

Title :**Integration of Surface Hydrology in the Spatial planning process.**

With Mumbai and Lonavla-Khandala region as case studies

Abstract:

Lakes and rivers as a part of natural water systems do occupy certain kinds of spaces varying in forms shapes and depths depending upon the physiography of the regions. Ecosensitive spaces along these water bodies including their catchments and river basins do exist but these boundaries get disturbed as they are not delineated in the urban planning process. The paper investigates into these aspects of urban hydrology and surface drainage patterns for two regions namely Mumbai region and Lonavla Khandala region. The paper is a part of the extensive research carried out for the Mumbai Metropolitan Region Environment Improvement Society (MMR Environment Society) and the Lonavla Municipal Council (LMC) which involved the use of Satellite images, Geographical Information System (GIS), available environmental data etc. to develop an understanding of not only the Surface hydrological issues but the entire Ecological, Hydrogeological, Social aspects and also the Urbanisation along the lakes and river edges and the impacts of the heavy downpour in these regions.

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Introduction :

Since ancient times, nomadic man's choice to settle down at a particular location has been linked with the availability of water or vice versa. But as the technological advancements gained momentum so did man's dependency on it. A system of harnessing, purifying and supplying water was put in place and its charge was shifted from individuals to government agencies. Large dams, purification plants were set up for this purpose. And the consequences of these developments resulted in reducing the significance of these natural water resources. Wells and lakes were filled up or abandoned and rivers became mere carriers of sewage out of the city. Mithi River in the Mumbai and the Indrayani river in Lonavla, like most of our rivers, exemplifies this scenario.

As development progresses in an urban environment the impervious areas increase with the direct consequence of higher runoff rates and volumes and shorter times of concentration. Indeed, the impervious surfaces rapidly contribute runoff to the receiving water bodies. Traditional storm water management in urban areas aims at removing runoff as quickly as possible, eventually gathering excess runoff in channelized drains and further disposed into rivers or the sea like in the case of Mumbai.

The focus of this paper is to examine the water land relationships for spatial planning in theory and practice to emphasize the need for integrating spatial planning and surface hydrological issues in the rapidly urbanizing regions. The paper reviews how urban growth critically endangers its own survival, through a survey of the condition of the Mithi river and lakes in the Mumbai Metropolitan Region and the Indrayani River and lakes of Lonavla

Mumbai city

Today the rapid and haphazard trend of urbanisation in Mumbai and its suburbs has extended relentlessly beyond its administrative boundaries. This explosive growth of urban areas has brought about fundamental changes, not only to the physical landscape, but also to people's perceptions of land and environment. Consequently, unsustainable pressures are placed not only on the environmentally sensitive landscapes but also to the basic natural processes that have contributed to the physical form of the city. The recent downpour and consequent flooding on 26th July 2005 has brought many environmental issues to the forefront. It was then that the city woke to the fact that the Mithi River ,and also the northern rivers of the city have a crucial environmental role to play in mitigating natural disasters. Not only is the city's infrastructure under question but its governance also come under the scanner. The catastrophic damage to the life and property during the deluge in the city are clear indicators of how haphazard development with no regard to the natural processes has affected the negatively.

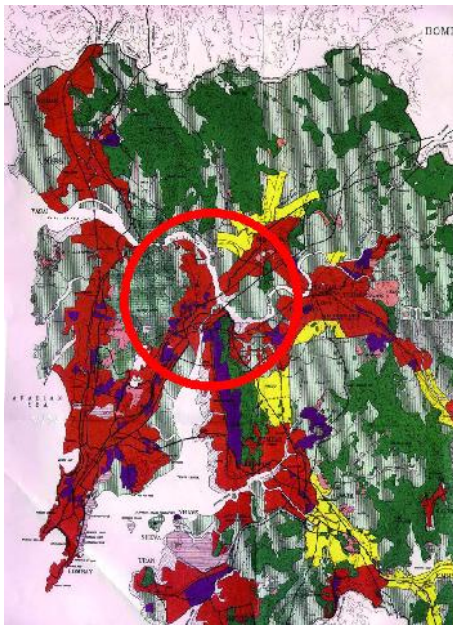


Figure 1. Location map of Thane and the Regional Development plan of Mumbai Region
Source: MMRDA

The only largest green zone of the city consisting of the Sanjay Gandhi National Park, Aarey Milk Colony, Film City with the three lakes Tulsi, Vihar and Powai where the main sources of the four major rivers Mithi, Ohiwara, Poisar and the Dahisar river are located, lies sandwiched in between the two traffic corridors almost choking the rivers at their origins. The role of rivers as natural carriers and river basins the mangroves as natural barriers was realized. The entire surface drainage system collapsed during the heavy floods of the year 2005. It was then that the importance of the need to manage storm water through these natural systems was realized . Being an island city the impact of the heavy showers within a short span during the high tides was all the more disastrous and hence the need for major disaster management and flood control and implementing the BRIMSTOWARD report (Brihan Mumbai Storm Water Drainage)for Mumbai region was felt urgently .

The lakes and the rivers of the city have never been considered as natural systems in the planning process of the City. Even the sanctioned Development plan of Mumbai city (sanctioned DP 1989) does not clearly demarcate the natural systems along with catchments their watershed

characteristics nor do the the Development Control Guidelines specify any regulations for such ecosensitive zones. Resulting in very complex issues of ownership patterns and the role of implementing authorities.

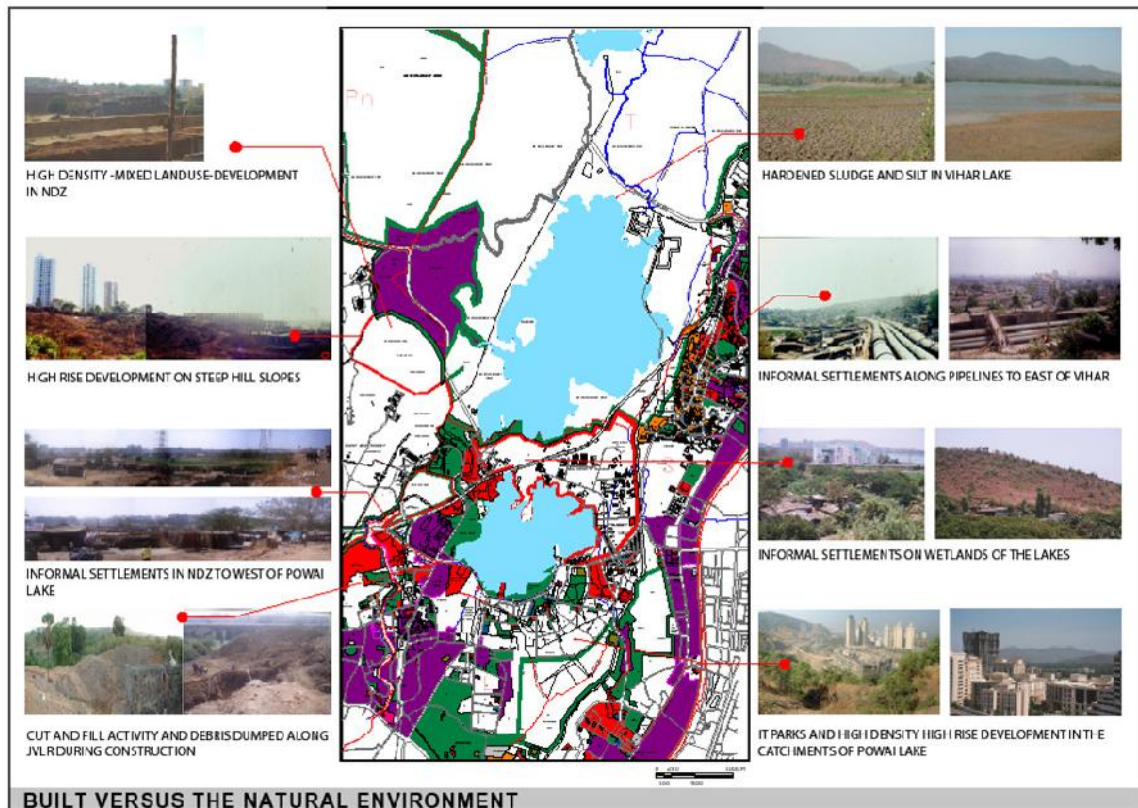


Figure 2. Development and Planning issues of the major lake region of the city.
Source: MMR Environmental Society

Lonavla Khandala Region

Lonavla and the adjacent Khandala are twin hill stations, located 622 m. above sea level, in the Sahyadri ranges of the northern Western Ghats of Maharashtra that demarcate the Deccan Plateau and the Konkan coast. These hill stations are listed amongst the important global biodiversity hot spots and are interesting regions for observing avifauna and flora of Maharashtra including several endemic species. The hill stations sprawl over an approximate area of 38 km². They are located midway between Mumbai and Pune, the two big cities of Maharashtra State and are an easy getaway place for the busy urban population of the two cities.

The undulating topography add aesthetics to the landscape and also support a rich and varied type of ecosystem. Some of the most frequented places of interest for the tourist during their stay in Lonavla are Rajmachi Point, Monkey Point, Sunset Point, Lions Point, Rye Wood Park, Lonavla Lake, Bushi Dam, Kuhne, Walwan Dam, Lohgad Fort, Tungarli Lake, etc. It is this physiography of the twin towns that has



Figure 3. Lonavla Terrain
Source: Grassroots and Lonavla Municipal Council

made them unique in all environmental aspects like the biodiversity of the region, the rock types of the hill stations, heavy precipitation during the monsoons etc. At the same time the towns have not escaped the pressures of urbanisation in the surrounding metros. They have borne the brunt of all the infrastructural needs for this development and now the effects are seen and felt more acutely. The wild life habitats in this once pristine locality are currently under immense pressure from human encroachments and urbanisation activities

It is surprising to see that a town with such high intensity rainfall and topographically on a difficult altitude for development has shown absolutely no regard to the natural drainage pattern of the region. The rapid development in the twin towns completely lacks comprehensive strategies for the conservation of the precious environment. The complete lack of environmental planning, water logging and extensive damage during heavy rains, the inability of the local authorities to handle the solid waste and traffic congestion generated due to heavy influx of tourists on weekends has generated a lot of discomfort and dissent amongst the residents of Lonavla.



Figure 4. Satellite Image of Lonavla
Source : Grassroots and Lonavla Municipal Council

The details of the physiography of the region including the entire landform analysis of the region have revealed very peculiar watershed characteristics for Lonavla Khandala town. The basaltic rock type of the region with its extensive steep zones have led to sharp escarpments along the valleys. Due to these peculiar physiographic features the drainage pattern in the Khandala town area is completely different from the drainage pattern in Lonavla town area. In addition to this, the topography/ watershed of Lonavla Khandala region has given rise to five significant rivers namely -Ulhas River, Indrayani River, Patalganga River, Amba River and, Uttara River. Besides these more important lakes there are many locally important tanks used mainly for

drinking purposes. The Lonavla Lake, Tungarli lake and the Valvan lake lie within the LMC boundary where as the Valvan sarovar, Pauna dam and the Shirawata Sarovar lie outside the administrative boundary of LMC, but are in close proximity to Lonavla.

Urbanisation, deforestation, haphazard development and lack of knowledge have stressed this wonderful, valuable and environmentally rich hot spot. As is the case with major developing cities, there are issues of depleting resources and neglect of the water bodies within its boundary, especially the lakes and rivers. An urgent need is felt to address these issues and take immediate action for their revival.

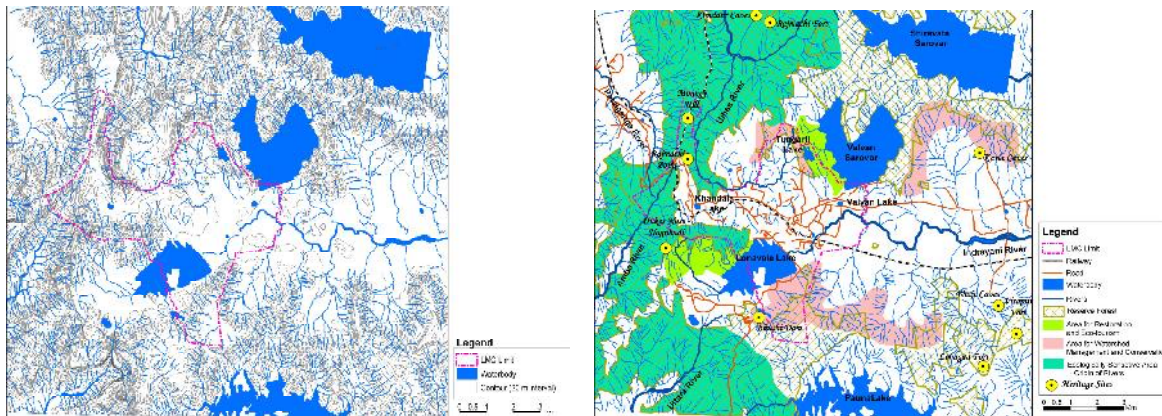


Figure 5.6. Analytical Maps of Lonavala region showing Drainage, Ecology and Forests
Source: Grassroots and Lonavla Municipal Council

The Khandala town area falls under the steeper Ulhas river basin. The steep landform and slopes being more than 50% in most of the areas, the rainfall runoff is extremely heavy giving rise to several waterfalls during the rains. Hence despite of very heavy rains Khandala town does not have any major problems due to water accumulation. Lonavla town being on a comparatively gradual sloping zone with most of the town area falls under the Indrayani river basin. This river basin is also incidentally the most dense in terms of development. As a result this region has suffered the most during the heavy downpours in monsoons. Each river system has its own flood prone low lying areas. These areas have important role in the ecosystem of the river. Discharge of heavy siltation, recharging of ground water are some of the ecological benefits of such river basins.

Indrayani river basin has many such developments in low lying areas. Banks are filled up, debris is thrown into the basin at many places, water hyacinth has filled the water way etc. All these issues collectively aggravate water flooding of the region. Tree cover which acts a buffer for absorption and percolation, is also very less. All major water flooding sites like Badrivishal, Kavayliadham, HUDCO colony, Bangargaon etc fall under this watershed. The smaller nallas which are evident only during the monsoons have been either built over or diverted by private developers. The low lying areas are hence more susceptible to water logging. The storm water drainage system or the road network for the town is not fully developed in all the areas and particularly in the river basin zone. This has also led to severe problems.

At the same time speedy runoff of water through constructed drains will be detrimental to the micro climate of the region. Hence it is all the important to ascertain and assess possibilities of soil moisture conservation and identification of areas for potential rain water permeability. Soil erosion control measures in the high hill ranges is urgently required to save the precious top soil as well as conserve the water table of the region. This in turn will revive the cooler climatic condition of the towns. In such cases the open spaces in the river basin will have maximum potential to retain water in the form of holding ponds /surface reservoirs etc as buffer zones during heavy monsoons. Within the low lying areas of the town there are a couple of water bodies which can be conserved and rejuvenated. These water bodies have turned into marshy dumping grounds. These water ponds can serve as holding ponds during the heavy rains provided the inflow and overflow channels for these water bodies are well designed.

The Tungarli hill region due to its scenic beauty and location is fast developing into exclusive weekend cottages. But ironically as per the ecological and hydrological analysis, the spatial maps illustrate the magnitude of damage if not planned with efficient environmental guidelines for such steep watersheds

that are the most critical and sensitive areas. Development is imperative, but development sensitive to the environment is essential. This is possible through efficient and urgent environmental and infrastructure management with informed peoples participation, political will and efficient administration.

The Thane city within Mumbai region

Thane historically known as the city of lakes has several lakes in existence earlier than 1881 and each one of them has a significant cultural and social significance associated with it. The total landscape of the region is unique because of its close proximity to the creek, river and the high altitude ranges with many natural and manmade water bodies. Surface depressions were used as a source of water conservation by the ancient civilizations, in the absence of nearby river course. These lakes also provided an intermediate storage in minimizing the surface runoff and floods. Malgajari tanks, Talavs and Lakes were constructed and maintained by the kings and jahagirdhars in Maharashtra. However, over a period of time due development has slowly crept up to the banks of these lakes thereby converting the once sprawling water bodies in to mere water tanks which are prone to degradation through development pressure, eutrophication and solid waste disposal. Though there has been immense economic growth little efforts were made to conserve the rich and natural resources of the region. On the contrary all the urban expansions and rampant construction activity in the region during the past two decades have had a negative impact on water systems as the site developments have ignored the local environmental and hydrological considerations. Heavy flooding in low lying areas of the cities as well in areas where the natural drainages have been either diverted or built over is a common occurrence during the heavy monsoons.

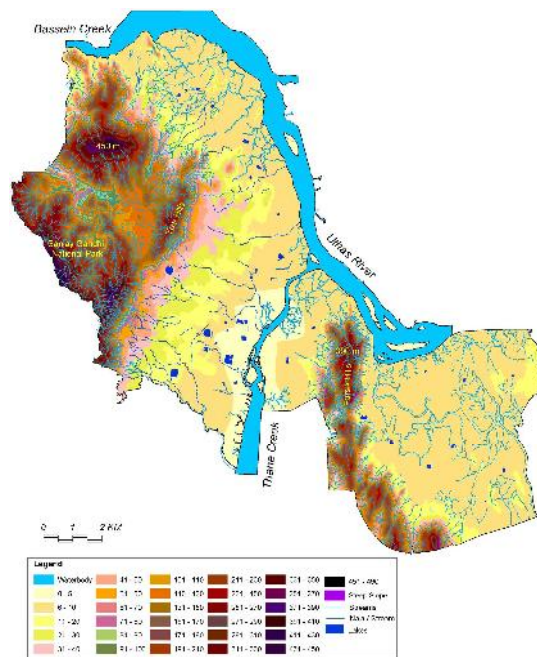


Figure 7. Ecological base map generated for Thane Region

Land use studies with respect to the built form, density, opens space structure and activity patterns clearly indicate an incongruous pattern completely oblivious to the environmental aspects of the catchments of the lakes. For instance a closer look at the major traffic and transportation routes within the city show how they have virtually cut across the natural drainage pattern of the region and in the process completely hampered the natural supply and the overflow systems of most of the lakes. The open space structure plan of the city also shows no connecting corridors for the natural ecosystems nor does it have any significant buffers along the major streams or in the lake vicinity. The major streams of the region are today dead concrete nallas trained haphazardly through the developments. The storm water drainage system has replaced the vibrant biologically active surface drainage ways which have

become collectors and accumulators of a number of deleterious or polluting materials including oils and

greases, toxic metals, and sediment, that are quickly transported through the system and discharged to the receiving water way without any detention and retention basins. The new developments towards the north of the city core depends heavily on bore wells and ground water for domestic, industrial and commercial use, as well as for all new construction activities. There has been an attempt in recent times by the Thane Municipal Corporation to revive the dying lakes through an elaborate study of the lake region 'Ecologically Integrated Lake Management Plan' which would take into consideration the natural and human ecology of the surrounding areas, explore and establish the linkages of the lakes and the natural drainage patterns in the larger context with the surrounding areas in an attempt to integrate the environmental aspects in the spatial planning process and development of the lakefronts.

In Conclusion:

All the above case studies the impacts of watershed urbanization have been detrimental. The imbalance between the natural systems and urban development have resulted in catastrophic damage to life and property. During the recent past all these cities have experienced heavy downpours in short spans resulting in immediate flooding and water logging in urban centres. The environmental and economic costs suffered by society at large are never accounted for in the developmental graph and hence public awareness about such a loss is lacking. Conventional surface drainage systems and engineered hydrologic controls are ineffective in mitigating development influences. Development of this kind has increased stormwater runoff, accelerated erosion, sedimentation, degraded water supplies, and caused severe disturbance of aquatic systems. Storm water drainage systems are only a tool in mitigating adverse watershed impacts. They are not a solution. Replacement of existing naturally vegetated areas with impervious and semi-impervious surfaces increases stormwater runoff and adversely impacts watersheds. Preservation of natural water bodies like lakes, ponds, river basins and vegetated areas can be considered as "Ecological stormwater management" tools providing climatic, environmental benefits and amenities for urban areas that can effectively reduce cumulative watershed function deterioration.
