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- 1. Cities have adopted the return periods for design of urban drainage systems based on the 1993 edition of the CPHEEO Manual on Sewerage.
- 2. According to this manual, the recommended values of flood frequency are:
 - a. For residential areas:
 - i. Peripheral areas: Twice a year (The implication is that we are designing to allow our peripheral areas to flood twice a year!)
 - ii. Central and comparatively high priced areas: Once a year (The implication is that we are designing to allow our central and high priced area to flood once a year!)
 - iii. Commercial and high priced areas: Once in two years (The implication is that we are designing to allow our commercial and high priced area to flood once every two years!)
- 3. Are we therefore prepared to <u>accept</u> the above recurrences of flooding in the future considering the fact that a large number of people will affected? It is clear that the above design parameters are very low and would lead to inundation every year!
- 4. The HPC report on urban infrastructure and services (Sep 2011) has projected India's urban population to increase from 377 m. in 2011 to 600 m. by 2031. The HPC has projected the New Improved JNNURM (NIJNNURM) of duration 20 years in which smaller cities and towns to be treated differently from large cities and metros.
- 5. If our future cities have to compete with other Asian cities like Kuala Lampur and Hong Kong, we should provide similar levels of protection against floods.
- 6. In recent years the amount of rainfall has increased due to urban heat island effect and other climatic factors and therefore higher return periods based on current international practices should be considered. The IPCC (Inter-Governmental Panel on Climate Change) has identified that we can expect increased frequencies of high rainfall intensities in shorter periods of high precipitation in the future. <u>For climate change effects</u>, the current guidance in the UK is to make an allowance of <u>an increase of 20%</u> in peak flows or volumes over the next 50 years (DEFRA and EA, 2003).
- Other developing countries like Malaysia which receives rainfall similar to India are now following higher return periods (1 in 5 year for residential-medium density and 1 in 10 year for residential-high density) for urban drainage design.
- 8. <u>It is therefore recommended that we should adopt at least 1 in 5 year return period</u> for residential-medium density and 1 in 10 year for residential-high density for future <u>drainage designs in India.</u>

The return periods adopted by various manuals/codes on urban drainage in Hong Kong, Europe, Malaysia, and Brazil are also summarized in Table 1.

Return periods (1 in N year)	European code (March 2008)		Brazil (2005) (Developin g with high pop density)	Malaysia (2007) (Develop -ping with high pop density)	Hong Kong (2003)	Singapore (Dec 2011)	Queen- sland (Austra lia) (2007)	Osaka, Japan
MICRO-DRAINAGE	Rational method	Advance d models			1 in 50			
Rural/open spaces/parks/agricultu ral lands	1 in 1	1 in 10		1 in 1			1 in 1	
Residential	1in 2	1 in 20	1 in 2					
Residential-low density				1 in 2				
Residential-medium density				1 in 5			1 in 2	
Residential-high density				1 in 10			1 in 10	
City centres/commercial/ industrial	1 in 5	1 in 30	1 in 5				1 in 10	
Underground								
railway/subway	1 in 10	1 in 50	 		 			
MACRO-DRAINAGE			1 in 10		1 in 200			
Flood risk zoning in flood prone areas			1 in 100					
Major system				upto 1 in 100			1 in 50 or 1 in 100	1 in 10
Catchment of less than 100 ha						1 in 10		
Catchment of 100 to 1000 ha						1 in 25		
Catchment of more than 1000 ha or critical installations						1 in 50 to 1 in 100		

Table 1: Return	periods adopted	by various	manuals/codes or	n urban	drainage in	different countries
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