

Floodplain Planning & Development Guidelines for River Godavari, Nashik Region

10.1 Background

Major ecosystem challenges faced by almost all the Indian Rivers are encroachment; wastewater disposal; solid waste disposal, ingress of fertilizers/ pesticides as runoff. These inputs temporarily vary due to festive celebrations, seasons and human development activities.

The intent therefore, in formulating these guidelines is to encourage an ecosystem based development approach that not only takes into consideration the environmental impacts of urbanization but also ensures enhancement of the River's inherent eco-service providing potential. The development paradigm for a city on the banks of a river needs a different way of use of river and respect for its functionality.

10.2 Objectives

The issues and / or objectives expected to be addressed through the application of these directives are as follows:

- Environmental aspects of urbanization - Increase in pollution loads in the River
- Prevention of risks due to flooding
- Appropriate zoning of land-use and other development activities within and in proximity of the floodplain
- Prevention of aquifer contamination
- Make river a system which sustains humans and other ecosystems.

The Outcome is expected to be a tool to assist in formulating advice to planning authorities on development rules or future vision of the city.

10.3 Flood Plain Management and Planning

Defining the "Floodplain" and related terms

The floodway is the channel of a river or stream and the overbank areas that must remain open to carry the deeper, faster moving water during a flood. No development is permissible in the Floodway zone.

The floodway fringe is the adjoining area which also has the probability of inundation in case of heavy rains. It could have restricted land-use permissibility and development based along flood protection guidelines such as not to obstruct flood flows.

An "encroachment" is any floodplain development that could obstruct flood flows, such as fill, a bridge, or a building.

The floodway and the flood fringe together comprise the 100 year floodplain.

"A **floodplain** or **flood plain** is an area of land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and experiences flooding during periods of high discharge." It is the area of low-lying ground adjacent to a river, formed mainly of river sediments and susceptible to inundation by the 100year flood as indicated in **Figure 10.1**.

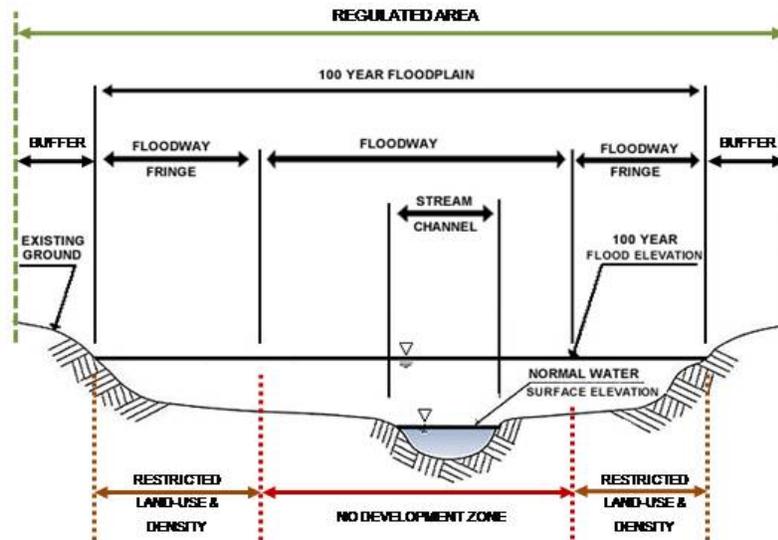


Figure 10.1: Defining Flood Plain and Related Terms

The Floodplain inclusive of the ecological buffer to the development beyond must be the **Administratively Regulated area** with stringent development guidelines and monitoring thereof. (Figure 10.2).

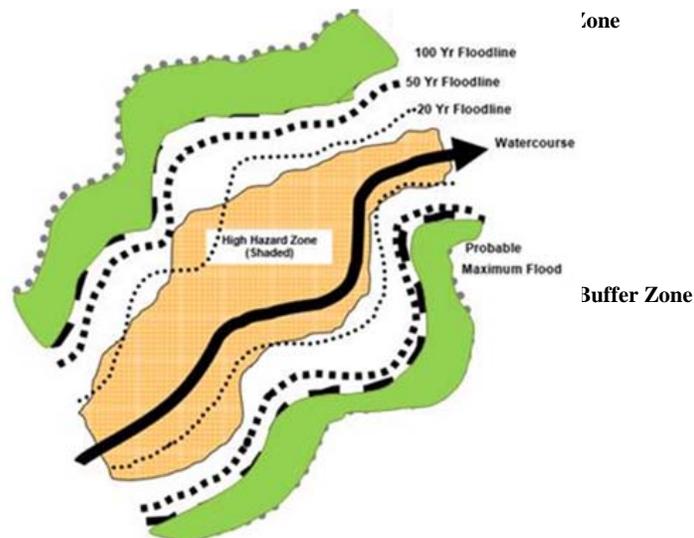


Figure 10.2: Floodplain Depicting Watercourse and Significant Flood lines

The floodplain as delineated on GIS maps and as illustrated in the figure above, is not a symmetrical area around River but would follow the site features. Therefore, the proposed development needs to be assessed at site to ensure there would be no encroachment. The relationship between recurrence interval and probability of area under inundation, though not

accurate is estimable. In addition to the 100 yr floodplain delineation, 10yr, 20 yr...50yr flood lines are mapped to enable assessment of degree of hazard the development may be prone to. The **Table 10.1** below is an example of the relationship between flooding area and return period. The maximum flood line of Godavari river is shown in **Annexure 24**.

Table 10.1 : Chance of Flood Over a Period of Years

Time Period	Flood Size			
	10-yr	25-yr	50- yr	100- yr
1 yr	10%	4%	2%	1%
10yr	65%	34%	18%	10%
20yr	88%	56%	33%	18%
30yr	96%	71%	45%	26%
50yr	99%	87%	64%	39%

10.4 Planning Guidelines & Development Controls

The ecological based planning guidelines and development controls vary for each of the above mentioned zones.

10.4.1 Ecologically Defined Stream Channel (at normal water surface elevation)

Natural systems such as streams have been formed and have evolved over thousands of years in direct relationship to the surrounding topography, soil type and vegetation cover. Focus should be to conserve this through minimizing human intervention.

General Prohibitions

- Impeding or diverting the flow of water in a watercourse
- Modification to the flood line
- Altering the bed, banks, course or characteristics of a watercourse
- Ground water Abstraction
- Construction of a dam in a free-flowing stream
- Storing water
- Using water for recreational purposes harming ecology
- No concrete channelling of the Rivers is permissible
- Intensive Agricultural cultivation in close proximity to the River bed

Permissible Restorative Activities and Recommended Approach

Pollution abatement : Point source pollution through storm water drains need to be periodically monitored for both solid waste and water quality

Maintenance access ways: Stretches of the River adjoining densely developed urban area need to be provided with 10mt wide maintenance access way to regularly dredge and clean the River bed. It is to be designed with a permeable ground cover as also any other pathways planned.

Erosion control: Stream channel embankment, where prone to erosion ought to be strengthened using eco-engineering techniques or vegetative methods

In channel biodiversity enhancement: Stretches of the river biodiversity corridor is fragmented, it is to be restored to maintain the ecological continuity of the River.

In stream water quality management: This is to be achieved only through low impact methods like eco-restructuring to facilitate aeration, plantation management through select species and any such natural methods such as creation of artificial constructed wetland for enhancing the ecosystem services. It may be noted that introduction of indigenous and native species is only permitted.

10.4.2 100 Year Floodway or "No-Development" Zone

The floodway, is subject to high variability of impacts due to climate change. Left natural, it serves as an extended drainage area protecting from risks due to flooding. Development, in form of built structures or any kind of impermeable cover like concretization in the form of roads or pathways is not permissible within the 100year floodway boundary.

General Prohibitions for this Zone

- Extensive vegetation clearing and levelling of the River bed
- Extensive landscaping
- No earthworks should be allowed within the buffer zone of any development
- Land reclamation
- No backfilling should be allowed in the 1:50 year flood line
- No development should be allowed in the 1:50 year flood line
- Interceptor sewers as it leads to high pollution potential.

Permissible Development and Activities

Maintaining ecological integrity of this area is the main goal for developmental planning groups of city or region. Minimum width of around 10mts along the edge of the River must be developed as ecological buffers like a Riparian Edge which would assist in restoring the aquatic and geo-morphological processes (**Figure 10.3**). This would provide continuous corridors and habitat for flora and fauna. Buffer is expected to provide other benefits such as water quality improvement of point or diffuse sources of pollution, stream bank and erosion protection from the hydrological impacts. This would additionally provide socio-economic benefits in the form



Figure 10.3 Ecological Buffers Zones like a Riparian Edge

of opportunities for environmental education / awareness. The visual enhancement of waterway would increase the property values of adjoining development. Pedestrian pathways planned herein for maintenance access may be created out of natural or biodegradable materials ensuring that they are largely permeable.

10.4.3 100 Year Flood Fringe Area

Land adjacent to streams is usually sought after by developers for high-density developments or business developments. In order to gain more valuable land for development it is common practice to modify the floodplain by filling it up, thereby either creating artificially steep stream banks of highly erodible material or finally converting the natural stream into a drainage channel.

Prohibitions

- The Flood fringe area should not be modified to increase the development area
- No backfilling should be allowed in the Flood fringe area and/or 1:50- year flood line.
- No concrete channelling of rivers should be permitted merely to accommodate a development proposal
- Increased property rights of existing owners to the remaining area that could be developed should be investigated
- Engineering efforts to reduce flooding - such as levees, concrete channels, damming and piping should not be allowed
- High rise, high density residential development or commercial or industrial development is not to be permitted
- Multiple ownership for land resulting in plot sub-divisioning is to be avoided
- Urban Agriculture plots, the use of pesticides is to be banned in this region.

Recommended Development Approach

1. 0mt to 10mts from the flood fringe line: The land may be developed for Urban agriculture; Urban forestry; soft landscaped public garden and the likes (**Figure 10.4**).



Figure 10.4 Use of Land Along the River for Urban Agriculture, Public

2. Cycling tracks & pedestrian pathways as access ways must be permeable allowing water infiltration for ground aquifer re-charge.
3. Identified groundwater recharge zones should preferably not be developed, or be appropriately developed to allow for the infiltration of water
4. Any natural steep slope susceptible to landslide must be form stabilized or terraced using eco-engineering techniques. Concretizing is not to be allowed.
5. Areas with potential subsidence due to undermining or reworked ground must be avoided for siting the structures
6. The most suitable terrain conditions for urban development is surface gradient with slope less than 12 degrees. This can be developed with less effect on erosion. Areas with a high erosion potential should be developed at lower densities, with more permeable surfaces.
7. A plotted development would be permissible, no hard division of land with compound walls would be permissible
8. The layout plan should make provision for an appropriate level of on - site sanitation treatment system
9. Single houses and low density residential development may be permitted provided the development impact is estimated not to increase the water level more than 1 fit 300mm above the base flood elevation level. The impact assessment is to take into account the cumulative impact of both the built structures as well as roads and/or any even other landscaped impermeable ground cover like paving.
10. Buildings must be located above the appropriate flood level on the upper extremities of the property and must front or provide views onto the watercourse to ensure adequate visual surveillance and integration of the system into the fabric of the development and the City as a whole **(Figure 10.5)**.
11. Where maintenance access is required for the River front, this must also be incorporated in the Sale Contract of the Owner.

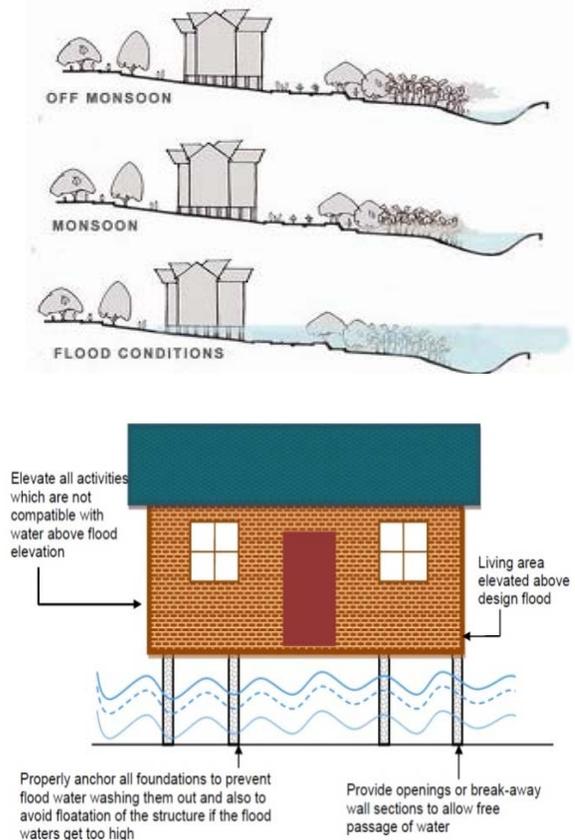


Figure 10.5 : Structures Allowing Free Water Flow from Below

12. All built structures if unavoidable must be on stilts allowing free flow of water below and around the structures. The structures should be designed along the Flood protection guidelines.
13. Perimeter fencing & landscape features must be visually permeable from ground level allowing the free flow of water and movement of aquatic fauna in flood events (e.g. Storm water drainage; fish ladder & palisade fencing) (**Figure 10.6**).



Figure 10.6 : Perimeter Fencing and Landscape Features Allowing Free Flow of Water

14. For Floodplains with base flood elevations being provided, but no defined floodway: When the flood hazard map designates base flood elevations (100-year flood heights) but no floodway is delineated, the cumulative effect of the proposed development, when combined with all other existing and anticipated floodplain development, must demonstrate it would not increase the water surface elevation of the 100-year flood more than one foot (300mm) at any location.

10.4.4 Development Beyond the 100 Year River Floodplain

Prevention of Ground Water Aquifer Pollution

The following activities can pollute the groundwater and special precautionary measures should be taken with regard to their location:

- landfills discharge leachate that may contain organic compounds (residential garbage) or trace elements like zinc, chromium and lead (industrial landfills);
- some urban storm water runoff infiltrates the water table and contaminates the groundwater;
- spills and leakages of petroleum products (petrol and diesel storage tanks) are known sources of groundwater and soil pollution;

Treated City sewer soak away drain fields may be located at a minimum distance 10 mts to 15 mts from the floodplain (**Figure 10.7**).

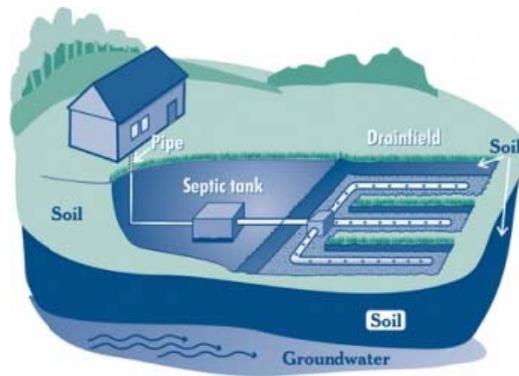


Figure 10.7 : Layout of Treated City Sewer Network

Temporary Septic Tank; treated intermittent sewer manhole location may be permitted at a minimum distance of 10mts from the flood fringe line as delineated on the Flood Hazard Map of the area (**Figure 10.8**).

Nashik Municipal Corporation should upgrade and maintain all the septic tanks and only overflows should go to the sewer system.

IIT Bombay design of upgraded septic tank called PSRT should be used for the whole catchment area of Godavari river basin in Nashik region.

Whereas, for **conventional wastewater treatment plant** a buffer of 30mts is to be maintained from the flood fringe line or a 10year recurrent flood line.

Ground water extraction: Bore wells and wells ought to be planned at minimum separation distance of 200mts from River edge

Liquid effluent discharge is to be located 50mts away from wells & bore wells supplying water for domestic use and 500mts away from the flood fringe line.

Solid and animal waste landfill sites are to be located beyond 500mts of flood fringe line.

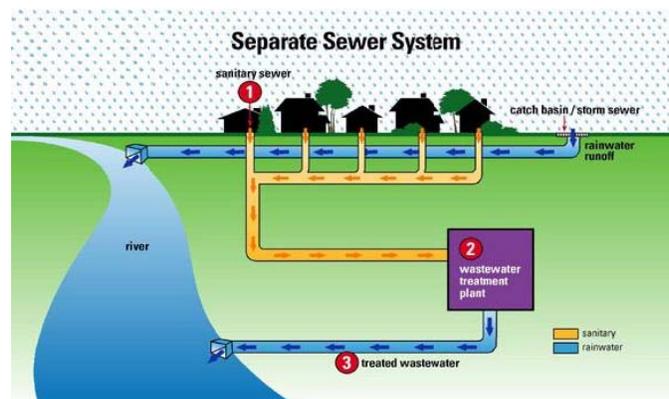


Figure 10.8 : Separate Sewer and Storm

Roads and parking lots be provided with bioswales and rain gardens

Combined sewer + storm water systems with poor construction and maintenance of sewers result in storm water runoff infiltrating the System during rain events. This overloads the System, with resultant overflow of sewerage effluent onto the land surface and potential “flooding” of the wastewater treatment works by excessive inflow.

It is recommended that there must be separate storm water and sewer line, however there is a need to study the whole storm and sewer network integration through proper simulation and modelling for future development.

Treated Wastewater Discharge Into River

3D Modelling carried out for determining the average velocity of river flow across the stream section shows that velocity of flow is highest at top. Hence, the outfall line of discharge be above surface water level thus avoiding stagnation of pollutants in the stream stretch. Disposal line should not be near the bank of river.

Groundwater Aquifer Recharge

It is recommended that contemporary approach towards Water Sensitive Urban Design be adopted for all development beyond floodplain level. This would hugely decrease loads on the floodplains and the River inturn.

Recommended Land-uses, Setbacks and Separation Distances

Setback distances are provided from water bodies (both above and below ground) to prevent pollution

Buffer distances for waste landfill operations are provided to prevent problems of litter, water pollution

Buffers or separation distances are not an alternative to source control and cleaner production methods. They are a means of reducing the effects of residual emissions

The distances quoted in the document should not be adopted as absolute criteria, but rather as indicative distances which may be adjusted having regard to specific site circumstances.

NMC should form a committee to define the control regulations for the Nashik region which shall help in overall preservation of the whole region.