HARIYALI
हरियाली
राष्ट्रस्य अलङ्कारः वनम्

5/702, Flower Valley,
Eastern Express Highway, Thane - 400 601.
5/702, फ्लावर व्हॅली,
ईस्टर्न एक्सप्रेस हायवे, ठाणे - 400 601.
Admn. Off.: 26, Dadoji Konddeo Stadium,
Khartan Road, Thane - 400 601.

Mobile : 93232-91890 Telefax : 022-25474119, 022-25408661 E-mail : punamsingavi@vsnl.com Web : hariyalithane.com

# PROJECT REPORT
# ON
# REPETITIVE WATER LOGGING
# IN THANE CITY
# ENGINEERING SOLUTIONS
# AND
# ENVIRONMENTAL MANAGEMENT PLAN

(SPONSORED BY THE MMR ENVIRONMENT IMPROVEMENT SOCIETY)

## (FINAL REPORT)

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# CHAPTER 1
# PREAMBLE

## 1.1 NEVER BEFORE SITUATION

The deluge of July 2005 in Mumbai, Thane and surrounding area created an unprecedented situation resulting in heavy losses of lives, property, infrastructure and services and severe environmental damages. This prompted HARIYALI an NGO, dedicated to environmental protection and up-gradation, to undertake a survey of public perceptions about nature, causes and effects of deluge in Thane and about preventive measures that could be taken to minimize losses, if such a situation recurs in future (Ann-I – P.60 to 85). Hariyali believed that public participation in such projects will yield maximum results. Hence Hariyali involved over 600 NSS students of various colleges in and around Thane to interview over 8200 families in Thane Municipal Corporation (TMC) area, using objective questionnaire specially prepared for the purpose. An Experts Committee, including technocrats, economists and social leaders, was formed to provide guidance in the study and to scrutinize and analyse the data compiled from the response sheets received (Ann-I - P.12) Shri K.D.Lala, City Engineer, TMC, kindly agreed to be a Member on the Committee (Ann-I - P.6) Meanwhile, Hariyali submitted a proposal to MMREIS in November 2005 seeking financial assistance. The Sub-Committee of MMREIS suggested to modify the proposal.

## 1.2 SUGGESTIONS BY MMREIS

While appreciating the efforts of Hariyali, the MMREIS made following suggestions:-

**a]** 'Deluge' being rare phenomenon, "Hariyali" should attempt to prepare a project report on repetitive water logging during last 20 years in Thane city.

**b]** While approach of "Hariyali" in eliciting public participation in the project on deluge in Thane is commendable, what is most required is engineering solutions (E.S.) for preventing repetitive water logging and minimizing losses. Hariyali should also prepare an Environmental Management Plan (EMP) for mitigating the impact of repetitive water logging.

**c]** As the implementing agency will be TMC, it is necessary that the TMC should be actively associated with the Project work. TMC engineers should also be involved in the collection of information and preparation of the report.

As per the above suggestions a modified proposal was submitted to MMREIS by end of November, 2005.

## 1.3 OBJECTIVES OF THE PROJECT

a] To identify causes and locations of repetitive water logging in Thane City in the last about 20 years.

b] To undertake study of flood prone areas and to assess impact of water logging.

c] To recommend Engineering Solutions for preventing water logging in Thane City.

d] To prepare environmental management plan for Thane City with reference to water logging.

## 1.4 METHODS OF OBTAINING DATA

### 1.4.1 Maps

The TMC had two separate maps showing Thane City and Mumbra, Kalawa, Diva area under its jurisdiction. Both the maps were of different scales. Hariyali combined the two maps, made them of same scale and used it as a base map for the study. EICHER maps were used to superimpose on the base map various locations and roads in TMC area. A map of Administrative Zones of TMC has been collected from TMC and reproduced in Annexure III. Similarly TMC had maps showing many (but not all) watercourses. Of these, major Watercourses were marked on the base map as shown in Annexure III (Page 97). The counter map showing watercourses in Thane City proper were available with TMC. Hariyali picked up certain important contours from this map to superimpose on the Base map. The countor maps of Mumbra, Kalwa and Diwa area were, however, not available.

### 1.4.2 Identification of water logging spots

As a pre-requisite to formulate EMP for Thane city, the members of the Experts Committee formed by Hariyali interviewed officers in 19 infrastructure and service providing organizations to know the impact of water logging on their services. The information of locations of repetitive water logging spots was obtained from them. These locations were confirmed during discussions with the ground level engineers of various 'Prabhag' of TMC and also during physical visits to the spots. The

locations of repetitive water logging spots were then marked on the base map.

### 1.4.3 Identification of Obstructions in the watercourses

Some of the major watercourses were visited extensively by the NSS students during preliminary survey and photographs of the same are reproduced in Annexure II. The Members of the Expert Team of Hariyali discussed the causes of water logging with the ground level engineers of TMC and made extensive visits to the watercourses and water logging spots to verify the situation. The table on repetitive water logging spots presented in Chapter 9 is a result of all these efforts.

### 1.4.4 Information regarding Kharland development

The information about Kharland development schemes in Thane City, Kalwa, and Mumbra region was obtained from the Irrigation Department of GOM. The Expert Committee of Hariyali visited the sites before marking the Kharland area on the base map.

### 1.4.5 Estimates of Economic Losses because of Water Logging

These were obtained from the Resource Persons in various infrastructure and service providing organizations interviewed during secondary survey.

## 1.5 SUBMISSION OF INTERIM REPORTS :

Hariyali presented Part I of the Project Report on 19 December 2005 showing the results of the Preliminary Survey of 8200 families & survey of 9 important watercourses, both conducted by NSS students.

Part II of the Project Report presented on 11 September, 2006 comprised various maps of TMC area prepared by Hariyali depicting administrative zones, repetitive water logging spots identified in each zone, 25 major watercourses flowing through TMC area, GTS levels and water bodies like Thane creek and Ulhas creek. EICHER and maps of TMC were used for preparation of the maps showing watercourses and water bodies. The repetitive water logging spots were identified in consultation with TMC engineers and the Resource Persons interviewed (Ann-I - P.13). The Part II report also included assessment of impact of water logging on various organizations and services and matrix for EMP and Engineering Solutions.

## 1.6 FURTHER GUIDENCE OF MMREIS

While Considering Part II of the project Report, the sub-Committee of MMREIS suggested that Hariyali should also identify causes of each location

of repetitive water logging in consultation with the ground level engineers of TMC and after physically visiting the spots, if needed, and to recommend ES and EMP for each such location. Accordingly, the members of the Expert Committee held discussions with the engineers of each "Prabhag" of TMC, made extensive visits to survey major watercourses and submitted Supplementary Report to the Sub-Committee of MMREIS in December, 2006 (Ann-I, P.37 to 59).

## 1.7 HIGHLIGHTS OF INTERIM REPORTS

Highlights of Part I of the Project Report, Part II of the Report and Supplementary Report are given in Annexure I of the accompanying volume.

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# CHAPTER 2
# EXECUTIVE SUMMERY

## 2.1. GENERAL

**2.1.1** The 'Deluge' of 2005 prompted 'Hariyali' to undertake a study of over 8200 families in the area of Thane Municipal Corporation(TMC) to know their perceptions about nature of 'deluge' in their locality, its causes, effects and possible solutions. 'Hariyali' approached MMREIS for funding. The Sub-Committee of MMREIS suggested to study repetitive water logging spots in TMC area and to suggest ES and EMP with particular reference to water logging in Thane City. This became the objective of the Project (Paragraphs 1.1 to 1.7)

**2.1.2** TMC area includes Thane city, Mumbra and Kalawa area. Most of the Watercourses flowing in Thane city are natural watercourses flowing from Yeoor hills/Sanjay Gandhi National Park in the North and West to Thane creek or Ulhas creek in the East. In Kalawa area they flow from Parsik hills to Thane creek and in Mumbra, from Mumbra hills to Ulhas river (3.2,3.4.1).

**2.1.3** There is no underground storm water drainage system but only roadside gutters, open or covered, for collecting local run-off (3.4.1).

**2.1.4** Existing sewerage facility, covering about 40% population, has been overloaded. There are 5 Sewerage Treatment Plants, all overloaded (3.4.3).

**2.1.5** The network of distribution of electricity services, telephone lines and gas pipe lines is underground, many times through watercourses (3.5).

**2.1.6** TMC has presently 35 rainfed lakes ( 3.7.4).

## 2.2. Field Work by Hariyali

**2.2.1** With the help of maps available in TMC and on the basis of 'EICHER', Hariyali, identified 25 major watercourses in TMC area, although the actual no of watercourses are many more. Hariyali prepared a base map of TMC area showing Thane, Kalawa and Mumbra and superimposed therein identified major watercourses, water bodies, GTS levels and water logging spots (1.4).

**2.2.2** Hariyali's Experts Team interviewed 19 resource persons from various infrastructure and service providing organizations to assess the impact of water logging on their services. With the help of these resource persons and the engineers of TMC, 75 water logging spots were

identified in TMC area, of which about 65 are of repetitive nature. Hariyali's team inspected all the spots (1.4 & 4.5).

**2.2.3** Hariyali's Experts Team also visited each of the 25 major watercourses identified and took photographs of the flow of the watercourse.

## 2.3. Observations

**2.3.1** It was observed that a steep gradient available in the initial part of the watercourse (from over 35 m. GTS to about 24 m GTS) gets converted into flatter gradients after the watercourse enters the developed area. While the initial catchment area has high run-off, less time of concentration and less travel time, the catchment area in the latter part of the watercourse has moderate run off, medium time of concentration and more travel time.

The carrying capacity of the watercourses has been considerably reduced during their travel in the developed area due to non-removal of silt including boulders in the watercourse, encroachments within and on the banks of watercourses, dumping of solid wastes, obstruction due to utilities, inadequate cross drainage, incorrect alignment of the watercourses, etc. These were also the common reasons for water logging during high run-off in the monsoon (4.2, 4.3 & 4.4)

**2.3.2** In slum areas, drainage lines are let out into the watercourses. Also overflow connections in the existing sewer lines are many times made into the watercourses (4.6).

**2.3.3** The Integrated Nalla Development Plan prepared by TMC, to be executed in next 3 years, includes review of carrying capacity of all watercourses and taking remedial action, including provision of holding ponds with flap gates (4.7).

**2.3.4** With a view to facilitating analysis of major causes of flooding, the 75 water logging spots have been broadly classified on the basis of their proximity to the creek, to the watercourses or to the forest boundary or on the basis of structures in the vicinity such as slums or normal/high rise buildings (5.3.1).

**2.3.5** Apart from the common reasons indicated above, the water logging occurred at some spots in the vicinity of the creek/s because the development levels are less than the highest high tide level of 1.9 m (GTS) and the area gets affected due to back water surge from the creek into the watercourse (5.3.2.).

**2.3.6** In the vicinity of the forest boundary, the high velocity of the water current brings down boulders and silt during monsoon which gets deposited in the watercourse when it enters flat grounds. The structures in and around the watercourse make it impossible to bring the machinery for de-silting and in many cases, even manual cleaning of the watercourse is extremely difficult (5.3.2.)

**2.3.7** The water logging spots in the vicinity of the watercourses are because of extremely reduced carrying capacity of the watercourse due to encroachments of structures, utilities, solid waste dumping, as also inadequate capacity of railway culverts, skewed alignment, inadequate cross-drainage, etc. The size of railway culverts constructed many years before has not been increased to meet the high co-efficient of run-offs of the increasing population (5.3.2 & 9.17).

**2.3.8** Major reasons for water logging spots in the slum area are structures making it difficult to de-silt the watercourse and solid waste dumping by the people because of absence of solid waste disposal facility (5.3.2 & 9.17).

**2.3.9** In the area of multi-storied buildings and normal structures, there are some water logging spots because the developers have turned the watercourse by 90 degrees or more for his convenience and there are compound walls or concrete paths or parking area on the watercourse making de-silting impossible (5.3.2 & 9.17).

**2.3.10** Some saucer type low lying area such as 'Krantinagar' in the vicinity of creek, face the problem of water logging during heavy rains because there is no outlet for water and there is back water surge during high tide and heavy rains (5.3.2 & 9.17).

**2.3.11** The consultants working for TMC appear to have considered rainfall of 50 mm for one hour while suggesting storm water design systems. However, each catchment area is subjected to various rainfall intensities and duration curve. It is therefore suggested that the TMC may take up a detailed study of rainfall intensity and duration curves in different catchment areas and prepare a master plan for storm water drainage system (6.1 & 6.2).

**2.3.12** There is a scope to design storm water detention facilities by utilizing the bunds constructed by Khar Land Development Division in the Irrigation Department of GOM (6.3).

**2.3.13** The water logging in TMC area affects adversely on various infrastructure and services such as roads, transport, railways, water

supply, electricity supply, telecommunication services, education and health services and on industries. The flooding and water logging also sometimes result in losses of human and bovine life, environmental losses and socio-economic losses (7.1 to 7.6)

## 2.4. Baseline Environmental Status

**2.4.1** The environmental status of water bodies such as lakes and creeks and Ulhas river is not satisfactory. The TMC has now taken up steps to monitor the quality of water in lakes with reference to important indicators. TMC also appears to have mooted a creek conservation program with the help of selected NGOs and professional bodies but it is necessary to study in detail the important hydrological aspects of the water bodies and this would require a joint study by all the corporations and councils bordering Ulhas creek and Ulhas river. They may take help of CWPRS for hydraulic modelling to reassess the assimilative capacities of the adjoining water bodies (8.1).

**2.4.2** The base line status of the solid waste management in Thane city is not up to the mark. In various slum areas, inaccessible for 'Ghantagadi', there is no arrangement for collection of solid waste. Most of the solid waste collected by TMC is dumped on the dumping ground. Inadequate machinery for collection, treatment and disposal of solid waste and lack of knowledge and lack of co-operation of people are the main reasons for this position (8.3).

**2.4.3** Bio-medical waste from big hospitals is presently collected and scientifically disposed off by one NGO, viz., Enviro-vigil. However, there is no provision for collection and disposal of bio-medical waste generated by individuals, private clinics, pathological laboratories, etc (8.3).

**2.4.4** Absence of recognizing khar land as 'no development zone' has resulted into allowing constructions in kharland area. This has affected existence of mangroves (8.4).

**2.4.5** The erosion of soil and boulders create repetitive water logging spots near forest boundaries (8.5 ).

**2.4.6** Uncontrolled development in the creek vicinity with disregard to development levels cause repetitive water logging in the area besides damage to flora and fauna (8.6).

## 2.5. Suggestions for EMP.

**2.5.1** TMC should collect data regarding generation, collection and disposal of bio-medical waste (9.4.3).

**2.5.2** TMC should take steps to improve the efficiency of the sewage treatment plants (9.4).

**2.5.3** The work of de-silting of watercourses is taken up only once before monsoon. The de-silting of watercourses up to the invert level should be done three times, viz., in May, November and February every year (9.2).

**2.5.4** Budgetary provision for storm water drainage should be adequately enhanced (9.2.9).

**2.5.5** A stormwater drain inventory should be maintained and a project for such drainage should be planned and implemented(9.2).

**2.5.6** A programme of shifting utilities in the watercourses should be pursued vigorously (9.2).

**2.5.7** Segregation of solid waste into bio-degradable and recyclable wastes should be enforced at every level and rules be framed for providing penalties (9.3).

**2.5.8** Community awareness and capacity building program for solid waste disposal should be taken up in association with NGO (9.3).

**2.5.9** Adequate bins should be provided and frequency of transportation of containers of solid waste should be increased (9.3).

**2.5.10** Centers should be opened for collection of bio-medical waste from private clinics and public (9.4).

**2.5.11** Data on generation and disposal of bio-medical wastes should be collected (9.4).

**2.5.12** Program should be taken up for stopping leakages from joints of sewerage lines and water supply lines (9.5 and 9.6).

**2.5.13** Sewerage plan for the city and a plan for treatment and disposal of sewerage should be prepared (9.5).

**2.5.14** A cell should be created in Water Dept at Head Office to monitor and rectify leakages in water supply lines (9.6).

**2.5.15** Rusted water supply lines should be replaced/repaired (9.6).

**2.5.16** Capacity building programs should be taken in association with NGOs to control epidemics (9.7).

**2.5.17** Slum dwellers in and around watercourses should be rehabilitated under a project of nalla development or under SRA/SRD, whichever is applicable (9.8).

**2.5.18** TMC should initiate action for setting up a Standing Committee to establish co-ordination with Central Railway for modification and maintenance of six railway culverts (9.9).

**2.5.19** TMC should design formation levels for all roads with due regard to HFL of surrounding water bodies (9.10).

**2.5.20** Rainwater harvesting technique by taking bores in roadside drains should be used to minimize run-offs (9.10).

**2.5.21** Even during monsoon potholes on the roads should be temporarily repaired (9.10).

**2.5.22** TMC should undertake study of possibility of interlinking all lakes for flood assimilation (9.14).

**2.5.23** New development should be 0.6m above HFL and any new development of plot should be not less than 4.9m(GTS) (9.15).

**2.5.24** Any new development between design width of once in 2 years and once in 10 years should be free of structures (9.15).

**2.5.25** Any new development in area with design width of once in 10 years and once in 100 years should be with stilt arrangement (9.15).

**2.5.26** Wet land and mangroves should be protected and a program for plantation of mangroves should be taken up (9.15).

**2.5.27** A plan and map showing minimum level of reclamation should be prepared and enforced (9.15).

**2.5.28** Plantation of trees near the origins of watercourses in the forest land should be taken up to reduce soil erosion (9.16).

**2.5.29** Contour trenches should be provided at appropriate places on the hills to arrest entry of boulders into the watercourses (9.16).

**2.5.30** Also provision of geo-fabrics to stop entry of boulders into the watercourses should be thought of as an alternative and cost thereof should be worked out (9.15).

**2.5.31** Insurance companies may consider evolving 'deluge' risk insurance and TMC may consider subsidizing its premium (9.16)

## 2.6. Engineering Solutions

**2.6.1** Design criteria of rainfall intensity of once in 10 years should be used to improve carrying capacity by training the major watercourses (10.1).

**2.6.2** Pumping stations should be provided in the requisite area for pumping out the run-off (10.1).

**2.6.3** Wherever even manual cleaning is not possible, on-line submersible pumps should be provided for cleaning of watercourses (10.1).

**2.6.4** Every road should have side-drains with sufficient fall and free flow (10.2).

**2.6.5** It should be made mandatory for architects to submit plans for development levels of front roads, locations and levels of watercourses, internal storm water drainage arrangement and plinth levels (10.3).

**2.6.6** Proposed development level of any plot in TMC area should not be less than 4.9m (GTS) (10.3).

**2.6.7** All utilities in the watercourses should be shifted in next 3 years and in case of utilities crossing the road, separate duct should be provided (10.5).

**2.6.8** Detention ponds with non-return flaps should be provided on the banks of Thane and Ulhas creeks, in co-ordination with Kharland Dept of GOM, to absorb unusual run-off (10.6).

**2.6.9** TMC should design and provide a complete sewerage scheme for entire area (10.9).

**2.6.10** Study of hydraulic modeling of Thane and Ulhas creeks may be taken up by all Councils and Corporations by appointing a suitable agency (10.10).

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# CHAPTER 3
# THANE CITY : PRESENT STATUS

## 3.1 HISTORY

The ancient city of Thane, capital of the Shilahara kings of Konkan, was apparently a land grant from Ankisara Devraja, sovereign of the city of Tagara. According to European travelers, it was a well developed port. The Portugese came to the city in 1530 and ruled it for 200 years before it was captured by Marathas in 1739. The city is known for the first railway line in the country (Mumbai to Thane in 1853). In 1863, the first Municipal Council was formed. As a result of growth of population the status of Municipal Corporation was granted to Thane city and surrounding areas in 1982.

## 3.2 TOPOGRAPHY

Thane city is situated at an altitude of 15' to 150' and the latitude of 19' – 10" to 19' – 50" and at the longitude of 72' – 56" to 73' – 50". It is at a distance of 33 km from CST(VT) in Mumbai. The area under jurisdiction of TMC can be broadly categorized as:

**a]** Areas within the limits of the original Thane Municipal Council.

**b]** Areas towards the North, bounded by Sanjay Gandhi National Park, Ulhas river and creek.

**c]** Areas to the East beyond Thane creek merged to form the TMC – Kalwa, Mumbra and Diva.

The city, spread over an area of 127 sq. km, has a large creek front (Thane creek and Ulhas creek) of over 10 km. The general topography of TMC comprises about 50 GTS contours in hilly areas sliding down to 10 GTS contours at Eastern Express Highway. The average invert of the creeks is 2 GTS. The average yearly rainfall for last 10 years is about 2500 mm.

## 3.3 DEMOGRAPHY

As a result of industrialization, urbanization and proximity to Mumbai, the city has witnessed unmanageable immigration of people from all sections of the society and from all over the country. The notable demographic characteristic are :-

**a]** The average annual growth rate over the last 7 decades is approximately 4 %.

**b]** Highly populated area of the city is its central region.

**c]** Literacy rate in the city is 56%. The same is higher in male population than in the female.

The total population of the TMC area was 12.61 lakhs in 2001 and is estimated to grow up to 19.7 lakhs, 26.11 lakhs and 33.66 lakhs by 2011, 2021 and 2031 respectively. About 35% population lives in slums.

## 3.4 INFRASTRUCTURE

### 3.4.1 Storm water drainage system

This infrastructure in Thane city comprises roadside drains emptying into natural watercourses flowing from hilly region towards creek. There is no underground storm water drainage system provided by the Corporation in TMC area. By and large, it can be stated that the TMC has provided roadside open gutters for collecting the local run-off from roads and abutting areas.

### 3.4.2 Water supply

The present water requirement of TMC is 335 MLD which is met from different sources such as MIDC, MJP, BMC and Shahad Temghar Water Authority. Most of the supply is for domestic and commercial purposes and only a small component of 5 MLD is for industries. The piped water supply is made through distribution system with a network of Elevated Service Reservoirs (ESR). Due to complexities of distributed water getting mixed with direct supply, the system gets affected. The TMC has undertaken an augmentation program for rectification. The future demand for water supply has been proposed to be met from dam across river 'Shai' to be developed by TMC as its own scheme.

### 3.4.3 Sewerage

Only 40% population is presently covered with sewerage facility. The existing system was developed by MJP (MWSSB) in two stages. Existing sewer network has been overloaded, blocked at many places, thus resulting in overflow of sewage on roads as well as into Nallas. As regards sewage treatment, five Sewage Treatment Plants (STP) provide the primary treatment to the sewage. The STPs are generally overloaded and also some of the units in the plants are non-functional.

### 3.4.4 Roads, Flyovers, Sub-ways and Railways

The Eastern Express Highway with its flyovers, multi-lanes and service roads symbolizes modern urban infrastructural development. The Ghoadbundar road, the LBS Marg and other link roads connecting Mumbai and Pune are transport hubs. The total length of the roads in Thane city is 280 kms, about 30 km of CC roads and 250 km of Tar

roads. There are in all 760 roads in the city. In addition to State Transport Service, private buses, cars and taxis ease the pressure of transport. Within the Corporation area Thane Municipal Transport, Auto-rickshaws and private cars serve the needs of the growing population. Thane station on the Central Railway is an important station where most of the trains halt on their way to all parts of India. Thane is also a major station for local trains connecting the city to the-suburbs of Mumbai, and townships up to Kasara and Karjat.

## 3.5 SERVICES

### 3.5.1 Electricity Services

Earlier the Maharashtra State Electricity Board and now Maharashtra State Electricity Distribution Company Ltd (MSEDCL) has been providing and supervising supply of electricity to domestic, commercial and industrial consumers in TMC area. The MSEDCL has one Circle Office, 3 Divisional Offices and a number of Sub-offices in Thane to supervise and maintain the distribution net work. The entire net work of distribution of 11 kv electricity power from the Sub-station at Colour-chem, Wagle Estate to the consumers in TMC area is through underground cables. Wherever feasible, the small feeder Sub- stations have been installed by MSEB/MSEDCL in the residential/commercial/industrial complexes to facilitate supply of electricity. The Company has recently taken up some steps to reduce losses in power distribution.

### 3.5.2 Telephones

Mahanagar Telephone Nigam (MTNL) has presently 8 exchanges in TMC area and one more need based exchange is being opened at Pokharan Road No. 2. Almost all the telephone cables are underground. Only in the slum area or in other areas where it is not possible to give connection through underground cables, MTNL has laid overhead cables for telephone lines. Every year before monsoon, MTNL takes up work related to precautionary measures to prevent leakages & to avoid water logging in the telephone exchange area. The new technology of jelly filled cables has been introduced to avoid seepage of water through cables/joints, etc. and over 90% of copper cables have been replaced by jelly filled cables.

### 3.5.3 Gas Lines

Till recently the cooking gas supply to the residents of Thane city was through LPG cylinders. During the year 2006, Mahanagar Gas Nigam Ltd. has installed District Regulating Stations (DRS) in Thane city for distribution of gas through the networks of pipelines. The first DRS was installed near 'Tarangan' on Eastern Express Highway and the Mahanagar Gas Nigam has planned to open 5 more DRS at different locations in Thane city. All the pipelines for gas supply are underground, either through the Nallas, roadside drains or through a separate trench dug for the purpose.

## 3.6 HEALTH SERVICES

There are 20 private hospitals, 565 private dispensaries and 60 maternity homes. TMC operates 5 Municipal hospitals, 20 dispensaries and 2 mobile dispensaries. There are 2 Government hospitals. Many hospitals have advanced facilities. Various health care programs, especially for women and children are conducted by TMC, such as family planning, special care for pregnant women and newly born infants, vaccination drives, etc.

## 3.7 LAND USE PATTERN

### 3.7.1 Non-developed Area

The non–developed areas of TMC comprise 32% forest land, 33% agricultural land, 11% creeks, tanks & Nallas, 11% low-lying and 13% vacant land capable of being developed.

### 3.7.2 Developed Area

As regards developed areas, the distribution is residential 38%, industrial 28%, defense 6%, open spaces 1%, commercial, godowns, office area, etc, 5%, health and education 3%, for railway, S.T. depots etc. 7% and remaining 12% for other purposes. The developed area of the city is about 25sq.km. and non-developed is 103 sq. km. inclusive of marshy land, forest, creeks, tanks and watercourses, agricultural land and vacant land. The residential and industrial areas are 10 sq. km. and 7 sq. km. respectively. Intermingling of 30% of the industrial areas with residential areas causes pollution in the city. The playgrounds, gardens and other open spaces serving as recreational centers occupy only about 1% of the developed area and only 0.16 % of the total city area. As of now, there are 47 gardens, 9 children's parks, 9 open grounds, 3 picnic spots and 12 transport islands in the city. Dadoji Kondeo stadium is a remarkable sign

of the development of the city. Agricultural areas are getting reduced on account of development pressure. From 53% it is now approximately 33% of the total city area. Wetlands, swamps and mangroves occupy about 9% of the city area with the blessed existence of creeks, Ulhas river and various lakes.

### 3.7.3 Forest Areas

Of the 32% forest land, 40% area is truly afforested, the rest being barren in the absence of afforestation projects. Part of barren forest land has been occupied by hutment colonies, quarries, stone crushing operations and brick kilns, which have posed a threat to the landscape and ecology.

### 3.7.4 Lakes

Thane was known as city of lakes – with more than 100 lakes. At present, TMC has about 35 rain fed lakes and a few of them have become major recreational attractions. The overall water quality of lakes has been found deteriorated and TMC is making efforts to improve the state of lakes by undertaking "Lake Beatification Remediation Program" with the support of MOEF, GOI.

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# CHAPTER 4
# STORM WATER DRAINAGE SYSTEM

## 4.1 NATURAL WATERCOURSES (WC)

There are many natural watercourses in TMC area flowing from hilly region through the city to meet Thane/Ulhas creek. The watercourses flowing from Yeoor hills pass through Thane city and those from Parsik hills pass through Kalwa and Mumbra. Hariyali has identified 25 major watercourses (Nallas) in TMC area, 20 in Thane and Kalwa area and 5 in Mumbra. All these major watercourses have been physically verified by the members of the Expert Committee and have been shown in the map (P.51) Apart from 25 major WCs identified by Hariyali, there are many small or minor watercourses starting either from hills or from some lake (like Upavan) or from locations where two road side drains meet. In Mumbra alone, as against 5 major WCs identified by Hariyali, there are as many as 30 cross-drainage. The total length of WCs in Thane City, Kalwa and Mumbra is about 81 kms, 13.5kms and 14.1 kms respectively.

## 4.2 CATCHMENT AREA

Considering ridge on west of Thane City from MCGM boundary up to end of Owla, all (WC1 on south to WC16 on north), the watercourses, start from hills at RL more than 35m (GTS) and drop down to about 24m (GTS). After crossing water pipe lines, the watercourses drop down to about 5m (GTS) near railway lines, meeting the Thane Creek & Ulhas Creek at average 3m (GTS). Thus a steep gradient in the initial part of these watercourses gets converted into flatter gradients in the further course. Similar configuration exists for WCs in Kalwa starting from Parsik hills and WCs in Mumbra from Mumbra hills. The catchment areas on the upstream of WCs in Thane and Kalwa are relatively large. In Mumbra, the slope of hills near the new bye pass road is very steep and the WCs flowing across this road have relatively small catchment areas. Each watercourse has developed topographically it's own catchment area having length ranging from 7 km to 11 km and width 2 km to 5 km, total drop 25 m to 50 m. The nature of catchment in TMC area is obviously with less time of concentration, less travel time and considerably high runoff in the initial 50% part. The remaining 50% part is with medium time of concentration, more travel time with addition of little less runoff than earlier part.

## 4.3 CARRYING CAPACITY

Considering the nature of catchments stated above, it is observed that for WC1 to WC6, sufficient carrying capacity exists to achieve initial considerable quantity of runoff in the undeveloped area of the watercourse. However, in the

further course of their travel in the developed area, the carrying capacity in these watercourses has been totally affected and reduced due to non-removal of silt, encroachments within and on the banks of the watercourses, indiscriminate dumping of solid waste, changing the alignment of the watercourses, obstructions due to utilities and such other reasons, both on upstream of Highway and downstream too. As regards WC 7 to WC 16 the carrying capacity is so far unaffected on upstream of Ghodbundar Road (undeveloped area) but due to inadequate cross drainage and few of the above reasons, it is reduced in the downstream of Ghodbundar Road (developed area). As regards watercourses in Kalwa (WC17 to WC21), the natural carrying capacities on upstream of Kalwa-Mumbra road appear to have remained unaffected but downstream the same have been totally affected due to few of the above reasons. The carrying capacities of watercourses in Mumbra, (WC22 to WC25), appear to have been affected due to inadequate cross drainage arrangements along Mumbra-Panvel road and few of the above reasons.

The initial natural carrying capacities of all the watercourses in the hilly portion of TMC have not been maintained. The main reason is disregard to the hydraulics of the watercourses while developing the TMC areas in last many years. Obviously, after the deluge of July 2005 there is a need to re-design the cross sections of all the watercourses for revised values of the storm frequencies. In this context the TMC has appointed consultants to fix up design frequencies and redesign the roadside drains, small watercourses and major watercourses and work out revised carrying capacities for implementation of Integrated Nalla Development Project.

## 4.4 OBSTRUCTIONS

### 4.4.1 Utilities

The utilities such as telephone cables, electric cables are laid underground, many times passing through the watercourses causing severe obstruction to the flows. In many cases, even TMC water supply lines are laid in across the storm water drains which cause not only obstruction to the flow but also pose a threat of contamination of drinking water. The pileup of utilities becomes stumbling block in the watercourses (Ann-II – Page 91) and once the utilities are laid down in watercourses, they are seldom removed even after they become non-functional or of no use.

### 4.4.2 Structures

Structures on the covered watercourses on both or either banks, is a common feature in TMC areas. These are not only hutments but also G+4 buildings with permanent constructions. In a few cases there are

structures in the watercourse itself. The watercourses become inaccessible for machine cleaning because of the structures on the banks. Many times developers divert the watercourses for their convenience which also obstructs the flow of water.

### 4.4.3 Dumping of solid waste

The residents, shopkeepers and industrial units in the vicinity of watercourses daily dump plastics and solid waste into the watercourse (Ann-II – Page 88). The floating population such as pedestrians, vehicle riders, hawkers, families visiting gardens, parks, lakes etc. throw plastic raps of eatables, plastic cups, thalis etc. into so called Nallas.

### 4.4.4 Limitation due to esturian mechanism

Major watercourses are either directly meeting the Thane Creek/Ulhas Creek/Ulhas River or let out in the open fields near such Creek/River. Both the creeks join Arabian Sea and the tidal variations in the sea affect the creeks and the watercourses. If the high tide coincides with the high intensity of rainfall with long duration, the tidal flows from Arabian sea into Thane/Ulhas Creeks result into backwater curve in considerable portion of the watercourses. The effect of this phenomenon is resultant rise in the water levels in a substantial portion of land adjoining the creek. This obviously results in the creation of water logging spots along watercourses.

## 4.5 IDENTIFIED REPETITIVE WATER LOGGING SPOTS

Hariyali has identified 75 repetitive water logging spots after discussions with the field engineers of TMC and classified them into following categories.

| Sr. No. | Category | Number of water logging spots |
|---|---|---|
| 1 | Creek Vicinity | 17 |
| 2 | Nalla Vicinity | 29 |
| 3 | Low Lying Area | 2 |
| 4 | Forest Boundary | 11 |
| 5 | Slum Area | 5 |
| 6 | In the vicinity of normal or High rise Buildings. | 1 |
| 7 | Water logging spots with less severity | 10 |
| **Total** | | **75** |

Thus about 2/3rd of the water logging spots are in the vicinity of creeks/watercourse. It is however surprising to note that as much as 1/6th of the

water logging spots exist near forest boundaries, mainly because of reduction in the carrying capacity of the watercourses as explained in Para 4.3 above.

## 4.6 INTER-CONNECTION WITH SEWERAGE

The phenomenon of letting out the drainage lines into the watercourses in slum areas exists. Even in sewered areas, many overflow connections from sewer lines have been made into the watercourses. While the sewage & sullage flowing in the Watercourses may not alone obstruct the flow of storm water during monsoon being a very small quantity compared to the runoff, it certainly causes back flow from watercourses into house drainage system. In addition, it creates hurdle in manual cleaning of watercourses.

## 4.7 STORM WATER DRAINAGE PLAN OF TMC

As indicated in the City Development Plan, TMC has prepared in the year 2005 an Integrated Nalla Development Project (INDP) costing over Rs.270 crores, to be completed in three phases. In phase I TMC proposes to take a review of all watercourses to find out the adequacy of their carrying capacity with reference to runoff and catchment area, take remedial measures and repair works and to consider cost benefit analysis. Phase II will include drawing of suitable hydraulic and structural designs and appropriate construction methodology with reference to the intensity of rainfall and decided storm frequency. The implementation of the construction phase of the project will start simultaneously. Phase III consists of periodic site visits and consideration for stability certificates. TMC has already approved following consultants for detailing the above program.

**a]** Dalal, Matt, Macdonald for Mumbra area.
**b]** M/s Shah Technical consultants for Kalwa area.
**c]** M/s Consulting Engineering Services for Thane city.

The entire project is expected to be completed within next 4 years. As envisaged in INDP, the resultant outcome of the project will be removal of encroachments and utilities and consequent reduction in water logging. The INDP also envisages, -

**a]** provision of holding ponds in specific areas, providing flap gates near the creek; and
**b]** arresting storm water run-off in the hilly areas with proper diversion

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# CHAPTER 5
# NATURE & CAUSES OF
# REPETITIVE WATER LOGGING IN TMC AREA

## 5.1 IDENTIFICATION OF WATERCOURSES (WCs)

**WC 1 to WC 25 :**

As indicated in paragraph 4.1, there are many major and minor watercourses in TMC area of which 25 major watercourses have been identified and marked by Hariyali on the map (P.51). Brief description of the route of each major WC is given below:-

**WC1.** Many small natural watercourses originating in Sanjay Gandhi Udyan/Yeoor hills merge together at different places in Mulund (West) and become a major watercourse, identified as WC 1. It enters Thane (West), Check Naka and after crossing railway line again enters Mulund (East) area. Two repetitive water logging spots in Kopri Vibhag exist between WC 1 & WC 2.

**WC2.** Originating in the hills on west side, this watercourse runs through Kisan Nagar in Wagle Estate area and Teen Hath Naka, runs parellel to the Eastern Express Highway for about 100 meters and crosses railway line. It further passes through Anand Nagar, Check Naka, Thane (East) and meets Thane creek in Mulund area. Five water logging spots have been identified in the vicinity of WC 2. Reasons for water logging are mainly silting, (including boulders), covering about 50% of the depth of watercourse, inadequate capacity of pipe culverts, utilities in the watercourses, etc. It is also observed that because of slums, there is no approach road for machine cleaning of the watercourse.

**WC3.** This originates from Thane (East) railway station. After crossing through railway culverts it meets Thane creek. Two water logging spots are identified in its vicinity.

**WC4.** This starts after box culverts on east side of Eastern Express Highway near Namdev Wadi and meets Thane creek after running through some densely populated area. There is a moderate run off in this watercourse since it does not originate in hills, and there are no water logging spots in its vicinity at present. However, major portion of this watercourse is covered and there are structures on it making it impossible to undertake de-silting operations either manually or by machines. After some years, therefore, the accumulated silt may stop the flow of storm water in this watercourse, if not properly desilted.

**WC5.** Originating near Khartan Road where two roadside drains meet, this watercourse is small in length with moderate velocity and it's major portion is covered. There are structures on covered portion and also on the banks of the watercourse making it inaccessible for de-silting. The accumulated silt may get filled up to the brink of the watercourse in future causing water logging problems. No identified repetitive water logging spots exist at present, but deluge in 2005 did cause flooding in electronic market near Prabhat Theatre.

**WC6.** Number of tributaries to this watercourse originate on hills on western side and merge into it after Karvalo Nagar. It flows by Ramachandra Nagar 2, Chandan Wadi, Civil hospital, and Yerawada jail compound wall to meet Thane creek. There are 12 identified water logging spots in the vicinity of this watercourse and its tributaries mainly because of structures on or within 10 feet from the watercourses. Silt including boulders, solid waste, etc. and utilities obstruct the flow. The WC 6 has a large catchment area on the hills with steep gradient. The de-silting work is taken up only once before the onset of monsoon. There after such silt and solid waste flowing through the watercourse get deposited when it reaches low lying areas in Junagaon, Sathe Nagar, Karvalo Nagar at the foot of the hills. Also with a low velocity in its further travel, coupled with common causes such as structures, accumulated silt, solid waste obstructing the flow, the low lying areas in Ambedkar Nagar, Uthalsar and Krantinagar get flooded.

**WC7.** Its tributaries originate on hills on the west side and have a vast catchment area. They merge into one another at different locations and a single fairly wide watercourse is formed before reaching J. K. gram area. The slums and structures in Rupadevi Pada on and in close viciity of a tributary of WC 7 near the foot of the hills make it inaccessible for machine cleaning. Silt, solid waste, etc. accumulated in it cause water logging at some locations in Rupadevi Pada. Further down, around Majiwada village, the backwater effect during high tide appears to be causing water logging in the area.

**WC8.** Two major tributaries of this watercourse start from Yeoor hills, one flowing through Kokani Pada, Vartak Nagar, Manpada and another through Kokanipada by Siddhachal towers and Jawahar Nagar. Both merge at Subhashnagar before crossing Ghodbundar road. Two more tributaries originate from the merging of road side drains. The WC 8 thereafter splits into two branches to meet Thane creek. One branch

crosses the Eastern Express Highway and also creek road and is affected because of back water during high tide and high run-off.

**WC9.** It starts near Balkum and running by the side of a road, meets Ulhas creek. There is no water logging spot in the vicinity of WC 9.

**WC10.** It flows from hills on the west through Wagle Industrial Estate, Manpada and crosses Ghodbundar road and runs through Kalpataru Industrial Estate and then through Kolshet Industrial area to be let out in the open shrubs near Ulhas creek. There are utilities in the watercourse near 'Ayush Nursing Home' but thereafter there is open plot. There is only one flooding spot at Manpada south mainly because of narrow width of watercourse in the vicinity. There is a pipe culvert on the road parellel to Ghodbunder road. Structures on both sides of the watercourse result into the storm water spilling on roads during monsoon.

**WC11.** Originating at Kolshet, this watercourse is small in length and is let out in the shrubs near the Ulhas creek. No water logging spot exists on this watercourse.

**WC12 & 13.** From hills on the west, WC 12 flows through Panchpakhadi, crosses Ghodbunder road and after running for a small length along side of the Ghodhbunder road, it flows through Patlipada to meet Ulhas creek. WC13 is its branch after Patlipada running through open shrubs to the north to meet Ulhas creek. Near Bombay Chemicals on Brahma Complex road, in the vicinity of WC 12 & 13, there is a low lying area with no outlet for water, causing water logging during heavy rainfall.

**WC14.** Starting from west hills near Vanipada, it crosses Ghodbunder road near Suraj Water Park and runs northward by the side of Goodlass Nerolac Paints factory to meet Ulhas creek at Wagh Bill. Two tributaries meet this watercourse: one from hills through reserved forests crosses Ghodbundar road before Ritu Enclave and merges into WC 14 after Kavesar. The other starts near Anandnagar which meets WC14 at Wagh Bill. No repetitive flooding spots exist on WC14 or on its tributaries.

**WC15.** This too starts from hills in the west and flows northward through forest and crosses Ghodbunder road to meet Ulhas creek. Many tributaries flowing from the same hills meet this watercourse on the down side across the Ghodbunder road. Five water logging spots on different tributaries of this watercourse are mainly because of inadequate cross drainage and permanent structures on the tributary

(Bhayandar Pada, Owala, Anandnagar & Vadavali ), utilities in the tributary and solid waste dumpings (Anandnagar) and eroded material blocking the watercourse (Vadavali & Anandnagar).

**WC16.** This watercourse is small in length originating in hills and meets Ulhas creek.

**WC17.** This watercourse originates from Parsik hills from the South of Thane city and runs through Kalwa to meet Ulhas river. Flowing through Surya Nagar, it is the smallest watercourse and has no water logging spots.

**WC18.** This starts from the hills adjoining the slow trains track on Central Railway before Kalwa station and runs through Manish Nagar and Shastrinagar to meet the Ulhas river. Flooding spot at Shastrinagar is mainly because of backwater during high tide coupled with high run-off. A low level area in Manish Nagar also gets moderately water logged during heavy showers.

**WC19.** It starts after Parsik Tunnel of fast line of railway track and runs through Mahatma Phule Nagar and Saibaba Nagar to meet Ulhas river. Repetitive but moderate water logging in the slum at Mahatma Phule Nagar was reported by hutment dwellers. There is a Nalla in reverse direction, duly trained to absorb high tide flow mixed with sewage from slums.

**WC20.** From Parsik hills, it crosses railway line after Kalwa station and runs through Jai Bhim Nagar to meet Ulhas river. One location in Jai Bhim Nagar and one at Sea Rock Building get flooded when high tide condition coincides with high run- off. The water logging at New Shivaji Nagar, near Kalwa (East) station occurs apparently because of inadequate railway culvert.

**WC21.** It starts from Parsik hills, crosses railway line and runs through Kharegaon to meet the Ulhas river. After crossing, a small cross section with 90° turn, it runs parallel to the road. The hutment dwellers have reported water logging every year. Also location at Budhaji Patil Marg in Kharegaon gets flooded because of silt and boulders. The area near railway line on Kalwa (East) after Kalwa station has also a water logging location apparently because of inadequate capacity of railway culvert.

**WC22.** It starts from Mumbra hills and through Kausa region meets Ulhas river. Inshanagar, which has an identified flooding spot is a low lying

area and is moderately subjected to high tide levels. Added to this problem is an inadequate cross drainage on the by pass highway.

**WC23, 24.& 25.** All the three watercourses start from Mumbra hills and meet Ulahs river. No water logging spot was located in their vicinity.

## 5.2 FLOODING SITUATION ON 26th JULY 2005.

The unprecedented heavy rains pouring continuously on 25th and 26th July, 2005 caused havoc in Thane, Kalwa and Mumbra, as in Mumbai. The watercourses which had already a reduced carrying capacity because of obstructions caused by silt, structures, solid waste, utilities, etc. were overloaded with high run-off from the hills for several hours and all the repetitive water logging spots and many more were flooded for hours together. The collapse of structures, trees, etc., into the watercourses aggravated the situation. As many as 32 citizens in TMC area died during the deluge. 'Hariyali' had conducted a survey of residents/shopping complexes/industrial units in TMC area to find out perceptions of the people about the nature, causes and effects of "Deluge' in July, 2005 and about the preventive measures that could be taken to minimize losses in case such a situation recurs in future. With the help of over 600 NSS students of various colleges in and around Thane, 8274 families having residence or work place in TMC were interviewed. Their responses were recorded in the objective questionnaire prepared for the purpose. About 47% of the families interviewed reported flooding in their locality and many of them had no electricity and no communication facility for two days. Nearly 32% of the respondents had no water supply on 25th & 26th July, 2005. Most of the affected respondents mentioned that apart from usual rains, failure of the drainage system was a major cause of flooding in their locality. As reported by the respondents, obstructions to flow of water were caused by garbage dumping, plastic menace, debris and structures in the watercourses. The respondents staying/working in the vicinity of Thane creek and Ulahs creek also gave reclamation of the creeks and constructions on such reclaimed land as major reasons for flooding. In Kausa area of Mumbra, the students and teachers in one college on the hill got stuck up in the college for 48 hours because of waist-deep water all round the college. The worst affected areas were Kausa, Mumbra, Talaopali, Jambhli Naka, Majiwada, Owala, Balkum, Saket, Rupadevi pada. Sathenagar and surrounding area in Railadevi Prabhag, Mahatma Phule Nagar at Kalwa, etc. Major findings of the survey in this connection are reported in Annexure I.

## 5.3 CAUSES OF REPETITIVE WATER LOGGING

### 5.3.1 Identified water logging spots

As indicated in paragraph 4.5 the water logging spots have been broadly classified on the basis of their proximity to the creek, to the watercourses or forest boundaries or on the basis of structures in the area such as slums or normal/high buildings. This is only a broad classification made to facilitate analysis and the categories are not mutually exclusive.

### 5.3.2 Causes for Identified water logging spots

The reasons for water logging enumerated under columns of the statement on page no 37 to 46 are summarized below.

#### 5.3.2.1 Area in the creek vicinity

a] Development levels are less than the highest high tide level of 1.9m (GTS). The area, therefore, gets affected due to back water levels in the watercourses joining the creek. (Examples : Saket, Vrindavan, Rabodi-Koliwada, Krantinagar, Majiwada village. Chendani Koliwada in Thane(East), Shastrinagar-Kalwa, Bhimnagar in Kalwa, Mahatma Fule Nagar in Kalwa, etc.)

b] Unauthorized constructions in CRZ-2 areas. (Diva – Dativali & other areas)

c] In many cases the watercourses have become narrow in the down stream because of authorized or unauthorized structures (including multi-storied buildings) or deliberately narrowing of watercourse by developers. The high run-off from the hills flowing in relatively wider watercourse on the upstream is subjected to quite inadequate carrying capacity of narrower watercourse on the downstream, causing overflow particularly in low lying area.

d] Inadequate cross sections of watercourses, inadequate cross drainage and silting of cross drains. (K.Villa, Khartan Road, etc.)

#### 5.3.2.2 Area in the vicinity of Forest Boundary

a] The velocity of natural watercourse flowing from the hills during rainy season gets reduced when it reaches relatively plain area. It is observed that at the foot of the hills there are structures within 6 to 8 feet of both sides of watercourse spread over considerable length, making it inaccessible for machine cleaning. Even manually it is difficult to lift big boulders and

carry them along the watercourses for de-silting. The accumulated silt, boulders and solid waste in watercourses (sometimes covering over 50% of its cross section) aggravate the situation during monsoon. When fresh load of boulders and silt is brought by the water current, the water overflows in the nearby areas. (Road no.22, Ambewadi Market, Rupadevi Pada, Vasant Vihar Circle, Vadavli, Ovala etc.)

**b]** Solid waste and plastics are dumped by people residing in the close vicinity of watercourse and sullage flowing in the watercourse make manual cleaning still difficult.

**c]** The utilities in the watercourse cause accumulation of silt, plastics and solid waste, further restricting the flow (Anandnagar).

#### 5.3.2.3 Area in the vicinity of watercourses

**a]** Encroachment of structures:-

In the densely populated area, there are structures including slums and G + 4 buildings with rewa projections on the banks of watercourse and hotels, school buildings, commercial complexes etc. on the covered watercourse. This makes desilting extremely difficult (Ram Maruti Road, Anand Nagar– Kopari, Teen hath Naka, Mental Hospital, Raghunath Nagar, Kausa & Kalwa). In some cases there are structures in the watercourse itself (Phule Nagar) (Ann-II – Page 88).

**b]** Utilities in the watercourses obstruct the flow (Srinagar, Bradma Company, Teen Hath Naka, Mental Hospital, Raghunath Nagar, SBI Circle in Wagle Estate, Kausa) (Ann-II – Page 91).

**c]** Inadequate capacity of Railway culverts:-

The size of Railway culverts constructed many years before has not been increased to meet the needs of the high co-efficient of run-offs of the growing city. This causes water logging mainly in the areas surrounding watercourses in Thane East (Downside of Kopari, Anand Talkies, Chendani Koliwada).

**d]** Inadequate carrying capacity and skewed alignment (Road No.34, TMT depot in Railadevi Prabhag).

**e]** Inadequate cross-drainage, inadequate culverts (Kamgar Hospital, Bradma Company, Runwal Junction in Vartaknagar, etc.).

**f]** Dumping of solid wastes by people (Ann-II – Page 88).

g] Watercourses covered by concrete footpaths making de-silting difficult (About 80% WC 4 is covered by footpath/structures).

#### 5.3.2.4 Water logging spots falling in slum areas

Major reasons for water logging in this area are structures on the banks of watercourse making de-silting extremely difficult. Moreover, absence of facilities for disposal of solid wastes in slum area results in wholesale dumping of such waste in the watercourses.

#### 5.3.2.5 Water logging spots falling in the area of multi-storied buildings :

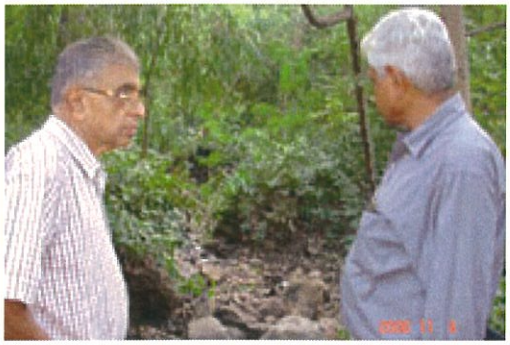
Apart from the common reason of obstructions to the flow such as utilities in the watercourse and solid waste dumping by people, a specific cause observed under this category is narrowing and turning the watercourse 90° or so by the developer for his convenience, and also construction of compound wall, concrete parking area or concrete play ground of school etc. on the watercourse (Tarangan, Shubharambh Society on WC 10, M H High school compound wall and its play ground, etc.).

#### 5.3.2.6 Water logging spots in low lying area

Some saucer type low lying developed areas with higher level of roads face the problem of water logging during heavy rains every year because there is no proper outlet for water. (Krantinagar in Uthalsar Prabhag, Vitava area near bridge, Rupadevi Pada, Ambewadi Market, Nalpada in Vartak Nagar, Patlipada (North), Bombay Chemicals and Brahmand Complex in Majiwada, Manishanagar at Kalwa, Inshanagar at Mumbra.)

## 5.4 PICTORIAL GLIMPSES OF CAUSES OF WATER LOGGING (OBSTRUCTION IN THE WATERCOURSES)

### 5.4.1 BOULDERS AND ROCKS ENTERING INTO THE WATERCOURSES AT THE ORIGIN

### 5.4.2 UTILITIES PASSING THROUGH, DUMPING OF GARBAGE, PLASTIC WASTE, ETC.

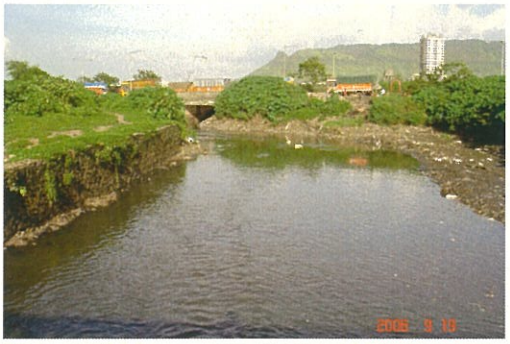


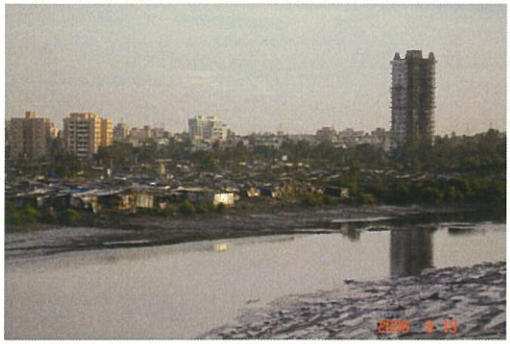



### 5.4.3 HUTMENT COLONIES, UNAUTHORIZED PUCCA CONSTRUCTION ACROSS AND OVER THE WATERCOURSES



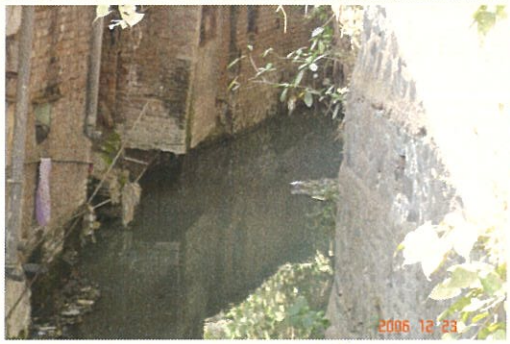

### 5.4.4 UNAUTHORIZED CONSTRUCTIONS IN CRZ AREA, DUMPING IN THE CREEK AND DESTRUCTION OF MANGROVES






### 5.4.5 UNNATURAL NARROWING DOWN OF WATERCOURSES ACROSS THE RUN-OFF






### 5.4.6 CHOKING OF CULVERTS, RUN-OFF AREA, UNTRAINED NALLAS, ETC.




### 5.4.7 MULTIPLE OBSTRUCTIONS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# CHAPTER 6
# TECHNICAL ANALYSIS

## 6.1 DESIGN CRITERIA

Rational method for calculating quantity of run off from the rainfall is as follows:

$$Q = C \times I \times A$$

Where **Q** - is the flow in cumecs.

**C** - is the coefficient of run off.

**I** - is the intensity of rain fall in m/sec.

**A** - is the area to be drained in sq. m.

The magnitude of C may be as per CPHEEO manual. The I am function of travel time/duration of storm/frequency of occurrence. It is practical to adopt different intensities for roadside drains, small watercourses and major watercourses. The contribution time of 10 minutes, 20 minutes and 30 minutes respectively can also be adopted. Though CPHEEO manual suggests frequency of occurrence twice in a year, the same needs revision looking to weather changes/global warming, etc. Once in two years/once in 10 years could be the possible alternatives but needs to be related to cost of master storm water drainage plan. The exceptionally rare storm of July 2005 can not become criteria for design. The change from twice in one year to once in 10 years could lead to 50% more cost of the master plan. Intensity/duration frequency curve appears to have been considered by the consultants working for Thane Municipal Corporation. Generally 50 mm for one hour appear to have been adopted till recently. However, each catchment is subjected to various rainfall intensities and duration curve. The larger catchment having higher time of concentration results in severe condition for long duration even with low intensity of rainfall. Small catchment with high intensity and long duration are also quite critical. The catchment should be combined with tidal surges. This study may be carried out by TMC in detail with Geographical modeling, if

necessary. Necessary data for the purpose may have to be collected and compiled by TMC.

## 6.2 USE OF DIFFERENT MODELS

The data referred to above can be used to develop and calibrate hydrological catchment models to simulate run-off from rainfall, computational hydraulic river model to simulate build up of flow and its entry into micro drainage system, routing to macro and further on to sea. The use of models can provide a better insight into natural flooding mechanism and enable TMC to think on options for flood alleviation. The design of the micro level storm water drainage system could be done on a sample basis for selected area for Thane city before considering its extension to other areas. Combination of physically distributed hydrological model including overland flows, unsaturated zone flows, groundwater flows, dynamically coupled with estuarine and creek hydraulic model has been evolved by experts. This will help comparison with traditional flood models. The tidal control and storage principle with respect to tidal gates, pumping requirements and storing capacities should be studied in general and its applicability to Thane city may be worked out in detail.

From the technical literature available on the subject, attention is drawn to technical paper, "Rain fall analysis for the design of storm water in Bombay" by Mr. S.D. Chawathe, et al, which could be used for design intensities. Following formula may be applied for frequency of occurrence range of 5 to 10 year.

$$I = \frac{(7606.12\,T)^{(0.5680)}}{(t + 101.97)^{(1.4273)}}$$

I = intensity of rainfall in mm/hr.

T = frequency of occurrence in months

t = Concentrate time (duration of storm) in minutes.

The calculated intensities for 't' of 10, 20 & 30 minutes and 'T' of 10 years work out as below :

| Sr. No. | 't' in minutes | 'I' mm/hr. | Locaion |
|---|---|---|---|
| 1. | 10 | 137 | Road side drain |
| 2. | 20 | 122 | Small Watercourse |
| 3. | 30 | 109 | Major Watercourse |

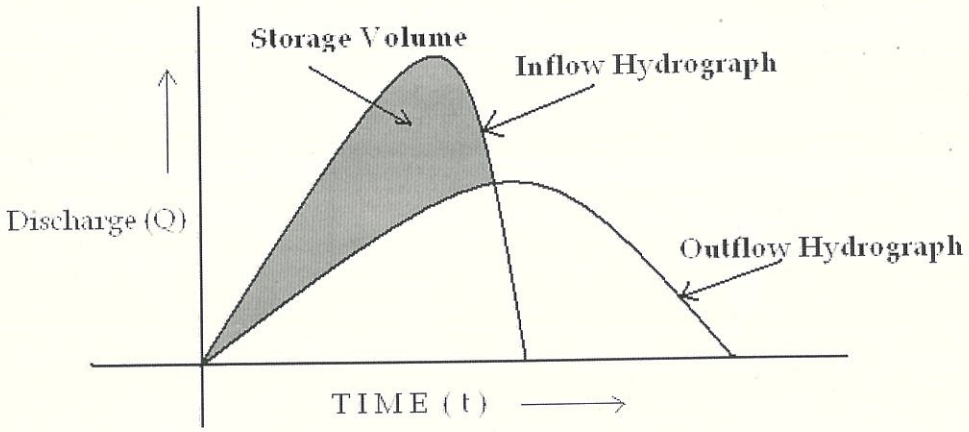
Optimization of frequency ( **T** ) against cost can be worked out by TMC for proper selection of '**I**' at different locations.

For design and prediction purpose, "MIKE URBAN" system may be utilized to understand

- ⇒ Storm water modeling - flooding water quantity, quality.
- ⇒ Evaluating network capacity and bottlenecks.
- ⇒ Prediction of local flooding.
- ⇒ Hydraulic analysis of open channels, closed conduits and combination system.
- ⇒ Storm water network analysis.
- ⇒ Analyse and design detention basins.
- ⇒ Fully dynamic modeling of flows in storm water systems with open channels, pipes, streets, etc.
- ⇒ Integrated storm water quantity and quality

## 6.3 DESIGN OF STORMWATER DETENTION

The storm water detention facilities are distinguished from retention facilities. In case of retention, the run-off is captured with no release of water into downstream. These structures are envisaged in case of storm water design




system. The detention ponds have outlet structures. Such ponds are provided for temporary storage of run-off with peak release rate to downstream which is substantially lower than the detention facility peak inflow rate. The conceptual design parameters involve an inflow run off hydrograph from tributaries to storage facility i.e. detention pond. A properly sized outlet has to be designed for a desired outflow hydrograph. The storage volume is obviously Q inflow minus Q outflow in relation to time and peak as follows.

**Figure 1 : Design of Storm Water Definition**

In the case of TMC, there is a scope to design these structures by utilizing the bunds constructed by "Khar Land Department of Irrigation" or elsewhere on similar basis.

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# CHAPTER 7
# EFFECTS OF WATER LOGGING IN THANE CITY

## 7.1 EFFECTS ON INFRASTRUCTURE AND SERVICES

### 7.1.1 Roads

The stagnation of flood water causes damage to the roads, and to sub-grade and sub-soil. Water logging and damaged roads are a major cause of increasing accidents during monsoon.

### 7.1.2 Water supply

The overflowing ETPs cause mixing of untreated wastewater with water bodies. This also contaminates ground water. Contamination of water increases on account of intermittent water supply and crossing of sewage lines. Shock loads of turbidity and contamination of water result in non-potable water.

### 7.1.3 Transport

Damaged roads and potholes on the roads affect tyres, suspension springs and break liners of vehicles. In case of State transport buses in Thane reduction in milage cover is observed from 40, 000 km per day to 36,000 km per day. Other effects of flooding are increase in operation and maintenance cost, and traffic jams resulting in loss of time and loss of fuel.

### 7.1.4 Electricity supply

Infrastructure of electricity supply, mainly substations of electric supply and equipment like transformers, etc., get affected in areas like Saket, Vrindavan, Anandashram, Naupada, K.Villa, Rabodi, Koliwada, Majiwada. There are more cases of short circuit in the water logged area.

### 7.1.5 Education

Educational institutes in low lying areas get affected. Damage to furniture and educational equipments results from this water logging. The loss of time in teaching and learning causes rescheduling of the time table.

### 7.1.6 Railways

Six culverts below railway tracks at Mumbra, Kalwa and Thane are not enough to carry the runoff even in normal times. Water logging occurs in railway tracks at Mumbra, Kalwa and Kopri. The water logging affects the timings of the trains. It also increases the O & M cost of railway tracks.

### 7.1.7 Communication services

Short circuits, damage to cables and water leakages render joints faulty. Leakages in MTNL installations and buildings too are caused by water logging. The telephone land lines and mobile services develop faults and bring down the efficiency.

### 7.1.8 Health

Whenever areas witness water logging on a higher scale, there is two-fold increase in the number of patients admitted in the nearby hospitals. Blood banks are put under strain as they have to provide blood in adequate quantity to the increased number of patients. General medical practitioners find it difficult to cope with the task of treating patients. The demand for prescribed medicines and curative medicines in affected localities result in the storage of such medicines. The spread of epidemics such as Dengue, Lepto, Gastro, Malaria occur due to flooding in localities such as Konkanipada. The TMC is required to conduct house to house survey in flood affected areas to treat patients, to take preventive measures and to conduct free medical check up. Consequently, severe strain is felt on health services, both private and public.

## 7.2 EFFECT ON INDUSTRIES AND SLUMS

### 7.2.1 Industries

Services such as transport, electricity, water supply, removing industrial waste are crucial to the efficient working of industry. Since they are affected, industry in turn is affected in the service to the customers. The small scale industries are more affected by water logging because of their resource-constraints. The machinery of small scale industries in low lying areas get submerged during intensive flooding causing loss of production for many days.

### 7.2.2 Slums

Slum dwellers constitute a significant source of man power. When they are themselves trapped in adverse circumstances due to water logging, their efficiency to discharge their services to the community is reduced. Water logging affects the services provided to the slum area more than in other places. Landslides, water logging and sinking of the ground, occur in slum areas particularly in Kalwa, Mumbra and Kausa. Deficiencies in construction aggravate this condition. Low lying area results in more

water logging particularly in the slums, which causes damage to huts, hutments and household goods.

## 7.3 LOSS OF HUMAN & BOVINE LIFE

Water logging results in loss of human and bovine life. Poor people having no shelter or rendered shelterless by flood fall victims to natural's furies. Epidemics make their life worse causing loss of human life before medical services reach poor locality.

## 7.4 ENVIRONMENTAL LOSSES

The surrounding in which people have to live under the conditions of water logging lead to lack of hygiene, water pollution, air pollution, disruption in services, and outbreak of various diseases. Insanitary conditions continue for long time. Mosquitoes, flies and water logging go together.

## 7.5 ECOLOGICAL LOSSES

Stormy weather and heavy rains during water logging sometimes result in uprooting of trees. The broken branches increase water logging. Unclean surroundings and pollutants pose a threat to plants and crops.

## 7.6 SOCIO – ECONOMIC – LOSSES

### 7.6.1 Social

Social relations are disturbed because of failure of communication systems due to irregular electricity supply and transport problems in the wake of water logging depression or boredom may result on account of deprivation of social life Cultural and intellectual quality is affected because of lack of social life.

### 7.6.2 Economic

Water logging causes extensive economic losses. As Indicated by the Resource Persons interviewed by the Experts Committee, the estimated losses caused by water logging in various services are as follows :

**7.6.2.1** The TMC is required to spend about Rs.3.5 to 4 crores annually to control and prevent spreading of diseases in flood prone areas.

**7.6.2.2** Economic impact of flooding is serious in case of wage earners.

**7.6.2.3** Water logging results in people spending more on medical services.

**7.6.2.4** Revenue loss to State Transport amounts to Rs.One lakh per day.

**7.6.2.5** Operation and maintenance cost of S.T.buses increases by about Rs.Two crores per year.

**7.6.2.6** Loss of Rs.One crore is estimated for additional fuel for about 3000 trucks in Thane city.

**7.6.2.7** Repairs and maintenance losses of Rs.10 lakhs per year is borne by MSEB in Thane city.

**7.6.2.8** Additional maintenance cost of Rs.One and half lakh is incurred by MTNL, Wagale Estate.

**7.6.2.9** Railways have to spend about Rs.65 lakhs per year for rehabilitation of tracks within TMC area.

**7.6.2.10** Loss in terms of production by small scale industry amounts to about Rs.10 crores per annum.

**7.6.2.11** Loss in maintenance of sub-merged machinery in industries is about Rs.2 crore per annum.

**7.6.2.12** Removal of silt in industrial installations takes about 8 days resulting in loss of Rs.4 crores per year.

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# CHAPTER 8
# BASELINE ENVIRONMENTAL STATUS

## 8.1 WATER POLLUTION

Thane is surrounded by the Thane and Ulhas creeks and Ulhas estuary. The city has still 35 rain fed lakes which is a precious ecological gift. The Thane creek is connected to Ulhas estuary in the North through a very narrow connection. The Ulhas estuary consists of riverine, middle portion and seaward zone. It has dense mangroves and mudflats.

Release of high amount of untreated sewage, industrial effluents, dumping of solid waste, reclamation and construction activities have caused deterioration in the water quality of Thane and Ulhas creeks and Ulhas river. The level of suspended solids has been increasing. Gradual lowering of salinity in the creek has been taking place.

Gross neglect of lakes, sewage ingresses, dumping of solid waste have resulted in near disappearance of some lakes and bad quality of water in others. Thus human activity, eutrification, siltation, sedimentation, contamination, toxicity of the water, salinity, etc. have created ecological problems for Thane city.

The TMC has taken steps to monitor quality of existing water bodies for important indicators such as S.S, BOD, pH, DO etc. Similar qualitative aspects of high tide zones like Kolshet, Balkum, Gaimukh, Saket etc. for above indicators have been checked for water bodies and pollution and kept on records. In case of few lakes the quality of water for indicators like DO at different levels, COD, BOD, $NO_3$, PO4, etc, has been monitored in a program of bio-remediation.

The environmental status of all these water bodies is not satisfactory. A creek conservation program appears to have been mooted by TMC with the help of Enviro –Vigil, NEERI, NIO, etc. The issues and indicators being considered are impact of human activity, toxic pollutants, habitat loss and status of DO, BOD, heavy metals, biological quality, fishery, wetlands, birds. The important hydrological aspects and hydraulics of these water bodies, however need to be studied in detail. In a typical configuration of Thane creek, Ulhas creek, Ulhas river and Arabian sea, the Corporations of Thane, 'Navi Mumbai', Kalyan-Dombivali, Ulhasnagar and few other surrounding councils may have to take up a joint program for reassessing the assimilative capacities of all these water bodies. Help of CWPRS for hydraulic modeling may be taken by them. There is a close relation of the above aspects with the water logging spots identified by

Hariyali. During water logging period the dry weather flow of sewage gets mixed with stagnated waters, Solid waste, floating material including medical waste also get mixed up with stagnated water. The polluted stagnated water finds way into adjoining watercourses and water bodies including lakes. The percolation of stagnated polluted water further causes pollution and contamination of ground water and water supply mains and branches. This obviously creates hygienic problems in the city.

## 8.2 AIR POLLUTION

The concentration of sulphur dioxide, oxides of nitrogen, SPM and RSPM, Amonia, hydrogen sulphides has been found more in industrial area than in residential and commercial area. The TMC has been conducting studies of primary and secondary pollutants.

The ambient air quality is also being monitored. The pollutants like SO2, NOX, SPM and RSPM have also been measured and monitored in Thane city. Ammonia, and H2S concentration are also being monitored in TMC area.

As regards water logging in Thane city during rainy season it may not cause or add to the air pollution. In fact rains may subside the concentration of SPM etc. However, immediately after the spells of rains the polluted stagnant flood water may add odour and increase RSPM, etc. It further becomes cause of bacterial/virus increase in the air borne SPMS. A detailed study of this effect may be taken up by TMC. The approach could be similar to the studies of air borne particulate matter with microbes near the Sewage Treatment Plant locations.

## 8.3 SOLID WASTE MANAGEMENT

The Thane Municipal Corporation has brought about some improvements in solid waste management such as sweeping of roads in the night, equipping the workers with proper tools and machines/vehicles, arrangement to separate organic from inorganic waste and entrusting the work of composting to an agency. Therefore, Thane was given the Clean City Award. Nevertheless, the city faces the problem of over accumulation of solid waste consisting of organic waste, bio-medical waste, plastic waste, dust and lot of dismantled material. The administration is not in a position to cope up with managing collection, treatment and disposal of solid waste due to inadequate machinery to handle increasing volume of the waste. Added to this is the lack of cooperation from public.

Solid waste management is rendered worse by the material swept from roads and garbage thrown by public into road side drains with the resultant silting of the drains. Most of the collected quantity of solid waste is dumped on the dumping ground. The composting plant is out of operation due to complaints by the local residents. Only about 50% to 60% of the solid waste is bio-degradable. The aerobic process of treatment was used for some time but unfortunately got discontinued. Silver line to this cloud is the bio-medical waste facility operated by an NGO – Enviro Vigil. The base line status of solid waste management in Thane city is not up to the mark. During water logging of the spots identified by Hariyali, the poor status of solid waste management aggrevates the pollution of surrounding watercourses and water bodies. Similarly, contamination of ground water and drinking water supply becomes severe during water logging period.

## 8.4 WETLANDS, MUDFLATS AND MANGROVES

Due to nearness of creeks TMC area has been by nature privileged with a good percentage of wetland, mudflats and mangroves as much as 9% of the city area. These lands are presently providing good holding capacities during situations of simultaneous high tides and high run-off. The mangroves which are specialized trees in saline and brakish waters exist in TMC area with good advantages of soil binder, protecting storm water damages and ecologically providing different aquatic life forms. They help controlling pollution of creek.

There are two Khar land schemes in TMC area at Kharegaon and Ovala. These have provided good agricultural potential to farmers. Moreover, these projects have created good detention capacity during high flood. Surprisingly, TMC development plan has not been taking expected cognizance of this detention potential for the run-off.

The TMC should make use of these lands for providing additional holding capacities by increasing heights of the bunds constructed by Khar land departments under the control of Irrigation Department of GOM. Instead, the absence of recognizing Kharland as 'no development zone' has resulted into allowing construction in Kharland area. This has further affected the very existence of mangroves.

It will be helpful to TMC in reducing the repetitive water logging spots in the creek vicinity if above situation is urgently corrected and additional holding capacities are provided in wet lands.

## 8.5 FOREST

The TMC is blessed with more than 30% of its area under forest land with a wide scope for afforestation. Instead, some of the lands have become places for hutments and slums.

The erosion of soil and boulders from the forest land adds lot of siltation in the upstream portion of all the watercourses, though, steep slopes help quickly taking the initial run-off on downstream. The heavy siltation is creating repetitive water logging situation near forest lands. The plantation of trees to reduce soil erosion, providing contour trenches as also geo-fabrics to arrest entry of boulders in watercourses, may have to be taken up on priority basis.

## 8.6 RECLAMATION

Uncontrolled development near the creek with total disregard to the development levels continues unabated in the TMC area. The entry of sullage in marshy lands has already reduced the agricultural areas from 53 sq. km to 30 sq. km in last 20 years. Unlike many other cities in India, the TMC is blessed with diverse ecological flora and fauna of forest as well as wet lands. Though urbanization needs reclamation, it should not be in unplanned manner and with disregard to hydraulics of watercourses and development levels. The repetitive water logging spots in the creek vicinity and also on upstream can be reduced by immediately taking up planned reclamation.

## 8.7 ROADSIDE TREES

There is no visible effect of water logging spots on the road side trees.

## 8.8 ECOLOGY AND MARINE HABITAT

The water logging does not directly affect flora and fauna of the locations.

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# CHAPTER 9
# ENVIRONMENTAL MANAGEMENT PLAN (EMP)

## 9.1 PURPOSE OF EMP

The EMP suggested in paragraphs 9.2 to 9.16 are actions in general for:

a] Preventing or reducing the repetitive water logging in TMC area.

b] Mitigation of hardships caused by water logging.

The identified water logging spots and the EMP applicable to each such spot have been indicated in the statement enclosed to this Chapter (P.37 to 46).

## 9.2 STORM WATER MANAGEMENT (Action: TMC)

**9.2.1** The TMC should plan and implement the program of de-silting of all watercourses up to invert level thrice in a year in the months of November, February & May.

**9.2.2** The program of shifting of utilities may be continued vigorously in respect all the watercourses.

**9.2.3** The TMC should plan and execute the programs of training of watercourses for improved carrying capacity for frequency of 1 in 10 years with suitable concentration time and duration.

**9.2.4** Roadside drains should be designed for higher intensity and less duration and the construction thereof should be implemented in a phased manner.

**9.2.5** A complete storm-water drain inventory with analysis should be maintained for monitoring and revision of the system.

**9.2.6** Before monsoon every year, a cell may be created at H.O. level to continuously monitor rainfall predictions of meteorological department and this cell should report to the City Engineer and the Municipal Commissioner.

**9.2.7** The TMC should conduct technical studies to find out expected quantum of flood in relation to runoff and high tides in different locations of TMC area. The study reports may be published every year during monsoon. The position at different locations should be monitored.

**9.2.8** A storm water drainage project should be prepared and implemented in next five years. This will also include demolition of structures in and on

the banks watercourses, keeping in view possible rehabilitation of residents and shopping units in such structures.

**9.2.9** The budgetary provision for storm water drainage should to be suitably stepped up for implementing the suggestions made above.

## 9.3 SOLID WASTE MANAGEMENT (Action: TMC and suitable NGO)

**9.3.1** The segregation of solid waste into bio-degradable & recyclable wastes should be enforced scrupulously at the level of individual households/shops/units, at collection machinery and at final disposal level. It may be necessary to frame rules for providing penalties for lapses in this regard.

**9.3.2** At the locations where 'Ghantagadi' can not go for garbage collection, adequate no. of litter bins should be provided and arrangements made to collect the garbage before it overflows.

**9.3.3** The frequency of transportation of container should be such that dustbin sites are cleared before they start overflowing.

**9.3.4** All organic/biodegradable waste may be composted by following suitable methods.

**9.3.5** Domestic hazardous waste, such as, used batteries, containers for chemicals and pesticides, etc, be disposed of by scientific land filling or any other suitable method.

**9.3.6** TMC should take up community capacity building and awareness program in association with suitable NGOs to nullify entry of any type of solid waste into road side drains and watercourses.

**9.3.7** With a view to avoiding entry of dung generated by cattleheds into the watercourses, owners should be prevailed upon to treat and produce manure or energy from dung.

## 9.4 BIO-MEDICAL WASTE (Action : TMC & NGO to be identified by TMC)

**9.4.1** TMC should plan opening of collection centers at appropriate places, such as hospitals, cluster of clinics, road squares, etc, for bio-medical wastes generated by private clinics, nursing homes and public at large and to plan for its collection and final disposal.

**9.4.2** TMC should initiate steps to prepare programs to make public aware of the hazards of bio-medical waste and of proper disposal of such waste.

**9.4.3** TMC should arrange for collection of data regarding generation and disposal of bio-medical waste.

## 9.5 SEWERAGE (Action: TMC)

**9.5.1** A time-bound program to stop leakages from joints should be worked, prepared out and implemented vigorously.

**9.5.2** TMC should finalise the sewerage plan for the entire city to avoid entry of sewage in open watercourses and to avoid body connection in sewer lines. The implementation of this plan should be ensured.

**9.5.3** With due consideration to the assimilative capacities of water bodies and treatment standards of MPCB, a plan for treatment and disposal of sewage should be prepared and implemented in a phased manner.

**9.5.4** A status report on sewage treatment plan should be prepared and steps should be taken to improve its efficiency.

## 9.6 WATER SUPPLY (Action: TMC)

**9.6.1** Priority is given to identify locations of contamination in the water supply distribution system and take preventive measures before monsoon.

**9.6.2** Identification of leakages in the water mains and distribution systems and their rectification should be attended to on a priority basis.

**9.6.3** TMC should also take up a program of identifying rusted pipes in the distribution system and prepare a plan for their replacement/rectification in a phased manner.

**9.6.4** A cell should be created in the Water Department at Head Office to monitor the program of leakage identification and rectification.

**9.6.5** A communication network for identification and reporting of leakage in the water supply distribution system may be created and published.

## 9.7 HEALTH (Action: TMC & NGOs/hospitals )

**9.7.1** TMC should develop 'capacity building programs' to take preventive measures to control epidemics. Assistance of NGOs, Rotary Clubs, Private doctors, Pathological laboratories etc, should be taken for testing of samples, house to house survey, free medical checkup, etc.

**9.7.2** Periodic meetings of NGOs, Rotary Clubs, etc, associated with the capacity building programs of Health Department should be convened to monitor programs.

**9.7.3** A plan for shifting of cattle sheds out of town should be drawn up and implemented.

## 9.8 SLUMS (Action: TMC)

**9.8.1.** The slum dwellers in and around watercourses, water bodies and on slopes of hills should be rehabilitated in a planned way to minimize losses of lives and structures due to floods and land slides.

**9.8.2.** TMC should take immediate action to prevent further erection of unauthorized structures including slums in and around watercourses and water bodies.

## 9.9 RAILWAYS (Action: Central Railway and TMC)

**9.9.1.** TMC should take a lead in setting up a Standing Committee to establish co-ordination at all levels between Central Railway and TMC for modification and maintenance of all the six railway culverts.

**9.9.2.** Maintenance of the railway culverts should be done well before monsoon.

## 9.10 ROADS (Action: TMC)

**9.10.1** TMC should identify and design formation levels for all roads in the city.

**9.10.2** While designing road level, due regard should be given to HFL of all surrounding water bodies instead of only local watercourse in front.

**9.10.3** The HR Dept. of TMC should convene seminars/conferences of personnel in different departments and of architects, engineers, etc, concerned with construction of roads and buildings so as to update their knowledge and for mutual exchange of knowledge and information.

**9.10.4** The efforts to maximize the concrete roads should be continued.

**9.10.5** New technologies should be adopted for longer durability of tar roads even in flood prone areas.

**9.10.6** Rainwater harvesting technique by taking bores in the roadside drains could be used to minimize run-off going to the watercourses.

**9.10.7** TMC should prepare plan for promptly repairing the potholes even during monsoon, even though such repairs are of temporary nature.

**9.11 TRANSPORT** (Action : Maharashtra State Transport Corporation, Thane and Thane Municipal Transport Corporation.)

**9.11.1** Available modern technology should be adopted so as to minimize damages to the tyers, suspension springs, break liners, etc, during flooding.

**9.11.2** A plan of upkeep and maintenance of the entire fleet of vehicles before onset of monsoon should be drawn and implemented with a view to keeping efficiency of vehicles at high level during monsoon.

**9.12 ELECTRIC SUPPLY: (Action: MSEDCL)**

**9.12.1** MSEDCL has been raising the levels of sub - stations in flood prone areas. This should be continued.

**9.12.2** Measures should be taken to prevent/minimize damage to pillars, cables, joints, etc. in floods prone areas.

**9.13 TELEPHONE SERVICES (Action: MTNL)**

**9.13.1** MTNL should raise the height of pillars above HFL in/and around water logging spots.

**9.13.2** The MTNL has been using modern technology for upgradation of cable joints to avoid leakages and to minimize disruption in services during flooding. This should be continued.

**9.14 WATER BODIES ( Action : TMC )**

**9.14.1** TMC should study the possibility of interlinking all lakes in Thane city for flood assimilation as well as for improvement in groundwater level.

**9.14.2** A study of the extent of pollution, dilution, advection, convection in case of estuaries and dilution during runoff in lakes should be carried out.

**9.14.3** Catchment area development to avoid pollution of flooding in water bodies and lakes should be taken up.

**9.15 DEVELOPMENT PLAN ( Action : TMC )**

**9.15.1.** Any new development in TMC area should be 0.6 m (2 feet) above HFL in relation to surrounding water bodies. Any development level of the plot should not be less than 4.9 m (GTS)

**9.15.2.** Any new development in TMC falling between design width of once in 2 years and once in 10 years should be free of any structures. Similarly, any development in area with design width of once in 10 years and once in 100 years should be provided with stilt arrangement.

**9.15.3.** In case of existing structures affected by backwater due to 'once in 100 years intensity', the developers/housing societies may be persuaded to convert the ground floor into stilt area.

**9.15.4.** TMC should prepare a plan for showing minimum level of reclamation and this plan should be enforced. No piecemeal reclamation should be resorted to.

**9.15.5.** Some area in open spaces should be earmarked to act as holding capacities for abnormal storm run–off and ingress of seawater.

**9.15.6.** For conservation of mangroves to work as buffers and for hydraulic assimilation, the TMC should ensure that wet land and mangroves are protected.

**9.15.7.** Growth of unauthorized habitats in violation of civic regulations is strictly prohibited.

**9.15.8.** Appropriate steps are taken for identifying and acquiring land for dumping and disposal of civic garbage taking into consideration the needs of at least next 25 years.

**9.15.9.** A well planned program for plantation of mangroves should be taken up by TMC.

**9.15.10.** Plantation of trees in the forest area and provision of suitable contour trenches should be taken up to reduce soil erosion and entry of boulders into the watercourses.

**9.15.11.** Provision of geo-fabrics to stop entry of boulders into the watercourses should also be considered.

## 9.16 RISK AND INSURANCE ( Action – TMC, Insurance Companies ).

**9.16.1** Data pertaining to structures at risk due to water logging may be compiled and a risk management plan may be evolved.

**9.16.2** Study of risk assessment factors such as, hazards identification, hazards analysis, consequence analysis, risk determination, risk evaluation may be carried out.

**9.16.3** Insurance companies may consider evolving 'deluge' risk insurance. While private people are expected to take such insurance, TMC may consider subsidizing the premium of 'deluge' insurance policies.

**9.17** EMP suggested for identified water logging spots are shown by indicating relevant paragraph numbers in the enclosed tables: (P.37 to 46)

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# IDENTIFIED WATER – LOGGING SPOTS IN TMC AREA
## SUGGESTED EMPs and ESs

| Sr. No. | IDENTI-FICATION NO. | LOCATION & PRABHAG | CAUSES OF WATER LOGGING | EMP main parameters for mitigation (Paragraph no.) | Engineering solutions (Paragraph No.) |
|---|---|---|---|---|---|
| 1.<br>&<br>2. | I(15)<br><br>I(52) | UTHALSAR PRABHAG<br><br>SAKET<br><br>BALKUM PIPE LINE | 1. Developments levels of this area are mostly less than 3.5 m (G.T.S.)<br>2. Water logging of 6" during high tide and heavy rainfall.<br>3. The run-off from road side is let out in pipe drain at a invert lower than highest high tide. | 9. 15. 1.<br>and<br>9. 15. 6. | 10.4<br><br>10.6 |
| 3. | I (2) | UTHALSAR PRABHAG.<br>VRINDAVAN SOCIETY. | 1. Total area is below the highest high tide.<br>2. The developmental levels are extremely on lower side. | 9.15.3<br>9. 15. 9. | 10.6 |
| 4 | I (1) | UTHALSAR PRABHAG<br><br>SHRIRANG SOCIETY | 1. Low lying area and extreme negligence by developer to bring development levels above high tide.<br>2. Surrounded by two Nallas subjected to tidal back water during heavy rainfall. | 9. 15. 9.<br>9. 3. 6.<br>&<br>9. 4. 2. | 10.1<br>10.6 |
| 5 | I (20) | UTHALSAR PRABHAG<br>K. VILLA | 1. Inadequate cross section of near by Nalla<br>2. Encroachment by slums in the watercourse. | 9. 3. 6.<br>&<br>9. 4. 2. | 10.1<br>10.8 |
| 6. | I (21) | UTHALSAR PRABHAG,<br>RABODI,<br>KOLI WADA,<br>KRANTI NAGAR | 1. Back water of high tide during rainfall.<br>2. Low lying area & encroachment by slums.<br>3. The compound wall of central jail has reduced cross section of Nalla.<br>4. During high tide due to less carrying capacity & skew alignment, water spills out. | 9. 3. 6.<br>9. 15. 7.<br>&<br>9. 15. 3.<br>9. 8. 1.<br>9. 8. 2. | 10.1<br>10.8 |

## IDENTIFIED WATER – LOGGING SPOTS IN TMC AREA
## SUGGESTED EMPs and ESs

| Sr. No. | IDENTI-FICATION NO. | LOCATION & PRABHAG | CAUSES OF WATER LOGGING | EMP main parameters for mitigation (Paragraph no.) | Engineering solutions (Paragraph No.) |
|---|---|---|---|---|---|
| 7. | I (22) | UTHALSAR PRABHAG<br>MAJIWADA<br>VILLAGE | Same as I (15), SAKET. | 9. 15. 1.<br>&<br>9. 15. 6 | 10.4<br><br>10.6 |
| 8. | II (6) | NAUPADA PRABHAG<br><br>RAM MARUTI ROAD. | **1.** Saucer type low lying area with higher level of roads.<br>**2.** Low carrying capacity of Nalla.<br>**3.** Encroachment by Hotel & school building.<br>**4.** Desilting becomes difficult because of encroachment.<br>**5.** Water logging occurs for about 2 to 4 hours. | 9. 15. 3.<br><br>9. 2. 1.<br><br>9. 2. 3.<br>&<br>9. 2. 4. | 10.1 |
| 9.<br>&<br>10. | II (27)<br><br>II(16) | NAUPADA PRABHAG<br><br>BRAHMAN SOCIETY.<br><br>ANANDASHRAM | **1.** Proximity to railway tracks with inadequate capacity of railway culvert.<br>**2.** Desilting of culvert is not properly done.<br>**3.** 1 to 2 hours water logging occur. | 9. 9. 1.<br><br>&<br><br>9. 9. 2. | 10.1<br><br>10.4 |
| 11.<br>&<br>12. | I (5)<br><br>I (4) | NAUPADA PRABHAG,<br>KHARTAN ROAD,<br>CHENDANI KOLIWADA | **1.** Subjected to high tide.<br>**2.** Cross drainage culvert inadequate.<br>**3.** Less carrying capacity of cross drainage & Nalla.<br>**4.** Encroachment hampering flow conditions. | 9. 3. 6.<br>&<br>9. 4. 2 | 10.1 |
| 13. | II (24) | NAUPADA PRABHAG,<br>KOPARI, DOWN SIDE | Inadequate capacity of railway culvert. | 9. 9. 1.<br>&<br>9. 9. 2. | 10.1<br><br>10.4 |

## IDENTIFIED WATER – LOGGING SPOTS IN TMC AREA
## SUGGESTED EMPs and ESs

| Sr. No. | IDENTI-FICATION NO. | LOCATION & PRABHAG | CAUSES OF WATER LOGGING | EMP main parameters for mitigation (Paragraph no.) | Engineering solutions (Paragraph No.) |
|---|---|---|---|---|---|
| 14. | I (11) | KOPARI PRABHAG<br>KOLIWADA, THANE (E)<br>(CHENDANI) | **1.** Low level area.<br>**2.** Affected by back water of creek.<br>**3.** Water from railway tracks leading to Hariyali tank spreads in low lying area. | 9. 2. 3.<br>&<br>9. 9. 1.<br>9. 9. 2. | 10.1 |
| 15.<br>&<br>16. | I (19)<br>II (3) | | | | 10.1 |
| 17. | II (23) | KOPARI PRABHAG<br>ANAND TALKIES | **1.** Inadequate capacity of culvert.<br>**2.** Affected by watercourse WC 1 & WC 2.<br>**3.** Inadequate carrying capacity of Nalla.<br>**4.** Skewed alignment of Railway culvert & TMC Nalla. | 9. 3. 1<br>9. 3. 6.<br>9. 4. 2.<br>&<br>9. 9. 1.<br>9. 9. 2. | 10.1 |
| 18. | II (61) | NAUPADA PRABHAG<br>ANAND NAGAR | **1.** Improper level of highway culvert.<br>**2.** Affected by WC 1 & WC 2 with inadequate carrying capacity.<br>**3.** Encroachment by slums. | 9. 3. 1.<br>&<br>9. 3. 6.<br>9. 4. 2. | 10.1 |
| 19. | II (29) | RAILADEVI PRABHAG,<br>ROAD NO.21 | The road side drains are not provided & designed. | 9. 2. 4. | 10.2 |
| 20.<br>To<br>22. | II (30)<br>IV (48)<br>IV (47) | RAILADEVI PRABHAG<br>ROAD No34,<br>RAM NAGAR,<br>HANUMAN NAGAR. | **1.** Due to slums Nalla has been diverted.<br>**2.** Inadequate carrying capacity of watercourse.<br>**3.** Silting due to boulders and soil erosion. | 9. 3. 6.<br>9. 4. 2 &<br>9. 8. 1<br>9.15.11 | 10.1 |

## IDENTIFIED WATER – LOGGING SPOTS IN TMC AREA
## SUGGESTED EMPs and ESs

| Sr. No. | IDENTI-FICATION NO. | LOCATION & PRABHAG | CAUSES OF WATER LOGGING | EMP main parameters for mitigation (Paragraph no.) | Engineering solutions (Paragraph No.) |
|---|---|---|---|---|---|
| 23. | IV (31) | RAILADEVI PRABHAG, TMT DEPOT | (1) SAME AS ABOVE | 9. 3. 6. 9. 4. 2 & 9. 8. 1 | 10.1 |
| 24. | VI (44) | RAILADEVI PRABHAG RUPADEVI PADA | (1) Low lying area. (2) The drop between invert level of Nalla & incoming drain is not adequate. (3) Encroachment and utilities have reduced carrying capacity of Nalla. (4) Silting due to eroded material from hills. (5) Dumping of solid waste. | (1) To avoid siltation & erosion grass cultivation in forest area is necessary. 9.2.2, 9.8.1, 9.3.6, 9.4.2 & 9.3.2. | 10.1 |
| 25. | II (40) | RAILADEVI PRABHAG KAMGAR HOSPITAL | (1) Proper cross drainage in the form of culvert is not constructed. (2) Pipe culvert wrongly provided improper invert level compared to Nalla invert level. | Nil | 10.1 |
| 26. | V (42) | RAILADEVI PRABHAG, INDIRANAGAR(Near Road No.22) | (1) Silting of Nalla due to soil erosion. (2) Solid waste is dumped by the people in the Nalla. (3) Inadequate cross drainage and pipes. | 9. 3. 2. 9. 3. 6. 9. 4. 2. | |
| 27. & 28. | V (43) II (35) | RAILADEVI PRABHAG SATHE NAGAR Road No.22 | (1) Affected due to development of slums e.g. Ajinkya Tara slums. (2) The invert level of cross drainage and watercourse are reverse. | 9. 3. 2. 9. 3. 6. & 9. 4. 2. | 10.2 |
| 29. | II (28) | RAILADEVI PRABHAG, BRADMA COMPANY | (1) Inadequate capacity of culvert. (2) Flow affected due to utilities. | 9. 2. 2. | 10.1 |

## IDENTIFIED WATER – LOGGING SPOTS IN TMC AREA
## SUGGESTED EMPs and ESs

| SR. NO. | IDENTI-FICATION NO. | LOCATION & PRABHAG | CAUSES OF WATER LOGGING | EMP main parameters for mitigation (Paragraph no.) | Engineering solutions (Paragraph No.) |
|---|---|---|---|---|---|
| 30. | II (67) | RAILADEVI PRABHAG, AMBEWADI MARKET | (1) Area is totally saucer like area.<br>(2) Difficult to remove the water. | Nil | 10.1 |
| 31. | II (68) | RAILADEVI PRABHAG, SAMARTH NAGAR | (1) Inadequate capacity of culvert. | Nil | 10.1 |
| 32. | II (33) | WAGALE ESTATE PRABHAG, TEEN HATH NAKA, MENTAL HOSPITAL | (1) Affected due to nearness of Nalla WC 2.<br>(2) Road side drains are inadequate.<br>(3) Utilities are hampering the flow.<br>(4) Silting of Nalla. | 9. 2. 2.<br>9. 2. 4.<br>&<br>9. 2. 1. | 10.2 |
| 33<br>&<br>34. | II (34)<br>II (37) | WAGALE ESTATE PRABHAG, RAGHUNATH NAGAR | (1) Low lying area.<br>(2) Affected due to encroachment by slums.<br>(3) Unauthorized construction has reduced carrying capacity resulting in narrowing in the Nalla.<br>(4) Affected due to watercourse WC 2.<br>(5) No road side gutter | 9.3.2.<br>9.3.6.<br>9.8.1.<br>&<br>9.2.4 | 10.1 |
| 35. | II (36) | WAGALE ESTATE PRABHAG, SBI CIRCLE WITH ROAD NO. 22. | (1) Affected due to watercourse WC 2.<br>(2) Flow affected due to utilities.<br>(3) Soil erosion from hills results silting. | 9. 2. 2.<br>9.15.10 | 10.5 |
| 36. | IV (53) | VARTAK NAGAR PRABHAG, MANPADA SOUTH | (1) Inadequate capacity of culvert.<br>(2) Nalla having narrow width on down stream result back water. | Nil | 10.1 |

## IDENTIFIED WATER – LOGGING SPOTS IN TMC AREA
## SUGGESTED EMPs and ESs

| SR. NO. | IDENTI-FICATION NO. | LOCATION & PRABHAG | CAUSES OF WATER LOGGING | EMP main parameters for mitigation (Paragraph no.) | Engineering solutions (Paragraph No.) |
|---|---|---|---|---|---|
| 37. | IV (62) | VARTAK NAGAR PRABHAG VASANT VIHAR CIRCLE | (1) Inadequate width of Nalla.<br>(2) Erosion of soil and boulders from hills affect the flow. | 9.15.10<br>9.15.11 | 10.1 |
| 38. | II (32) | VARTAK NAGAR PRABHAG MAJIWAD PAPER PRODUCTS | (1) Solid waste dumping in the Nalla by surrounding slum Locality. | 9. 3. 2<br>9. 3. 6.<br>&<br>9. 4. 2. | |
| 39. | IV(45) | VARTAK NAGAR PRABHAG MAHATMA PHULE NAGAR. | (1) Low lying area.<br>(2) Inadequate capacity due to encroachment affecting width of Nalla.<br>(3) Slum area & solid waste disposal create problems in smooth flow. | 9. 3. 6.<br>9. 3. 2.<br>&<br>9. 4. 2.<br>9. 8. 1. | 10.1 |
| 40. | II (63) | VARTAK NAGAR PRABHAG, HARDAS NAGAR | (1) Low lying area.<br>(2) Solid waste dumped by people in slum area. | 9. 3. 2.<br>9. 3. 6. &<br>9. 4. 2.<br>9. 8. 1. | 10.1 |
| 41. | II (64) | VARTAK NAGAR PRABHAG, RUNWAL JUNCTION KORAS ROAD | (1) Improper capacity of culvert.<br>(2) Alignment of Nalla is skew. | Nil | 10.1 |
| 42. | III (65) | VARTAK NAGAR PRABHAG, SAMBHAJI NAGAR | (1) Low lying area.<br>(2) Solid waste dumping by people in slum. | 9. 8. 1.<br>9. 3. 2.<br>&<br>9. 3. 6. | 10.1 |

# IDENTIFIED WATER – LOGGING SPOTS IN TMC AREA
## SUGGESTED EMPs and ESs

| SR. NO. | IDENTI-FICATION NO. | LOCATION & PRABHAG | CAUSES OF WATER LOGGING | EMP main parameters for mitigation (Paragraph no.) | Engineering solutions (Paragraph No.) |
|---|---|---|---|---|---|
| 43. | II (66) | VARTAK NAGAR PRABHAG, NALPADA | (1) Low lying area.<br>(2) Solid waste dumping by people in slum. | 9. 8. 1.<br>9. 3. 2. &<br>9. 3. 6. | 10.1 |
| 44. & 45. | IV (59)<br>IV (60) | MAJIWADA PRABHAG<br>BHAYANDAR-PADA,<br>KAJUPADA ( outside TMC) | (1) Inadequate cross drainage.<br>(2) Upstream of Ghodbundar road Nalla affected by structures of permanent nature on the Nalla. | (1) To compel occupants of normal (G + 2 or more) buildings to treat the waste or to reuse it within their compound till regular sewerage system is provided by TMC.<br>(2) 9.2.2., 9.8.1.,9. 8. 2. | 10.1<br>10.8 |
| 46. | IV(57) | MAJIWADA PRABHAG<br>ANAD NAGAR | (1) Inadequate cross drainage.<br>(2) Affected due to slum area.<br>(3) Eroded material cause silting.<br>(4) Solid waste dumping by surrounding people.<br>(5) Affected flow due to utilities.<br>(6) Upstream affected due to permanent structures on the Nalla. | 9. 3. 2.<br>9. 3. 6.<br>9. 4. 2.<br>9. 8. 2.<br>9. 15. 1 **to** 9.15.3.<br>9.15.10 | 10.1<br>10.8 |
| 47. | IV (58) | MAJIWADA PRABHAG, OWALA | (1) Inadequate cross drainage.<br>(2) Upstream affected due to permanent structures on Nalla. | As above. | 10.1<br>10.8 |
| 48. | IV (56) | MAJIWADA PRABHAG<br>VADAVALI | (1) Inadequate side gutter on roads.<br>(2) Eroded material from Takardapada road block the watercourse & side drains.<br>(3) Inadequate cross drainage. | As indicated against Sr.No.47 | 10.1<br>10.8 |

## IDENTIFIED WATER – LOGGING SPOTS IN TMC AREA
## SUGGESTED EMPs and ESs

| SR. NO. | IDENTI-FICATION NO. | LOCATION & PRABHAG | CAUSES OF WATER LOGGING | EMP main parameters for mitigation (Paragraph no.) | Engineering solutions (Paragraph No.) |
|---|---|---|---|---|---|
| 50. | II (55) | MAJIWADA PRABHAG. BOMBAY CHEMICALS, BRAHMAND COMPLEX ROAD TO DEEPNAGAR | (1) Low laying area. (2) No outlet for easy discharge of run-off. | As indicated against Sr.No.47 | 10.1 |
| 51. | II (69) | MUMBRA & DIWA PRABHAG. RASHID COMPOUND | (1) Low lying area. (2) Development levels are wrong. | 9. 15. 1. | 10.2 |
| 52. | I (70) | MUMBRA & DIWA PRABHAG, INSHA NAGAR | (1) Low lying area. (2) Development levels are wrong. (3) Moderately subjected to high tide levels. (4) Cross drainage on by pass highway under construction is not properly designed. | 9. 15. 1 9. 15. 7. & 9. 8. 1. 9. 8. 2. | 10.1 |
| 53. | I (9) | KALWA PRABHAG SHASTRI NAGAR | (1) Subjected to high tide conditions. (2) People from slum dump solid waste in the Nalla. | 9. 3. 2. 9. 3. 6. & 9. 4. 2. | 10.6 |
| 54. | II (7) | KALWA PRABHAG, MANISHA NAGAR | (1) Low lying area. (2) Subjected to moderate water logging to some extent. | Nil | 10.1 |
| 55. | V (49) | KALWA PRABHAG, BHIM NAGAR | (1) Subjected to high tide conditions. (2) People from slum area dump solid waste in Nalla. | 9. 3. 2. 9. 3. 6. 9.4.2. & 9.8.1 | 10.6 |
| 56. | II (71) | KALWA PRABHAG, NEW SHIWAJI NAGAR KALWA (E) | (1) Railway culvert is inadequate. (2) Silting due to erosion from hills. | 9. 2. 1 9. 9. 1. & 9. 9. 2. | 10.1 |

## IDENTIFIED WATER – LOGGING SPOTS IN TMC AREA
## SUGGESTED EMPs and ESs

| SR.NO. | IDENTI-FICATION NO. | LOCATION & PRABHAG | CAUSES OF WATER LOGGING | EMP main parameters for mitigation (Paragraph no.) | Engineering solutions (Paragraph No.) |
|---|---|---|---|---|---|
| 57. | I (8) | KALWA PRABHAG, KHAREGAON, BUDHAJI PATIL MARG | (1) Inadequate capacity of Nalla.<br>(2) Due to Erosion from hills silting of Nalla. | 9. 2. 1. | 10.1 |
| 58. | II (73) | KALWA PRABHAG 'Sea' ROCK BUILDING | Subjected to high tide conditions. | 9. 15. 3. | 10.1<br>10.6 |
| 59. | III (74) | KALWA PRABHAG VITAVA BRIDGE | (1) Low lying area.<br>(2) Accumulation of silt on the road.<br>(3) Existing bridge below high tide level appears to be low level causeway. | 9. 2. 1. | 10.3 |
| 60. | I (75) | KALWA DIWA PRABHAG DIWA DATIVALI & OTHER AREAS. | (1) All unauthorized construction without consideration to development levels will cause flooding in this area in near future.<br>(2) No regards to CRZ – 2 regulations. | 9. 8. 1. & 9. 8. 2. | 10.3 |
| 61. & 62. | I (10) I (26) | MUMBRA, KUMBAR KOLIWADA, MUMBRA STATION. | (1) Railway culverts inadequate.<br>(2) Inadequate cross drainage | 9.9.1 & 9.9.2 | 10.1 |
| 63. | V (50) | ULHAS NAGAR PRABHAG, AMBBEDKAR NAGAR | (1) Low lying area.<br>(2) Solid waste dumping | 9.3.1 9.3.2 & 9.3.6 | 10.1 10.7 |

## IDENTIFIED WATER – LOGGING SPOTS IN TMC AREA
## SUGGESTED EMPs and ESs

| | | | | | |
|---|---|---|---|---|---|
| 64. | II (13) | UTHALSAR PRABHAG<br>VANDANA TACKIES | (1) Inadequate cross-section<br>(2) Solid waste dumping | 9.3.1<br>&<br>9.3.6 | 10.1<br>10.7 |
| 65. | II (61) | KOPARI PRABHAG<br>AZAD NAGAR | (1)Solid waste dumping<br>(2) Slum area | 9.3.1<br>9.3.6<br>9.8.1<br>9.4.1<br>9.4.2 | 10.1<br>10.7 |

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# CHAPTER 10
# ENGINEERING SOLUTIONS

## 10.1 TRAINING OF MAJOR WATER COURSES

**10.1.1** The design criteria in terms of improvement of carrying capacity should be decided on the basis of intensity of rainfall once in 10 years for major watercourses. Accordingly, width of these watercourses and cross sections should be worked out. The watercourses should be provided with walling and bedding with suitable material like stone/R.C.C. walls and c.c. beds.

**10.1.2** As regards intensity of rainfall once in 100 years, the width and zone for each major watercourse should be calculated and no permission for any structure should be granted in this zone.

**10.1.3** As and when required, the pumping of run-off should be resorted to in the requisite area. For this purpose, the sites requiring such arrangement should be identified and pumping stations and pumping arrangement should be provided.

**10.1.4** On-line submersible pumps should be provided for de-silting of nallas wherever machine cleaning or even manual cleaning is not possible.

## 10.2 PROVIDING ROAD SIDE STORM WATER DRAINS

**10.2.1** Every road should have side-drains based on intensities suggested by TMC consultants by taking due cognizance of technical presentation by Mr. S.D. Chawathe et al, The camber for the road and drains have to act in a perfect manner of no stagnation of rain water on any part of the road.

**10.2.2** All road side drains emptying into watercourses should be provided with sufficient fall and free flow as far as possible.

**10.2.3** Based on 10.2.2, formation levels of the roads have to be decided and constructed.

## 10.3 CONTROL BY TOWN PLANNING AND DEVELOPMENT DEPARTMENT OF TMC

**10.3.1** It should be made mandatory for the architects to submit plans of formation level of roads in front, location of watercourses, invert levels of watercourses, proposed width of watercourses, proposed

development levels, internal storm water drainage arrangement and proposed plinth levels.

**10.3.2** The proposed development level of any plot in TMC area should not be less than 4.9 m (GTS).

**10.3.3** A plan showing proposed formation levels of roads in TMC area should be released.

**10.3.4** A plan showing areas covered with mangroves should be released by TMC.

**10.3.5** All these requirements should be incorporated in the Commencement Certificate issued by TMC for any structure.

**10.3.6** The TMC should design and incorporate locations of detention ponds on the development plan of TMC.

## 10.4 CLEANING OF WATER COURSES

**10.4.1** All the major watercourses should be provided with a side road of minimum width of 4 m. for plying of machinery and equipment for de-silting.

**10.4.2** The frequency of desilting program for watercourses should be three times a year.

**10.4.3** Similarly, all road side drains should be cleaned at least three times a year.

## 10.5 SHIFTING OF UTILITIES

**10.5.1** TMC should declare and coordinate program for shifting of utilities every year.

**10.5.2** In next three years, shifting of utilities should be completed.

**10.5.3** In case of cross drainage, the utilities along the roads should cross, free of culverts.

**10.5.4** In case of utilities crossing the road, a separate duct should be provided.

## 10.6 CONSTRUCTION OF DETENTION PONDS

**10.6.1** It is possible to provide for detention ponds on the bank of Thane and Ulhas creek as absorption capacities for unusual run -off.

**10.6.2** The TMC should coordinate with Khar land department of GOM and enforce CRZ regulation to enable providing such detention ponds.

**10.6.3** Wherever needed and feasible, simple embankment structure on the bank may be thought of by TMC, to avoid entry of high tide water.

**10.6.4** The required non-return flaps should be designed and provided.

## 10.7 CONTROL ON SOLID WASTE IN THE WATER COURSES

**10.7.1** No engineering solution will be effective until entry of domestic and other solid waste into the watercourses is totally stopped.

**10.7.2** The TMC should float an awareness program with the help of suitable NGOs to prevail upon all the public in general not to dump solid waste into the watercourses and road side drains.

**10.7.3** TMC should prepare and implement a plan for collection, treatment and disposal of solid waste.

## 10.8 DEVELOPMENT OF LOW LYING AREAS AND SLUMS

**10.8.1** In near future, TMC should implement development of slums and of low lying areas so that sullage from slums is not let out in the watercourses and storm water is not accumulated in such areas.

**10.8.2** The necessary provisions for SRD/SRA application on the lines of Mumbai Mahanagar Palika should be made for these schemes.

## 10.9 SEWERAGE NETWORK

**10.9.1** It is utmost necessary for TMC to design and provide for a complete sewerage scheme with treatment and disposal methods.

**10.9.2** As a temporary solution in slum area, construction of shallow sewer to collect sullage from slums should also be considered.

**10.9.3** If required, short outfalls for disposal of effluents from STPs may be considered by TMC.

**10.9.4** For the above purpose pollutant carrying capacities of Thane/Ulhas creek should be worked out.

## 10.10 HYDRAULIC MODELLING OF CREEKS

**10.10.1** All Corporations and Councils abutting Thane and Ulhas creek should come together to study rainfall, run-off and estuarine mechanisms of the creeks.

**10.10.2** The agency like CWPRS may be appointed by all the above Corporations and councils jointly with NIO and NEERI to carry out such studies.

## 10.11 TUNNELING AS OPTION

**10.11.1** A deep interceptor or tunneling option with under ground reservoir and use of storm water for dilution of sewage may be studied on macro basis.

**10.11.2** This option will be quite costly. However, cost comparison may be kept on record.

## 10.12 INTERLINKING OF LAKES

**10.12.1** The topography of TMC is suitable for preservation of lakes which are absorbent of run-off.

**10.12.2** Interlinking of lakes may be studied with due regards to surrounding creeks.

**10.12.3** The block cost of such a project may be worked out and kept on record.

**10.12.4** Engineering solutions for Identified water logging spots are shown by indicating paragraph numbers in the table in chapter 9 (P.47 to 56).

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# CHAPTER 11
# ACTION PLAN FOR TMC

## 11.1 IMMEDIATE ACTION POINTS

TMC should take immediate action, preferably before next Monsoon, on following action points:

**a]** Twelve dead water pipelines should be removed from the watercourse near Ambewadi market in Railadevi Prabhag.

**b]** Redesigning the watercourse near Bradma company( Railadevi Prabhag)in such a way that there are two streams from two sides of the road so as to prevent water logging at the low level near Bradma Company.

**c]** Removal of collapsed wall from the Watercourse near Hiranandani Road at Patlipada North

**d]** Removal of structures from within the Watercourse at K Villa (Uthalsar Prabhag) and Bhayandar pada in Majiwada Prabhag.

**e]** Removal of blockage of cross-drainage at Hiranandani Road in Patlipada North.

**f]** Request BMC for widening and training of culvert at Anandnagar on Eastern Express Highway and pursue the matter vigorously with them.

**g]** Deepening of the watercourse at Ambewadi market near Road no 33, and at Rupadevi pada and Sathenagar in Railadevi Prabhag and at Kharegaon and Budhaji Marg in Kalawa Prabhag.

**h]** Removal of water supply lines from the watercourse at Bradma Company in Railadevi Prabhag and near Shubharambha Society ( before Soham Hava Mahal ) in Uthalsar Prabhag and if the utilities in the watercourse contain such water supply lines near water logging spots at Rupalipada, ITI Naka, Teen Hath Naka and Mental Hospital, all falling in Railadevi Prabhag.

**i]** Redesigning and reconstruction of drains at Khartan Road in Naupada Prabhag

**j]** Redesigning of culverts to provide proper invert level in the watercourse near Civil Hospital and Kamgar Hospital and near Samartha Nagar in Railadevi Prabhag, at Manpada South and Runwal Junction-Koras Road in Vartak Nagar Prabhag and at Suraj Water Park in Majiwada Prabhag.

k] Redesigning and implementation of cross-drainage at Indiranagar in Railadevi Prabhag and at Bhayandarpada, Vadavali and Anandnagar in Majiwada Prabhag.

l] Redesigning and training of downside of the watercourse up to the creek even in the marshy land in Bhayandapada in Majiwada Prabhag.

m] Identifying pockets for undertaking public awareness programs for solid waste disposal and arranging such programs with suitable NGOs. Simultaneously arrangements should be made to provide bins for storage of solid waste and for its collection, transport and disposal.

n] Enforcing the development levels by all the developers while taking up any new development works.

## 11.2 MEDIUM TERM STRATEGY

**11.1.1** TMC should take up a detailed survey of one watercourse originating in Railadevi Prabhag and meeting Thane creek to find out alternate solutions for minimizing water logging in its vicinity and mitigating the environmental problems such as water pollution, air pollution, etc. the work in this pilot project should include, *inter alia*, provision of sewer lines including shallow sewers, avoiding solid waste dumping by people by provision of training, imposing fines, provision of collection and transport of solid waste, providing removable 'dhapas' on the watercourse running through the hutments, considering whether rehabilitation of slum dwellers is necessary for providing pathway enabling to ply the desilting machinery. Costs of such works could be worked out and, if necessary, the possibility of approaching a funding agency could be explored.

**11.1.2** TMC should consider construction of detention ponds as suggested in the Report.

**11.1.3** TMC should set up a Standing Committee for Co-ordination with Central Railway for modernization and de-silting of railway culverts.

**11.1.4** TMC should co-ordinate with Forest Dept for putting geo-fabrics on slopes near watercourses and for plantation of trees/ grass. Action to be initiated by TMC and take help of 'Hariyali' for follow-up.

**11.1.5** TMC should seek co-operation of service providing bodies such as MTNL, MSEDCo, Mahanagar Gas Nigam, etc for shifting utilities from watercourses.

## 11.3 LONG TERM STRATEGY

**11.1.6** TMC should frame development regulations containing, among others, development levels of land with reference to HFL in relation to surrounding water bodies, development levels of roads etc and to enforce the regulations.

**11.1.7** TMC should seek co-operation of other Corporations and Councils for study of Thane and Ulhas creeks in the saucer type low lying areas as suggested in the Report.

**11.1.8** In the saucer type low lying areas planned program should be implemented on the lines of slum redevelopment strategy to nullify any water logging in such areas.

**11.1.9** The ideal situation of total absence of sewage and solid waste in the watercourses should be planned and achieved by TMC in the next 5 years.

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# ACKNOWLEDGEMENT

HARIYALI

**Regd. Office**: 5/702, Flower Valley, Eastern Express Highway, Thane 400601
**Administrative Office**: 26, Dadoji Konddeo Stadium, Khartan Road, Thane 400601
Mobile: 093232-91890 Tel/Fax: 022-25474119 Admn. Office Tel: 022-25408661
Email: punamsingavi@mtnl.net.in Web Site: hariyalithane.com

## ACKNOWLEDGEMENT

What was originally scheduled to be only a Report on the Deluge of July 2005 in Thane City, ultimately turned out to be a well carved out 'PROJECT REORT ON REPETITIVE WATER LOGGING IN THANE CITY – ENGINEERING SOLUTIONS AND ENVIRONMENTAL MANAGEMENT PLAN", thanks to the motivation and sponsorship provided by the MMR-Environment Improvement Society. Hariyali is indeed thankful to the Board of Directors, their respective Sub-Committee and the Administrative Staff of the Society, without whose encouragement, support and guidance preparation of Project Report like this would not have been possible.

Support received by the Thane Municipal Corporation led by its Administrative Head, Shri Nandkishore Jantre, I.A.S. and his worthy predecessor, Shri Sanjay Sethi in procuring necessary feed back from the records of the Corporation was remarkable. Shri K.D. Lala, City Engineer of Thane Municipal Corporation not only extended necessary support through his deputies, but also gave his consent to act as a Member of the Experts Committee set up by HARIYALI for the execution of this project. Other Members of Engineering faculty of TMC, more particularly, those working at different Prabhags, participated in the field visits and gave benefit of their experience and knowledge in an unreserved manner.

Names and designations of all the Members of the Experts Committee with Shri S.N. Patankar as its Convener are given at an appropriate place in the compilation of Annexures to the Main Report. All of them, stalwarts in their respective fields, lent their voluntary services, working with a zeal and enthusiasm disregarding their age. Special mention must be made of Shri S.N. Patankar, M.V. Date, H.M. Oswal and Prin. L.S. Bhole for their tireless work right from processing of the Deluge Survey Forms to preparation of the Final Report. Shri. V.S. Kelkar and S.V. Deshmukh's rapport with the TMC came very handy. Similarly, the support staff and volunteers who assisted the Experts Committee in conducting interviews of people from various disciplines also performed their designated task in a competent and diligent manner. Names of the

persons from various disciplines who were interviewed and whose opinions were of immense value in drafting the Final Report have been given separately in the Annexures. The assistance received from M/s. Gurukripa Enterprises in preparing the maps, Shri Arun Singavi of M/s. Balaji Enterprises and Shri Vijay Lad in data compilation was remarkable.

Students from N.S.S. Units of various Participating Colleges and their respective Professors in charge showed an exceptional zeal and competence in conducting the preliminary survey within a pretty short period. The encouragement received by them from their respective managements in associating with the activities of Hariyali and this Project particularly, was worth appreciating. So did the Moderators perform their job in a competent manner. The Preliminary Survey would not have been possible and Hariyali would not have been able to take up the further Project of preparing Engineering Solution and Environmental Management Plan without the forthright response from more than 8000 families who were interviewed during the first stage. Support received from the young administrative staff of HARIYALI, too, cannot go without mention.

HARIYALI is indeed thankful to all whose names are mentioned hereinabove and others who were directly or indirectly associated with the preparation of this Report.

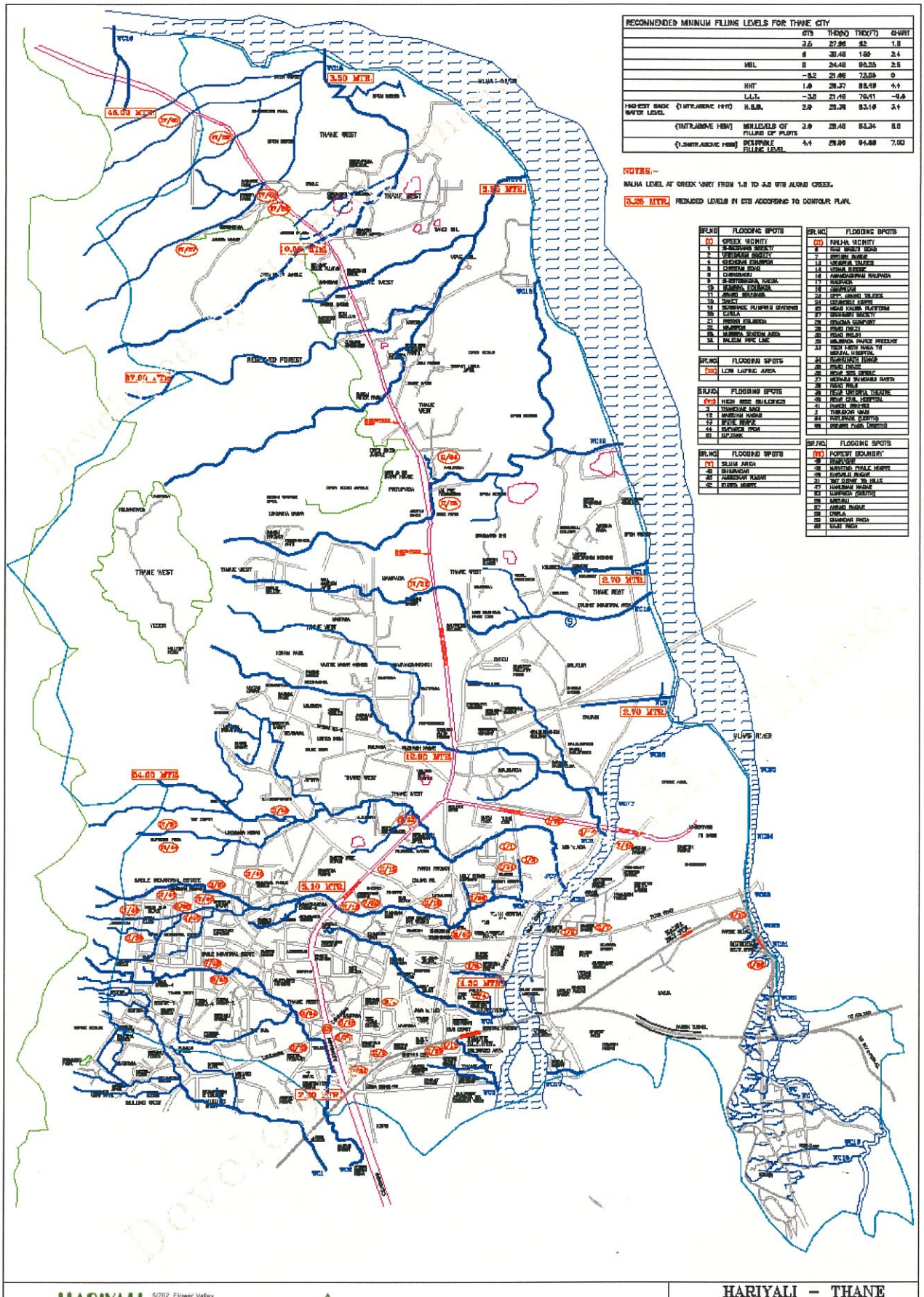
**HARIYALI would like to dedicate this Report to all those who lost their lives and to those others who had to suffer a lot of monetary loss, mental and emotional torture and inconvenience during the period of Deluge of July 2005 and who continue to undergo the same year after year because of the repetitive water logging in Thane City.**

For and on behalf of all the Members of Hariyali
Managing Committee, Board of Trustees and
The Experts Committee.

Thane, 16th April 2007.

Punam Singavi
(President, Hariyali)

# COMBINED LAYOUT OF THANE CITY




HARIYALI हरियाली
5/702, Flower Valley, Eastern Express Highway, Thane - 400 601.
5/702, फ्लावर व्हॅली, ईस्टर्न एक्सप्रेस हायवे, ठाणे - 400 601.
Admn. Off.: 26, Dadoji Konddeo Stadium, Khanan Road, Thane - 400 601.
Mobile 93232-91890 Telefax 022-25474119, 022-25408661 E-mail: punarmingavi@vsnl.com Web : hariyalithane.com

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HARIYALI – THANE

PROJECT:- SMP AND EB FOR THE PREVENTION OF REPETITIVE WATER LOGGING IN THANE CITY.

TITLE:- COMBINED LAYOUT OF THANE CITY

DRAWN BY:- DEPUTY CORPORATION ENGINEER SCALE:- 1 : 500

DRG.-HRL-01 DATE:- 04.05.2006

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