building Bye-Laws 2001	-
18	Mizoram	Mizoram Urban & Regional Development Act, 1990	Mizoram Urban and Regional Development Act, 1990	-

S.No.	Name of State	T & CP Act	Urban Development Authority Act	Industrial Development Act
19	Nagaland	Nagaland Town and Country Planning Act, 1980	Nagaland Town and Country Planning Act 1966	-
20	Orissa	Orissa town Planning and Improvement Trust Act, 1956	The Odisha Development Authorities Act, 1982	-The Orissa Industrial Infrastructure Development Corporation Act, 1980
21	Punjab	Punjab Regional Town Planning and Development Act, 1995	Punjab Regional & Town Planning & Development Act, 1995	-
22	Rajasthan	Rajasthan Urban Improvement Act, 1959	Jaipur/ Ajmer/ Jodhpur Development Authority Act	Rajasthan Industrial Area Development Authority Act, 1995
23	Sikkim	The Sikkim Urban and Regional Planning and Development Act, 1998	-	-
24	Tamil Nadu	Tamil Nadu Town and Country Planning Act, 1971	-	Tamil Nadu Industrial Township Area Development Authority Act, 1997
25	Tripura	Tripura Town and Country Planning Act, 1975	Tripura Municipal Act 1994,	-
26	Uttar Pradesh	Uttar Pradesh Urban Planning and Development Act, 1973	Uttar Pradesh Nagar Planning & Development Act 1973	U.P. Industrial Area Development Act ,1976
27	Uttarakhand	Uttarakhand Urban Planning and Development Act, 1973	Uttarakhand (U.P. Urban Planning and Development Act,1973) Adoption & Modification order, 2006	-
28	West Bengal	West Bengal Town and Country (Planning and Development) Act, 1979	Town & Country (Planning & Development) Act, 1979	Durgapur Industrial Board (Development & Control of Building Operation) Act 1958
29	A & N Islands.	Andaman & Nicobar Town and Country Planning Regulations, 1994	-	-
30	Chandigarh	The Capital of Punjab (Development and Regulation) Act, 1952	-	-
31	Delhi	Delhi Development Act, 1957	Delhi Development Act, 1957	-
32	Dadra & Nagar Haveli	Dadra & Nagar Haveli Town and Country Planning Act, 1974	Dadra & Nagar Haveli,	-
33	Daman & Diu	Daman & Diu Town and Country Planning Act, 1974	-	-
34	Lakshadweep	Yet to be enacted	-	-
35	Pondicherry	Puducherry Town and Country Planning Act, 1969	The Puducherry Town & Country Planning Act, 1969	-

Source: TCPO

Note: Review of listed various acts should be useful in the context of different suggestions made by URDPFI under 10.4.1 and 10.4.2. State Governments are urged to do the useful.

2. In view of '**The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013**' (effective from 1st January 2014), the State Governments could review and if found necessary modify their land policies and legal system in order to facilitate – simplification of planning process and effective implementation of development plan.
3. All the States have full-fledged Departments of Town and Country Planning. However, based on the deliberations in the 'Brainstorming Sessions on Planning and Development, 2025: Professional and Academic Challenges' conducted by TCPO, it was learnt that several States are functioning without a qualified Director/Chief Town Planner as the post is being held either by an Administrator or charge is given to Senior Town Planner. Hence, the cities/towns of such States continue to suffer from lack of attention to the development aspects apart from infrastructure deficiencies and ad-hoc decisions which lead to mismatch between the actual availability and requirement of the infrastructure facilities. It is suggested that all State Governments appoint a **qualified Town Planner as the head** of State Town and Country Department.
4. **Regulatory Authority at the State level:** The major institutional reforms suggested by the URDPFI Guidelines, 2014, at the state level are the constitution of Urban and Regional Planning & Development Authority (or Town Planning Board or Town Planning Council as existing in some states). This apex body should be chaired by the Chief Executive of the state, Chief Minister of an Urban and Regional Development Regulatory Authority at State level and creation of City Level Infrastructure Fund. The regulatory authority at the state level may function as an appellate authority to address the related grievances redress. The regulatory body could review the smooth functioning of the agencies to overcome the multiplicity, duplication or gaps. The authority will guide the preparation of Perspective plan for the State which should provide the frame for all regional and urban development plans in the State. The regulatory authority should be responsible for guiding land utilisation based on suitability and proposed structure of transportation networks. It should guide the state for development focusing on protection of environmentally sensitive areas, natural land forms, natural vegetation and water bodies etcetera.
5. **City Infrastructure Fund** could raise funds from direct and indirect taxes which have direct relevance to urban and state subjects, this consolidated fund at State and ULBs level to be exclusively used for urban infrastructure. Apportionment of the tax for the proposed fund between the State government and ULBs to be based on the State policies.
6. State Finance Commission could bring **uniformity in accounting and budgeting at municipal level**. TCPO, IIPA, NIUA to recommend a uniformed accounting system based on the JnNURM reform(s). The Model Municipal Law could be revised keeping in view of the same.

7. State level policy could be adopted for institutional requirements to **meet the demand of manpower** in planning:

Every State could have a Planning School.

Standardization of nomenclature for planning courses.

Schools of Planning could have continuous interface with the profession/industry.

8. Under the attempts to improve implementation of plans, State Governments could develop **Good Governance systems**, including:

- i. Citizen's charters could be formulated by the State government taking into account the local condition that determine level and discharge of the services. This may include items like issue of licence, approval of building plans, issue of completion certificate etc. This could consider Right to Information (RTI) system also.
 - ii. Direct responsibility of the project progress by the responsible field officers to chief of the division/ departments.
 - iii. The details of the start and progress of the local projects including financial and time allocation could be displayed publically, at strategic locations within the development sites and updated regularly.
 - iv. Maintenance of regular updated land and property records preferably with the changes of land use in land transactions. This database integrated with GIS maps should be on a digital platform easily accessible to the public. This approach will also initiate Smart city concept.
 - v. The practice of monitoring land prices in cities as followed by some cities including Delhi Development Authority. Monitoring and dissemination of land/ property prices should be done by Development /State Authorities for benefit of real estate market.
9. Respective State Town and Country Planning Department to approach NRSC/Bhuvan for the authorised access to the spatial data and attribute data for the preparation of Development Plan/Master Plan. Each State/ UT to identify one town/city (medium/ metropolitan size) **Development/Master Plan pilot project on Bhuvan platform.**
10. Creation of real time demographic and other database at State level which can be accessible to public on Government website. This should be integrated on a National level platform. Use of advanced techniques for digital database and hyper database uploaded on the website which is user-friendly.
11. Every State should formulate the **State Level Planning Guidelines** within the Framework of URDPFI Guidelines (making key amendments in the provisions as per the State's vision or contextual requirements) and National and State level policies.
12. In order to promote **affordable housing** for low income & EWS, State Governments to set norms and initiate its adoption.

In order to promote the visionary approach of urban and regional development, facilitation of effective implementation of the plan it is necessary to have availability of number of qualified planners at the state level and municipal level. The State Governments are urged to notify Statutory Towns & Cities and prepare Statutory Plans. State Governments may seek support from MoUD for the plan preparation or existing plan revision, for capacity building, standardization of technical assistance with the adoption of URDPFI Guidelines, 2014.

Before concluding, it may be desirable to note that for promoting planned urbanization, the rural areas contiguous to a town/ city need not necessarily be amalgamated with the parent city. It may often be more helpful to notify such rural areas as a new city, like a 'Nagar Panchayat' and allow it to grow into a bigger city at its own pace.

"The Growth Story of India shall be written on the canvass of planned urban development and the script writers shall be the town and country planners!"

Endnotes

ⁱ“Area specific regulatory parameters” shall include height of buildings, quantum of built-up area, regular lines of streets and building lines, setbacks, floor area ratios, façade controls, parking spaces, loading and unloading spaces, sizes and locations of projections and advertisement signs, and circulation pattern.

ⁱⁱIn 2005 the Ministry of Urban Development and M/o Housing & Urban Poverty Alleviation launched JNNURM with the aim to encouraging reforms and fast track planned development of cities. It focused on efficiency in urban infrastructure and service delivery mechanisms, community participation, and improvement in urban governance.

ⁱⁱⁱIbid.

^{iv}A charrette is an intensive planning session where citizens, designers and others collaborate on a vision for development, giving immediate feedback to the designers. This process allows everyone who participates to be a mutual author of the plan. It is located near the project site, team of design experts and consultants sets up a full working office. Formal and informal meetings are held throughout the event and updates to the plan are presented periodically. Through brainstorming and design activity, many goals are accomplished during the charrette.

- (i) Everyone who has a stake in the project develops a vested interest in the ultimate vision.
- (ii) The design team works together to produce a set of finished documents that address all aspects of design.
- (iii) Since the input of all the players is gathered at one event, it is possible to avoid the prolonged discussions that typically delay conventional planning projects.
- (iv) The finished result is produced more efficiently and cost-effectively because the process is collaborative.

Charrettes are organized to encourage the participation of all. That includes everyone who is interested in the making of a development: the developer, business interests, officials, residents, and activists. Ultimately, the purpose of the charrette is to give all the participants enough information to make good decisions during the planning process.