Urban Floods: Case Study of Surat

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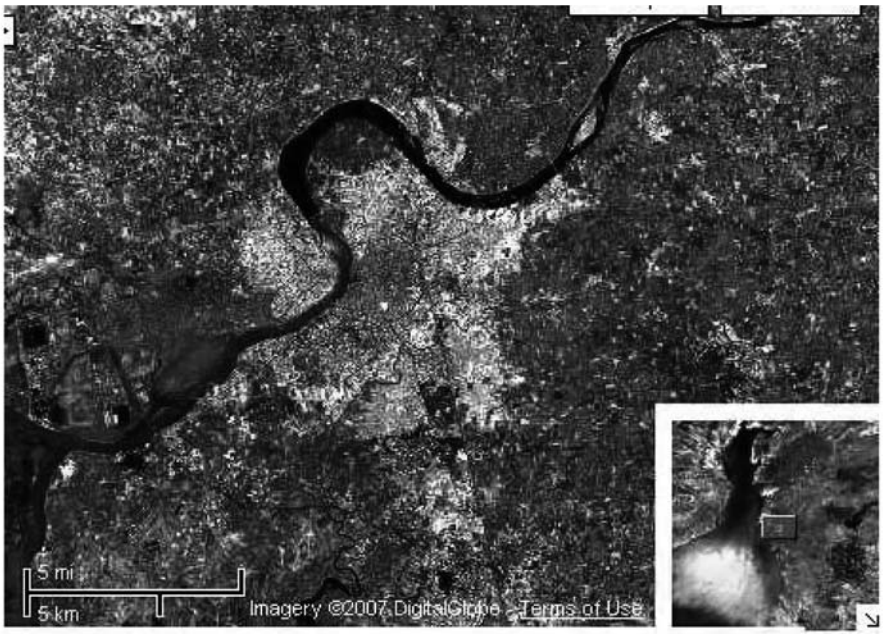
City Profile

Surat is located midway on the 500 km long Ahmedabad-Mumbai western railway corridor and as many as forty pairs of express, mail and passenger trains pass through it. The state government has also established an airstrip to facilitate smaller aircraft landings but no domestic air service has been started yet.

The city forms the major urban core on the Ahmedabad- Bombay regional corridor, centrally located at a distance of 260 kms North of Bombay and 224 kms South of Ahmedabad.



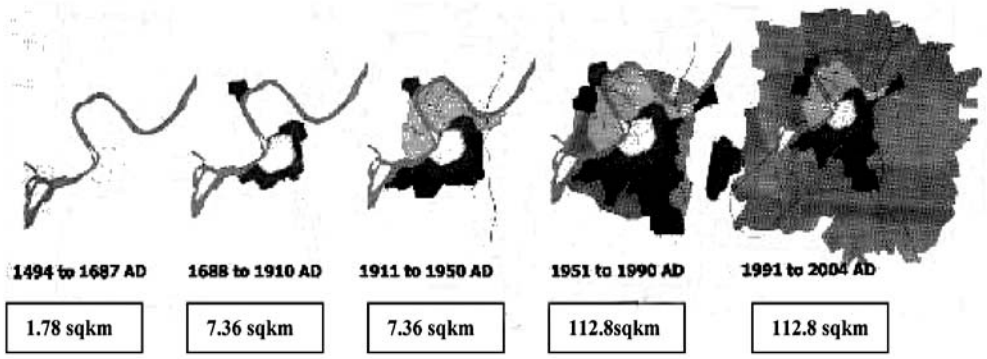
Surat: A Satellite Image Indicating Urban Sprawl (Source: www.google.com)

* Contributed as Surat city team under National Coordination Project of NIDM (Anil K Gupta and P.G. Dhar Chakraborti, Disaster & Development, 3 (1): 1-14,2009).

The area of Surat Urban Development Authority is 722 sq. km. which falls within 2I°-00' N latitude to 2I°-I5'N latitude & 72°-40f East longitude to 73°-00f East longitude

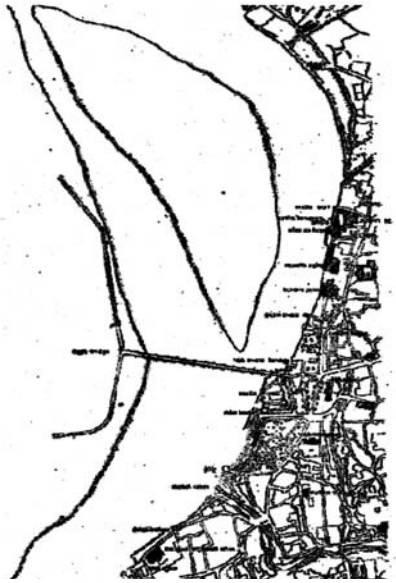
Historical Development of the City

The city of Surat has glorious history that dates back to 300 BC. The origin of the city can be traced to the old Hindu town of Suryapur, during 1500 – 1520 A.D., which was later colonized by the Brigus or the King from Sauvira on the banks of River Tapi. In 1759, the British rulers took its control from the Mughals till the beginning of the 20th century. The city is located on the River Tapi and has about 6 km long coastal belt along the Arabian Sea. Due to these reasons, the city emerged as an important trade centre and enjoyed prosperity through sea trade in the 16th, 17th and 18th centuries. Surat became the most important trade link between India and many other countries and was at the height of prosperity till the rise of Bombay port in the 17th and 18th centuries. Surat was also a flourishing centre for ship -building activities. The whole coast of Tapi from Athwalines to Dumas was specially meant for ship builders who were usually Rassis. After the rise of the port at Bombay, Surat faced a severe blow and its ship building industry also declined. During the post-independence period, Surat has experienced considerable growth in industrial activities (especially textiles) along with trading activities. Concentration of these activities combined with residential developments has resulted in considerable expansion of the city limits.

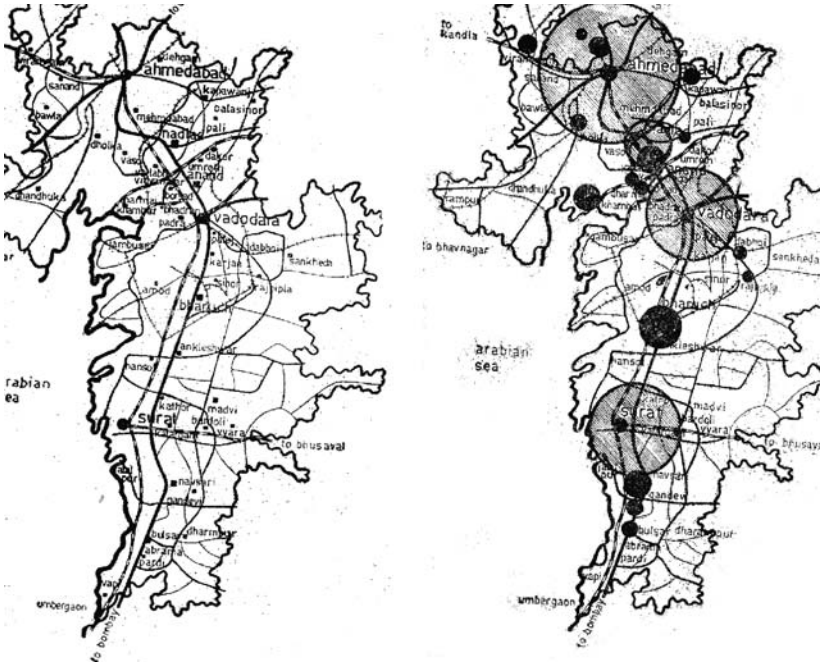


Surat: A City in Transition, Since 1400 AD

Source: Surat Vision 2020 Report



River Front 1877, Detail Sketch

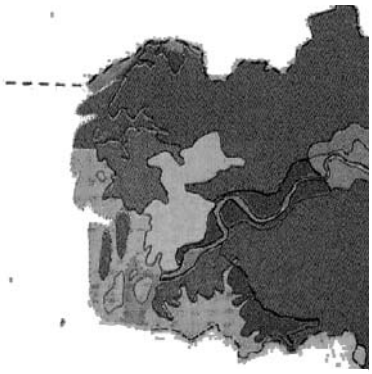


Source: Surat DP 1

Regional Context and Integration

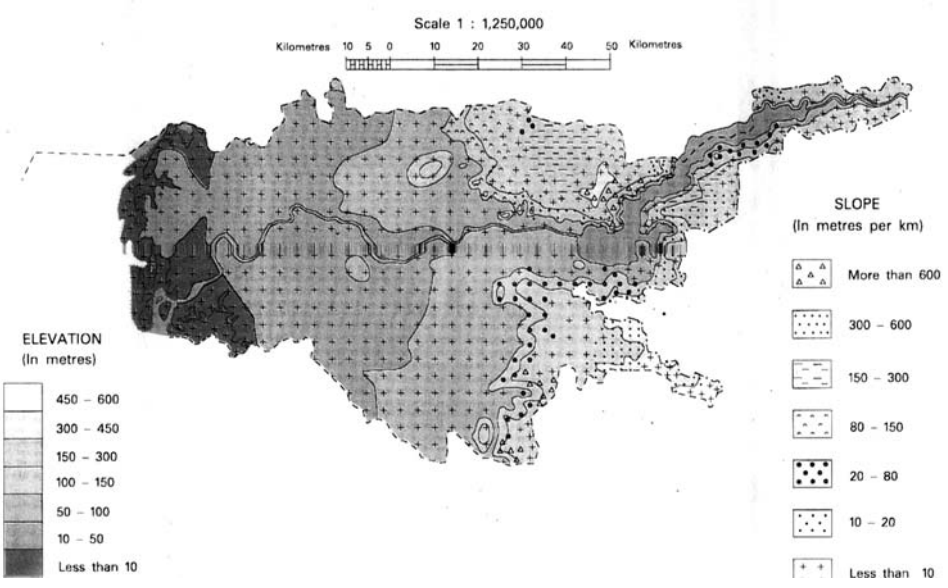
Physical Characteristics: Topography

The city lies at a bend of the River Tapi, where its course swerves suddenly from the north-east to southwest. With the walled city at its centre, the city forms an arc of a circle, the bends enclosed by its walls stretching for about a mile and a quarter along the bank. From the right bank of the river, the ground rises slightly towards the north, but the height above mean sea level is only 13 meters. The topography is controlled by the river and the general slope is from north-east to south-west. The area of Surat Urban Development Authority has a gradual slope towards the western and southern side having natural drainage systems towards Tapi River. The city is 13 m above mean sea level. Certain areas are low lying and during the monsoon season get flooded. The coastal lines along the villages of Hazira, Mora, Damka, Limla, Dumas, Bhimpor, Abhava, Gavier, Sarsana and Vesu and the land between the mouth of the rivers Tapi and Mindhola are very low-lying.



Soil Condition

Source: Survey of India

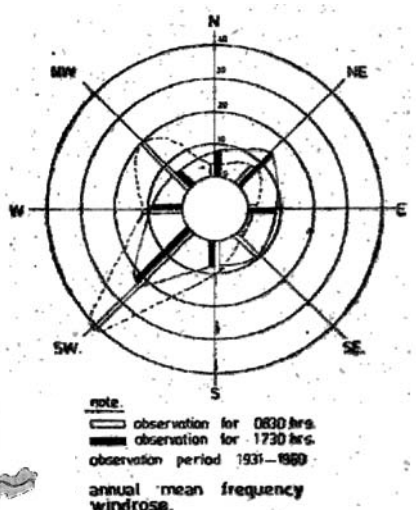


Relief and Slope

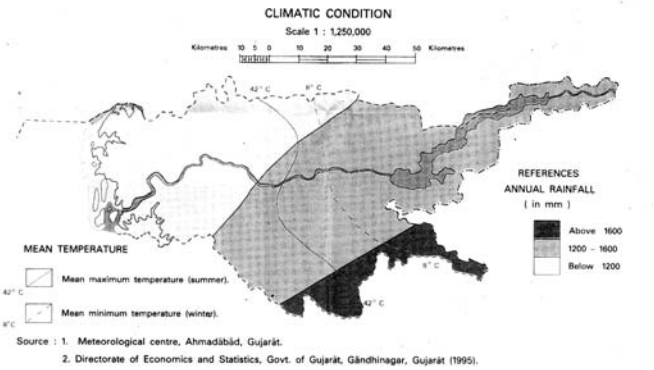
Source: Meteorological Centre, Ahmedabad, Directorate of Economics and Statistics, Govt. of Gujarat, Gandhinagar

Climate and Rainfall

The summers are quite hot with temperatures ranging from 37.78 degree C to 44.44 degree C. The climate is pleasant during the monsoon while autumn is temperate. The winters are not very cold but the temperatures in January range from 100 C to 15.50 C. The average annual rainfall of the city has been 1143 mm. the monsoon onset months are June and July and the monsoon wins recede during late September.



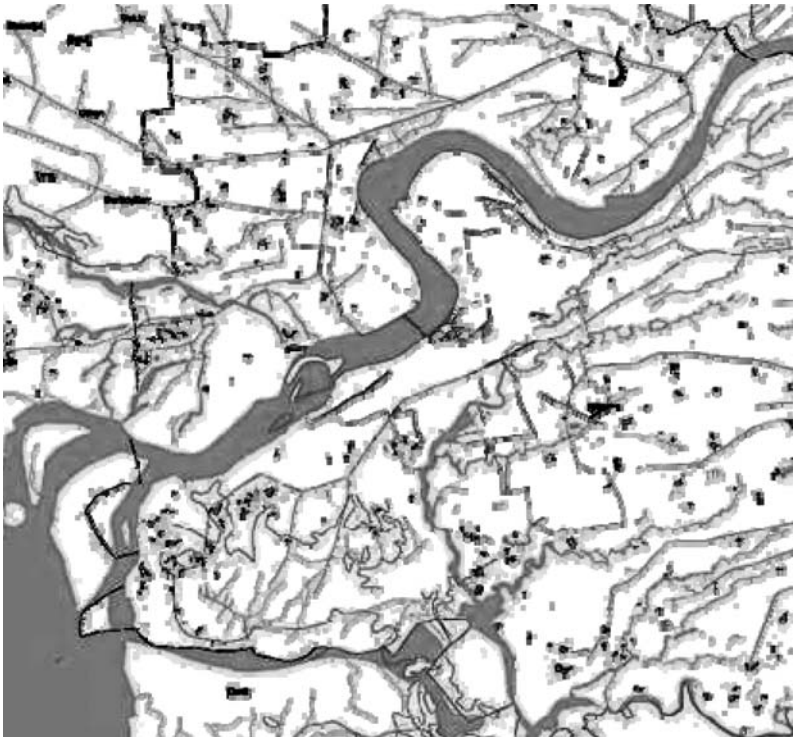
Annual Mean Frequency Wind Rose



Source: Meteorological Centre, Ahmedabad, Directorate of Economics and Statistics, Govt. of Gujarat, Gandhinagar

Ecology

The dominating geographical and ecological feature in the Surat region is the presence of an estuary condition, making the landscape unique in terms of both opportunities and threats. The condition of an estuary combined with a small delta, with changing land cover in the coastal regions over a period of time, have made it difficult to 'map' the region in the past due to technological constraints. Now, with the latest technology in remote sensing and GIS mapping has presented before the authorities a chance to detail surveys done periodically to understand the geographical parameters of the region better. Most of the area falls under water shed of the perennial river Tapi, and is prone to floods. This poses a major challenge to town planners for locating potential area for development.



Map of water bodies

Source: DPVIC Pvt. Ltd. Surat

SUDA area and SMC area Population Trends

DISTRIBUTION	AREA	POPULATION IN LAKHS				REAL GROWTH RATE %		
		1971	1981	1991	2001	1971-81	1981-91	1991-2001
SMC								
Walled city	8.18	3.63	4.4	4.2	-	78.0	-4.0	-
Areas added upto 1975 limit	47.37	1.3	3.3	6.4	-	157.6	91.4	-
Area added thereafter	56.53	0.3	1.6	4.3	-	335.1	168.32	-
Total	112.08	5.3	9.3	14.9	24.3	76.7	59.8	
SUDA								
Area excluding SMC area of 1994	609.72	1.4	2.0	2.9	6.5	36.9	43.1	
Area including SMC area	722.00	6.7	11.4	17.9	30.9	68.0	56.96	72.9

Source: SUDA DP 2004

City Infrastructure

Roads

"The contours of the city landscape underwent basic and cosmetic changes in the mid 1990s along with growth of infrastructural facilities, which earned Surat the tag of being one of the cleanliest cities of the country. But lack of a viable transport system, has left the city with a crumbling face. In the absence of any traffic planning, over 7.5 lakh vehicles leave the city roads gasping for space. The public transport services have remained as they were years back and need for a proper system to cater to the growing population is felt overwhelming. For industrialists, with lack of an airport in the second largest city of the state, business travels abroad still mean taking a flight from Mumbai or Ahmedabad".

– Surat Forum : Times of India, May 22, 2001.

Recent efforts at better management of the road network in the city have resulted in effective widening of the main corridors of the city. The roads in the city cover an area of 28.29 sq. km, which is about 25 percent of the total area of SMC. So far, 80 Percent of the area of the city has been effectively connected through a total length of 1133.37 km. of road network. Of this, 93.5 percent of the roads are surfaced mostly with asphalt. The region is characterized by "black cotton soil with high shrinkage and swelling" and high rainfall. These are the major causes for the unsatisfactory condition of the asphalt roads in the city. Keeping this in view, SMC has come up with a proposal to change the major arterial road network into a cement concrete road. The conversion of asphalt road in to C.C. Roads has been started in the city since 2004. In the first phase, The Surat- Dumas Road was selected. The other roads selected in this year are: Surat-Navasari Road and Kadodara Road. In the next phase, major ring roads and corridors, important link roads, roads wider than 24.39 m. are proposed to be changed to CC roads; the total cost of this work will be Rs. 4409.96 million.

Major Radial Roads/ Corridors

Major Radial Roads/ Corridors	
Existing bridges across river tapi	
1	Hope Bridge adjoining Nehru Bridge (1877)
2	Railway Bridge No. 452 near Utran (1915)
3	Nehru Bridge Near Chowk Bazar (1966)
4	Katargam-Amroli Bridge (1982)
5	Sardar Vallabhbhai Patel Bridge near Atwa Gate (1991)
6	Morarji Desai Setu near Singanpore (1995)
7	Swami Vivekanand Bridge near Makai Pool (1996)
8	SH 167 & SH 168 connecting bridge near Nana Varachha (2001)
*Figures in parenthesis indicate the year of completion and commissioning	

Bridges/ flyovers

Existing Road Network as on 31-3-2004

Roads	Length (km)	Percentage
Surfaced roads	1080.12	95.3
Black topped	1059	93.44
WBM	19.677	1.74
Concrete	1.319	0.1
Un-surfaced Roads	53.250	4.6
Total Length of roads	1133.37	100

At present there are 37 major and minor bridges and two underpass ways in the city. Of them eight bridges are across River Tapi at various locations. There are three fly over bridges in the Surat city.

The Bridge Cell of SMC carries out the construction and maintenance of bridges, culverts, underpasses, flyovers and road over bridges within SMC limits.

Two major bridges across the River Tapi are planned to be constructed within a span of three years each. While the one at Ved-Dabholi shall start during this year (2005-06) the other one near Paanch Pandav bungalow, Athwalines shall start in 2006-07. The construction of two major fly-overs road over bridge will be completed during 2006-07 and the other fly over on the Ring Road near Majura-Udhana Gate, will be completed during 2007- 08.

In addition, several fly overs and bridges are proposed on major and busy junctions/routes to ease traffic congestion and for easy movement of vehicles; thereby reducing air/noise pollution also.

In SUDA area there are two major bridges across river Tapi and 15 bridges across various creeks. The current network of roads in the city comprising asphalt, WBM, concrete and un-surfaced roads covers 8.46 km. per sq. km. of the corporation area accounting for a per capita road length of 0.40 m. On an average, the area covered by the present network is around 25.20 percent of the total area of the corporation.

Major Issues:

- Improper connectivity in peripheral areas
- Major operation & maintenance costs on roads
- Discontinuity in Ring Road and major roads
- Encroachments and Informal activities on major corridors of the city
- Lack of consideration for future growth patterns in planning for roads outside SMC

Sewerage

Emerging Issues

- **Outdated sewerage system in the walled city area, Athwa, Umra and Adajan**
- **Mixing of sewage with storm water and solid waste in several areas**
- **Low number of sewer connections**
- **Very low nil per-capita cost recovery**
- **Unavailability of comprehensive wastewater system in Industrial Area.**

Future Requirements

Surat Municipal Corporation has prepared a master plan for comprehensive sewerage system (more than 1000 km of sewers and 6 sewage treatment works) to serve not only the domestic and commercial, but also the industrial developments for the year 2021. Wastewater generated from all this development is to be collected by a network of underground sewers and pumping stations and conveyed to sewage treatment works for physical and biological treatment to meet the parameters prescribed by the GPCB before discharge into the nearest watercourse.

Sewerage Network

The comprehensive sewerage system designed for the city of Surat as per the master plan is expected to be in place by the end of 2006. Phase wise execution of the master plan will cover not only the present population of the city but also the population expected by the year 2021. Complete area coverage is expected to be achieved by 2006. This is apart from the revitalisation of the entire sewerage network in the central zone, where the present system is outdated. Complete revitalisation of the system in the central zone is to be completed by 2010.

At present, there is no drainage system exists in the Pandesara GIDC area, which leads to the flowing industrial wastewater open into the open surface water body.

Indicators

Total sewerage Generation	390 MLD
Area served to total area	92.19 %
Population served to total population	97.11%
Treatment capacity/Total Sewage Generated	100.00%

Zone	Area (Sq. km)	Area Coverage (%)		
		2005	2011	2021
Central	8.18	100	100	100
North	20.54	95.0	100	100
East	13.86	96.8	100	100
West	19.63	74.6	100	100
South	21.70	90.0	100	100
South-East	8.60	96.9	100	100
South-West	14.96	98.6	100	100
Total	112.274	92.19	100	100

Sewerage Pumping Stations

With the newly proposed sewerage pumping stations at Jahangirabad and Jahangirpura-Pisad, the sewerage pumping stations will total to 30. These are expected to cater to the needs of the population of the city till 2021. After the completion of the gravity mains that diverts the sewerage generated in the central zone to the Singanpore and Bhatar STPs, the sewerage pumping stations at Salabatpura and Saiyadpura shall be abandoned. Hence the total number of sewerage pumping stations in the city will be 28. Few of the existing sewage pumping stations i.e. Athwa, Umra, Adajan, Salabatpura shall be rehabilitated. In, Pandesara GIDC area a sewage pumping station exists. However, practically very little wastewater is collected, as there is no comprehensive drainage system exists.

Sewerage Treatment Plants

As per the master plan, to cater to the needs of the present population sewerage treatment plants have been constructed at Singanpore and Bamroli-Vadod. But to cater to the needs of the population in 2011 and 2021, the treatment capacities of these plants need to be augmented without the necessity of new treatment plants. Augmentation of Bhatar STP to 120 MLD and Karanj STP to 100 MLD has been recently completed, is under run since 2003 and the Singanpore STP is operational at present with a capacity of 100 MLD. For Pandesara GIDC area, there is no facility for common effluent treatment plant. Hence, the industrial wastewater directly flows to the nearby creek.

Indicators

Collection Performance (% Collected to Generated)	98.1%
Total vehicle capacity to total waste generated	108.5%
Trips per vehicle of Existing Fleet	-
% of total waste put to recycle reuse	-

Solid Waste Management

Processing and Disposal of Waste

Processing and disposal met hods like

incineration etc. are not used in Surat. Land available for treatment and disposal of waste, where the land filling is carried out, is about 10 km from the city.

The life expectancy of land for the treatment and disposal of waste is 30 years at the Khajod final disposal site. There is sanitary landfill cell created and the cell is ready for its use for disposal of inert material obtained at the end of treatment process of MSW Treatment. One Bio-Medical Waste Treatment Plant is working on a BOOT basis from 2003.

Solid Waste Management in Suda Area:

- To provide Dust Bins.
- To have collection system from each house.
- To provide transfer station.
- To provide vehicles for Transportation of solid waste.
- Develop landfill site for systematic disposal of solid waste including segregation of the waste.
- The scheme will be provided for 67 T.P. Schemes at a cost of Rs. 80 Crores.
- SUDA has identified and reserved land of 24 lacs sq.mtr for solid waste and garbage disposal.

Solid waste Generation (Metric Tons)

Zone	Area	Solid waste Generation		
	(Sq. km)	2001	2011	2021
Central	8.18	150.1	139.5	116.2
North	20.54	121.7	179.1	220.6
East	13.86	210.7	295.9	337.7
West	19.63	90.9	166.3	224.5
South	26.01	177.6	291.45	383.1
South East	9.1	59.2	97.15	127.7
South West	14.96	73.2	108.7	139.9
Total	112.28	883.5	1278.0	1549.7

Drainage System

Due to its location on banks of the River Tapi near the estuary of the Arabian Sea, the land drainage in Surat City is relatively poor and in the past, during the monsoon months, many areas of Surat city suffered temporary flooding and blockage of storm water.

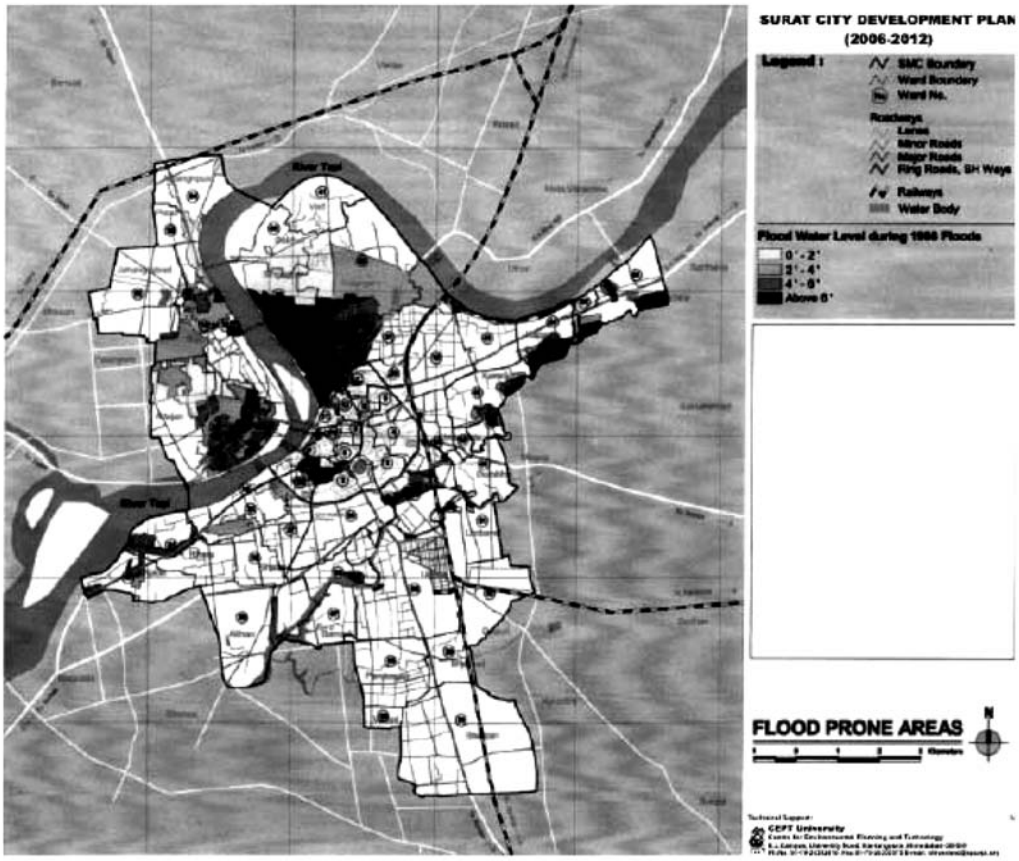
The monsoon in the region is seasonal and is active between the months of June to December. Rainfall during this period can be extremely intense. Hence, the SMC has laid an extensive network of storm water drains in the entire city.

Existing Situation

The gentle slope of the city has greatly aided in the natural storm water drainage. 85% of the city is covered with a storm water drainage network, but well built leader lines to support the natural system are lacking in most parts of the town except in the well-developed areas. Generally, the storm water flows through un-built open surface drains and joins the nearby khadi or the River Tapi. These drains discharge storm

water in to the River Tapi at 16 locations in 5 zones of the municipal corporation. The storm water outlets provided backwater entry to the floodwaters of

River Tapi and thereby caused temporary flooding of areas from which they were carrying out storm waters. Hence, it was felt necessary to provide flood protection gates at the outlets of storm water drains. SMC completed the construction of flood protection gates at 15 locations in the year 1999 at a total cost of Rs.210 lakhs. These works were completed in 3 months. A total of 22 cast iron manually operated vertical sliding gates were provided. Normally, these gates are kept open, but at the time of heavy floods in the River Tapi, these gates are closed to prevent the entry of floodwater in to the city. At present the area outside Municipal Corporation does not have any storm water drainage system. SUDA has proposed storm water drainage system covering 68 TP schemes to be developed.



Flood Protection Scheme of River Tapi

After the ravaging floods of the River Tapi in 1968, the Government of Gujarat had decided to have a flood protection scheme to protect Surat city and its adjoining area. It was planned to provide flood protection for a total of 46.85 km. on both banks. The Tapi embankment scheme was designed for a 10 lakh cusecs flood, which is inclusive of 1.5 lakh cusecs discharge, contributed from the catchment between the Ukai Dam which is about 80 km. upstream of Surat city. The flood protection works consist of raising of both banks of the river by construction of an earthen embankment/ brick masonry retaining walls with/without river slope pitching and also by constructing sluice regulators across natural creeks/drains etc. meeting the River Tapi.

The major part of the scheme was executed by the Government of Gujarat from 1971 to 1995 at a total cost of Rs.1542 lakhs. But the long delay in completion of the project proved fatal during the floods of 1994 and 1998. The works of embankment/sluice regulators at village Chhaprabhatha, Variav and Tunki were not completed. with technical guidance from the Narmada and Water Resources Department of the Government of Gujarat, SMC executed the flood protection works, which fall within the Surat city limit. The project cost of Rs.2406 lakhs is being borne equally by the Government of Gujarat and SMC. Initially, SMC will execute the works from its own resources and later on, the Government of Gujarat will reimburse its 50 percent share within 3-5 years depending upon the availability of funds. The works of the first phase have already been completed by SMC and the remaining works are proposed to be taken up only after finalisation of the scheme/ design-drawings etc. by the Irrigation Department of the Government of Gujarat.

Emerging Issues

Mixing of Sewer and Storm Water Drains

With a very small number of sewerage connections in the city, large amounts of sewage are let out illegally into the storm water drains. The closed drains of the city amount to only 20.3 percent of the total length of surfaced roads. Solid waste is also dumped into the natural drains of the city in many areas near the slums. Due to this, the city witnesses frequent flooding of roads during the monsoon.

Delay in Implementation of the Flood Protection Scheme

The flood protection scheme of the River Tapi that started in 1971 is still under progress. This long delay on the part of the Government of Gujarat proved fatal during the floods of 1994 and 1998. A large portion of the scheme falling under the city limits is still

pending and is largely dependent on the availability of funds with SMC as the reimbursement from the Government is expected to come only at a later stage.

Silting of Khadis and Open Storm Water Drains

The city has the advantage of a good natural drainage pattern, which is not, unfortunately, exploited properly. Silting and constriction due to uncontrolled solid waste dumping and encroachments by the poor on the banks have interrupted the flow of wastewater and storm waters, thus, causing them to spill into neighbouring areas. Never has there been an attempt to desilt and clean the natural drains of the city. The open storm water drains are in a similar condition, with sewerage waters getting mixed with them at places.

Indicators

Storm Drain network/Total Road Length	30.6%
Closed Drains length/ Total Surfaced Road Length	20.3 %

Zone Wise Storm Water Drains

Zone	Area (Sq. km)	Total Length (km)	
	2001	2005	2011
Central		34.14	39.94
North		48.44	59.42
East		57.47	68.50
West		75.00	93.80
South		20.13	24.13
South-East		34.00	39.50
South-West		52.36	75.79
Total		321.53	401.08

Future Requirements

The Surat Municipal Corporation has appreciated the importance of an effective storm water drainage wherein the current and future needs point to effective roadside storm water lines. This is in consideration of the fact that apart from draining the storm water they also help in maintaining the condition of the road surface. A total length of 532 km of present storm water drains are to be extended to a minimum of 401.076 km by 2011 to effectively control flooding during the monsoon. This is also expected to assist the flood protection scheme of the River Tapi by reducing the sudden pressure on the system during emergencies.

Storm Water Drainage in the Peripheral Areas (Suda Area)

Due to its location on banks of the river Tapi and on the bank of river Mindhola near the estuary of the Arabian Sea, the land drainage in SUDA area is relatively poor. In monsoon months, during heavy rains many areas of SUDA suffer flooding. Till now, such flooding was not posing a major problem as major part was agricultural area. With rapid development of SUDA area, it is necessary to see that the storm water is disposed off as early as possible to exert only minimum hardships on residential, commercial and industrial area.

Due to paucity of funds, normally low priority is being given to the costly project of disposal of storm water. Moreover, as the area is located on the banks of the river, there are number of natural creeks which meander at number of places. It is possible to provide systematic underground system of storm water disposal, unless storm water drain in place of these creeks are

properly planned on the roads of TP Schemes, as by preparing TP Schemes at many places the land falling under portion of the schemes are allotted to final plot holders. Now, as the TP

Schemes are being prepared and finalized gradually the road network is also finalized which facilitates to provide storm water drain. Initially projects are prepared for Vesu and Pal-Palanpor area at a cost of Rs. 60 crores covering the total area of 1800 Ha. It is proposed to cover the major part of the SUDA area by efficient network of storm water disposal at a cost of Rs. 176 crores over a period of 7 years. The project becomes costlier, as the same is to be designed keeping in view the disposal points which are mainly in river, the latter is not only in tidal range but also has to face abnormal floods. To prevent the flood water entering into SUDA area, provisions are to be made for flood gates at disposal points.

Floods in the City

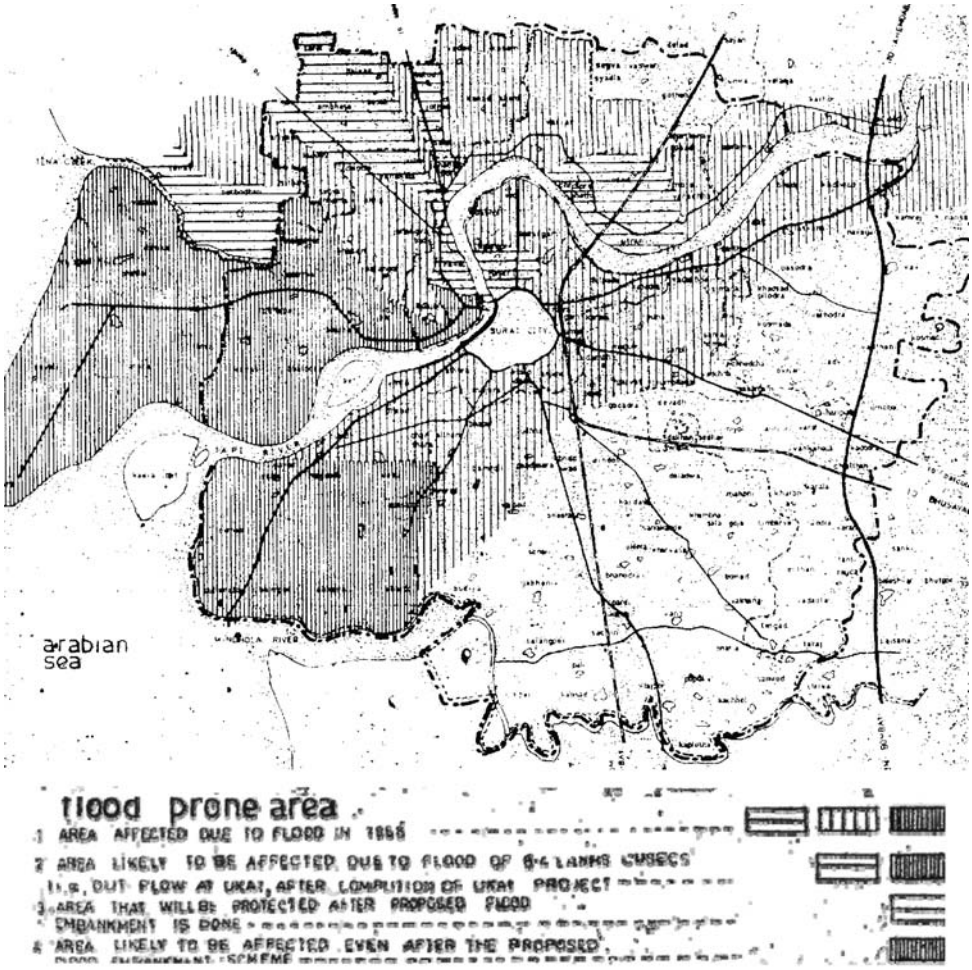
Year-wise Area to be Covered Under Storm Water Drains in SUDA Area

Year	Area in Ha.
2006	285
2006-07	2385
2007-08	2385
2008-09	2385
2009-10	480
2010-11	240
2011-12	240
Total	8400

Natural Hazard

Flood Prone Areas

Development of Surat in the past has been affected a number of times due top the high flood in Tapi, until recently until the Ukai project was complete. Now this area is safe from floods upto 18.5 lakh cusecs of water. The height of the Nehru Bridge on Tapi within the city is one of the controlling points for the further strengthening of the flood embankment. Ukai reservoir is designed to a gross storage of 6.9 million acres feet at FRL 345. During floods, this can be raised to a height of about 351 to hold the excess of about 1 million acres feet.



Map showing flood prone areas

Source: SUDA DP1

The above figure shows the typically low-lying areas in the region. According to the flood embankment scheme the development of Rander, Adajan is still under flood-affected zone. The walled city areas have few pockets of low-lying areas such as Navasari bazaar, etc get flooded in the monsoon season. The areas on the other side of the railway line towards the southern side of Kamrej.

Flood history

Year	Flood Flow(Lakh Cusecs)
1968	15.5
1994	3.5
1998	7.5
2006	10

Surat: General Flood History

History of Floods in Surat

Located at appoint where the river meets sea, Surat is flood prone since centuries. Available data and various flood maps recognize this fact. The cty earlier witnessed a major floods of varying intensities in 1737, 1782 april, 1835 and 1837 aug-sept, 1949 and 1968 aug sept, 1944 aug, 1954 sept, 1959 and 1968 aug-sept, 1998 sept, 2002 sept and the recent flood of 2006 aug. evidently the period between july to sept has generally been period of flooding. During this period, the rains lash south Gujarat and the upstream regions through which tapi meanders its way to finally meet the sea near Magdalla, dumas and Hazira confluence.

Available Data of Floods in Surat

indicate a broad pattern of regularity in occurrence. Since 1869 upto 1884 on average the city was flooded every 2 and a half years, followed by a pronounced fall in frequency upto 1914. this went again with frequency rising to an average of a flood every three and half years during 1914-49, the corresponding average of floods came to once every four years followed by their occurrence every six years between 1979-2006. Such regularity indicates natural tendency for tapi to flood especially its downstream settlements including the city of surat. Duringthe last 6 decades, the years that have witnessed consecutive floods are 1994 and 1945, 1958 and 1959, 1968 and 1969 and 1982, 1983 and 1984.

While floods in surat have often been due to heavy rains in the upstream regions, they have also been compounded y the unpredictable storms in the tapi basin. Together, these add to uncertainty in the recurrence pattern. Flood having intensity of 23 lakh cusecs may actually occur within a few years or a flood of a much lesser intensity of even less than 5 lakh cusecs may not occur even within the next ten years. This is particularly because changes in the climatic have increasingly been getting

erratic in magnitude and extent. Given this, while it is rather difficult to predict the intensity of future floods, it is hardly difficult to visualise that the overall vulnerability of the city and its region has increased manifold over time. Needless to say, that this has serious implications on the socio-economic and the changing geomorphological fabric of the city. Given the indiscriminate growth of city in terms of residences, activities, infrastructure, encroachments and a swelling population on one hand and reclaiming parts of the floodplain, the delta and adding structures on the land unable to carry such interventions, the frequency, magnitude and duration of floods have indeed increased during the last few decades.

A Discussion of 'Causes': Natural or Human?

Natural factors:

Heavy precipitation in the catchment

Even with differential precipitation rate in the larger catchement of a smaller tributary may lead to heavy flooding

Cyclonic storms

As in the case of 1959 and 1968 floods. These type of floods remain very uncertain

Effects of tides and silting

Silting in gulf of cambay due to tapi and narmada bringing hue quantities of silt causes floodwaters rise higher and thereby extended inundation

Low bankful capacities

Data on past floods indicate that surat city and some adjoining villages remain safe upto a limit of 5.8-6 lakh cusecs discharge

Human induced factors:

Effects of railway embankment

Barrier created by western railway line from Bombay to Ahmedabad

Effects of city growth

Due to growth related activities spaces that have been natural flood routes have been covered up. e.g.

- Hazira Master Plan
- Airport Development Project
- Aaliya Bet Development Proposal
- Convention Center for Chamber of Commerce

- Satellite Township of Abhva

It is significant to note here that two most important documents viz. Vision 2020 for the city and CDP 2006-12 hardly takes into cognisance the implications of their development strategies in terms of floods and their impacts. Due to claimed and reclaimed lands, the floods in surat can get aggravated even at lower quantum of discharge, as low as a level of 5 lakh cusecs.

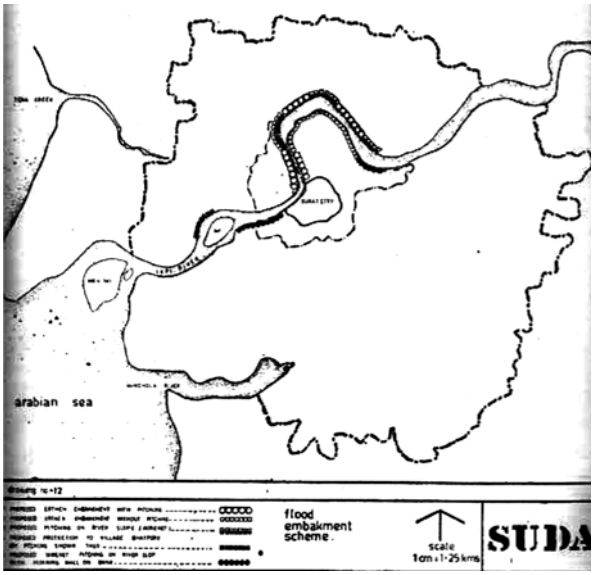
Projects of misplaced priorities with potential of increase vulnerability to floods:

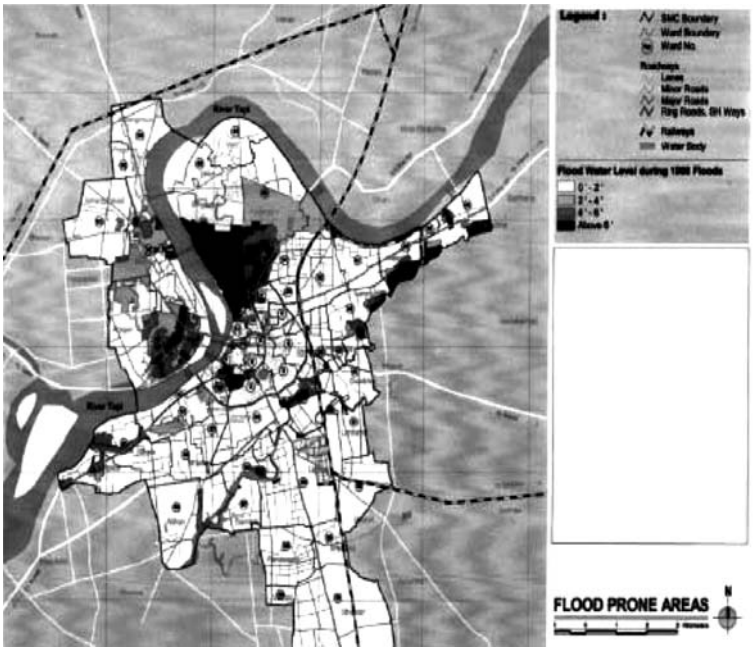
Riverfront project: aimed at constricting the width of the river

Singanpore weir project funded by Hazira industries: an offence under relevant regulations as it comes under the CRZ norms. The afflux caused by weir leads to capacity reduction of the embankments. This afflux generated has been so significant that the entire design of the embankment was being revised since 2004. Data related to such afflux is given below:

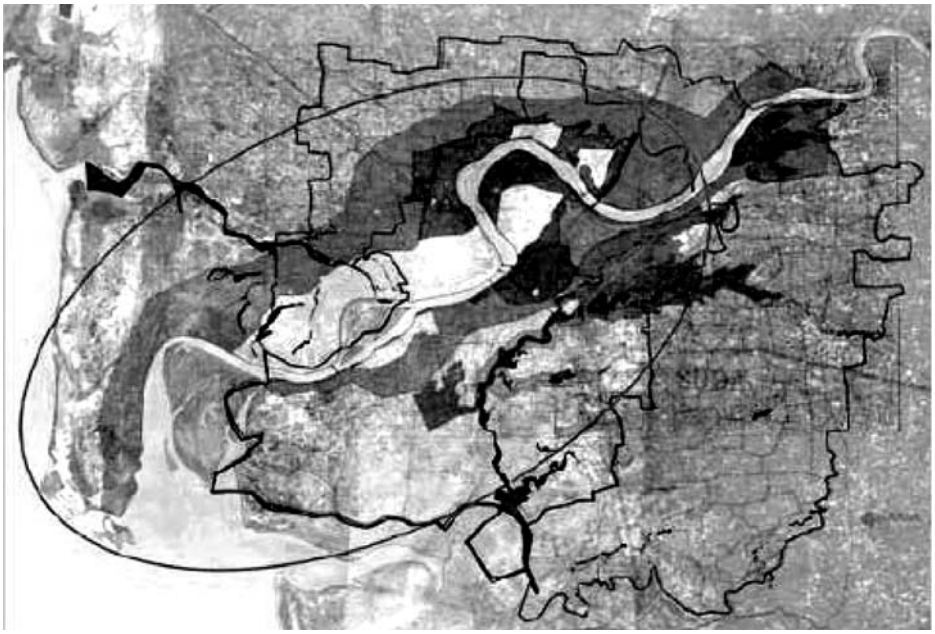
Afflux induced by Singanpore weir (1998 floods)

Flow in lakh cusecs	Afflux in mertres (CWPRS estimates)	Afflux in metres (actual in 1998 floods)
4	1.90	2.20
5	1.77	3.07
6	1.65	3.25
7	1.33	3.63
8	1.10	-
10	1.10	-





A Plate from the SUDA DP Report: 1980



Flood Prone Areas 1998, (*Source: Surat CDP)*
Map showing flood affected areas-2006, and the SUDA boundary

Source: DPVIC Pvt. Ltd. Surat

Flood is mapped only within the boundaries of the SMC – in 1998. The Surat 2006 floods have caused a loss of approximately Rs. 20,000 Crores (as predicted) besides the invaluable loss of lives.

Strategies for Future

Short Term Measures

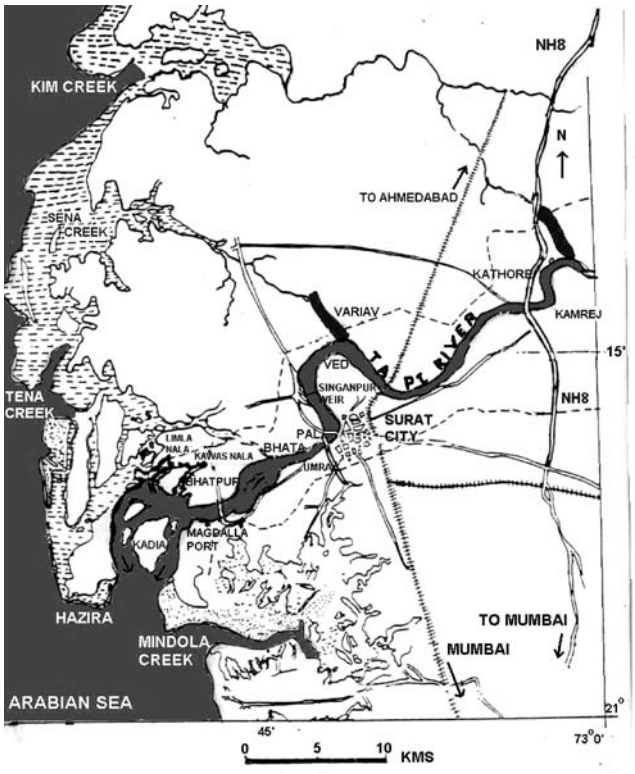
1. Every reservoir is operated as per the rule book prescribed. It is essential to follow the rule book without any deviation, to manage the water quantities of the reservoir. It is imperative that the Ukai Reservoir rule book is to be followed. Unnecessary storing the excess water towards the end of the monsoon season reduces the flood absorption capacity of the reservoir and poses a potential flood hazard. It is even recommended to reduce the maximum URL by 2 to 3 meter for

the September month, as compared to the present prescribed level.

2. A network of warning sirens is to be installed in the flood prone areas of the region. These should be able to warn the public at large, giving at least 5 hours time to act for protection. This should have linkage with releases from Ukai Reservoir.
3. Detailed contour map (levels) of the city should be properly marked on the distinct objects in the city with colour codes indicating different water levels during different intensities of floods (depending upon the flood releases from Ukai Reservoir).
4. River training works and flood control works should be completed on priority.

Long Term Measures

1. In order to reduce the releases from the Ukai Reservoir, diversion canals at the appropriate locations on its upstream should be provided. Two suggested



locations are indicated below.

(Reference : CWPRS, Pune)

2. It is necessary to develop a mathematical model for flood routing for the entire Tapi River Channel Network.
3. The encroachments along the banks of the river have to be removed.
4. The present rule book for Ukai Reservoir can be reviewed and can be transformed to comprehensive guidelines encompassing the alternatives and their scope of operation during emergency situations and at the same time providing the water optimally so as to support the socio-economic life of Surat City.
5. It is also recommended to provide partial flood embankments from Nehru bridge to Magdalla bridge on both the banks.
6. A state of the art ***Flood forecasting and Flood Management Centre*** specifically for the Surat City, is needed to be established. At the same time disaster management cell of SMC / local authority needs to be strengthened.
7. Physical model studies on flow control structures should be encouraged.
8. It is necessary to formulate long term legislative policies with regard to water allocation to different sectors and to empower the Catchment Management