INFRASTRUCTURE STUDIO

WATER & SANITATION

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ADITI

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PRATIK

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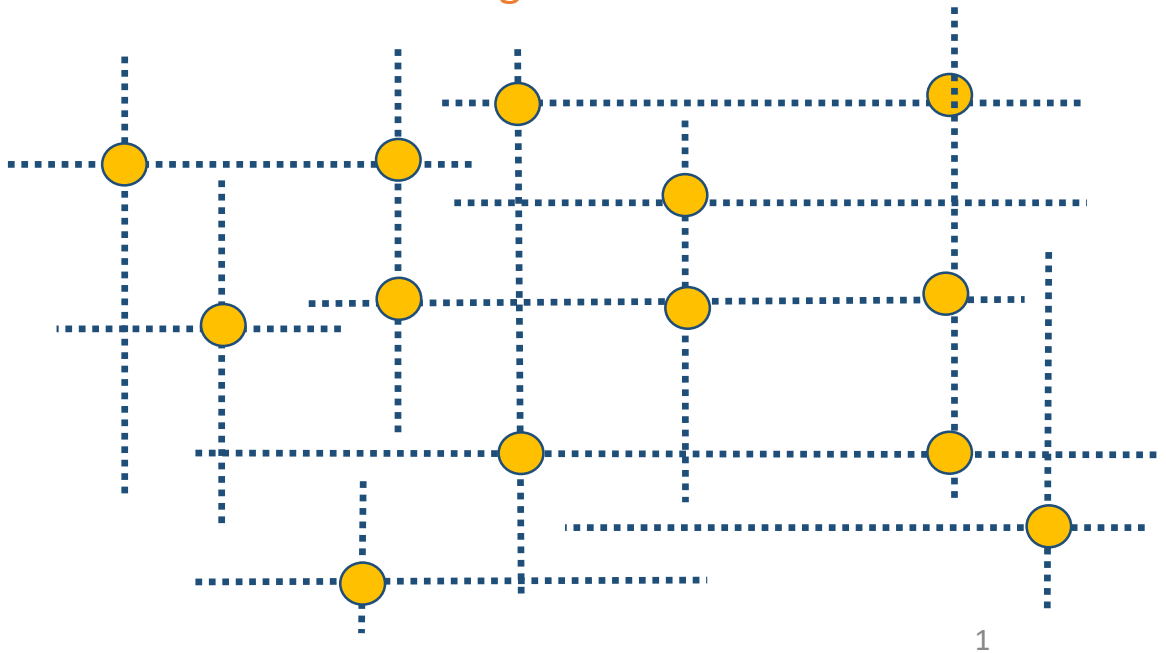
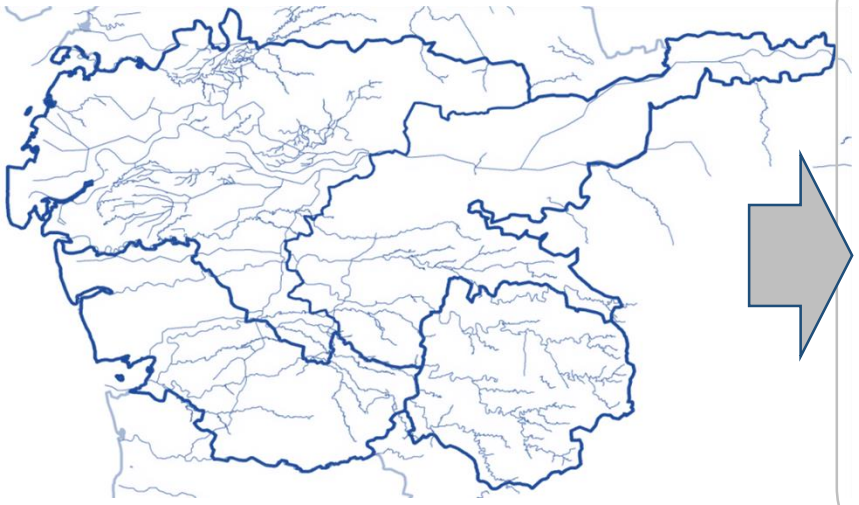
VIVEK



SMRDA Region



Study Area includes Navasari, Surat, Tapi, Dang

CURRENT STATUS 5 weeks

1. Water | Waste Water | Storm Water | Solid Waste

Institutional

National | State | Local

2. CURRENT SCENARIO → SMC level

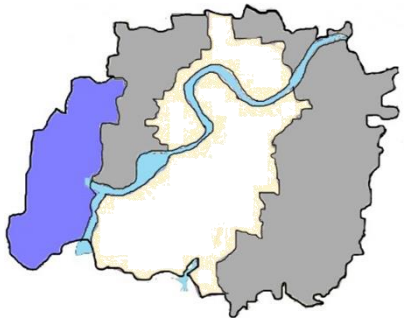
CONCEPTS (NEW THINKING) 1 week

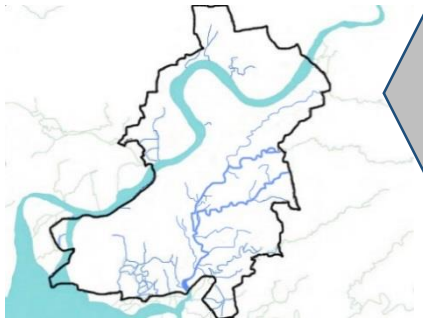
- IWRM
- IUWM

Appropriate to our lab scope

GROUPS 5 weeks

1. RIVER BASIN | 2. SUDA | 3. SMC



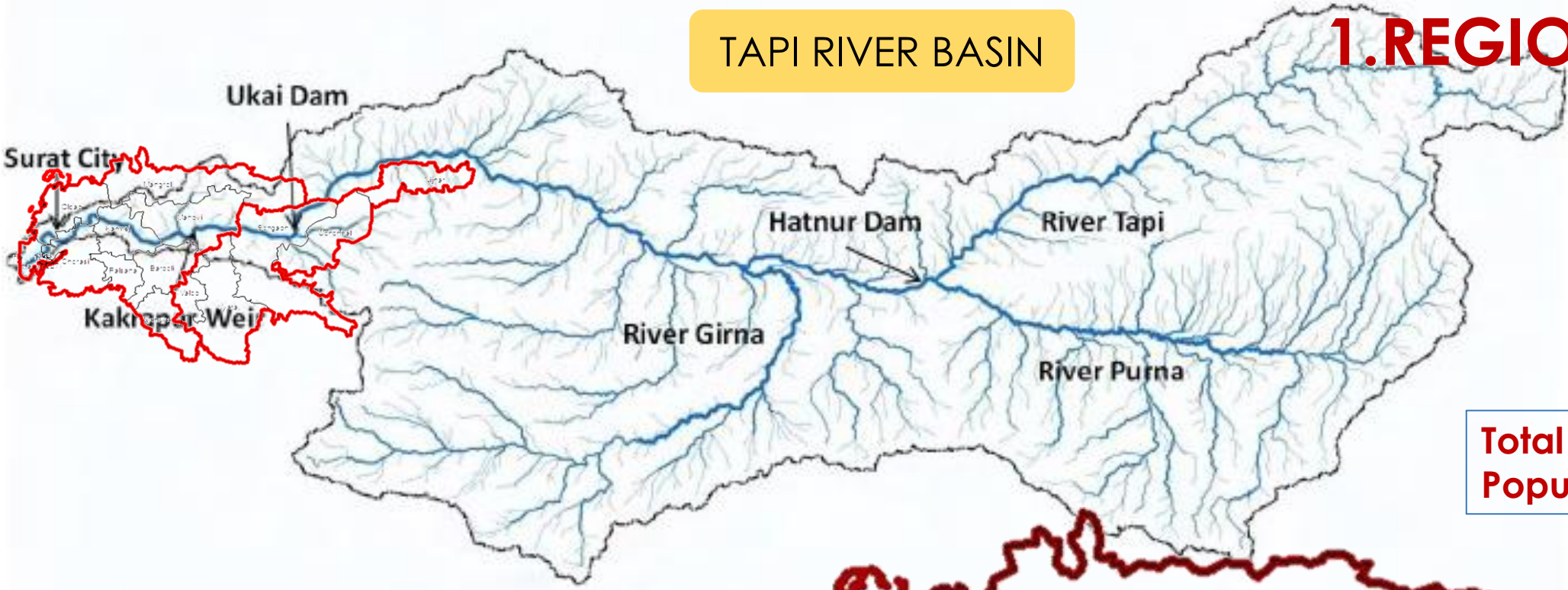


APPLICABLE TO AREA

IWRM	At Regional Level
IUWM	At SUDA Level
Infra Provisioning	At Project Level

1.REGIONAL LEVEL

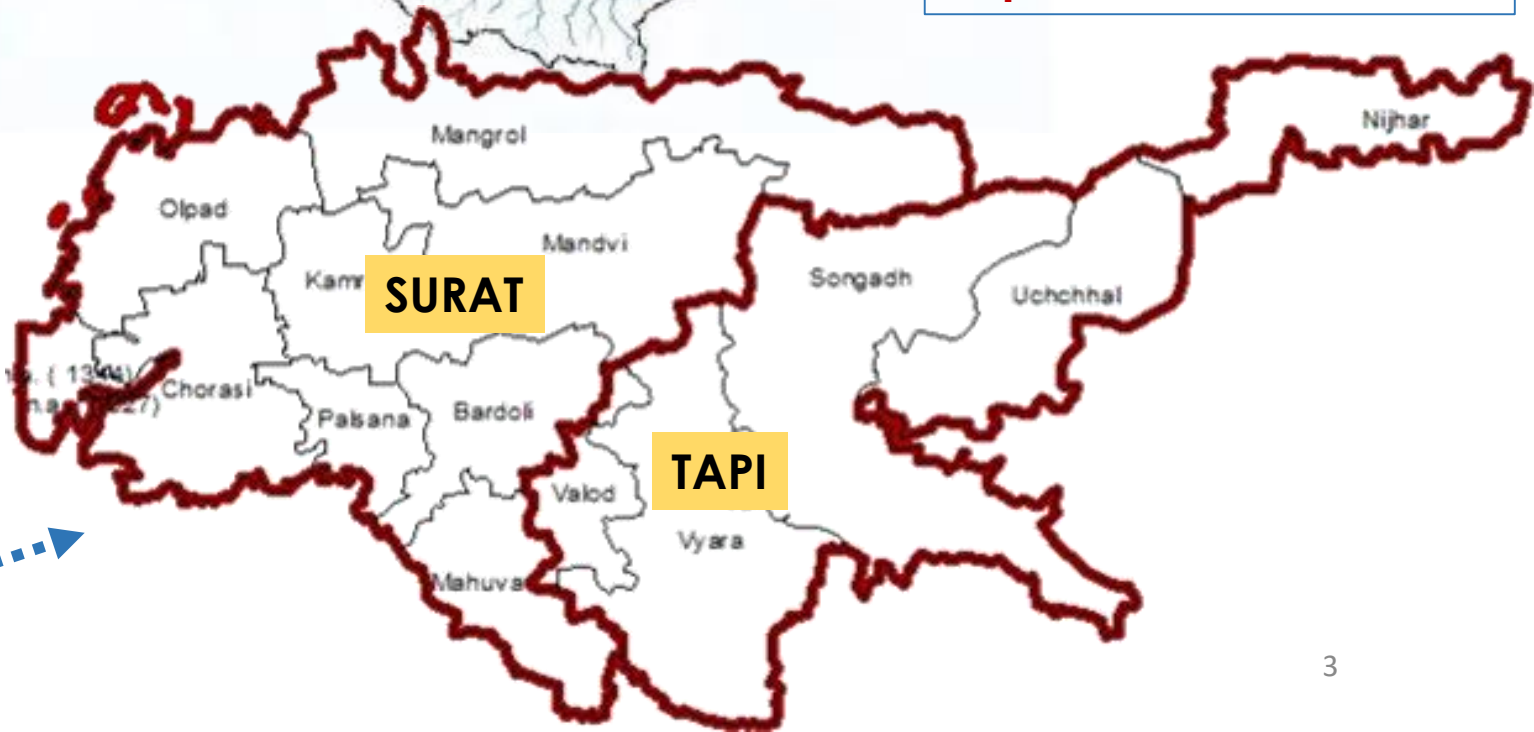
TAPI RIVER BASIN



Total Area – 7657sq.km
Population – 68.8 lac

PURPOSE –

Management of Water allocation and water resources at River basin level. **(Using concept of IWRM)**



SUB – BASIN

2. SUDA LEVEL

SUB-BASIN

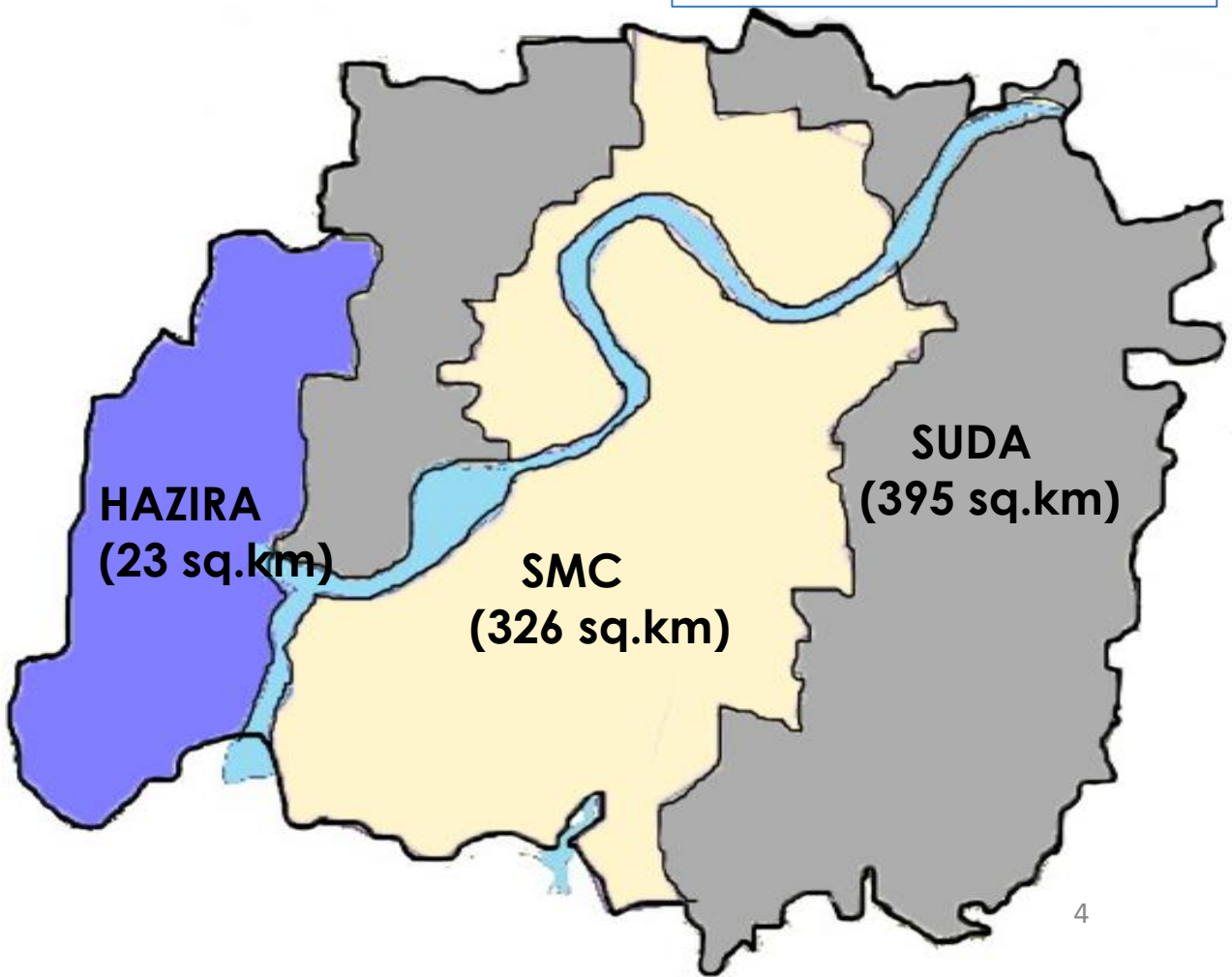
Total Area – 744 sq.km
Population – 60 lacs

PURPOSE –

Urban and Industrial Synergy for water management.

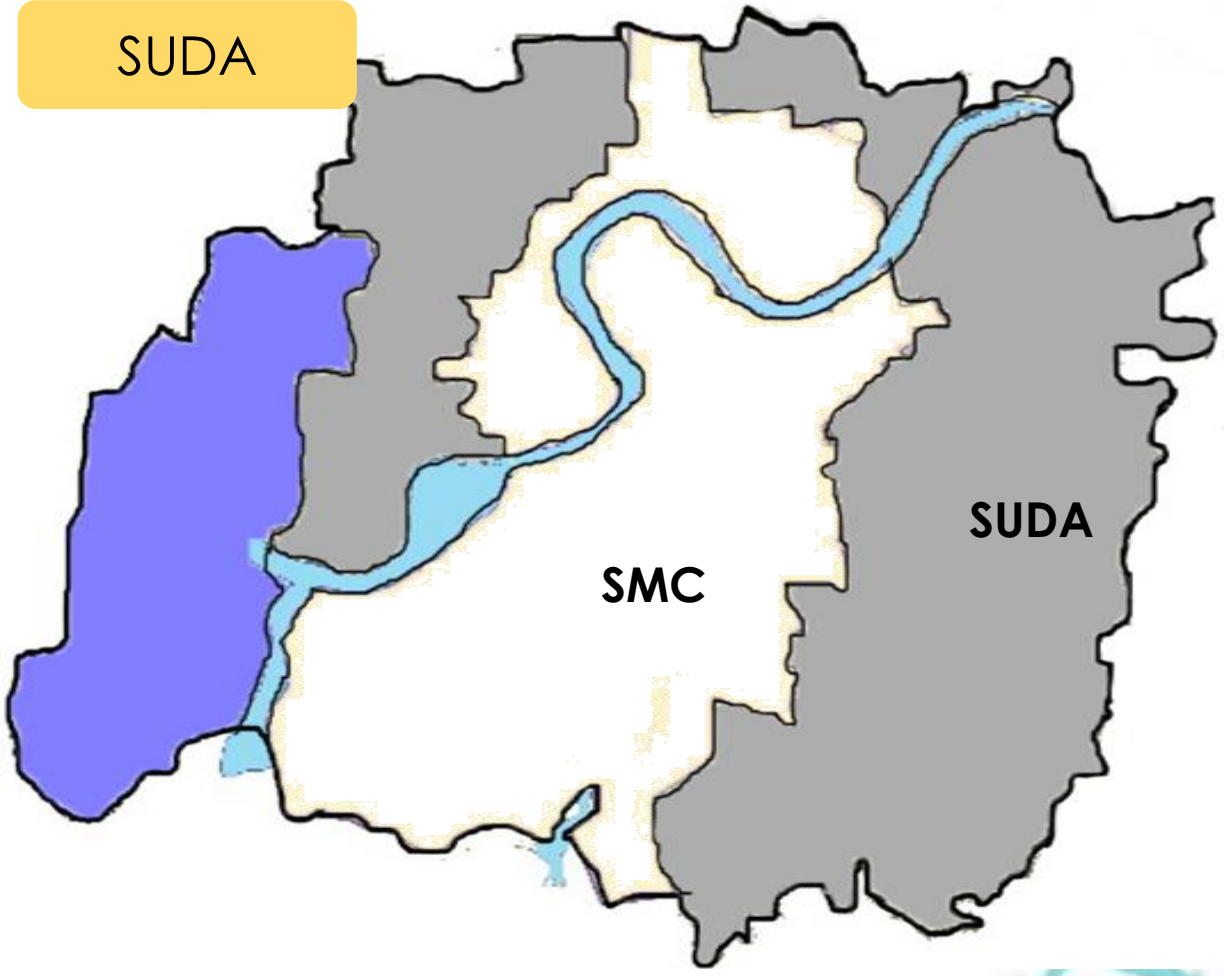
(Using concept of IUWM)

STUDY AREA OF SUDA



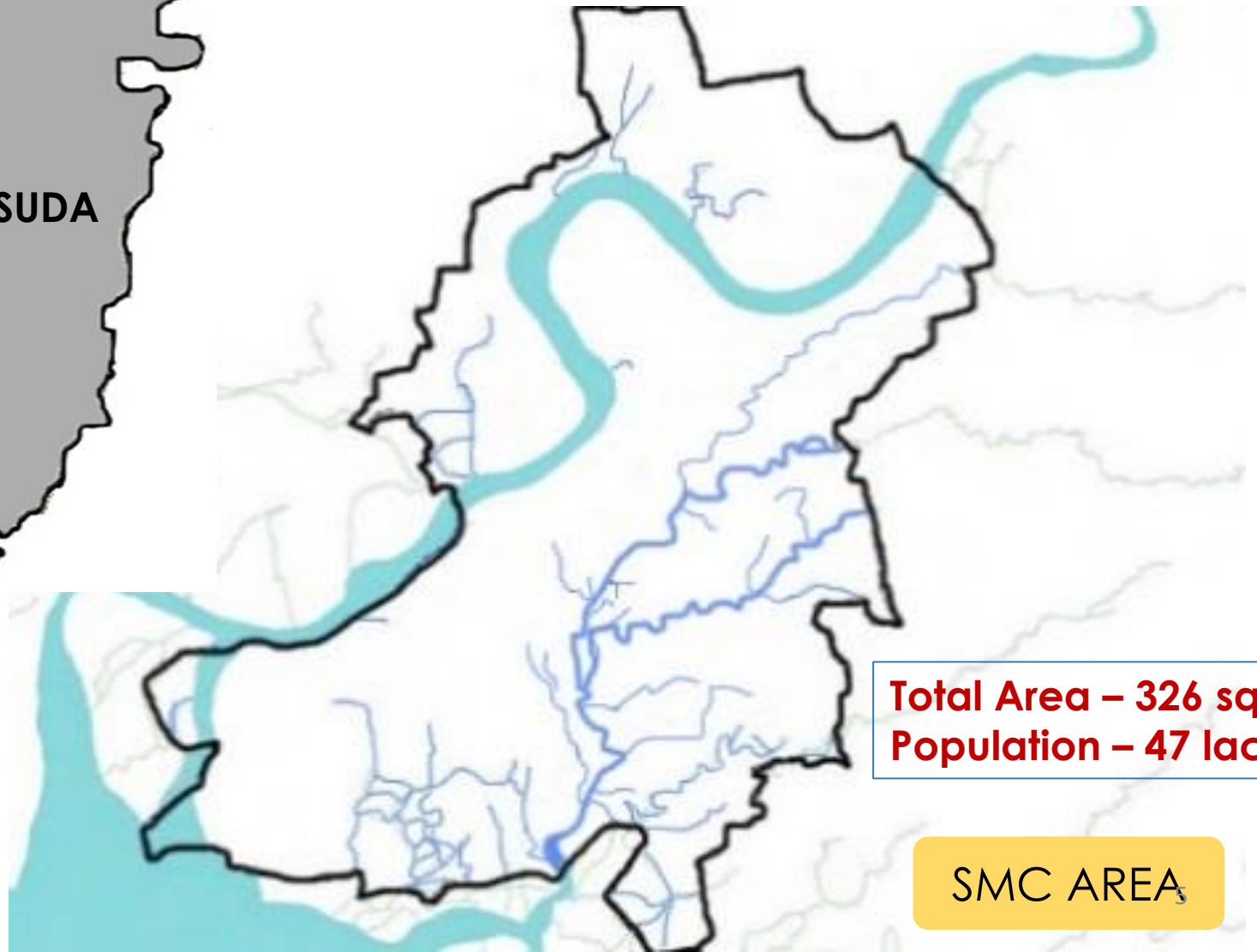
3. SMC LEVEL

SUDA



PURPOSE –

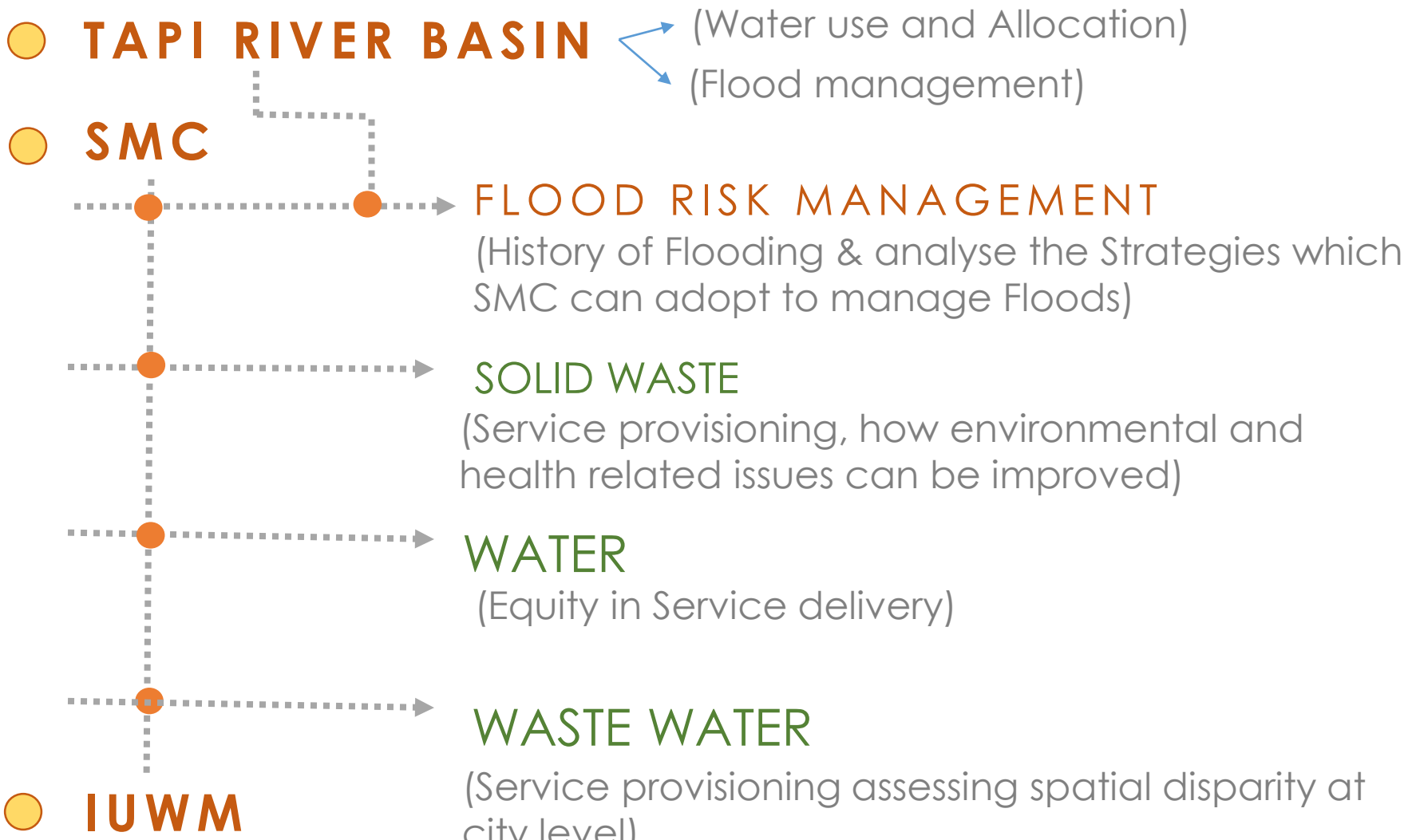
To study all four infrastructure services at city level.
(water, wastewater, solid waste and storm water)



Total Area – 326 sq.km
Population – 47 lacs

SMC AREA

STRUCTURE


TAPI RIVER BASIN
(Water use and Allocation)
(Flood management)
SMC
FLOOD RISK MANAGEMENT
(History of Flooding & analyse the Strategies which SMC can adopt to manage Floods)
SOLID WASTE
(Service provisioning, how environmental and health related issues can be improved)
WATER
(Equity in Service delivery)
WASTE WATER
(Service provisioning assessing spatial disparity at city level)
IUWM
(Reuse of waste water at urban and industrial areas.)

IWRM

INTEGRATED WATER RESOURCES MANAGEMENT

(Lower Tapi Basin)

WORK SCOPE... Methodology... Concept...

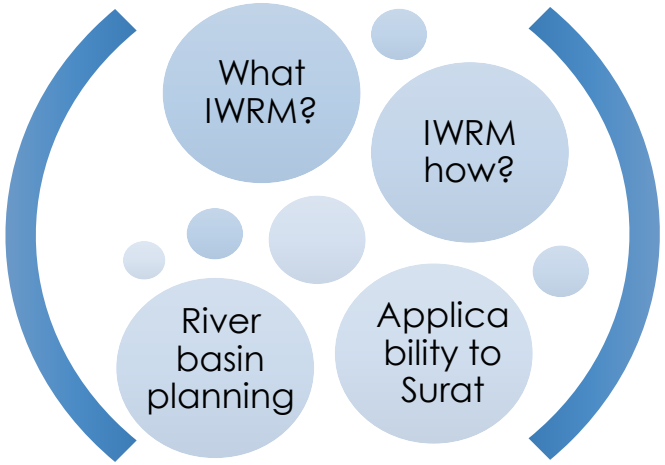
To apply an Integrated Water Resources Management strategy to Tapi river basin area in SMRDA region

"**IWRM** is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." (GWP 2008)

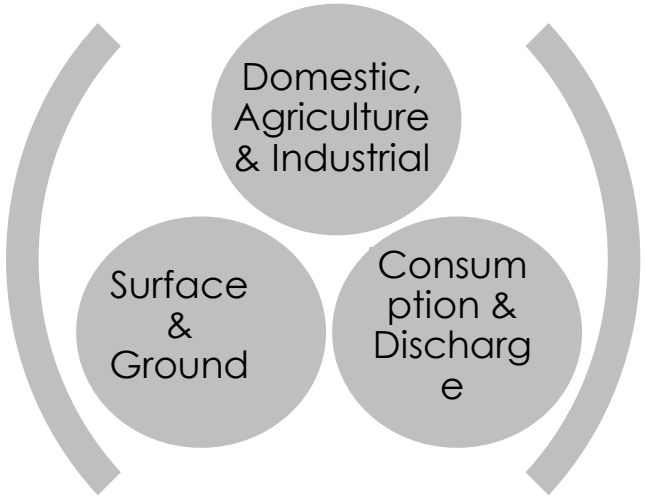
Trans-sectoral

Trans-boundary

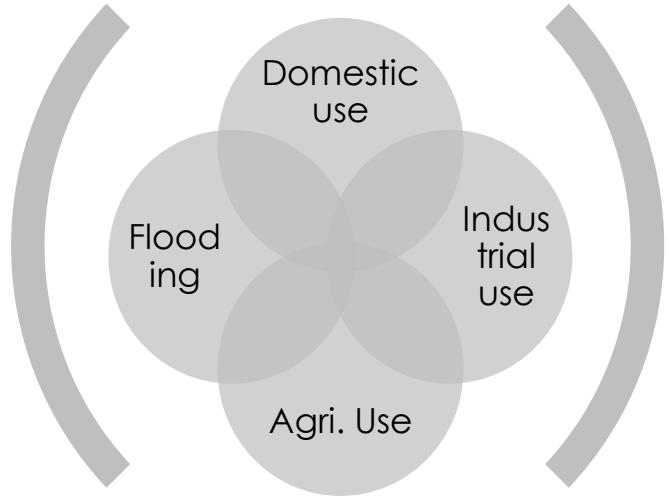
Stakeholder inclusive



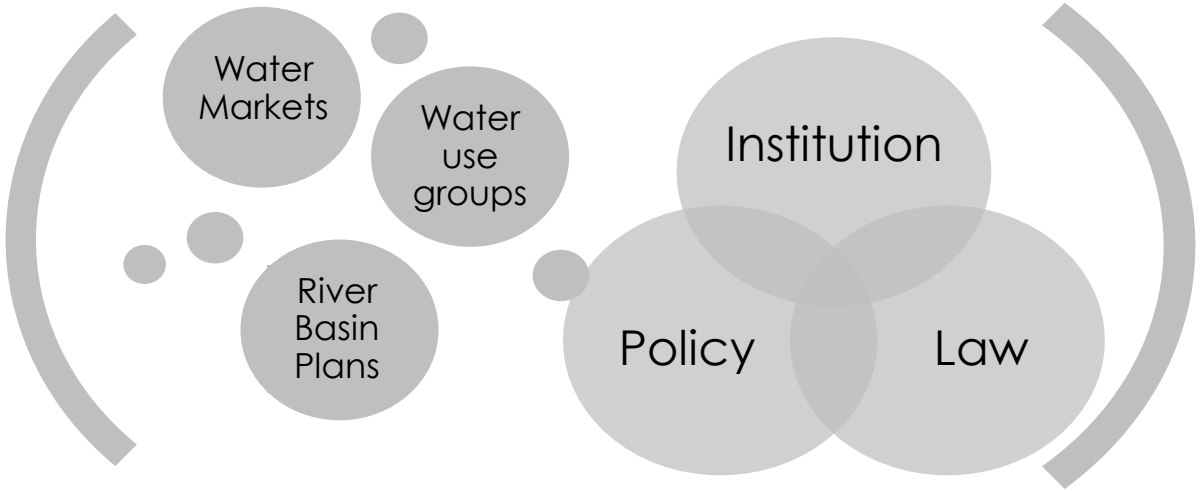
Work Scoping



WATER USE



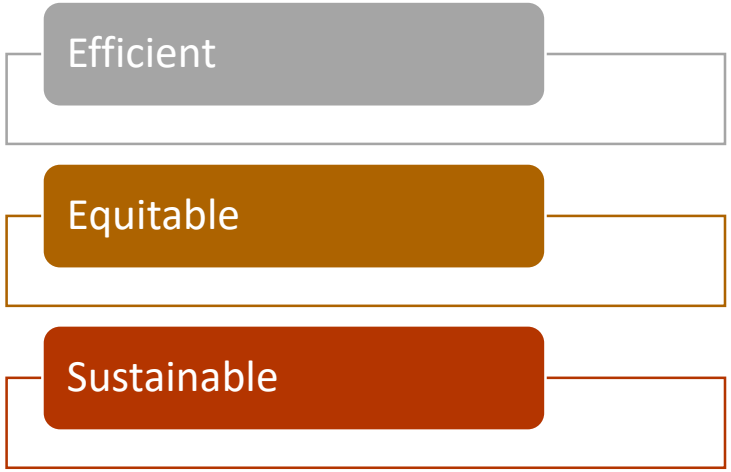
FUTURE SCENARIO



ALTERNATIVE OPTIONS AVAILABLE TOOLS

Why IWRM…?

- Demographic and climate changes increases the stress on water resources.
- Traditional fragmented approach is no longer viable
- Integrated Water Resources Management (IWRM) approach that has now been accepted internationally as the way forward for efficient, equitable and sustainable development and management of the world's limited water resources and for coping with conflicting demands



IWRM is based on the understanding that water resources are an integral component of the ecosystem, a natural resource, and a social and economic good.

Water for people

Water for food

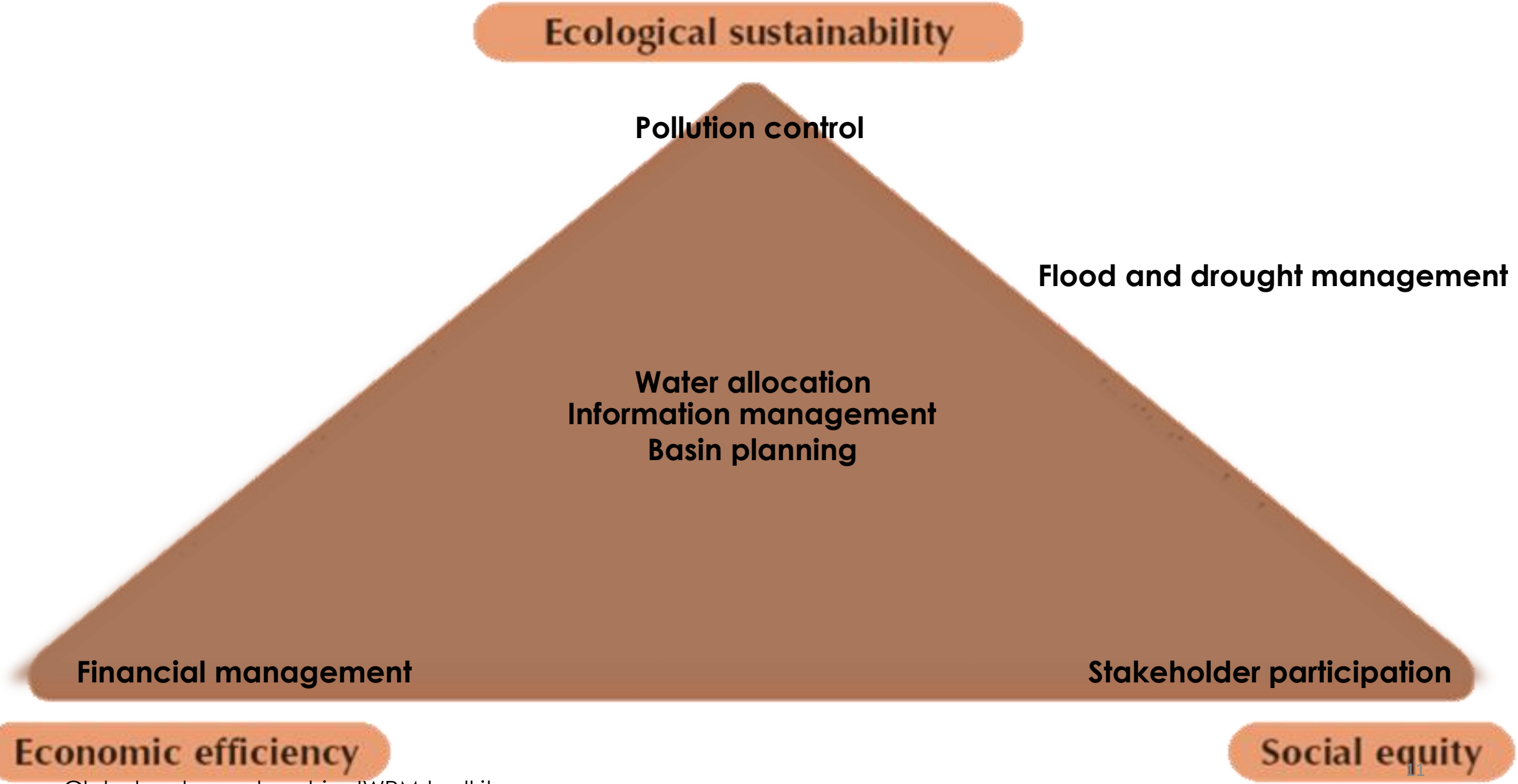
Water for nature

Water for Industry

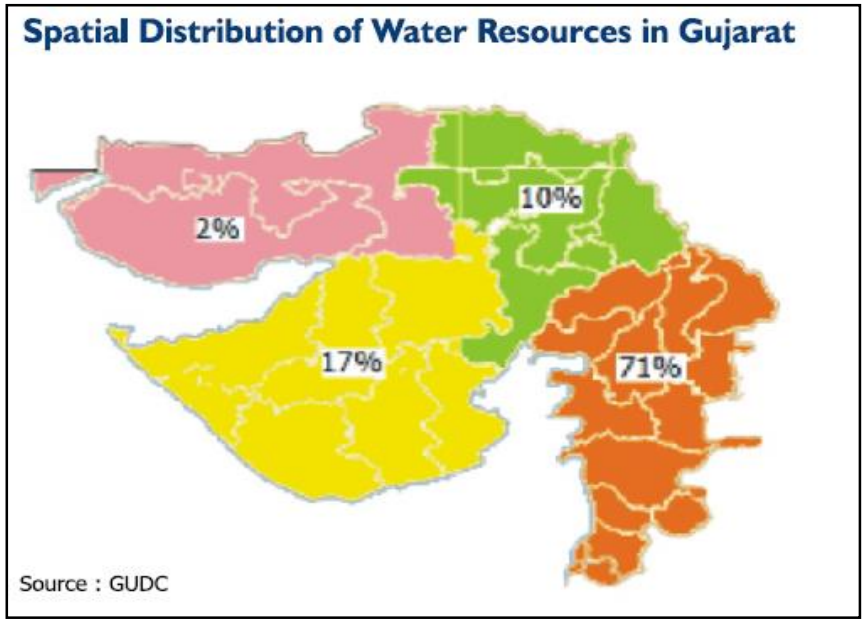
Cross-Sectoral Integration through

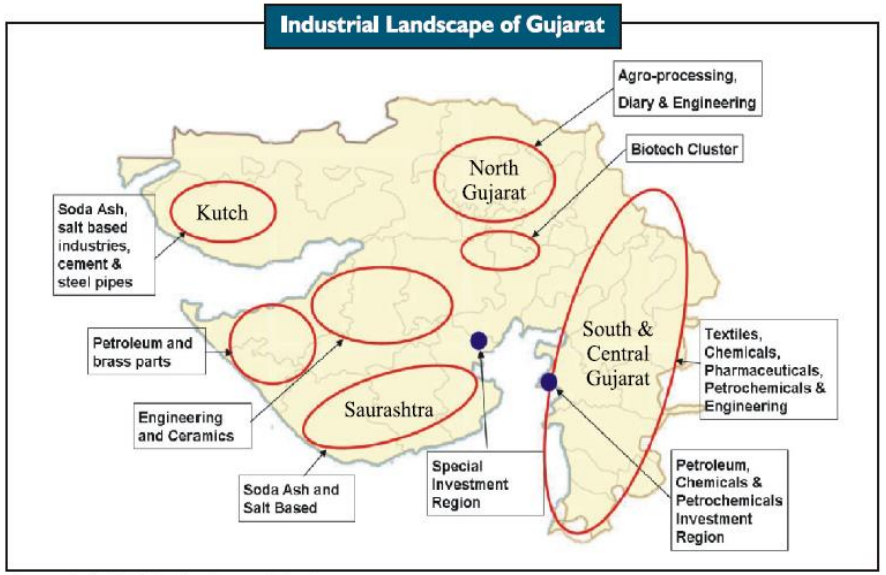
- Enabling Environment
- Institutional roles
- Management Instruments

Source – Global Water Partnership



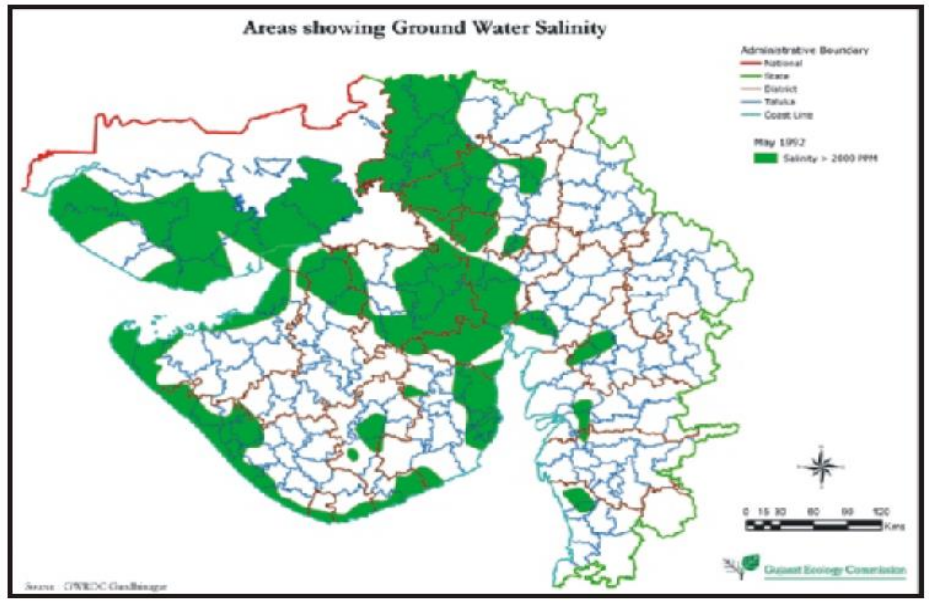
Source: Global water partnership- IWRM toolkit



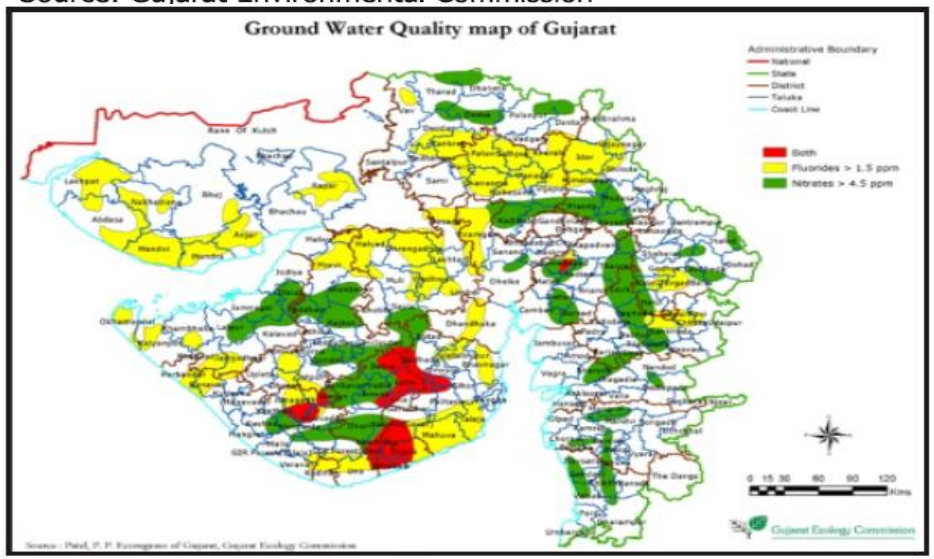


Source: Industrial Extension Bureau, Gujarat

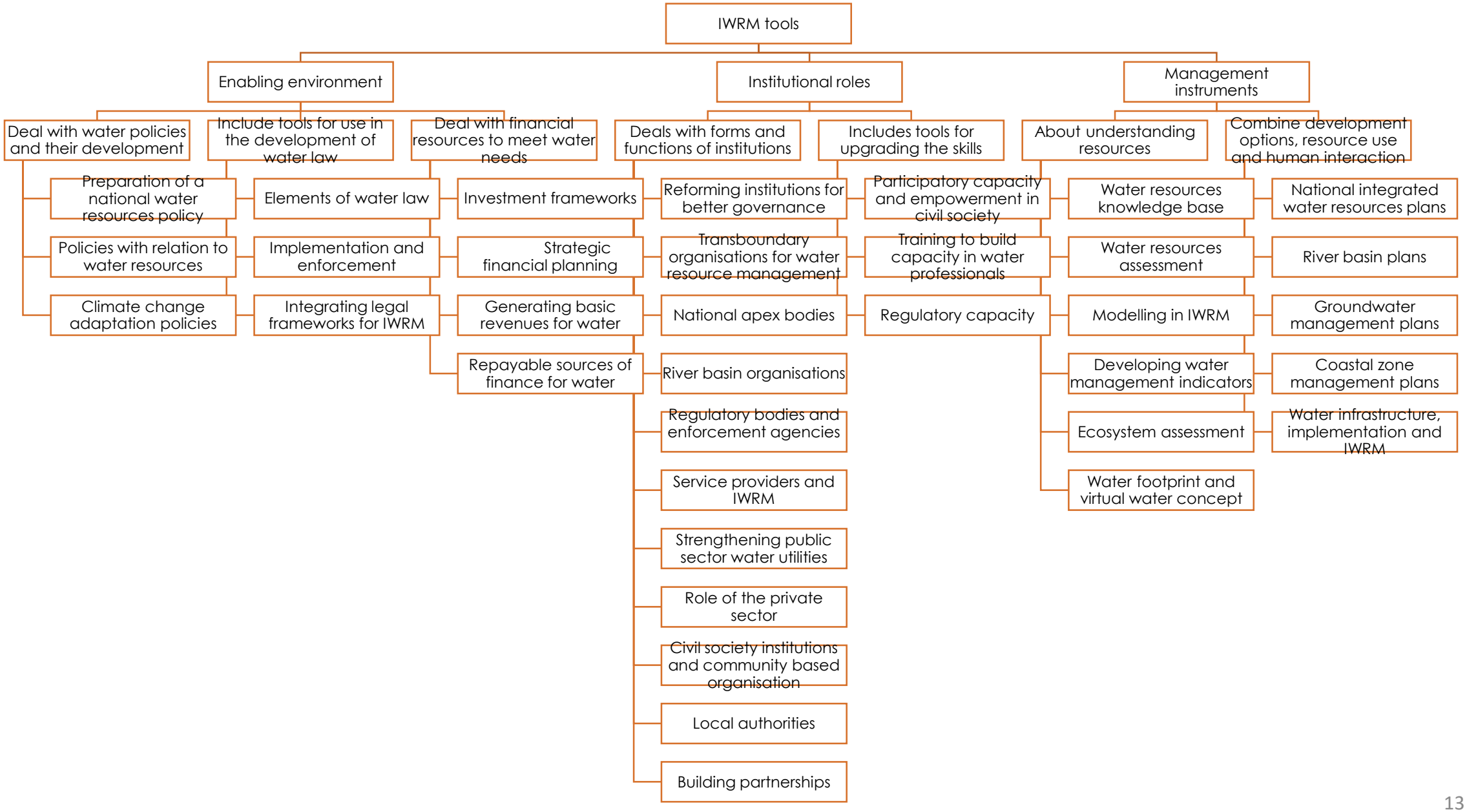
- ¾ surface water resources in 1/3 geographic area – rest scarce – need to conserve in water sufficient areas
- Water intensive industries
- GW status comparatively good – need to preserve status
- Tapi flood prone
- Allocation conflict



Source: Gujarat Environmental Commission



Source: Gujarat Environmental Commission



Adapted from Global water partnership- IWRM toolkit

Enabling Environment Institutional Roles Management instruments

National Water Resources Act
Water allocation

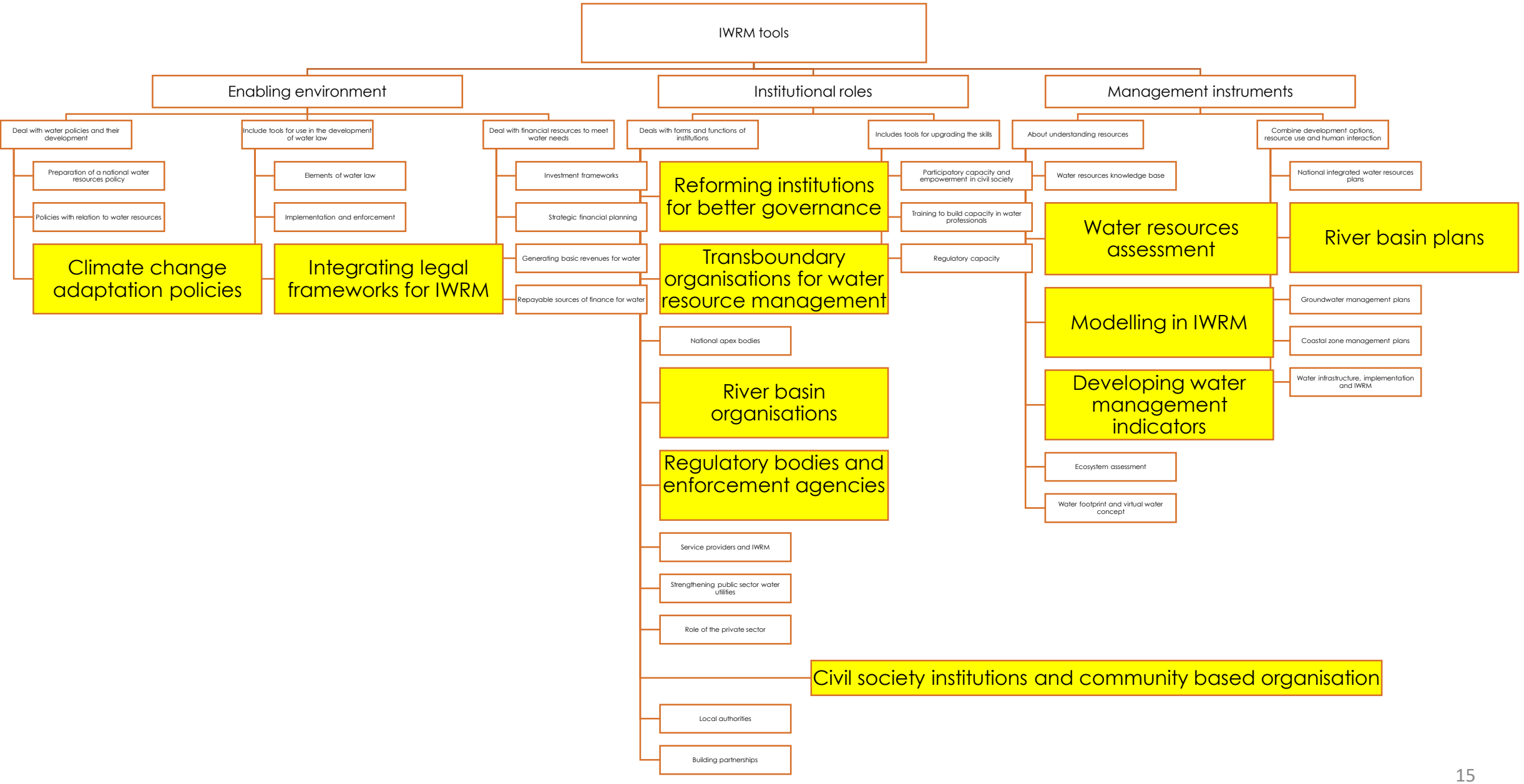
Stakeholder participation
Public Pvt Partnership
Water User associations
Tans boundary coordinAtion

Stakeholder participation
Financial Management
River Basin Plans
Flood Management plans

Adapted from Global water partnership- IWRM toolkit

Detail*

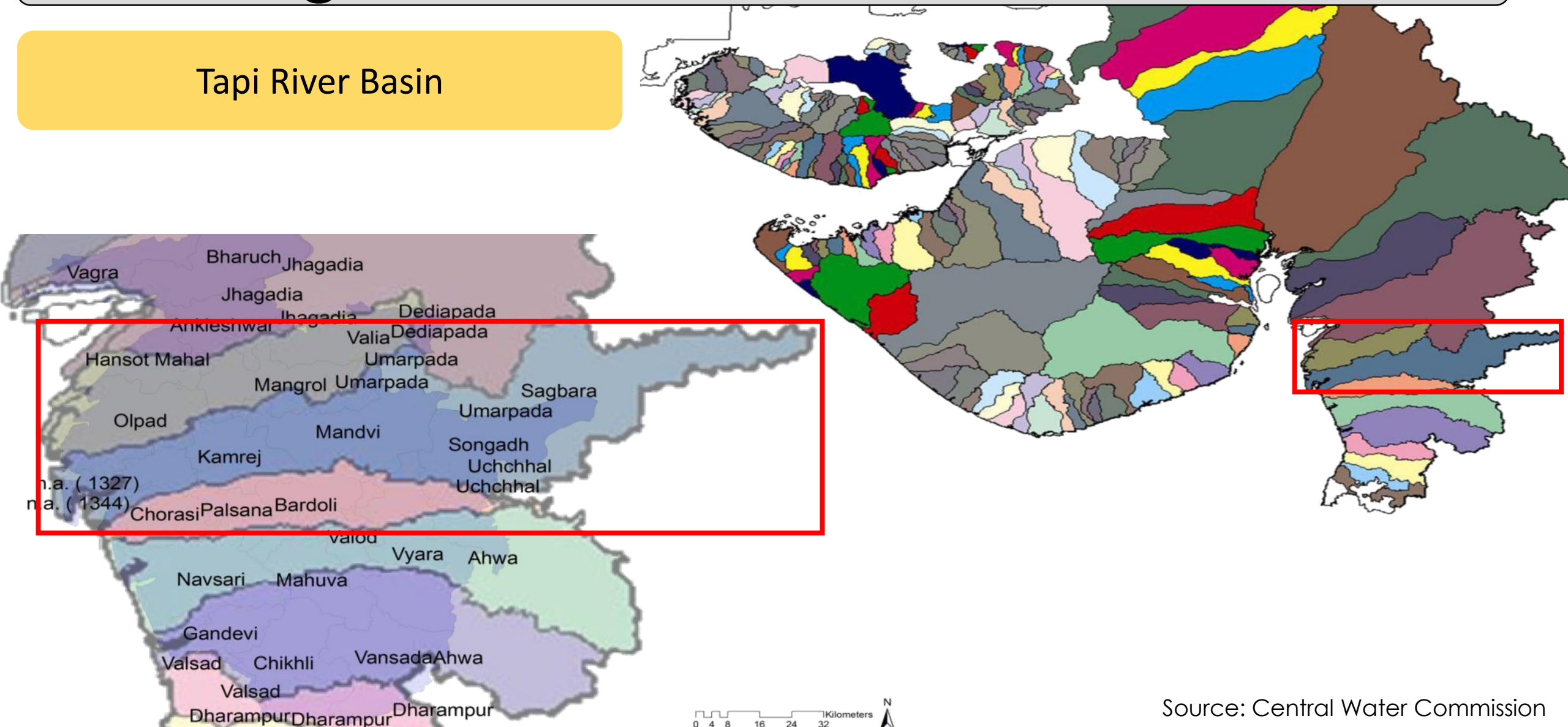
Very high High Medium Low Data unavailable



Adapted from Global water partnership- IWRM toolkit

Logical unit for IWRM = River basin

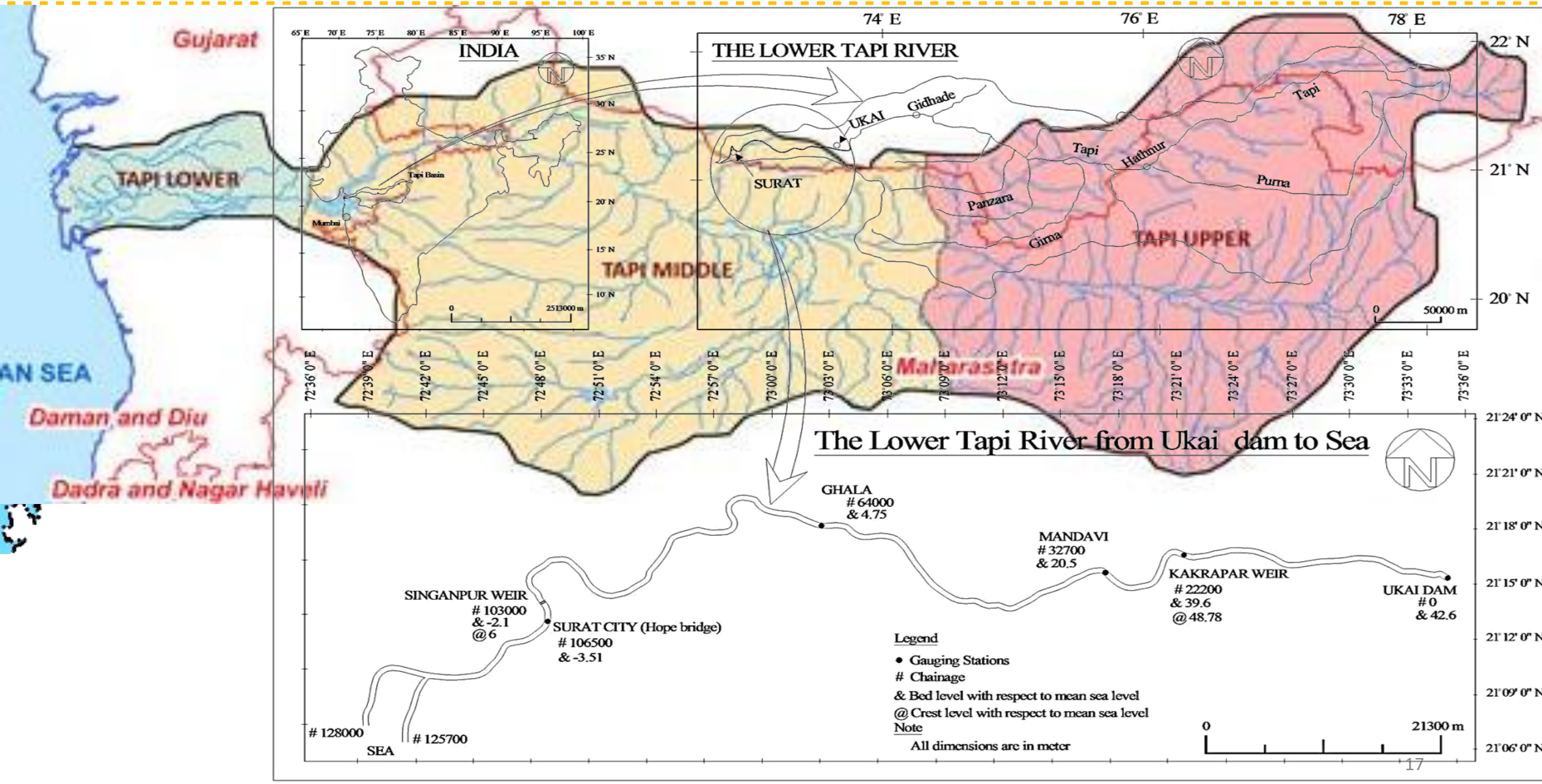
Tapi River Basin



Source: Central Water Commission

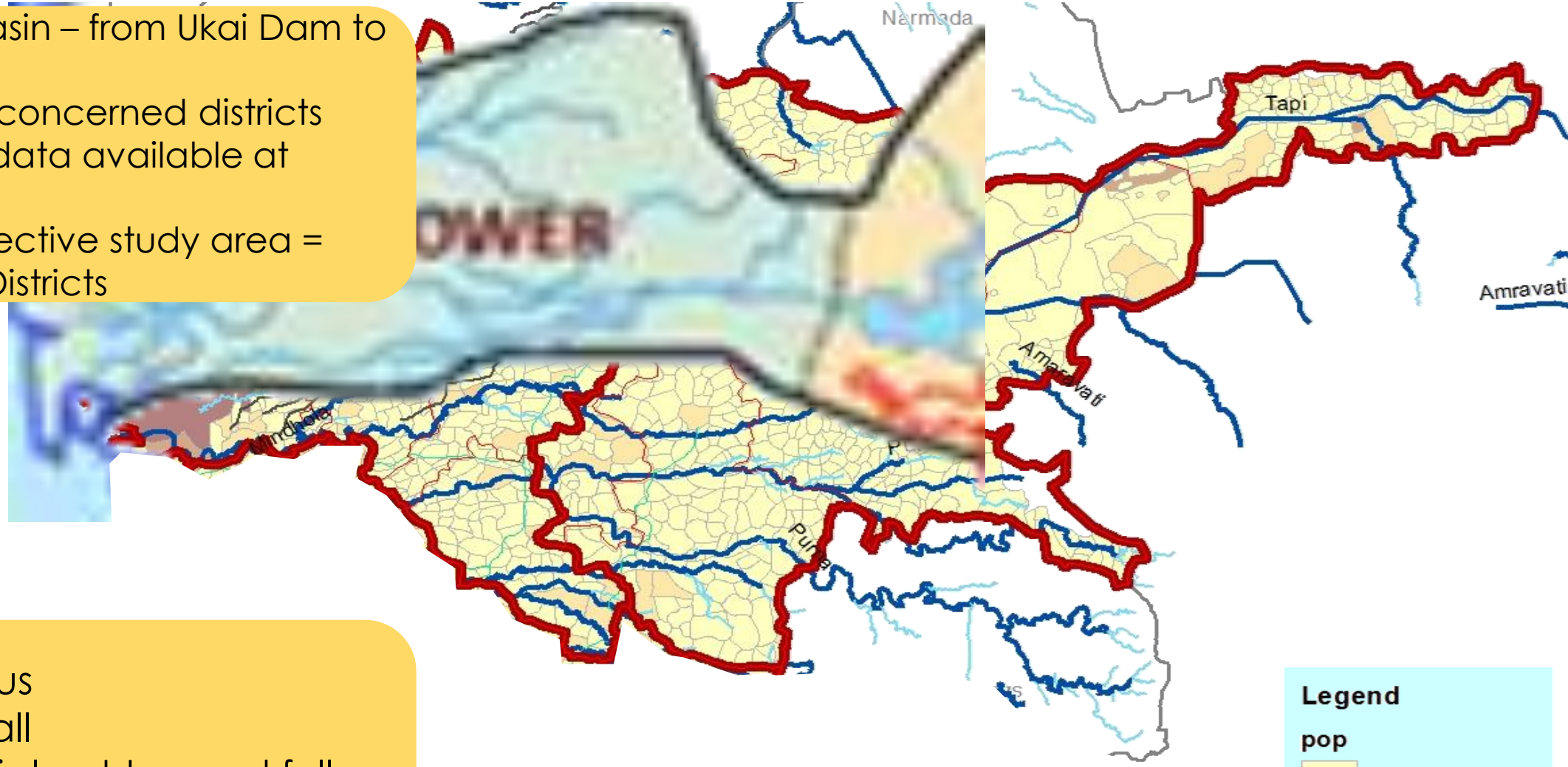
CONTEXT AREA… PHYSICAL SCOPE…GEOGRAPHY…USERS

Lower Tapi Basin



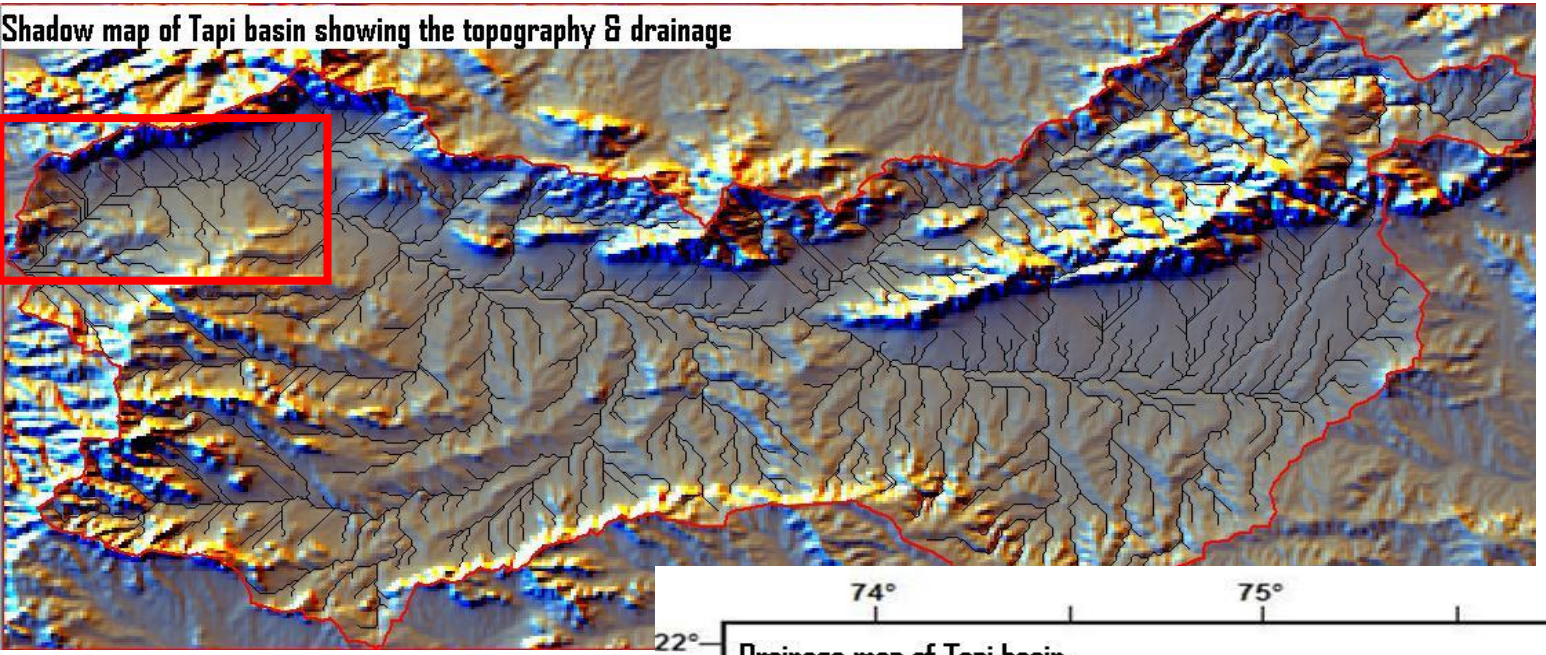
Surat and Tapi Districts

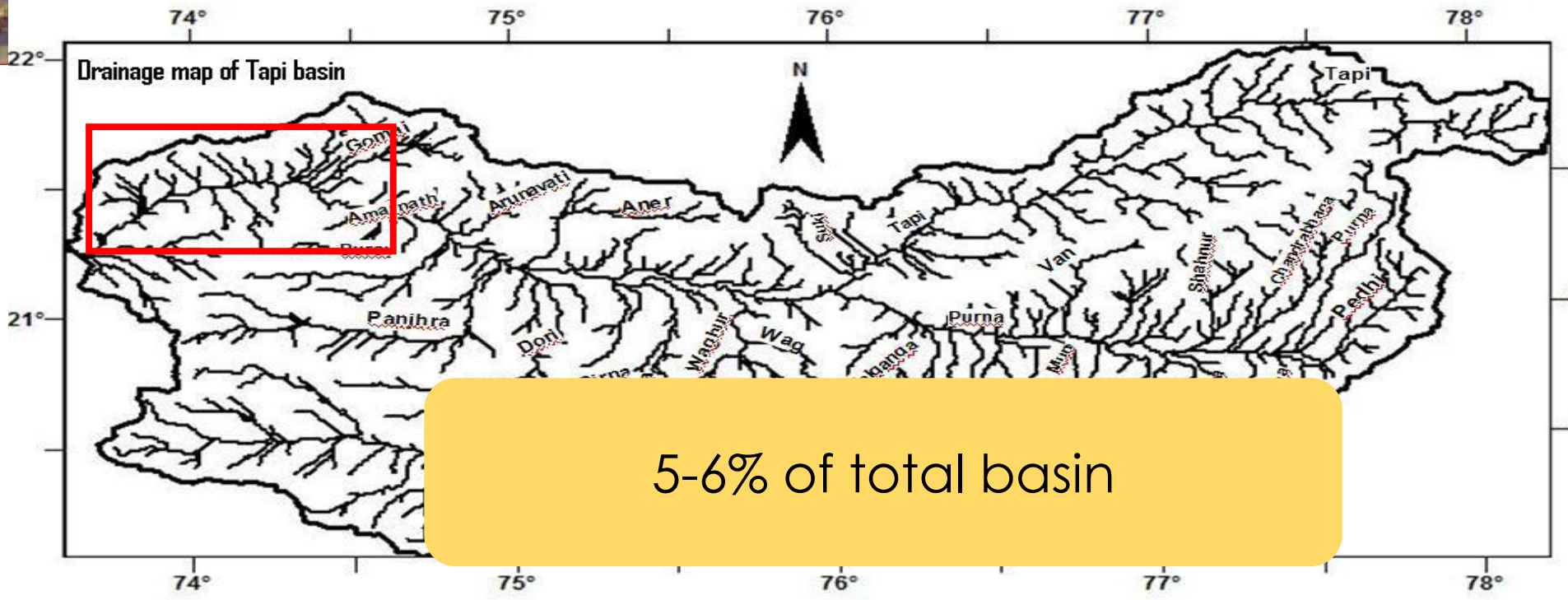
- Lower Tap basin – from Ukai Dam to Arabian sea
- Basin covers concerned districts partially but data available at district level
- Therefore effective study area = Surat + Tapi Districts



- Water surplus
- Good rainfall
- Tapi Potential not tapped fully
- Recurring Flood problem
- Sea water intrusion issues

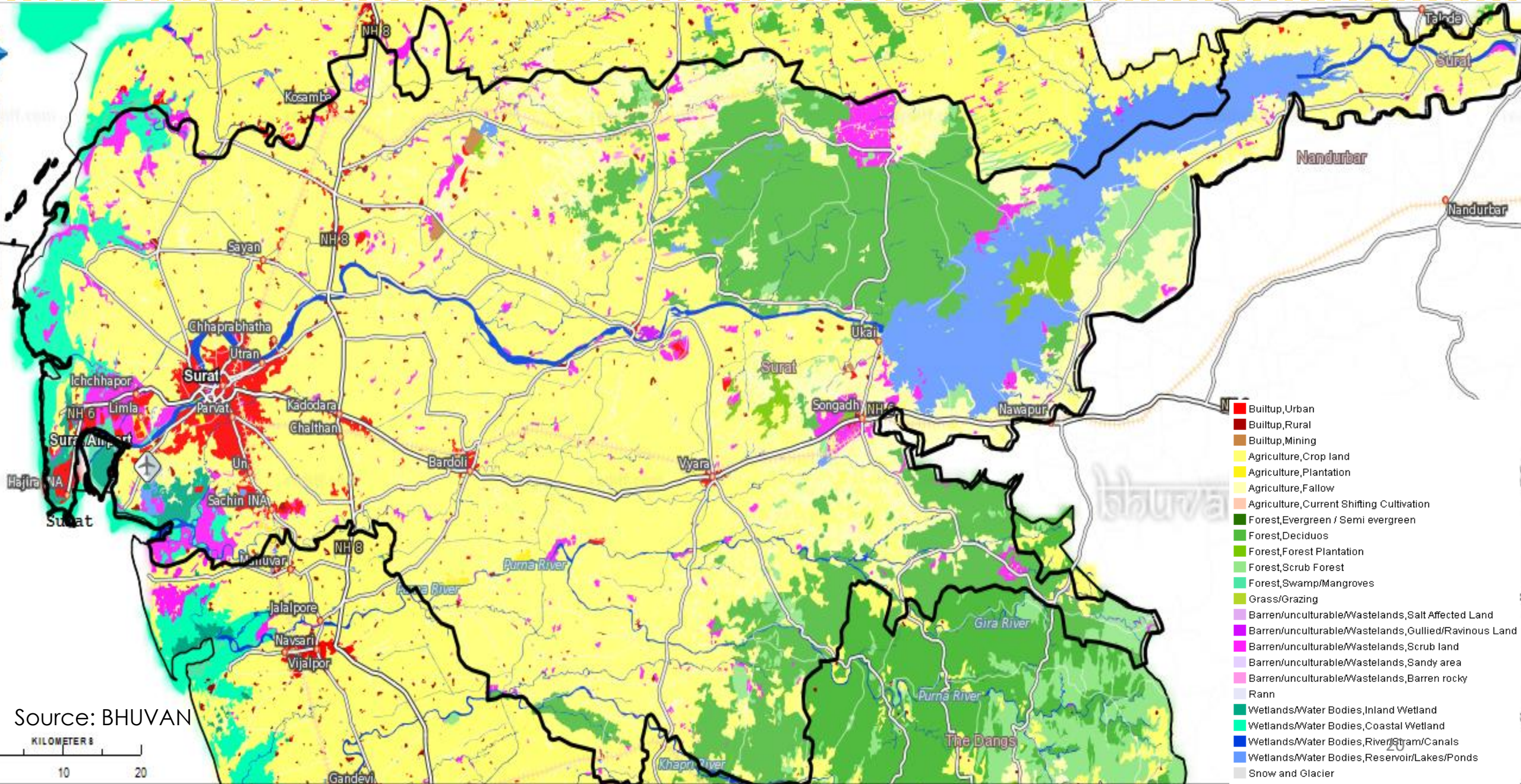
Surat and Tapi Districts





5-6% of total basin

Surat and Tapi Districts- Land Use



Source: BHUVAN

	India	SE Asia	EU	USA
Plan	Ganga River Basin Environnent Management Plan	Basin Development Strategy for Mekong lower basin	Thames River basin Management plan, Solway Tweed River Basin management Plan	Colorado River region basin plan
Directive	Environment (protection) Act 1986	Agreement for the Cooperation for the Sustainable Development of the Mekong River Basin 1995	Directive 2000/60/EC Water Framework Directive	Clean Water Act + Watershed Management intiative
Agency	National Ganga River Basin Authority	Mekong River Commission	"appropriate agency" generally respective environment agencies eg: SEPA	State water quality control Board
Objectives	**pollution control, cleaning of surface water**		**"good" status of surface bodies, reduce pollution**	**Reducing pollution, quality control of surface water**
	ensure minimum ecological flow	Fisheries management	prevent deterioration of aquatic ecosystems, habitat conservation, separate marine plan	
		Wetlands management	Protected areas management	
	regulate abstraction, promote storage	**equitable distribution of resources- inter-govt coordination**	**sustainable use of water**	
	longitudinal and lateral connectivity	navigation development	navigation development	
	floodplain reclamation	**Flood and drought management**	**flood and drought mitigation, separate plan**	
			regulation of physical modification	
		Hydropower generation		
		Food security and poverty alleviation through agricultural irrigation development		
			reduce groundwater pollution, monitor extraction	**reduce groundwater pollution, control overdraft**
			Agency coordination	

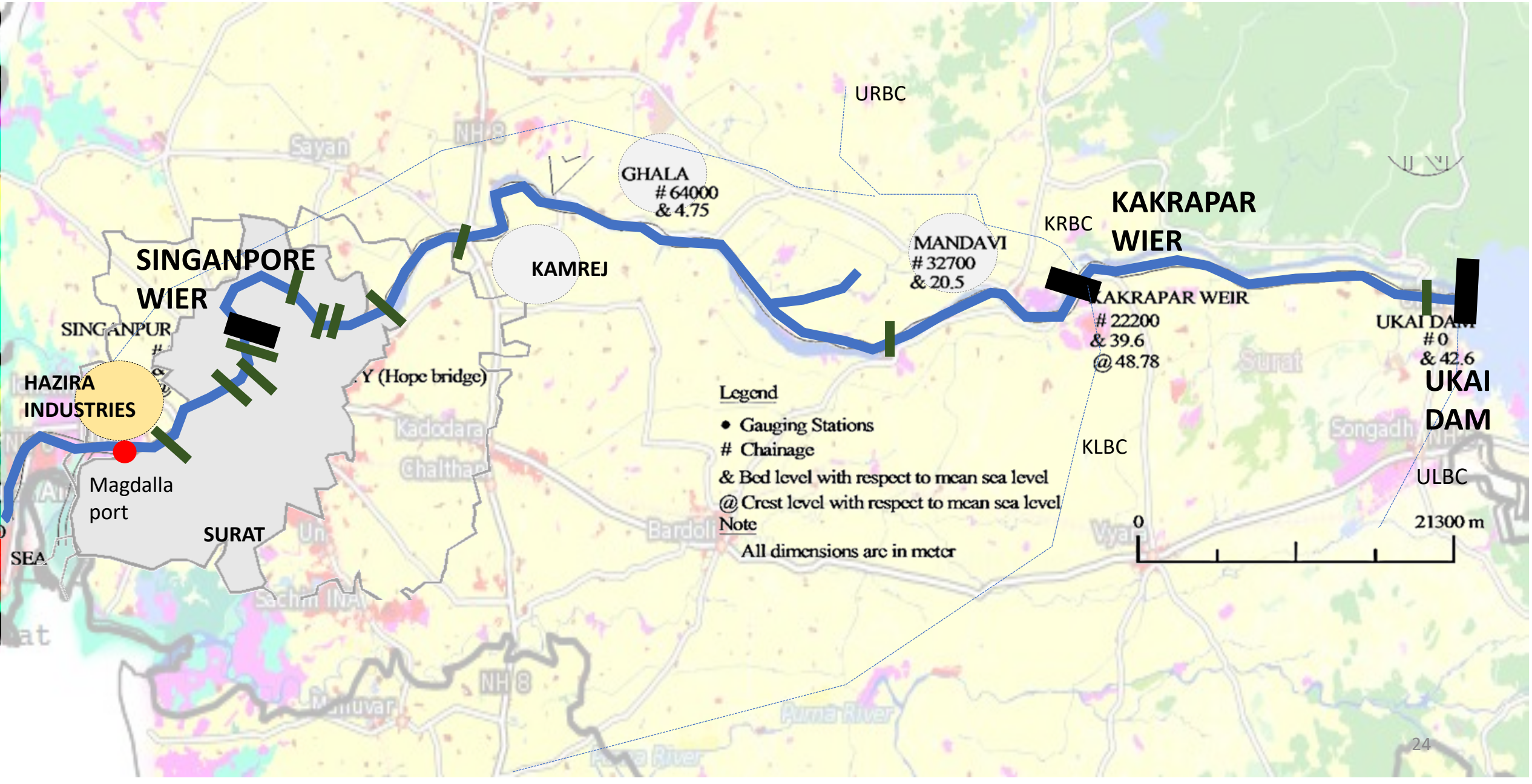
Adapted from respective River Basin plans

1. Plan for equitable allocation of water between domestic industrial and agricultural demand

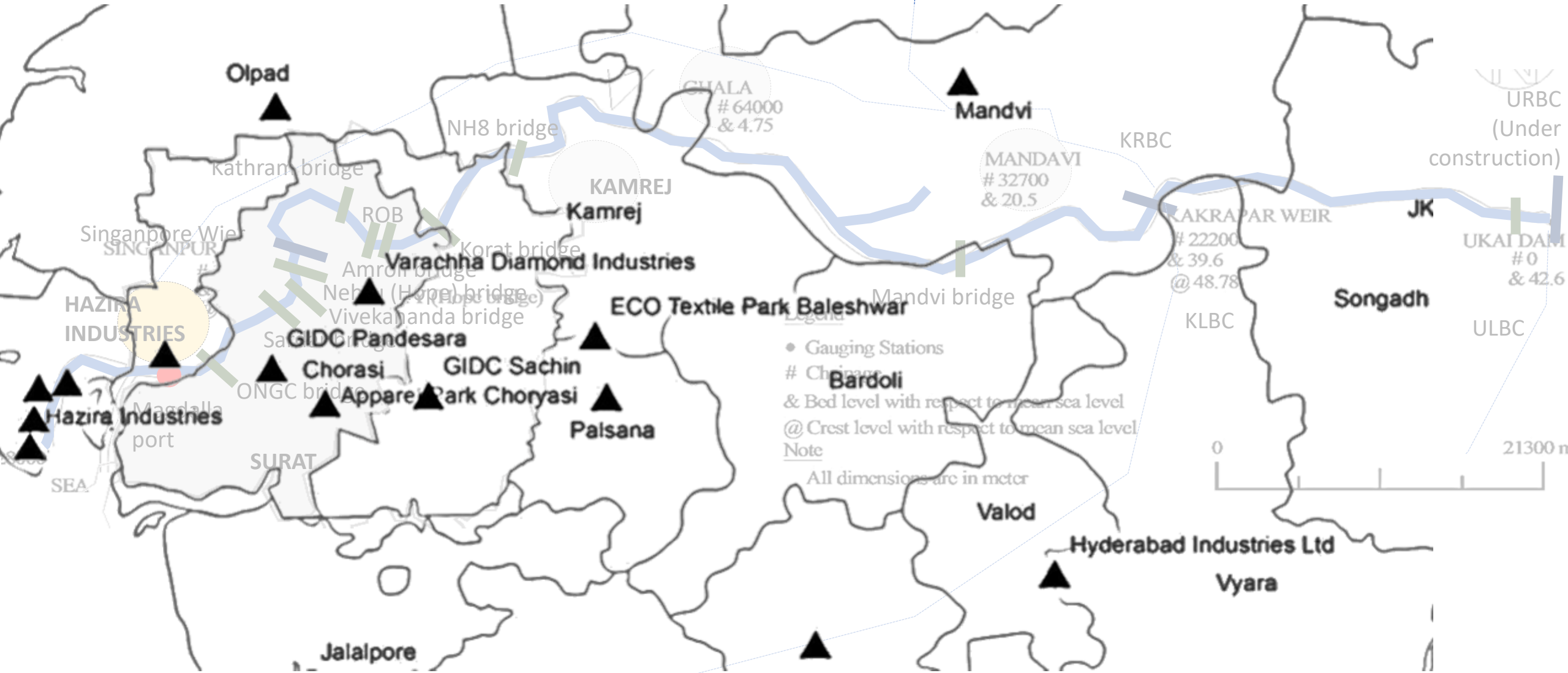
2. Identify gaps and potentials in institutional arrangement for integrated management of geographical area
   - Flooding issue
   - Water use and allocation

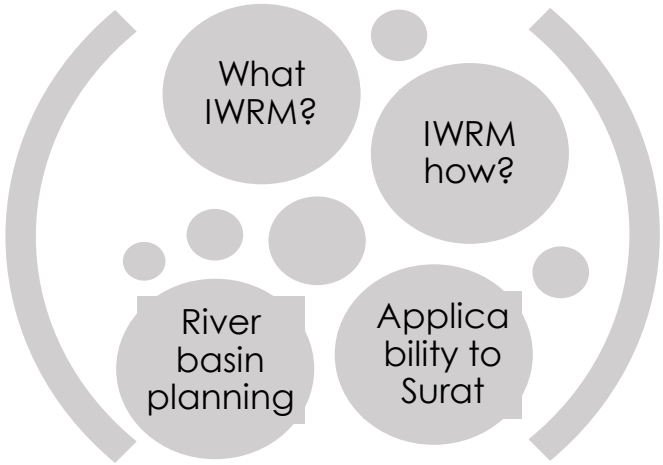
Part 1: Water Use and Allocation

Settlements, canals, bridges

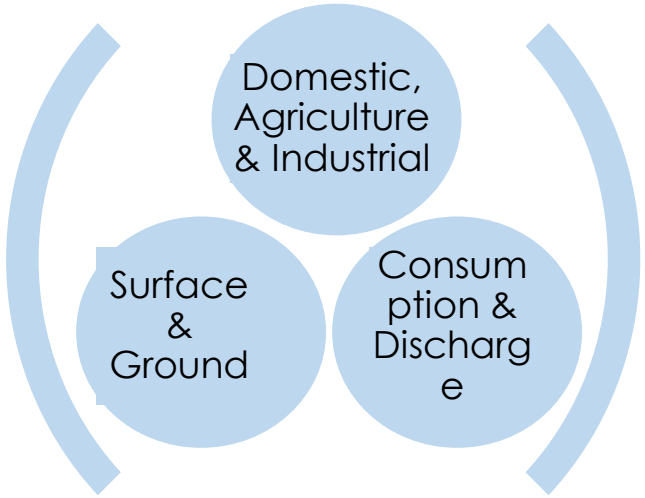


Settlements, canals, bridges

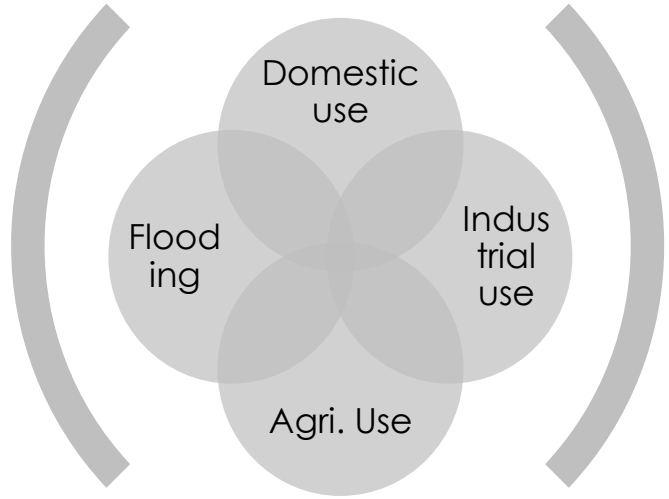




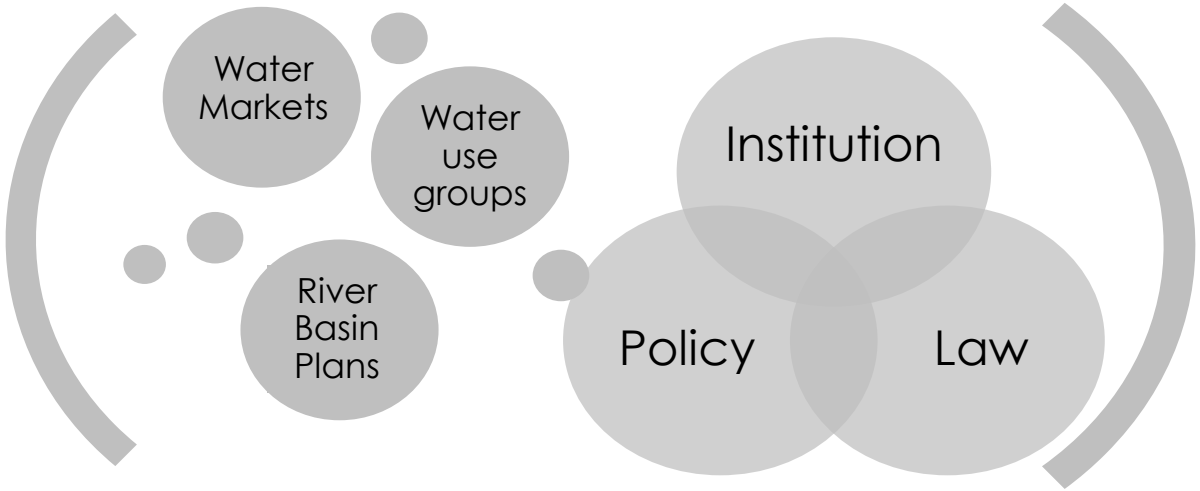
Work Scoping



WATER USE

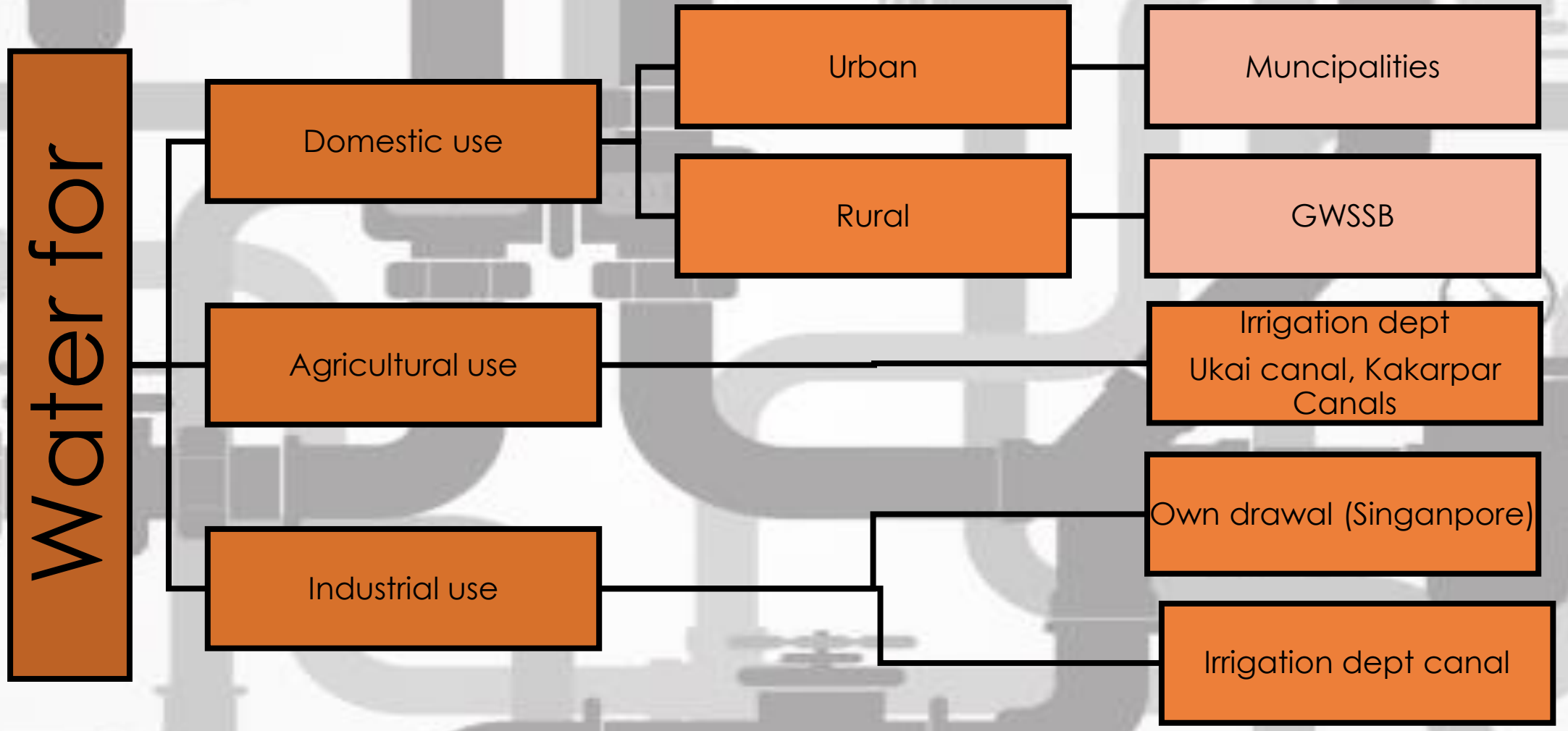


FUTURE SCENARIO



ALTERNATIVE OPTIONS AVAILABLE TOOLS

BASIN WATER USE… COMPETING USES…SURFACE/GROUND … Water Users

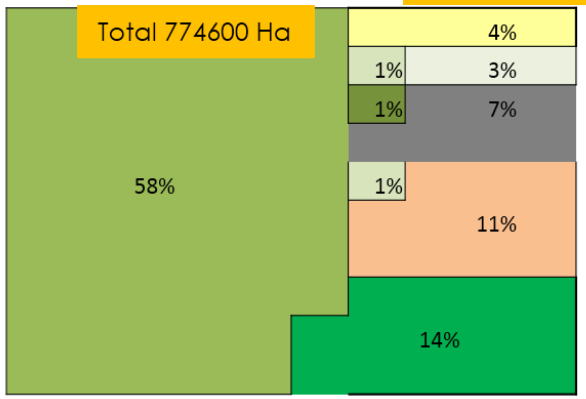


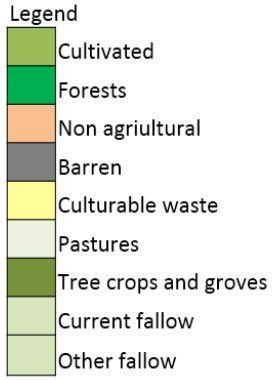
BASIN WATER USE… COMPETING USES … SURFACE/GROUND Water demand…

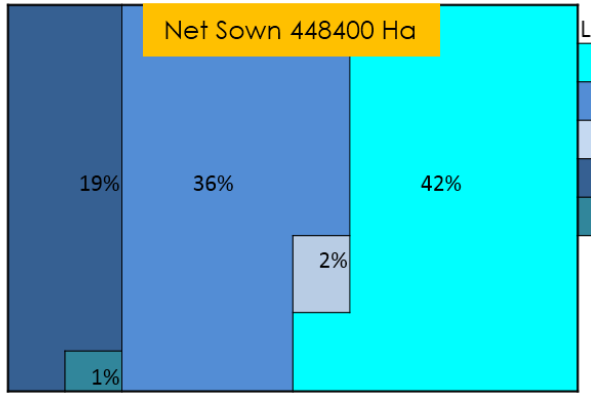
Irrigation Demand

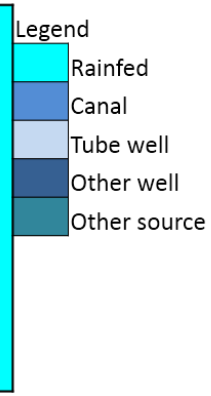
Gross irrigated area → Crop wise irrigated area → Cropping seasons → Daily crop wise water req (ht in cm) → Daily water demand

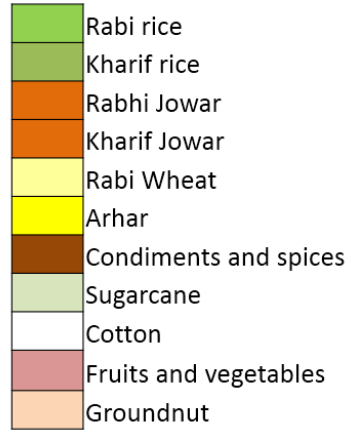
13-20 thousand MLD depending on season, Command area of canals is much more , Around 28% depend on ground water also ~3504 MCM on surface in SURAT+TAPI

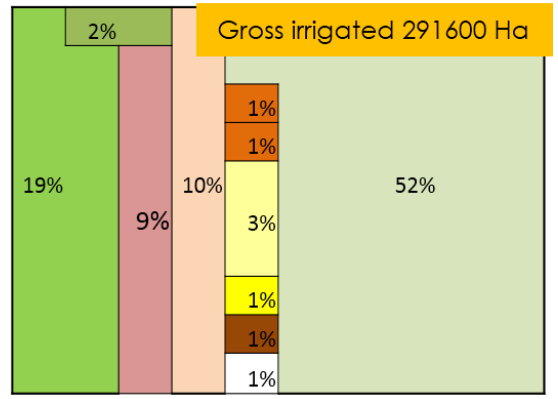




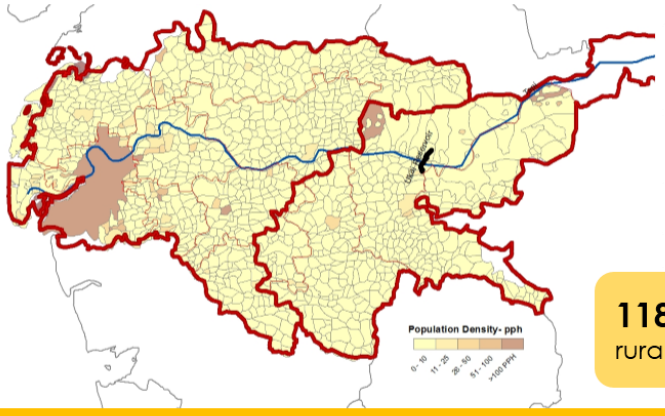








Domestic Demand



1182 MLD According to rural and Urban Populations

Rural/Urban taluka populations → x lpcd: Rural @70, Urban @135 → + % NRW: Urban @20, Rural @40 → Total Water demand

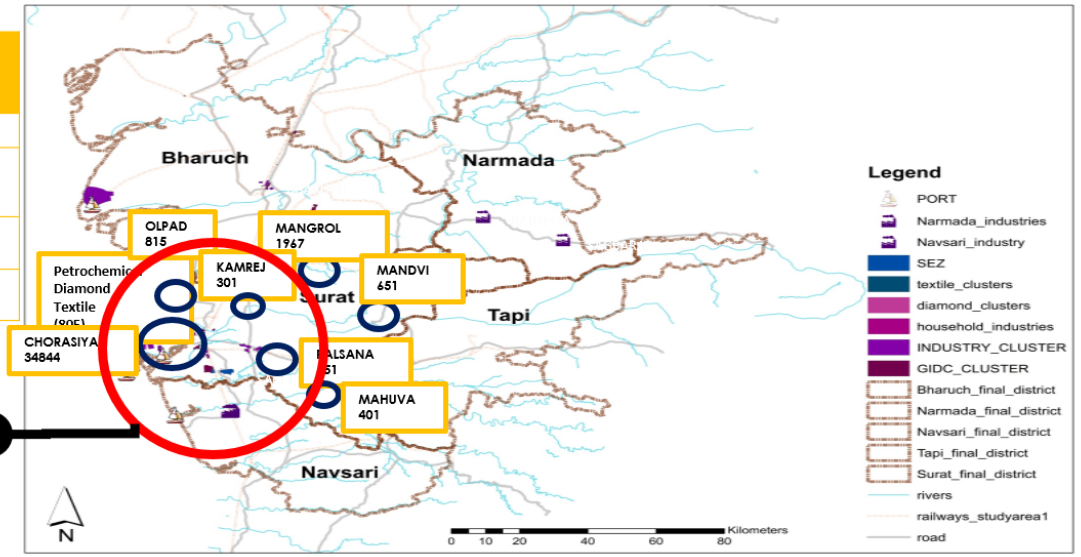
Industrial Demand

Name of Industry	Type of Industry	Water Demand (MLD)	Drawl Rights (MLD)
Reliance Industries Ltd.	Petrochemical	90	97
Essar Steel Ltd.	Steel	25+20 (2008)	57
O.N.G.C.			57

Name of Industry	Type of Industry	Water Demand (MLD)	Drawl Rights (MLD)
N.T.P.C.	Power	21	57
Rama newsprint Ltd.	Printing	6	33
GIDC Ichchhapore		3	10
L & T	Engineering	9	1.5

53% manufacturing – extrapolate accordingly

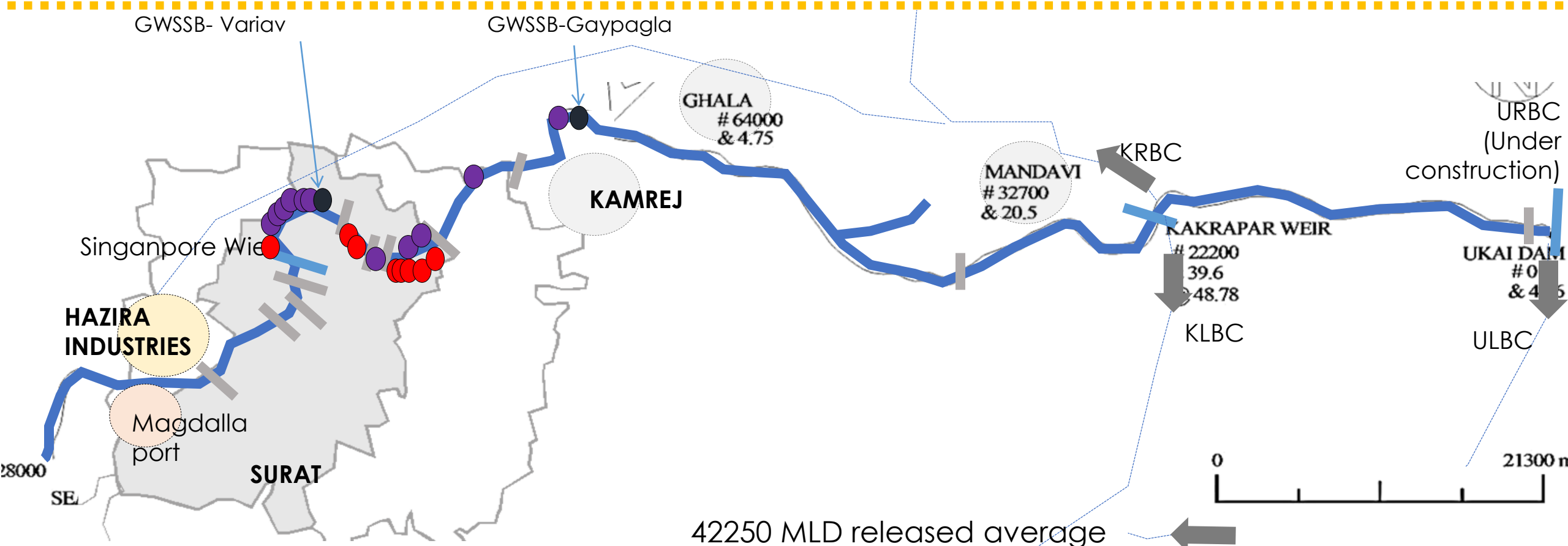
~ 1368 MLD



Source: Irrigation Department Surat Circle, Survey of India Maps, Min of Agriculture: LUS 2008, Census of India 2011, Singanpore Drawal agreement

Detail*

SURFACE/GROUND ..Surface Water extraction



42250 MLD released average
800 MLD ULBC
735 MLD
391.44 MLD
55+3MLD=58 MLD
10686 MLD KLBC+KRBC+URBC

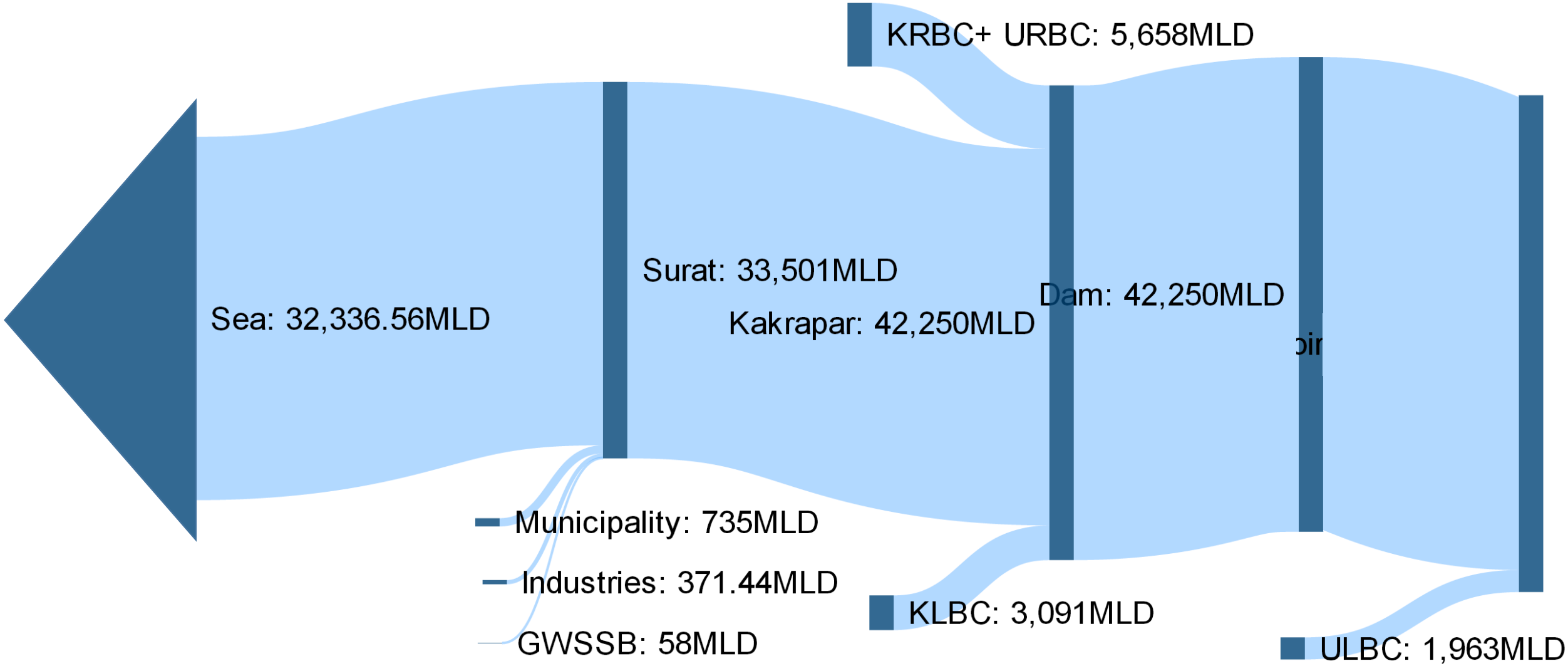
- Municipality intake well
- Industry intake well
- GWSSB intake well
- Irrigation Main canal

Some goes out of district for irrigation

11870 ML abstraction daily

4332 MCM yearly – well within Gujarat allocation

WATER EXTRACTION BALANCE



BASIN WATER USE... COMPETING USES...SURFACE/GROUND ...

Domestic Demand
1182 MLD

Industrial Demand
1368 MLD

Irrigation Demand
13,000-20,000 MLD

With 11870 ML surface water extraction daily

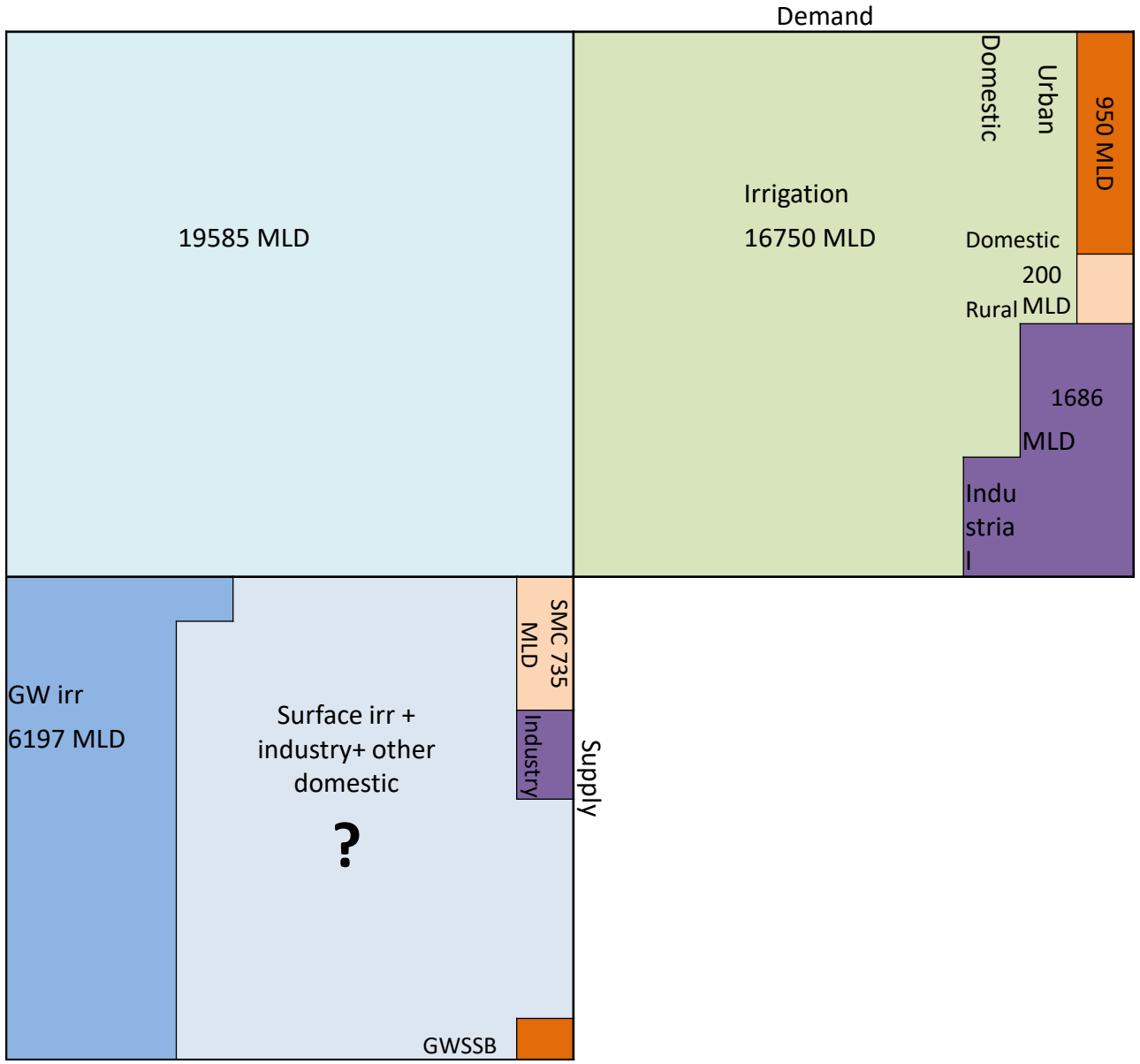
In order to cater to multi-sectoral water demands and for an optimum and judicious utilization of the available land and water resource , an **I**ntegrated **W**ater **R**esource **M**anagement is necessary.

Water available at Ukai and allocated to Gujarat

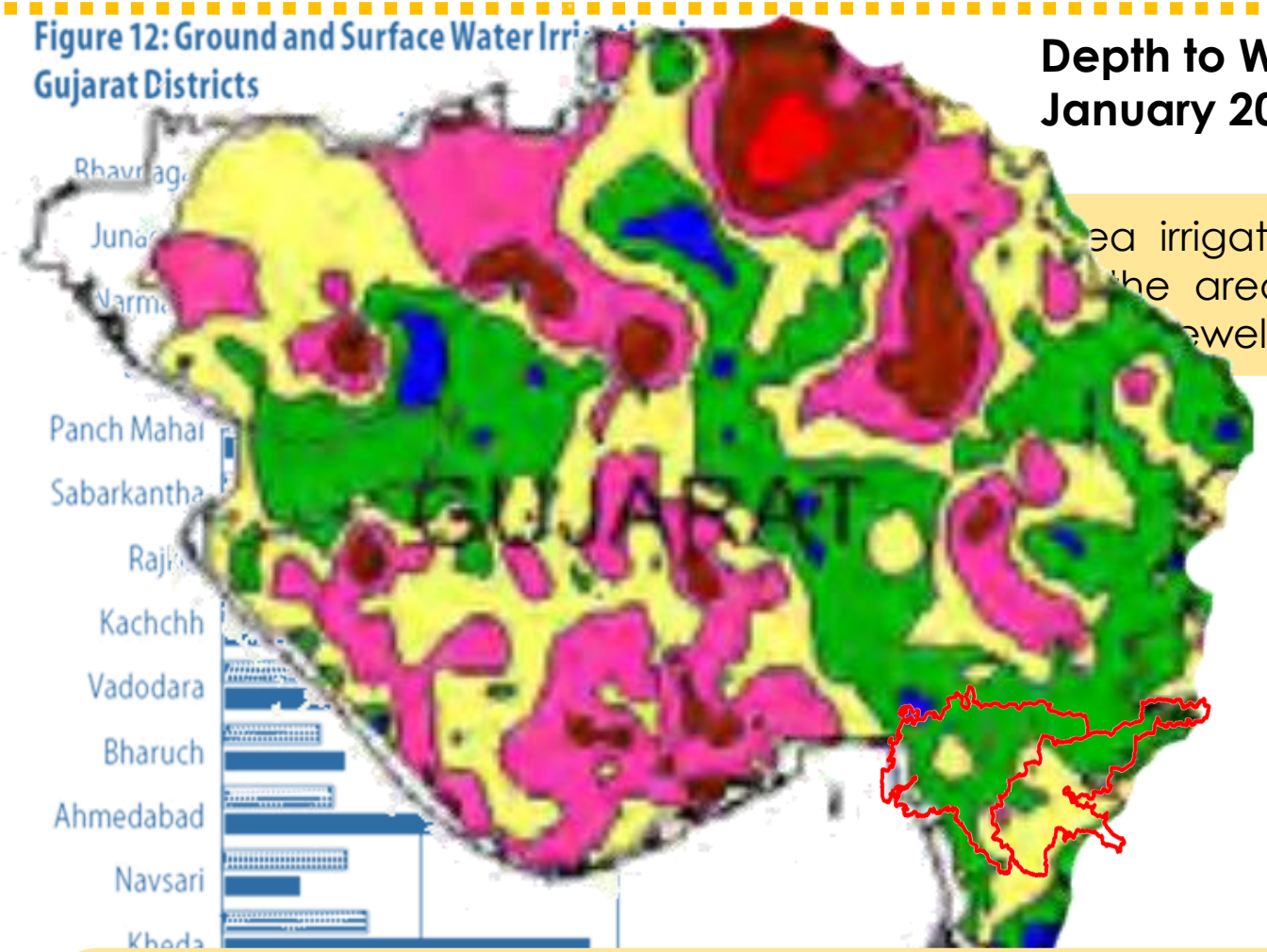
Total water availability at Ukai in Tapi	At the time of project planning , 1975	Presently
Total water availability at Ukai	11,350 MCM	
Total allocation to Gujarat	3,947 MCM	4390 MCM
Irrigation	3,232 MCM	3562 MCM
Domestic and industrial water supply	715 MCM	825 MCM

Source : People committee on Gujarat Flood 2006 : A report

WATER BALANCE

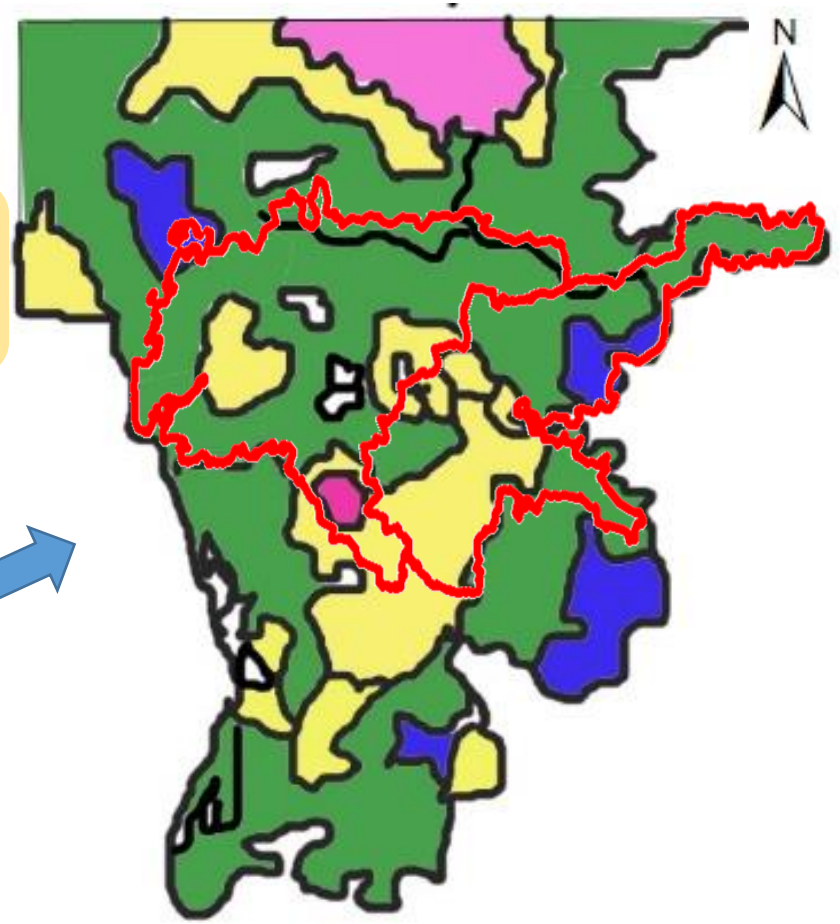


SURFACE/GROUND… Ground Water abstraction



ea irrigated by canals
he area irrigated by
ewells

Depth to Water Level – January 2014



Depth to water level (m bgl)

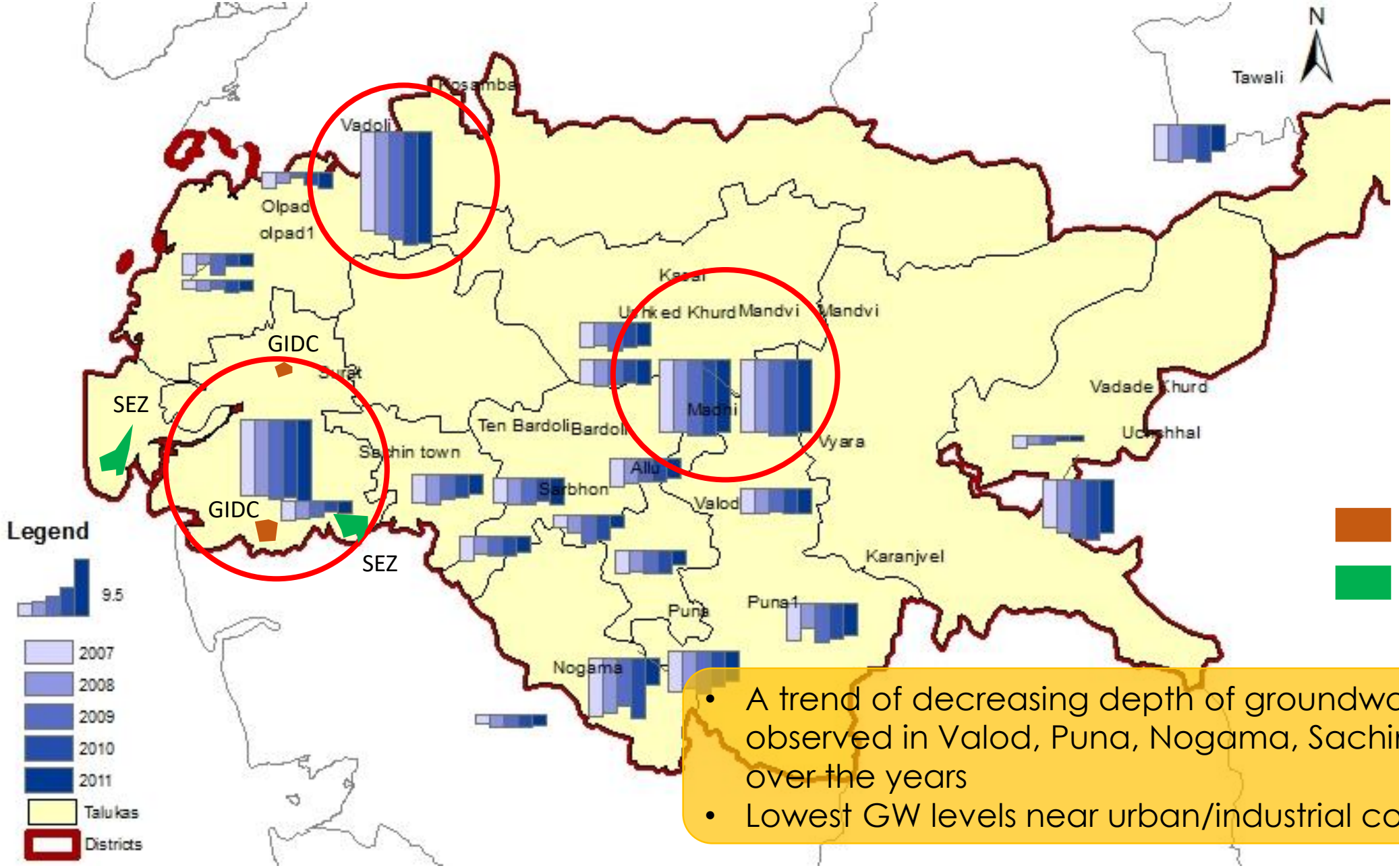
- < 2
- 2-5
- 5-10
- 10-20
- 20-40

- The depth to water level recorded in the state of Gujarat during January 2014
- The depth of water level in wells analysed in Surat have shown water levels in the range 2-5 and 5-10
- **Ground Water Levels Good so far…..BUT**

Source: Gujarat's Agricultural Growth Story, Kumar, D. et al (March 2010)

Groundwater board report 2014

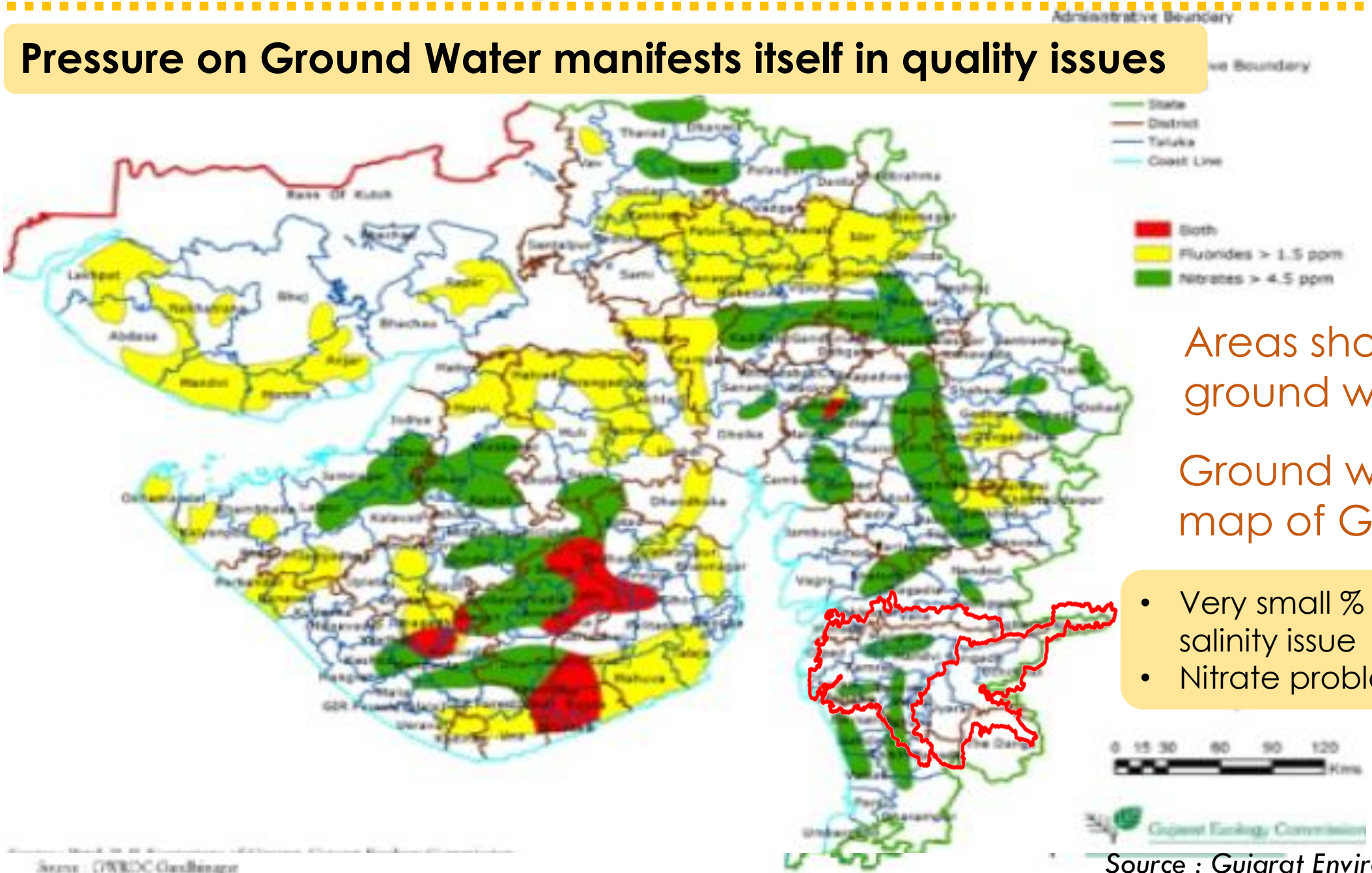
GROUND WATER ABSTRACTION



- A trend of decreasing depth of groundwater is observed in Valod, Puna, Nogama, Sachin town, Olpad over the years
- Lowest GW levels near urban/industrial concentrations

Water Quality Issues

Pressure on Ground Water manifests itself in quality issues



Areas showing ground water Salinity

Ground water quality map of Gujarat

- Very small % of area has salinity issue
- Nitrate problem in more

Source : Gujarat Environmental Commission

Water Quality Issues – DRINKING WATER SOURCE

Water Quality Issues – IRRIGATION

In order to construct river intake well…

- Permission from irrigation dept.

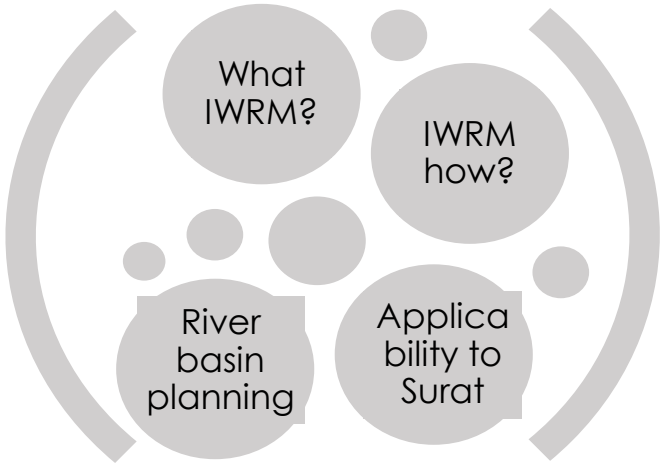
In order to construct borewell…

- No permission
- Just reference from GWSSB hydrologist

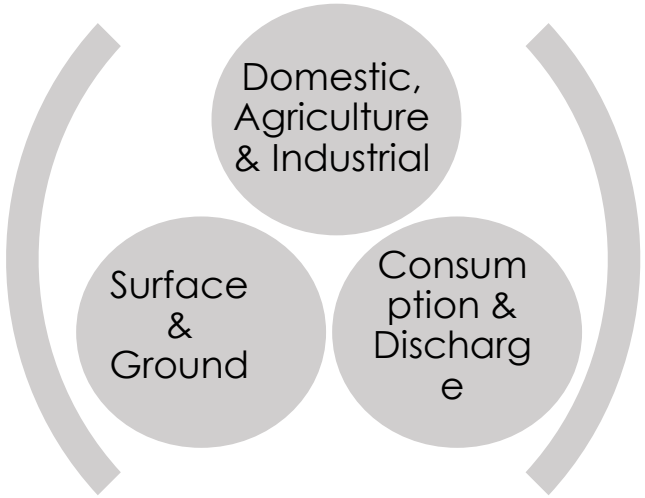
Tapi not tapped to full potential therefore water allocation non conflicting

→

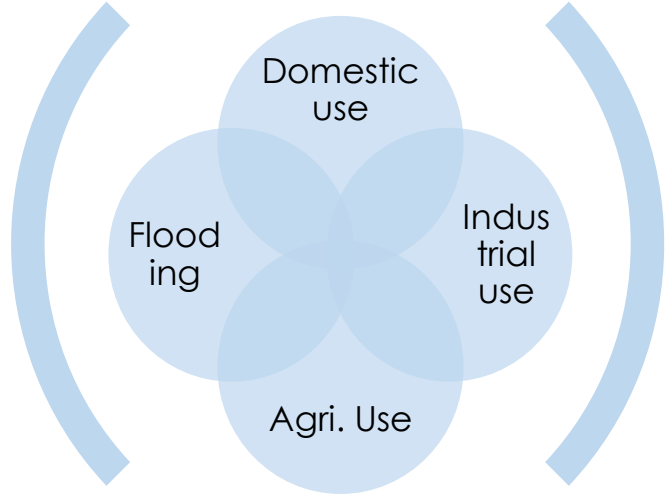
Tapi "water surplus"… BUT…



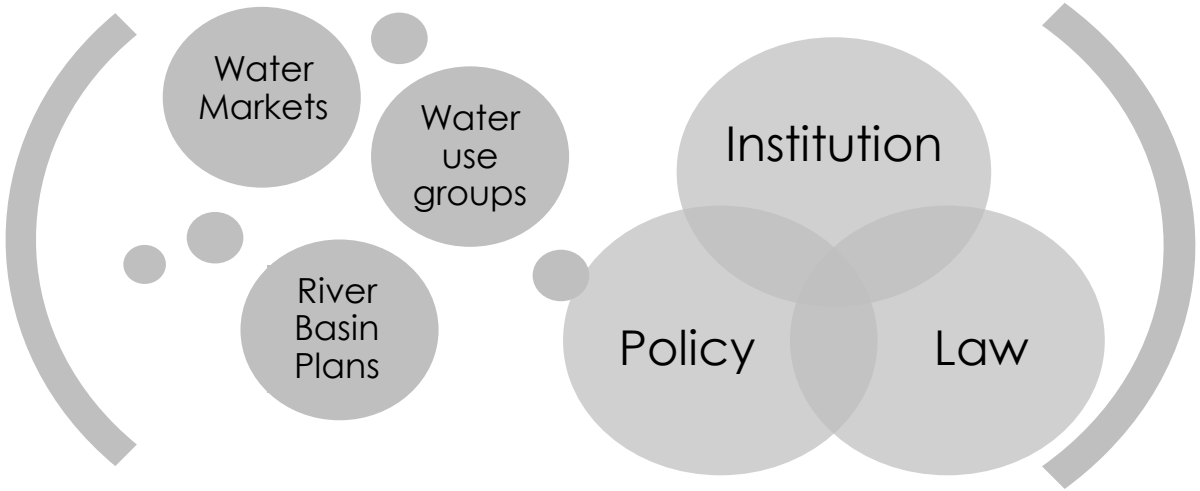
Work Scoping



WATER USE



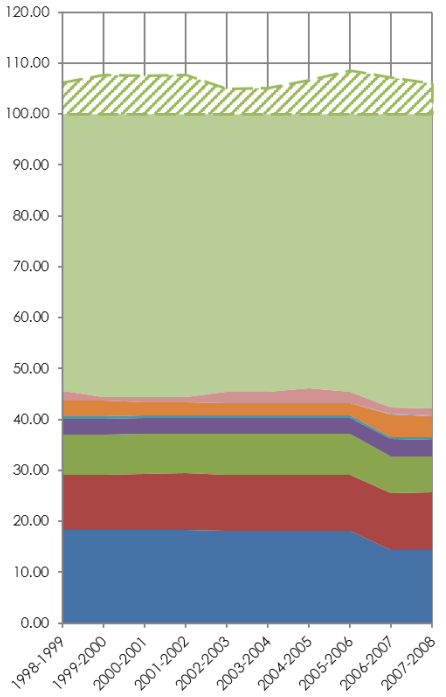
FUTURE SCENARIO

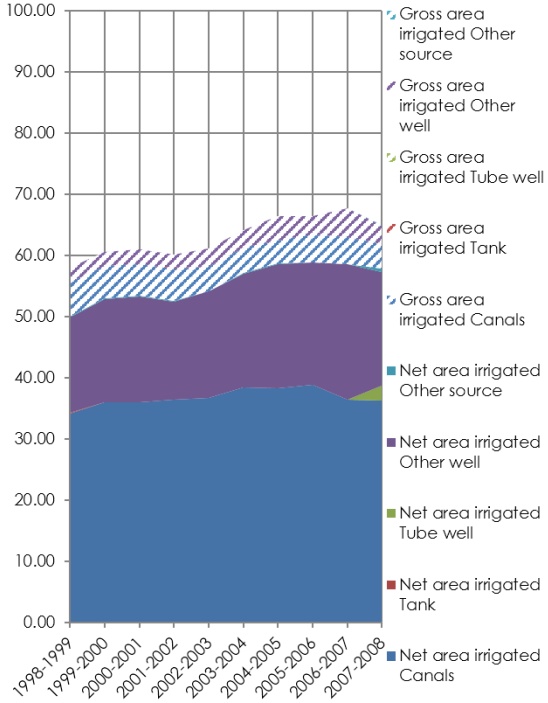


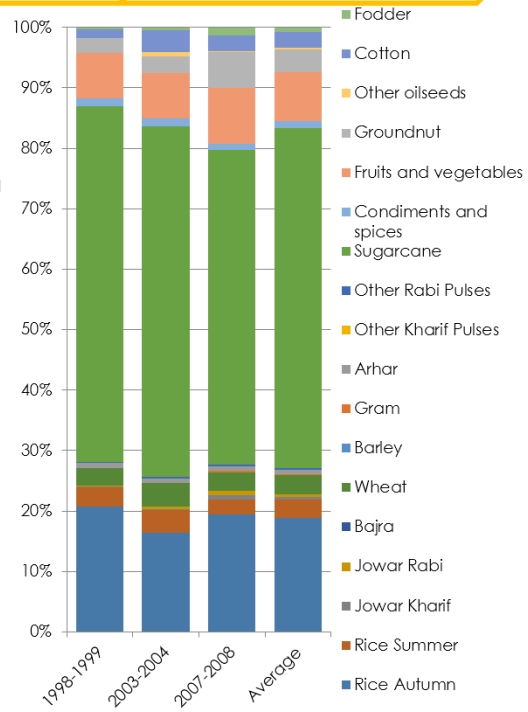
ALTERNATIVE OPTIONS AVAILABLE TOOLS

Future scenario… DEMAND PROJECTIONS…

Area under agriculture – trend -1 → Area under irrigation trend- 2 → Cropping pattern trend -3 → Water req for crop types - 4 → Water Demand 1*2*3*4

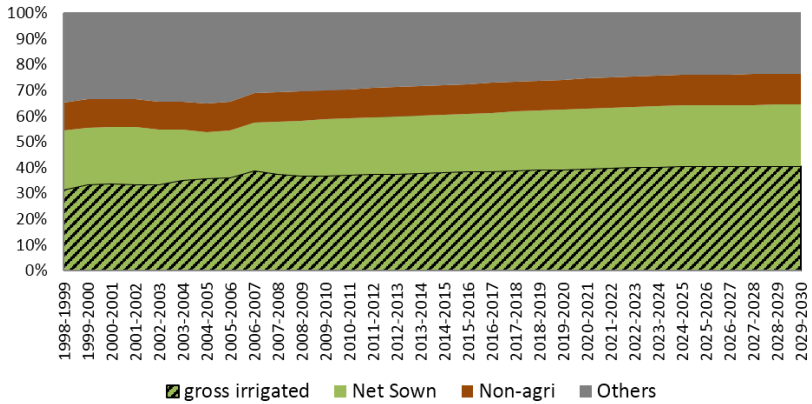




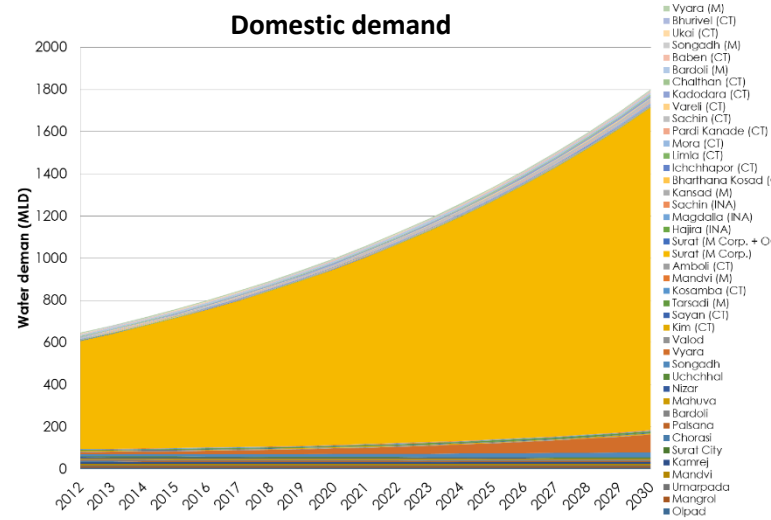


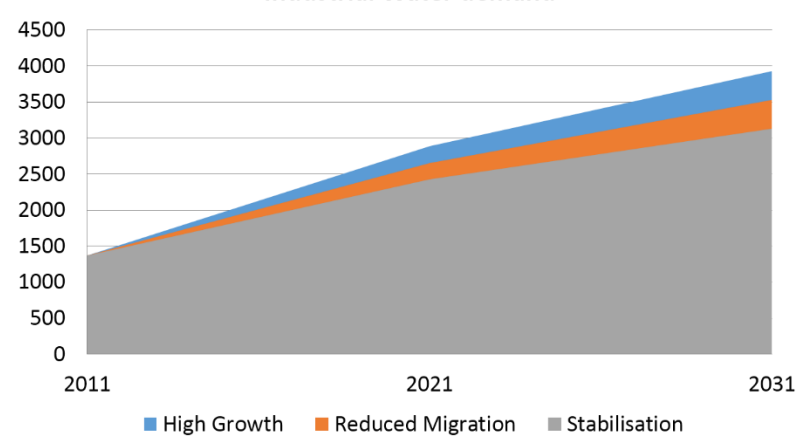
Source: Min of Agriculture: LUS 1998-2008

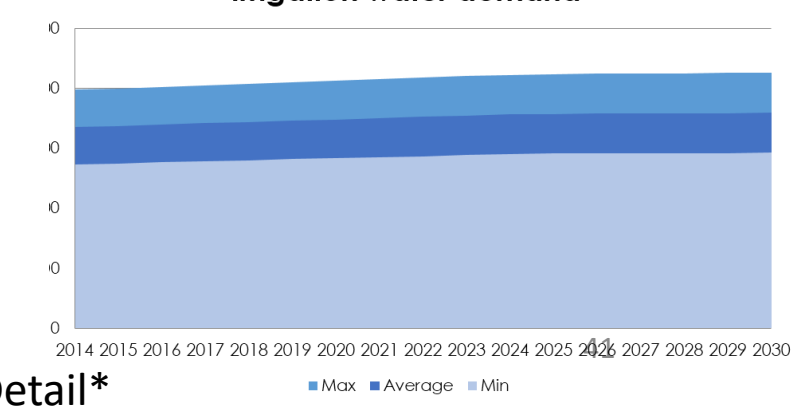
Average 34% GW usage of total irrigation



% area under crop	water ht req (cm)	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice	1.075	0.188	0.188	0.188	0.031	0.031	0.031	0.031		0.188	0.188	0.188	0.188
Jowar	0.575	0.004			0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Wheat	0.425	0.033	0.033							0.033	0.033	0.033	0.033
Arhar	0.35	0.008	0.008							0.008	0.008	0.008	0.008
Other	0.35	0.002	0.002							0.002	0.002	0.002	0.002
Sugarcane	0.65	0.562	0.562	0.562	0.562	0.562	0.562	0.562	0.562	0.562	0.562	0.562	0.562
Condiments and spices		0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Fruits and vegetables		0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
Groundnut	0.525					0.038	0.038	0.038	0.038	0.038			
Other	0.525					0.003	0.003	0.003	0.003	0.003			
Cotton	0.525			0.026	0.026	0.026	0.026	0.026	0.026	0.026			



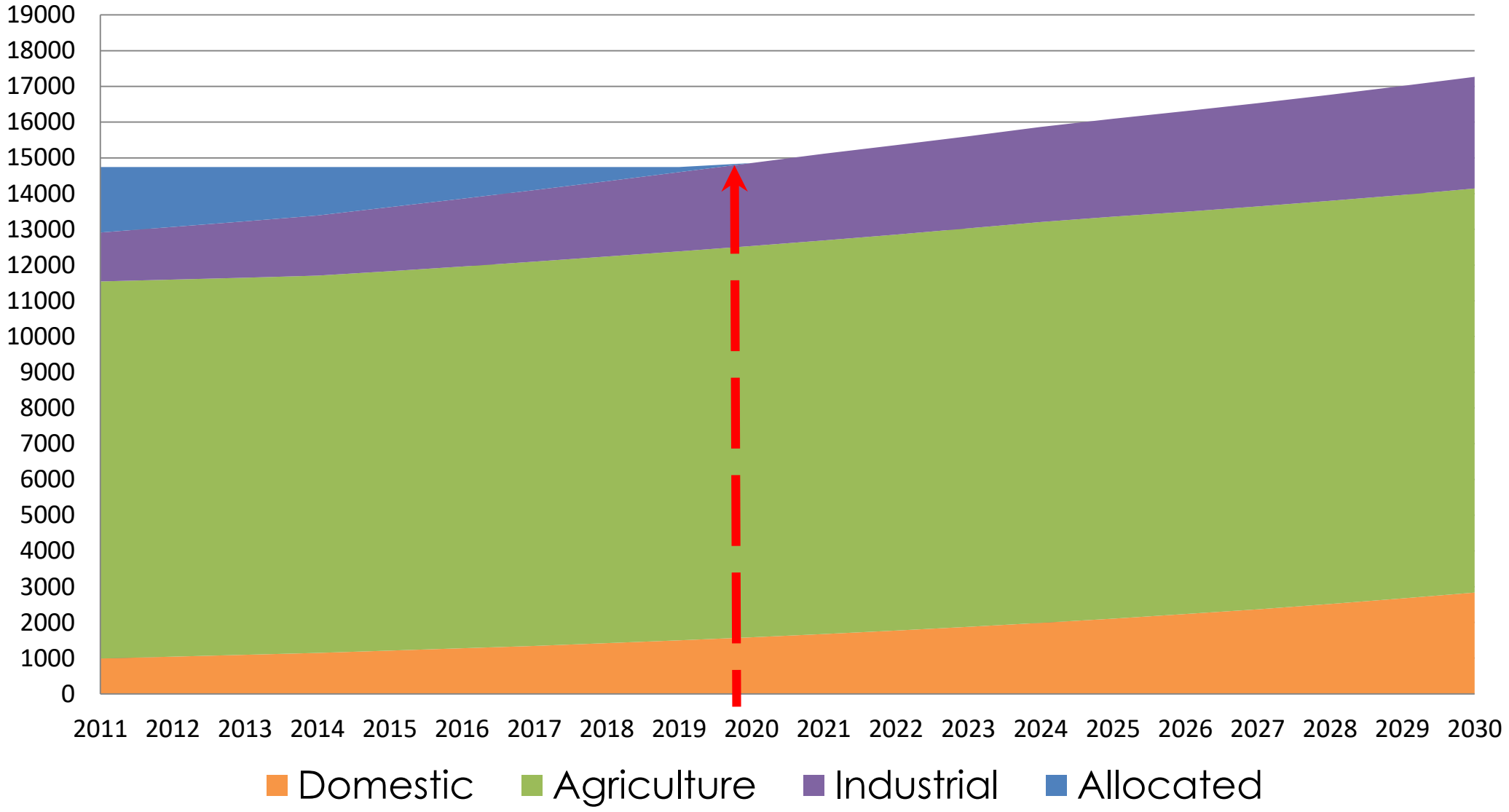




Detail*

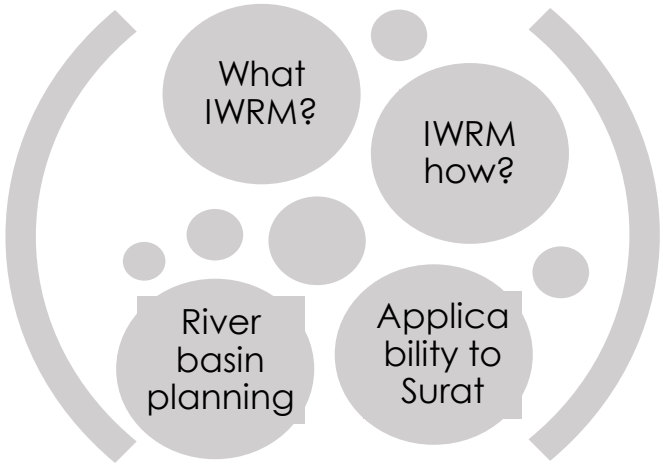
Future scenario... DEMAND PROJECTIONS...COMPETING USES... Water apocalypse!!!

Latest allocation to Gujarat from Tapi → 14740 MLD

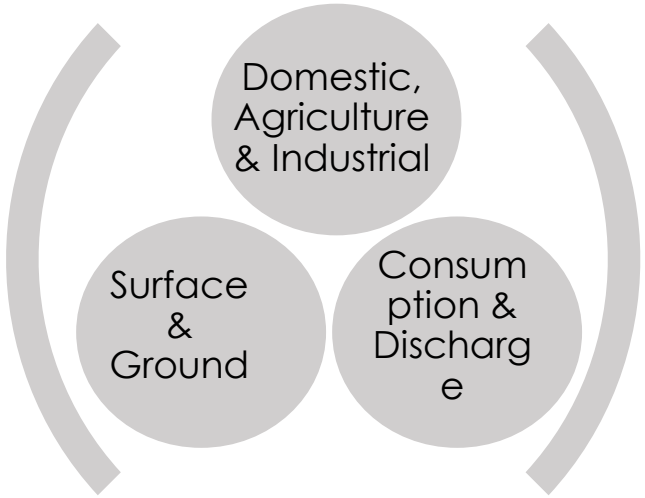


Issues in Water use

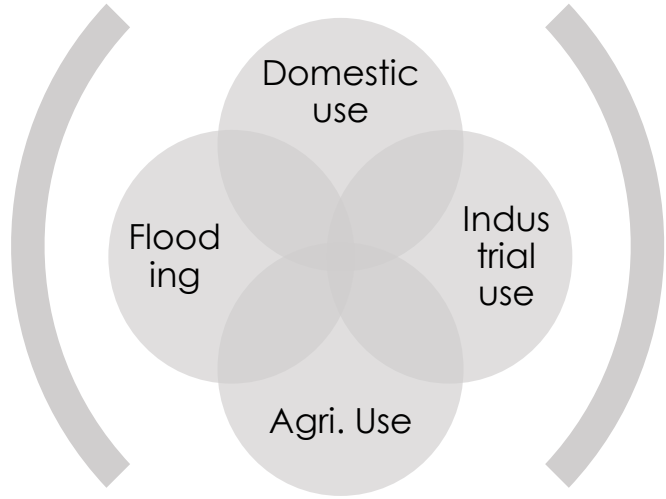
- Irrigation biggest guzzler
- But Urban population growing very fast – demanding more and more water
- Industries demanding more and more water from Kakrapar canals that is allocated to agriculture
- Tapi deemed ‘water surplus’ thus no measures to manage demand
- Ground water dependency low for irrigation but exploitation in urban and industrial concentrations



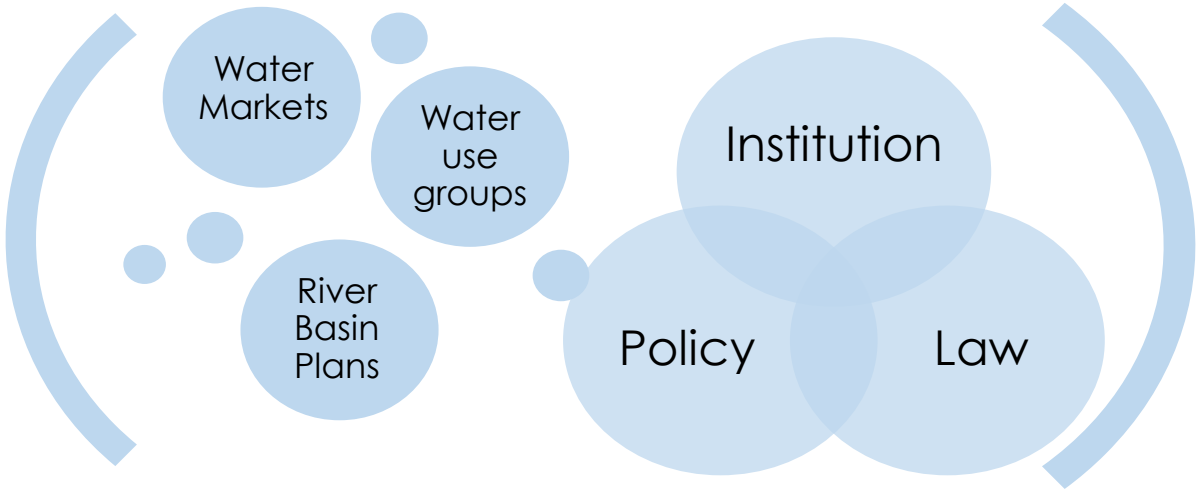
Work Scoping



WATER USE

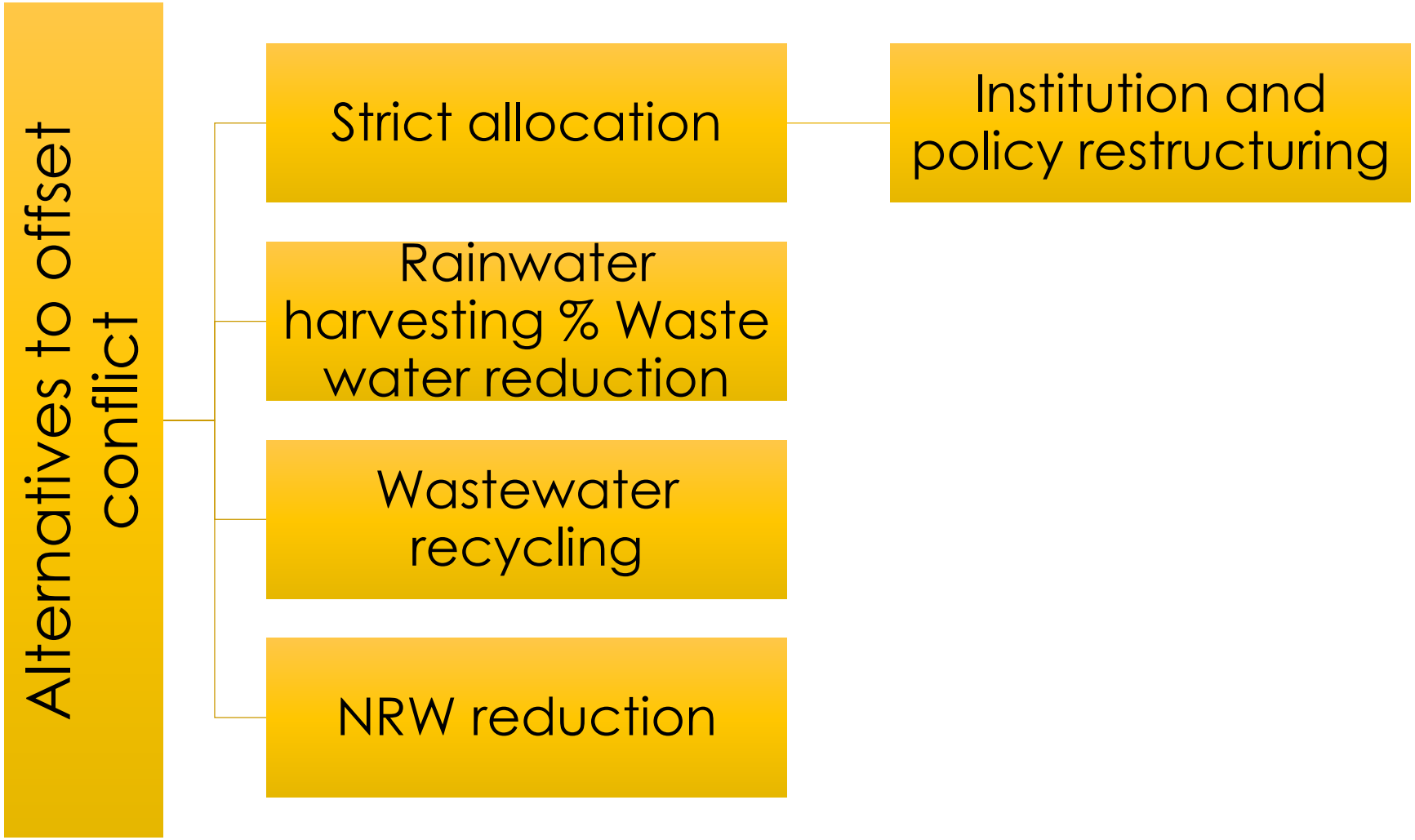


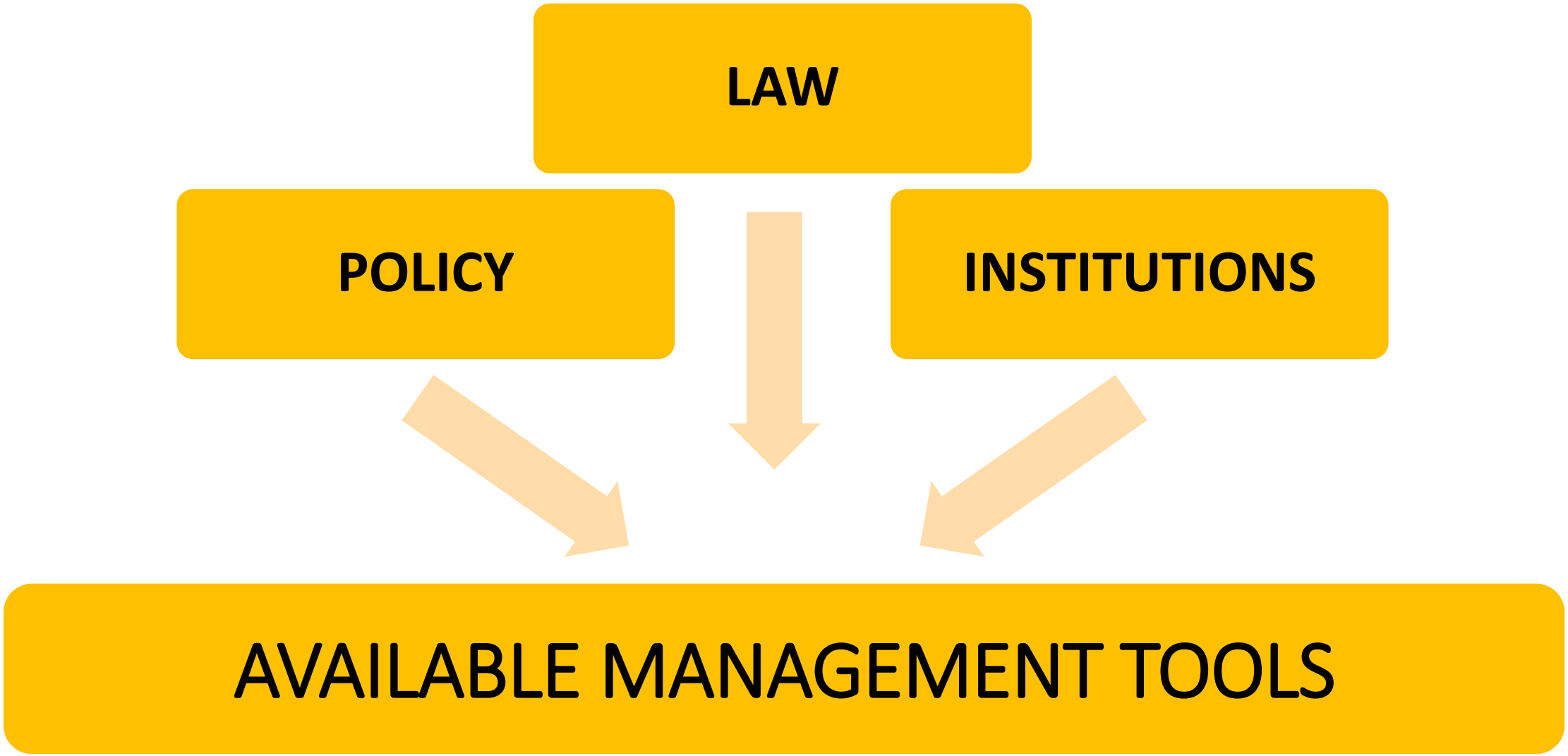
FUTURE SCENARIO



ALTERNATIVE OPTIONS AVAILABLE TOOLS

Alternatives... SCENARIO MODELS... Way Forward




LAW
POLICY
INSTITUTIONS
AVAILABLE MANAGEMENT TOOLS

Laws and policy

No.	Key Regulation	Key Features
1	National Water Policy (2002)	1) Prioritised rights on water in the following order -> Drinking, Irrigation, Hydropower, Ecology, Industry 2) Promote PPP in water projects 3) Emphasis on integrated planning of water projects 4) Supports rationalization of water tariffs at ULB level
2	Water Prevention and Control of Pollution Act (1974)	1) Establishment of pollution control board at State level to enforce effluent standards 2) Define MINAS i.e. Minimum National Standards for effluent discharge norms for industries 3) MINAS updated periodically to cover more industries and enforcement of stricter norms 4) Central Board to assist State boards in pollution control activities 5) Collect, collate and publish data pertaining to water pollution 6) State Boards shall lay down water and wastewater quality norms and conduct inspection on industries / effluent treatment plants etc.
3	Environment Protection Act (EPA) (1986)	1) Planning and execution of a nation-wide programme for the prevention, control and abatement of environmental pollution 2) Lay down standards for the quality of environment in its various aspects 3) Restriction of areas in which any industries, operations or processes or class of industries, operations or processes can operate 4) Laying down procedures and safeguards for the prevention of accidents which may cause environmental pollution and prescribe remedial measures for such accidents 5) Examination of manufacturing processes, materials and substances likely to cause environmental pollution 6) Carry out and sponsor investigations and research relating to problems of environmental pollution 7) Powers to inspect any premises, plant, equipment, machinery, manufacturing or other processes, materials or substances
4	Water Prevention and Control of Pollution Cess Act (1977)	Allows State boards to levy cess on water extracted for industrial / domestic use
5	Customs Tariff Act, Central Excise Act	Excise exemptions on water treatment chemicals / equipment, tax benefits for water sector projects

Source: Ministry of Water Resources, Ministry of Environment & Forests, Central Groundwater Commission

NRCP (National river conservation Plan)

- Sewage Treatment Plants
- Low Cost Sanitation Works
- River Front Development Works
- Interception and diversion of sewage- Divert them for treatment
- Pollution abatement schemes
- Electric and Improved wood crematoria
- Public Awareness and participation
- Capacity Building , training and research
- Other Miscellaneous work- Location specific conditions

Central Government set up NGRBA (National Ganga River Basin Authority) in feb 2009 to ensure effective abatement of pollution and conservation of river Ganga.

Out of 19 rivers in Gujarat including Tapi, there are 19 number of polluted stretches.

Ganga Action Plan (GAP)

Phase I

- Started in 1985
- 100 percent centrally funded scheme
- Main objective – to improve water quality of Ganga
- Pollution abatement works taken up in 21 class I towns in UP, Bihar and West Bengal
- Completed on 31st March 2000
- Cost : 451.70 crore

Phase II

- 1993- 1996
- Covered river Ganga and its tributaries Yamuna, Gomati, Damodar.
- Pollution abatement works in 95 towns
- 50:50 Cost sharing basis by state and Central Government
- Cost : 1498.86 crore

- Scheme was merged into National River Conservation Plan
- NRCP approved in 1995 for 772.80 crore on 50:50 cost sharing basis between Central and State Government.
- Ganga Project Directorate converted into NRCD
- Major initiative started under NGRBA in 2010

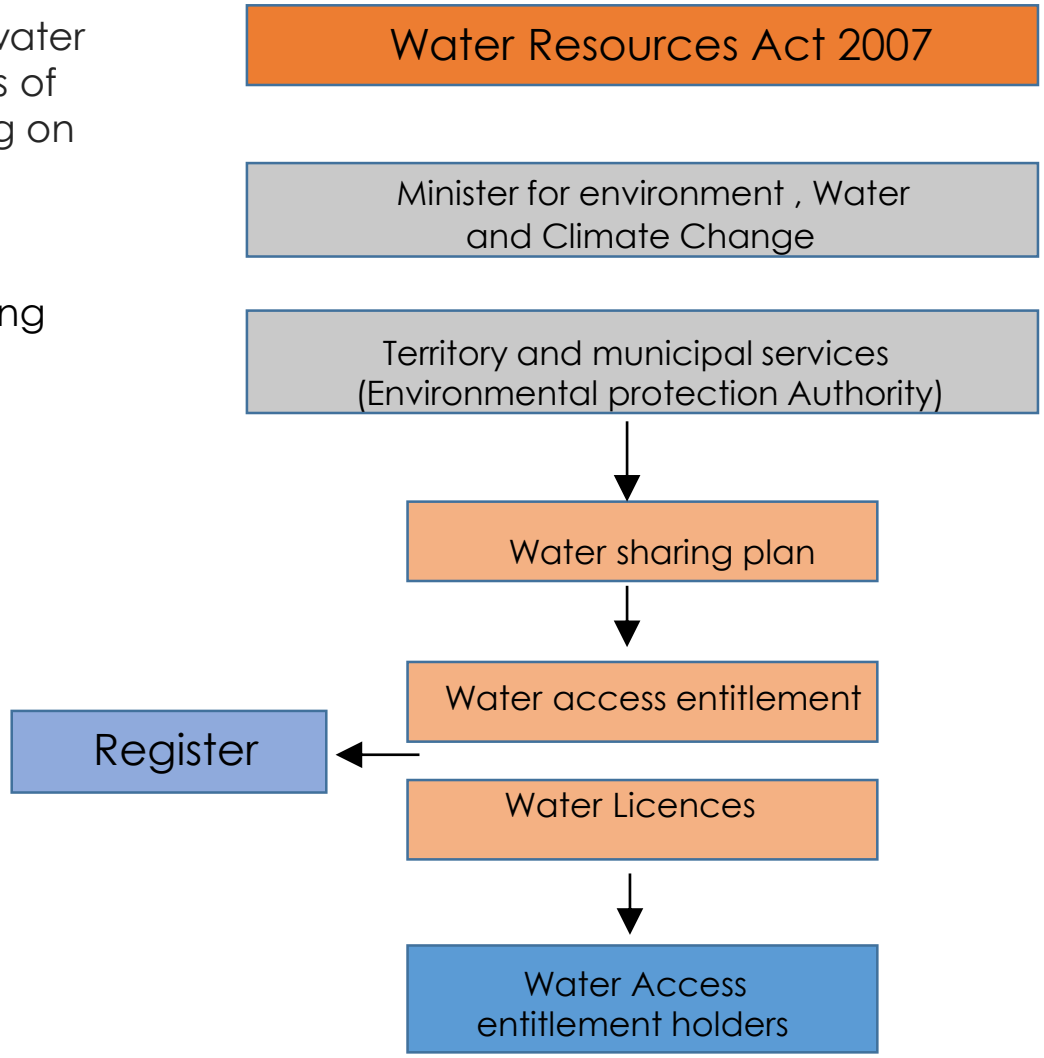
Water Markets

Water Markets (trading) is the process of buying and selling water access entitlements, also often called water rights . The terms of the trade can be either permanent or temporary, depending on the legal status of the water rights.

Some of the western states of the United States, Chile, South Africa, Australia and Spain's Canary Islands have water trading schemes.
Some consider Australia's to be the most sophisticated and effective in the world

Water Resources Act 2007

- to ensure that management and use of the water resources of the Territory sustain the physical, economic and social wellbeing of the people.
- to protect aquatic ecosystems and aquifers from damage
- to ensure that the water resources are able to meet the
- reasonably foreseeable needs of future generations.



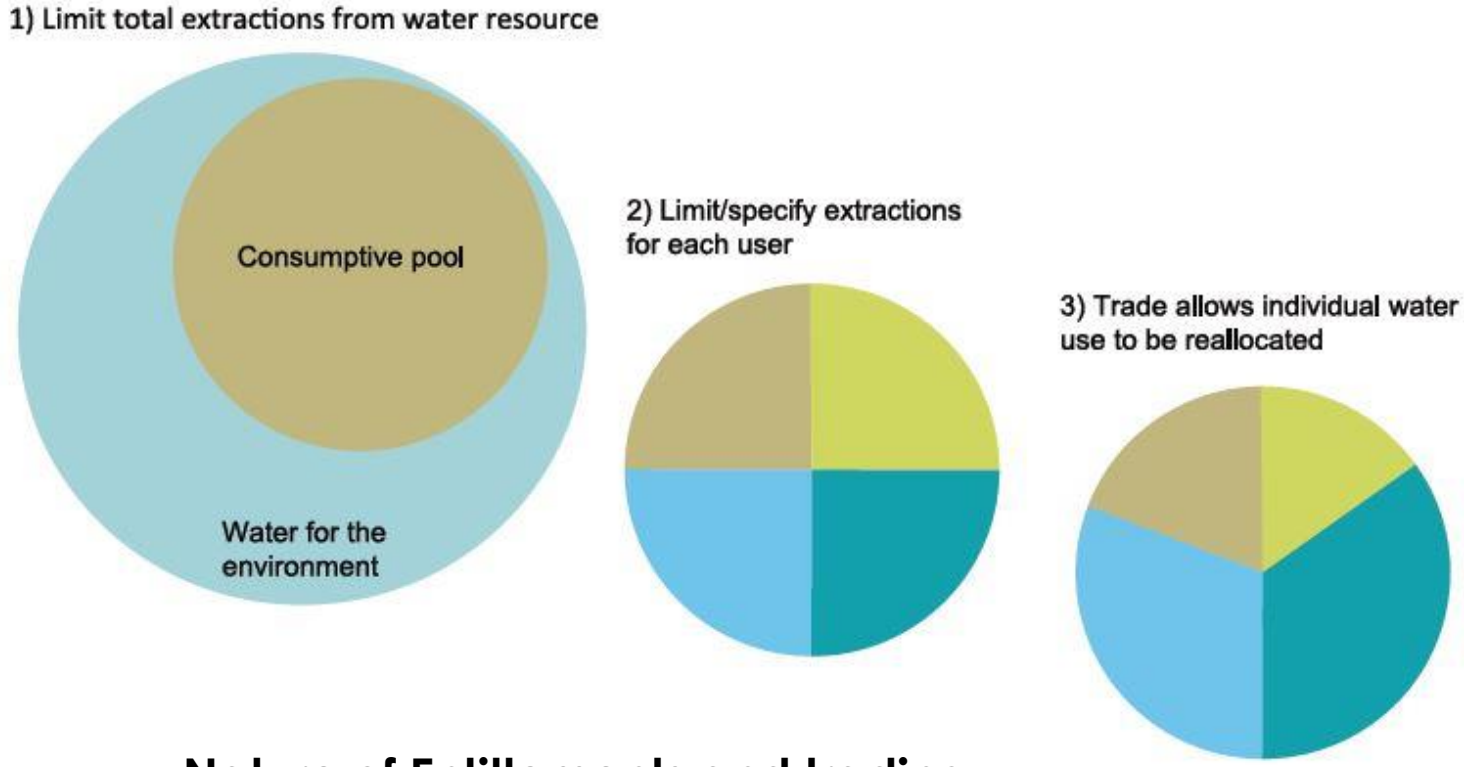
National water Market system(NWMS)

An initiative by Australian Government.
Working with the state and territory govts to improve the efficiency of water registers, transactions and market information functions.

Water Markets: Cap and Trade Approach

The 'Cap and Trade' approach to establishing water markets

The objective of the cap and trade water market approach is to facilitate the economically efficient allocation of water while ensuring environmental sustainability



Economic Objectives

- Allocative Efficiency
- Dynamic Efficiency
- Productive Efficiency

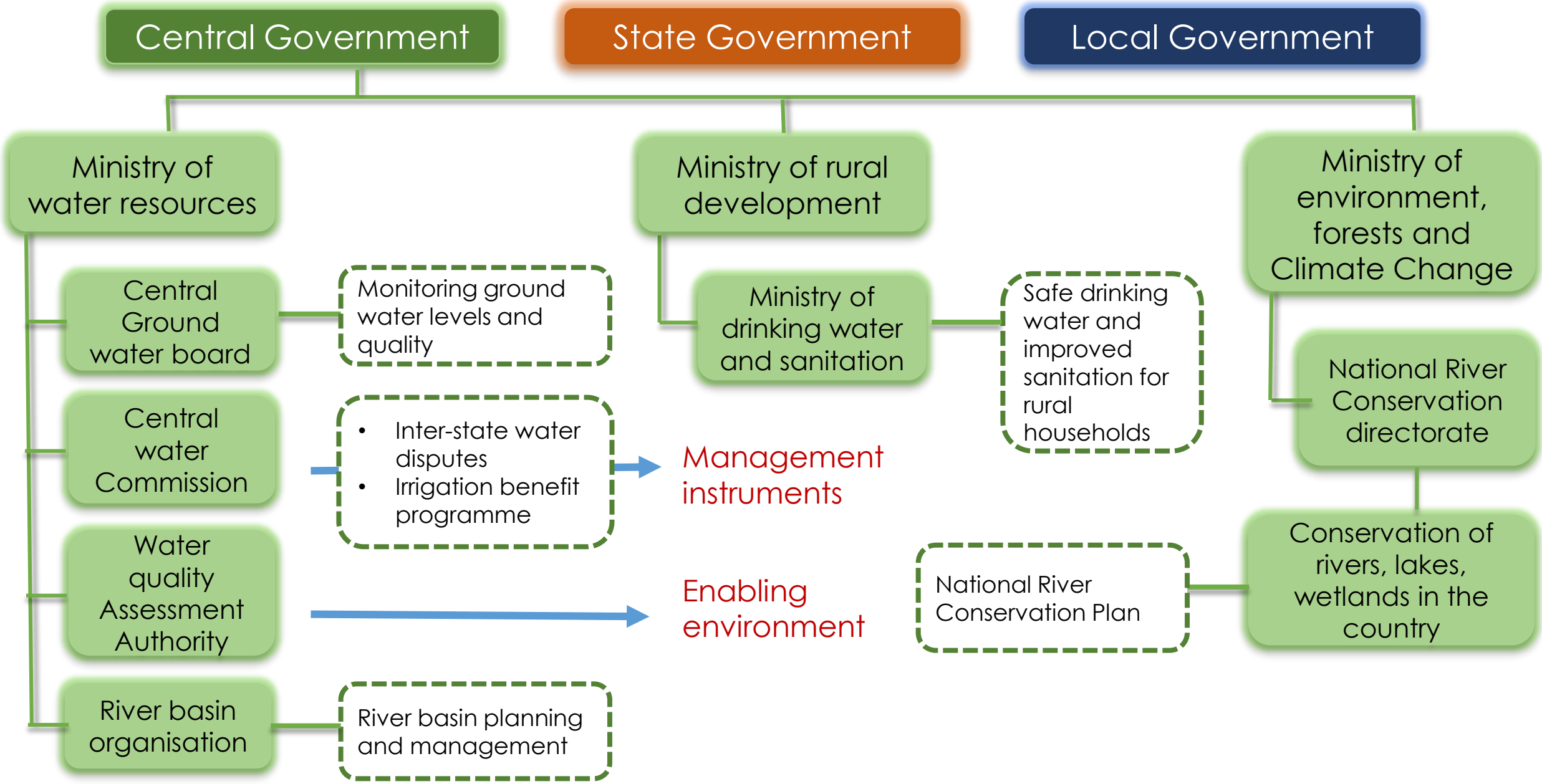
Nature of Entitlements and trading

Two types of property rights to access water

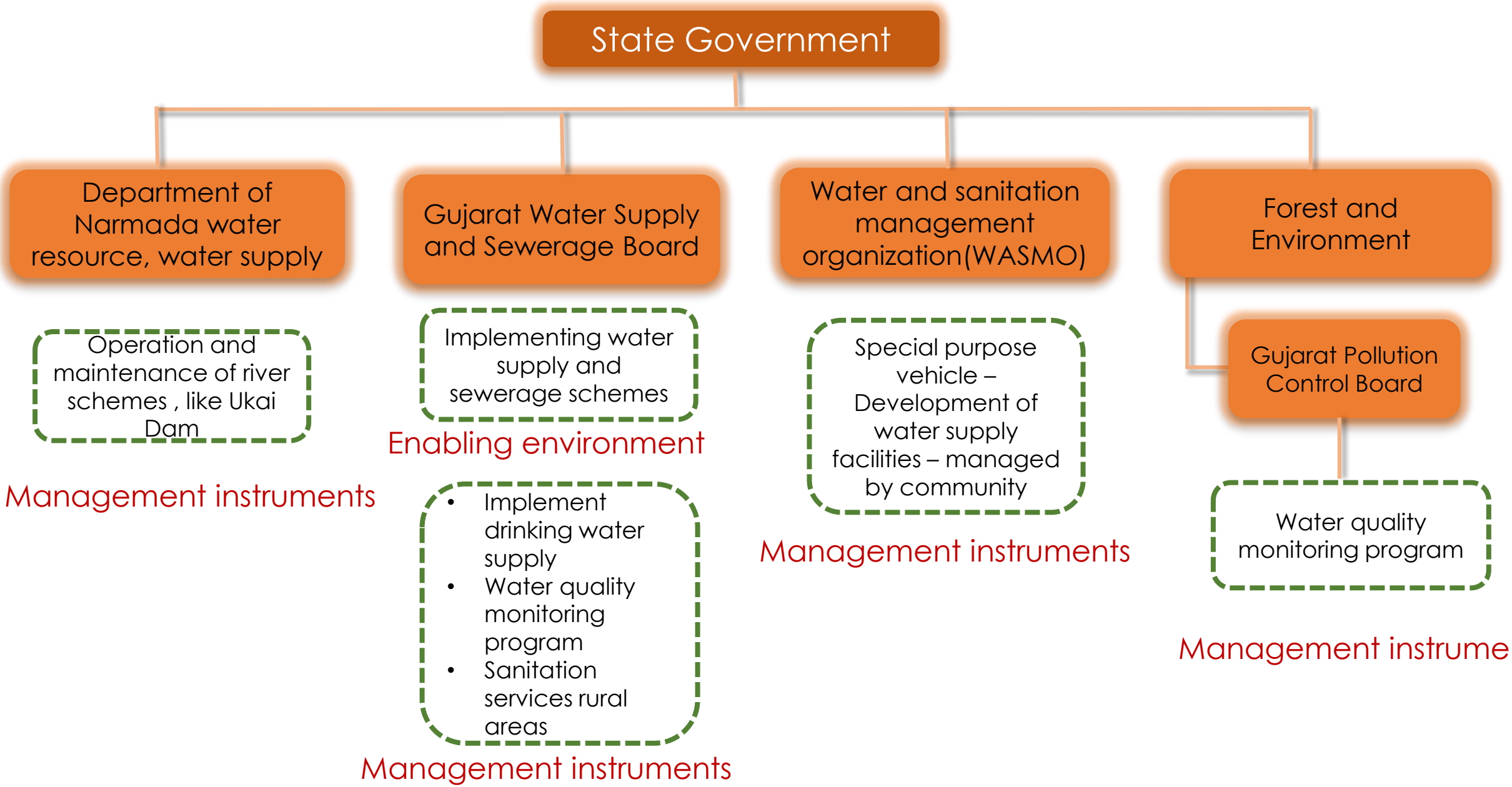
- **water access entitlement:** the perpetual or ongoing entitlement to exclusive access to a share of water from a specified consumptive pool
- **water allocation**: the specific volume of water allocated to a water access entitlement in a given season.

Detail*

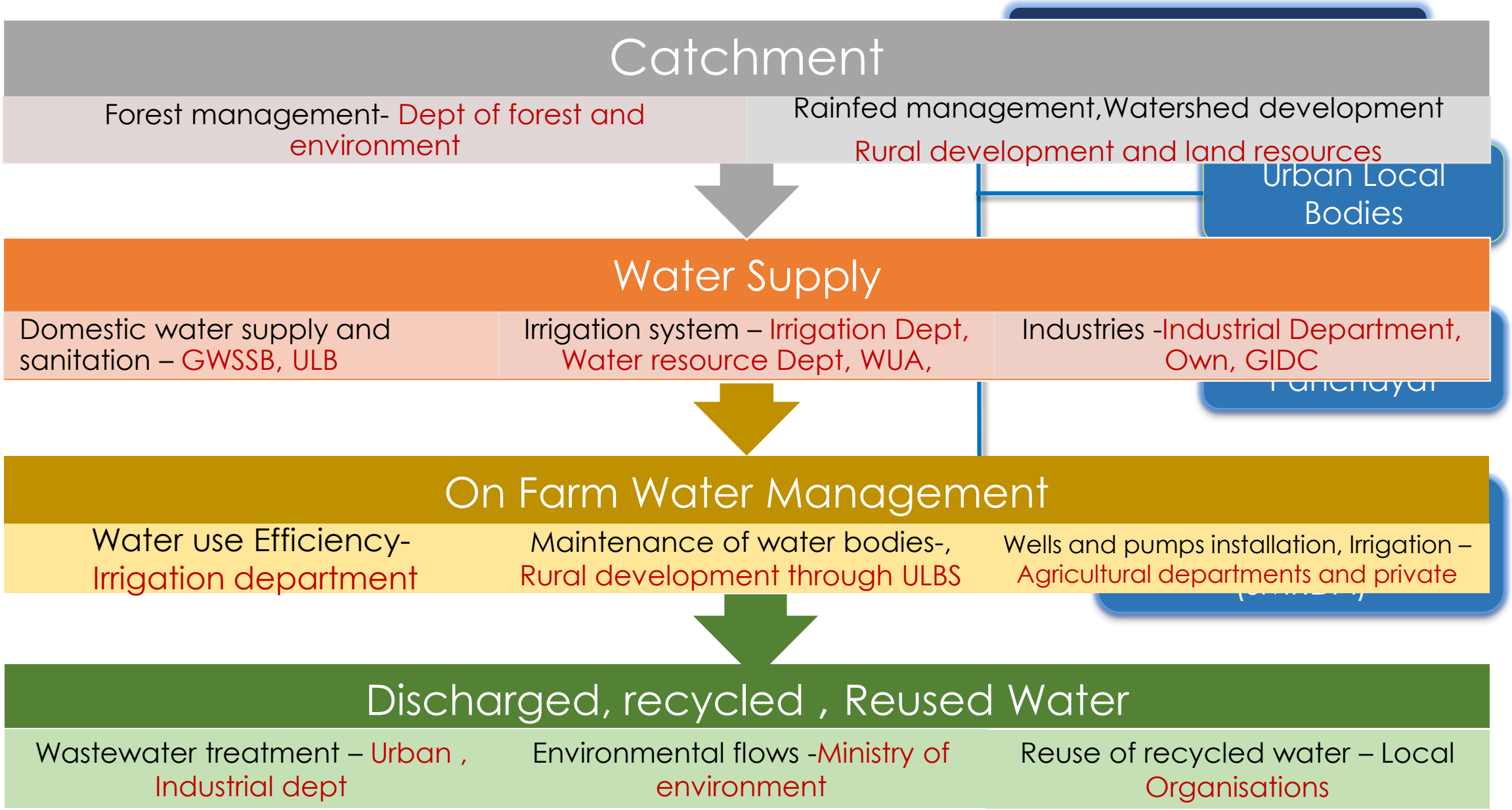
INSTITUTIONAL ROLES…



INSTITUTIONAL ROLES…



Existing multiplicity of Agencies…



All institutions*

River Basin Management Institutions …

- **Damodar Valley Corporation (DVC)** – water allocation state independent
- **Ganga Flood Control Board (GFCB) and Ganga Flood Control Commission (GFCC)** (1972)– advisory. Implementation state specific
- **Brahmaputra Board (1980)**
- **Bhakra-Beas Management Board** – water allocation according to predetermined %
- **Upper Yamuna River Board**- allocation according to MoU between states
- **Betwa River Board**
- **Bansagar Control Board**
- **Mahi Control Board**
- **The Narmada Control Authority** – allocation according to award by Narmada Water Dispute Tribunal

Application of the Concept of IWRM - proposal

PROPOSAL 1

Under River Boards Act 1956, establishment of **Tapi River Basin Organisation** to implement the principles of IWRM

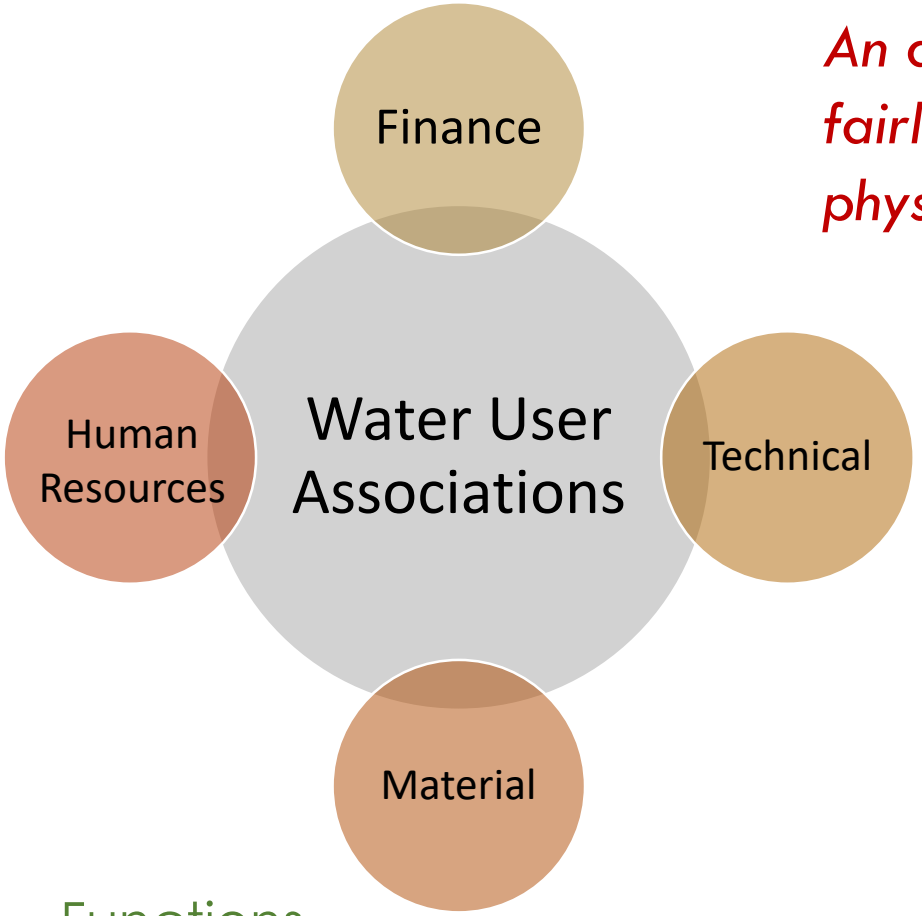
- Water quality Monitoring
- Water Allocation
- Inter state water disputes
- Improved sanitation services in rural areas
- Participatory Approach (WUAs)

Composition of the Organisation would include

- Member – CWC
- Chief Engineer – Irrigation Department
- Hydro-geologist - CGWB
- Environmental engineer – CPCB
- Member – NRCD
- Member – Ministry of Rural Development

Water User Associations - proposal

PROPOSAL 2



An active and successful WUA is one which efficiently and fairly distributes water and maintains and improves the physical structures of the irrigation systems. . .

Functions

- To ensure sustainable use of water
- Efficient utilization of water
- Prudent use of irrigation of water
- Leading to evolving of a viable policy for equitable, efficient, environment friendly and sustainable irrigation development .

Mohini village situated in Choryasi taluka of Surat District.

- Irregular rainfall, lack of water
- Irrigation department not responsible for internal water distribution
- Irrigation department granted permission
- Buying water from Irrigation dept and distributing proportionately

Part 2: Flood management

Surat floods…

Flood History

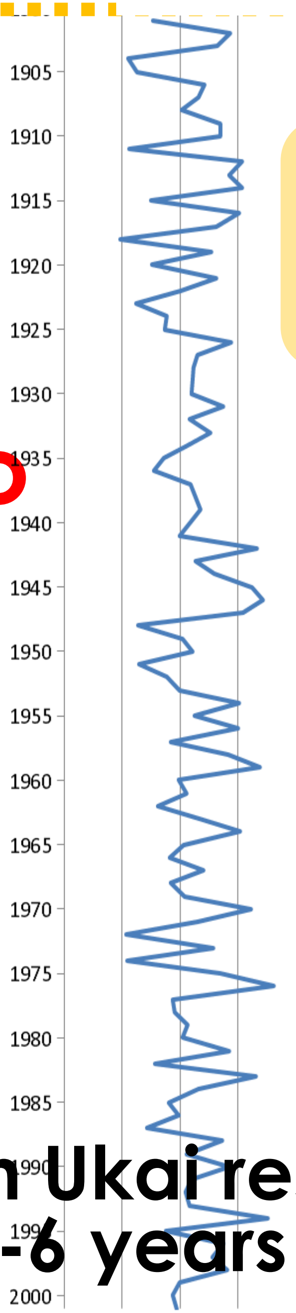
			Max Discharge lac cusecs	Max Level Ft.	Max Discharge lac cusecs	Max Level Ft.	Max Level Ft.	Causeway Max Level Mt.	Rainfall m.m.
1	1959	17th Sept	----	----	12.94	179.20	101.75	----	2551.43
2	1968	6th Aug	----	----	15.60	187.50	103.50	----	1292.10
3	1969	8th Sept	----	----	8.56	174.30	95.75	----	907.54
4	1970	6th Sept	----	----	13.00	181.00	100.00	----	1858.77
5	1978	31st Aug	----	----	----	----	93.00	----	1136.65
6	1979	12th Aug	----	----	----	----	91.95	----	1496.82
7	1990	25th Sept	----	----	3.70	174.80	94.20	----	1074.93
8	1994	8th Sept	5.08	345.00	5.25	175.80	97.64	----	2095.50
9	1998	16th Sept	7.62	345.00	6.73	178.90	101.30	13.90	1432.60
10	2002	7th Sept	3.32	341.26	3.25	172.40	91.94	10.64	1129.80
11	2006	9th Aug	9.61	346.07	9.01	182.70	106.52	14.20	1352.00
12	2013	24th Sept	4.40	344.62	4.36	175.40	97.00	11.73	2135.00

Very High discharge + medium to high rainfall = flood

YEAR WISE DETAILS OF TAPI RIVER LEVEL:-

Sr. No.	Year	Ukai Dam F.R.L. 345		Kakrapar Dam Danger Lvl-170		Weir Cum Causeway	Hope Bridge Dang Lvl-95'	Annual Rainfall m.m.
		Max Discharge lac cusecs	Max Level Ft.	Max Discharge lac cusecs	Max Level Ft.	Max Level Mts.	Max Level Ft.	
1	1994	5.08	345.00	5.25	175.80		97.64	2095.50
2	1995		328.12			7.55		1379.40
3	1996		338.67			7.95		1134.80
4	1997		344.16			7.83		1431.04
5	1998	7.62	345.00	6.73	178.90	13.90	101.30	1432.60
6	1999		344.53			7.45		954.20
7	2000		321.61			7.03		785.80
8	2001		322.54			7.34		1180.50
9	2002	3.32	341.26	3.25	172.40	10.64	91.94	1129.80
10	2003		343.81	0.51	164.20	8.23	79.22	1647.00
11	2004	0.56	331.95	0.95	166.40	9.39	84.22	1962.02
12	2005	0.62	342.20	0.62	164.60	8.24	77.50	1894.[illegible]
13	2006	9.61	346.07	9.10	182.70	14.20	106.52	1352.00
14	2007	2.42	344.20	2.45	170.50	9.70	96.00	1940.60
15	2008	0.25	335.46	0.36	163.00	7.55	80.23	1475.02
16	2009	0.28	326.71	0.15	161.30	6.89	[illegible]	[illegible]
17	2010	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	2011	2.31	342.31	2.28	170.30	9.90	88.00	1018.00
19	2012	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	2013	4.40	344.62	4.36	175.40	11.73	97.00	2135.00

= Shows Year of Flood in Tapi River



Surat- Flood prone area

Rule level chart – time table for water level in Ukai reservoir
Decided by CWC expert team once every 5-6 years

Flood History

Political interference ?

Sensing the danger of flood, Surat Collector and Municipal Commissioner on night of 4th August, asked for release of 2 lakh cusecs and of 4 lakh cusecs of water from the night of 5th
August. However, one of the engineers reacted, 'there is no point in collectors making such attempts as they do not have the necessary technical knowledge'. The **officers of the Narmada Water Resource & Water Supply (NWRWS) department, specialized experts in flood control, were supposed to advise the government.** Replying to the demand of releasing water, Minister for Narmada Water Resource & Water Supply (NWR&WS), Mr. Narottambhai Patel, on August 3, 2006, has reportedly said, 'at present the water level in the reservoir is 334 ft. and it is necessary to reach the rule level of 337 ft. by 15th August. If water level goes beyond 345 ft., then there is danger to the dam, but before that there is no question of releasing any water**'.**

No major releases were made even after the floodwaters had started entering the reservoir in a big way on 6th August.

(People's Committee on Gujarat Flood 2006: A Report)

Concept- Flood management

IFM- Why?

Why include climate change in IWRM?

Water - primary medium through which the expected effects of climate change will materialize

Climate change & increased climatic variability

- Sea level rise
- Changing precipitation pattern
- Coastal floods
- Flash floods & riverine floods

Traditional Flood Management

Controlling measures, localized

- Draining quickly
- Storing temporarily
- Separating water from population through dams and levees

What is Integrated flood management?

Encourages the use of the resources of a **river basin as a whole**, employing strategies to maintain or augment the **productivity of floodplains**, while at the same time providing **protective measures against losses** due to flooding.

Aiming at maximizing the net benefits from flood plains, meanwhile minimizing loss of life.

Integrated Flood management as part of IWRM

IWRM

Coordinated management and development of water, land and related resources

Economic and social welfare + ecosystem sustainability

Integrated Ecosystem approach

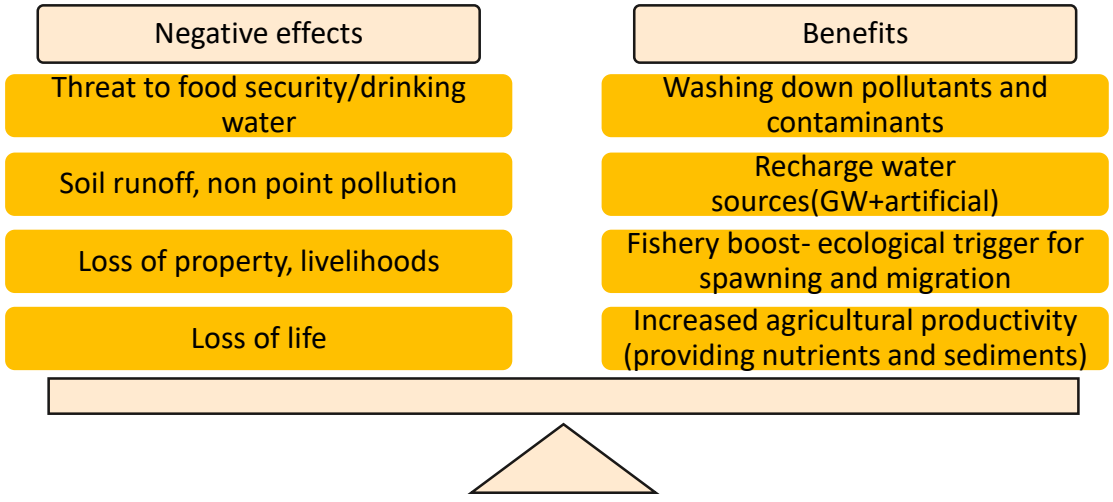
Single intervention has implications for the system as a whole

Intervention to improve river basin assets (land and water) cannot ignore flood risk and consequences

Manage land and water use links

IFM

Link Land use & water use , Both natural and human



Concept- Flood management

IFM- Why?

Key elements

- Manage the water cycle as a whole
- Integrate land and water management
- Manage risk and uncertainty
- Adopt a best mix of strategies
- Ensure a participatory approach
- Adopt integrated hazard management approaches.

Tools

Flood hazard mapping	Transboundary management	Management of flash floods	Flood forecasting and Early warning	Flood proofing
Conservation and restoration of rivers	Flood emergency planning	Risk sharing	Land use planning	Organizing community
	Flood loss & risk assessment	Basin flood management plan	Reservoir operations and managed flows	

Case studies

Case study	Spatial scale	Structural measures	Administrative/ Institutional Measures
Cameron	National		National Secretary for disaster management
Ethiopia, Awash river basin	River basin	Dam, dykes	River training unit to maintaing riverbed and flood plain River Basin organization with community representation
Mauritiana	River basin		Public awarness through advertisment
Zimbabwe	Districts	Dam,weir	Land use integration- identifying flood prone
Bangladesh		Drainage and irrigation works	Flood forecasting and warning system Flood plain clearing
Damodar, India	River valley		Damodar Valley Reservoir Regulation Committee

Concept- Flood management

IFM- Why?

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- Integrate land and water management
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Tools

- **Flood hazard mapping**
- Transboundary management
- Management of flash floods
- Flood forecasting and Early warning
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- Flood emergency planning
- Risk sharing
- **Land use planning**
- **Organizing community**
- **Flood loss & risk assessment**
- **Basin flood management plan**
- **Reservoir operations and managed flows**

Risk assessment

Using Flood Vulnerability index by UNESCO

FVI = FVIs + FVIe +FVIev + FVIp

		Value	Value in Formula	
Social negative - less=good	Pop in flood prone area	4600000	0.46	
	Rural population	28%	0.28	
	Disabled,minor, aged	22%	0.22	
	Urbanization	11%	0.11	
	Child Mortality	3.8	3.8	
				0.011844448
Social positive- more=good	Past experience of affected	2737500	0.27375	
	Awareness/preparedness	8	0.8	FVIs
	Communication penetration	90%	0.9	0.013
	Warning system	5/10 rated	10	
	Evacuation roads- % asphalted roads	90%	0.9	
	Human Development index	0.527	0.527	
				0.9348453
Economic negative- less=good	Land use- economic	2%	0.02	
	Unemployment	60%	0.6	
	Inequality- Gini coefficient	0.305	0.305	
	Urbanization	11%	0.11	
				0.0004026
Economic positive- more=good	Life expectancy index	0.9166	0.9166	
	Flood insurance	0	1	FVIe
	Investment in flood preparednenss/GDP	6%	0.6	0.010
	Storage capacity of Dams/ catchment	0.108	0.108	
	Economic Recovery	70	0.7	
				0.0416

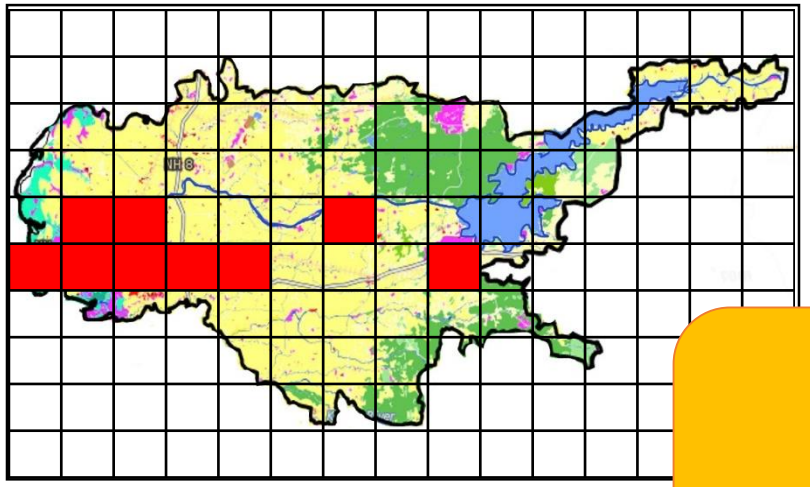
Environment negative- less=good	Rainfall	1.042	1.042	
	Degraded area	0.11	0.11	
	Urban Growth	0.02	0.02	
				0.0022524
Environment positive- more=good	Forested area	0.14	0.14	FVIev
	Evaporation Rate	0.365	0.365	0.583
	Natural Reservation	0.14	0.14	
	Unpopulated area (<10 pp sq km)	0.55	0.55	0.0039347
Physical positive	Topography, slope	0.214	0.214	0.214
physical negative- Less=good	Evaporation rate/ rainfall	3.5	3.5	FVIp
	Storage capacity/discharge	0.87	0.87	0.242
	Embankment	0.29	0.29	0.88305
			FVI	0.847

FVI of 0.84 – Very high risk

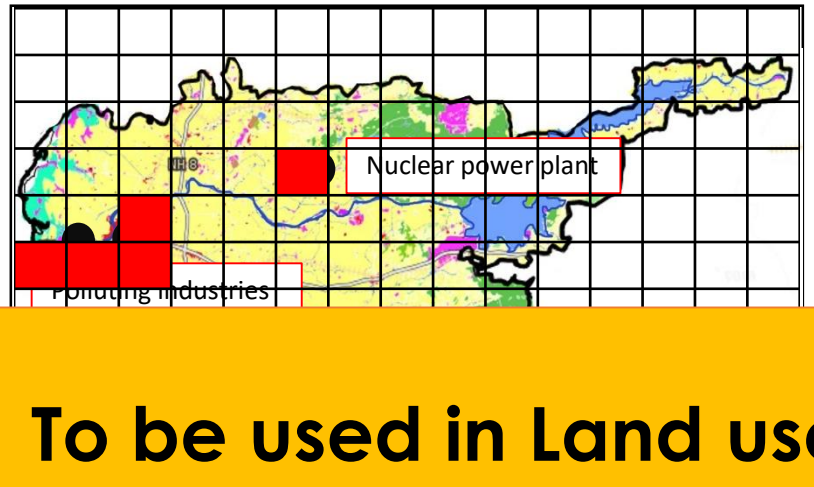
Vulnerability and risk Mapping

PROPOSAL 3

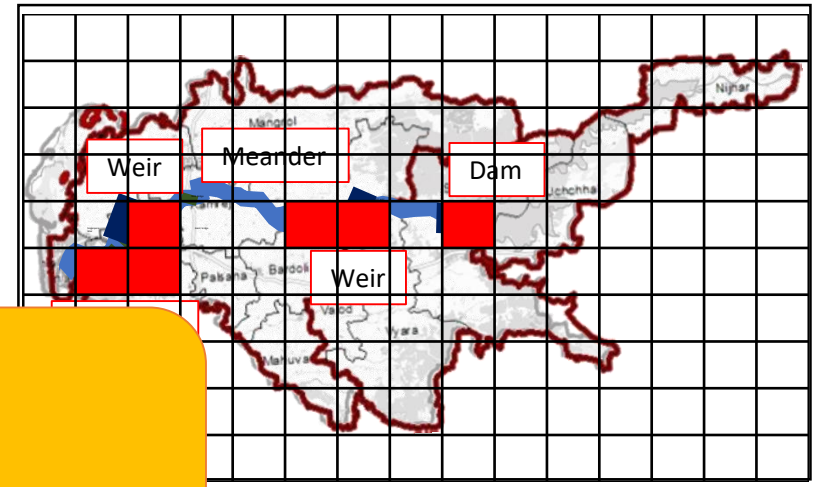
Population concentration & Built form obstruction



Hazardous Damage potential

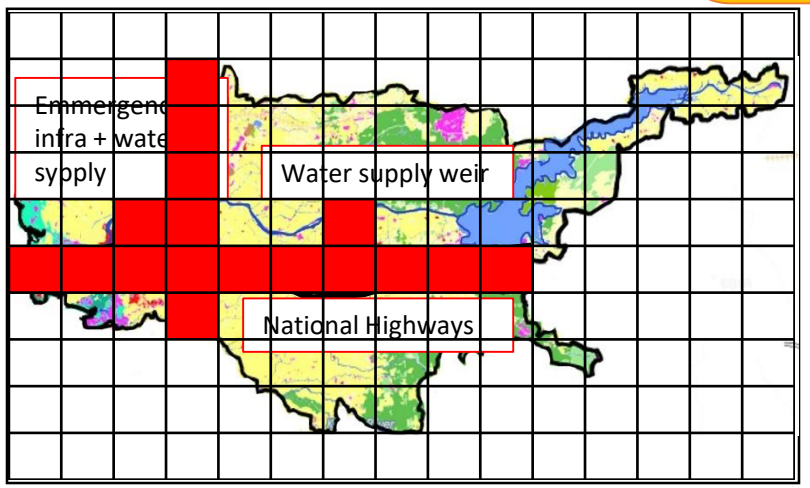


River course obstruction & meander bank

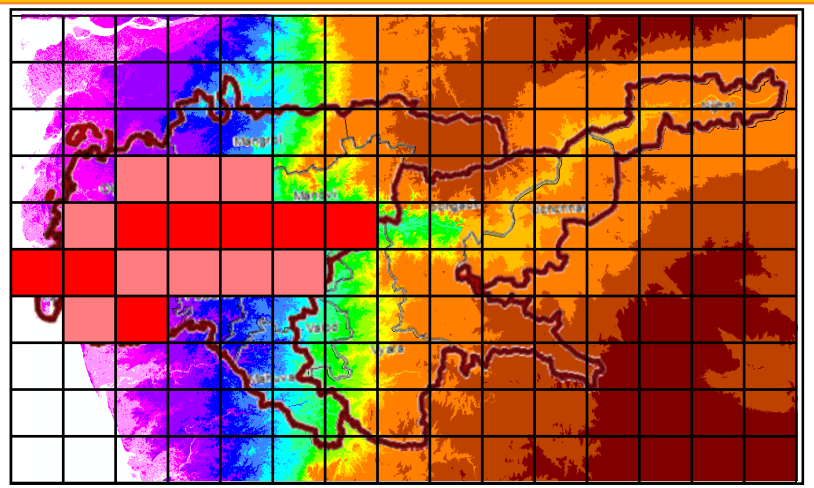


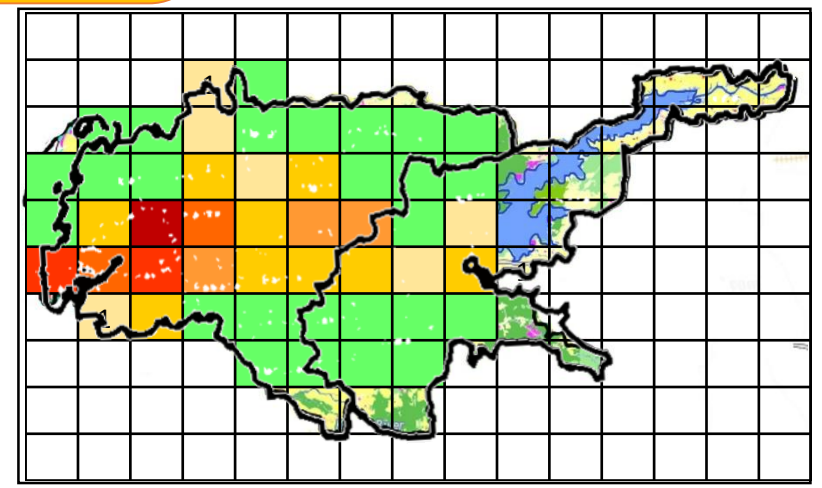
To be used in Land use planning and Flood Plain Zoning

Vital infrastructure



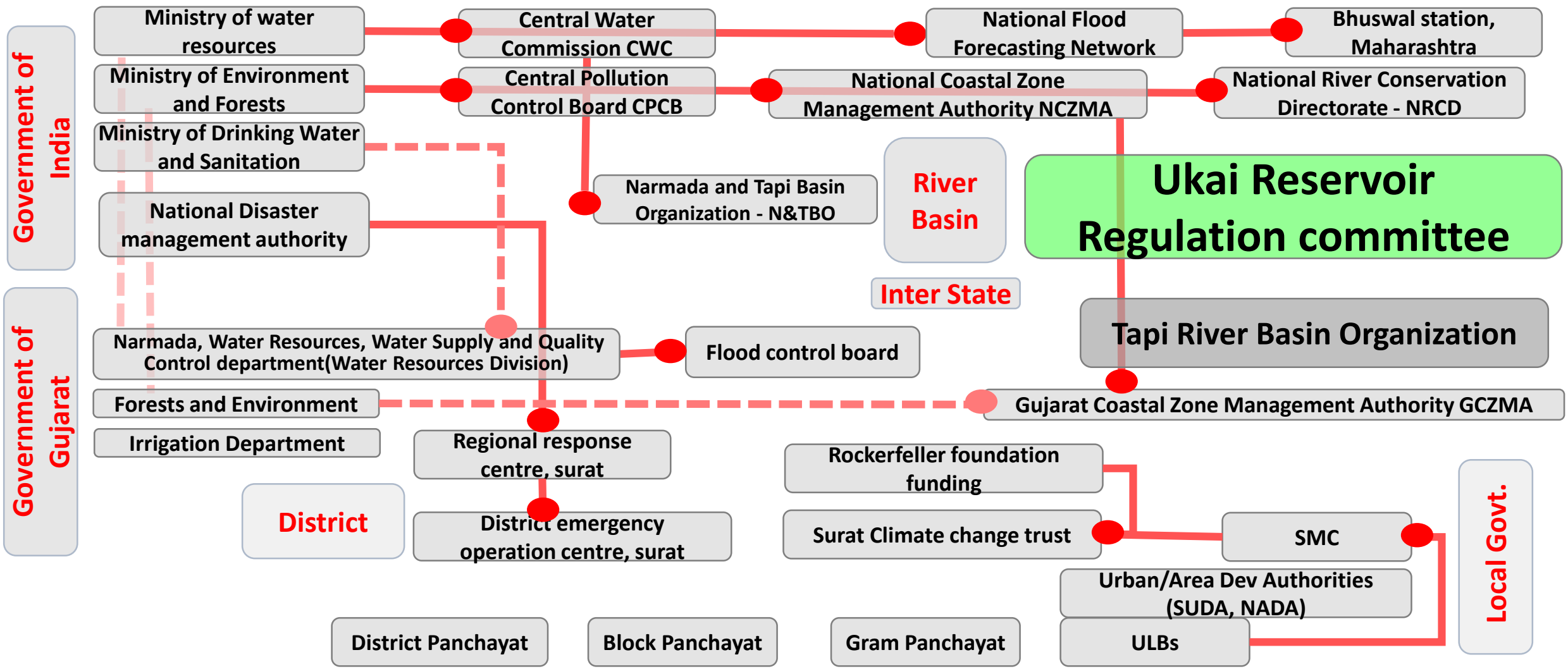
Overlay





Vulnerability and risk Mapping

PROPOSAL 4



Source: From respective websites and Acts

Reservoir Regulation committee

PROPOSAL 4

Irrigation circles

CWC

Narmada, Water Resources, Water Supply and Quality Control department(Water Resources Division)

Ukai Reservoir Regulation Committee

Tapi River Basin organization

Representatives from concerned panchayats, ULBs

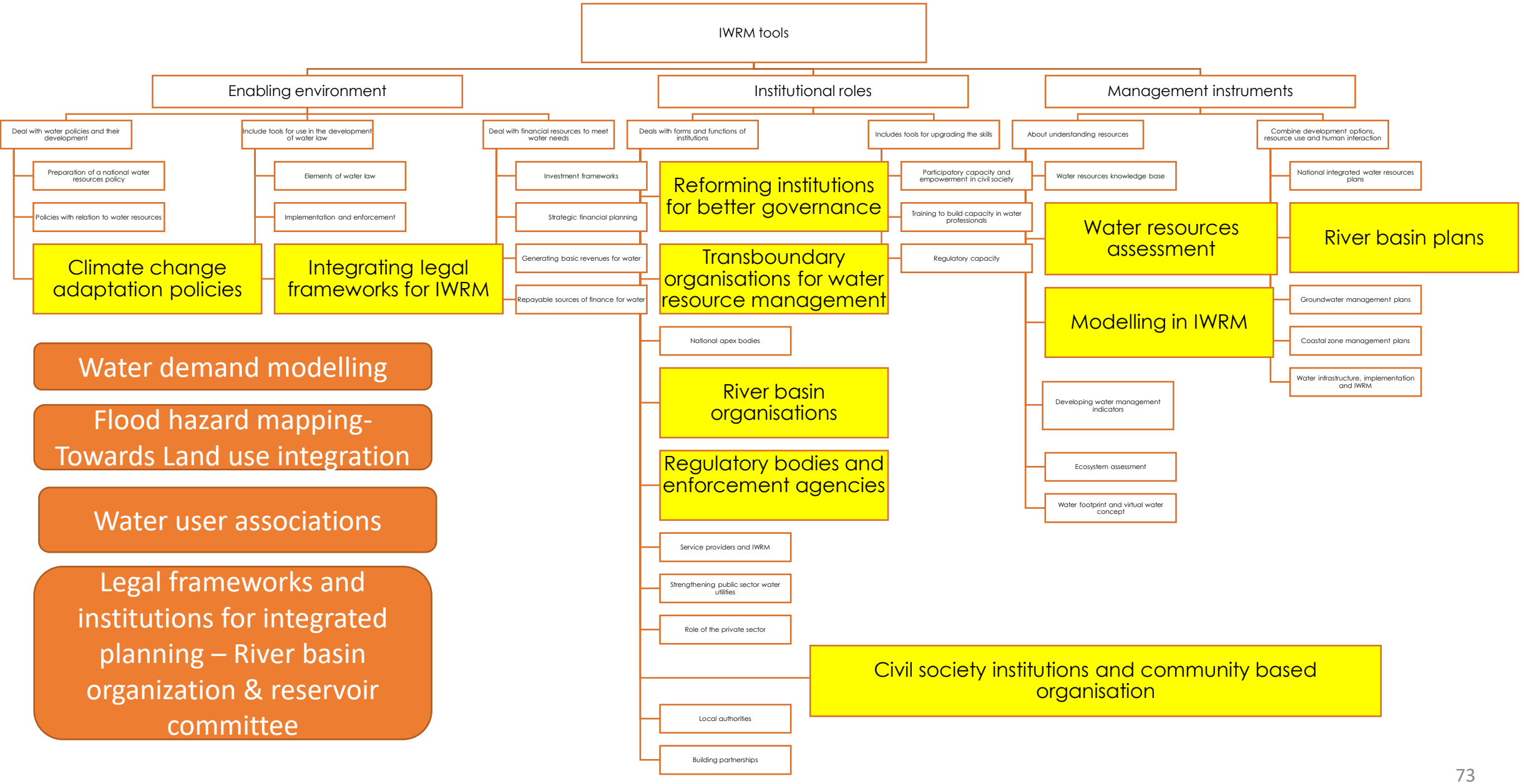
Dam operation engg

Independent functioning and decision making with respect to

- Dam management
- Flood forecasting (with CWC)
- Flood prevention with flow management

PROPOSALS

IWRM- How? ?



Water demand modelling

Flood hazard mapping- Towards Land use integration

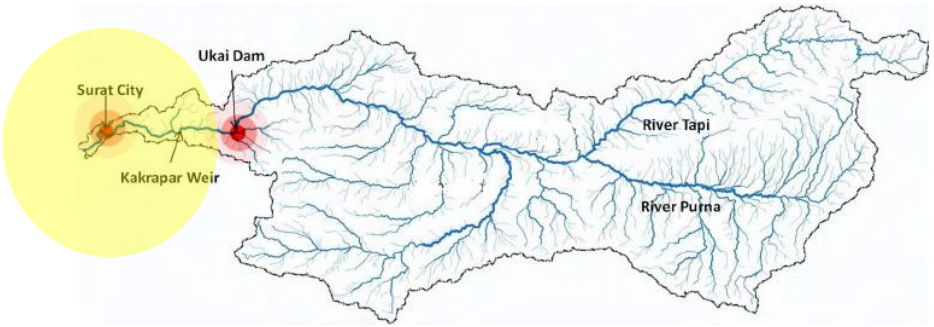
Water user associations

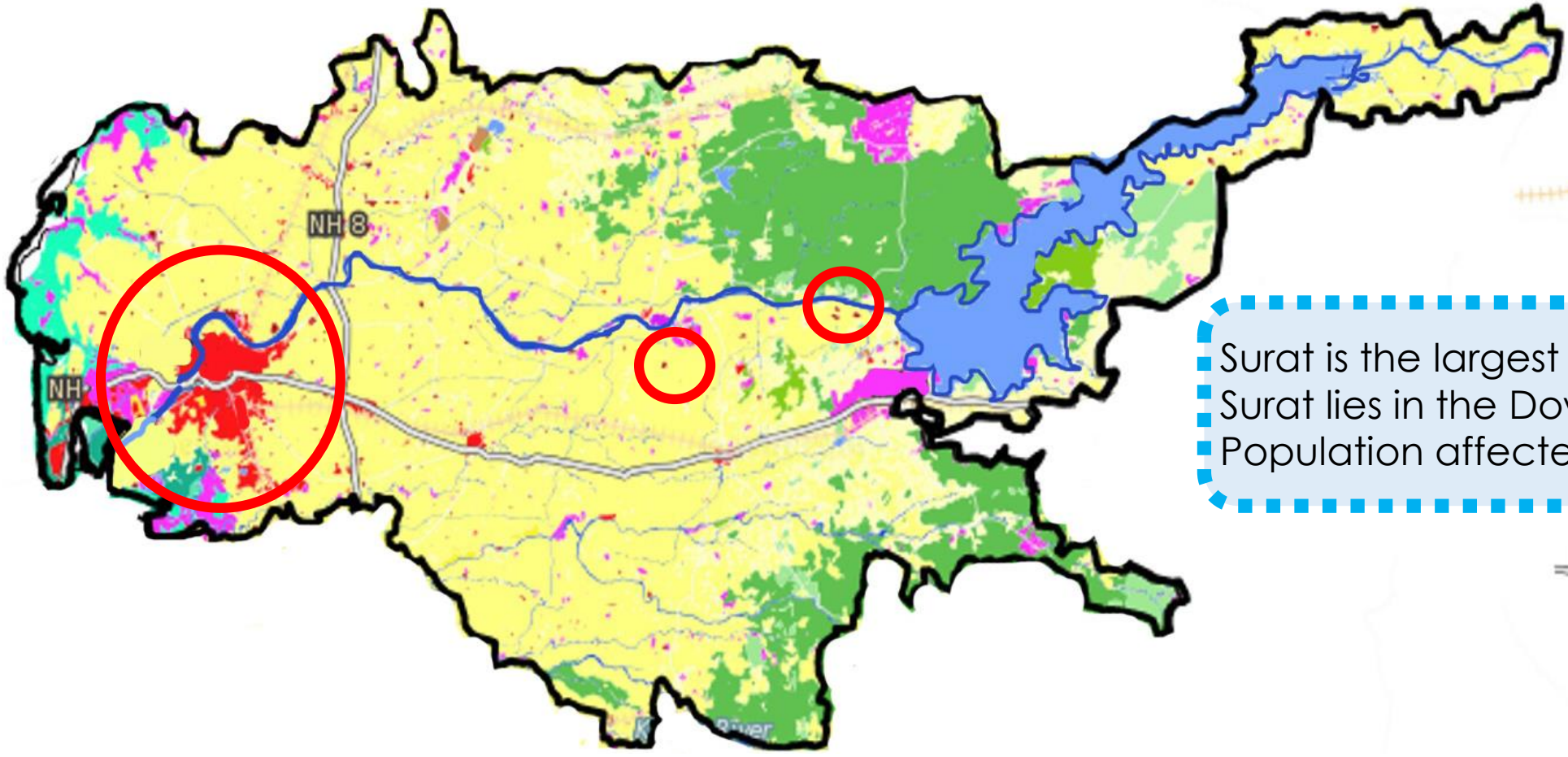
Legal frameworks and institutions for integrated planning – River basin organization & reservoir committee

Adapted from Global water partnership- IWRM toolkit

From Tapi Basin Level – SMC level

Floods occurring in Tapi basin are affecting the settlements most, Surat being in the lower Tapi is affected the most.





Surat is the largest Settlement along Tapi
Surat lies in the Downstream.
Population affected is around 4.7 millions

FLOOD RISK MANAGEMENT

Predicted Changes that would affect Surat ?

What were the impacts (physical) on Surat ?

What were the reasons for Flood ?

Is there a need for Surat to be Resilient ?

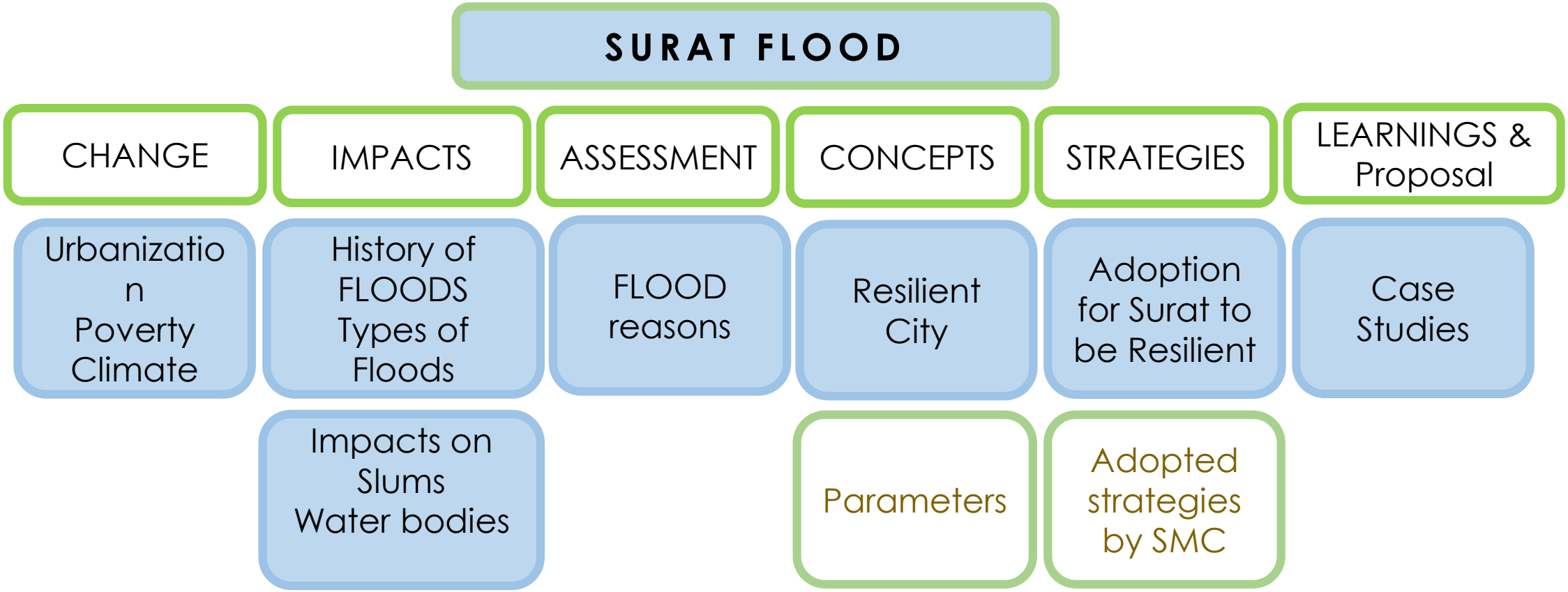
What is Resilience?

What is a Resilient city ?

What Strategies Surat is adopting to go towards Resilience ?

What should be done to make Surat a Resilient city ?

STRUCTURE

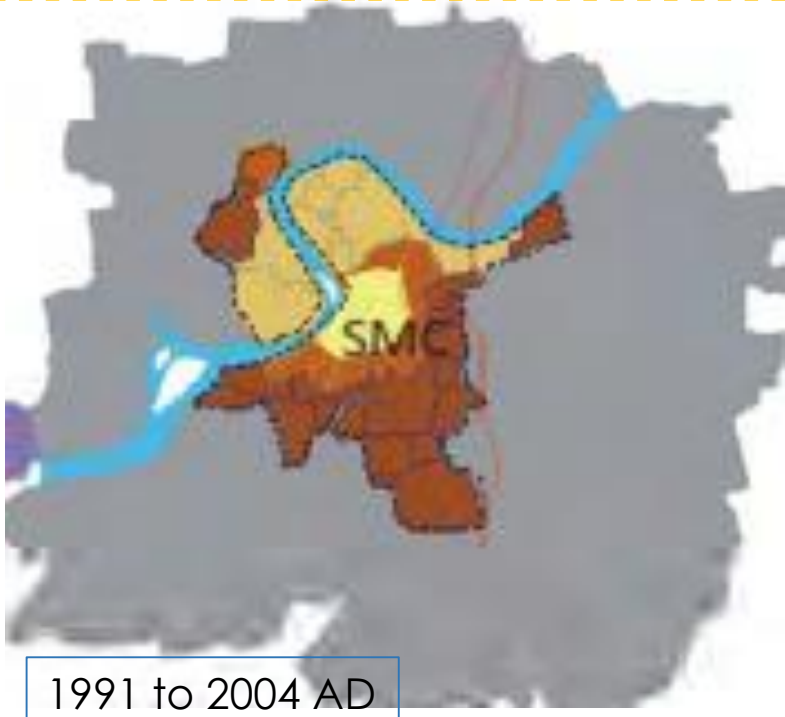

SURAT FLOOD
CHANGE
IMPACTS
ASSESSMENT
CONCEPTS
STRATEGIES
LEARNINGS & Proposal
Urbanizatio n Poverty Climate
History of FLOODS Types of Floods
FLOOD reasons
Resilient City
Adoption for Surat to be Resilient
Case Studies
Impacts on Slums Water bodies
Parameters
Adopted strategies by SMC

Introduction... SURAT

CITY GROWTH (spill over)

149

1951 to 1990 AD



1991 to 2004 AD

Source: Surat Trans-Vision 2030

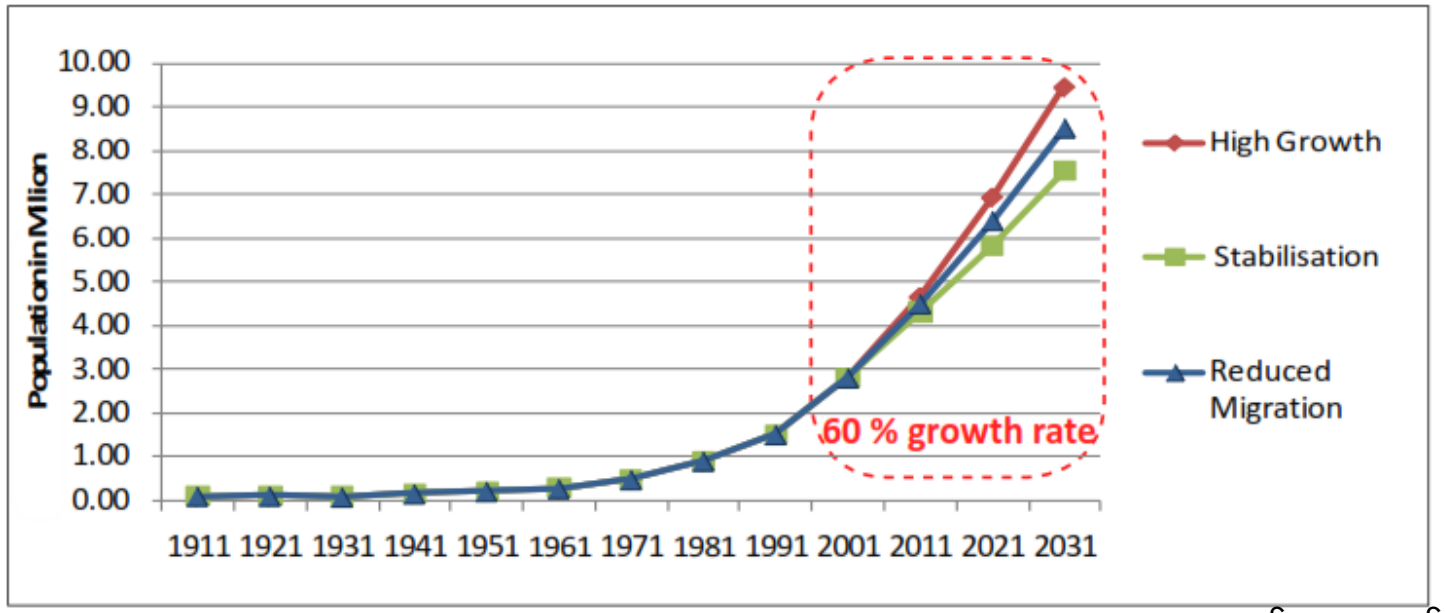
URBANIZATION

- The city area has expanded with time (major expansion being in 2006) and presently covers
- **326.515 sq.km**.

- Total Population(2013) – **4.7 million**

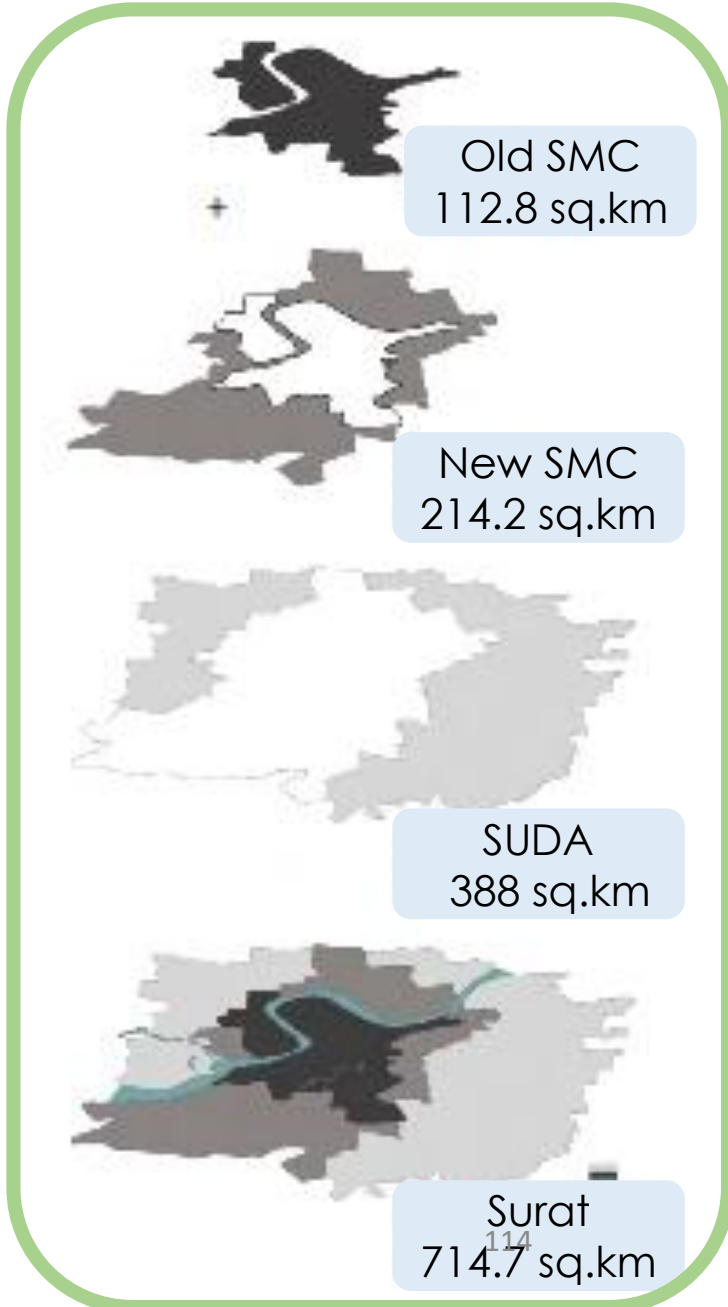
Increased Rate of Urbanization

POPULATION & DECADAL GROWTH

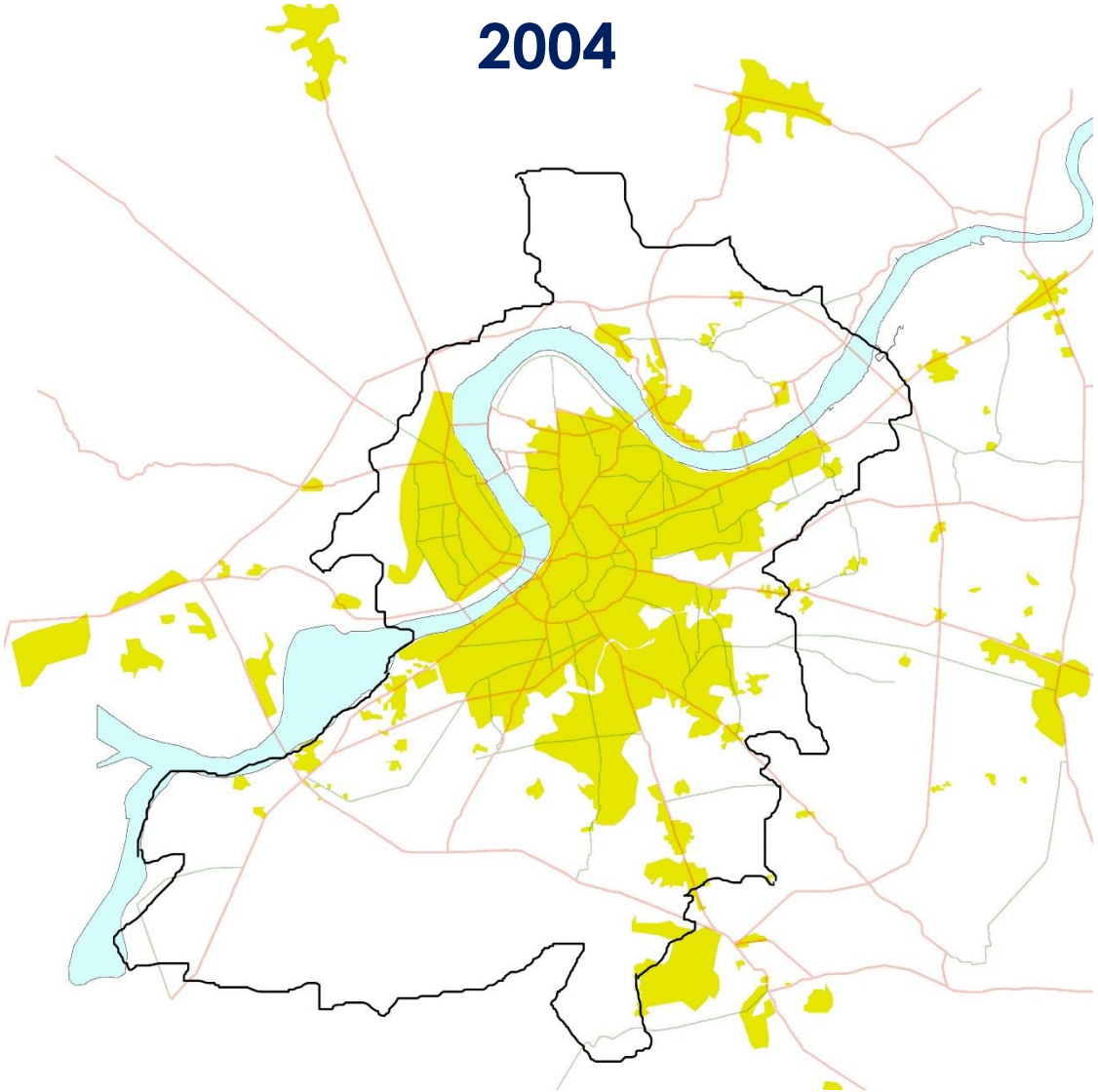


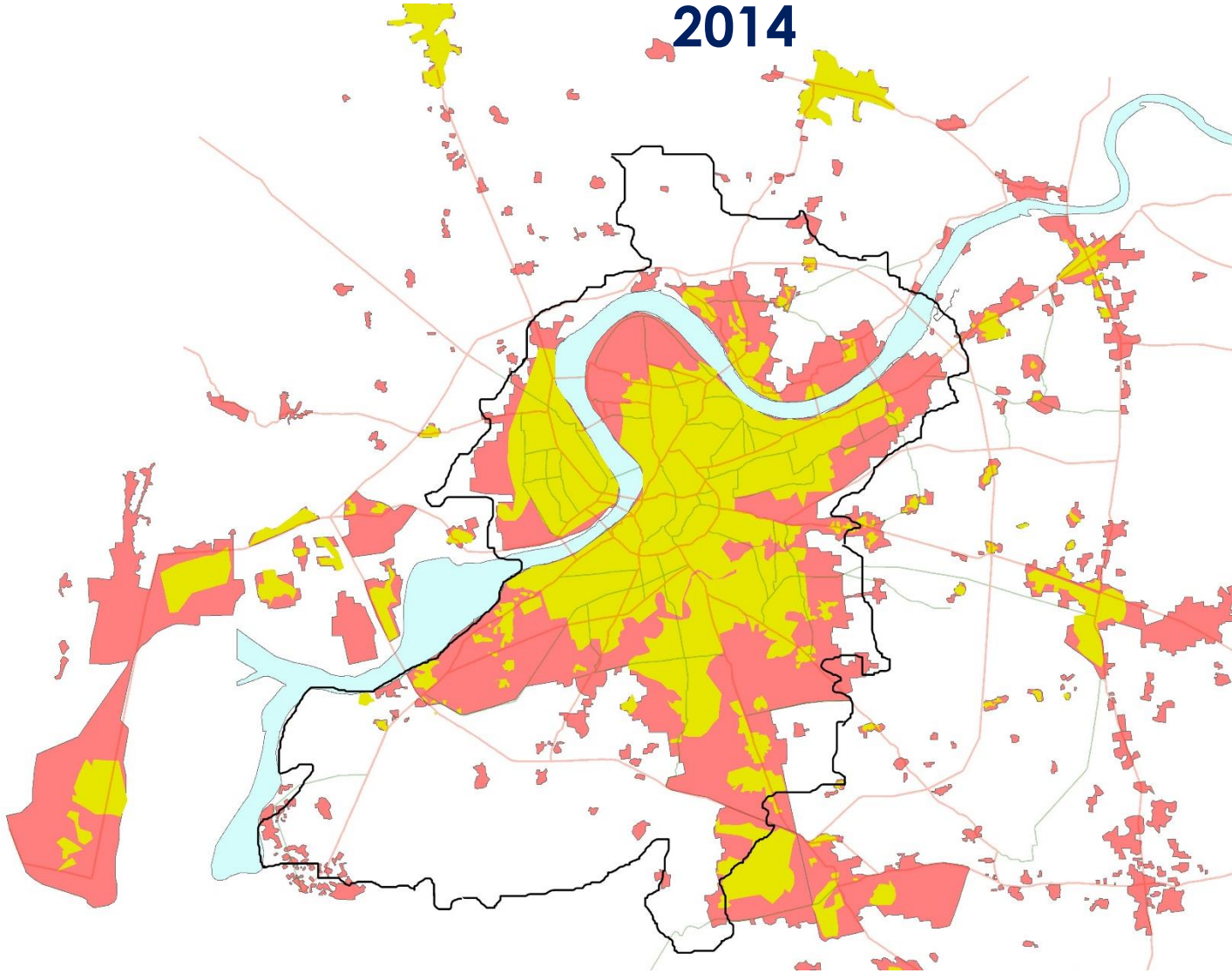
Source : Surat CDP, 2006-12

The spill over of Population into the periphery has also been observed



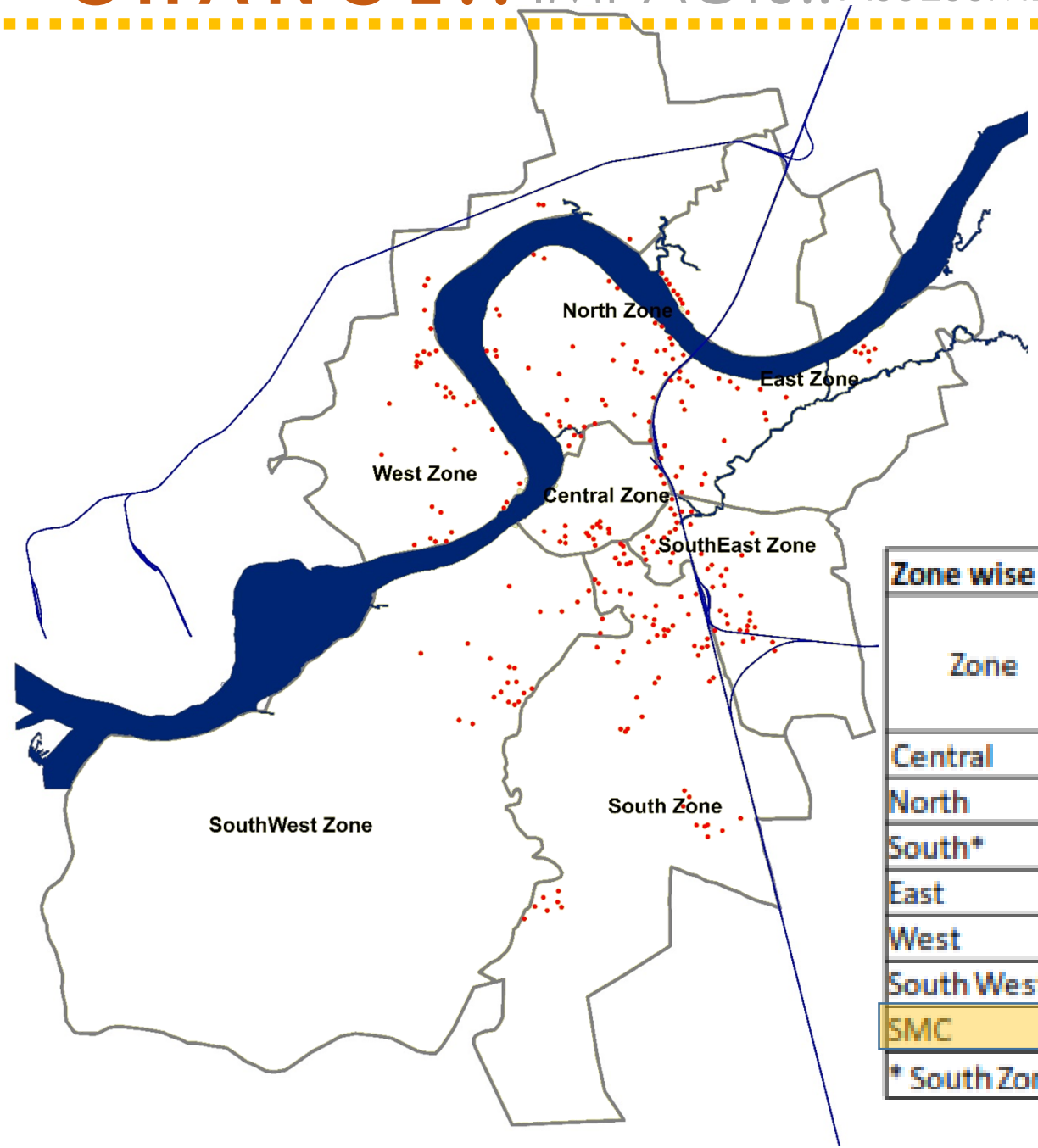
URBAN SPRAWL





SUBSTANTIAL DECADAL GROWTH CAN BE SEEN

CHANGE.. IMPACTS.. ASSESSMENT.. POVERTY (INFORMAL SETTELMENTS)



- Many of these slums are **located along the tidal creeks, along the river,** between the embankments and other drainage lines.
- **These slums face higher risk of flooding (pluvial, and tidal).**
- Having recognized this, efforts to relocate the slums were initiated by the government under various schemes (under various national projects including JNNURM)

Zone wise Slum Settlement(2005)

Zone	No of Slums	No. of slum Households	Slum Population	Percentage to zone Population	Percentage to total population
Central	25	9,189	45,618	11.03	1.87
North	40	9,603	45,596	13.60	1.87
South*	128	58,213	2,33,658	35.82	9.60
East	53	19,364	79,009	13.61	3.25
West	38	11,333	51,712	20.65	2.12
South West	23	8,961	34,712	17.20	1.43
SMC	307	1,16,663	4,90,305	20.15	20.15

* South Zone was bufurcated in the year 2004

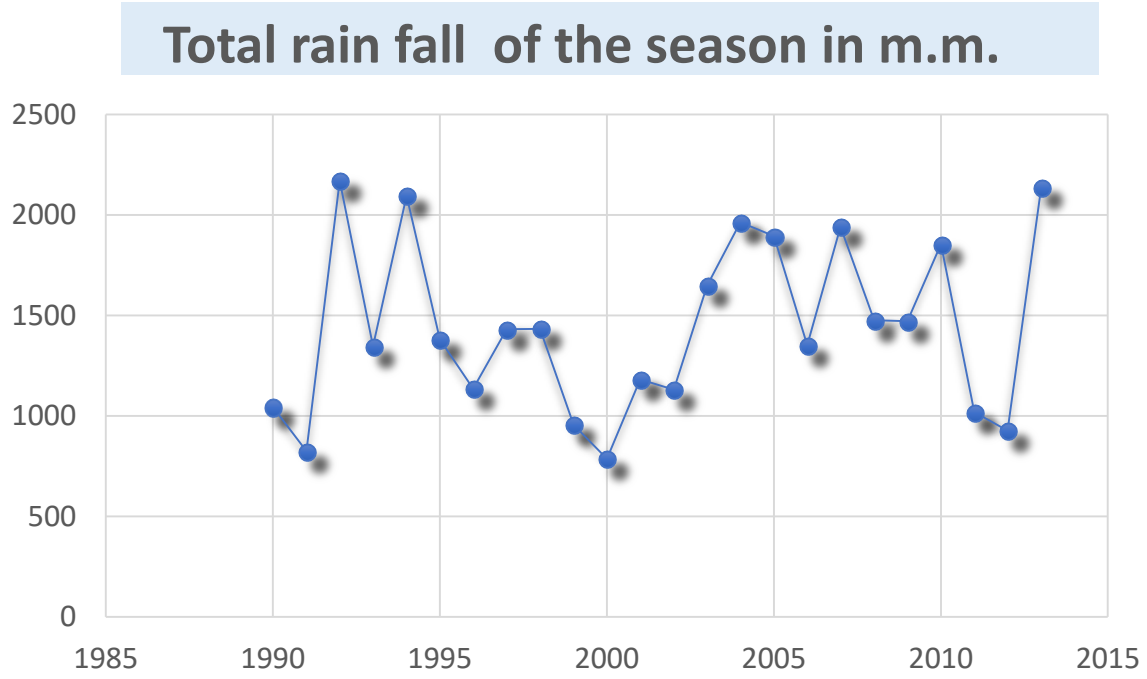
Current it is 17%

Source : Surat CDP, 2006-12

CLIMATE CONDITION (PRECIPITATION)

Surat receives an annual rainfall ranging between **950-1200 mm**. About **90%** of the rainfall occurs in period between June to September

THE INCREASE IN RAINFALL MAY ADD ON TO THE EXISTING RISKS OF PLUVIAL FLOODING.



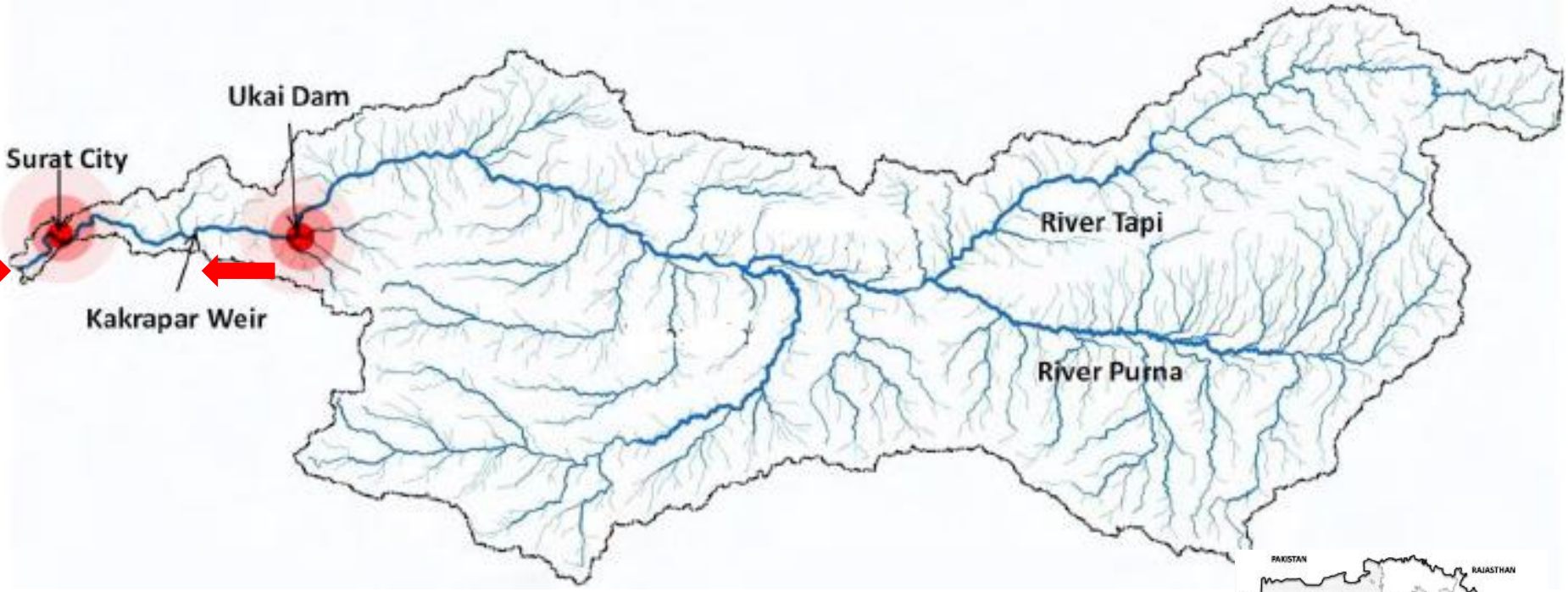
Source : Surat Disaster Management Plan 2013

Sr. No.	Year	Total rainfall of the season in inch	Total rain fall of the season in m.m.
1	1990	42.32	1044.09
2	1991	32.48	0825.01
3	1992	85.40	2169.02
4	1993	52.43	1346.10
5	1994	82.50	2095.50
6	1995	54.28	1379.40
7	1996	44.67	1134.80
8	1997	40.60	1431.04
9	1998	56.39	1432.60
10	1999	37.56	0954.80
11	2000	30.92	0785.80
12	2001	46.50	1180.50
13	2002	44.57	1129.80
14	2003	66.00	1647.00
15	2004	77.31	1962.02
16	2005	74.46	1894.00
17	2006	53.22	1352.00
18	2007	76.12	1940.60
19	2008	57.95	1475.02
20	2009	57.77	1470.00
21	2010	72.99	1854.00
22	2011	40.25	1018.00
23	2012	36.64	927.00
24	2013		2135.00

Surat is a coastal city and lies near the estuary of Tapi River. Several tidal creeks cut across the city. Tidal range of Surat is about **5.8 m.**

During rainy months, the high tides (the highest during in the year) often cause the **sea water to inundate the slums located along the creeks.**

Combined effect of Sea level rise and excess rainfall to increase likelihood of FLOODS



During the last one century, there has been an increase in sea level along the Gulf of Cambay by around **0.67 m**. If such increase prolongs into the future, it could have a major impact on the city.

Source : Study of Sea level Changes in Arabian sea – by A.S. Unnikrishnan 2007

FLOOD HISTORY

	1942	1945	1959	1971	1993	1998	2004	2012
DISCHARGE	8.6 Lac Cusecs	10.24 Lac Cusecs	12.94 Lac Cusecs	Tapi Flood protection project was sanctioned	Tapi Flood protection project was revised	7.0 Lac Cusecs	5.25 Lac Cusecs	
WL at Hope	10.56m	11.09m	11.55m			11.40m	10.10m	
Rainfall						56.39inch (incomplete construction of embankment)	77.3inch	36.64inch

20th & 21th CENTURY

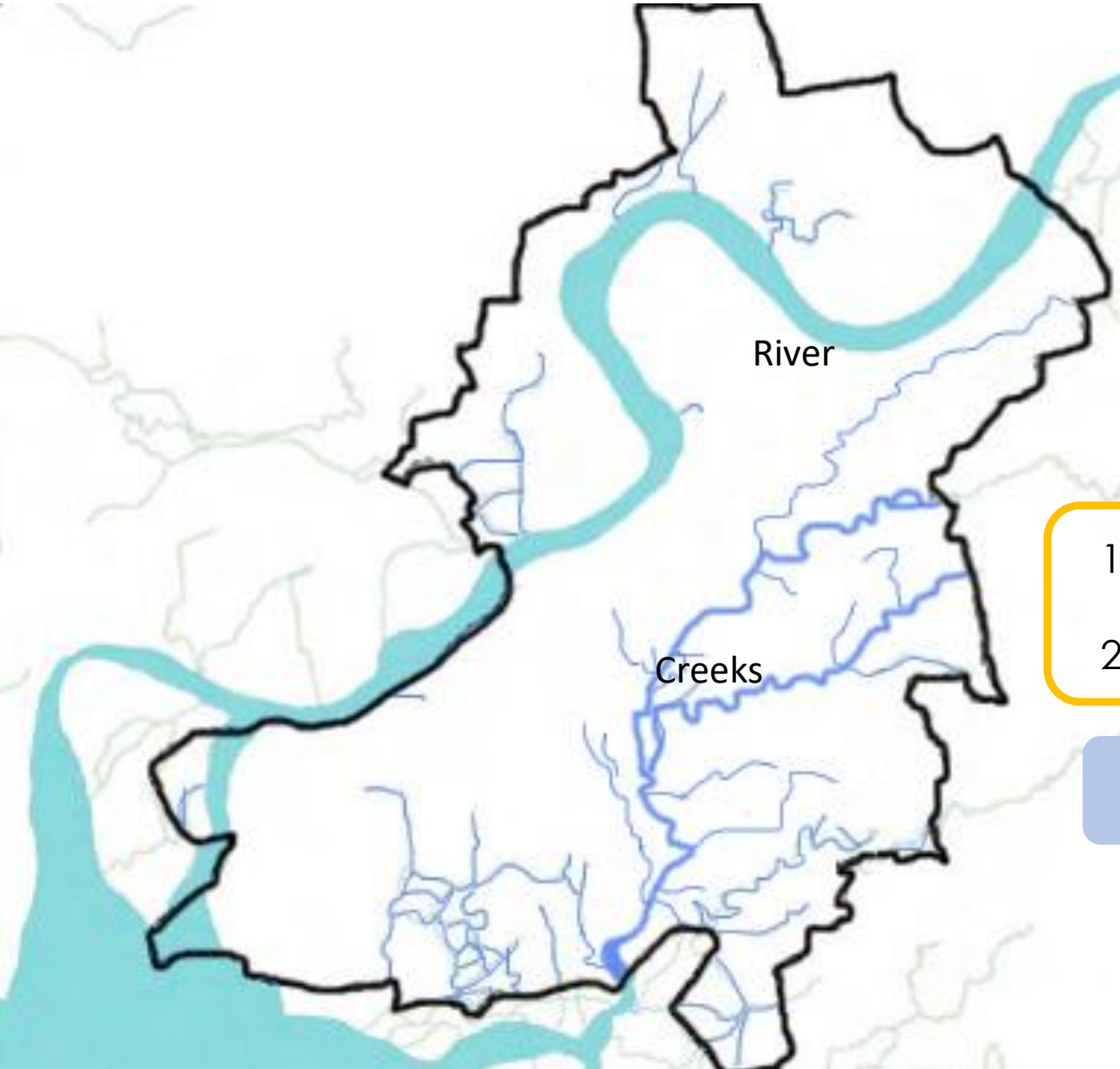
	1944	1949	1968	1972	1994	2002	2006
DISCHARGE	11.84 Lac Cusecs	8.42 Lac Cusecs	15.6 Lac Cusecs	SMC constructed Ukai dam 8.4 Lac cusec of flood water was put under control	5.25 Lac Cusecs	3.25 Lac Cusecs	9.09 Lac Cusecs
WL at Hope	11.32m	10.49m	12.08m		10.10m	8.2m	12.40 m
Rainfall			During 30hrs of rainfall 25" in Ukai 15" in Surat		82.5 inch water was not released gradually and in a timely fashion.	44.57inch	53.22inch 80% of city area was affected

FLOOD SCENARIO






Source : Surat Google images



URBAN FLOOD

High intensity rainfall can cause flooding when the city sewage system and draining canals do not have the necessary capacity to drain away

RIVER (Fluvial)FLOOD

Rainfall over an extended period and an extended area can cause major rivers to overflow their banks.

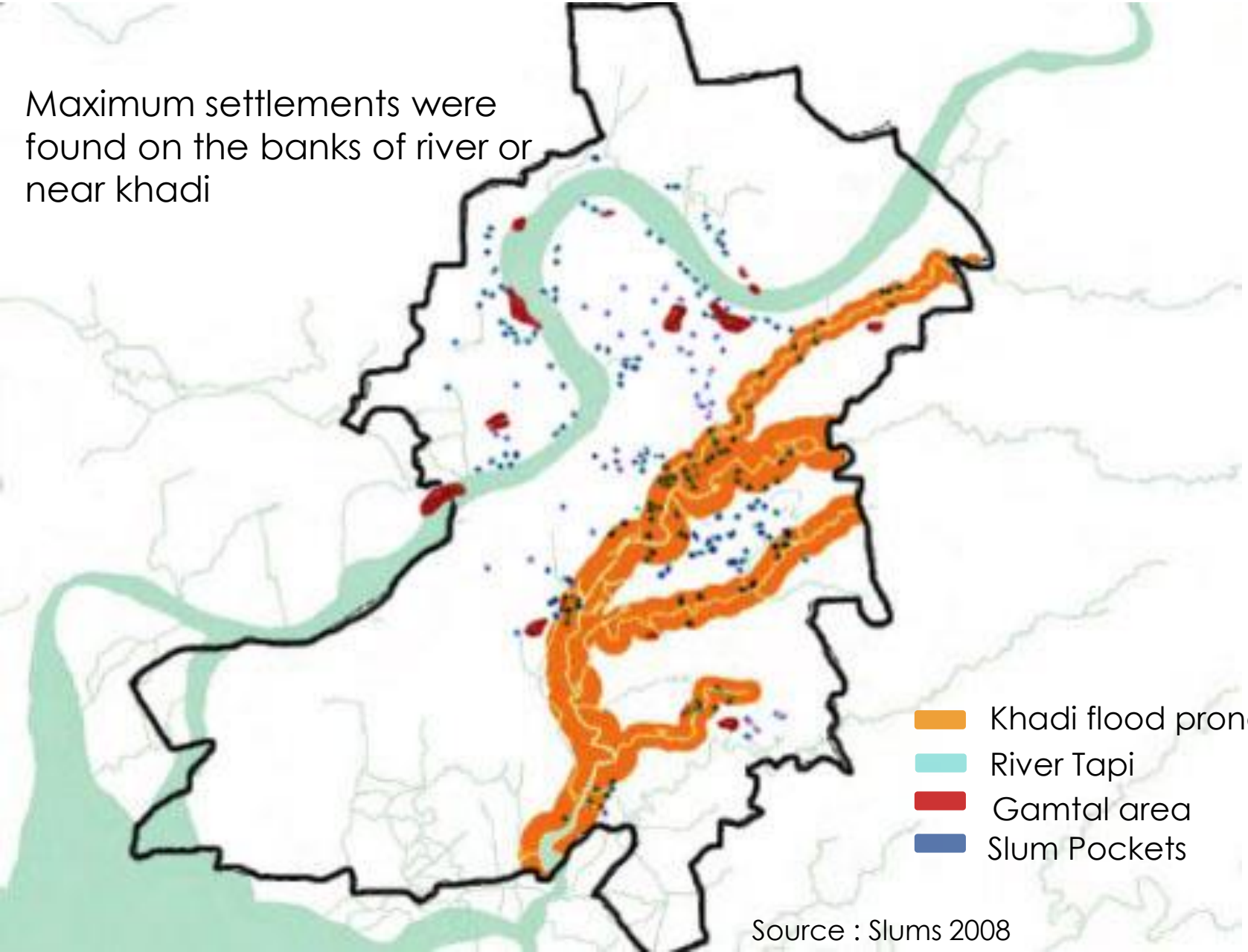
UKAI DAM ← → KHADI

19TH CENTURY (1801 – 1900)	10 Heavy floods
20th CENTURY (1901 – 2000)	19 Heavy floods

Tapi river basin is frequently affected by floods at an interval of 4 years

Source : Surat Disaster Management Plan 2013

Maximum settlements were found on the banks of river or near khadi



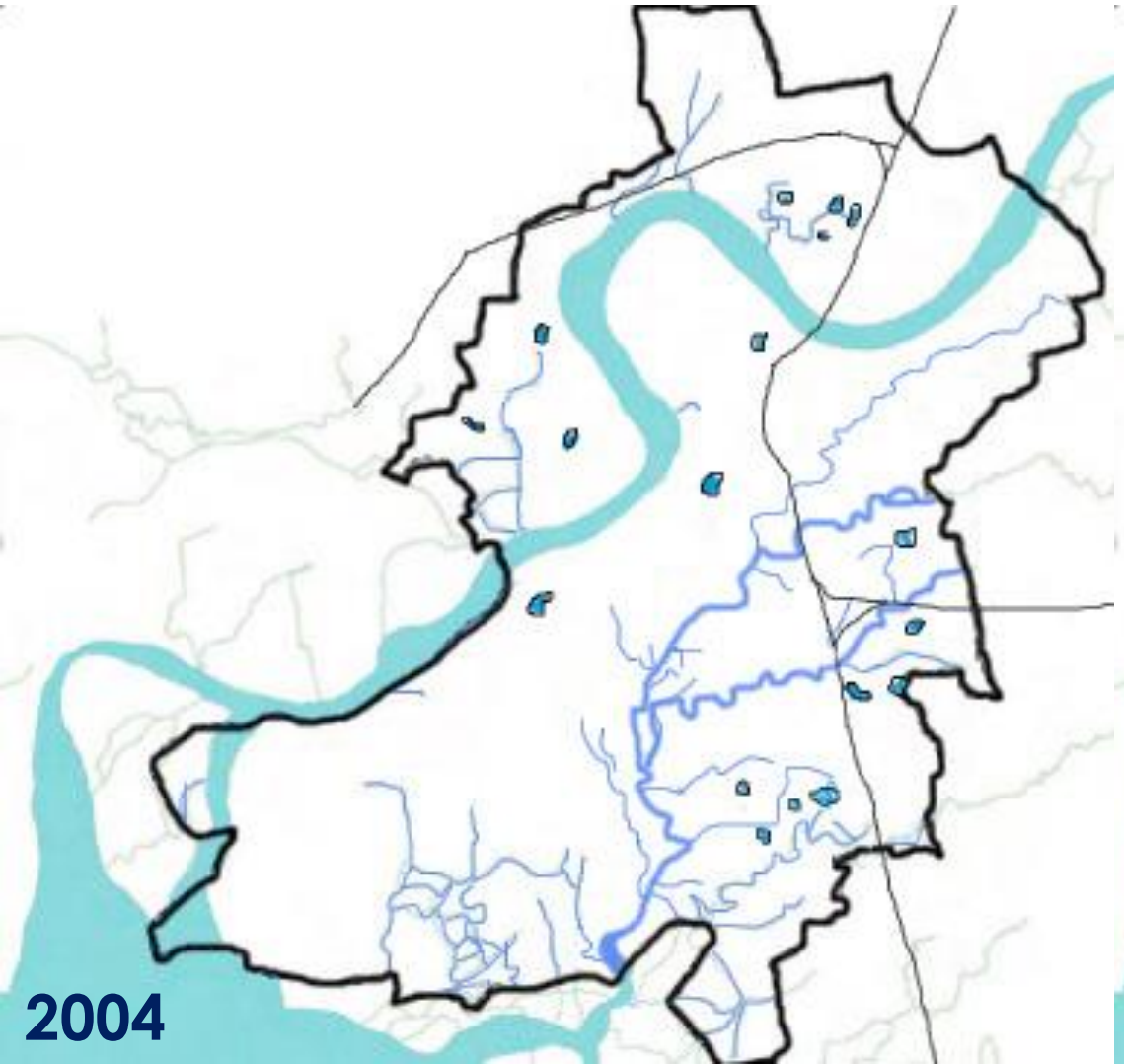
Source : Slums 2008

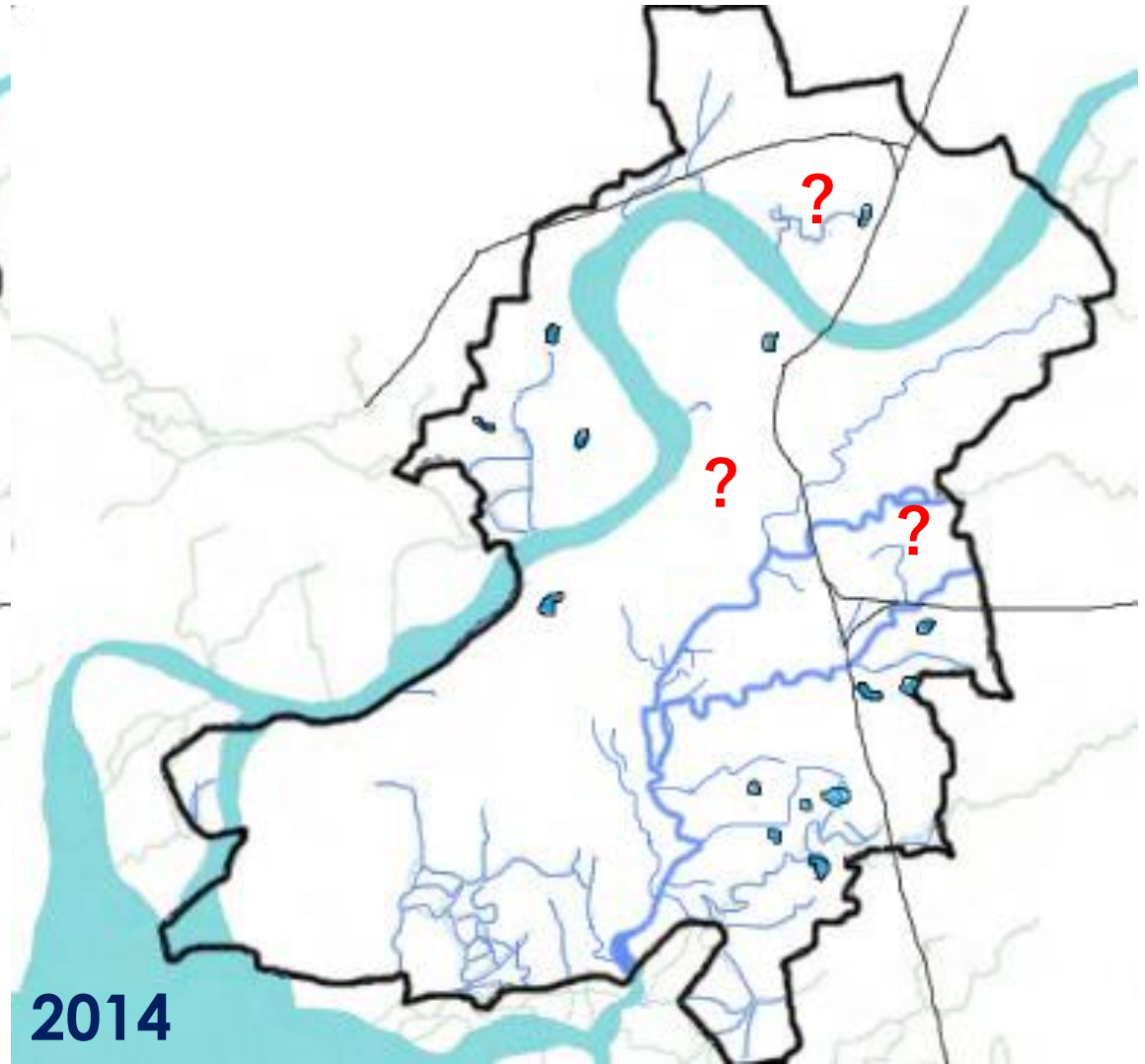
Life on the banks

WATER BODIES

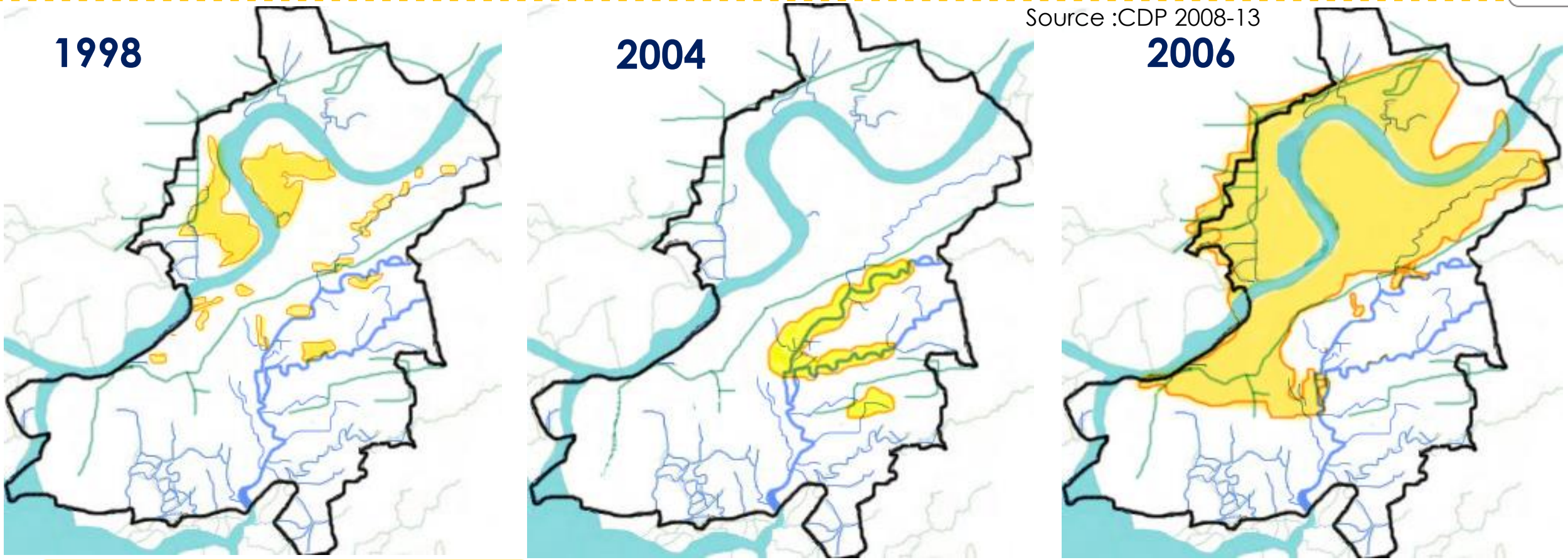
(Shrinking of water bodies)

Impacts of Climate and Urbanization is also seen on Water bodies of Surat





Source :CDP 2008-13



The peak inflow at Ukai during 1998 was more than 8 lakh cusec only for a period of **6 hours** and yet the peak outflow from the dam was **7 lakh** cusec. **This indicated that water was not released gradually and in a timely fashion.**

Source : IIM research paper

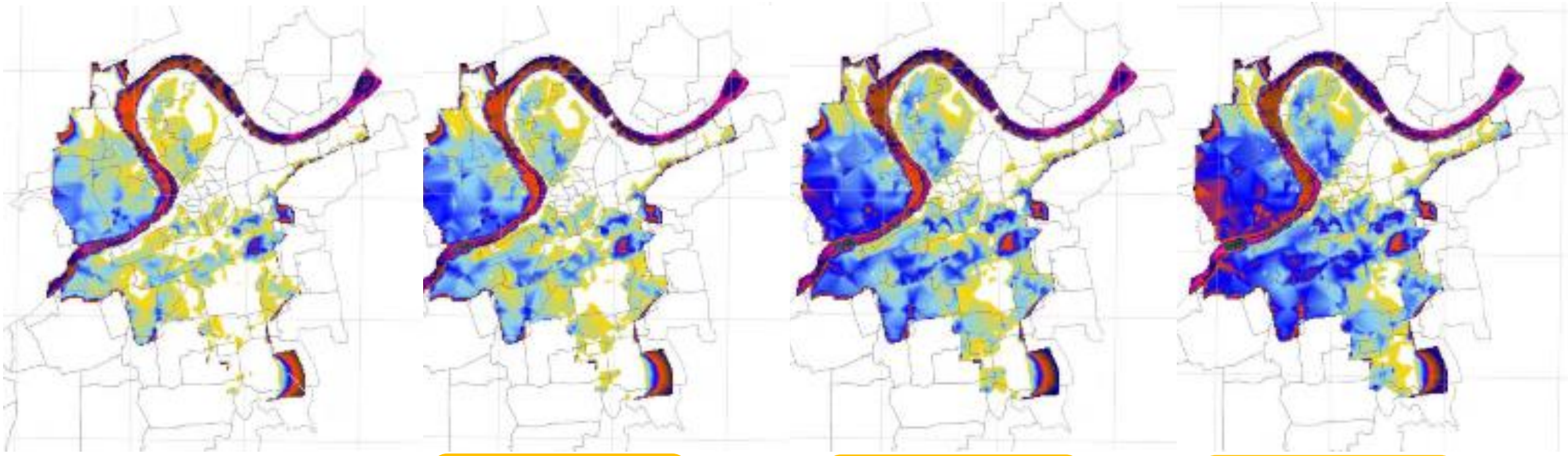
Due to Heavy rain**, khadi flood was seen**
Total rain fall of the season was 1962 m.m

Source :India situation report, Gujarat floods

7.5 Lac Cusecs of water was discharged continuously for 13 hrs.
9 Lac Cusecs for 42 hrs.
128 Sq.km out of SMC (326sq.km) was flooded.

Source :DMP 2013

AREAS PRONE TO FLOODS DUE TO UKAI



4 lac cusecs discharge

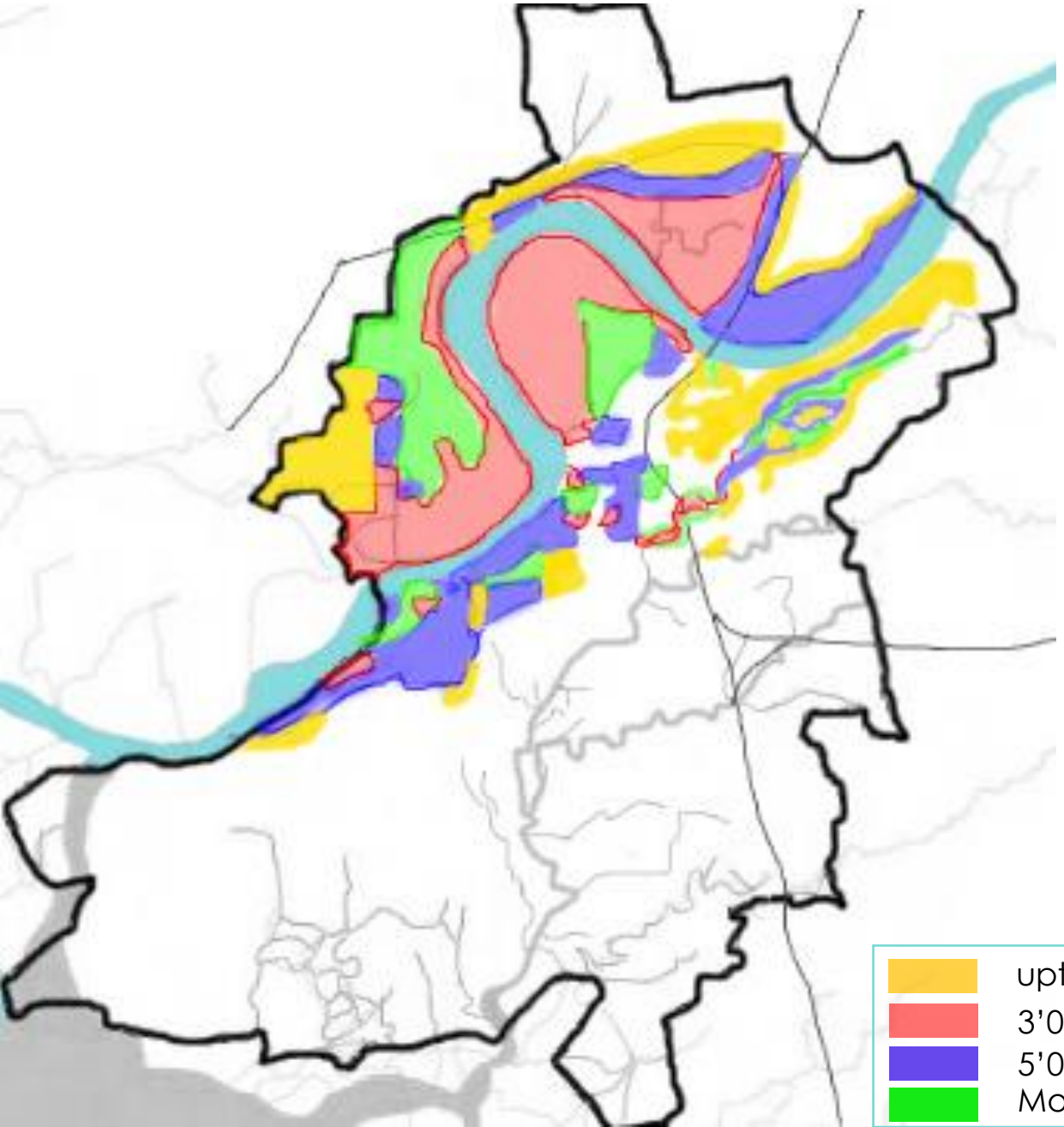
5 lac cusecs discharge

6 lac cusecs discharge

7 lac cusecs discharge

Source : Research on Surat city Resilience strategies by Rockefeller Foundation

2006 FLOOD



The year 2006 was clearly the year of major flood disasters for Surat.

REASON :

- By sudden release of large quantities of water from Ukai dam.
- This was the **biggest flood in last 34 years**.
- The water level in the river at Surat crossed the previous highest level of 12 meters (of 1968 flood) and reached 12.5M, submerging more than **80%** of the city under water.

Normal Situation

Flood Situation

Source : Disaster Management Plan 2013

Comparison of Different Floods in Surat

Flood Year	Peak inflow (lakh cusec)	Max outflow (lakh cusec)	Rose level at Hope bridge (meter)	Outcome
1968 (No dam)	-	15	12.01	Major Flood
1978	< 8	4.4	-	No flood
1979	< 8	3.3	-	No flood
1994	8.9	6	10.2	Flood
1998	10.5	7	11.5	Flood
2006	10.6	9	12.01	Major Flood

Source :People Committee on Gujarat floods 2006 : A report

The rise level of water with different outflow level is increasing, which shows that the safe carrying capacity of the river has decreased considerably from the earlier time.

REASONS

- Inappropriate discharge from Ukai dam
- Intensive rainfall causing khadi floods
- Decreasing Safe carrying capacity of River Tapi
- Incomplete or damaged construction on embankment

Need for Surat to be Resilient

21% RURAL

79% URBAN

(As per Census 2011)

More people means more opportunity it also means more **RISK**

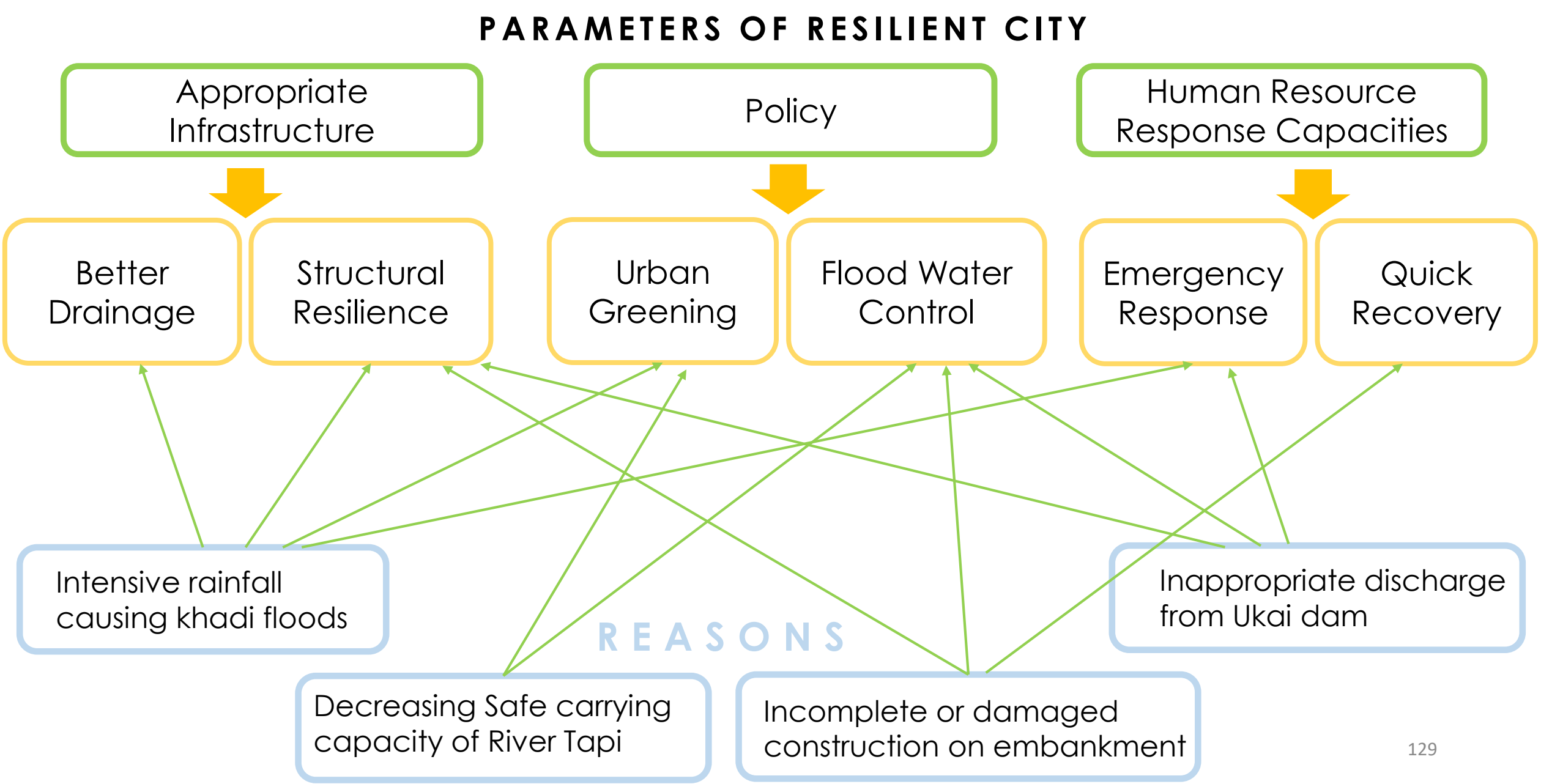
Is Surat prepared ?

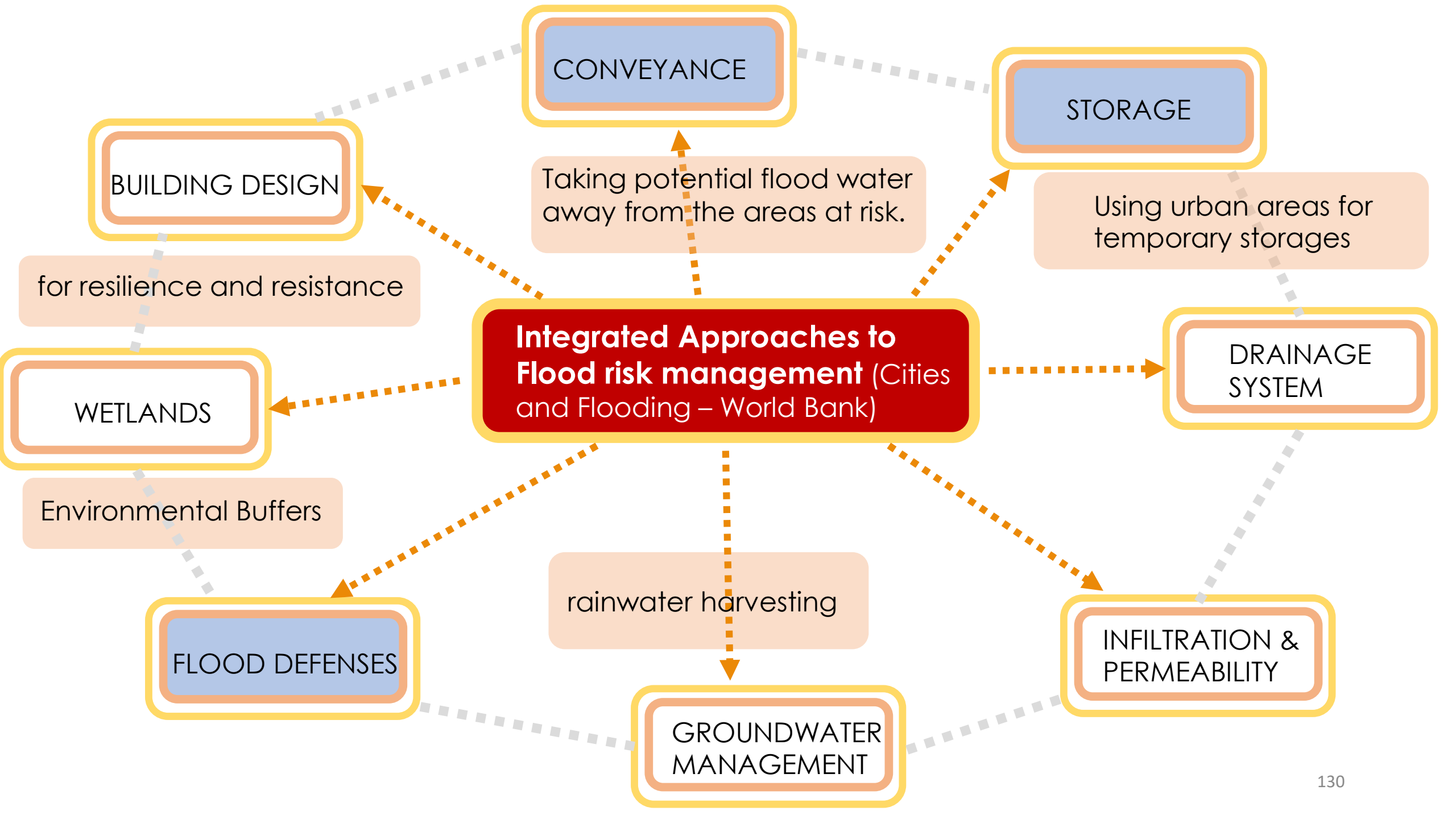
RESILIENCE : It is the capacity of a community or society to adapt when exposed to a hazard

RESILIENT CITY : It is one that is able to sustain itself through its systems by dealing with issues & events that threatens, damage or try to destroy it.

Source : Climate Resilient Cities by World Bank

"the capacity of individuals, communities, institutions, businesses and systems within a city to survive, adapt, and grow no matter what kinds of **chronic stresses** and **acute shocks** they experience."


PARAMETERS OF RESILIENT CITY
Appropriate Infrastructure
Policy
Human Resource Response Capacities
Better Drainage
Structural Resilience
Urban Greening
Flood Water Control
Emergency Response
Quick Recovery
REASONS
Intensive rainfall causing khadi floods
Inappropriate discharge from Ukai dam
Decreasing Safe carrying capacity of River Tapi
Incomplete or damaged construction on embankment


CONVEYANCE
STORAGE
BUILDING DESIGN
Taking potential flood water away from the areas at risk.
Using urban areas for temporary storages
for resilience and resistance
Integrated Approaches to Flood risk management (Cities and Flooding – World Bank)
DRAINAGE SYSTEM
WETLANDS
Environmental Buffers
rainwater harvesting
FLOOD DEFENSES
INFILTRATION & PERMEABILITY
GROUNDWATER MANAGEMENT

STRATEGIES..

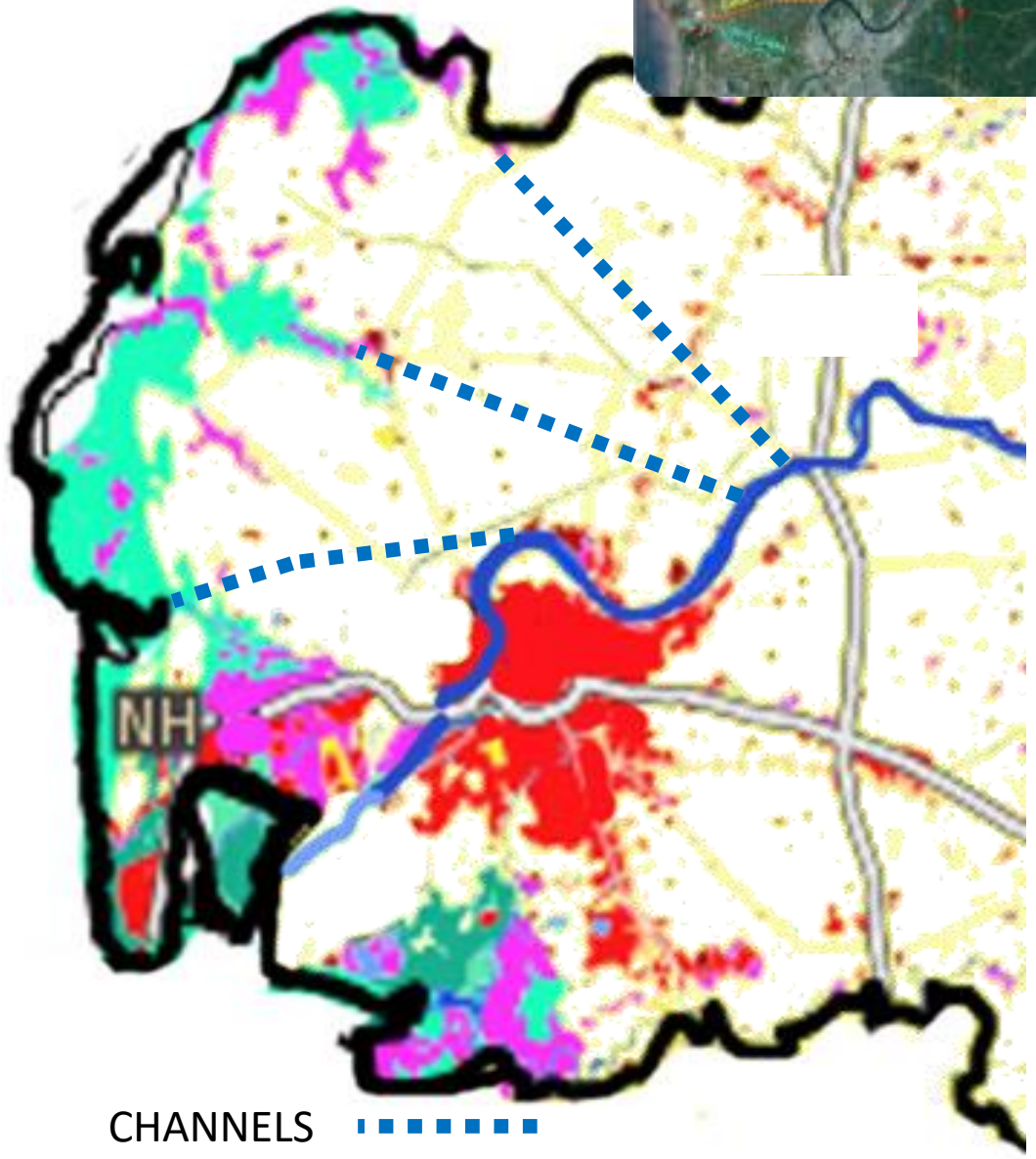
Surat's Approach

Institutions involved – SMC, ACCCRN, SCCT

REASONS / RESILIENT PARAMETERS	Intensive rainfall causing khadi floods	Decreasing Safe carrying capacity of River Tapi	Incomplete or damaged construction on embankment	Inappropriate discharge from Ukai dam
Better Drainage	Storm water Drain pumping stations (SMC)	Multi purpose detention reservoir	Temporary Storage in urban areas	To avoid water logging in urban areas
Structural Resilience		Singanpore Weir cum Causeway Project(1995)	Construction of River Embankment Road (2012)	
Policy & Programmes	Mindhola river rehabilitation project	Water bodies cleaning Programme	Conveyance	
Flood Water Control	HOLDING Ponds	Multi purpose detention reservoir	Diversion of flood water from River Tapi (CRS)	Ballon barrage project
Emergency Response				End to end early warning systems for Ukai (SCCT, ACCCRN))

Store flood water

Diversion of flood water from River Tapi (CRS)



TEMPORARY STORAGE During floods

Maximum water depth it will carry is 0.5m but if secured it can carry 1m depth

Open Grounds
Open stadium
Play fields

MAP of uncultivable land & Swamp

HOLDING ponds

Places can be identified also in uncultivable land or existing water bodies

GOPI Talaav

Limit flooding
Pollutant removal.
Accommodate high water during rainy times.

Redevelopment of **HOLDING ponds** in Navi Mumbai

Converted these spaces into beautiful public parks without affecting their function,

To maintain these ponds institutions involved?

Coastal Zone Management Authority ?

Surat Municipal Corporation?

Ukai Reservoir Regulation committee

EFFECT OF THE SOLID Waste in DRAINAGE and Water Bodies

Environment degradation by transport of polluted water

Obstruction in runoff during rains

Losses of hydraulic efficiency of the Drainage and water body

An increase in flood frequency.

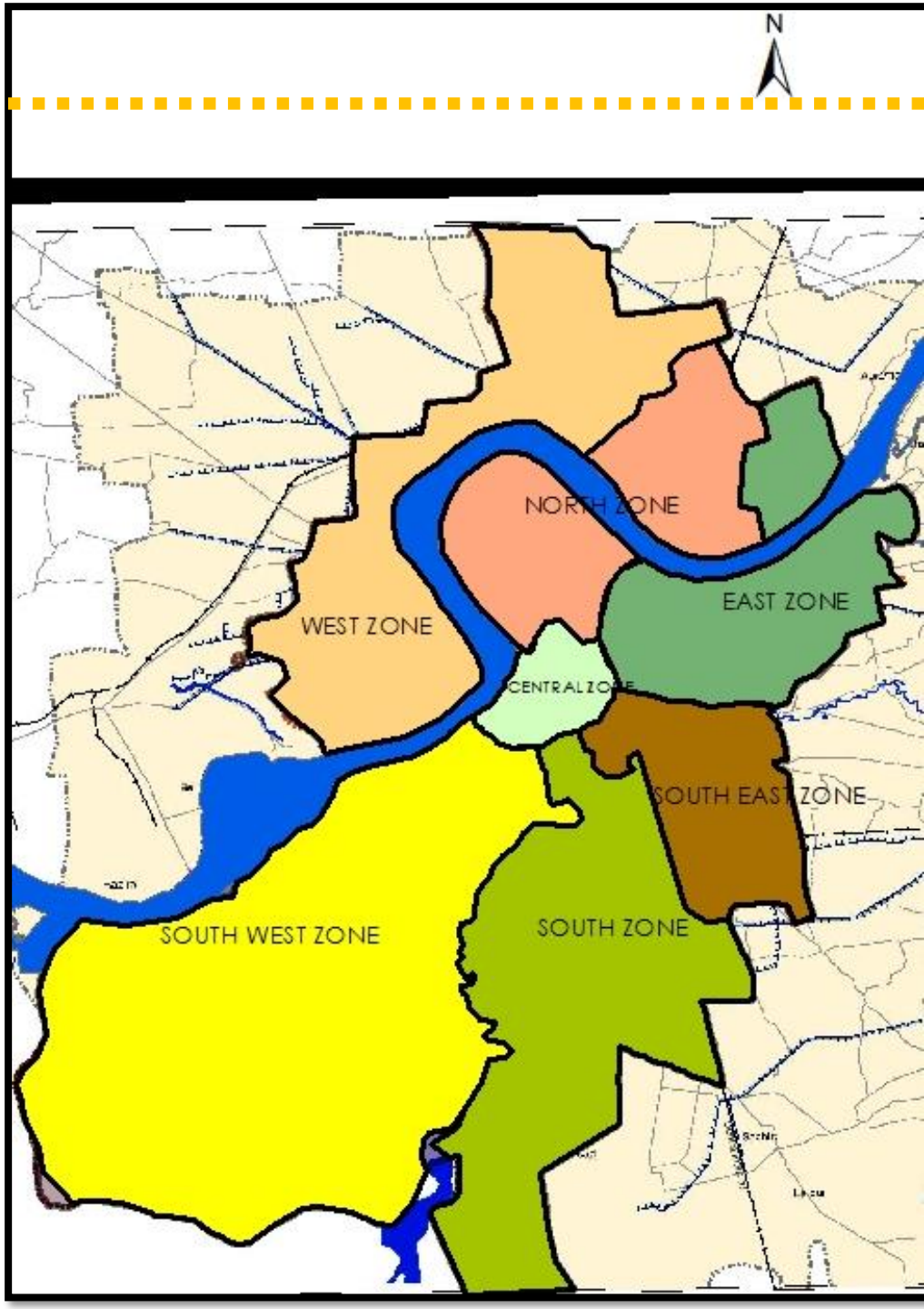
Mindhola creek

SOLID WASTE MANAGEMENT

SOLID WASTE MANAGEMENT

- Total area – 326.5 sq.km
- Average generation – 350gm/capita/day
- Over 1500metric ton garbage is collected and disposed
- Expenditure – Rs. 1.20/capita/ day

Solid waste management parameters	Bench mark	Surat Status 2010-11	Achieved year 2013-14	Target for year 2017-18
Household coverage	100%	97%	92.3%	100%
Efficiency of collection	100%	97%	88%	100%
Extent of treatment	100%	15%	13%	30%
Segregation at common facility	100%	36%	18%	80%
Extent of scientific disposal	80%	29%	15%	75%
Extent of redressal of customer complaints	100%	85%	93%	100%
Extent of cost recovery	90%	83%	100%	100%
Efficiency in collection of charges	80%	97%	91%	100%



SERVICE PROVISIONING

Door to Door Collection
Private Contractor

Container Collection
SMC + Private Contractor

Street Sweeping
SMC Labourer

Night Scrapping
SMC Labourer

Society Anudan Scheme
Society People-Private

Hotel Waste
Hotel Authorities

Transfer Station

Secondary Transportation
Private Contractor

Disposal Site

Waste to Energy Plant (1000TPD) [under construction]

Treatment
Private Contractor

Compost & RDF Plant (400TPD) [under operation]

Plastic & organic waste (100TPD)

Inert waste (250TPD)

Source – SMC office 2014

SERVICE PROVISIONING

Door to Door Collection
Private Contractor

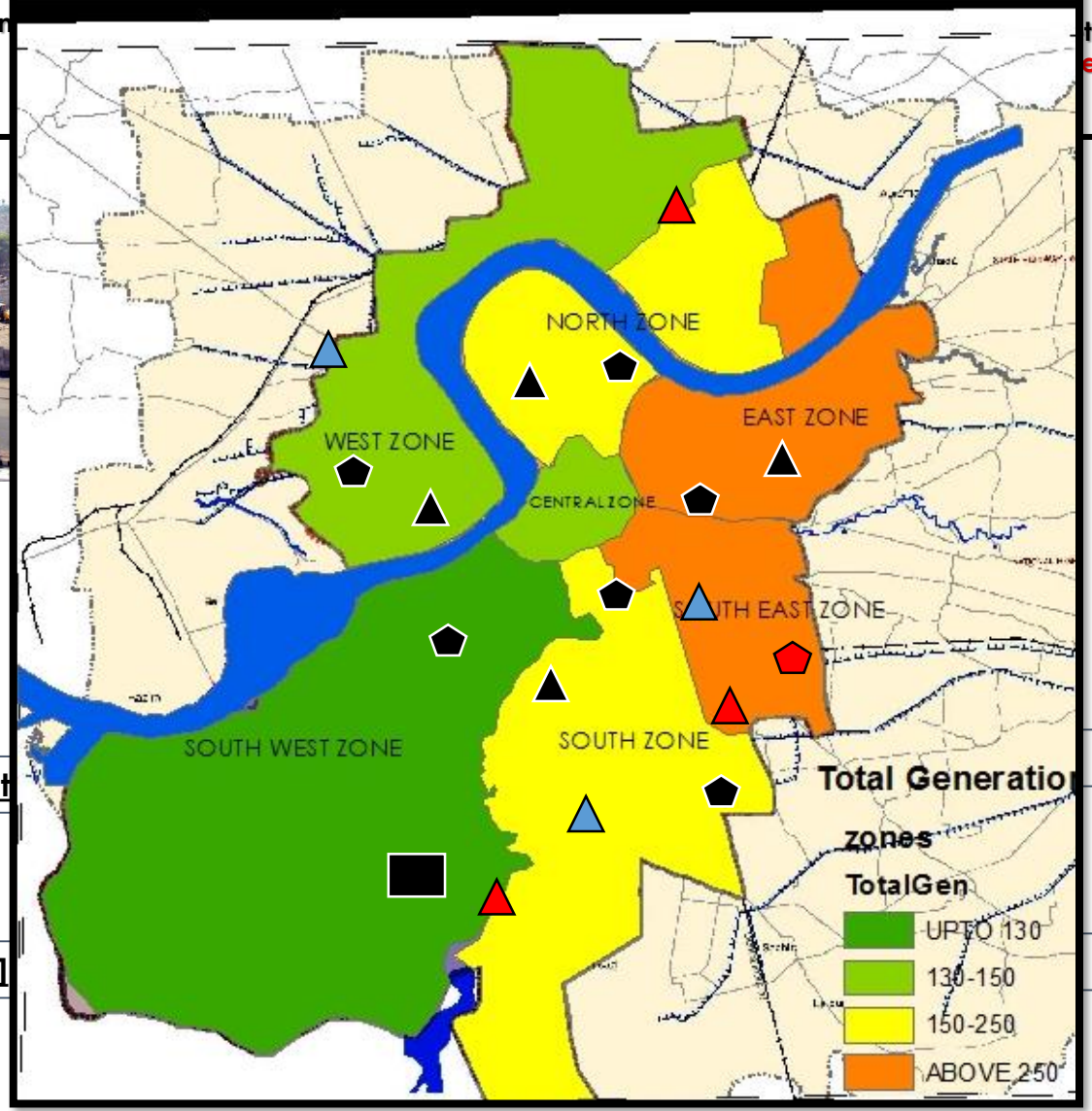
Container Collection
SMC + Private Contractor

Waste to Energy Plant (1000TPD) [under construct

Treatment
Private Contractor

Compost & RDF Plant (400TPD) [under operation]

TRANSFER STATIONS & DISPOSAL SITE



ty Anudan Scheme
ety People-Private

Hotel Waste
Hotel Authorities

- Transfer Station
- Proposed Transfer Station

Plastic & organic waste (100TPD)

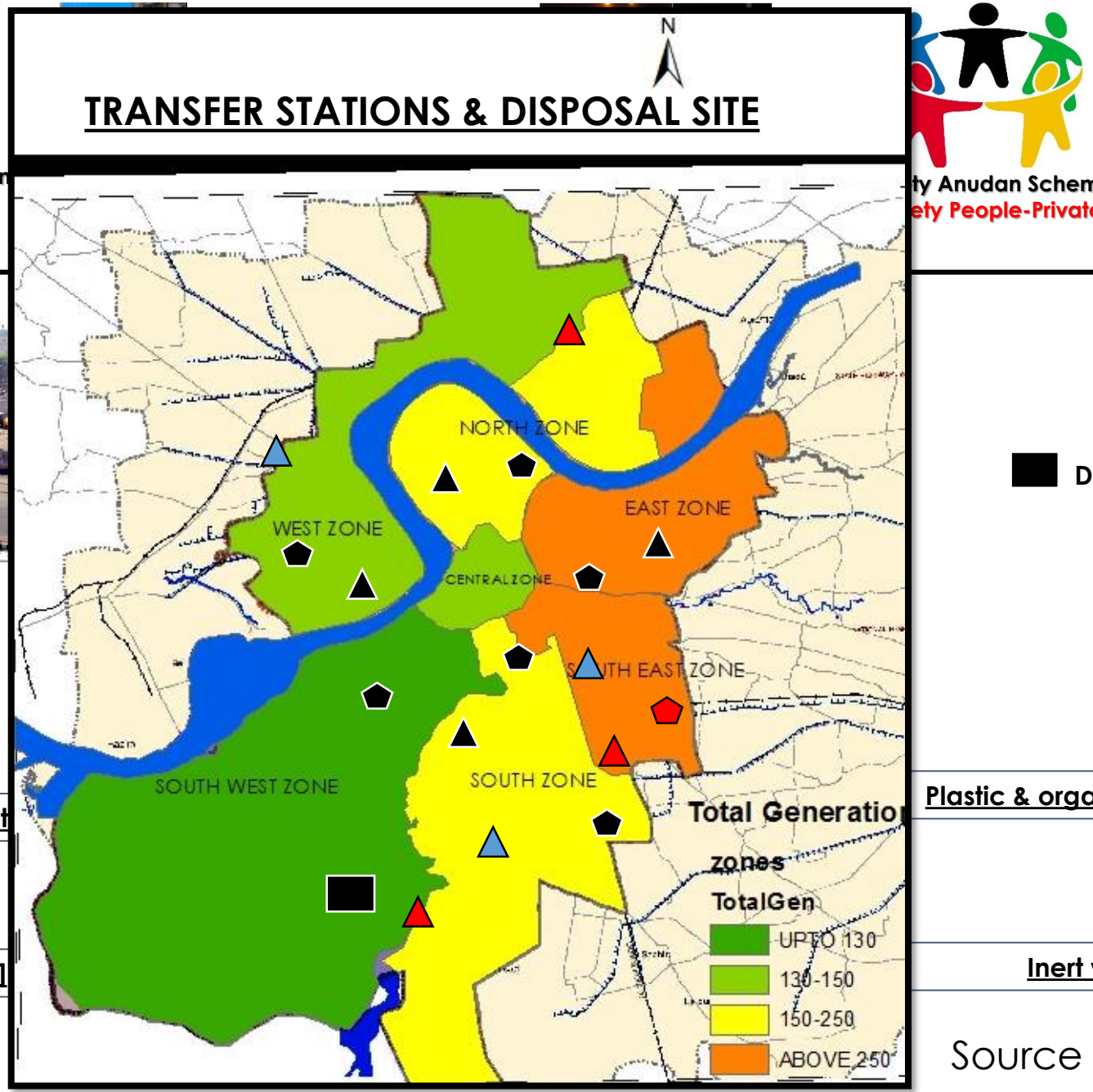
Inert waste (250TPD)

Source – SMC office 2014

SERVICE PROVISIONING

Door to Door Collection
Private Contractor

Container Collection
SMC + Private Contractor



ty Anudan Scheme
ety People-Private

Hotel Waste
Hotel Authorities

Disposal Site- Khajaud

Waste to Energy Plant (1000TPD) [under construct

Treatment
Private
Contractor

Compost & RDF Plant (400TPD) [under operation]

Plastic & organic waste (100TPD)

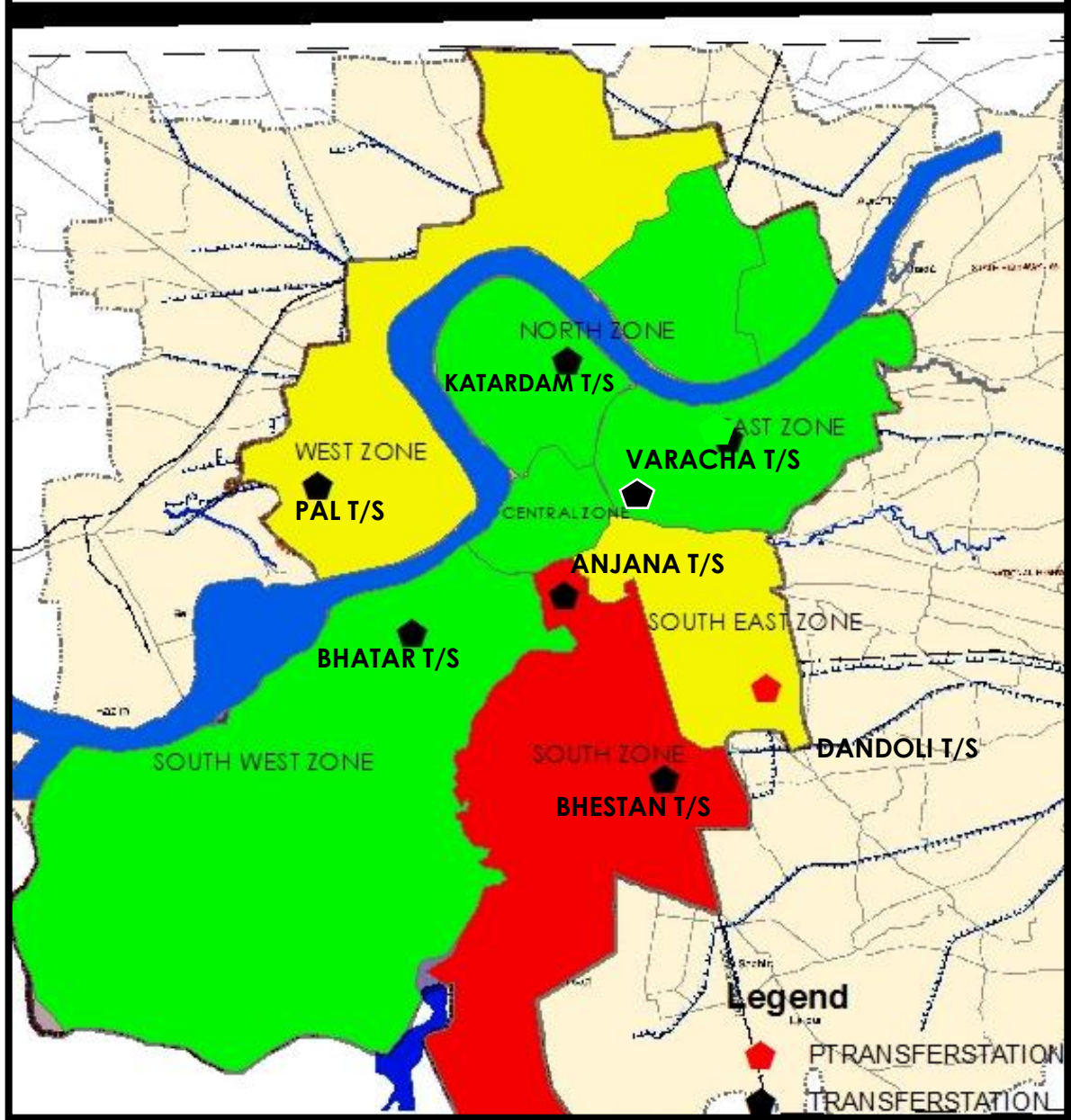
Inert waste (250TPD)

Source – SMC office 2014

EFFICIENCY OF COLLECTION

Efficiency of collection

- South Zone - 60%
- South East Zone & West Zone - 77%
- South West Zone ; North-Central & East Zone - 90%



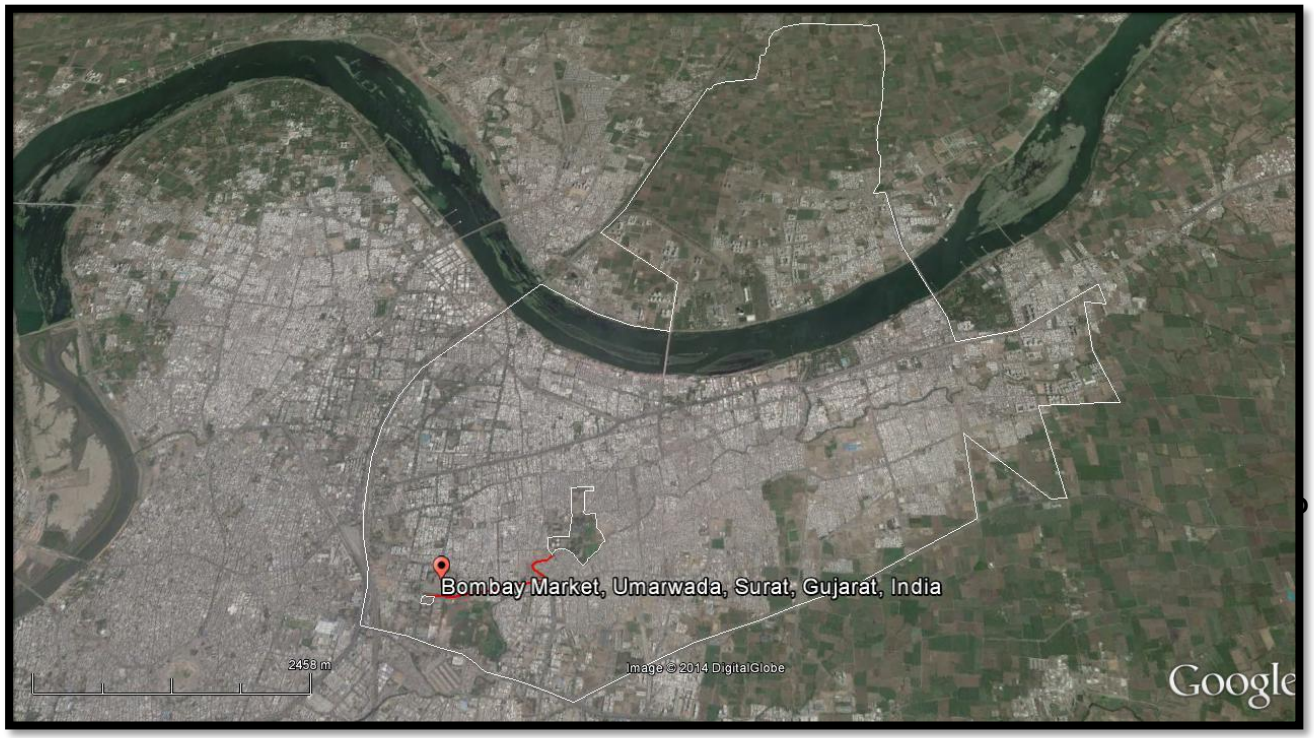
ALTERNATE WAY

Zones	Transfer station	Existing Scenario					Original Capacity of container	Equivalent Weight	Alternate Way	
		Vehicles	Trips	Total Weight	Weight/ vehicle	Volume/vehicle			Vehicles	Trips
South-West	Bhatar	10	5	49 T	0.973 T	1.144 cu. mt	4.5 cu. mt	3.825 T	10 + 3	1
East	Varachha	13	5	159 T	2.45 T	2.88 cu. mt	4.5 cu. mt	3.825 T	13 + 3	3

Transfer Station Zone	Existing			Profit/ year	Capital cost	Cost recovered in years
Bhatar Transfer Station South West Zone	Vehicles	Trips	Expense/day	**13,32,000**	3 @ 2,90,000 = **8,70,000**	1
	10	5	5000			
	Proposal					
	13	1	1300			
	Profit/day		**3700**			
Varacha Transfer Station East Zone	Existing			**4,03,994**	3 @ 2,90,000 = **8,70,000**	3
	Vehicles	Trips	Expense/day			
	13	5	3120			
	Proposal					
	16	3	1998			
	Profit/day		**1122**			

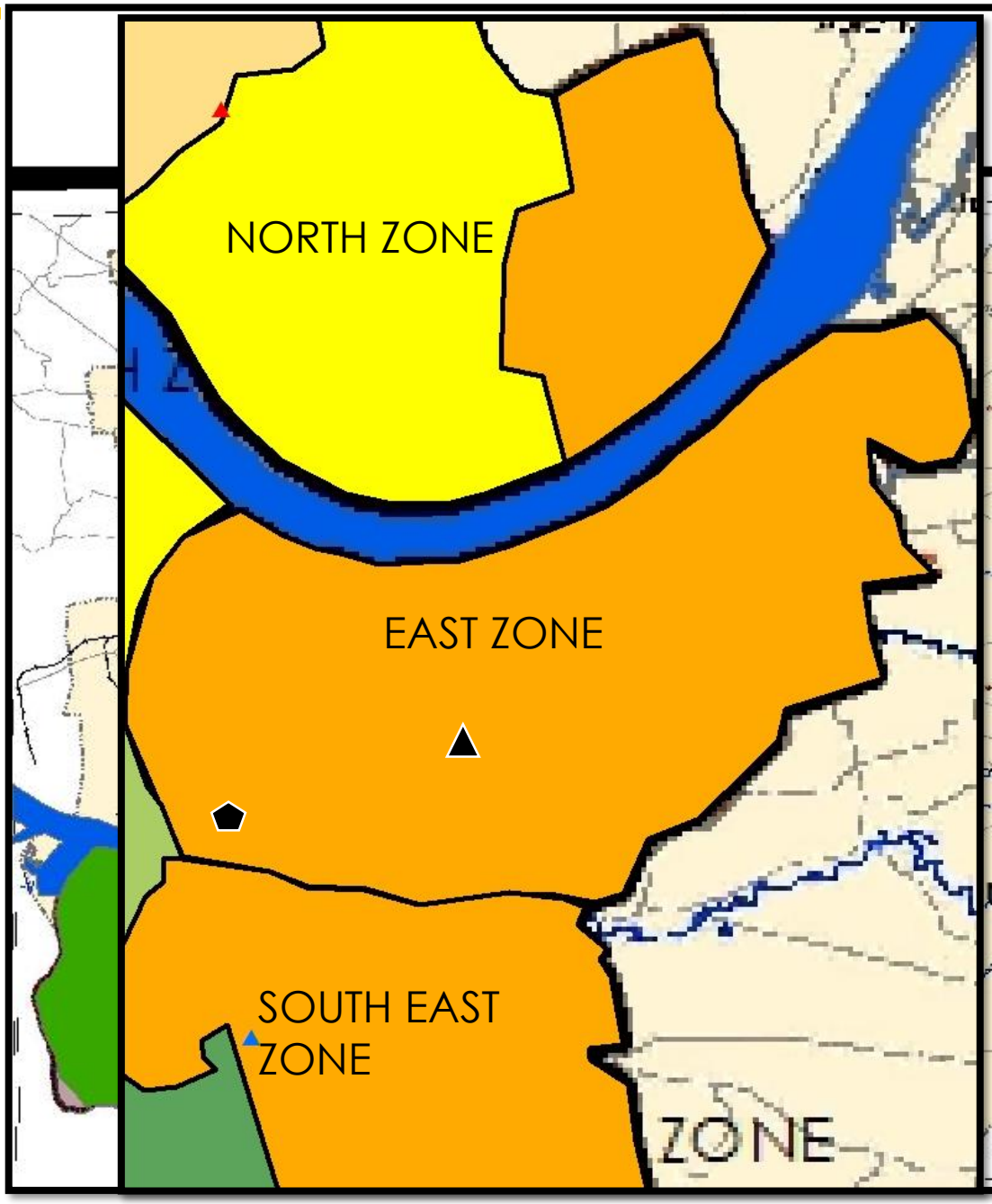
- **Average Total No Of Trips B/W Jan-aug,14 - 677**
- **Average No Of Vehicles Utilised In Same Time - 153**
- **Average No Of Trips Per Vehicle - 5**

PROPOSAL



For the implementation of the proposal East Zone is chosen because—

1. The distance between Transfer Station and STP is about 1.5km
2. The waste generation is maximum in this zone
3. The STP is already being augmented and Transfer Station is under augmentation



COLLECTION MECHANISM

- Population – 11.37lacks
- Per capita generation – 0.35kg
- Total generation- 398 MT
- Total household Wet waste- 173MT
- Total household Dry waste – 46MT
- Hotel Waste – 40MT

Note:-
Paper – 12%
Plastic – 4.12%
Metal – 2.76%
Glass - 2.06%
Hotel waste – 10%

	Trips	Vehicles	Weight (MT)	Situation
Household collection	3	70	219	Existing
Hotel	1	25	40	
	1	1	2	Ideal
HH Wet Waste	2	70	173	Proposal
HH Dry Waste	1	25	46	
Hotel Waste	1	20	40	

DRY WASTE RECYCLING AT MRF

- A materials recovery facility (MRF) is a place where solid wastes are delivered to be separated, processed and stored for later use as raw materials for remanufacturing and reprocessing.
- The main function of the MRF is to maximize the quantity of recyclables processed, while producing materials that will generate the highest possible revenues in the market.

Household Dry waste- 46MT/d
Informal Sector- 26MT/d

Total Dry waste= 72MT/d
= **26280MT/year**

Items	% of Weight can be recovered	Weight can be recovered MT/year
Paper and Card boards	39.4	10354
Plastic	1.3	341.6
Metals	6.4	1682
Glass	2.9	762

Out of the total dry waste, half of the weight is recovered from Paper, Plastic, Metals and Glasses

WET WASTE + SEWAGE SLUDGE TO ENERGY

- **Co-digestion** is a process where energy-rich organic waste materials (e.g. Fats, Oils, and Grease (FOG) and/or food scraps) are added to dairy or wastewater digesters with excess capacity.

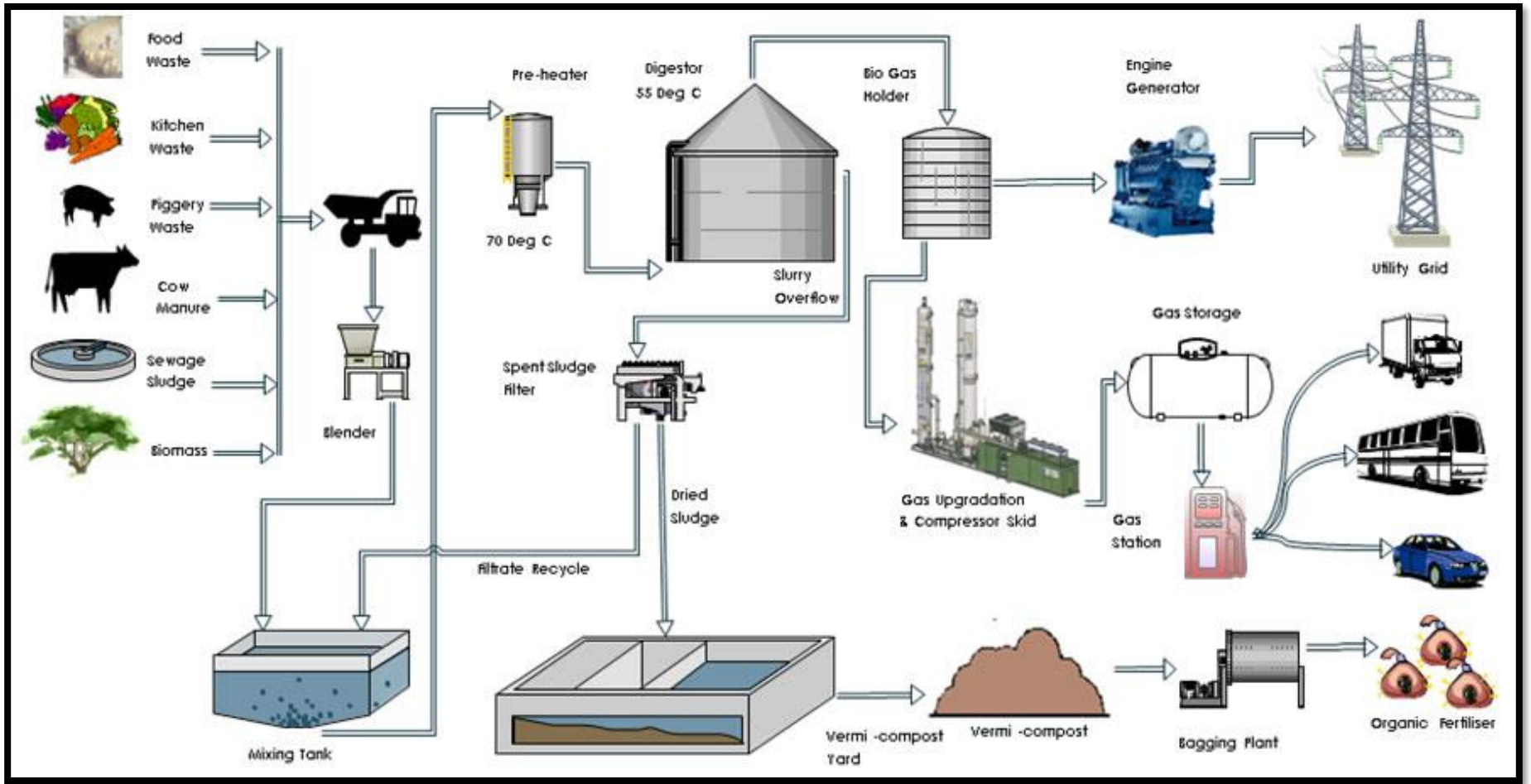
Advantages-

- Diversion of organic waste from landfill to reduce greenhouse gas emission and meet targets set by regulations.
- Increase in biogas production which can be converted into energy to meet the needs of the Anaerobic Digestion system itself, for local use, supply of electricity to the national grid or for biofuel in transportation.
- Additional revenue from sale of surplus energy and digestate
- Improved sludge digestion due to synergistic effects of increased nutrients and improved degradation
- Production of organic fertiliser for agricultural use which results in a reduction in the production of chemical fertilisers.
- Small land area required (most of the structure can be built underground)
- Low to moderate capital costs; low operating costs provided Long service life

WET WASTE + SEWAGE SLUDGE TO ENERGY- FLOW DIAGRAM

Capacity	100MLD	Volume of Sludge	Volume of HH wet waste	Volume of Hotel Waste	Total Volume of Solids to be treated
Treat	80MLD				
Solid	8MLD	8MLD	0.6	0.15	8.75= 9MLD
Water	72MLD				
Power generation	1MW				

- Present quantity of Solids treated – 8MLD
- Under proposed scenario quantity will be – 9MLD
- Power generation will increase



DRY WASTE RECYCLING AT MRF

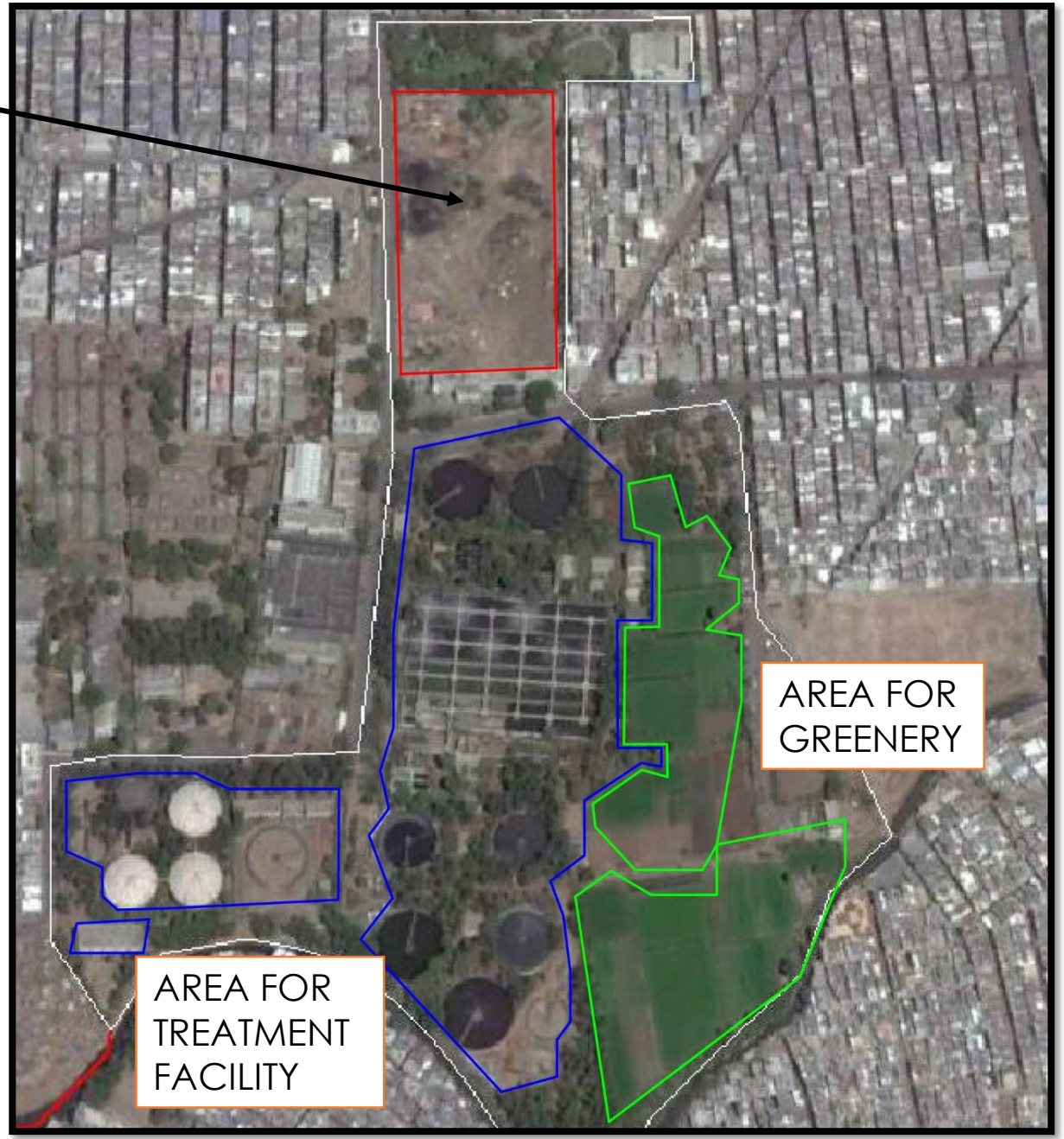
PROPOSED AREA FOR SETTING UP MRF & TREATMENT PLANT

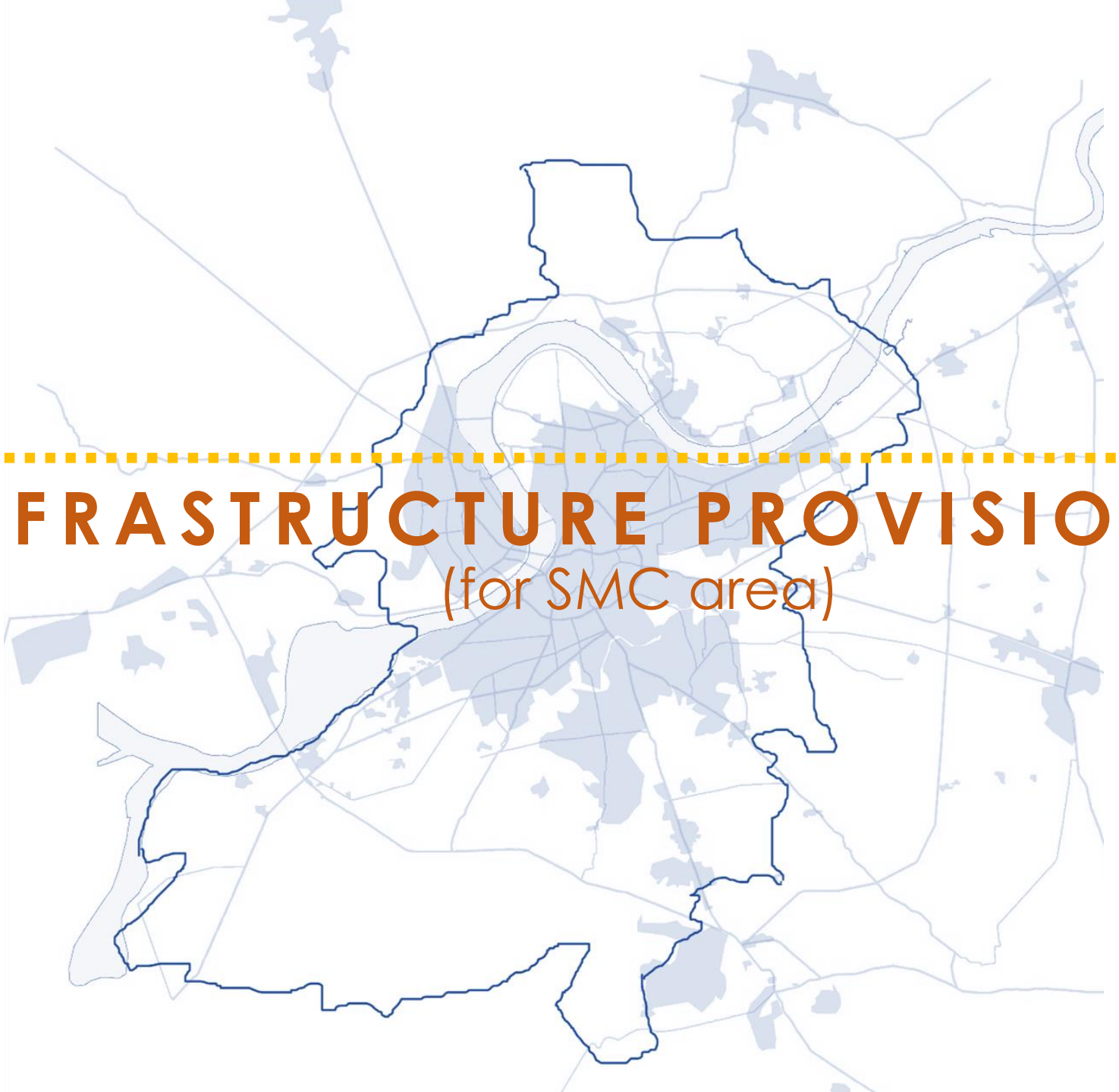
- The area marked with Red has a total area of 16416sqmt
- So the land can be well utilized for setting up MRF as well as Treatment Plant

- To recycle 76MT/day we need a medium size MRF

It requires a land area of about 1900sqmt

- And also the treatment plant can be setup within 5000sqmt





INFRASTRUCTURE PROVISIONING

(for SMC area)

WATER SUPPLY

WATER SUPPLY

ASSMENT..

Concept

River Tapi

Inlet Water Works

Treatment

Water Distribution

Distribution Network

Urban & Slums

SERVICE

Institutional Assessment

NRW

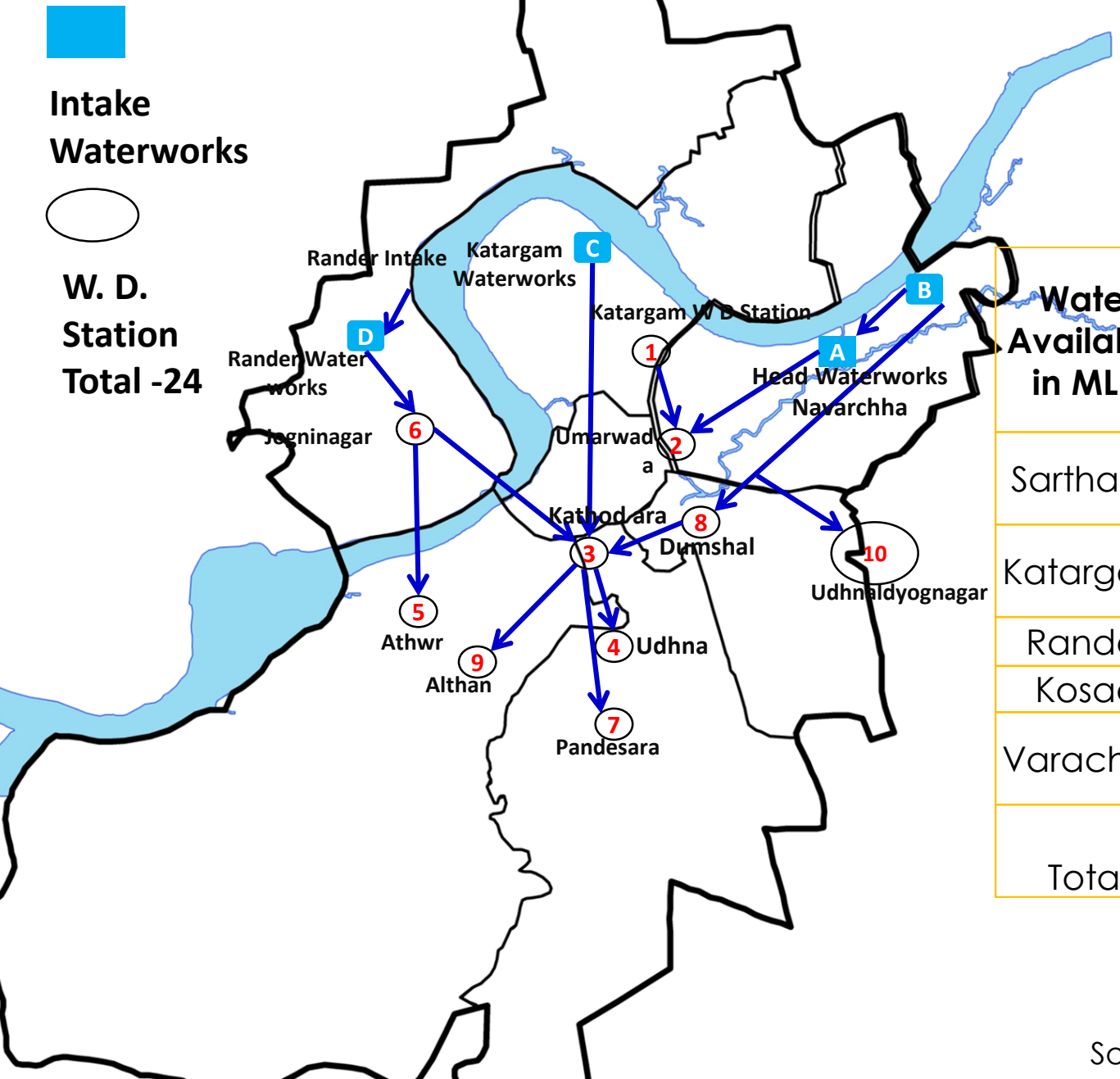
USER END

O & M

Complaint Redressal

WATER SUPPLY

Inlet Water Works



Surface Water Source

Water Available in MLD	Installed Capacity MLD	Yield MLD	% yield
Sarthana	600	375	62.5
Katargam	503	350	69.58
Rander	360	190	52.78
Kosad	90	15	16.67
Varachha	68	50	73.53
Total	1621	980	641 MLD

Ground Water Source

- Total 125 borewells existing
- 100 Proposed
- 60 completed

Source : SMC Hydraulic Department

Water Supply

Water Treatment Plant

Varachha

68 MLD

Katargam (1997)

120 MLD → 240 MLD

Sarthana (2000)

120 MLD

Rander (2003)

200 MLD

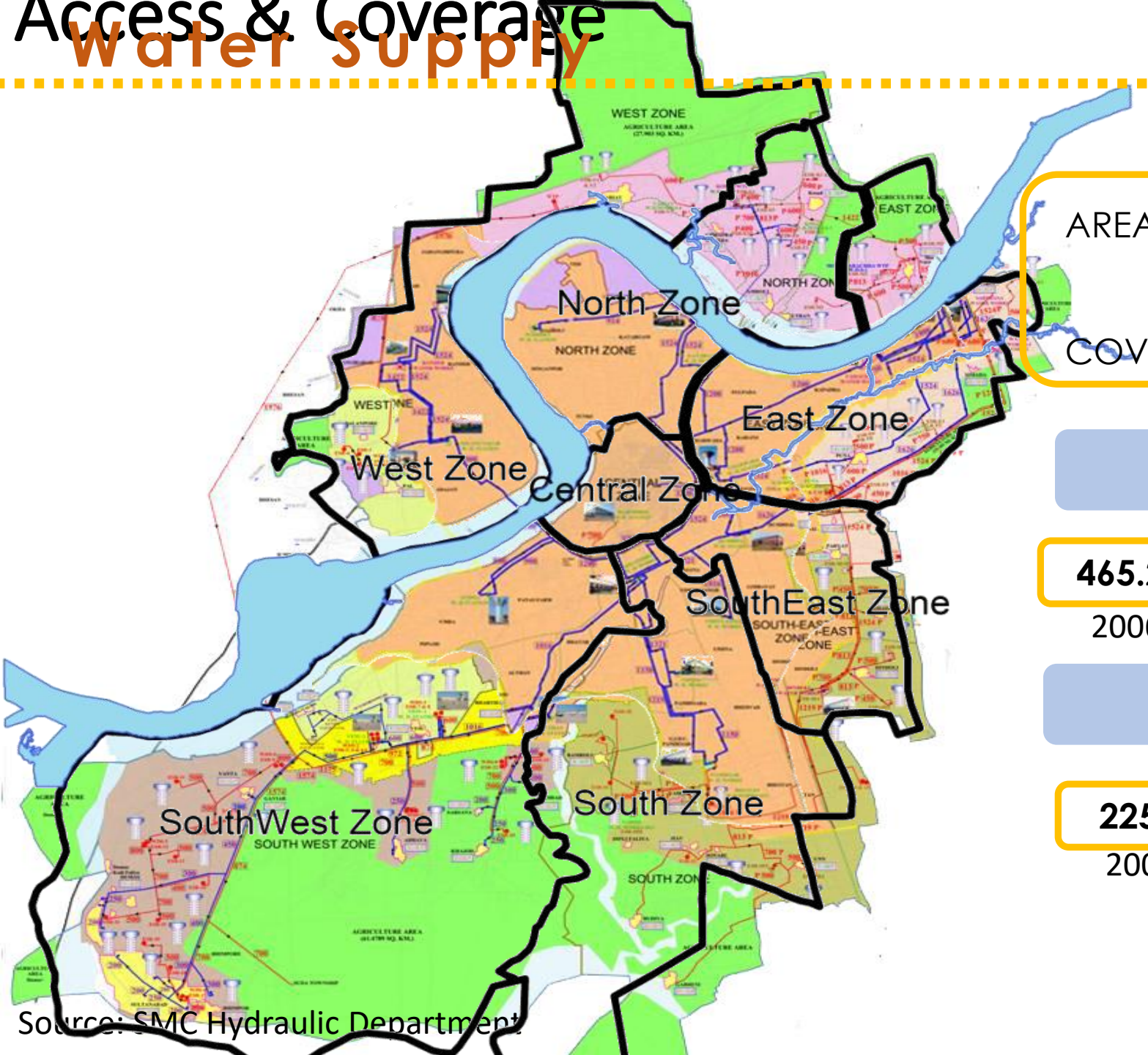
Kosad

98 MLD

Total- 1268 MLD

Access & Coverage

Water Supply



Source: SMC Hydraulic Department

AREA	112.28 sq. Km.	326.51 sq. Km.
COVERAGE	98%	75%

Storage (ESR & UGSR) ml

2006	2013	2015
465.2	747.1	825.3

Pipeline (Km.)

2006	2013	2015
2250	3030	3350

Source : SMC Hydraulic Department

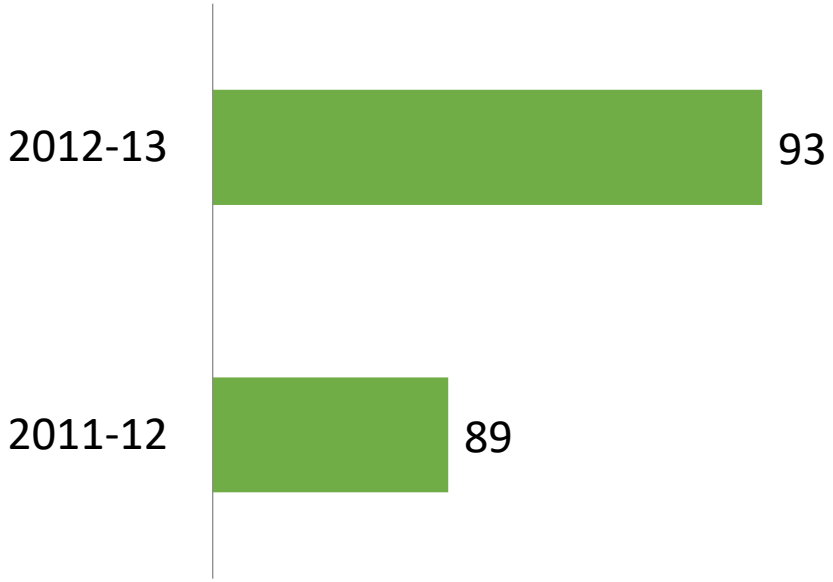
WATER SUPPLY

Service Level Benchmarks

Access & Coverage

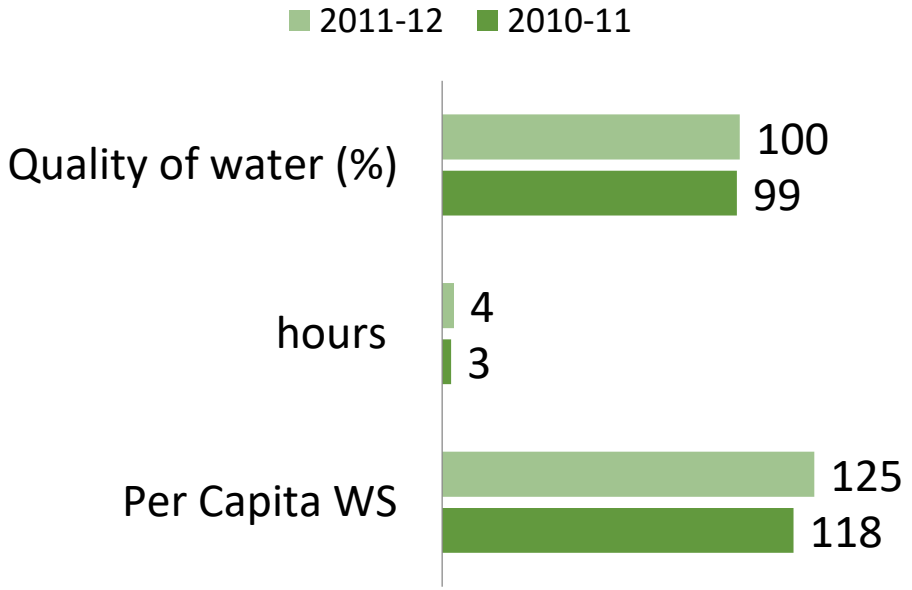
Service Levels & Quality

WS Coverage



1 connection is serving more than 1 HH

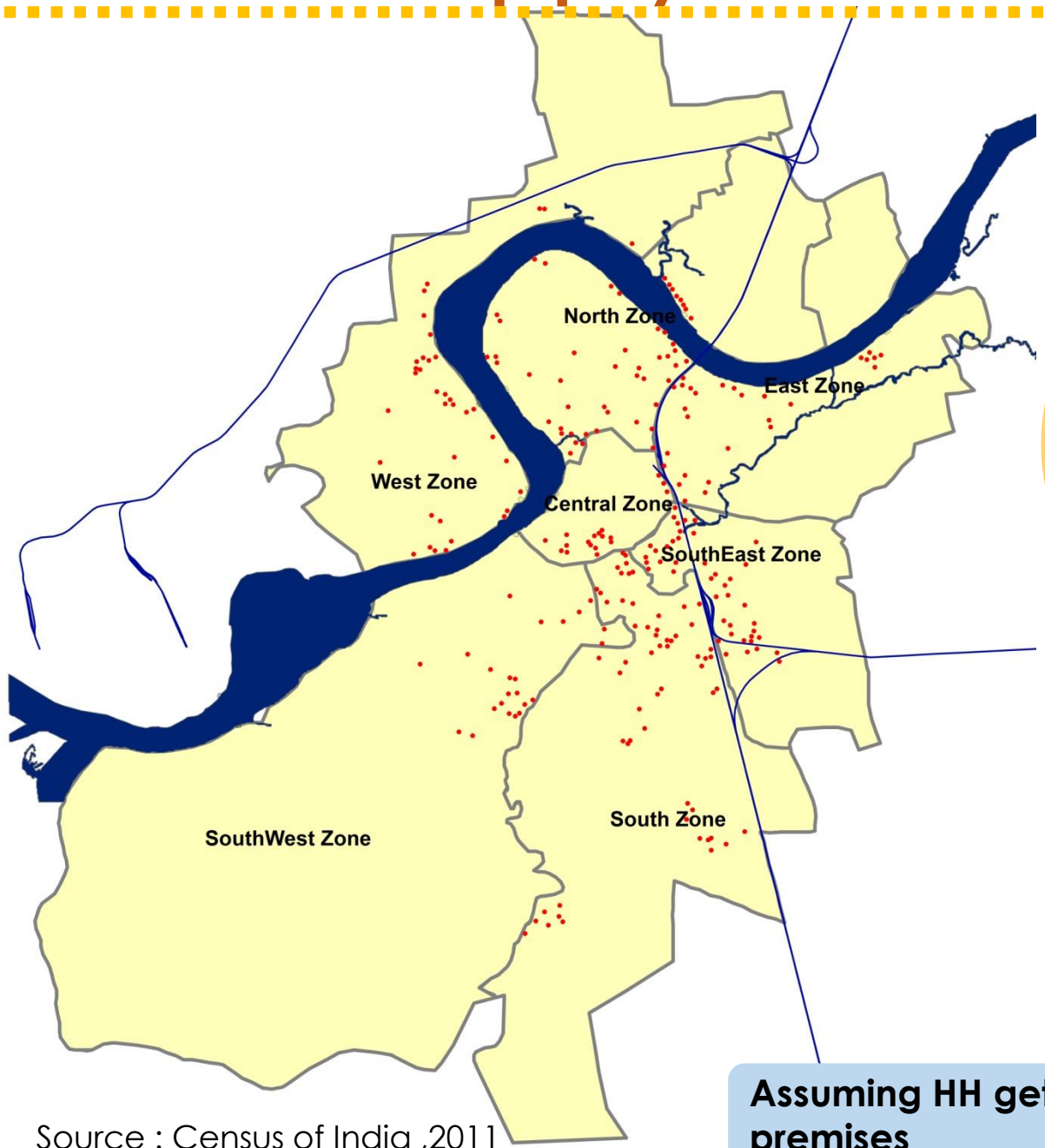
Service Levels & Quality



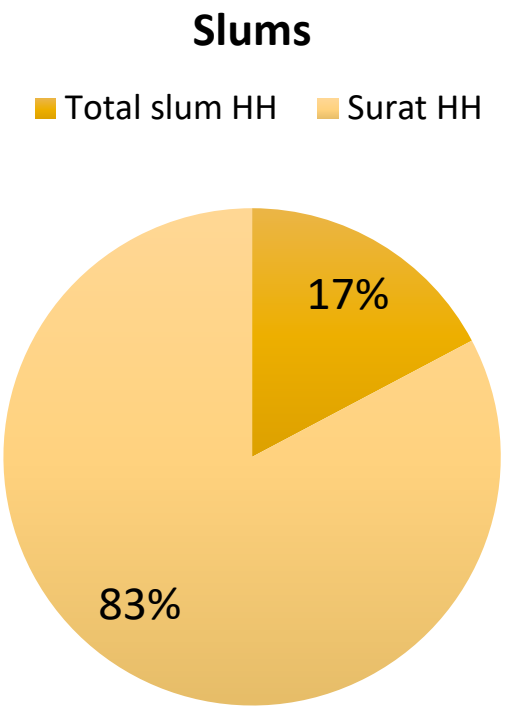
Source : PAS

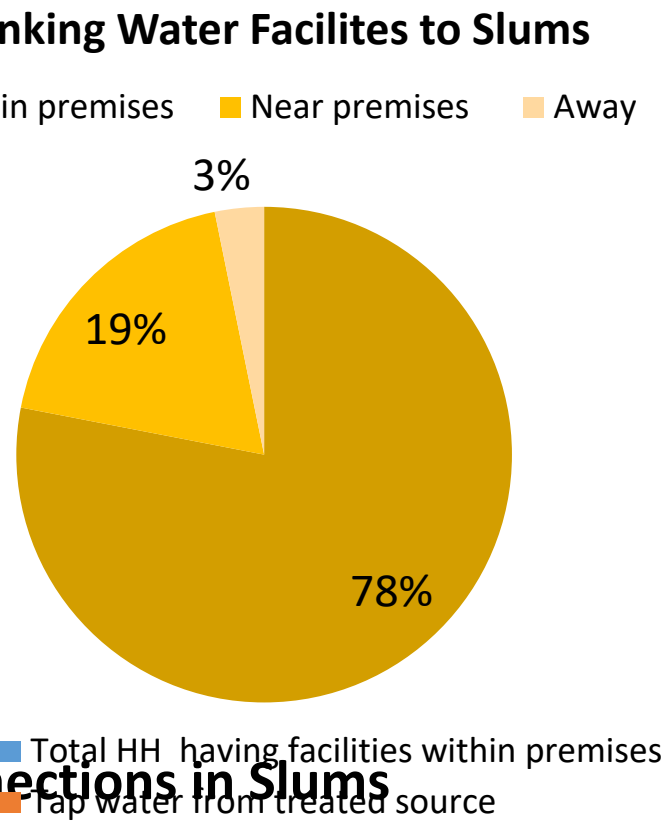
Water Supply

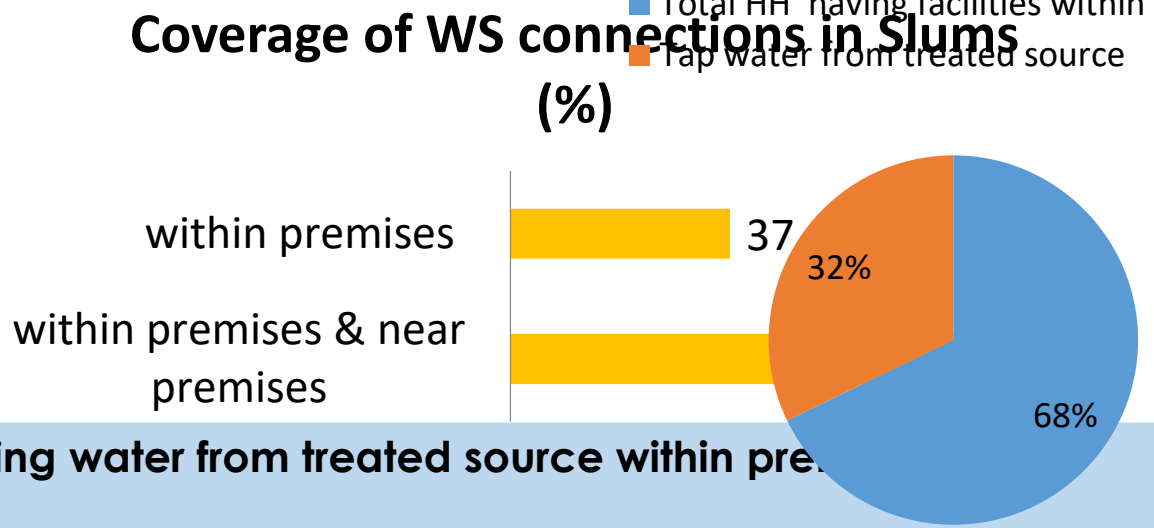
Equity in Service Delivery



Source : Census of India ,2011







Assuming HH getting water from treated source within pre… premises

WATER SUPPLY

Efficiency in Service Operations

Service

Corporation has given annual contracts to private agencies for

- Operation & Maintenance of Water Treatment Plants.
- Operation & Maintenance of Water Distribution Stations.
- Valve operation in the different parts of the city.
- Collection of water samples during the water supply period.
- Housekeeping of Water Works & Water Distribution Stations

User End

COMPLAINT MANAGEMENT SYSTEM

1

CONVENTIONAL Approach

- SMC office
- Zone office

2

SMART Approach

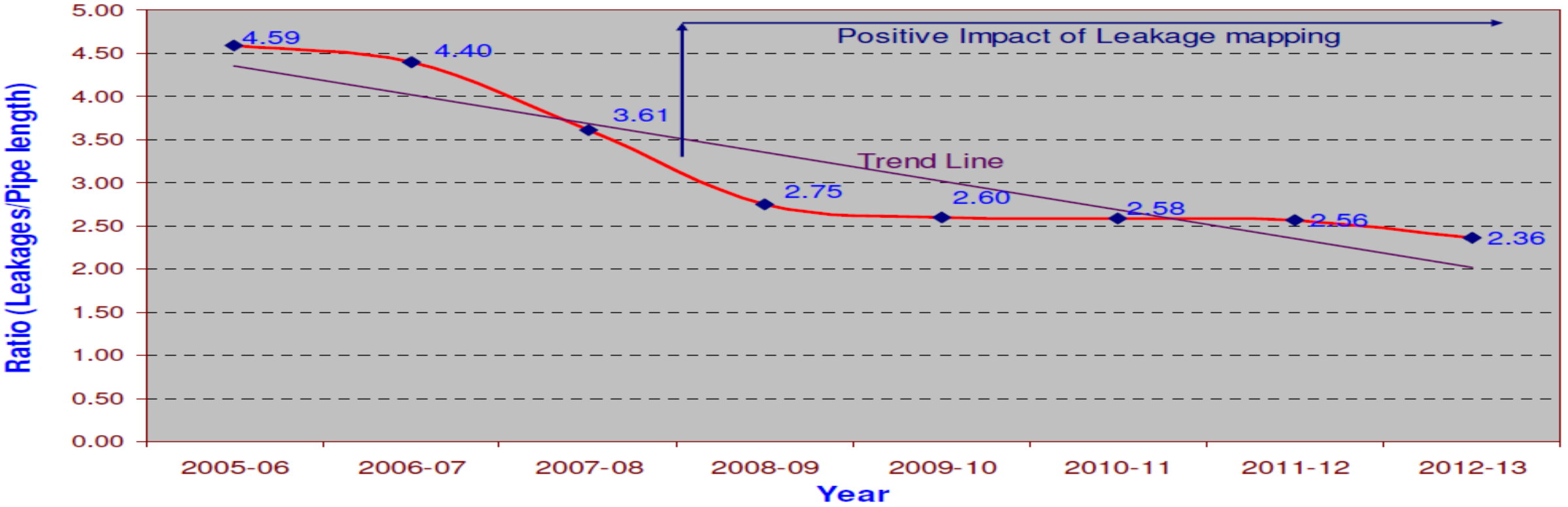
- online
- Helpline No.
- Watsapp

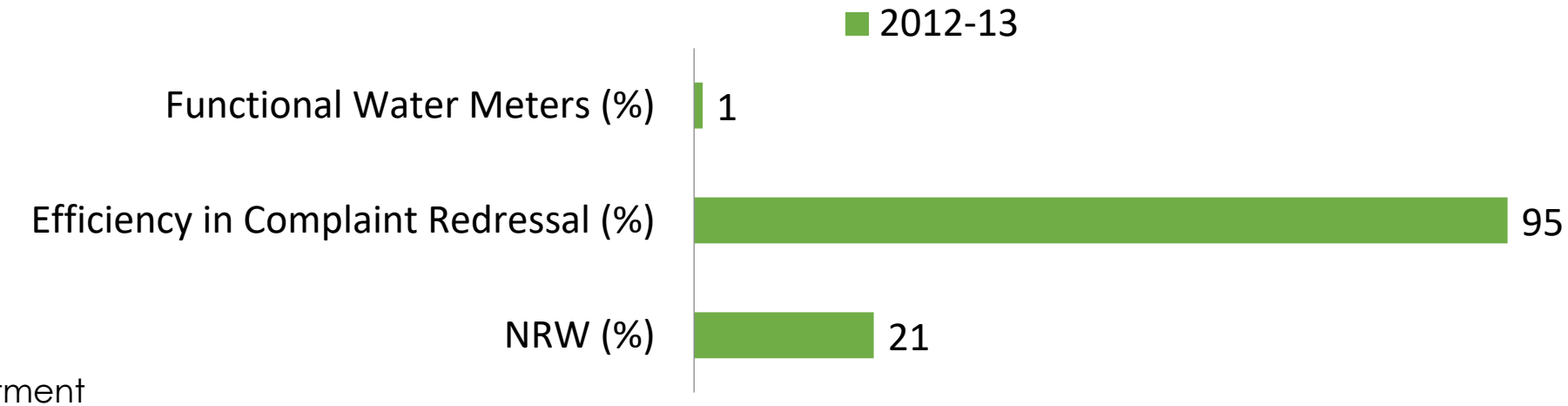
Complaints are directly assigned to concerned employee on his mobile phone by Complaint Management System, which are **tracked, reviewed and replied within 48 hours in most cases.**

Source : SMC Hydraulic Department

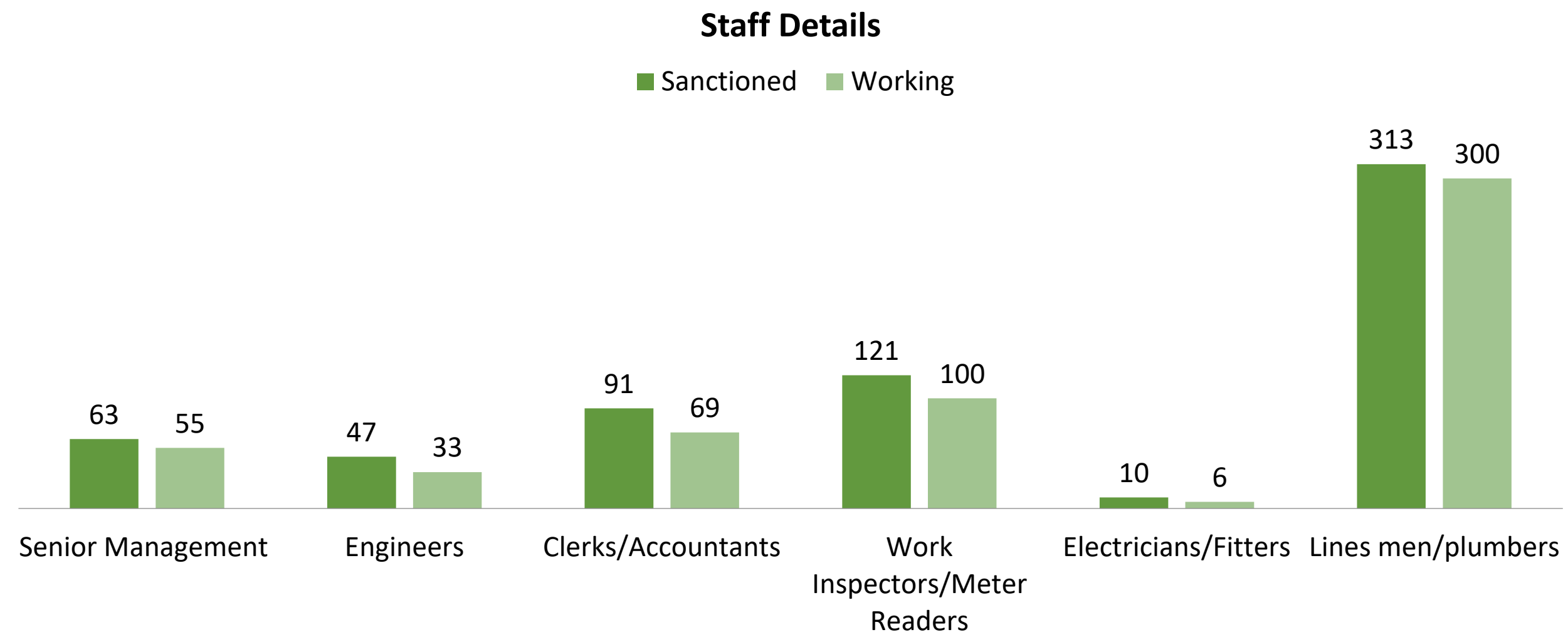
WATER SUPPLY

Efficiency in Service Operations





Source : PAS, SMC Hydraulic Department

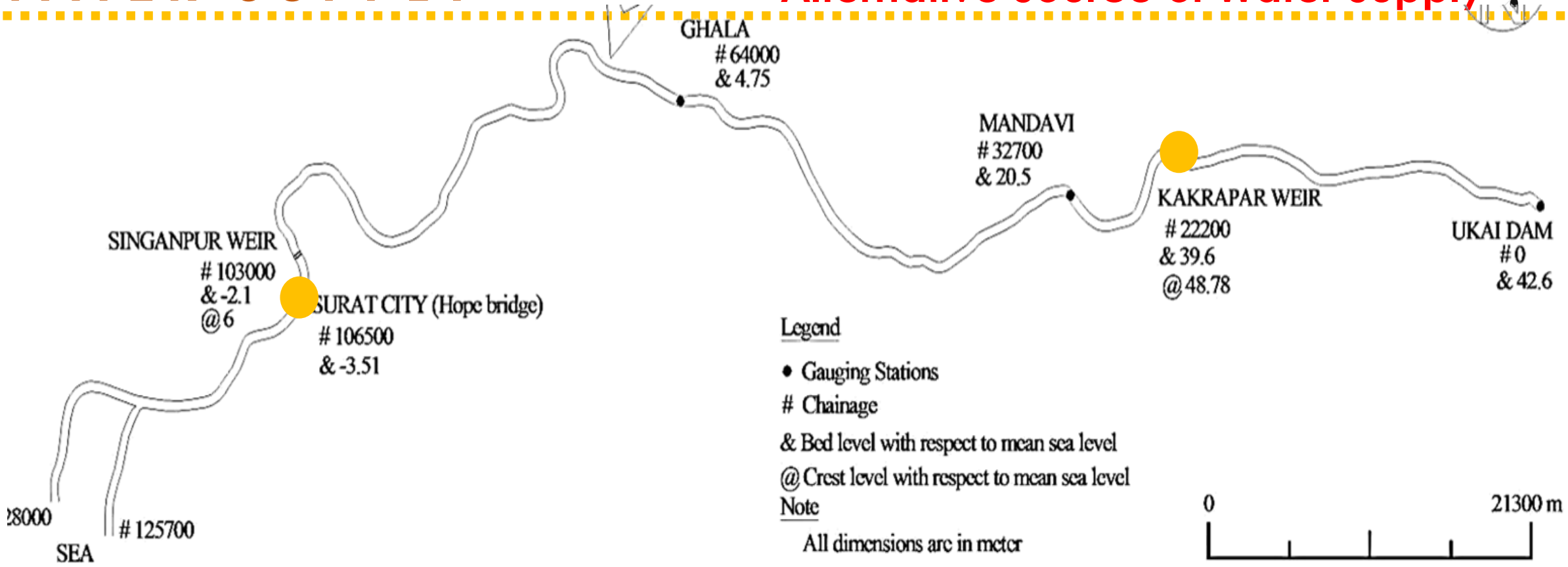


Gap is constant since many years

Source : PAS

WATER SUPPLY

Alternative Source of Water Supply

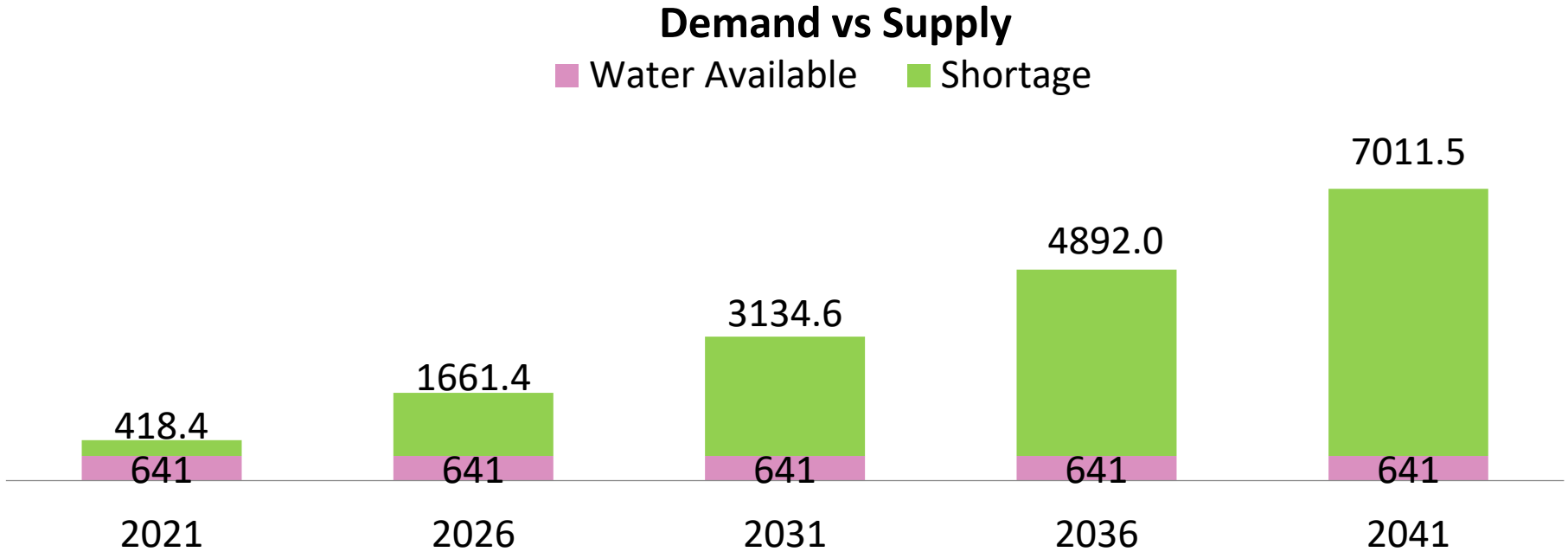


To create an alternate source of water, three options are being actively considered:

- Laying of pipeline from Kakrapar to Surat
- Constructing 2 new French wells
- Construction of Balloon Barrage

Source : SMC Hydraulic Department

WATER SUPPLY



There is increase in demand of water in coming years . And w.r.t. available resources there will be big gap between demand & supply of water

Issues

- Providing Resources for the future.
- 100% coverage of water supply
- Inequity in service delivery (slums 37% coverage)
- Laying pipelines from Kakrapar can affect the finances of Surat

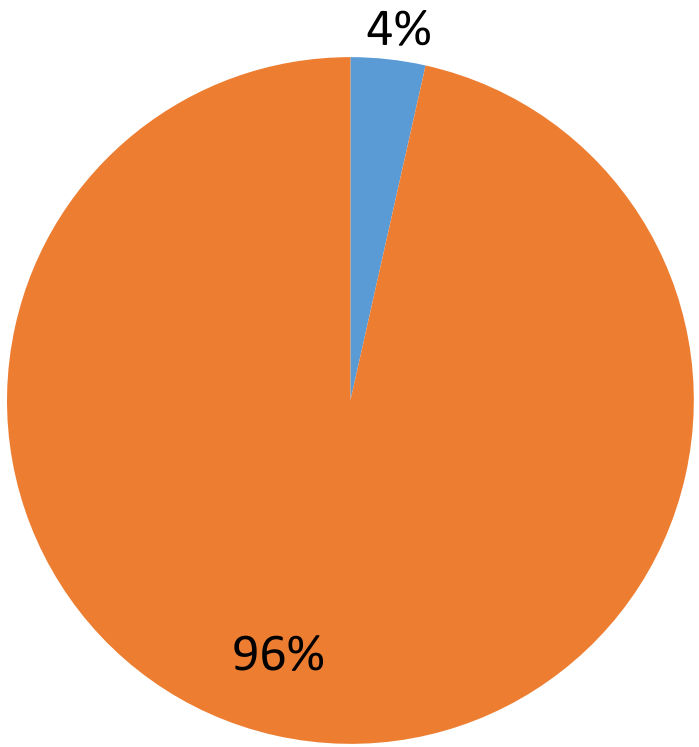
STRATEGIES

- Water Conservation
  - Rain water Recharging & Harvesting
- Equity in service Delivery
  - Providing water from treated source , 100% coverage
- Financial Assessment of alternative source
  - Laying of 58 km long pipelines

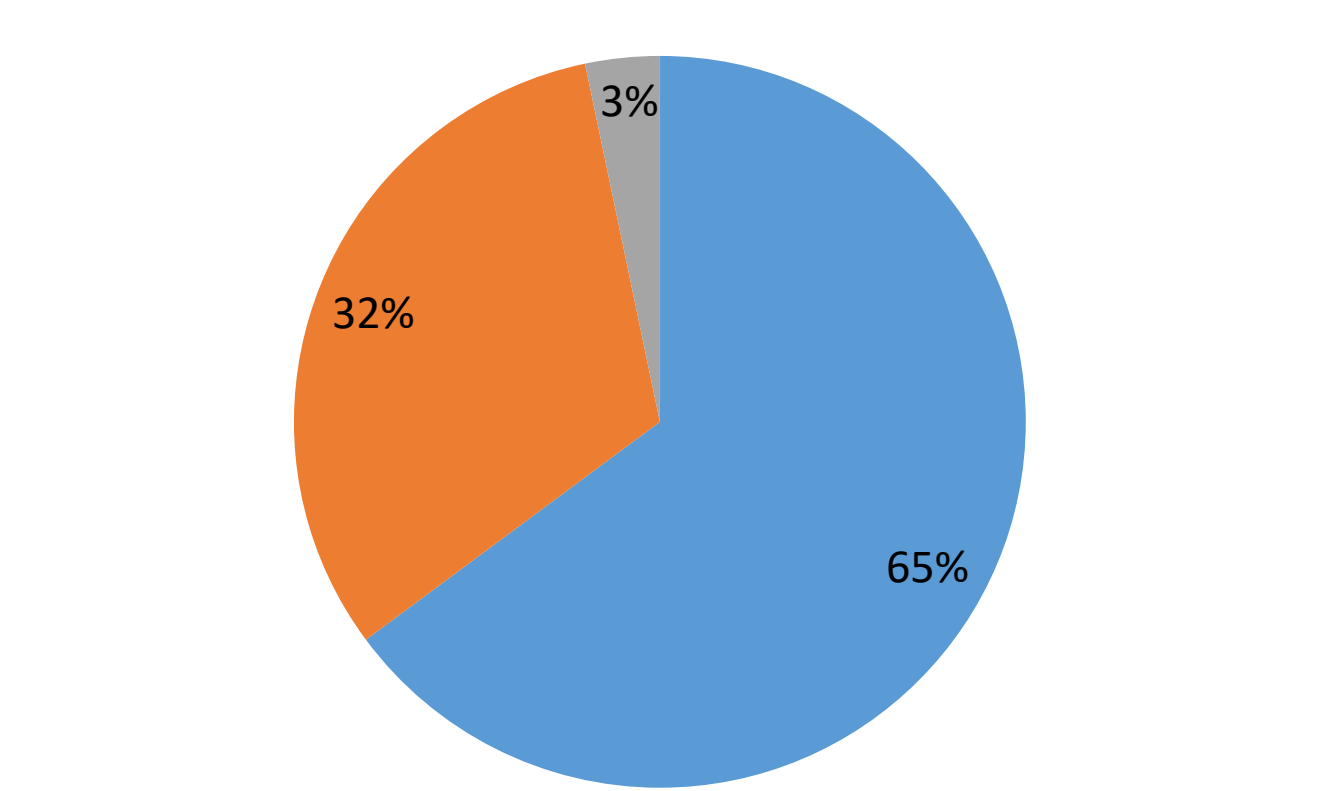
Proposal

Equity in Service Delivery

Slums



Drinking water facility

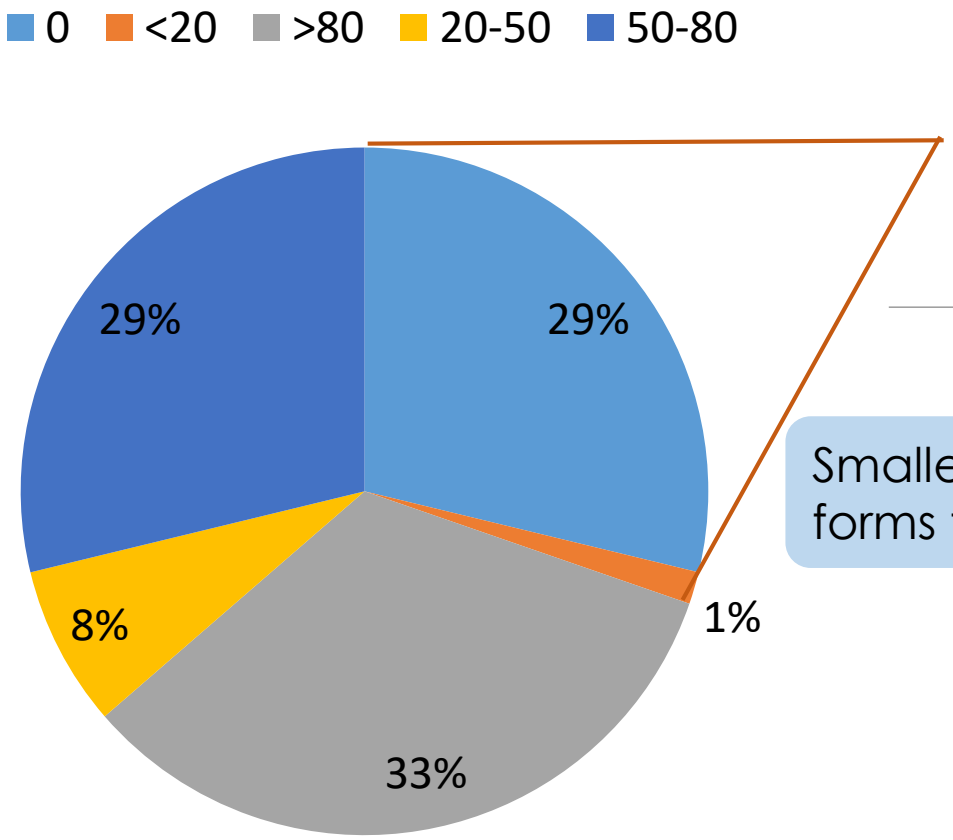


Source : Ws Department , West Zone Office , Surat , 2014

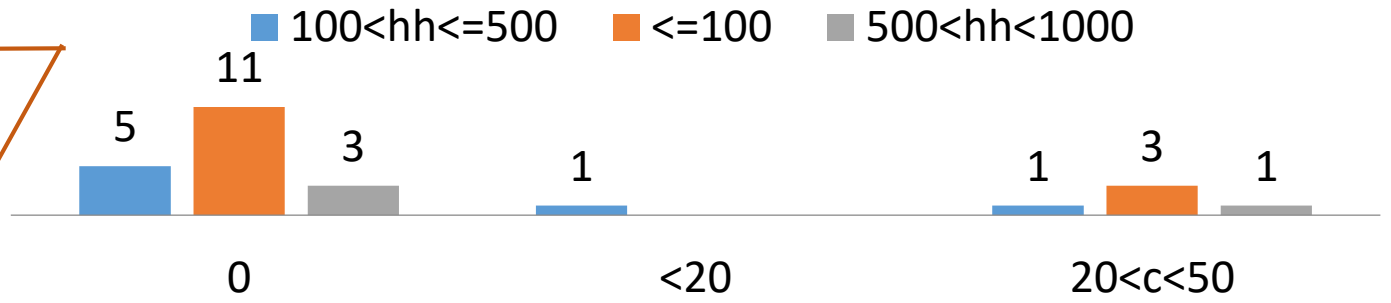
Proposal

Analysis

% coverage of Individual Connection

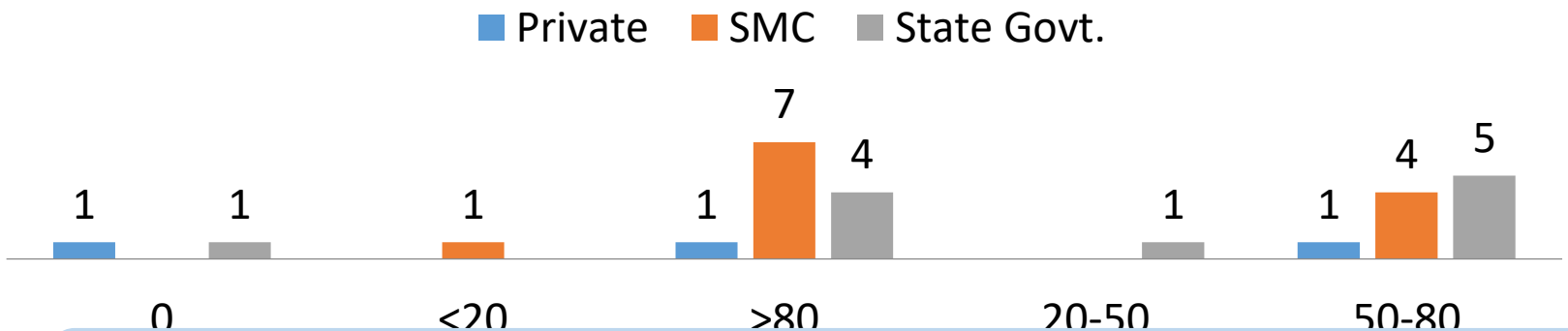


% Coverage of individual connections as per hh size



Smaller slum pockets with HH size of 100, & the newly formed slums forms the major chunk with no individual water supply facility.

Ws coverage as per land ownership

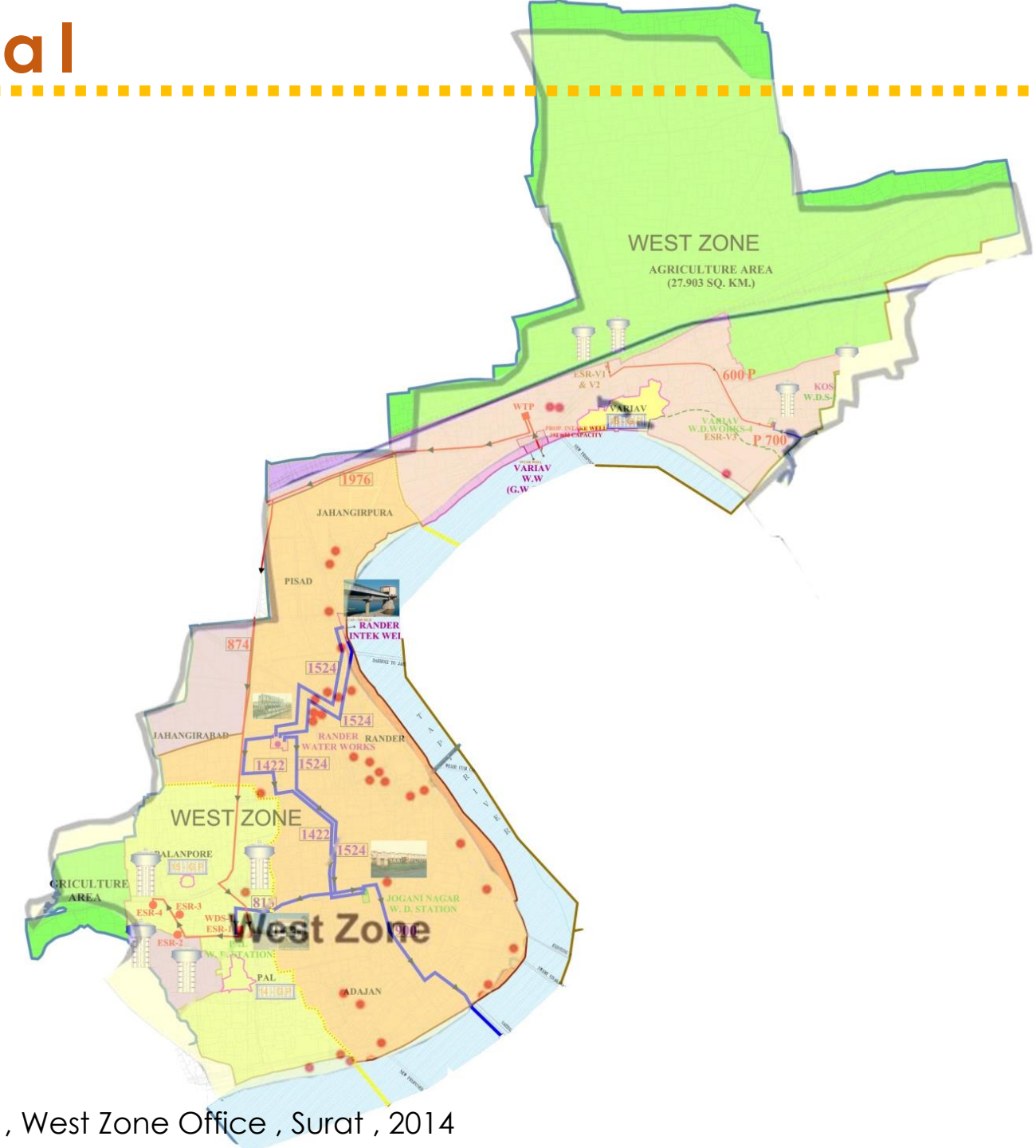


Slum pockets under SMC have good coverage of ws connections & one with no ownership /new slums have no individual water supply connections

Source : Ws Department , West Zone Office , Surat , 2014

Proposal

Slum Location



Source : Ws Department , West Zone Office , Surat , 2014

Water Supply

Iqbalnagar

No. of HH- 823
Land Tenure- State Govt.
No. of Individual water conn. – 0
No. of Standpost - 1

Source : Google earth, 2014

Water Supply

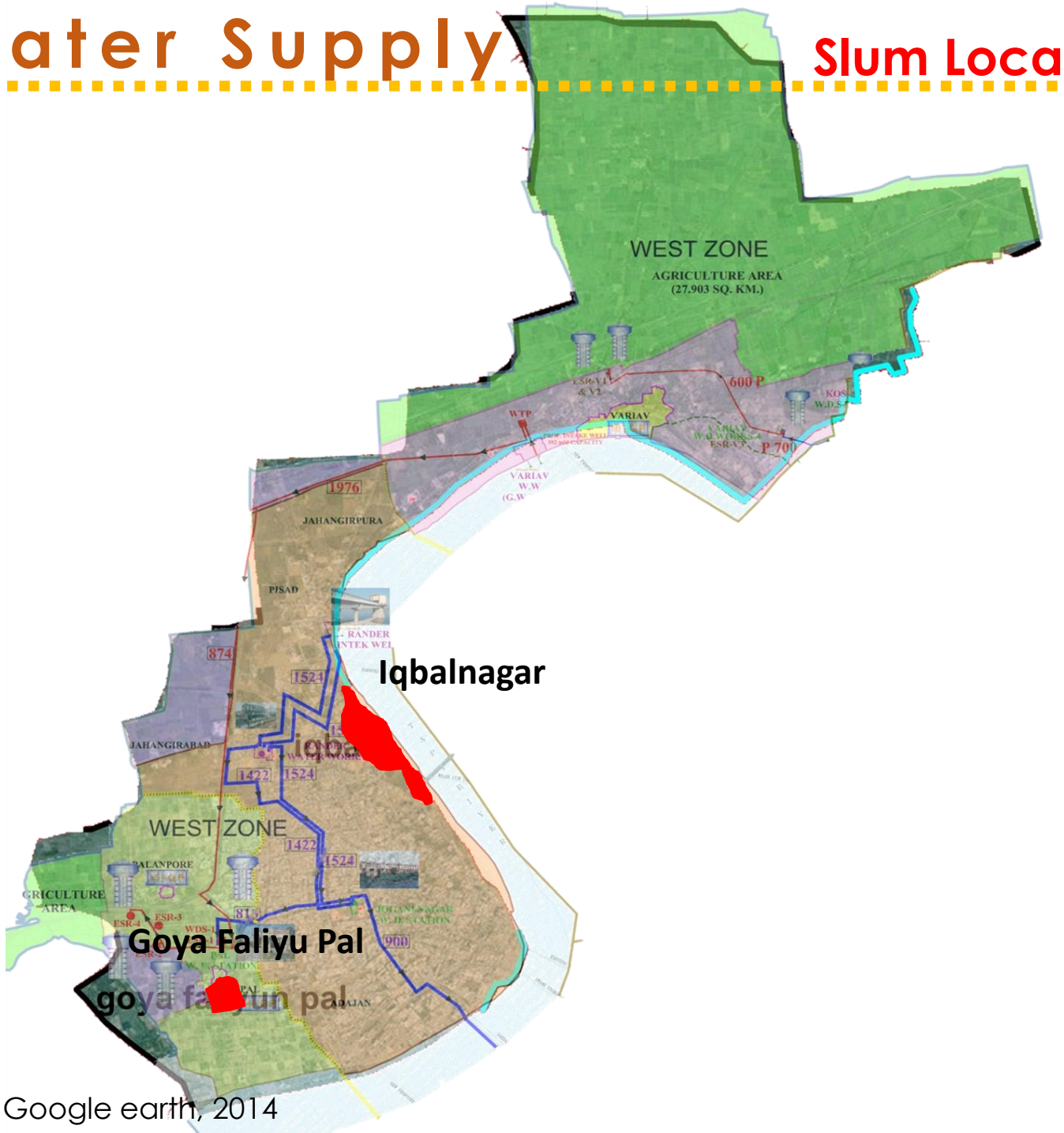
Goya Faliyu Pal

No. of HH- 25
Land Tenure- Na
No. of Individual water conn. – 0
No. of Standpost – 0
Source of water- water tanks (SMC)

Source : Google earth, 2014

Water Supply

Slum Location & water supply Network



Source : Google earth, 2014

Equity in Service Delivery

Model 1

Iqbalnagar

No. of HH- 823
Length of pipe from main supply line till society- 720 m & Cost= Rs. 17.85 lacs
Length of internal network of w.s. Pipeline- 5 km & cost= Rs. 25 1.04 cr
Cost of providing individual conn- Rs.24.70 lacs
Total cost - Rs. 1.50 cr
Cost / hh= Rs. 18,000/-

Main ws line

150 mm ws line from main line to slum entrance

100 mm ws internal network

Source : Google earth, 2014

Water Supply

Model 2

Iqbalnagar

No. of HH- 823
Length of pipe from main supply line till society- 720 m & Cost= Rs. 17.85 lacs
Length of internal network of w.s. Pipeline- 5 km & cost= Rs. 25 1.04 cr
Cost of providing individual conn- Rs.24.70 lacs
Storage reservoir – 3m stagging , 25 lacs liters
Sump - 50,000 liters
Total cost - Rs. 2.19 cr
Cost / hh= Rs. 26,626/-

Storage Reservoir (25 lacs. lit)

Main ws line

150 mm ws line from main line to slum entrance

100 mm ws internal network

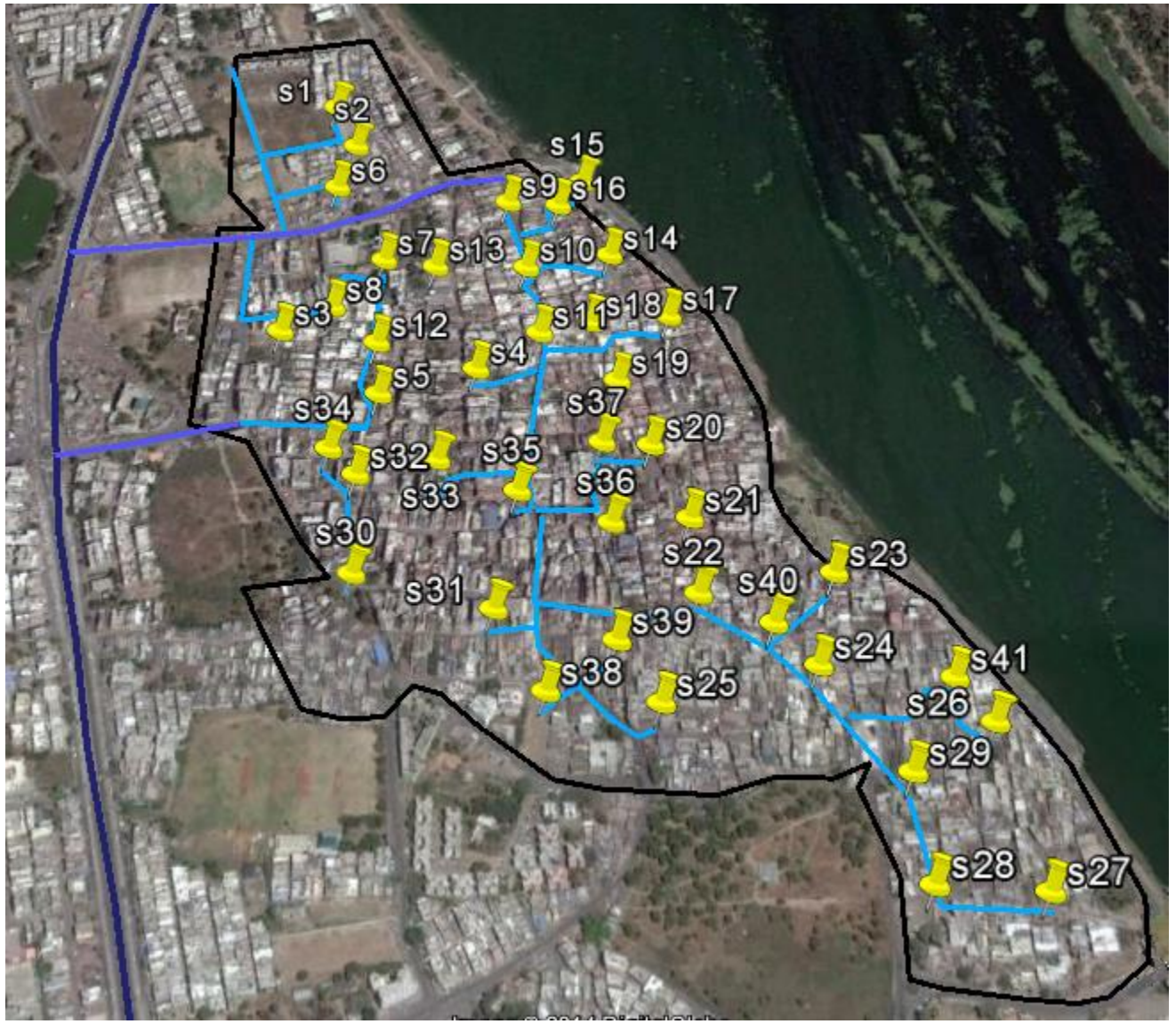
Source : Google earth, 2014

Water Supply

Model 3

Iqbalnagar

No. of HH- 823
Stand post – 41 (1 stand post for 100 person)
Total cost - Rs. 99,34,650
Cost / hh= Rs. 12,071/-



Main ws line

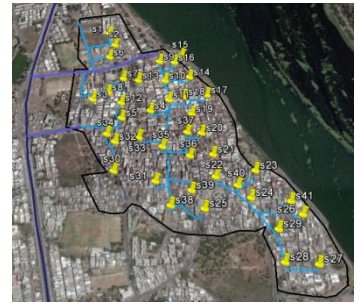
150 mm ws line from main line to slum entrance

100 mm ws internal network

Source : Google earth, 2014

Water Supply

Models Comparison

	Model 1	Model 2	Model 3
			
Description	w.s. directly from main w.s line along tp road	24x 7 w.s. (reservoir)	w.s. through stand post
Total Cost (Rs.)	1,50,00,000	2,19,13,200	99,34,650
Cost (cost/hh) (Rs.)	18,226	26,626	12,071
Advantage	convenient	24x 7 water supply to HH	Cost effective
Disadvantage	w.S will be limited to supplied hours only	Will be costly	Inconvenience to people

Water Supply

Model 2

Goya Faliyu Pal

No. of HH- 55
Length of pipe from main ws line till slum entry - 1.1 km & Cost= Rs. 27.50 lacs.
No. Of Stand post = 3 (1 stand post for 100 pop.)
Stand post = Rs. 5000/-
Approx. – Rs. 30 lacs.

Source : Google earth, 2014

Water Supply

Budget Allocation Assessment

West Zone						
	Total hh	**total cost**	**Cost/hh**	**Total**	**Budget Allocation**	**Gap**
Model 1	18164	15000000	18226	331057108	98140000	-232917108
Model 2	18164	9934650	12071.26	219262433	98140000	-121122433
Model 3	18164	21913200	26626	483634708	98140000	-385494708

Ws budget- Rs.**98,14,00** ,000
10% of w.s. for slums=Rs. 9,81,40,000

Budget Allocated by Surat is not able to serve even 1 zone

Proposal

Funds for slums water supply

Slums Up gradation

Grants	**Rajeev Awas Yojana**
Budget Allocation	**10% of budget**
Beneficiary Participants	**Slum Networking**

Slums not to be formed in future

Policies	• Providing individual water connections not shared •Allocating estimated future infrastructure shortage for urban poor amongst prospective suppliers of Urban Poor services. •Encouraging Government of India schemes.

Proposal

Funds for slums water supply

	GoI	GoG	ULB	Beneficiary	
Schemes at National level					
Rajiv Awas Yojana	50%	28%	10%	12%	Housing
	50%	28%	22%	0%	Infrastructure
Basic service for urban poor (BSUP)	50%	25%	10%	15%	Housing
	50%	25%	25%	0%	Infrastructure
Schemes adopted by Surat					
EWS Housing Scheme	9%	-	9%	82% (thru loan)	
VAMBAY Housing	100%	-	-	-	
LIG Housing Scheme				100% (thru loan)	
JNNURM	50%	20%	30%	-	
Schemes at ward level can be adopted					
Slum Networking	-	-	80%	20%	

WASTE WATER & SANITATION

SERVICE LEVEL OF SURAT

Top 15 cities:

Overall Service Index	Water Supply Index	Wastewater Management Index	Solid waste management Index	Storm Water Drainage Index
Navi Mumbai (Mah.)	Malkapur NP (Mah.)	Nashik (Mah.)	Mahilpur (Punj.)	Bhagur (Mah.)
Nashik (Mah.)	Navi Mumbai (Mah.)	Pimpri Chinchwad (Mah.)	Ghanaur (Punj.)	Janjgir naila (Chgrh.)
Shornur (Ker.)	Bhawanigarh (Punj.)	Surat (Guj.)	Lalru (Punj.)	Jagdalpur (Chgrh.)
Surat (Guj.)	Muvattupuzha (Ker.)	Navi Mumbai (Mah.)	Bhawanigarh (Punj.)	Berhampore (WB)
Vadodara (Guj.)	Neyyattinkara (Ker.)	Gandhinagar (Guj.)	Nashik (Mah.)	Thane (Mah.)
Pune (Mah.)	Shornur (Ker.)	Vadodara (Guj.)	Fazilka (Punj.)	Rajnandgaon (Chgrh.)
Ahmedabad (Guj.)	Thiruvananthapuram (Ker.)	SAS Nagar (Punj.)	Jalalabad (Punj.)	Dhamtari (Chgrh.)
SAS Nagar (Punj.)	Patiala (Punj.)	Ahmedabad (Guj.)	Muktar Sahib (Punj.)	Bhattapara (Chgrh.)
Ambarnath (Mah.)	Barnala (Punj.)	Rajkot (Guj.)	Malerkotla (Punj.)	Jashpurnagar (Chgrh.)
Karnal (Har.)	Kalamassery (Ker.)	Vrindavan (UP)	Rayya (Punj.)	Ambikapur (Chgrh.)
Mumbai (Mah.)	Kalpeta (Ker.)	Pune (Mah.)	Shornur (Ker.)	Garulia (WB)
Anandpur Sahib (Punj.)	SAS Nagar (Punj.)	Ambarnath (Mah.)	Batala (Punj.)	Kulti (WB)
Faridabad (Har.)	Angamaly (Ker.)	Faridabad (Har.)	Tarn Taran (Punj.)	Champdany (WB)
Kanpur (UP)	Chalakudy (Ker.)	Mahabaleshwar (Mah.)	Kodungallur (Ker.)	Kawardha (Chgrh.)
Mahabaleshwar (Mah.)	Ambarnath (Mah.)	Panchkula (Har.)	Ahmedabad (Guj.)	Konnagar (WB)

Source: City Ranking on Service Levels by PAS, CEPT University (1100 cities)

NUSP RATING OF SURAT

NUSP Ratings					
	City	**Total**	**Output**	**Process**	**Outcome**
1	Chandigarh	73.48	36.25	21.08	16.15
2	Mysore	70.65	33.08	25.07	12.50
3	Surat	69.08	29.75	23.83	15.49
4	N.D.M.C.	68.26	36	19.71	12.55
5	Delhi Cantt.	61.36	30.75	19.41	11.20
9	Rajkot	56.11	21.833	21.52	12.76
19	Ahmedabad	51.29	21.16	21.16	8.96

No.	Category	Description	Points
1	Red	Cities needing immediate remedial action	< 33
2	Black	Needing considerable improvement	34-66
3	Blue	Recovering	67-90
4	Green	Healthy and clean city	91-100

Source: NUSP, Rating of Cities 2010

Indicators of Sewerage		
Output Related	Points (50)	Surat
A) No open defecation	16	
i) Access and use of toilets by urban poor and other un served households (including slums) individual and community sanitation facilities	4	0
ii) Access and use of toilets for floating and institutional populations -adequate public sanitation facilities	4	4
iii) Open defecation visible	4	1
iv) Eliminate Manual Scavenging and provide personnel protection equipment to sanitary workers	4	4
B) Proportion of total human excreta generation that is safely collected	6	5
C) Proportion of total black waste water generation that is treated and safely disposed off	6	7.50 (9)
D) Proportion of total grey waste water generation that is treated and safely disposed off	3	-
E) Proportion of treated waste water that is recycled and reused for non potable applications	3	0

Indicators		
Process Related	Points (30)	Surat
A) M&E systems are in place to track incidences of open defecation	4	0
B) All sewerage systems in the city are working properly and there is no ex-filtration (Not applicable for cities without sewerage systems)	5	4.72
C) Septage/sludge is regularly cleaned, safely transported and disposed after treatment, from on-site systems in the city (MAXIMUM 10 marks for cities without sewerage systems)	5	5
D) Underground and Surface drainage systems are functioning and are well-maintained	4	4
E) There is clear institutional responsibility assigned	4	1

Outcome Related	Points (20)	Surat
A) Improved water quality in water bodies in and around city compared to baseline	7	0

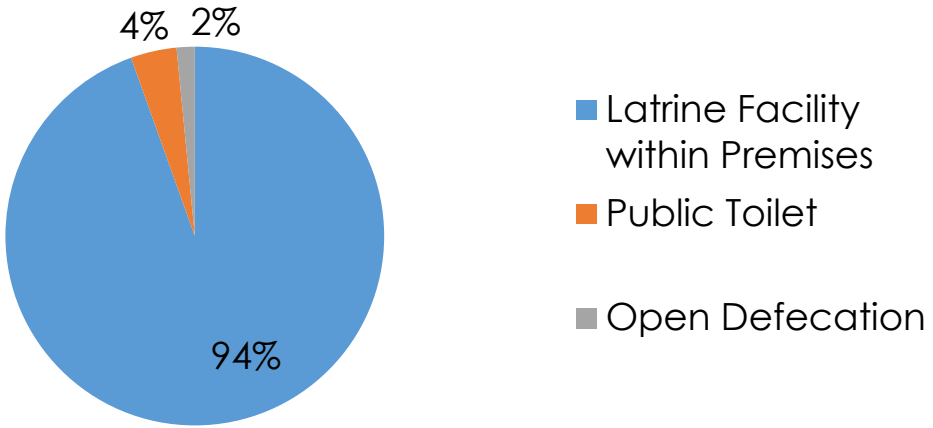
SCOPE..

Availability of sanitation service	Environmental Safe	Institutional Arrangement
Access to sanitation (Slums and Non Slums) Service Deliveries in city	Safe disposal of waste water in creeks and river Quality of waste water disposal	Institutional structure for sewerage Gaps if any in Institutional arrangement

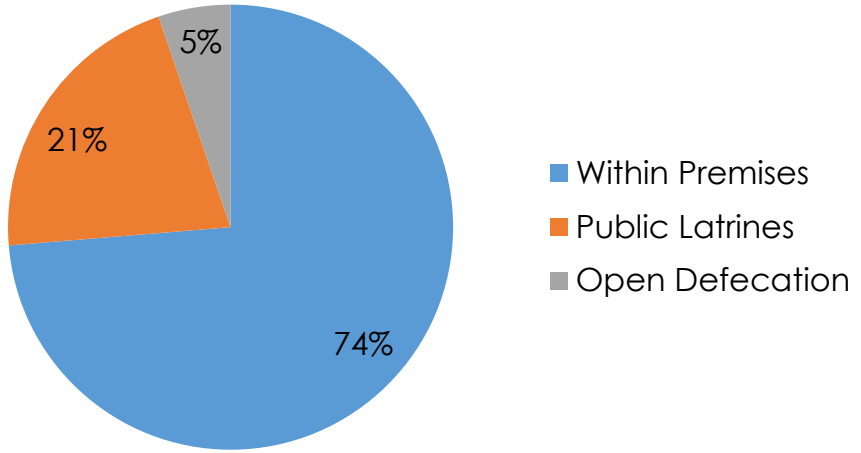
EXISTING SCENARIO

Access | Collection | Pumping | Treatment | Disposal | Reuse

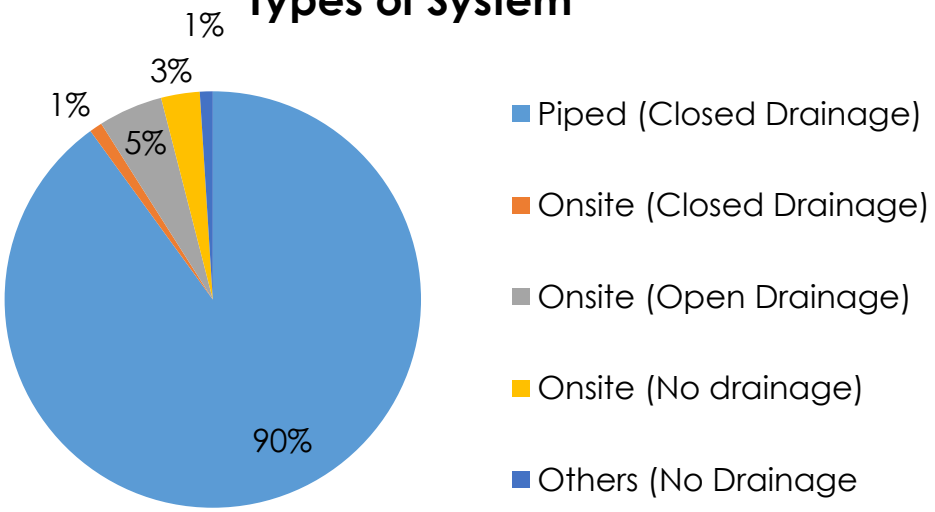
Availability of Latrines



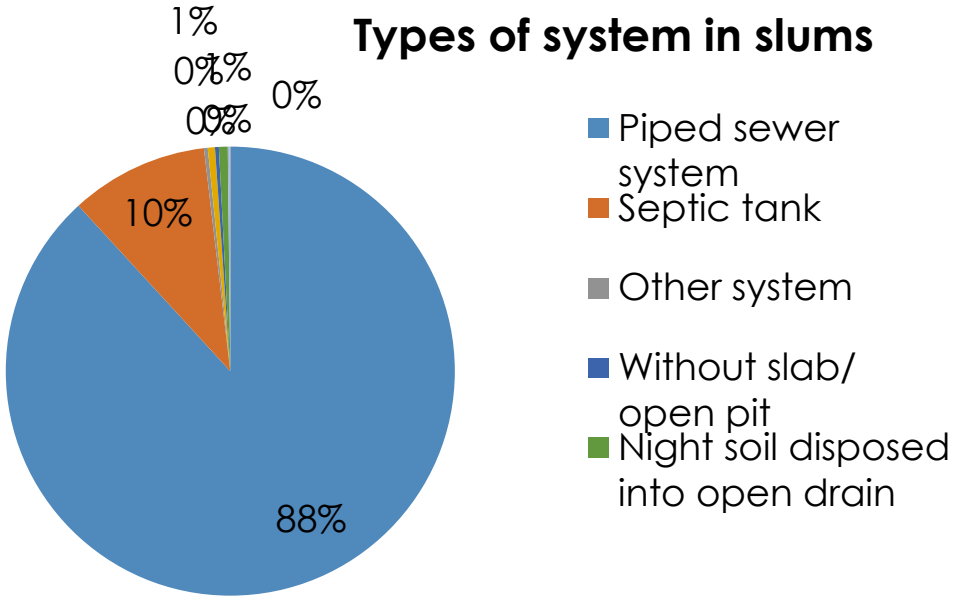
Latrine Availability in Slums



Types of System



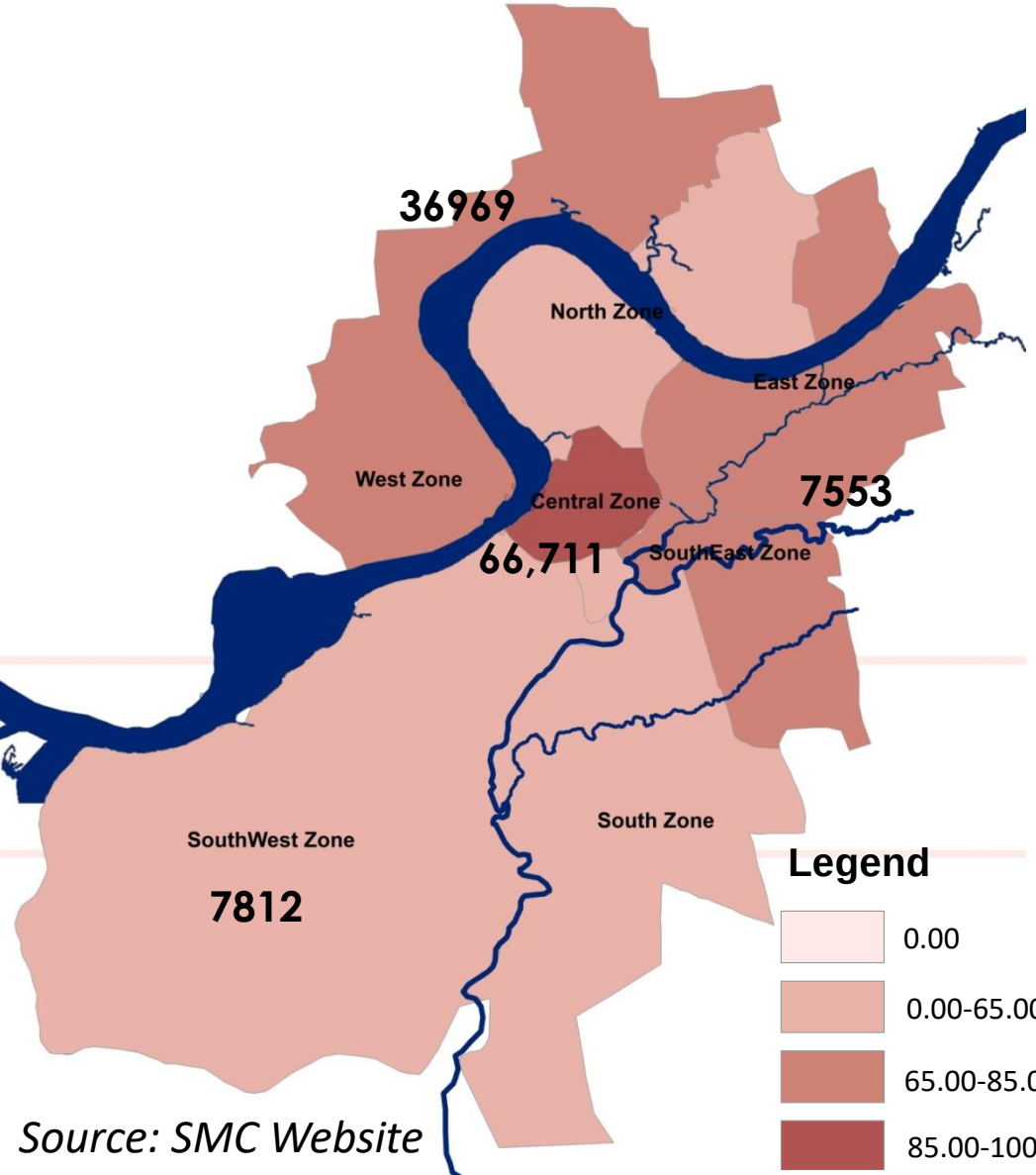
Types of system in slums



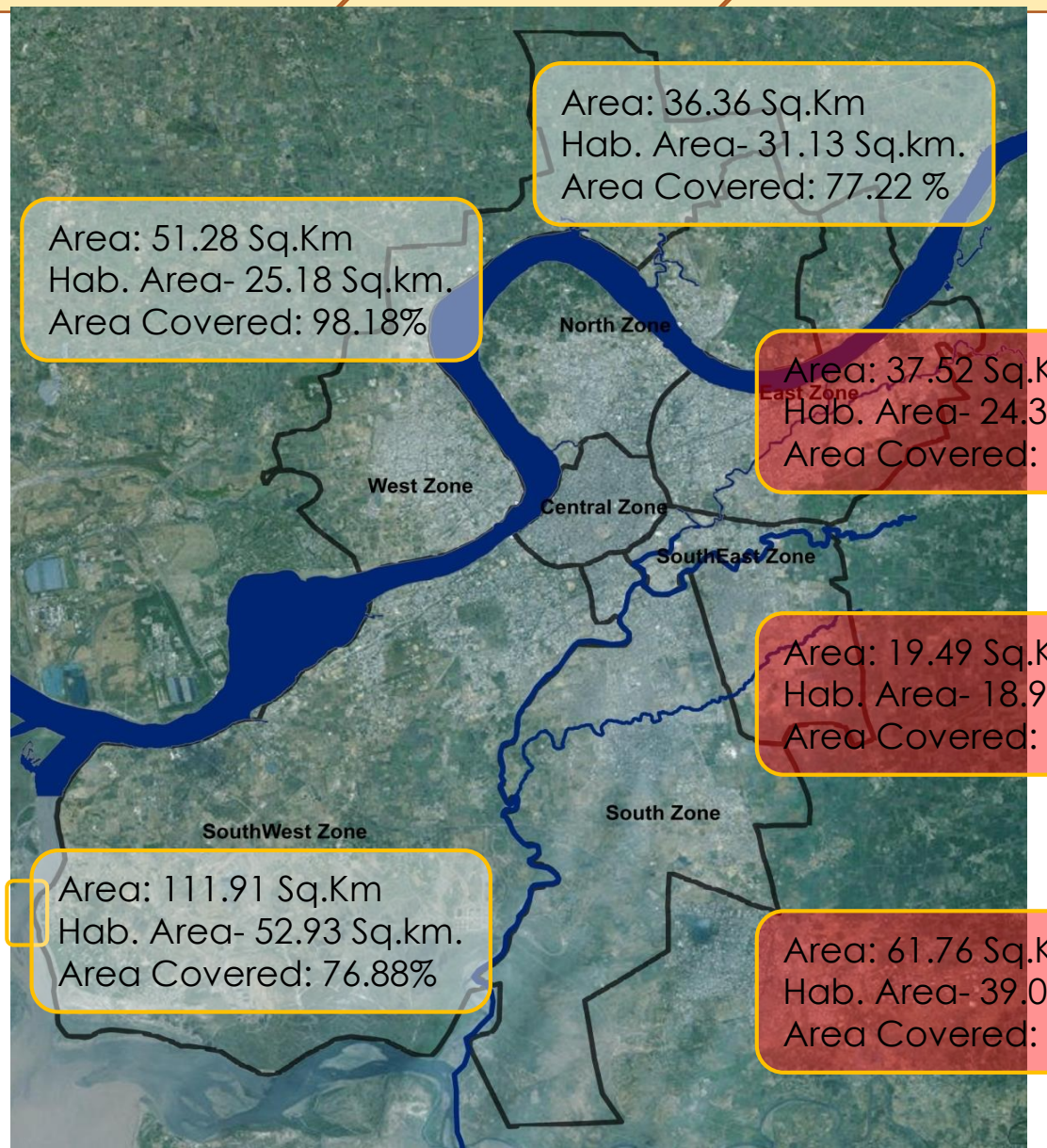
Source: Census 2011

EXISTING SCENARIO

Access | **Collection** | Pumping | Treatment | Disposal | Reuse

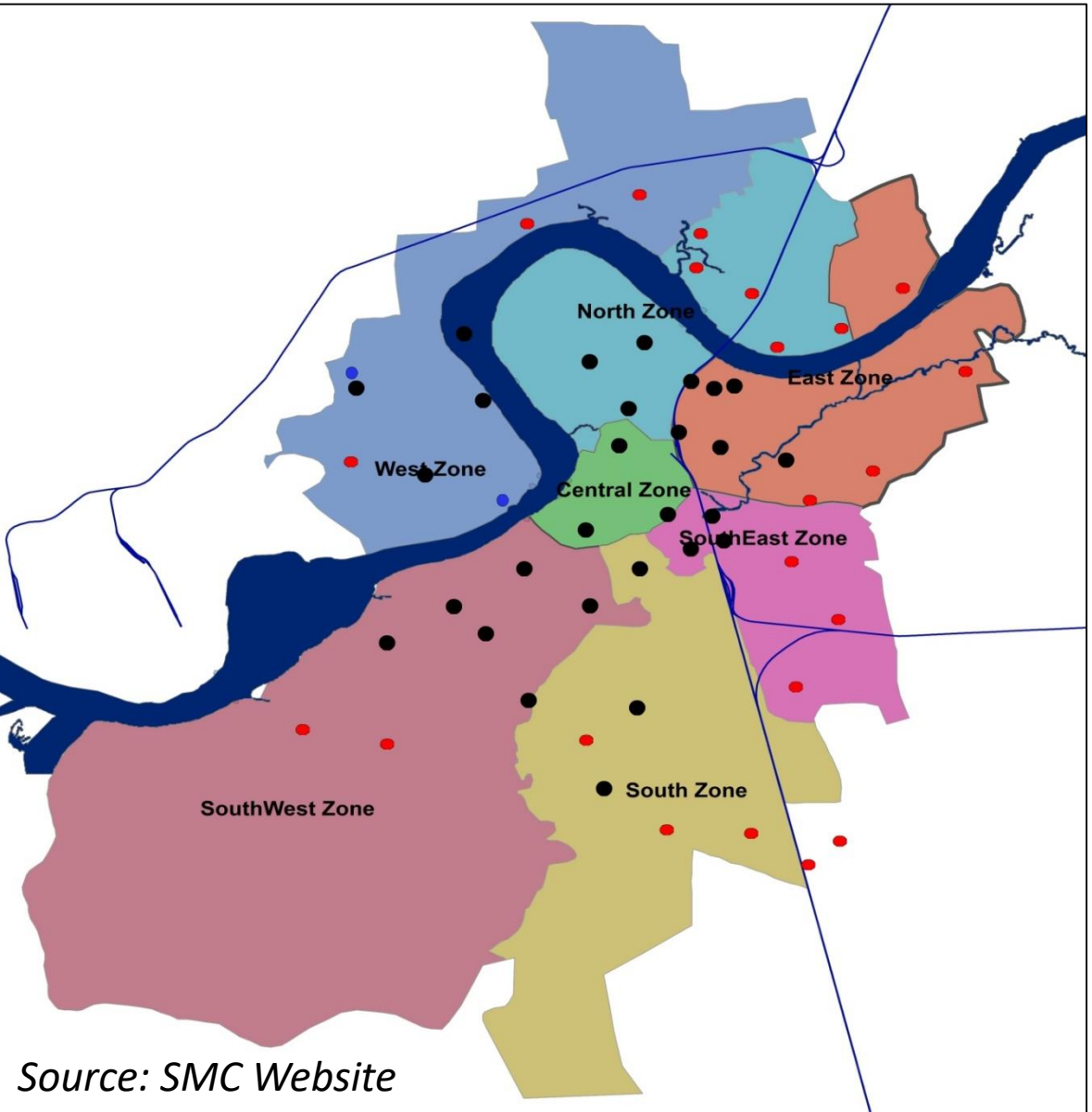


Source: SMC Website



EXISTING SCENARIO

Access | Collection | **Pumping** | Treatment | Disposal | Reuse

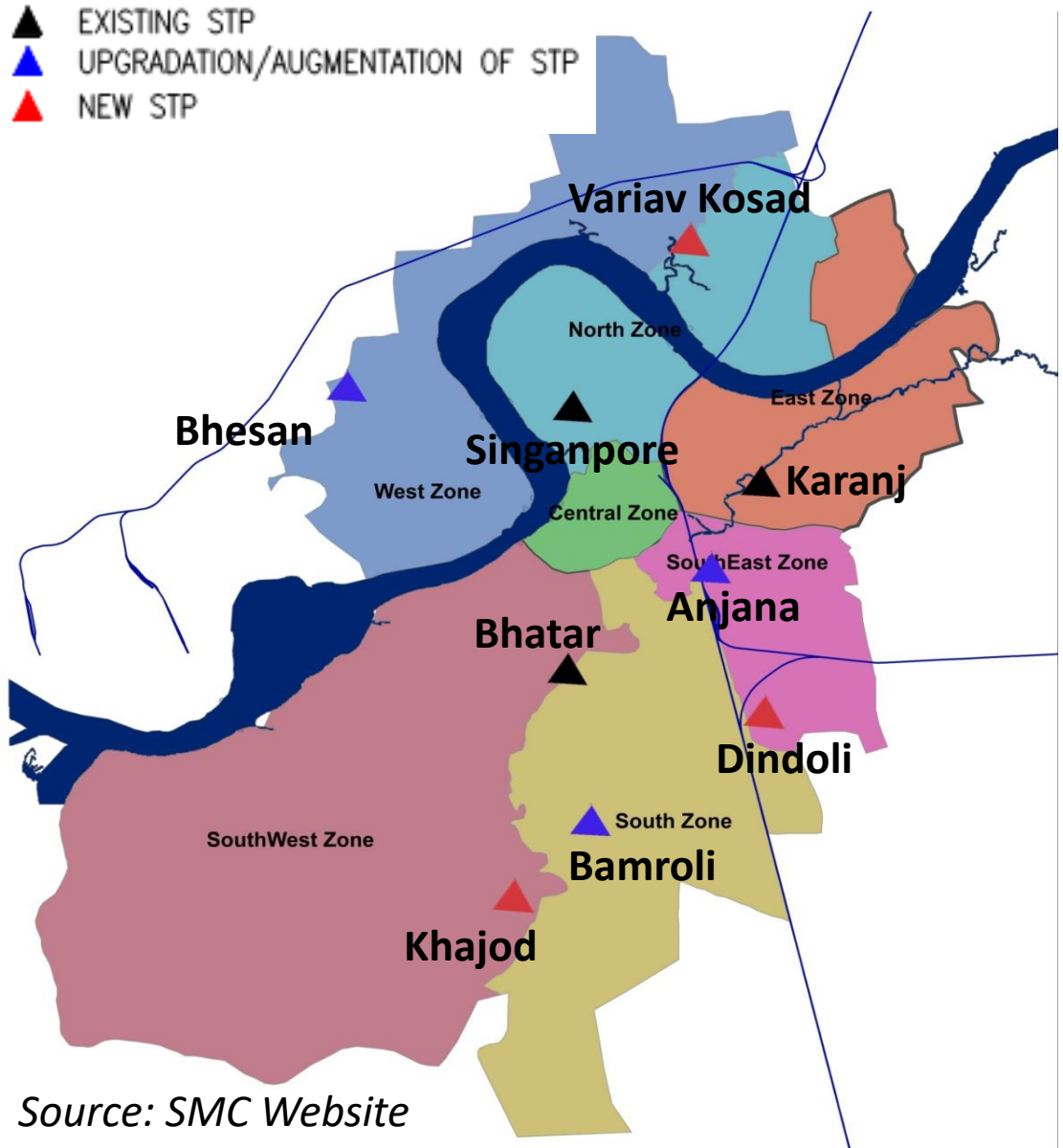


Source: SMC Website

Existing Sewage Pumping Stations:	34 Nos	1482 MLD Capacity
Pumping Station under Execution	15 Nos	411 MLD Capacity

EXISTING SCENARIO

Access | Collection | Pumping | **Treatment** | Disposal | Reuse



Source: SMC Website

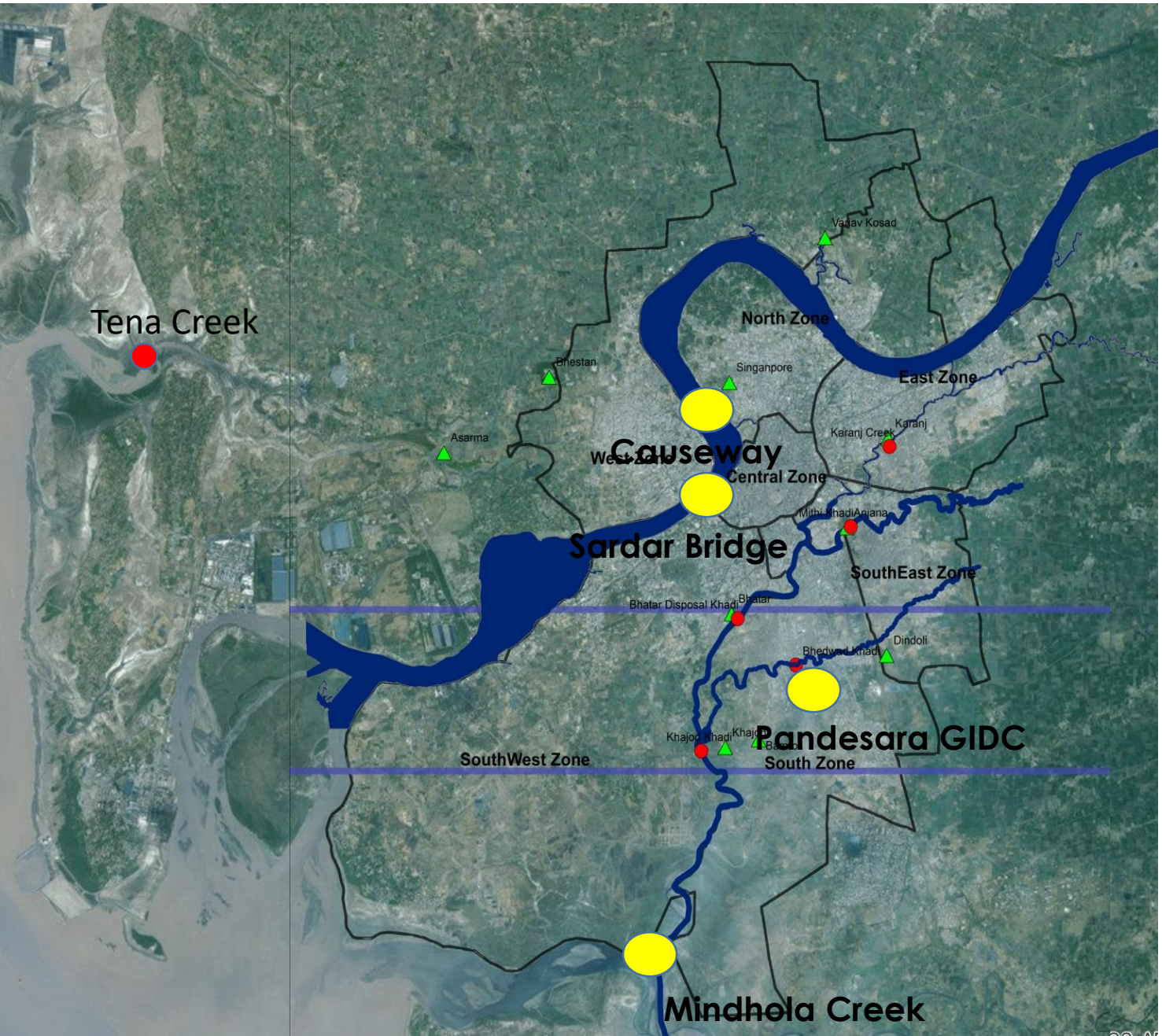
Existing Sewage Treatment Plants:	Capacity	Proposed Extension	Catering Zones
Anjana STP	82.50 MLD		Southeast Drainage Zone
Bhesan STP	100.0 MLD	70 MLD capacity	West Drainage Zone
Bhatar STP	120.0 MLD	120 MLD capacity	Southwest Drainage Zone
Karanj STP	100.0 MLD	80 MLD capacity	East Zone
Singanpore STP	100.0 MLD	100 MLD capacity	North Zone
Bamroli STP	100.0 MLD	60 MLD capacity	South Drainage Zone
Asarma STP	15.0 MLD		West Drainage Zone
Khajod STP	25.0 MLD		Southwest Drainage Zone
Variav-Kosad STP	84.0 MLD		North Zone
Dindoli STP	**66 MLD**	**Ongoing**	**South East Zone East Drainage Zone**
Total	**792.5 MLD**		

Disposal Locations

Access | Collection | Pumping | Treatment | **Disposal** | Reuse

Source: SMC Website
Google Earth

Drainage Zones	STPs	Discharge Points	
		Treated	**Untreated**
West Zone	Bhesan	**Tena Khadi**	
	Asharma		
South East Zone	Anjana	**Mithi Khaadi**	Mithi
	Dindoli	**Bhedwad Khaadi**	Koyali Creek
East Zone	Karanj	**Karanj Khadi**	Karanj Khadi
	Dindoli		
North Zone	Singanpore	**River Tapi**	
	Variav-Kosad	Tena Creek	
South Zone	Bamroli-Vadod	**Khajod Khadi**	Kakra Khadi
			Khajod Khadi
South West Zone	Bhatar	**Kakra Khadi**	
	Khajod	**Kankara Khadi**	



Khadi	Location	Parameters *			
		pH	D.O.	B.O.D.	C.O.D.
Standards (Inland surface Waters)		**5.5-9.0**	**4.0 -5.0**	**30**	**250**
Bhedwad khadi	Pandesara	7.94	3.94	1.75	11.5
River Tapi	Causeway	8.35	7.17	0.83	7.98
River Tapi	Sardar Bridge	7.99	6.82	1.29	13.9
Mindhola Creek		7.9	5.6	2.4	18

* Except pH all the parameters are expressed as mg/L

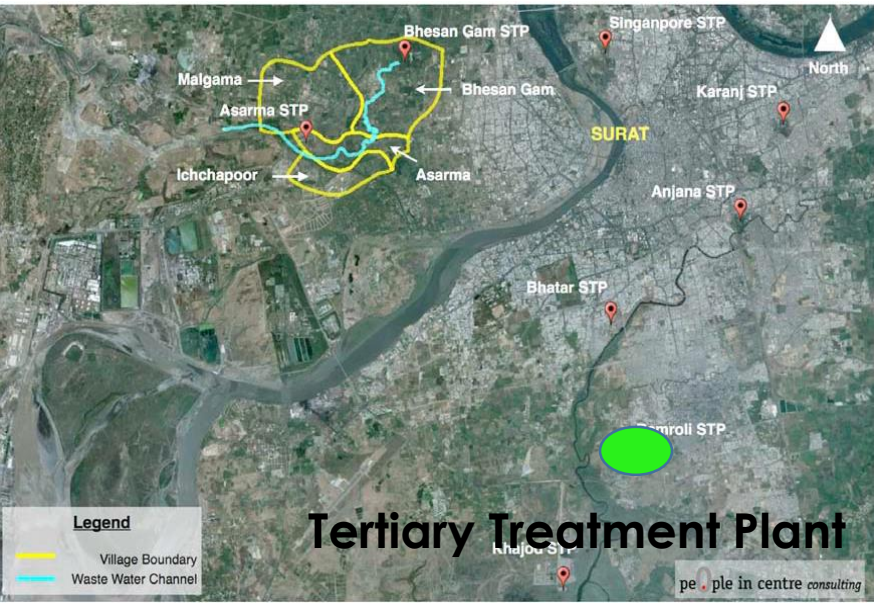
Source: http://cpcb.nic.in/GeneralStandards.pdf
Monitoring of Indian National Aquatic Resource System

Reuse of waste water..

Access | Collection | Pumping | Treatment | Disposal | **Reuse**

Waste Water Irrigation

• Total gross area of 146 ha out of 745 ha is being irrigated using wastewater



The estimated agriculture receipts are around Rs. 1.08 crore with a cash profit of around Rs. 85 lakhs.

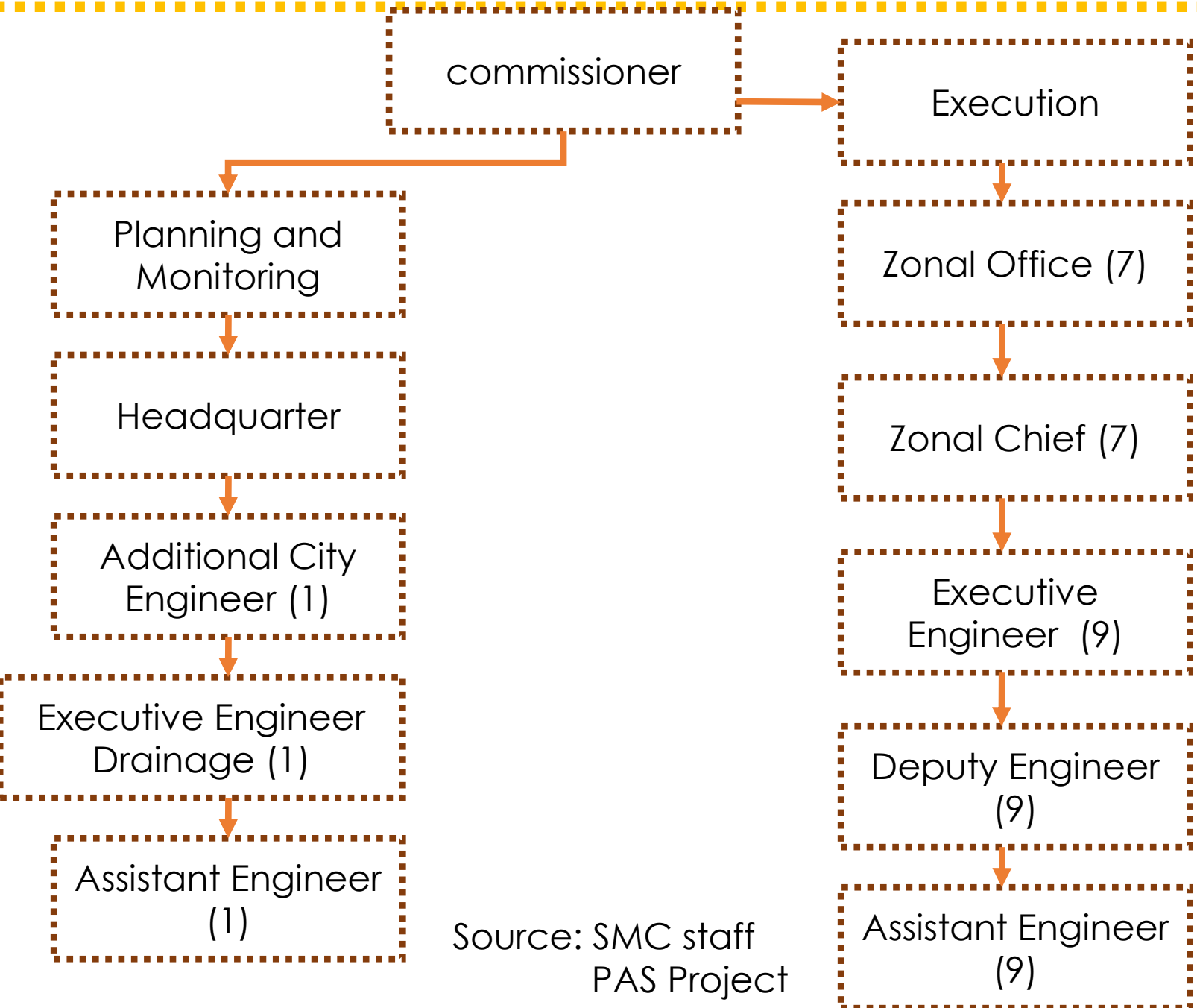
Source: *Wastewater Irrigation in Gujarat: An Exploratory Study – IWMI, 2012*
SMC Website, Surat CDP

Existing Sewage Treatment Plants:	Capacity	Use of Waste Water	Installed Capacity of Power Plant
Anjana STP	82.50 MLD		0.5 MW
Bhesan STP	100.0 MLD	Agriculture	
Bhatar STP	120.0 MLD		1.0 MW
Karanj STP	100.0 MLD		1.0 MW
Singanpore STP	100.0 MLD		1.0MW
Bamroli STP	100.0 MLD	40 MLD Tertiary treatment plant for Industries at Pandesara (Rs 18.2/KL)	0.5 MW (Proposed)
Asarma STP	15.0 MLD	Agriculture	
Khajod STP	25.0 MLD		
Variav-Kosad STP	84.0 MLD		0.5 MW (2 Nos.) (Proposed
Dindoli STP	66 MLD		0.375 MW (2 Nos.) (Proposed)
Total	**792.5 MLD**		**5.75 MW**

Gas Based Power Plant

•Provides electricity to **respective plant equipments**.
• Total electricity generated till Dec 2012 **3.87 Crore units worth Rs. 17.96 Crore**
• Sewage gas has resulted the total savings of **68.7 lac unit per annum Rs. 3.18 Crores/annum**

INSTITUTIONAL ARRANGEMENT..



Source: SMC staff
PAS Project

Sewerage Services		
	Staff Information	**FY 2011-2012**
1	Senior Management (Sanctioned)	11
2	Senior Management (Working)	9
3	Engineers (Sanctioned)	39
4	Engineers (Working)	30
5	Clerks/Accountants (Sanctioned)	19
6	Clerks/Accountants (Working)	15
7	Labourers/Cleaners (Sanctioned)	632
8	Labourers/Cleaners (Working)	524
9	Total (Sanctioned)	701
10	**Total (Working)**	**578**

INSTITUTIONAL ARRANGEMENT..

Sectors	Sanctioned	Working	Gap	% of Total Working
Sewerage	701	578	123	42.31
Water Supply	673	591	82	43.26
Solid Waste	235	197	38	14.44
Total	1609	1366	243	

Max Gap of employees in Sewerage

Zone wise distribution
West Zone, Central Zone, Southwest Zone has maximum gap in terms of No. of employees per connections

Source: PAS Project,2011-12

COMPLAINT REDRESSAL..

CONVENTIONAL Approach

- SMC office
- Zone office

SMART Approach

- online
- Helpline No.
- Watsapp

No of Complaints: **20 to 25/month**
Major reason: **Clogging of the Drains**
Method to Lodge Complains:
On Call Basis

Operation and Maintenance
Cleaning: 2 times per year
Duration: 1) Pre monsoon
2) After one month of monsoon

Complaints are directly assigned to concerned employee on his mobile phone by Complaint Management System, which are **tracked, reviewed and replied within 24-48 hours in most cases.**
As per SLB, Efficiency in complaint Redressal is 100%

Source: SMC Officer

WAY FORWARD..

ISSUES

Access of Sanitation for all (slums and non slums)

Institutional Gaps of Employees

Reuse of waste water

POSSIBLE PROJECT PROPOSAL

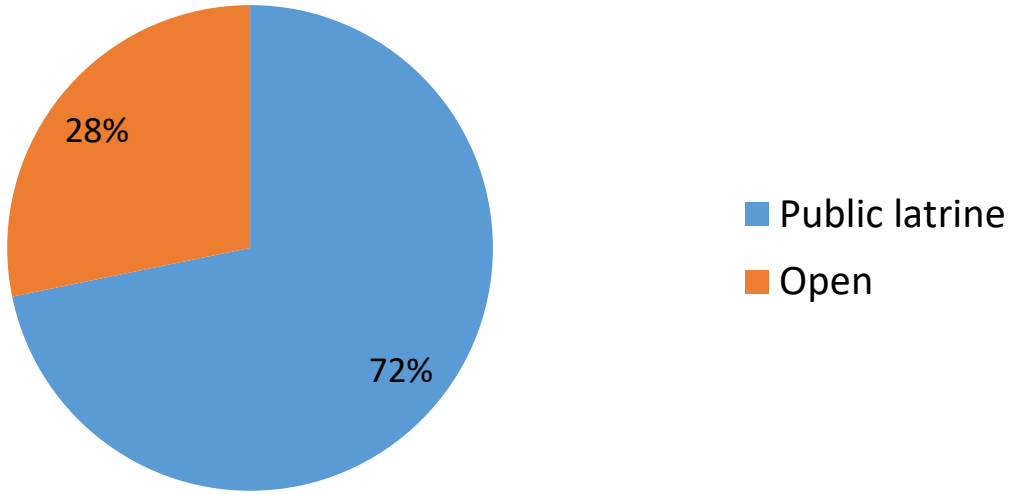
- Access of sanitation in all zones having low coverage of service in order to make surat open defecation free.
- Preparing cost effective plans for waste water reuse by identifying and supplying waste water to possible options within the city (for e.g. public parks, urban agriculture, industries etc)

PROJECT PROPOSAL..

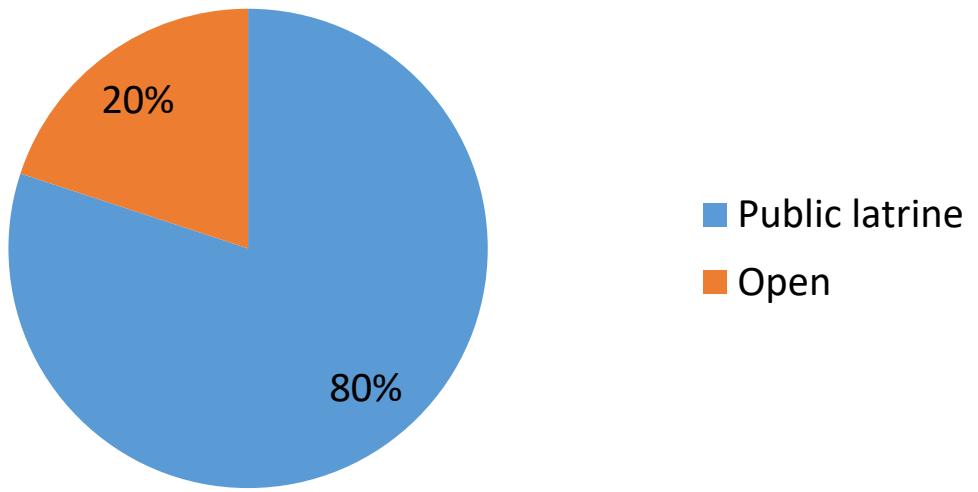
ACCESS OF SANITATION IN SLUMS

CENSUS DATA ON SANITATION..

No Latrines within Premises



Alternative Source



Number of households not having latrine facility within the premises	No latrine within premises	
	Alternative source	
	Public latrine	Open
50292	36287	14005
2099	1322	777
52,391	**37,609**	**14,782**

Number of households not having latrine facility within the premises	**Public latrine**	**Open**
25,965	20,787	5,178

Source: Census 2011

SLUM DETAILS AS PER SMC..

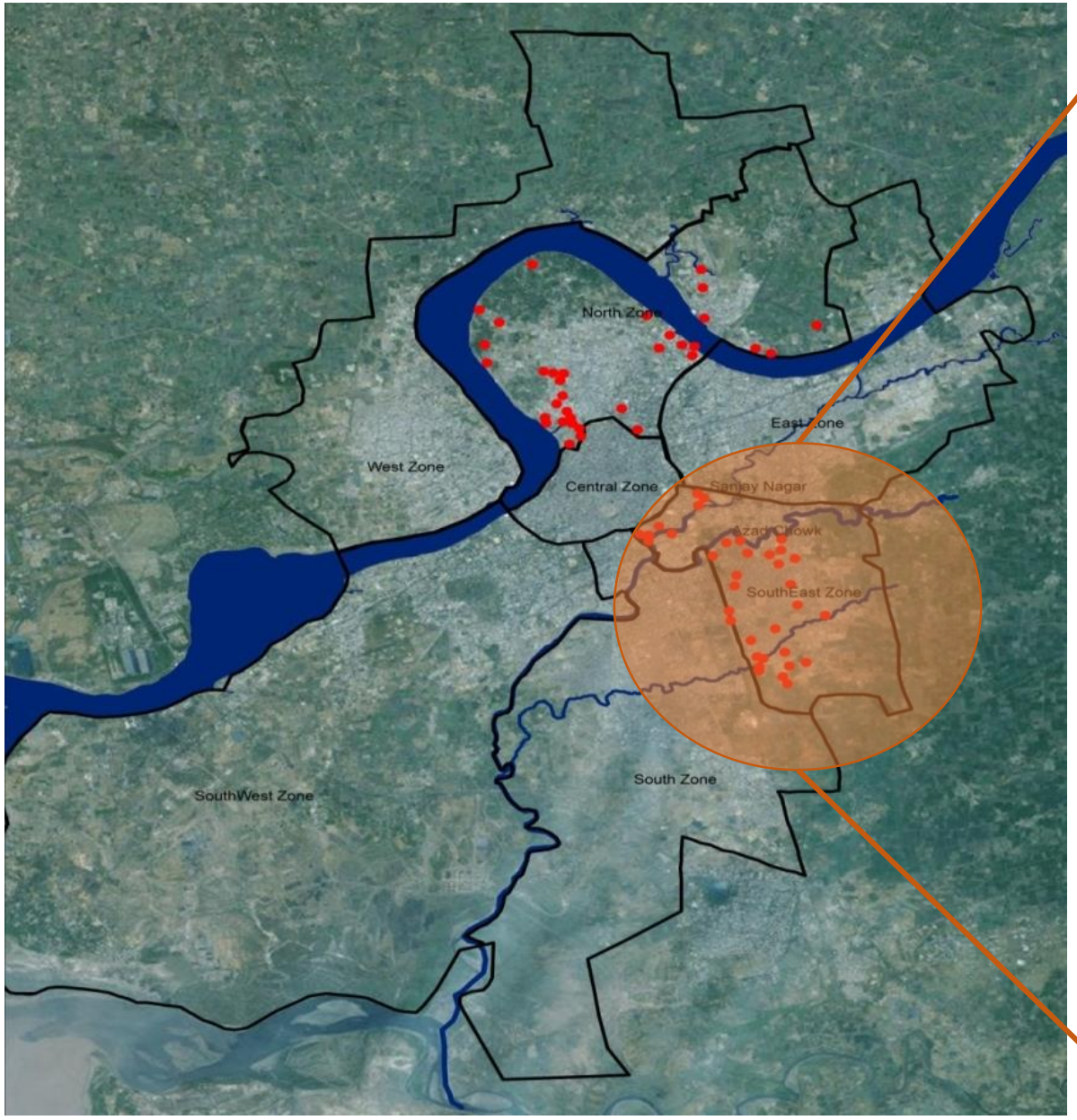
Zone	Existing Slums	Households	Population
South West	25	5,061	23,301
Central	38	8,443	38,838
North	51	9,167	42,168
South East	45	17,215	79,189
West	43	6,343	29,178
South	80	24,307	1,11,812
East	57	11,314	52,044
Total	**339**	**81,850**	**3,76,531**

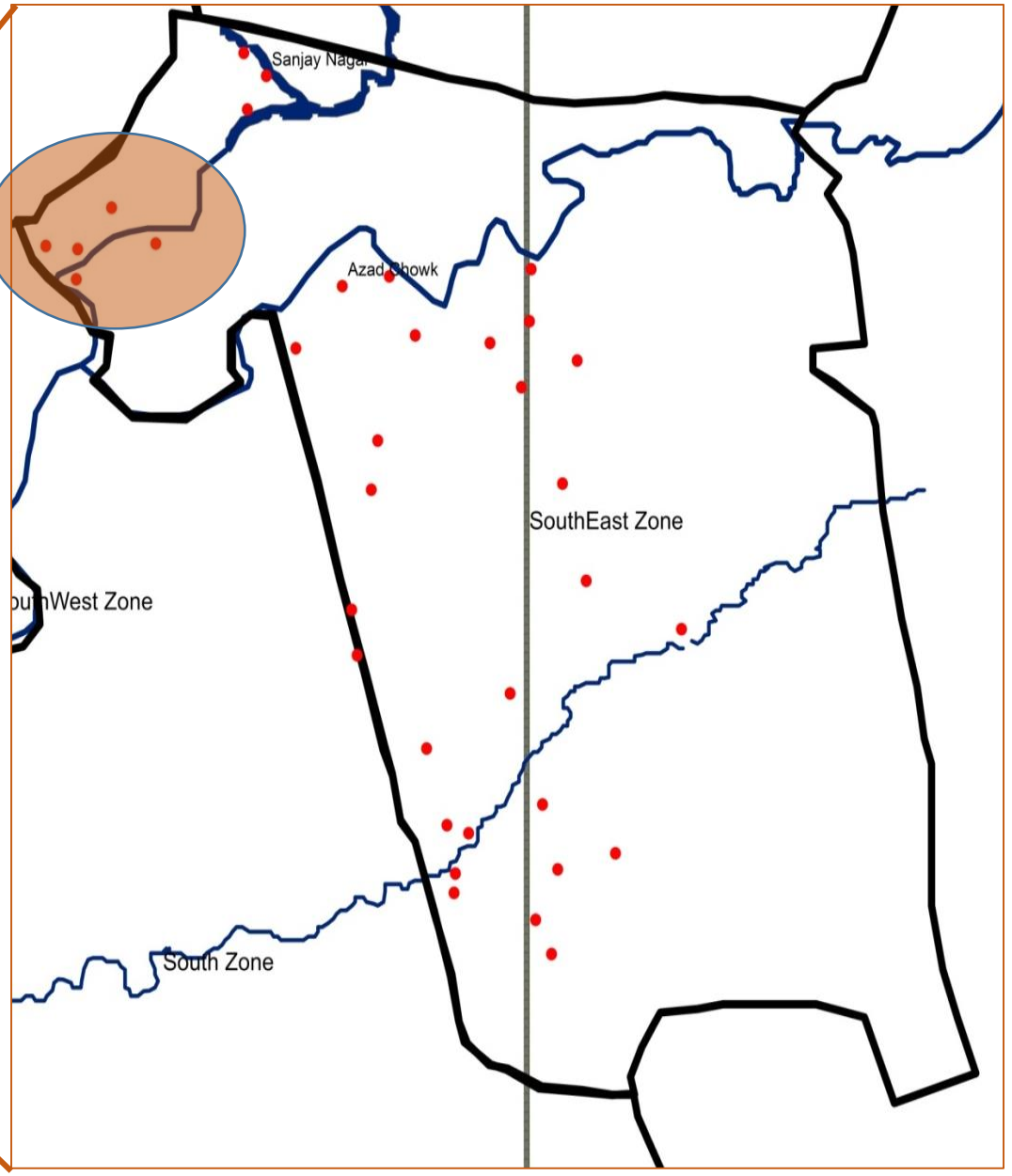
Source: SMC

Zones	Toilets remaining as per SMC survey	Slum Rehabilitation	Remaining Toilets	Households having space for individual toilets	No space
Southwest	6,052	5485	567	567	0
Central	3317	2885	432	432	0
North	8183	6779	1404	216	1188
Southeast	11848	9855	1993	468	1525
West	3982	3061	921	921	0
South	13402	11754	1648	1160	488
East	1562	692	870	245	625
Total	**48,346**	**40,511**	**7835**	**4009**	**3826**

Source: SMC

SLUM LOCATION..





SOUTH EAST ZONE..

Sr. No.	Ward Name	Remaining Toilets as per census 2011	Remaining Toilets	Slum Rehabilitation	Households having space for individual toilets	No space
1	Aanjana	1957	722	1235	113	609
2	Umarwada	5826	302	5524	67	235
3	Umarwada	81	148	67	140	8
4	magob	11	0	11	0	0
5	Dumbhal	430	0	430	0	0
6	Aanjana	30	0	30	0	0
7	Limbhayat	1331	367	964	117	250
8	Dindoli	607	86	521	0	86
9	Magob	58	38	20	0	38
10	Parvat	194	34	160	19	15
11	Godadara	319	48	271	0	48
12	Dindoli	1004	248	756	12	236
	Total	**11848**	**1993**	**9989**	**468**	**1525**

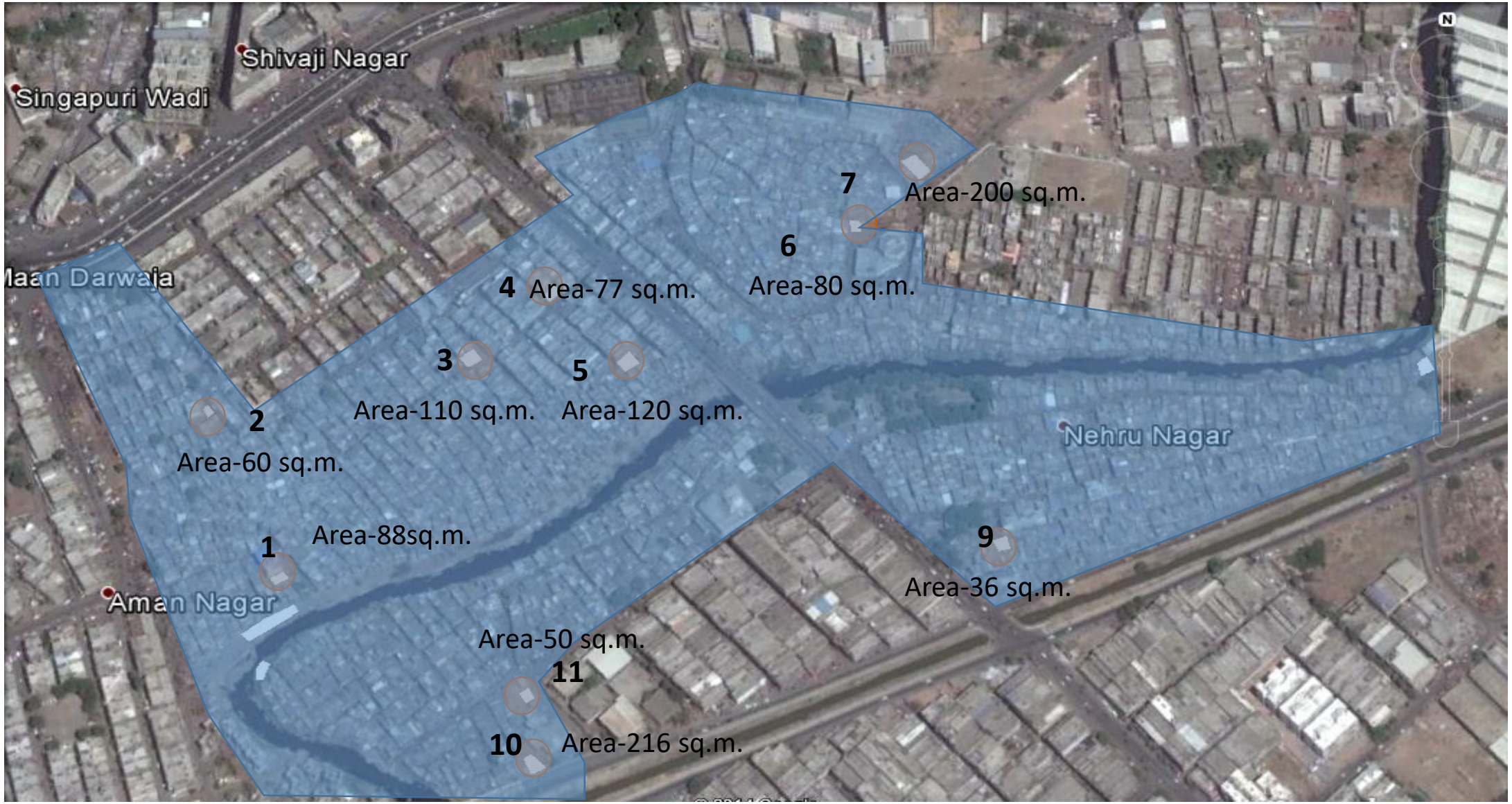
Sr. No.	Slum Name of Anjana	Slum Household	Slum Population
1	PriyankaNagar,Umarwada	100	460
2	Zundiakua Zuppadpatti	80	368
3	**Rail Rahat Colony, beside Nurani Masjid, Mandarwaja**	**463**	**2130**
4	**Chimani Tekro(Old Depot), Opp Ring Road**	**899**	**4135**
5	Halapati Nagar at S.E Road, Beside Ring Road	174	800
	Total	**1716**	**7894**

SLUM LOCATION..

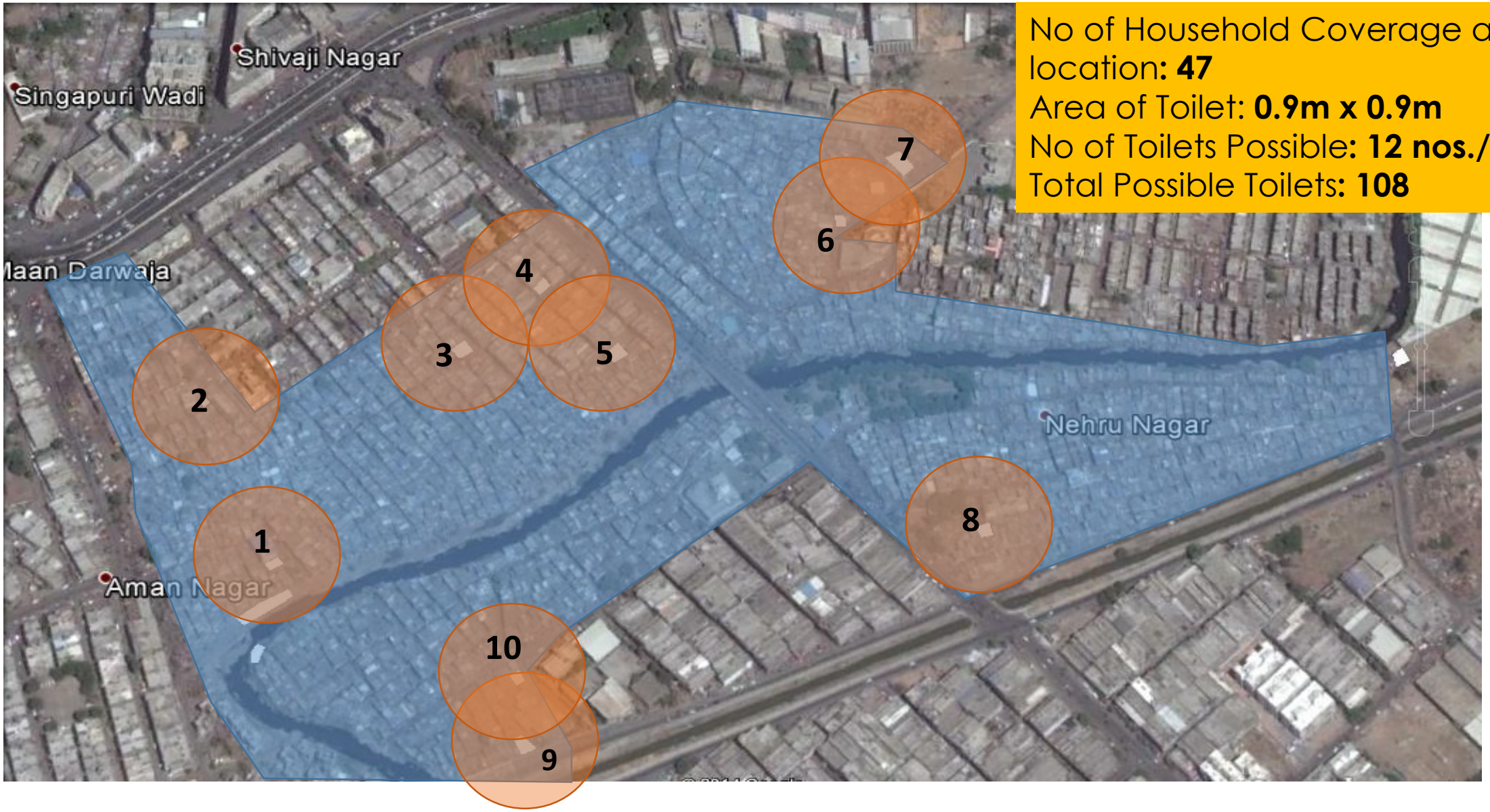
Area	**0.21 sq.km (20.50 hectares)**
Household	**1362**
Population	**6265**
Density	**29,833 persons/Sq.km. (305.60 persons/hectare)**

Disposal Near Creek

SLUM LOCATION..



SLUM LOCATION..



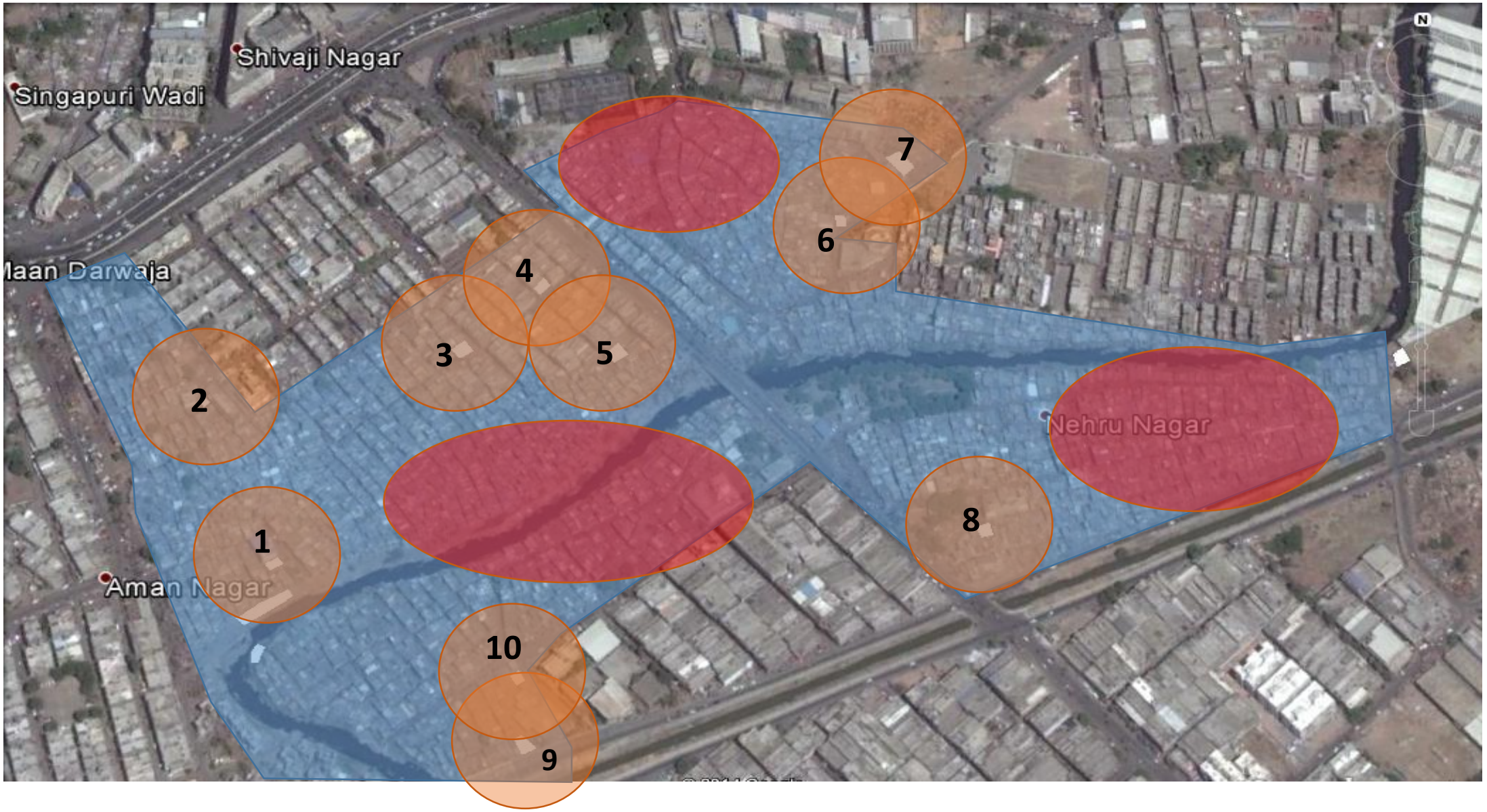
No of Household Coverage at each location: **47**
Area of Toilet: **0.9m x 0.9m**
No of Toilets Possible: **12 nos./location**
Total Possible Toilets: **108**

TOILET BLOCK SPECIFICATION..

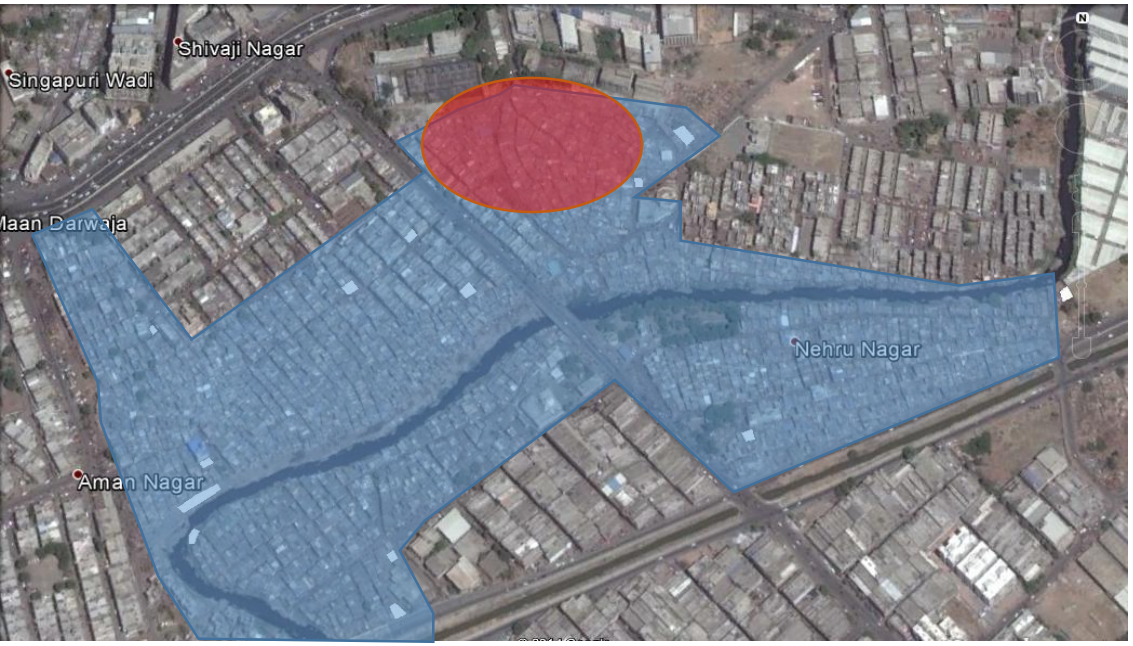
Items	Cost
Toilet Block	Rs. 16,142
Add 2% for Electrical item	Rs. 322
Add 7% contigency and supervision Cost	Rs. 1130
Cost for Individual Toilet	**Rs. 17,594**
Cost for 108 Toilet	**Rs. 19,00,152**
Cost of Laying Pipelines (490m Length)	**Rs. 1,37,200**
Total Cost	**Rs. 20,37,352**

Source: SOR 2012-13

GROUP/SHARED TOILET..



GROUP/SHARED TOILET..



Items	Cost
Toilet Block	Rs. 16,142
Add 2% for Electrical item	Rs. 322
Add 7% contingency and supervision cost	Rs. 1130
Cost for Individual Toilet	**Rs. 17,594 Rs. 18,000 (approx.)**

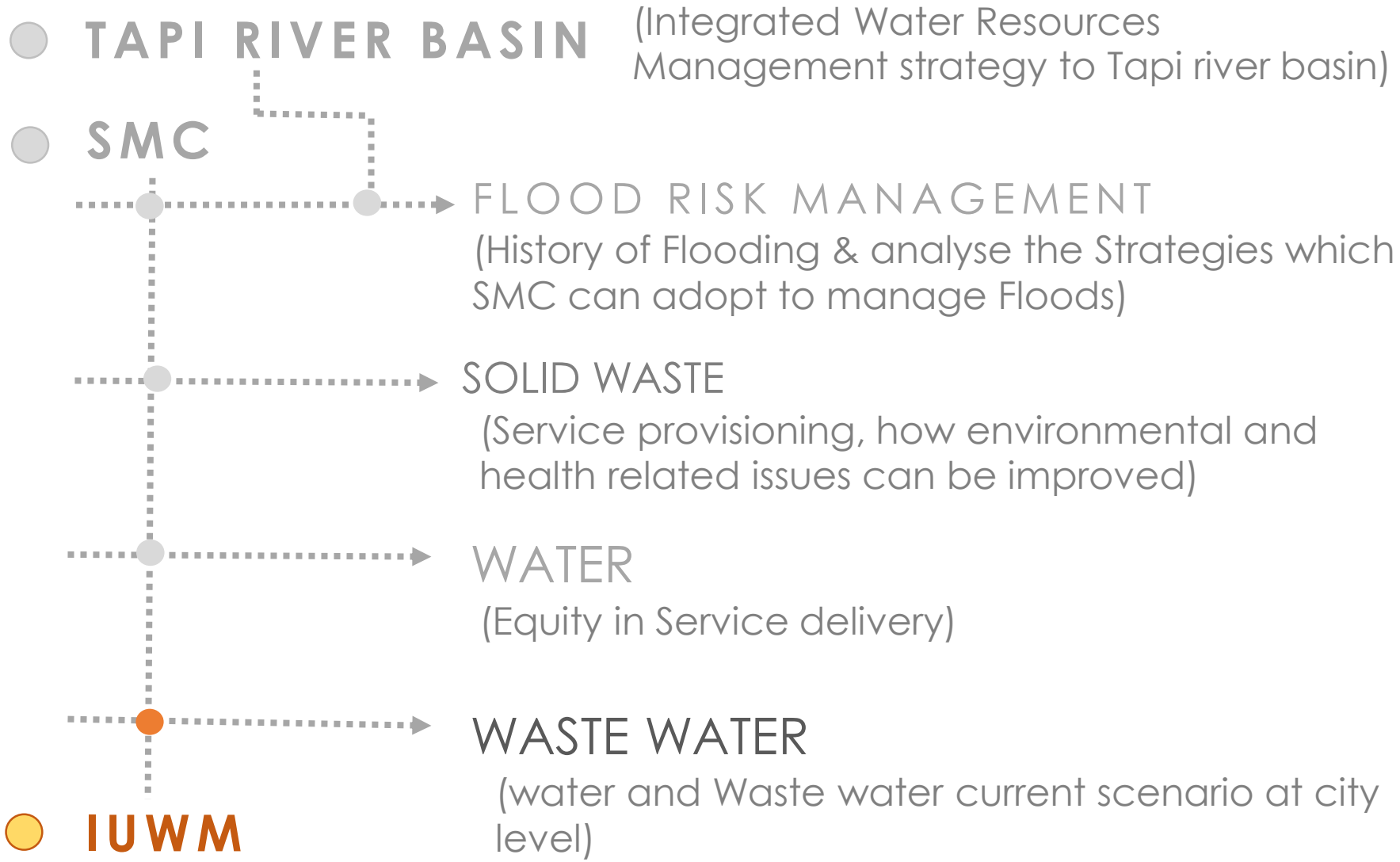
Source: Draft Guidelines for Swachh Bharat Mission(SBM), MoUD, GOI

Financing Pattern	Individual Toilet (1HH)	Group Toilet (2HHs)	Group Toilet (3HHs)
Average block cost of a toilet	18000	18000	18000
Subsidy for each Household	5000	10000	15000
Cost on each HH	**13,000**	**4,000**	**1000**

APPROACHES..

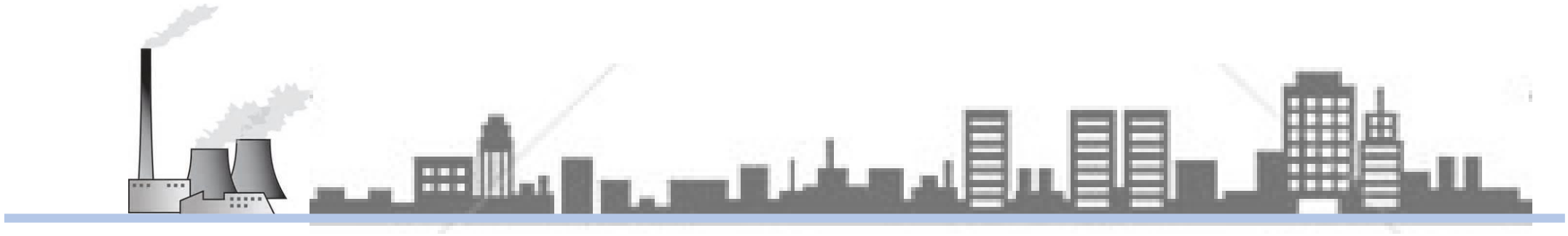
	Community Toilet	**Shared/Group Toilet**
Cost of Toilet	Rs. 18,000	Rs. 18,000
Grant From Govt.	Rs. 5000/household	Rs.5000/household
Cost incurred by SMC	Rs.13,000/Toilet	Cost can be shared amongst the no. of family sharing the Toilet
Ownership	SMC	Individual house owners
Cost of O&M	Totally on SMC	Done by individual households

Up till now…


TAPI RIVER BASIN
(Integrated Water Resources Management strategy to Tapi river basin)
SMC
FLOOD RISK MANAGEMENT
(History of Flooding & analyse the Strategies which SMC can adopt to manage Floods)
SOLID WASTE
(Service provisioning, how environmental and health related issues can be improved)
WATER
(Equity in Service delivery)
WASTE WATER
(water and Waste water current scenario at city level)
IUWM
(Integration of urban water management and its Reuse at urban and industrial areas.)

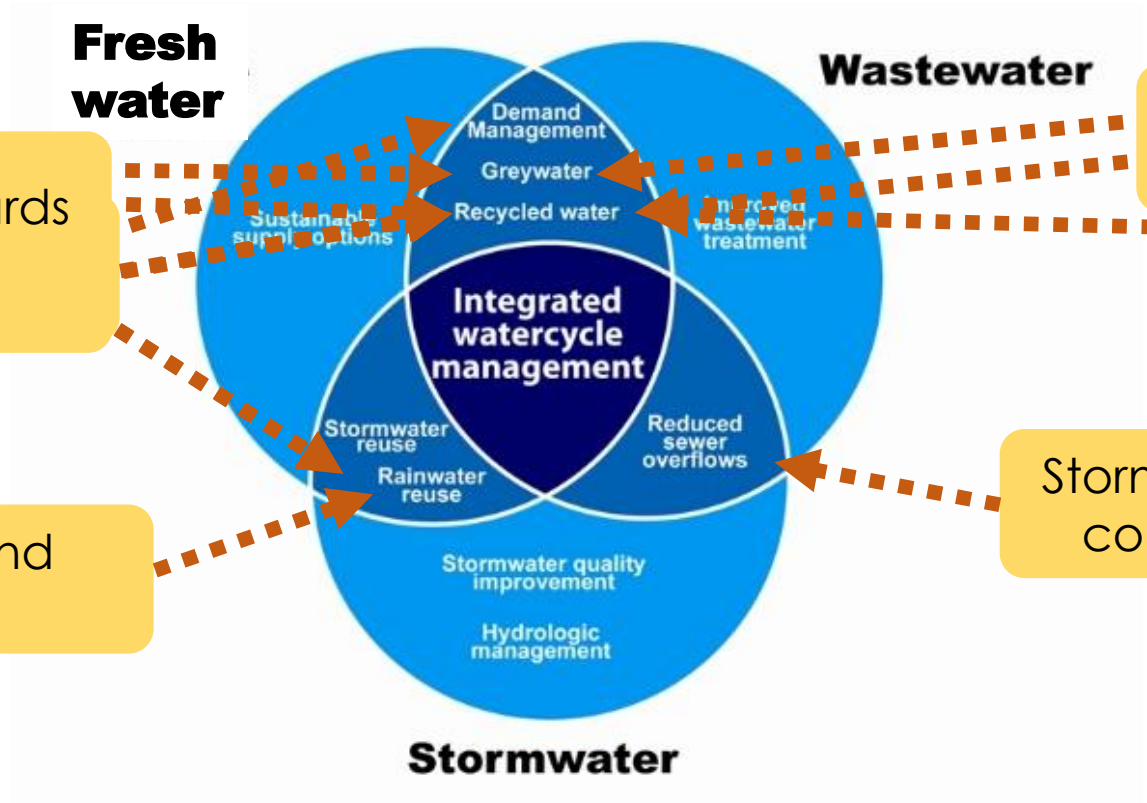
IUWM

INTEGRATED URBAN WATER MANAGEMENT



INTEGRATED URBAN WATER MANAGEMENT..

- IUWM takes a comprehensive approach to various water services.
- It views water supply, storm water and wastewater as components of an integrated physical system.



Water quality standards and abstraction tax

Pollution tax/ pollution

Land availability

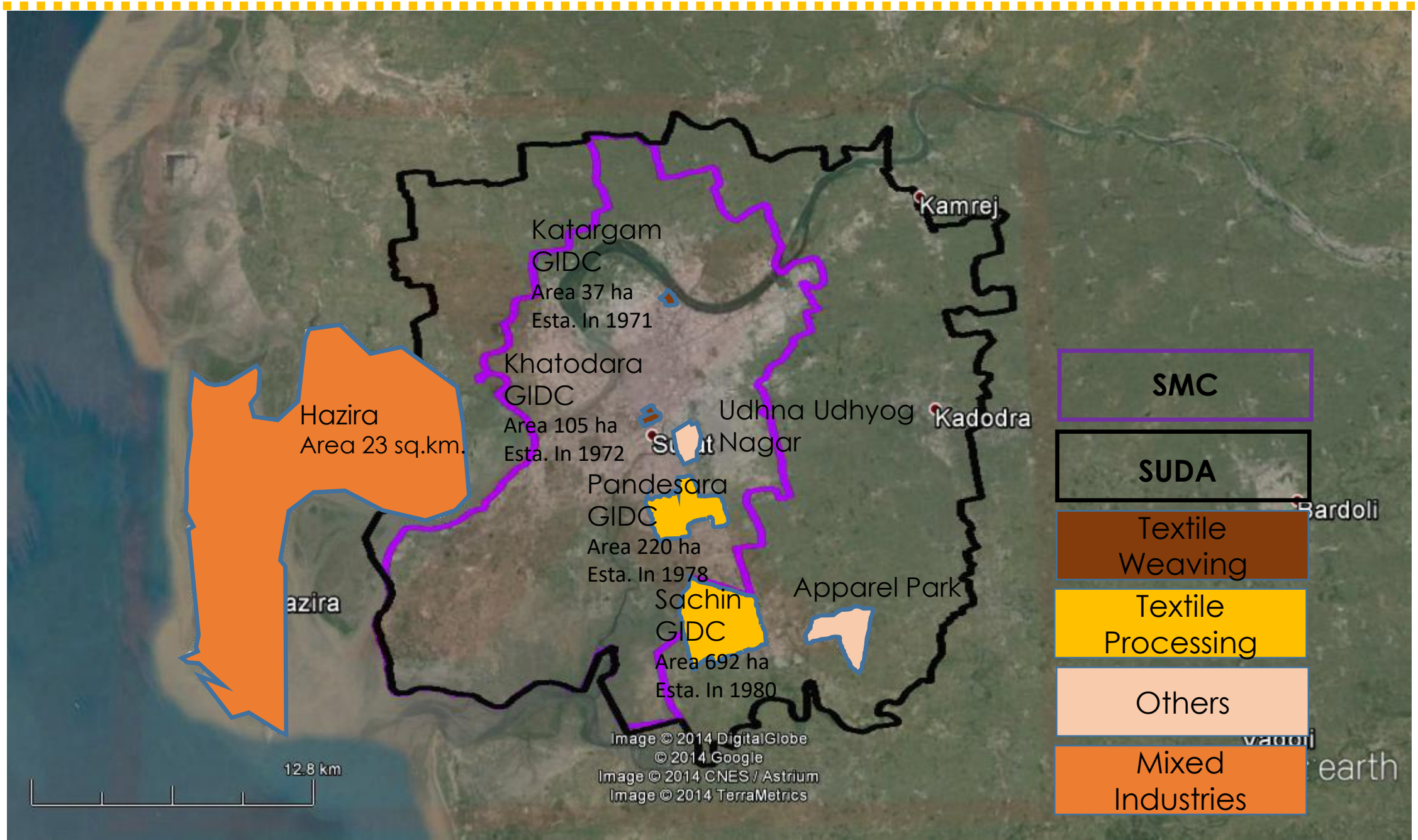
Land use and land cover

Stormwater and wastewater source control and pollution prevention

- Use of infrastructure technologies
- Institutions and organizations
- Non-structural tools such as education, pricing incentives, regulations and restriction regimes

Source : Adapted from waterbydesign.au and An approach to IUWM, Mulbagal Experience, Arghyam

INDUSTRIAL MAPPING



WATER DEMAND Industries within SMC boundary

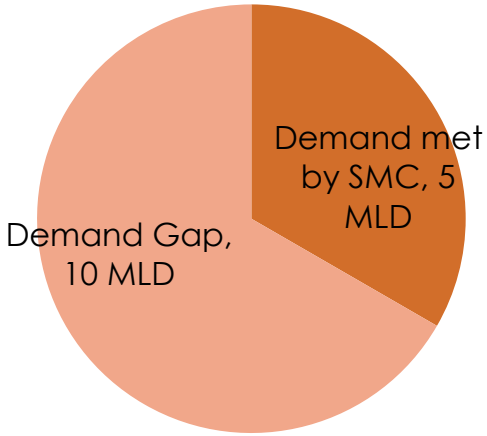
Pandesara GIDC

Total Water Demand-110 MLD
Demand Met by SMC- 80 MLD
Demand Gap- 30 MLD

Demand Gap is managed through the use of ground water and other sources, which is very expensive

Sachin GIDC

Total Water Demand-15 MLD
Demand Met by SMC- 5 MLD
Demand Gap- 10 MLD



- Total Water demand is not met by Municipal water supply
- Potential for reuse of wastewater

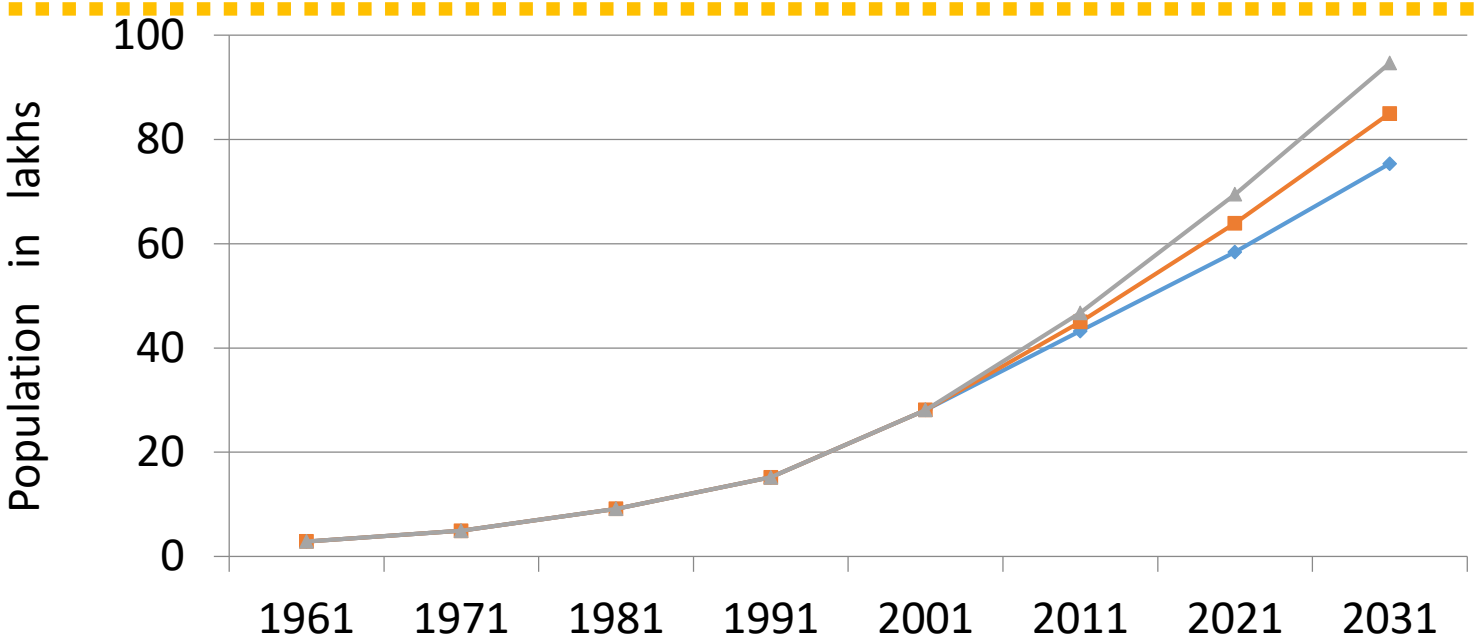
WATER DEMAND Hazira Industries

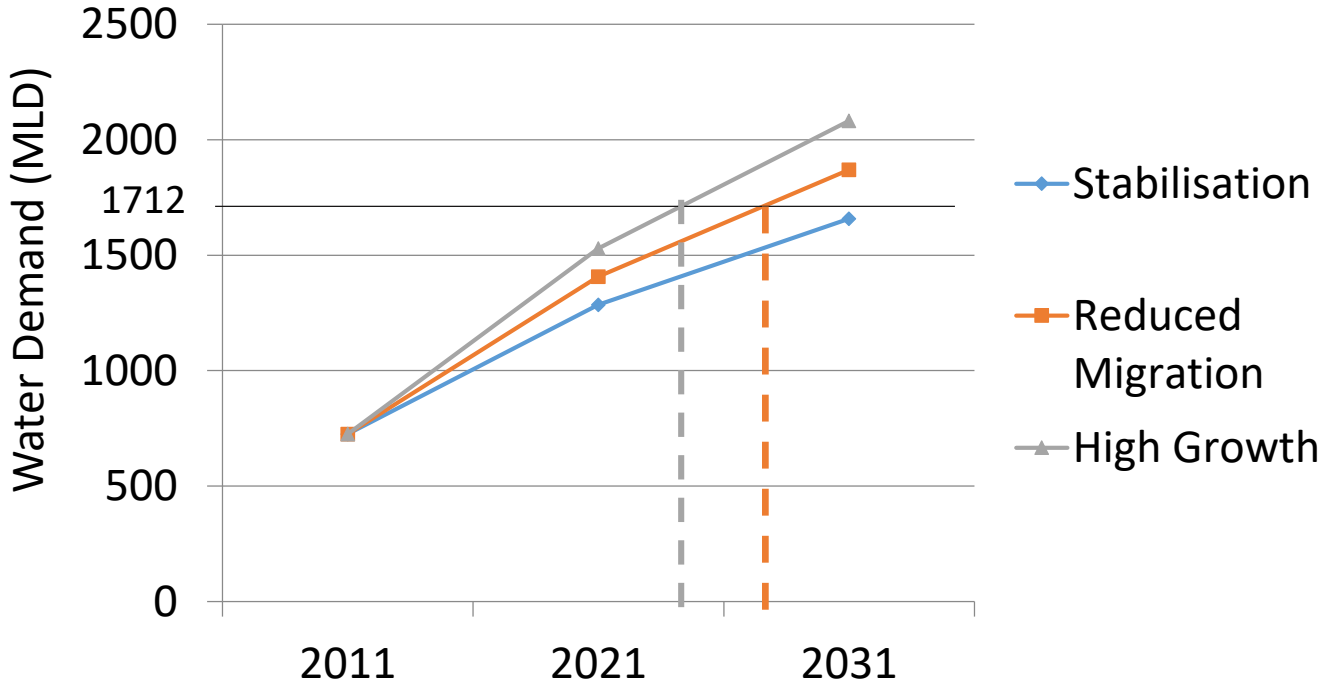
Name of Industry	Type of Industry	Water Demand (MLD)	Drawl Rights (MLD)
Reliance Industries Ltd.	Petrochemical	90	97
Essar Steel Ltd.	Steel	25+20 (2008)	57
O.N.G.C.			57
KRIBHCO	Fertilizer	146	
N.T.P.C.	Power	21	5
Rama newsprint Ltd.	Printing	6	33
GIDC Ichchhapore		3	10
L & T	Engineering	9	1.5

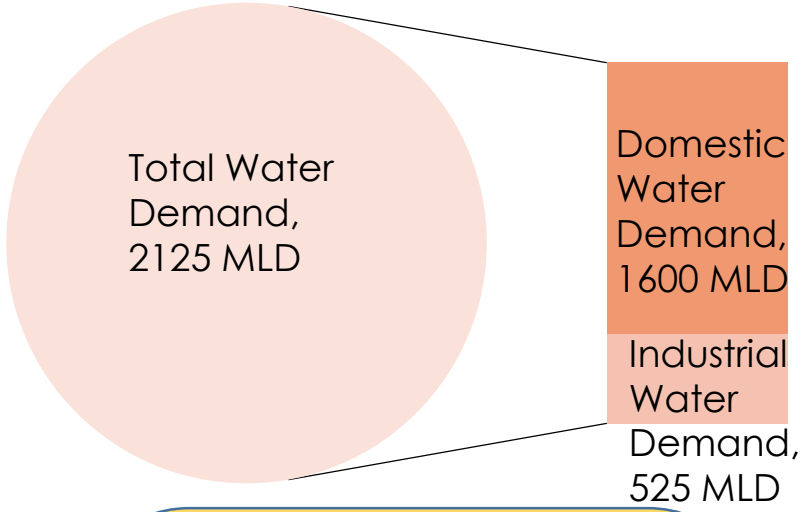
Total capacity- 10340 TPD
CPHEEO guidelines- 80-140 kL/ tonne

- Present Total Water demand for large scale industries is around 250 MLD
- Maximum Drawl Rights allow them to draw 400 MLD water
- Some industries are already reusing water but there is huge potential

FUTURE PROJECTIONS



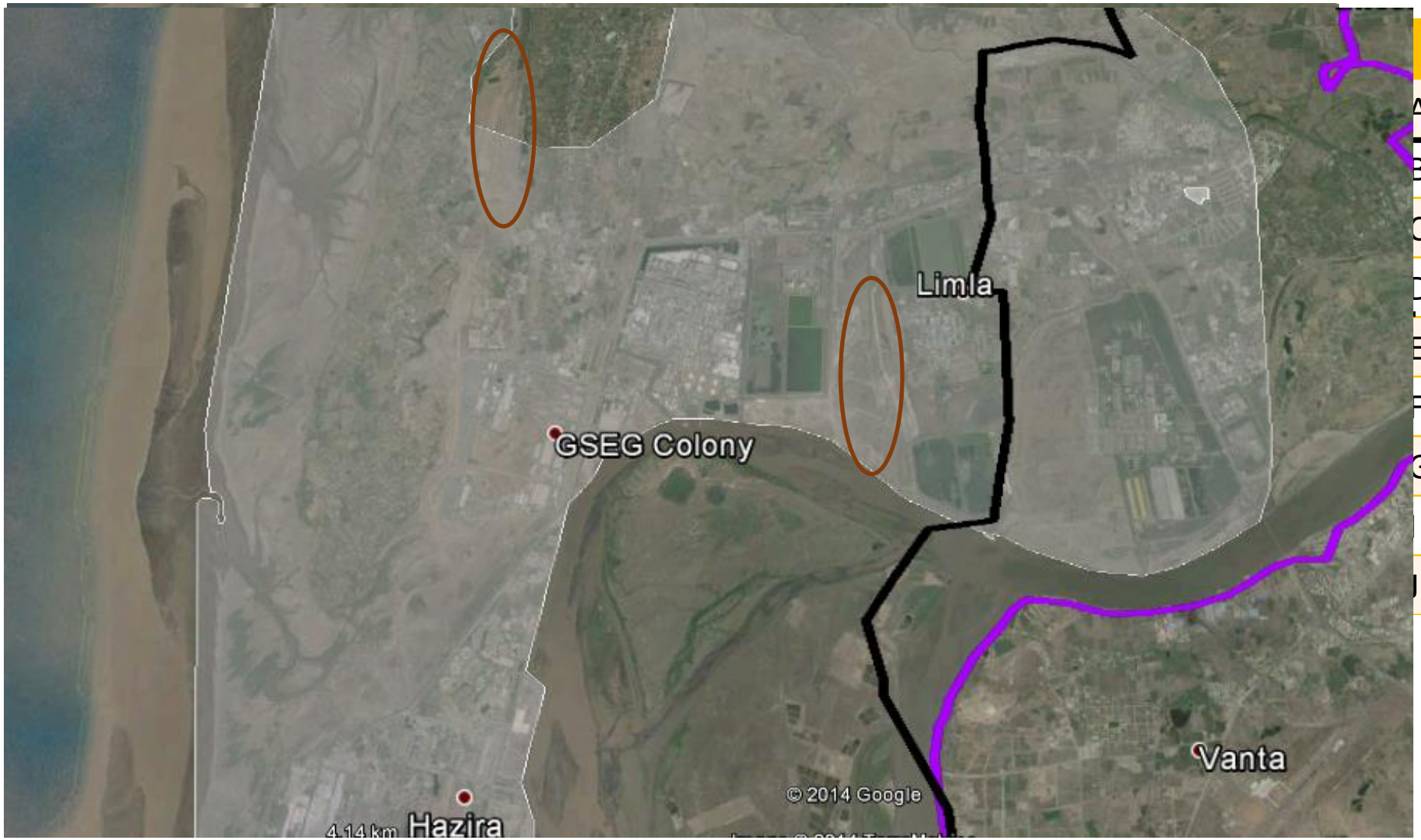




- Under Reduced Migration Scenario, The water demand will reach up to 2125 MLD by 2025
- Maximum Availability during peak summer will be 1712 MLD
- Chances of Water Scarcity

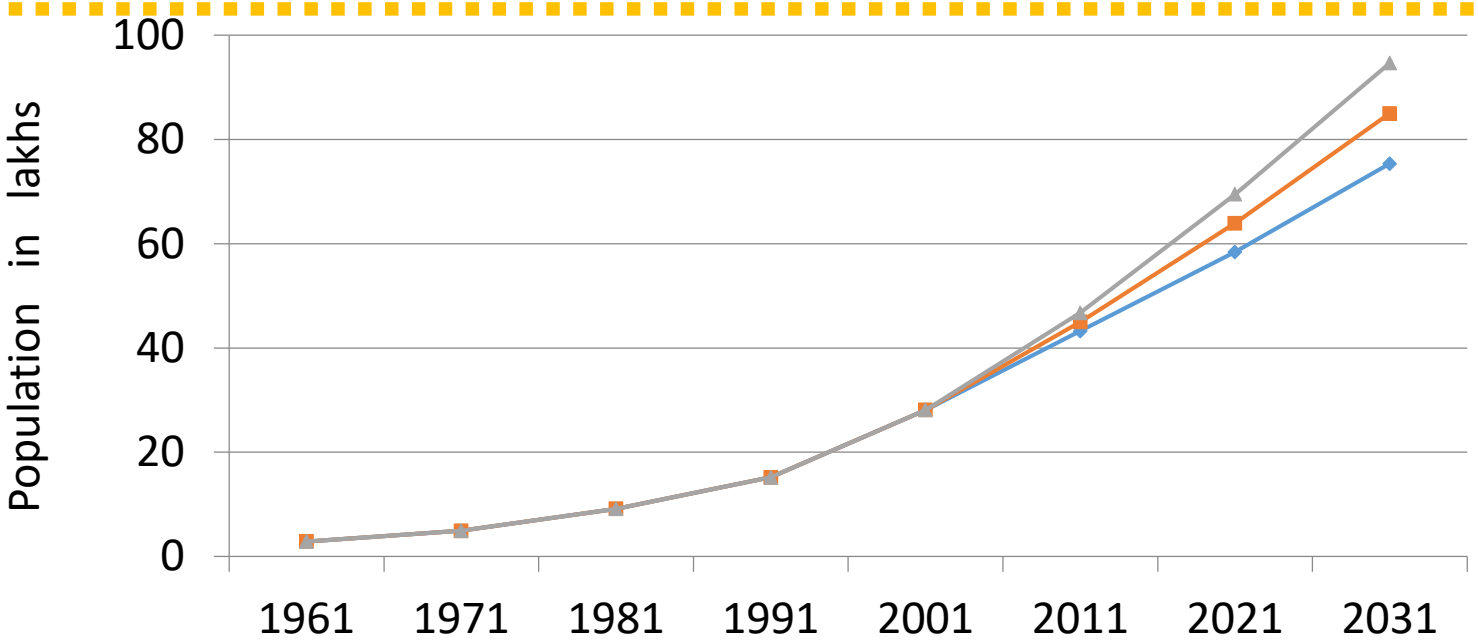
Source : Surat CDP (2006- 2012) & Surat City Resilience Strategy

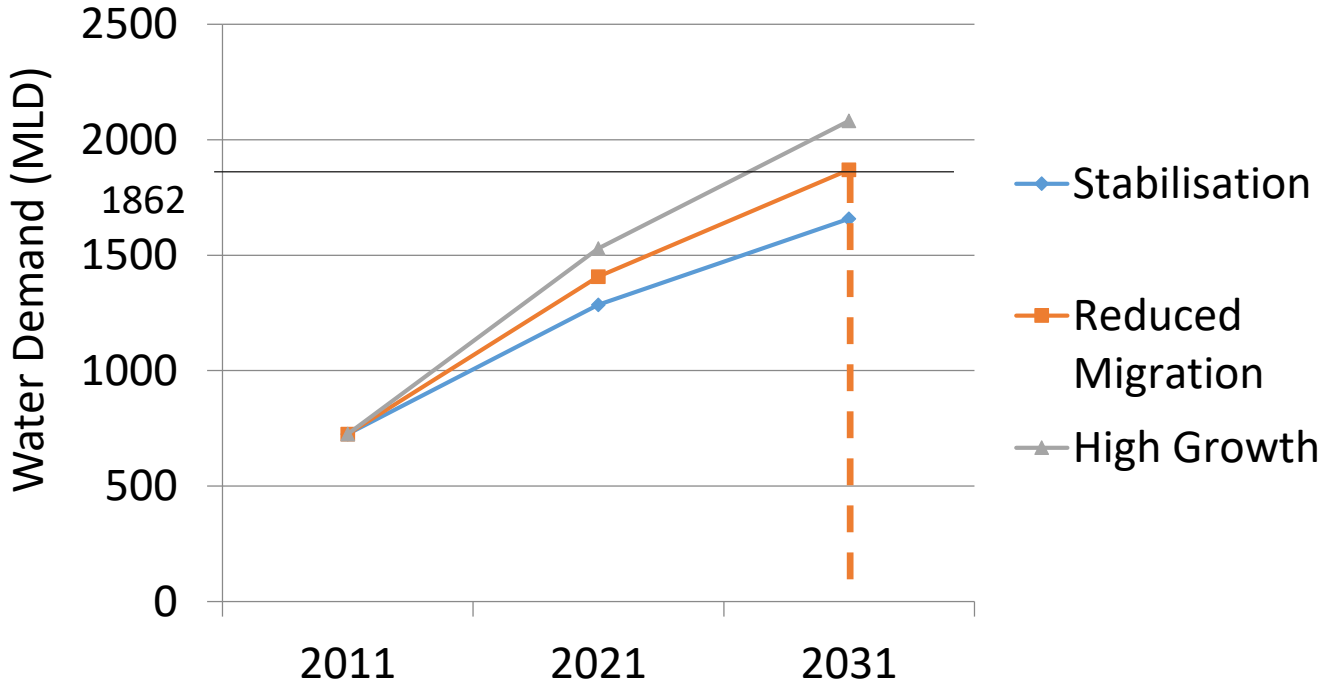
WASTEWATER REUSE Hazira Industries



	STP with capacities
A	Variav-Kosad (84 MLD)
B	Singanpore (100 MLD)
C	Bhesan (100 MLD)
D	Asarama (15 MLD)
E	Karanji (100 MLD)
F	Anjana (82.55 MLD)
G	Bhatar (120 MLD)
	Bamroli (100 MLD)
	Khajod (25 MLD)

WASTEWATER REUSE Hazira Industries

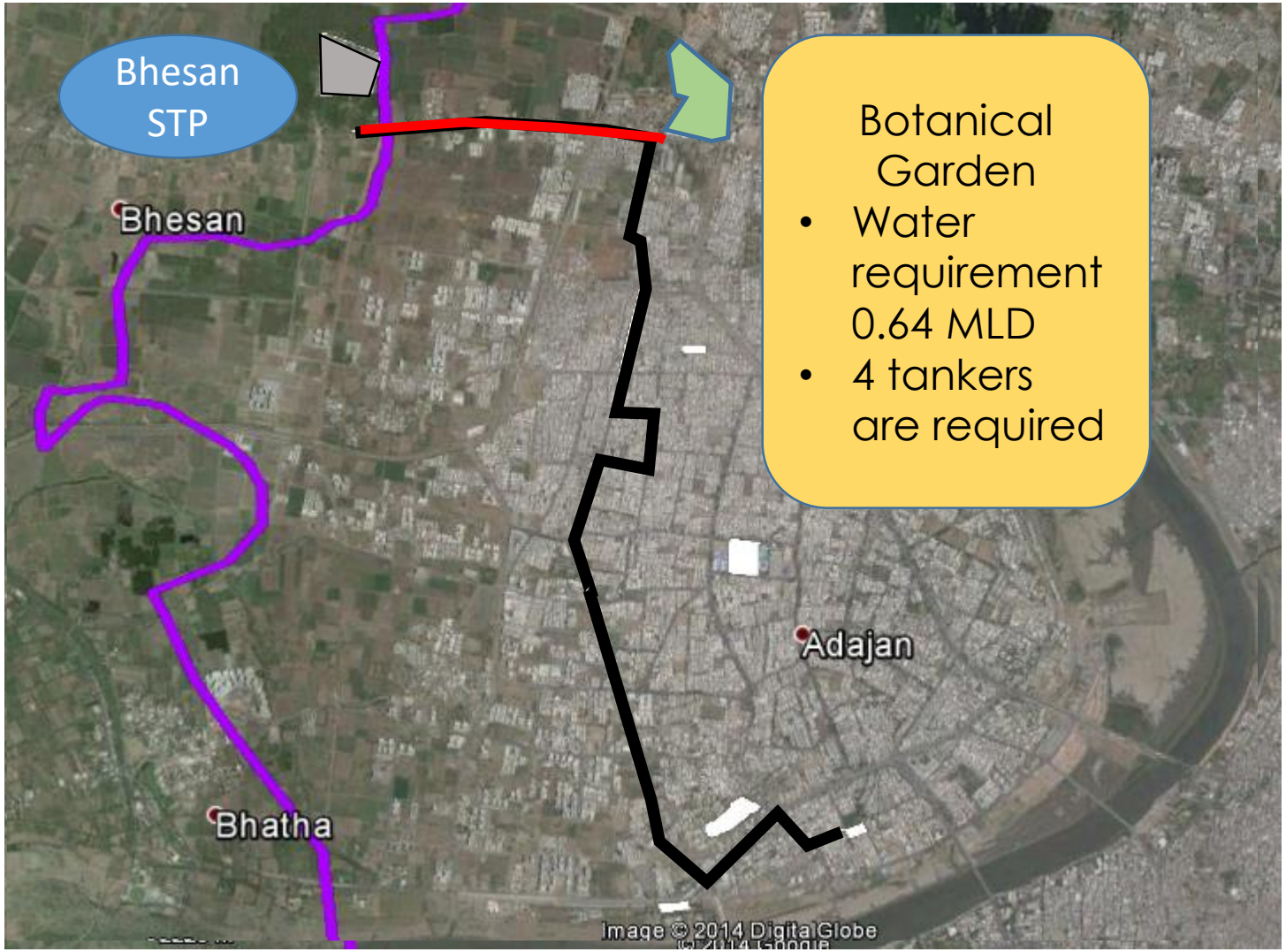




- If 150 MLD of wastewater reuse is done for Hazira Industries, the fresh water scarcity can be delayed by 4 years
- With reuse of wastewater in Urban and industrial activities, more freshwater can be made available for increasing population's domestic purpose

Source : Surat CDP (2006- 2012) & Surat City Resilience Strategy

WASTEWATER REUSE Gardening



Botanical Garden

- Water requirement 0.64 MLD
- 4 tankers are required

- Total area of all gardens within SMC boundary is 89 ha
- Water requirement for gardening purpose using thumb rule is estimated to be 10 MLD
- In west zone, gardens are densely located and hence laying down water transmission infrastructure comes out to be cheaper than transporting water by tankers

For watering all the gardens in West zone, 24 water tankers are required and their capital cost is higher than laying down water pipelines

Source : Industry practice for ahmedabad area

RAINWATER HARVESTING..

- Rainwater harvesting (RWH) is the accumulation and deposition of rainwater for reuse on-site, rather than allowing it to runoff.
- Uses include water for garden, water for irrigation, water for domestic use with proper treatment, water for ground water recharge etc.

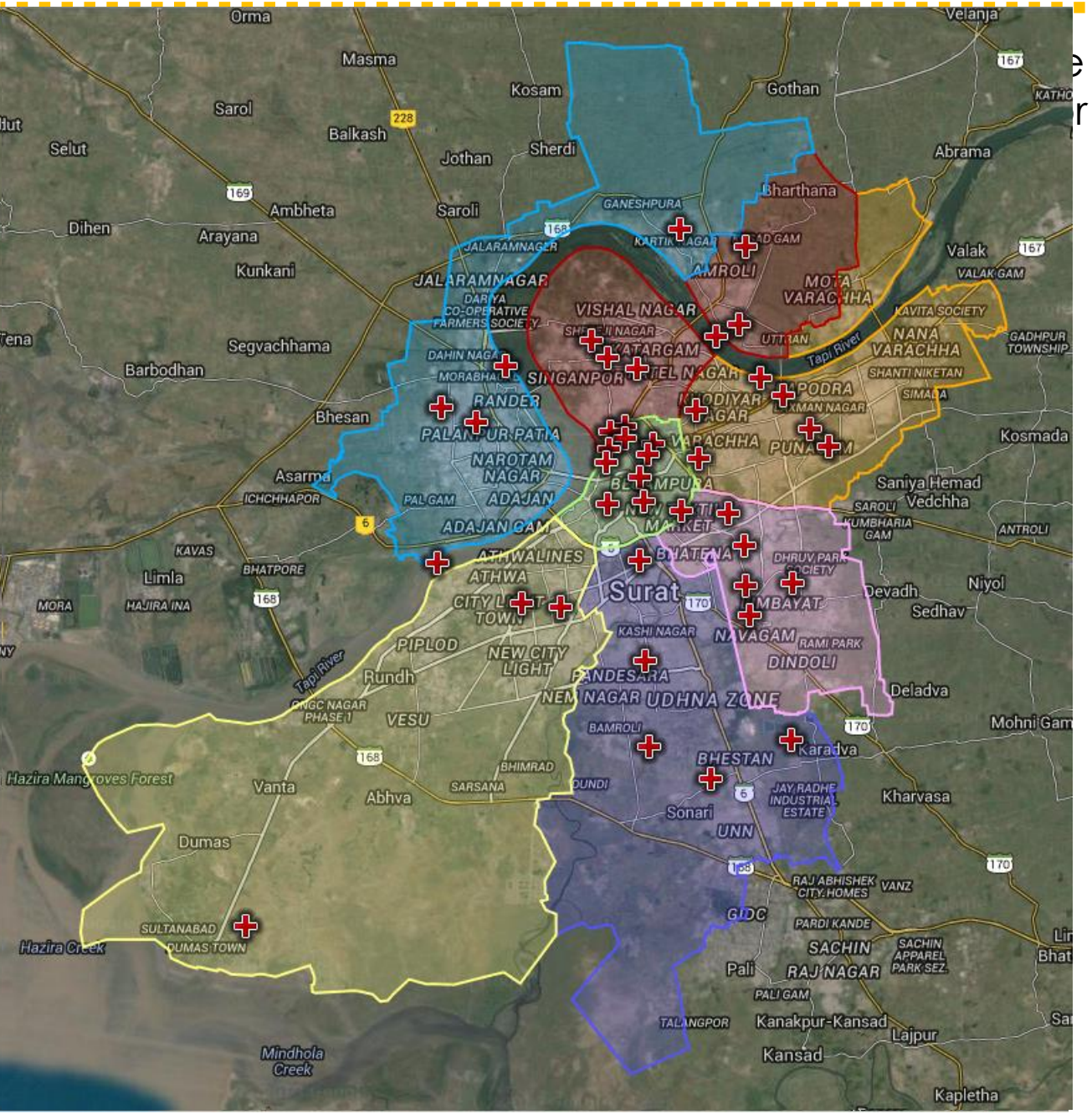
- So why does Surat need RWH?

- "Ground water table is fast depleting in the city and the natural recharge has been stopped completely. However, there is an urgent need to recharge the water tables by digging bore wells for harvesting the rainwater"

- Few years ago the residents were getting sweet water in their borewells. But, now they are getting saline water due to the depleting ground water level.
- The construction of paved areas, walls, roads and buildings has stopped the rain water to percolate in the ground thereby putting a brake on the natural recharge.

Source : TOI Article – 'SMC takes up Rainwater harvesting on a bigger scale' (2012)

POTENTIAL OF RWH IN SURAT..



Zonal Offices (7 nos.)

Total roof area covered – 5624 sq. m.

- East zone- 11 parks

Civic Centres (17 nos.)

Total roof area covered – 10342 sq. m.

- ૭,૦૪,૯૩૭ sq. m.

Health Centres (41 nos.)

Total roof area covered – 24651 sq. m.

Total roof area – 40617 sq. m.

Source :SMC website – www.suratmunicipal.org

SAMPLE CALCULATIONS FOR RWH..

Morarji Desai Garden

- Area – 6138 sq. m.
- Avg. rainfall – 1139 mm
- Volume of rainfall over the plot = 6138x1.139
  = 6991 cum.
  = 6.9 million lt.
- Runoff coefficient for parks = 0.1-0.25
- Coefficient for evaporation, spillage and first flush wastage = 0.80

- **Effective harvested water quantity** = 6.9x0.15x0.8
  = **0.828** million lt.

- Water required for dry period i.e. 245 days
- Water requirement for garden per hectare = 22500 lt/day (As per Indian railway manual on water supply)
- **Total water requirement** = 245x22500x0.6138
  = **3.3** million lt.

RWH will be able to meet water requirements of only around 60 days if water is stored.

Source : SMC website – www.suratmunicipal.org; Rainwater Harvesting and conservation manual by CPWD, GOI;

SAMPLE CALCULATIONS FOR RWH..

SMC central zone office

- Roof Area – 2073 sq. m.
- Avg. rainfall – 1139 mm
- Volume of rainfall over the plot = 2073x1.139
  = 2361.14 cum.
  = 2.4 million lt.
- Runoff coefficient = 0.80
- Coefficient for evaporation, spillage and first flush wastage = 0.80
- Effective harvested water quantity = 2.4x0.8x0.8
  = 1.536 million lt.
- As per table from CGWB guide, RWH quantity = 1.72 million lt.

- **We can safely assume RWH quantity as 1.6 million lt.**

- Assuming 300 employees
- 45lpcd water is required in offices as per cpheeo
- **Water requirement** = 365x300x45
  = **4.9** million lt.

RWH will be able to meet water requirements of only around 120 days if water is stored.

Source : SMC website – www.suratmunicipal.org; Rainwater Harvesting and conservation manual by CPWD, GOI;

COST OF STORAGE TANKS AND RECHARGE STRUCTURES FOR RWH..

Cost of storage tank

- In case of Morarji Desai garden = 0.828 million lt. (828 cum)

Cost of storage tank = Rs. **6.5 lakhs**

- In case of SMC office = 1.6 million lt. (1600 cum)

Cost of storage tank = Rs. **12.5 lakhs**

Cost of Recharge Structures for Ground water recharge

- Cost of typical recharge pit (1-2 m wide and 2-3 m deep) – Rs. 6000 to Rs. 12000 (Suitable for shallow aquifers)
- Cost of recharge pit through trench (0.5-1 m wide and 1-1.5 m deep and 10-20 m long) – Rs. 12000 to Rs. 24000 (Suitable when permeable strata of suitable thickness is available at shallow depth)
- Cost of bore wells/ tube wells (100-300 mm dia. and 10-30 m deep) – Rs. 120000 to Rs. 192000 (Suitable where ground water level is low and land availability is less.)

Comparing the costs and the number of days for which the water requirement is met, it is not viable to construct storage tanks.
Bore wells for ground water recharge will be apt in Surat's case.

As per the calculation (105 parks and 65 buildings), the total quantity of water available for ground water recharge = **140 million lt. (26% of yearly water requirement)**

Source : Rainwater Harvesting and conservation manual by CPWD, GOI; Schedule of rates valid for Gujarat State

REVIEW OF STATE POLICIES..

Tamil Nadu	Madhya Pradesh	Kerela	New Delhi	Gujarat
- Mandatory for all buildings irrespective of roof area - Water and sewer connection given only after RWH is implemented - Phase wise implementation - Website and information centres set up in all district offices in Chennai. They provide free technical guidance. - In case of non-compliance the authorities will provide RWH and recover it's cost through property tax.	- Mandatory for all buildings with area greater than 250 sq. m. - Separate department set up under IMC for awareness and technical guidance - Initial incentive of one year complete property tax waiver.	- Implementation of RWH structures taken up by agencies (KWA and Jalanidhi) - Mostly for groundwater recharge - KWA grants 90% subsidy while Jalanidhi grant 75% subsidy	- Mandatory for buildings with roof area more than 100 sq. m. and plot area more than 1000 sq. m. - Site inspection before issue of completion certificates - Separate RWH cell - Incentive of 50% of construction cost or Rs. 2 lakhs.	- Mandatory for buildings with area 500-1500 sq. m. Percolation wells to be provided for area of 1500-4000 sq. m.

Source : Jnnurm primer – Revision of Byelaws to make Rainwater harvesting mandatory

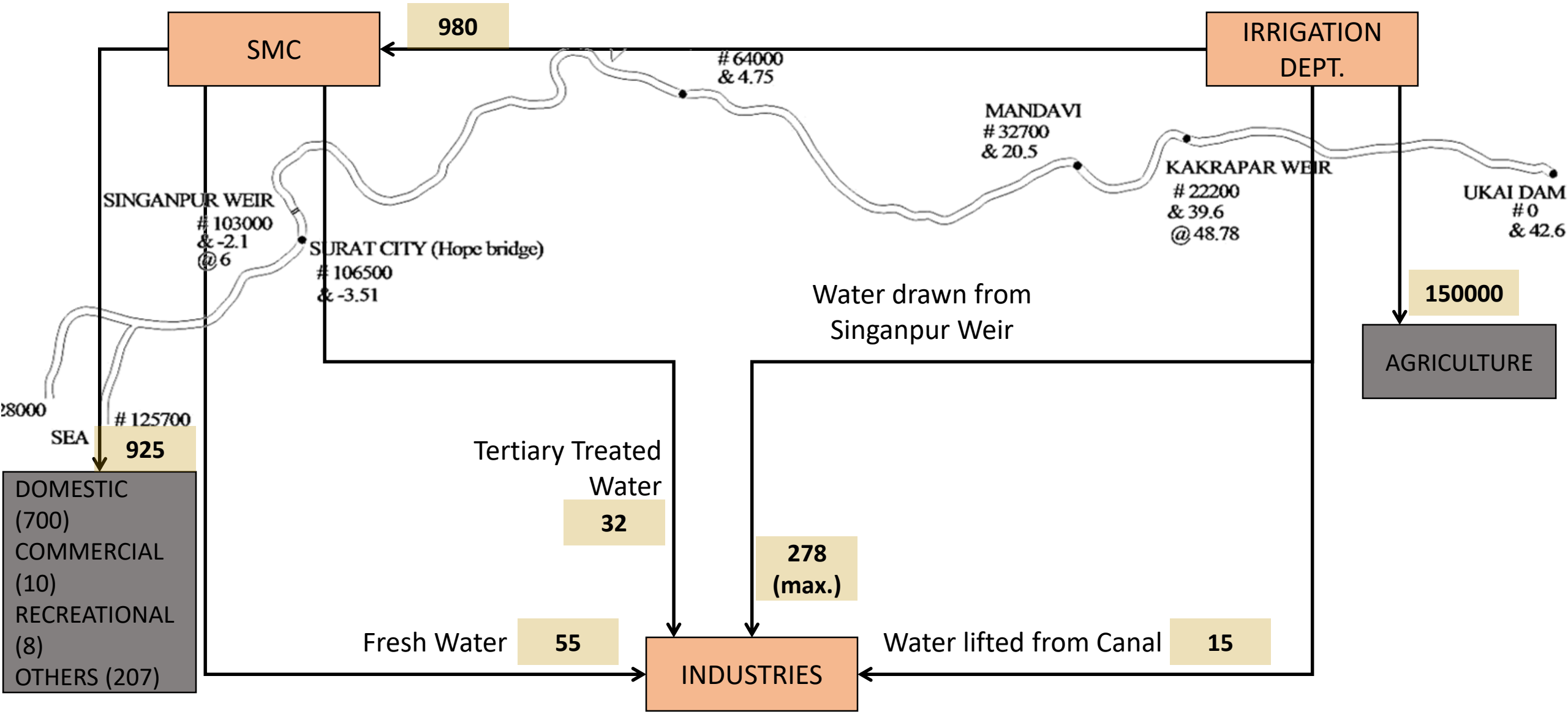
ISSUES AND AREAS OF INTERVENTION..

- Almost all policies lack provision of Monitoring and Technical aspects.
- No incentives in Gujarat do not attract much attention to RWH.
- Along with incentives, there should be provision for penalties also in case of non-compliance.
- Lack of awareness among people.
- There should be separate RWH department to ensure monitoring and implementation.
- Website and information centres should be set up.
- Not much focus is given to RWH in the ULB's budget allocation.

IUWM IMPLEMENTATION CONSTRAINT

- Surat being a water sufficient region
- Strong industrial base
- Lack of vision in resource planning
- Environment concerns overlooked
- Water being an undervalued commodity

UNDERSTANDING WATER DISTRIBUTION



Data Source: SMC and GIDC

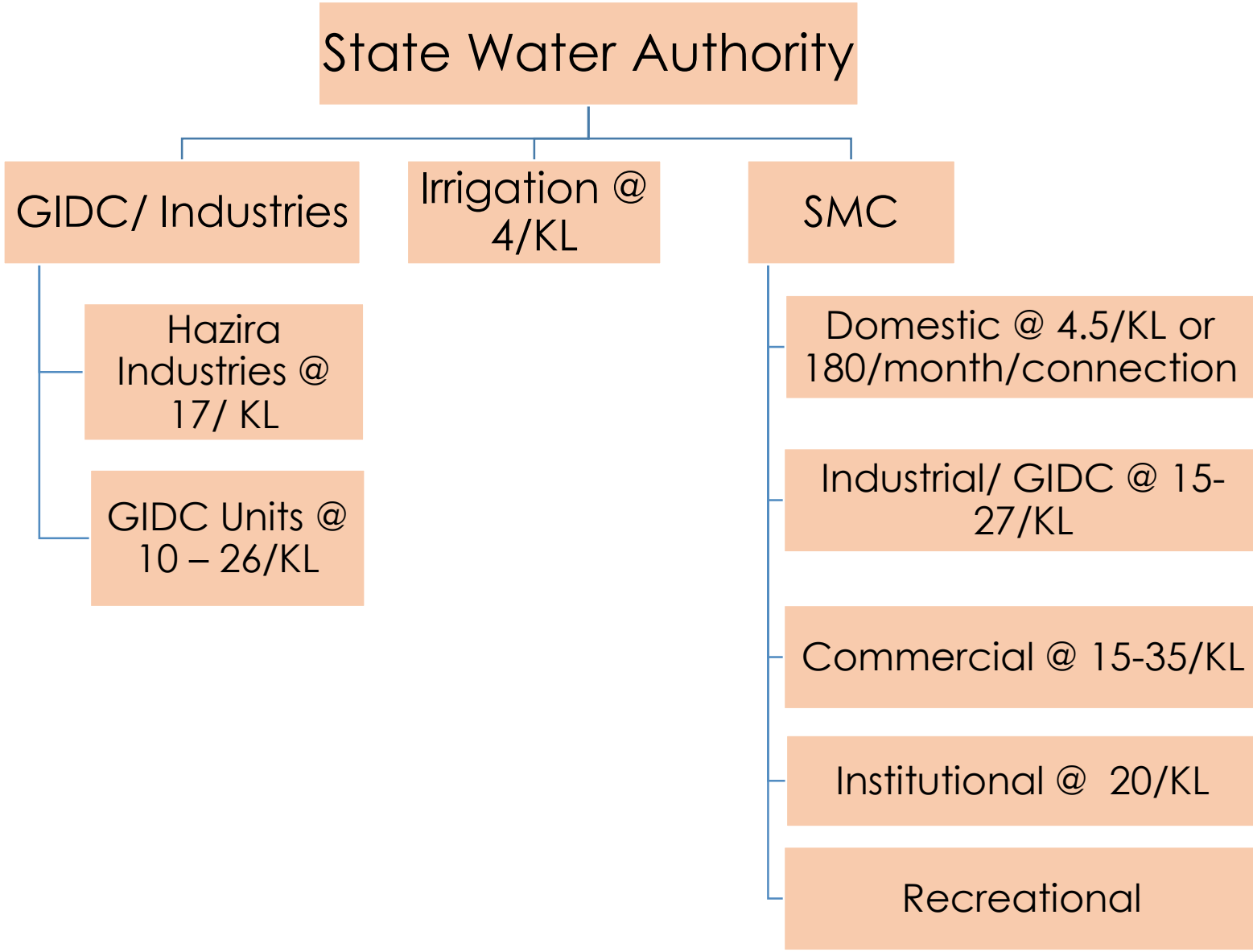
Note: All figures are in MLD

PRICE CONUNDRUM

- Water – State subject
- Multiple providers of water- Irrigation Dept, ULB, GIDC, etc
- Multiple Uses- Domestic, Irrigation, Industrial, Recreational, etc.

For best use of resource – proper pricing is a must

Market based or Regulatory based approach needs to be used



Data Source: GIDC, NWRWSK & SMC

ISSUES WITH WATER PRICING & DISTRIBUTION

- Meagre recovery of O&M cost
- Reluctance of State Governments to revise water user charges
- Low water use efficiency
- Fragmented approach to water resources planning and development
- Injudicious inter-sectoral and intra-sectoral distribution of water amongst various categories of water users
- Capital intensive projects and lack of funds for its completion

APPROACH TOWARDS PRICING

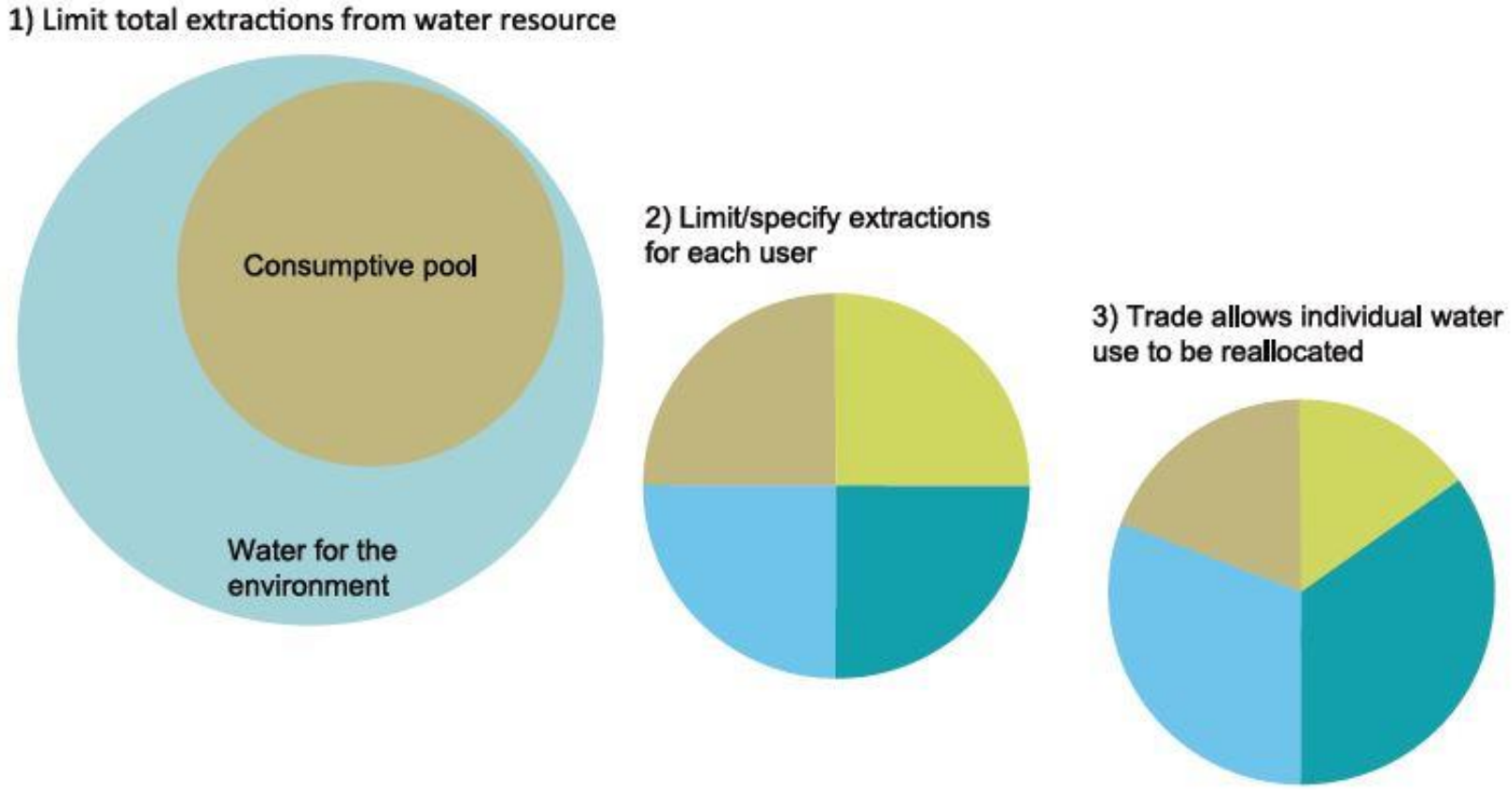
- **Market Based Approach**
  - Cap and trade method similar to that of Australian Water market
  - The objective of the cap and trade water market approach is to facilitate the economically efficient allocation of water while ensuring environmental sustainability
  - Water Markets were established under its Water Resource Act 2007

- **State Water Regulatory Authority (SWRA) Approach**
  - Best example is of Maharashtra Water Resources Regulatory Authority (MWRRA) formed under MWRRA Act, 2005
  - Main functions are:
    - To determine, regulate and enforce the distribution of water entitlements
    - Establishing water tariff system
    - Review and clear water resources projects within the ISWP
    - Determine priority of equitable distribution of water available at different scales/ levels during periods of scarcity
    - Resolve disputes with regard to entitlements and tariff
    - Promote sound water conservation and management practices

MARKET BASED APPROACH

ELEMENTS OF WATER MARKET DESIGN

- property rights to access water are secure
- market participants are well informed
- market participants take account of all the costs and benefits generated by their actions (that is, any externalities are internalized)
- low barriers to entry and few impediments to trade
- low transaction costs



MWRRA APPROACH

- MWRRA is to establish a water tariff system and to fix the criteria for water charges at sub-basin, river basin and state level through a process of **consultation with the beneficiaries**, based on the principle that the water charges shall reflect the **full recovery of the cost** of the irrigation management, administration, operation and maintenance of water resources project. It is expected to **review and revise the water charges** after every three years.
- Price for various user group designed with following principle:
  - Water as social and not economic good
  - Financial Sustainability
  - Allocation of O & M cost between each user category based on Affordability, Accessibility, Quantity and Timeliness of supply
  - WUAs to be formed and 95 % of collection to be handed over to WUA for O&M

BULK WATER TARIFF BY MWRRA

AGRICULTURE

- Rabi – Basic Rate (BR), Kharif – 50% of BR, Hot Weather – 150% of BR
- Area Based tariff
  - small farmers are incentivized
  - Incentive for adoption of micro irrigation for each crop
- Volumetric tariff
  - Not more than 75% of Area based tariff and even less for some crops

DOMESTIC

- Basic rate linked to source of supply
- Rebate for effluent treatment
- Polluter pays" principle
- Stepped tariff
  - 75 % for GP, 90% for Municipality & 125 % for MC of Basic rate
- low transaction costs
- Water for commercial use will be charged appropriately
- Additional requirement by ULBs subject to review of supply norms, water audit

INDUSTRIAL

- Polluter pay principle for all type of industries
- Incentive to Agro based industries
- Rebate for recycling provided utilization is reduced by 25%.

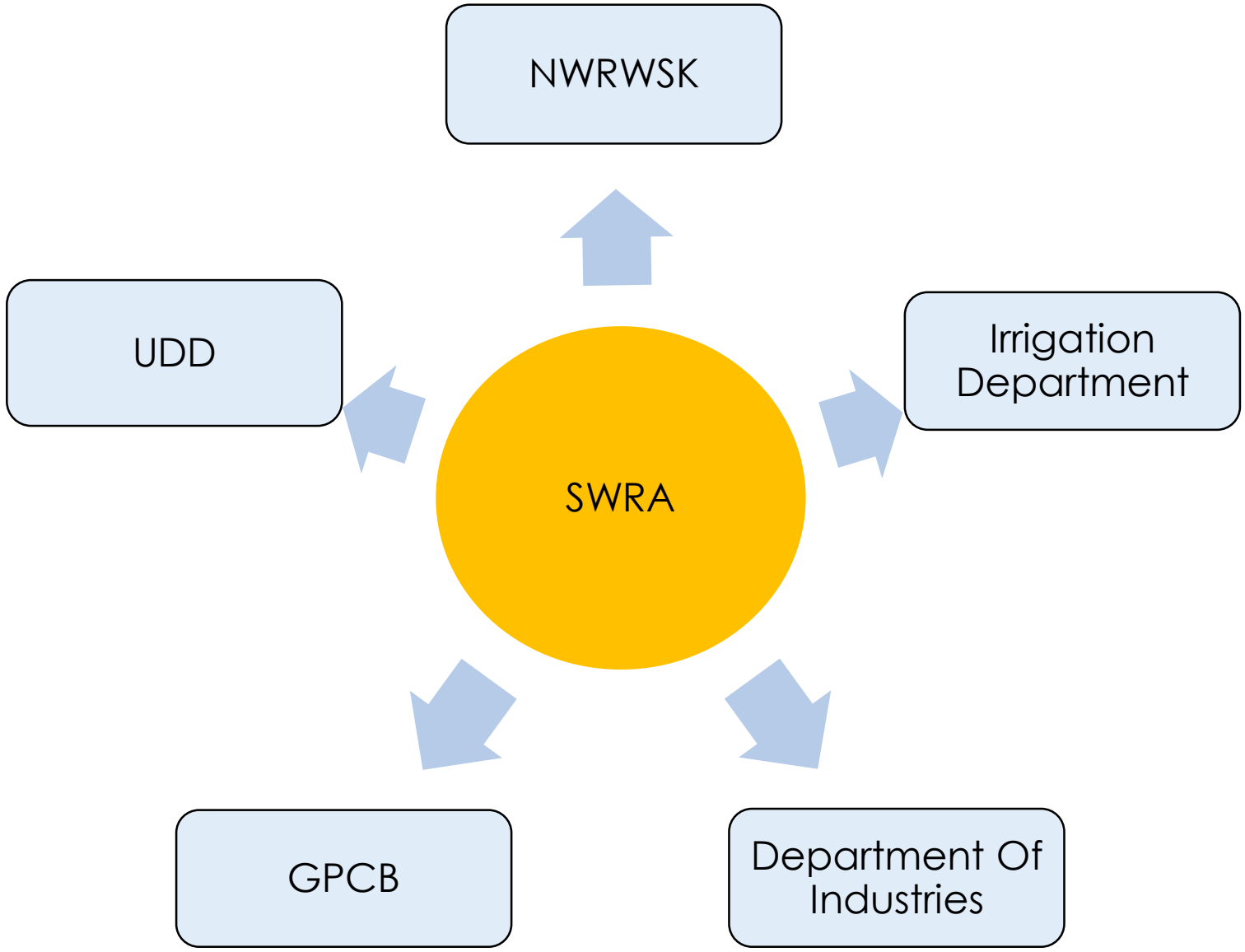
ISSUES WITH MWRRA APPROACH

- Power to allocate water across different uses was taken away from the MWRRA by amendment
- Settling of entitlement disputes by Primary Dispute Resolution Officer (PDRO)
  - PDROs are: Chief Engineer concerned with major projects; Superintendent Engineer concerned with medium projects; and the Executive Engineer concerned with minor projects
- MWRRA not truly an independent authority which it was meant to be
  - Consist of chairperson and two other members, in addition to five special invitees from each of the river basin
  - All members are retired government officials from the water resources and finance department
  - Members selected by a committee of secretaries from seven different departments headed by the Chief Secretary

POSSIBLE SOLUTIONS

- Regulatory authority needs to be independent from Implementation authority
- Members of regulatory authority needs to be professional experts in field such as Civil Engineering, ecology or Environment science, Finance or Accounts, social or political science, geology or hydrology.
- Role of elected representative should be restricted at just formulating legislation
- Selection committee must also include retired or sitting High court judge, representative from Ministry of Water Resources, GOI or CPCB, senior professor from reputed institute such as IIM, IIT, NIT, CEPT, NEERI, etc.
- State Government must constitute separate fund for Regulatory authority for its financial independence.
- Members will be barred from accepting any government or other jobs for few years
- Authority also need to have representation from Farmer's association

WATER INSTITUTIONS



CASE STUDIES

	ISSUE	KEY LEARNINGS
Brazil	Lack of Access to Water & Sanitation to rural areas due to lack of funds	**Public Participation** by legislative recognized group can be effective
Turkey	Centralized system causing Institutional & Financial burden	**Public Participation** by legislative recognized group can be effective
North China Plains	Water supply to agriculture under stress from other competing uses	**Economic incentive** via volumetric billing can bring balance
Philippines	Degradation of watershed due to pollution	People respond to **economic incentive**; integration of institutional design for enforcement & regulation is essential
Peru	Devolution causing difficulty due to poor financial capacity of ULB	**Institutional strengthening & capacity building** necessary
Zambia	Low cost recovery, poor human resource capacity& lack of clarity of roles	Reform & regulations by government by **Institutional strengthening and structuring**
Namibia	Shifting to prepayment drinking water facility due to economic difficulty	Benefit of system needs to be adequately informed to the system **(Marketing)**
Bolivia	Social Conflict due to privatisation of Water Supply	Creation of common forum to explain the need for reforms and bring about consensus **(Marketing)**
Chile	Lack of affordability by poor HHs due to privatisation	**Social safeguarding** of disadvantaged group is essential when going for privatisation

Literature Source : GWP toolbox for IWRM

Map Source : http://worldmap.harvard.edu/

PUBLIC PARTICIPATION

GOOD MARKETING OF SYSTEM BENEFITS

INSTITUTIONAL STRENGTHENING & CAPACITY BUILDING

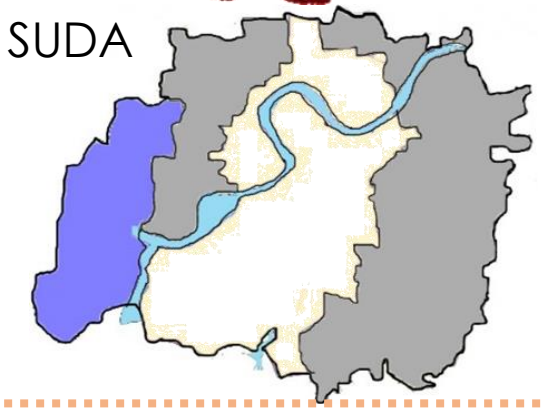
So what it takes to make any scheme successful?

ECONOMIC INCENTIVE FOR PROMOTING GOOD PRACTICE

SOUND LEGISLATIVE FRAMEWORK

SAFEGUARDING MARGINAL GROUP

WAY FORWARD.. Different types of proposal at different scale and Level

	Institutional	Policy/ Programmes	Project
1. RIVER BASIN 	Tapi Basin organization Ukai reservoir regulation Committee Water user Associations	Water demand assessment Flood Hazard zoning- towards landuse integration	
2. SUDA 	Rainwater harvesting & Wastewater Reuse	Institutional Mechanism for Integrated Water Management	•Wastewater Reuse in Urban and Industrial activities •Proposal of a 215 MLD TTP
3. SMC 		Programmes for disaster management. Policy modification in other infrastructure services.	Structural & non structural measures for disaster management Infrastructure investments at city level & proposals. Equity in service delivery

THANK YOU

INFRASTRUCTURE GROUP