

Water Sensitive & Sanitized Ahmedabad

Planning for the
better future

3rd Semester
Infrastructure
Planning | MURP
DATE: 08-11-17







Under Guidance of
MEERA MEHTA
MONA IYER
MAITREE PATEL



To prepare a water sanitation plan envisioning 2035 for

Ahmedabad

WATER	WASTEWATER	SOLID WASTE	HERITAGE
 <p>Optimum utilisation of resources and enhancing water supply system</p>	 <p>Using waste water and sludge as a resource with improved service level</p>	 <p>Delivering equitable sanitation services</p>	 <p>To revive the ancient water practices and sensitize sanitation in heritage precincts of Ahmedabad</p>

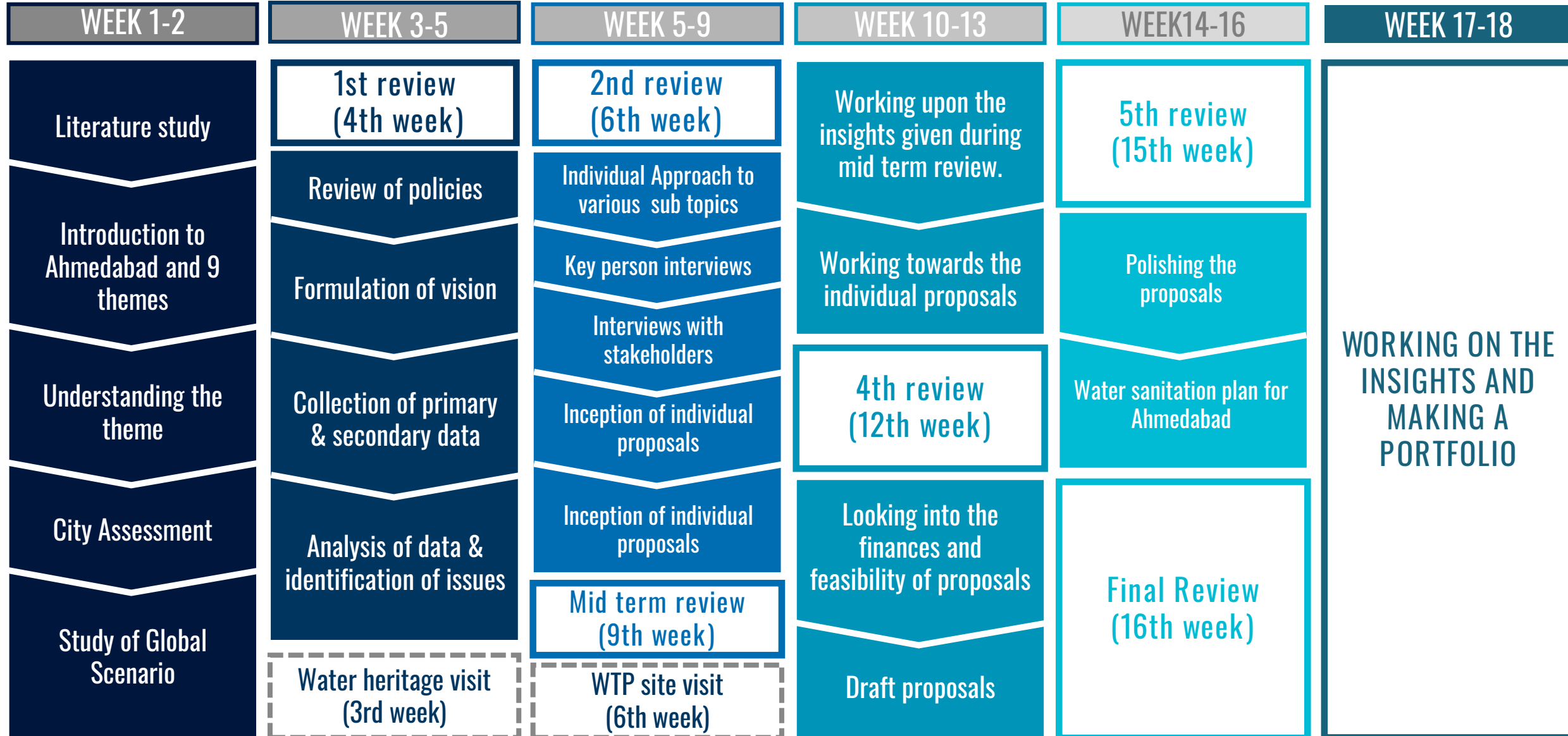
 **FINANCE** | Ensure fund allocation and cost recovery mechanisms



VISION | **Water sensitive and sanitized Ahmedabad**

Service • Resource • Finance

Methodology



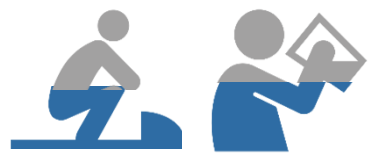
Water Sanitation at Global Level

MILLENNIUM DEVELOPMENT GOALS (2000-2015)



The MDG Gap Task
Force Report 2015

SUSTAINABLE DEVELOPMENT GOALS (2015-2030)



Reduction in lack of access to water & sanitation to half



Equitable access



Hygiene



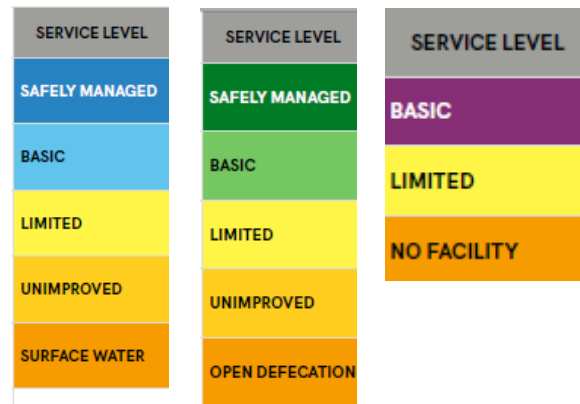
Affordable



Needs of women

JMP Service Ladder Benchmarking

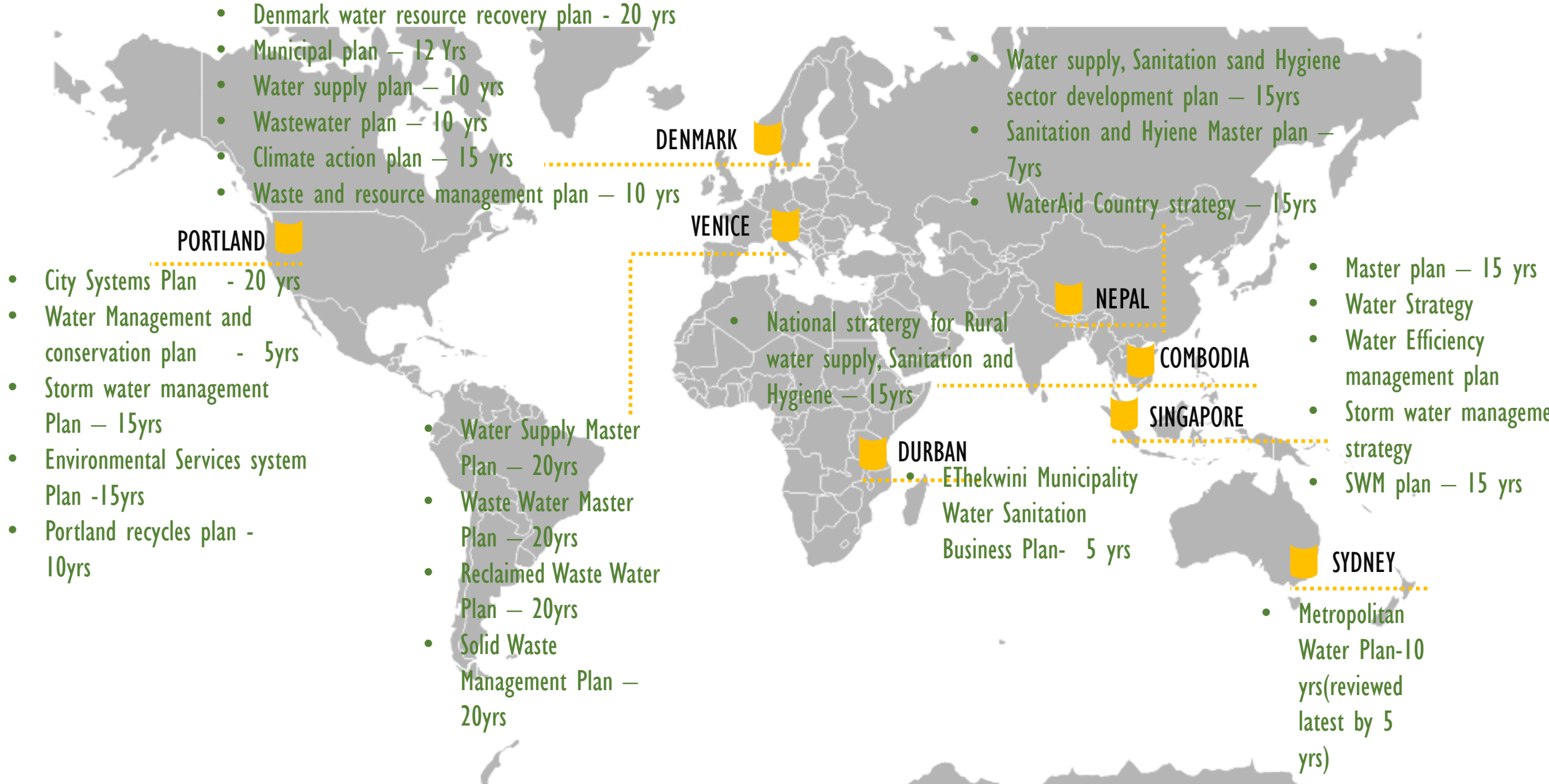
Improved Drinking water source
Improved Sanitation facilities
Improved Hygiene



Progress on Drinking Water,

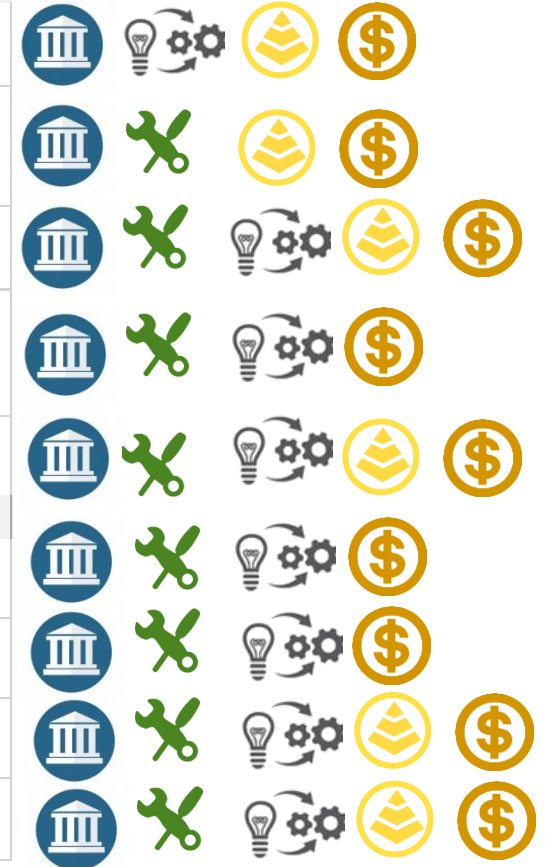
Sanitation and Hygiene (2017)

Global Perspective on Water and Sanitation



Global Perspective on Water and Sanitation

SECTORS COVERED										
	City Plans	Water Supply	Waste water Management	Stormwater Management	Ground Water Recharge	Toilets	Water Recycling & Reuse	Solid Waste Management	Urban Poor	Heritage
PORTLAND										
1	Citywide systems plan									
2	Water Management & conservation									
3	Storm water management									
4	Environmental Services system Plan									
5	Portland Recycles Plan									
VENICE										
1	Water Supply Master Plan									
2	Waste Water Master Plan									
3	Reclaimed Water Master Plan									
4	Solid waste management plan									



 Finance

 Technical

 Implementation

 Institutional

 Capacity Building



NITI –AYOG (National Institute for Transforming India)

Align targets with UN Sustainable Development Goals

VISION

2017-18 - 2031-32

15 Year
16 Long Term Vision

Combine National Social
and SDG

STRATEGY

2017-18 - 2023-24

7 Year
Mid Term Strategy

Converts to broader vision
into implementable policy

ACTION PLAN

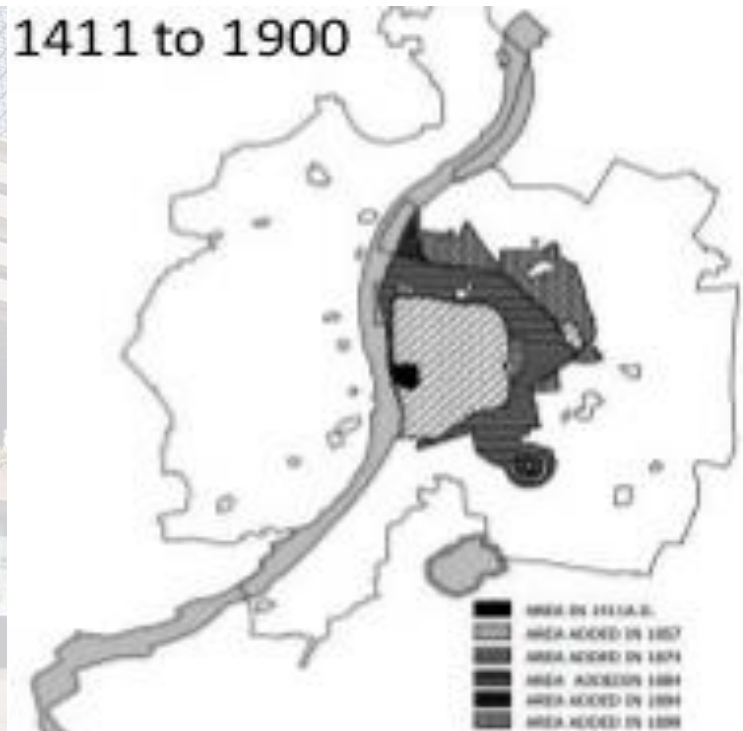
2017-18 - 2019-20

3 Year
Short Term Action Plan

Policy to actions by 2019

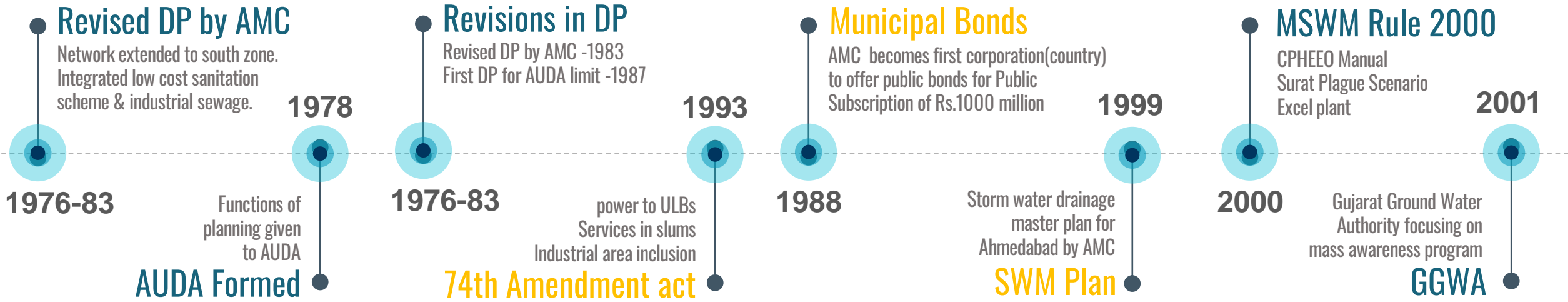
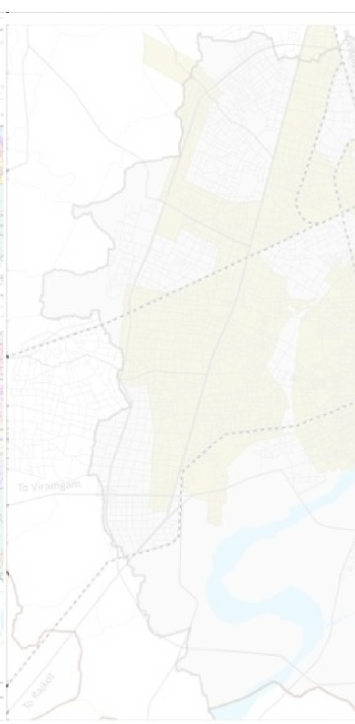
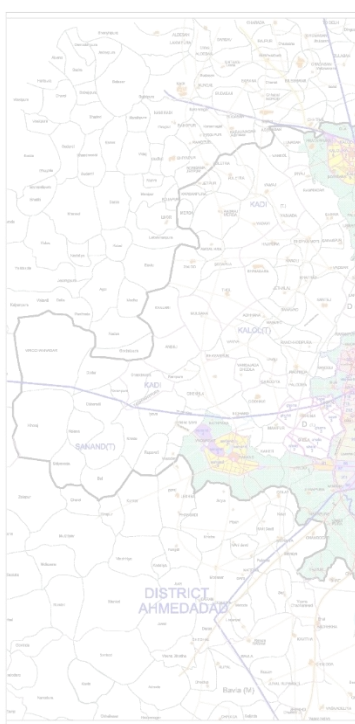
Short listed Ministries for each Goal and Programs to assist them

Infrastructure evolution of Ahmedabad (1400–2017)

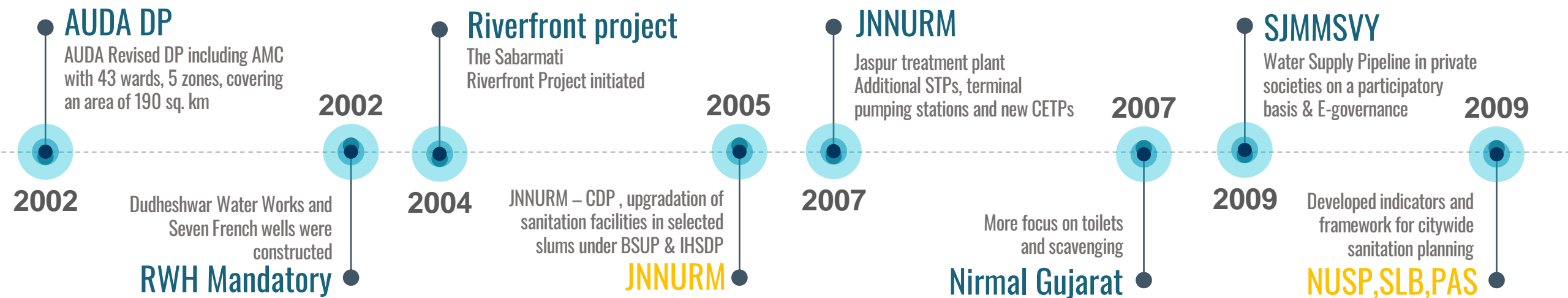
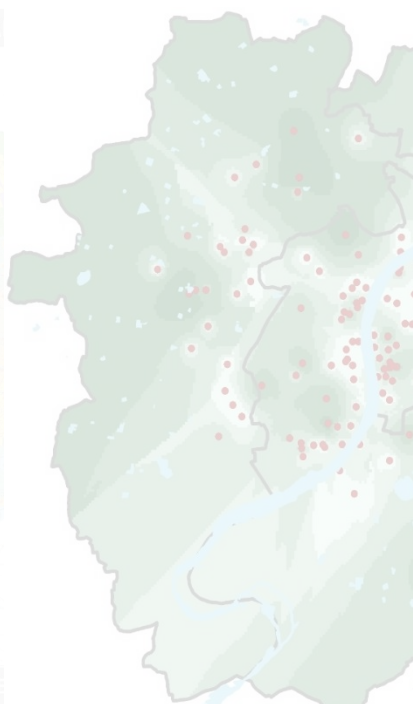
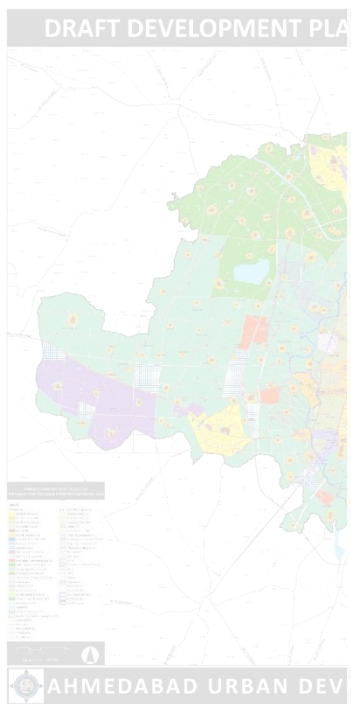


<p>1411</p> <p>Foundation of Ahmedabad On the banks of Sabarmati River, Manek Chowk, Bhadra Fort, Muhurt pol.</p> <p>1834</p> <p>Municipal work Beginning of infrastructure development</p> <p>City Committee</p>	<p>1847</p> <p>Water works Construction of First Water Tank by city committee and municipal work started for network layout</p>	<p>1890-1931</p> <p>Sewerage First sewers laid, 1894 Pirana Sewage Farm built, using sewage for irrigation. Entire Old City is sewered.</p>	<p>1950</p> <p>Municipal Corporation under the BPMC act. Expansion of water and sewer lines to the north and east. New water pumping station added</p> <p>1960</p> <p>In 1965 First Ahmedabad DP formed by AMC under Bombay Town Planning Act</p> <p>Capital City</p>	<p>1974</p> <p>GPCB Estd. In 1976, GTPUDA in into effect and formation of Development authority</p>
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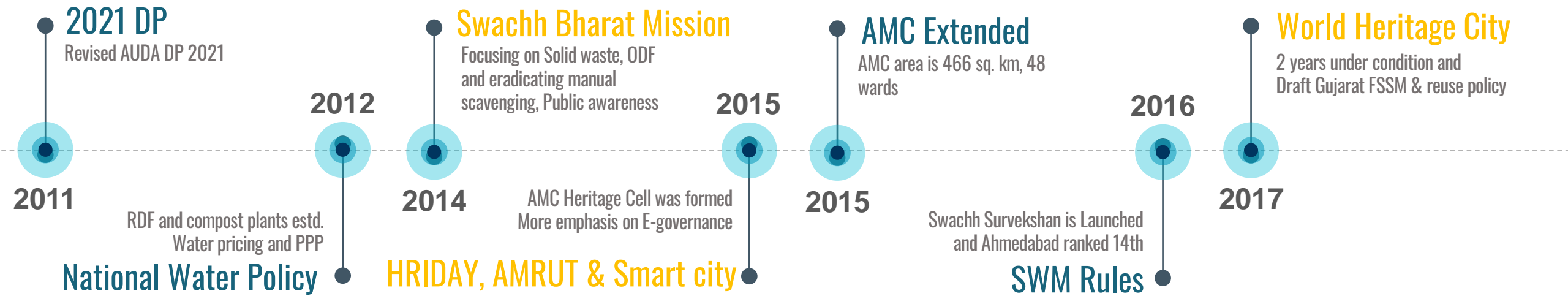
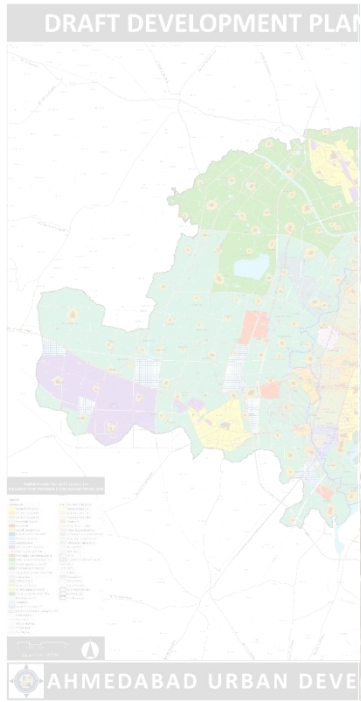
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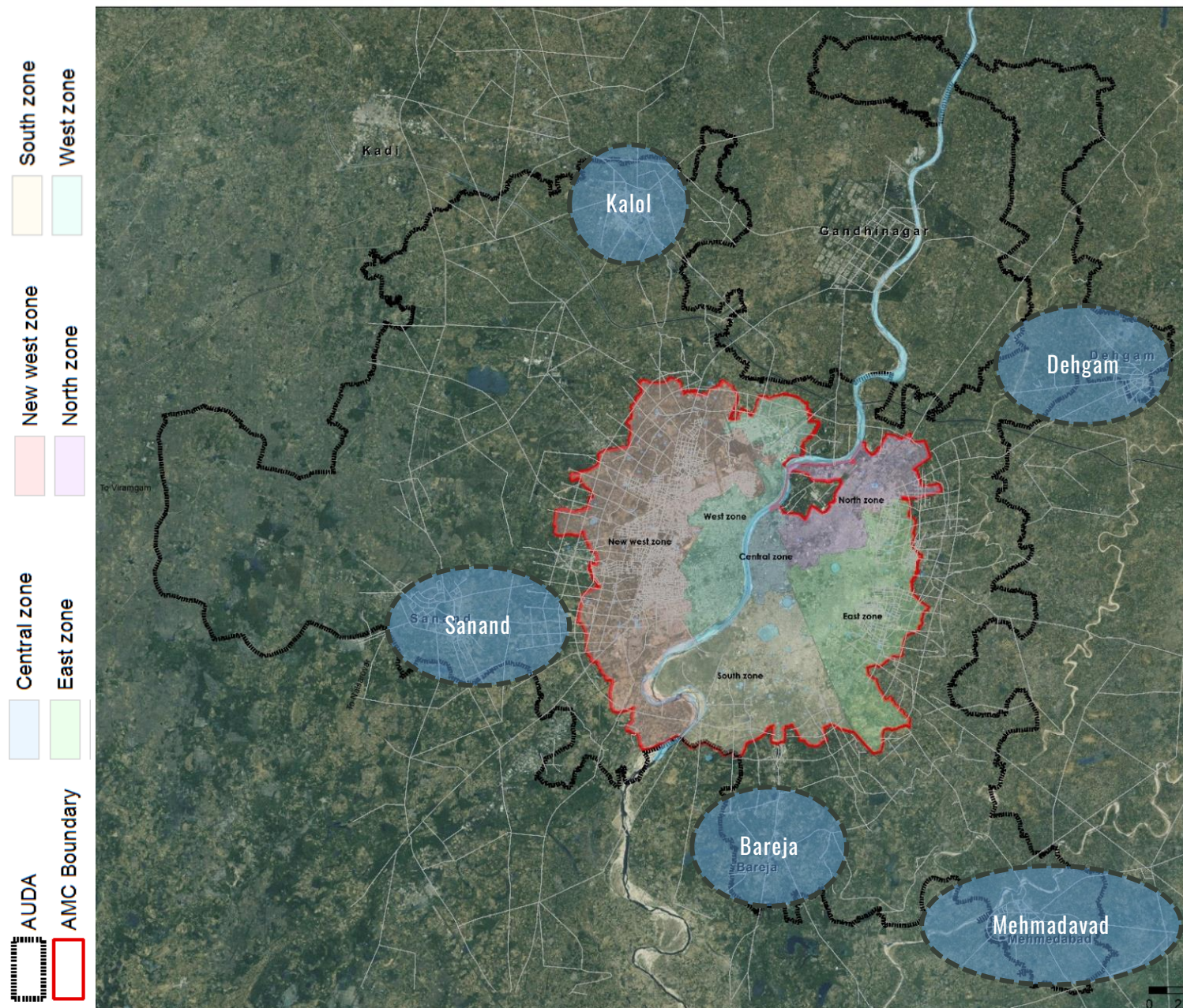
Infrastructure evolution of Ahmedabad (1400–2017)



Infrastructure evolution of Ahmedabad (1400–2017)



Ahmedabad City Profile




Administrative boundary:
AUDA(1866 sq. km) & AMC(466 sq. km)

Administrative Setup in AMC:
Zones: **06** & Wards: **48**

DEMOGRAPHY

Population 
69.5 L

Literacy 
86.6% | 79.3%
Gujarat

 Sex ratio
853 | 919
Gujarat

 Gross Density
850/sq. km

CILMATE

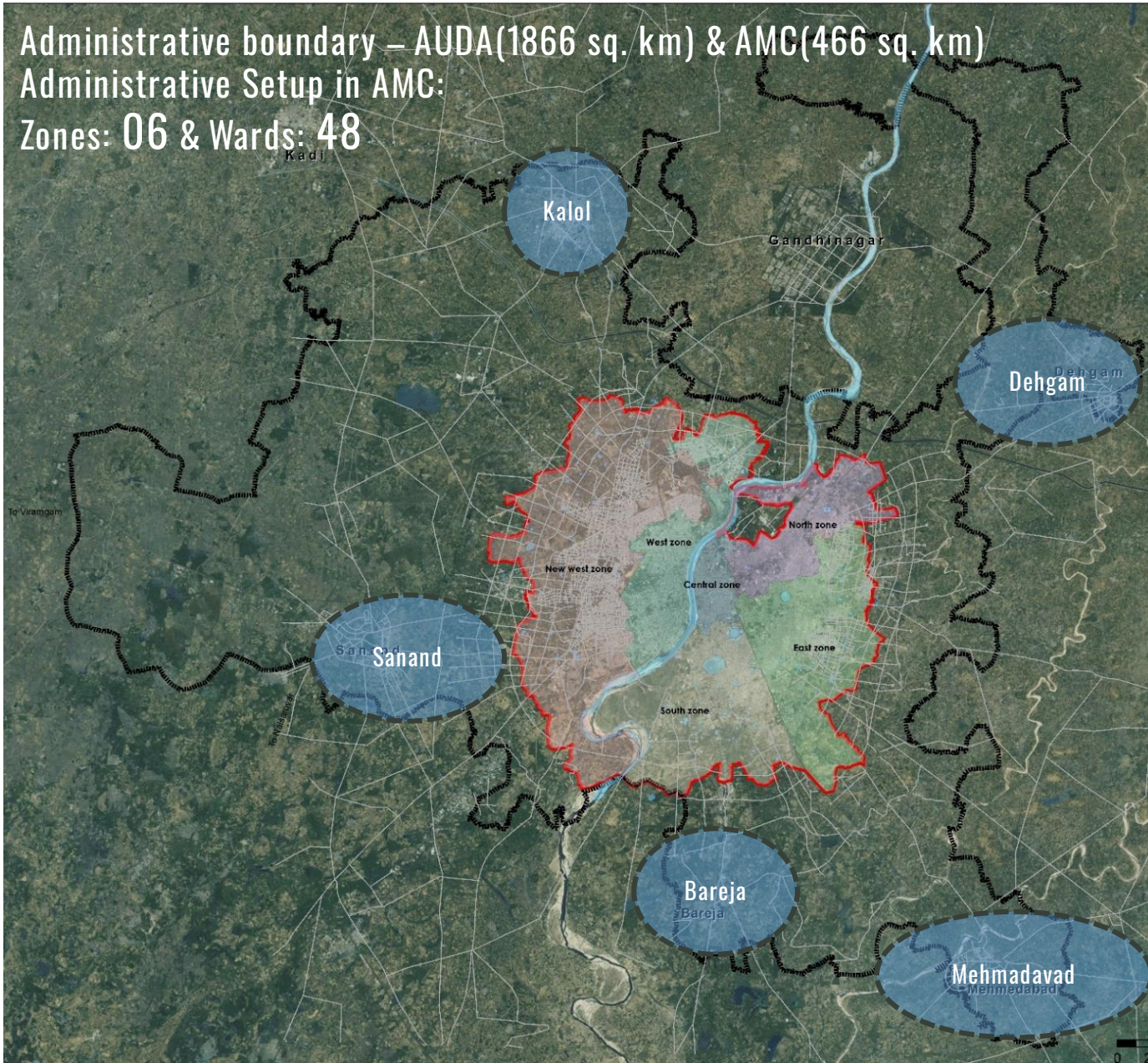
Ahmedabad experiences predominantly dry climate which is of semi-arid nature.
Average Rainfall - 750mm

Source: Census of India 2011, <http://www.ahmedabadonline.in/> India Meteorological Department (record high and low up to 2010, AUDA DP 2021)

Governance-roles and responsibilities

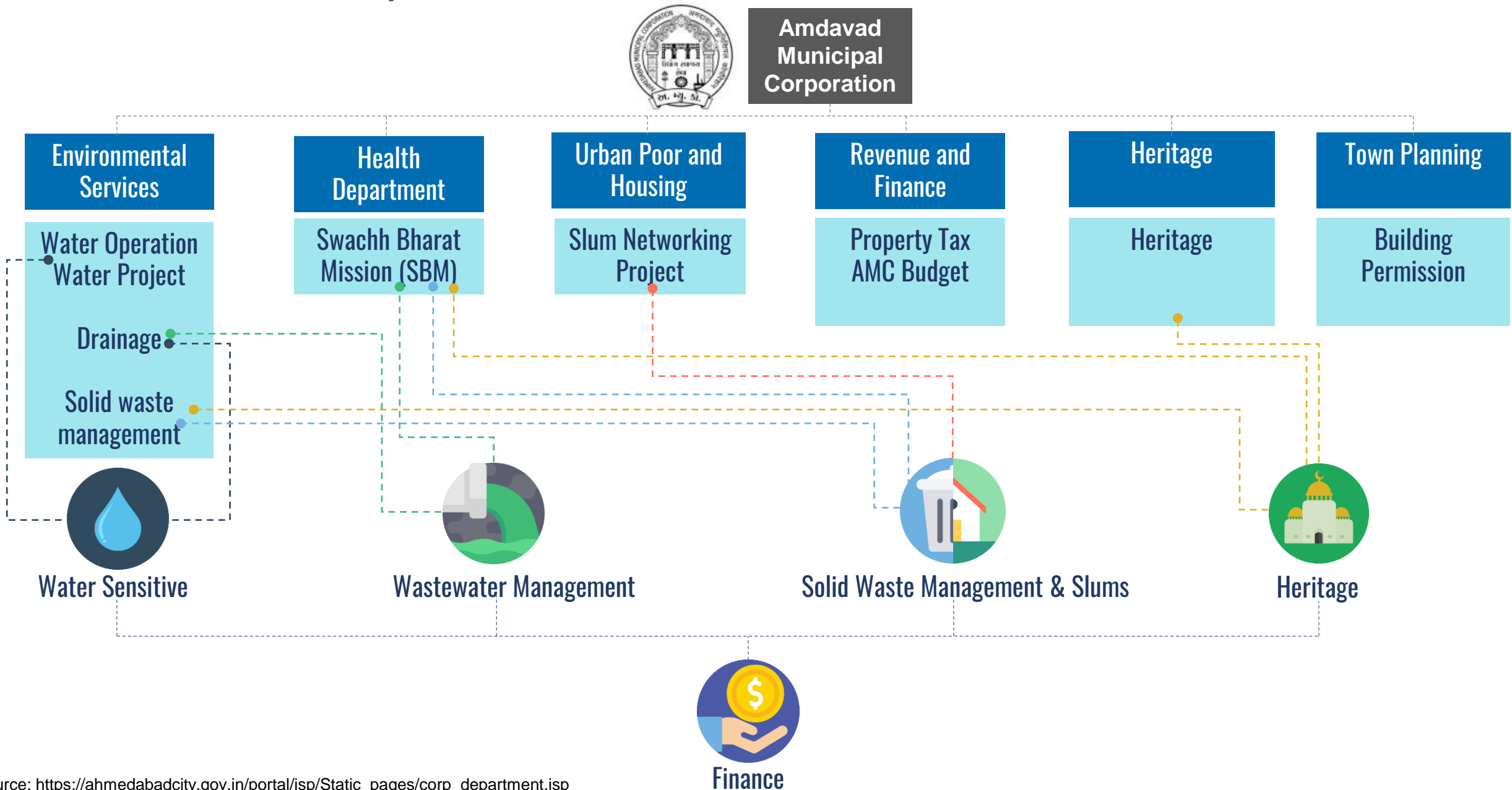
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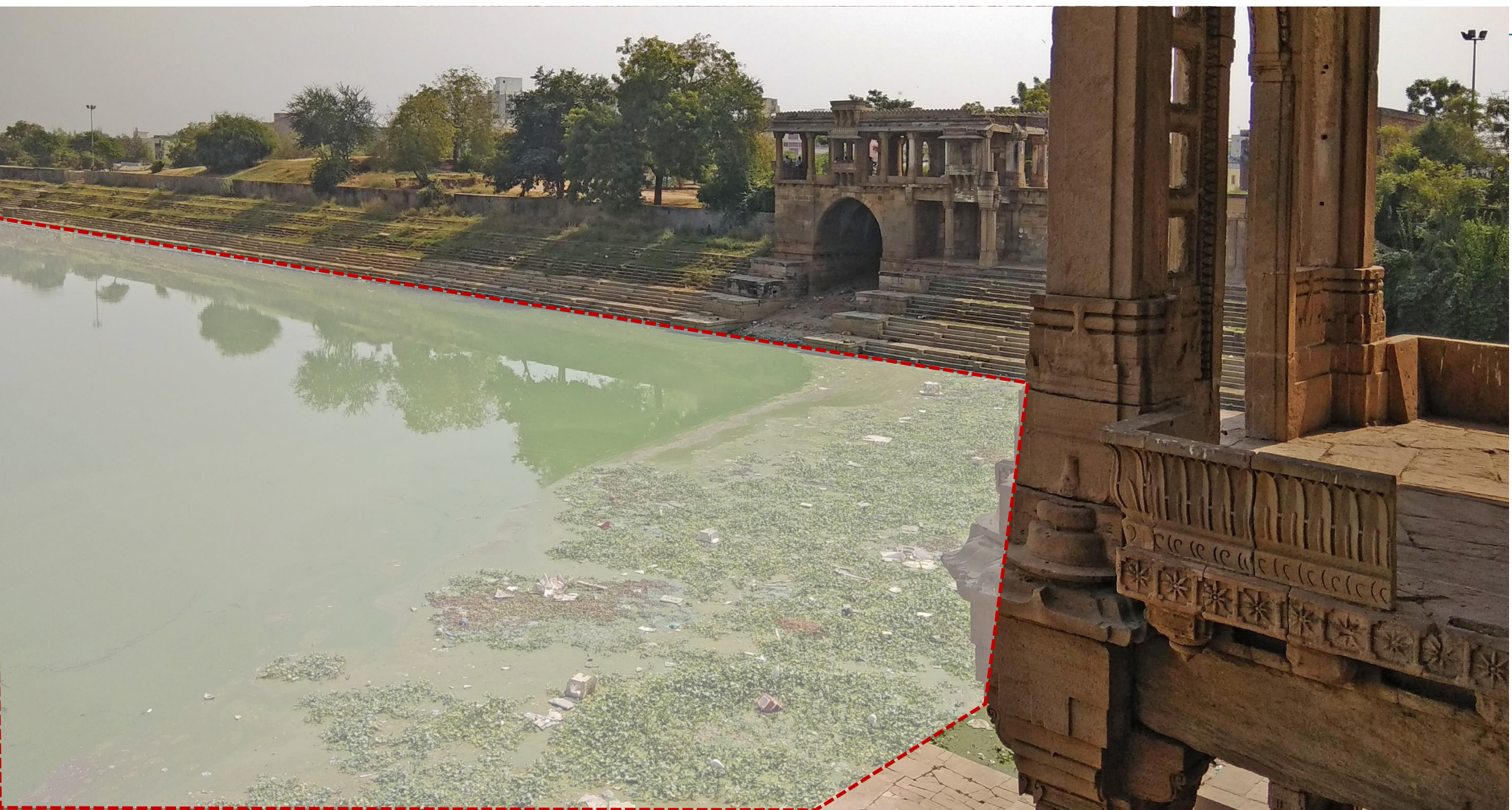
- South zone
- West zone
- New west zone
- North zone
- Central zone
- East zone
- AUDA
- AMC Boundary



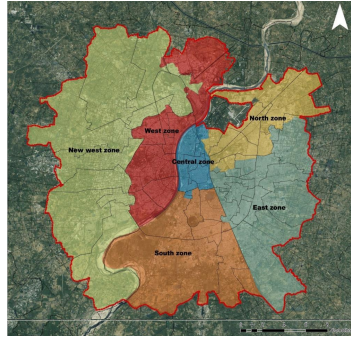
Area	Authority	Infrastructure Service Provided
Regional level	AUDA	Capex
City level	AMC	Capex & O&M
Outgrowths	Municipalities	O&M
Villages	Gram Panchayats	O&M

Governance-roles and responsibilities





What is the Budget and the Budgeting Process?



Zonal Offices



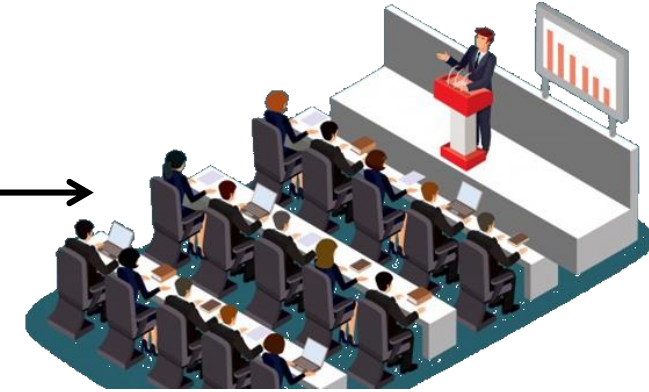
AMC
Central Office



Municipal
Commissioner



Standing Committee



General Board

AMC asks Zonal Offices for Sectoral Project Details in the month of November

Revised Budget Estimates of the current Financial year & BE for the upcoming year.

Abstract Report of Income and Expenditure estimates are presented to the Municipal Commissioner

Modifications from MC are taken into consideration if any.

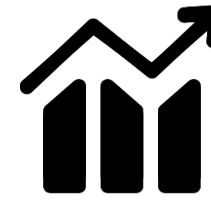
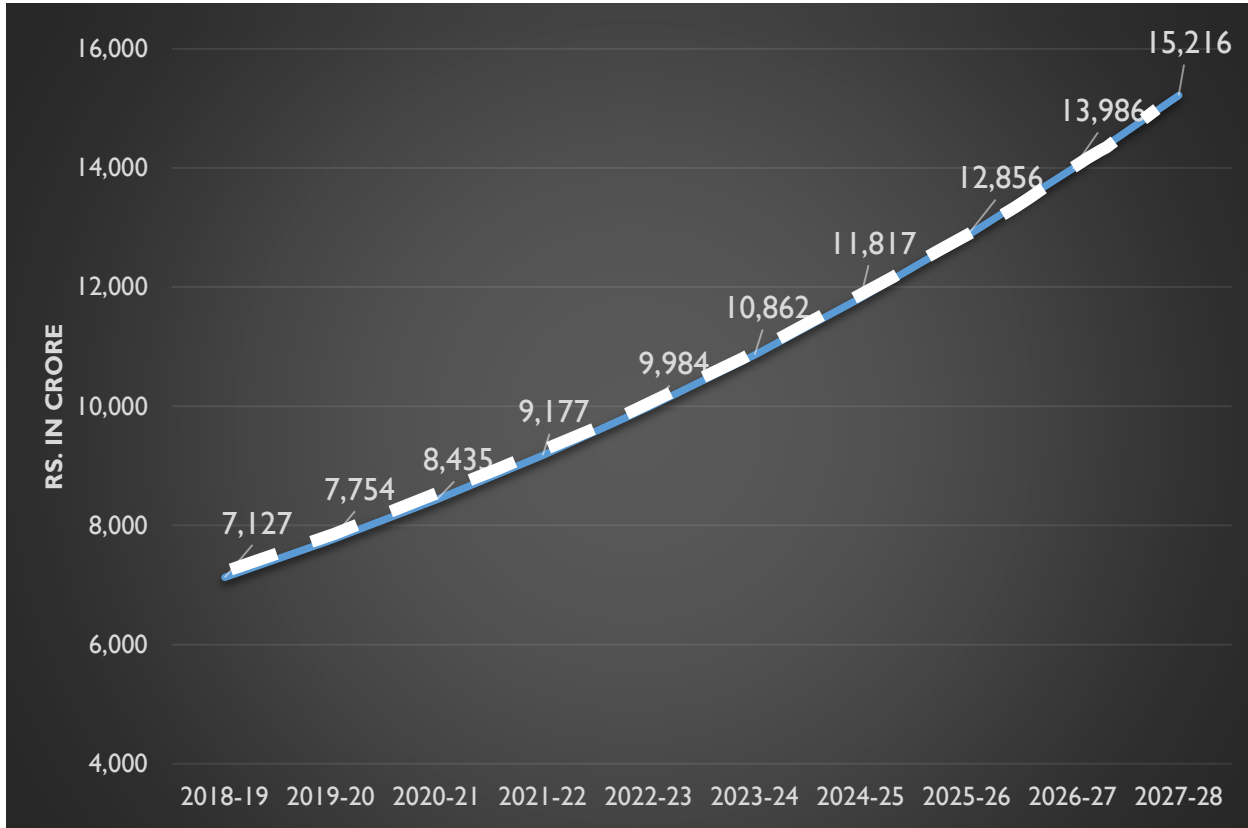
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11 members
Headed by MC

Finally, the budget estimates approved by the Standing committee are incorporated in the Budget book for the coming year and is presented to the General Board and the final approval rests within them.

4 ward councillors x 48 wards
= 192 members
Headed by Mayor

AMC Budget – In a Nutshell



Budget Projections are approx. with increase of around 7-9% each year. **9% CAGR**

Per Capita Budget Allocation

For 2011: Rs. 7,093

For 2017: Rs. 9,478

For 2027: Rs. 15,368

Per sq. km. Budget Allocation

For 2011: Rs. 8.5 crore

For 2017: Rs. 14 crore

For 2027: Rs. 33 crore

Comparison with other cities' ULB

Name of the City	Area (in sq. km.)	Population in 2017	Budget in 2017 (in Rs. Crore)	Per Capita Budget Allocation (in Rs.)	Per sq. km. Budget Allocation (in Rs. Crore)
Ahmedabad	466	69,11,432	6,551	9,478	14.06
Surat	326.5	58,71,679	5,662	9,643	17.34
Mumbai	604	1,28,64,234	25,141	19,543	41.62
Hyderabad	625	97,58,502	5,800	5,944	9.28
Chennai	426	94,66,054	5,123	5,412	12.03
Gurugram	732	20,90,996	1,836	8,781	2.51

POPULATION PROJECTION				
Year	2001	2011	2017	2027
Population	35,20,085	55,70,585	69,11,432	99,01,023
Budget (Rs. In Crore)		3,951	6,551	15,216

Water – Sanitation in Amdavad 2017



SWM

Collection efficiency

Segregation
Scientific Disposal

O&M Cost recovery

Mixing with sewerage

Network Efficiency



WATER



LPCD of supply

Metering of supply

Connection Coverage

Reuse & Recycle



STORMWATER

WASTEWATER



Water

- Supply
 - Network and its components
- Resource
 - Ground water
 - Storm water



Waste water management

- Network- Centralised WWM
 - Decentralised WWM,
 - Reuse

- Waste collection and management
- Dumpsite closure
- Slums and services
- Community and Public Toilets



- Heritage precinct's surroundings
 - Heritage water structures

Solid waste management

Heritage

What we ACHIEVE??

Improve network efficiency

System Atomisation

Improve Network efficiency

On- Site sanitation solutions

Bin free city

Community and public toilet

Improving services in slums

Maintaining heritage surroundings

Service Efficiency

Reduce Non-revenue water

Reduce ground water extraction

Storm water recharge

Recharge Ground Water

Improve treatment efficiency and reuse

Waste water reuse in DWATS

Improve waste segregation

Improving treatment and recovery

Recharging the water structures

Resource Optimisation

Water metering

Ground water tariff

Waste water reuse

Cost Reduction - network efficiency

Income from waste treatment

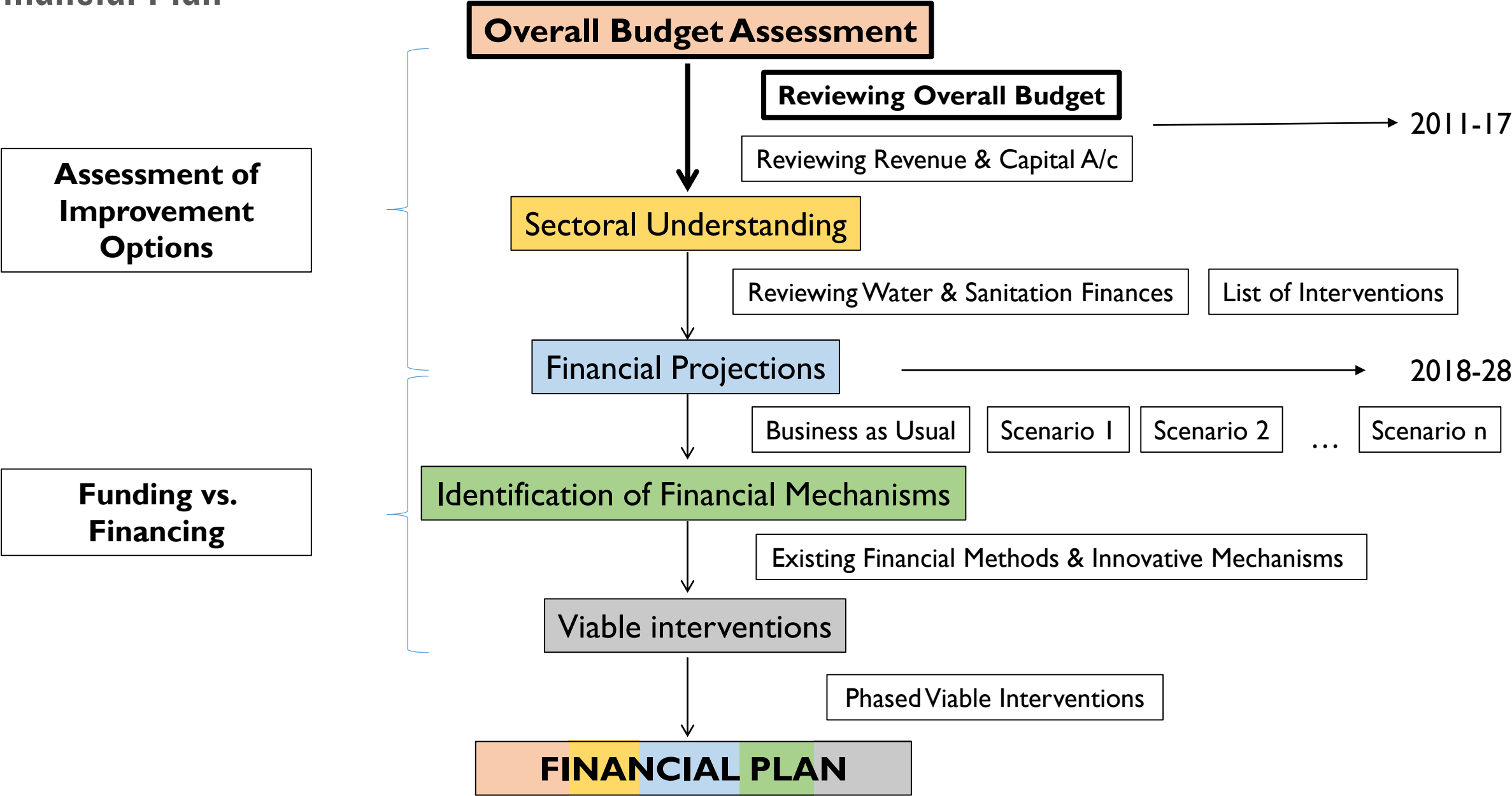
Waste management charge

Financial Improvement

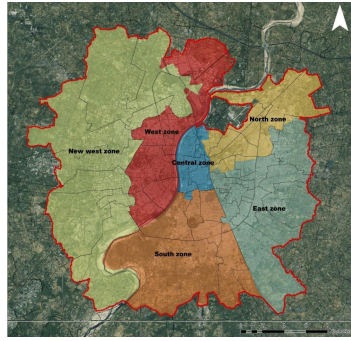
THANK YOU

Finance & Governance

Overall Budget



What is the Budget and the Budgeting Process?



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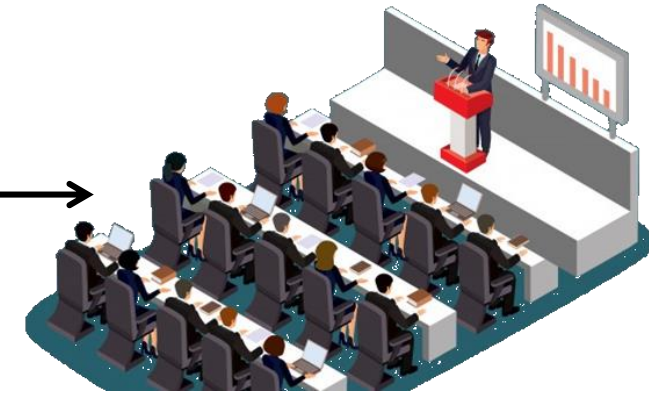
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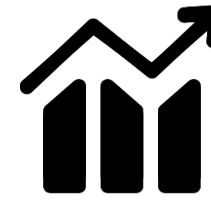
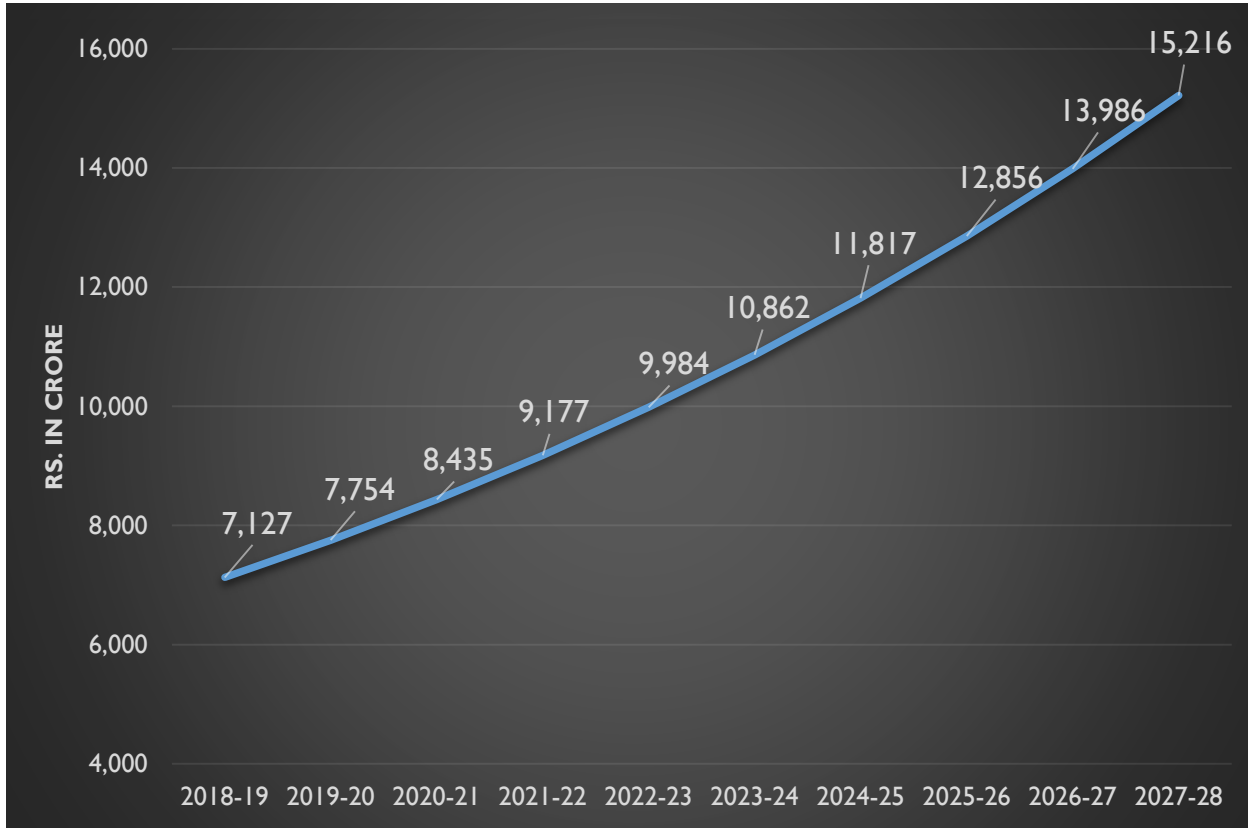
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Source: Various Newspaper Articles

AMC Budget – In a Nutshell

Particulars	2011-12(A)	2012-13 (A)	2013-14 (A)	2014-15 (A)	2015-16 (A)	2016-17 (A)	2017-18(BE)
Revenue Account							
Revenue Income	2,142	2,117	2,538	2,891	3,432	4,465	4,934
Revenue Expenditure	1,564	1,761	1,924	2,103	2,316	2,868	3,241
Surplus/Deficit	578	356	614	788	1,116	1,597	1,693
Capital Account							
Capital Income	1,369	1,442	1,941	2,372	2,577	3,012	3,310
Capital Expenditure	1,226	1,574	1,829	2,082	2,274	2,889	3,310
Surplus/Deficit	142	-132	112	291	303	323	0

Share of WSS Sector in the Overall Budget

33.4% of Total Revenue Expenditure budget

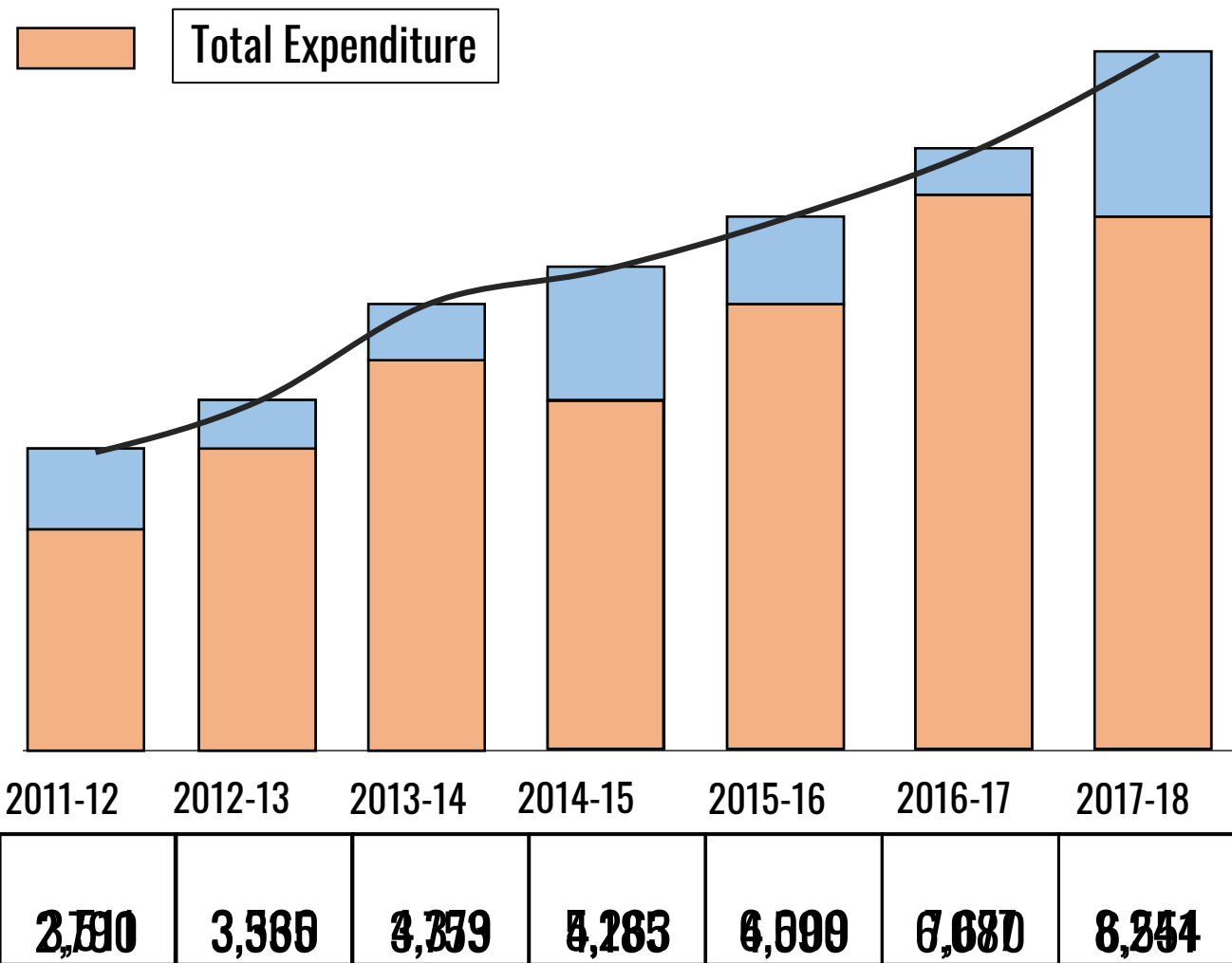
9.11% of Total Revenue Income budget

23.48% of Total Capital Expenditure budget

22.37% of Total Capital Income budget

*All the values above are in **Rs. Crore**

AMC Budget – In a Nutshell



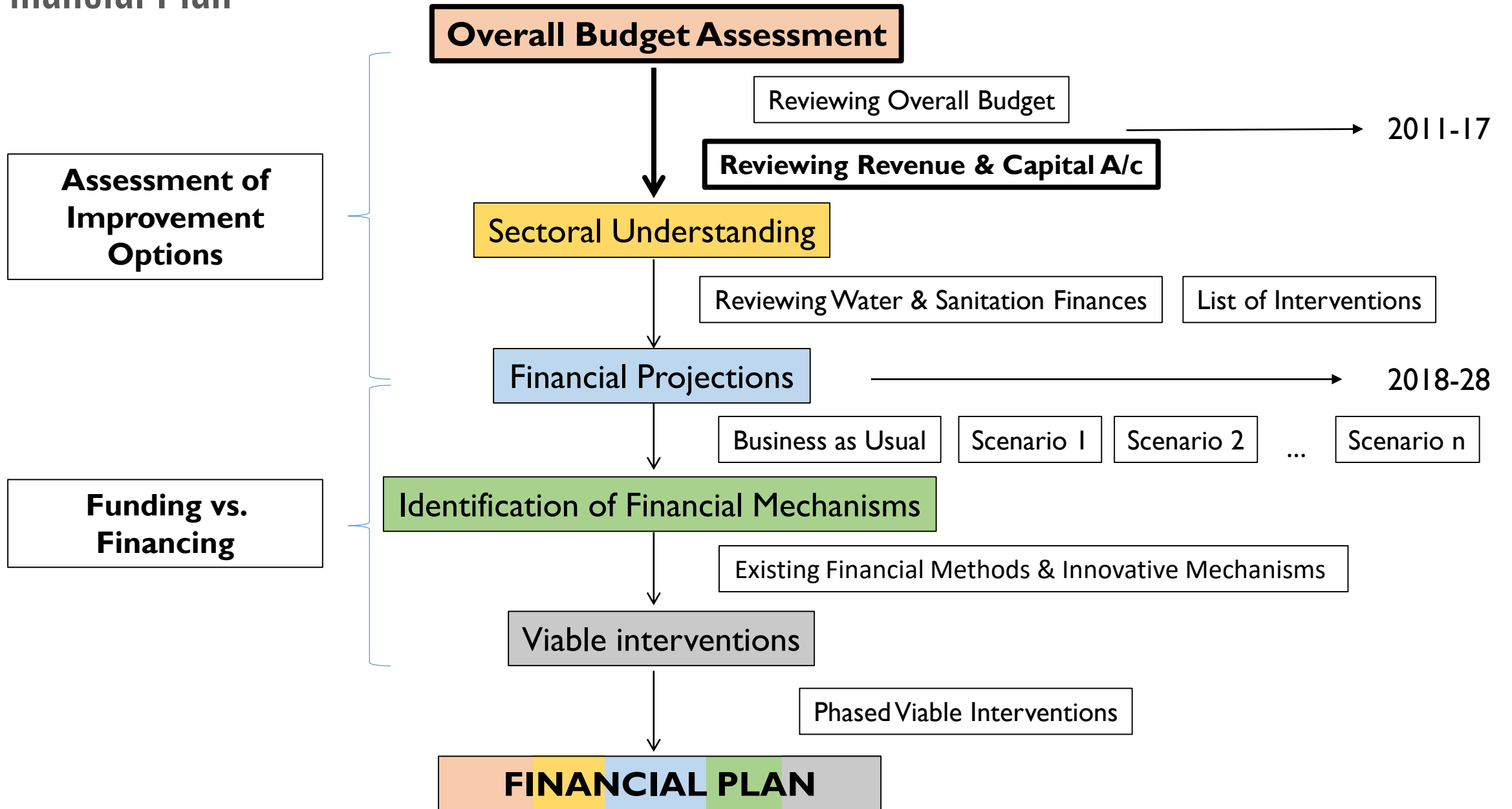
The Total Expenditure of AMC is growing at a rate of **16%** over the years.

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Total Income	3,511	3,560	4,379	5,263	6,009	7,677	8,244
Total Expenditure	2,790	3,335	3,753	4,185	4,590	6,080	6,551
Surplus	721	225	626	1,078	1,419	1,597	1,693

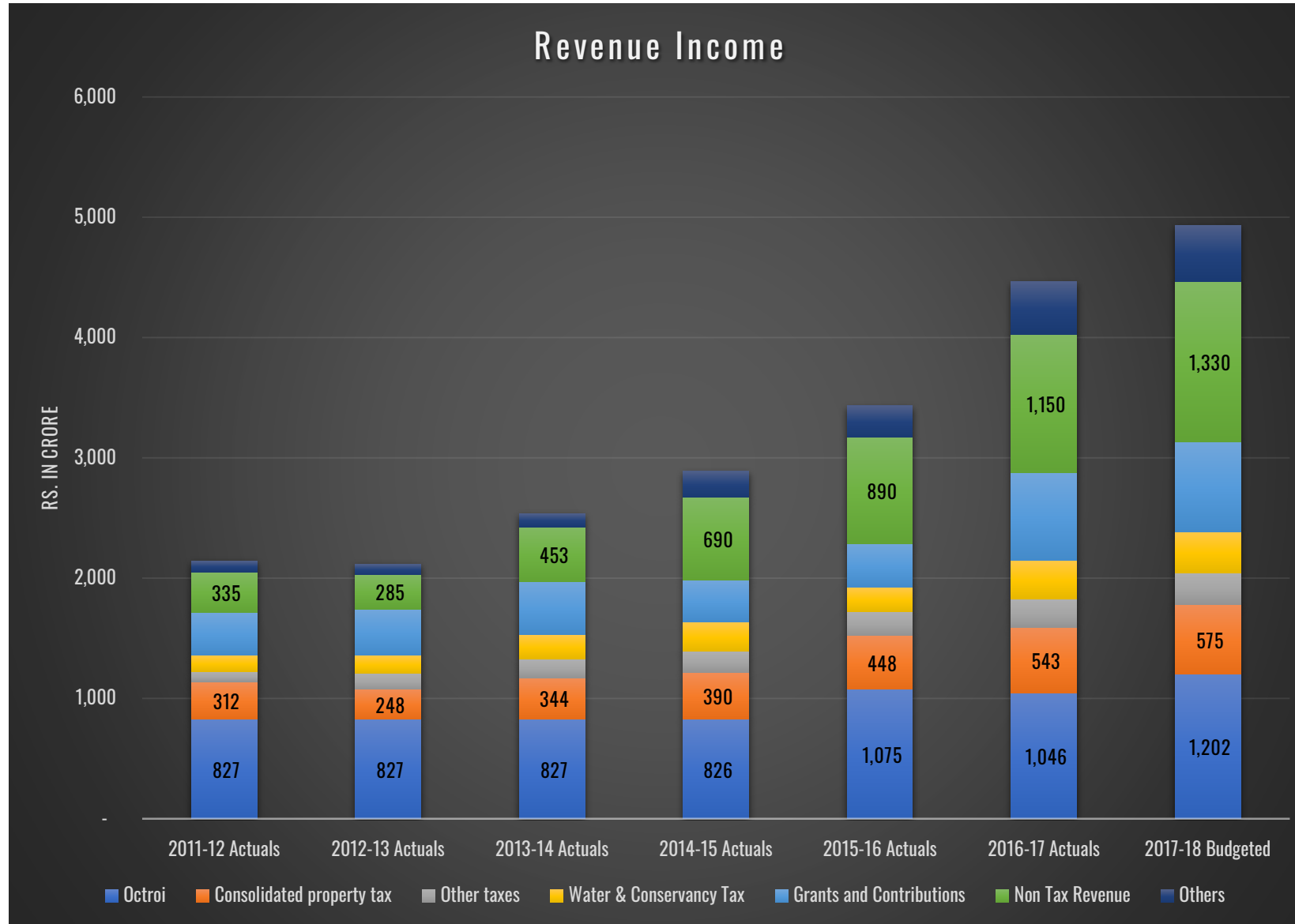
*All the values above are in **Rs. Crore**

*The above rates are calculated using CAGR method

Source: AMC Budget 2011-12 to 2017-18



Financial Analysis – Revenue Account



Non tax revenues Hire Charges, Fees, Rent on Assets, Fine

335 Cr. (2011-12) $\xrightarrow{26\%}$ **1,330 Cr. (2017-18)**

General Tax + Water Tax (30%) + Conservancy Tax (30%) + Education Cess (10%) **Property tax**

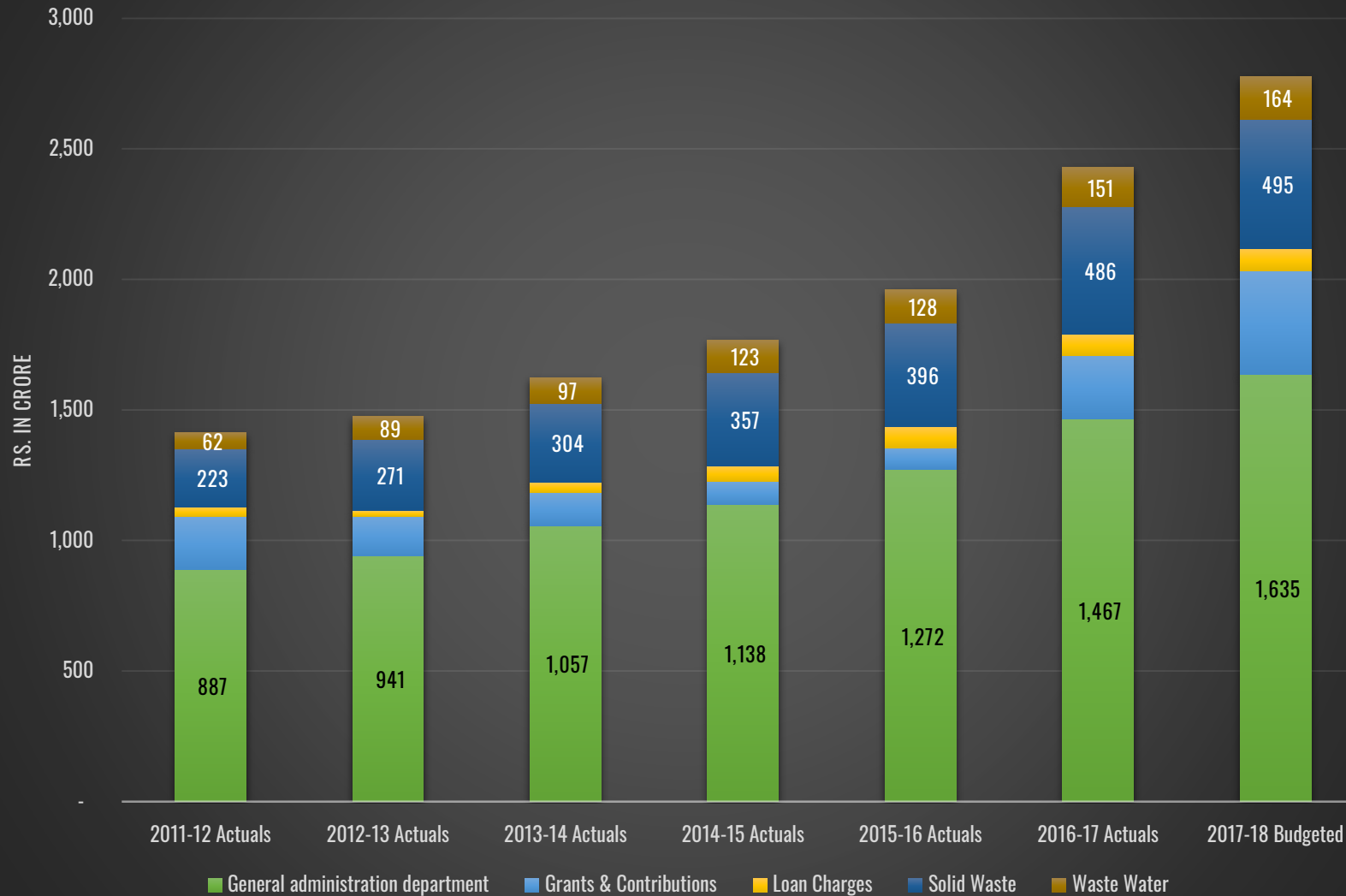
312 Cr. (2011-12) $\xrightarrow{11\%}$ **575 Cr. (2017-18)**

Others Income through Special Provision, Other Revenue Income for Hospitals, Recreation

Source: AMC Budget 2011-12 to 2017-18

Financial Analysis – Revenue Account

Revenue Expenditure



General Administration

Establishment costs, Office Expenses, Electricity Bills, Repairs & Maintenance

887 Cr. (2011-12) $\xrightarrow{11\%}$ **1,635 Cr.** (2017-18)

Road Cleaning
City Waste Collection
& Disinfection, Salary of
Employees

Solid Waste

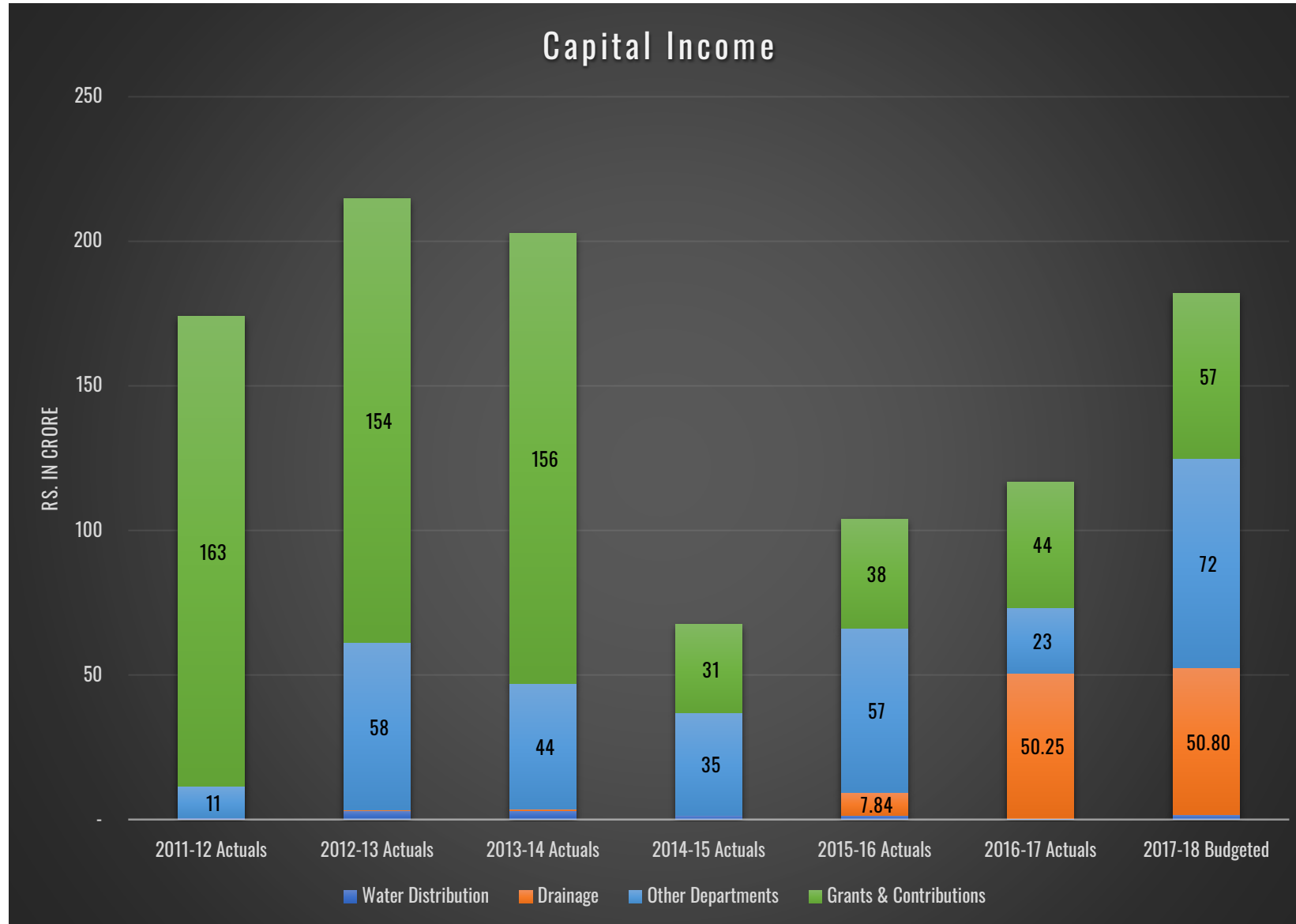
223 Cr. (2011-12) $\xrightarrow{14\%}$ **495 Cr.** (2017-18)

Drainage

Salary Of Employees, Light Charges, Pump & Compressor Charges

62 Cr. (2011-12) $\xrightarrow{18\%}$ **164 Cr.** (2017-18)

Financial Analysis – Capital Account



Grants JnNURM Project, AMRUT, MLA/MP Grant, GMFB Priority Services,

163 Cr. (2011-12) $\xrightarrow{-23\%}$ **57 Cr.** (2017-18)

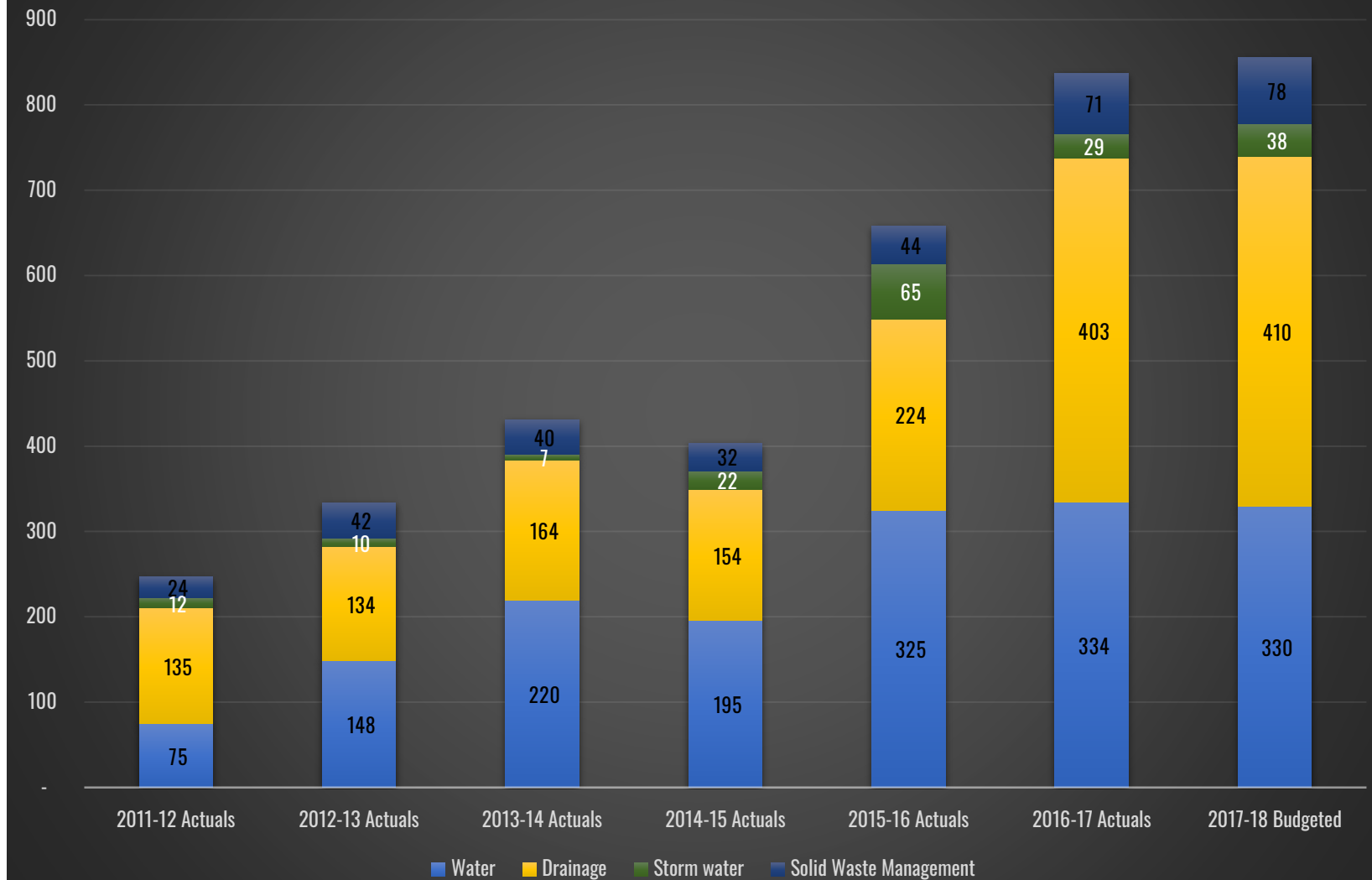
Capital Works Allocation for Drainage lines, JnNURM funding, State & Central Funding **Drainage**

8 Cr. (2015-16) $\xrightarrow{155\%}$ **51 Cr.** (2017-18)

Source: AMC Budget 2011-12 to 2017-18

Financial Analysis – Capital Account

Capital Expenditure



Water

Water Distribution Lines & other Water Related Projects

75 Cr. (2011-12) $\xrightarrow{28\%}$ 330 Cr. (2017-18)

Drainage Lines, Pumping Station & other Drainage Related Projects

Drainage

135 Cr. (2011-12) $\xrightarrow{20\%}$ 410 Cr. (2017-18)

Storm Water

Storm Water Drain

12 Cr. (2011-12) $\xrightarrow{21\%}$ 38 Cr. (2017-18)

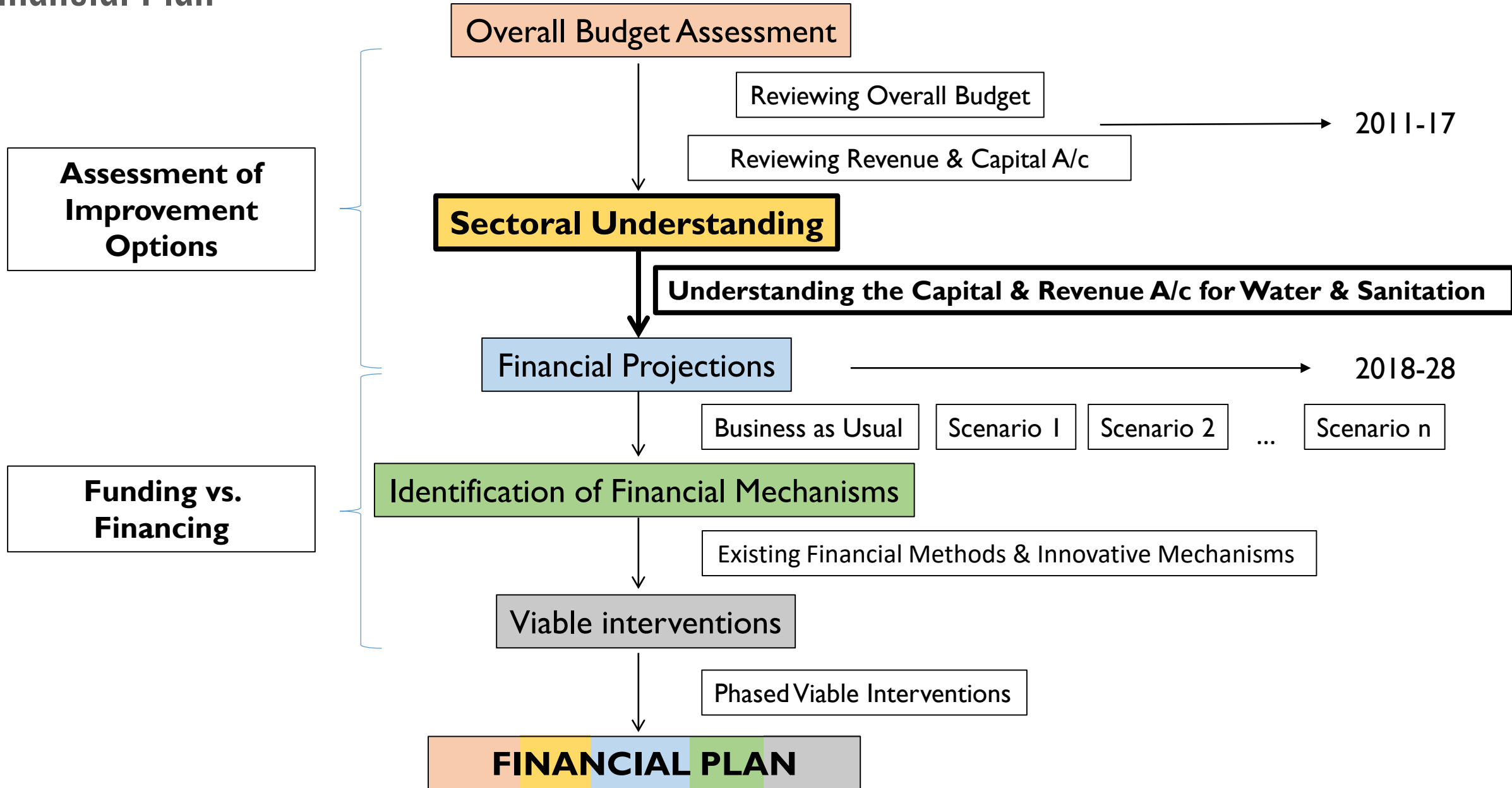
Solid Waste Management

Solid Waste

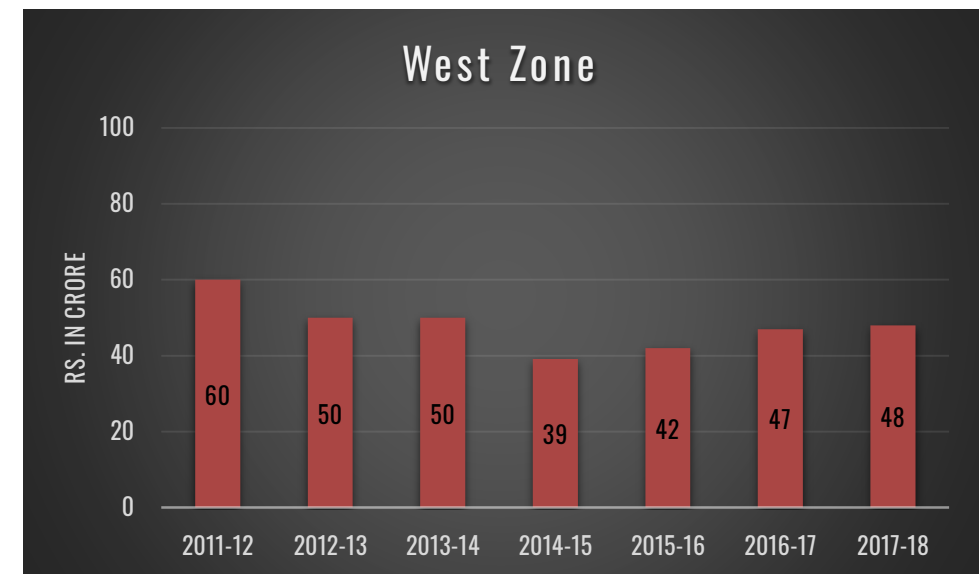
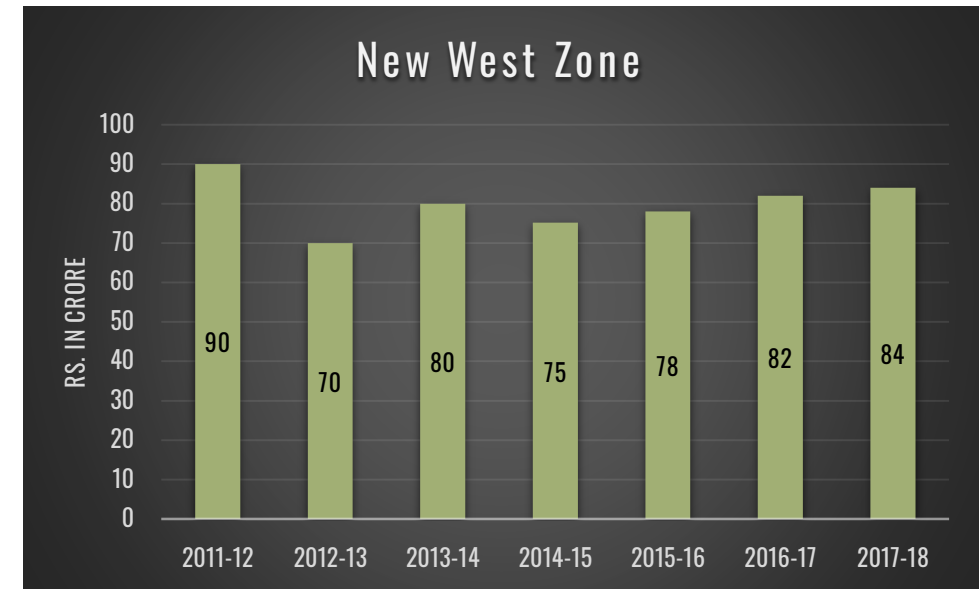
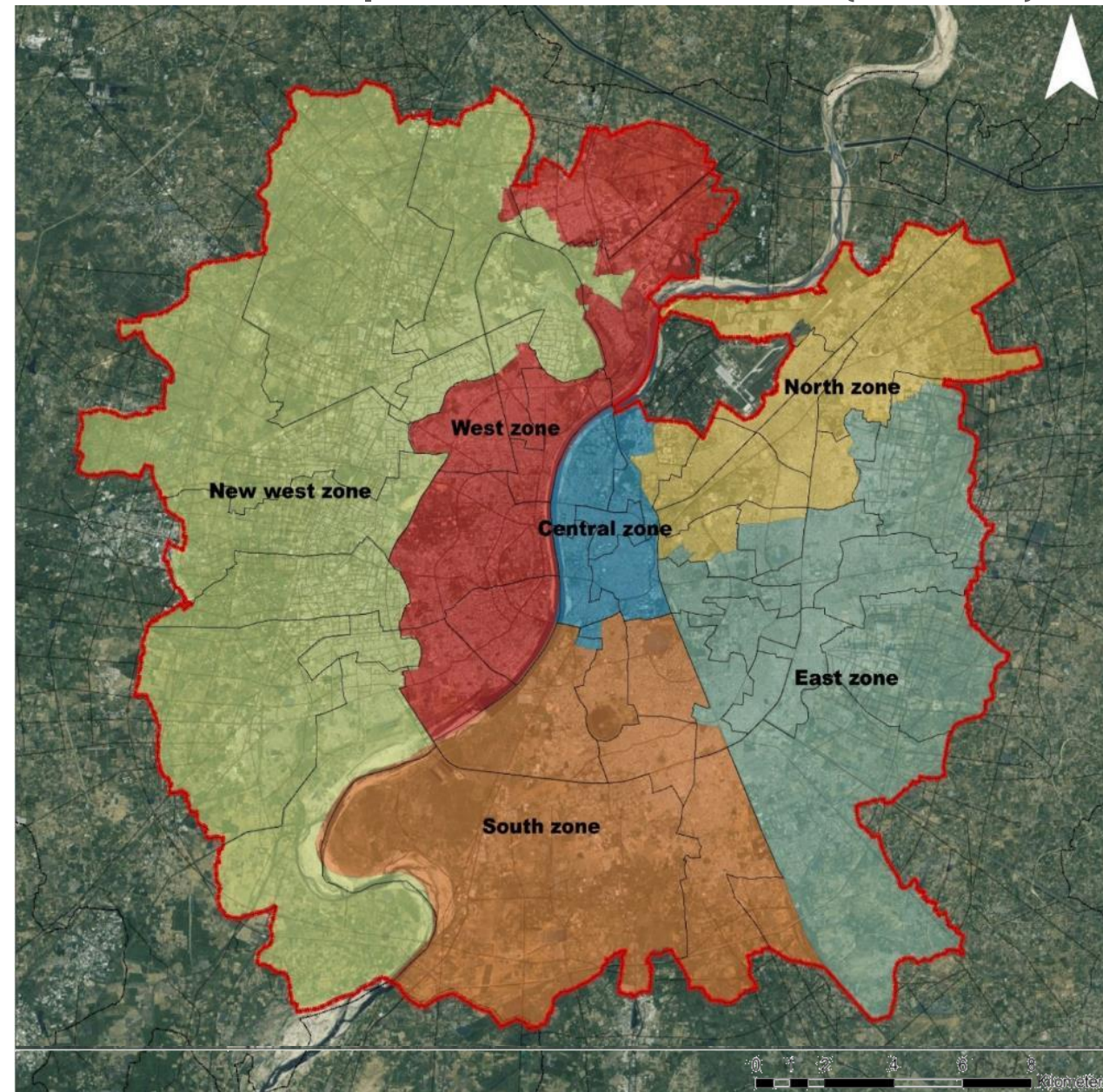
24 Cr. (2011-12) $\xrightarrow{21\%}$ 78 Cr. (2017-18)

Source: AMC Budget 2011-12 to 2017-18

Financial Plan

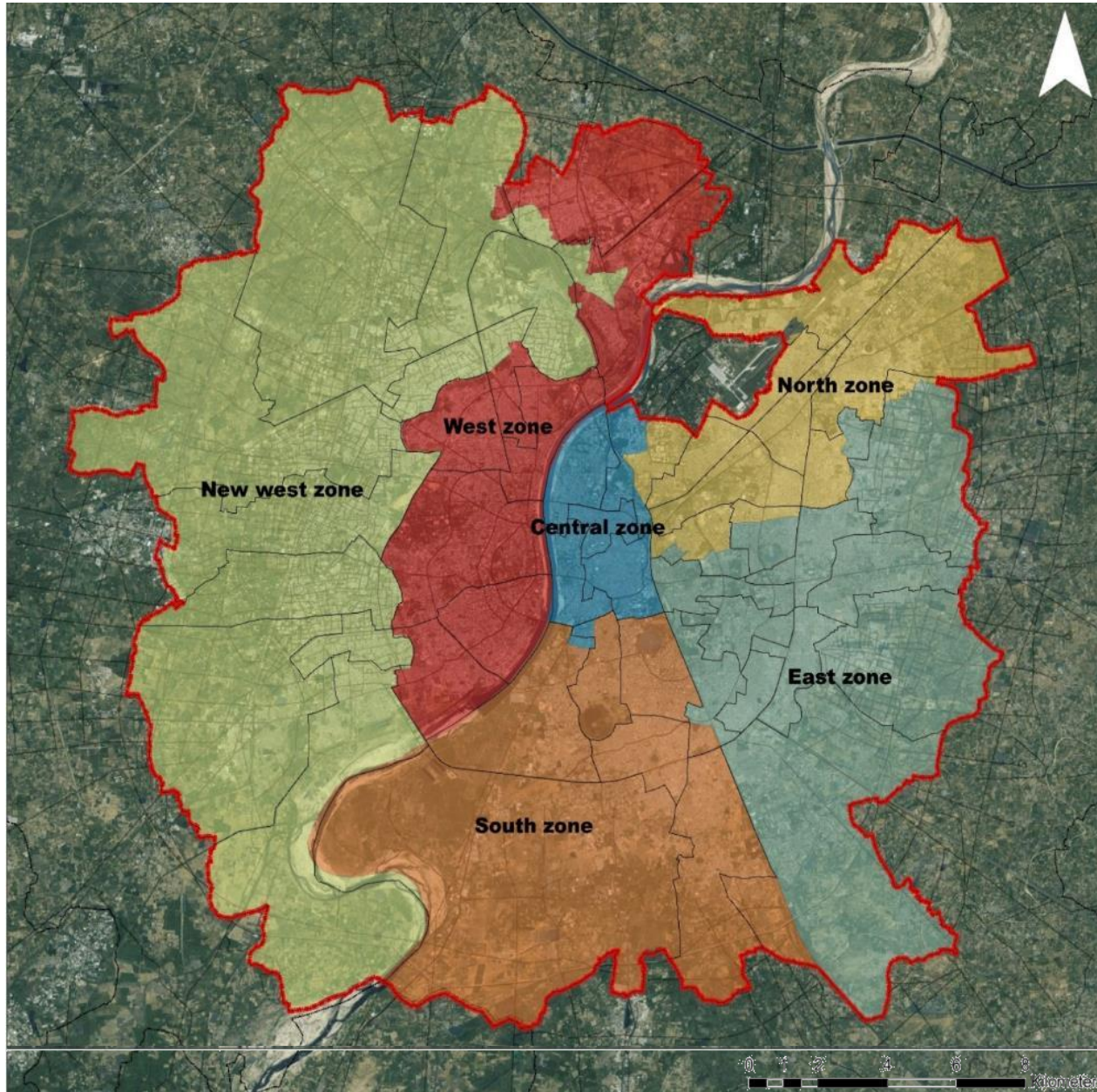


Zone wise Capital Works Allocation (2011-17)

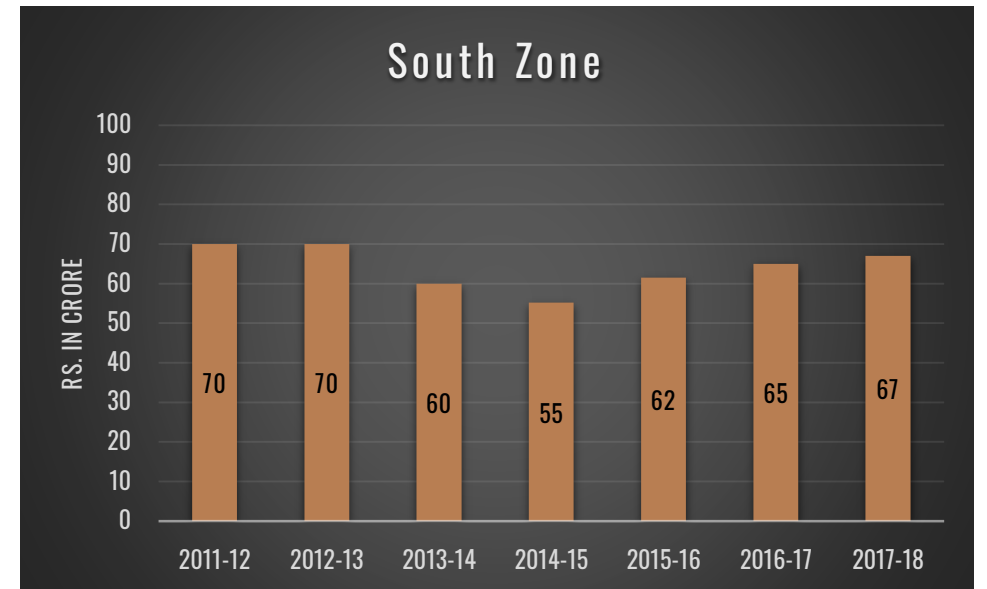
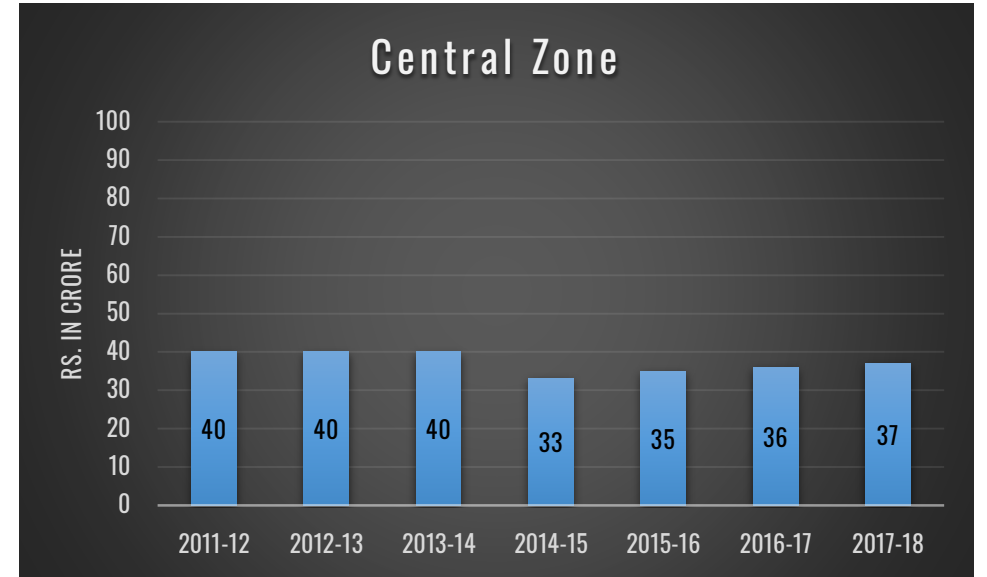


Source: AMC Budget 2011-12 to 2017-18

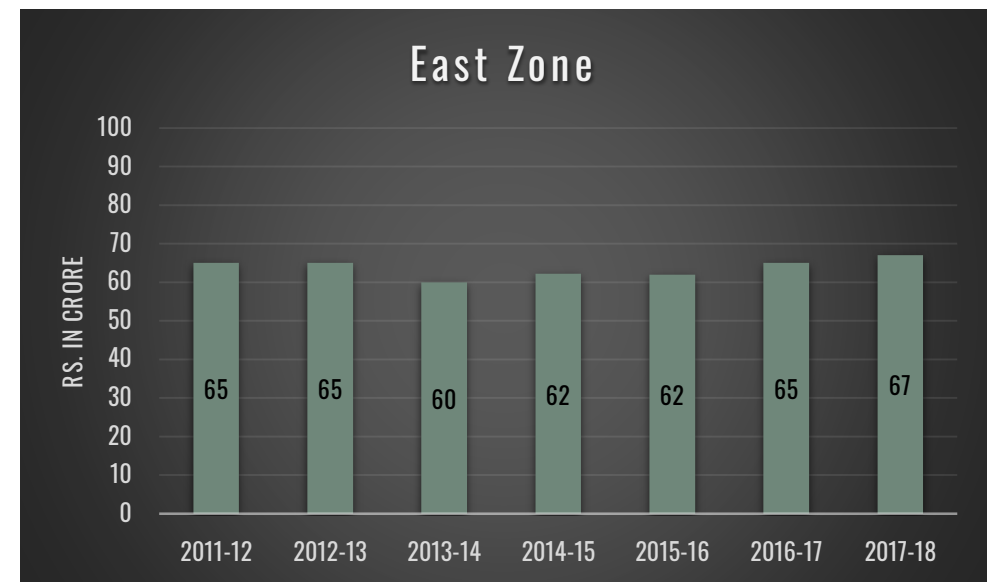
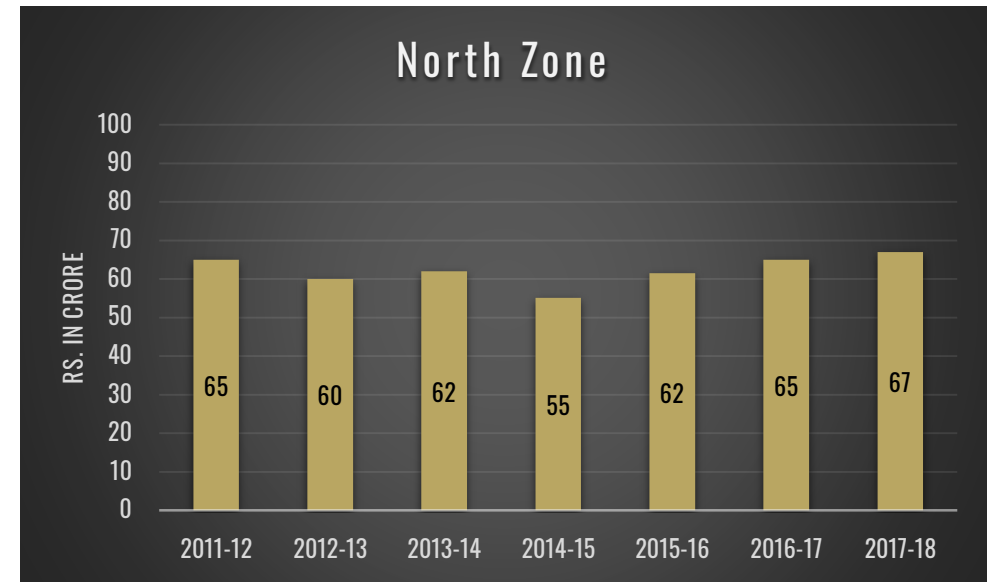
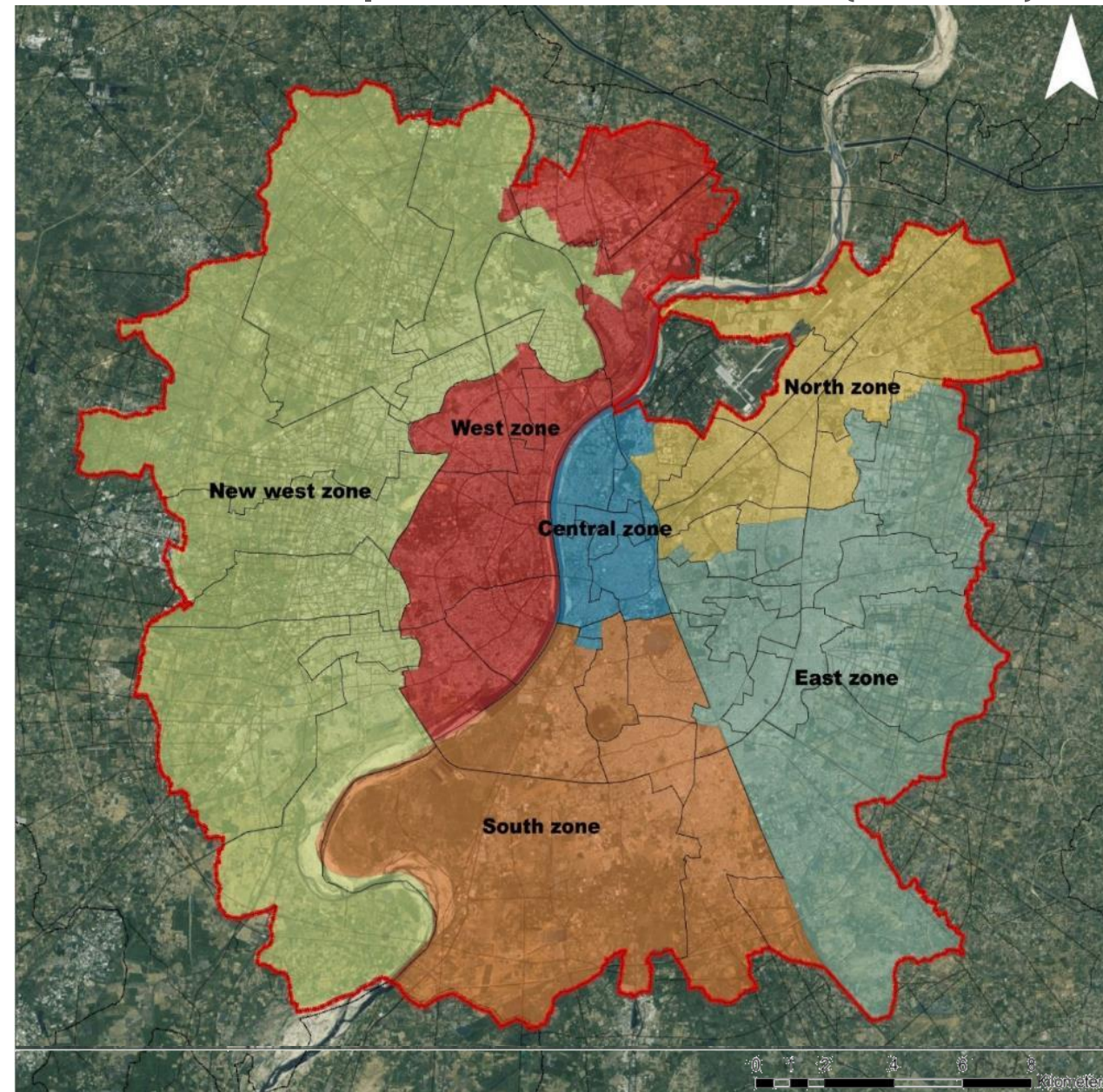
Zone wise Capital Works Allocation (2011-17)



Source: AMC Budget 2011-12 to 2017-18



Zone wise Capital Works Allocation (2011-17)



Source: AMC Budget 2011-12 to 2017-18

Zone wise Allocation (2017-18)

48 crore

Ongoing Projects:

1. Water Distribution lines in various wards.
2. Drainage lines in various wards.

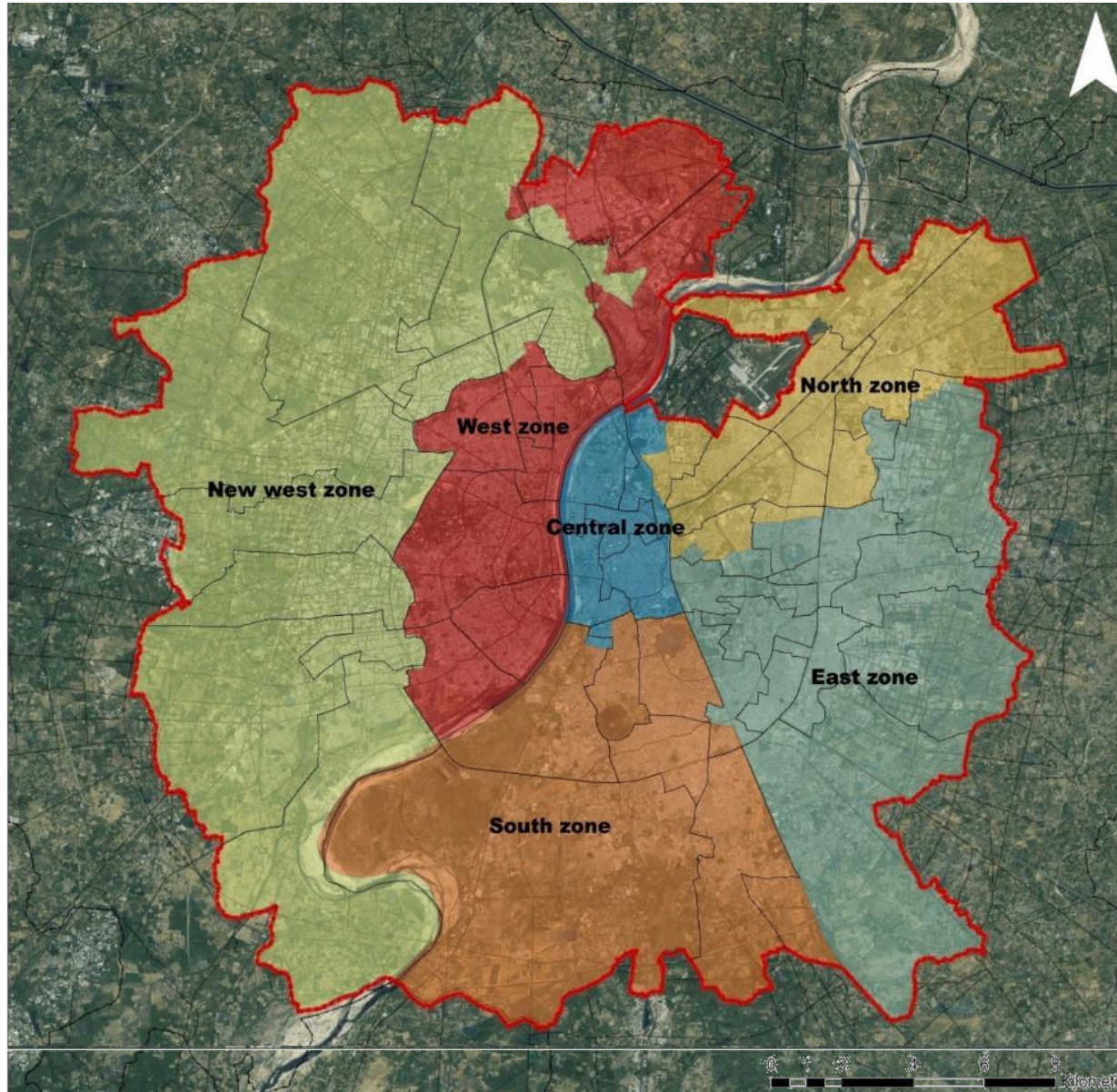
Upcoming Projects:

1. Water Distribution lines in remaining wards.
2. Drainage lines in the remaining wards.

67 crore

Ongoing Projects:

1. Storm water Drainage line in Vatva Ward.
2. Water Distribution and Drainage lines in Vatva Ward.



67 crore

Upcoming Projects:

1. Water and Drainage works for slums and chawls.
2. Improvement in Water and Drainage lines in various wards.

37 crore

Upcoming Projects:

1. Rehabilitation of the Main Trunk Line

Zone wise Allocation (2017-18)

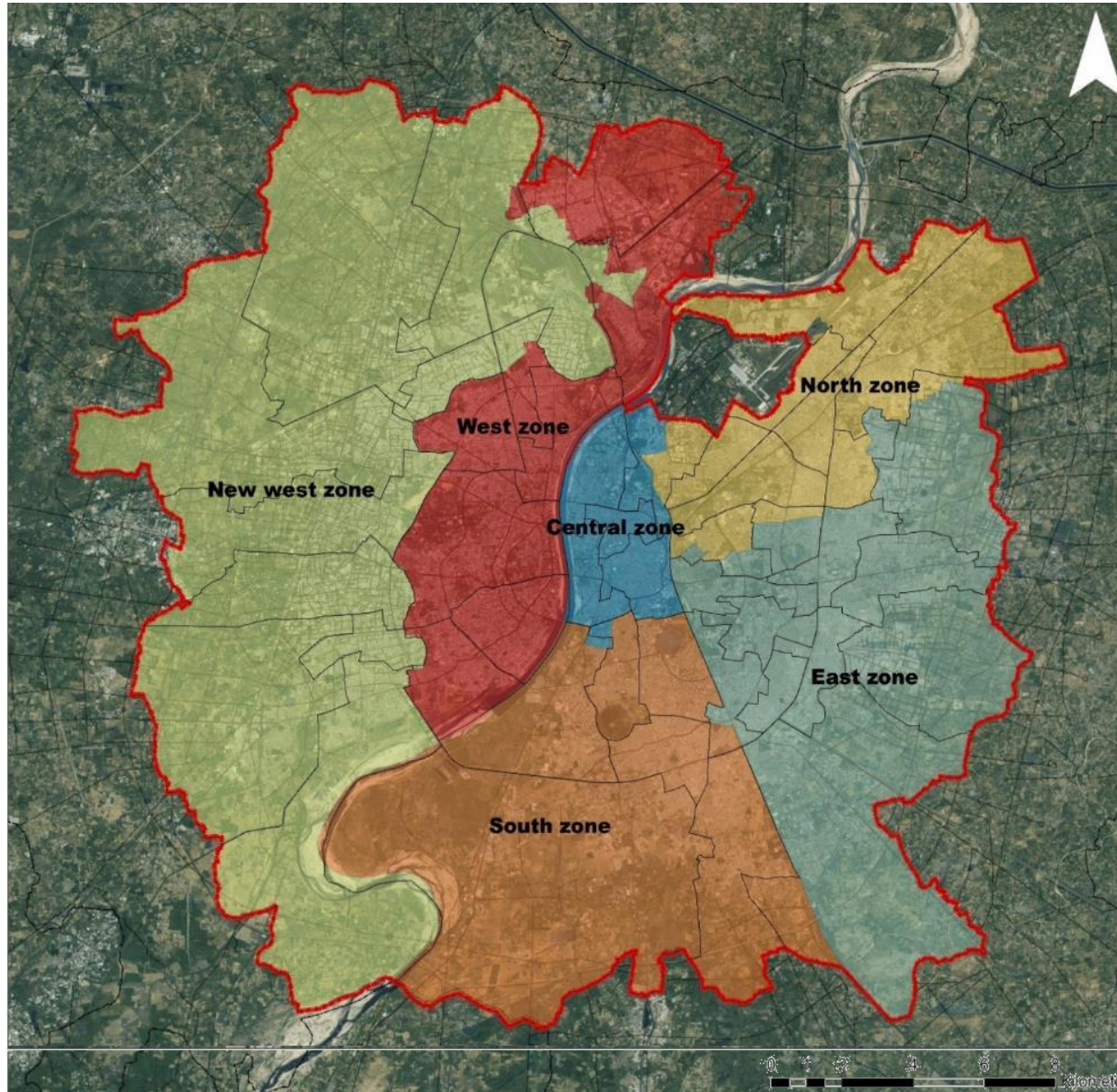
84 crore

Ongoing Projects:

1. Storm Water lines & Drainage lines in Jodhpur ward.
2. Water distribution lines from WDS to various societies in Thaltej Ward.
3. Drainage lines in Sarkhej Gamtal

Upcoming Projects:

1. Improvement in Water Distribution lines in Thaltej, Gota, Vejalpur ward.
2. Drainage lines in the new TP scheme area of Ghatlodia ward



67 crore

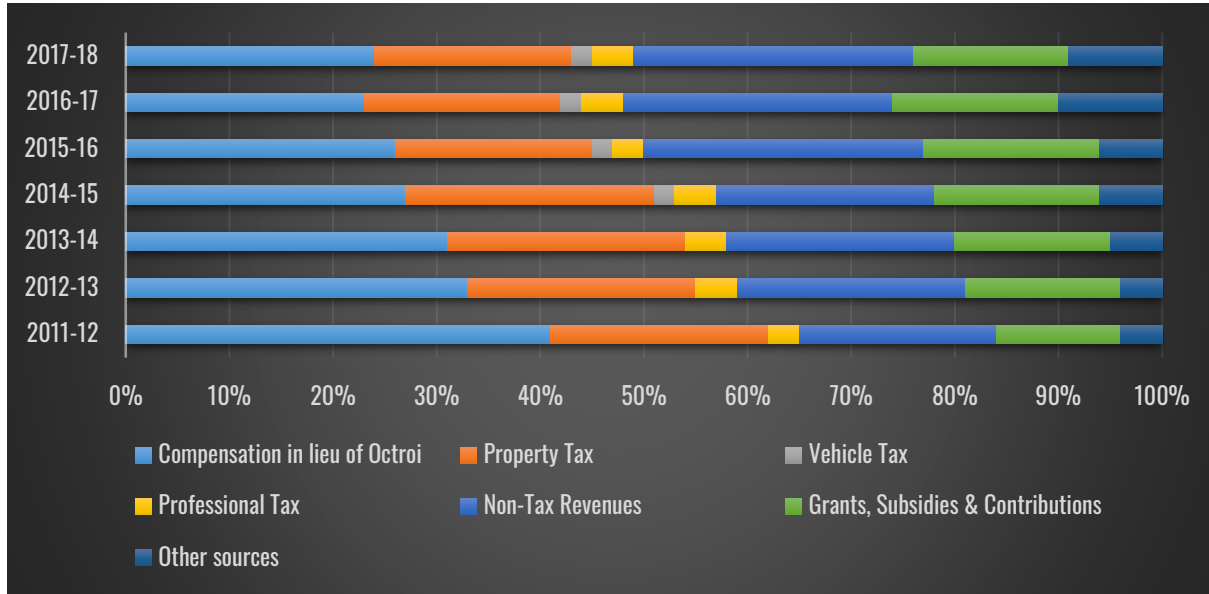
Ongoing Projects:

1. Water Distribution lines in Bhaipura ward for slums & Chawls
2. New Water Distribution lines and Drainage lines in Vastral ward.

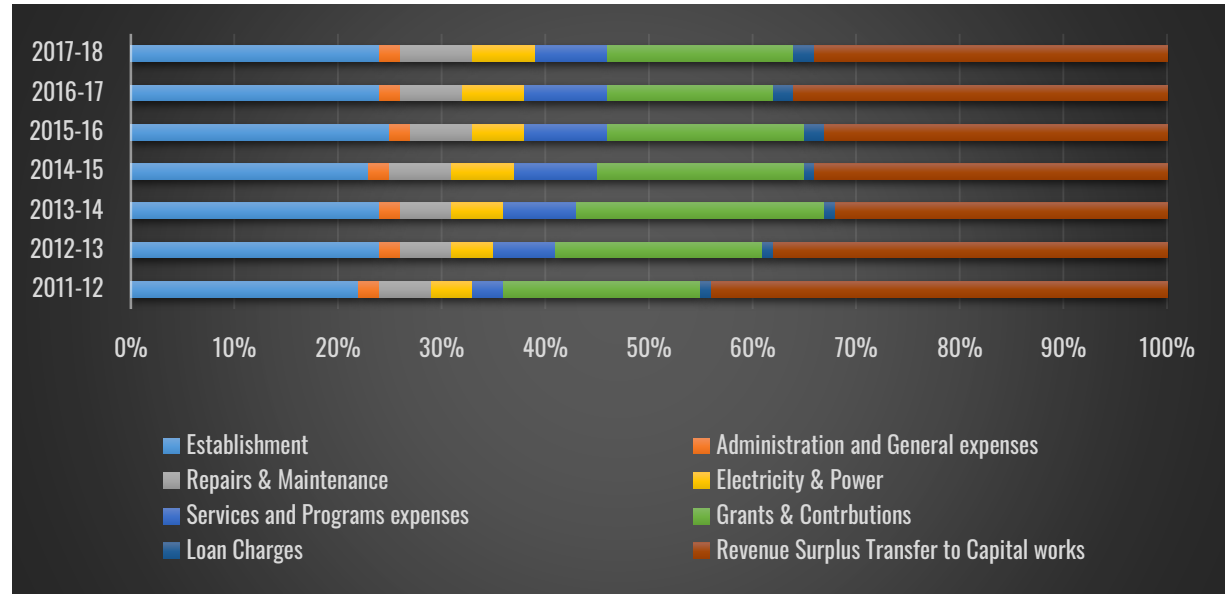
**Total Capital Works
Allocation
370 crore**

ULB's flow of Funds

Where will the Rupee come from ?



Where will the Rupee Go ?



Loans

Swarnim Jayanti Mukhyamantri Shaheri Vikas Yojana

Government Loans

G.M.F.B. Priority Services

HUDCO Loan (Gap Fund)
Smart Cities

AMRUT

Tax free Bonds

JnNURM Grant

MP/MLA Grants

G.S.F.S. Loan

70:20:10 Contribution Scheme

Water – Sensitive Ahmedabad

– Planning for the better future –

Under the guidance of
Meera Mehta
Mona Iyer
Maitree Patel

3rd Semester

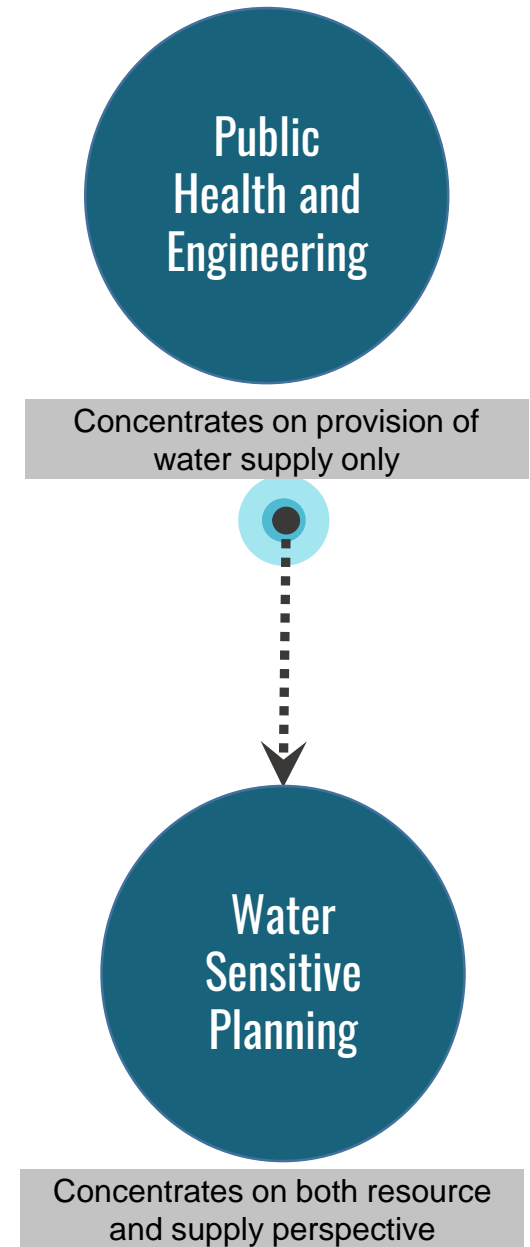
CEPT University

DATE

10th November, 2017

Conceptualization

Concept		IWRM	IUWM	WSUDP	WSP
Scale of Implementation	Basin Scale	✓			
	City Scale		✓	✓	✓
	Zonal Scale			✓	
	Local Scale			✓	
Parameters Considered in the Concept	Accessibility to water	✓	✓	✓	✓
	Water Quantity		✓	✓	✓
	Water Quality		✓	✓	✓
	Water Supply System		✓	✓	✓
	All Water Resources are Considered		✓	✓	
	Flood Mitigation	✓		✓	
	Waste Water Reuse		✓	✓	✓
	Regulations			✓	✓



“Water sensitive planning is amalgamation of water resource management, and efficient water supply system”

Water Resource Management

Urban Water Cycle

Check on Water Pollution and Usage

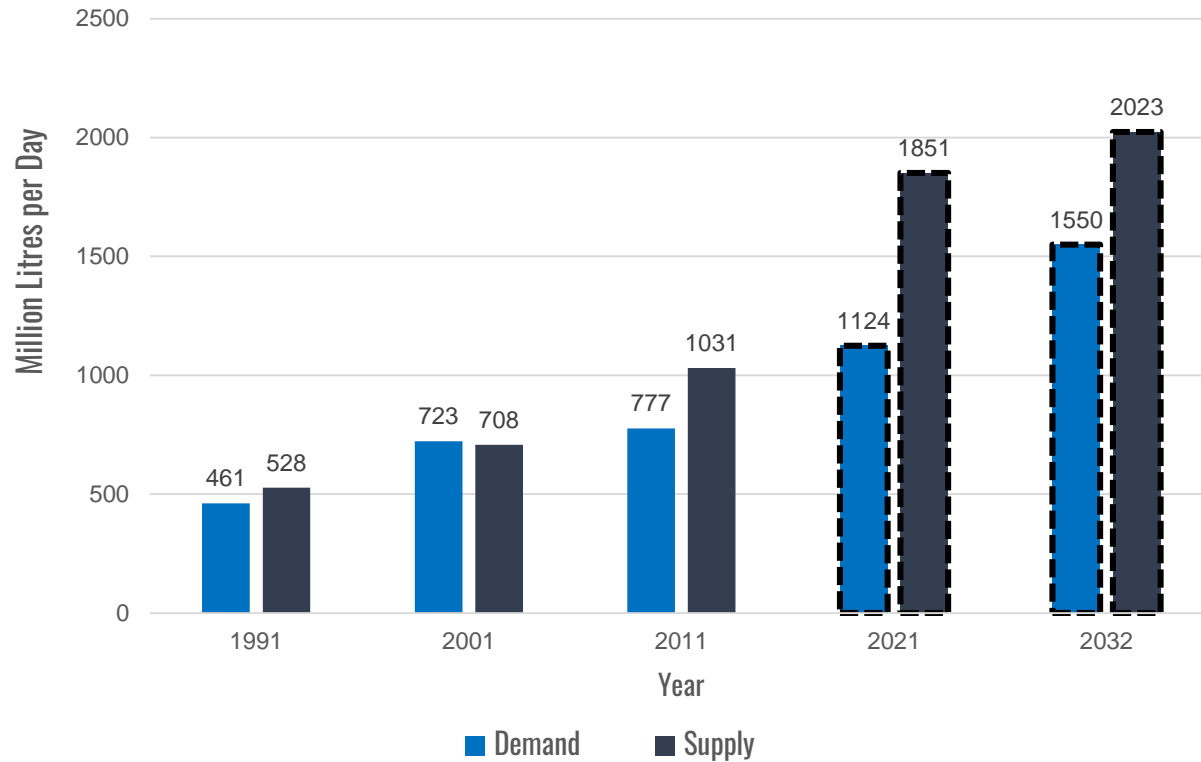
- Surface water sources
(Lakes and rivers)
- Ground water
- Storm water

Efficient Water Supply System

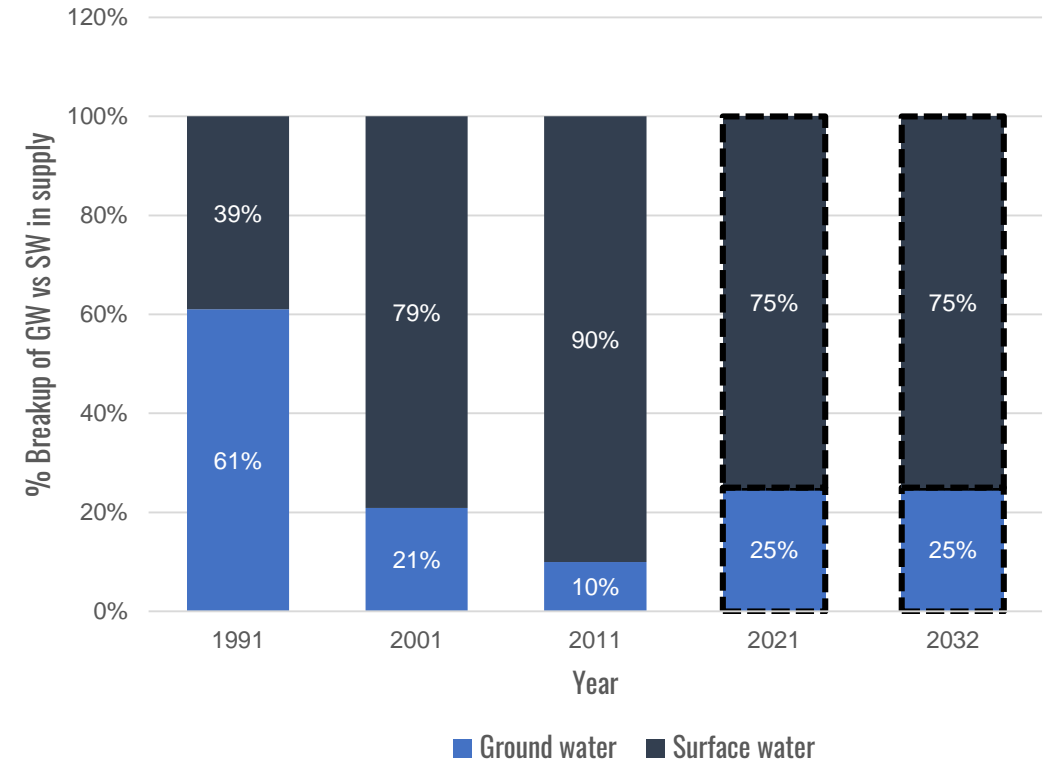
- Efficient Usage of current water withdrawal from source
- Treatment system
- Supply and distribution system
- Inefficiency in the system
(Losses)

Demand & Supply Analysis

Demand V/s Supply over the Years

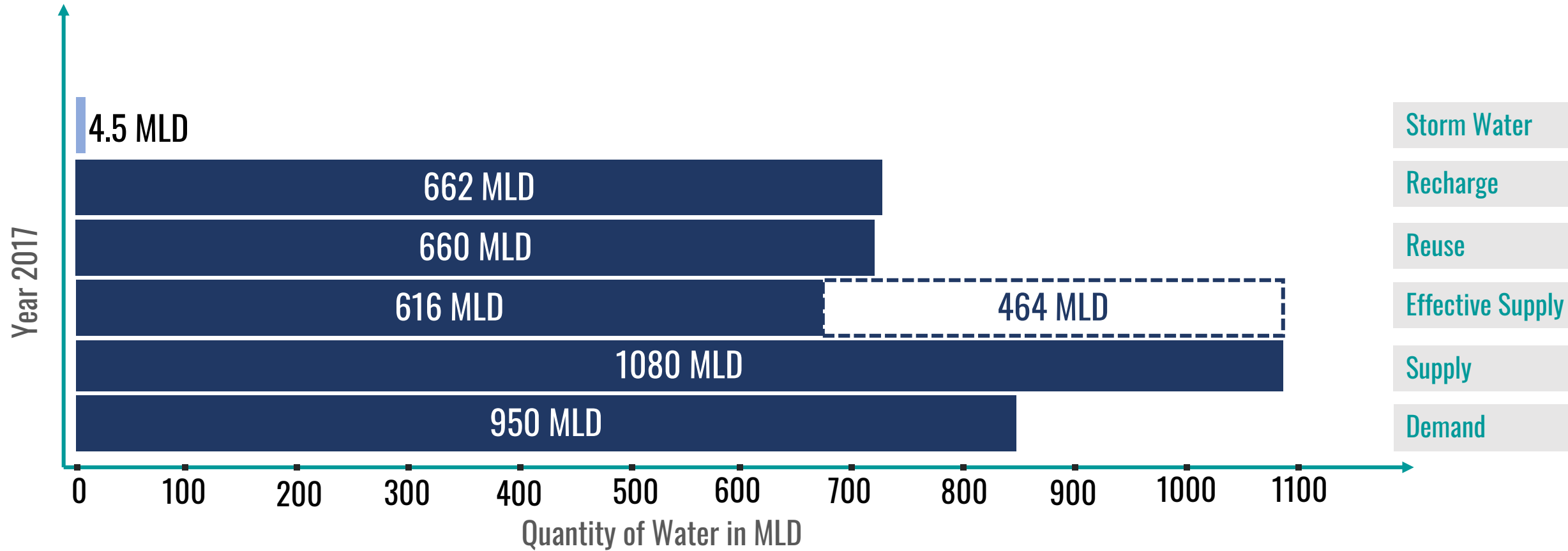


Trend analysis of Ground water usage



Ahmedabad has been supply surplus over the decades thereby increasing the need for efficient management of resources.

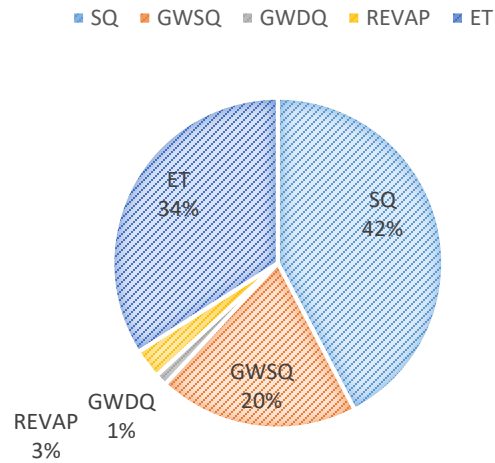
Demand & Supply Analysis – Present Scenario



Water Resources

Overview of Water Resources in Ahmedabad

WATER BALANCE OF AHMEDABAD



Total Water Supplied by AMC= 1080 MLD

Comparison w.r.t. Water Supplied by AMC

Water Precipitated : 1581.3 MLD → + 46.4%

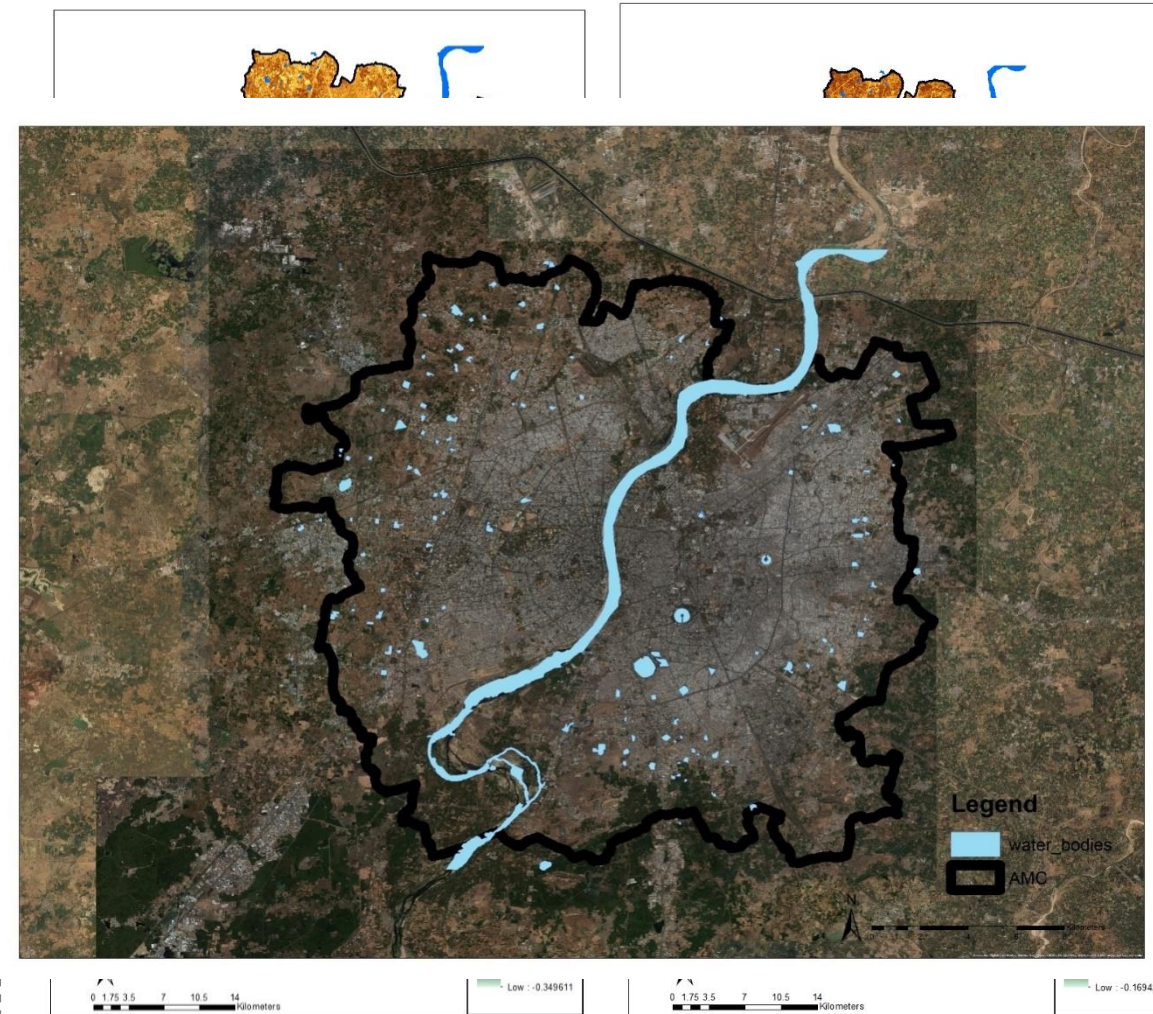
Water infiltrated as ground water: 335.63 MLD → 31.07%

Water flowing as runoff: 639.314 MLD → 59.19%

Water losses in natural processes: 591.36 MLD

Over two decades there has been increase in the built up area of the city and simultaneously decrease in the vegetative cover, hence the storm water is lost mostly as a runoff. Also, there has been decrease in infiltration capacity of the soil due to same.

Source: Arc GIS Analysis from USGS map data for December 2010 and 2017.



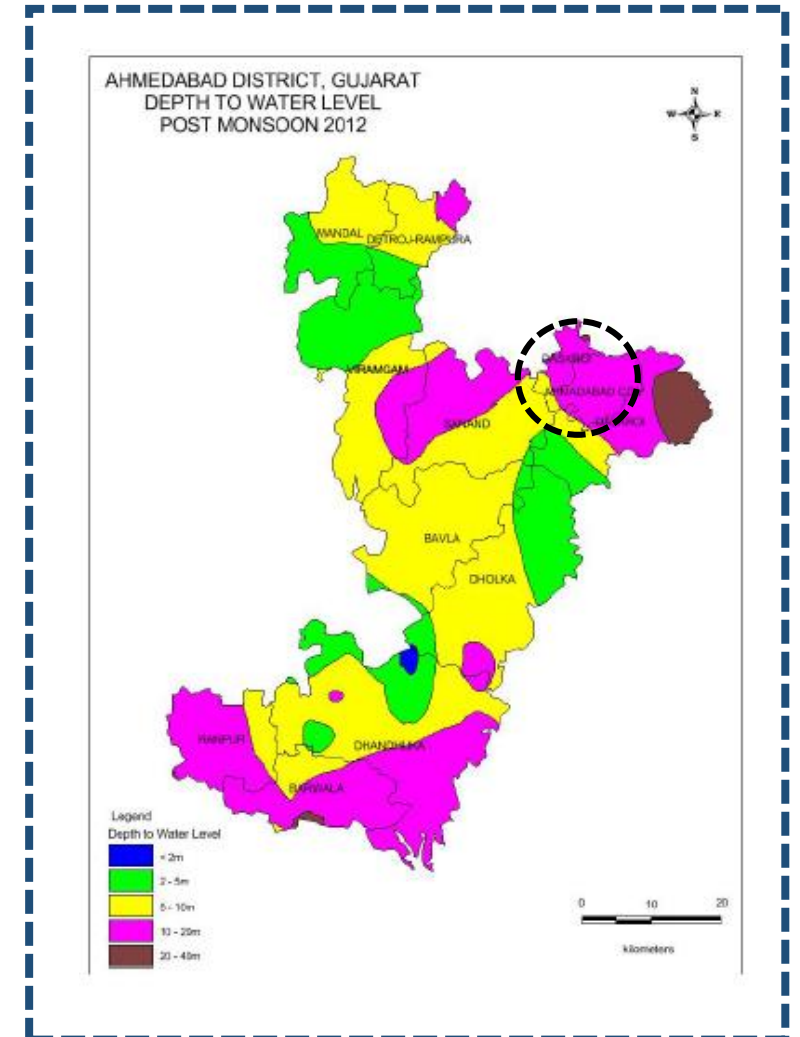
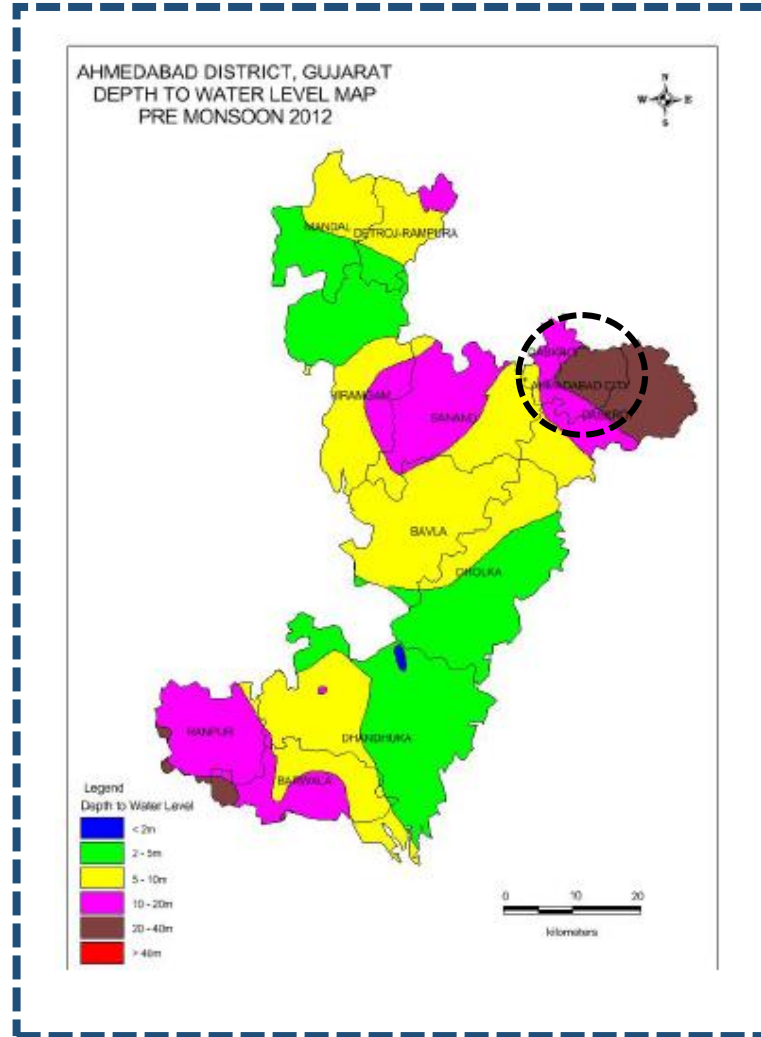
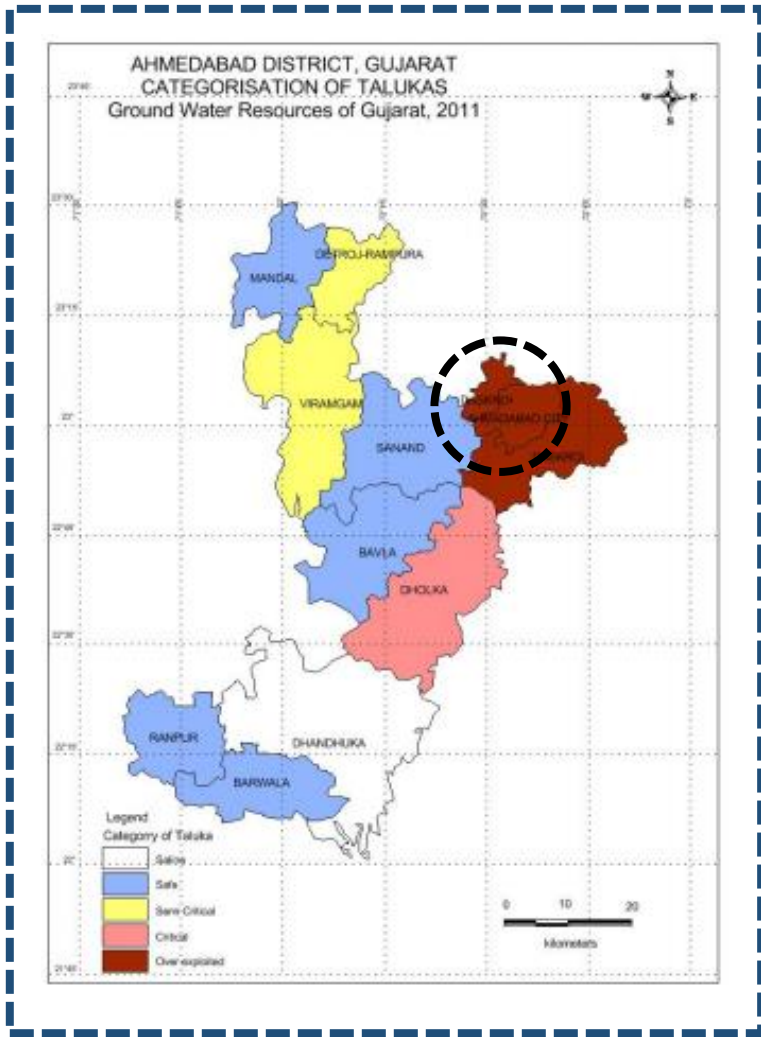
Total number of water bodies within AMC boundary: 94

NDVI for year 2010

NDVI for year 2017

Total area of water bodies within AMC boundary: 2.07 sq.km.

Existing Scenario – Ground water



Entire Ahmedabad district falls under over exploited state for ground water for year 2014

The pre and post monsoon levels show that there has been decrease in water levels from pre monsoon period to post monsoon period for Ahmedabad district.

Source : SLIP 2016-17, Water sensitive group Water sanitation studio 2017-18

Methodology for Ground Water Analysis

Ground Water Infiltration

To know the infiltration characteristics of the soil in the city and total water that infiltrates within city aquifer annually.

Primary Survey and SWAT Tool of Arc GIS Software

Ground Water Levels

To know the existing GW conditions of the city as well as mapping the areas requiring attention in terms of GW level degradation

Primary Survey, AMC borewells data and GWRDC borewell data, Thesis Reference

Ground Water Extraction

To map the areas having the high water extraction as well as to know the quantity and the extent of GW usage in the city

Primary Survey, AMC borewells data and GWRDC borewell data, Thesis Reference

Ground Water Quality

To know the quality of GW in various areas and mapping the areas that are exploited by various landuses and users

Primary Survey, AMC borewells data and GWRDC borewell data, Thesis Reference

Aquifer Analysis

To know whether there have been attempts to recharge the aquifers in the city or not in terms of policies, plans

Samples from Private Borewell contractors

Recharge Initiatives

To know the infiltration characteristics of the soil in the city and total water that infiltrates within city aquifer annually.

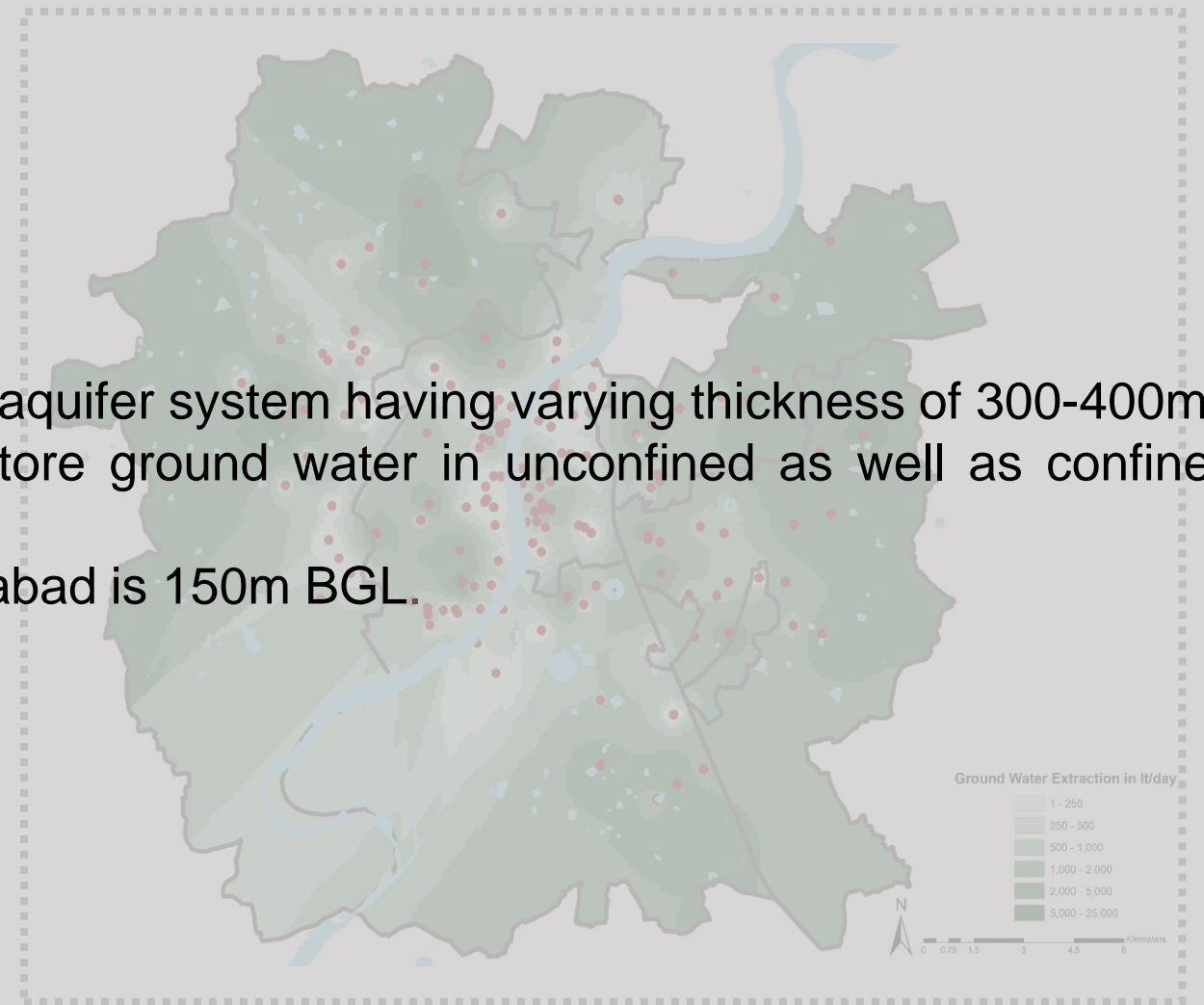
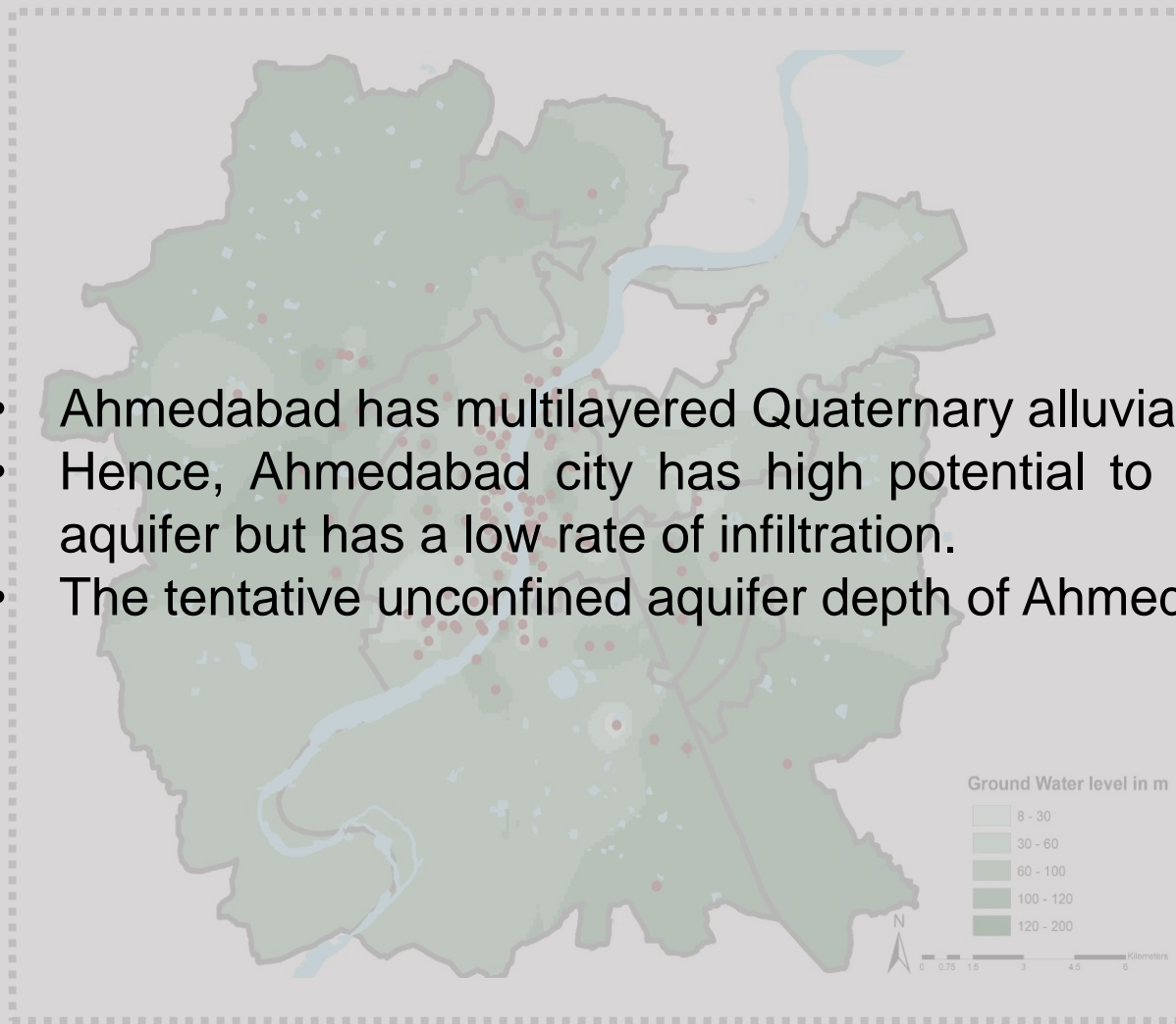
Primary Survey and AMC cnsultation

Overview of Ground Water Resources in Ahmedabad

DEPTH OF GROUND WATER FROM THE SURFACE

GROUND WATER PUMPING ANALYSIS

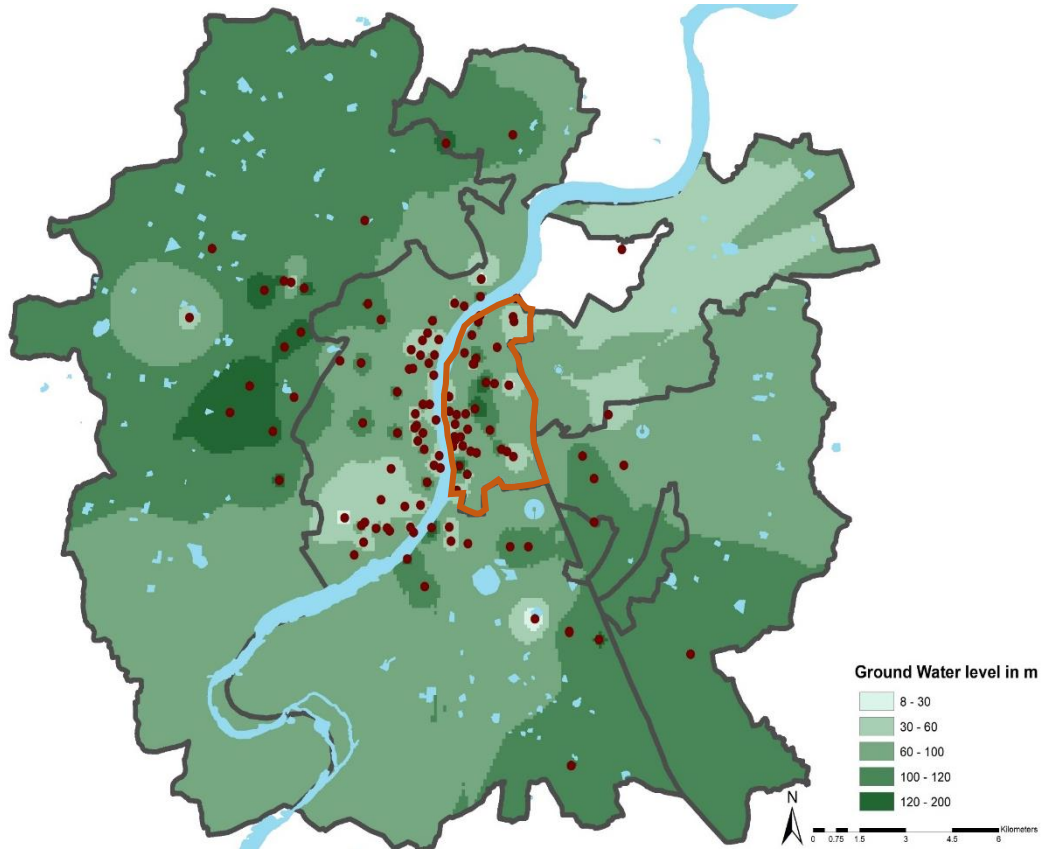
- Ahmedabad has multilayered Quaternary alluvial aquifer system having varying thickness of 300-400m.
- Hence, Ahmedabad city has high potential to store ground water in unconfined as well as confined aquifer but has a low rate of infiltration.
- The tentative unconfined aquifer depth of Ahmedabad is 150m BGL.



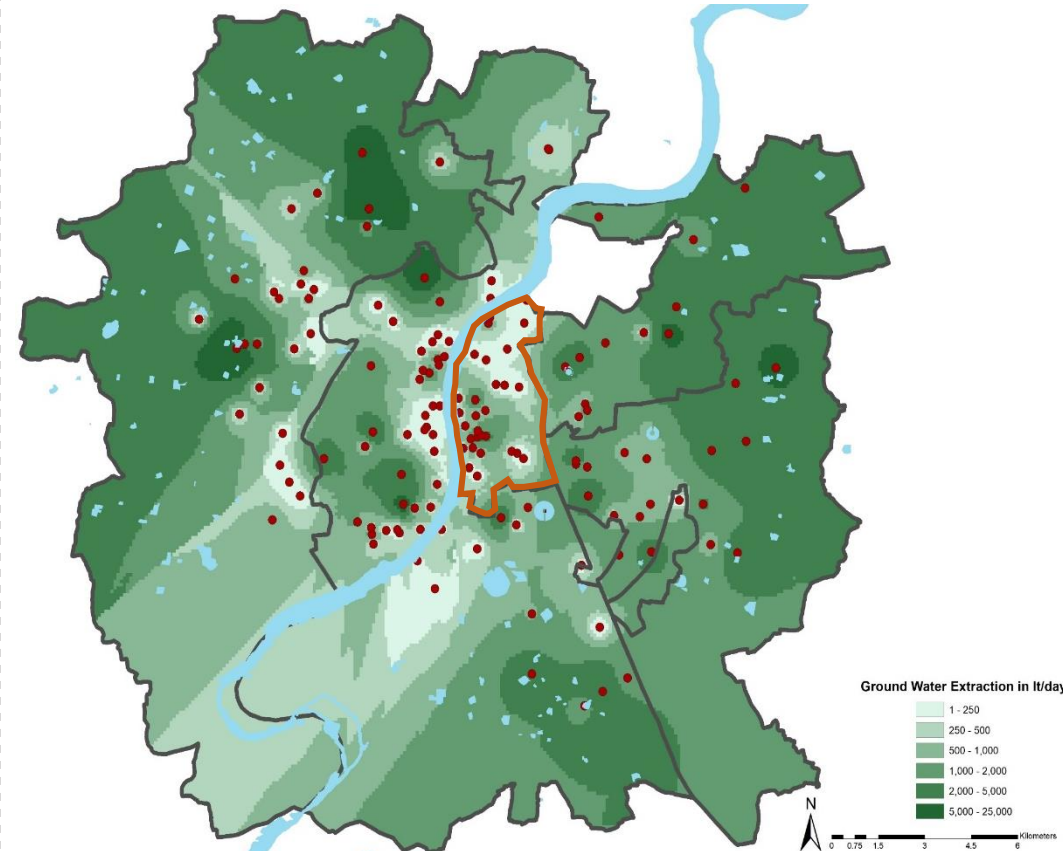
Source: Primary Survey, Water and Sanitation Studio 2017 (100 Samples) and Impact of Sabarmati Riverfront on Ground Water by Shipra Patel 2016 (25 Samples)

Overview of Ground Water Resources in Central Zone

DEPTH OF GROUND WATER FROM THE SURFACE



GROUND WATER PUMPING ANALYSIS



60 - 100m



500 - 1500 lt/hr



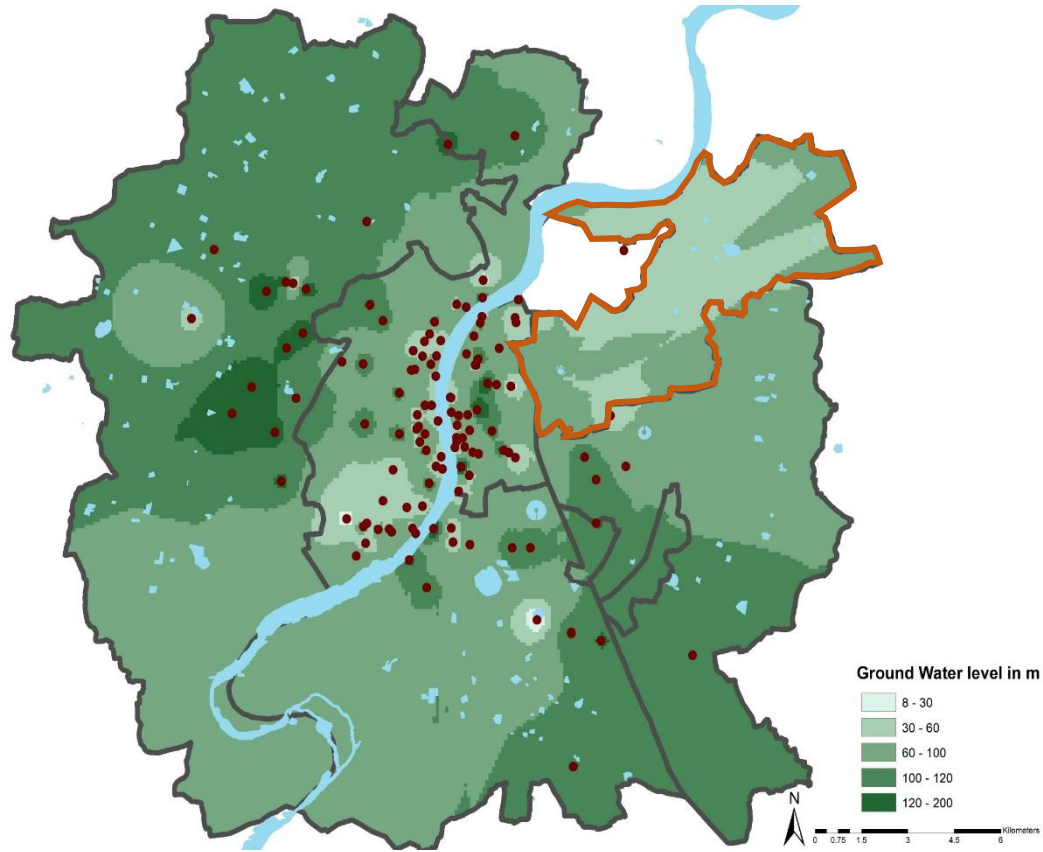
Majorly Residential

- High Ground water table with low extraction
- Highly dependent on AMC water supply
- Because of AMC bore wells and newly constructed apartments, some parts of this zone shows more extraction and lower ground water table
- Aquifer analysis also justifies the water levels as well as availability of GW at lower depth from ground

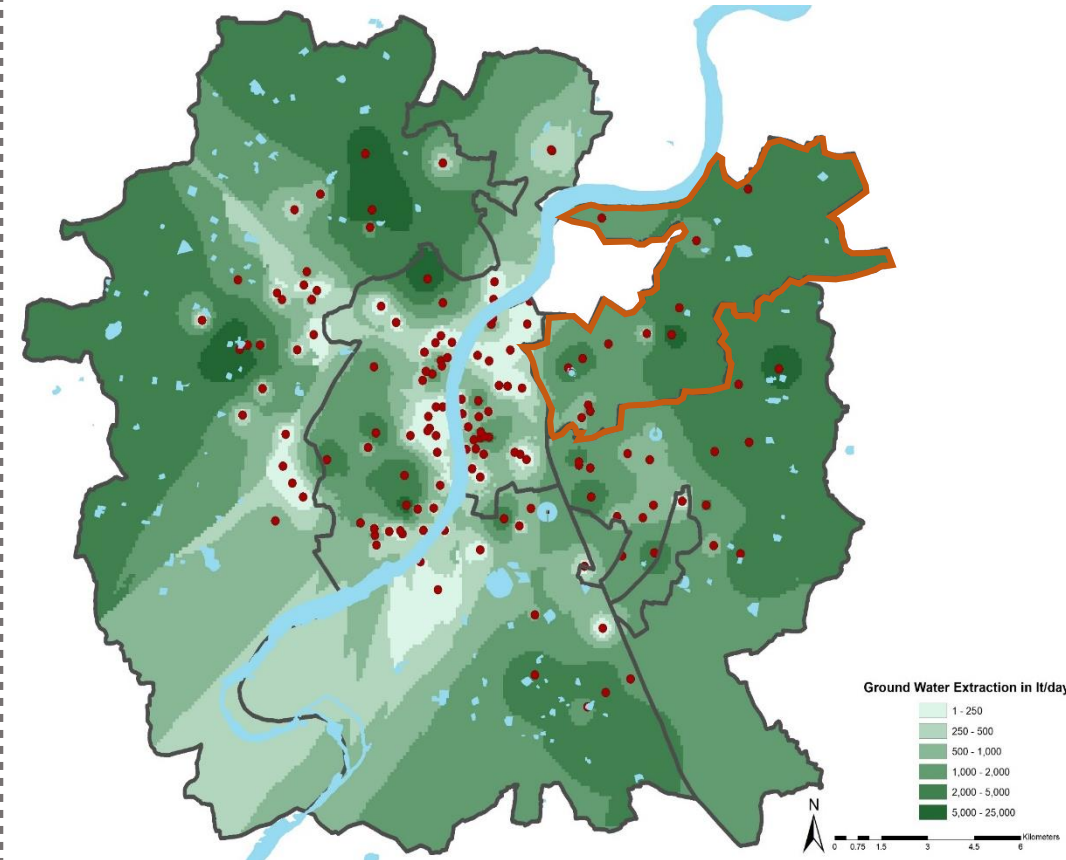
Source: Primary Survey, Water and Sanitation Studio 2017 (100 Samples) and Impact of Sabarmati Riverfront on Ground Water by Shipra Patel 2016 (25 Samples)

Overview of Ground Water Resources in North Zone

DEPTH OF GROUND WATER FROM THE SURFACE



GROUND WATER PUMPING ANALYSIS



60 - 100m



3000 - 5000
lt/hr



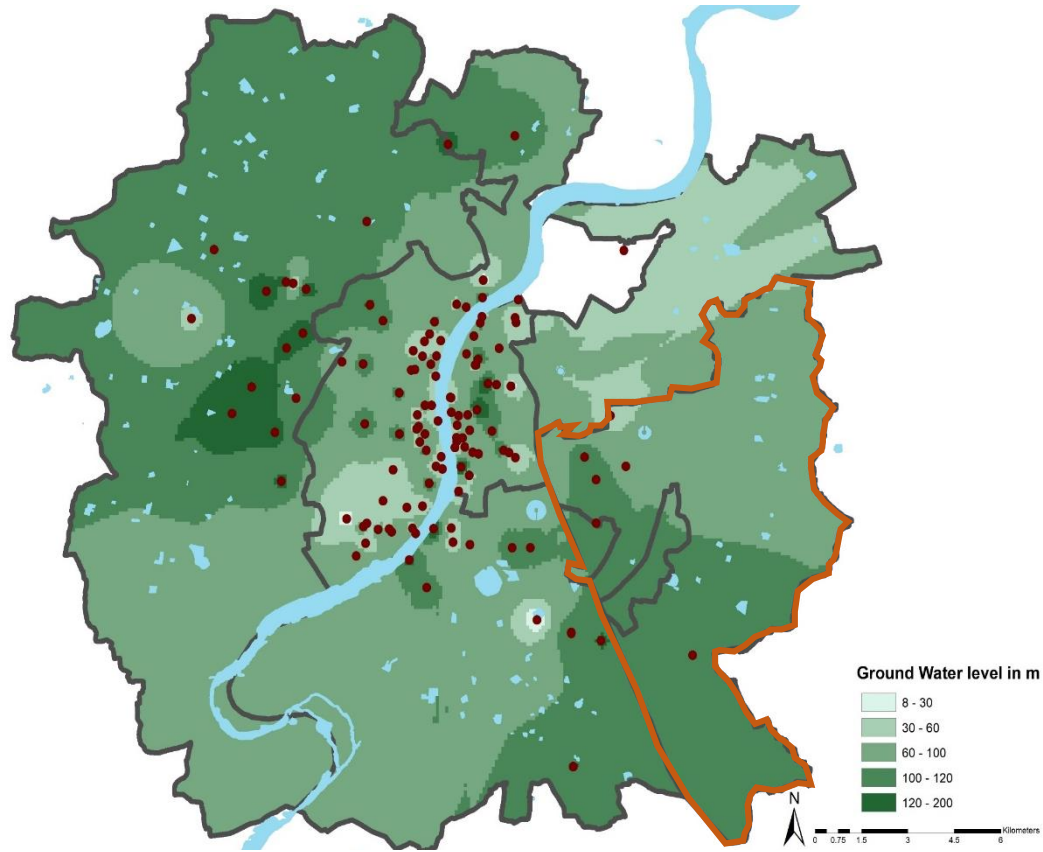
Residential and
Industrial Clusters

- Continuous Aquifer available at depth of 80m
- There are certain regions where GW level is 100 – 120m which is majorly Industrial area (Naroda)
- These Industrial clusters have higher extraction rate also
- From stake holder consultation we came to know about the quality issues around Naroda GIDC at the shallow level due to re flushing of chemicals

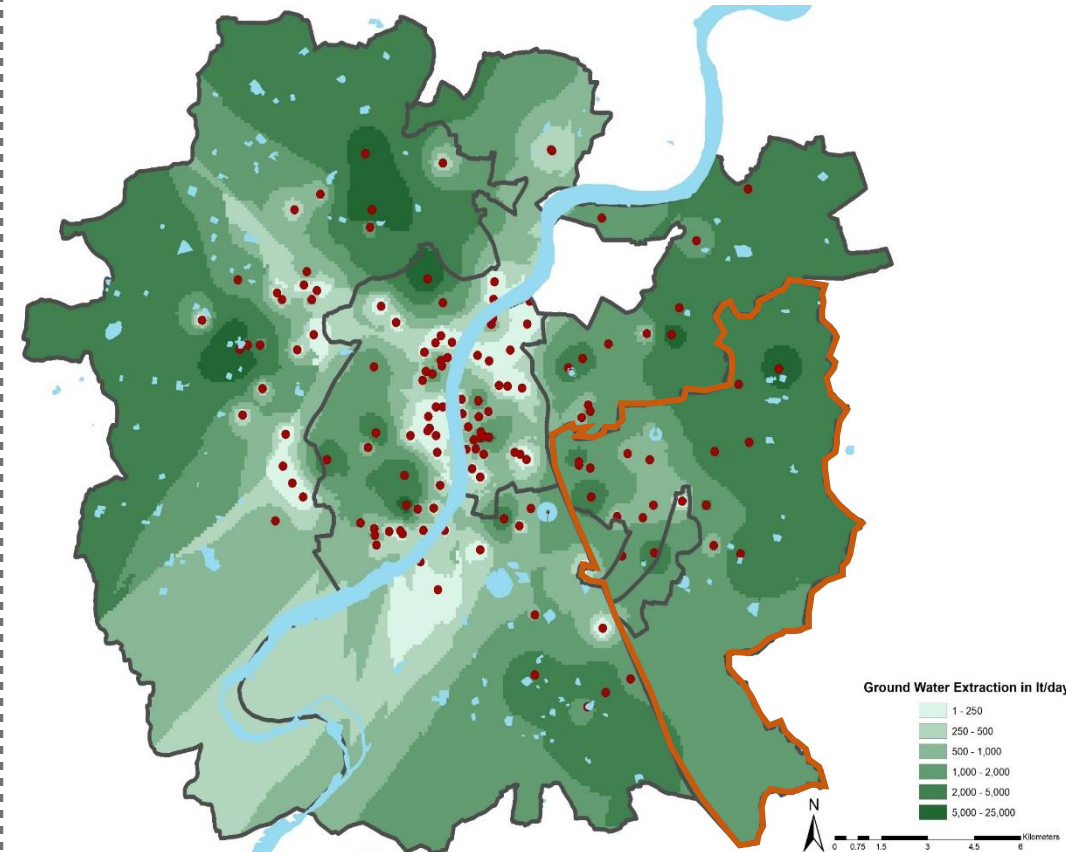
Source: Primary Survey, Water and Sanitation Studio 2017 (100 Samples)

Overview of Ground Water Resources in East Zone

DEPTH OF GROUND WATER FROM THE SURFACE



GROUND WATER PUMPING ANALYSIS



100-120 m



3000 - 5000
lt/hr



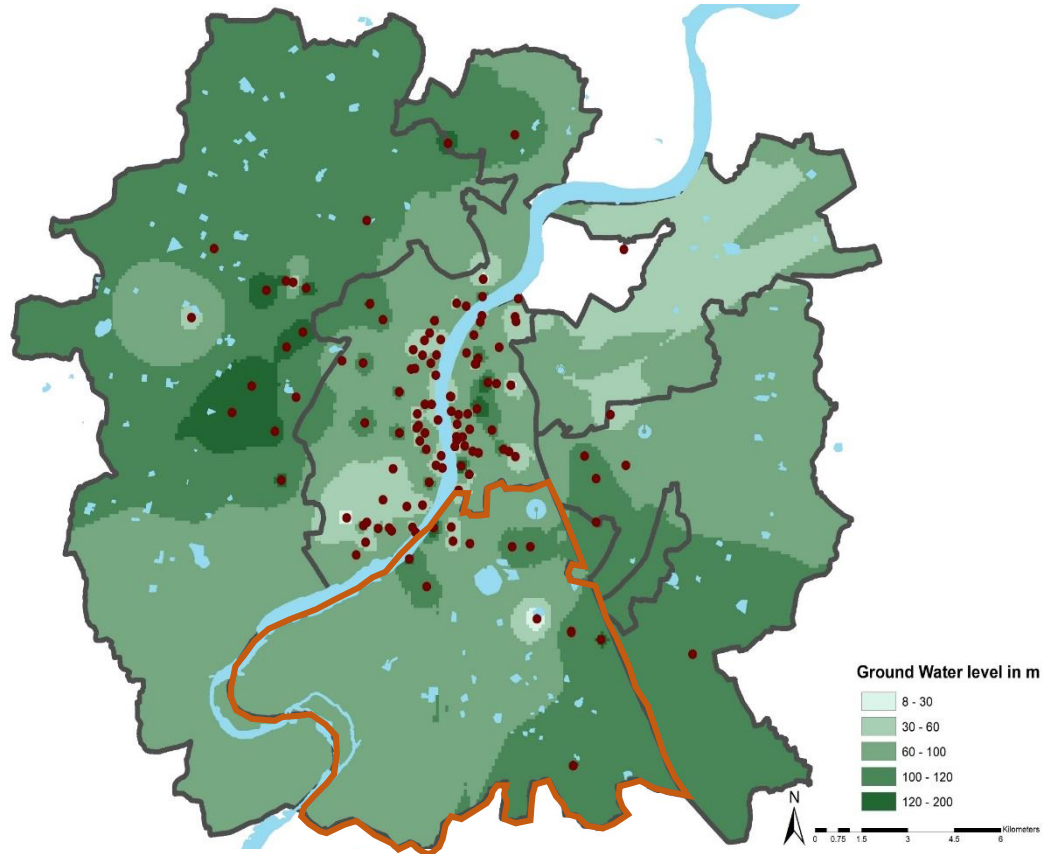
Residential and
Industrial Clusters

- In spite of having more open space the GW level is low
- If we see Aquifer actual GW is available at 40m but due to high extraction by industries the water is available at 120m depth
- Quality issues around Vatva Industrial clusters at shallow level due to re flushing of chemicals

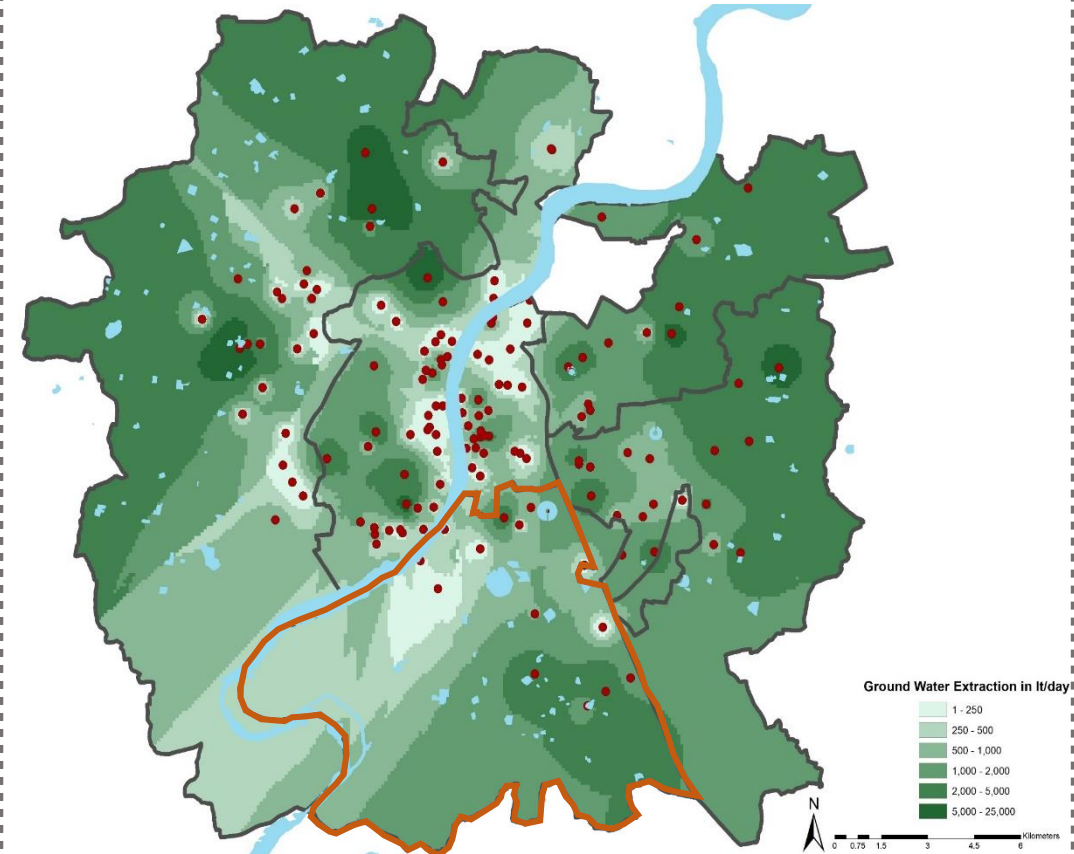
Source: Primary Survey, Water and Sanitation Studio 2017 (100 Samples)

Overview of Ground Water Resources in South Zone

DEPTH OF GROUND WATER FROM THE SURFACE



GROUND WATER PUMPING ANALYSIS



30 - 60m



500 - 3000
lt/hr



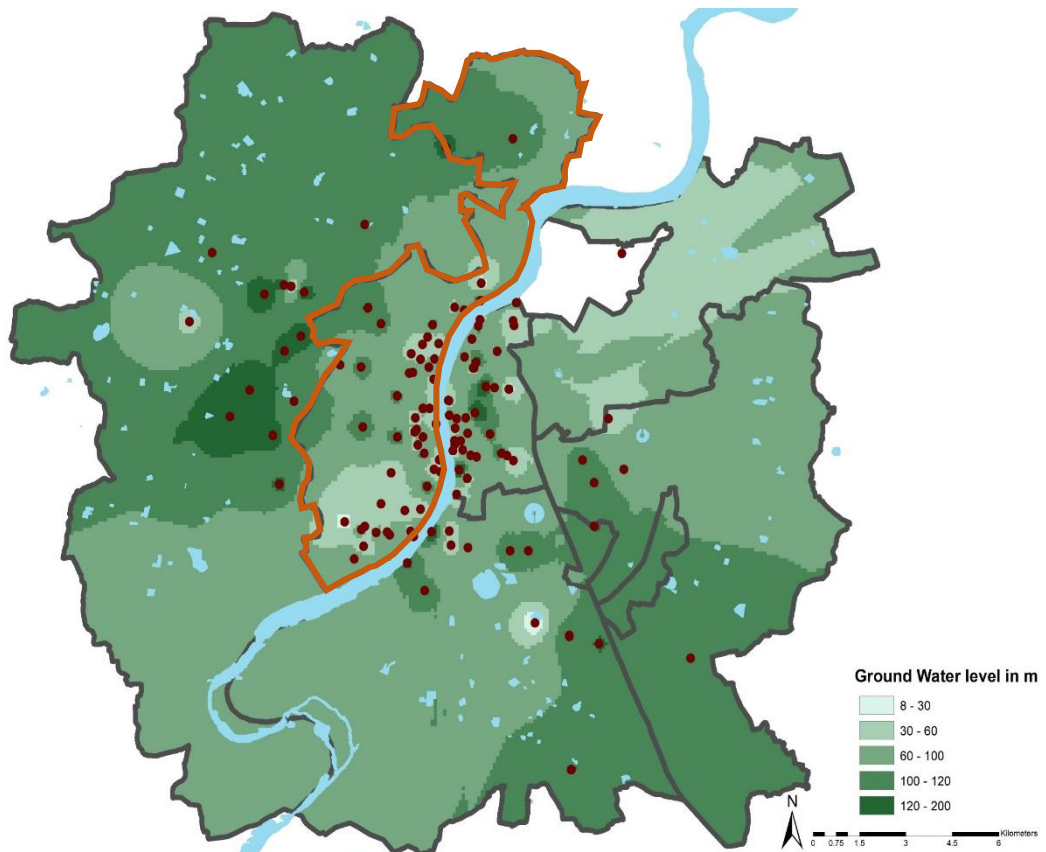
Predominantly
Residential with Open
spaces

- High Ground water table with low extraction
- Aquifer analysis justifies the water levels as well as availability of GW at lower depth from ground
- Quality of water is seen to be affected by presence of some dye industries indulged in flushing of waste water in the aquifer.

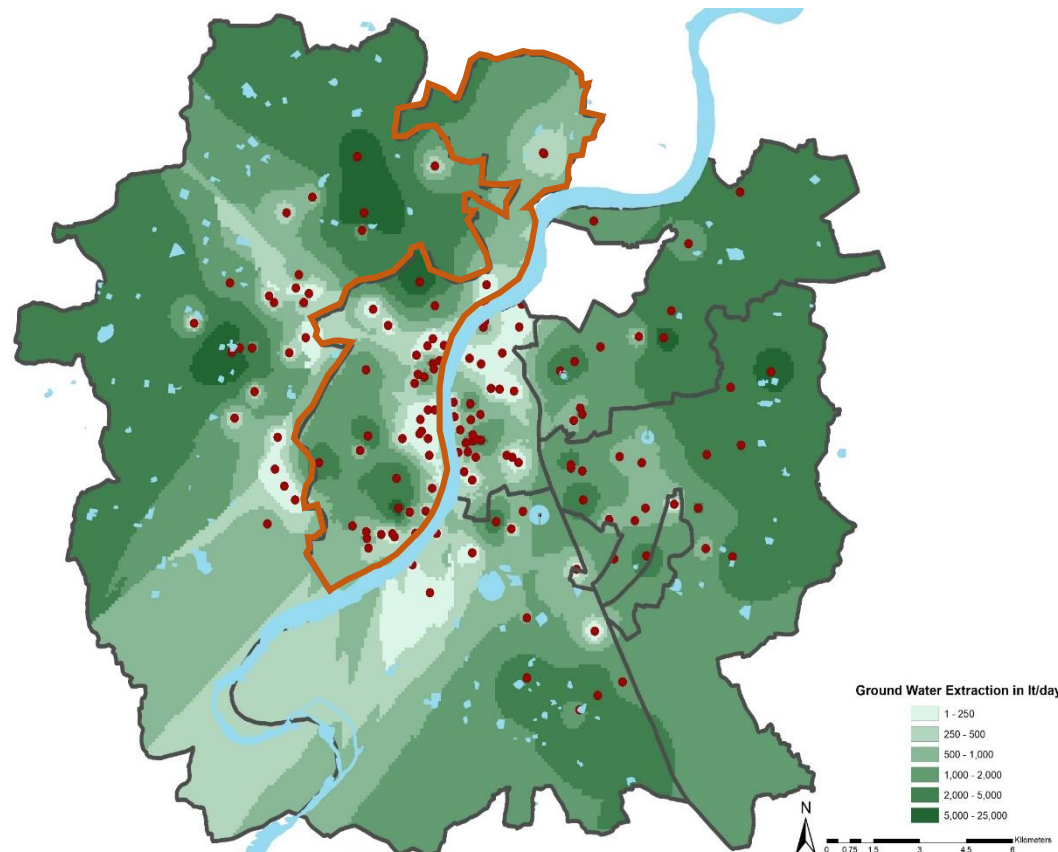
Source: Primary Survey, Water and Sanitation Studio 2017 (100 Samples)

Overview of Ground Water Resources in West Zone

DEPTH OF GROUND WATER FROM THE SURFACE



GROUND WATER PUMPING ANALYSIS



60 - 100m



500 - 1500
lt/hr



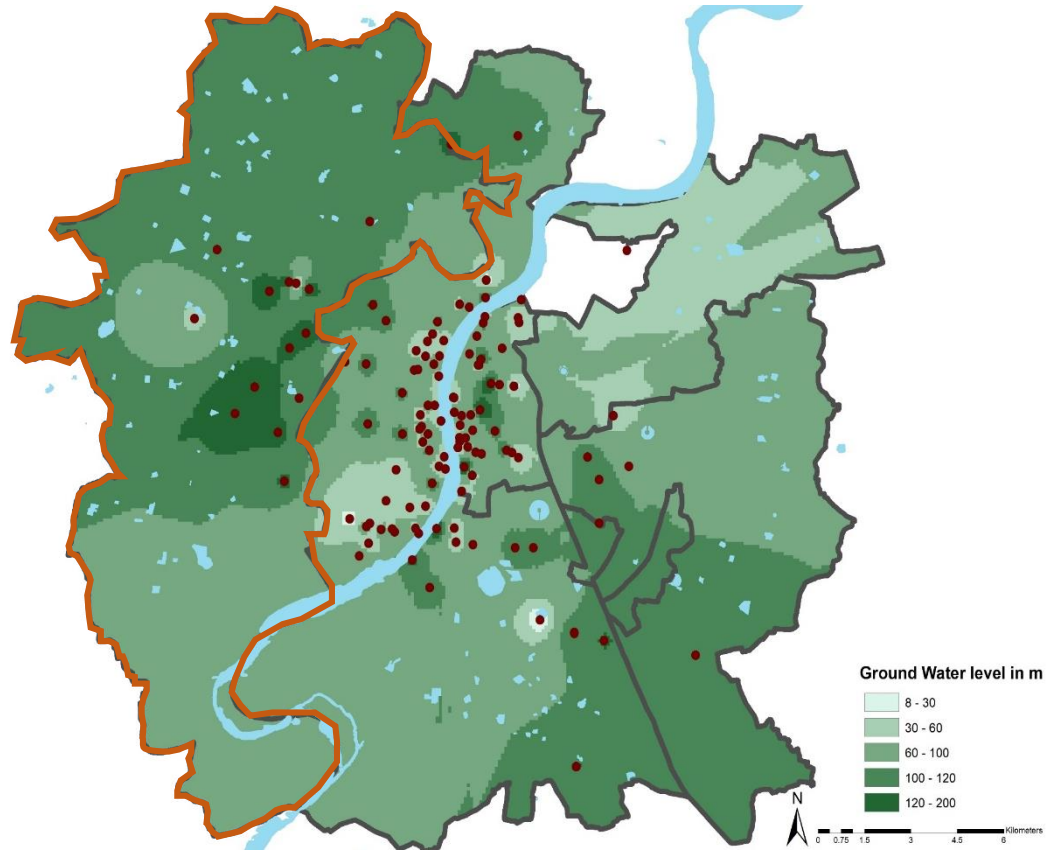
Majorly
Residential

- Water is available at average depth of 70m and extraction is also low
- Dependency of private water suppliers is more in these areas

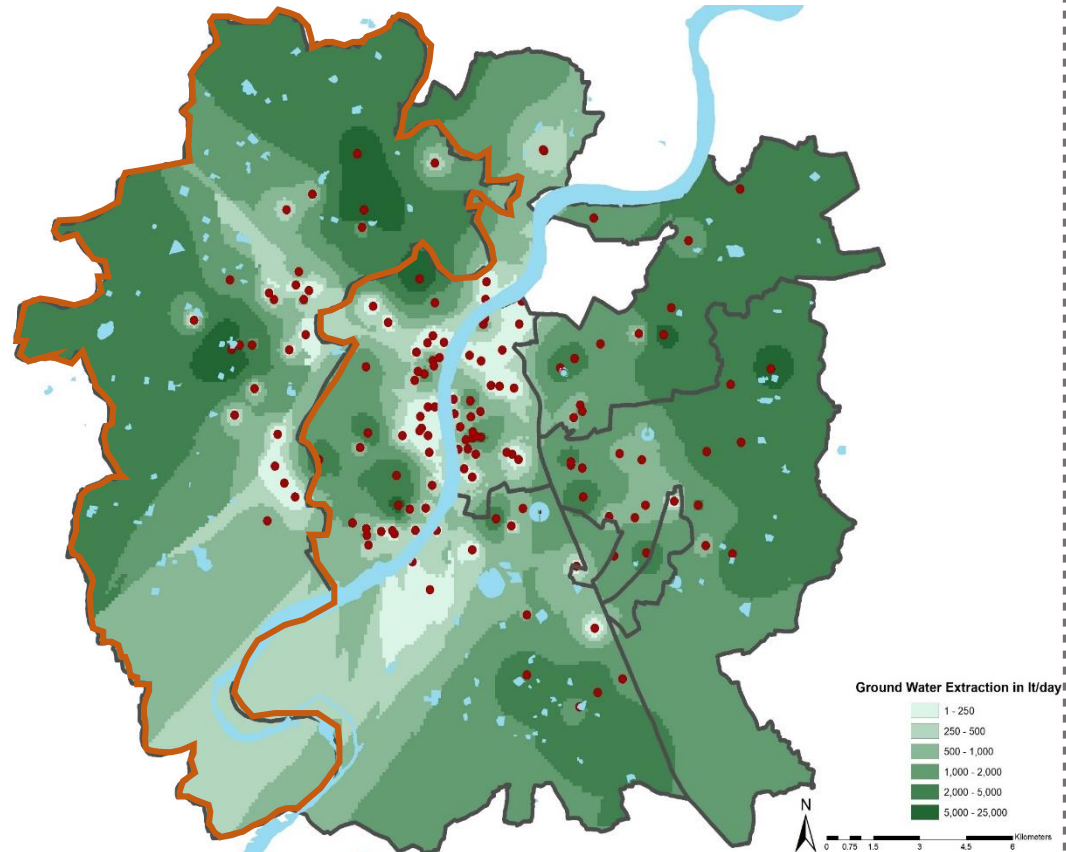
Source: Primary Survey, Water and Sanitation Studio 2017 (100 Samples)

Overview of Ground Water Resources in New West Zone

DEPTH OF GROUND WATER FROM THE SURFACE



GROUND WATER PUMPING ANALYSIS



100 - 120m



500 - 1500
lt/hr



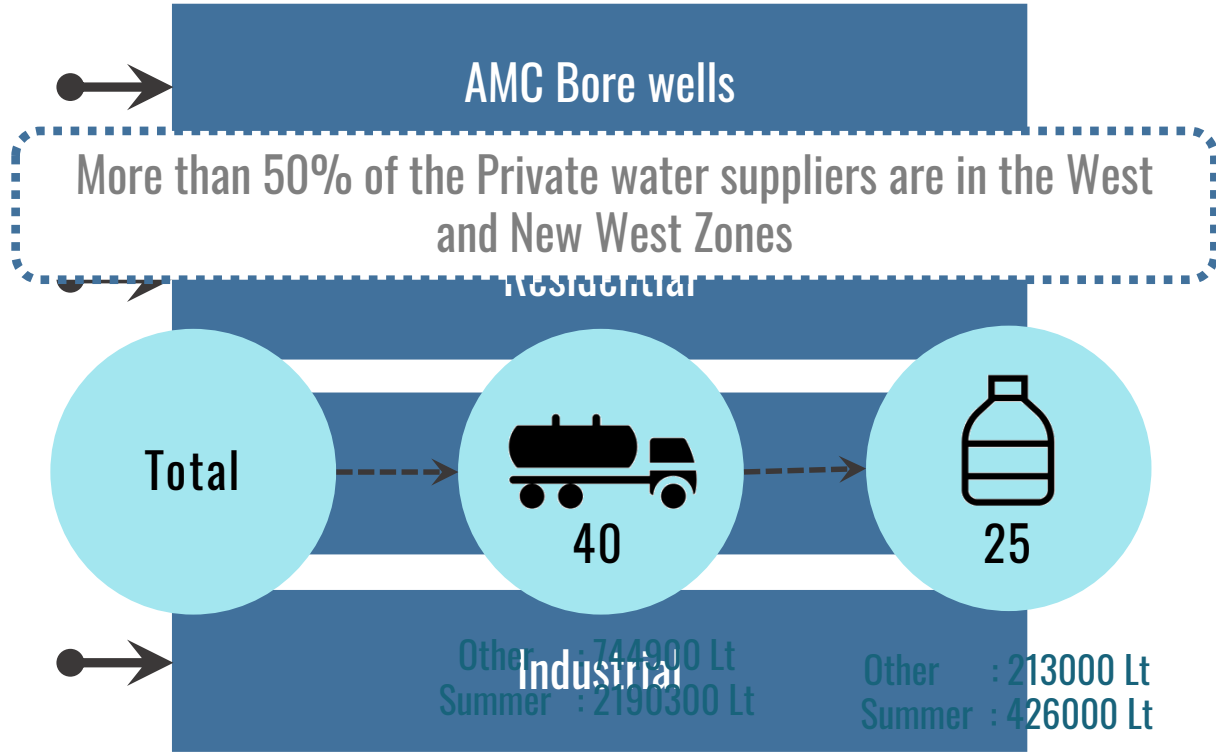
Residential and
Open

- When we see the Aquifer water is available at 20m due to more open space
- Due to high extraction the water is available at 100 – 120m
- High extraction is mainly due to the private water suppliers located more in the New West zone

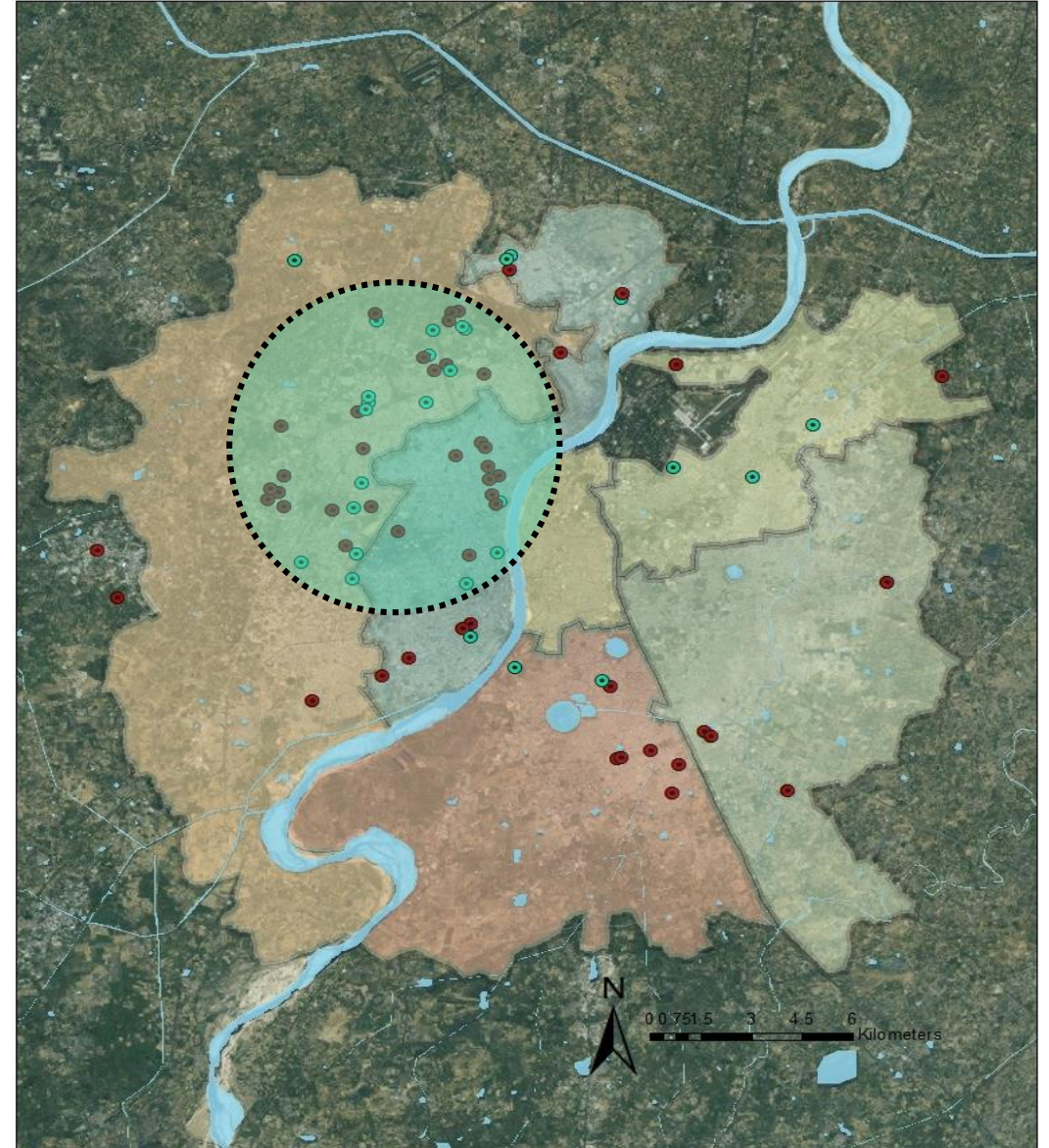
Source: Primary Survey, Water and Sanitation Studio 2017 (100 Samples)

Users and Ground Water

MAJOR USERS OF GROUND WATER



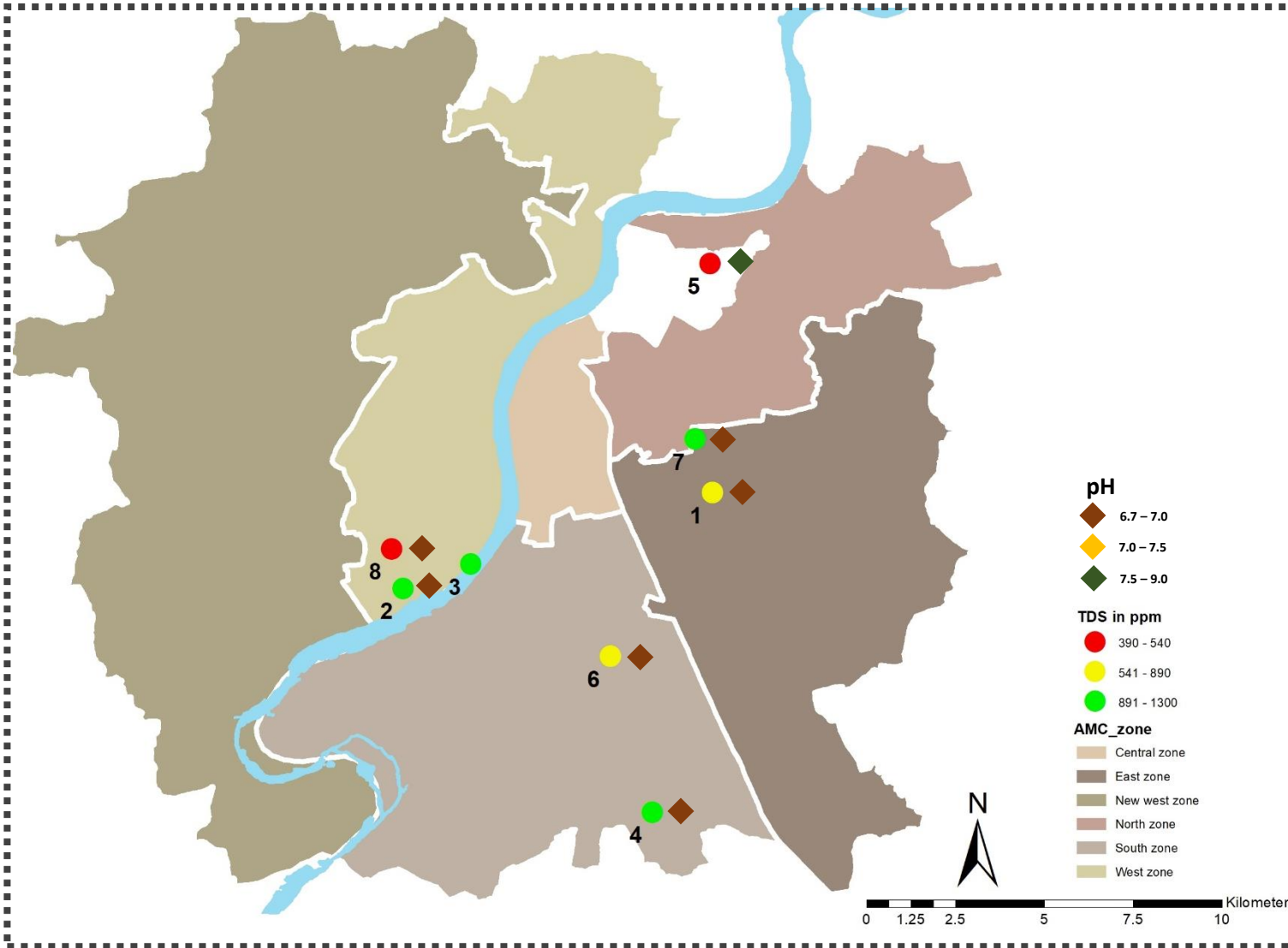
PRIVATE WATER MARKET



Source: Primary Survey, Water and Sanitation Studio 2017

Overview of Ground Water Resources in Ahmedabad

QUALITY OF GROUND WATER BASED ON OBSERVATION WELLS



1.Rakhiyal 2.Vasna(Barrage) 3.Scout Bhavan(Paldi) 4.Vatva-1 5.Vatva-2 6.Vatva-3 7.Airport 8.Isanpur 9.Rakhiyal –1 10.Vasana

Source: GWRDC , Vasna barrage, Ahmedabad,2017.

Parameters	Pre Monsoon	Permissible Limit
TDS (ppm)	998	2000
pH	6.7-7.0	6.5-8.5
Magnesium (mg/L)	16.2	100
Chloride (mg/L)	286	1000
Calcium (mg/L)	10	200

Inference

- TDS is within permissible limits(2000 ppm) however people find it difficulty for portability so they prefer usage of RO and filters in individual household level
- pH shows basic nature of GW especially in industrial areas of vatva and naroda due to flushing of chemicals into Borewells

Regulatory Framework

Central

- Central Ground Water Authority
- Central Ground Water Board
- Central Pollution Control Board
- National Water Resources Council
- National Water Board
- Ministry of Water Resources
- Ministry of Urban development
- Ministry of Agriculture
- Ministry of Environment and Forests

State

- Irrigation Department
- Tube well Corporation
- State Pollution Control Board

Local

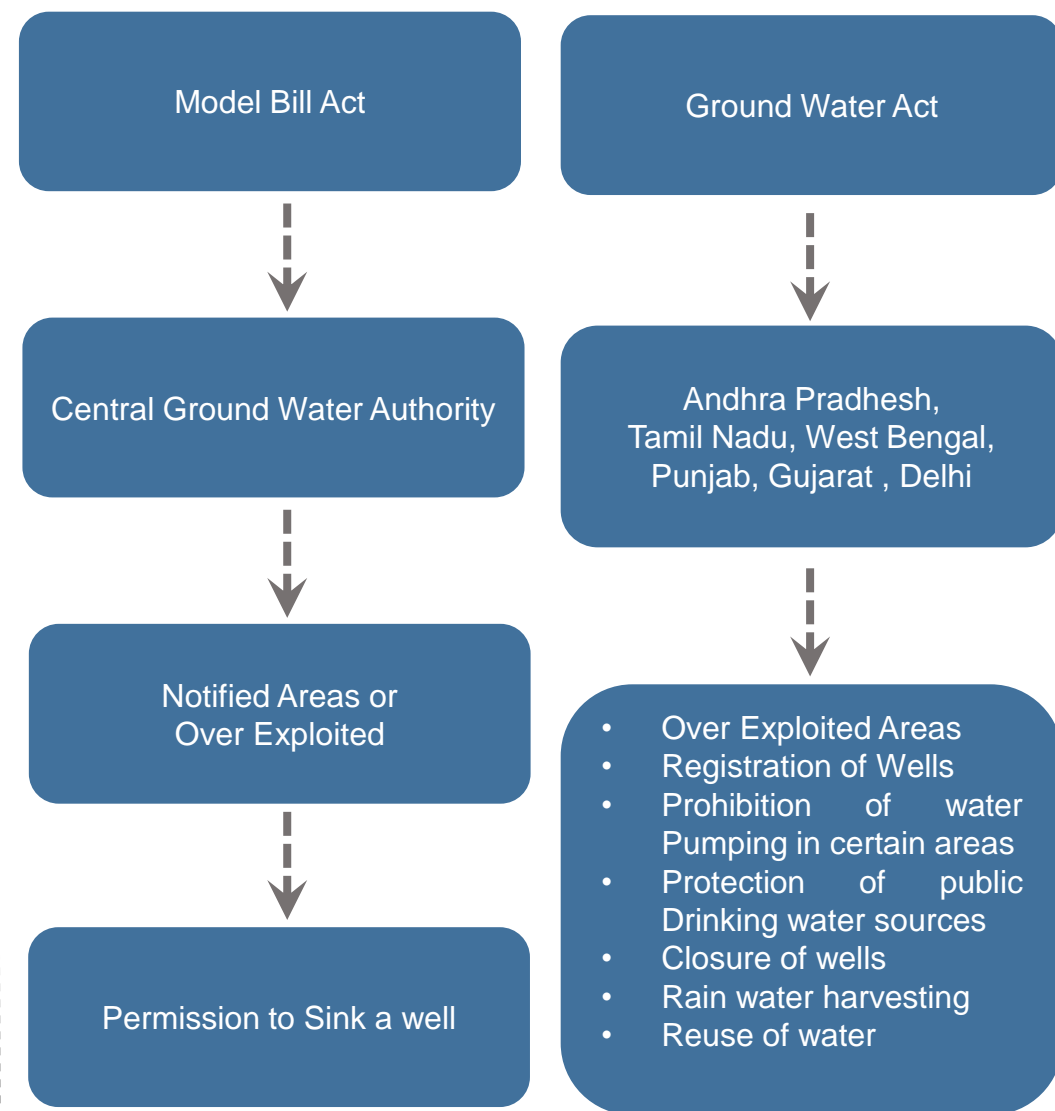
- Panchayat and Municipalities

Others

- NGO
- Water Associations

Issues

- There are no provisions for restricting the **quantum of water extracted** from the existing ground water structures.
- Administrative **implications** of the regulatory system have **not** been either understood or **properly followed**.
- **Adequate funds** as well as **manpower** having dedicated responsibility and proper accountability exclusively for regulation and control
- **Massive awareness programme** is, therefore, required for the successful implementation
- **No punitive action** (including imposition of fine) has been taken anywhere even though the number of over-exploited, critical and semi-critical units are increasing.



Initiatives for Managing Ground Water Sources



INITIATIVES OF AMC

- Has a mandate in GDCR for provision of recharge wells and percolation pits in any new constructions for obtaining built use permission.
- AMC has its own 10 recharge wells of diffang and percolation well type.
- Recharge wells installed in some of the AMC and AUDA parks

ISSUES

- GDCR has provision of recharge shafts in any new constructions but these are not monitored and are mostly filled up after permissions.
- The bores are not technically designed, unmonitored and hence most of them are in non-working condition.

Source: Primary Survey, Water and Sanitation Studio 2017 and Impact of Sabarmati Riverfront on Ground Water by Shipra Patel 2016

Site Selection Parameters

Zone	GW levels	GW Quality	GW extraction
West	3	3	3
New West	4	4	4
East	4	3	5
North	3	4	5
South	2	4	3
Central	3	2	3

Note: Lower the value better the parameter aspect.

GW Levels (Quantitative Analysis)

8-30m	-----	1
30-60m	-----	2
60-100m	-----	3
100-120m	-----	4
120-200m	-----	5

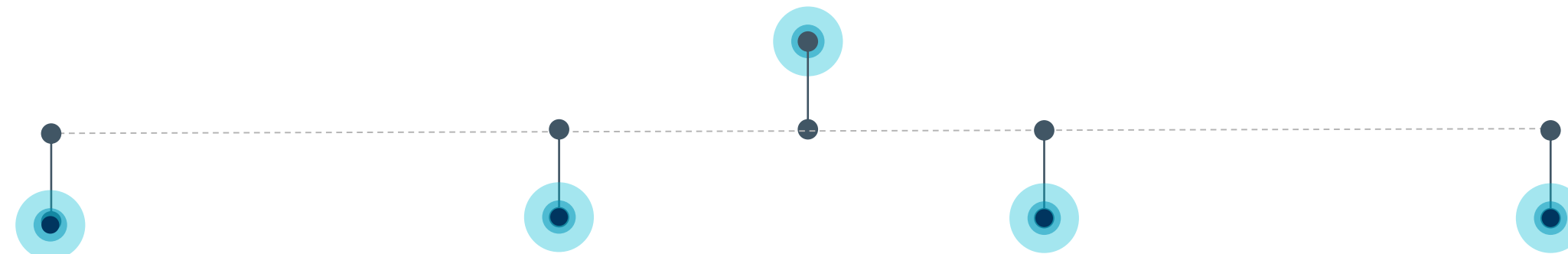
GW Extraction (Quantitative Analysis)

1-250 l/day	-----	1
250-500 l/day	-----	2
500-1000 l/day	-----	3
1000-2000 l/day	-----	4
2000-5000 l/day	-----	5
5000-25000 l/day	-----	6

GW Quality (Qualitative Analysis)

Excellent	-----	1
Very Good	-----	2
Good	-----	3
Average	-----	4
Poor	-----	5

RECHARGING OF GROUND WATER THROUGH WATER BODIES AND PARKS



ANALYSIS OF GROUND WATER CONDITIONS

- Mentioned earlier in the presentation

ANALYZING PRESENT CONDITIONS OF PARKS AND WATER BODIES

- Conditions of lakes explained in previous presentations.
- The information available for parks is as follows:
 - ✓ Number of public parks
 - ✓ Quantity of Water used in maintenance of parks
- The information to be obtained is:
 - ✓ The proposal feasibility mentioned in next point

IDENTIFY SUITABLE METHOD FOR GW RECHARGE

- Provision of Recharge Shafts near to water bodies considering the nearby catchment area/ area of the lake.
- Provision of recharge shafts in public parks to accommodate storm water as well as linking it to the root zone of the garden to catch the sprinkled water as well

PROJECT DETAILING FOR ONE PARK AND ONE LAKE AS A SAMPLE

- The site will be decided on the basis of the areas identified in the analysis that require most attention..

Memnagar Lake: Existing Scenario



Source: Primary Survey, Water and Sanitation Studio 2017, Faculty of Planning, CEPT University, Ahmedabad.

Memnagar Lake: Proposal



The natural slope is towards the west area of the lake and hence a recharge shaft at that end will be preferable as the water will naturally drain towards that end.

Also, it is assumed that the ground water will follow a similar pattern to the surface water.

Thus, the recharge shaft along with the percolation tank will be provided in the highlighted area.

Note: Infiltration through recharge wells is technically viable also owing to its pre-dominant usage in aquifers where the shallow aquifer has dried and existing tube wells are tapped in deeper aquifer.

Source: Primary Survey, Water and Sanitation Studio, Faculty of Planning, CEPT University, Ahmedabad.

Memnagar Lake: Proposal



Level of Ground Water in Zone(m)	Availability of Potential Aquifer for recharge
	120
100-120	160
	200

Source: Primary Survey, Water and Sanitation Studio 2017

The recharge shaft will be designed for a depth of 142m from ground level due to:

- Availability of substantial aquifer
- More economical due to lesser boring as compared to other two depths.

Also, a percolation pit will also be provided as shown below:

- It facilitates frequent cleaning of the well so as to avoid clogging due to fine sand particles.

RECHARGE THROUGH INJECTION (BORE) WELL

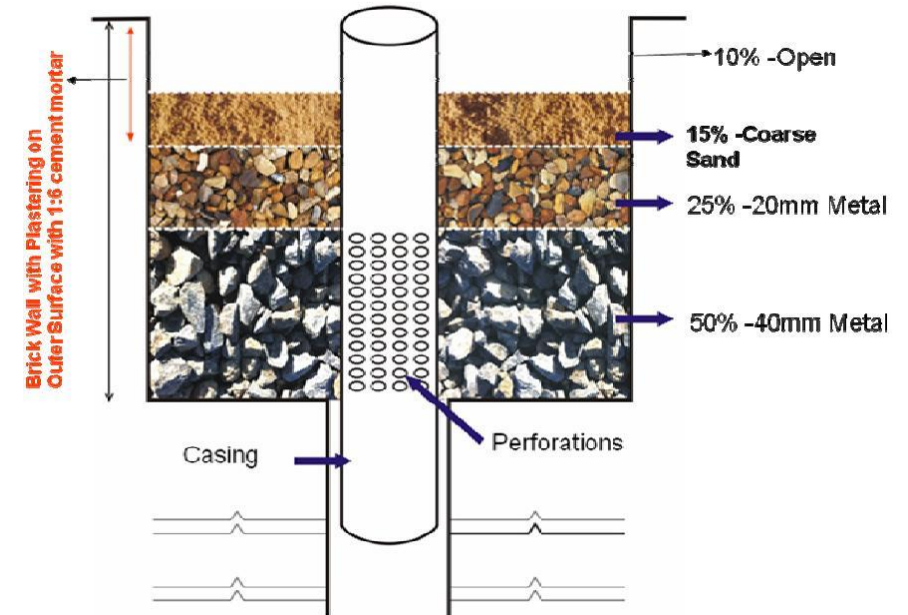
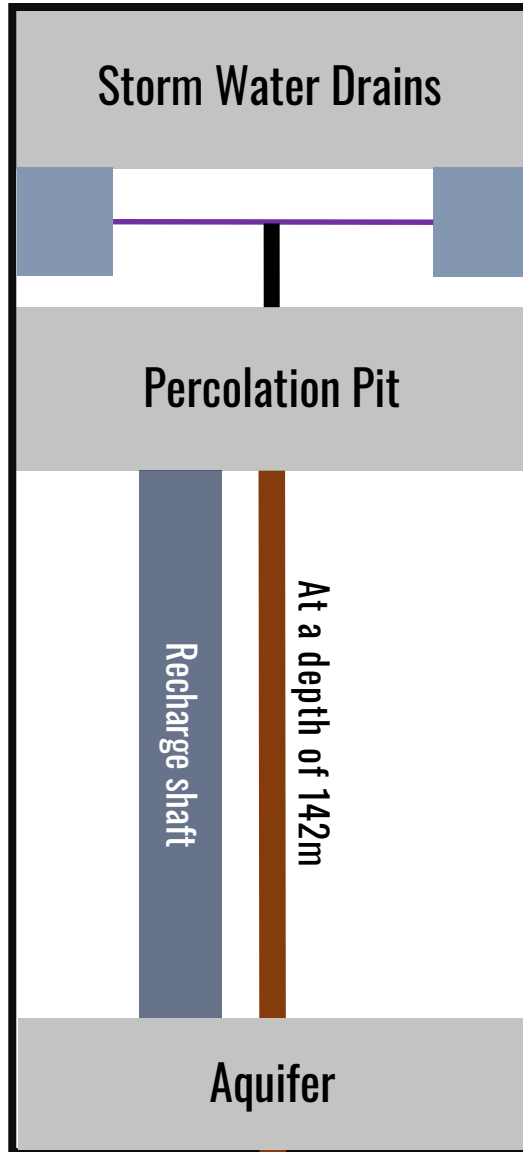
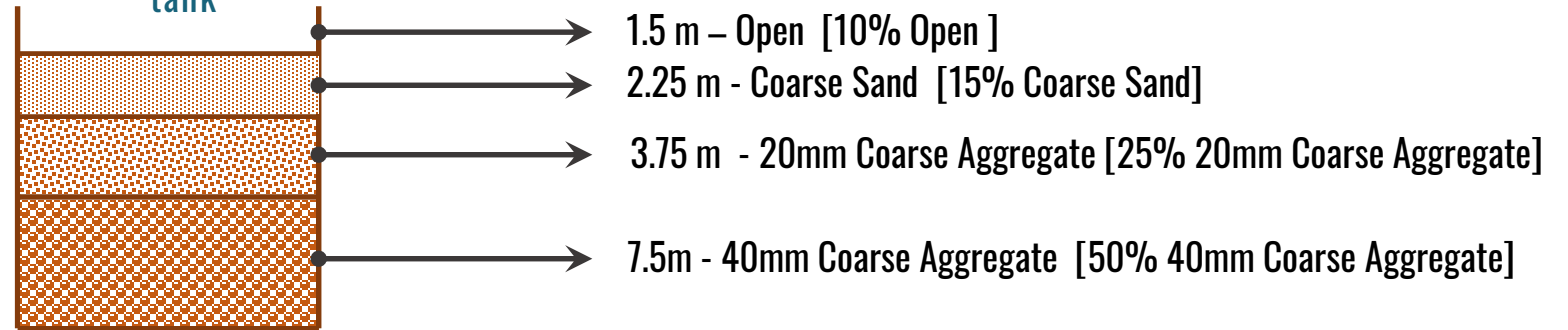


Image Source: <https://www.hyderabadwater.gov.in/en/rainwater/images/img6.png>



Percolation Pit Design [3 pits]

Sectional elevation of the filter tank



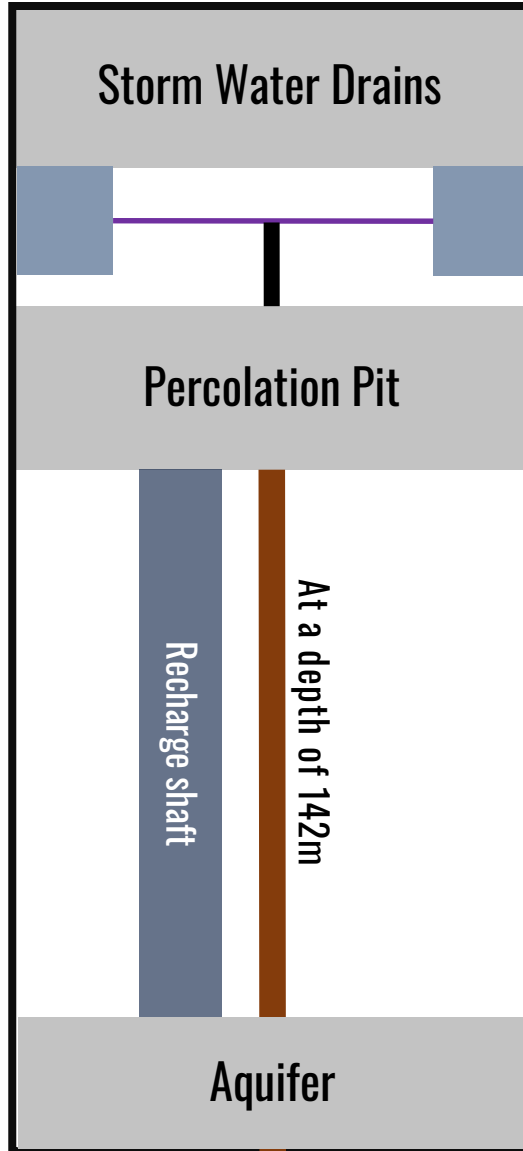
Design of one filter tank

Size of one filter tank = 10m x 6m x 15m

Recharge Shaft Design [250mm dia pipe]

- No. of strainers required depends on the aquifer typology and hence by looking at electro-log one can say that
- No. of strainers required=1
- Depth up to which boring will be done=142m (aquitard level)
- Depth at which strainers will be provided= 125 – 135m i.e. 10m strainer
- Percentage of water Recharged = 61.31%

Memnagar Lake: Proposal



Reference: *<http://www.thewatertreatments.com/water-treatment-filtration/rapid-sand-filters/>

Memnagar Lake - Proposal Costing

Cost of Project ~78 lakhs

Sr. No	Description	Unit	Quantity	Cost per unit	Cost incurred
1	Levelling of Lake surface	lumpsum			5,00,000
2	Boring of recharge well up to 130m depth	lumpsum			2,50,000
3	Casing Pipe of 250mm dia	m	142	1,700	2,41,400
4	Percolation pit	sq m	60	15,000	9,00,000
5	Sand for pit	per tonne	206	900	1,85,400
6	Gravel for pit	per tonne	1147	1,000	11,47,000
7	Strainers	Running m	10	4,000	40,000
	Total Cost of one tank				22,72,400
	Total cost of 3 tanks				68,17,200
Total Cost					78,08,600

Time Taken for Project ~10 Months

Type of Work	Days
Design	60
Construction	
Bore drilling	60
Filtration tanks	180
Total time in Days	300
Total Time in Years for a lake	0.822 = ~10 months

Reference: http://shodhganga.inflibnet.ac.in/bitstream/10603/139309/14/14_chapter%204.pdf

Recharging of Ground water by Utilizing Parks

Total number of Parks within AMC boundary : 232
Total area of Parks within AMC boundary : 24052 Sq.m



- New West Zone**
- → GW level 100 -120m
 - → GW Extraction 500 – 1500
 - → Predominantly Residential and Open spaces

PRAHALAD NAGAR GARDEN:

- Area : 15600 Sq.m
- Very well Landscaped
- Ground water dependent
- Provided with Storm water Drains based on provided slope on the footpath
- Park is maintained by Amul



Existing Scenario of Prahalad Nagar Garden

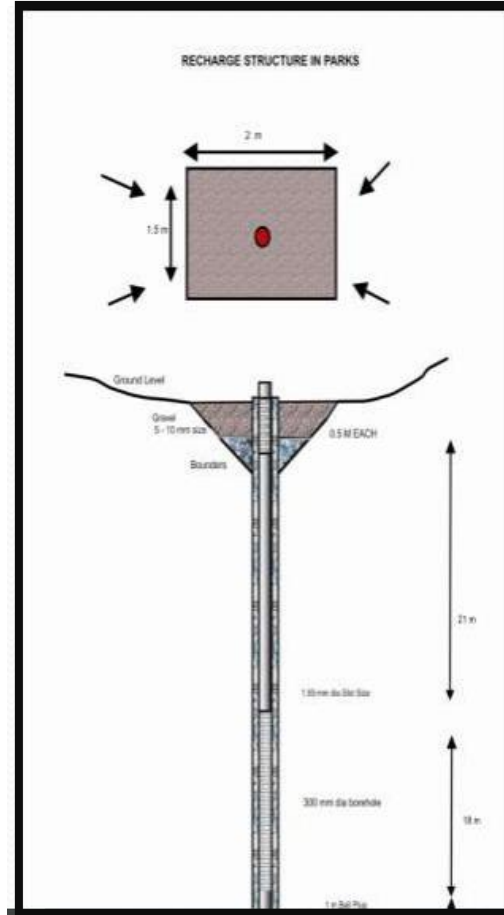
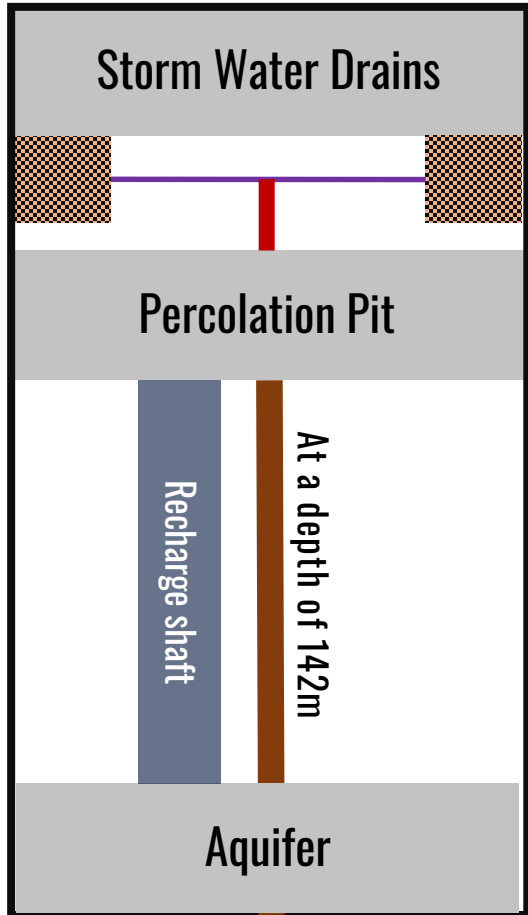


Source: Primary Survey, Water and Sanitation Studio 2017

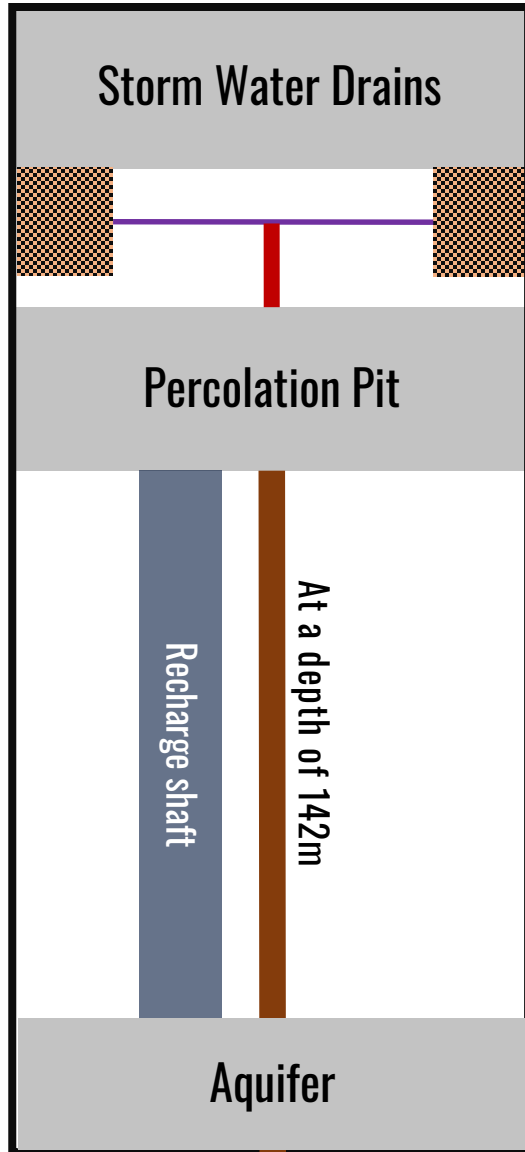


Proposal for Prahalad Nagar Garden

Connecting Storm water drains to Percolation pit and Recharge shaft at depth based Aquifer Analysis of that Area

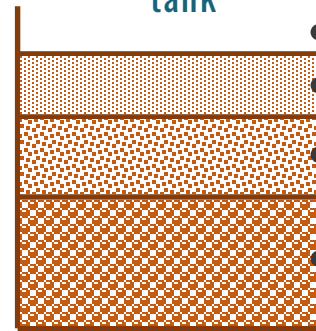


Prahalad Nagar Garden Proposal Design



Percolation Pit Design [2 Pits]

Sectional elevation of the filter tank



2 m – Open [10% Open]

3 m - Coarse Sand [15% Coarse Sand]

5 m - 20mm Coarse Aggregate [25% 20mm Coarse Aggregate]

10m - 40mm Coarse Aggregate [50% 40mm Coarse Aggregate]

Design of one filter tank

Size of one filter tank = 10m x 6m x 20m

Recharge Shaft Design [250mm Dia pipe]

- No. of strainers required depends on the aquifer typology and hence by looking at electro-log one can say that
- No. of strainers required=1
- Depth up to which boring will be done=142m (aquitard level)
- Depth at which strainers will be provided= 125 – 135m i.e. 10m strainer
- Percentage of water Recharged = 23.5%

Prahalad Nagar Garden Proposal Costing

Cost of Project ~59 lakhs

Sr. No	Description	Unit	Quantity	Cost per unit	Cost incurred
1	Boring of recharge well up to 130m depth	lumpsum			2,50,000
2	Casing Pipe of 250mm dia	m	142	1,700	2,41,400
3	Percolation pit	sq m	60	15,000	9,00,000
4	Sand for pit	per tonne	275.4	900	24,78,600
5	Gravel for pit	per tonne	1530	1,000	15,30,000
6	Strainers	Running m	10	4,000	40,000
	Total Cost of one tank				22,72,400
	Total cost of 3 tanks				54,35,720
Total Cost					59,27,120

Time Taken for Project ~10 Months

Type of Work	Days
Design	60
Construction	
Bore drilling	60
Filtration tanks	180
Total time in Days	300
Total Time in Years for park	0.822 = ~10 months

Reference: http://shodhganga.inflibnet.ac.in/bitstream/10603/139309/14/14_chapter%204.pdf

GROUND WATER TARIFF



ANALYSIS OF GROUND WATER CONDITIONS

- Mentioned earlier in the presentation

INTRODUCTION OF CONTROL MEASURES THROUGH CASE STUDIES

- Referring to the best practices in other cities worldwide/nation wide for efficient utilization of ground water resources.

INTRODUCTION OF GROUND WATER TARIFF

- Identification of ground water users which has been conducted and explained.
- Levying user tariff based on the city assessment and willingness to pay of users.

Ground Water Tariff

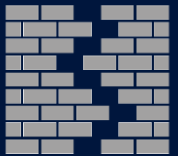


- Increasing critical areas over the years
- One way to control exploitation of the ground water



Criteria to be considered in fixing the GW Tariff

- Existing water and sanitation charges
- Complete or partial dependency on ground water
- Domestic and Non domestic categories
- Horse power of the pump used
- Dia of the pipe
- Metered or Not metered
- AMC borewells, Areas and scale that had been served should be captured



Gaps

- Registration of Bore wells
- Data on capacity of pump
- Water metering



Case of Bengaluru

Tariff

For Domestic connections fixed flat charge

For Non Domestic connections charged per HP of Bore well pump

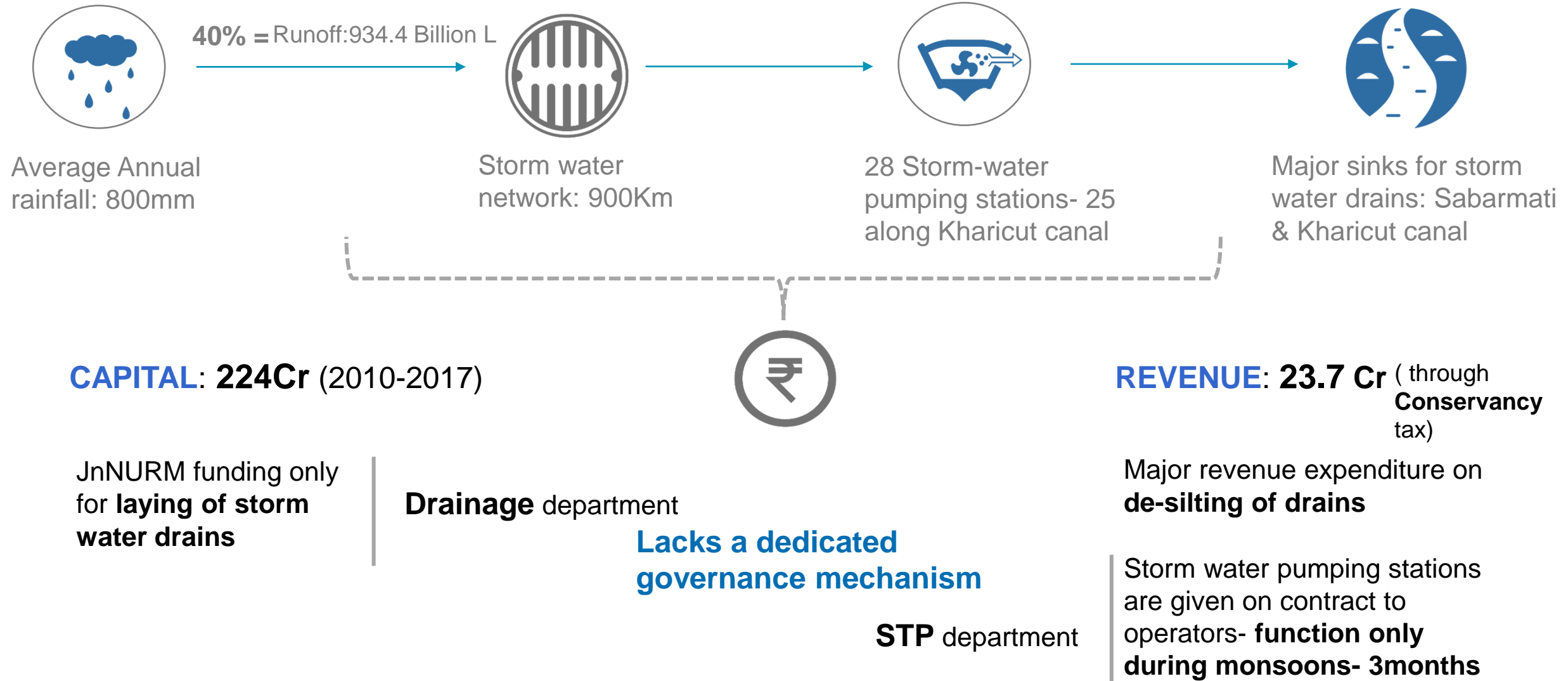
For Non Domestic connections like hospitals, lodges, shopping malls charges are fixed based on scale

Bulk Users like Industries, Flats , multi-storeyed buildings charges are fixed based on consumption of water

All the above said charges may vary based on partial or complete dependency

Storm Water Management

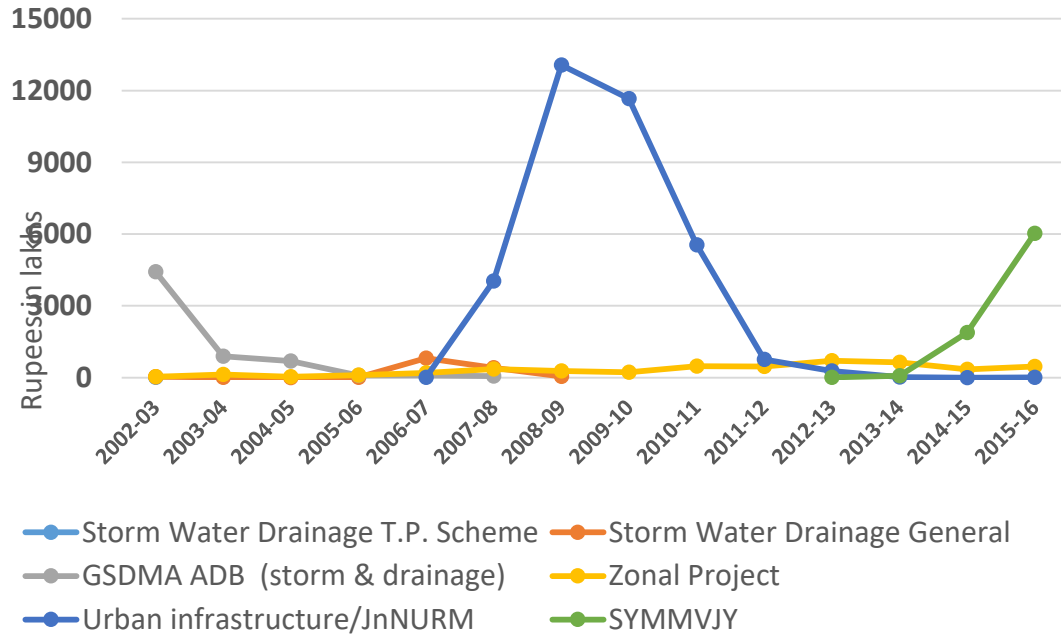
Existing Scenario



Source : SLIP 2016-17, Water sensitive group Water sanitation studio 2017-18

Financing Storm Water Management In Ahmedabad

CAPITAL EXPENDITURE- SOURCES

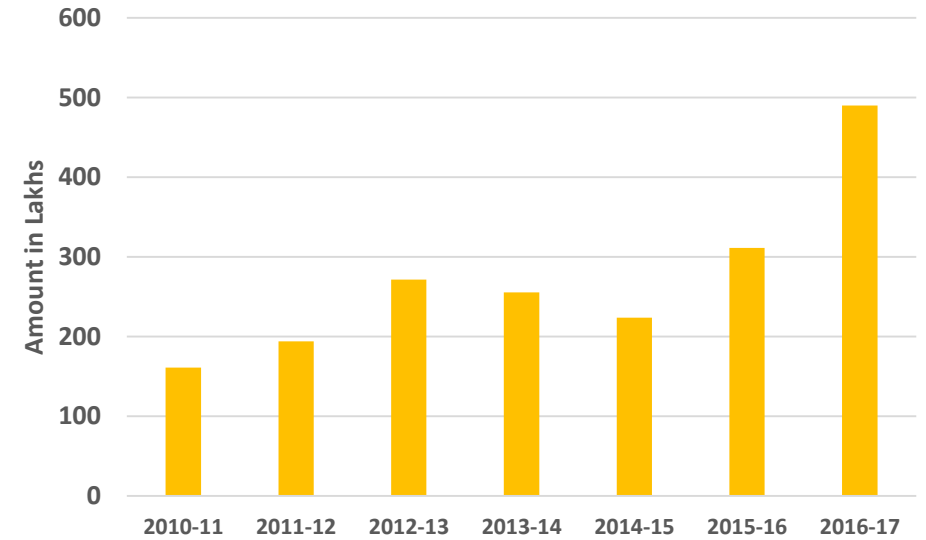


Investments only in Storm water drains and its de-silting

Total: **224 Cr.** (from 2010)
Major components: **Storm Water Drains, Pumping Stations**

Source: AMC Budget 2002-2017

REVENUE EXPENDITURE

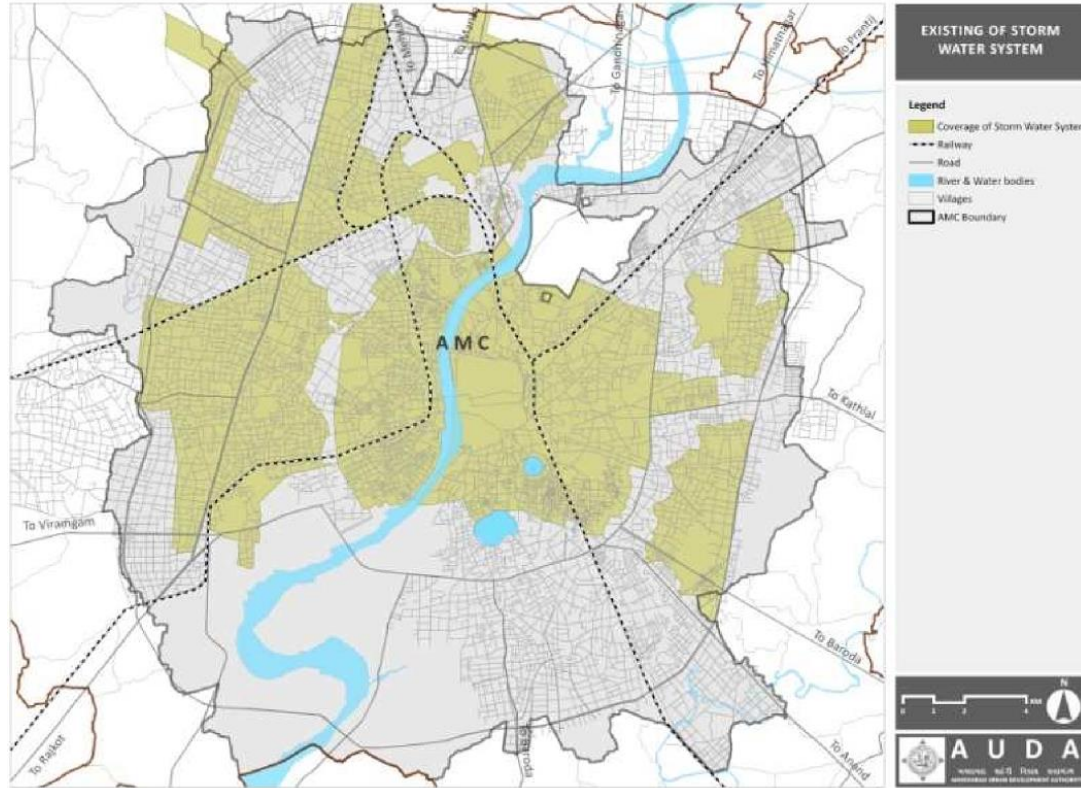


No Recovery in Revenue from own sources

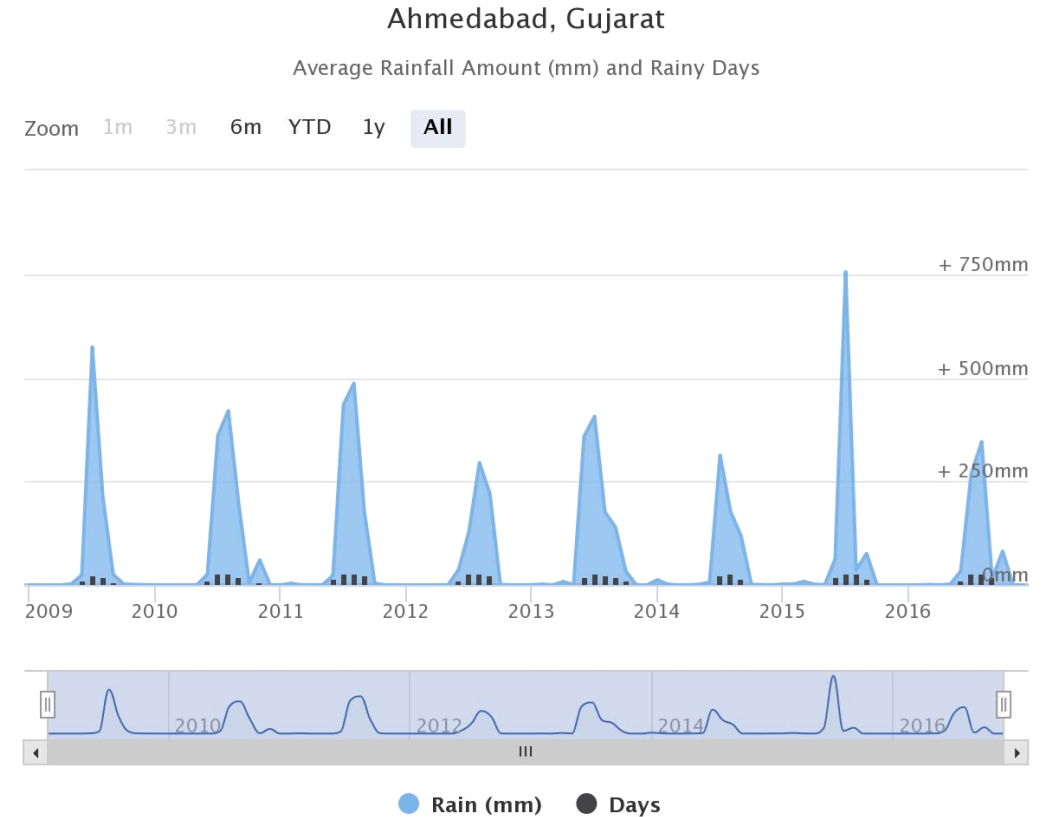
Total: **23.6 Cr.**
Major components: **Desilting, Salary, Operating cost (pumping stations)**

Existing Scenario

Storm water Coverage - 55%



Average annual Rainfall – 800mm

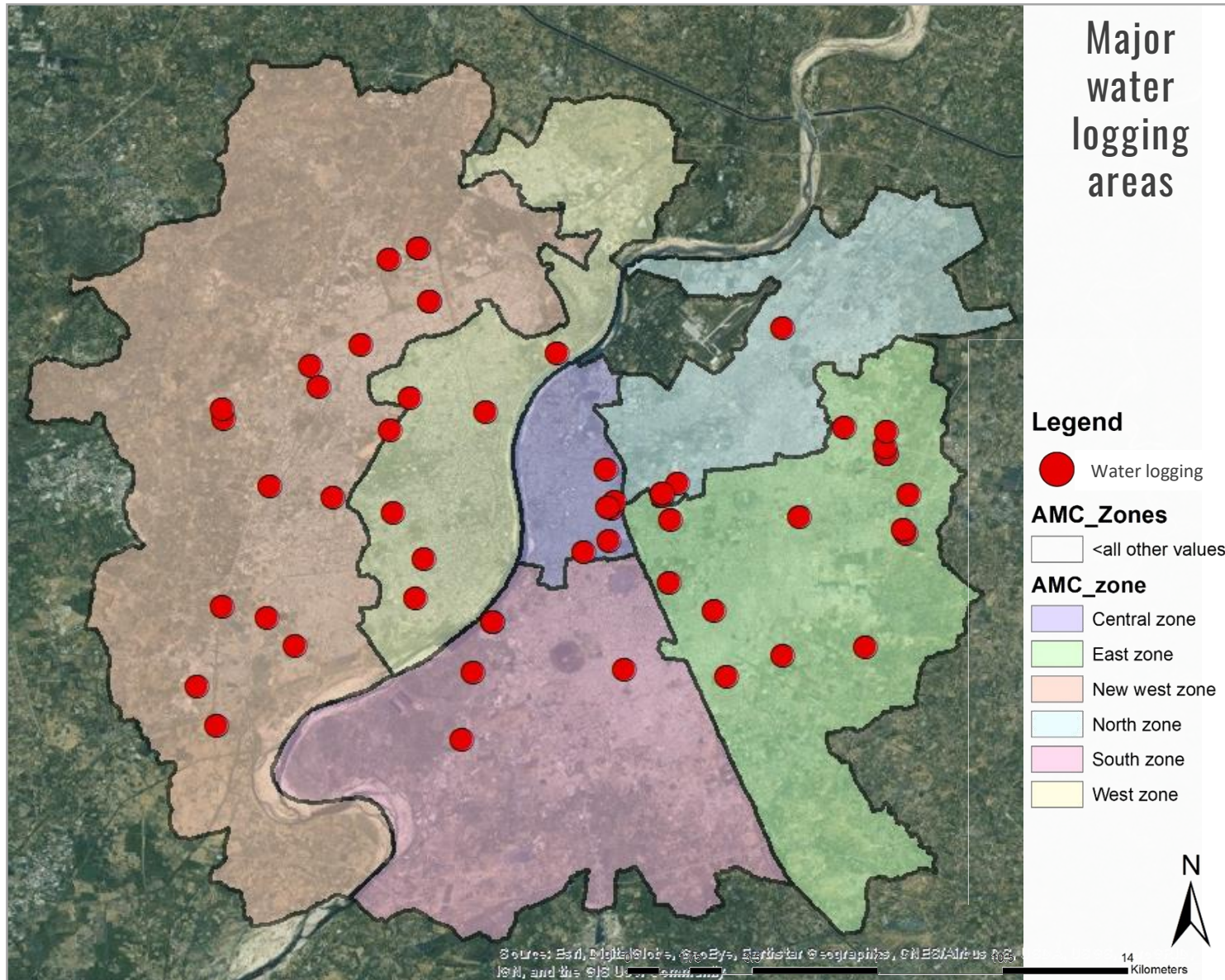


Predominant Issue



Water Logging

Source : AUDA DP, <https://www.worldweatheronline.com/lang/en-in/ahmadabad-weather-averages/gujarat/in.aspx>, AMC Monsoon Control Room



Water logging - stagnant water for more than four hours of a depth more than 6" (SLB guidelines)

But Water logging is considered if it is affecting the transportation and normal life.

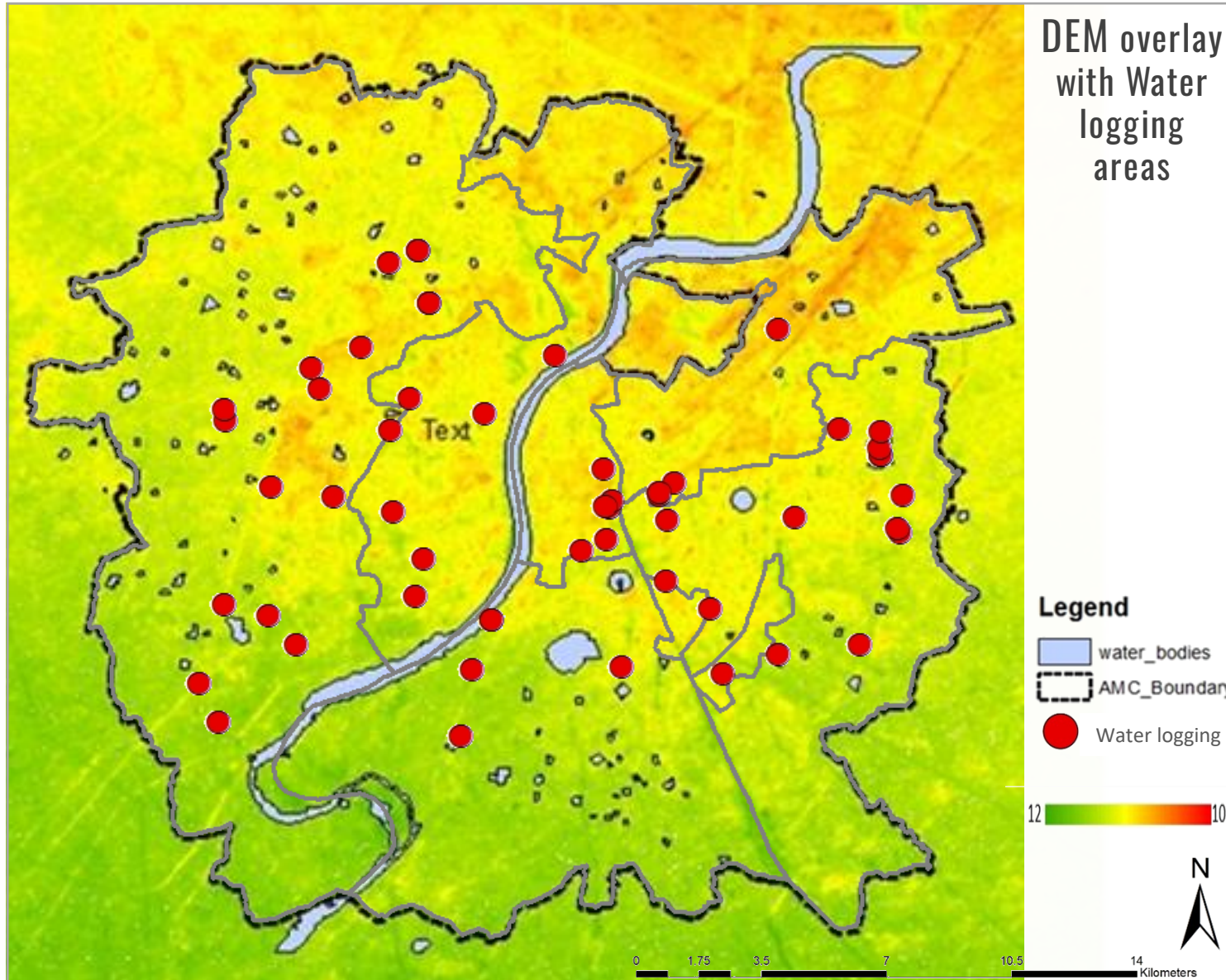
992 total water logging complaints registered in 2017

There are **45 major Water Logging** location in the city

(i) Along roads (length-50m or more)

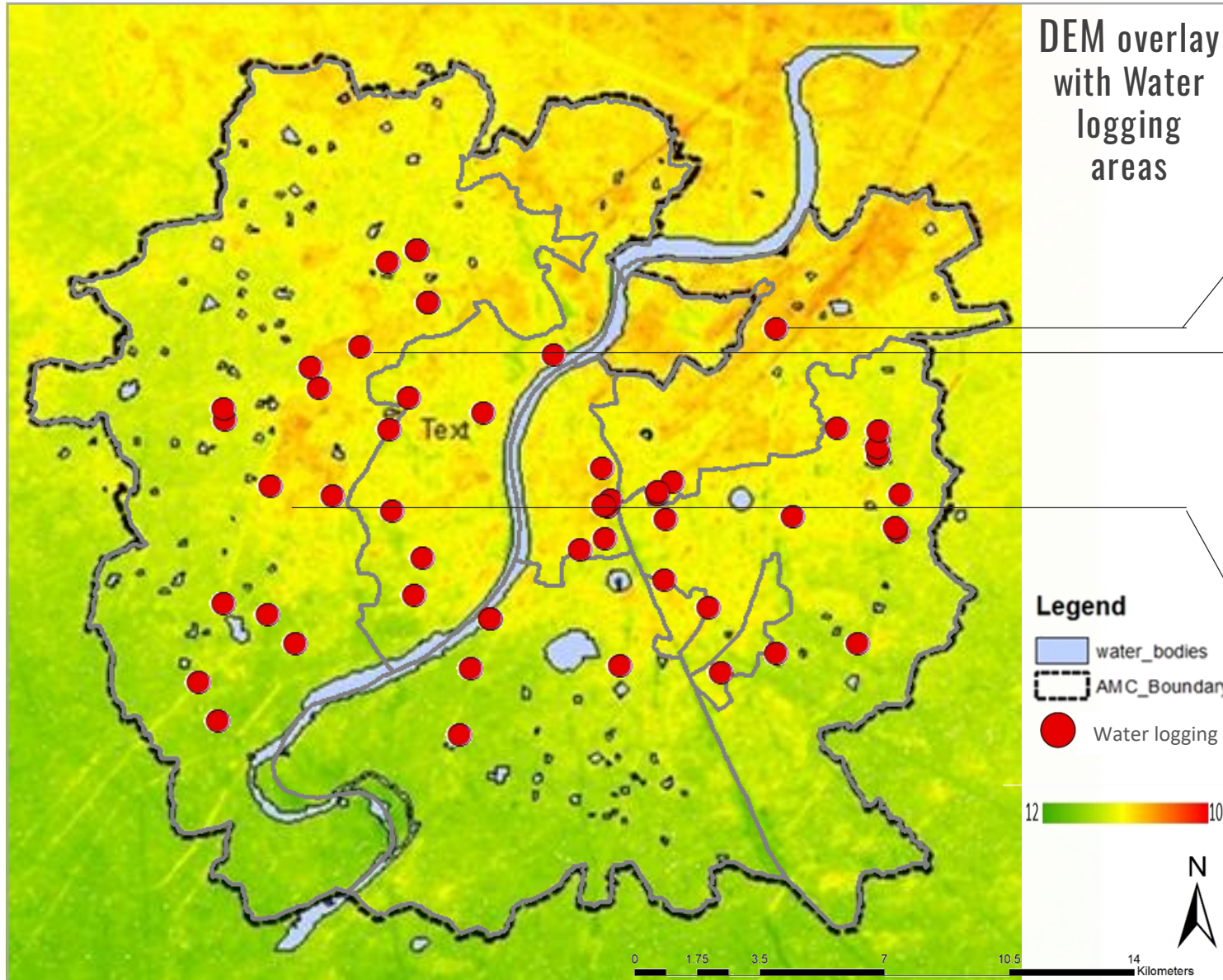
(ii) Key intersections

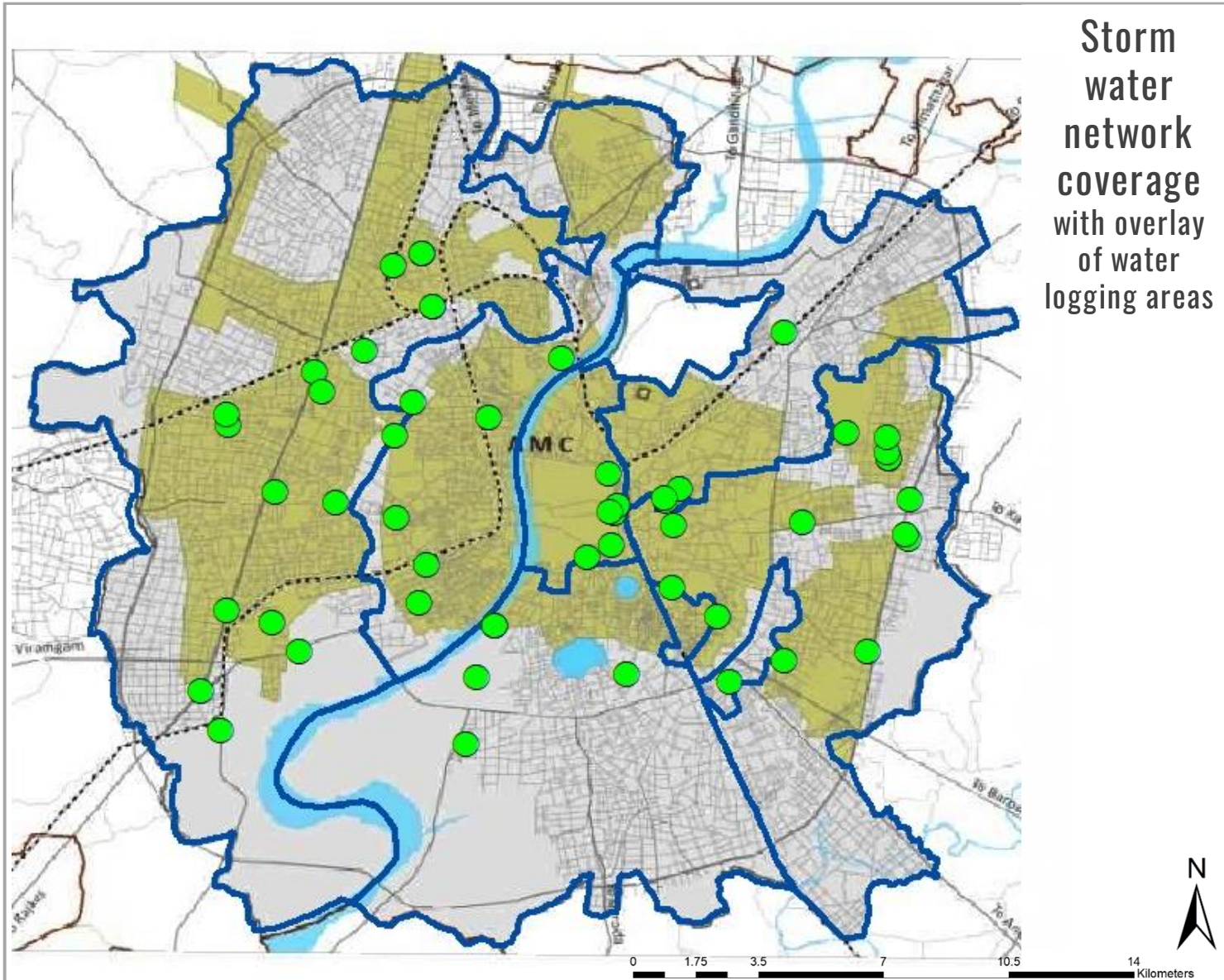
(iii) Localities



- East, New West and South zones are the low laying areas
- But major Water logging is also seen in higher elevation region
- This is the impact of change in natural topology due to new construction of roads and buildings

Source: AUDA DP 2021, Secondary data – AMC, SLIP – Amrut, AMC Monsoon Control Room

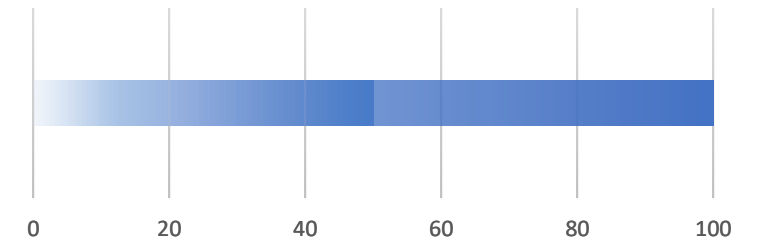




Storm water network coverage with overlay of water logging areas

- The storm water coverage is 55%
- But yet Water logging is seen majorly seen in the storm water covered area.

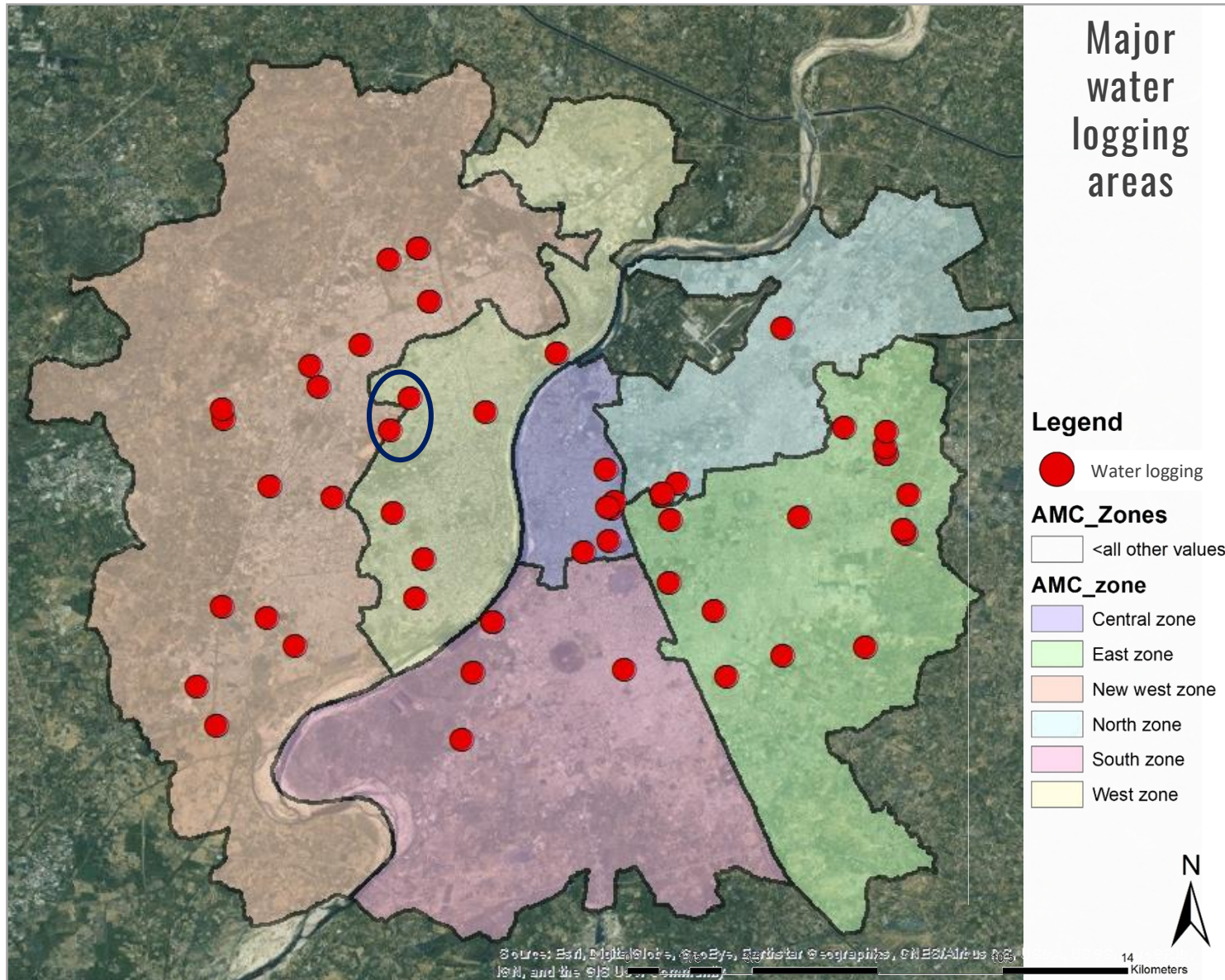
STORM WATER COVERAGE



Will Storm Water system become 100% efficient by achieving 100% coverage ??

No because these storm water networks are not designed to collect 100% runoff of peak rainfall intensity.

It is designed for 25-50% of peak rainfall intensity.



Pilot project

Water logging along
Helmet circle to Torrents Power
(Naranpura) which includes water
logging

(i) Along roads (length-50m or more)

(ii) Key intersections

(iii) Localities

Printed from
THE TIMES OF INDIA

City soaked to bones

TNN | Jul 23, 2017, 04:00 AM IST

Ahmedabad: Rains continued to lash the city unabated as many Amdavadis chose to remain indoors on Saturday. The city received average 65.71mm rainfall from 6 am to 10 pm. This is by far the highest rain received on a single day this season. In several areas like Valinath Chowk, Jaymangal BRTS stretch, Pallav Crossroads, complaints of waterlogging were reported. In the West zone, Chandkheda received the highest rainfall of 119.5 mm from 6am to 10pm on Saturday.

In the East and North zones, too, there were issues of drainage spills and waterlogging complaints from several areas. In several areas of Nikol and Bapunagar, citizens moved around knee-deep and waist-deep water for several hours.

"Both roads flanking the Kharicut canal were waterlogged. Many societies located alongside the canal could not move for around for several hours," said a resident Satish Patel.

One of the worst affected stretches was on 132 feet Ring Road, from Helmet Flyover to Shastrinagar Crossroads. Since there was waterlogging at Helmet Crossroads, traffic police diverted people towards the flyover. However, the move did no good as it led to severe traffic congestion right from Helmet Flyover to AEC Flyover till Shastrinagar and Pragatinagar BRTS stops.

"I had to turn towards Drive-In Road, but since the road was waterlogged, I had no option but to take the Helmet Flyover. Going further, as I descended the flyover, there was heavy waterlogging. At one point, I almost thought my car will stop and not start. It was scary and tiring," said Falguni Patel, a commuter.

<https://timesofindia.indiatimes.com/city/ahmedabad/city-soaked-to-bones/articleshowprint/59718623.cms>

WATERLOGGED ROADS

Amdavadis woke up to an overcast sky which soon turned into a torrential downpour on Saturday. The city received 4 inches of rain in five hours between 6 am and 11 am. City roads were waterlogged, traffic came to a standstill even as AMC-run schools as well as several government schools in the city declared a holiday. Residents of Shrinandnagar in Vejalpur had to wade through knee-deep water as the entire area was inundated with rainwater.



"The situation is the same as it was years ago but it has failed to solve our waterlogging problems," says Rahul Parekh, who lives in Shrinandnagar-3.

"Every year, rain causes severe waterlogging in our society. This time due to waterlogging. There was three feet of water inside and outside the society for several days. A wall fell near Shrinandnagar 1."



The area around Sonal Cinema also witnessed waterlogging. Several cars got stuck on the flooded roads. Vehicles were also stranded near Jivraj Park where the problem is severe due to the ongoing metro train project. The same situation was witnessed at Helmet Circle due to the work on MEGA project. Office-goers were stranded at most intersections. Ankit Patel, a 25-year-old MA student from Memnagar who got stuck at Helmet Crossroads said, "This crossroad witnesses flooding every year. Our roads are never rain ready even though AMC always boasts of having a monsoon plan."

1/2



- Storm water
- During peak
- insufficient
- To reduce
- efficiency of



er bodies

rains,

n increasing

be provided.



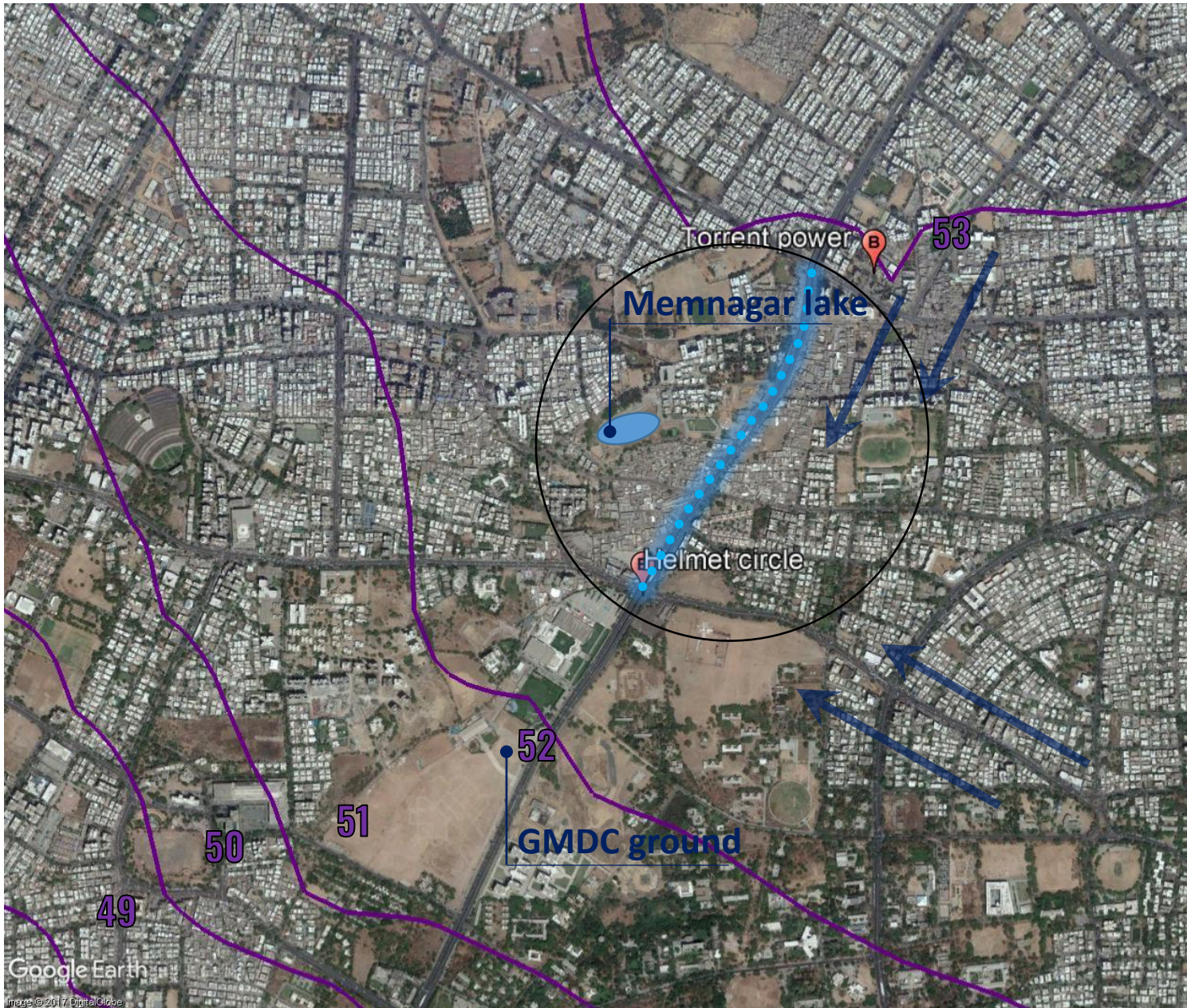
Intervention



Present condition of drains in Helmet cross road and Torrents circle stretch

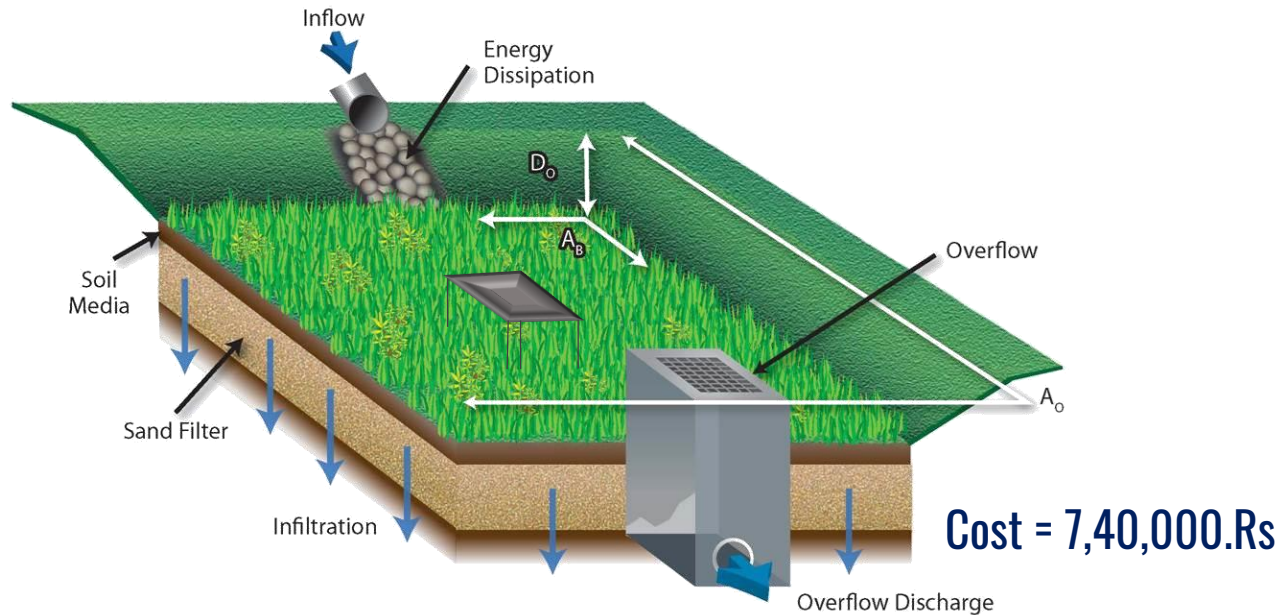
Findings of the primary survey in this stretch,

- The residents of this stretch said that cleaning of drains will happen during monsoon when the water get clogged
- No pre monsoon cleaning is seen.

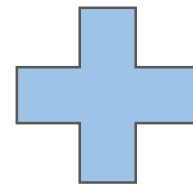


- The pilot stretch considered is 1.1km (from Helmet circle to Torrents power circle)
- The flow is towards Helmet circle.
- Catchment area of 4,75,165.89 sqm is considered
- The Runoff obtained in this area is **35.34 lakh litres**
- The capacity of drains is **12.44 lakh litres.**
- The excess of runoff is **23 lakh litres.**

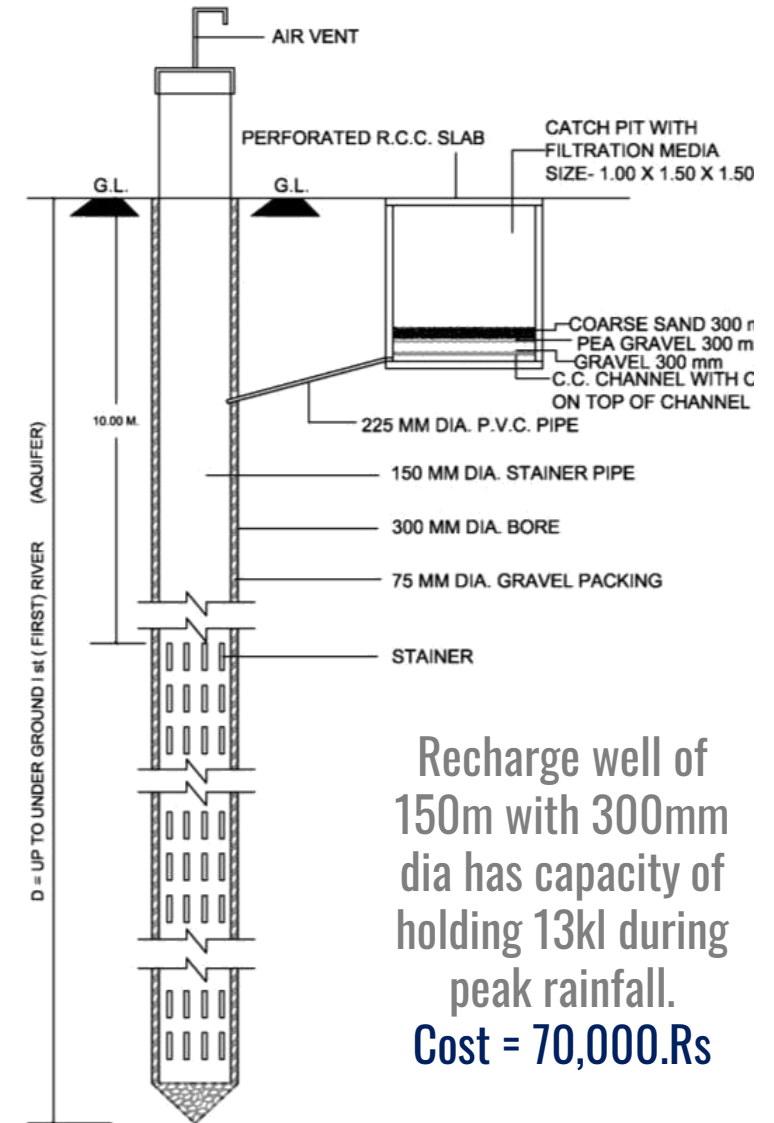
Bioretention Basin



- Bioretention basins water quality and water quantity control treatment practices .
- The shallow depression of the garden holds the water so it can slowly infiltrate back into the soil as the plants and soil naturally remove pollutants from the runoff.
- Infiltration of shallow aquifer is possible from his structure.
- The runoff is allowed to pass through filtration tank before entering to the basin for further reduce silt formation.



Recharge well



Financing

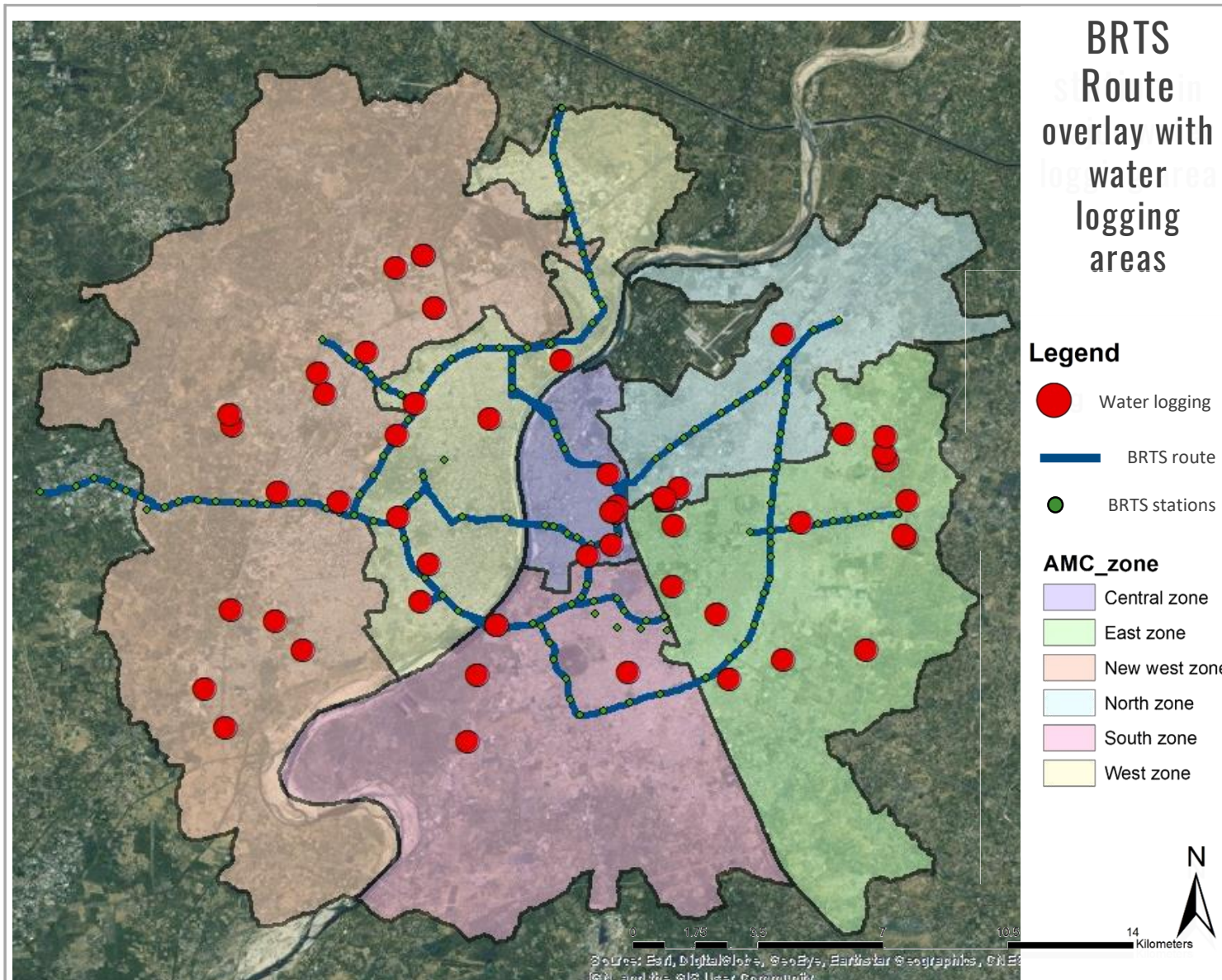


Capital investment of 16.5 lakh [Cost of drain connecting Memnagar lake 8.35lakh and Cost of Recharge basin 8.1lakh]

- Net profit of GMDC = 354.8 Cr
- 2% of Net profit for CSR = 7.1 Cr
- Capital investment accounts for 2.4% of its CSR budget

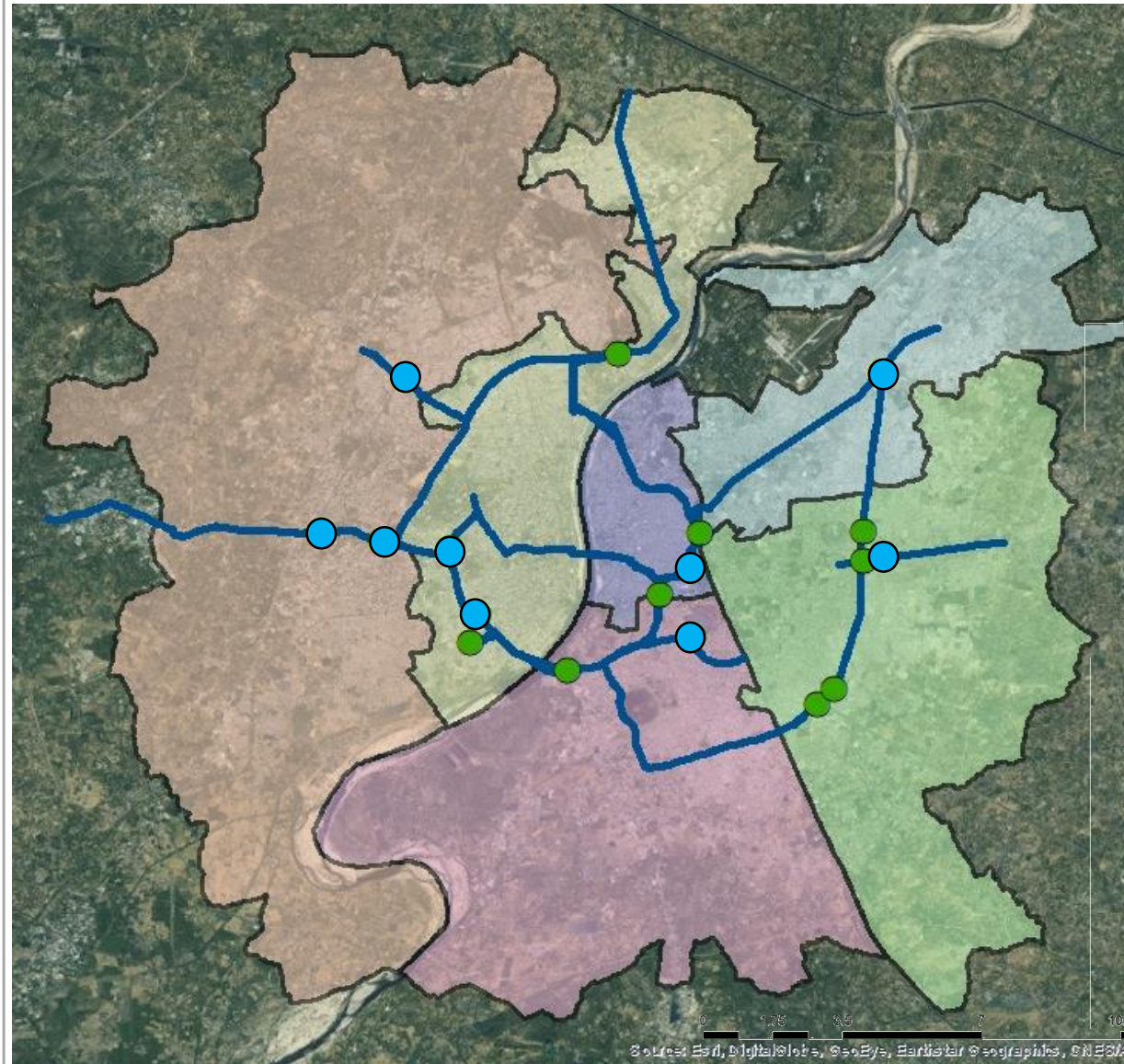
Operation and Maintenance

- Total O&M cost = 5000. Rs annually (for labour and pressurised water for cleaning)
- Cleaning of filtration tank during Pre-action Monsoon Plan



- Alternative method to reduce water logging along roads and junction is to provide recharge structures in BRTS
- 86 km BRTS route with 127 BRTS station
- 18 among 127 station are major water logged areas
- Providing Rainwater harvesting structure in these BRTS station in 1st phase

Source: AUDA DP 2021, Secondary data – AMC, SLIP – Amrut, AMC Monsoon Control Room, www.ahmedabadbrts.org/, <http://www.unescap.org/sites/default/files/4.2%20Institutional%20issues%20and%20coordination%20in%20sustainable%20transport%20-%20CEPT.pdf>



BRTS station in major water logging area

Legend

- BRTS route
 - BRTS stations
 - BRTS station with proposed Bio swale
- AMC_zone**
- Central zone
 - East zone
 - New west zone
 - North zone
 - South zone
 - West zone

Rain water harvesting at BRTS stations

9 among 19 BRTS station has space available for bioswales within the station

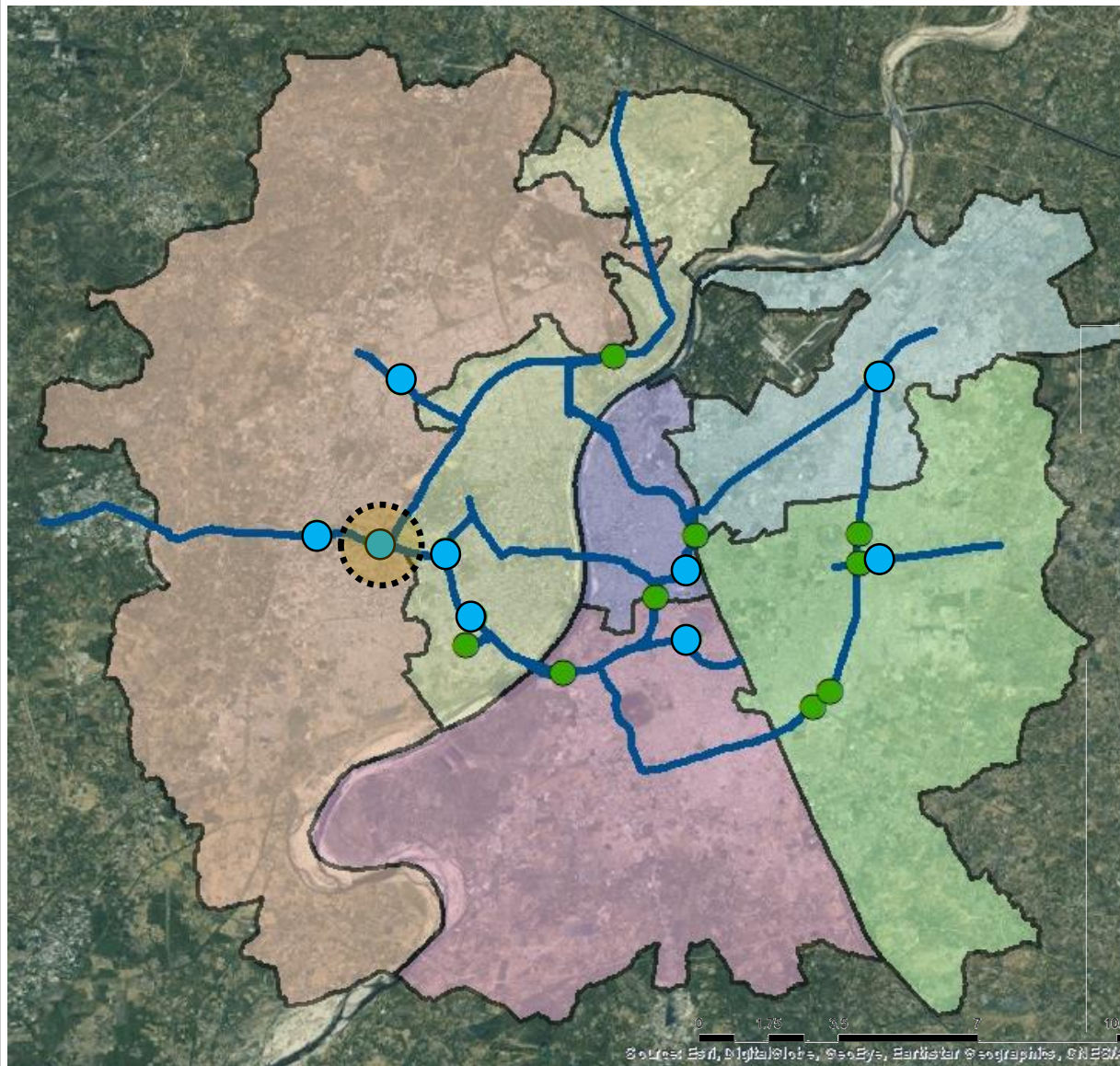
BRTS station	Area (m ²)	Capacity (m ³)	Cost
Satadhar char rasta	100	40.00	48,880.00
Ramdev nagar	50	20.00	24,440.00
Jodhpur char rasta	50	20.00	24,440.00
L colony	50	20.00	24,440.00
Dharnidhar Karnamukteshwar Mahadev	50	20.00	24,440.00
Naroda Patiya	50	20.00	24,440.00
Grid Station	60	24.00	29,328.00
Kankaria lake	50	20.00	24,440.00
Total cost	520.00	208.00	2,54,176.00

Daily revenue of BRTS service – Rs. 16 lakh

Source: AUDA DP 2021, Secondary data – AMC, SLIP – Amrut, AMC Monsoon Control Room, www.ahmedabadbtrts.org/,

<http://www.unescap.org/sites/default/files/4.2%20Institutional%20issues%20and%20coordination%20in%20sustainable%20transport%20-%20CEPT.pdf>

Intervention



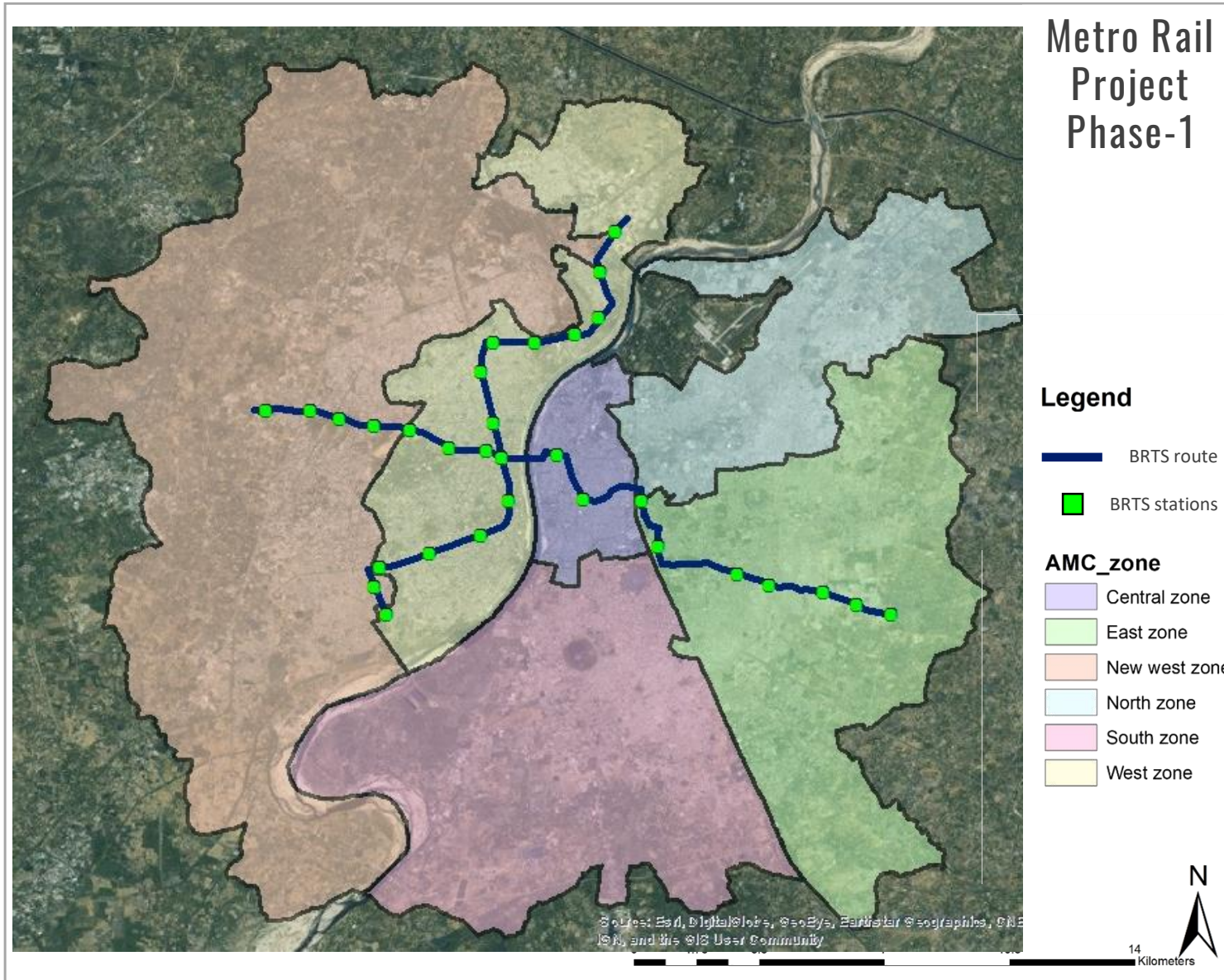
BRTS station in major water logging area

Legend

- BRTS route
 - BRTS stations
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- AMC_zone**
- Central zone
 - East zone
 - New west zone
 - North zone
 - South zone
 - West zone



Source: AUDA DP 2021, Secondary data – AMC, SLIP – Amrut, AMC Monsoon Control Room, www.ahmedabadbrts.org/, <http://www.unescap.org/sites/default/files/4.2%20Institutional%20issues%20and%20coordination%20in%20sustainable%20transport%20-%20CEPT.pdf>



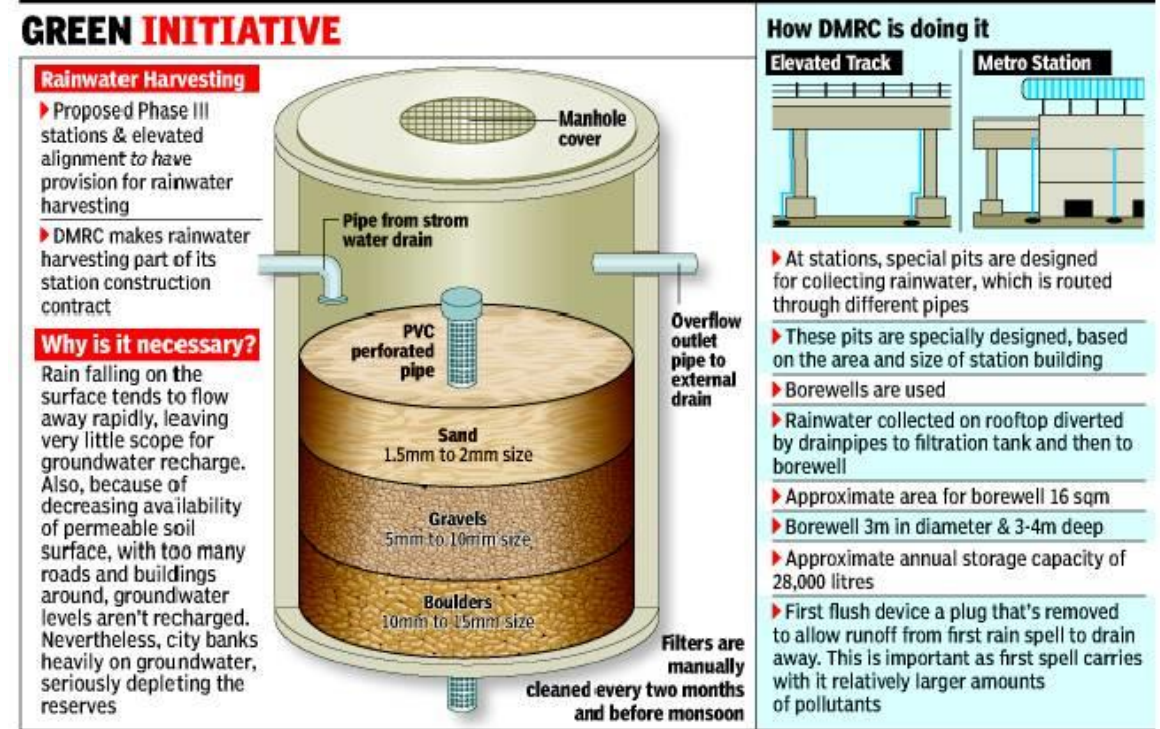
- **Alternative method to reduce water logging along roads and junction is to provide recharge structures in BRTS**
- 39.3 km Metro rail in phase-1 route with 32 metro station
- As number of rainy days is less in Ahmedabad providing RWH structure for an interval of 20m or 100m would not seem physically and financially feasible
- Providing Rainwater harvesting structure in these phase1 Metro station

Rain water harvesting at Metro stations

Bangalore

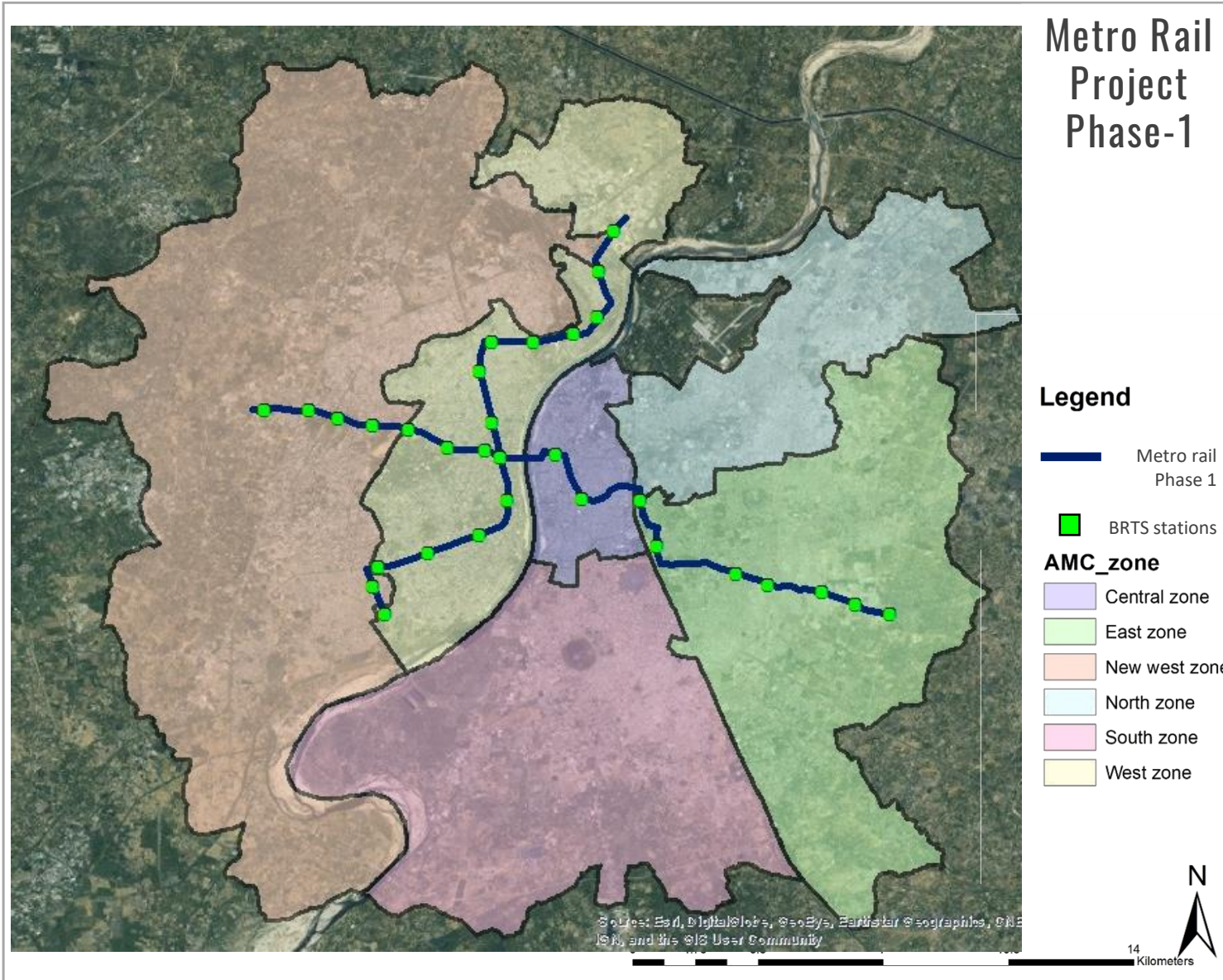
- BMRCL has launched its rainwater harvesting project.
- Storage tank of 3000l capacity on both side of every second pillar.
- 18ft deep and 5ft diameter recharge pit to recharge overflowing water from the storage tank located between two pillars at 28m interval
- The water collected in the storage tanks could be used by general public or companies for a fee.
- Proposal to harvest rooftop rainwater harvesting in the metro station.

Delhi



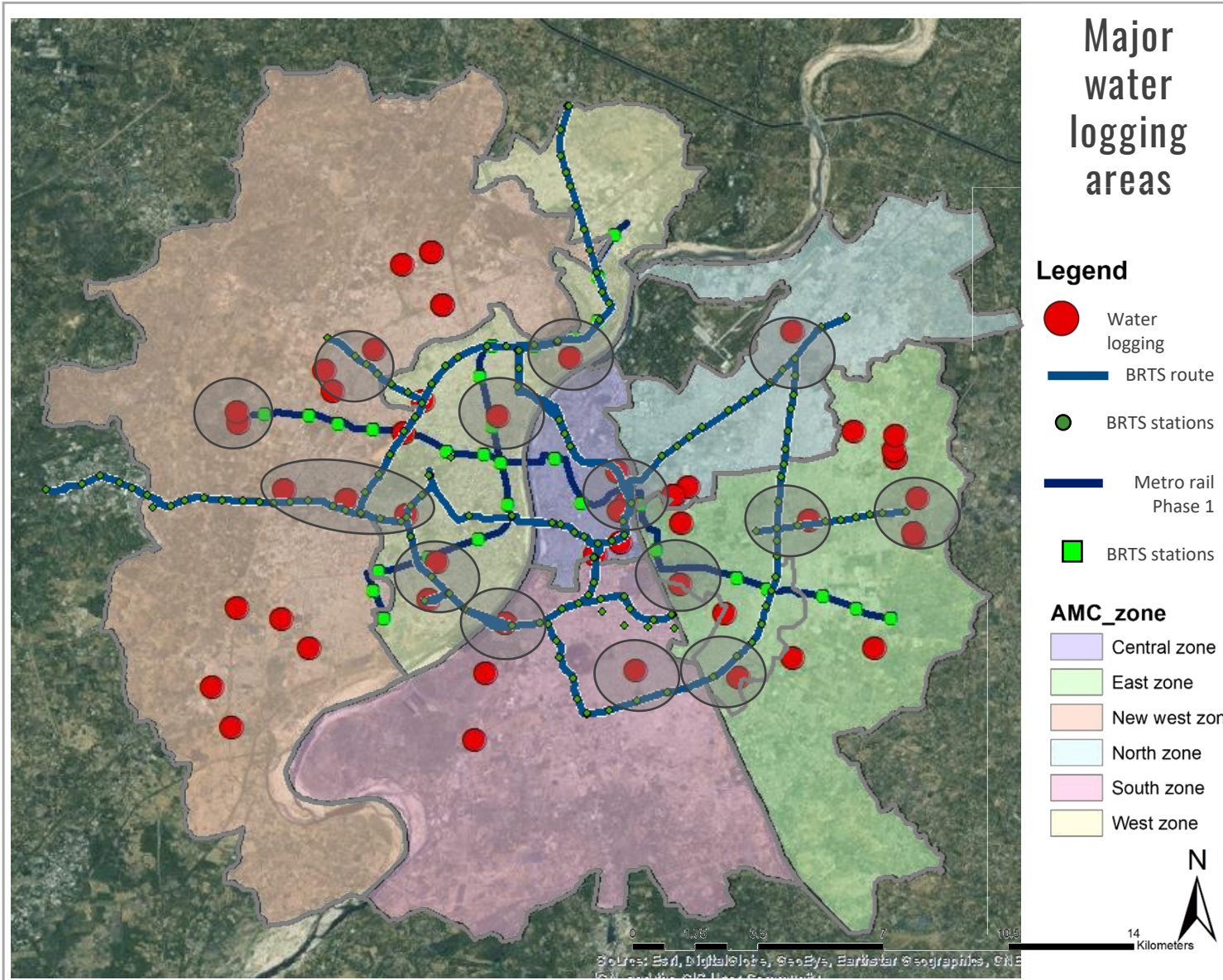
Source: SWM Retrofitting our urban streets for sustainable drainage by Oasis Design Inc. for UTTPIEC – Delhi Development Authority

<http://www.thehindu.com/news/cities/bangalore/bmrcl-gets-to-work-on-rainwater-harvesting/article3383145.ece> , <http://www.deccanherald.com/content/602583/metro-extend-rainwater-harvesting-project.html>
http://epaper.timesofindia.com/Repository/getFiles.asp?Style=OliveXLib:LowLevelEntityToPrint_TOINew&Type=text/html&Locale=english-skin-custom&Path=CAP/2011/09/03&ID=Ar00201



Total cost of installing 27 Recharge well = **21,73,933.62 Rs.**

Recharge well of 150 meter for recharge of deep aquifer



There will be reduction in 24 water logging points by implementing RWH structures any by proper maintenance of it in the circled points.

WHO ARE THE MAJOR **USERS** OF THE RESOURCE ?



Residences

Townships



Commercial

Shopping malls



Industries

Industrial estates

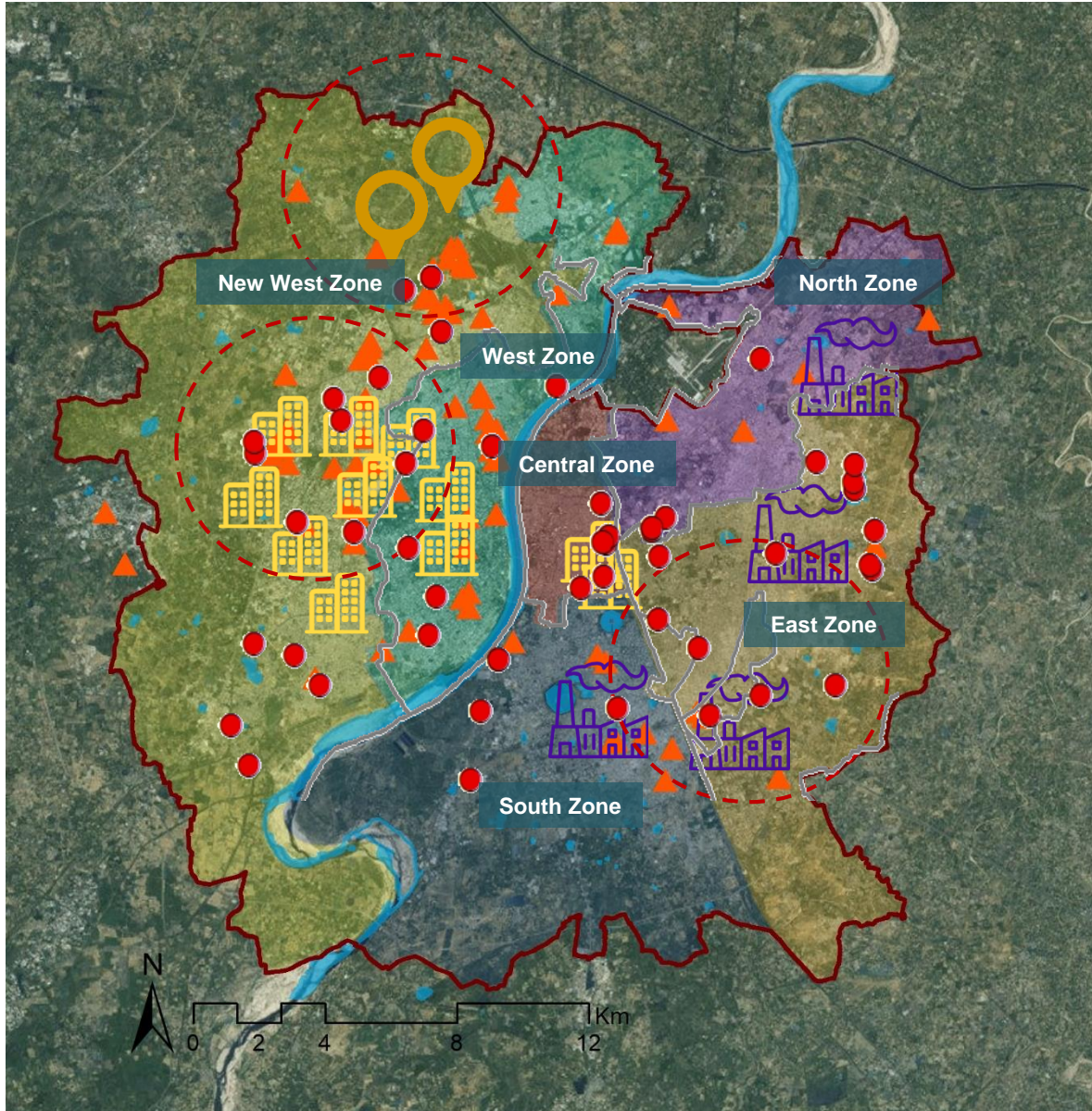
WHY?

Higher **consumption** of water & **dependency** on ground water

Easily **implementable** in initial stage

Better **monitoring** in clusters

Availability of **space**



Private water suppliers

- Increased private bore wells
- Increase in water demand



Industrial clusters

Ground water dependent



Shopping malls

Large paved areas within the city – reduced natural infiltration



Townships

High potential for RWH



Water logging areas

in m

Mainly along the West- New West regions

- Incomplete storm water coverage & water logging issues
- High dependency on alternative water sources- private & bore wells

Source : AUDA DP, Water sensitive group Water sanitation studio 2017-18

Residences - Townships

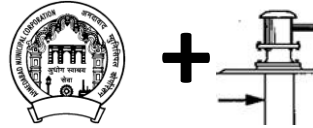
Case study: Savvy Swaraaj, Gota- 227800 Sq.m

Total No of Units: 2976

Towers: 62 organized in 5 clusters

Expected demand: 1607KL/day

Source of supply:



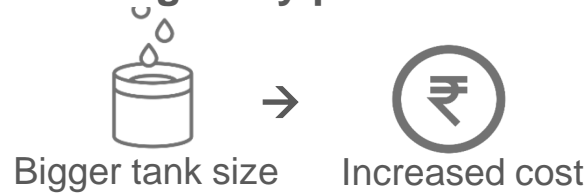
Recharge Potential

Reuse club houses & Recharge

REUSE potential in Clubhouse: 384 KL/Yr (area 600Sq.m)

Demand : 82KL/ Yr (Drinking)

ISSUE: Longer dry period



RECHARGE Rooftop : 7300 KL/yr

Paved area: 62900 KL/yr

Unpaved area: 13439 KL/yr

TOTAL HAVESTING POTENTIAL : 84095KL/yr

Requires 14 recharge wells with trenches of 50m3

COST: 3 Cr (approx.)

Source : site visits, www.savvygroup.in/projects

Cost (for 80KL)	Harvested rain water	20L Bottle can	AMC Water
Capital cost	350000	@ Rs 30/20L	@ 200/ year
Maintenance cost	3000		
5 years	350000	90000	1000
10 years	365000	180000	2000
20 years	395000	360000	4000

Total water harvested = 16% of water consumed
 Cost of harvesting = 1% of overall construction cost

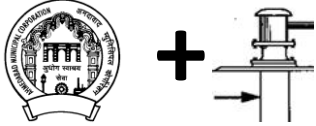
Recharge pits – Harvest capacity 1500 KL

Existing recharging pits

Commercial

Case study: Acropolis Mall, Thaltej- 6800 Sq.m

Source of supply:



Water demand: 12600KL /Yr

Exiting bore wells : 2

Depth of bore well: 200m

Rooftop area: 6400 Sq.m

Paved area: 250 Sq.m

Total harvesting potential : 3264 KL/Yr

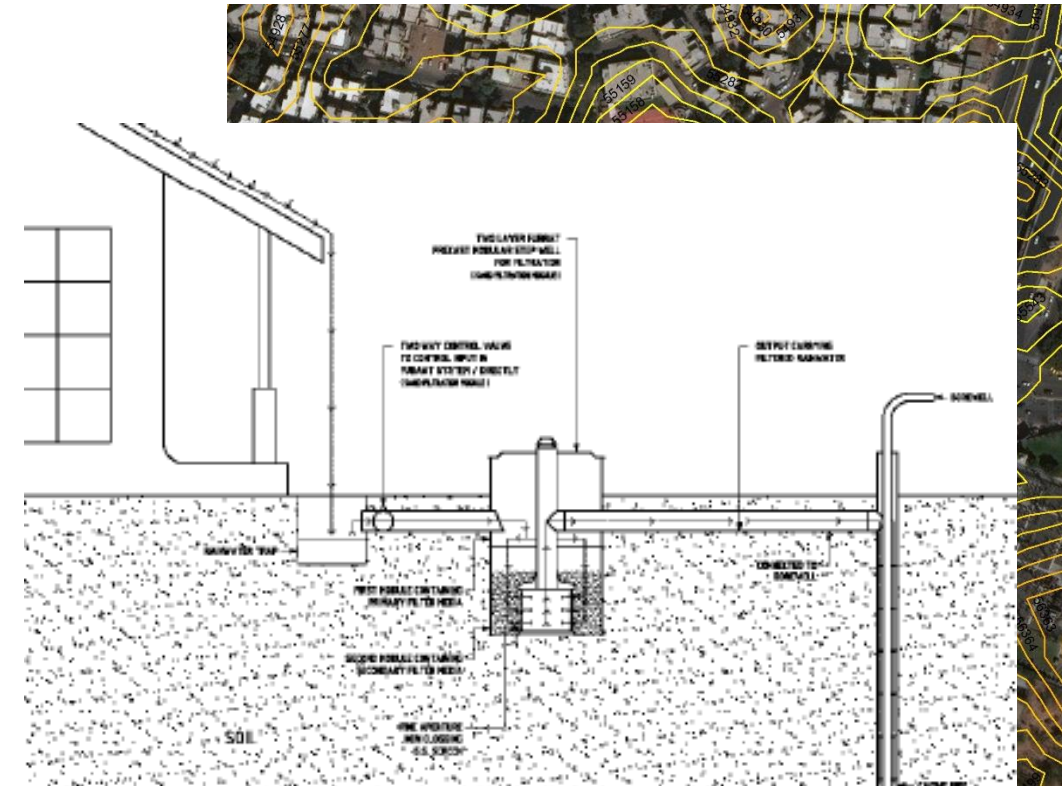
Considering 12 such malls:

Total harvesting potential

Area = **169919 Sq.m**

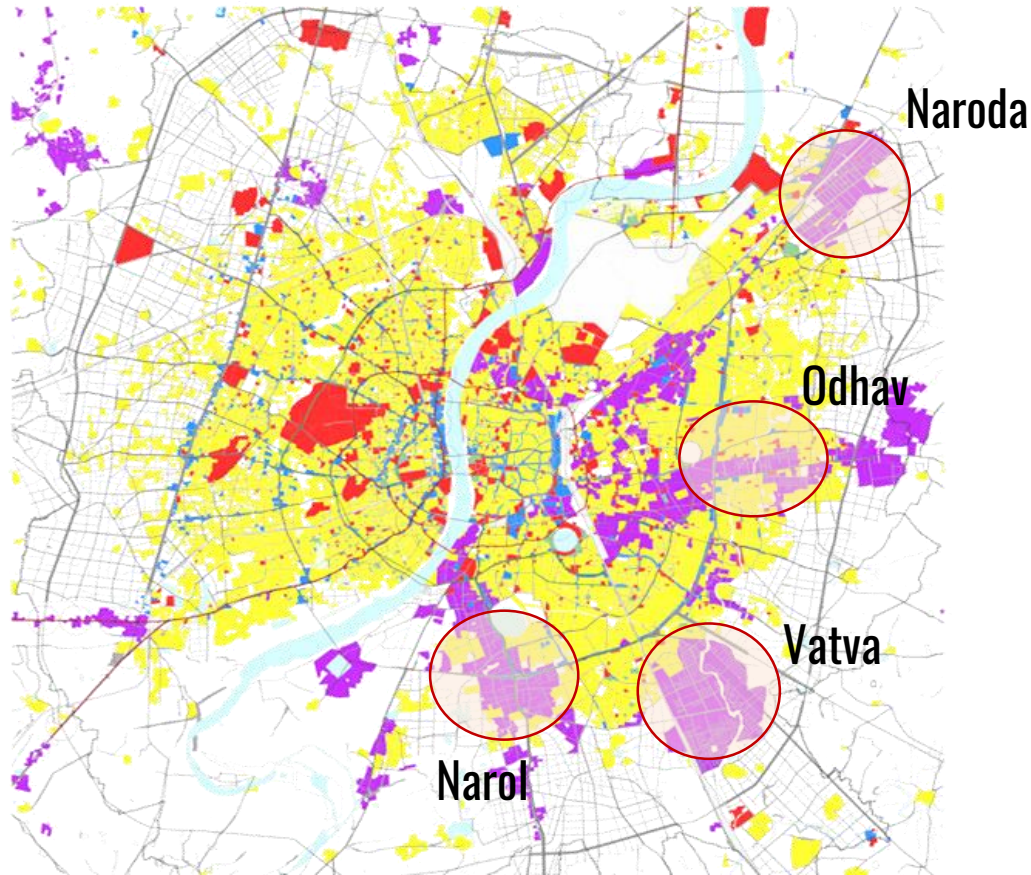
Harvesting potential = **108700 KL**

Total Cost = 16 Lakhs for each mall (approx.)



HOW: Harvested through the existing bore wells
After passing through sand filter into bore well through perforated pipes

Case study: Industrial Clusters



EXISTING SCENARIO

- **High dependency of industries on ground water** (As AMC doesn't provide to the industries)
- Recharge: **NIL**
- **Negative boring** techniques were used to pump waste water to ground water, thus **contaminating the ground water**

Guidelines/Criteria for evaluation of proposals/requests for ground water abstraction

Industries	Water intensive industries
Recharge 50% of withdrawal	Recharge 100 of withdrawal

Industrial

Industrial Estate	Type of Cluster		No. of units		
	Zone	No. of borewells			
O				70	
M				24	
V	Central	34		00	
Na	South	111		15	
	West	69			
	East	117			
				Narol	Total
Water Consumption (in MLD)	6.7	1.7	23	98	129.4
Water to be harvested	6.7	1.7	34.04	163	205.44
Area (Ha)	346	127	527	500	1500
Units	1115	470	2500	224	4309

Water intensive industries:

Here include Textile , water production & chemical

Onsite recharge limitation:

Lack of **space**

Possibility of **contamination**

Increased **cost of filtration units** due to extra filtering for oil and dirt

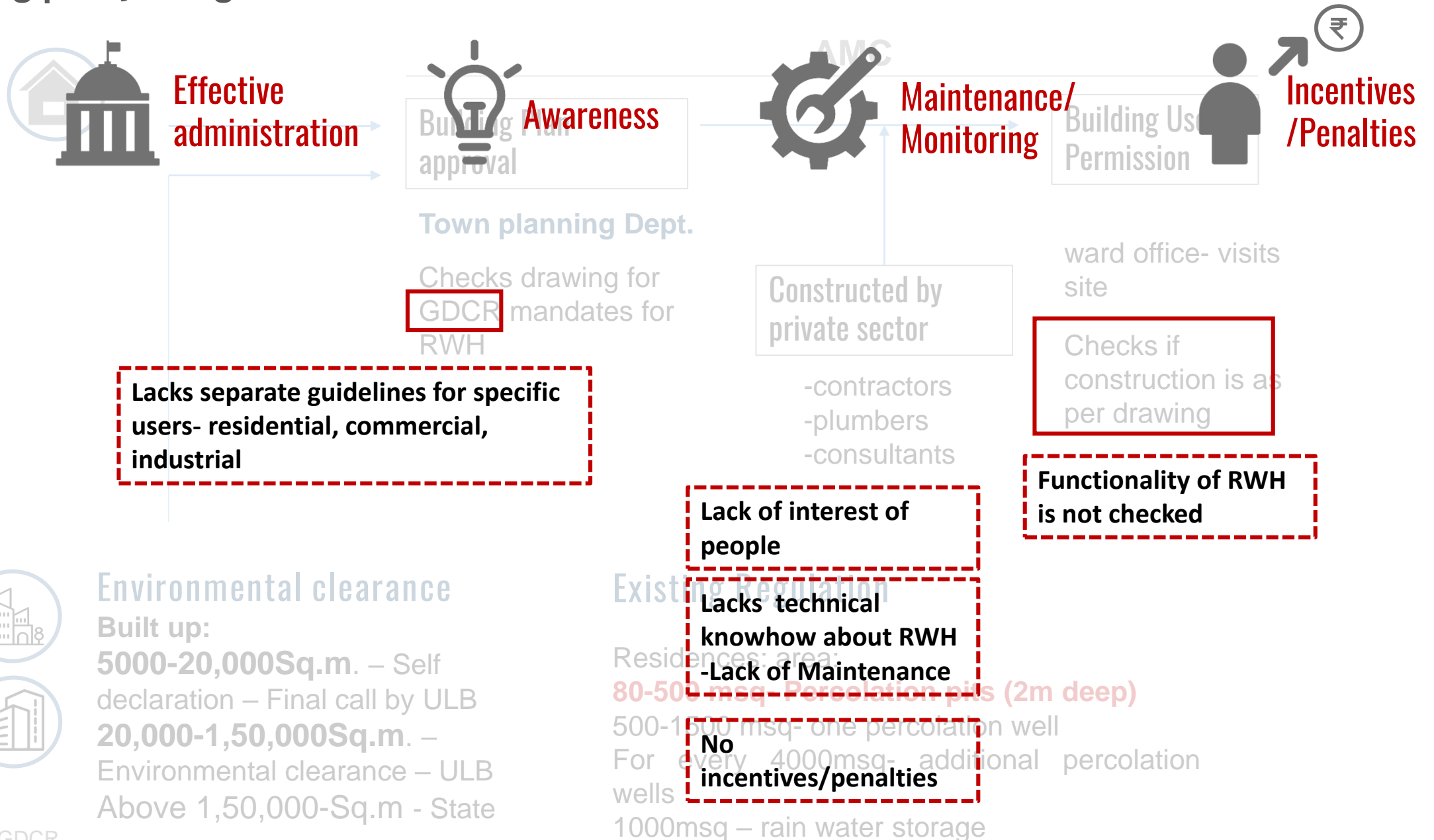
Potential Harvest Option

AMC Wells – 547 bore wells

If at least **10% of industries** usage is recharged, all the bore wells can be recharged

Source : CEPT Thesis : Agglomeration of industries, AMC visit

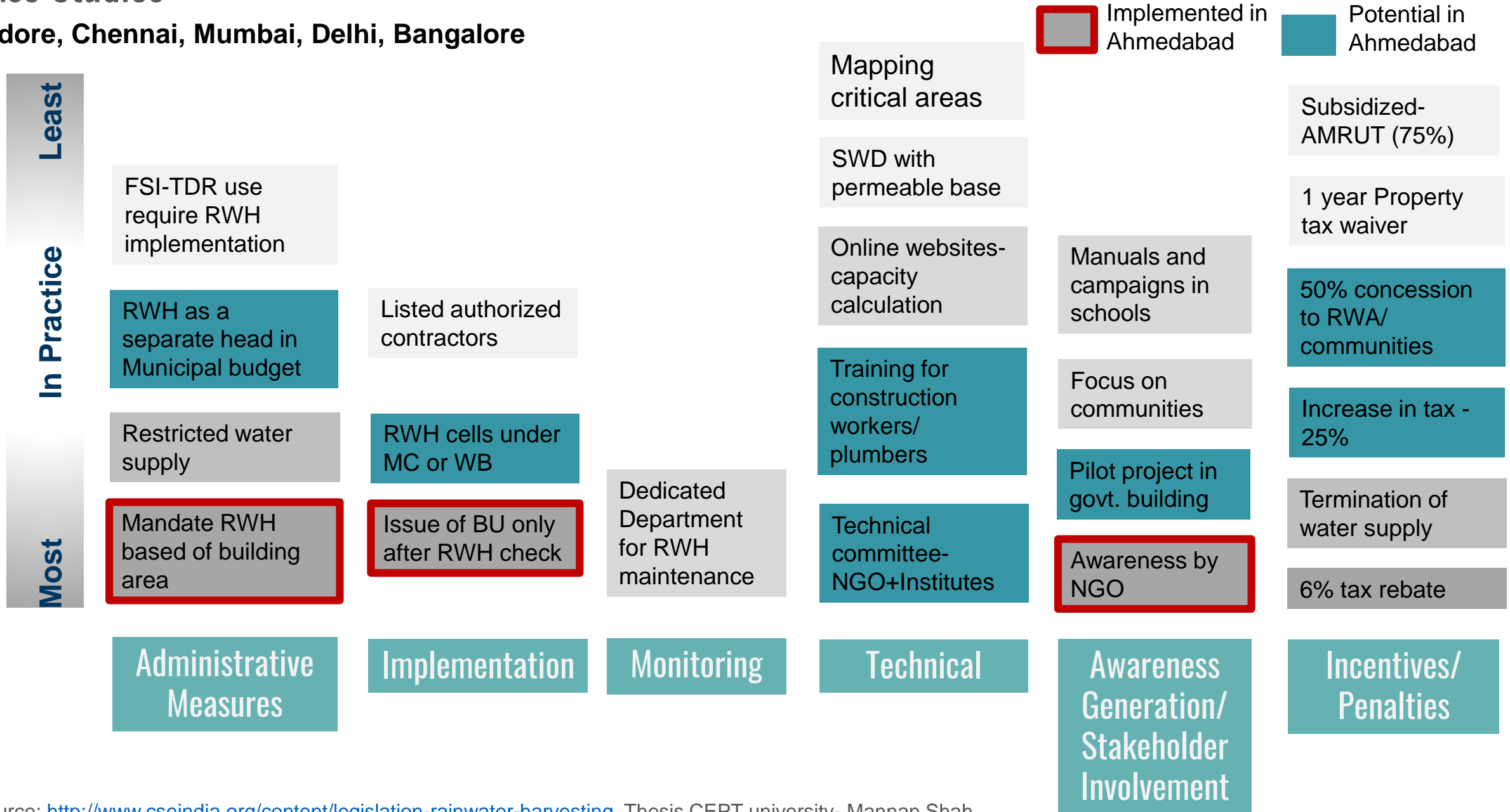
Existing policy and governance



Source : GDCR

Case Studies

Indore, Chennai, Mumbai, Delhi, Bangalore



Source: <http://www.cseindia.org/content/legislation-rainwater-harvesting>, Thesis CEPT university- Mannan Shah

Approaches

BANGALORE



Bruhat Bengaluru
Mahanagara Palike

- **Mandate** in 2009
- State level Rain water harvesting policy
- High **NGO** + Institution participation
- Focus on **awareness programs**- rainwater theme parks
- **Step by step process- High importance to awareness**
- **Rainwater harvesting cell**
- **Incentives** for reduced piped use
- **2% tax rebate**
- **Penalization** by increase of 25% monthly water bill (2016)

CHENNAI



- **Mandate** in every building since 2003
- Critical issue of **water scarcity** and heavy flooding urged the people
- One year deadline
- Inspection in 2003 and **Rushed implementation- awareness and penalties drove the initiative for RWH**
- **Decided by the State government and political support**
- High importance given by **State government and political support**
- No incentives/ subsidies
- **Strict penalization** as **increase in property tax**

DELHI



- **Mandate** in every building since 2001
- **Delhi Jal Board Rain cell**
- Several institutions involved
- **Subsidies** up to 2 lakh
- **Trained plumbers/ construction workers**
- **Involvement of multiple institution caused inefficient implementation**
- Implemented successfully in societies through Bhagyadhara scheme

Source: www.ksrst.org.in/rwh.html, rain water harvesting in Chennai - IIM Kozhikode Week 2010



Effective administration

Support from State government : **GWSSB**
Revision of GDCR with respect to type of building and detailing of rain water harvesting options

Formation of a dedicated cell- **Rain water harvesting cell**



Monsoon control cell

- Functional for 4 months only
- Collects rainfall & water logging data
- Complaint redressal during monsoon

RWH cell

- Technical evaluation and support of projects
- Approval of subsidies
- Act as a single dedicated system for RWH
- Coordinates between NGO's people and government



Maintenance/ Monitoring

- Making a **detailed manual** considering the hydrologic and climatic conditions as RWH is a **local level management**
- **AUDIT** is performed to monitor and bring about changes in the reforms and to ensure functioning of the systems
- **TRAINING** to plumbers and contractors through GJTI (Gujarat Jalseva Training Institute)

Interventions



Options	Incentive/Subsidy	Amount	Effectiveness	% of assistance
Option 1	Rebate (@10%) on property tax	Comes upto 500 annually	Less tax collection efficiency- maynot be effective	only 5% assistance
Option 2	Subsidies	Upto 10000 or 50% (which ever is less)	More attractive option to user	nearly 18% assistance
Option 3	Tax waiver	Average 5000	Easy to implement	9% assistance

- Good incentive should comes with **strong penalizations**
- **25% extra on property tax** till RWH is installed



Creation of awareness through **NGO and Private RWH firms**



Sr. No	Description	Cost incurred	Years
1	Formation of Rain water cell		1
i	Establishment cost	50,000	
ii	Salary	1,00,000	continues
2	Awareness activities	1,00,000	2
3	Subsidies	5,90,00,000	1 (continues)

Total cost – 6 Crores

Time frame : 3 years

Water Supply

Overview – Level of Services

Indicators	Present Status	MOUD Benchmark	Reliability
Coverage of water supply connections	Avg. 90%	100%	B
Per capita supply of water	145 LPCD	150 LPCD	C
Extent of metering of water connections	NIL	100%	
Extent of non-revenue water	43%	20%	C
Quality of water supplied	98%	100%	B
Cost recovery in water supply services	31%	100%	C
Efficiency in collection of water supply related charges	70.44%	95%	A

Total length of the supply network is 4015 km.

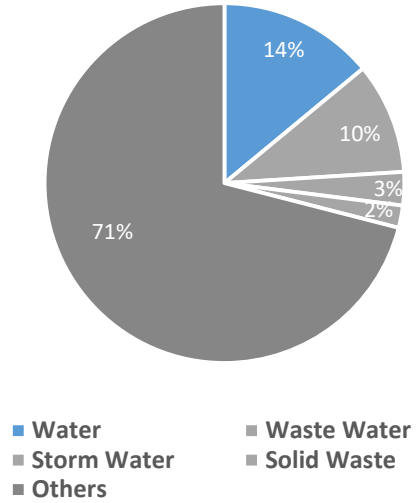
90% of the network has metallic pipes and 5% of the network has non metallic pipes.

Total storage capacity is 1306.19 MLD
 UGT– 1224.66 MLD
 OHT– 81.53 MLD

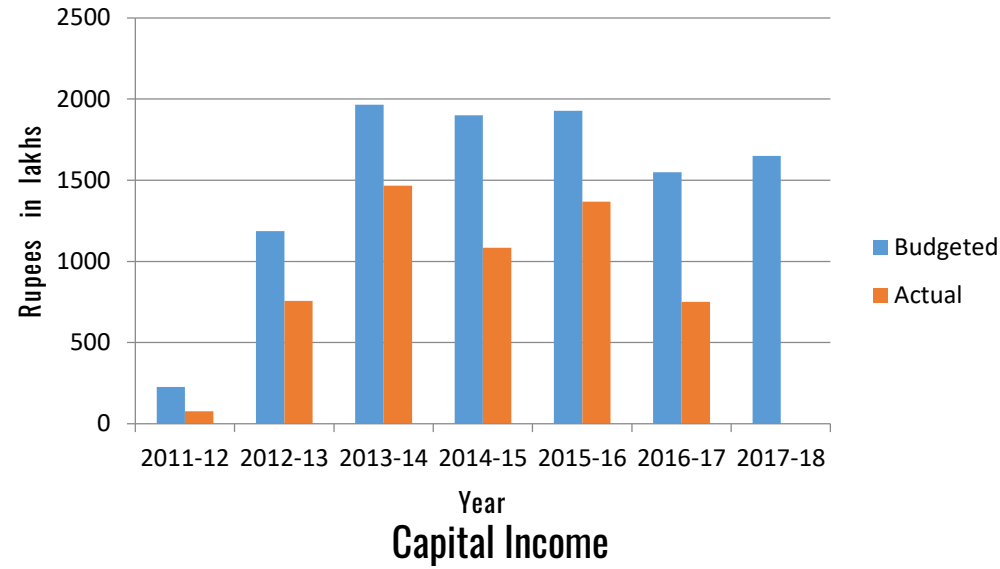
Source: SLIP – Amrut, Secondary data-AMC

Financial Overview

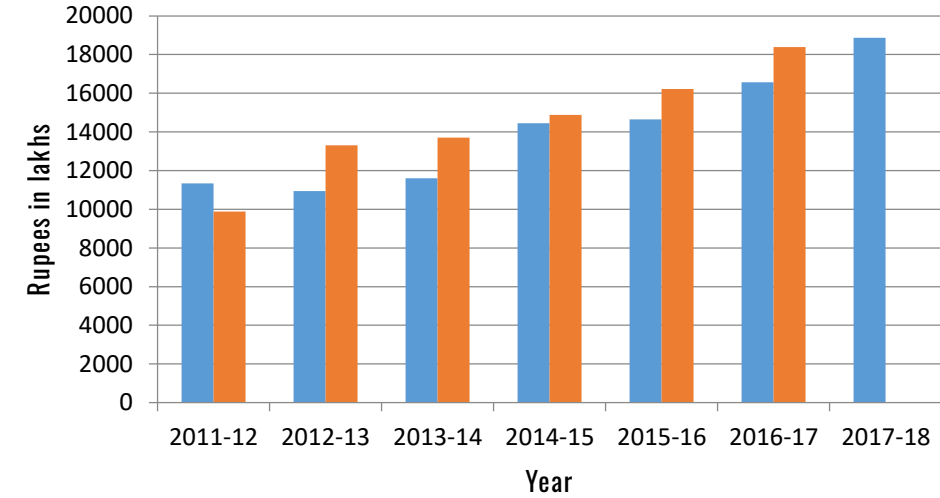
2015-16



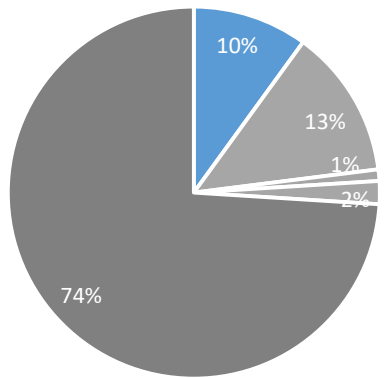
Capital Expenditure



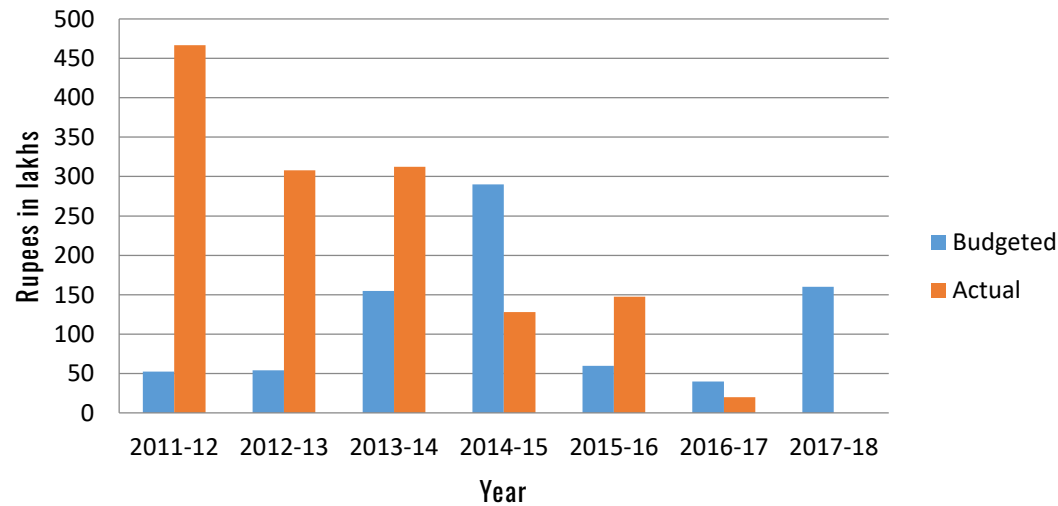
Revenue Expenditure



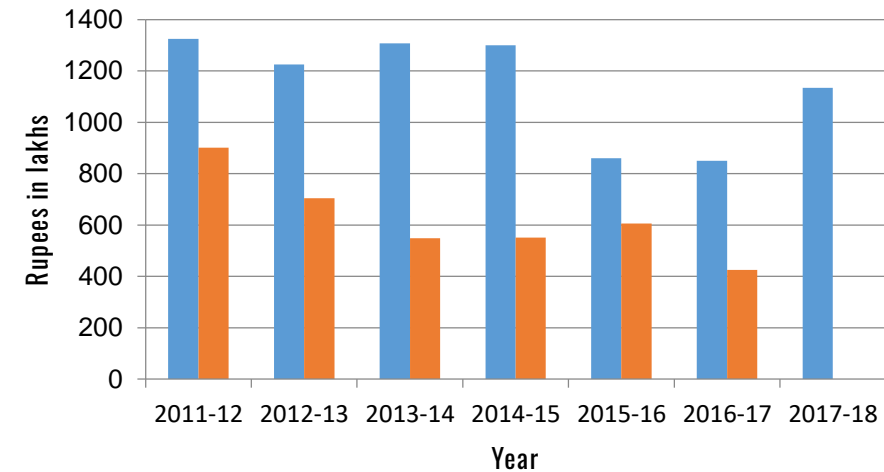
2016-17



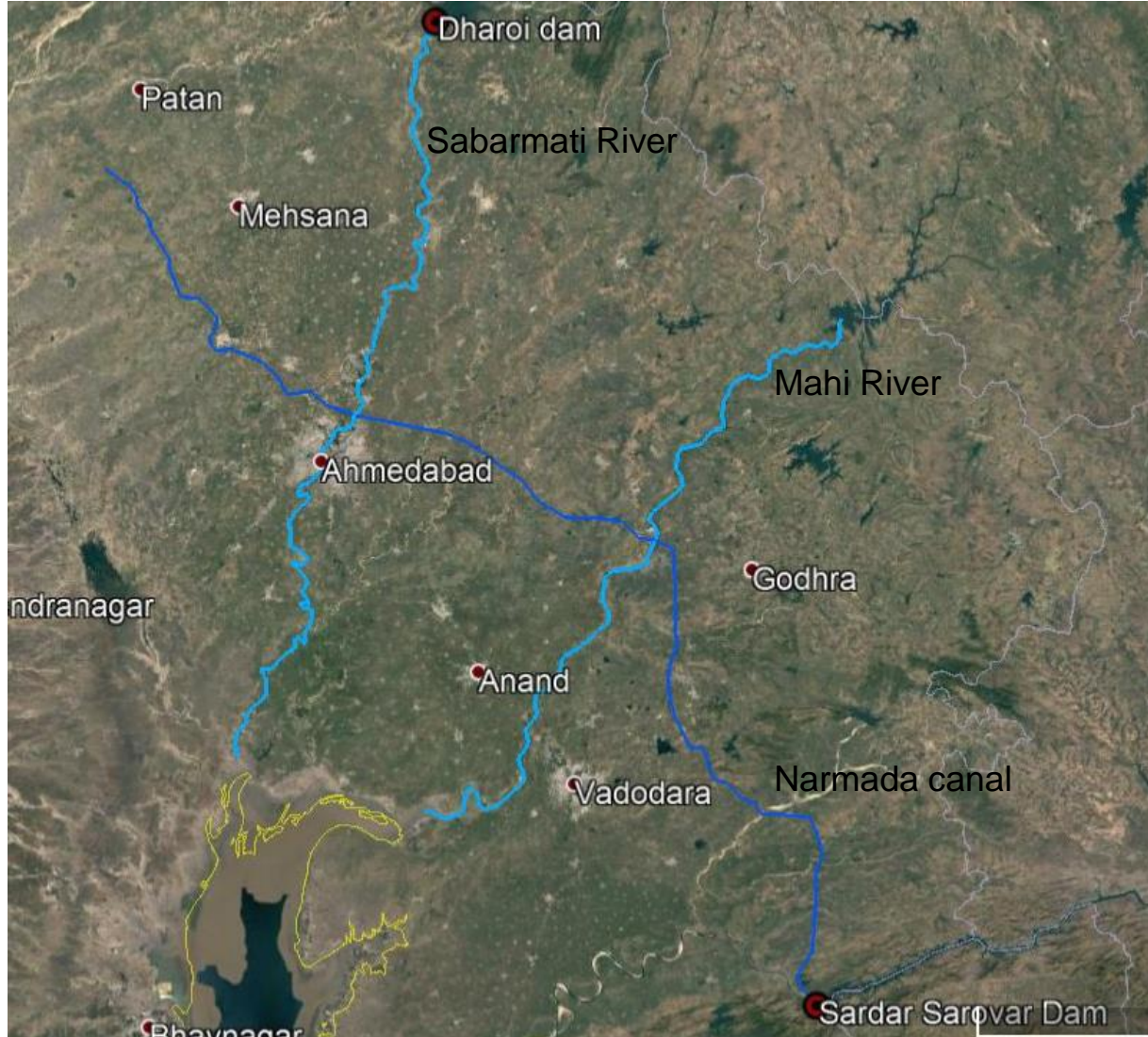
Capital Income



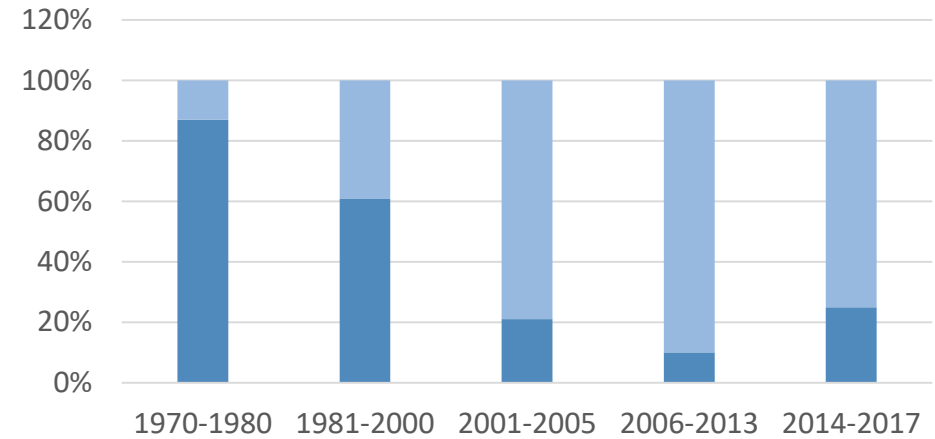
Revenue Income



Source of Water in Ahmedabad



Source: AMC



Historical Trend: Source of water

Surface Water:

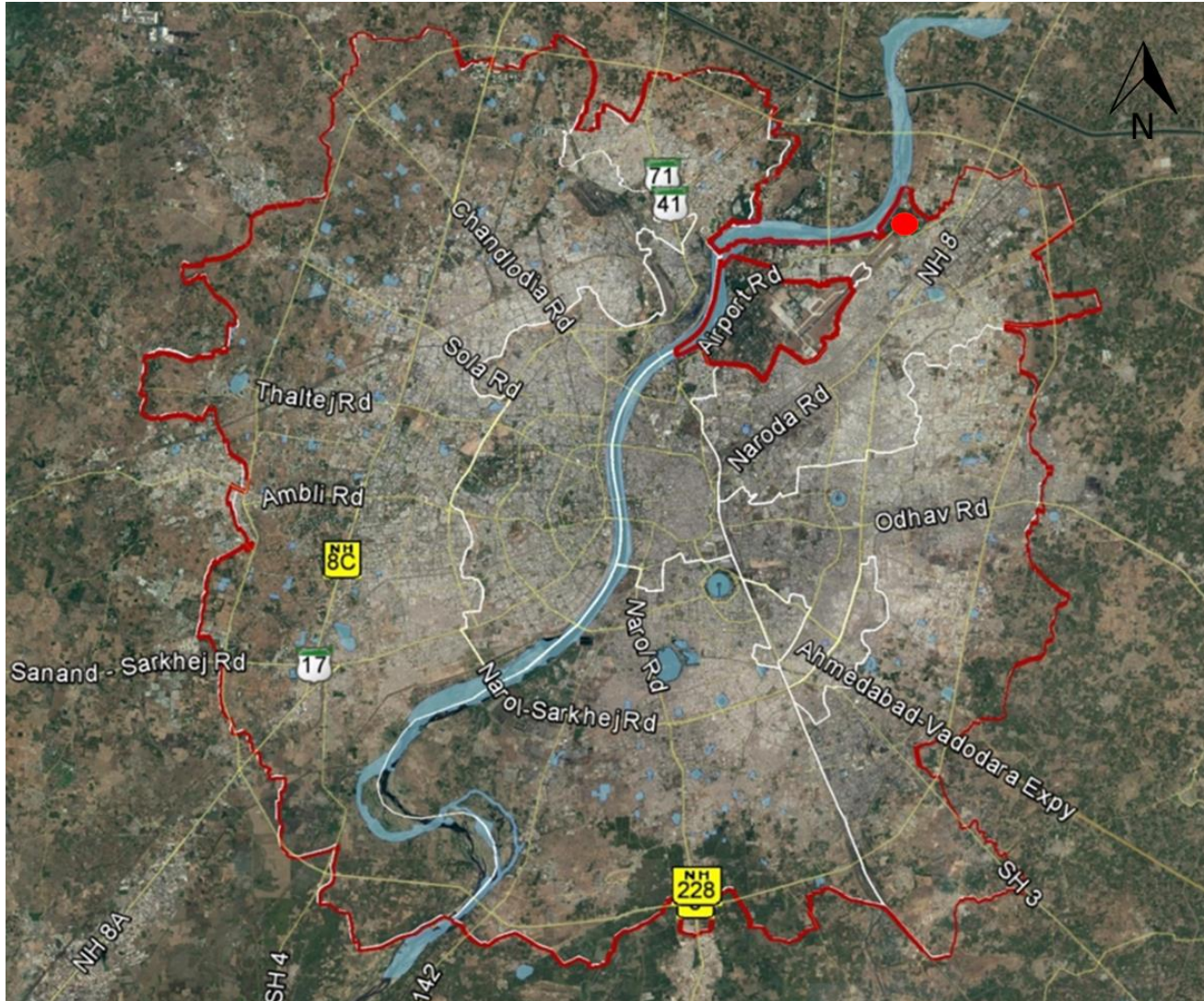
1. Narmada main canal – 330 MLD
2. Intake wells – 495 MLD
3. Dholka branch canal – 275 MLD
4. Sabarmati river – 70 MLD
5. Shedhi branch canal – 200 MLD

75.0%

Ground Water:

1. French wells (7nos)-170MLD
2. Bore well – 300MLD

25.0%

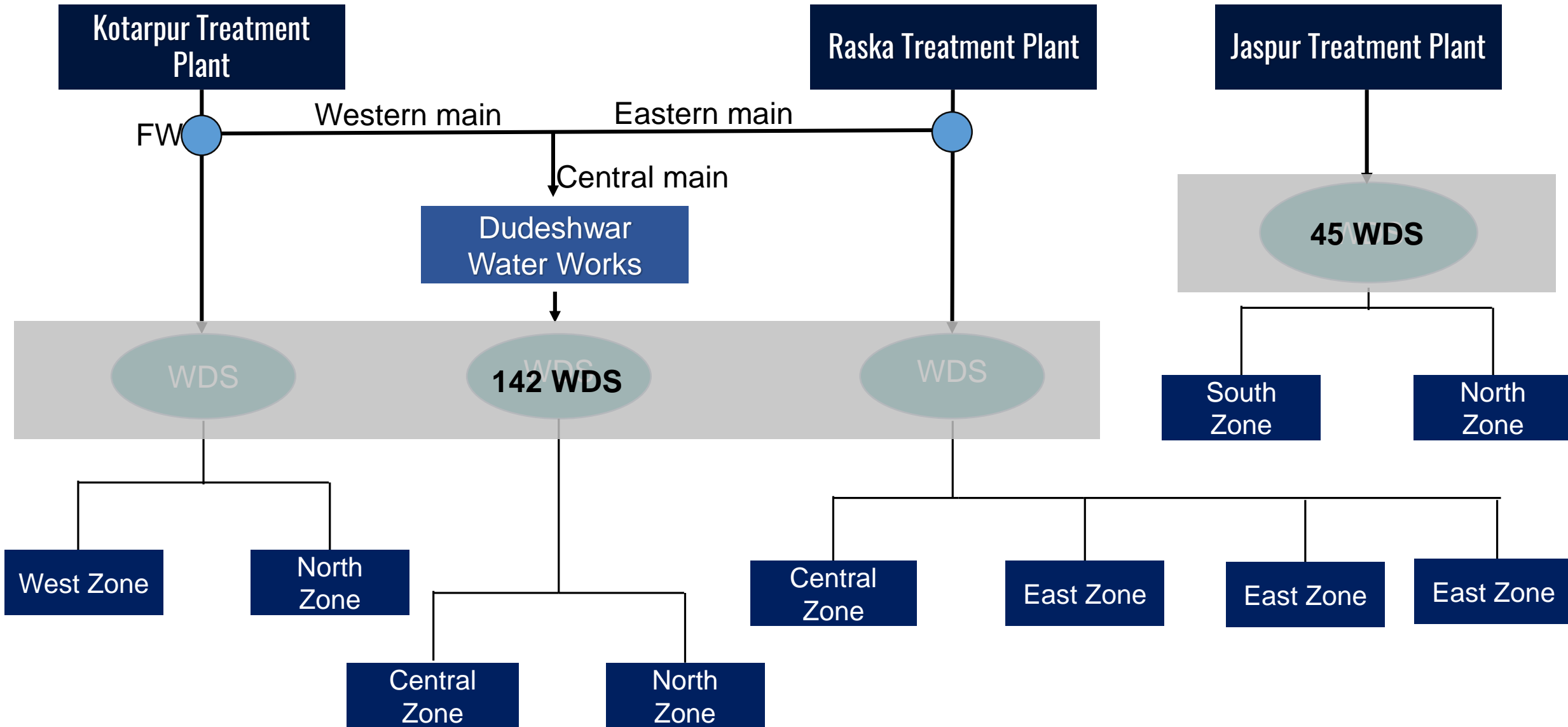


Source: Field survey

Kotarpur Water Treatment Plant

1. Year of construction : 1987
2. Year of operation : 2000
3. Acquisition of land : 215 acres
4. Plant process : Conventional water treatment with declining rate filtration
5. Capacity : 650MLD + 200 MLD
6. Quality and quantity checks of raw and treated water
7. Water supplied to : West, Central, East, North zones (70%) of Ahmedabad
8. 4% loss of water at WTP.

Overview – Distribution stations



Source: AMC

O&M Contracts

Water Treatment Plant

1. O&M contracted to **Vivatech Vabhag for 3 years**
2. Contract is given a lump sum amount as per the lowest bid (Lump sum amount – **Rs30 lakh/month**)
3. 8 key persons
4. Works in 3 shifts
5. If **maintenance is not done on time** AMC gives notice to the contractor and then it is **penalized** for the same on the basis of:

- Less water supply
- Power factor
- Treated water quality
- Attendance of key person



AMC

- Supervision
- Payment of electricity bill
- Procurement of chemicals



O&M

- Check on quality and quantity of material supplied.
- Transportation of chemicals.
- Maintain, repair of equipments
- Change of damaged equipments with consultation with AMC officials.
- Maintenance a power factor for saving electricity.

Water Distribution Station

1. **163 WDS** outsourced for O&M to 8 contractors who are spatially distributed.
2. 3 operators/WDS
3. Contract given on lump sum amount of **Rs. 35,000- 40,000 per month**
4. Maintenance checks on **daily, monthly, quarterly, half yearly and yearly** basis as mentioned in contract.
5. **Cleaning and housekeeping** of pumping station.
6. **Security** of pumping station



AMC

- Supervision
- Impose and collect penalty from the private contractor who fails to deliver.



O&M

- Security
- Maintenance checks for machineries on daily, monthly, quarterly, half yearly and yearly basis.
- Cleaning and housekeeping.
- Maintenance a power factor for saving electricity.

Source: AMC office; O&M contract document

Contracts Improvement



Performance based evaluation



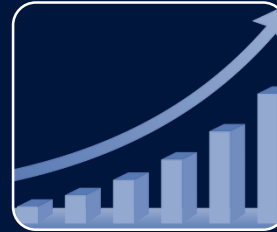
Integration of the SCADA and O&M contracts



Records of repair and maintenance- leads to preventive maintenance



Capacity building of O&M staff regarding SCADA Basic analysis of SCADA and give recommendations



Financial Performance Indicators

- Savings in energy costs
- Savings in transportation of chemicals and replacement of machines if required.



Indicators measuring efficiency of operations

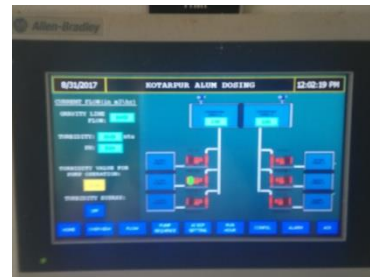
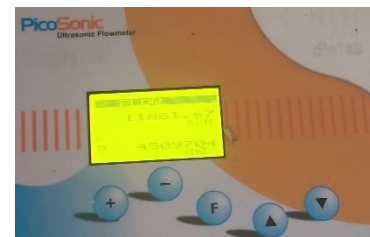
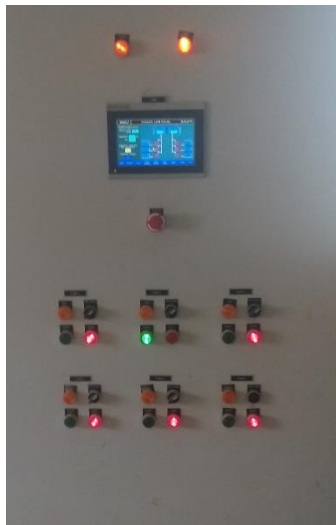
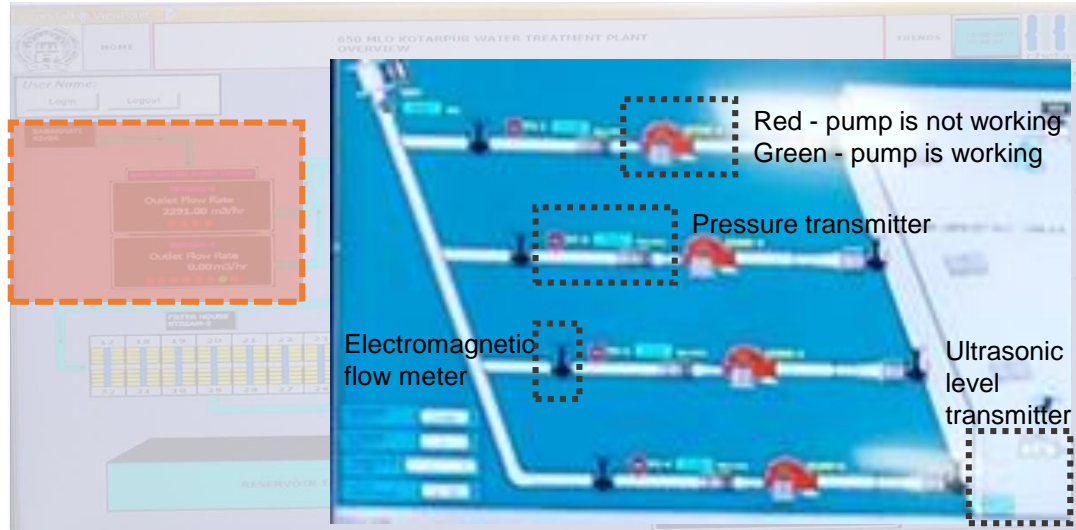
- Reduction in staff
- Response time



Indicators measuring operating performance

- Water quality
- Level of treatment

Source: Capacity for Water Cooperation in Eastern Europe, Caucasus and Central Asia



Source: Site visit; SCADA office and Water Production Department

Contract

Contract for 5 years

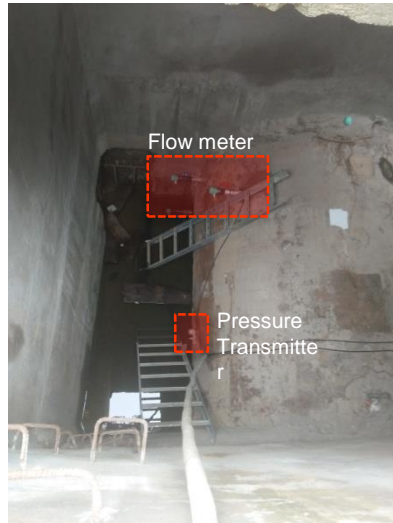
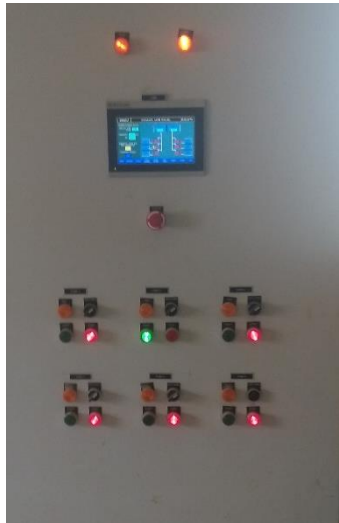
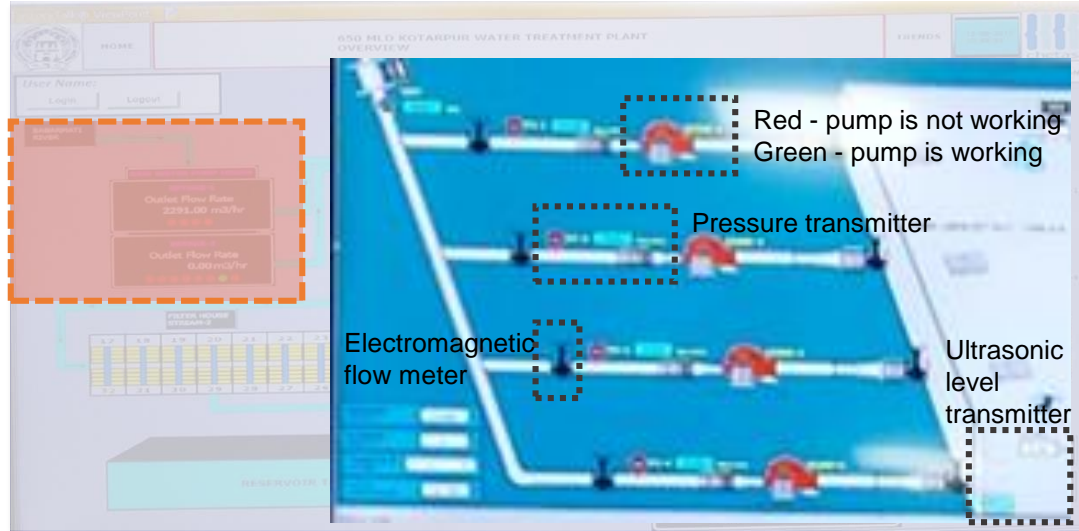
1. Roles of AMC

- Supervising
- Monthly payment for maintenance and monitoring (Nearly 2.4 lakh / 5 years (per WDS))
- Capital amount during construction (Nearly 30 crores)
- AMC staff – 6-7 people
- Electricity bill

2. Role of Private Contractor

- Install all equipments
- O & M of equipments
- Monitoring of data
- Generation of reports

Initiatives - SCADA



Quantitative Data

1. Flow rate
 - Raw water
 - Treated water
2. Income and supply (current day and previous day)
3. Functioning of the equipments (coloured signals)
4. Pump parameters
 - Number of pumps running
 - Actual capacity
 - Run hours
 - Energy Consumption (Power factor)
 - Pressure
5. Filter bed levels
6. Storage tank sump levels

Qualitative Data

1. Quality (pH, Turbidity, Chlorine)
 - Raw water
 - Treated water



High potential of usage

Source: Site visit; SCADA reports analysis

Interventions-SCADA Usage

Data management

Equipment management

SCADA sensors - managerial purposes including historical trending of water quality, water usage and bill generation, regulatory reporting etc.

SCADA provides equipment status monitoring including run-time, oil pressure and temperature and use this data for maintenance prediction or repair and replacement forecasting

Automated operations

Analyze losses

Automatic switching pumps on and off will reduce the manpower requirement

Capture information regarding losses from WTP to WDS and analyze them for estimating NRW trends

Source: Site visit; SCADA reports analysis

Data Set	Kind of Information				Inferences/Use		
					Long term	Day to day	
Quality of water	Pre-monsoon	Particular	Raw water	Treated water		<ul style="list-style-type: none"> Medium quality of raw water-conventional treatment process. Management of sludge - Sludge from the clarifier is low in normal season and is almost double in the monsoon season. 	<ul style="list-style-type: none"> Amount of chemical dosing - When turbidity is low, less chemical is added.
		pH	7	-			
		Turbidity	1	-			
	Monsoon	Chlorine	-	307.98			
		Particular	Raw Water	Treated water			
		pH	9	7.89			
	Post-Monsoon	Turbidity	28.8	-			
		Chlorine	-	274.77			
		Particular	Raw water	Treated water			
	Post-Monsoon	pH	8.05	8			
		Turbidity	1.3	1.2			
		Residual Chlorine	-	0.29			
Energy consumption	Normal Season	Particular	Intake 1	Intake 2	CWPH	<ul style="list-style-type: none"> Power consumption is higher in monsoon season so is the amount of bill generation and ways to minimize the same. 	
		Pumps running	3	4	10		
		Power consumption	1219465	-	3371264		
	Monsoon	Particular	Intake 1	Intake 2	CWPH		
		Pumps running	4	5	10		
		Power consumption	1113303	-	3371264		

Interventions-SCADA Usage

Data management

SCADA sensors - managerial purposes including historical trending of water quality, water usage and bill generation, regulatory reporting etc.

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Capture information regarding losses from WTP to WDS and analyze them for estimating NRW trends

Data Set	Kind of Information		Inferences/Use		
			Day to day	Long term	
Pump Parameter	Intake 1	Particular		<ul style="list-style-type: none"> The pumps are almost 12 years old so there is a decrease in its efficiency. There can be a data discrepancy for intake 2. The pumps are also not used to its full capacity 	<ul style="list-style-type: none"> Knowing the pump parameters can help AMC to take preventive measures and save time as well as money.
		No. of pumps	4		
		No. of pumps running	3		
		Capacity of pumps(theoretical)	7500 m3/hr.		
		Inlet flow	7500 m3/hr.		
	Intake 2	Efficiency	71.4%		
		Particular			
		No. of pumps	7		
		No. of pumps running	4		
		Capacity of pumps(theoretical)	10000 m3/hr.		
	CWPH	Inlet flow	3912 m3/hr.		
		Efficiency	40%		
		Particular			
		No. of pumps	10		
		No. of pumps running	10		
Filter Beds	Capacity of pumps(theoretical)	41000 m3/hr.	<ul style="list-style-type: none"> Backwashing time ad frequency. 	<ul style="list-style-type: none"> Can help in determining the efficiency of filter media i.e. if the level remains high. 	
	Inlet flow	17728 m3/hr.			
	Efficiency	44%			
	Level of water above filter media (should not be greater than 1.7mtrs)				

Source: Site visit; SCADA reports analysis

Interventions-SCADA Usage

Data management

SCADA sensors - managerial purposes including historical trending of water quality, water usage and bill generation, regulatory reporting etc.

Equipment management

SCADA provides equipment status monitoring including run-time, oil pressure and temperature and use this data for maintenance prediction or repair and replacement forecasting

Automated operations

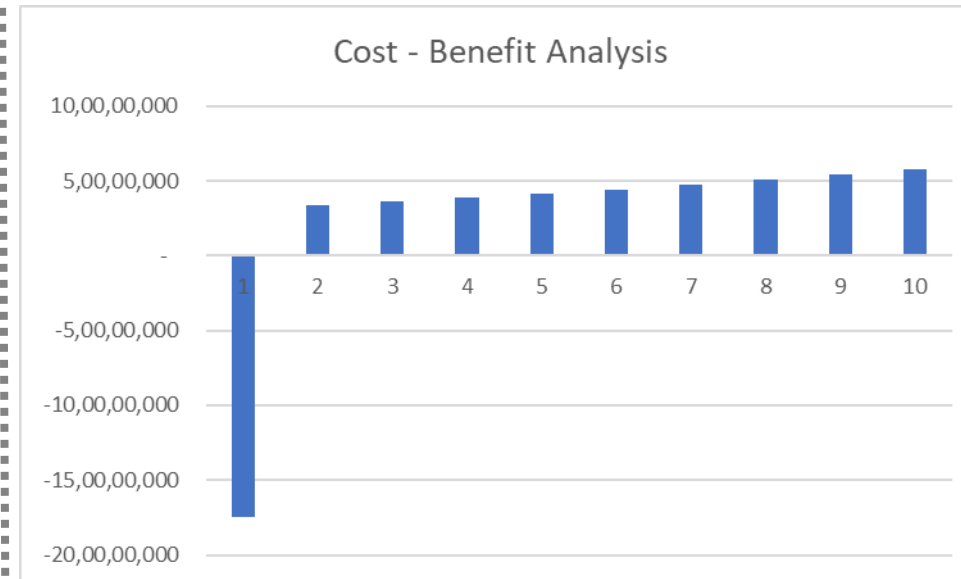
Automatic switching pumps on and off will reduce the manpower requirement

Analyze losses

Capture information regarding losses from WTP to WDS and analyze them for estimating NRW trends

Assumptions:

1. Cost of installing automation is half the cost of SCADA.
2. Water demand increase by 2% per annum.
3. Chemical savings due to automation is 10%.
4. O&M savings is equal to 15%.
5. Energy saving by reduction in power factor is 5%.
6. Inflation is assumed to be 7%.



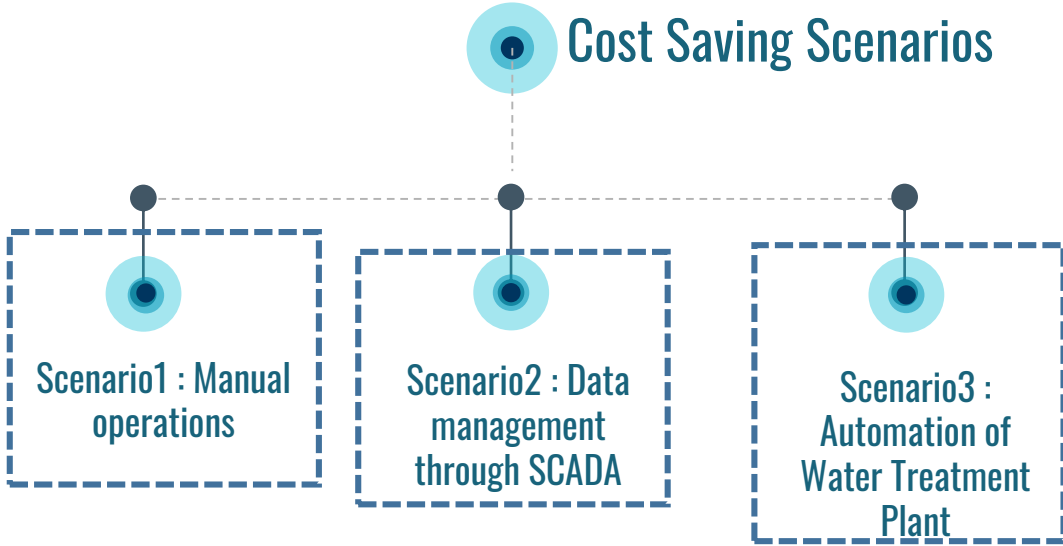
IRR 19%

NPV

₹ 2,30,50,863.26

Source: Site Visit; Cost-Benefit Analysis of complete WTP Automation, AWWA Research Foundation

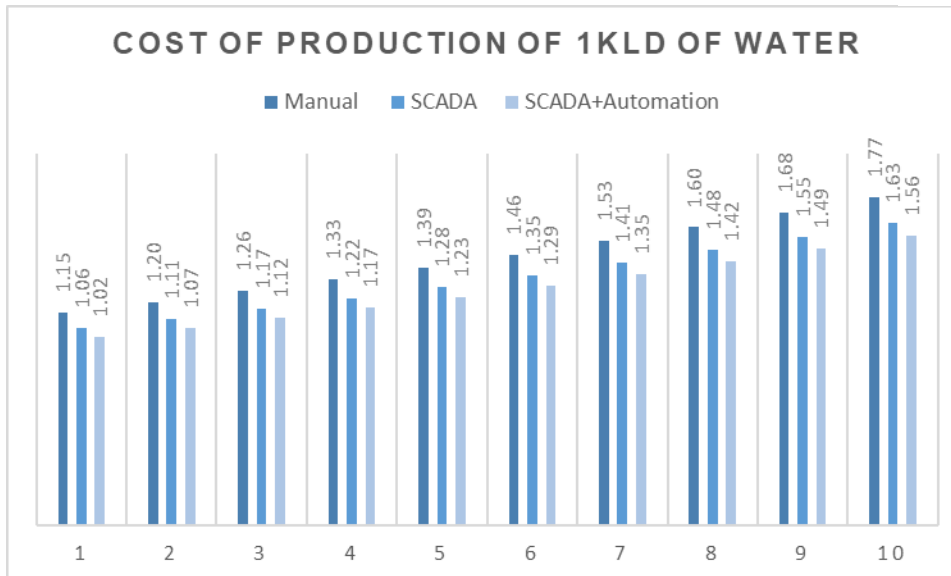
Interventions-Cost Savings



Scenario 2: Data management through SCADA

1. O&M cost is 2% per year. is equivalent to one person.
2. Monthly electricity charge is 2 lakhs.
2. Chemical savings and automation 10% per year reduction in manpower.
3. Monthly chemical cost is 59 lakhs.
3. Energy saving is increased by 2% as compared to SCADA.
3. Average water production per day is 700MLD.
3. Energy savings by maintenance and repair is 10%.

Description	AMC: Water Projects Department	Scenario 1: Manual operations
	Cost of water per kilo litre (Rs)	Cost of water per kilo litre (Rs)
Raw water cost	2.86	3
Water Production cost (including energy cost, O&M cost, chemical cost)	1.152	1.15



Assumptions

1. Water demand is increasing by 2% yearly.
2. Inflation rate is 7%

Source: Water Project Department Disclosure; Site Visit; Establishment of SCADA (Vibrant Gujarat); AWWA Research on automation

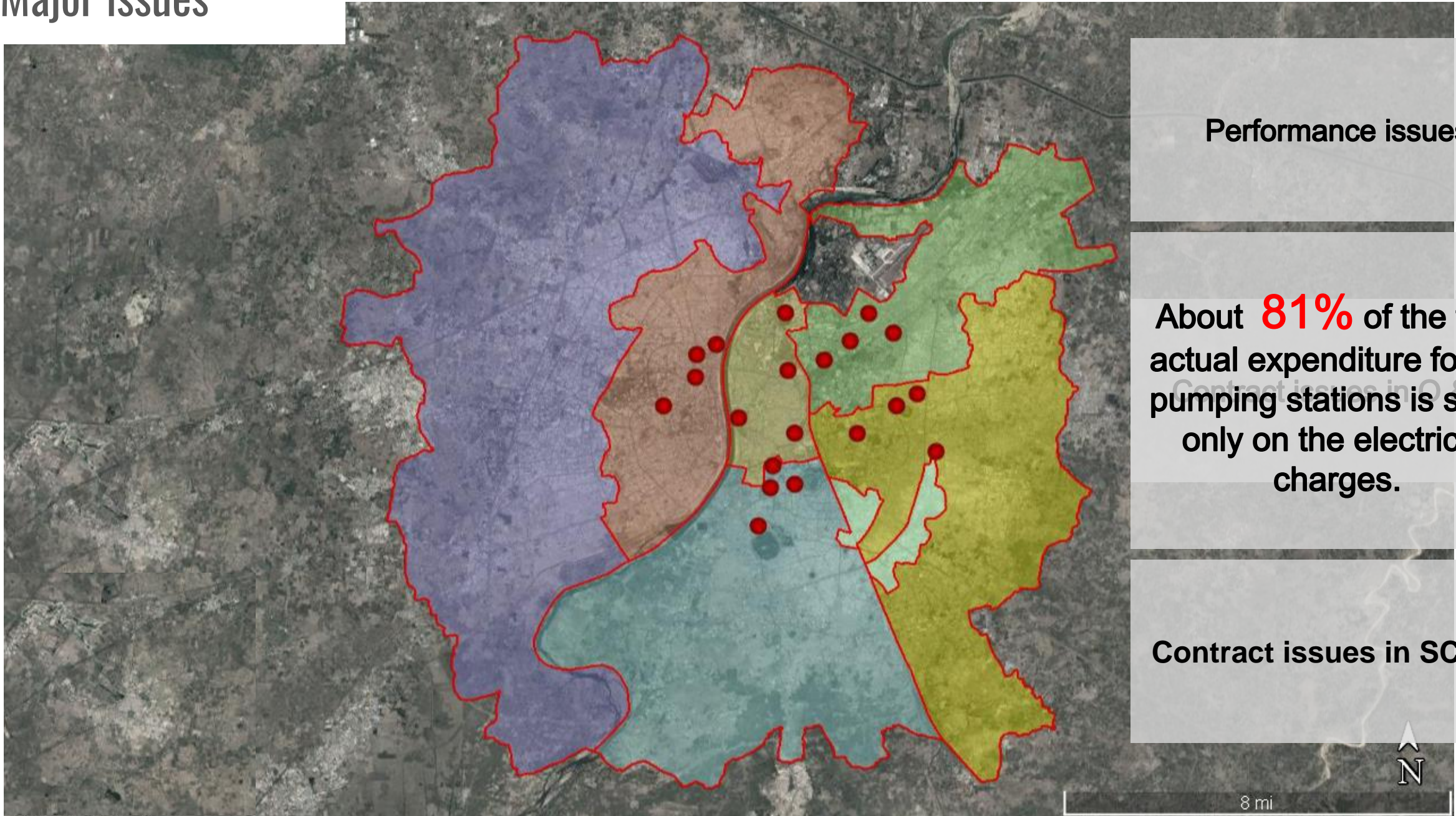
Initiatives taken by AMC

Reports	Daily report	Monthly report	Zonal report	Daily pump report
	Total inlet	Total inlet	Capacity of tank	Pump parameters
	Total supply	Total supply	Total inlet	Pressure for every 15 min
<div style="border: 1px dashed black; padding: 5px;"> <p>Pump specifications</p> <ul style="list-style-type: none"> • Pump type • Pump age • Pump capacity </div>	Pressure	Chlorine plant operation time	Total	Capacity and Level of water in OHT
	Sump level	Peak sump level	Head at 6:30 and 7:30	
Qualitative data	High potential for usage of these data			
	Turbidity			
	Chlorine (ppm)			

How this data can be utilized in understanding the performance of the Distribution stations ??

Source: SCADA

Major issues



Performance issues

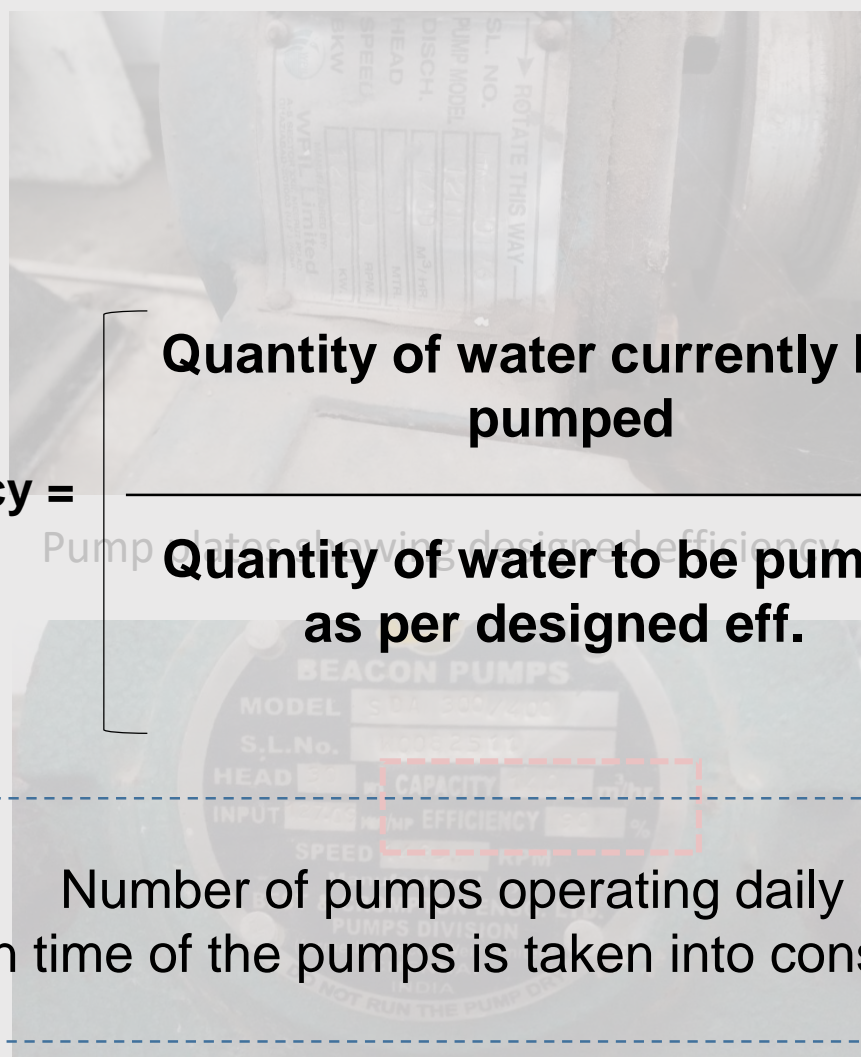
About **81%** of the total actual expenditure for the pumping stations is spent only on the electricity charges.

Contract issues in SCADA

Performance issues



Lal Darwaza Water distribution station



Quantity of water currently being pumped

% Efficiency =

Quantity of water to be pumped as per designed eff.

X 100

Number of pumps operating daily and Run time of the pumps is taken into consideration

અમદાવાદ મ્યુનિસિપલ કોર્પોરેશન
દરિયાપુર - માધુપુરા વોટર ડિસ્ટ્રીબ્યુશન પંપીંગ સ્ટેશન

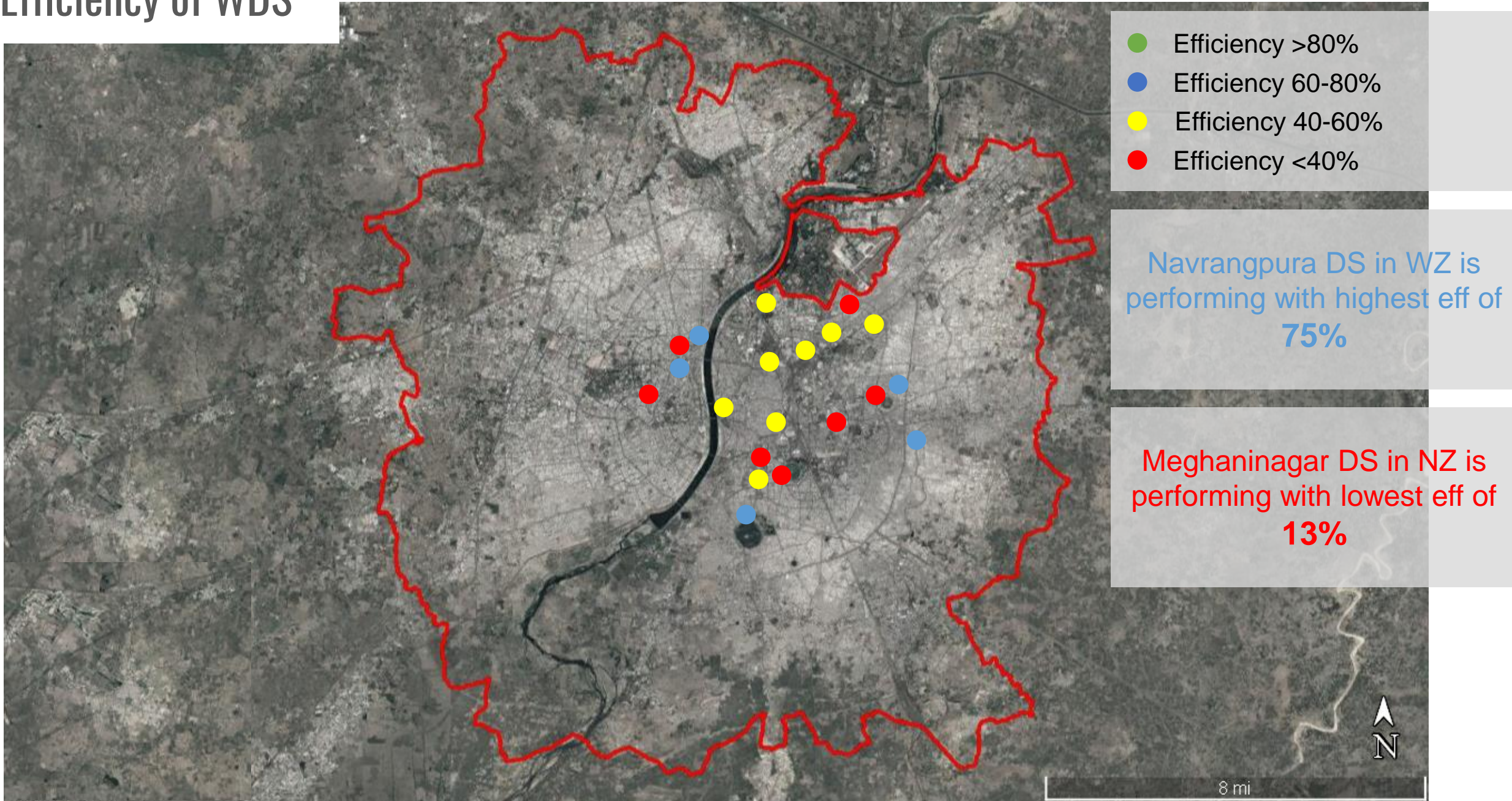
ટેકનિકલ ડીટેઇલ્સ

અનુસ્થાપિત ડિઝાઇન કોષ્ટકો	:- ૬ વાલ્વ ગેલન
પંપની કોષ્ટકો - વેડ	:- ૯૦૦ મીટર / ૬લાક - ૩૦ મીટર
પંપની કોષ્ટકો - વેડ	:- ૬ વોલ્ટ / ૧૦૦૦ વાટ
પંપની મોડેલ	:- "WPIL"
પંપની કોષ્ટકો - વેડ	:- "VG50071-72-73"
પંપની મોડેલ	:- C 20 TC
પંપની કોષ્ટકો - વેડ	:- ઘોડન બેરીંગ
પંપની કોષ્ટકો - વેડ	:- 400 mm / 400mm
પંપની કોષ્ટકો - વેડ	:- ૬લાક માર્કેટ સ્વીચલ કેબલ ઈન્ડસ્ટ્રી મોટર
પંપની કોષ્ટકો - વેડ	:- 110 KW / 4 POLE
પંપની કોષ્ટકો - વેડ	:- DV 315 S
પંપની કોષ્ટકો - વેડ	:- "મિરાષોન ઈલેક્ટ્રીક મોટર"
પંપની કોષ્ટકો - વેડ	:- DE-6319 / NDE-6316
પંપની કોષ્ટકો - વેડ	:- ૨૦૧૪૨૫
પંપની કોષ્ટકો - વેડ	:- ૬૦૦ mm.
પંપની કોષ્ટકો - વેડ	:- ૬૦૦ mm.
પંપની કોષ્ટકો - વેડ	:- "વોલ્ટેજ ટ્રાન્સફોર્મર લી."
પંપની કોષ્ટકો - વેડ	:- ૫૦૦ કે.વી.એ. (૨ નંગ)
પંપની કોષ્ટકો - વેડ	:- "સન ઓટોમેટ પ્રા. લી."
પંપની કોષ્ટકો - વેડ	:- "બીકો સોરી લી."
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પંપની કોષ્ટકો - વેડ	:- રૂ. ૧,૨૩,૨૦,૦૦૦/-
પંપની કોષ્ટકો - વેડ	:- "K. R. Pumps & Co"

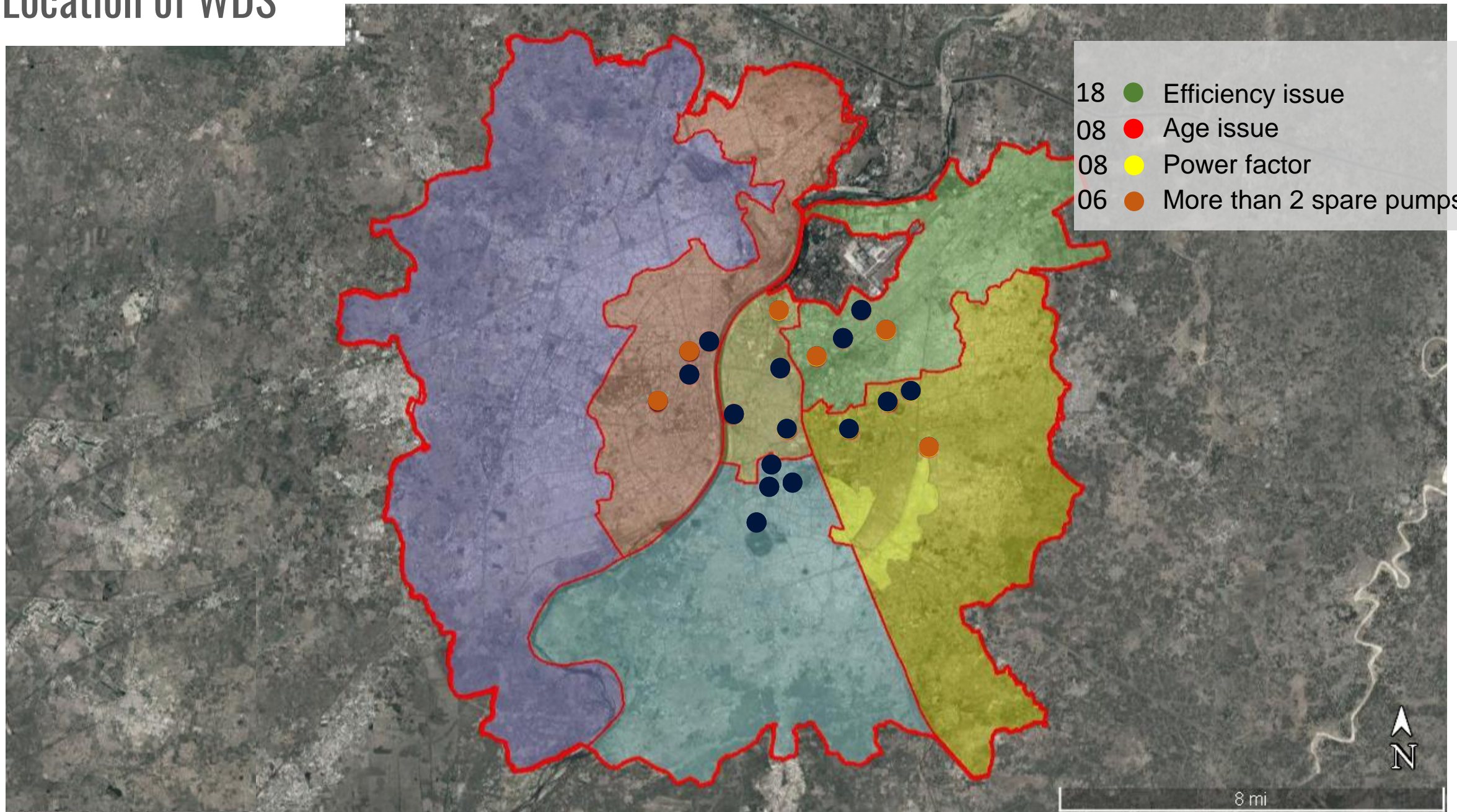
Pump specifications displayed in WDS

Source: Primary survey

Efficiency of WDS



Location of WDS



Inferences

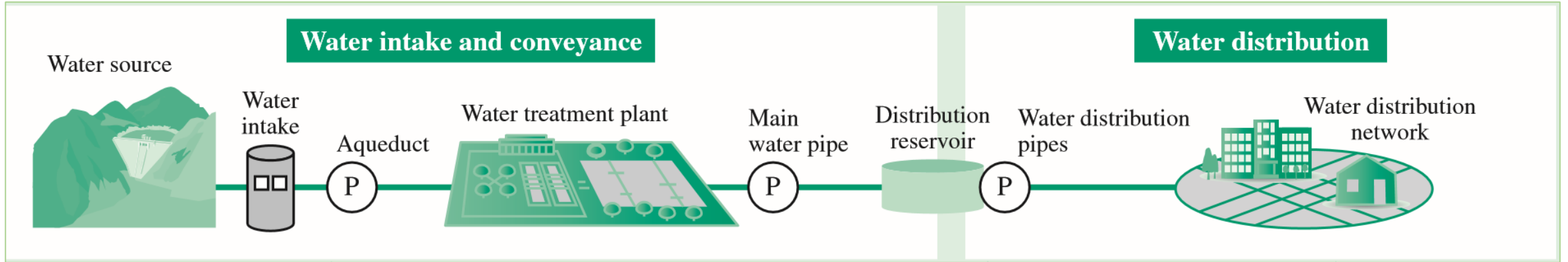
Zones	WDS	Eff.	Age	> 2 spare pumps	PF	OHT
CZ	Batata mill	50.2	7	1	0.8-0.85	NO
	Lal Darwaza	50.3	25	1	0.8-0.85	Yes
	Madhubag	51.3	20	1	0.85-0.90	NO
	Shahibag	57.4	9	0	0.8-0.85	NO
NZ	Asarwa	57.5	5	3	0.85-.90	NO
	Chamanpur	50.3	7	1	0.85-0.90	NO
	Kalapinagar	56.3	1	3	0.85-0.9	NO
	Meghaninagar	12.3	36	2	0.9-0.95	NO
EZ	Bapunagar	14.18	35	2	0.8-0.85	Yes
	Anand bapunagar	71.7	9	1	0.8-0.85	NO
	Gomtipur Hati	30.6	1	2	0.8-0.85	Yes
	Odhav Fire	65	8	4	0.8-0.85	NO
WZ	Gulbai tekra	33.8	25	4	0.9-0.95	Yes
	Navrangpura	74.6	8	2	0.85-0.9	NO
	Stadium	40.9	4	4	0.9-0.95	Yes
	Usmanpura	67.9	16	1	0.9-0.95	Yes
SZ	Kankaria football ground	39.27	9	1	0.8-0.85	NO
	Jamalpur	17.68	15	2	0.85-0.9	NO
	Dhanilimda	61.02	12	2	0.85-.9	NO
	Berampura	58.2	14	2	0.85-0.9	NO

8 WDS have 3 out of the 4 issues

4 WDS have pumps which are <5years old and are working with <60% efficiency.

4 WDS have pumps which are over 20years old and are working with PF< 0.9

Interventions at Distribution station



SCADA related interventions

Automated operation using GSM based management tool

Reducing the manpower and enhancing the performance of the system

Contractual improvement

Integrating the SCADA and o&m contracts

Non- SCADA interventions

Life cycle cost assessment

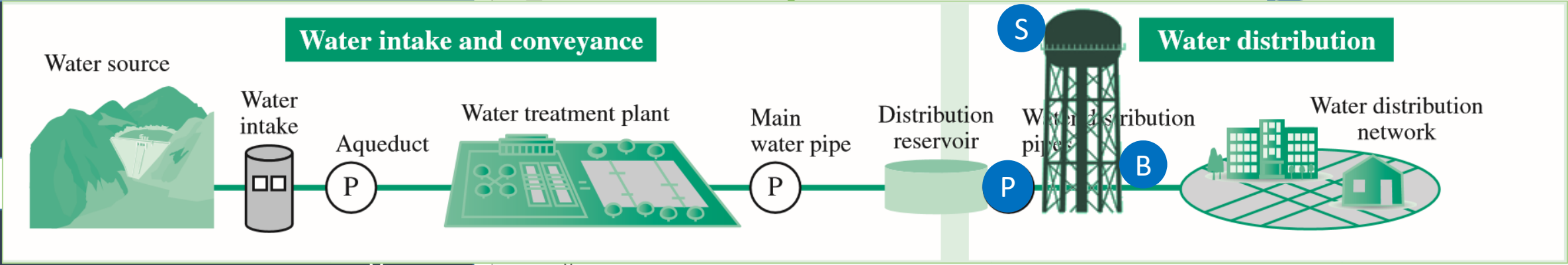
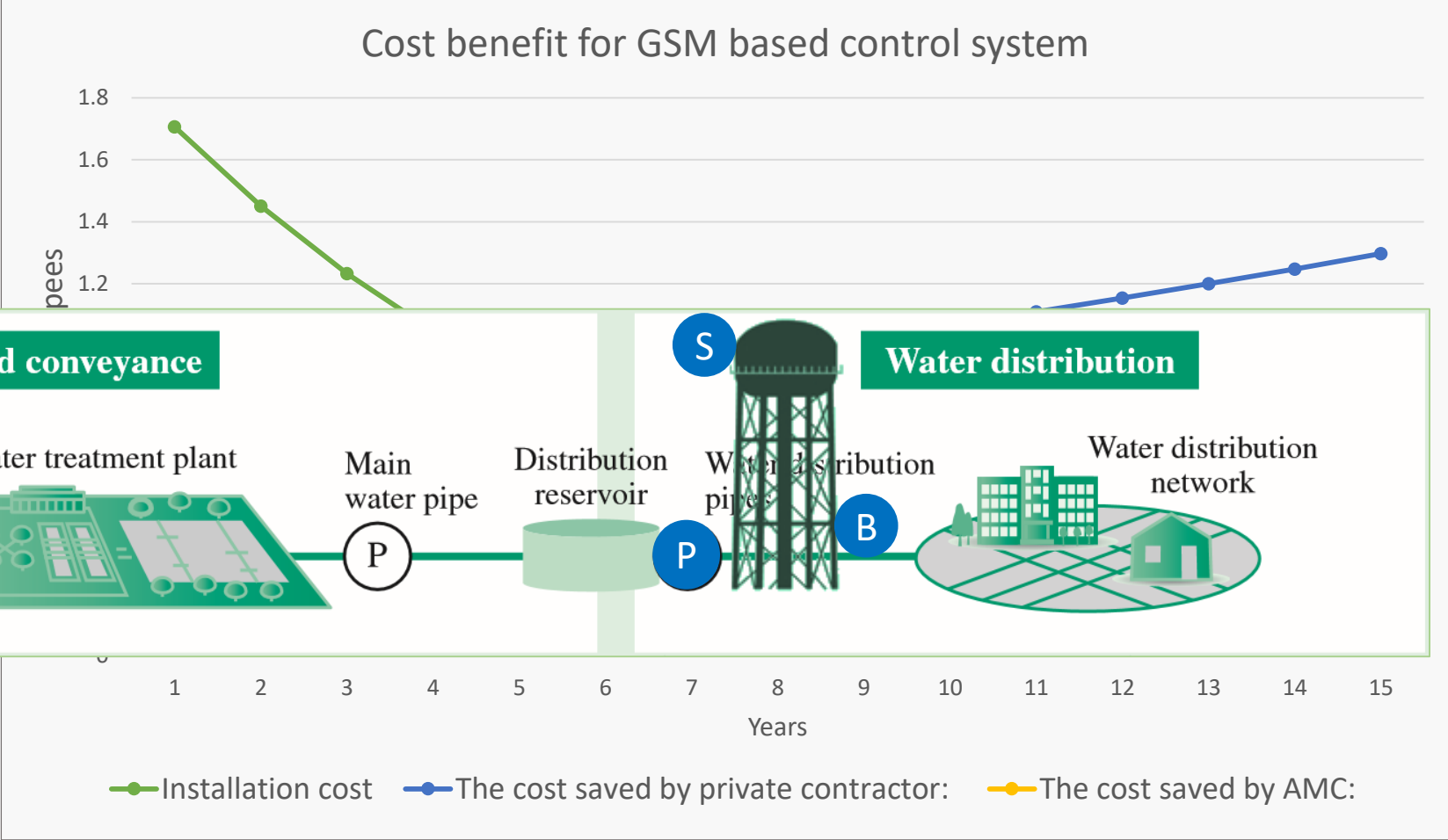
Finding the best time to replace the network equipment thereby operating at lowest cost

Altering time of operation of pumps thereby reducing the operational cost

Shifting the peak hour demand to low tariff hours.

SCADA related Interventions- Automated operation of pumps

This will reduce the o&m cost and increases efficiency of asset management

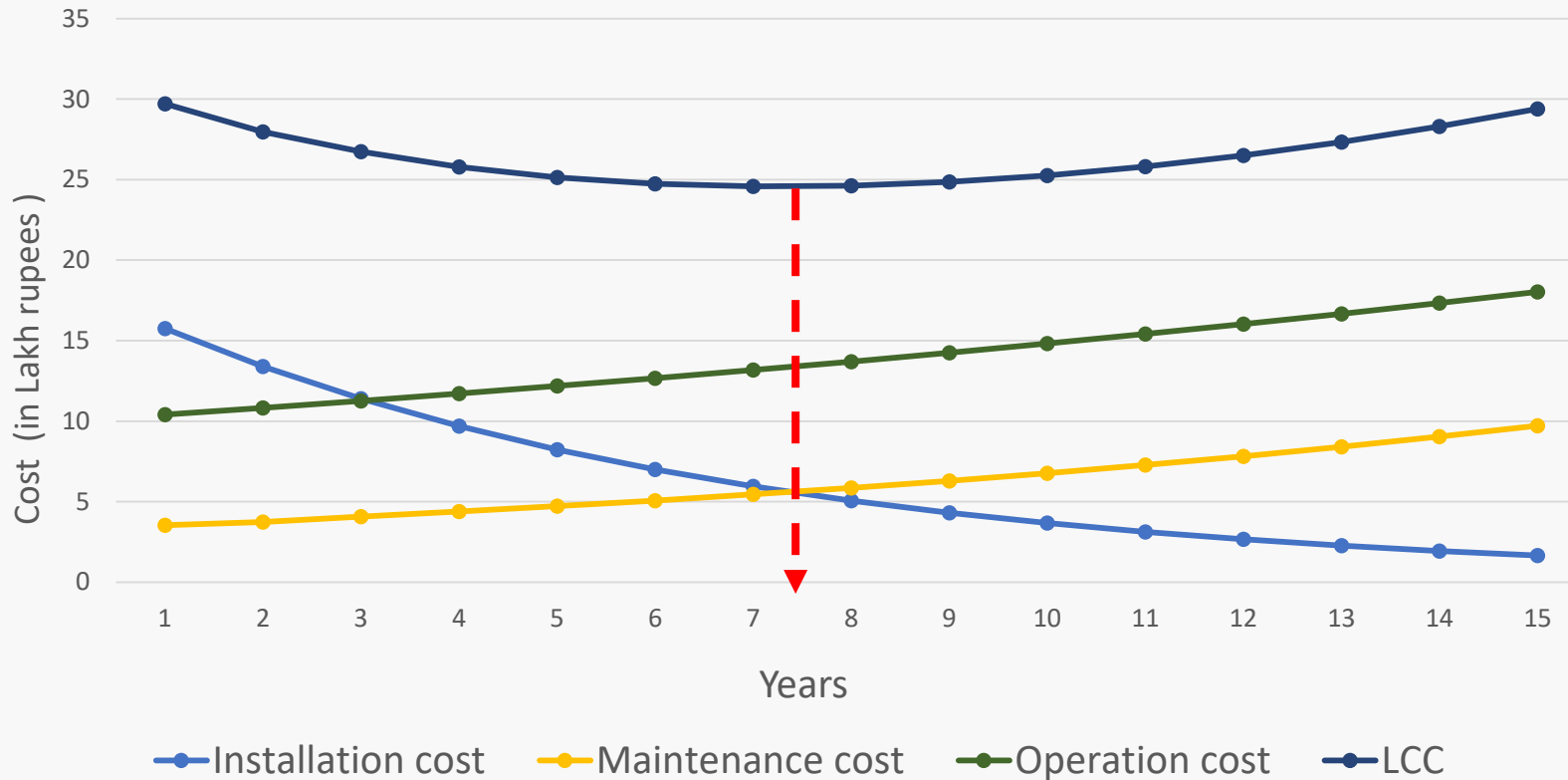


the repairs, services and the scheduled pump run hours.

This will reduce the cost per KL of water at the WDS from ₹ 3.23 to ₹ 2.72

Non SCADA Interventions

Life cycle cost

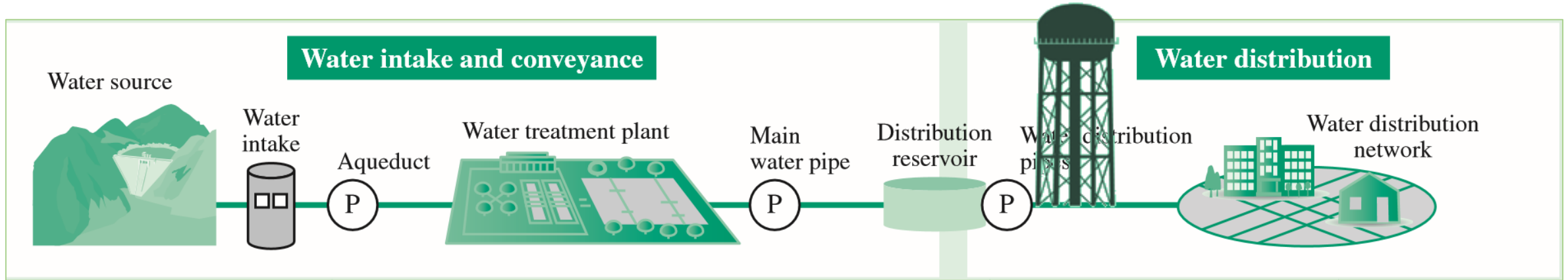


Maintenance charges include regular service charges and repair charges.

Operation cost include the electricity charges

1. 8th year is the optimum time to replace the pumps at the lowest cost, thereby reducing the total life cycle cost.
2. Similar assessment can be done for the pipes in the distribution network for estimating the optimum period for the replacement of network pipelines.

Non SCADA Interventions



1. Maintains constant, reliable water supply and pressures.
2. Increased operational flexibility, efficiency and convenience.
3. Decreasing power costs – particularly for “time-of-day” energy pricing.

We can also learn from other cities with better operation and maintenance of the distribution system

Surat city

GRID system

- All water works and the distributions stations are interlinked
- Any water work can feed any distribution station.
- Various energy saving measures reduced specific energy consumption n water supply.
- Re engineering of water supply routes helped them saving over 34000 KWH/day

Usage of renewable energy in water supply:

- 2 wind mills were installed.
- 6.4GWH/annum of Energy is generated.

Including both re engineering of route and usage of renewable energy

- Over **138 lakh KWH/ annum** is saved.
- Rs **6.36 crores/ annum** is saved.

Non-Revenue Water

Overview – Non Revenue Water

Physical losses

- Leakages during transmission
- Lack of active leakage control
- Poor quality of pipes

50%

Commercial losses

- Data handling errors
- Illegal connections and theft

Unbilled but authorized consumption

- Fire fighting
- Water fountains
- Gardens
- Public toilets
- Free connections - Educational and religious institutions

3.80%

Physical losses

Majorly during backwashing of filter beds

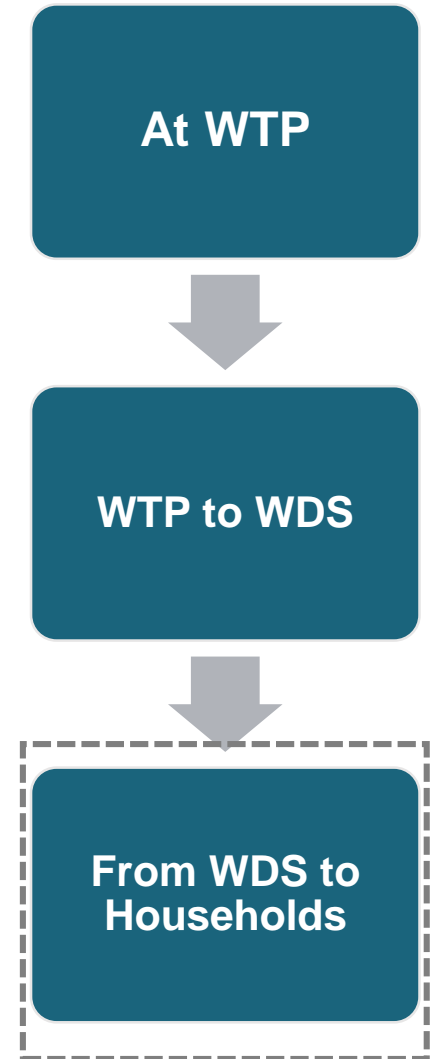
4.0%

During continuous transmission of water from WTP to respective WDS

14.0%

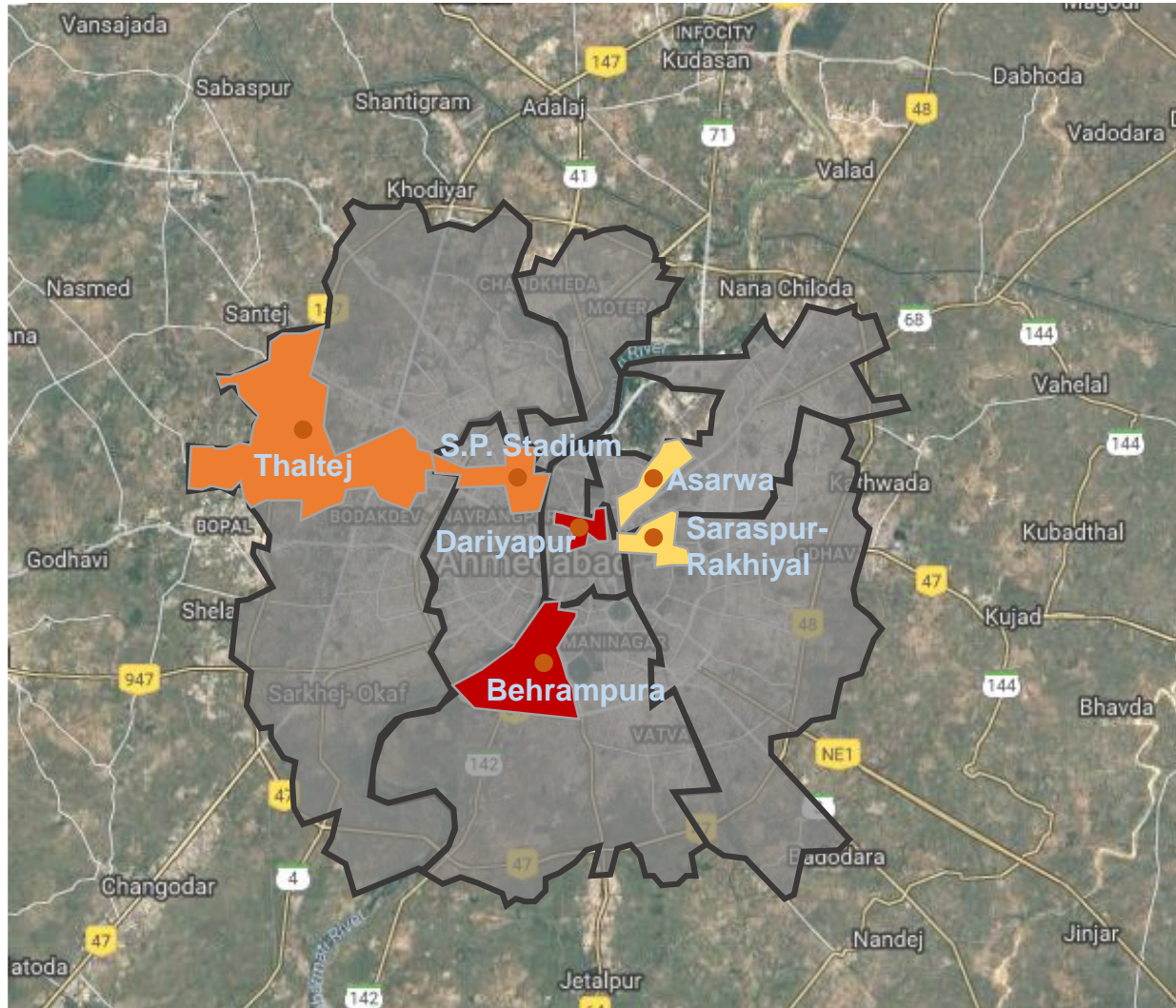
Due to High pressure, badly installed pipes and service connections, aging network, poor choice of network materials, lack of maintenance

32.0%
(391 MLD)



Source: AMC and Field surveys

Physical Losses – Bucket Survey



- Selection of 1 ward in each zone
- Around 20 samples in each ward considering the **distance of samples from the WDS and typology of buildings**

Ward Name	Network Type	LPCD – supplied from WDS	LPCD - consumer end	Losses in %
Thaltej	New	265 lpcd	180 lpcd	32%
S. P. Stadium	Medium	220 lpcd	138 lpcd	37%
Dariyapur	Old	160 lpcd	90 lpcd	44%
Asarwa	Old	197 lpcd	160 lpcd	18%
Saraspur- Rakhiyal	Old	156 lpcd	130 lpcd	19%
Behrampura	Medium	164 lpcd	94 lpcd	43%



Source: Bucket Survey - 2017

Physical losses

Majorly during backwashing of filter beds

4.0%

At WTP

During continuous transmission of water from WTP to respective WDS

14.0%

WTP to WDS

Due to High pressure, badly installed pipes and service connections, aging network, poor choice of network materials, lack of maintenance

32.0%
(391 MLD)

From WDS to Households

Source: AMC and Field surveys

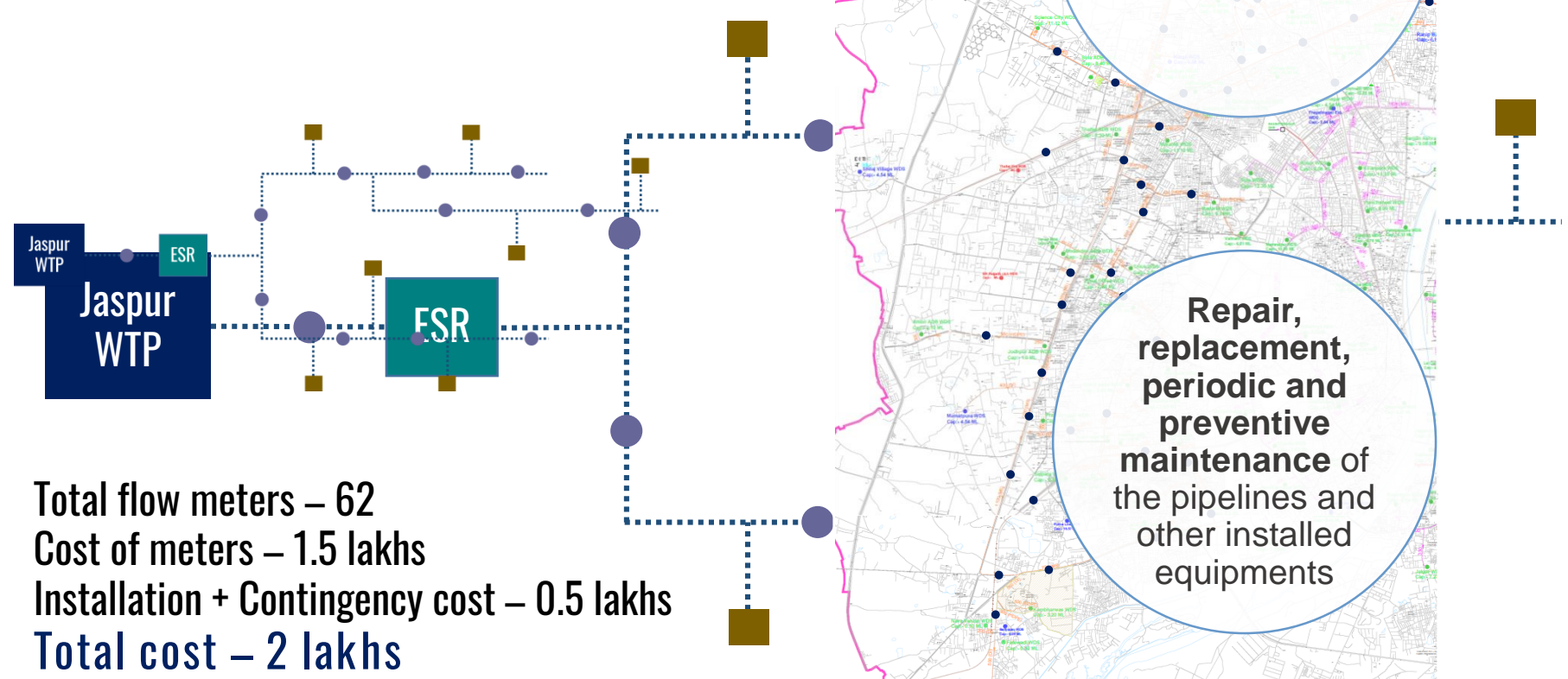
Interventions

Reduction of losses in main transmission lines:

Standardization and establishing **baseline data** (asset information)

- Network map (GIS) with flow direction and junctions
- Pipe diameters
- Pipe materials
- Age of the pipeline
- Quantity of water carried by each pipeline

Installation of **flow meters** which can be clubbed with **SCADA** (for ready information)



Source: Map taken from AMC Water Projects department

Physical losses

Majorly during backwashing of filter beds

4.0%



During continuous transmission of water from WTP to respective WDS

14.0%



Due to High pressure, badly installed pipes and service connections, aging network, poor choice of network materials, lack of maintenance

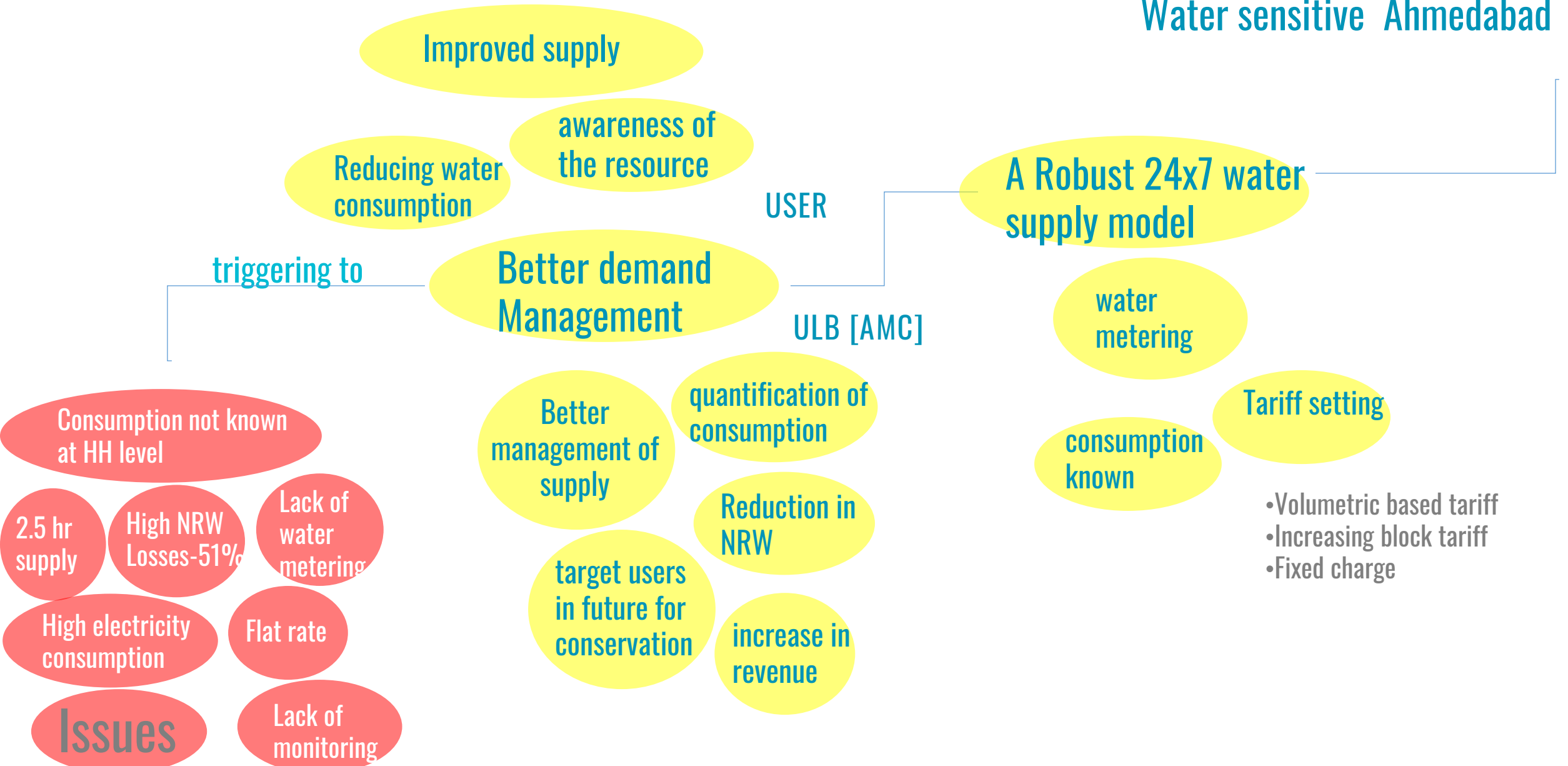
32.0%
(391 MLD)



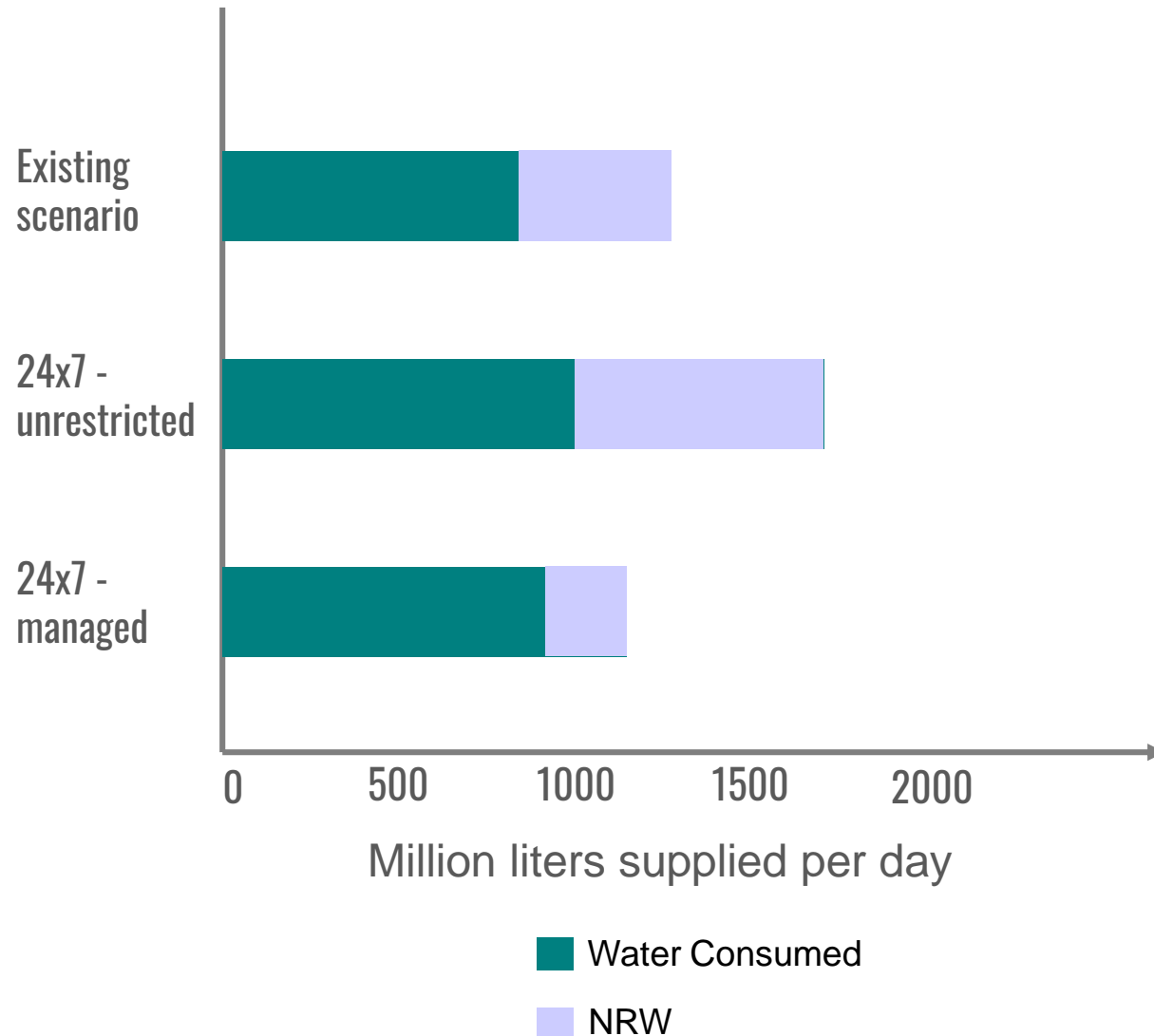
Source: AMC and Field surveys

Strategies to reduce NRW

Water sensitive Ahmedabad



Scenarios - 24x7 water supply



ADVANTAGES

- Water flows at lower rate as compared to intermittent supply → **Lesser losses**
- System pressure is routinely measured and controlled → **Lesser bursts in pipes**
- Always full and under constant pressure → **leaks can be identified using traditional sounding techniques and can be accurately located**
- Unauthorized connections can be identified

Source: Guidance Notes for Continuous water supply (24-7 Supply), MOUD

Case Studies

Parameters	Ho Chi Min City, Vietnam	Selangor, Malaysia	Bangkok, Thailand	Nagpur, India	Mysuru, India
Duration of Contract	5 years	10 years	4 years	25 years	6 years
Responsibilities of private contractor	<ul style="list-style-type: none"> Establishment of DMAs Asset rehabilitation Leak detection and repair 	<ul style="list-style-type: none"> DMA management Leak detection Installation and repair of meters 	<ul style="list-style-type: none"> Leak detection and repair O&M of all DMAs Efficiency in metering 	<ul style="list-style-type: none"> 24*7 water supply 100% metering Billing efficiency NRW reduction Redressal of customer complaints 	<ul style="list-style-type: none"> Rehabilitation of assets Improving operational performance
Financial model	<ul style="list-style-type: none"> Fixed + Performance based fee 	<ul style="list-style-type: none"> Lumpsum Contract Penalty clauses for failure to achieve target 	<ul style="list-style-type: none"> Fixed Fee + Performance fee + Reimbursable payments 	<ul style="list-style-type: none"> Fixed Fee + Performance fee Bonus for NRW reduction, additional billing Penalty linked to quality, pressure, customer complaints 	<ul style="list-style-type: none"> Share of private contractor in capital cost+ fixed O&M fee + Performance fees

Source: 1.Moving Towards 24*7 water supply in Class “A “ Municipalities in Maharashtra , PAS Project

2.Running Water in India’s Cities: A Review of Five Recent PPP Initiatives, The World Bank

3.Bill Kingdom & Roland Liemberger -The Challenge of reducing Non- Revenue water in Developing Countries, 2006

4.Paul Fanner, Non-Revenue Water reduction Contracts and illustrated examples

Metering Initiatives - Ahmedabad

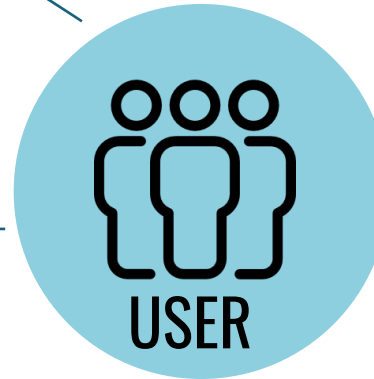
79 HH



Purchase of meters



Rehabilitation of networks
Installation of meters



Issues in Up scaling :



Incentives + Rebate



Lack of Monitoring



Total cost - **Rs. 3,00,000**

Source: Primary Survey – Water and Sanitation Studio 2017

Metering Initiatives - Ahmedabad

Before



Rs500 annually
water tax part of P.T

Wastage of water

Usage of Borewell
[7-8 days]

High pumping cost-
electricity billsRs.36,000

Suvarnadham society -



- AMC & Bore well



After



Rs.5000/- annually

Better management of water

Bore well hardly used

Low electricity
billsRs.10,000-15,000



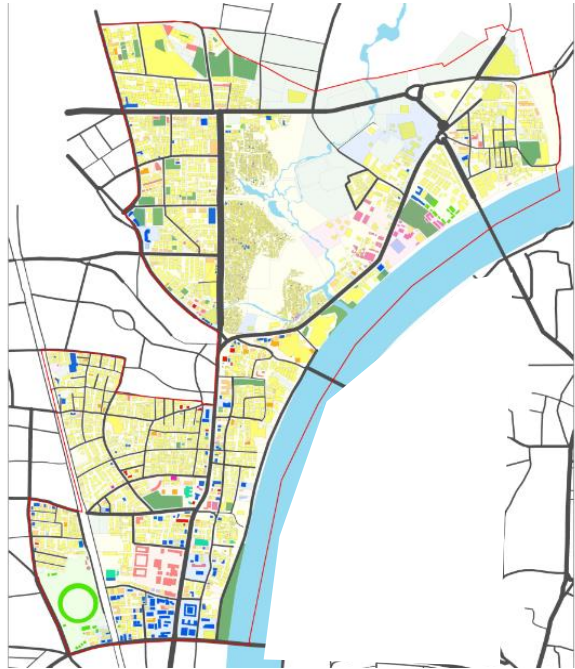
Source: Primary Survey – Water and Sanitation Studio 2017

STAGE 1

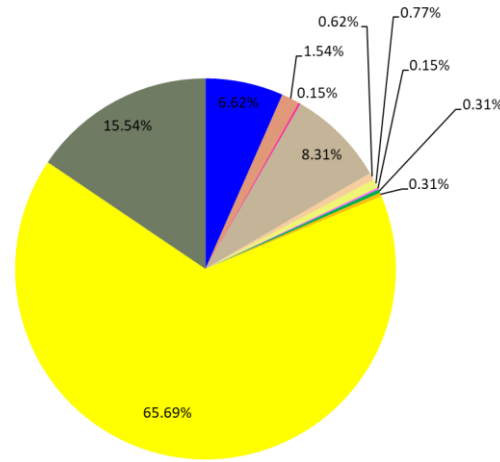


Pilot Area - Selection

1. Ground water Exploitation



2. Mixed Land Use - Residential, Commercial & Institutional

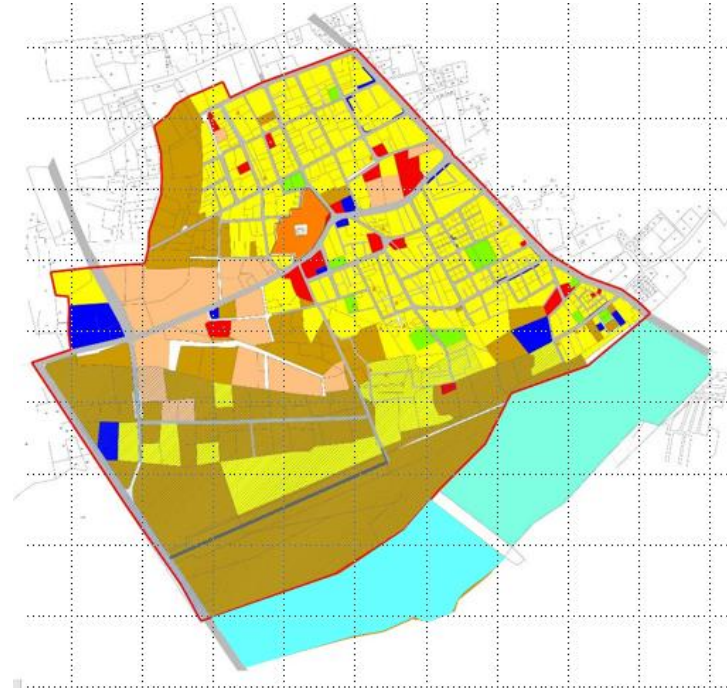


- Commercial
- Education
- Industrial
- Mixed Use
- Others
- Public Facilities
- Public Services
- Recreational
- Religious
- Residential
- Vacant

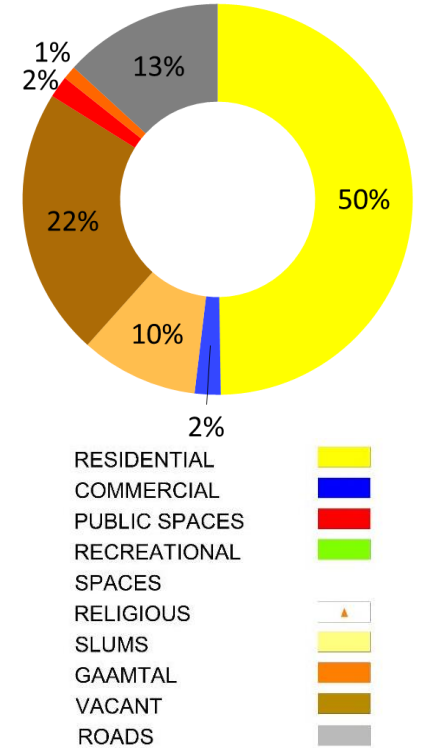
Total Population (estimated) – 1,40,000

S.P. Stadium

3. Mix of Typology – Individual houses, Low Rise & High rise



4. Data Availability

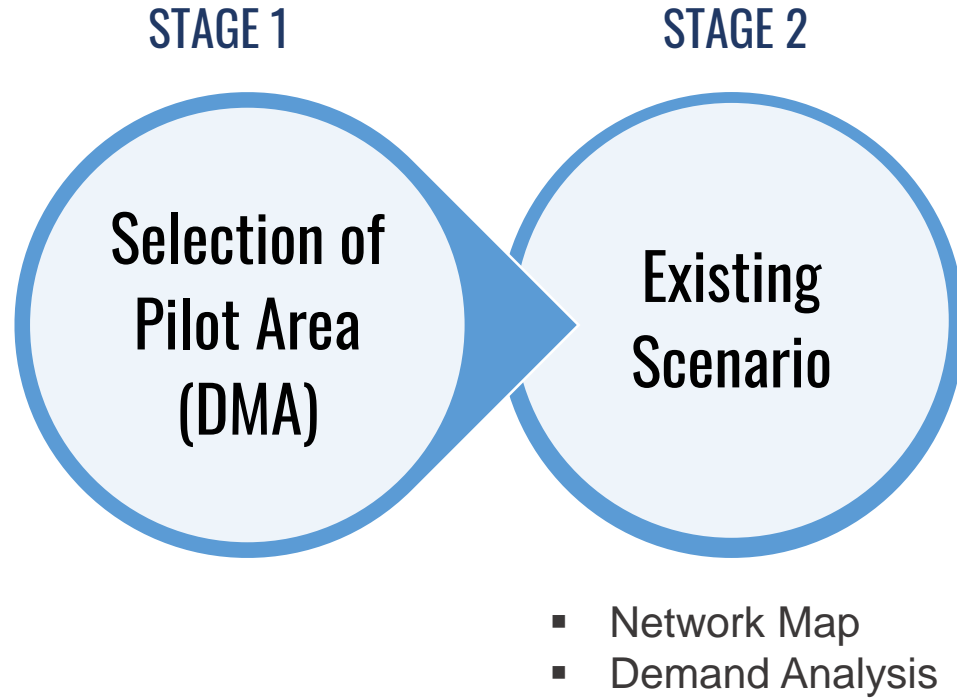


- RESIDENTIAL
- COMMERCIAL
- PUBLIC SPACES
- RECREATIONAL
- SPACES
- RELIGIOUS
- SLUMS
- GAAMTAL
- VACANT
- ROADS

Total Population (estimated) – 1,25,000

Vasna

Moving Towards 24*7

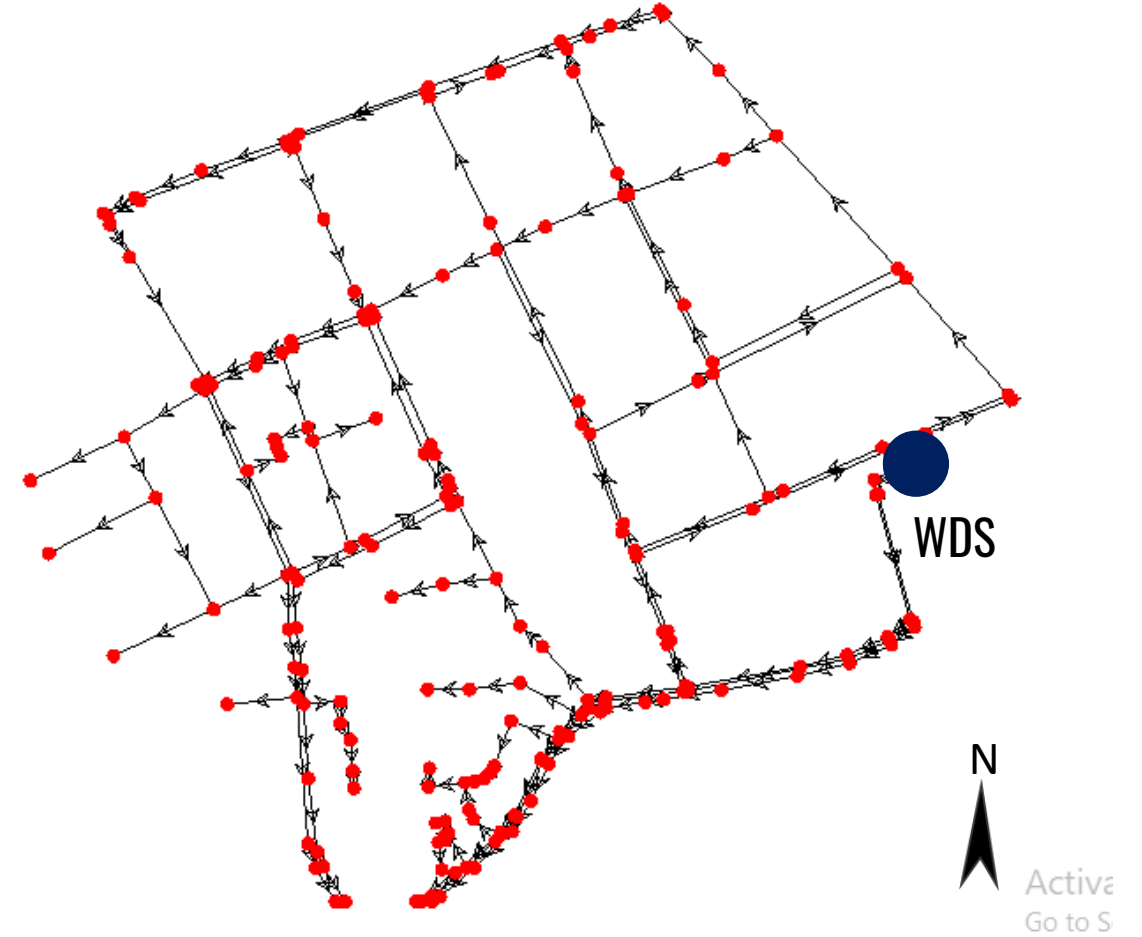


Existing Network Map



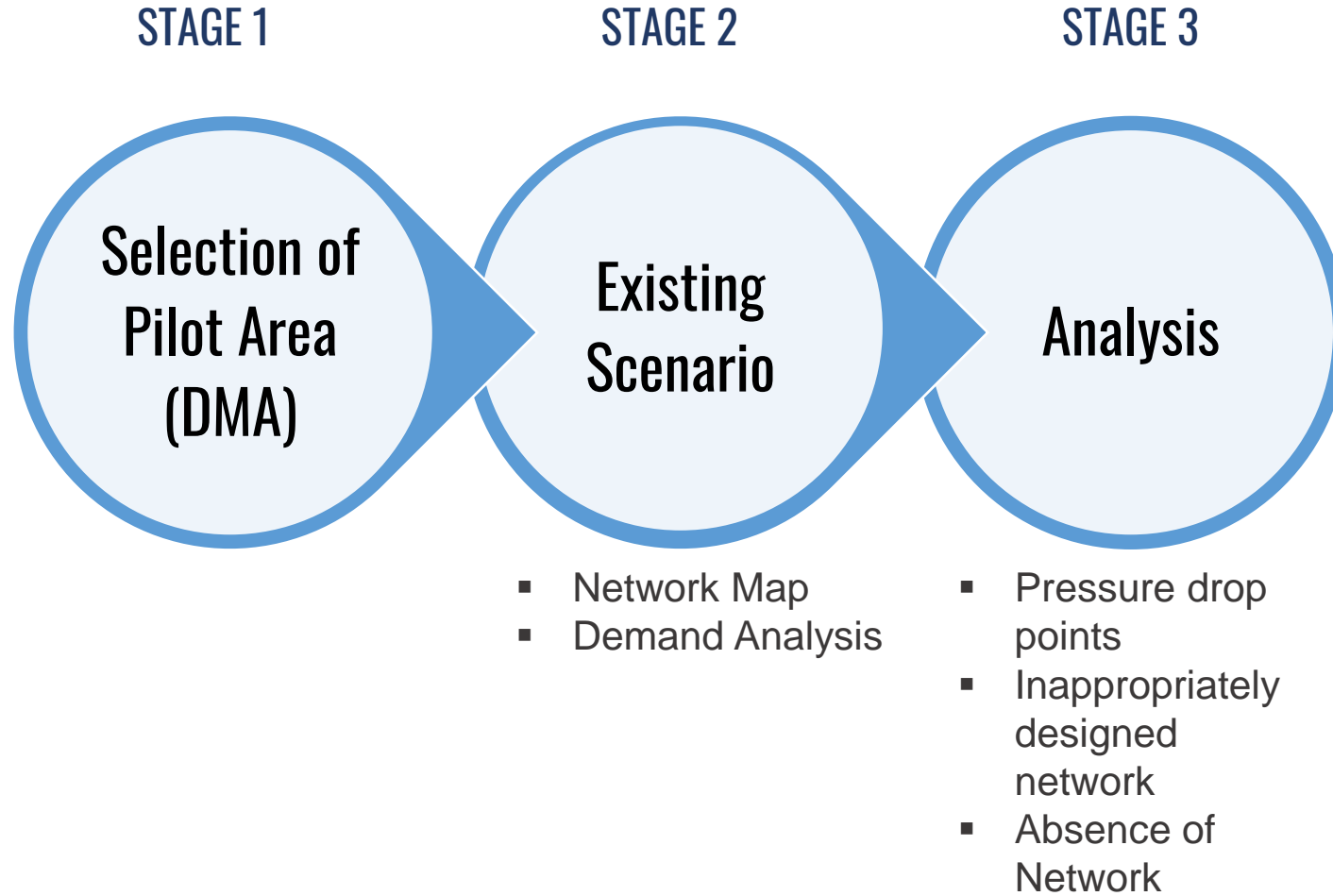
Pressure head ranges from **2m to 7m**

S.P. Stadium WDS

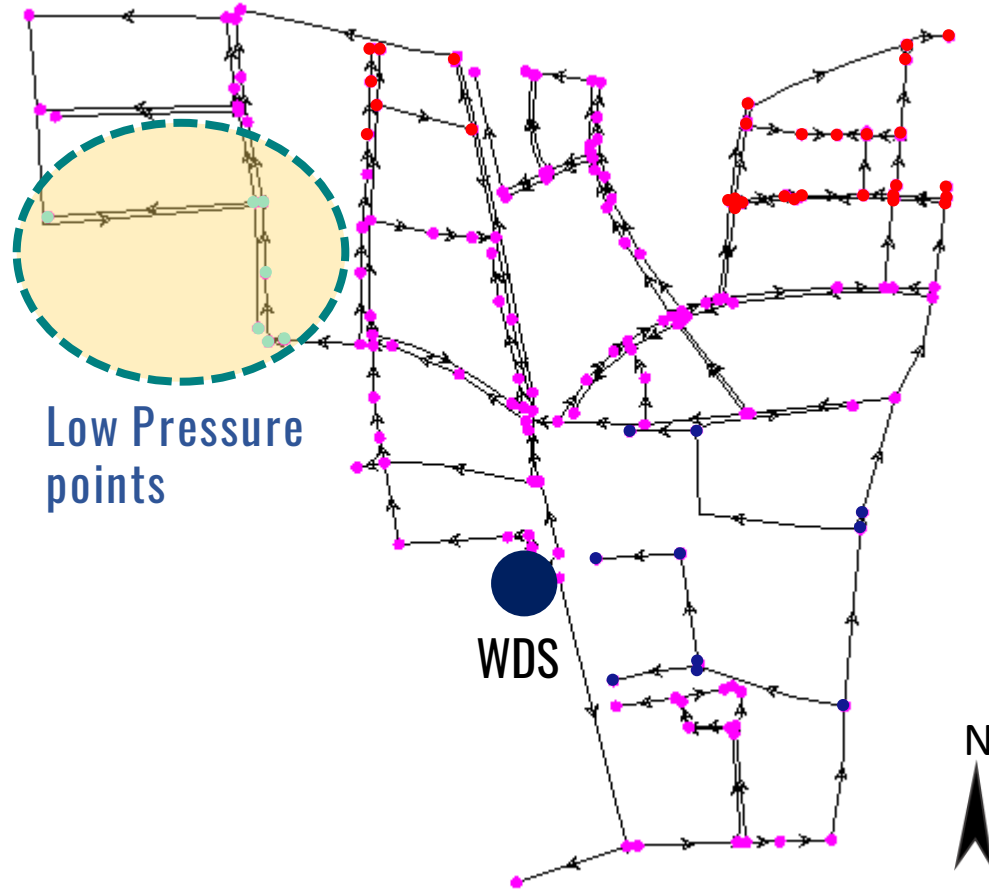


Pressure head ranges from **5m to 12m**

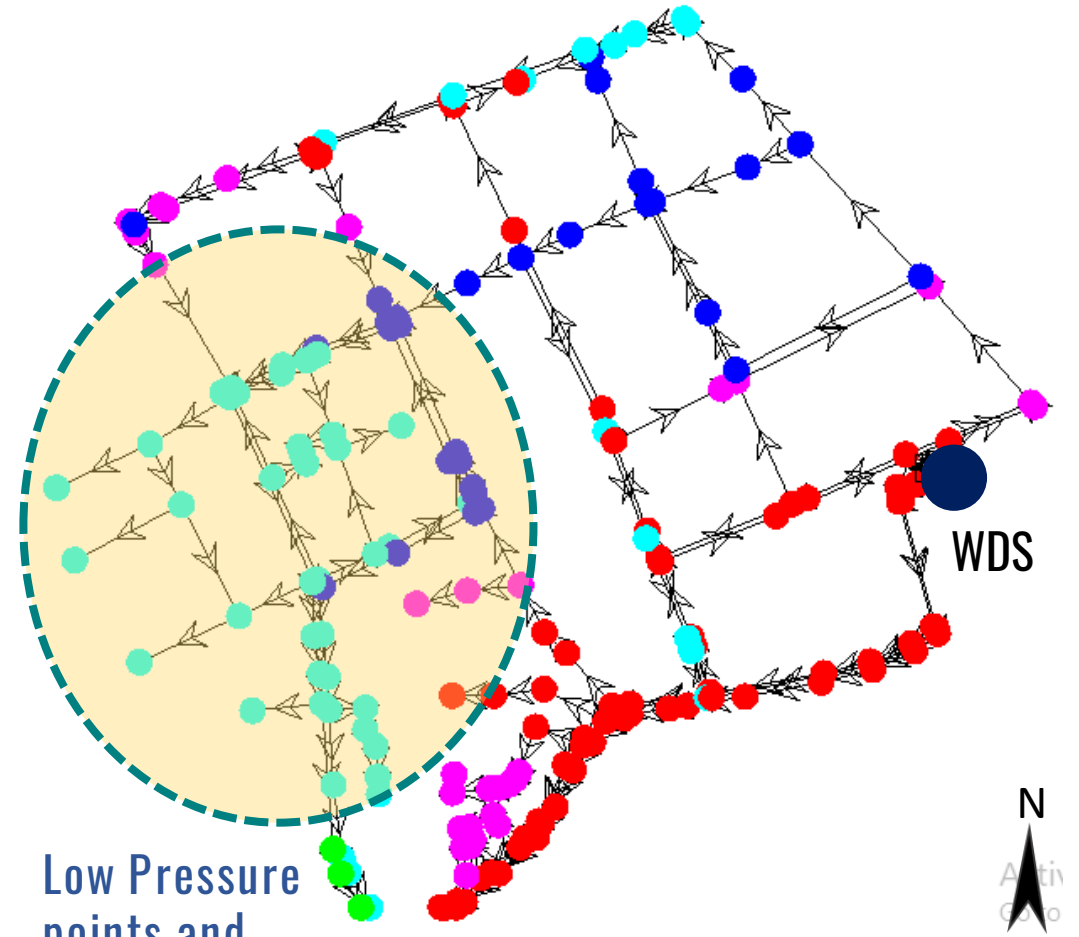
Jawaharnagar WDS



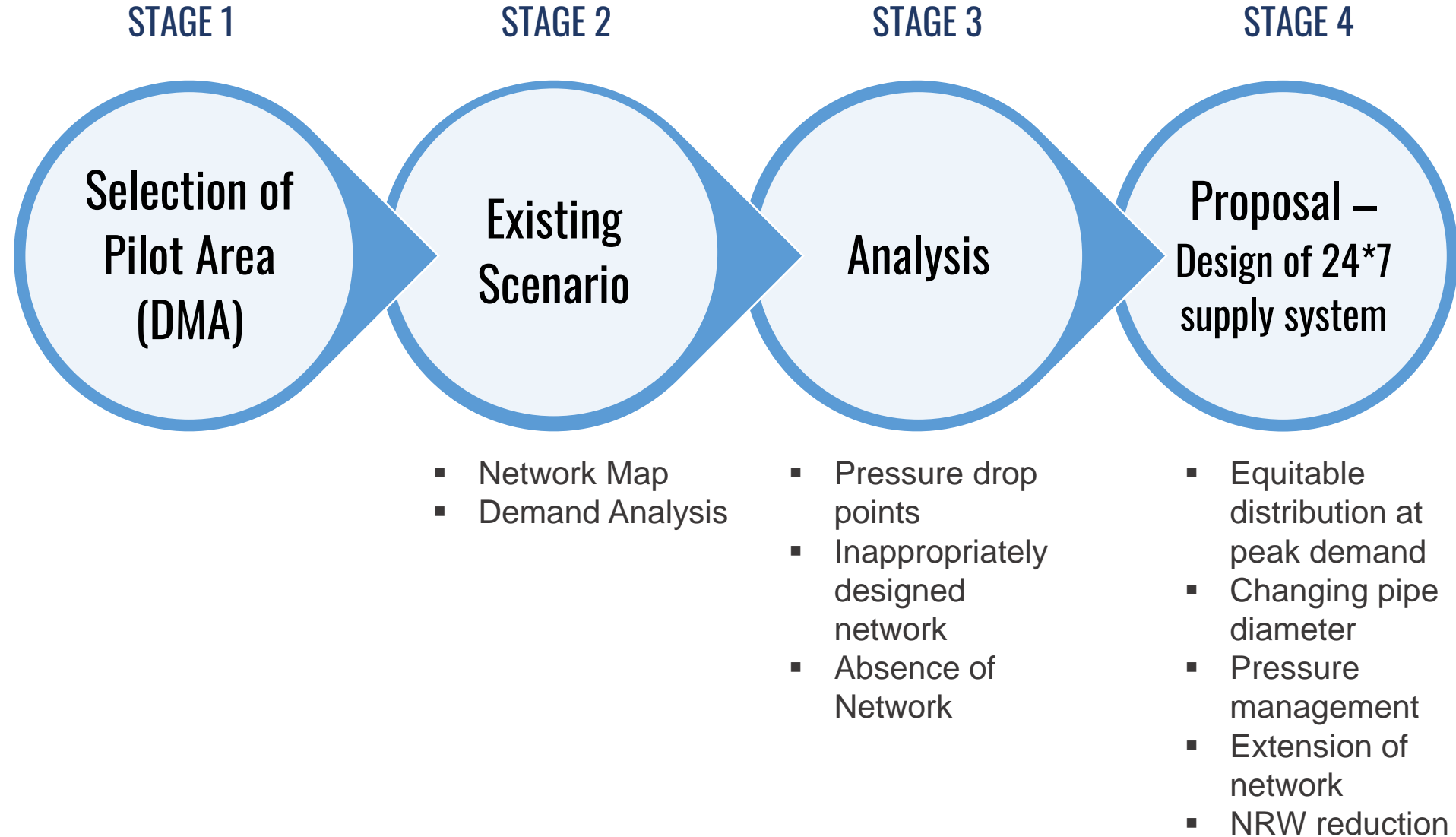
Existing Network Map



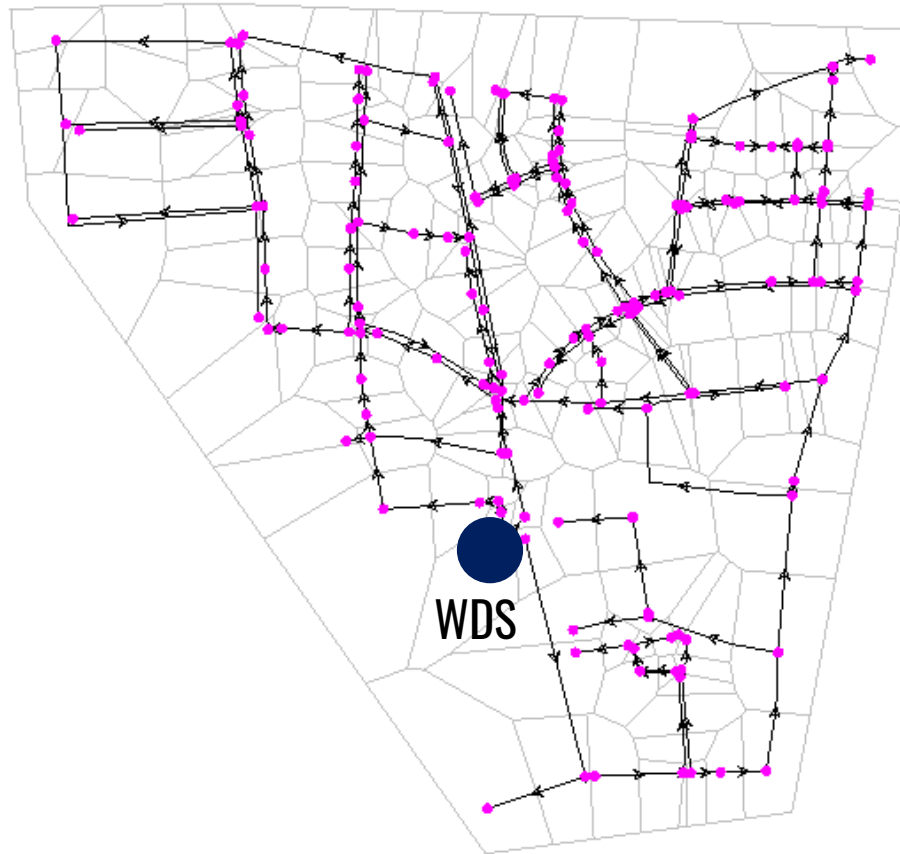
S.P. Stadium WDS



Jawaharnagar WDS

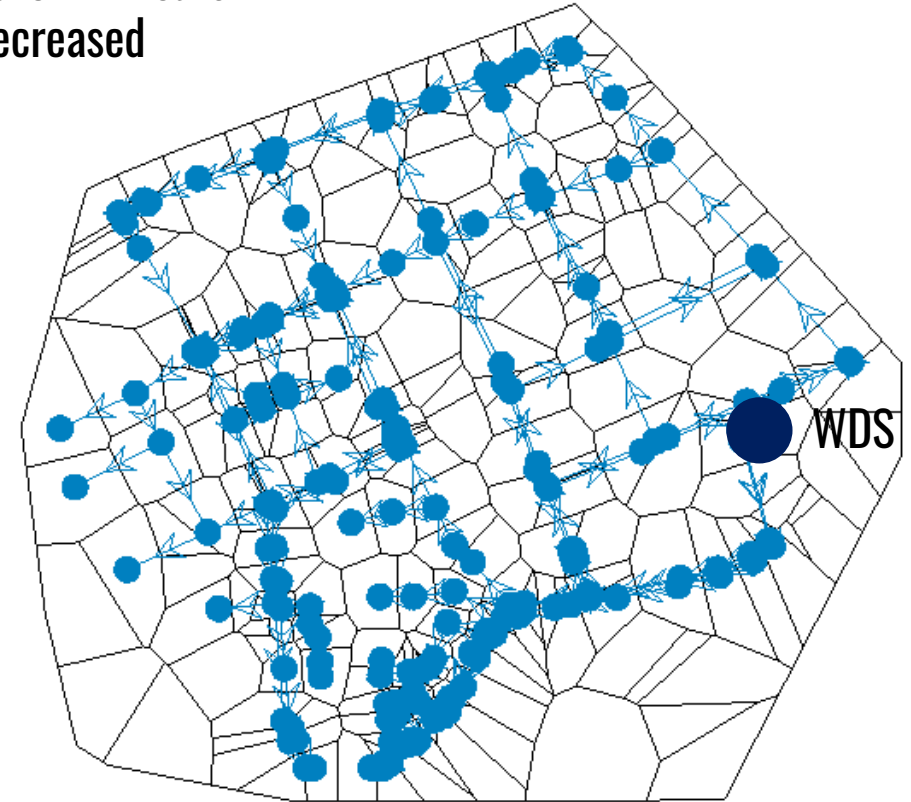


24*7 Water supply



3 Pumps – Pressure head = 65 m
1 Pump – Pressure head = 15 m

Demand distributed over 24 hours
Peak Demand Decreased



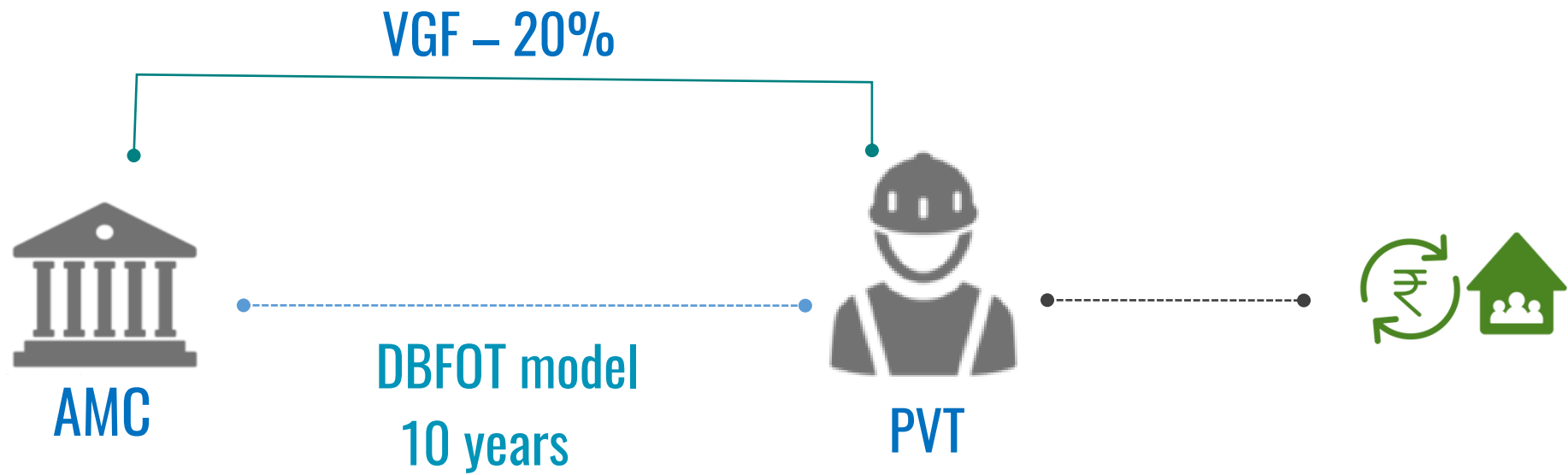
3 Pumps – Pressure head = 82 m
1 Pump – Pressure head = 18 m

Intermittent supply

1. Reduction of Losses
 - distribution networks
 - storage reduction
 - household connections
2. Demand Management
 - water metering

→ 24 X 7 Water Supply

Funding Mechanism



Total Project Costing

For Water metering:

Ward- S.P stadium	West Zone
HH with water connections[DMA area]	6000
Cost per water meter connection[in Rs]	3000
Total cost for meters [in Rs]	180
Contingencies @5%	9
Total project cost [in Rs lakhs]	189

Revenue Income:290 lakhs

Revenue Income:117 lakhs

For 24 * 7 water supply: Capital Expenditure

Name of the ward	Length of DI pipeline	Total cost
S.P Stadium	5.2 km	1.2
Vasna	6.1km	6.7
Total project cost [in Rs lakhs]	11.3 km	7.9

Project costing & Funding

Name of the project	Overall cost (INR Cr.)	Time frame/contract period	Funding agencies
Automation of water treatment plant	18	2	Central + State
Recharge wells in lakes	0.78	1	CSR
Recharge wells in parks	0.59	1	CSR
Rain water harvesting in townships, commercial, industries	6	3	Central + ULB
Automation of water distribution stations	0.03	1	ULB
24*7 water supply & metering	14	10	ULB (VGF) + Private
Rain Water Harvesting structures along transit corridors	0.41	2	CSR+ Ahmedabad Janmarg Ltd

Service Improvement

Service Level Water

Extent of metering of water connections— **60%** from **0%**

Extent of non revenue water— **25%** from **43%**



= **43.5 crore**

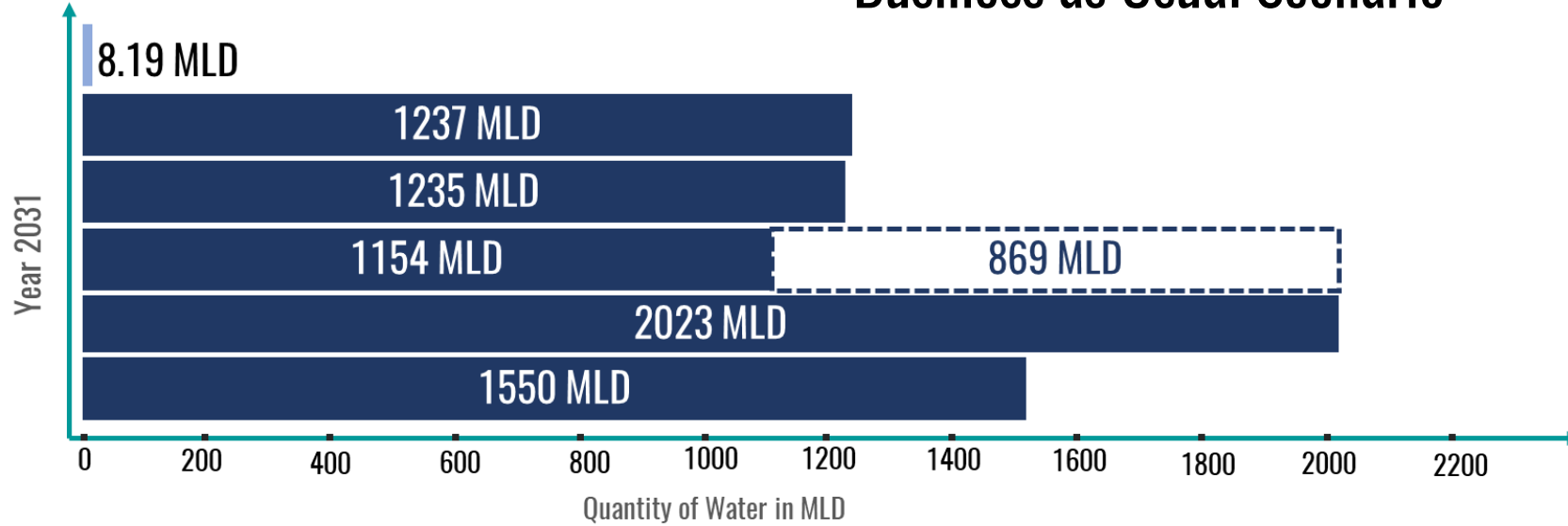


1.78 crores

PVT

Conclusion

Business as Usual Scenario



Storm Water

Recharge

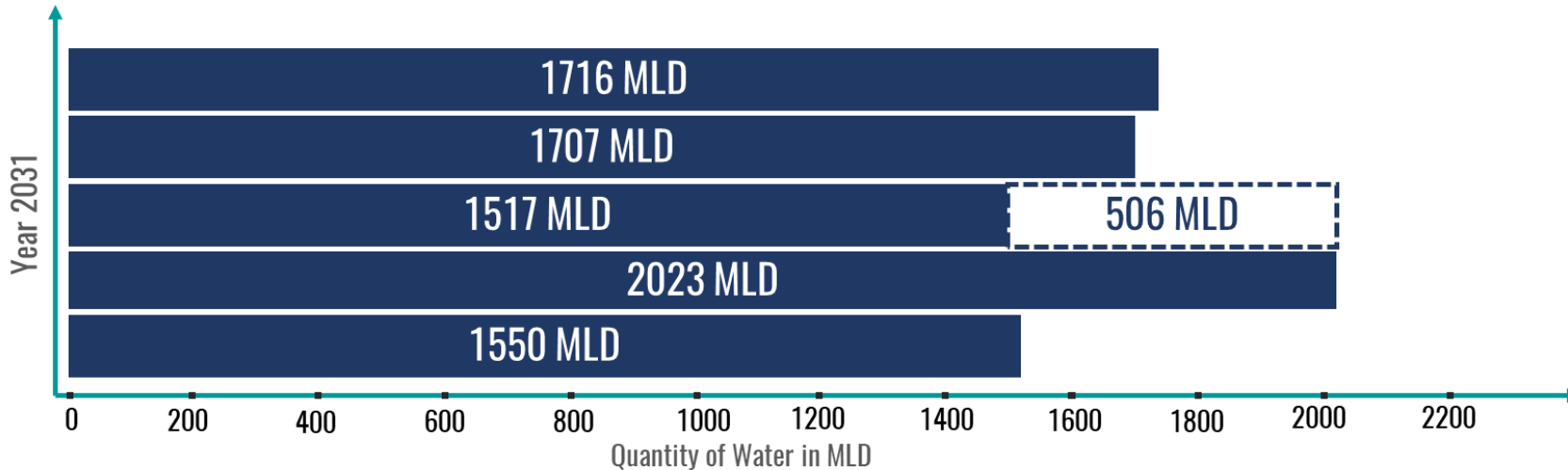
Reuse

Effective Supply

Supply

Demand

Post Interventions...



Recharge + Rain water harvesting

Reuse

Effective Supply

Supply

Demand

An aerial photograph of Ahmedabad, India, showing the city's layout and the Sabarmati River. The city is surrounded by a circular wall, and the river flows through the center. The text 'WATER SENSITIVE AHMEDABAD' is overlaid in large, bold, dark blue letters.

WATER SENSITIVE AHMEDABAD

**Thank
You**

Wastewater Management

Vaishvik
(PP0002216)

Pratik
(PP0002816)

Gargi
(PP0003216)

Prasenjit
(PP0007216)

Ravi
(PP0007616)

Rhea
(PP0007716)

INTRODUCTION : Urban Area

% of HH connected to Sewer System

% of HH having Septic Tanks

% of Open Defecation

Indian Scenario



32.7

38.2

7.5

7% urban HHs use **Pit latrines**

64% STPs are functional only with 37% treatment **capacity** only

Gujarat Scenario



60.4

24.5

0 (OD free)

100 out of 167 cities in the state do not have any **underground drainage system** and are dependent on technologies of OSS for **waste water disposal**.

Ahmedabad Scenario



86.0

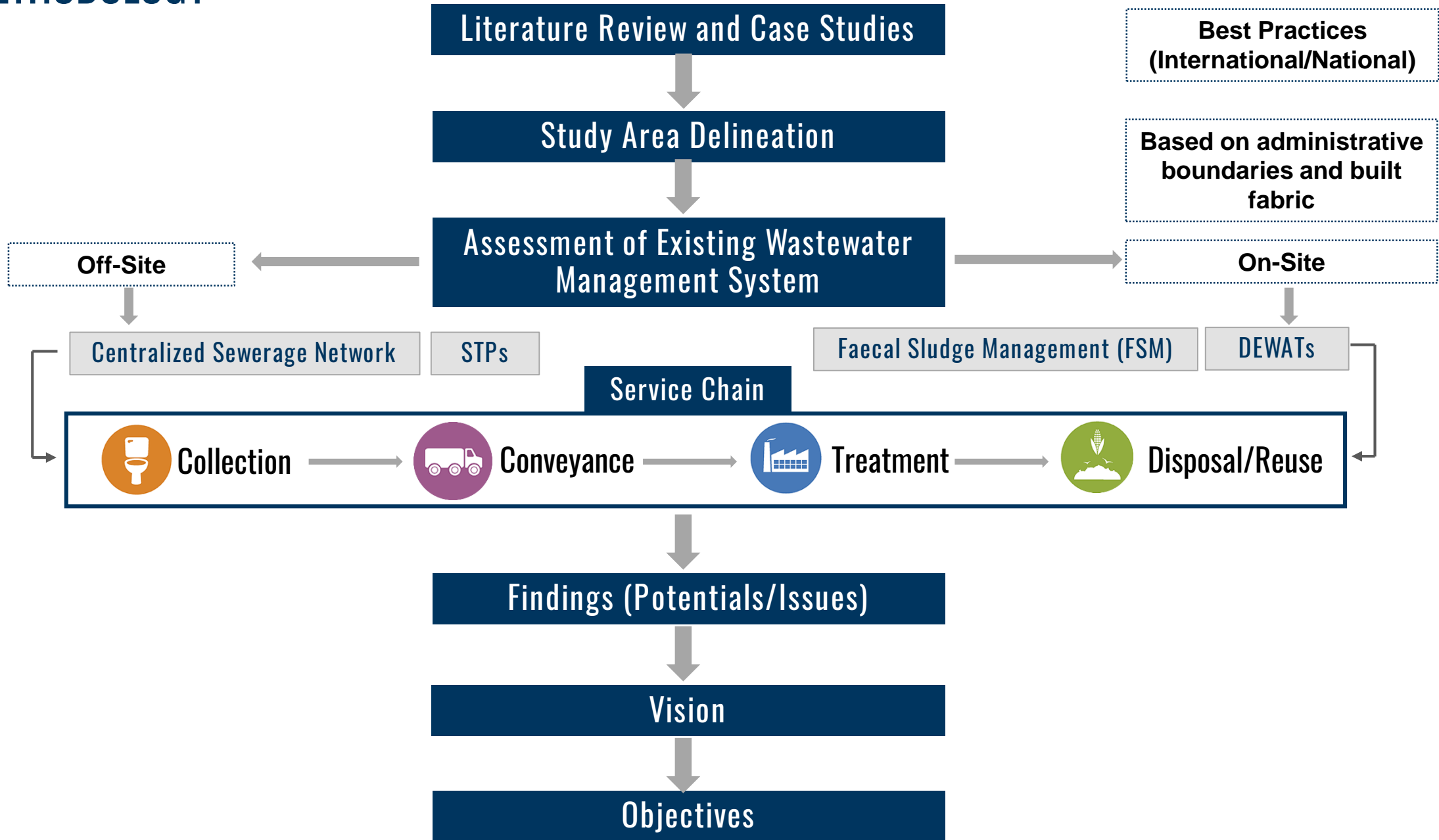
4.9

0 (OD free)

24750 (2%) HHs are without any outlets for toilets.

Toilet coverage reached 100% under SBM, but **treatment** still pose a **challenge**

METHODOLOGY



CONTENTS

OFF-SITE SANITATION

Centralized Sewerage Network in Ahmedabad City

Centralized Sewage Treatment Plants (STPs)

RE-USE of Treated Wastewater

ON-SITE SANITATION

Decentralized Wastewater Treatment (DEWATs)

Faecal Sludge Management

RE-USE of Treated Wastewater and Sludge

Conclusion

THEMES



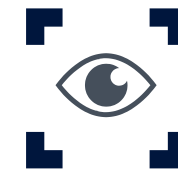
SEWERED



NON-SEWERED



REUSE



Vision

“Wastewater as a Resource”

SPATIAL GROWTH

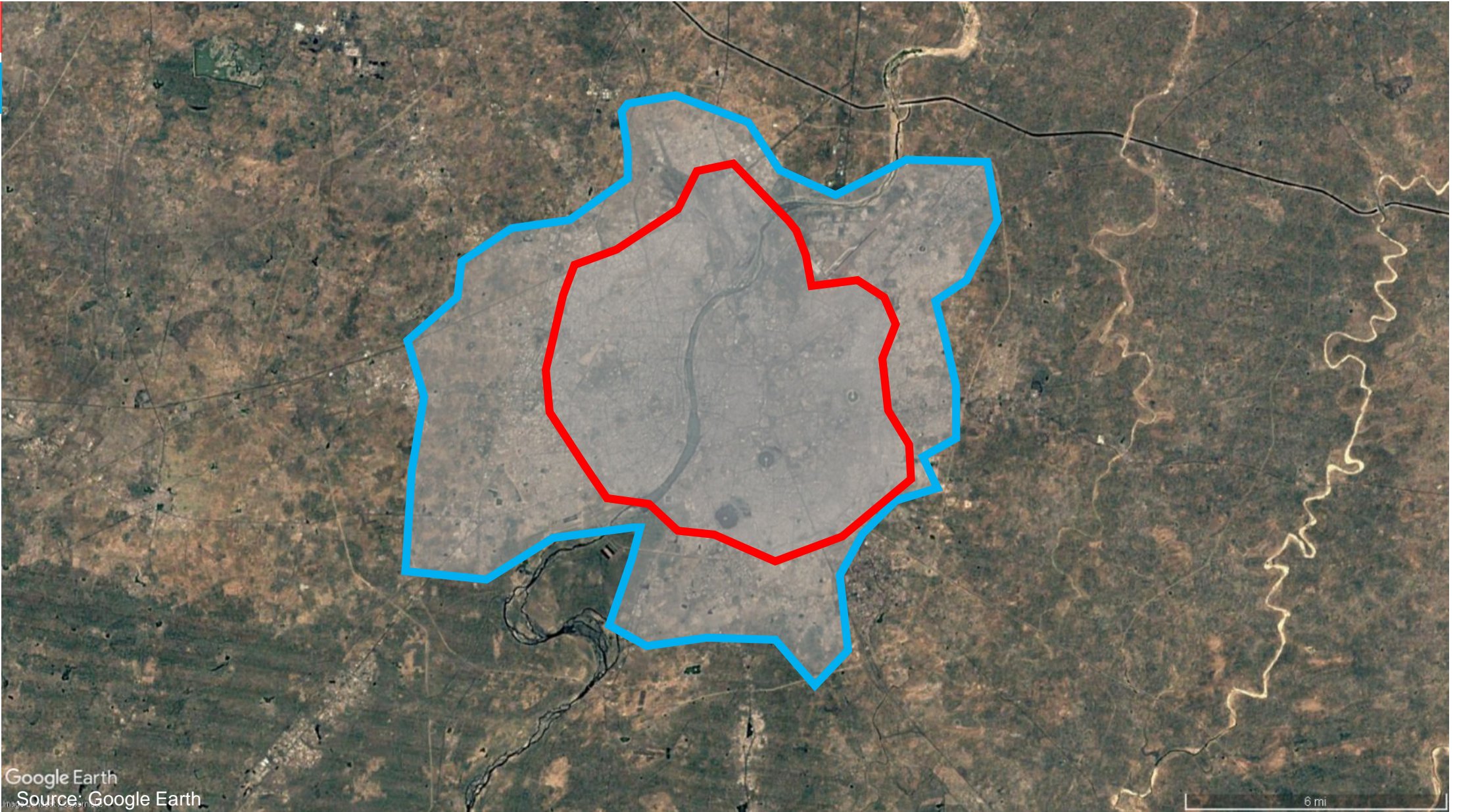
1995



SPATIAL GROWTH

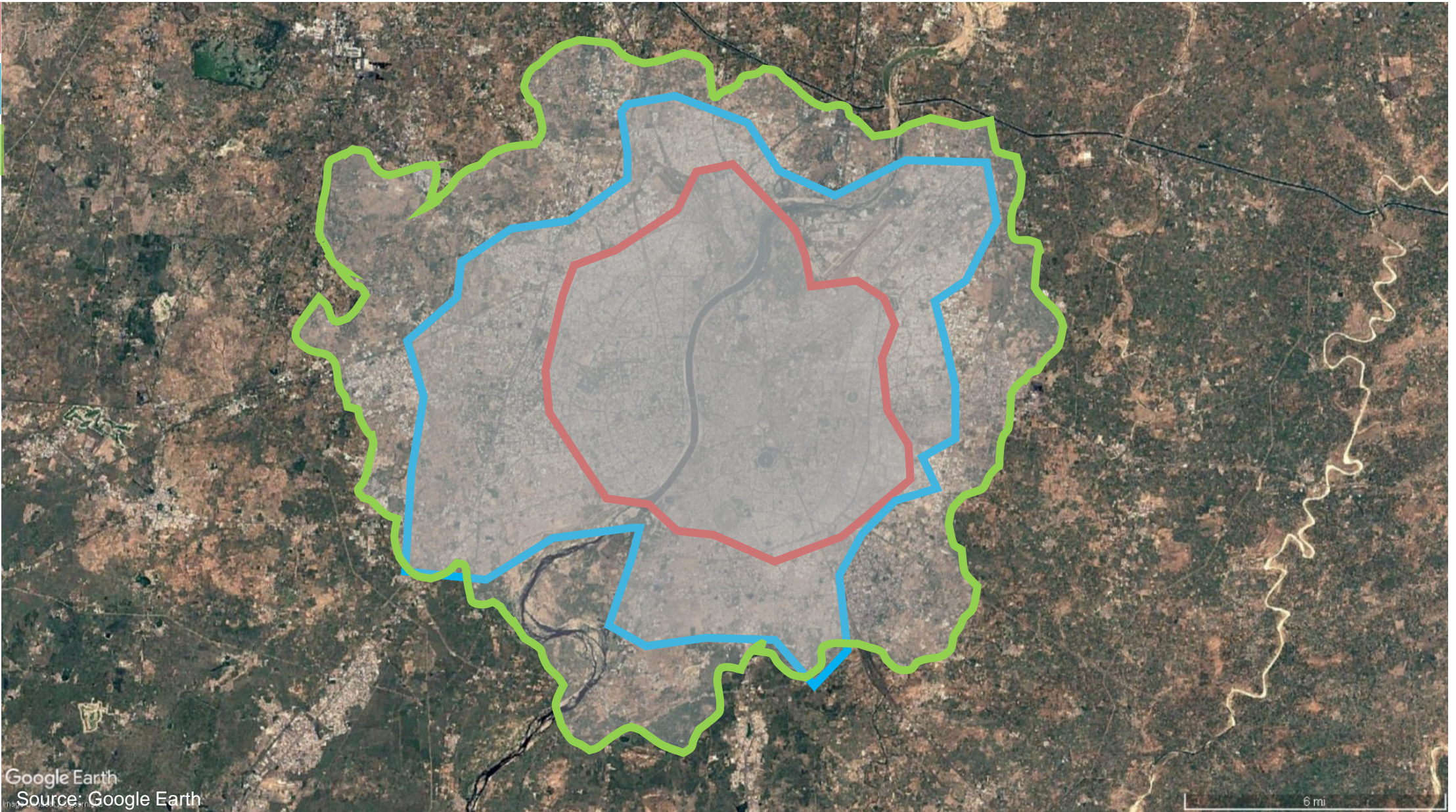
1995

2005



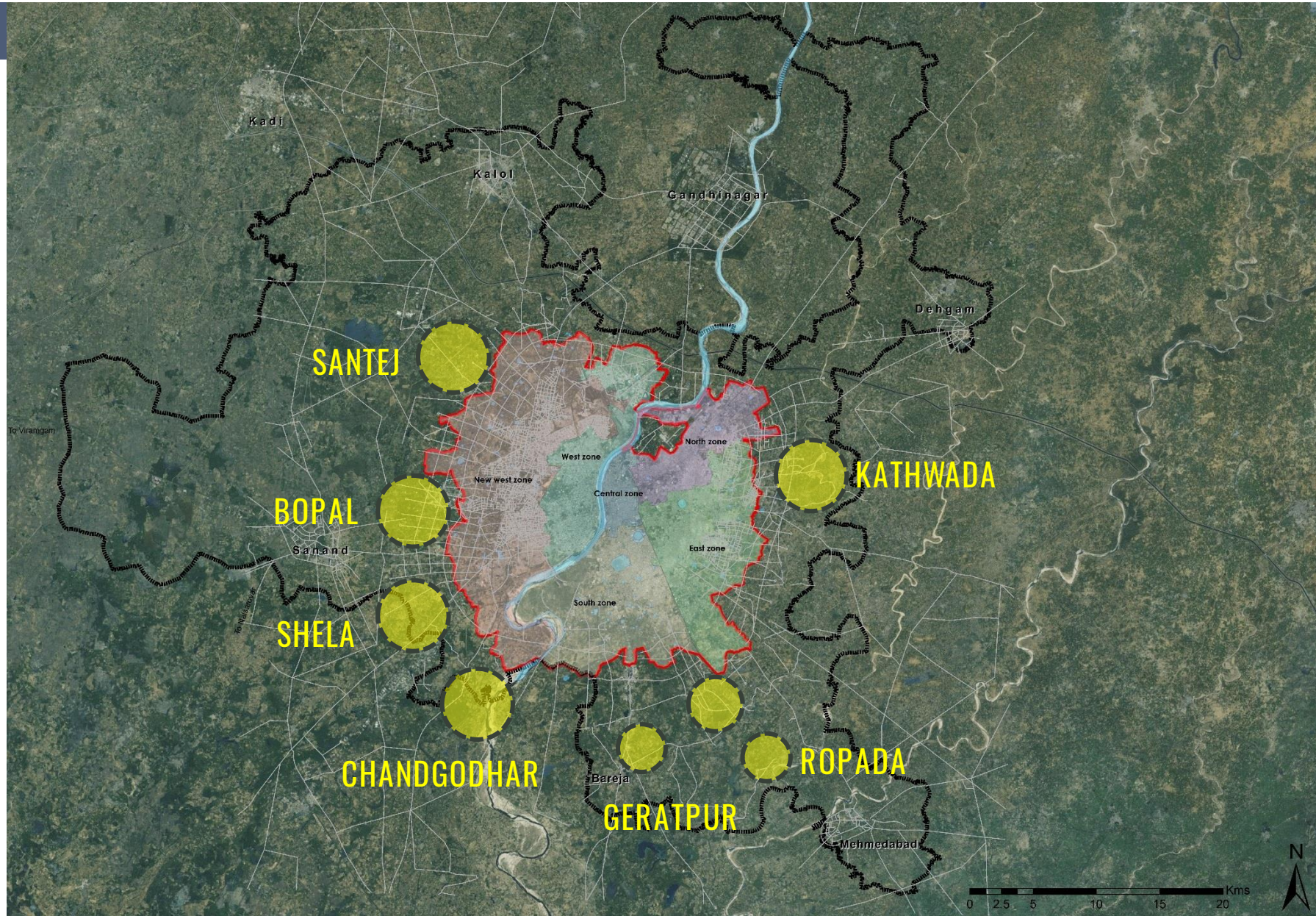
SPATIAL GROWTH

- 1995
- 2005
- 2017



STUDY AREA DELINEATION

2017






Spatial growth generally observed towards **Western direction.**

Study Area includes **AMC and PERIPHERAL areas**

Area: 446 sq. km.
Population: 68.04 Lakhs
Zones: 06
Wards: 48

POPULATION PROJECTION

2021		70	lacs
2031		87.5	lacs

-  AMC Boundary
-  AUDA Boundary
-  Peripheral areas

COVERAGE OF SEWAGE NETWORK

| 90% to 100%

ADEQUACY OF TREATMENT CAPACITY

| 97% to 100%

EFFICIENCY OF COLLECTION OF SEWAGE

| 97% to 100%

COST RECOVERY – O&M IN WW MANAGEMENT

| 50% to 100%

REUSE AND RECYCLING OF SEWAGE

| 0% to 20%

INSTITUTIONAL FRAMEWORK



Ahmedabad Municipal Corporation (AMC): Departments



Health

- **Health Department**
- Birth & Death Registration
- Malaria Cell
- Epidemic Control Cell
- Immunization
- Yellow Fever
- National Health Mission
- Revised National TB Control Programme
- Status of H1N1 (Swine Flu)
- Swachh Bharat Mission Scheme

Road & Transportation

- Engineer Bridge Project
- Engineer Road Project
- Light Department
- Traffic
- Bus Rapid Transit System

Environmental Services

- Central Laboratory
- Solid Waste Management
- Water Operation (Electrical & Mechanical)
- Water Project Department
- **Drainage**

Urban Poor & Housing

- Urban Community Development
- Housing & Slum Networking Project

Support

- **E-Governance**
- Municipal Secretary
- Election
- Municipal Chief Audit Department
- Central Workshop

Town Planning

- Building Permission Fee Calculator
- Town Development Department
- Building Permission
- List of available TDR(Transferable Development Rights) holders
- Restoration of Heritage Building and Heritage T.D.R.
- Building Height more than 45 Mtr.
- Notified Heritage Buildings (Walled City)

Finance

- Professional Tax
- Shops & Establishment
- Vehicle Tax
- **Assessment and Tax Collection Department (Property Tax)**

Other Services

- Cattle Nuisance Control Department
- Heritage Department
- Garden Department
- Fire Department

Source: AMC, 2017

INSTITUTIONAL FRAMEWORK



Ahmedabad Municipal Corporation (AMC): Departments



Health

• Health Department

Functions:

- Provision of new sewer connection
- Plays an important role at **zonal level** in **cleaning** and **maintaining** of **Septic tanks** and khalkuva

Environmental Services

- Central Laboratory
- Solid Waste Management
- Water Operation (Electrical & Mechanical)
- Water Project Department
- **Drainage**

Functions:

- **Setting up** and **maintaining** new STPs, SPS, Storm water pumping stations
- **Laying** drainage / storm water drainage **networks** in AMC area.
- **Cleaning** of main storm water and drainage trunk lines and rehabilitation (strengthening) of old sewage lines

Support

• E-Governance

Functions:

- Communication (**G2C, G2G, G2B**)
- **JnNURM DPR Implementation**
- **CCRS (Comprehensive Complaint Redressal System)**
- **GIS**
- Managing 54 **Civic Centres**
- **CCTV** Surveillance
- **E-Tendering**

Finance

- Professional Tax
- Shops & Establishment
- Vehicle Tax
- **Assessment and Tax Collection Department (Property Tax)**

Functions:

Tax collection and assessment

Source: AMC, 2017

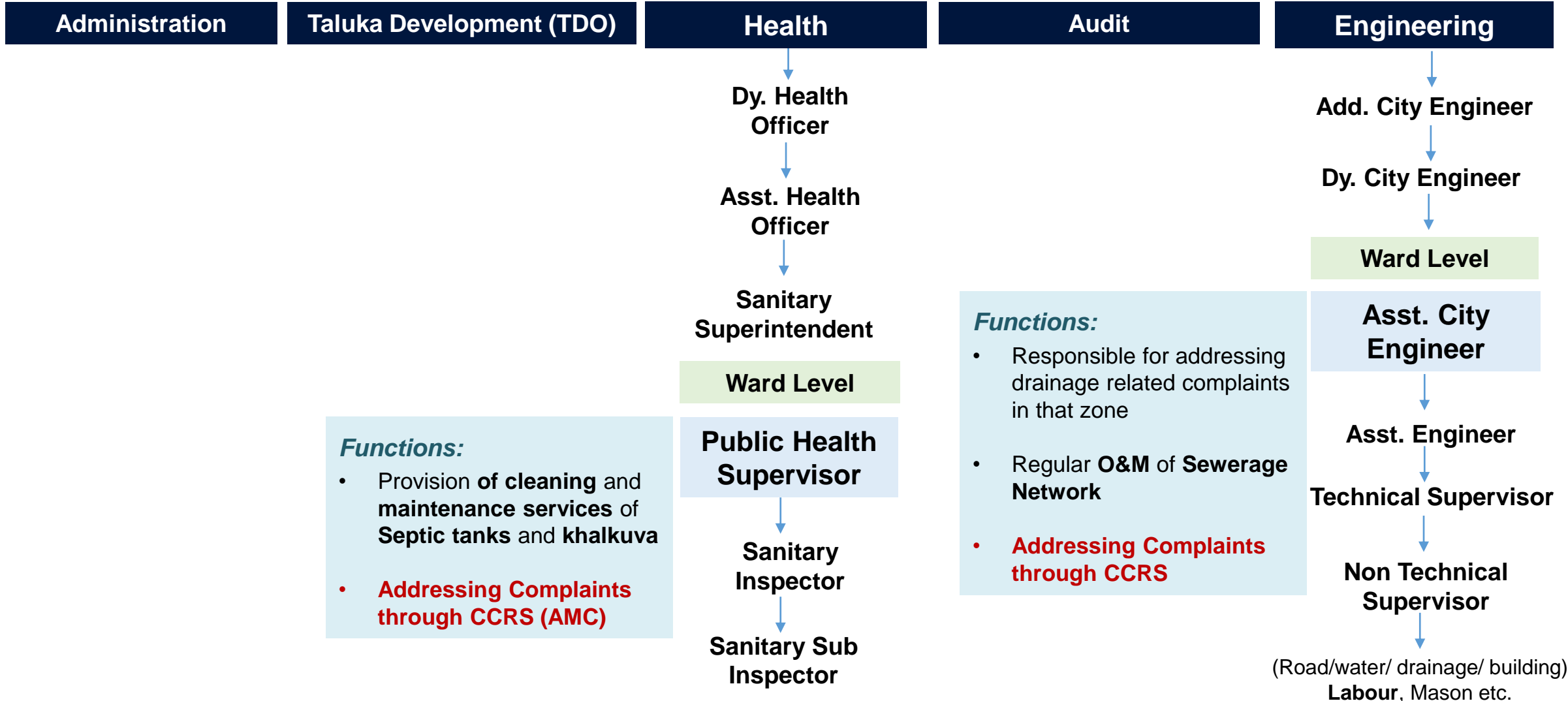
INSTITUTIONAL FRAMEWORK

AHMEDABAD MUNICIPAL CORPORATION Zonal Level: Departments and Organization Structure

AMC

ZONAL

WARD



Source: AMC, 2017

INSTITUTIONAL FRAMEWORK

Peripheral Areas



AUDA

Ahmedabad Urban Development Authority

AUDA

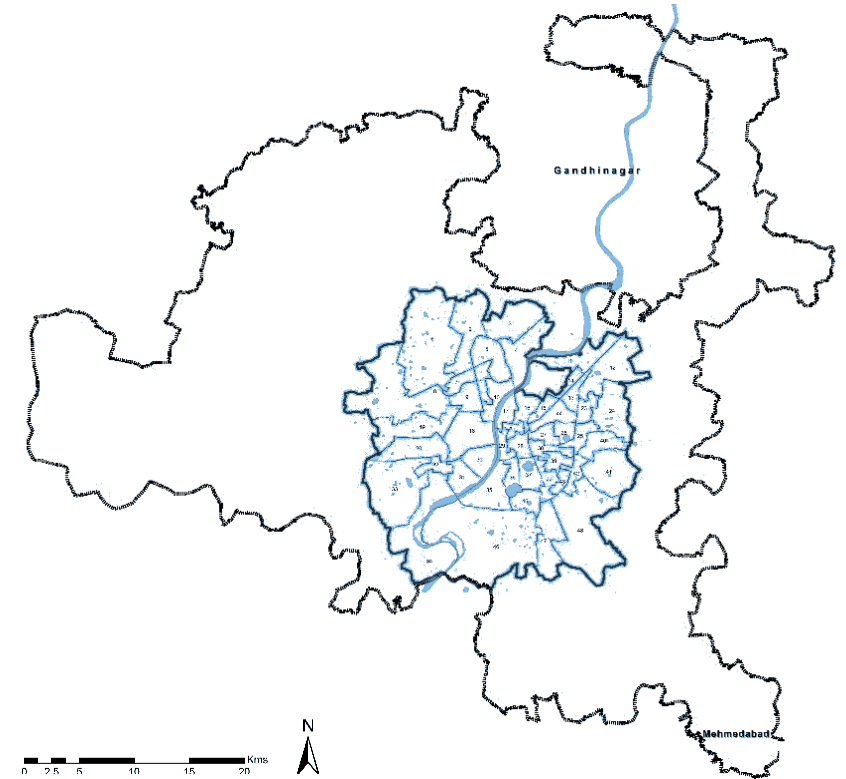
Functions:

- Preparation of **TP Scheme**
- Planning of **trunk sewer network**
- Providing **Capex** for installation of STPs, SPS and network

Gram Panchayats (GP)

Functions:

- Regular **O&M** of **Sewerage Network** and **Septic tanks**
- Addressing **complaints** received
- Collection of **Property taxes** and user fee

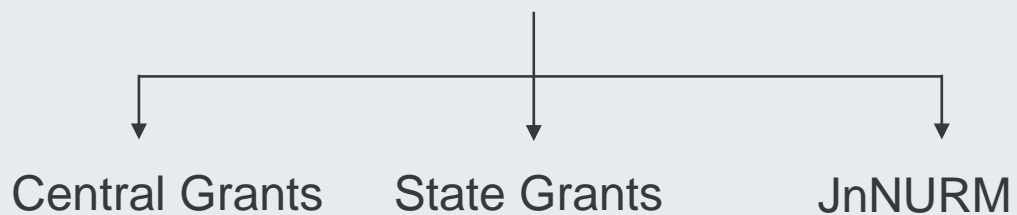


Issue lies in areas where TP Schemes are **not prepared** but settlements are present.

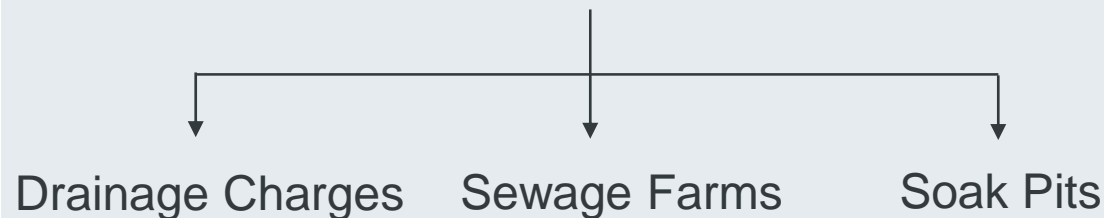
- Pressure on **OSS increases** which needs **regular O&M** by GPs.
- **Improper disposal** of wastewater and sludge in natural drains due to **lack of treatment**

Coordination between different agencies becomes a **challenge**.

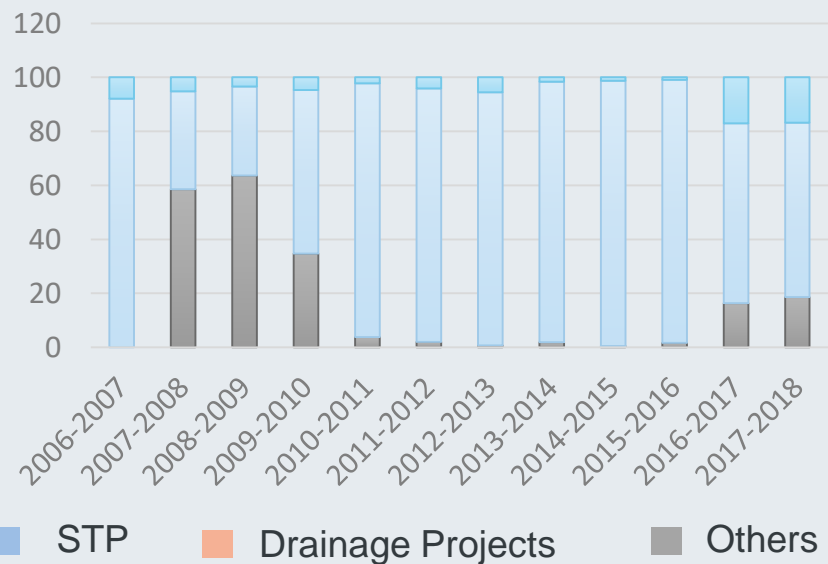
Capital Income



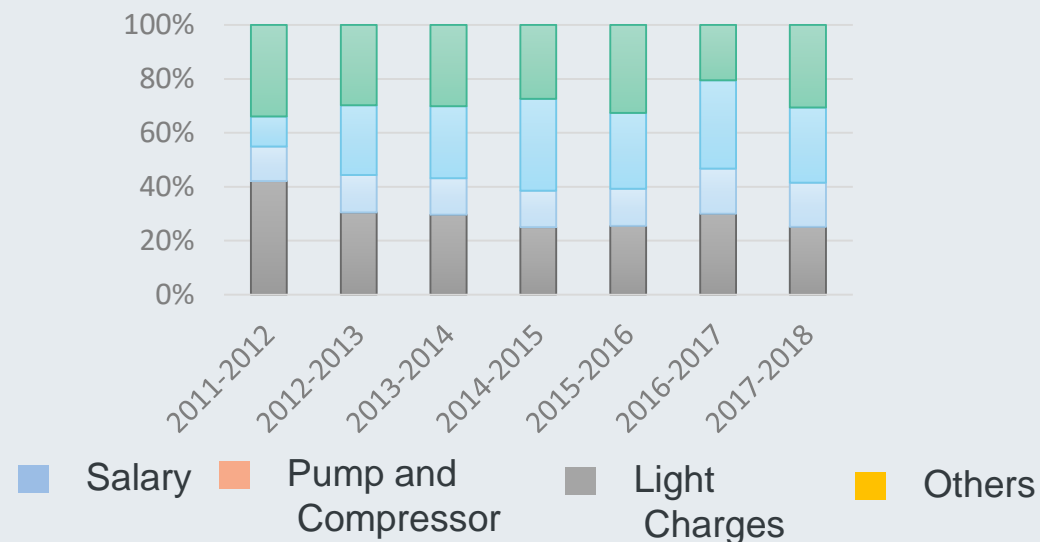
Revenue Income



Capital Expenditure



Revenue Expenditure



Source: AMC Budget

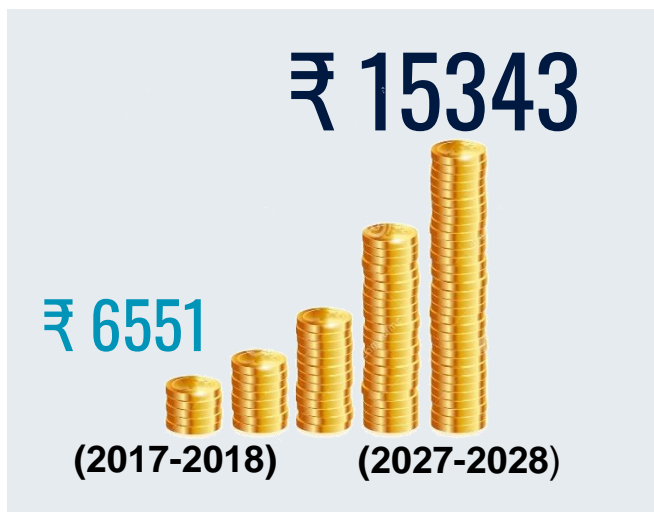
Financial Projections



Suitable assumptions were made to arrive at Financial Projections under all 4 heads

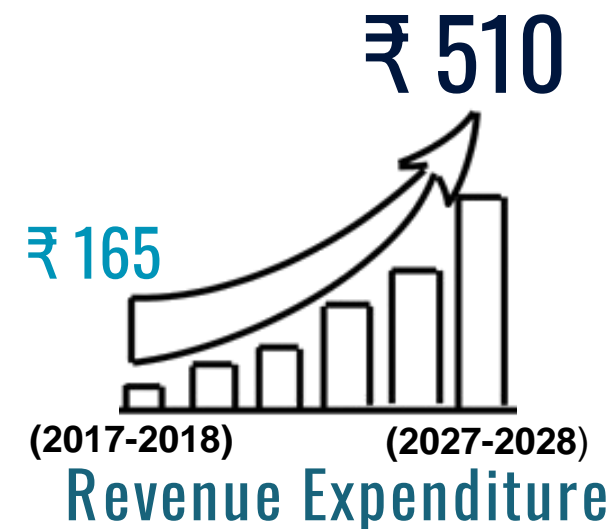
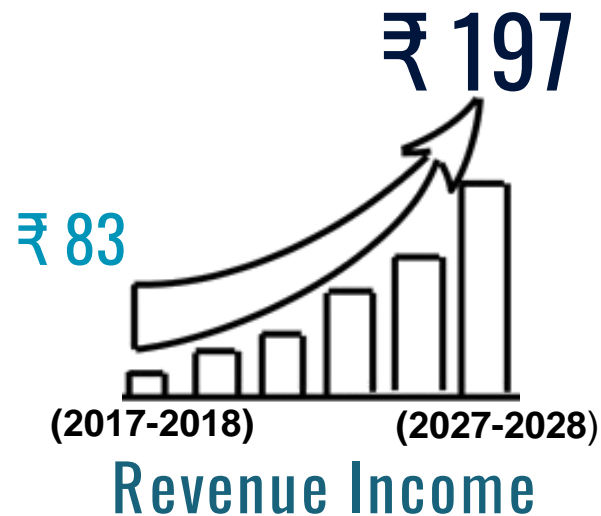
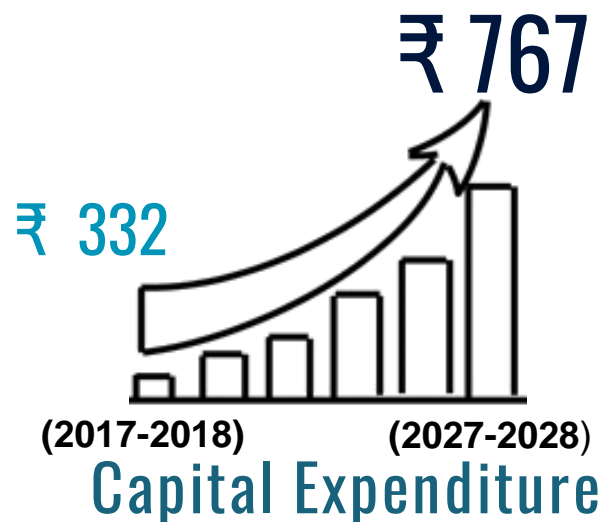


Total City Budget



Financial Projections were made for future 10 years (2017-2018 to 2027-2028)

Wastewater Sector Budget



Source: AMC Budget

All numbers are in INR Crores

Centralised Sewerage Network

Existing Sewerage Network



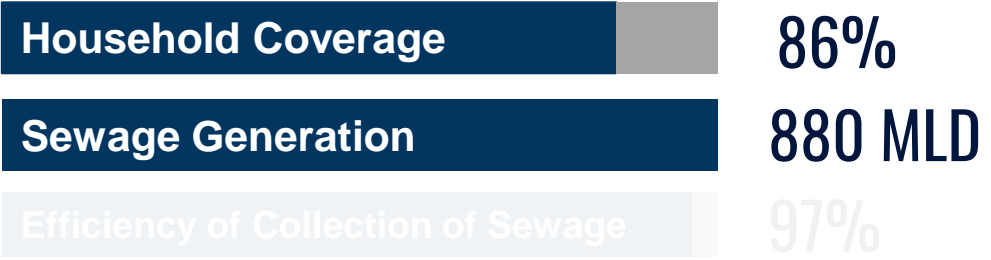
Collection



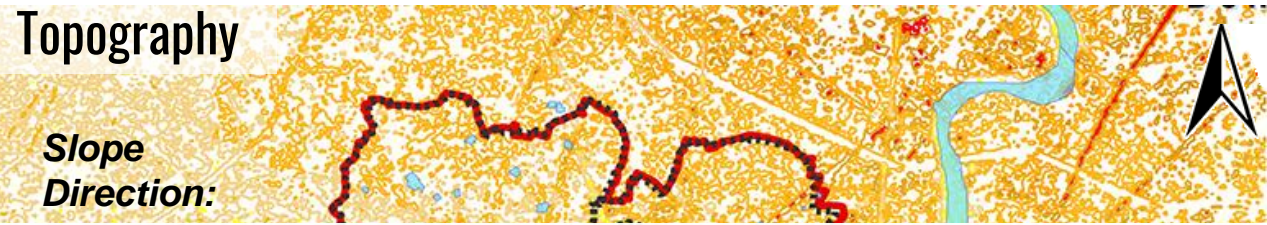
51 Pumping Station



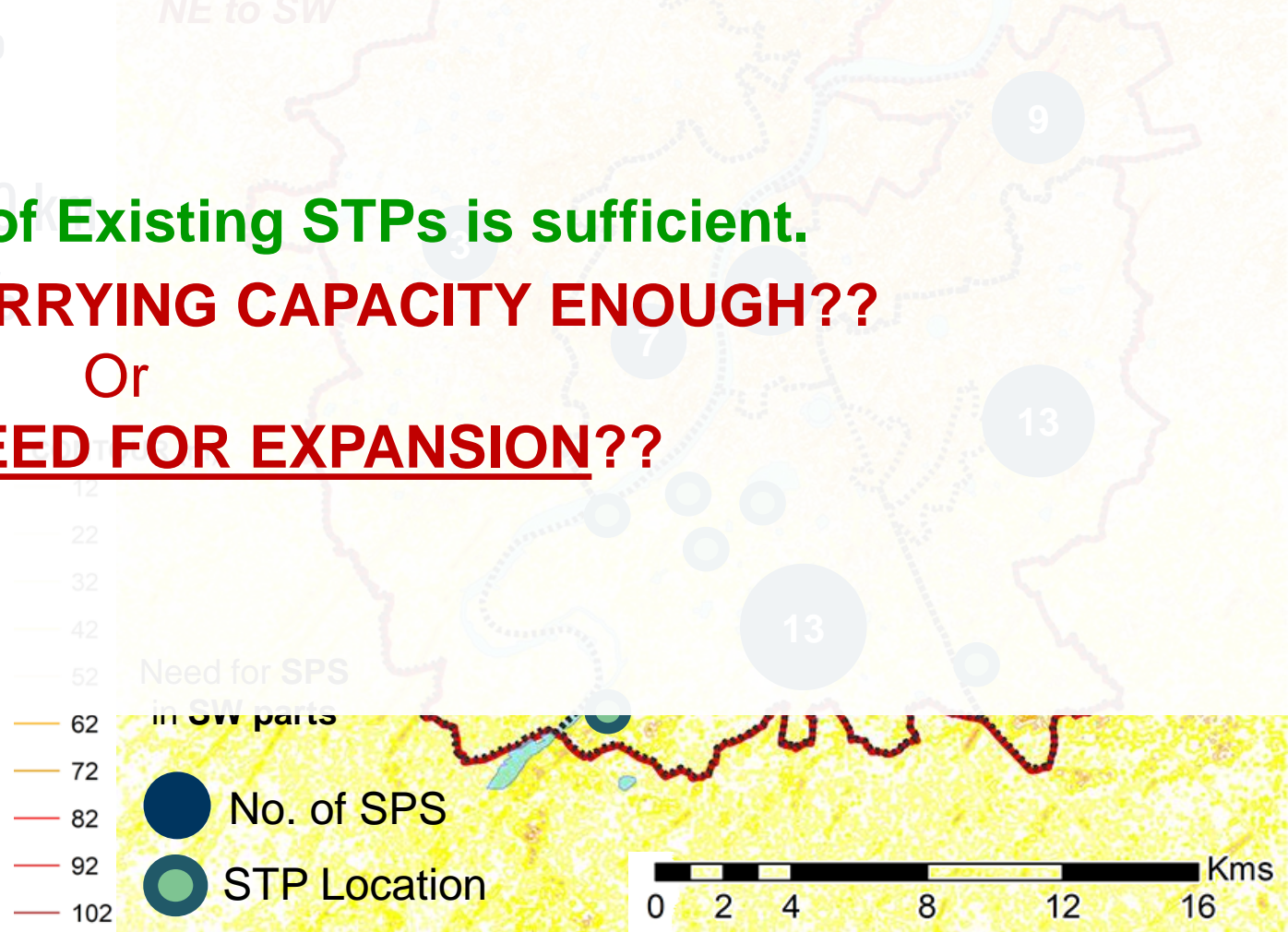
7 STP



Sufficient capacity of existing STPs



Treatment Capacity of Existing STPs is sufficient.
 But, is the **NETWORK CARRYING CAPACITY ENOUGH??**
 Or
IS THERE A NEED FOR EXPANSION??

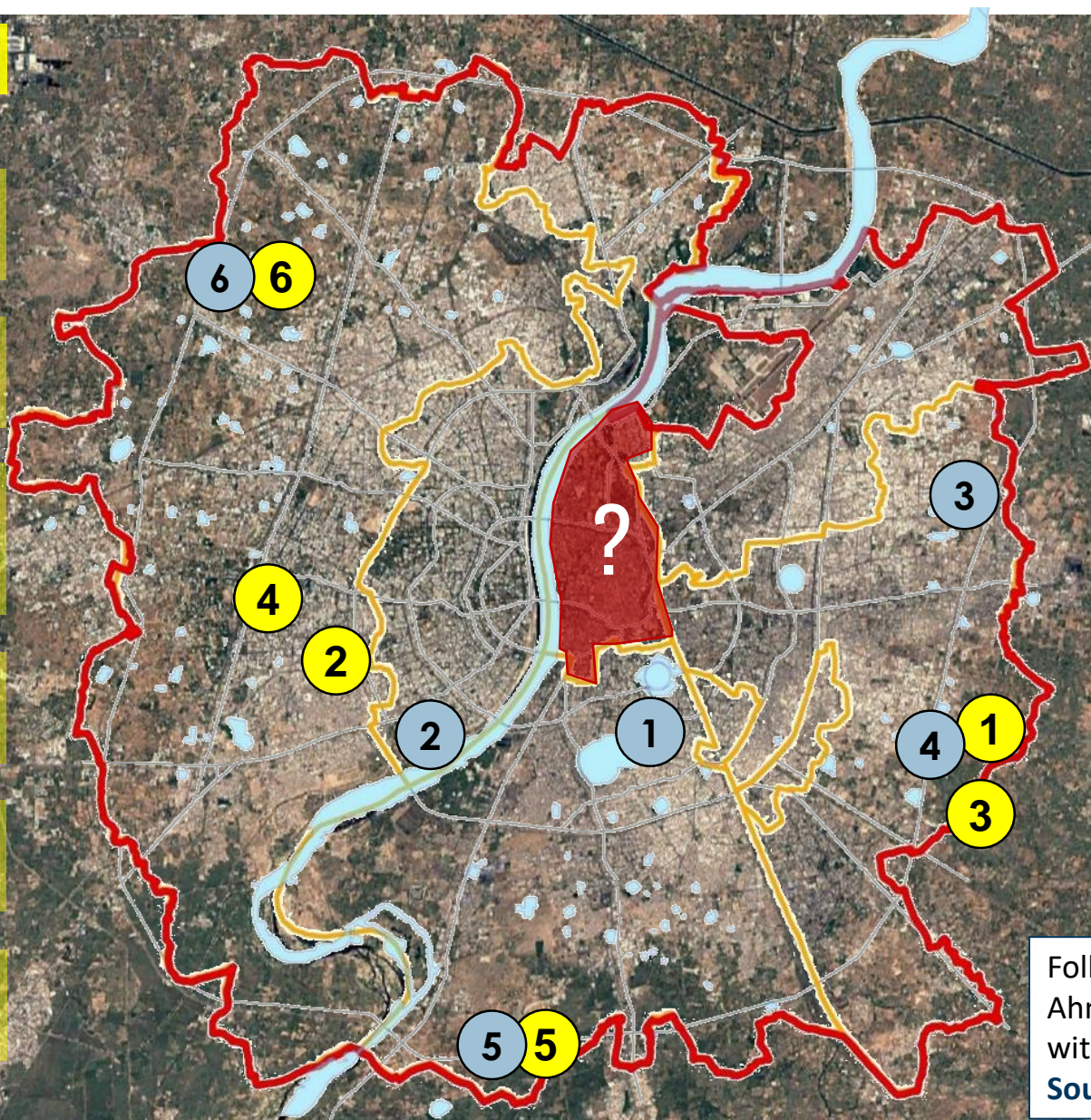


Source: Sewerage SLIP, AMRUT, 2017

Government's call on Expansion of Sewerage Network (Proposed Projects)

Proposed Networks

1. 8.3 km Trunk line from Odhav to Vinzol. (AMRUT)
2. Network in TP 98 and part of Nobalnagar. (SJMMMSVY)
3. 2 km Sewerage pipeline (bypass) from Panjarapol to Ramol tollplaza. (SJMMMSVY)
4. 1.5 km Sewerage network in Vejalpur Area. (SJMMMSVY)
5. 21 km Sewerage Network Lambha. (SJMMMSVY)
6. 15 km of Sewerage Network at Sola. (SJMMMSVY)



Proposed SPS

1. Maninagar (NRCP)
2. Vasna (NRCP)
3. New Nikol (NRCP)
4. Vastral (NRCP)
5. SPS at Lambha (SJMMMSVY)
6. Pumping Station at Sola. (SJMMMSVY)

Following the recent spatial growth trend of Ahmedabad, expansion of network (along with new SPS) proposed in **Western and Southern parts**

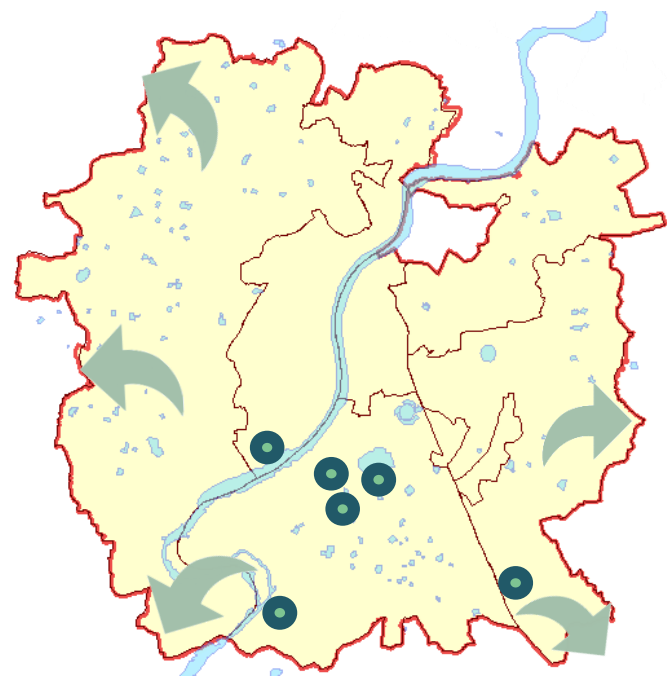
Image Source: Google Earth

Source: Sewerage SLIP, AMRUT, Swachhta Report-2017

Two Possible Scenarios upon Sewerage Network Expansion

Scenario 1

Expansion of Sewer Network as per Government's Proposals



Total
83.3 Crores

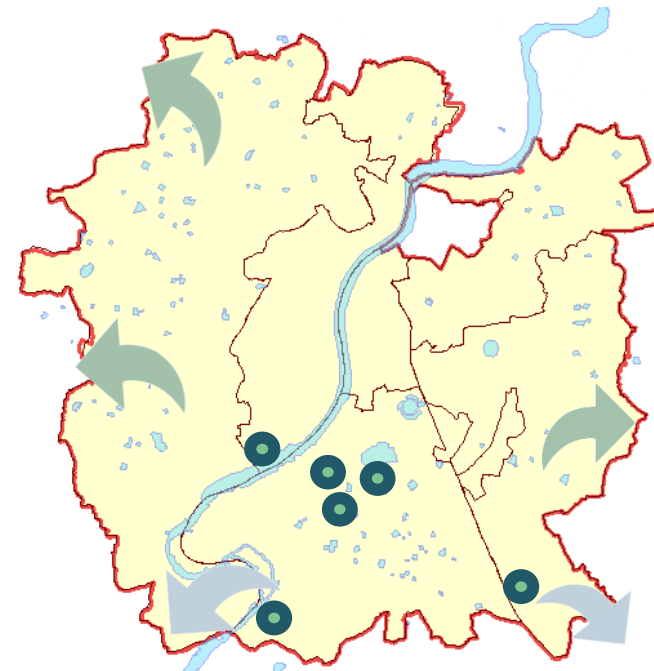
Total Length
47.8 km

● STP Location
➔ Expansion of Sewer Network

0 1.25 2.5 5 7.5 10 Kms

Scenario 2

Limited Expansion (Combined Off-Site and OSS Systems for the City)



12% CAPEX
Reduction

21 km Reduced

● STP Location
➔ Expansion of Sewer Network
➔ Development of OSS Facility

0 1.25 2.5 5 7.5 10 Kms

Following recent spatial growth trend: Expansion of network along Western, Southern and Eastern parts

- **High Capital Costs** (laying new Sewer Network and SPS)
- **Additional O&M Costs** (difficult to pump from low lying areas)
- **Time consuming process**
- **Temporary disturbance to built environment**

Expansion of network along Western and Eastern parts only. Developing OSS facility in Southern low lying areas

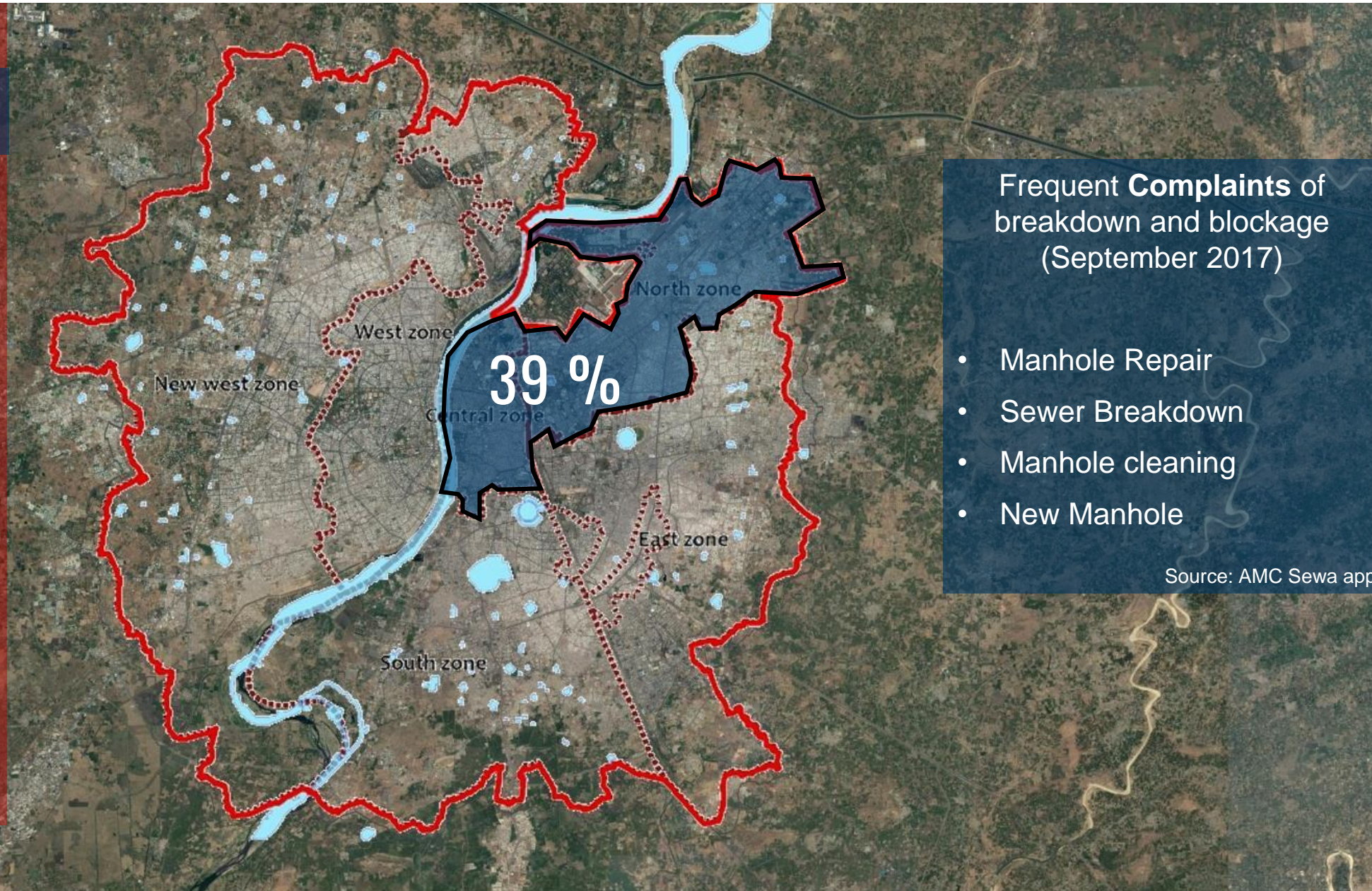
- **Cost and time efficient**
- **Less disturbance to built environment**

Hence, Scenario 2 preferred over Scenario 1 due to its financial, environmental benefits.

Existing Issues in Centralised Sewer Network

CENTRAL ZONE

- Frequent **Complaints** of breakdown and blockage
- **Old city**: drainage lines were laid in **1921**.
- Highest Density : **415 PPH**
- **Increasing cases of water borne diseases (Jaundice, Typhoid)**.
- **No interventions** proposed by government



Frequent **Complaints** of breakdown and blockage (September 2017)

- Manhole Repair
- Sewer Breakdown
- Manhole cleaning
- New Manhole

Source: AMC Sewa app

Image Source: Google Earth

Existing Issues in Centralised Sewer Network

CENTRAL ZONE

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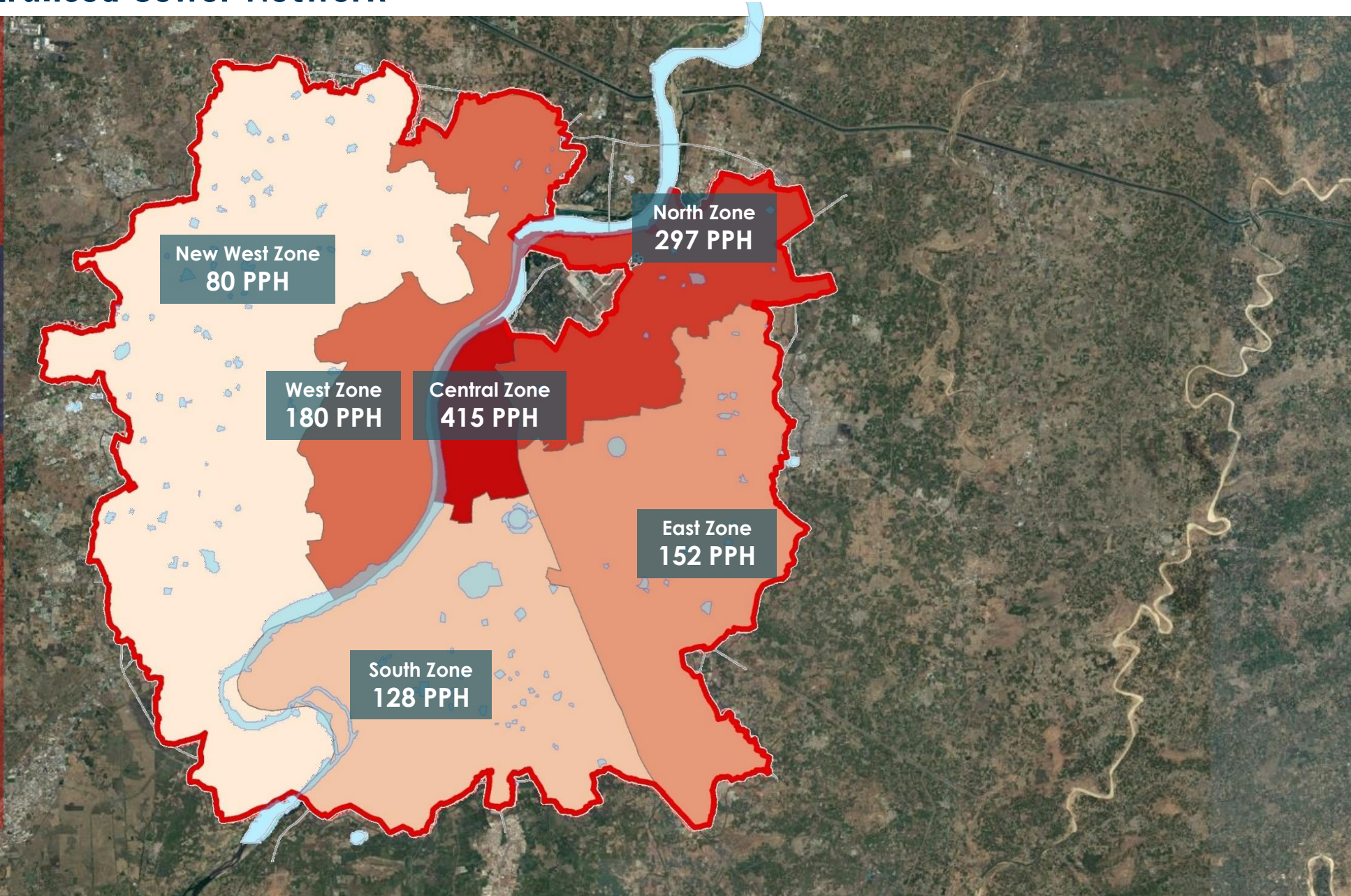


Image Source: Google Earth |

Existing Issues in Centralised Sewer Network

CENTRAL ZONE

- Frequent Complains about breakdown and blockage
- **Old city:** drainage lines were laid in 1921.
- Highest Density : 415 PPH
- Increasing cases of **water borne diseases (Jaundice, Typhoid).**
- **No interventions** proposed by government



Water borne diseases

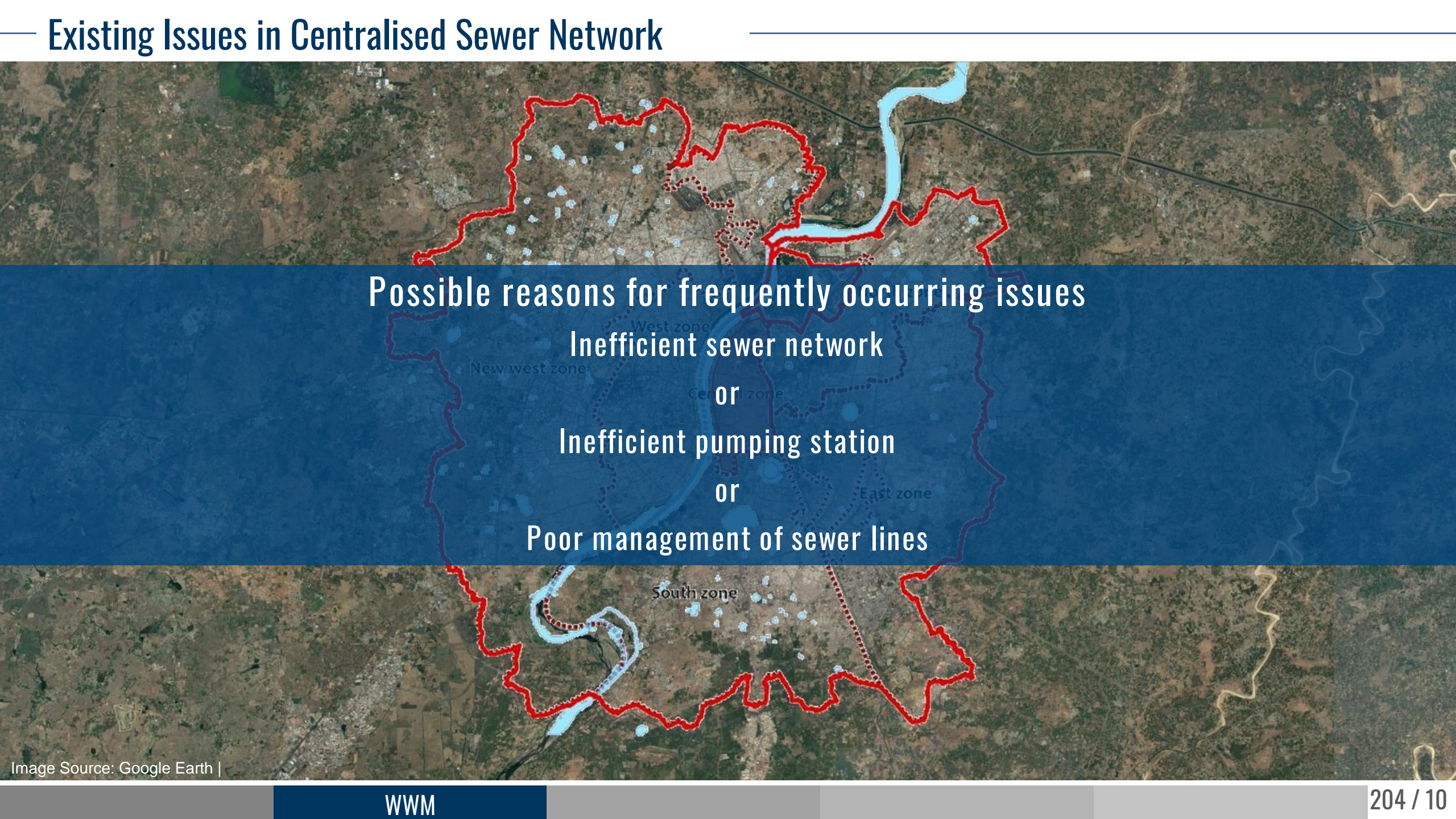
Year	Cases
2000	1700
2002	500
2008	800
2011	1000

Jaundice Case: CZ

2001-02	2011-12	Death 2011-12
277	716	5

Source: Impact of improper sewerage system and its management in urban areas. Anusha Pallapu

Existing Issues in Centralised Sewer Network

An aerial photograph of a region with a centralised sewer network. A large, irregular blue area is overlaid on the map, representing the sewer network's catchment area. This area is divided into several zones: 'West zone', 'New west zone', 'Central zone', 'East zone', and 'South zone'. A red outline follows the perimeter of the blue area. A river or stream flows through the central part of the network. The text 'Possible reasons for frequently occurring issues' is centered over the blue area, followed by three options: 'Inefficient sewer network', 'Inefficient pumping station', and 'Poor management of sewer lines', each separated by the word 'or'.

Possible reasons for frequently occurring issues

Inefficient sewer network
or
Inefficient pumping station
or
Poor management of sewer lines

INTERVENTION & OBJECTIVE

Intervention 1: Identifying need for retrofitting existing Sewer lines in Central Zone

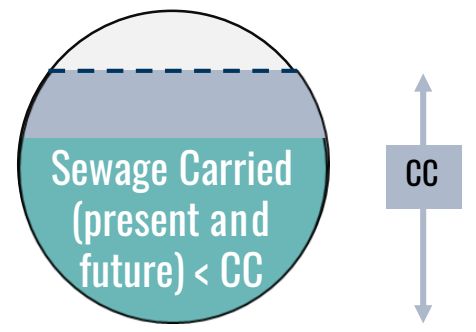
A Sewage carried presently (2017) – 880 MLD Sewage to be carried in design year (2031) – 1180 MLD

↕ Current GAP ? ↕ Future GAP ?

B Identify carrying capacity (CC) and flow velocity of sewer lines (Flow assessment)

Scenario 1

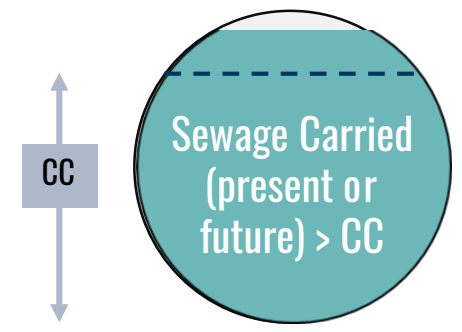
If $(B-A) = +ve$



Sufficient for present and future demand

Scenario 2

If $(B-A) = -ve$



Identify technology, cost estimate and phasing

Need for retrofitting existing lines



OBJECTIVE: To strengthen the efficiency of existing centralized WW conveyance system (Network and SPS)

INTERVENTION 1: Retrofitting Sewer lines in Central Zone

Central Zone

Area 16.6 Sq. Km

Population (2017) 6.9 Lakhs

HHs covered by Sewer Network 86 %

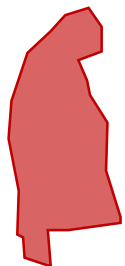
74.48 MLD 89 MLD

Sewage Generated (2017)

Estimated Sewage Generated (2031)

● SPS with SCADA System (Trunk line diameter)

Shahibaug	750 mm
Old Girdharnagar	450 mm
New Girdharnagar	500 mm
Dariyapur	1400 mm
Jamalpur	1800 mm



Density 415 PPH

- Water Bodies
- Zone Boundary
- Roads
- Trunk Lines

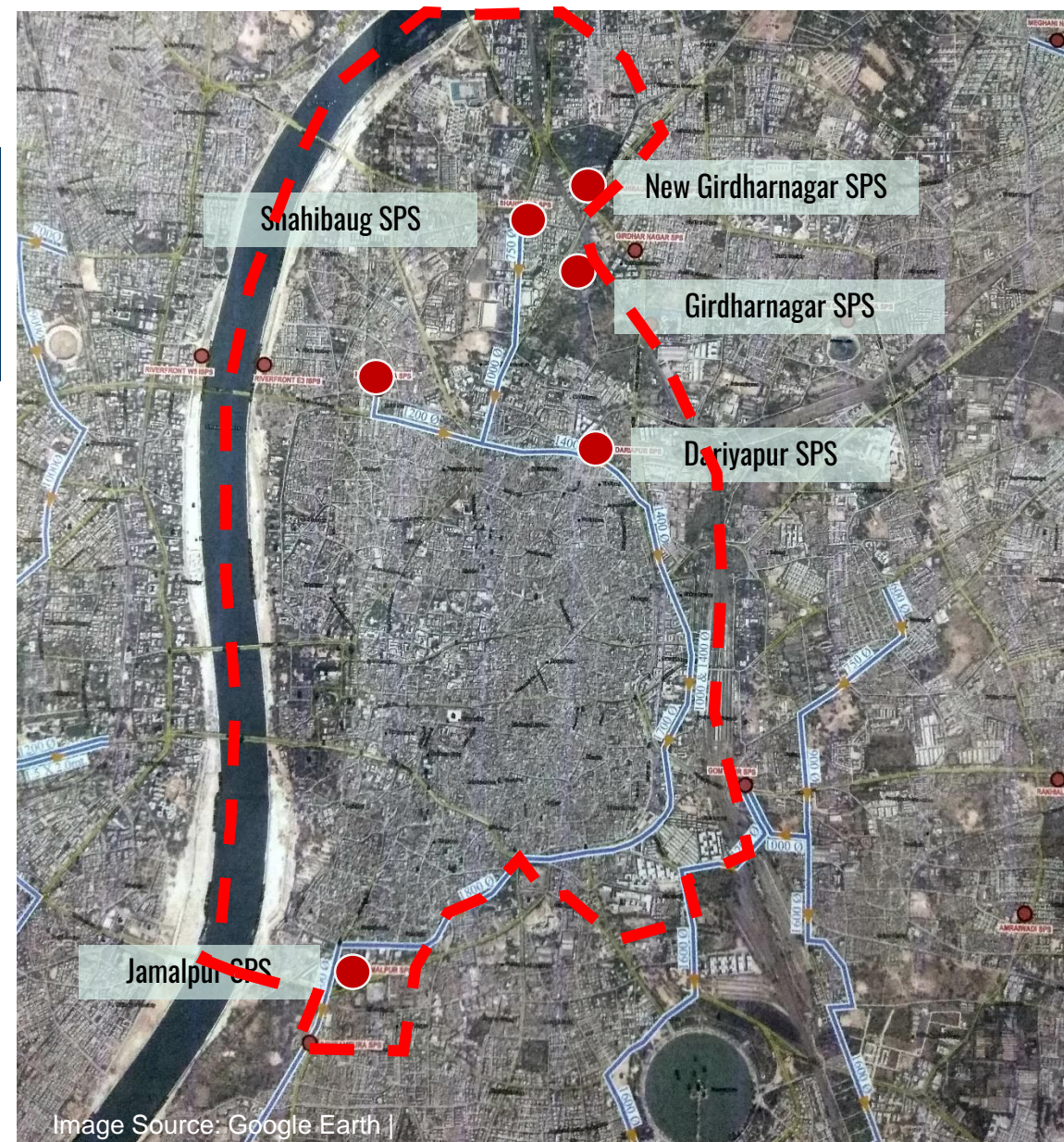


Image Source: Google Earth |

INTERVENTION 1: Retrofitting Sewer lines in Central Zone

Central Zone

● SPS

	Diameter (mm)	Existing flow rate (m ³ /hr)	Desired flow rate (m ³ /hr)*	Efficiency (%)
Shahibaug	750	266	1145-1908	32
Old Girdharnagar	450	128	412-687	31
New Girdharnagar	500	290	509-848	57
Dariyapur	1400	719	3988-6477	18
Jamalpur	1800	1576	6592-10987	24

* For desired flow rate, velocity ranges between 0.9-1.5 m/s

Total Length of trunk line: 6.2 km

Existing flow rate of WW is much lower than the desired flow rate.

Sufficient Design CC of sewer lines

-  Water Bodies
-  Zone Boundary
-  Roads
-  Trunk Lines

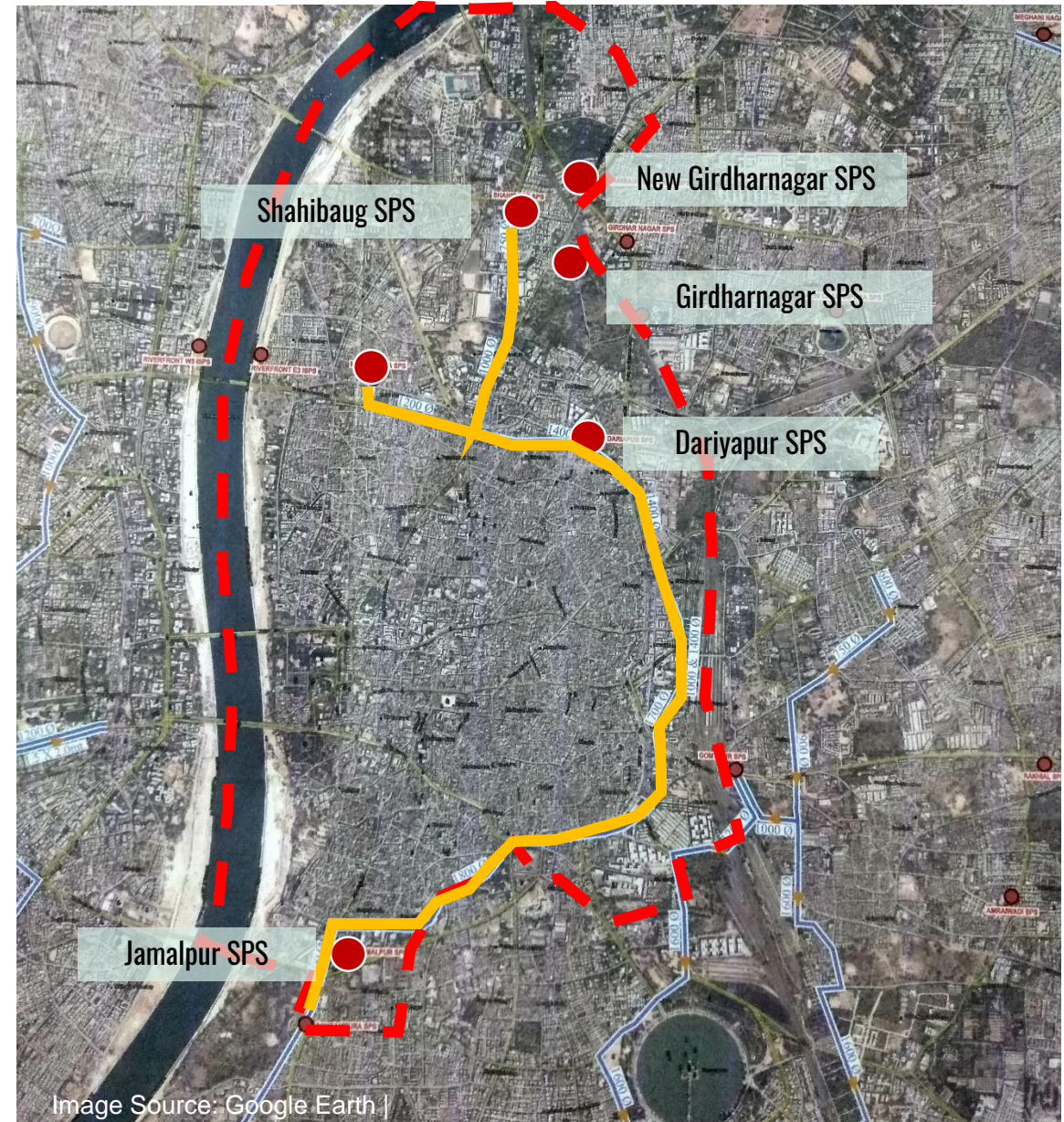


Image Source: Google Earth |

INTERVENTION 1: Retrofitting Sewer lines in Central Zone

Central Zone

● SPS

	Diameter (mm)	Existing velocity (m/s)	Scouring velocity (m/s)	Efficiency (%)
Shahibaug	750	0.29	0.9	32
Old Girdharnagar	450	0.28	0.9	31
New Girdharnagar	500	0.51	0.9	57
Dariyapur	1400	0.16	0.9	18
Jamalpur	1800	0.22	0.9	24

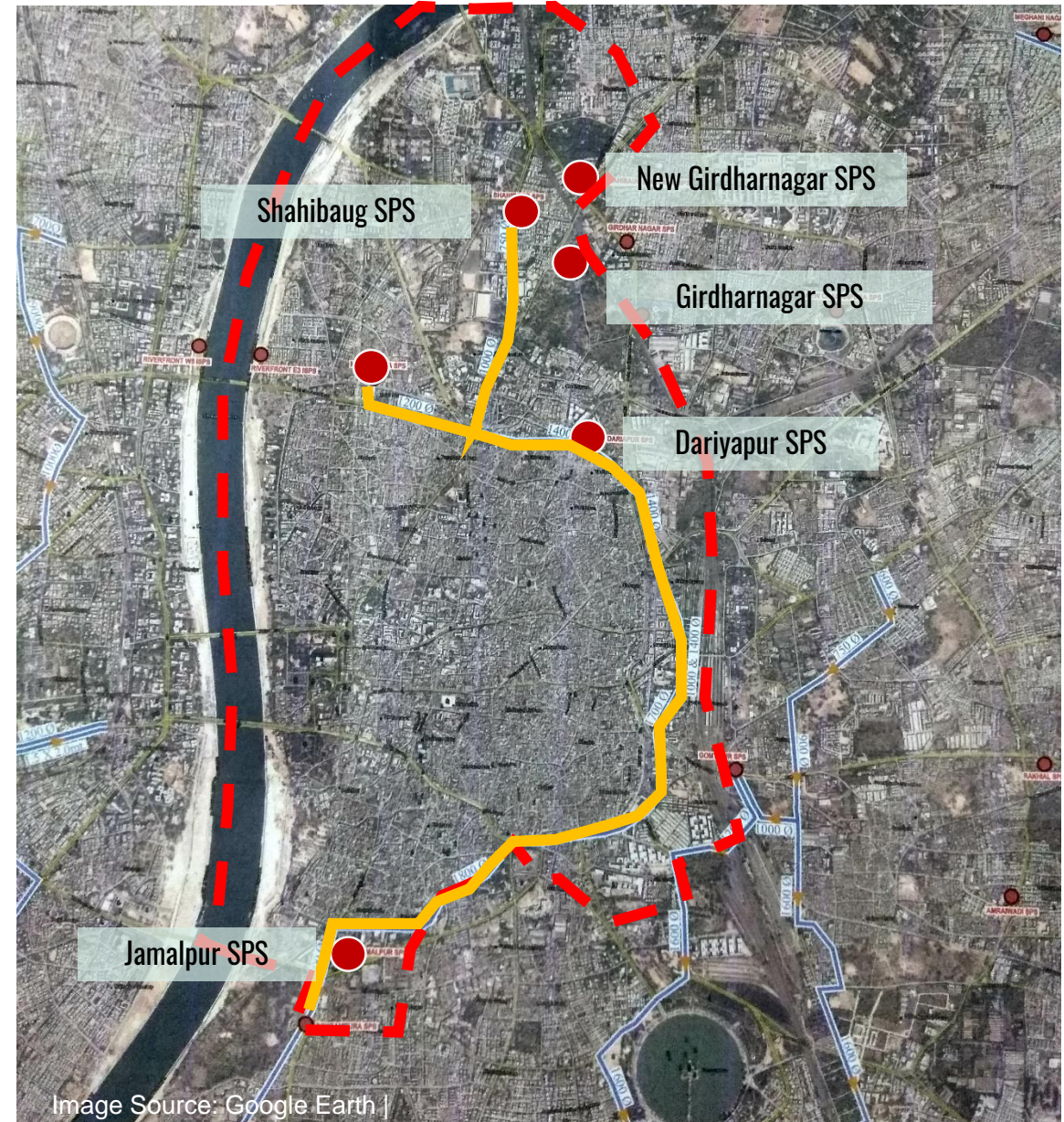
* For desired flow rate velocity ranges between 0.9-1.5 m/s

Total Length of trunk line: 6.2 km

Existing flow velocity lower than scouring velocity causing **silting**.

(Chances of abrasion, pipe burst)

-  Water Bodies
-  Zone Boundary
-  Roads
-  Trunk Lines

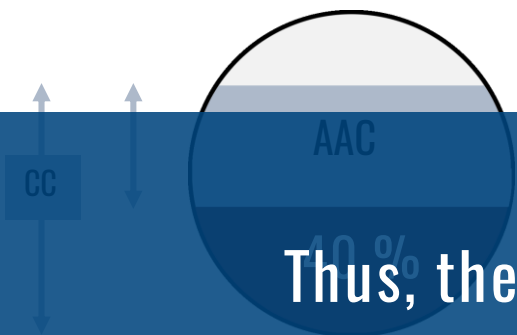


INTERVENTION 1: Retrofitting Sewer lines in Central Zone

Central Zone

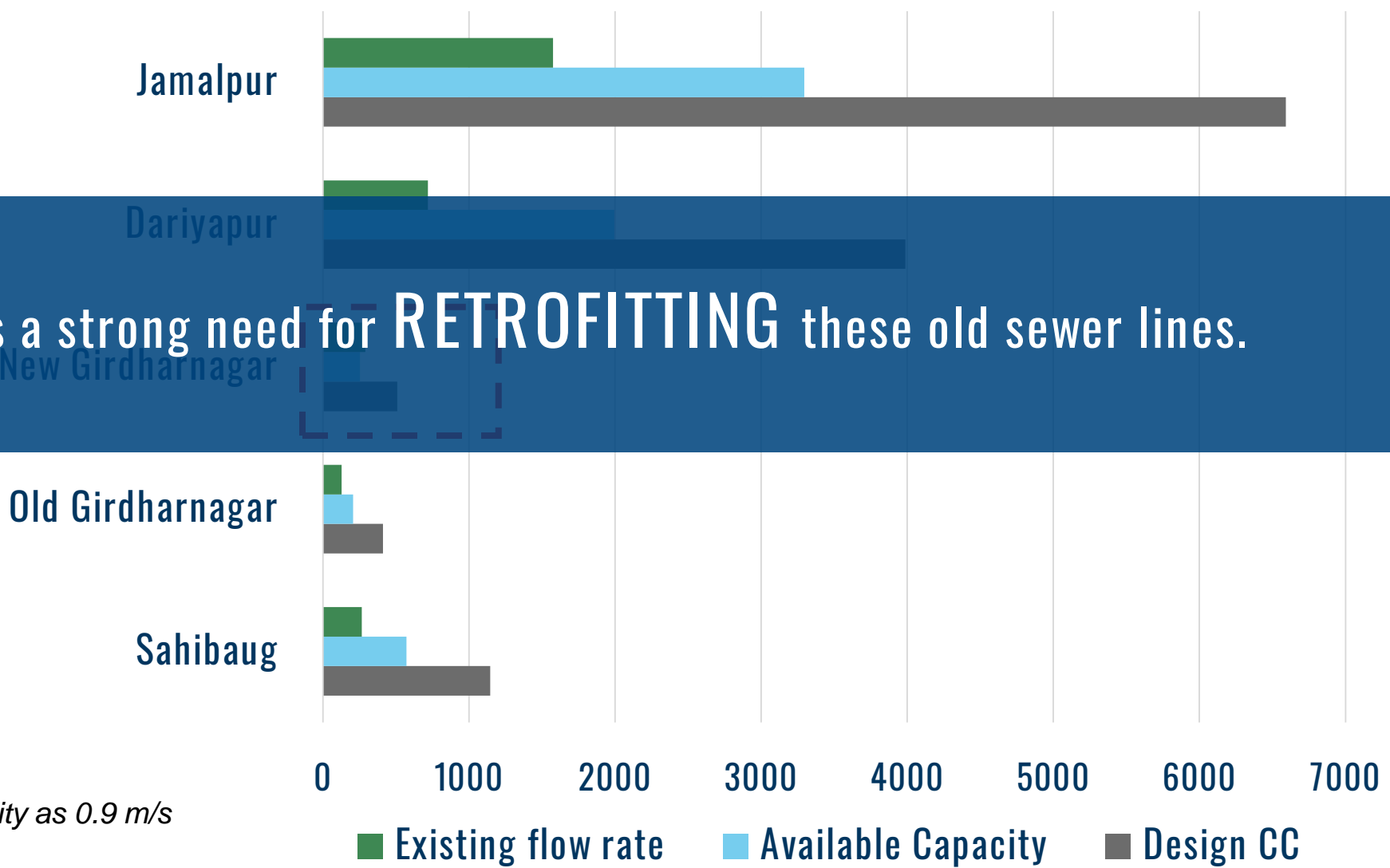
Design Carrying capacity* V S Available capacity**

Assumption : 40 % SILT



Thus, there is a strong need for **RETROFITTING** these old sewer lines.

Available Capacity is very **less** because of the silting, which will be **insufficient** for our design year.



* Considering minimum Scouring Velocity as 0.9 m/s

** Assuming 40% silt deposition

INTERVENTION 1: Identifying methods for Retrofitting



Trenchless Technology



Installation



Inspection



Replacement



Location and Leak
Detection



Rehabilitation



Time Saving



No disturbance
to surrounding



Cost efficient

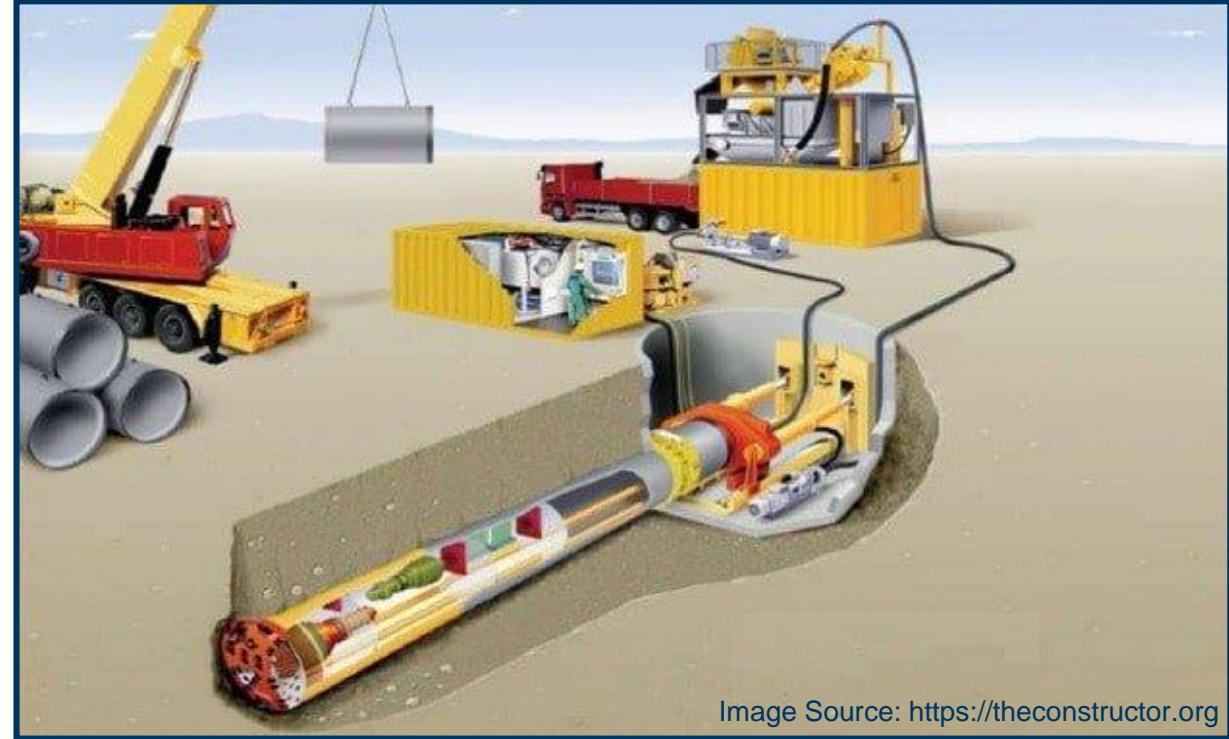


Image Source: <https://theconstructor.org>



Equipment with AMC



Super sucker

8

Jetting Machine

35

Gully Emptier

8

High flow Jetting

12

Rickshaw mounted
Grad Machine

10

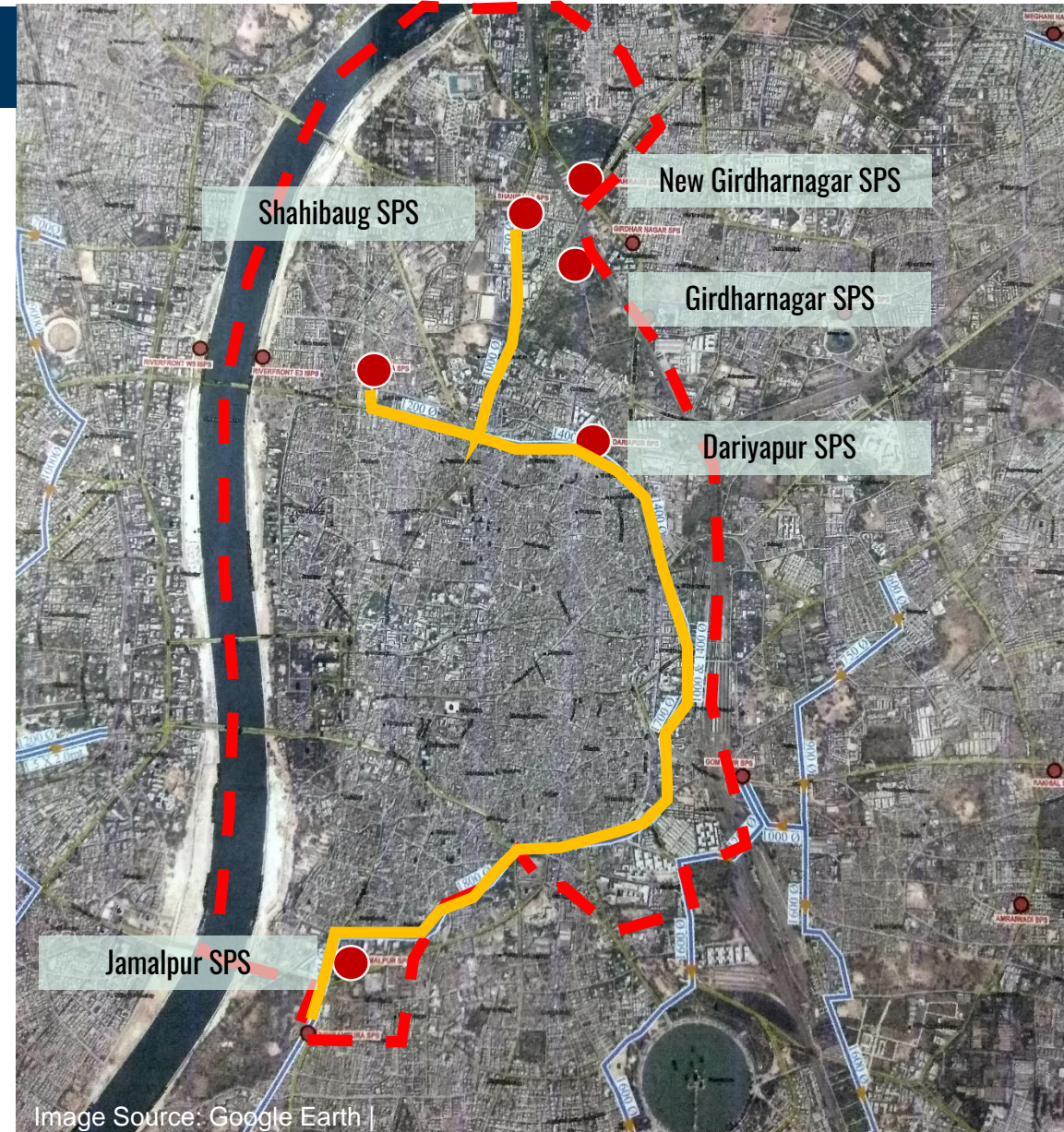
Source: Sewerage SLIP, AMRUT

INTERVENTION 1: Phasing and Costing

Total Length to be Retrofitted: **6.2 km**

₹	Funding & Implementing Agency	AMC, Central and State Grant
🔧	Operation & Maintenance	AMC
🌐	Intervention type	Physical
🕒	Time Period	4 Year
₹	Total Cost*	96.7 Crores

* AMRUT SLIP, under NRCP Scheme 70.6 Crores for 4.5 km



INTERVENTION 1: Phasing and Costing

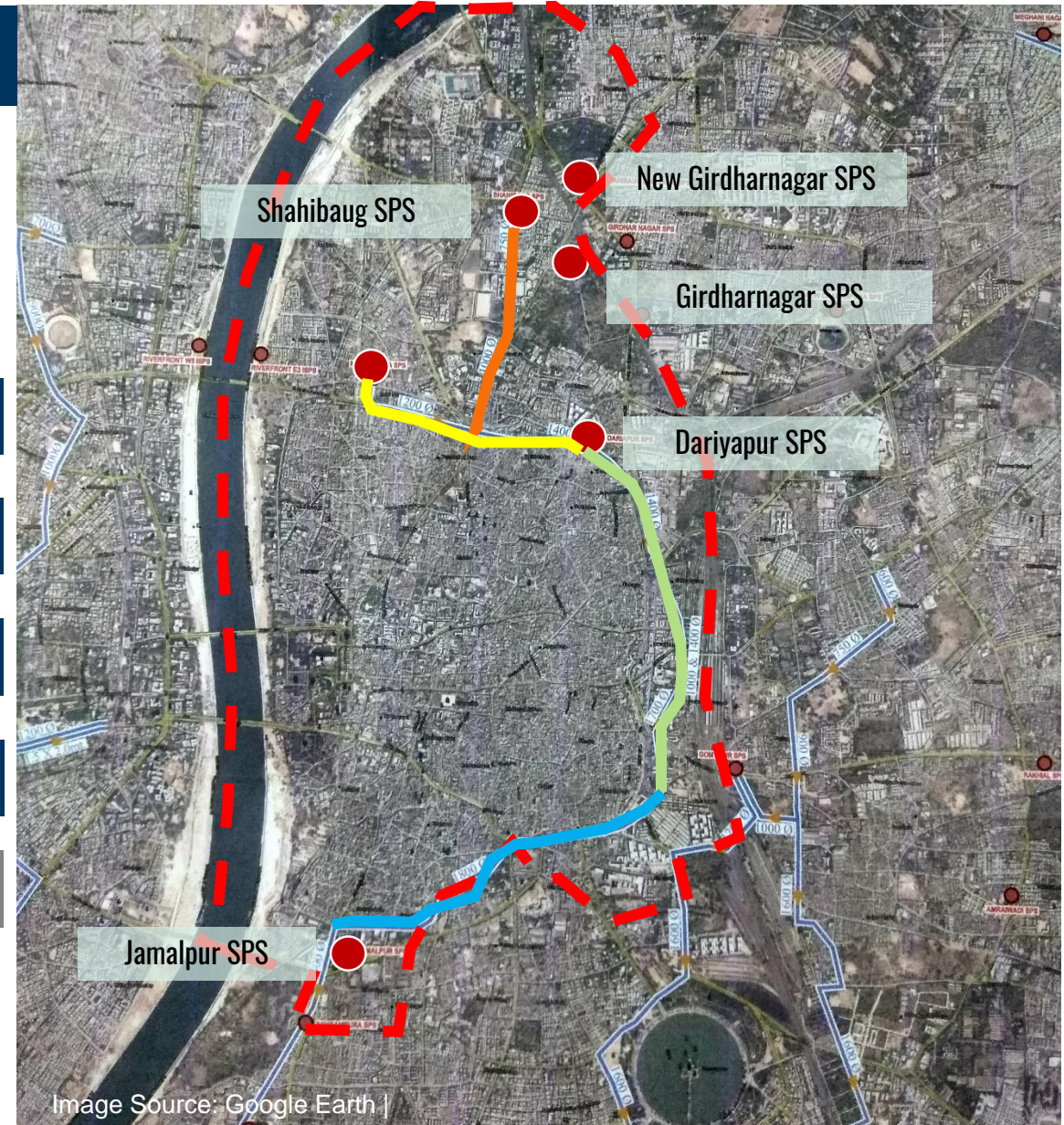
Total Length to be Retrofitted: 6.2 km

Capital Expenditure : ₹ 332 Crores (2017-18)

			
Phase 1	1.7 km	26.5 Cr	2018-19
Phase 2	1.5 km	23.4 Cr	2019-20
Phase 3	1.5 km	23.4 Cr	2020-21
Phase 4	1.5 km	23.4 Cr	2021-22

Total Cost: 96.7 Crores

Implementation of this project will ensure sufficient carrying capacity for the future population.



INTERVENTION & OBJECTIVE

Intervention 2: Improving efficiency of Sewage Pumping Stations.

HOW?

- By improving **Cost & Energy Efficiency**
- Utilizing **SCADA** up to its **maximum potential**



Assessing & Improving Operational Efficiency

Design Capacity

Actual Performance (SCADA Data)

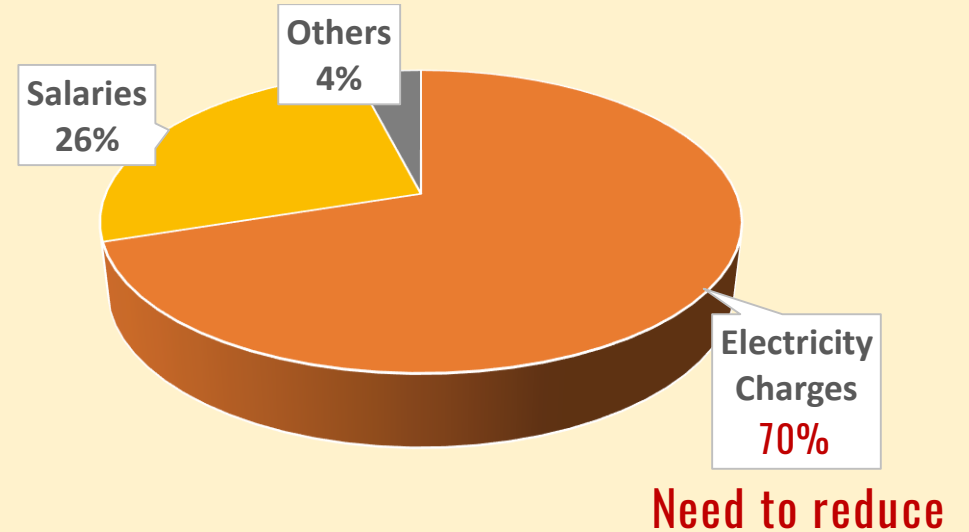
Age of Pumps



Contract Improvement:
O&M

SCADA (Supervisory Control and Data Acquisition)

Current O&M Expenditures for SPS (2016-17)



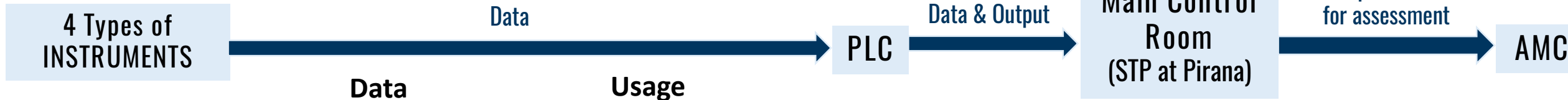
SOURCE: AMC Budget (FY 2017-18)



OBJECTIVE : To strengthen the efficiency of existing centralized WW conveyance system (Network and SPS)

INTERVENTION 2: Improving Efficiency of Sewage Pumping Stations

Process of Functioning of SCADA for SPS



Pressure Meter
(Kg/cm sq.)

Data	Usage
Monitors Sewage Surface, indicates when pressure is low i.e. fault	Identifies need for repair or replacement of parts incase of fault.

Flow Meter
(Cu. M/ hr.)

Data	Usage
Flow rate vs. power consumption at regular intervals	Determines need for flow control for less power consumption. Assessment of flow variation.

Level Indicator
(meter)

Data	Usage
Minimum Level Current Level Maximum Level	Determination of need to turn a pump on/off No automatic on/off provision Done manually at present.

Energy Meter
(KWH)

Data	Usage
Monitors Power Consumption regularly Calculates KWH/MLD	Helps O&M contractor to maintain power factor (>0.9) and prevents penalty from Torrent. Penalty paid by O&M contractor

Programmable Logic Controller (PLC)

Data from SCADA on PLC at Jamalpur Main SPS (Central Zone Control Room)

No data on Quality of Water for SPS, unlike STPs

Image Source: Primary Survey

INTERVENTION 2: Improving Efficiency of Sewage Pumping Stations

Total SPS in Ahmedabad: 51

with SCADA: 40

without SCADA: 11

Separate Contracts for outsourcing O&M of SPS and SCADA

SCADA Contractor: Chetas Control Pvt. Ltd.
SCADA Operation began in July, 2016

General Benefits of SCADA

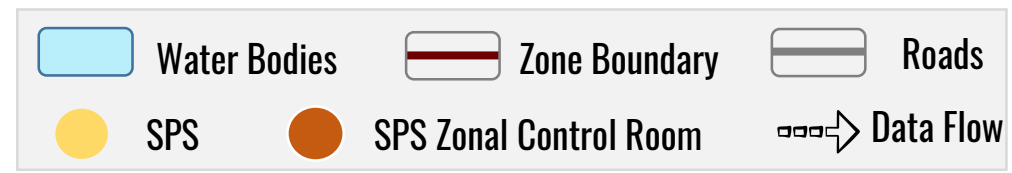
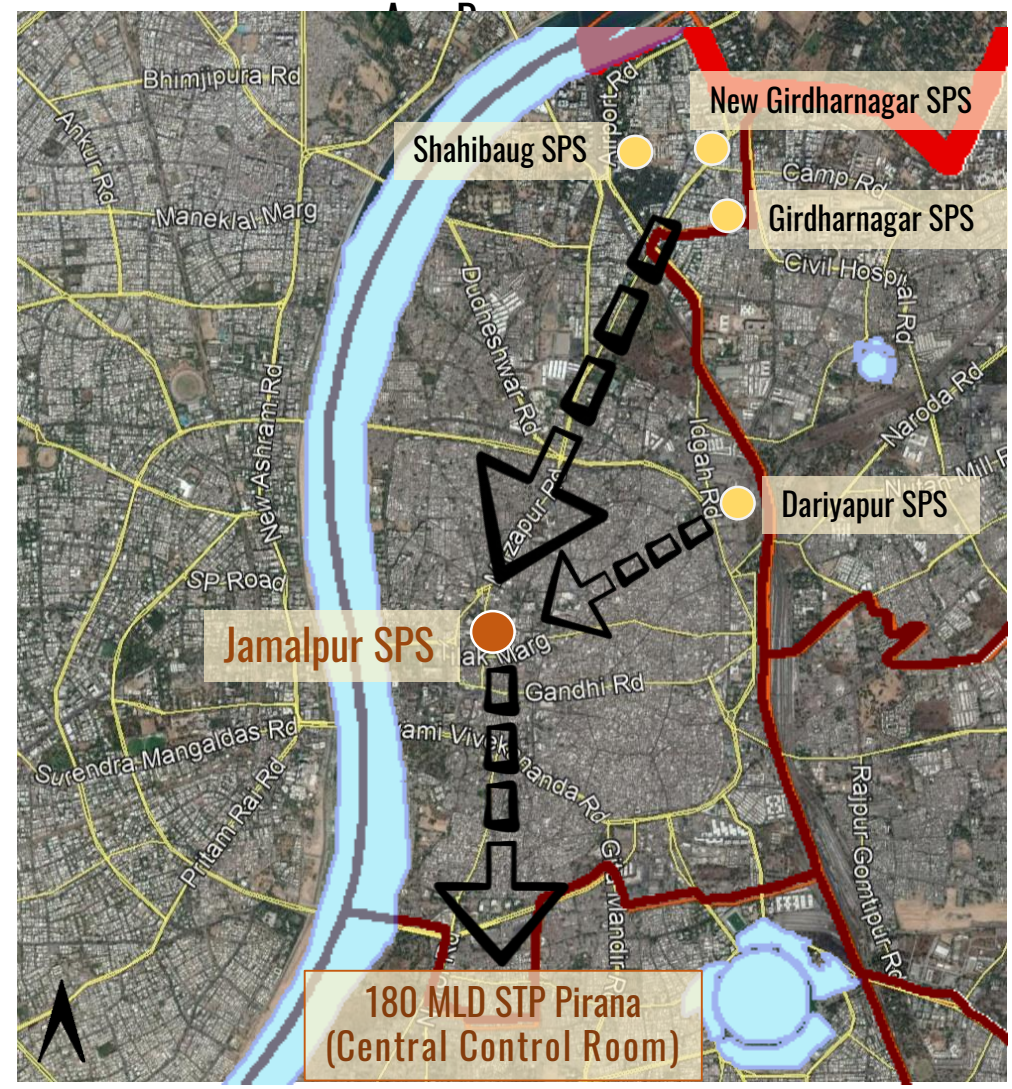
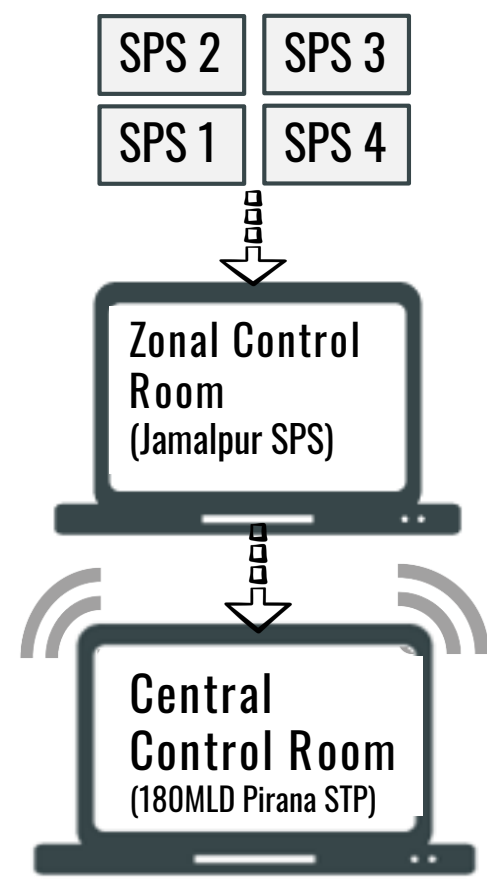
- Performance Improvement
- Better management
- Indication of problem before hand
- Reduction in Operation Cost (Opex)

Data Source: AMC, 2017

Total SPS in Central Zone: 5

with SCADA: 5

Schematic Diagram: SCADA

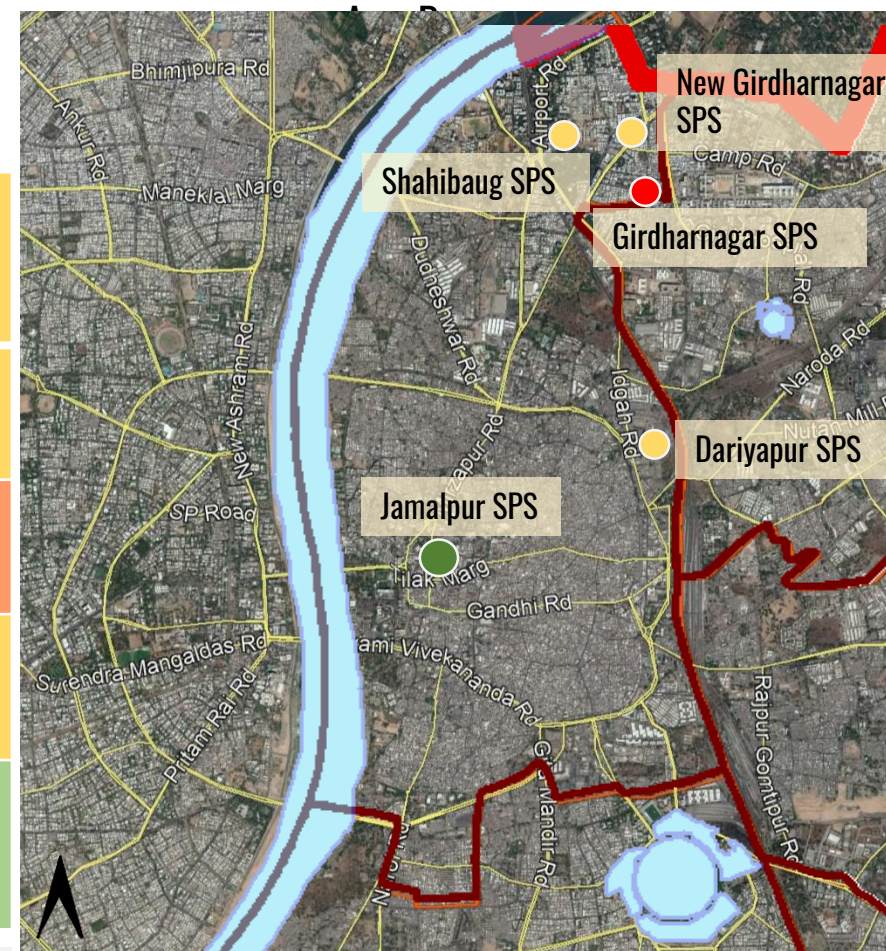


INTERVENTION 2: Improving Efficiency of Sewage Pumping Stations

Efficiency of SPS: Central Zone

	Pump Age	Scrap Pumps	Avg. Sewage Pumped	Avg. Power Consumed /MLD	Design Capacity	Efficiency (%)
Shahibaug SPS	11	-	3.98 MLD	42.9 KWH/MLD	7.58 MLD, (57.9 KWH/MLD)	52.5
New Girdharnagar SPS	8	-	4.56 MLD	39.3 KWH/MLD	9.2 MLD, (53.26 KWH/MLD)	49.5
Old Girdharnagar SPS	17	-	0.67 MLD	25.75 KWH/MLD	8.52 MLD, (55.6 KWH/MLD)	7.8
Dariyapur SPS	12	-	14.85 MLD	27.66 KWH/MLD	25.6 MLD, (44.37 KWH/MLD)	58
Jamalpur SPS	14	2	25.5 MLD	100.1 KWH/MLD	32.9 MLD, (101.2 KWH/MLD)	77.5
Total:			49.56 MLD	36.52 KWH/MLD		

Central Zone: SPS



Water Bodies Zone Boundary Roads

Considering life cycle (15 years) and efficiency of pumps, Need for replacement to be identified

INTERVENTION 2: Improving Efficiency of Sewage Pumping Stations

Jamalpur SPS



INTERVENTION 2 : Improving Efficiency of Sewage Pumping Stations

O&M Contract

SCADA Contract

Type of Contract
Comprehensive
O&M, Repair
Work Contract

Type of Contract
O&M and
Repair



Concession Period
2 Years

Concession Period
5 Years



Private Contractor's Scope

Energy Conservation Maintain power factor above 0.9. else, pay Torrent penalty.

Cleaning, gardening. Deploy staff.

The Tenderer must have to maintain SCADA system & operate SPS on SCADA basic.

AMC Scope

Pay Electricity Bills, monthly fees

Recover penalties

Monitor and assess monthly reports

Private Contractor's Scope

Help in Energy Conservation
Send daily reports/SMS to AMC officials

Generate monthly and zonal report

Staff: 1 per zonal center and 010

AMC Scope

Pay Electricity Bills, monthly fees

Recover penalties

Monitor and assess monthly reports



2 separate
contracts in
isolation

Difficult
Coordination

Need for
Integration

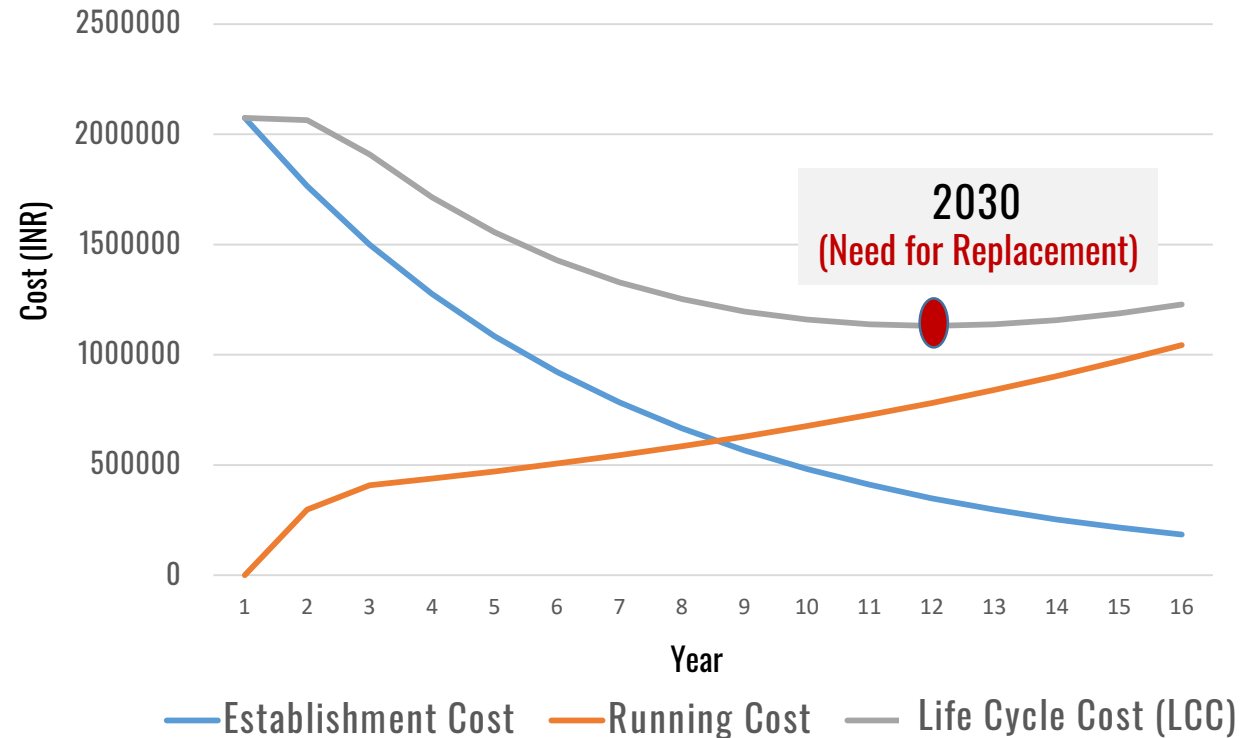
Data not
efficiently
used in
Decision
Making

INTERVENTION 2 : Improving Efficiency of Sewage Pumping Stations

Improving Operational Efficiency of SPS

1. Repair/Replacement of Pumps: LCC Analysis

Girdharnagar SPS



Installation of New Pump: 2018
Replacement of parts/pump: 2030

CapEx: INR 20.5 Lakhs

Source: GSM Based Energy Management System In Pumping & Water Management, GoI

2. Utilizing SCADA to its maximum potential

Automation of SCADA

- Software installation
- Customized set up of tank configuration,
- Activating SMS services
- Training of staff

Capacity building and training



CapEX: INR 1.3 Lakhs per pump
Total Capex: INR **52 Lakhs**

3. Integrated O&M-SCADA Contract



Concession Period: 5 Years
Staff Required: 2 per SPS

The Tenderer must have to maintain SCADA system & operate SPS on SCADA basic.

Benefits

Reduced manpower by 33%



Energy savings up to 20%



Cost savings up to 25%

Sewage Treatment Plant (STP)

INTRODUCTION-Centralised STPs

9 Sewerage Treatment Plants under AMC.

46 Sewage Pumping Stations.

Capacity of STPs

5 STP- ASP technology

2 STP- UASB technology

2 STP-Lagoon technology (under up gradation)

Total (Western Side) : 477 MLD.

Pirana (Eastern Side) : 528 MLD

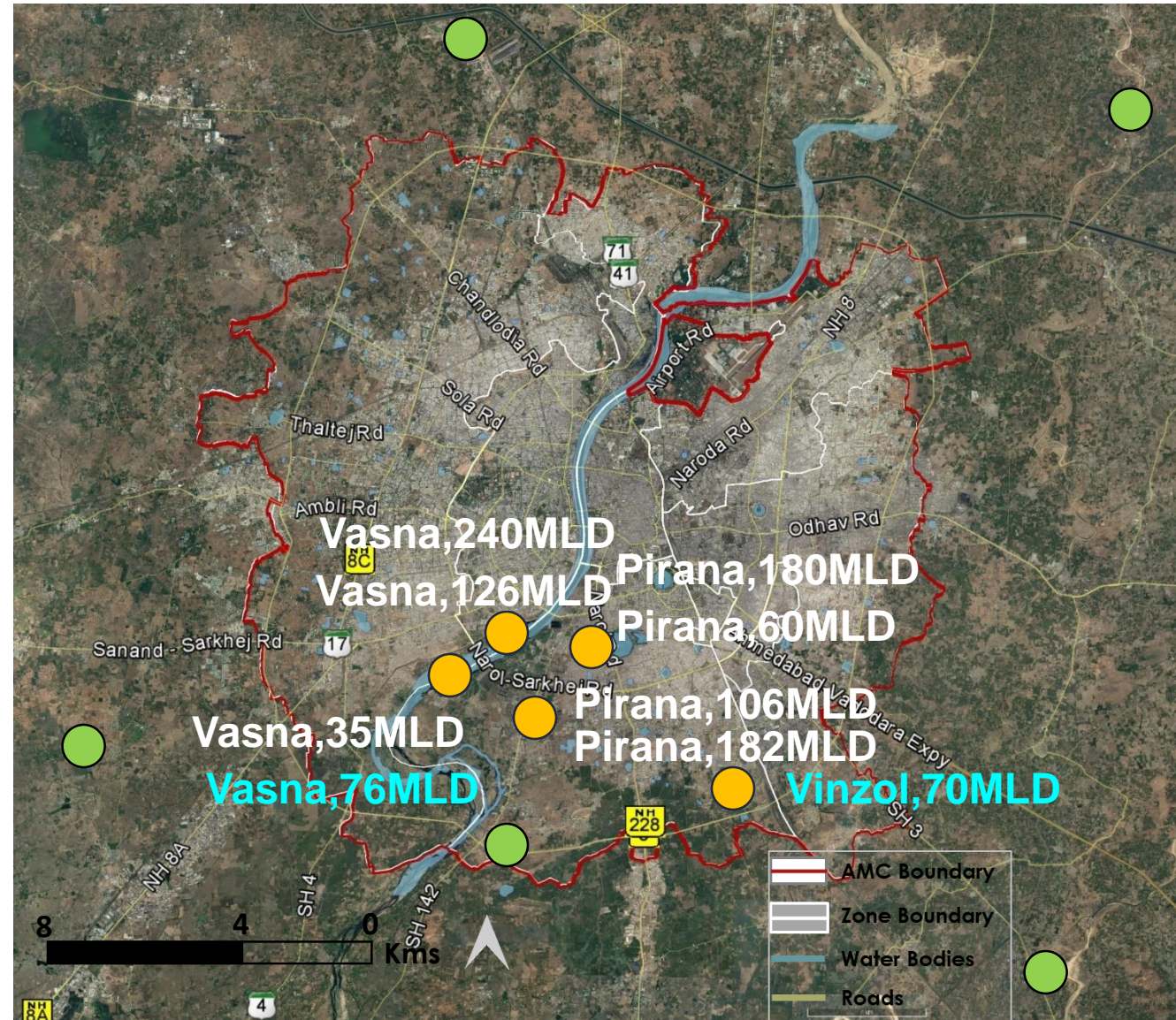
Vinzol (Eastern Side) : 70 MLD

Total (Eastern Side) : 598 MLD.

**Total (Eastern & Western Side) 477 + 598
= 1075 MLD.**

5 STPs are also proposed for the major growth centers of AUDA,

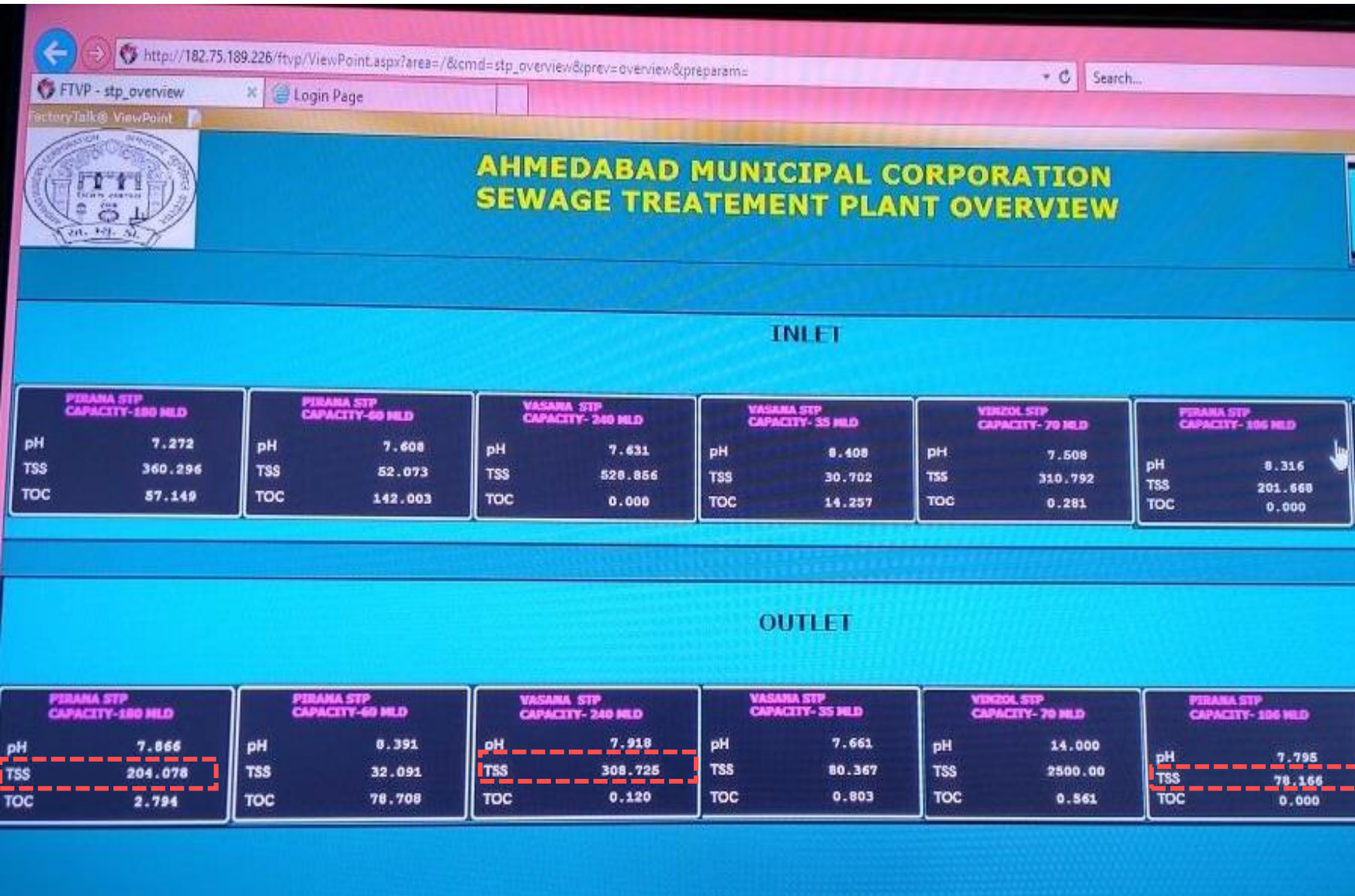
- Sanand
- Kamod
- Mehmdabad
- Dehgam
- Kalol



Source: Primary Survey

Current Scenario

Are these STPs working efficiently?



Parameters	ASP
BOD	< 30
COD	< 250
TSS	< 50

Total Suspended Solids standards are not meeting.

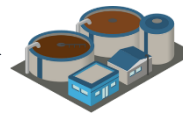
Need for Intervention



Collection



Conveyance



Treatment/Disposal



Reuse

- **91%** coverage of sewerage network
- Capacity of treatment plants is **adequate** in ratio of the sewerage generated in the city.

- **Broken** sewer lines
- **Open** manholes
- **Illegal** connections
- **Blockage** of lines
- Sewage **backflow**
- **Mixing** of storm water and waste water during monsoon.
- This **increases** the load on **sewerage line** and in turn increases the load on **capacity** of treatment plants.
- **27km long** mega pipeline laid from naroda to pirana carrying treated effluent from CETP **discharges into Sabarmati river.**

- Treatment of water till **secondary level.**
- **Discharge** of partially treated waste water in the **river.**
- As per **CPCB** domestic sewage is responsible for **80%** of water pollution in India.
- Existing STPs need to **upgrade** their effluent **standards** as per new standards released in 2015.
- **Poor disposal** of segregated solid waste.
- **Flaring** of biogas generated in the air.

Reuse practice only in 1 STP
180mld-pirana

↓ ↓ ↓
Sludge **Solid waste** **Biogas**

25% of sludge is taken by AMC and sold to vendors	Sorting done by corporation and then recycled.	4045m3 gas is generated and used as CNG.
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Why No Reuse in other STPs?

No Incentives to Reuse

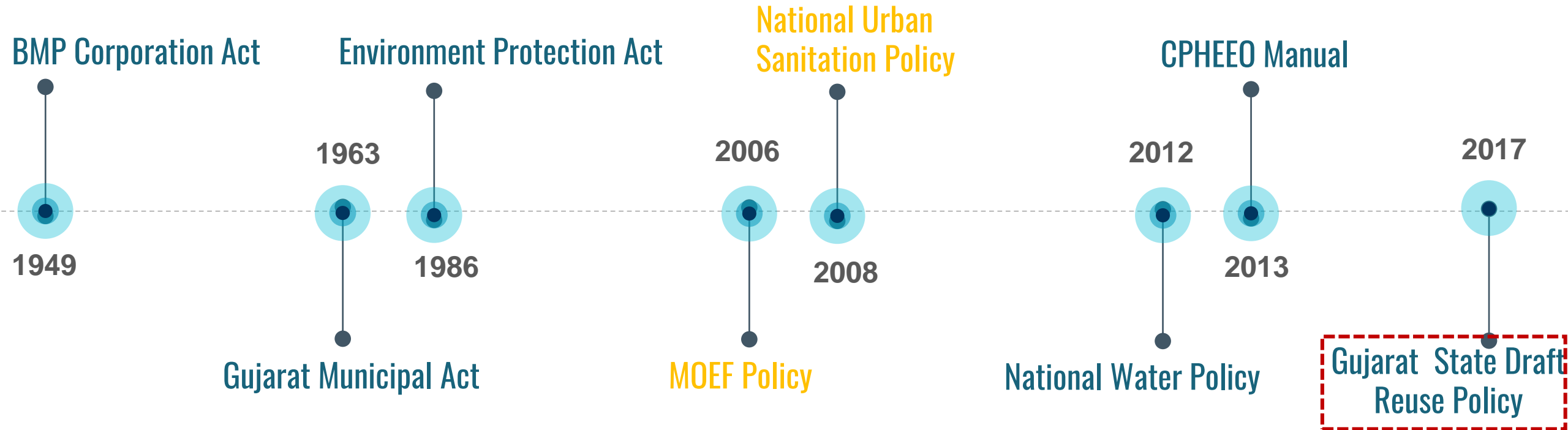


No Direct Economic Returns



No involvement of local authority

Policy Framework – Need for Intervention



State of Gujarat has drafted a policy for promotion of Waste Water and Reuse (2017)

At least **20%** of total recycle of waste water should be used for recharge of ground water and discharge into surface bodies (maintaining norms prescribed by CPCB for discharge into surface water bodies) to reduce their pollution load and enable minimum environmental flow.

How can we ensure 20% of reuse of waste water?

Who are our Stakeholders/Users?



Agriculture

Landscaping

1. To improve efficiency of treatment systems in terms of **performance** and **cost recovery**.
2. To implement/promote the idea of **reuse** of treated waste water to its maximum extent.

2

Tertiary level

What is the scope of treating and using?

Level of Treatment

Is this reuse feasible?

Parameter	Units	Municipal raw sewage characteristics	UASB	ASP	SBR
BOD	Mg/l	200 to 250	< 30	< 30	< 10
COD	Mg/l	400 to 450	< 250	< 250	< 50
TSS	Mg/l	200 to 250	< 100	< 50	< 10
Overall Plant Odour			Very High	Med. To High	Odourless

Source:- All India Institute of Hygiene & Public Health, Govt. of India

Comparison with new standards

Parameters	ASP	SBR	New Standards
BOD	< 30	< 10	20
COD	< 250	< 50	50
TSS	< 50	< 10	20

Source:- Primary Observation, Discussion with AMC officials

Operation and Maintenance

SBR technology requires less land, low periodic maintenance and the **treatment efficiency** is also **very good**.

Other technologies like membrane process which requires **periodic maintenance** and a lot of **man power** which is currently lacking.

Addition to treatment technology and infrastructure needed **management aspect** should be given importance.

Trained staff should be appointed and periodic monitoring of the quality of sewage water should be conducted by the officials.

Though the **initial capital cost** of this technology is **high** but the **O&M cost** is **less** comparatively to other technologies.

Is improvement in the Technology the only Solution? or

Is it the Management Issue?

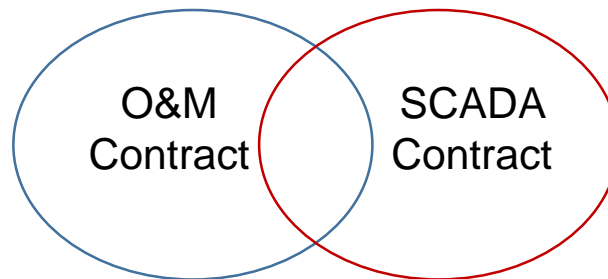
No integration between Contracts

Working of STPs- BOOT/DBOT basis



SCADA Controller Operator

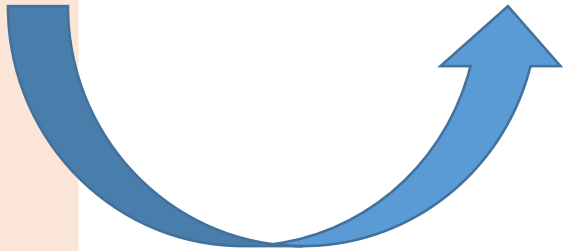
The **O&M contract** should be outsourced to a **common contractor** which looks after efficient operation and maintenance of STP with the help of **SCADA monitoring system** on a regular basis to achieve required standards.



Agriculture - Reuse of Wastewater

Sr.No.	Sewage Treatment Plant	Type of sewage treatment	Disposal point after secondary treatment of sewage
1	106 MLD STP, Pirana	UASB	Sabarmati River
2	60 MLD STP, Pirana (JNNURM)	ASP	
3	180 MLD STP, Pirana (JNNURM)	ASP	
4	240 MLD STP, Vasna	ASP	
5	126 MLD STP, Vasna	UASB	
6	35 MLD STP, Vasna (JNNURM)	ASP	
7	70 MLD STP, Vinzol	ASP	Kharicat Canal
8	182 MLD STP, Pirana	Facultative lagoon	Sabarmati River
9	76 MLD STP, Vasna	Facultative lagoon	Sabarmati River

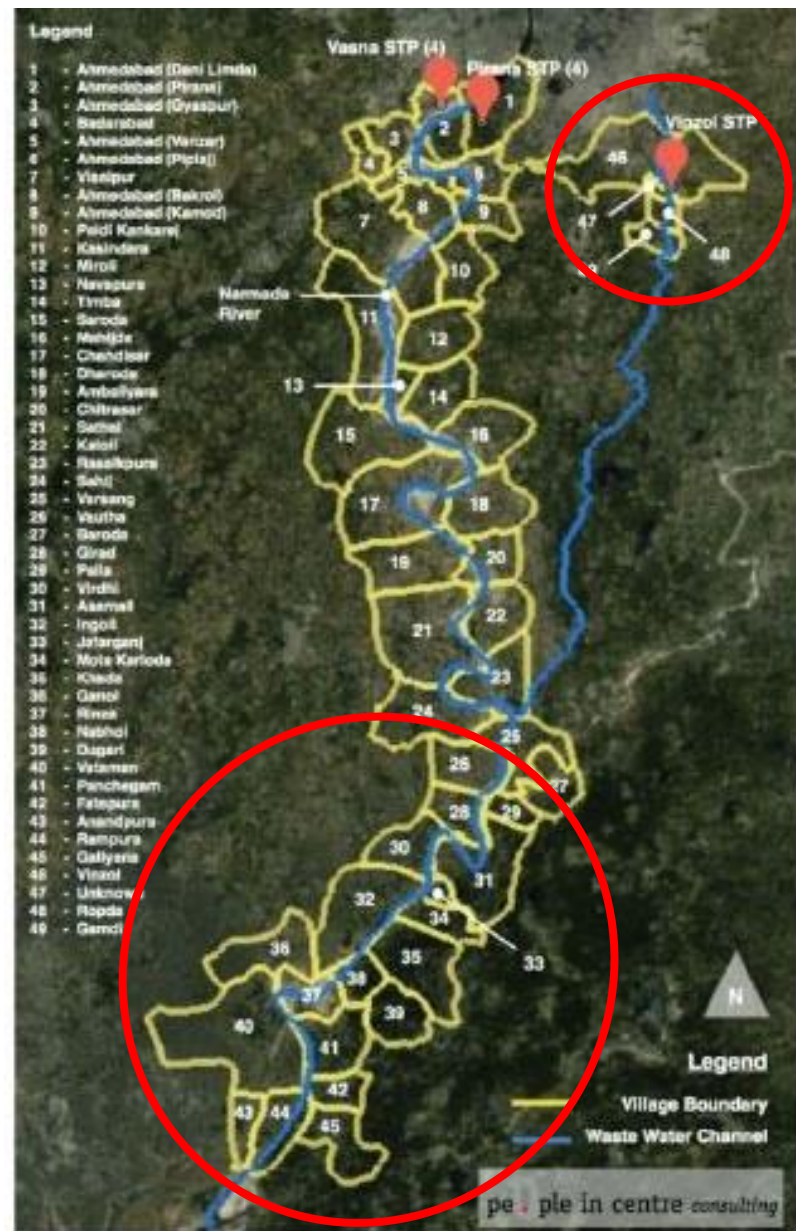
Indirect reuse of secondary level treated waste water in irrigation



Where is this happening & how much?

Source: Primary Survey

Agriculture Reuse Interventions



No of Villages availing waste water	Wastewater irrigated net area (in ha)	Wastewater irrigated gross area (in ha)	Agriculture receipts (Rs. in crores)	Cash profit (Rs. In crores)	% of net profit
45	9450	13346	83.7	50.77	61

Case Study

535 agriculturalists-**Pirana Sewage Farm**

Water Requirement-**268 MLD**

Cost-**0.15 Rs/kl**

650 agriculturalists-**Miroli Mandali**

Water Requirement- **160 MLD**

No. of farms - **17 farms**

500 Farmers are members

Cost- **0.08 Rs/kl**

Sewage water is **partially treated**.

It is **good for farms** but **not for health** of farmers and livestock.

Farmers face a lot of **skin diseases** when this water comes in contact with their skin.

There is **no other source** of water available for these farmers.



Agriculture Reuse Interventions

Parameter	Land for irrigation
PH value	5.5 to 9.0
BOD	100
Suspended Solids	200
Oil and grease	10
Arsenic	0.2
Cyanide	0.2
Alpha emitter micro curie/m	10^{-8}
Bio-assay test	90% survival of fish after 96 hrs in 100% effluent
Beta emitter micro curie/m	10^{-7}

Source: CPCB,1993

Health risks associated with wastewater use in agriculture

Group exposed	Helminth Infections	Bacterial/virus infection	Protozoa Infections
Consumers	Risk of Ascaris infection for both adults and children with untreated waste water.	Cholera,typhoid,diarrhoea	Parasitic protozoa on irrigated vegetable surfaces
Farm workers and their families	Risk of Ascaris infection for both adults and children,hookworm infection in workers	Young children- Cholera,typhoid,diarrhoea if water quality exceeds 10^4 coliforms/100ml and elevated seroresponse to norovirus in adults exposed to partially treated water	Risk of amoebiasis when contact with untreated waste water
Nearby Communities	Risk of Ascaris infection for flood or furrow irrigation when in heavy contact.	Sprinkler irrigation with poor water quality and high aerosal exposure associated with increased rates of infection	No data on transmission of protozoan infections during sprinkler irrigation with wastewater

Source: WHO Guidelines

Irrigation water is safe from point of view of CPCB established standards ,health implications for farmers and consumers need to be assessed.

Permitted limit for grey water reuse

Test	Irrigated of ornamental fruit trees and fodder crops	Irrigation of vegetables likely to be eaten uncooked
BOD (mg/l)	< 240	< 20
Sample no	Sample/month	2 samples/month
TSS	< 140	< 20
Sample no	Sample/month	2 samples/month
Thermotolerant coliforms (cfu/100ml)	< 1000	< 200
Sample no	2 samples/month	Sample/2 weeks

According to WHO guidelines, wastewater of **high microbial quality** is needed for irrigation of certain crops – **crops which are eaten uncooked.**

Low quality of water-crops which are cooked like potatoes, industrial crops like cotton, sisal but this **quality will affect field workers and crop handlers.**

Crops can be divided into 2 category.

Category A

Protection required for **consumers, agricultural workers and general public.**

This includes crops which are **eaten uncooked, spray irrigated fruits.**

Category B

Protection required for **agricultural workers** only because here crops are not eaten raw.

This includes **cereal crops, industrial crops, food crops for canning, fodder crops, vegetable crops which grow above the ground (potatoes,paes,chillie tomatoes and green beans)**

In this case it is necessary to **ensure crop is not contaminated with sprinkler irrigation.**

Are the Current regulations adequate to meet wastewater use objectives?

- Protect Public health
- Prevent environmental damage
- Meet quality standards

Despite presence of standards, discharge of treated sewage is almost completely unmonitored and unregulated.

Strong Institutional Framework

There **does not exist any organization** dedicated to wastewater treatment and reuse.

There is **no clarity** in framework.

Appointment of trained staff to monitor the quality of water.

Changes in Reuse Policy

Waste Water reuse **regulations** for irrigation **should specify type of crops** that can be irrigated with recycled water of a given quality as well as **public access and other restrictions**.

Dos and don'ts during irrigation for farmers with specific quality of water and the **risks and health hazards** associated to the user.

Creating Awareness

Heavy metals and **faecal coliform** are the parameters of **concern** for use of sewage for irrigation.

Farmers should be advised of the **importance and necessity of the restrictions** drafted in the policy.

They should be assisted in developing a **balanced mix of crops** which makes full use of the partially available treated waste water by conducting **awareness campaigns, irrigation programs in local language**.

Industrial Profile

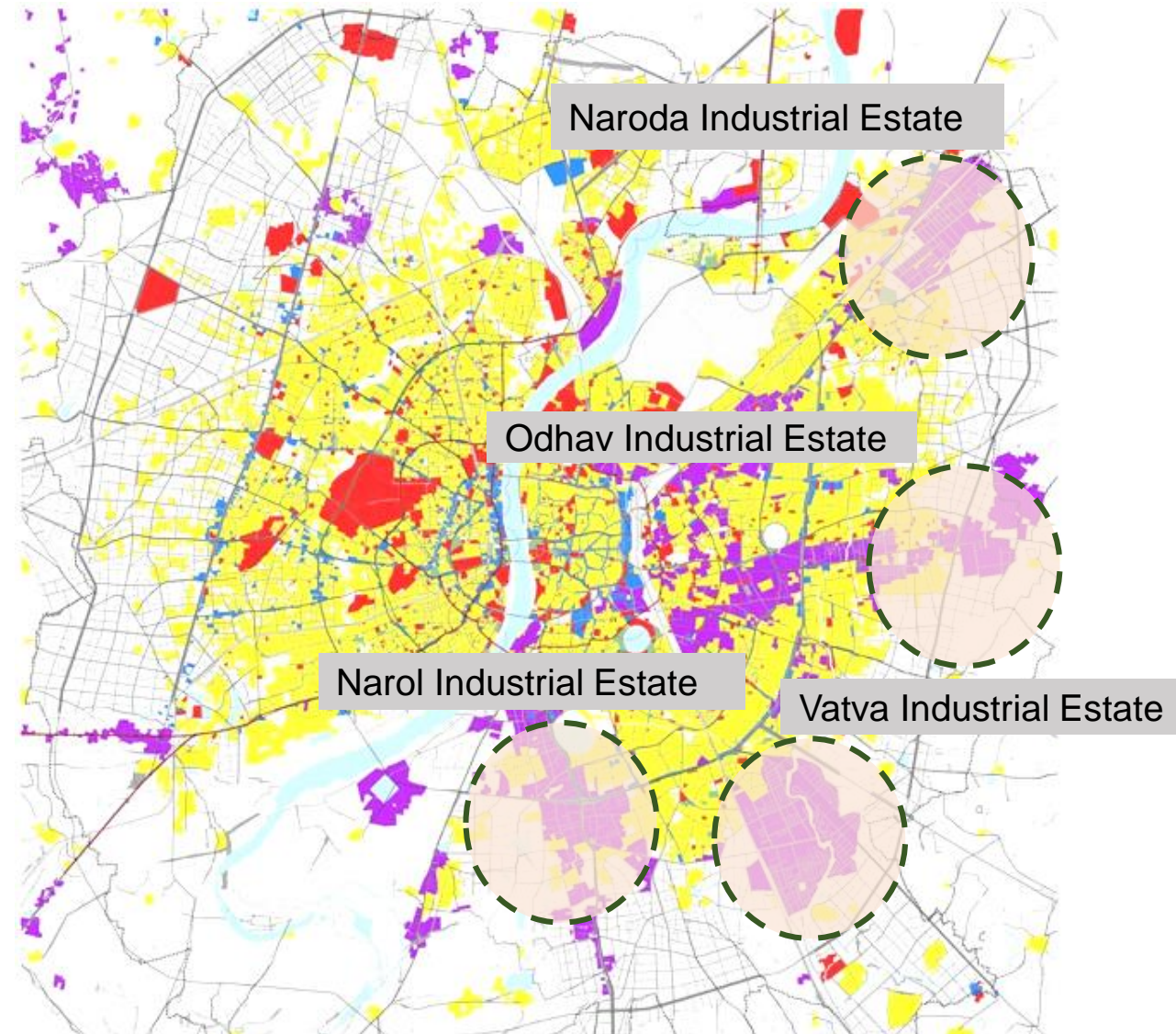
Dominant Types of Industries

Estate	Dominant Type of Industries	No. of Dominant Industries
Naroda	Engineering Industries	285
Vatva	Chemical Industries	600
Odhav	Metal Industries	143
Narol	Textile Industries	150

Classification of Industries in Odhav

Type of Industry	Number of units
Metal Industries	225
Engineering Industries	95
Foundry	50
Paper, Pulp and Packaging	15
Rubber, Plastic and Insulation	12
Chemical Industries	35
Pharmaceuticals	18
Miscellaneous Industries (Electronics, Oil Mill, Pesticide)	20
Total	470

Source: Primary Survey



Industrial Profile

Classification of Industries in Naroda

Type of Industry	Number of units
Chemical, Dyes and Intermediates	221
Ceramics, Minerals and Glass	38
Engineering Industries	285
Paper, Pulp and Packaging	26
Rubber, Plastic and Insulation	67
Textile	47
Food and Agro Based	80
Pharmaceuticals	38
Service Industries	12
Miscellaneous Industries (Electronics, Oil Mill, Pesticide)	226
Vacant/Closed	75
Total	1115

Classification of Industries in Vatva

Type of Industry	Number of units
Chemical, Dyes and Intermediates	675
Engineering Industries	565
Metal Industries	375
Foundry	125
Paper, Pulp and Packaging	18
Rubber, Plastic and Insulation	15
Textile	25
Food and Agro Based	22
Pharmaceuticals	60
Service Industries	15
Miscellaneous Industries (Electronics, Oil Mill, Pesticide)	550
Plastic Manufacturing and Processing	55
Total	2500

Source: Primary Survey

Assessment of Industries

GIDC Estates	Area (Ha)	Units
Naroda	346	1115
Odhav	127	470
Vatva	527	2500
Narol	500	224

Industrial Estate	Type of Cluster	No. of units
Odhav	Metal	225/470
Narol	Textile	150/224
Vatva	Chemical	600/2500
Naroda	Engineering	285/1115

Water Consumption (in MLD)	Naroda	Odhav	Vatva	Narol
	6.7	1.7	25	98

Desirable Water Quality Parameters for Textile Wet Processing

- pH → 6.5-7.5
- TDS → 300 ppm
- Color → 5 Hazen No.
- Residue on ignition → 250 ppm
- Total Hardness → 30 ppm
- COD → nil
- Turbidity → nil
- Suspended Solids → nil
- Copper → 0.01 ppm
- Iron → 0.01 ppm
- Chromium → 0.01 ppm
- Manganese → 0.05 ppm
- Aluminium → 0.2 ppm
- Chloride → 150 ppm
- Sulphate → 150 ppm
- Nitrite → nil

Parameters	Raw Sewage	Secondary Treated Sewage	New Standards	Tertiary Treated Sewage
PH	6.5-8.5	7-8.5	7-8.5	6-7.5
BOD	320 mg/l	20 mg/l	20 mg/l	<5
TSS	350 mg/l	30 mg/l	20 mg/l	<2
COD	600 mg/l	100 mg/l	50 mg/l	<50
FAECAL COLIFORM		1000-10000 ml	<100 ml	

Quality Requirement

Parameter	Textile Input Standard	Tertiary Treated Sewage
PH	6.5-7.5	6-7.5
COD	Nil	<5
BOD	Nil	<2
TSS	Nil	<50

Quantity Requirement

Pirana STP -180MLD

Narol industries water requirement- 98 MLD

Reuse Feasibility

Textile Industries

PLANT EFFICIENCY & COST AT DIFFERENT TECHNOLOGY LEVEL

3 types of water quality are suggested for use in textile industry: high quality water, moderate quality and low quality water.

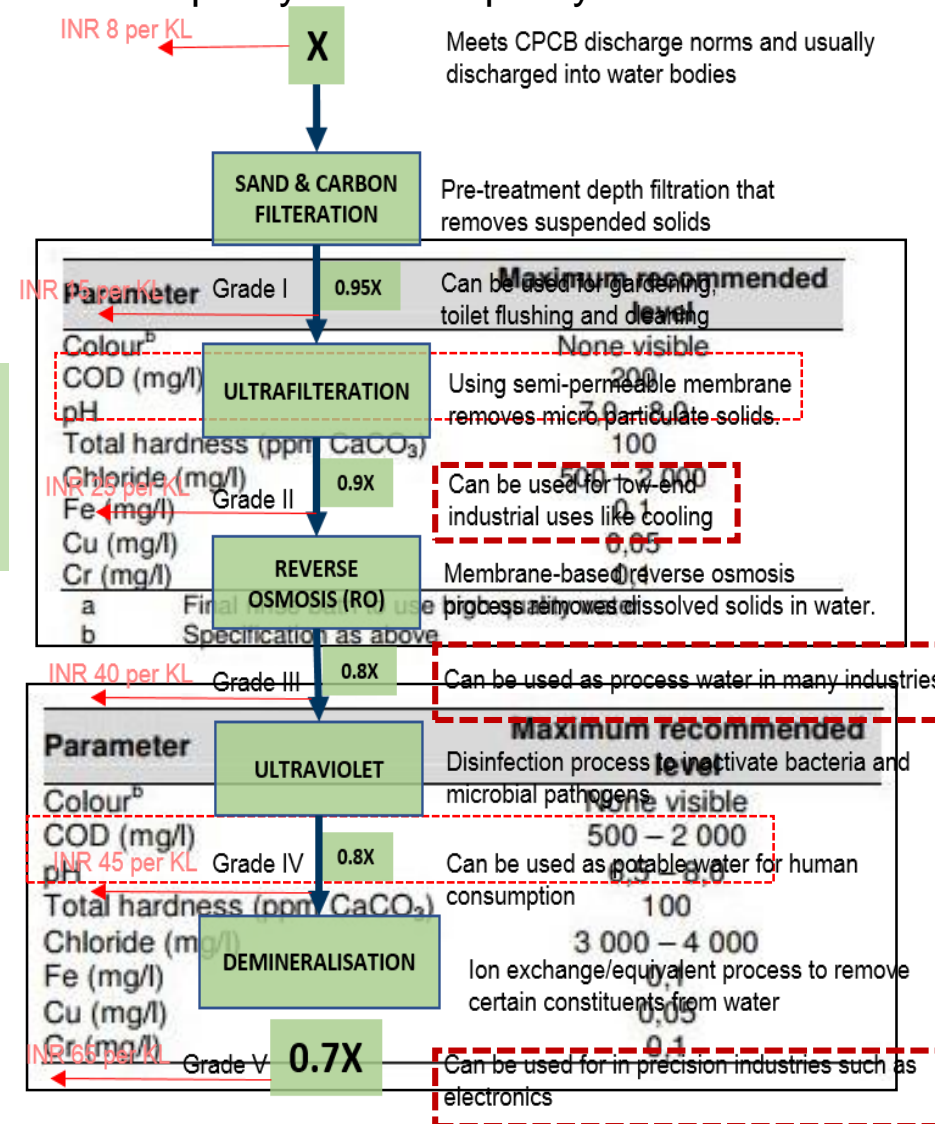
High quality:- Dye baths, print pastes, finishing baths, final rinse bath.
Consumption of such water is **20 – 30 %** of total water consumption

Tertiary Treated water + Further treatment

Moderate quality:- Washing-off stages after scouring, bleaching, dyeing/printing and finishing.
About **50 – 70 %** of total water consumption consists of such water needs.

Colour??- Advanced oxidation, flocculation, electrochemical methods- Very expensive, operational problems

Low quality:- Washing down equipment, screen washing in print works and general wash down of print paste containers and floors.
Quantity presents only **10 – 20 %** of total water consumption, but it is wasteful to use high quality water for such operations.



Source: Research paper on Water demands in industries

Industries - Sample Study

Current Scenario – Vatva Industrial Estate

Total Industrial units- **Approx 2000 units**

Source of water supply- **Ground water supply for 24 hrs.**

Agency involved- **Vatva GIDC Association**

No. of Bore wells-**12 with 1000m3 depth,**
- 40 private unaccounted bore wells

Total demand of water in industries- **25-30mld per day**

Average cost of water supplied – **Rs.10/KL.**

Where is the Problem?

Supply of Narmada water

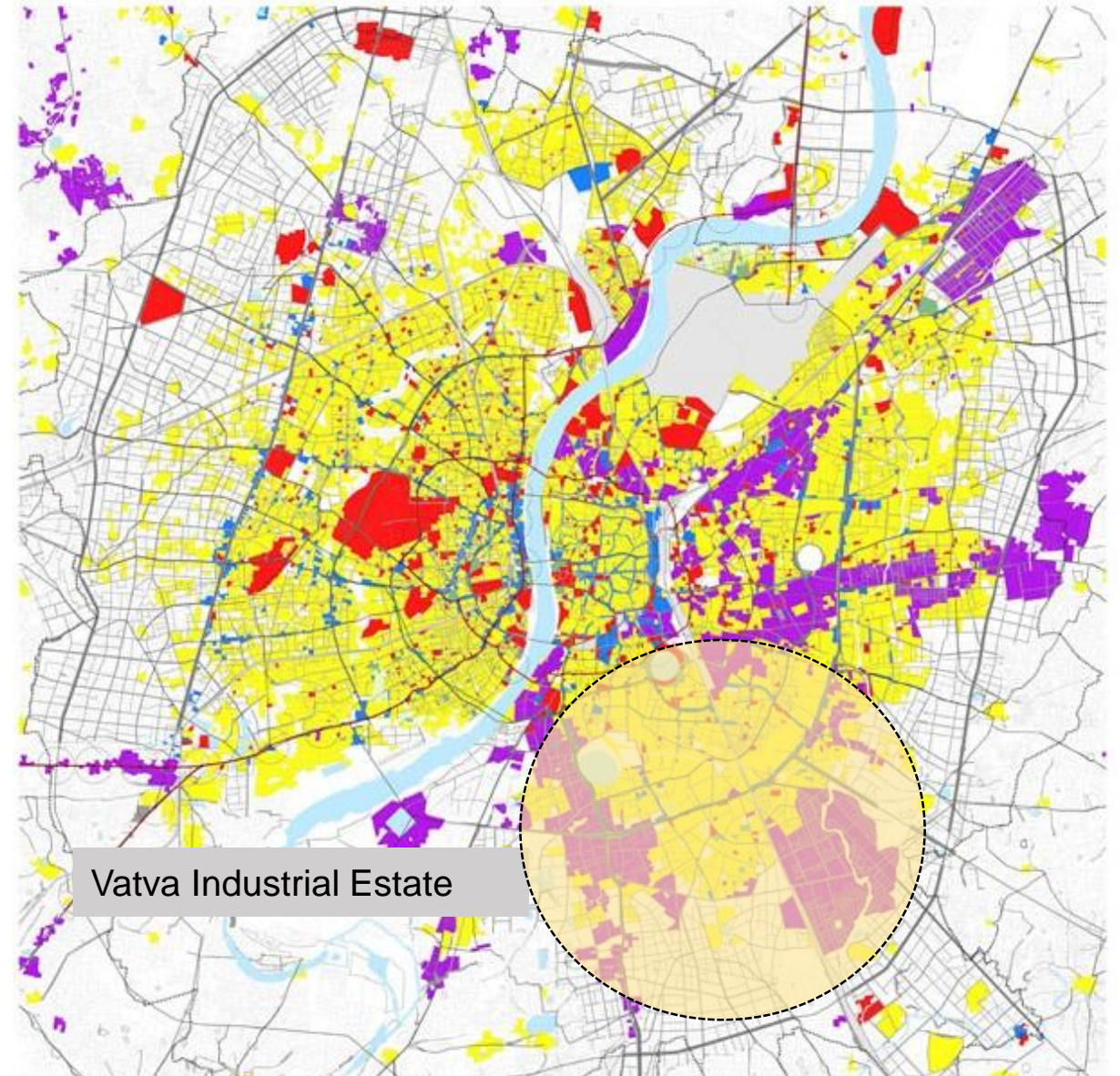
Priority 1 :- Residential area

Priority 2:- Irrigation (Rs.16 per KL)

Priority 3:- Industries (only 2%)



No other option Available



Current cost of water supply – **Rs.10 per KL**

Cost of tertiary level treated water – **Rs.25-35 per KL**

It is difficult for the industries to shift from usage of ground water to reuse waste water because of increase in price.

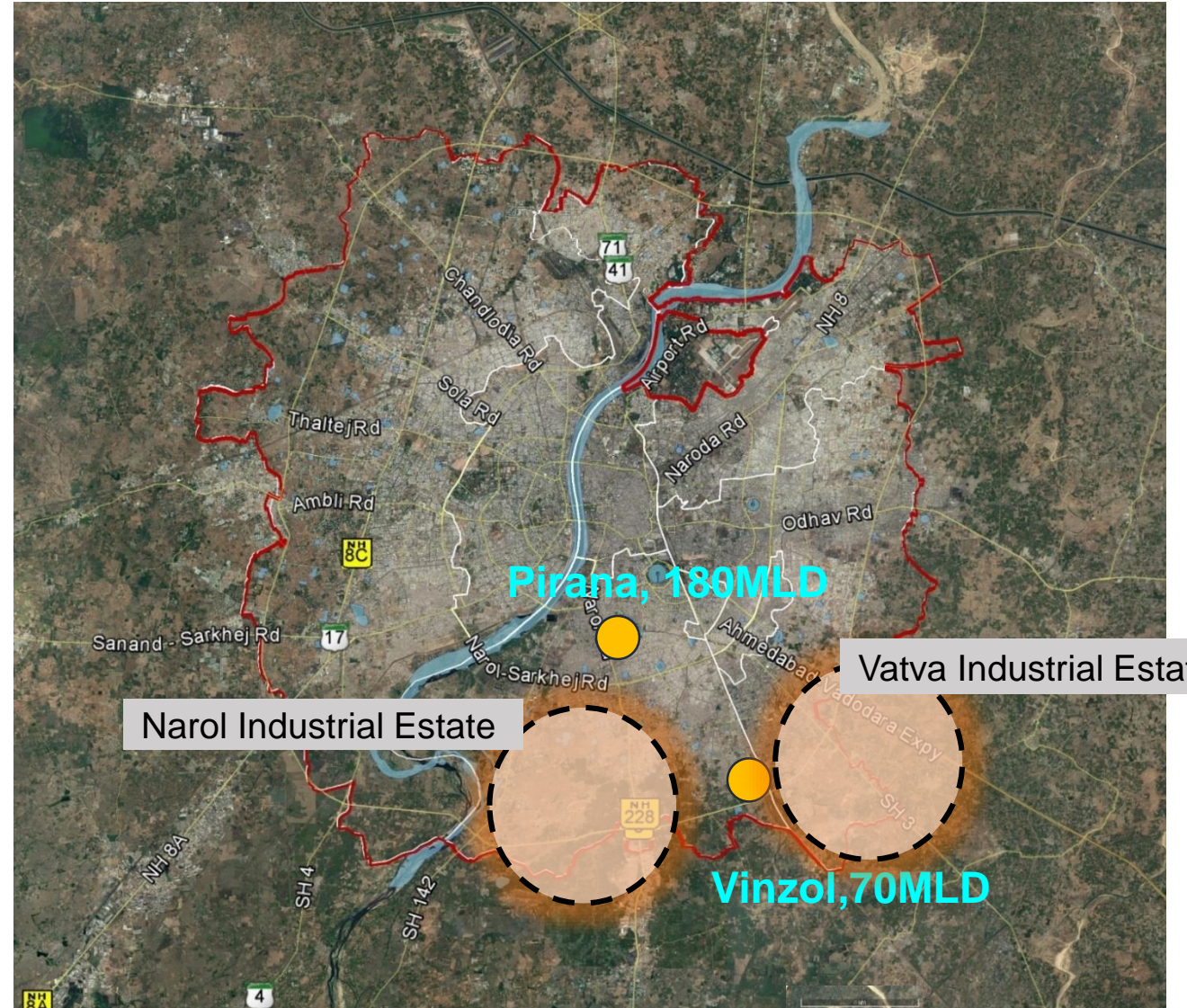
What needs to be done? (options to be explored further)

- **Strict policies and regulations** should be made to ban usage on ground water. (Ground water policy is since 10 years but yet no result)
- **State government** should get involved in this process and strive to provide treated waste water at a subsidized rate (max 15-20 Rs.)
- This has to be a **gradual process**, the **standards** of the tertiary treated water should more or less match the standards of the water supplied now to industries to **avoid human health hazards** like typhoid, cholera, polio, diarrhea, miscarriages etc.

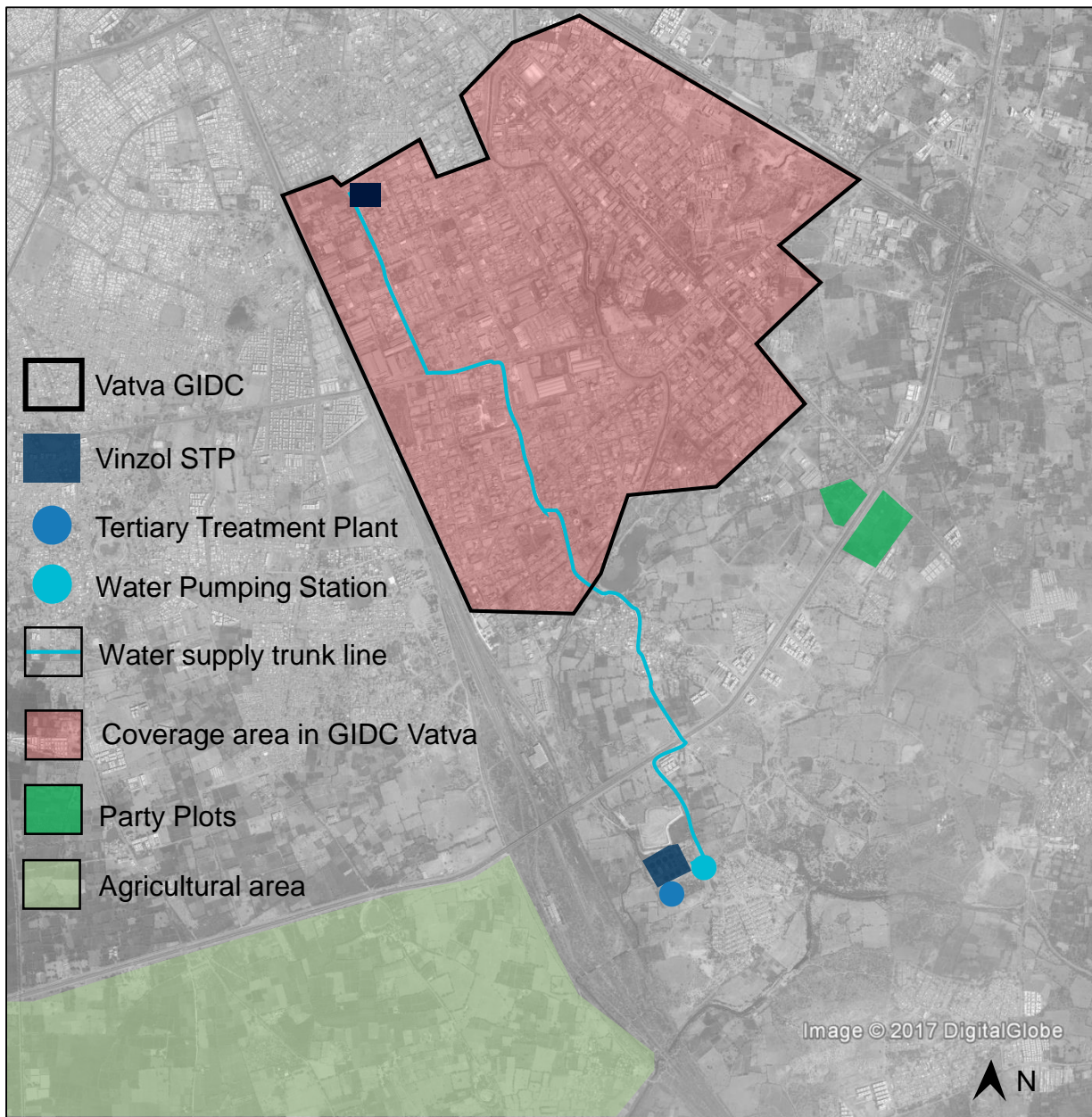
Recommendation 1:- To propose a tertiary level treatment plant in Vinzol STP in order to provide the treated water in Vatva Industries.

Recommendation 2:- To propose a tertiary level treatment plant in 180 MLD Pirana STP in order to provide the treated water in Narol Industries.

Is this reuse Feasible?



Industrial Reuse – Vinzol Project



Existing Scenario

Vinzol STP	Vatva GIDC
Capacity : 70 MLD	Demand : 25 MLD (Future 30 MLD)
Treatment : Secondary	Current Source : Bore wells

➤ 72 km network in Vatva GIDC



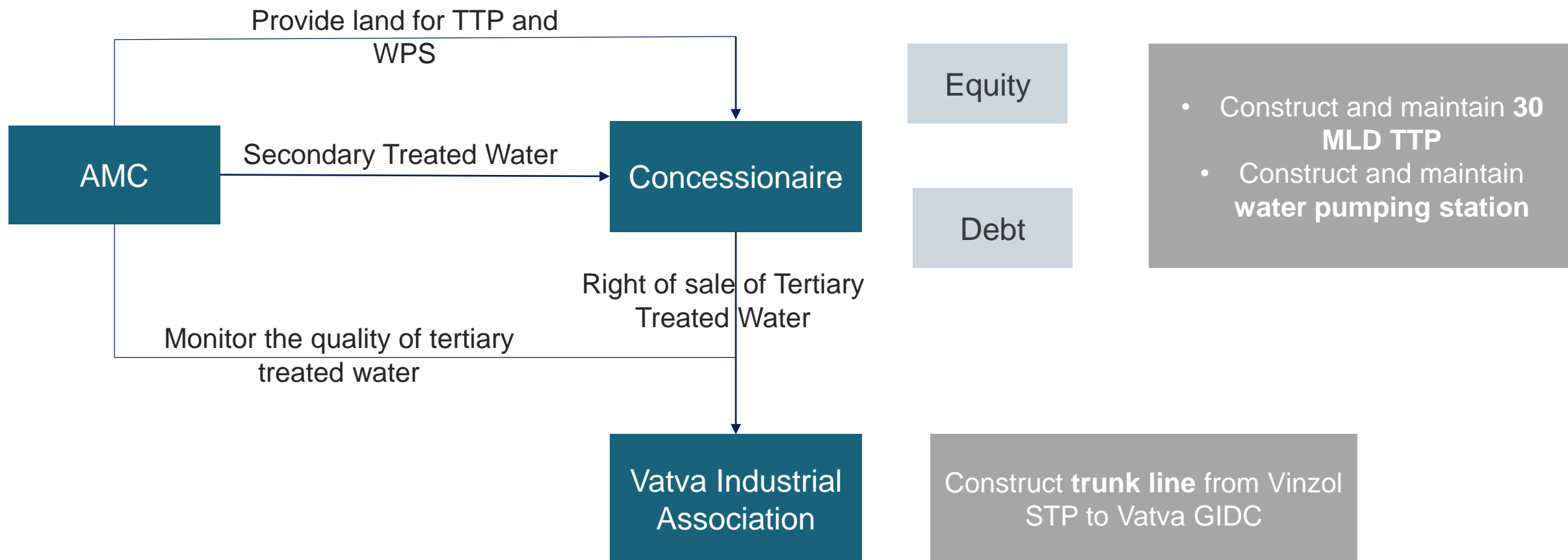
Capital Investments

TTP of Capacity 30 MLD	4575 lakhs	Total 5895 lakhs
Water Pumping Station	75 lakhs	
Water supply trunk line	1000 lakhs	

Major Stakeholders

AMC	Vatva Industrial Association	Private Player
-----	------------------------------	----------------

Project Structuring



- Equity : 30%
- Debt : 70%
- Concession period : 20 years (including construction period of 24 months)

- Interest on debt : 11%
- Tenure of loan : 7 years (excluding 2 years of moratorium period)

Financial Feasibility

Secondary Treated Wastewater



₹ 3 per KI

@ 5% increase in rate pa

Tertiary Treated Wastewater



₹ 19 per KI

@ 5% increase in rate pa

Project IRR
26%



Equity IRR
16%

Benefits to AMC

1. Saving in Capital Investment

₹ 6900 lakhs

3. Revenue from the sale of Secondary treated water

During Concession period

₹ 27 lakhs

(2019-2020)



₹ 62 lakhs

(2039-2040)

After Concession period

₹ 2000 lakhs

Risk in executing project

If Vatva Industrial Association do not agree to pay for thr trunk line and concessionaire has to bear that cost, **then**

Project IRR drops to 22%

&

Equity IRR drops to 12%

Tertiary Treated Wastewater



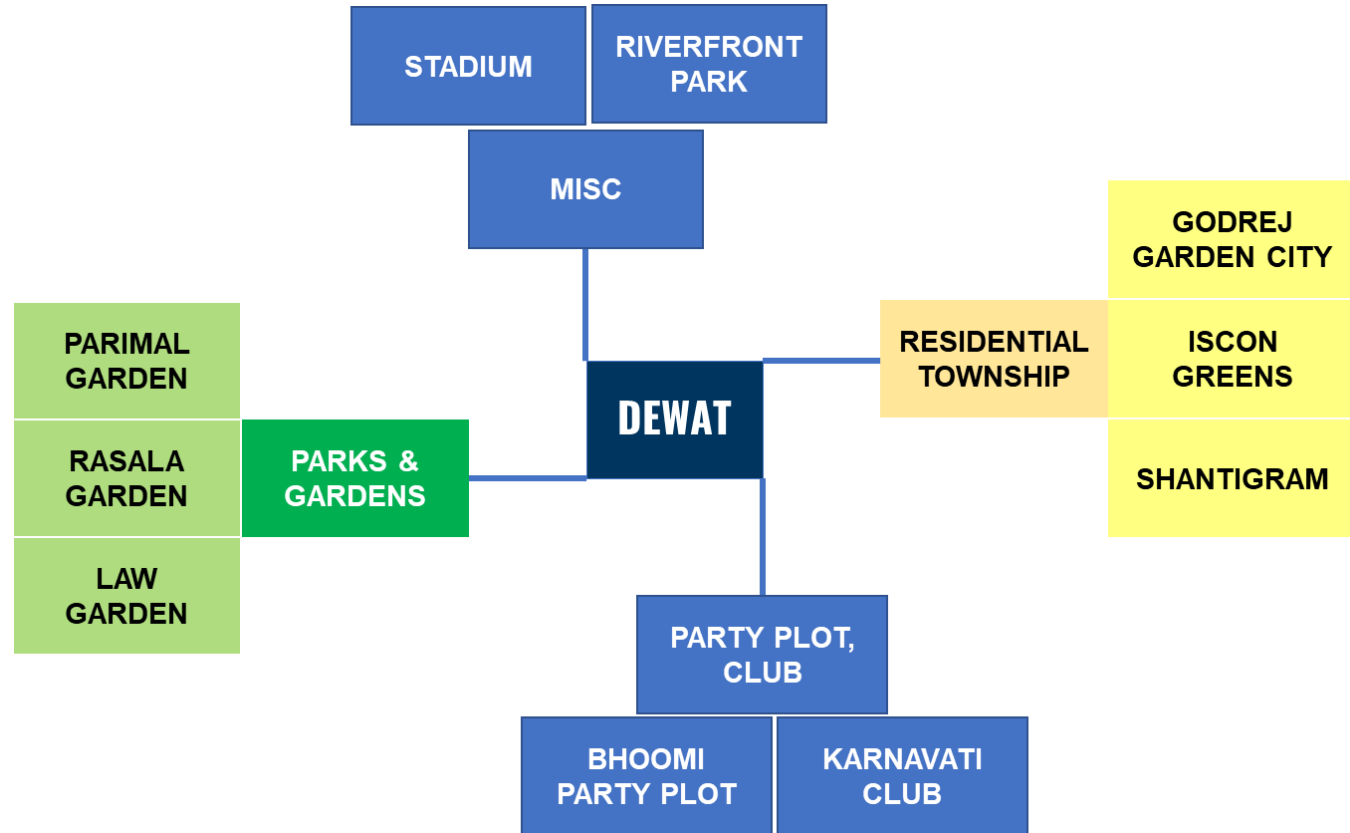
₹ 22 per KI

@ 5% increase in rate pa

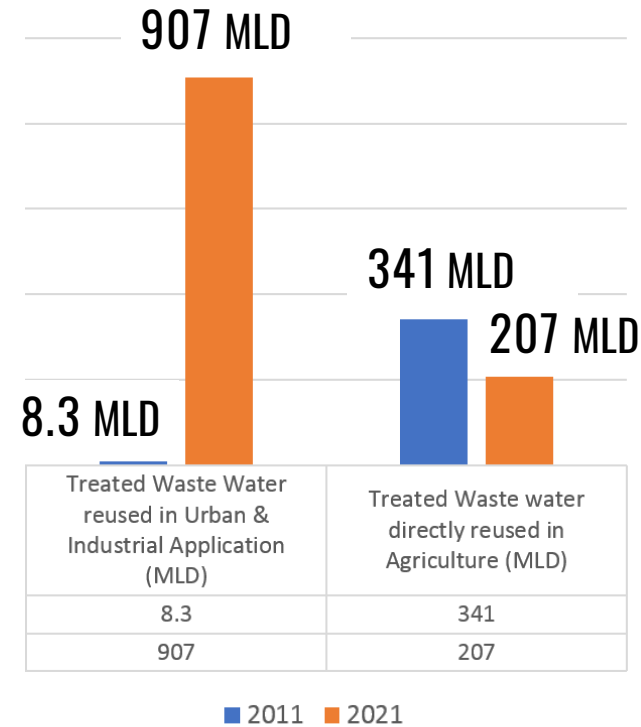
Wastewater DEWATs Reuse

Wastewater Reuse Profile of City

POTENTIAL SECTORS



Wastewater Reuse in Ahmedabad



Treatment Capacity of Centralized STPs
1075 MLD

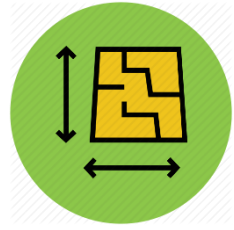
Total Reuse Capacity by DEWAT Plants
22.53 MLD

Only **2.09 %** of wastewater is treated by DEWAT systems.

Population Coverage of DEWATs
3%

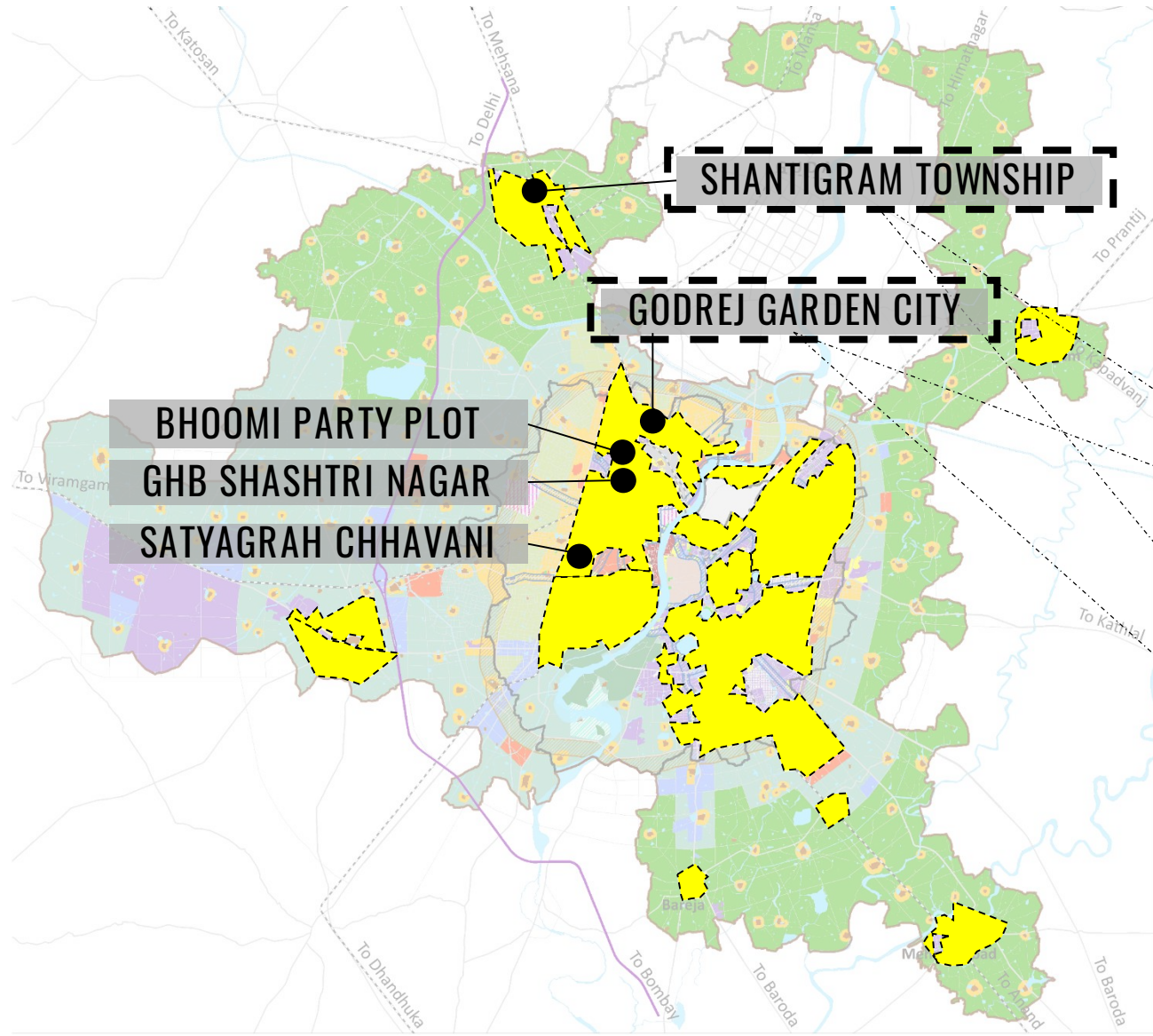
Source : Mona Iyer, "Urban wastewater reuse governing paradigms and enabling environment : a case study of Ahmedabad, Gujarat" - 2016

TECHNOLOGY ASSESSMENT



TECHNOLOGY	AREA REQUIREMENTS (SQM)	CAPACITY (KLD)	CAPITAL COST (LAKHS)	O&M COST (LAKHS/ANNUM)
Soil Bio Technology	400	100	8	2
Fixed Film Bio-Technology	2.80	1	0.35	0.01
DEWATs	2000	100	30	4
Phytorid	3000	100	30	2
Anaerobic Baffled Reactor	1000	100	40	3

LAND USE MAP OF AMC& AUDA



PROPOSED ZONING 2021

Legend

- Residential Affordable Housing Zone
- Transit Oriented Zone
- Central Business District
- Residential Zone 1
- Residential Zone 2
- Residential Zone 3
- Core Walled City
- Gamtal
- Gamtal Extension
- Central Business District
- Commercial & Logistics Zone
- Industrial Zone-General
- Industrial Zone-Special
- Knowledge & Institutional Zone
- Parks & Garden
- General Agriculture Zone
- Prime Agriculture Zone
- Special Planned Development
- Road
- Railway
- Heritage
- Burial Ground & Cremation Ground
- Sewage Treatment Plant
- Central Jail
- High Flood Hazard
- Waterbody
- Railway
- Road
- River & Water bodies
- DFC Corridor
- AUDA Boundary
- AMC Boundary
- GUDA Boundary

0 2.5 5 10 KM

AUDA
અમદાવાદ શહેર પાલિકા સંસ્થા
AHMEDABAD URBAN DEVELOPMENT AUTHORITY

R1 ZONE

Area – 174.5 sqkm.



214 MLD

53.2 MLD

160.8 MLD



15 MLD

1 MLD

11.15 MLD

SATYAGRAH CHHAVANI



0.41 MLD



0.96 MLD



0.22 MLD



DEWATs Packaged
Plant - 0.51 MLD



Rs 1.65 Cr

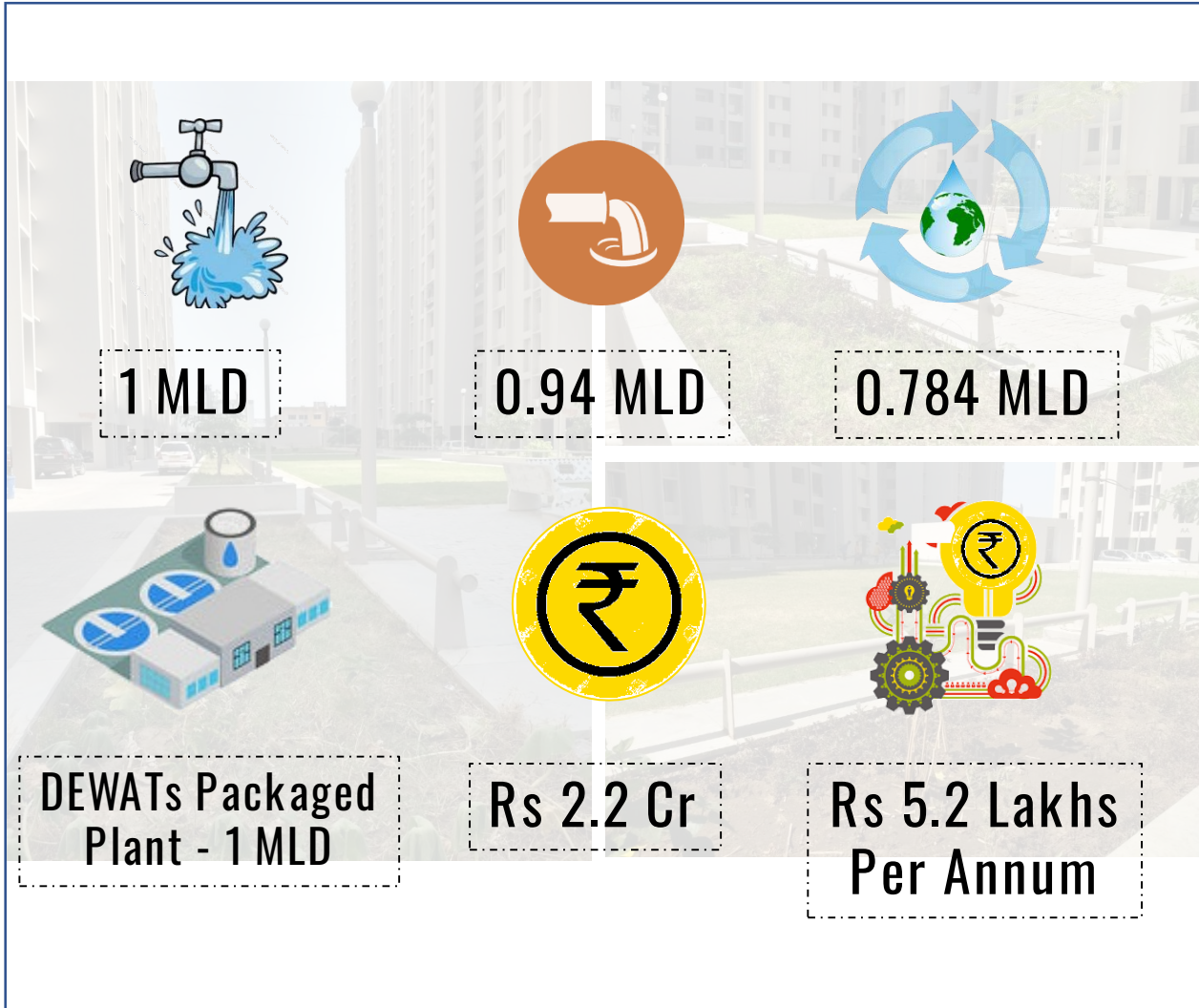


Rs 4.2 Lakhs
Per Annum



 Green Space  Built Up Space  Proposed STP site location

GHB TRANSPORT NODE, SHASTRINAGAR

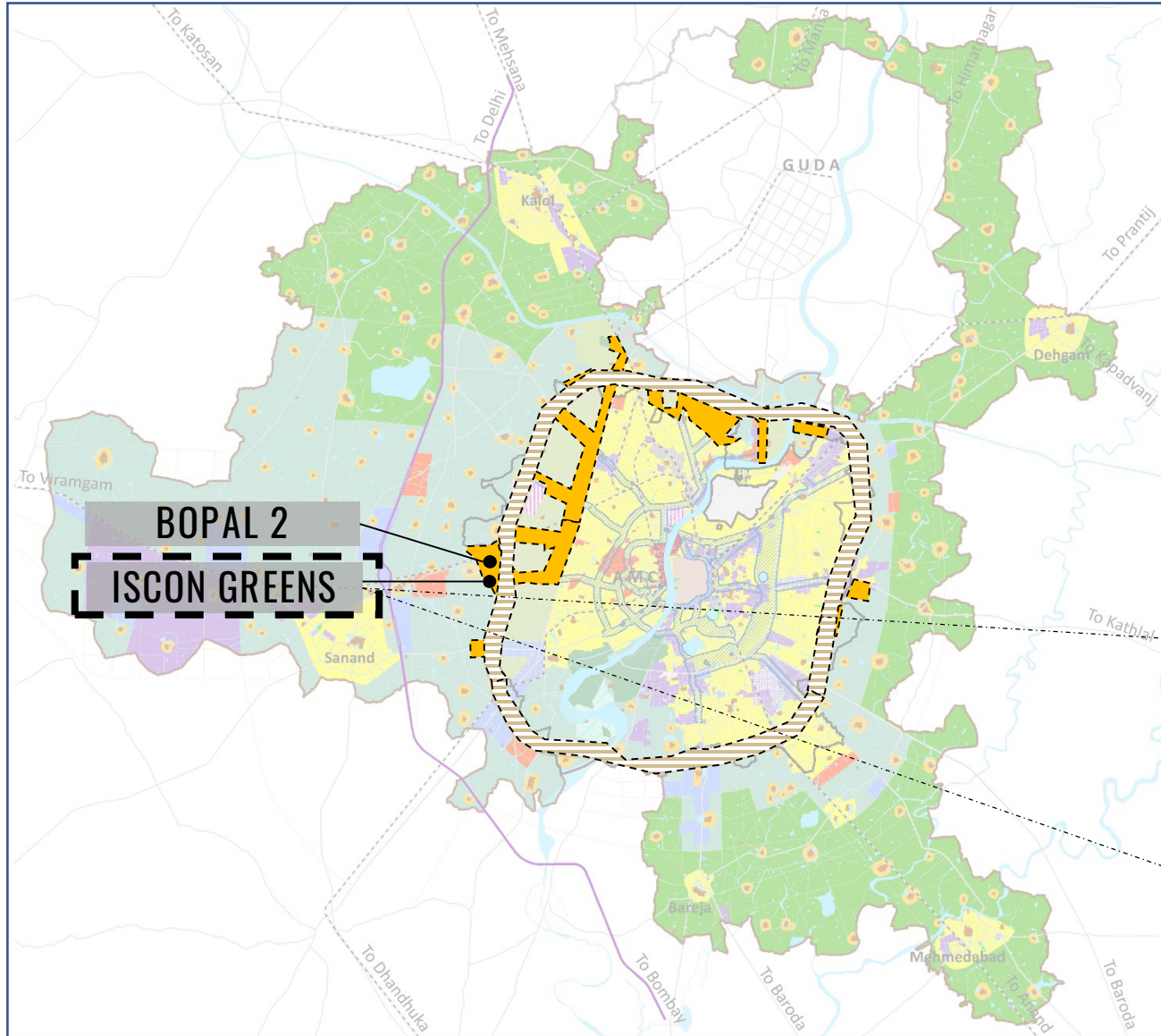


● Possible STP site location

MASS-BALANCE

NAME	GODREJ	SHANTIGRAM	SATYAGRAHA CHHAVANI	GHB SHASTRINAGAR	BOPAL 2
Total Water Demand (MLD)	10.01	11.55	0.41	1.18	2.5
Wastewater Generated (MLD)	7.72	8.91	0.33	0.94	2
Total Reuse Potential (MLD)	4.14	7.75	0.22	0.78	0.88
Reduction in Fresh Water Demand	41%	67%	54%	83%	35%

LAND USE MAP OF AMC& AUDA



PROPOSED ZONING 2021

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- Burial Ground & Cremation Ground
- Sewage Treatment Plant
- Central Jail
- High Flood Hazard
- Waterbody
- River & Water bodies
- DFC Corridor
- AUDA Boundary
- AMC Boundary
- GUDA Boundary

Scale: 0 2.5 5 10 KM

AUDA
 અમદાવાદ શહેરી વિકાસ સંસ્થા
 AHMEDABAD URBAN DEVELOPMENT AUTHORITY

R2 ZONE

Area – 14.2 sqkm.



14.4 MLD

0.42 MLD

13.95 MLD

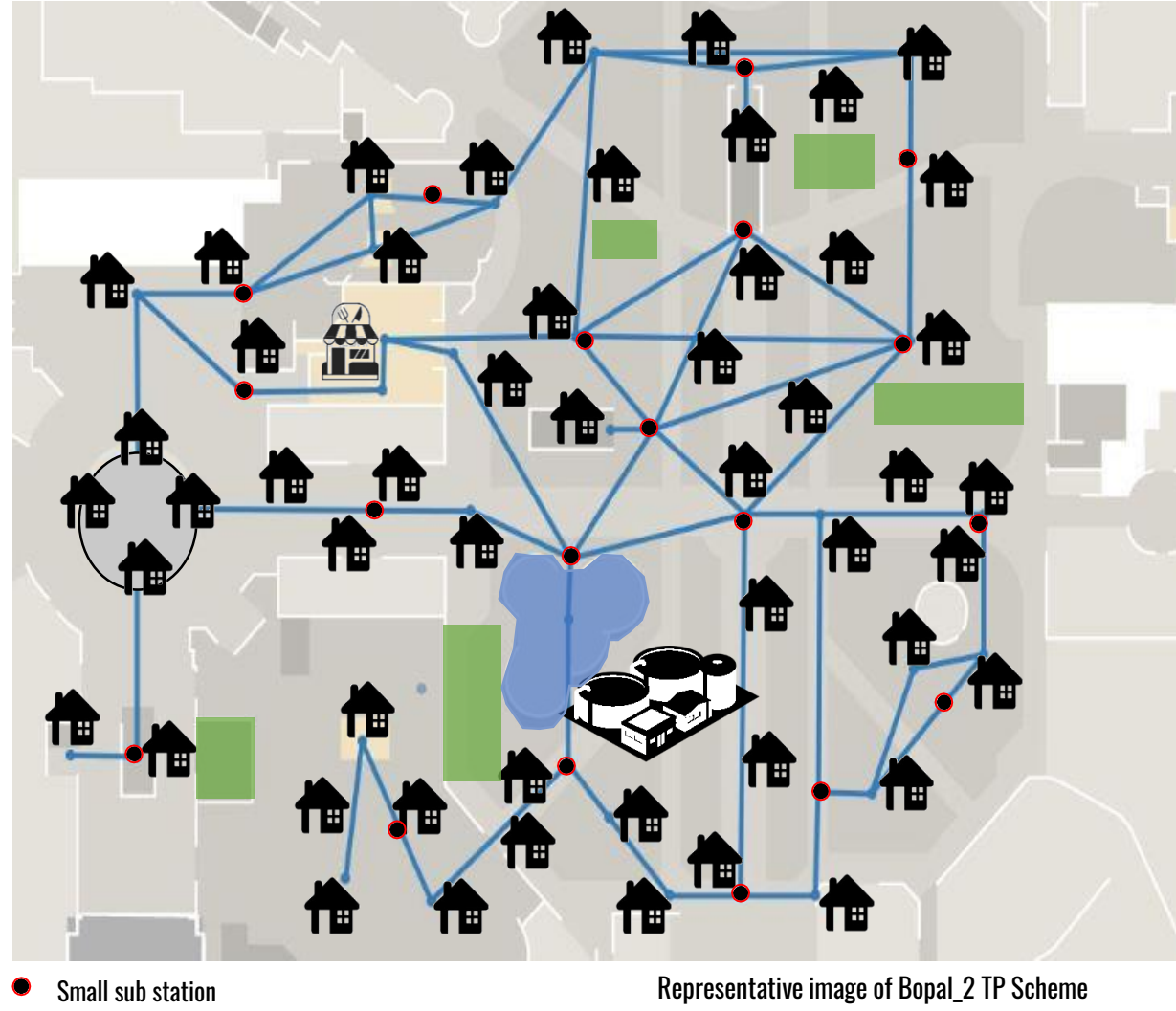
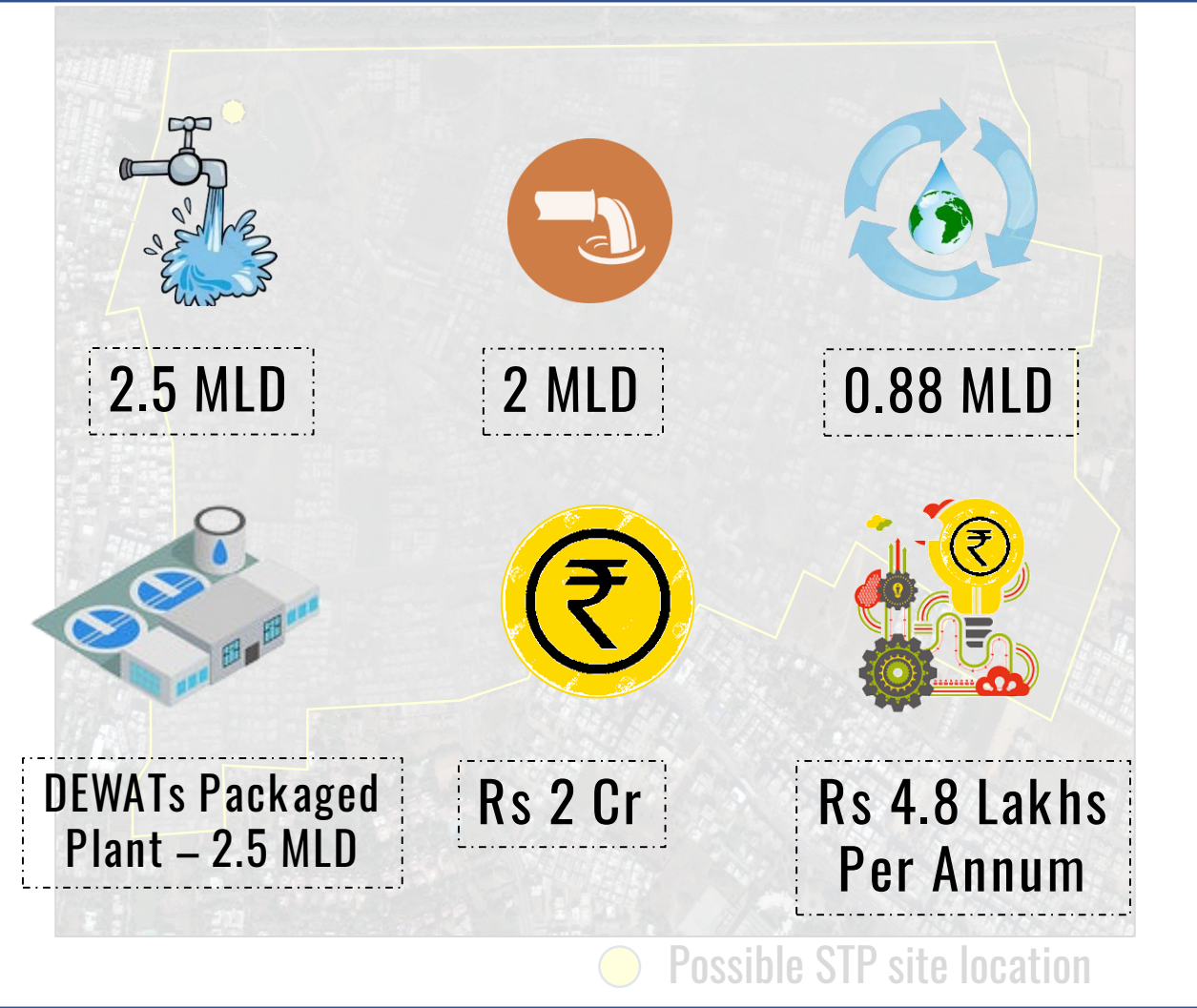


150 KLD

95 KLD

30 KLD

BOPAL -2



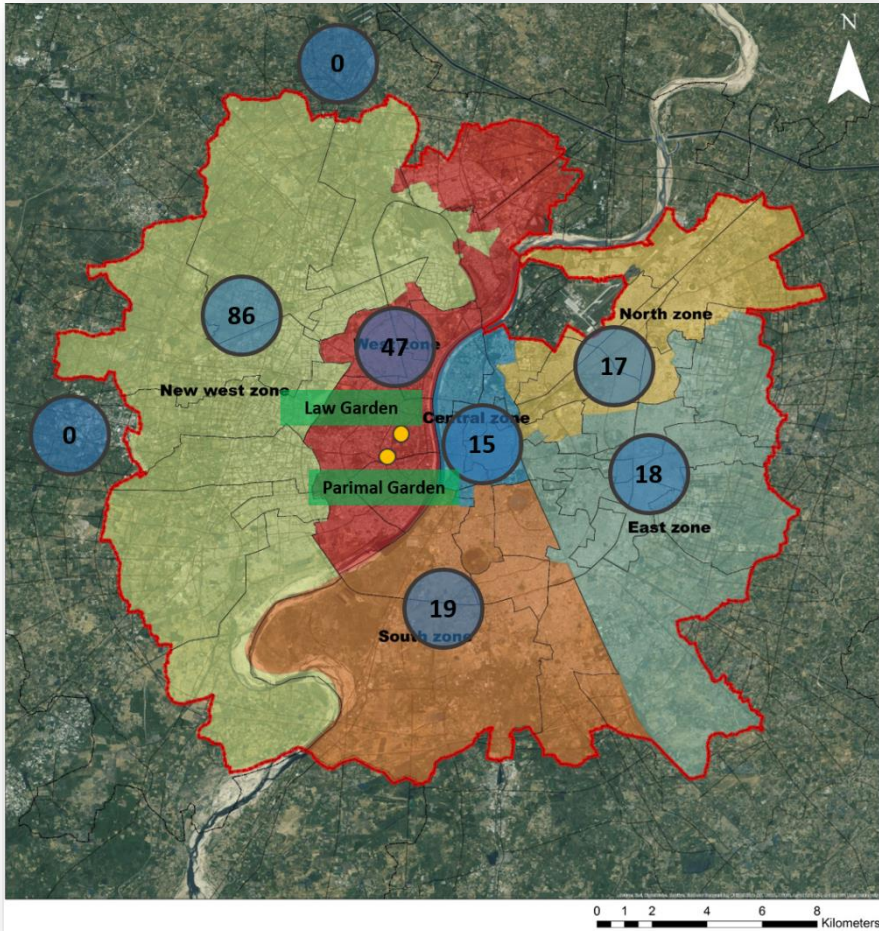
Spatial Study

Parks & Garden

Total No. of Parks & Garden : 202

Total Area: 17,27,296 sq.mt.

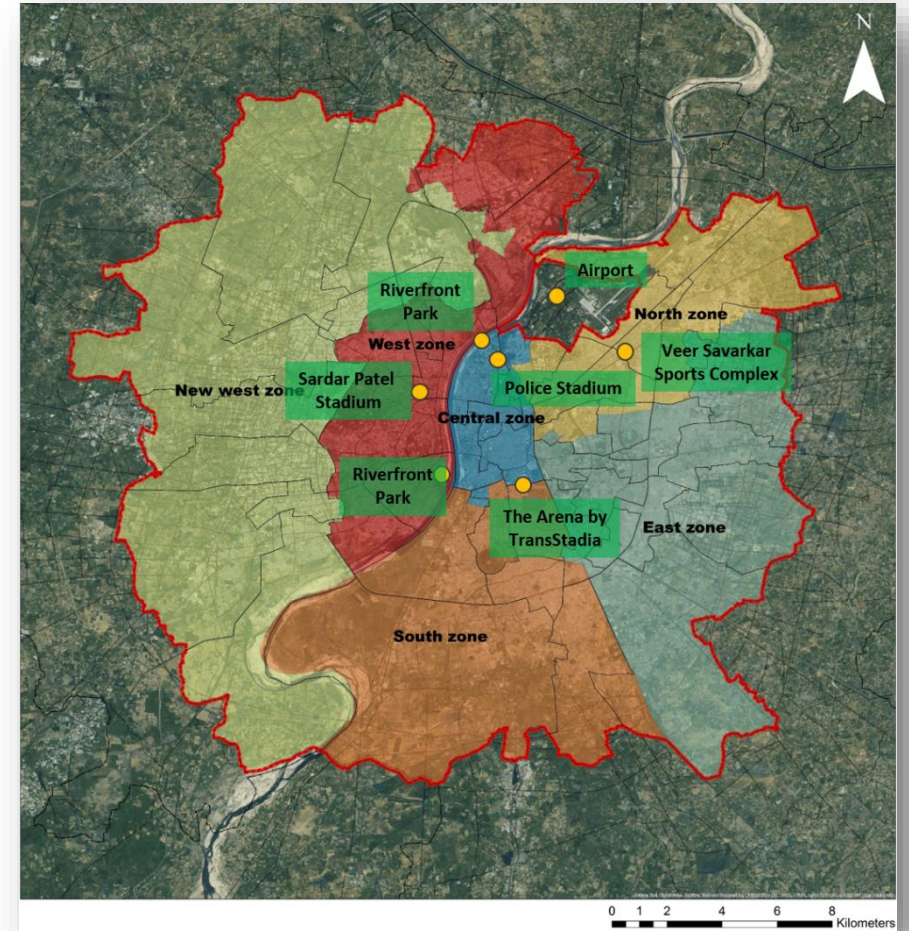
Total potential Reuse of Wastewater : 13.48 MLD



(Source: AMC)

Major Projects

Potential WW reuse assessment in miscellaneous activities with huge water demand - **Riverfront, Stadium, Airport**



Spatial Study

Technical Details(Parks & Gardens)



● **Rasala Treatment Plant**
(1,530 sq.mt.)

● **Law Garden**
Area: 43422 sq.mt.
WW Reuse: 0.086 MLD
Storage tank: 10,000 Lit.

AMC's Proposal

- 2 MLD treatment plant at
 - Asarwa Lake(Central Lake)
 - Udadi Lake & Gotil Garden (New West Zone).
 - Dedki Garden(South Zone)
 - Shramik Garden(East Zone)

Intervention

- Treated WW for refilling of various lakes.
- Excess of treated wastewater can be used in Gujarat college ground.



● **Parimal Garden**
Area: 36625 sq.mt.
WW Reuse: 0.072 MLD
Applications: Landscape,
2 Adjoining Public Toilets.

(Source: AMC Draft Budget,2016-17)



Technical Details(Parks & Gardens)

WW supply: Near By Sewerage Network

Rasala Nature Park (Tertiary Treatment Plant)

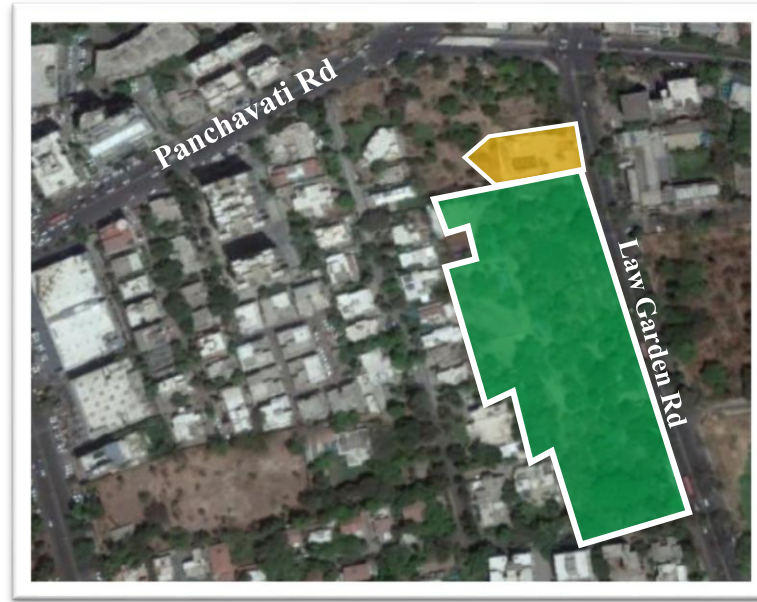
Treatment Capacity: 1 MLD

Underground storage tank: 10

Lakh Lit.

Contract : EPC(4.5 Crore)

O&M contract: Shivam Water Treaters (10 Years)



Treatment Plant

Rasala Garden (Area:14,900 sq.mt.)

Treatment Process

Coarse Screen

Sump Tank

Bio-Reactor (Aeration)

Pre-Sand Filter

Carbon -Filter

UV/RO filter

(Proposed for Potable Reuse)

Treated Wastewater

Other Applications

Parimal Garden

Law Garden

(Source: AMC, Shivam Water Treaters)

Spatial Study of Major Projects

Technical Details(SP Stadium)

The stadium holds the honor of hosting the first ever [One Day International](#) match played in India.

- At present, no provision of Wastewater Reuse for maintaining cricket ground.
- Continuous (14 Hrs) Supply of Water Through Individual Bore well.



Sports Club

Swimming Pool: 4.5 Lakh Lit

- WW generated disposed directly into sewers.
- No reuse of water in Swimming pool.
- Fresh water Consumption from Bore well.



SP Stadium, Navrangpura: Potential consumption/Day: 0.055 MLD

Ground Area: 18,500 sq.mt

Arena/Stands: 21,500 sq.mt.

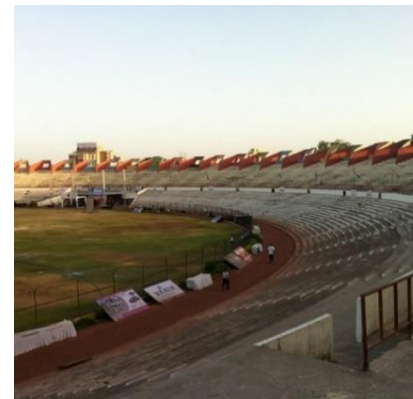
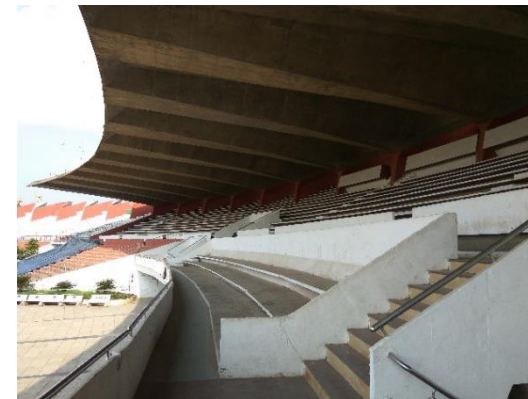


Total Area: 90,681 sq.mt

Treatment Plant



Bore Well



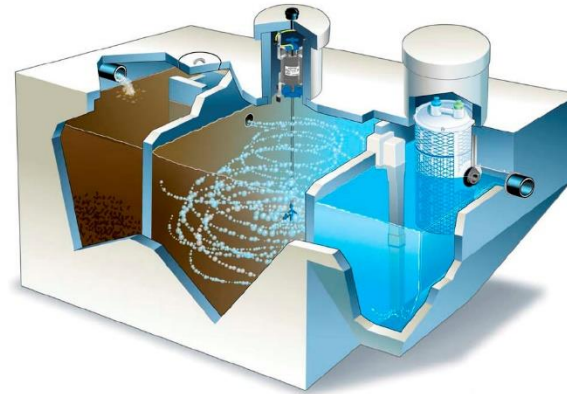
(Source: AMC Stadium Curator, Vijay Bhatt)

Spatial Study of Major Projects

Treatment Plant(SP Stadium)

The stadium holds the honor of hosting the first ever [One Day International](#) match played in India.

Use Of Packaged Treatment Plant by CDD



Advantages

- Decentralized system – useful in areas with space constraint
- Low operation and maintenance cost
- Does not require skilled human resources for operation.
- Re-use of treated water
- Low/Nil post installation management burden.

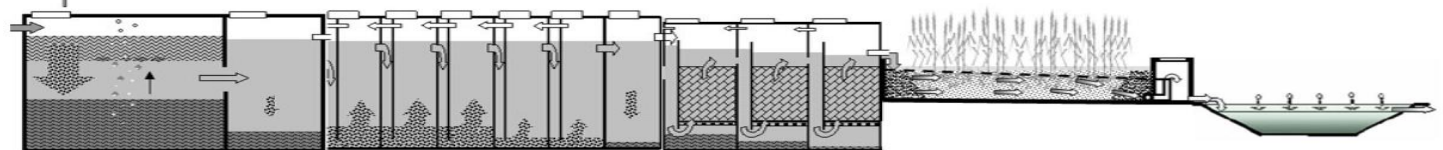
Best Practices: IIM Udaipur, Kadi Municipality (World Bank Funded project), Samarpan Ashram-Dandi Raksha Shakti University- Ahmedabad, etc.

Plant Specifications:

- Cost: 3.5 – 4 Crore
- Capacity: 0.5 MLD
- Space Required: 500 – 750 sq.mt.
- O&M expenses- 5,000-10,000/Month



Components of treatment plant:



Settler Tank| Horizontal Baffled Reactor| Constructed Wetlands| Polishing Ponds



■ Treatment Plant ● Bore Well

Reuse Potential: 0.25 - 0.3 MLD

■ Proposed Treatment Plant Location

(Source: Shubham Inc, Ahmedabad)

Spatial Study of Major Projects

Technical Details(SP Stadium)



- Freshwater Source: AMC supply + Bore Well
- O& M Cost : 40-50,000/Month
- Freshwater consumption/day: 15,000 Lit.

- Treatment Type/Level: Ultra Filtration Plant
- Footfall/day : 500-800
- Water recycled from last 7 years.

- Capital Cost:52 Lakhs/Unit
- Treatment Plant: 3.6 lakh lit/hr.



AMC Swimming Pool

Swimming Pool_1:
28 Lakh Lit.

Swimming Pool_2:1.90 Lakh Lit.

Treatment Plant

Bore Well

- Very less amount of water is being discharged into sewerage network.
- AMC practices reuse at 14 such swimming pools in city with individual **UF TP**.



(Source: AMC Stadium Curator, Vijay Bhatt)

Spatial Study of Major Projects

Technical Details(Sabarmati Riverfront)



Key Challenges faced while implementing SRFD Project

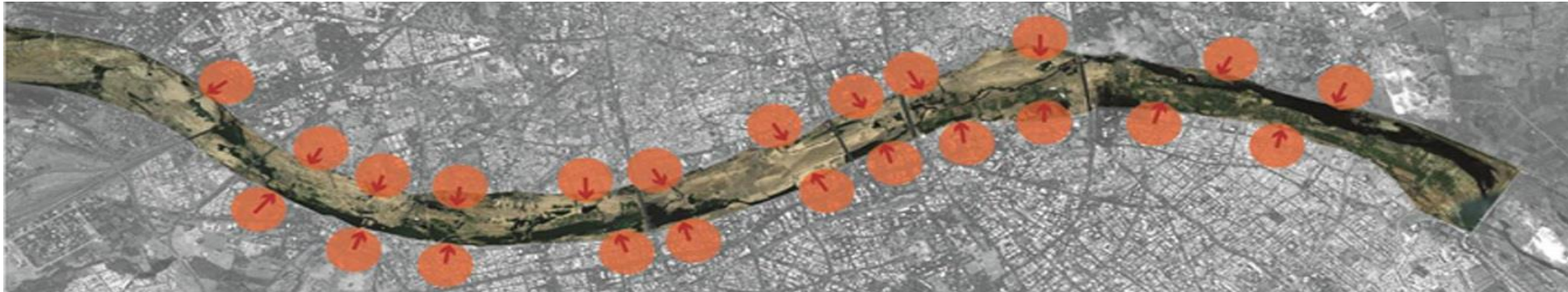
- Unorganized *Gujari Bazaar* of more than 1200 vendors on the banks of the river.
- Thoroughly polluted and contaminated Sabarmati river through 38 storm water outlets.
- Nearly 160 *Dhobis* using both the banks of the river for washing activities.



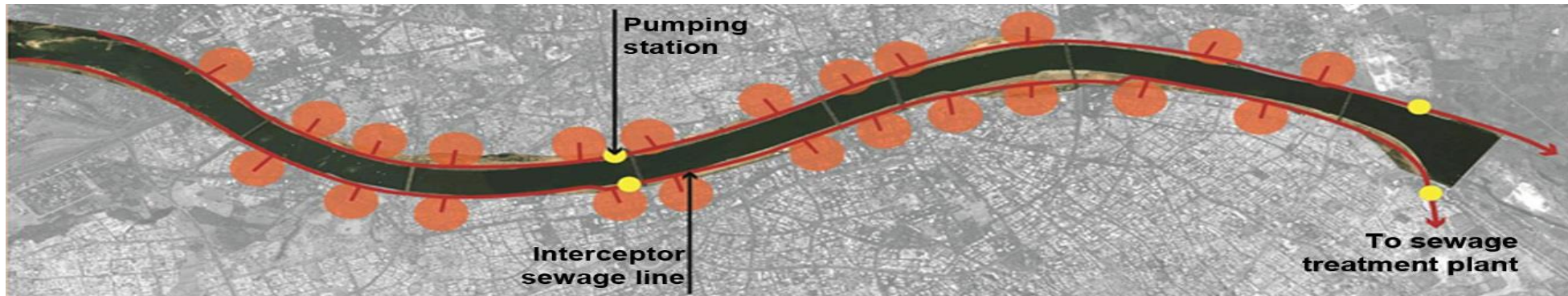
(Source: Sabarmati Riverfront Development Corporation Limited)

Spatial Study of Major Projects

Technical Details(Sabarmati Riverfront Interceptor Lines)



- Pollution of the river from the 38 storm water outfalls and industrial effluents, for that integrated storm water and sewage system with interceptor sewers has been installed.



- In, operation from **2011** as part of Environmental improvement objective at SRFD Project.

- Dia. For interceptor lines ranging from **1200 to 2000mm**.
- At present, **90%** of the WW is being trapped by Interceptor lines.
- Around **80 MLD** of Untreated WW is conveyed from this interceptor lines to STP at south of Vasna Barrage & Pirana separately.

(Source: Sabarmati Riverfront Development Corporation Limited)

Spatial Study of Major Projects

Technical Details(Sabarmati Riverfront Park)



- At present fresh water application, to maintain landscape
- **Water source:** Each park has individual bore well.
- **Water disposal:** Generated WW from Toilet, Cleaning of promenades is directly disposed into sewer lines.

Subash Bridge Garden



Area:
50,000 sq.mt.
Reuse potential:
0.1 MLD

Area:
18,500 sq.mt.
Reuse potential
0.038 MLD

Usmanpura Garden



Garden Area:
52,000 sq.mt.
Reuse potential
0.104 MLD

Event Ground:
25,000 sq.mt.
Reuse potential:
0.05 MLD

Flower Garden

Event Ground



(Source: Sabarmati Riverfront Development Corporation Limited)

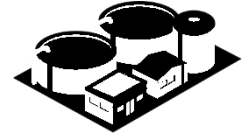
Spatial Study of Major Projects

Technical Details(Sabarmati Riverfront)

Total Water Requirement/Day for maintaining Landscape & other applications: 1.5-2.0 MLD

Proposal: Two 1.5 MLD treatment plant are proposed at Subhash park & Flower Garden.

- WW source can be tapped through Interceptor lines for treatment & Reuse.
- Greywater reuse for flushing, Treated WW reused for maintaining Landscape, cleaning purpose at Amusement Park.



Subash Bridge Garden



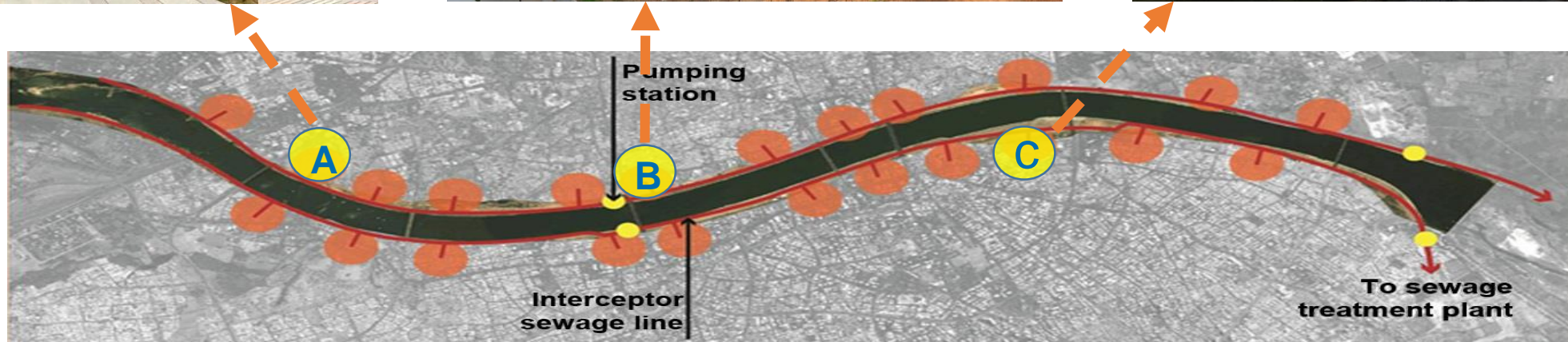
Usmanpura Garden



Event Ground



Flower Garden

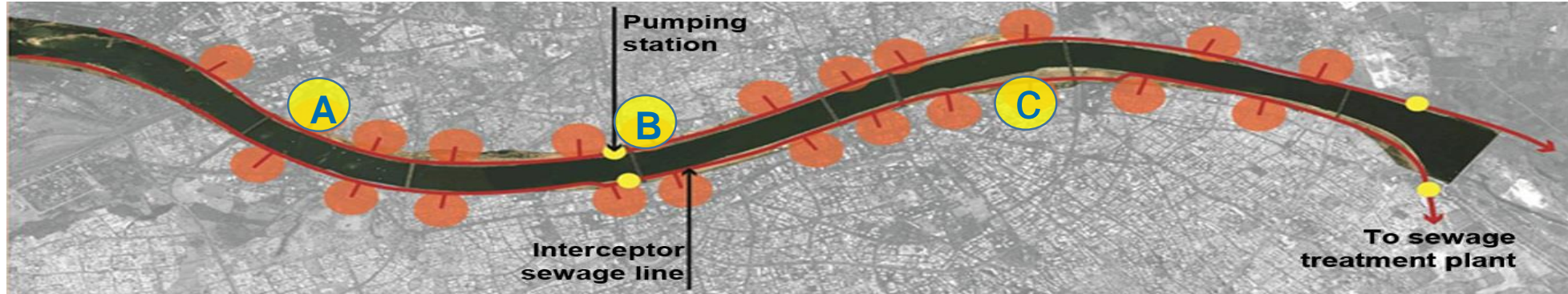


Policy Intervention: Mandatory treatment plant for new development along riverfront with specific capacity respective to the built-up Area.

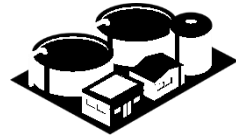
(Source: Sabarmati Riverfront Development Corporation Limited)

Spatial Study of Major Projects

Technical Details(Sabarmati Riverfront)



Proposed Technology

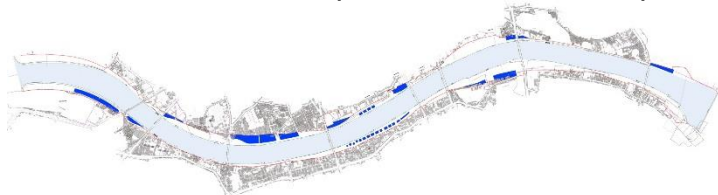


- Sequencing Batch Reactor(SBR)
- Membrane Bioreactor(MBR)
- CDD Technology

(Source: Shubham Inc, Ahmedabad & CDD)

Funding Mechanism

- Likely revenue from sale of land Rs. 2300 Cr.
- Out of which, Rs. 1200 Cr. to be returned by SRFDCL to AMC.
- A corpus of Rs. 500 Cr. to be kept aside for O & M Exp. of the project.



Cost of Installation

Civil Work: 60 lakhs & **System:** 18-20 Lakhs, **O&M Cost:** 27-30K per month
System: 0.8 -1.0 Crore **O&M Cost:** 45-50K per month
System:1.2 Crore/ 150KLD , **O&M Cost:** 8K per 150 KLD per month

Comparison with Alternative Technologies

	Space Reqd	CapEx	O&M Costs
Sequential Batch Reactor	Yellow	Yellow	Red
Membrane Bioreactor	Green	Red	Red
Stabilization Pond	Red	Red	Red
Reed bed Systems	Green	Green	Red

■ Lower than DEWATS™
■ Same as DEWATS™
■ Higher than DEWATS™

(Source: Sabarmati Riverfront Development Corporation Limited)

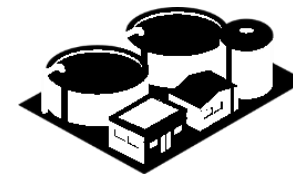
Spatial Study of Major Projects

Project Feasibility & Structuring



Cost of Ground Water Extraction v/s Cost of treated WW.

5-6Rs/kl is cost for extraction v/s 4-6Rs/KL for STW
10-12Rs/kl for TTW.



Ease of Operation

Low O&M expenses

Smaller Footprint

Project Benefits

Under Gujarat State Reuse Draft policy_2017, it ask for clear measures to restrict Ground water use for Public parks, gardens, non-domestic uses, etc.

- Direct cut on extraction of ground water(1.5-2 MLD), help to reduce ground water depletion.
 - As, a part of **Environmental improvement objective** with goal for water retention & recharge as self sustained model.
- Taping Untreated WW from the inceptor lines directly in return helping in **reducing the load** on existing infrastructure.

Business Model & Project Structuring

Three Business models based on the needs of local government & Market conditions are,

a. Service contracts to private party:

AMC

Ready infrastructure



O&M Contract

Private Company(Short term for 3-5 years)

(Revenue generation by selling out excess of treated WW to industrial commercial sector).

b. Hybrid-Annuity Model:

(Lack of Funds/No infrastructure Provision)

Local/State Government

Govt. 30%-40%



BOT Contract

Private Company to invest in remainder cost (Long term for 12-15 years)

c. Fully Independent:

(Market Demands but Government is disinterested)

Local/State Government

Specific Incentives:

a. Land related- Concessions on registration charges, property tax, etc.

b. Infrastructure- Rebates in tariffs for electricity/water/gas, etc.



Private Company Provide treated wastewater to ULBs at fixed low rates.

(Source: Sabarmati Riverfront Development Corporation Limited)

Spatial Study

Ahmedabad International Airport



(Source: AAI Office, Ahmedabad)

SVPIA Total Area: 45.5 lakh sq.mt.



(7.4 million passengers, 165 Aircraft/Day)



- AAI Office, Ahmedabad
- Airport Terminal 1 (45,000 sq.mt.) & 2 (52,000 sq.mt)



- Garden/Landscape Area – 1.35 Lakh sq.mt.
- TTP (In operation from 2010)



Spatial Study

Technical Details(TTP at Airport)



Fresh water Consumption/Day:5–6Lakh Lit. .

Source- AMC supply

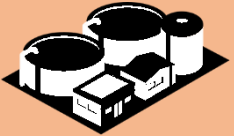
Applications of Freshwater- Flushing, Drinking, Cleaning, Primary water for chilling Plant of AC.



Total amount of Wastewater Generated/Day:
4 - 4.5 Lakh Lit.



Treatment Capacity:0.5MLD
Treatment Level: Tertiary Treatment
O & M Cost - 1.5 to 2 Lakhs/Month
(Including Electricity, Staff, Chlorine Cylinder)



Applications for treated Wastewater:

- **Maintaining Landscape of 1.35 Lakh sq.mt.**
(Usage: 3 Lakh Lit./Day)
- **Cooling tower purpose (AC system of 2 terminals)**
(Usage: 1.5- 2 Lakh Lit./Day)



(Source: AAI Office, Ahmedabad)

Technical Details(Applications & Future Provision)



Future Provision

- Installation of two **0.75 MLD TTP** with higher efficiency & treatment level near ATC tower (By Dec,2018).

Following MBBL for Climate Resilient Construction-**Environmental Clearances** it ask for, Sewage Treatment Plant with 100% efficiency shall be installed.

(Source: Model Building Bye Laws-2016 & AAI Office, Ahmedabad)



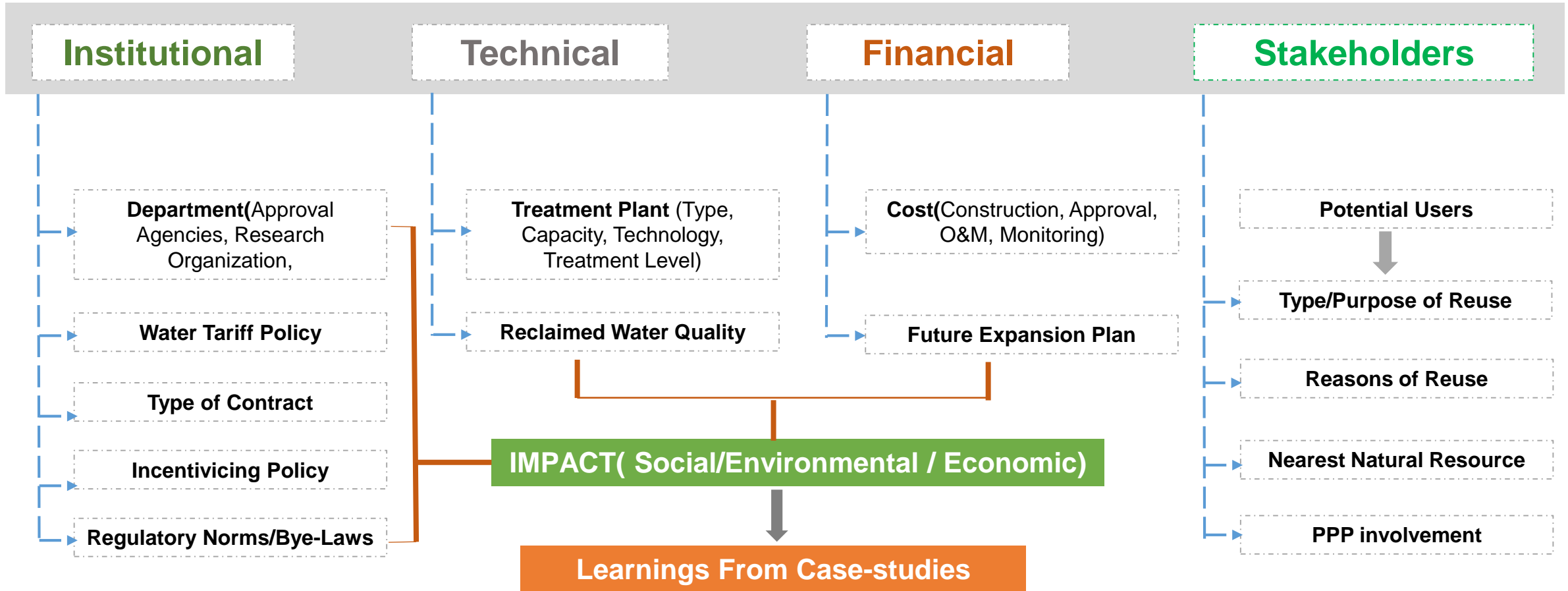
Intervention

- Use of **WSUD** concept for existing infrastructure on both terminals.(Reuse of Greywater for flushing).
- Layout of Dual Plumbing system from 2 new 0.75 MLD TTPs to new development & expansion near Terminal 2.



Inferences from best Reuse Practices in India

Parameters defining best Reuse Practices



Inferences from best Reuse Practices in India

Institutional

Bangalore Case Study

- **First city** to initiate wastewater reuse in **municipal** sector by 1990.
- Preparation of **Technological & Manual Guidance** for Reuse/disposal Wastewater.
- **Guidelines** for supplying through **Dual Water Pipeline** to new developments.
- Integrated Domestic **WSUD concepts** in residential units/small scale treatment plant in **Resi.Townships**(150 KLD-1 MLD).
- **Application** : Residential, Gardens, International Airport.
- International Case study: **Japan Greywater Reuse.**

Technical

Delhi's Initiative

- **Delhi Jal Board** installed dual water pipeline system in new development.
- **Use Specific** installation of treatment plant.
- At present, Delhi Jal Board **retrieves 40 to 50 MCD** by tertiary treatment.
- **Application:** GW recharging, household, Irrigation, Fire Stations, **Water cannon**, etc.
- International case study: **NEWater, Singapore**

Financial

Chennai's Reuse Model

- **Chennai Municipal corporation** charges Rs.100/month irrespective of usage .
- City's economic resource(**Sewage**) is sold to Chennai Petroleum Company Limited(**CPCL**).
- CPCL uses **Advanced TTP** to filter sewage reclaims 41 MLD of water for reuse.
- **CPCL** pays **Rs.12 crore** per annum to Chennai Metropolitan Water supply & Sewerage Board.
- International case study: **Ghana, West Africa**

Stakeholders

Surat's PPP model

- As a part of **ADB-GoI & GoG initiative**, preparation of **strategic business model** .
- To involve industrial sector, implementation of **rational pricing** for water to incentivize wastewater.
- As per **Water Meter policy,- SMC**,2008 all religious, commercial, non-residential connections are **metered**.
- Online **Payment Security** by **SMC**, creation of payment reserve account.
- **Proposed-** Recovering at least **O&M cost** from potential users, limiting ground water abstraction.
- International case study: **Beijing, China**

(Source: Water Recycle & Reuse- Workshop, MoUD)

Suitable Regulatory Framework Assessment

Three forces that influence Reuse

- **Water Security**
- **Treatment level of treated wastewater**
- **Sustainable use of natural resources**

Utilization of Treated wastewater in India is influenced by Certain factors

Direct Factors

- Policy Framework/
Regulations/Bye-Laws, etc.

Indirect Factors

- Availability of fresh water at very
Low Rates

- Preparation of India specific Recycle & Reuse guidelines which accommodates **STPs** in policy to encourage the reuse factor.
- Setting up **mandatory targets** for Re-use in specific sectors such as irrigation, **industrial** & commercial.
- **Capacity building** for institutions(ULBs) to improve **collection efficiency, Supervision & Efficient Enforcement** for the existing regulations/bye-laws.
- Inter ministry cooperation between different hierarchy-Local body, Ministry of Industries, MoA, MoUD.(**Clarity in roles & responsibility, contract structuring**).
- Involvement of private sector with strategic business model/subsidizing on capital investment for treatment plant.
- **Stakeholders**(Potential users, NGOs, CSOs, etc.) engagement at **formulation stage** for WW management & FSSM **strategies** while considering WW treatment cost v/s providing fresh water.
- **Indicators** to be developed to track the **efficiency** & accountability for service delivery, **O&M** contract through **PPPs**.

Comprehensive Plan

Agriculture Reuse

- Direct Treated – 341 MLD
- Indirect Reuse in periphery villages

INTERVENTION

Industrial Reuse

30 MLD TTP, Vinzol
Cost-58.95 Crore

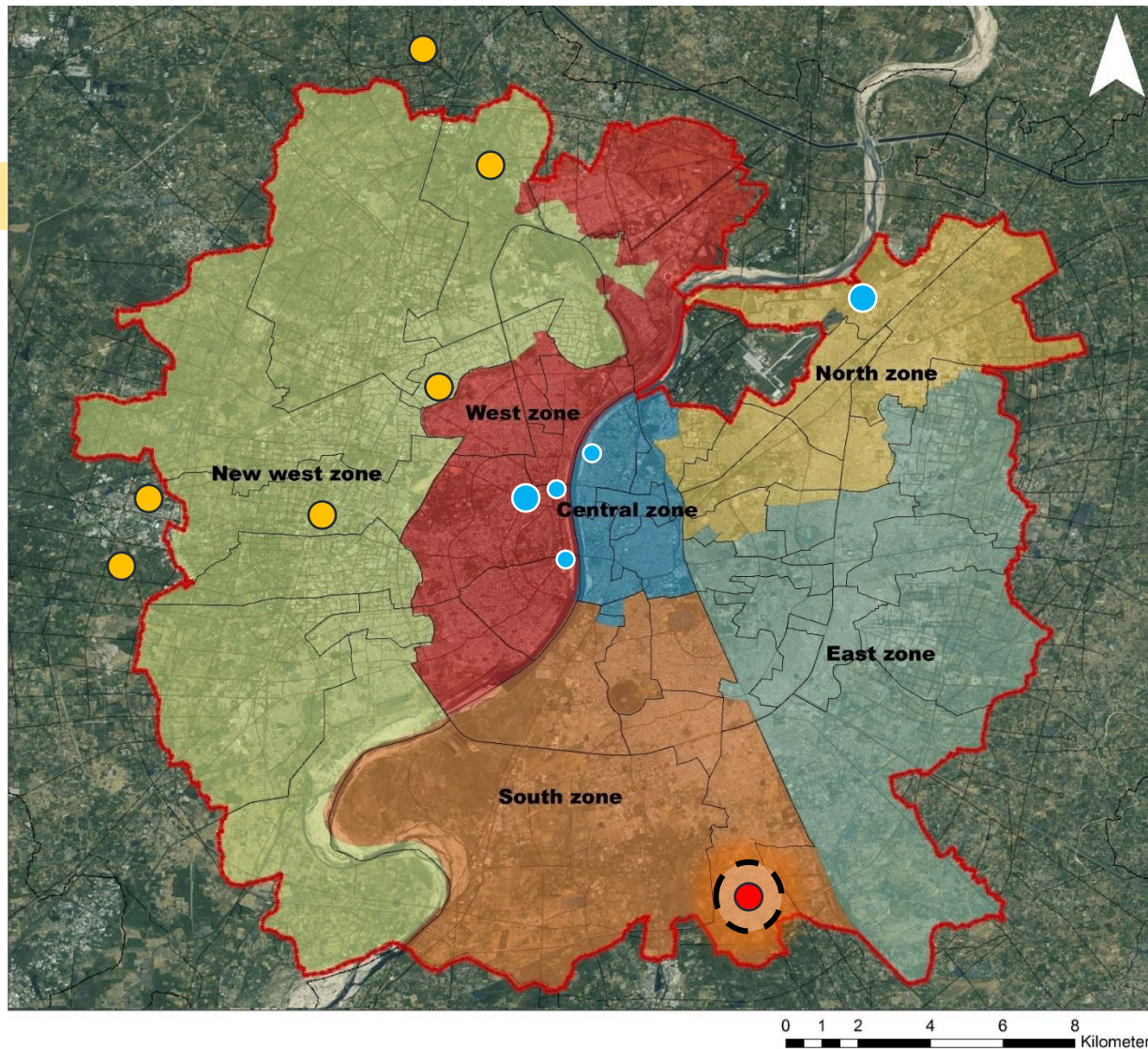
Residential/Commercial Reuse

- Residential Townships
Reuse- 4.0 MLD
Cost-5.85 Crore
- Major Projects – 3.5 to 4 MLD
Cost- 16 Crore

Public Domain Reuse

- Parks/Gardens
Reuse- 13.48 MLD
Cost- 60.66 Crore

Total Cost – 150 Crore



Overall Reuse Benefits

Dec, 2018

Overall Reuse – 51.48 MLD

3.81 Lakhs



5.85%



By 2021

Overall Reuse – 170 MLD

12.50 Lakhs



18.72%



(Source: CPHEEO Manual_2013)

Faecal Sludge Management (FSM)

INTRODUCTION | Why FSM?

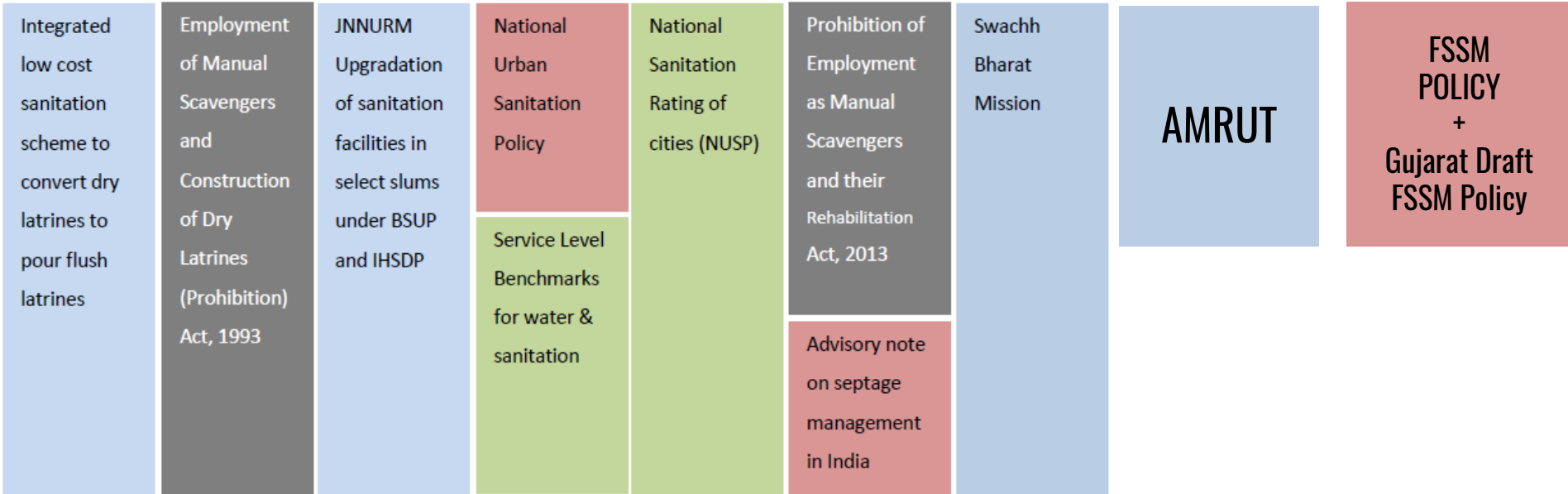
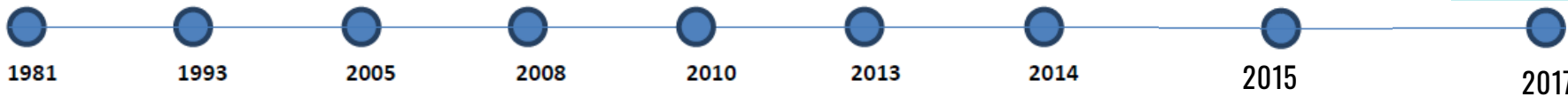
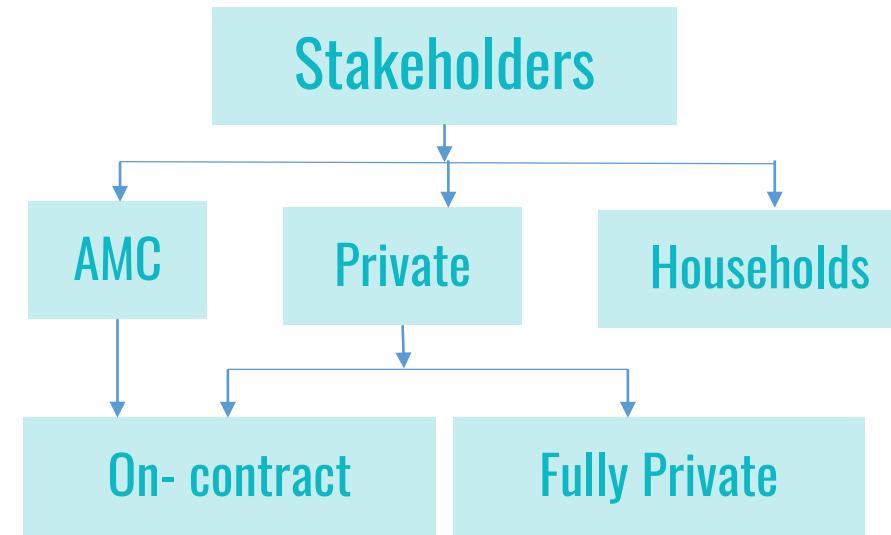
Coverage of OSS - 9% HH in AMC

+

Peripheries practiced where OSS is

Parallel system to centralized sewerage which is used as an **alternative** in **new developing areas** and **peripheries** which needs to be addressed.

Ahmedabad SLIP focused on centralized sewer systems with large STPs & does not account for FSM*.



Acts & Legislations
Policy and Directives
Performance Assessment
Funded Programs for infrastructure creation

Source: SLIP Ahmedbad, Amrut*

City Assessment: Existing Service Chain

Individual to community Septic tank

Majorly septic tank & soak pits at individual HH level

Unbundled Contracts

Zonal Contract - AMC & Pvt.

O & M Contract for STP
O & M Contract for SCADA

O & M Contract for SHP

Methods of Conveyance:

- Fighter pumps and tanker
- Effluent emptied in nearest manhole



Containment



Emptying



Transport



Treatment



Reuse

Limited reuse of Sludge (180 MLD Pirana STP)

- Depth of septic tank :
Resi. – 10 to 15 ft.
Comm. – 40 to 50 ft.
- Frequency of cleaning =
15 days to 12 years

Septage load augmented to STPs currently

City Assessment: Issues(gaps) and Potentials

Delay in complaint redressal by AMC

Augmentation in existing STPs

Pvt. players overcharge

Improper design of ST

Inadequate method of conveyance

SCADA does not record quality and quantity of sludge generated



Containment



Emptying



Transport



Treatment



Reuse

Lack of database of septic tanks in AMC

Proposed Sludge Hygienization Plant is a value addition

Lack of capacity at AMC & private level requires training of operators

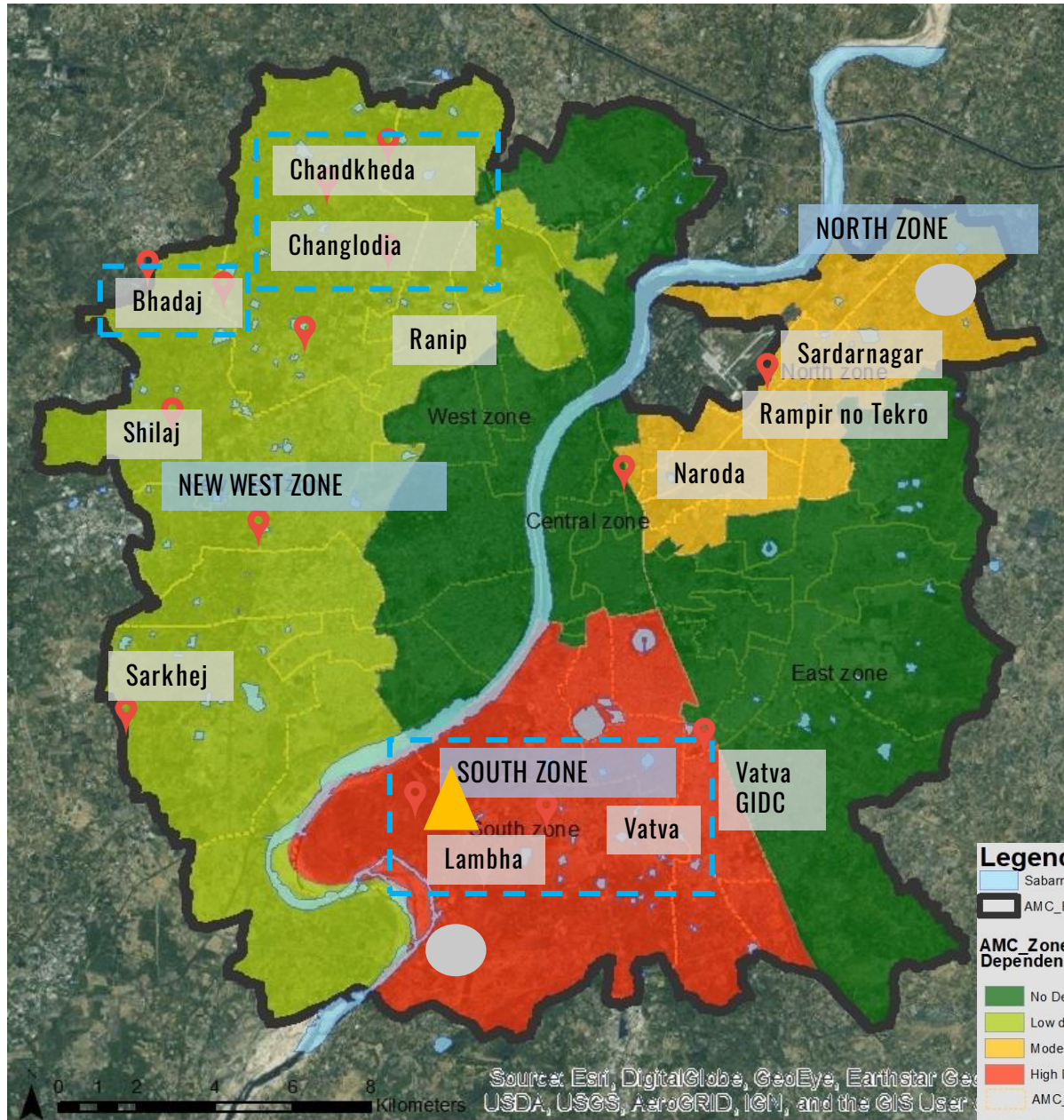
Irregular desludging

Operators not able to afford the transport of FS over large distances to treatment facilities

Lack of market opportunities

Good cost recovery

Dependency of OSS facilities in AMC Zones



📍 Location of site visits



100%

Dependency on Sewerage system



Outer areas like Lambha, Vatva have **sewer lines not existing or non-functional sewers.**



Presence of slums with OSS is practised



Reducing dependency on OSS system new TP schemes implemented after 2011 and presence of more private players in NWZ area.



New secondary sewerage Network in **Eastern, Southern, Western Ahmedabad 100% coverage in 2018 & completed in 2020.***

📍🏗️ Construction of Sludge Hygeination plant & New Sewage Treatment Plant for South and North Zone in AMC limit.*

Uncovered areas getting covered by sewerage network : Lambha and Vatva till ring road*

Source: SLIP Ahmedbad, Amrut* and AMC**

Aim : To develop a project on Faecal Sludge Management (FSM) for Ahmedabad City and its Peripheries.

Objective 1: Develop an efficient FSM service chain

Objective 2: Performance Monitoring and Improvement



Containment



Emptying



Transport



Treatment



Reuse

FSM Proposal : AMC & Peripheries with OSS

Areas outside AMC dependent OSS

Lack of service provided by AUDA or GP leading to **private players overcharging** as high as **500 Rs** against **30 Rs** within AMC

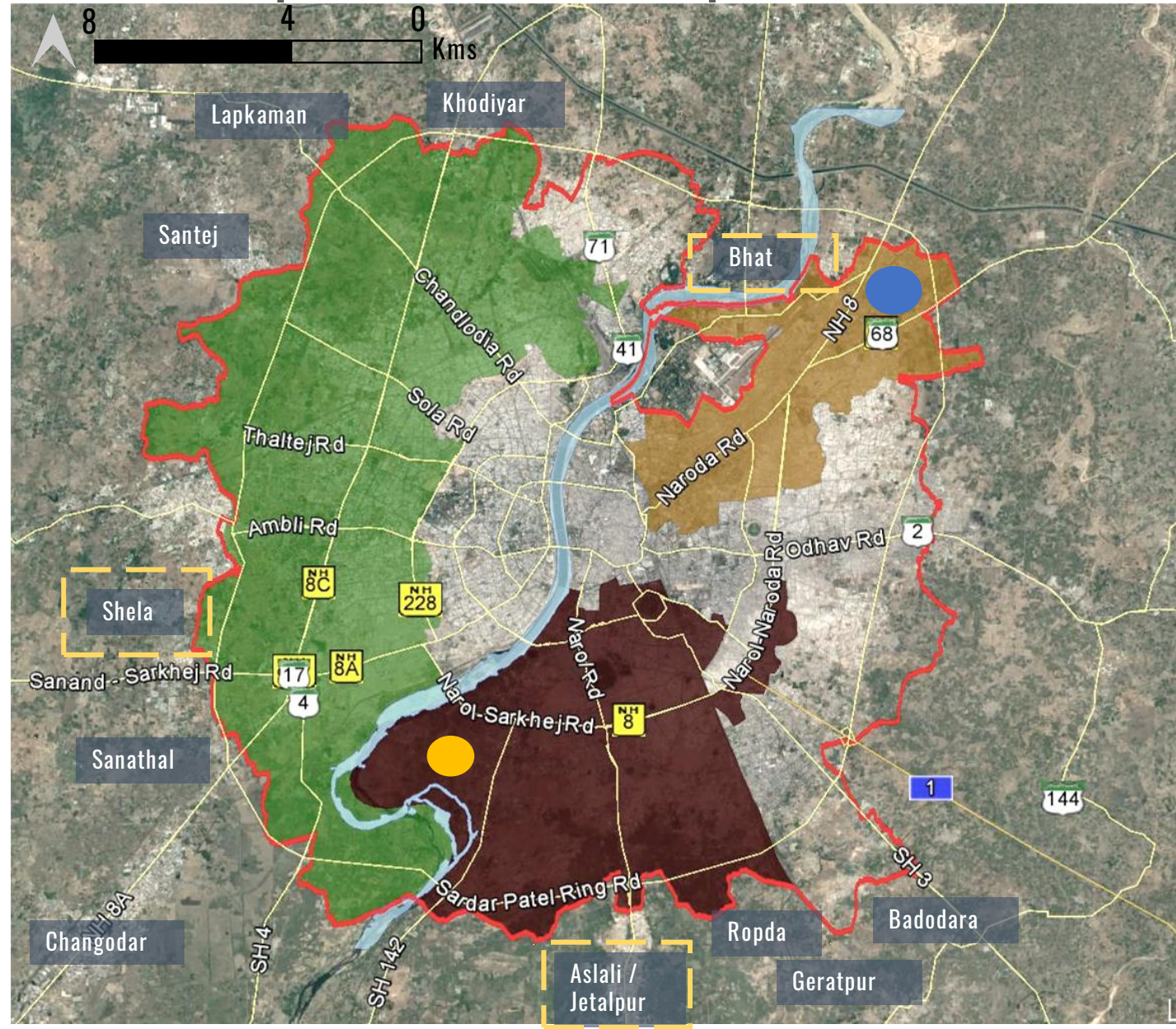
Unsafe disposal of faecal sludge by these private players is done into open field or water body

8 Villages (GP)

Urban Municipality ward : Sanathal (Sanand)

3 areas – TPS is proposed

SIR – Changodhar



Source: Primary Survey, Infrastructure Studio - 2017








FSM Proposal : AMC & Peripheries with OSS

Institutional Arrangement : AMC + AUDA + GP (8 Villages) for extension of Zonal Contracts to peripheries

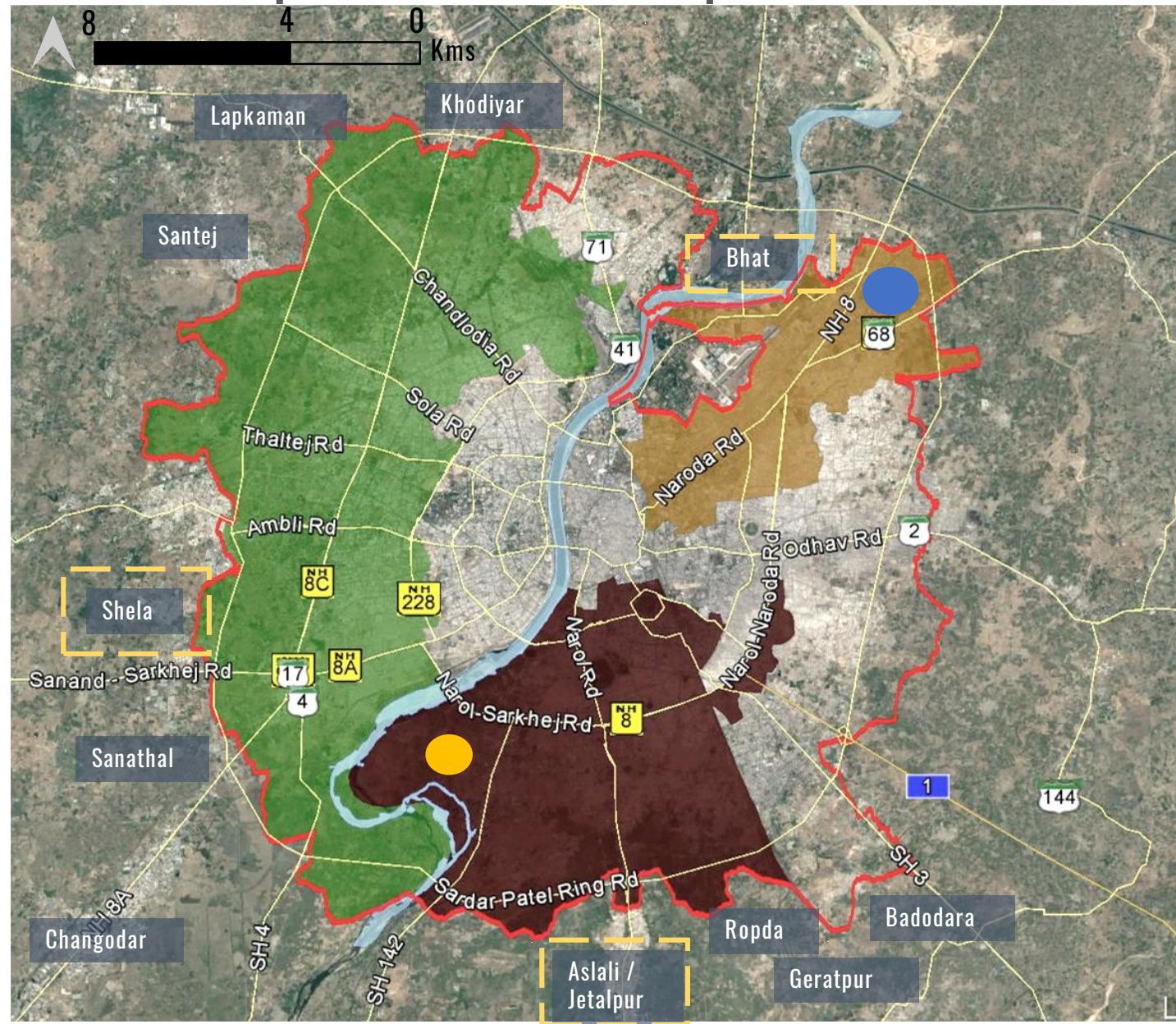
Contract Area	No. of Septic tanks	Faecal Sludge generated (cu.m./day)	WW generated (MLD)
SZ + Peripheries	23159	174	12
NWZ + Peripheries	5536	42	3
NZ + Peripheries	1872	14	1
TOTAL	30567	270	16

Treatment is required

Design Year 2031:
Add. no. of Septic tank = 1832

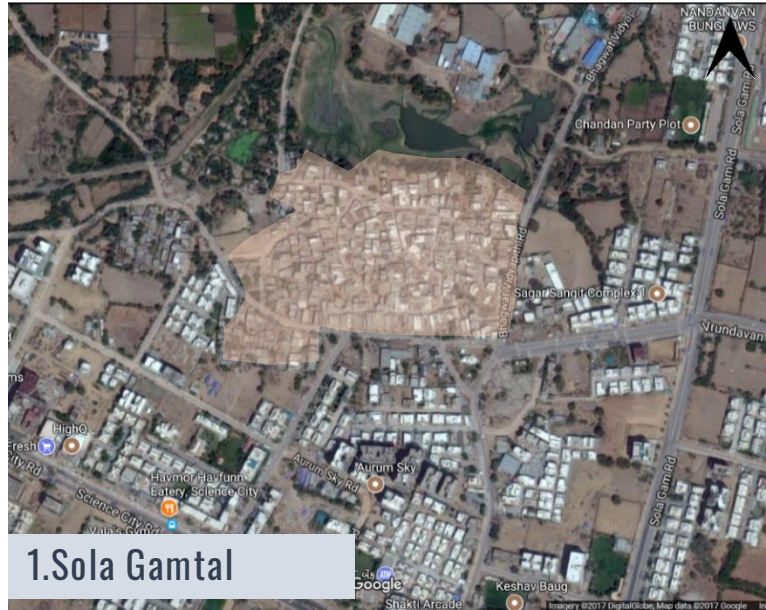
-  AMC Boundary
-  Zone Boundary
-  Water Bodies
-  Roads
-  Draft TPS Sanctioned
-  PROPOSED STP (NZ)
-  180 MLD STP LOCATION

Source: Primary Survey, Infrastructure Studio - 2017



Existing Scenario: 3 cases

Sewered area in AMC



1. Sola Gamtal

- > **Inefficient performance** of sewerage network due to **congested roads**
- > **High Sewerage Connection Charges**

Non - Sewered area in AMC



2. Lambha

- Monsoon GWT – 20-25 ft.
- > **Water body being polluted** by improper disposal of WW & haphazard installation of network
- E.g. Vatva – Non functional Sewers

Non - Sewered area in AUDA



3. Shela

- Monsoon GWT – 20-25 ft.
- > **Less distance b/w bore well & ST**
- > **Scum disposed off in water body or open field**
- > **Lack of enforcement by AUDA**

Need to realize high degree of complexities to arrive at context specific solutions

Develop GDCR to insist on a range of on-site sanitation options as mandatory depending on location & groundwater table.

Existing Scenario: 3 cases

Sewered area in AMC



Non - Sewered area in AMC



Non - Sewered area in AUDA



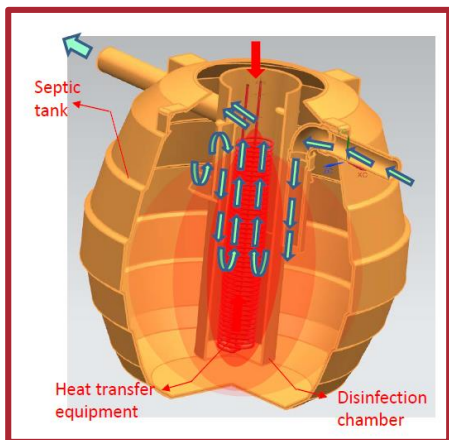
	Parameter	Conventional sewers	Settled Sewers	Septic tank	Effect
1	Excavation	Deeper	Shallow	Depends on groundwater level	+ve for Settled Sewers
2	Water Supply	More w/s (125-135 lpcd)	Less w/s (40 lpcd)	-	+ve for Settled Sewers
3	Separation of black water & grey water	No	Yes	Yes	
4	Capital cost	77 – 171 lakhs/km	8 to 15 lakhs/km	0.9 – 1 lakhs	+ve for Septic tanks
5	Individual Septic tank	Not required	Required	Required	+ve for conventional
6	O and M cost	Very high	Very low	High	+ve for Settled Sewers
7	People's perception	More preferred	Not Available	Less preferred	+ve for conventional
8	AMC	More preferred	Not Available	Less preferred	+ve for conventional



Source: Primary Survey, Infrastructure Studio - 2017

Objective 1: Develop a efficient FSM service chain

Solar Septic Tank



Cost = 1.6 lakhs
 Life = 10 years
 Desludging period = 5 to 6 years

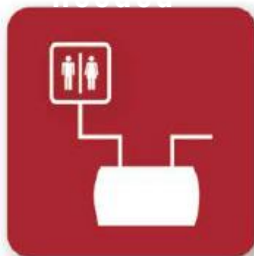
OR

Interventions : Schedule Cleaning of 2 years
 Enforce type of ST design in GDCR
 Remuneration of zonal contract linked to trips per day at STP

No additional trucks are



Containment



Emptying



Transport



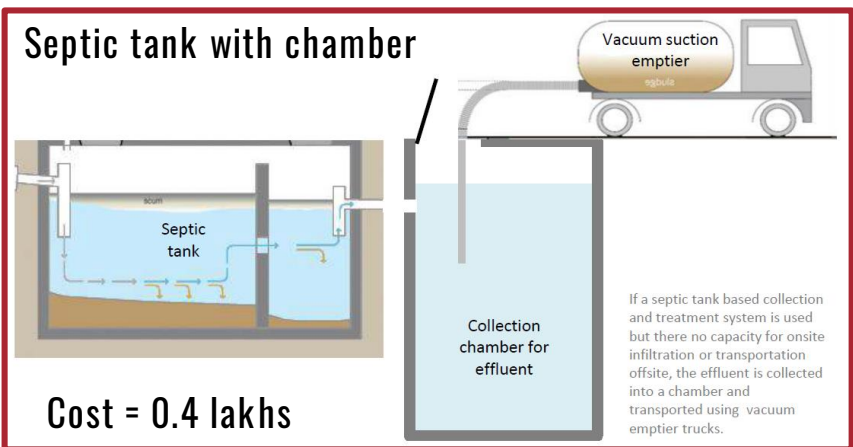
Treatment



Reuse

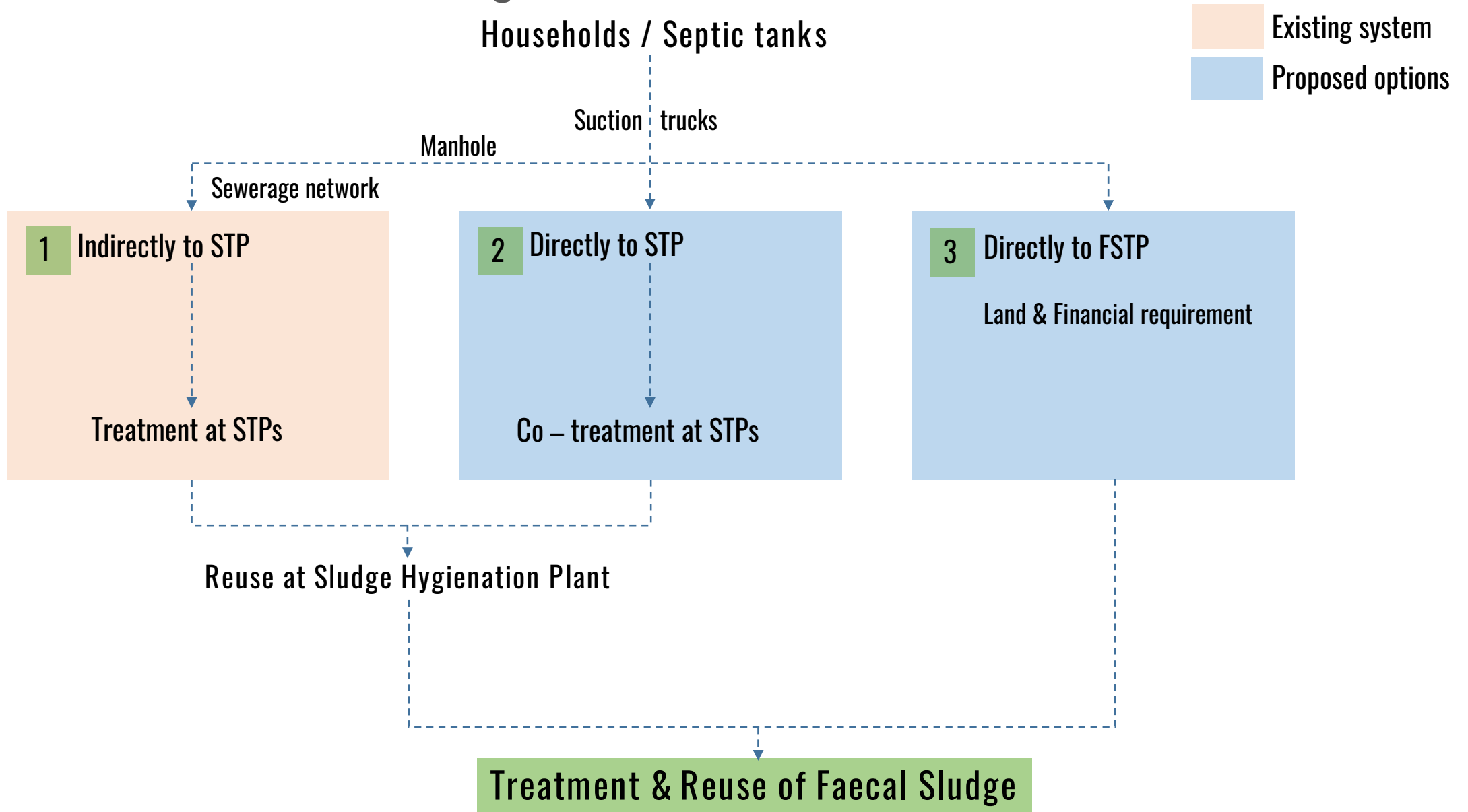
Reuse of FS as manure at SHP

Treatment of 230 cu.m/day of FS directly at 180 MLD STP



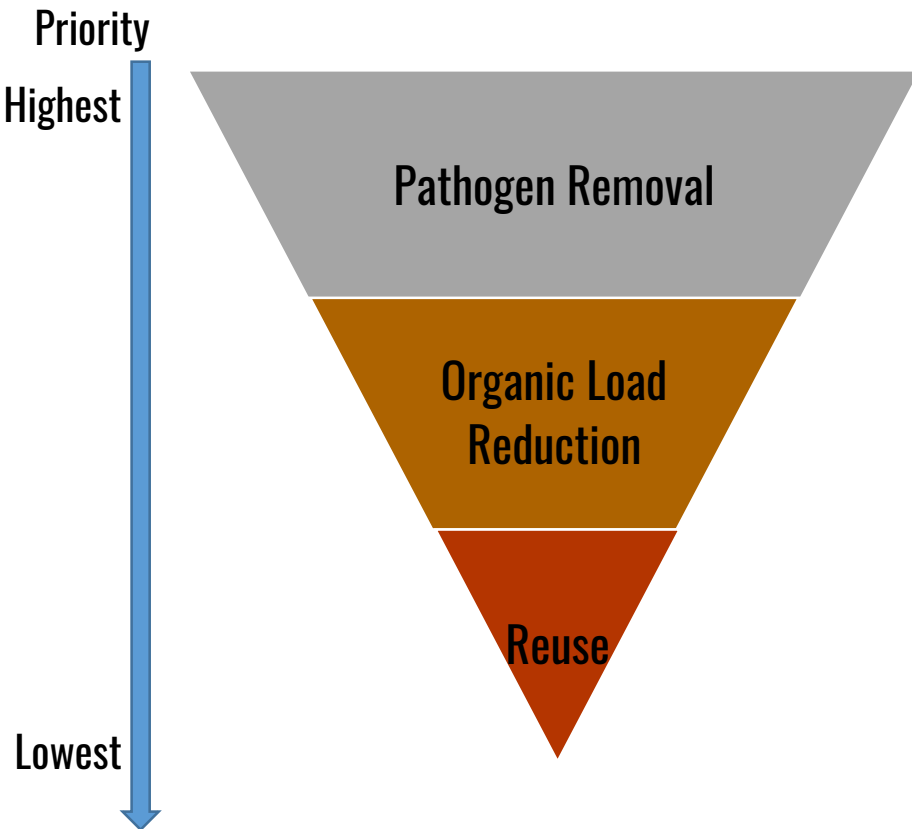
Cost = 0.4 lakhs

Options for treatment of Faecal Sludge



Treatment – Objectives

Selection of treatment options based on achievement of following objectives

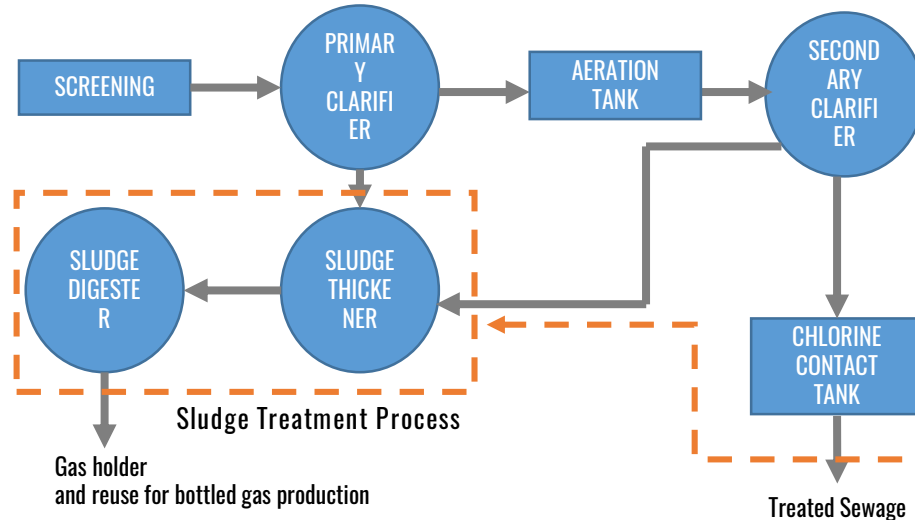


Intervention – Co-treatment of FS with STP

Basis for Intervention

1. Recommended for Class 1 City**
2. Add. Design Capacity
3. Monitoring – SCADA at STP can be used measure physical parameters

STP 180 MLD with ASP Technology



Design Standards for ASP technology*		
Organic Loading (kg BOD/m ³ .day)	1.2 - 2.4	1.23

Physical parameters for Septage**			
	CPHEEO	USEPA	180 MLD STP
BOD	6480	7000	
COD	15000	15000	
pH	1.5 – 12.6	6	
Moisture content	40-60%	40 – 60%	

Quality of FS need to be monitored at STP

Source: *CPHEEO,2013 , **Advisory on Septage Management, MoUD,2013

Objective 2 :Performance Monitoring and Improvement



DEVELOP A DATABASE FOR SEPTIC TANK AT ZONAL LEVEL

OSS indicators augmented with SLBs by citywide GIS mapping using Census of 2021



INSTALLATION OF EQUIPMENT FOR MONITORING SLUDGE QUALITY AT STP- By O & M Contracts for SCADA



ULB LEVEL RESOLUTIONS

- ST Design checked at BU permission level
- Penalties for improper disposal of FS
- Licensing & Monitoring of desludging service providers in AUDA region.

PERFORMANCE MONITORING

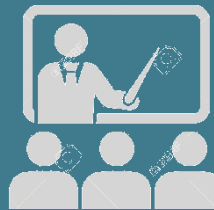
SOCIAL AWARENESS

CAPACITY BUILDING



TRAINING BY AMC FOR ENSURING SAFETY & AWARENESS

Municipal Staff & Pvt. Operators



Norms for Professional

Regular Training of

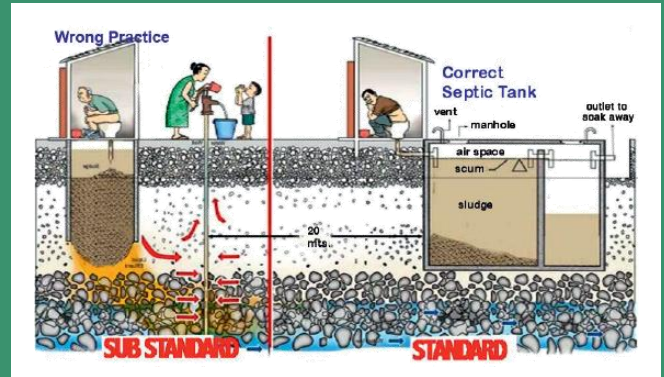
1. Operators of AMC & private
2. AMC Engineer (BU permission)
3. Plumbers
4. Architects
5. Civil Engineers



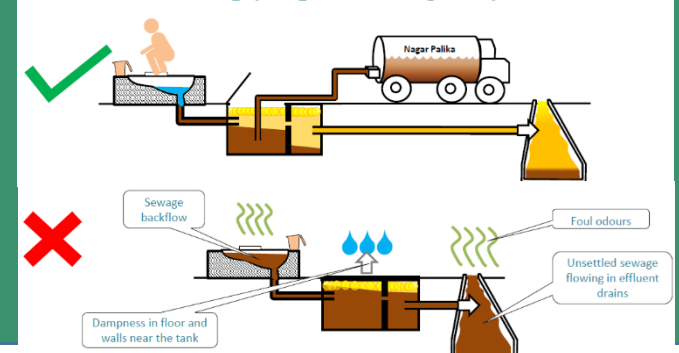
MARKETING APPROACH OF SANITATION BUSINESS TO THE COMMUNITIES

Gujarat FSSM Policy - ULB level Implementation - Publicity Dept. – AMC

IEC promoting Schedule cleaning of ST for safe OSS



Empty Septic tank regularly



Fecal Sludge Management – Business Model

Proposed Model



Cleaning Frequency

Once in **2** years



Number of Trips

6 per day



Disposal

180 MLD **STP**



New Service Charge




Rs. **325** per cleaning



Removal

Both Sludge & Wastewater

(Zone + Nearest settlements)

(Zone + Nearest settlements)	 <u>No of Households</u>				
		<u>6 cu.m.</u>	<u>3 cu.m.</u>	<u>Trucks</u>	<u>Admin</u>
<u>South Zone</u>	23159	8	1	21	5
<u>North Zone</u>	1872	1	3	12	5
<u>NW Zone</u>	5536	3	1	12	5

Trucks Owned by AMC
6 cu m : 12 3 cu m : 5

Total Trucks required
6 cu m : 12 3 cu m : 5

Fecal Sludge Management – Business and Financial Model

To STP



Expenditures : 138 lakhs

Salary : 70.20 lakhs

Diesel : 52.45 lakhs

Repairs : 15.74

Total Income : 58.50 lakhs

GAP: 80 lakhs

To nearest Manhole



Expenditures : 97 lakhs

Salary : 70.20 lakhs

Diesel : 20.2 lakhs

Repairs : 6.06 lakhs

Total Revenue : 58.50 lakhs

GAP : 38 lakhs

Current Spending

Salary : **466** lakhs

Diesel : **37** lakhs

Total : **503** lakhs

Budgeted Income

25 lakhs

Gap

473 lakhs

New charge collected : **Rs 325** per cleaning

Previous charge – Rs 30

Improper cleaning resulting in increased frequency

Approximate money spent : $30 \times 2 \times 12 \times 2 = \text{Rs. } 1440$

Or $30 \times 1 \times 12 \times 2 = \text{Rs. } 720$

Cost Recovery - Wastewater Sector

Current Cost recovery : **50%**
(2016-2017)



Cost recovery to be achieved : **60%**
(2029-2030)

Financial Year	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Cost Recovery to be met	50%	51%	51%	52%	52%	53%	54%	55%	56%	57%	58%	59%	60%

Sewage Charges....????

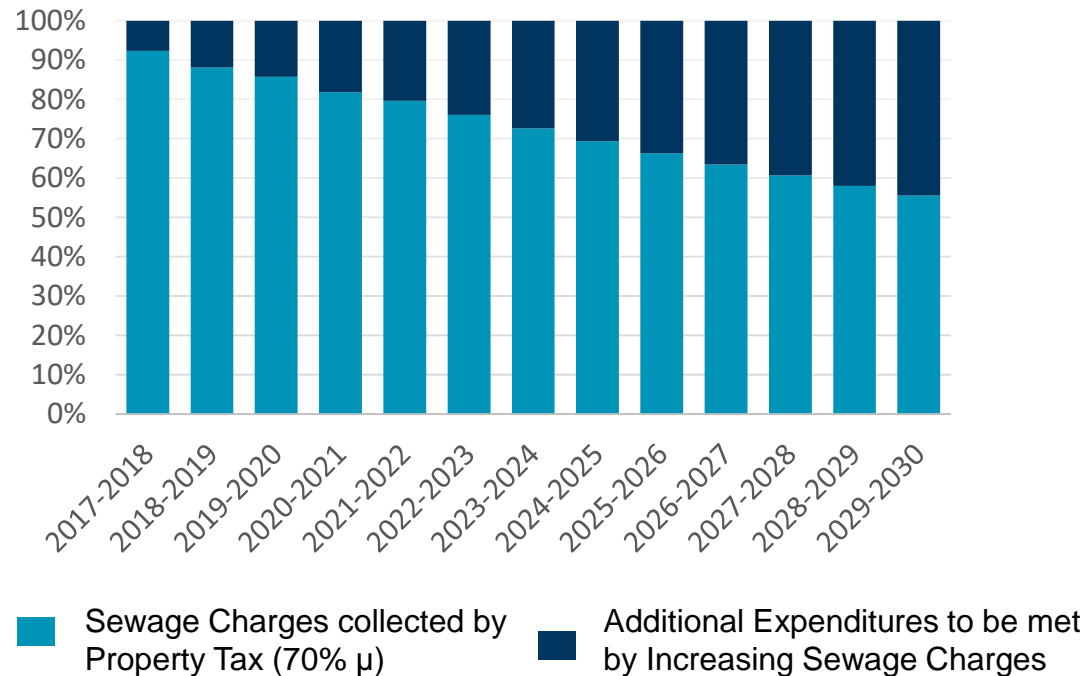
Collected as **15%** of base Property Tax

Efficiency of Collection is **70%**

Cost Recovery – Property Tax

Case 1

“All expected expenditures to be met by property tax only with **current collection efficiency**”

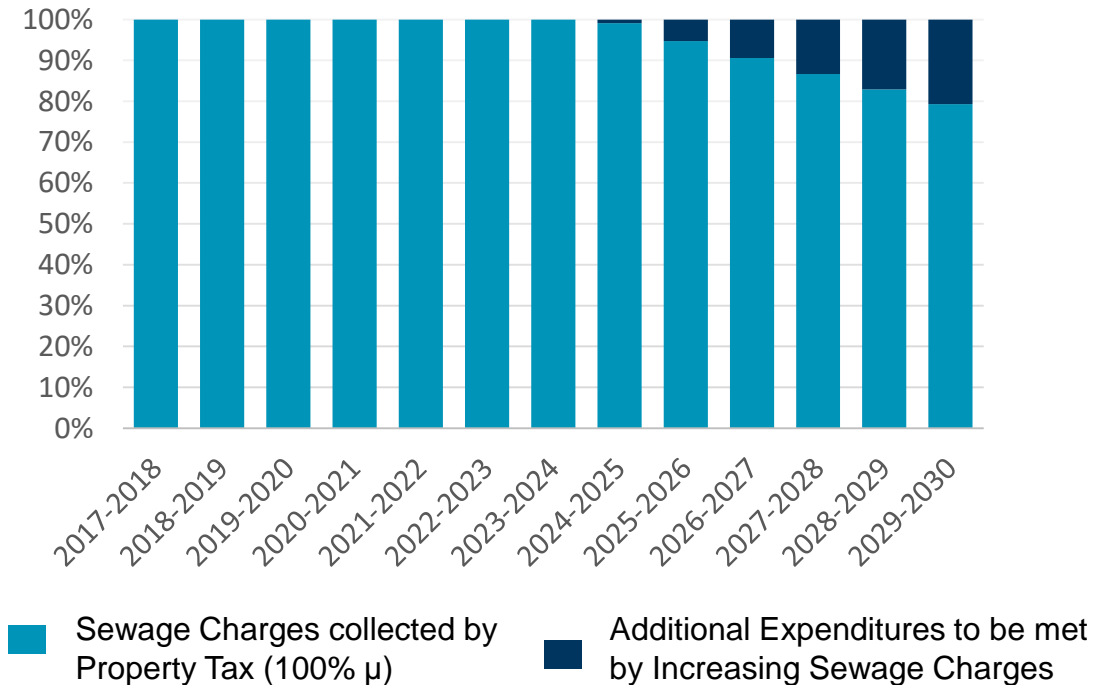


% Sewage charge in Property tax

15% to 27%

Case 2

“All expected expenditures to be met by property tax by improving collection efficiency to 100%”



% Sewage charge in Property tax

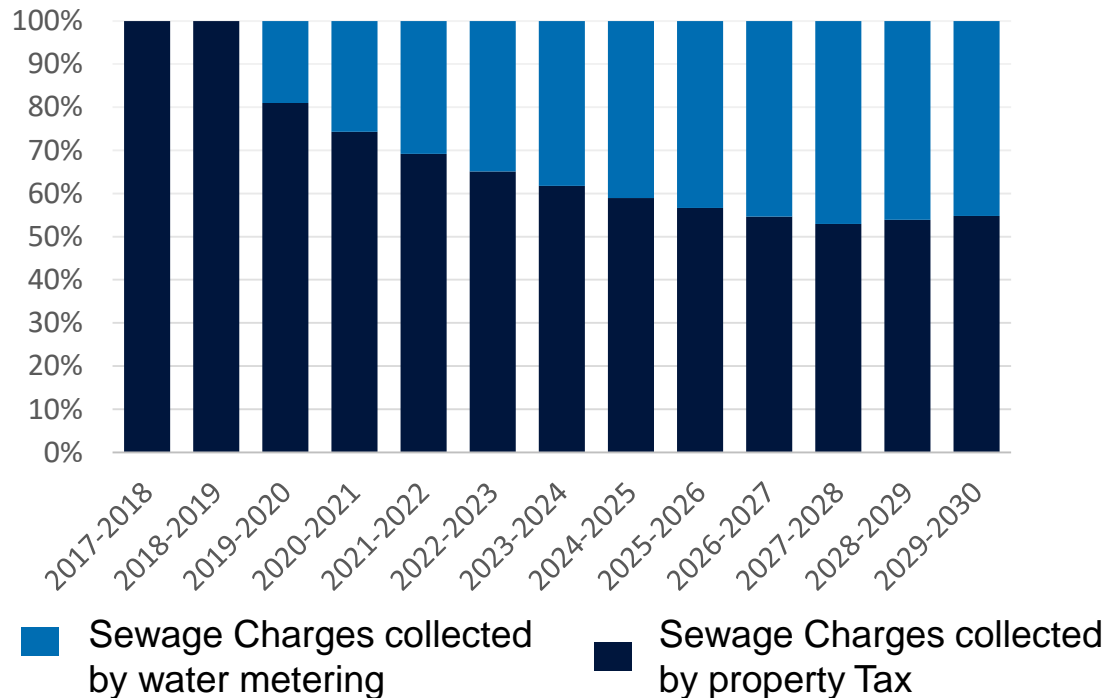
15% to 16%

Cost Recovery – Water Metering

Case 3

“All expected expenditures to be met by property tax and water metering”

Resource perspective & Finance perspective



Total number of households **13.32** lakhs

Water charge **5** Rs per KI

Percentage of sewage charge **30%**

Minimum water charges **Rs 125**

Minimum waste water charges **Rs 37.5**

Total minimum charge **Rs 162.5**

Rebate up to **4%** can be given over the years on the Property Tax

CONCLUSION

Sewered Interventions

 Retrofitting Sewer Lines

Automation of SPS

Nature

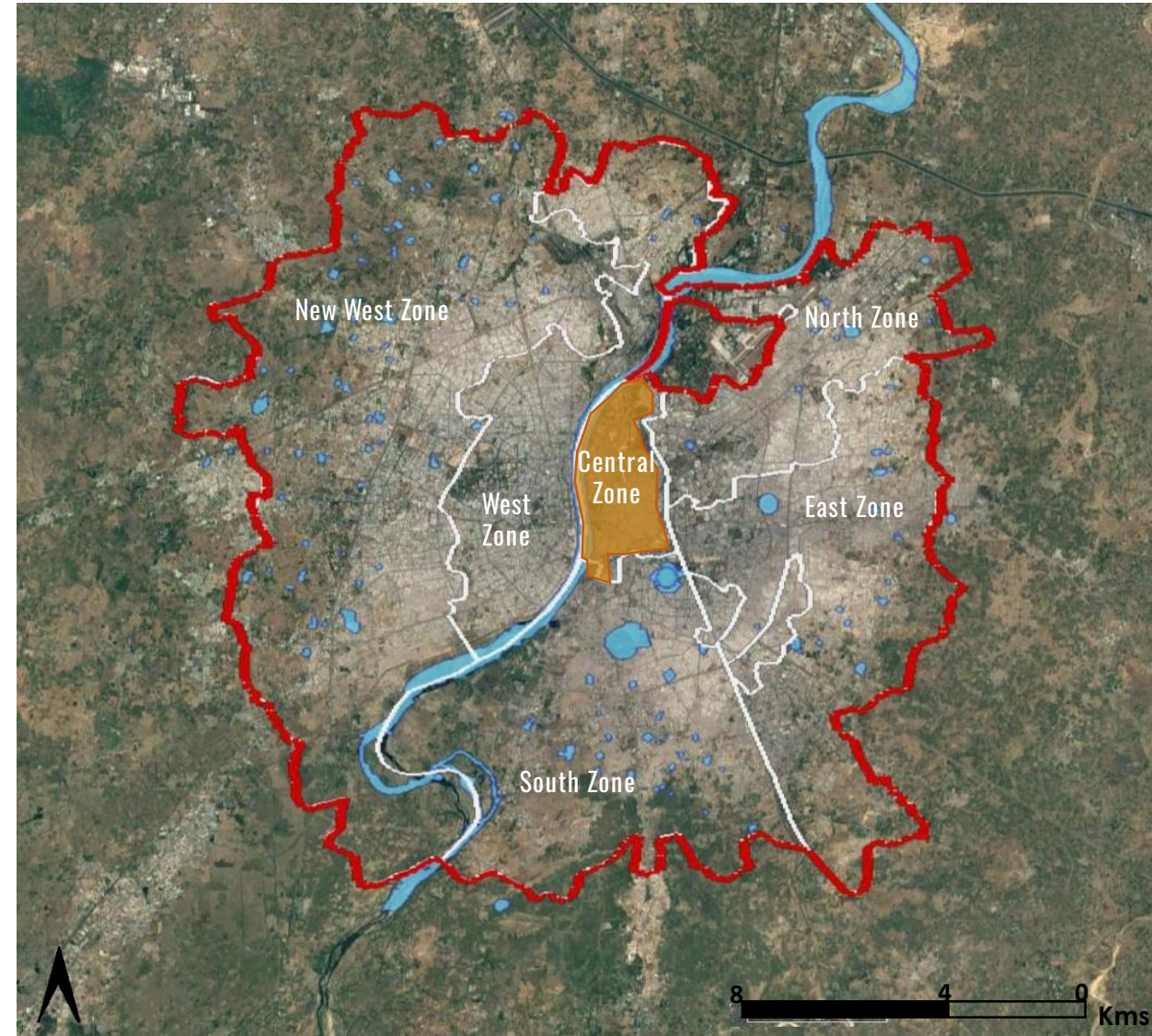
Physical

Physical, Policy



Cost (INR Cr.)

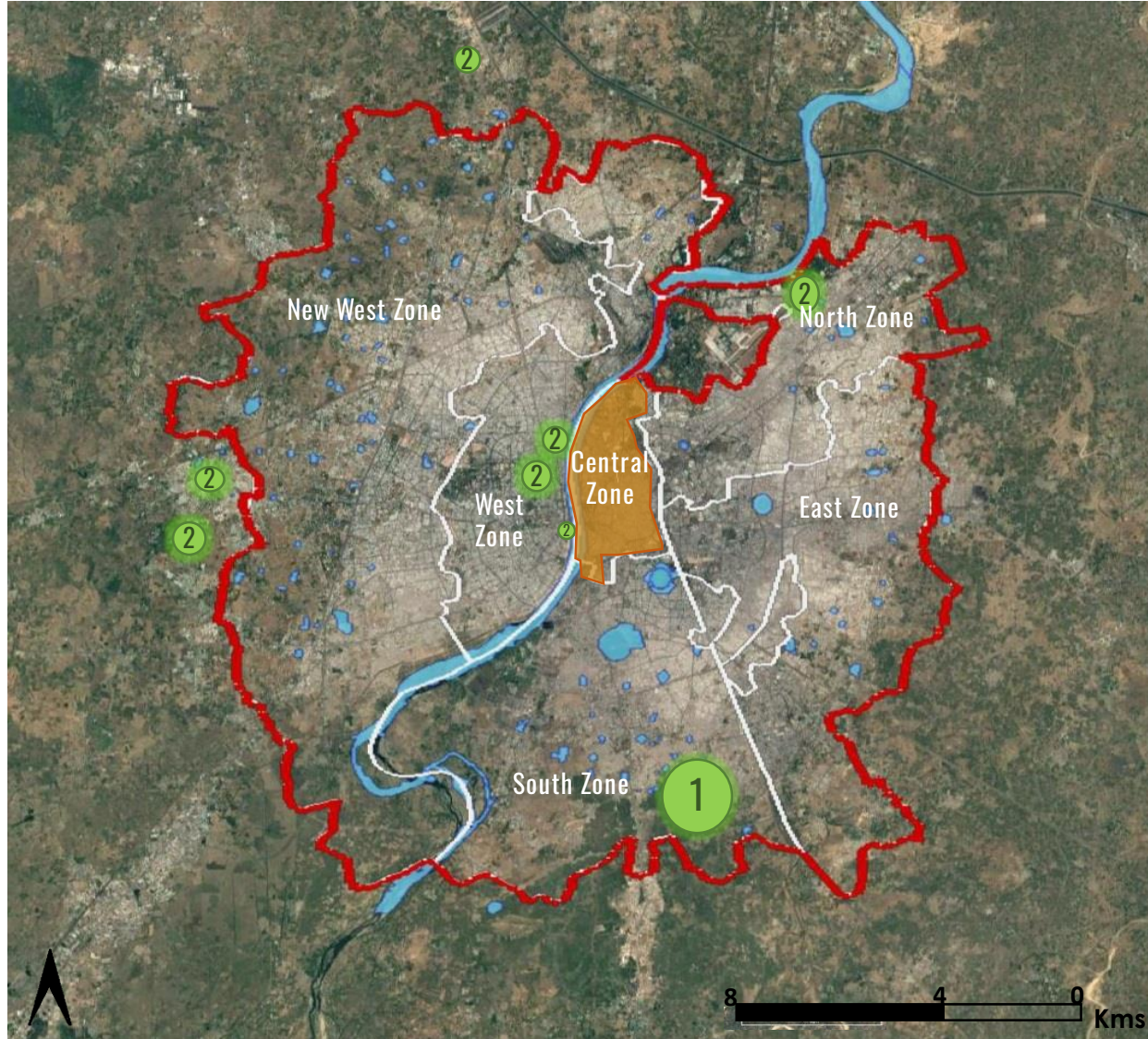
INR

INR







Sewered Interventions		Nature	Cost (INR Cr.)
	Retrofitting Sewer Lines	Physical	INR
	Automation of SPS	Physical, Policy	INR

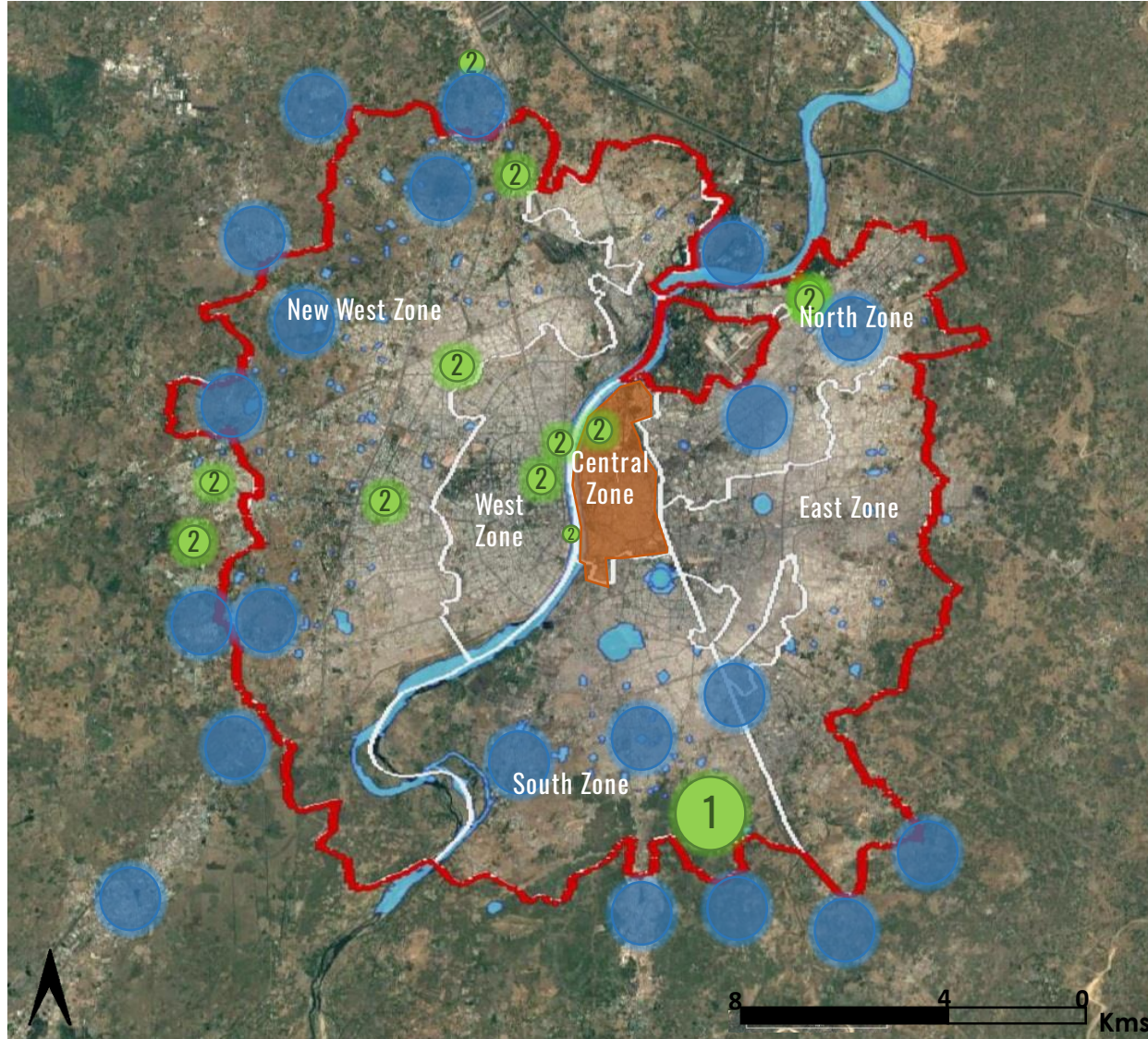
Re-Use Interventions		Nature	Cost (INR Cr.)
	Tertiary Treatment Plant (Industrial)	Physical, Policy	
	Reuse (Residential, Commercial, Parks/Gardens)	Physical, Policy	



Comprehensive Plan

Vision | “Wastewater as a Resource”

Sewered Interventions		Nature	Cost (INR)
	Retrofitting Sewer Lines	Physical	9720 Lakhs
	Automation of SPS	Physical, Policy	52 Lakhs
Re-Use Interventions		Nature	Cost (INR)
	Tertiary Treatment Plant (Industrial)	Physical, Policy	5895 Lakhs
	Reuse (Residential, Commercial, Parks/Gardens)	Physical, Policy	8100 Lakhs
Non Sewered Interventions		Nature	Cost (INR)
	FSM Project (Zones + Peripheries)	Physical, Policy	105 Lakhs
Total:			



Comprehensive Plan

Service



Increasing efficiency in
Centralized Network



Effective service
deliverance by FSM

Vision | "Wastewater as a Resource"

Resource



Re-Use OF **50 MLD**
Treated Water



5% reduction in fresh
water consumption

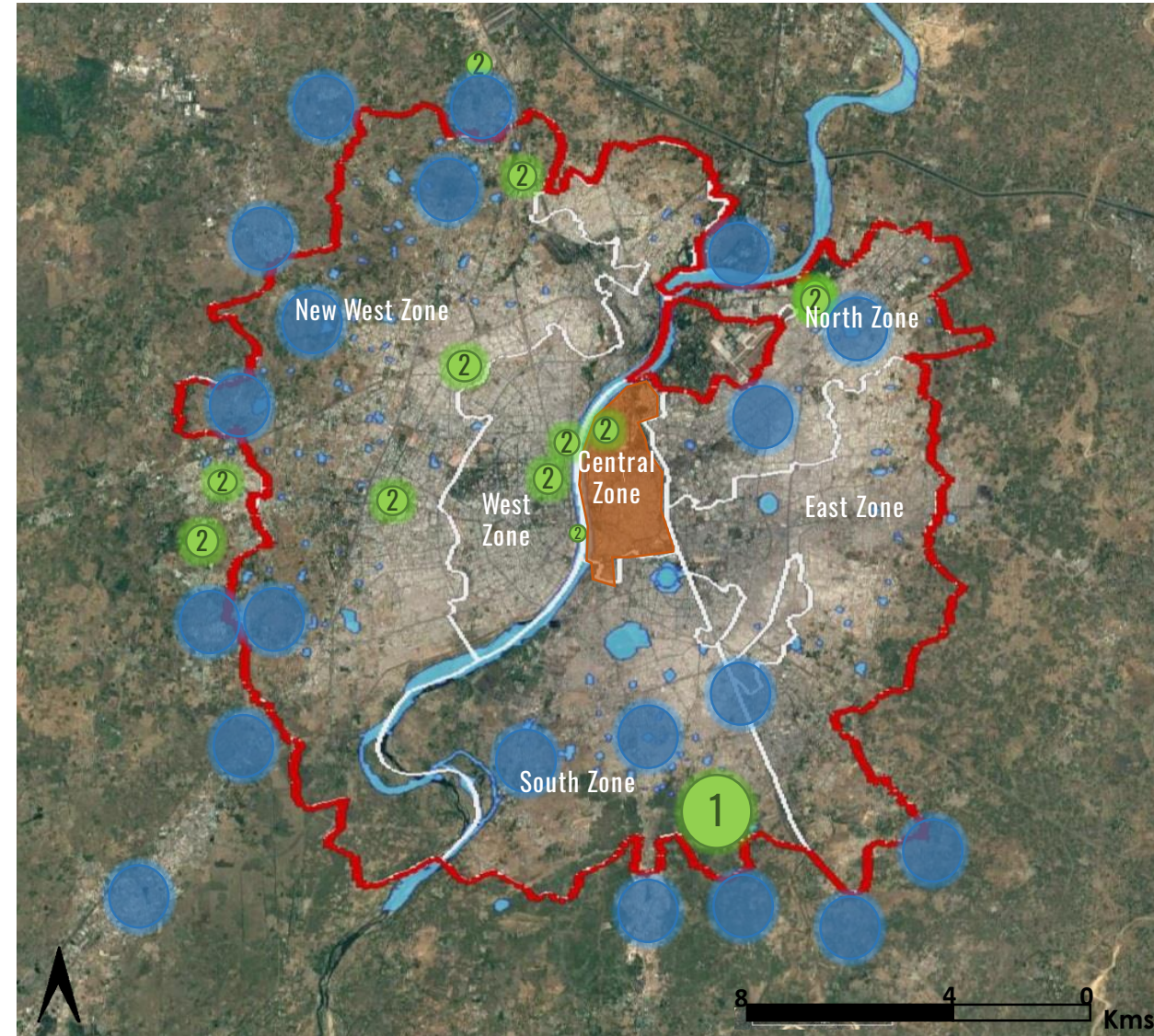
Financial



Defining Revenue Income Sources
Sewage Charges
Revenue sale of Treated water



Savings of **1500+** lakhs
in annual expenditure



Swachh Amdavad

- Public Sanitation

" Improve quality of life of people by having access to hygienic public sanitation facilities in Ahmedabad"

So key to clean and healthy urban environment is to focus on :

- adequate and efficient infrastructure provision
- robust operation and maintenance mechanism
- awareness among public

Scope:

Study on access to toilets:

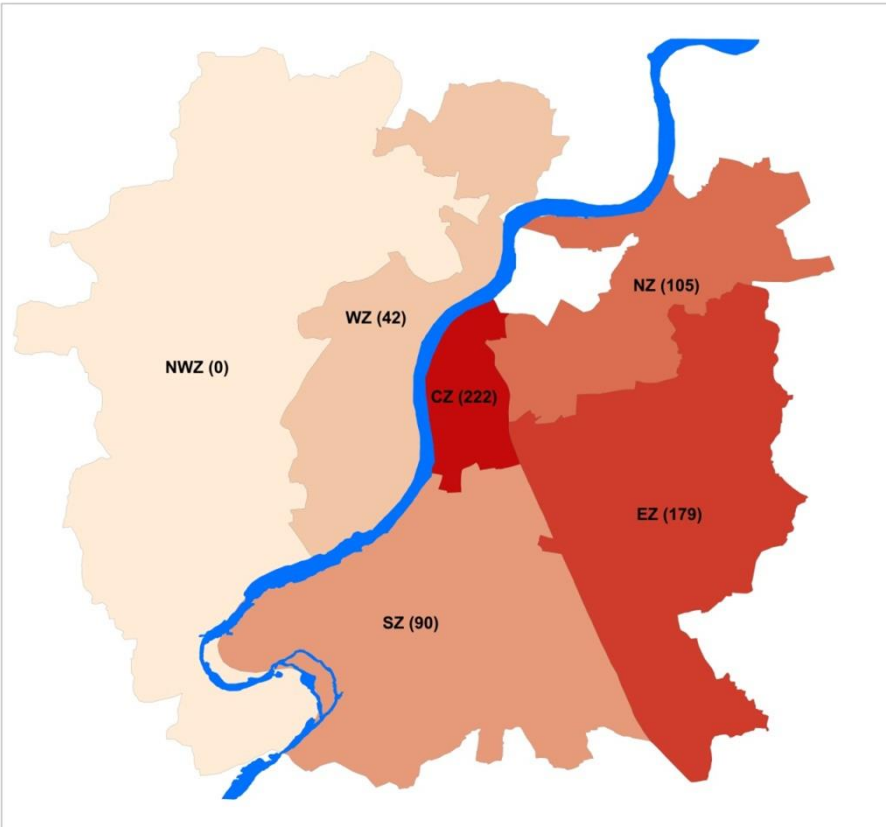
Community Toilets and Public Toilets

PUBLIC SANITATION IN AHMEDABAD

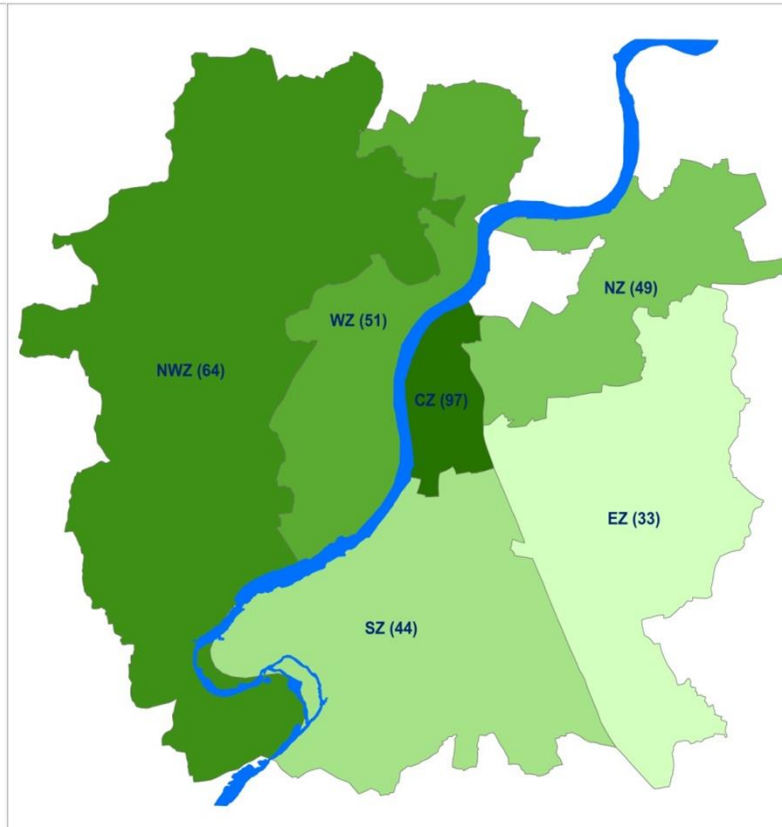
Community Toilet
638

Public Toilet
338

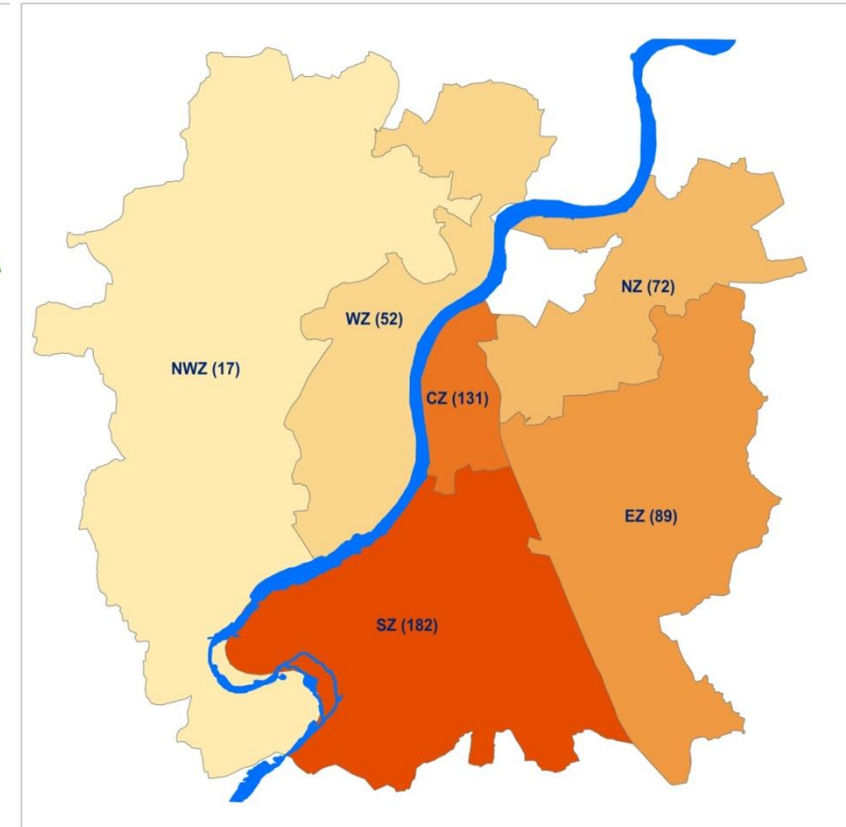
Public Urinal
543



ZONE WISE CTs in 2016



ZONE WISE PTs in 2016



ZONE WISE Public Urinals in 2016

Source: Health Department, AMC

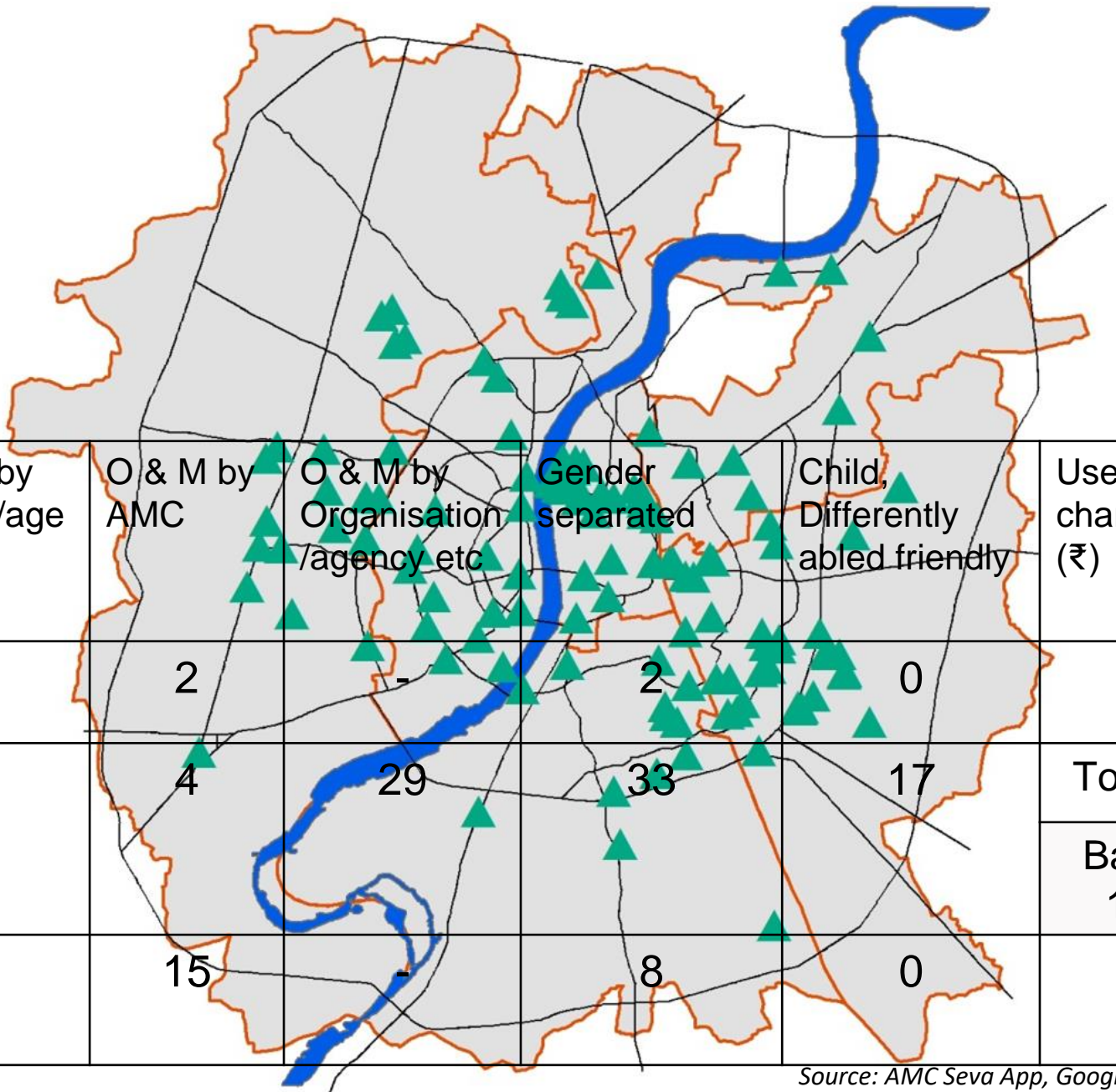
DIFFERENT PUBLIC SANITATION SERVICE MODELS in CITY

	COMMUNITY TOILETS	FREE PUBLIC TOILETS	PAY & USE PUBLIC TOILETS	PUBLIC URINALS
USERS	COMMUNITY ONLY	NEAR BY COMMUNITY + FLOATING POPULATION	FLOATING POPULATION	FLOATING POPULATION(men)
LAND	AMC	AMC	AMC (to private body on lease for 10-30 yrs.)	AMC
TOILET BLOCK CONSTRUCTION		AMC/PRIVATE BODY	PRIVATE BODY (revenue from user fees fixed by AMC)	
OPERATION		PRIVATE BODY (₹25000/month by AMC)		
MAINTENANCE		AMC	AMC	
SUPERVISION		AMC	AMC	
OWNERSHIP		AMC	AMC after concession period	

FIELD SURVEY

• 188 public conveniences mapped out of 1500

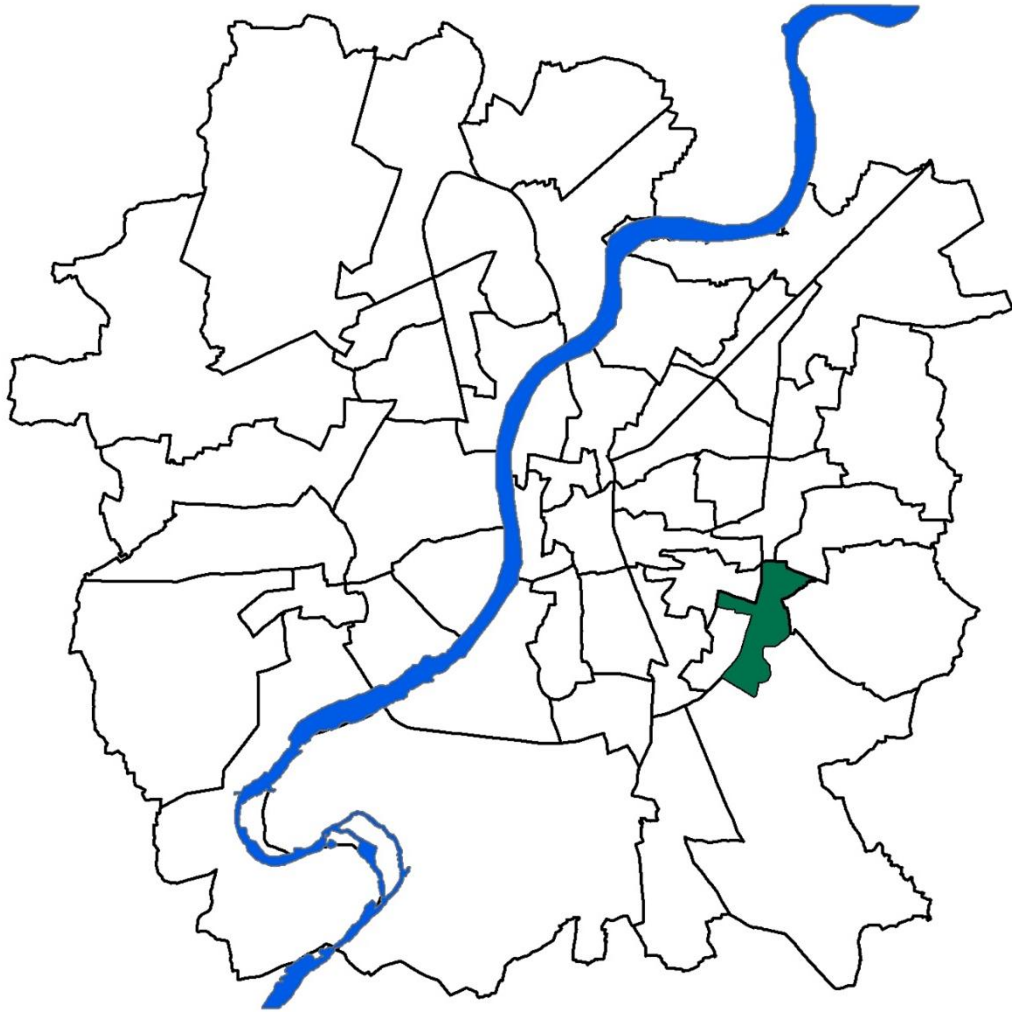
• 50 visited



Type	No. Visited	Constructed by AMC	Constructed by Organisation/agency etc	O & M by AMC	O & M by Organisation/agency etc	Gender separated	Child, Differently abled friendly	User charges (₹)
CT	2	1	1	2	-	2	0	0
PT	33	18	25	4	29	33	17	Toilet: 2-5 Bathing: 10-15
PU	15	15	-	15	-	8	0	0

Source: AMC Seva App, Google Maps

Indrapuri Ward Profile



- citizens and officials are engaged and dedicated towards making their Indrapuri Swachh
- Area: 9.4 sq km
- Households: 20104

PUBLIC SANITATION IN INDRAPURI

Community Toilet

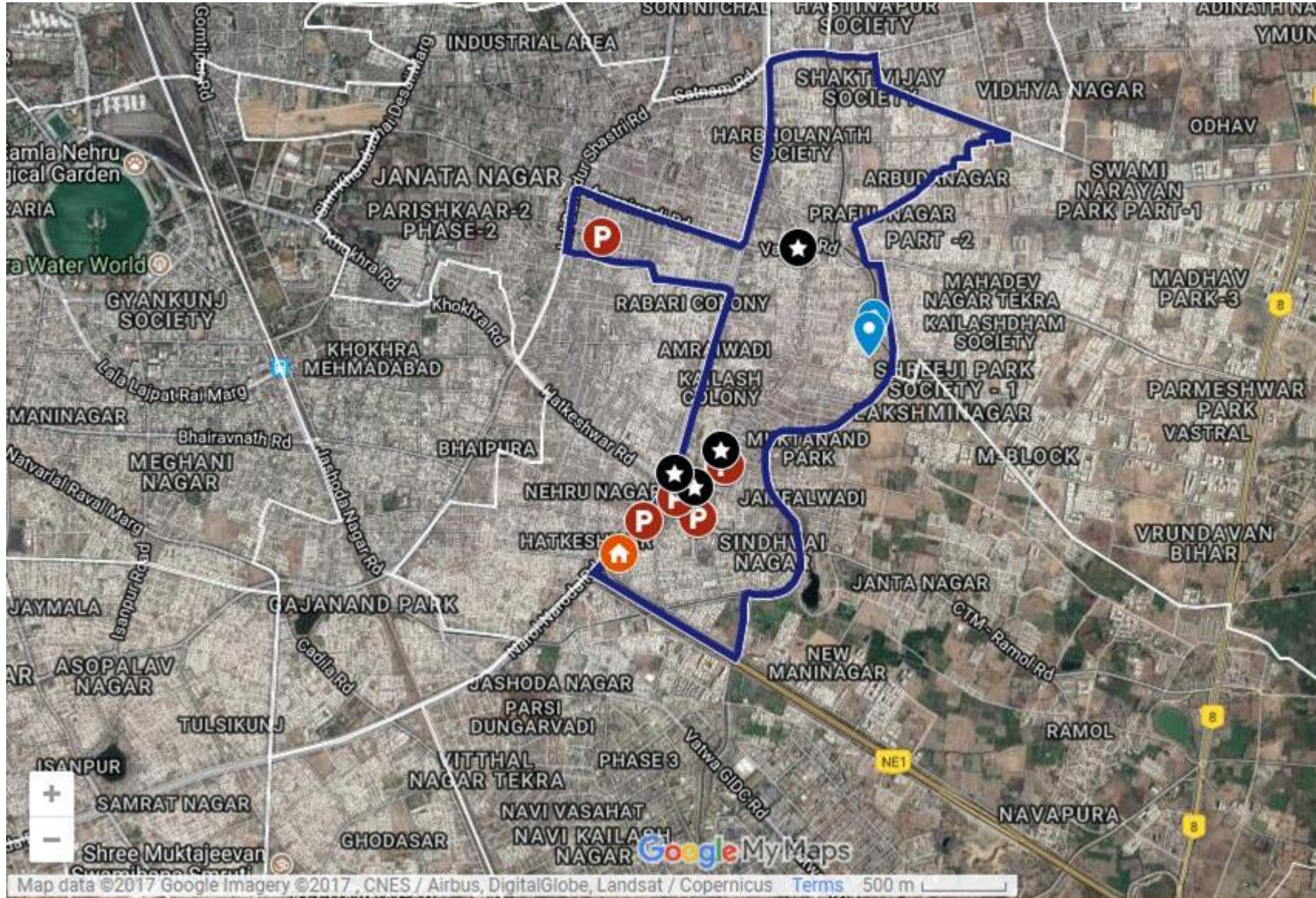


2

Public Urinal



5



Public toilet



Free-2
Pay & Use-3
Mobile-1

COMMUNITY TOILET in INDRAPURI

Location: **Rakt pitya nagar/Leprosy colony**
(run by Gandhi Seva Sangh Trust)



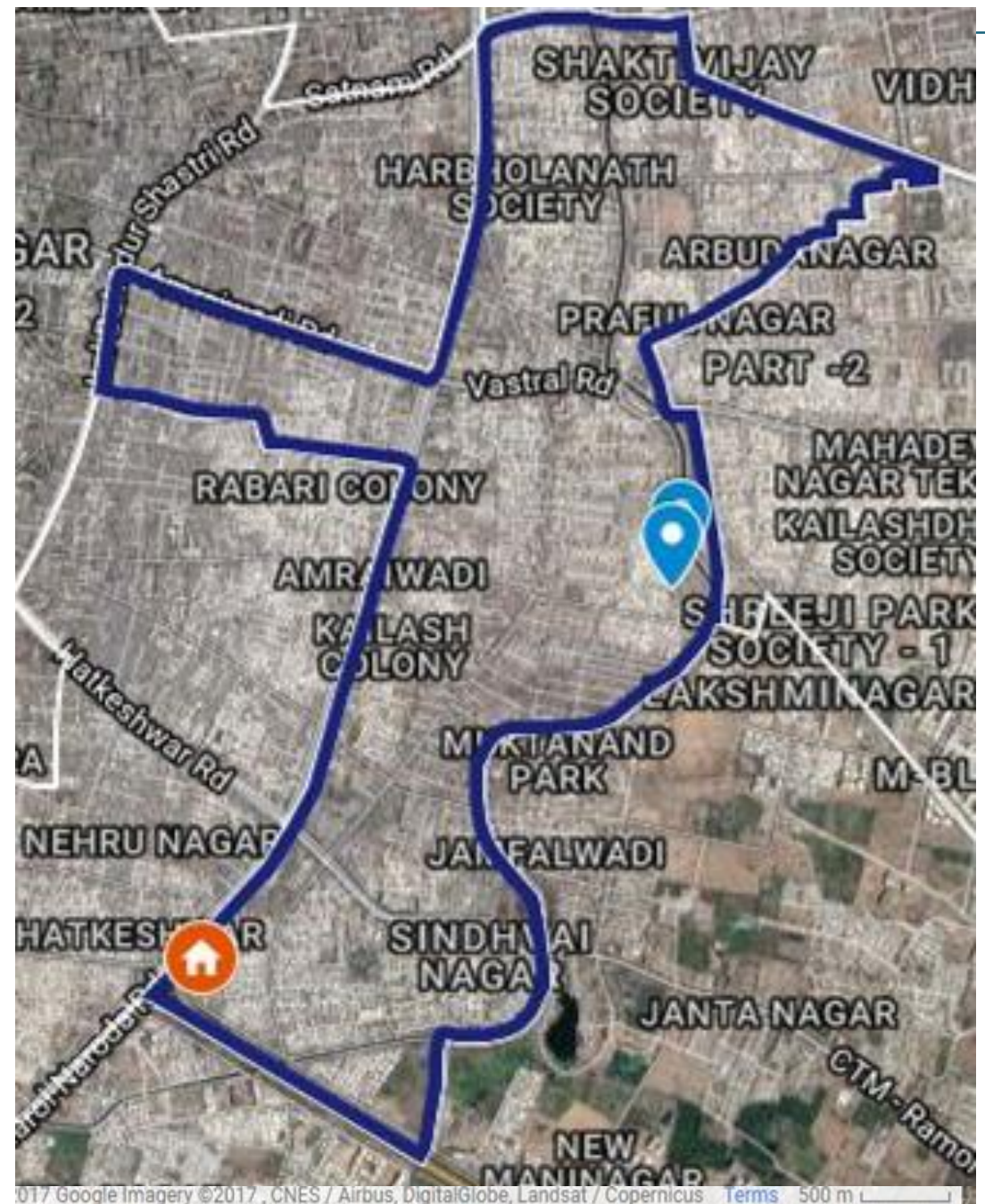
127



500

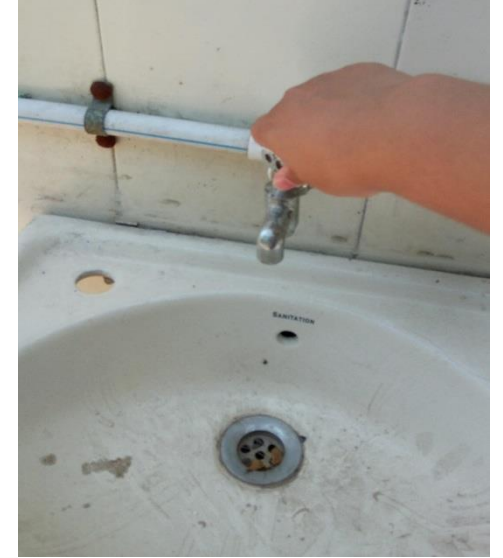
Every House has an individual toilet.

COMMUNITY TOILET BLOCK	MALE (seats)	FEMALE (seats)
1 st	3	3
2 nd <i>Constructed and maintained by AMC</i>	3	3



© 2017 Google Imagery © 2017, CNES / Airbus, DigitalGlobe, Landsat / Copernicus Terms 500 m

Observations



- toilets with stains
- rusted doors
- broken floor tiles
- no water in taps
- no soap for hand-washing
- no bins were kept inside and as well as outside the block
- no separate entry for men and women
- no provision differently abled people and not age friendly

Community engaged in Swachh campaign every Sunday



Major Issue: Infrastructure provision present, but lacking in O&M

Solution: COMMUNITY MANAGED TOILET

**Aware and
Active
Community
dweller**

**Strong support
of the Trust**

COMMUNITY MANAGED TOILETS

AMC

Bear the water supply and electricity cost since these are major expenses

Provide the cleaning materials at subsidised rate

Under-take the major repair work

Regular Monitoring

Gandhi Seva Sangh Trust

Act as a facilitator

Assist in forming SSGs

Train the SSG members to adopt SOP

SAFAI SHAKTI GROUP (SSG)

Operate and Maintain the CT.

Collect monthly cleaning fee* from HHs.
(utilised in purchasing consumables and equipments)

Spread awareness of hygienic practices.

*The fee shall jointly finalised by the community dwellers after taking into account all the recurring expenses needed in maintaining the toilet blocks.

Raktpityanagar or Leprosy Colony Community

- No. of toilet blocks: 2(each with 2-male, 2-female)
- No. of SSGs: 3 (SSGs selected on annual basis.)
- No. of members in each SSG: 10(with at least 5 female members)

- Rotation cycle:

- Option 1: one month cycle

↓
1 SSG- 30 days

↓
1 SSG member - 3 days

- Option 2: 10 days cycle

↓
1 SSG- 10 days

↓
1 SSG member - 2 days

Community Managed Toilet Project (CMTP) Scaling up

- Based on Leprosy Colony model, CMTP shall be framed.
- Community classification:
- Project Phases:4

Type	Community active &/or aware	Existing NGO support
C1	Yes	Yes
C2	Yes	No
C3	No	No

Type	Community active &/or aware	Existing NGO support
Phase 1		Phase 2
• Community Inventory creation and classification C1	Yes	• Implementation in C1 Yes
C2	Yes	• Engaging NGOs in C2 & C3 No
• Bringing potential NGOs on board. C3	No	No
		• Sensitize C3 dwellers

Phase 3

- Implementation in C2
- Sensitize C3 dwellers

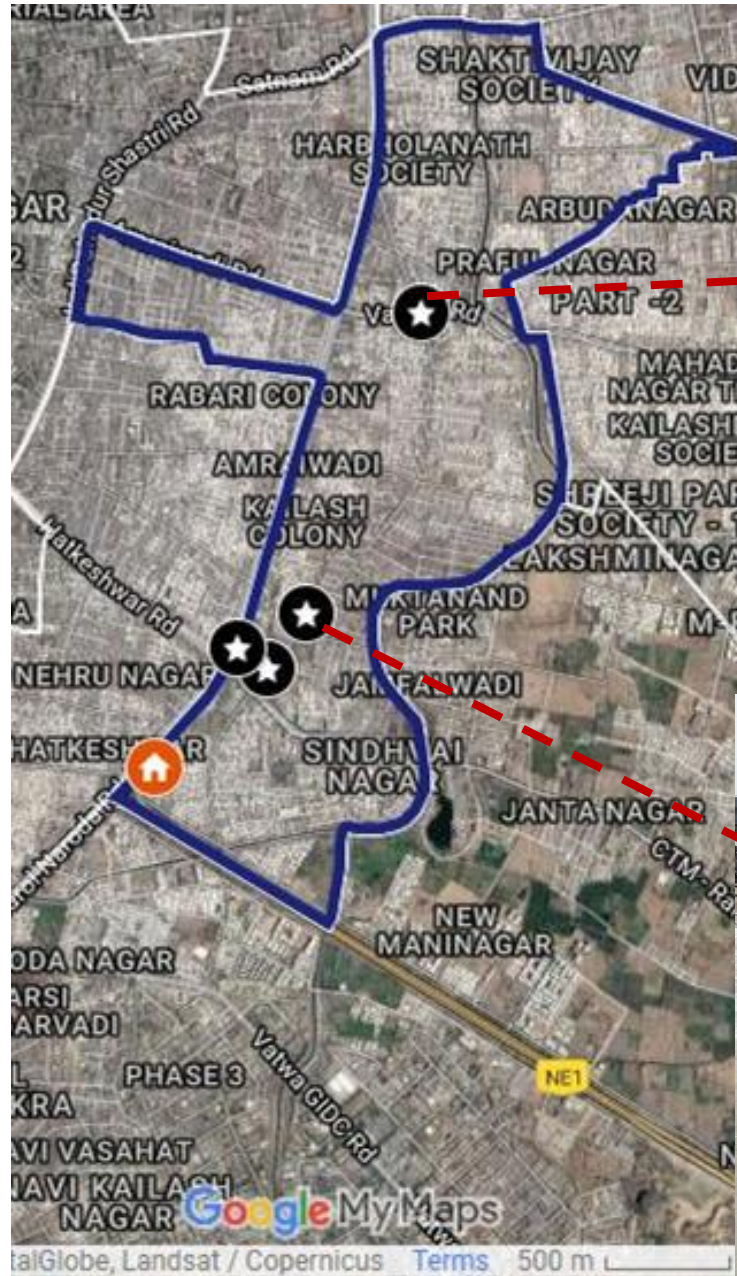
Phase 4

- Implementation in C3

PUBLIC URINAL in INDRAPURI

Public Urinal: 5

- For male users
- Constructed and maintained by AMC
- Mostly the surrounding areas had bad odour
- Hand washing facility was not observed.



- Due to **irregular cleaning** and **lack of proper monitoring** has resulted into:
 - insanitary condition of public urinals and mobile toilets
 - disturbing experience for the passer bys, specially pedestrians and vendors in the vicinity.
- The reasons behind such issues:
 - Lack of man power
 - Lack of finance
 - Lack of due importance/involvement
- Public urinals only for male users, no provision for female users.

Intervention

- Converting the existing one into waterless urinal either by:
 - Retrofitting
 - Replacement
- Various technologies:

DESCRIPTION	MEMBRANE TYPE	SEALANT LIQUID	BIOLOGICAL BLOCKS	ZERODOR TYPE
Odour control	Good	Good	Good	Good
Retrofitting possibility	Yes	No	Yes	Yes
Replacement of parts	Membrane to replaced annually	Sealant liquid (apprx 1000 users) Cartridge replacement –once a year	Bio blocks once in 2-3 days based on usage	Not required
Cost of system	Trap cost-₹1200	Entire system-₹6500 to 14000	One Bio-block-₹ 20	₹2000 to 3000 for converting existing one
Maintenance of pan & Trap	High	Medium	Low(only pan)	Low(only pan)
Dependence on suppliers	Supply of membranes	Supply of cartridge and sealant liquid	Supply of bio block	Nil

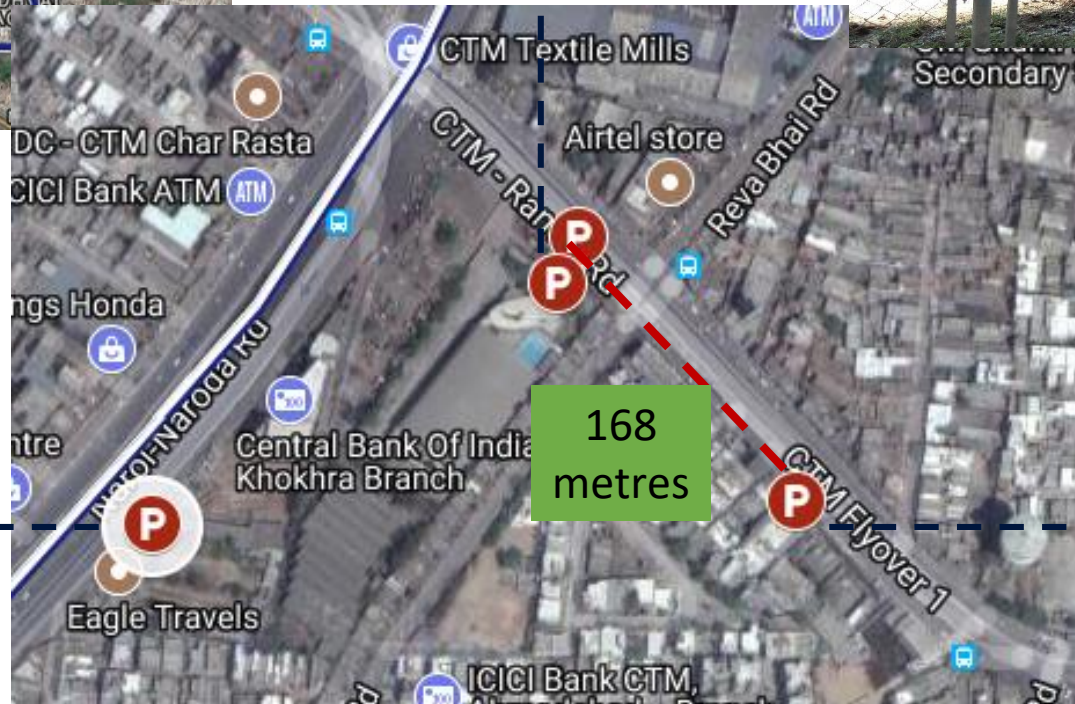
Source: <http://web.iitd.ac.in/~chanjary/WLURResource%20BookFinal.pdf>

PUBLIC TOILET in INDRAPURI

Free (AMC)



Pay & Use (Nasa Foundation)



Pay & Use (Global Foundation)



Observations at mobile toilet located opp. to vegetable market

- Irregular cleaning by AMC sweepers .
- Regular water supply into overhead tank by AMC but no water by afternoon because of the broken water pipeline.
- People are urinating or defecating in the open space behind the mobile toilet.

Solution

- Installing e-toilets which are:
 - automated and do not require manpower for cleaning
 - remotely monitored with the help of GPRS technology.
- There are different e-toilet models available for men and women users (provision of MHM facility).
- The basic model of the toilet costs ₹2 lakh, while the advanced stainless steel version costs ₹ 4-5 lakh.(as of 2016)
- After installation, the operation costs are covered through the small usage charge and the income derived from the advertisement area on its interior and exterior walls.



Free PUBLIC TOILET in INDRAPURI

Free Public toilet (Niti nagar)

- Operated by Maha Gujarat Foundation
- Mostly used by nearby Valmiki Samaj community (500-1000 users daily)
- Open Timing: 24*7
- Caretaker unable to maintain regularly due to monetary issues.

- Handing over materials from agency to caretaker in presence of AMC official every 1st of the month.

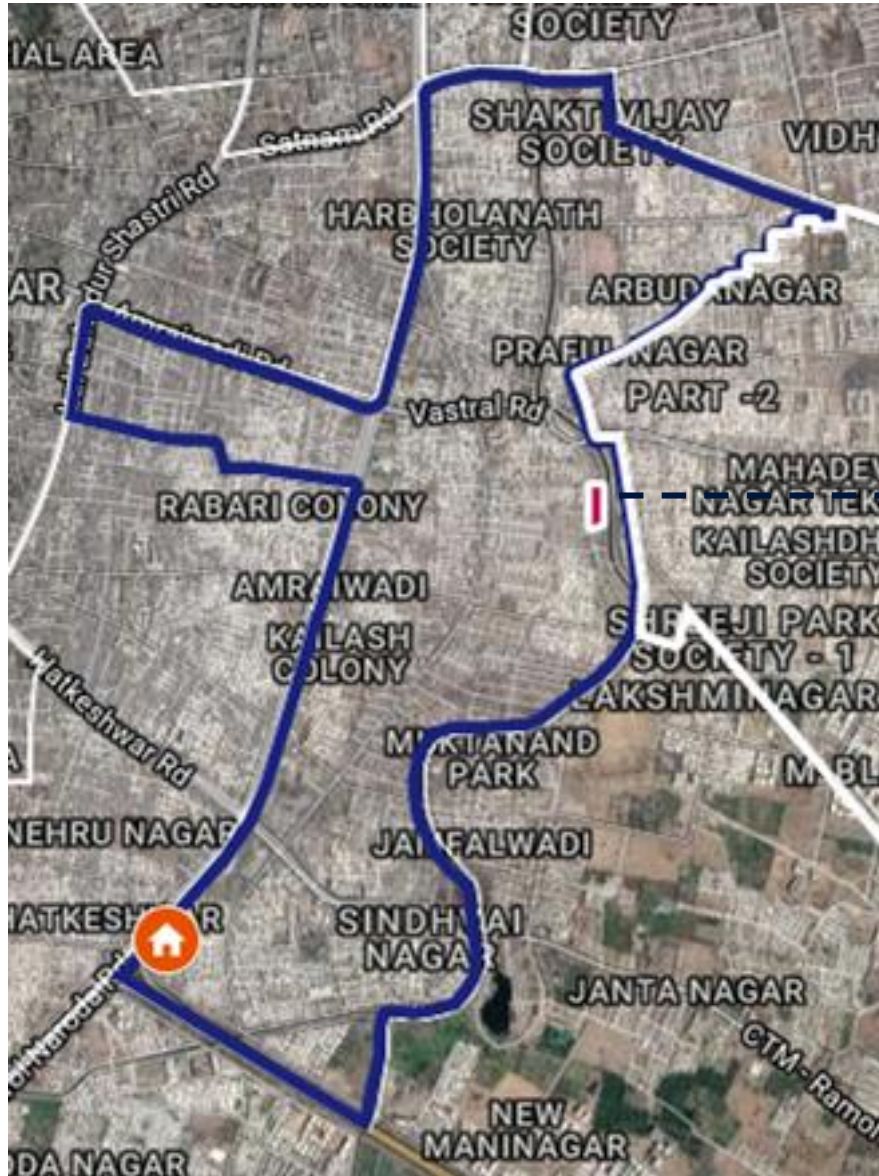


- Stricter supervision by the AMC officials
- Stronger actions against the sweepers failing their duty
- height of the compound wall isolating toilet blocks from the road can be reduced upto the extent where road activities or the passer bys are visible

Free Public toilet (Tusharbhai Deshmukh Municipal garden)

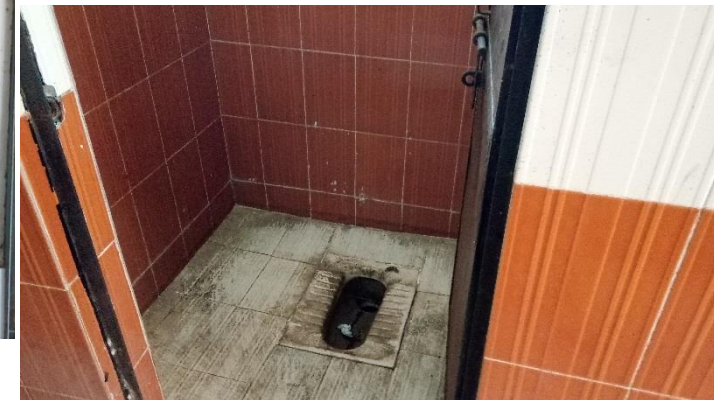
- Lack of regular cleaning.
- Two blocks out of only one is opened for public.
- No separate toilets for men and women.
- Design not women friendly

Sanitation in Municipal school



Bage Firdaus Shala No. 1
(upto class 8)

- Gender Separate toilets for children and teachers.
- Facilities absent



MAJOR ISSUES

- Daily cleaning
- Regular maintenance
- No water supply within toilet for hand washing
- Lack of Facilities: (1) soap/sanitizer for handwashing (2) MHM
- No separate toilet for CWSN

- AMC should sign the annual School Sanitation Contract, wherein the contractor shall have to:
 - follow the SOP guidelines laid out by AMC for cleaning and maintenance of the toilets
 - report to PHS of ward about water or electricity related issues
 - provide facilities and instructions on how to use them like- liquid soap for handwashing, necessary accessories for girls
 - spread awareness about importance of hygienic practices through posters.
- Performance based contract.
- The same contractor shall be appointed to clean fixed number of schools in one particular zone considering the shifts in the schools assigned and the student strength.

**Thank
You**

Heritage

Through the lens of Water and Sanitation

Prepared by :

Ghata Radia

Palak Panchal

Yash Sugandhi

Living Heritage of Ahmedabad

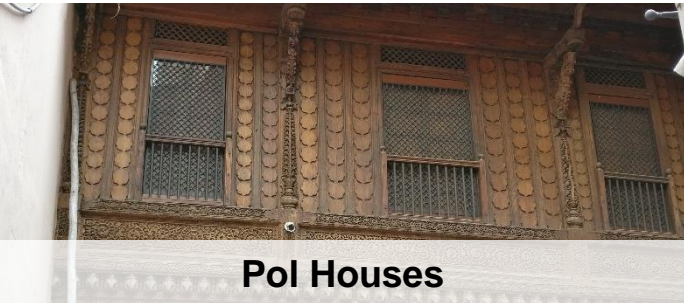
HERITAGE



Teen Darwaja



Jama Masjid

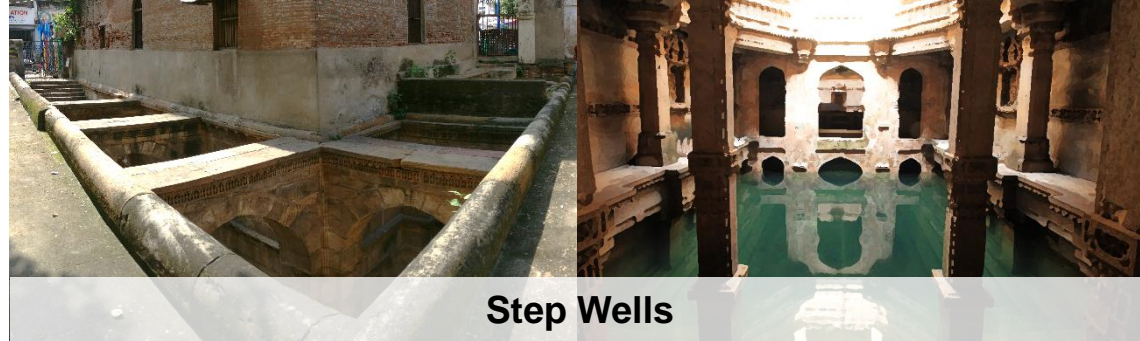


Pol Houses

WATER HERITAGE



Sarkhej Roza Tank



Step Wells



Tankas

LIVING HERITAGE



Manek Chowk



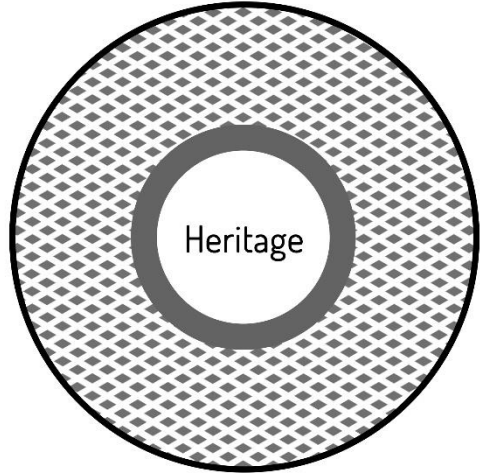
Pols



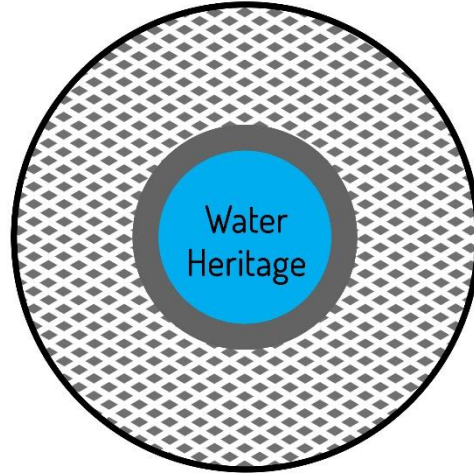
Streets

Our Understandings

WHAT WE IDENTIFIED IS !!!



Monument



Water Based Monument

Our Understandings



Institutional Framework

ASI
Under archaeological sites and remains Act, **1958**

WAKF Board
Established in **1995**
(under Govt. Of Gujarat)

1995

Heritage Cell
Established in collaboration with **CRUTA Foundation** in July **1996**

1996

Heritage Walk
AMC & CRUTA Foundation have been conducting heritage walk in Ahmedabad in, **1997**

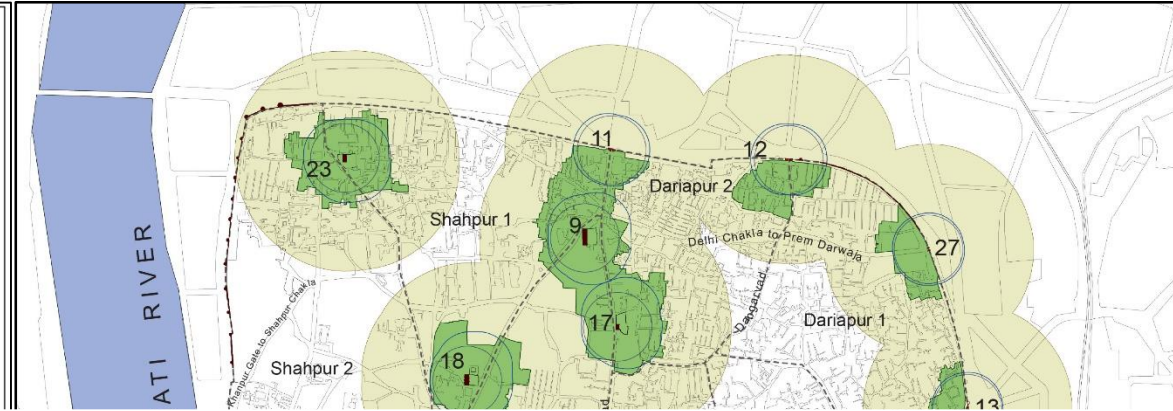
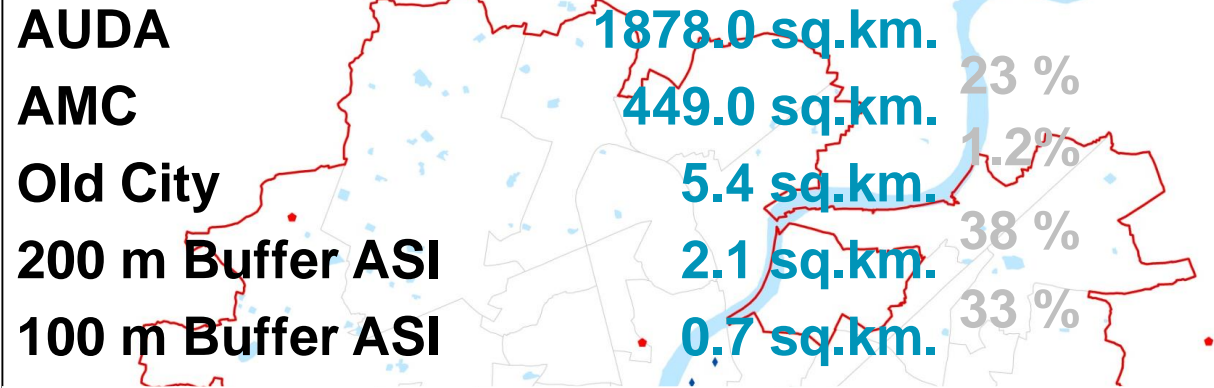
1997

Heritage Conservation Committee
Formed by state government for ahmedabad to identify and prepare a new inventory list of heritage buildings (**AMC**) in **2005**

2005

UNESCO World Heritage City
Declared on July **8**, **2017**

2017



Level of Institution	Institutions	Fort	Stepwells	Pols	Mosque	Temples	Lake	Gates	Pol Houses
National Level	Archaeological Survey of India, GOI	2	3		37		2	10	
State Level	State Department of Archaeology, GOG		1				1		
Urban Local Body	Heritage Department, AMC		15	600			5	3	2244
Community/Trust	WAQF, Sarkhej Roza Committee, Hindu & Jain Community, Trust, Vahivatkarta, pol panchayat				10	2			

Reconnaissance Survey

14 INVENTORY FOR INTANGIBLE SURROUNDING

3 Management
3 GATES
3 STEP WELLS
2 POLS
5 MOSQUE
1 LAKE

1 lag 2 to 3 monument daily basis. 22 log. 44 log. 8 hr duty
to 3 wards
Drainage 50 water lagging within gate & surrounding boundary wall.
RL < G.L of Road

Inventory form for Swachh Surrounding

1. Name of Place: 16. Astodia Gate

2. Categorization: 1. ASI Monuments 2. Step-wells 3. Pools 4. Lakes

3. Sub-Category:

<input type="checkbox"/> 1.1 Tomb	<input type="checkbox"/> 1.5 Gate
<input type="checkbox"/> 1.2 Mosque	<input type="checkbox"/> 1.6 Temples
<input type="checkbox"/> 1.3 Well	<input type="checkbox"/> 1.7 Public Buildings
<input type="checkbox"/> 1.4 Tomb/Haziro	<input type="checkbox"/> 3.1 Street Plaza
	<input type="checkbox"/> 3.2 Community Area

1 Monument Status:

1.1 Managed by: (a) AMC (b) ASI (c) Community (d) NGO (e) _____

1.2 Current usage: (a) Religious (b) Commercial (c) Residential (d) no use (Gate only)

1.3 Littering on structure: (a) Present (b) Absent

2 Solid Waste:

2.1 Degree of cleanliness on Visual Basis: 1 (Worst=1, Very Good=10)

2.2 Littering in Surrounding: (a) Present (b) Absent

2.3 Type of Littering: (a) Plastic (b) Organic (c) Animal Dung (d) Debris (e) _____

2.4 Dustbin Availability: (a) Present (b) Absent if present then number _____

2.5 Cleaning Frequency: (a) Daily (b) Alternate days (c) Once in a week (d) Twice a week

2.6 Managed by: (a) By AMC (b) By Local Community (c) No Collection. ASI

3 Sewerage:

3.1 Visual of Drainage: (a) Open (b) Covered (c) Septic Tank. no.

3.2 Frequency of Maintenance: (a) Daily (b) Alternate days (c) Once in a week (d) Twice a week

4 Toilets

4.1 Public Toilet in 100m: (a) Present (b) Absent

4.2 Cleaning Frequency: (a) Daily (b) Alternate days (c) Once in a week (d) Twice a week

5 Urban Pressures:

(a) Unsympathetic additions and alterations

(b) Presence of pollutants / Industries Presence

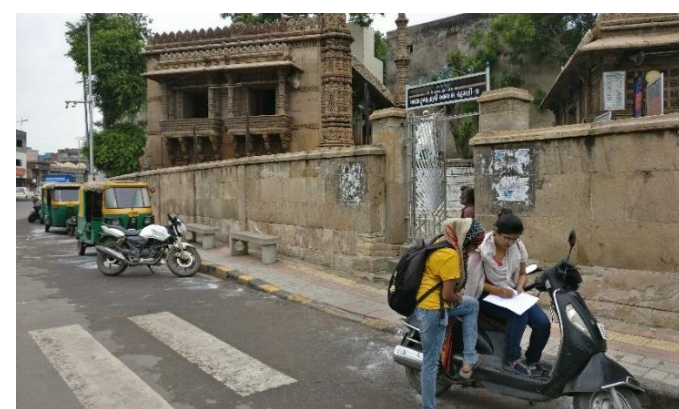
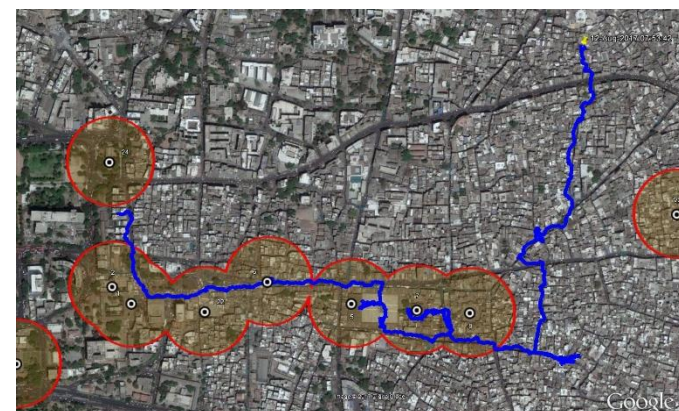
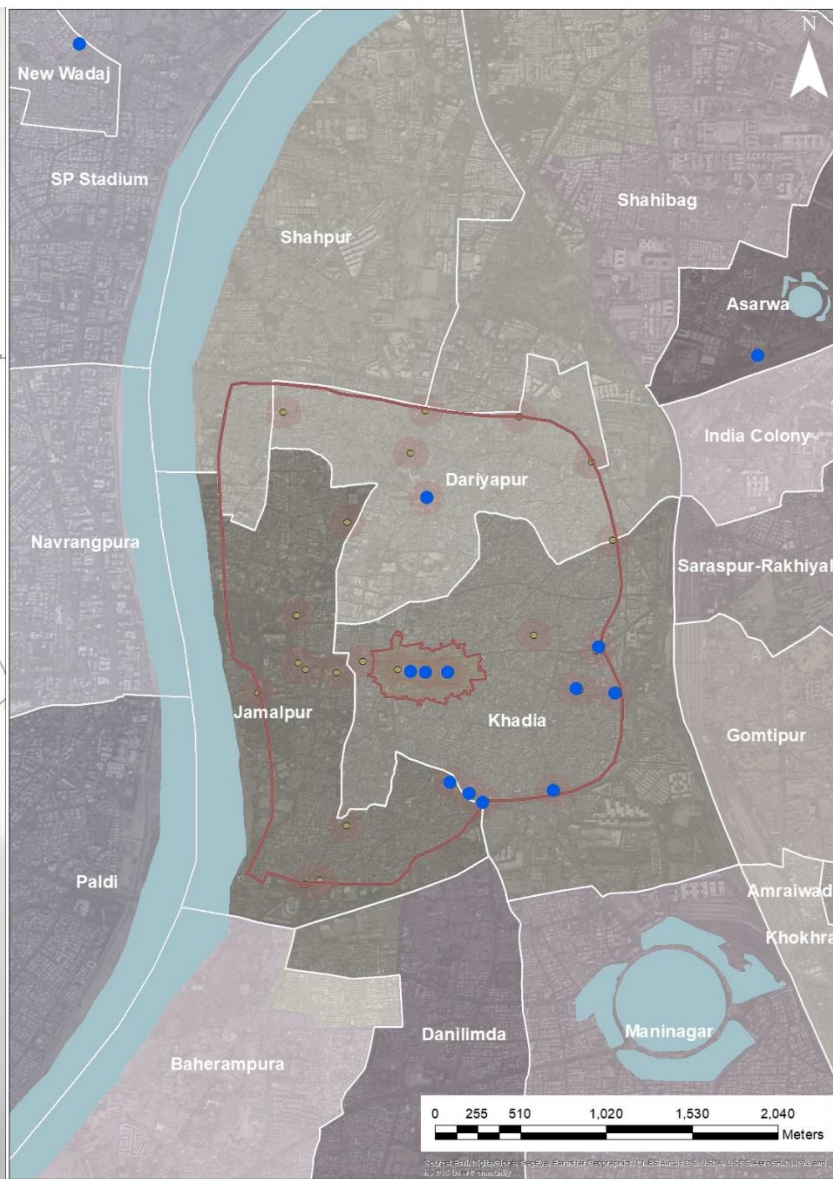
(c) Encroachments

(d) Infrastructure additions (e.g. water supply)

(e) Traffic Overflow.

Surrounding twice a day

**All these data is for academic purpose. Kindly cooperate.*



*100 M Buffer is considered for Inventory of these structures,

Issues Identified at First Glance

SEWERAGE



Open Drains in Pals



Open Drainages near Astodia Gate



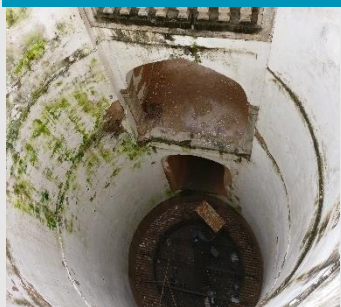
Manual Process of Cleaning Old Drainages

URBAN PRESSURE



Encroachment in front of Entrance

WATER



Dried up Step-Wells



Water Logging due to rise in Road level



Ancient Water Systems in Ruins

SOLID WASTE



Uncleaned Public Toilet and Littering near Amrutvarshini Vav



Solid Waste inside Dried Step-Well

MULTIPLE STAKEHOLDER

for management of infrastructure services

61% Littering Present

40% Dustbin Present

6 out of 14 Heritage Precincts have Public Toilet

The area is the heritage site and it is used as a place for rituals before marriage. The area is the heritage site and it is used as a place for rituals before marriage.



Resident in Amrutvarshini Step Well

Why Intervention is necessity ??

41st session of the World Heritage Committee Krakow, Poland 2-12 July 2017
City of Ahmedabad was inscribed into *UNESCO World Heritage City*

Criteria considered for Inscription of City of Ahmedabad as Heritage City

(ii) to exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on **developments in architecture or technology**, monumental arts, **town-planning** or landscape design;

(v) to be an outstanding example of a traditional human settlement, **land-use**, or sea-use which is representative of a culture (or cultures), or **human interaction with the environment especially when it has become vulnerable under the impact of irreversible change**;

(vi) to be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and **literary works of outstanding universal significance**.

UNESCO Requests the State Party to submit to the World Heritage Centre, by 1 December 2019, a report on the **implementation of the recommendations**, for examination by the World Heritage Committee at its 44th session in 2020.



VISION

To create a consensus by preserving the *fragile intangible heritage precincts* in Ahmedabad focusing on its **Clean Surrounding and Management of Water as a Resource.**

OBJECTIVE : WATER AS RESOURCE IN WATER BASED HERITAGE MONUMENTS

- To identify and **preserve built-heritage** which were associated with **practices of water** such as preserving **natural watershed, rain water harvesting system, tankas as storages.**
- To create a consensus among stakeholder about the **idea of Water-Heritage** by restoring **Water System and Network**, which are **vulnerable to be forgotten.**

OBJECTIVE : SWACHH SURROUNDING

- To sanitize heritage city of Ahmedabad by inclusion of component like **Solid Waste Management and Sanitation in Integrated Management Plan (Heritage)**

Detailed Study Area

- Study Area
- Step-wells
- Old City



Our Pilot Study Areas is limited to 100 m buffer area:

Area 1 : Cluster of 3 monument near Jama Mosque

Area 2 : Cluster of 3 monument near Amrutvarshini Step Well

Area 3 : Cluster of 3 monument near Delhi Darwaja

Area 4 : Sarkhej Roja

AREA 1				
Jami Masjid Raja no Haziro Rani no Haziro				
AREA 2				
Panch kuwa Gate Amrithvarshini Vow Sarangpur Gate Queen's Malik Sarang Mosque				STEP WELLS RAIN WATER HARVESTING
AREA 3				
Delhi Darwaja Qutbudin Shah's Mosque Muhafiz Khan's Mosque Rani rupmati's Mosque				
AREA 4				
Sarkhej Roja				LAKES

Heritage

Solid Waste Management

Solid Waste Management

WHAT WE SAW AT FIRST GLANCE IN HERITAGE PREMISES AND PRECINCTS !!!!



Unhygienic condition of collection points in Old City



Old City



Generic Issues

- Maintenance of monument premises
- Solid Waste dumping in Step Wells
- Segregation by Rag Pickers
- Cattle feeding from Waste Dumps
- **Dumping of Kitchen Waste**
- Unhygienic Collection Points



Ahmedabad is the First UNESCO World Heritage City from India

Sanitation Ranking of Ahmedabad
Swachh Survekshan – 2017

14

Spatial Analysis of Solid Waste

ISSUES

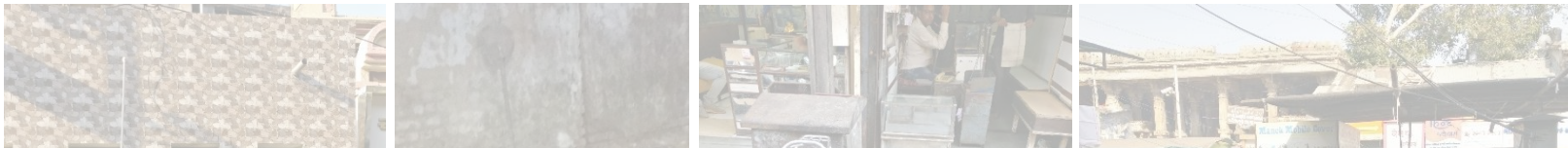
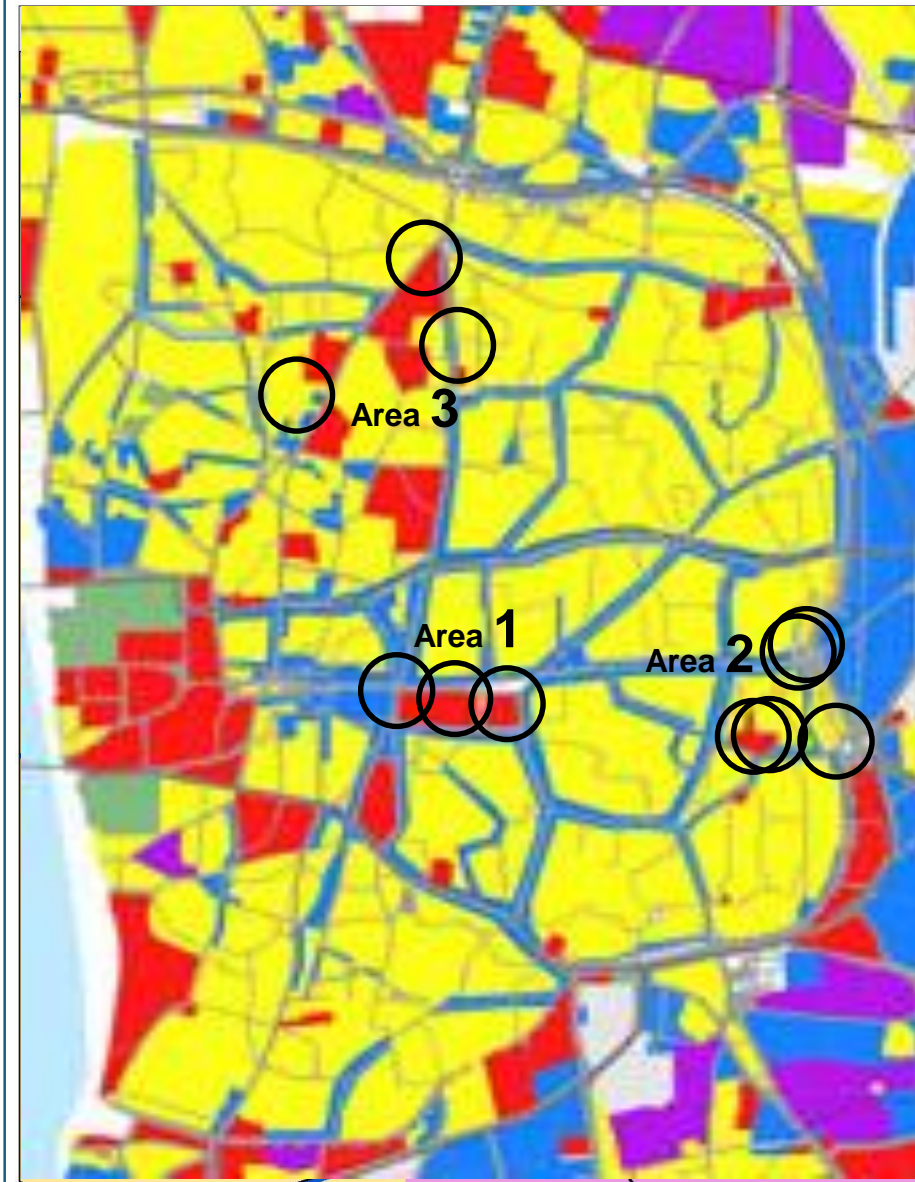
1. Proximity of Collection Points

2. Type of Waste*

3. Frequency of Collection of Waste

4. Land use

AREA 1	AREA 2	AREA 3
ORGANIC PLASTIC	PLASTIC	ORGANIC
COMM ERCIAL	RESIDE- NTIAL	RESIDE- NTIAL



Stakeholder Consultation

We all shopkeepers are tired of Food Waste which is spilled over during night time in Manek Chowk

Nuisance Points due to Food Waste near Jama Masjid

Lack in Segregation of Waste at source is major issue

Commercial Area near Manek Chowk lacks dustbin availability leading to road side littering

Dustbins are used as dustbins near Rani no Haziro

Area 1 Assessment

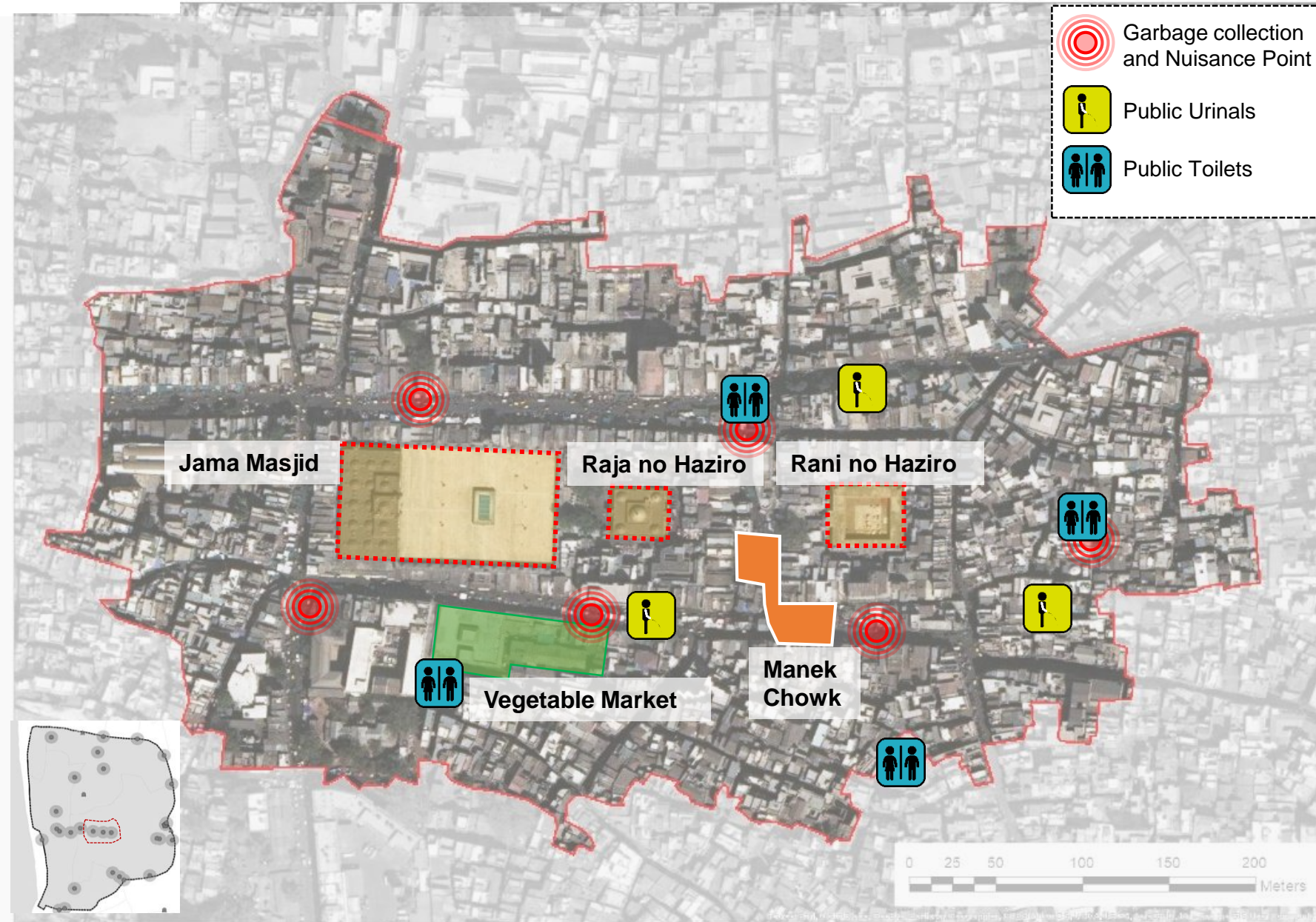
Characteristic of waste: **Organic, Paper & Plastic**

Nuisance Point: **6**

No. of Official Collection Points: **3**

No of waste pickers involved in area: **15-17**

- 80-90% coverage is present for vegetable market but collection frequency is only one time in a day.
- Wholesale Fruit market has no collection point they throw their waste in community bin. They have private sweeper
- Vendors & shopkeepers do not have a dustbins.
- In night time 90% waste is organic due to Manek Chowk
- Handcarts are provided for these markets for 2 times collection in a day.
- Street sweeping is done only one time in a day early morning



Current Scenario of Solid Waste Management in Manek Chowk (Area 1)

Manek Chowk Food Shops



Waste Collection and Segregation



Current Scenario of Solid Waste Management in Manek Chowk (Area 1)

Washing of Floor



22

23

00

01

02

03

04

05

Manek Chowk

Washing of Floor



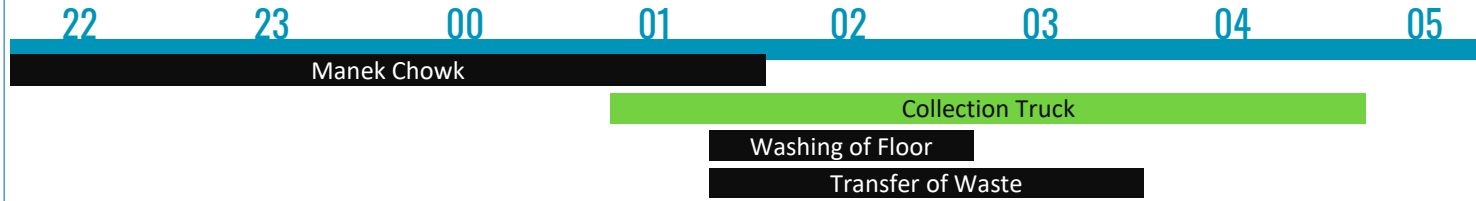
Barrels used for collecting plates with leftover food



- Food waste and plastic waste is dumped un-segregated
- Unhygienic condition of barrels and it is always kept in middle of Manek Chowk till morning hours

Current Scenario of Solid Waste Management in Manek Chowk (Area 1)

3 Tons Capacity Trucks



Barrels are moved to the Collection Trucks



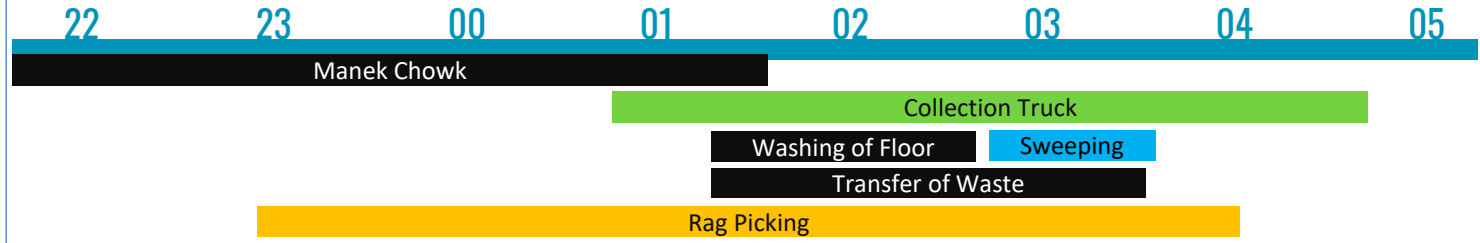
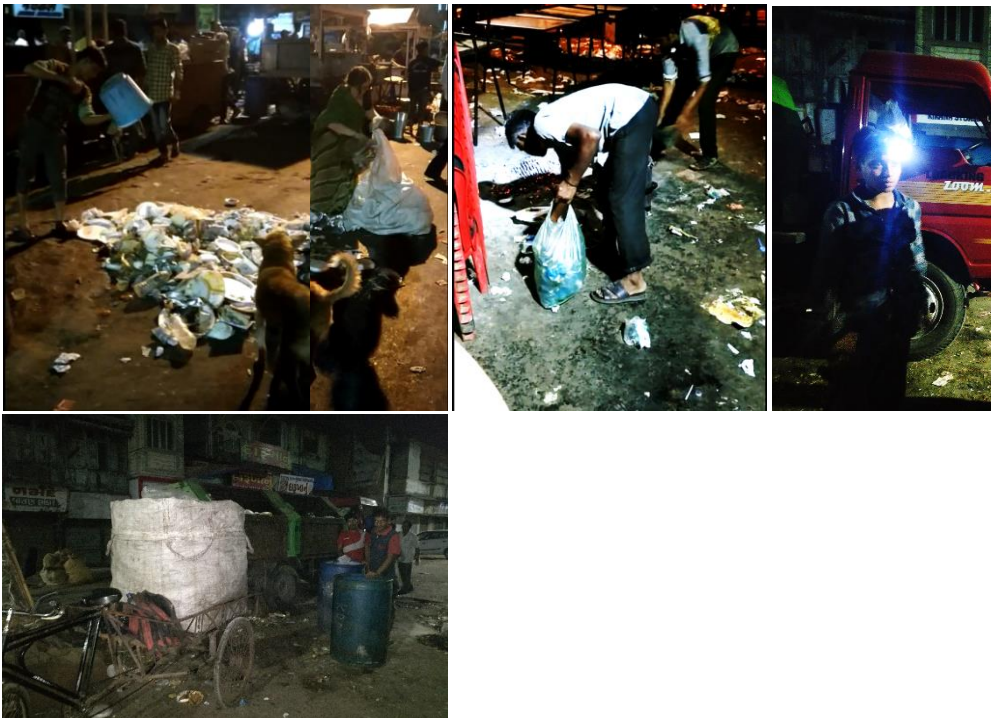
- Spillover of food waste while transporting and dumping in truck.
- Dustbin without wheels make them drag barrel to 600 m distance
- Rough way to handle barrels is being observed

Current Scenario of Solid Waste Management in Manek Chowk (Area 1)

Sweeping



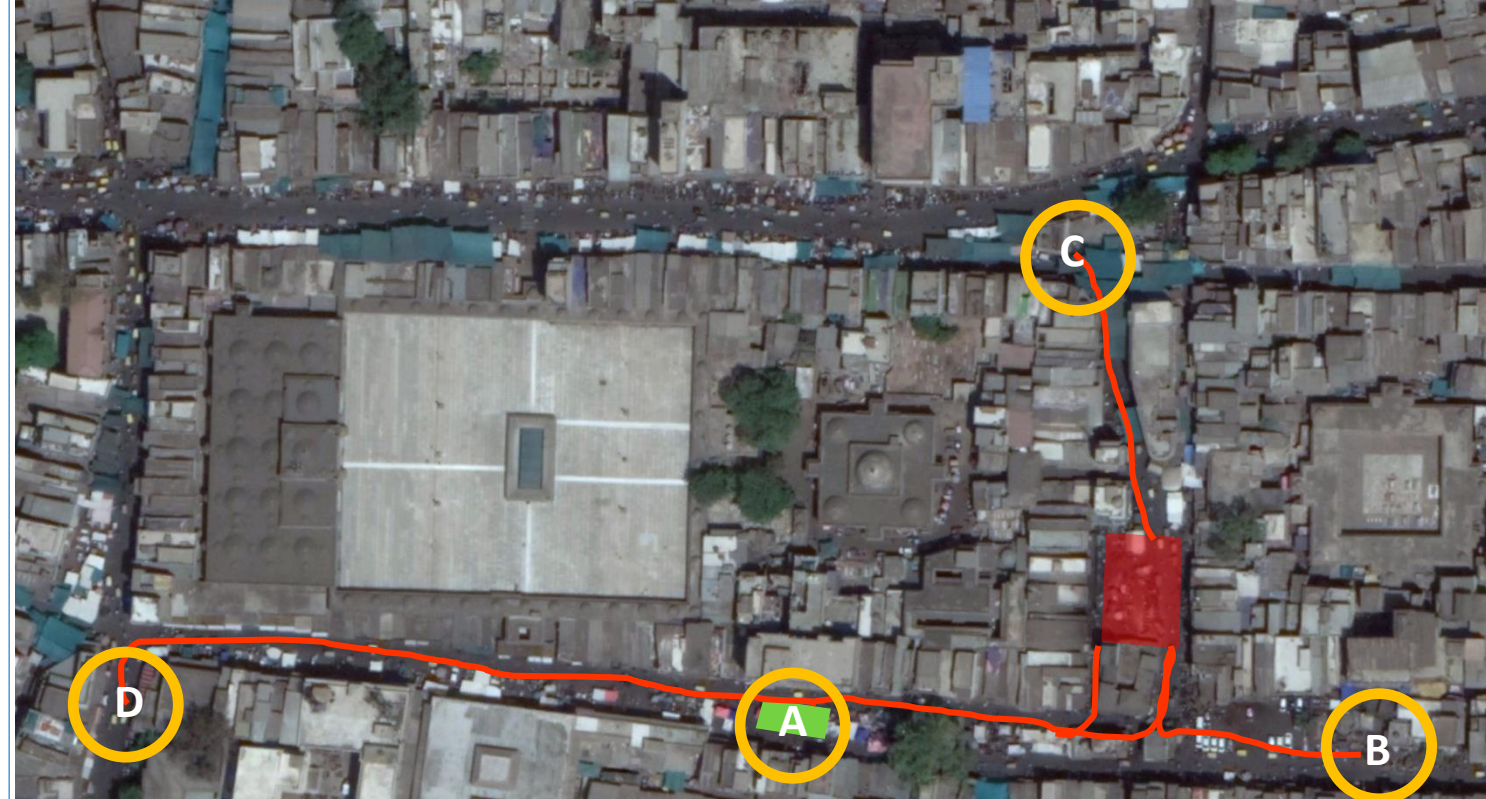
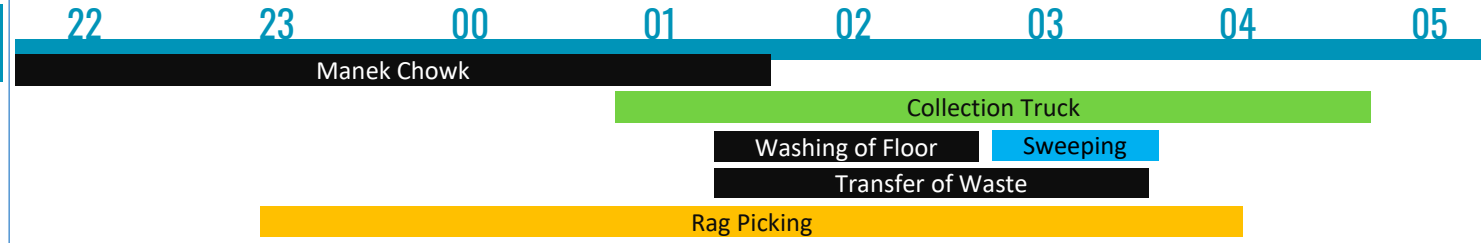
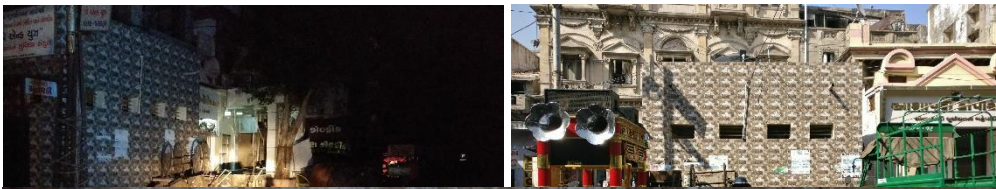
Rag Picking



- No monitoring on quality of sweeping and on whether mentioned number of sweeper in contract present or not
- Rag Picker collects Plastic, Glass and Paper from rotten leftover.

Current Scenario of Solid Waste Management in Manek Chowk (Area 1)

Other nuisance points



- Parking is major factor because of which nuisance point cannot be cleaned twice or thrice
- Dumping of un-sold food at collection points which lies in 100 m

Current Scenario of Solid Waste Management in Manek Chowk (Area 1)

Dry Waste Collection



- Un-availability of proper equipment for dry waste
- Dogs and Cows feeding on leftover

Generic Issues

- Maintenance of monument premises
- Solid Waste dumping in Step Wells
- Segregation by Rag Pickers
- Cattle feeding from Waste Dumps
- **Dumping of Kitchen Waste**
- Unhygienic Collection Points

Area 1 Specific Issues

- Un-availability of proper equipment's with workers
- Absence of monitoring on quality of sweeping and cleaning.
- Excessive littering during business hours in manek chowk
- Organic waste is not segregated (kitchen, fruits and vegetable)
- Rough handling and unhygienic condition of barrels/dustbins
- Parking at collection points in day time
- Dumping of un-sold food at collection points

कचरे से बनी बिजली से रोशन हुआ बिट्टन मार्केट का हाट बाजार



भोपाल। बिट्टन मार्केट का हाट बाजार अब कचरे से बनी बिजली से रोशन हो रहा है। यहां 1 करोड़ पांच लाख रुपए से बनकर तैयार हुआ बायोमिथेनाइजेशन प्लांट पर

कचरे से बिजली बनाने का काम शुरू हो गया। छह महीने पहले प्लांट की शुरुआत हुई थी, पहले इसमें मिथेन गैस बनाई गई, इसके बाद गैस को परिवर्तित कर मार्केट

में लगी स्ट्रीट लाइट को बिजली सप्लाई की जा रही है। निगम अधिकारियों ने बताया कि प्लांट में मार्केट से निकलने वाली सब्जियों को ग्रीन वेस्ट और एमपी

नगर के होटलों से आने वाले किचिन वेस्ट का निष्पादन किया जा रहा है। शहर का यह पहला प्लांट है, जहां कचरे से बिजली बनाई जा रही है।

AWARENESS DRIVE THROUGH IEC



Loudspeaker on Waste Picking Truck

Installation of loudspeaker on Waste Picker trucks for creating awareness to keep the heritage precincts Swachh

AMC

SBM



Launching of monthly Heritage Newsletter

Local newspaper and AMC can initiate newsletter to promote cleanliness and Clean Precincts competition in Heritage Area

AMC

CSR

Spot Fixing Cleaning Drive

A group of people can come together to clean nuisance point on weekly basis. AMC should provide full resources for successful delivery.

Community
Committee
Trust
NGO

Swachh Heritage Ambassador

His role is to promote and build capacity and promote segregation of waste to other shopkeeper, rag pickers and make them aware about the UNESCO Heritage status.

Community
Committee
Trust
NGO

AMC should give separate Dustbins

AMC should provide separate dustbins to Shopkeeper in Manek Chowk so that waste can be segregated at source.

AMC



CONTRACTS

Contract : MIS System for Cleanliness Worker

- Development of Management Information System for monitoring and maintaining records of staff attendance and performance, fee collection directly from Ahmedabad Municipal Corporation

Performance Based Contract

- For those working in Heritage Precincts, 2 day mandatory capacity building workshop.
- Proper Equipment for Worker
- Direct transfer of salary based on Bio-metric System

DESIGN SOLUTIONS



Urban Design Solution for Nuisance Points

Competition for students and professionals

AMC

TECHNICAL SOLUTIONS

Segregation and Reuse of Organic & Kitchen Waste to Energy

Ahmedabad Municipal Corporation can in with coordination with APMC Market can install Waste to Energy Plant.

Capital Cost: 2 Crores

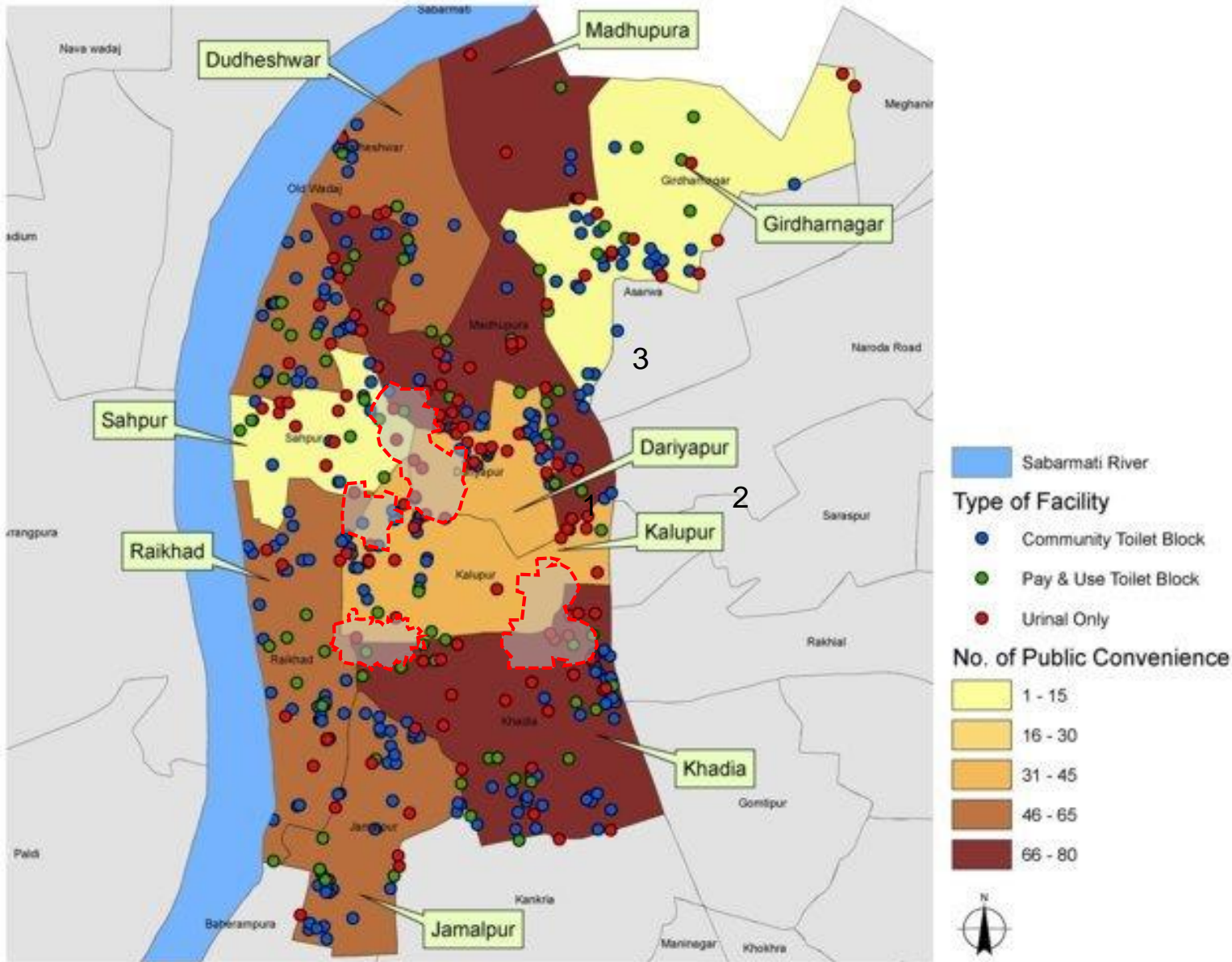
Capacity: 5 Tons/D

Total energy generation: 5 MW

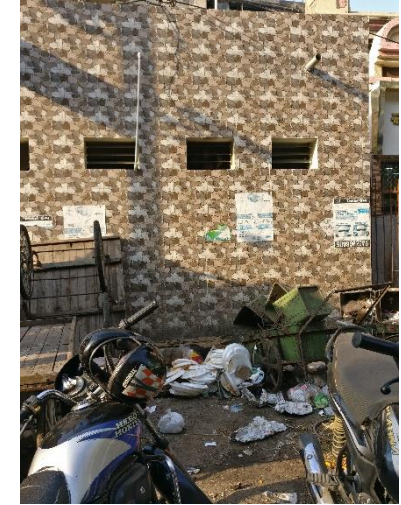
[For Details](#)

Heritage Public Toilets

Spatial Analysis of Public Toilet in Heritage Precincts



State of Public Toilets within 100 m of ASI preserved Heritage Precincts

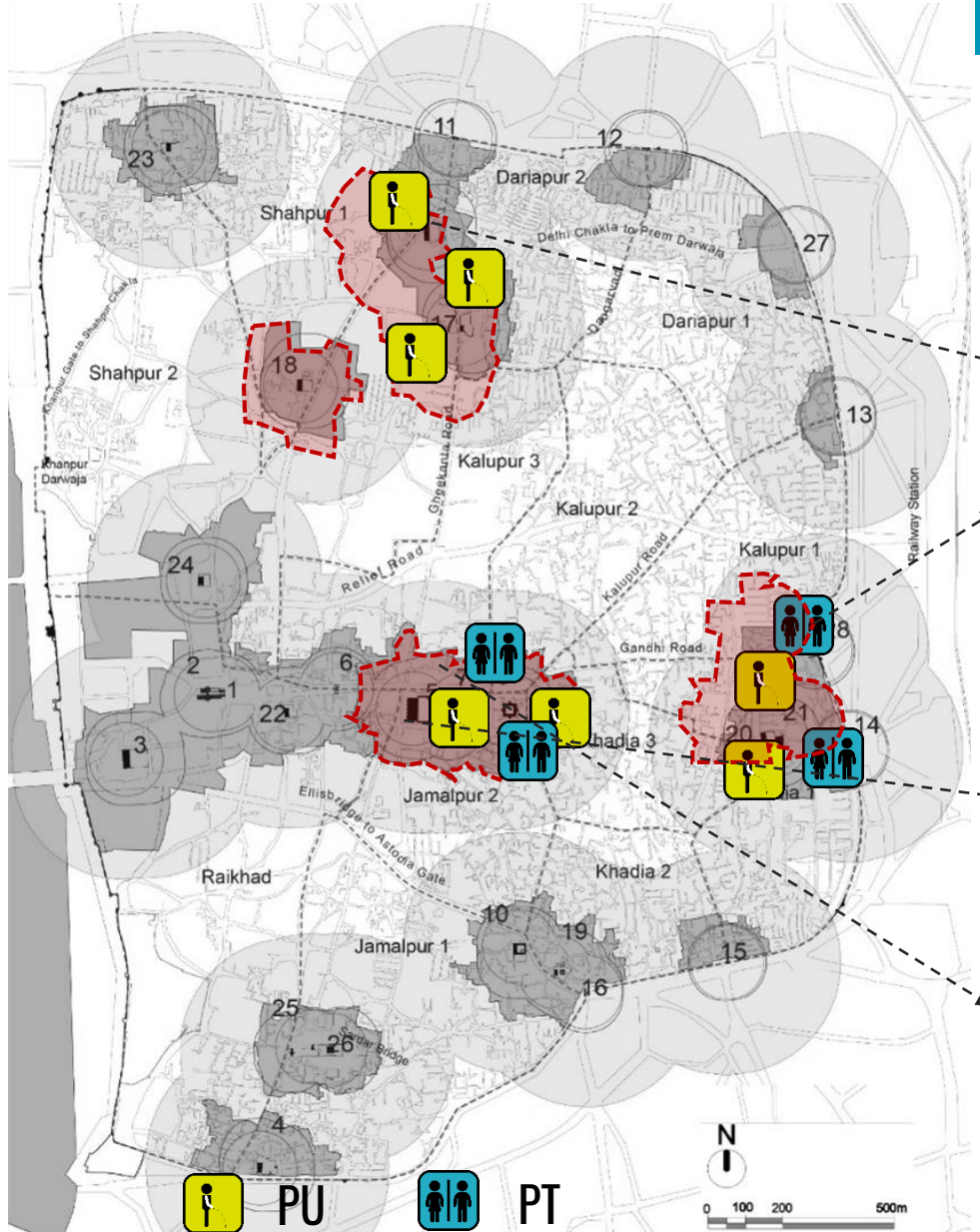


Existing condition of Public Toilets/Urinals surrounding heritage Precincts



State of Public Toilets within 100 m of ASI preserved Heritage Precincts

Existing condition of PT/CT



Encroachment in front of



Waste dumping near PT

Assessment of PT/PU

Types of Toilet	No.of Toilets	Average No. of Users	Managed By AMC	managed by Private agency	Gender seperated	Paid_Unpaid
Public Toilet	6	1000	3	3	6 Paid	
Community toilet	2	300	1	1	1 Unpaid	
Public Urinal	7	1200	7	0	0 Unpaid	
Mobile Toilet	1	150	1	0	1 Unpaid	

40% of Public Urinals cleaned **once in a 3 days**

People are urinating & **defecating** in public Urinals

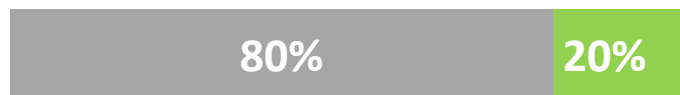
No Urinals for **Female**.

Unhygienic condition due to irregular cleaning In PT

50% Public Toilets has **insufficient WC seats & Urinals** as compare to SBM guidelines

Private Agencies failing to clean toilets on day to day basis

Cleaning Frequency of PT



■ Once in a day ■ 2 times in a day

Cleaning Frequency of PU

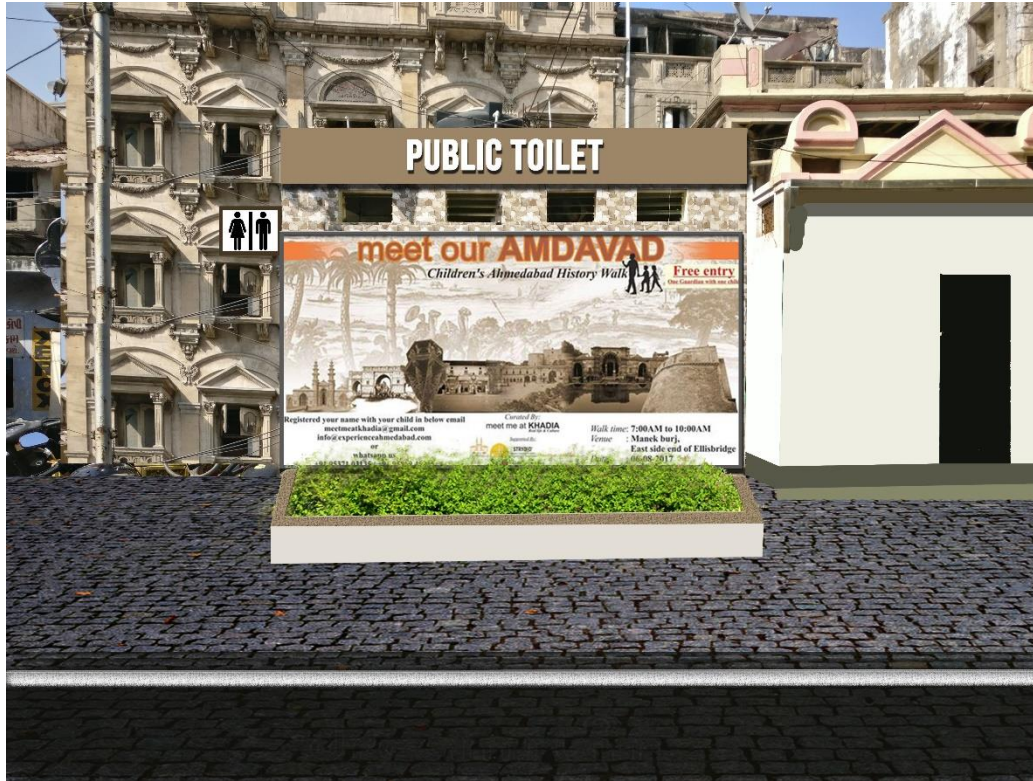


■ Once in a 3 days ■ Once in a Day ■ Once in a week

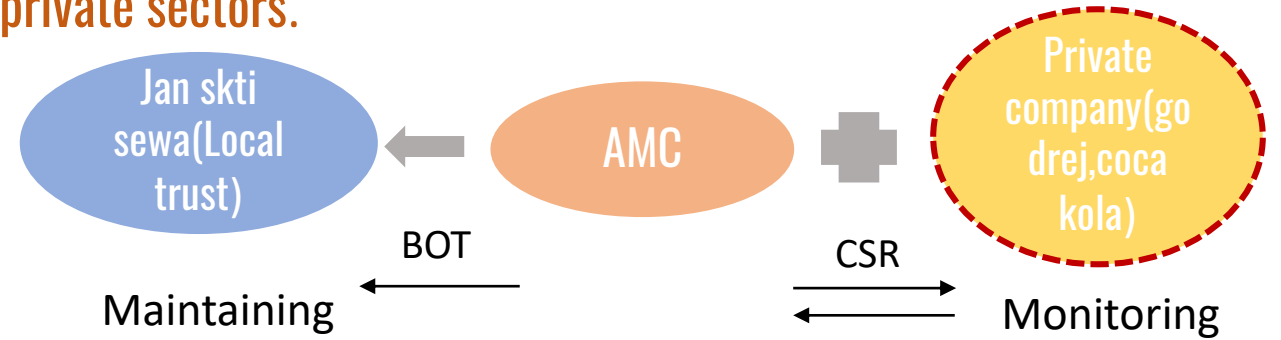
Intervention : Retrofitting of PT/PU

CSR through Private companies like NTPC, Godrej, Amul

Mobilize funds for advertisement rights through involving private sectors.



Before



Tri-partite agreement for maintaining of public toilets (TPA) between AMC+ Private company+Local trust(NGO/CBO)



The revenue from the user fees should contribute to pay for Maintenance of PT



To exploit the advertising potential, the private contractor entered into a contract with a public outdoor advertising

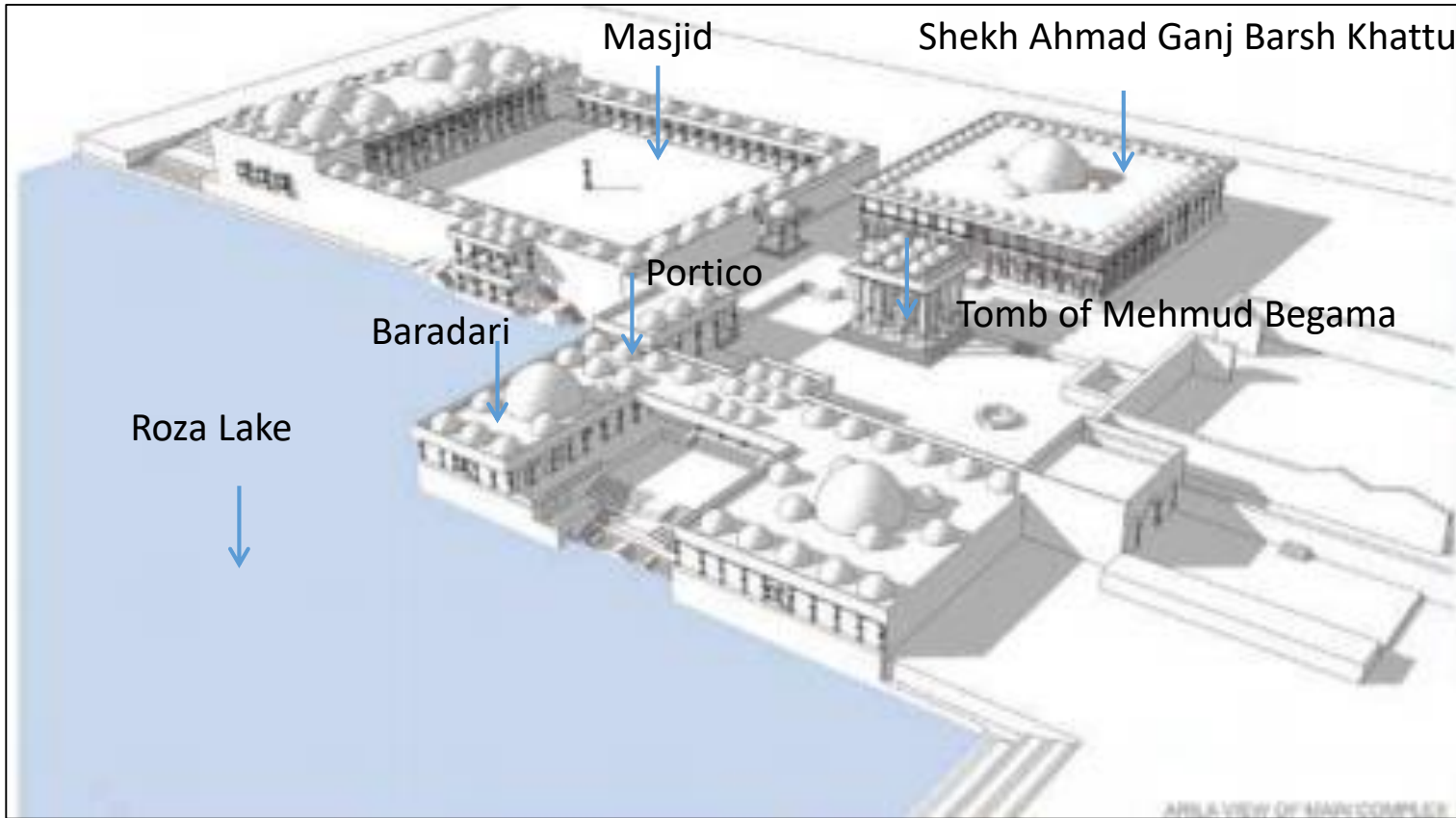
Retrofitting of PT :

Operation & Maintenance : Toilet Maintenance policy should encourage corporates to provide funds for the O & M of toilets through their CSR funds.

Heritage

Water as Heritage | Sarkhej Lake

Sarkhej Roza : Context



Area:

Total Area: 24 Acres

Roza Tank: 17 Acres

Events at Sarkhej Roza:

- Sarkhej Roza Lighting
- Heritage Day
- Sufi Festival
- Award Ceremony
- Concerts
- Mushairas
- Rajab festival celebration
- Celebration of Janmashtami
- Round table meets
- Tree Plantation

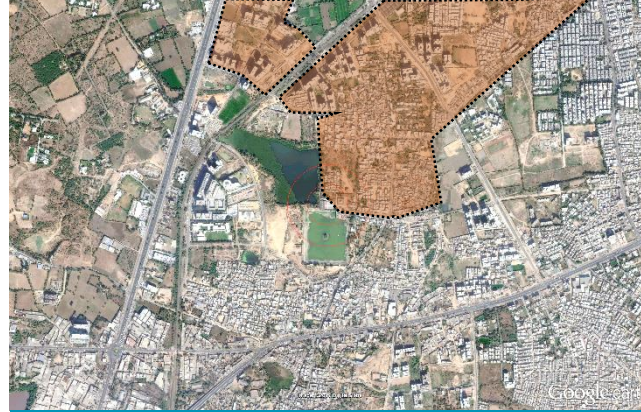


1. High rate of excavation from the lake has lowered the level of Makarba talaav

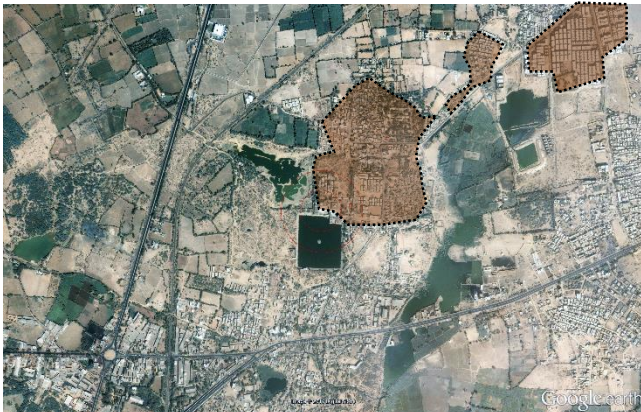
2. Upcoming New development has disturbed watershed of Makarba lake



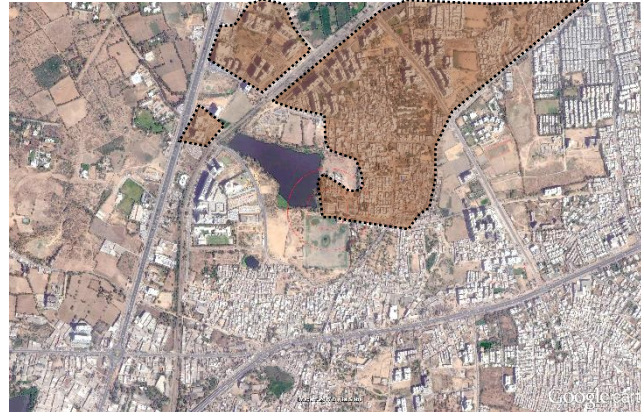
DEC,2000



DEC,2016



FEB,2001

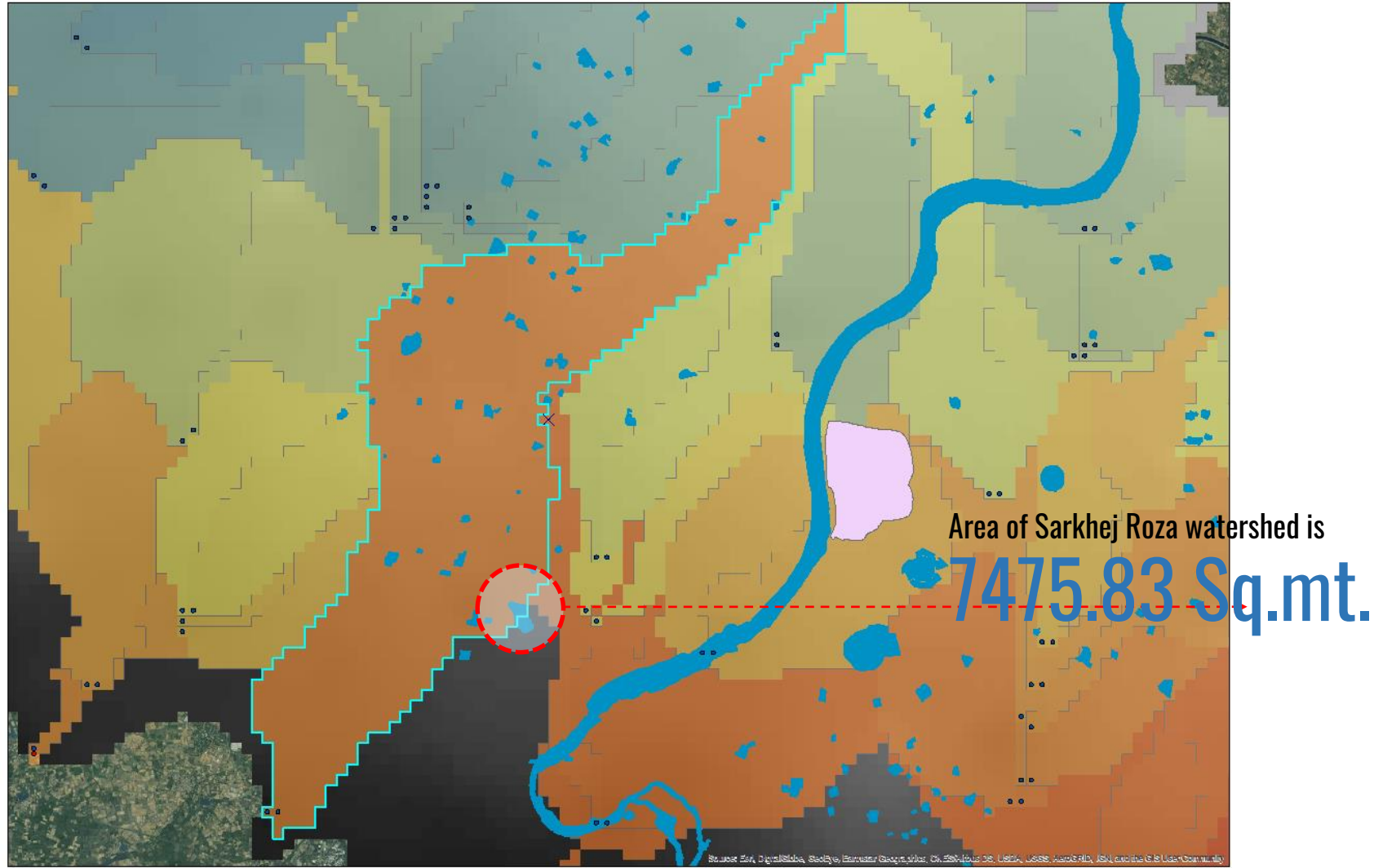


FEB,2017

ISSUES:

- Natural Flow Obstructions & Drying Of lake

MONUMENT PRECINCTS : SARKHEJ ROZA (Water Based)



ISSUES:

- Natural Flow Obstructions & Drying Of lake

Sarkhej Roza Watershed

Source : Elevation points from zomus.com

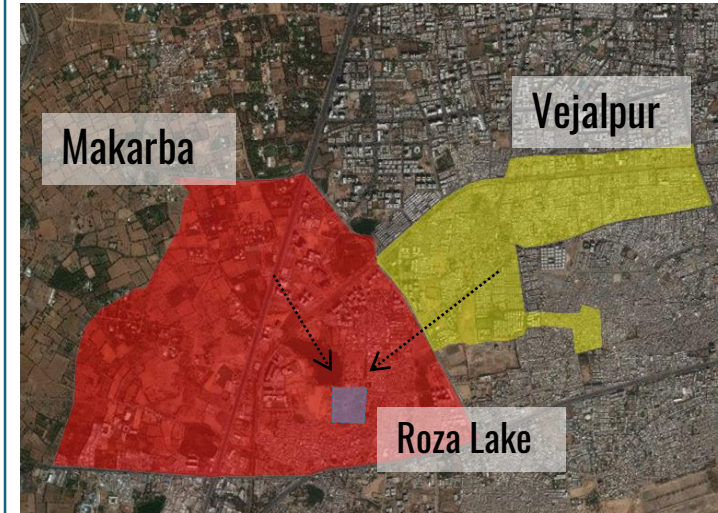
Issues

MONUMENT PRECINCTS : SARKHEJ ROZA (Water Based)



ISSUES:

- Natural Flow Obstructions & Drying Of lake
- **Black water is draining into Makarba lake**





Algal Growth in Roza lake

ISSUES:

- Natural Flow Obstructions & Drying Of lake
- Black water is draining into Makarba lake
- **Eutrophication Within Makarba lake**
- **Solid Waste Dumping**
- **Silting and sludge are contaminating Makarba lake and depleting rate of water recharge..**



Eutrophication in Makarba lake



Eutrophication in Roza lake

Cloths and plastic waste outside monument area





ISSUES:

- Natural Flow Obstructions & Drying Of lake
- Black water is draining into Makarba lake
- Eutrophication Within Makarba lake
- Solid Waste Dumping
- Silting and sludge are contaminating Makarba lake and depleting rate of water recharge..
- **No cleaning of stairs surrounding Roza lake**

Sweeping and maintenance:

Tomb:

- Sweeping is done by housekeeping staff and the rituals are performed by Maulana.
- Steps: ASI allocates 12-15 people 1 times on yearly basis for its maintenance.

Toilets:

- Total 20 gents toilet and 10 ladies toilets
16 WC and 4 urinals in gents toilet.



No Proper Maintenance

No. of staff is decreased from 10 to 4

Very less people are coming due to lack of maintenance

ISSUES:

- Natural Flow Obstructions & Drying Of lake
- Black water is draining into Makarba lake
- Eutrophication Within Makarba lake
- Solid Waste Dumping
- Silting and sludge are contaminating Makarba lake and depleting rate of water recharge..
- No cleaning of stairs surrounding Roza lake
- **AMC garden just within Sarkhej Property is not being maintained properly.**



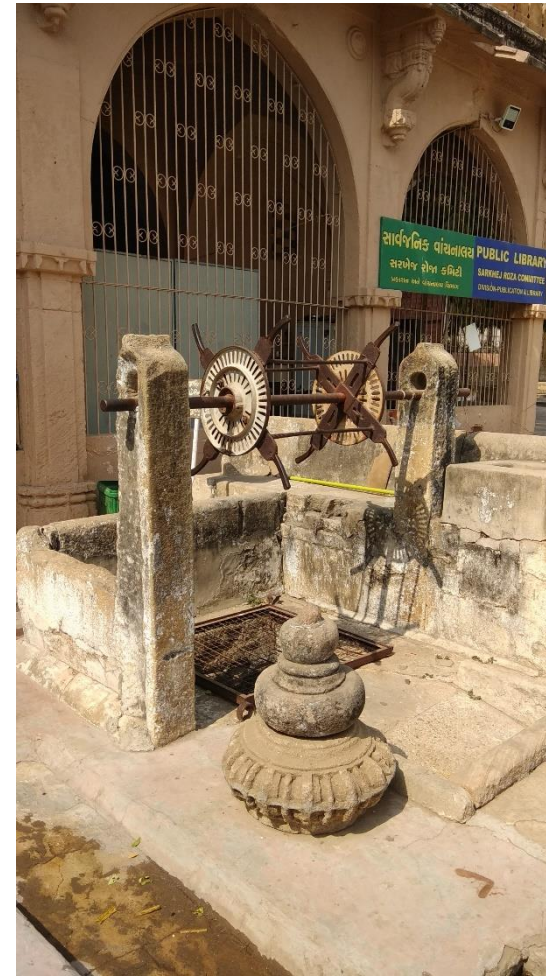
ISSUES:

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- Silting and sludge are contaminating Makarba lake and depleting rate of water recharge..
- No cleaning of stairs surrounding Roza lake
- AMC garden just within Sarkhej Property is not being maintained properly.
- **Obstruction in the way of paths for inlets of water from surrounding area.**



800 Feet Tube well –AMC

- Used for water supply without any treatment except chlorination
- Contaminated water supply.



80 Feet well –

- No water
- Used for throwing Religious books

ISSUES:

- Natural Flow Obstructions & Drying Of lake
- Black water is draining into Makarba lake
- Eutrophication Within Makarba lake
- Solid Waste Dumping
- Silting and sludge are contaminating Makarba lake and depleting rate of water recharge..
- No cleaning of stairs surrounding Roza lake
- AMC garden just within Sarkhej Property is not being maintained properly.
- Obstruction in the way of paths for inlets of water from surrounding area.
- **Poor quality of water being extracted from Bore wells just beside Roza lake**
Depth = 1000feet, 800 feet

Activities	Implementing Agencies	Approvals	Funding
Watersupply	SRC	SRC	SRC
Drainage	SRC	ASI	ASI
Electricity	SRC	SRC	SRC
Accessibility	ASI	ASI	ASI
Marketing	SRC	SRC	SRC
Land Use	SRC	ASI	SRC

“The Archaeological Survey of India (ASI) was renovating the monuments around the lake, but they did not stop the illegal excavation because they are “only supposed to take care of the monument and not the water body adjacent to it”, says an ASI official.”

ISSUES:

- Natural Flow Obstructions & Drying Of lake
- Black water is draining into Makarba lake
- Eutrophication Within Makarba lake
- Solid Waste Dumping
- Silting and sludge are contaminating Makarba lake and depleting rate of water recharge..
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- Obstruction in the way of paths for inlets of water from surrounding area.
- Poor quality of water being extracted from Bore wells just beside Roza lake
Depth = 1000feet, 800 feet
- **Governance**

Best Practices:

Udaipur Lake conservation System: JHEEL SANRAKSHAN SAMITI

- **silt removal Programs**
- **Developing Reservoir operation policy**
To maintain Minimum conservation pool level of at least 10% of total storage capacity of lakes at all times.
- **Revenue generation : No water no Tourism**
transferring the surplus water of nearby Sabarmati basin.



Eradication Of Water Hyacinth by Efforts Of JSS



Organizing Lake Management Workshop for stake holders

Water Augmentation and Governance

Management role

Awareness

Source: Citizens Role in Ecological, Limnological, Hydrological Conservation of Udaipur Lake System.

Proposals

1. Makarba Lake



- Clean Lake from Eutrophication
- De silting of lake
- Seal openings of all sewage lines into lake
- Provision Of foot path along lake to Prevent OD
- Provision Of signages that can aware people if there is any pollution in waterbody

સૂચના	
 શેવાળ છે?	પાણી પીવા યોગ્ય નથી
 મચ્છર હાજર છે?	સ્થાનિક સંસ્થાઓને જંતુનાશક છંટકાવ માટે પૂછો
 સીવેજ નિકાલ થાય છે?	સ્થાનિક સંસ્થાઓ પાસે ફરિયાદ કરવી
 ફ્લોટિંગ ડિબ્રીસ અને કાદવ નિકાલનું પ્રમાણ વધુ છે?	ઓગળેલા ધન કચરા દ્વારા દૂષણ
 પશુ સ્નાન થઈ રહ્યું છે?	લોકોને તેમના ઢોરોને સ્નાન લેવા દેવા અટકાવી

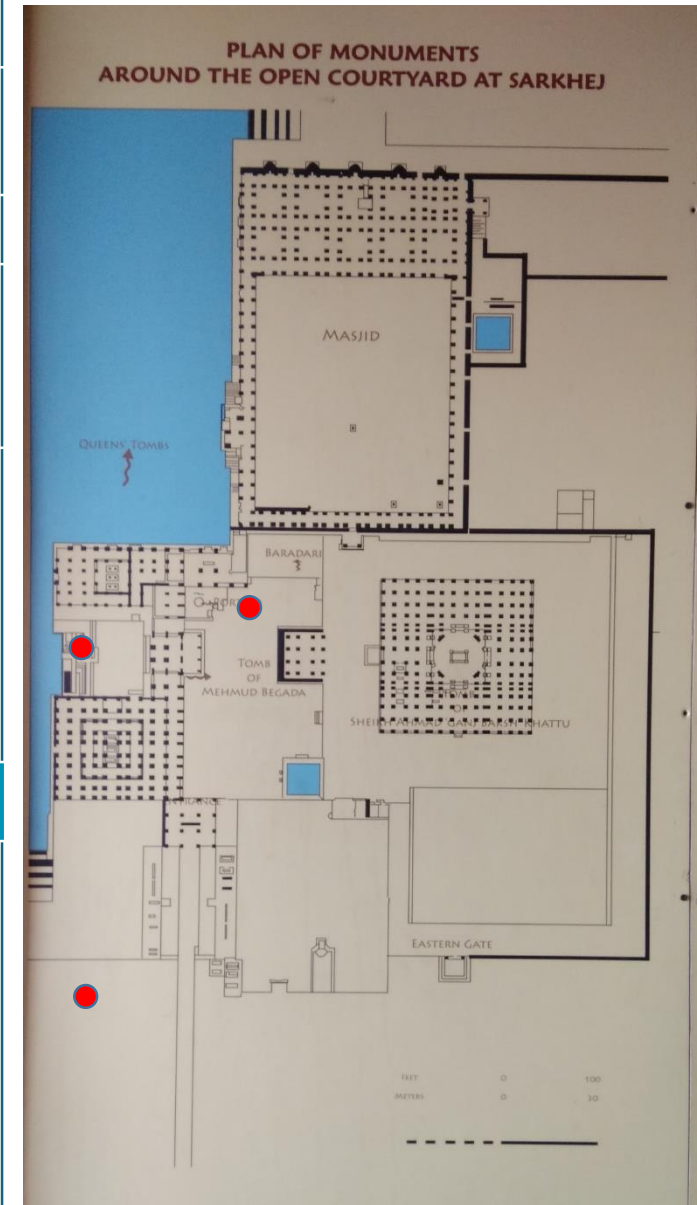
If any of Above present then contact management Agency

Water supply

- Barrier free Water inlets.
- Provide Treatment Facilities to the water before supply to people
 - 1.Alum Treatment
 - 2.Chlorination
 - 3.Primary settling of solids
- Planned growth of surrounding land such that it can not disturb natural drain and watershed
- Use Religious Well as a recharge well from roof top rain water harvesting purpose.

Solid Waste

- Clean steps surrounding Roza at least once in month by ASI
- Use Ancient religious well as a recharge pit for R.W.H.



Helping Agencies And their Roles

ASI

- Research and protection of the cultural heritage
- Maintenance

Sarkhej Roza Committee

- Maintenance
- Seeking permission from ASI regarding any construction, repair and renovation
- Organizing events
- Rent collection
- Staff recruitment

Waqf Boards

- Litigations Tracking Management
- Properties Registration Management
- Funds Management to Mosques, Durgah, Kabristan, Imams ,etc

National Monuments Authority (NMA)

- Protection and preservation
- Statutory provision
- Seeking permission for construction/repair/renovation
- Grading and classification

Amdavad Municipal Corporation (AMC)

- Creating awareness
- Providing basic utilities
- Initiating restoration efforts

ASI
AUDA
AMC
Gujarat Tourism
House of M.G.
INTECH – Gujarat Chapter
H.N. Safal
Navneet Publication
Parsoli Motors
The Craft of Art

Funding :

Rs.9 crore AMC spent on storm water drainage lines in Vejalpur and Makarba village

6.84 crore worth of projects aimed at reviving the Roza lake by AMC under **JNNURM**

Costing

Work	Length / Area	Per Unit Cost	Total cost	Operation cost	Total cost
Clean Lake from Eutrophication	100000	45	4500000	225000	4.73
De silting of lake	100000	65	6500000	325000	6.83
Foot path provision	2250	600	1350000		1.35
Provision Of signages					0.03
Railing surrounding lake	2250 sq.m	700	1575000		1.58
Maintenance of AMC garden					0.20
Barrier free water inlets					0.20
Use Ancient religious well as a recharge pit for R.W.H					0.15
					0.20
				Total cost of	15.25 Crore

Heritage

Stepwell

Step wells- A traditional water Harvesting systems



Ancient practices to use water from step wells



Built area below ground level enhances Beauty



Step wells- A community level traditional water systems

MONUMENT PRECINCTS :Issues



Lowering of G.W.T from 25 m to 100 m within central zone of Ahmedabad

ISSUES:

- 1) No water present
- 2) Solid waste dumping
- 3) Urban pressure

Source: Water Group

Interventions

MONUMENT PRECINCTS: Step wells



DCR based Interventions

Enforcement to people for compulsory water recharge according to **Aquifer** of that Stepwell.

recharge wells- structures 3 to 5 feet in diameter and 10 to 30 feet deep are being dug and rooftop rainwater filtered and led into it.

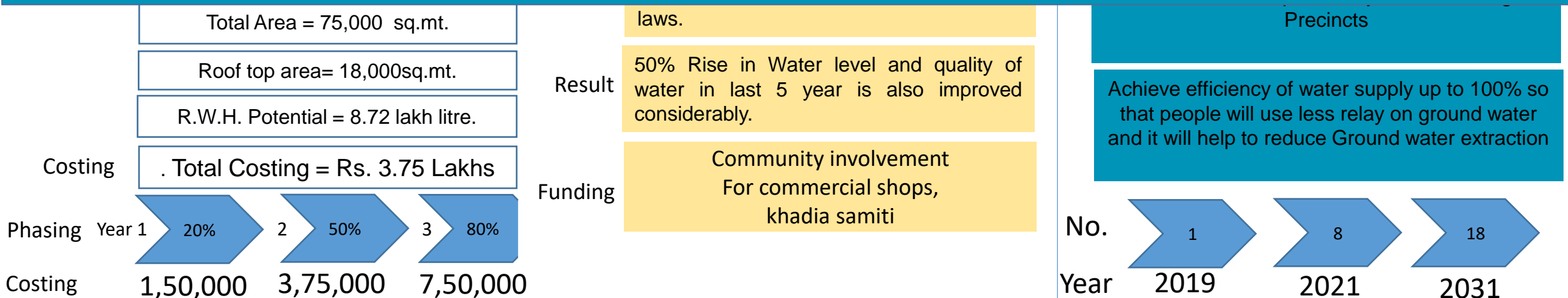
Management Intervention

There is a provision of Fine of Rs. 5000/- over throwing garbage inside it. But monitoring should be strict for this rule.

Urban pressure should be removed as nobody can actually identify location of the step wells.

Considering One criteria of narrowed streets and lack of spaces within old city to provide recharge wells. In order to solve this problem we can Directly recharge into stepwell within its catchment area.

3.84 lakh litre within step well itself and cost for one step well is approx. **1.5lakhs.**



Interventions:

MONUMENT PRECINCTS :2 Scenarios

State Protected monument

Scenarios

Implementation /
Impact

Output



PPP or CSR based Small scale business, Revenue generation, Cleanliness also maintained by them

5% of their profit or minimum token amount whichever is less will be taken by government as a part of contract. CSR can also possible.

Involve local community and bring them together to explain importance of this older system to tourists and they can promote it.

Heritage

Tankas and Rainwater Harvesting

Traditional Rain water harvesting system

Tankas as a 'Living Heritage'

'Unique underground structure has immense potential to solve the water crisis'

Existing Tankas: **55**

Tankas in Use: **17-18**

Tankas in Pol:
Bathing, washing, drinking

Religious tankas: religious & drinking purpose

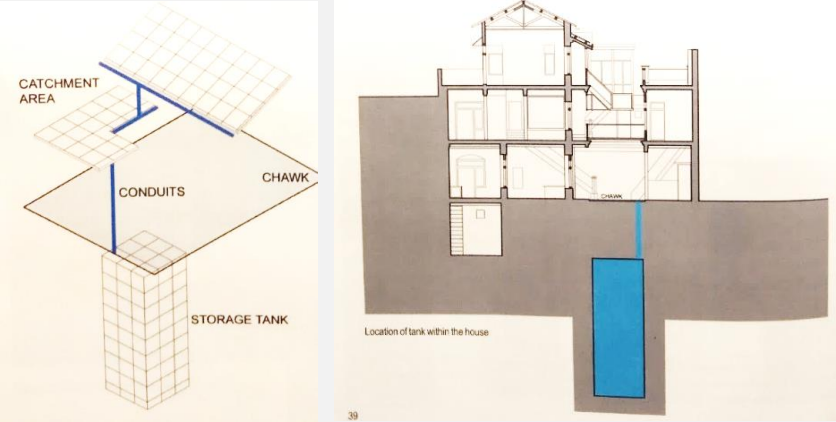


First flush system
Average Volume of tanka:
58cub.mt which contains 58000 liters/tanka
Harvested water /HH/ Da:**148** liters

Reasons For dying tankas:

- Availability of Municipal tap water
- Lack of maintenance
- No strict regulations for tankas in DCR
- Lack of awareness towards importance & function of tankas

Tankas and Pol House of Ahmedabad



Catchment area: 32sq mt
Harvesting potential: 20,400
Capacity : 1,03,000 liters



Principal: The basic principle of water used in tankas was collected of direct rainwater from rooftops and diverting it to underground storage tanks through gravity.

Usage

- Drainage: firstflush system, overflow pipe, both connected to a storm water drain, which leads to the outside. once the tank is filled excess water is diverted directly to the storm water drain.

Well Recharge, Pol House of Ahmedabad



Existing well recharge:

Funded by AMC: 1,65,000

7-8 house
Rain water
harvesting Tank
5 ft deep



Possible Solutions for reviving the Tankas:

Make it incentivize:

Give subsidy or Tax relaxation in retrofitting of tankas Like property tax rebate.

TDR shall be provided to unnotified buildings through improvement in the grade for revival of tankas.

Involve database monitoring system for tankas in each pols

Heritage building shall be classified on the basis of its traditional water heritage system.

Give tradable floor space:

Heritage structure	Possible Tradable FSI	Grade
Tankas in Use	50% of utilized FSI	Grade-1
Tankas with AMC supply	30% of utilized FSI	Grade-2
Tankas exist but not in Use	10% of utilized FSI	Grade-3

Benefits:

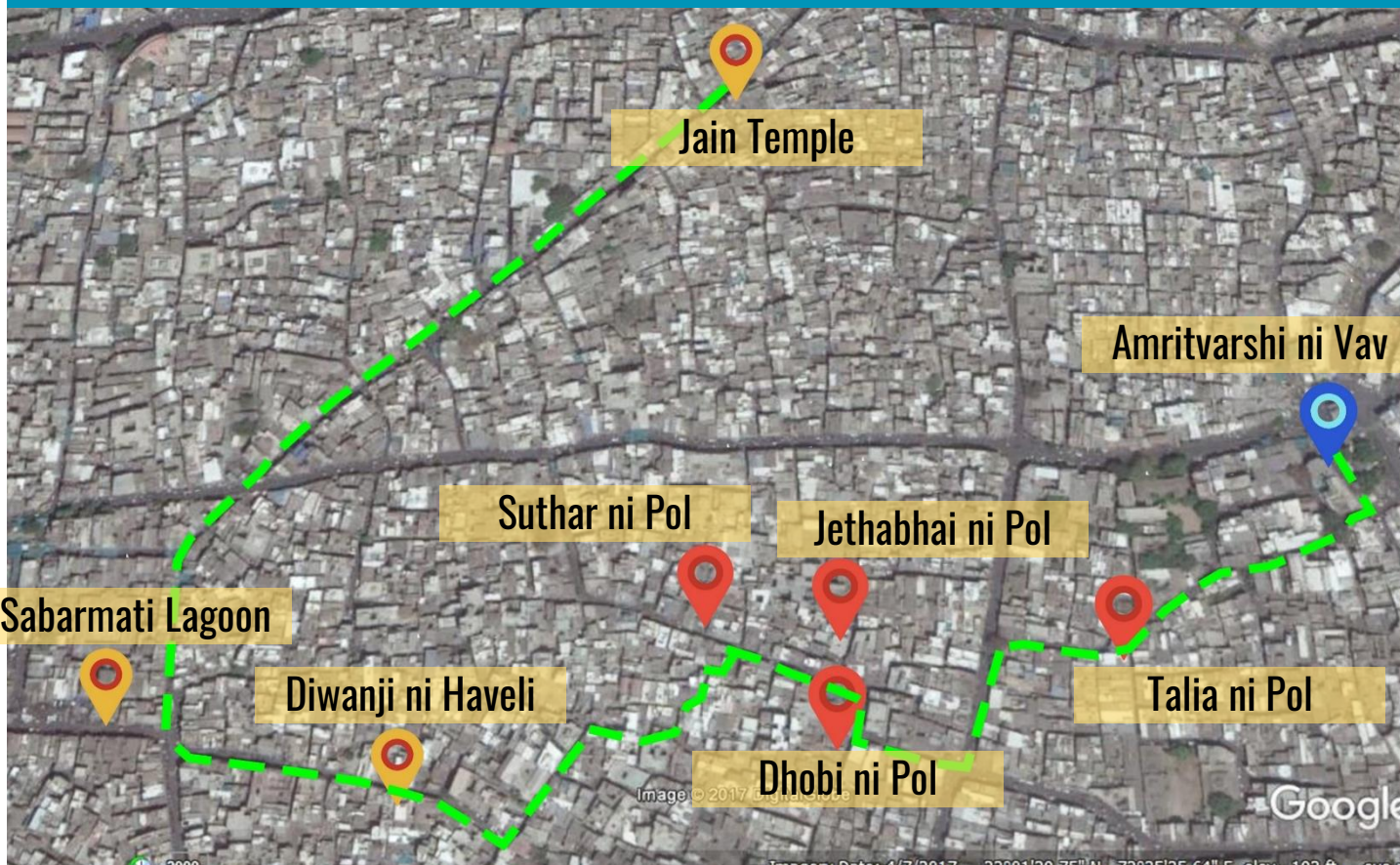
- Traditionally it has 24*7 efficiency of water
- It can reduce the potable water demand during monsoon

Promote water heritage through Living Heritage Museum:

AMC should prepare nominations for that museum so that traditional water practices can get a boost & international recognition for water heritage precincts of Ahmedabad [engage technical experts, water professionals and the creative arts community through a networked-approach]

Revival of Traditional wisdom for stringing of rain water: a unique water heritage walk

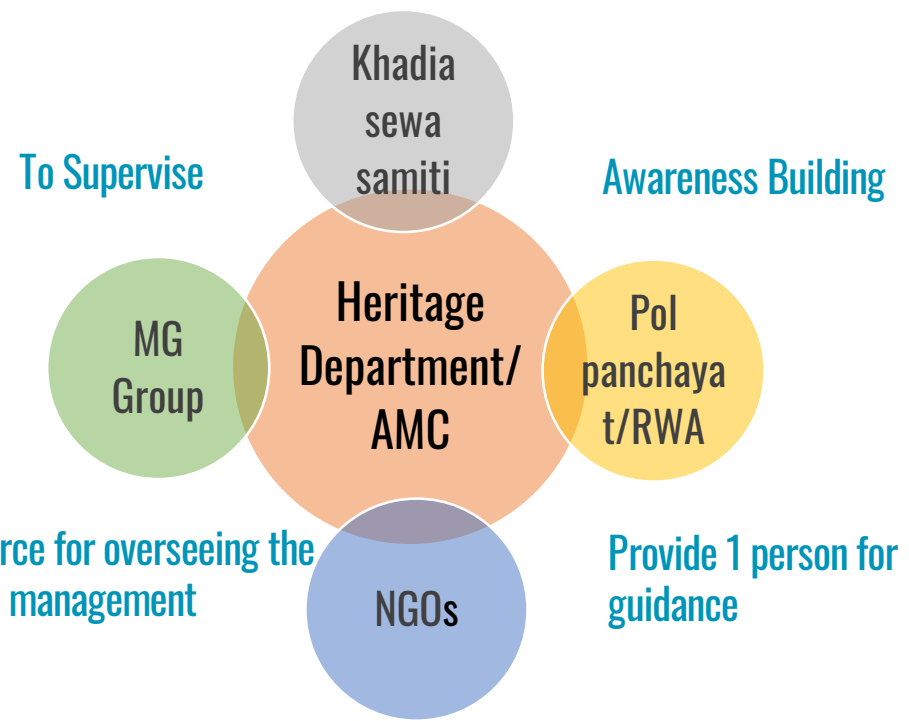
Generating Awareness through: A unique water heritage walk



“Visualizing Narratives, Cultures and Ecologies of Water”

Length of Walk: 1.7km
User charges: 20-30/- (Nominal)

Integration of stakeholders:



2 types of traditional water conservation practices

-  Tanka of Haveli & Pols
-  Stepwell

Community participation approach:

- Advertisement hording in pols/wall posters
- Pamphlet distribution
- puppet shows through this walk

Heritage Institutional Framework

Issues in Governance

Role of Department of Archaeology, GoG & Archaeology Survey of India, Gol

ASI and SDA recommend two buffer zones (100 meters and 300 meters) around the national and state heritage sites and structures for regulating and controlling development in the surrounding areas.

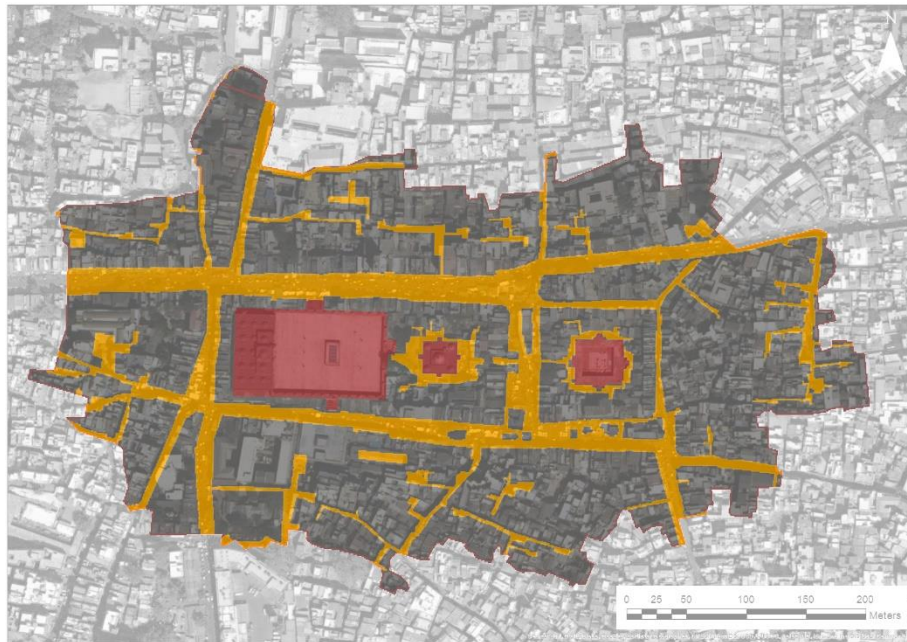
ASI has assigned Guard cum Sweeper to clean premises only

Role of Heritage Department, Ahmedabad Municipal Corporation

To deal with conservation and inclusion of Notified Heritage Houses. Their role is to manage TDR incentives and to enforce regulation made for heritage building under AMC.

Role of Health Department, Ahmedabad Municipal Corporation

Looks after Management of Solid Waste and Public Toilets



Cleanliness Responsibility Distribution

■ AMC managed Area* ■ Private Owner

■ ASI managed Area

* Contracts

- **First UNESCO World Heritage City of India with multiple stakeholder and jurisdiction area with limited roles. Lack of Power and integration is absence.**
- ASI sweeper works only into premises of monuments
- Heritage Department cannot initiate any cleanliness process on its own.
- No extra efforts for upgrading quality of space in terms of cleanliness made by Health Department.
- Public Toilet contracts are dealt by health department. Hence Heritage Department has no power to upgrade it for tourist.
- Heritage Department has no power to control encroachment by Hawker and on Parking.

Roles of Different governing agency

Ahmedabad Municipal Corporation

Solid Waste Department

- Maintenance and cleaning in surrounding residential and commercial areas, Heritage precincts.
- Allocate work force for cleaning and management of door to door collection of waste within city

Heritage Department

- Management and Retrofitting of Buildings Having Heritage importance.
- Documentation, Condition survey, Restoration, branding, Funding of heritage buildings
- Creating Awareness to preserve Heritage value within old city.

- .No integration of roles between two departments
- For cleaning Heritage cell is dependent on Solid waste department.

ASI

- Maintenance of the monuments which are protected by ASI.
- Restricting or monitoring the upcoming development within 100 m buffer surrounding monuments.

- Not responsible for maintenance surrounding precincts.

NGO & Other community organization

- Management and cleaning of mosque.- WAQF BOARD
- Funding from State government
- Sindhi Market manages toilet for their community.

- Overlapping In duty of cleaning as in ASI protected monuments 2 people is appointed by ASI and WAQF board is also There for cleaning of mosque.

Khadia Itihas Samiti

- Management of Heritage listed buildings.
- Children friendly Residential poles.
- Discourage commercialization within residential poles.
- Awareness amongst people to Register their houses which has heritage value, within AMC by filling forms for that.

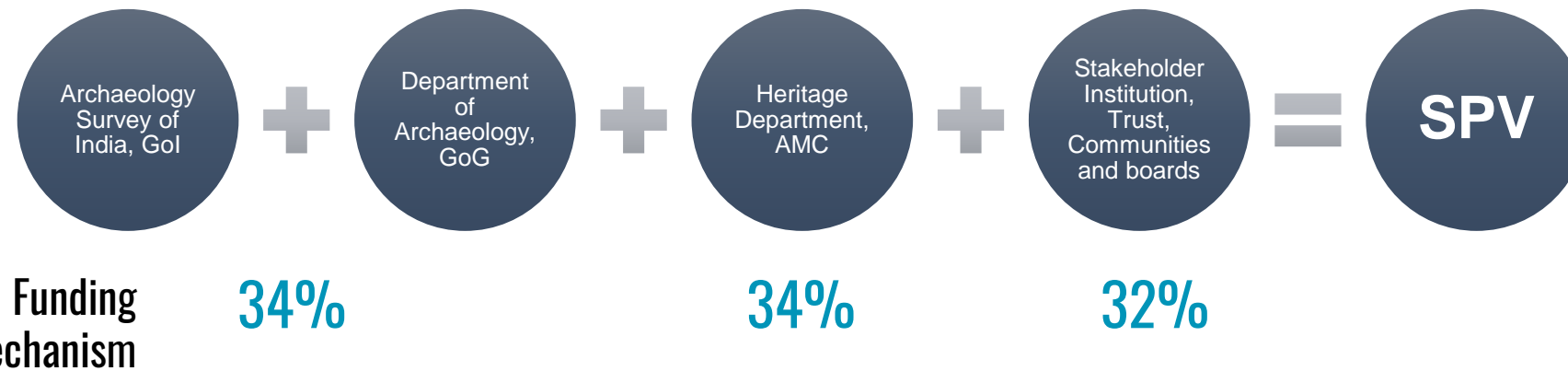
- No collaboration amongst AMC and Samiti.
- No incentive from ULB or no grant to such an organization in that can incentivize them to work more efficiently in that direction.

Intervention in Governance

Proposal 1

Development of Special Purpose Vehicle for efficient working towards betterment of Heritage

- Inclusion of multiple Stakeholder like ASI, State Archaeology Department, Heritage Department and various trust who owns and manage Monuments
- Strengthening the role of SPV in conserving, preserving monuments and most importantly by inclusion of responsibility of managing services (Solid Waste Management) and amenities (Public Toilet), to remove visual imbalance and nuisance in heritage precincts
- Officers from different department of AMC should be part of it and act as representative for mobilizing the decision.



- **First UNESCO World Heritage City of India with multiple stakeholder and jurisdiction area with limited roles. Lack of Power and integration is absence.**
- ASI sweeper works only into premises of monuments
- Heritage Department cannot initiate any cleanliness process on its own.
- No extra efforts for upgrading quality of space in terms of cleanliness made by Health Department.
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Intervention in Governance

Proposal 2

Implement UNESCO Recommendation that the state party give consideration to the following:

- Conduct **comprehensive and accurate documentation** of the historic buildings of the property, particularly the privately owned timber houses, according to accepted international standards of documentation of historic buildings for conservation and management purposes,
- Conduct a detailed assessment of the extent and impact of the new constructions and development projects on the western section of the property and its buffer zone,
- Ensure the effective **implementation of the Heritage Management Plan** and the finalization, ratification and implementation of the modification and additions to the development control regulations,
- Complete and implement the **Local Area - Heritage Plan** as a part of the **Heritage Conservation Plan**, with a special focus on conservation of wooden historic houses.
- Prepare, approve and implement a visitor management plan for the property to complement the Heritage Management Plan and ensure an **informed and sensitive development of tourism** for the site,
- **Enrich the Heritage Department at Ahmedabad Municipal Corporation with capacity building and technical capacity relevant to the challenging size and extent of responsibilities of the documentation, conservation and monitoring of the property and its buffer zone;**

Requests the State Party to submit to the World Heritage Centre, by 1 December 2019, a report on the implementation of the abovementioned recommendations, for examination by the World Heritage Committee at its 44th session in 2020.

Source: <http://whc.unesco.org/en/decisions/6889>

- **First UNESCO World Heritage City of India with multiple stakeholder and jurisdiction area with limited roles. Lack of Power and integration is absence.**
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Heritage

Phasing and Financing

Phasing and Financing

Project	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Awareness Campaign for promoting Clean Heritage Precincts	■	■													10 Lakhs
Segregation and Reuse of Organic/Kitchen Waste to Energy/Compost		■	■	■	■										200 Lakhs
Design Intervention for Unhygienic Nuisance points Heritage Precincts	■	■	■	■											0.2 Lakhs
Performance based Contract and Monitoring															
Rainwater Harvesting in Step Wells	■	■	■	■	■	■	■	■	■	■	■	■	■	■	7.5 Lakhs
Lake Water Rejuvenation for Monuments with Waterbody	■														1600 Lakhs
Promotion and Branding of Stepwells as Water Heritage					■	■	■								
Revival of Tankas as Water Heritage	■	■	■	■	■	■	■	■	■	■	■	■	■	■	10 Lakhs
Retrofitting of Public Toilet in Heritage Precincts			■	■											
Water Heritage Walk in Old City	■	■	■	■	■	■	■	■	■	■	■	■	■	■	1.5 Lakhs

Total 18.3 Crore

Funding Agencies

ASI
SBM
AUDA
AMC

WAKF Board
Khadia Itihas Samiti
Sarkhej Roja Committee



Thank You

WE WOULD LIKE TO THANKS

Shri P.K. Ghosh, Retd. IAS

Chairman of the Heritage Conservation Committee
Ex-Commissioner, AMC

Mr P K Vasudevan Nair

Dy General Manager Heritage Department, AMC

Shri Gunjan V. Patel

Asst. Engineer, Heritage Department, AMC

Prof. Jigna Desai

Faculty of Architecture, CEPT University

Mr. and Mrs. Bhatt

Khadia Itihas Samiti

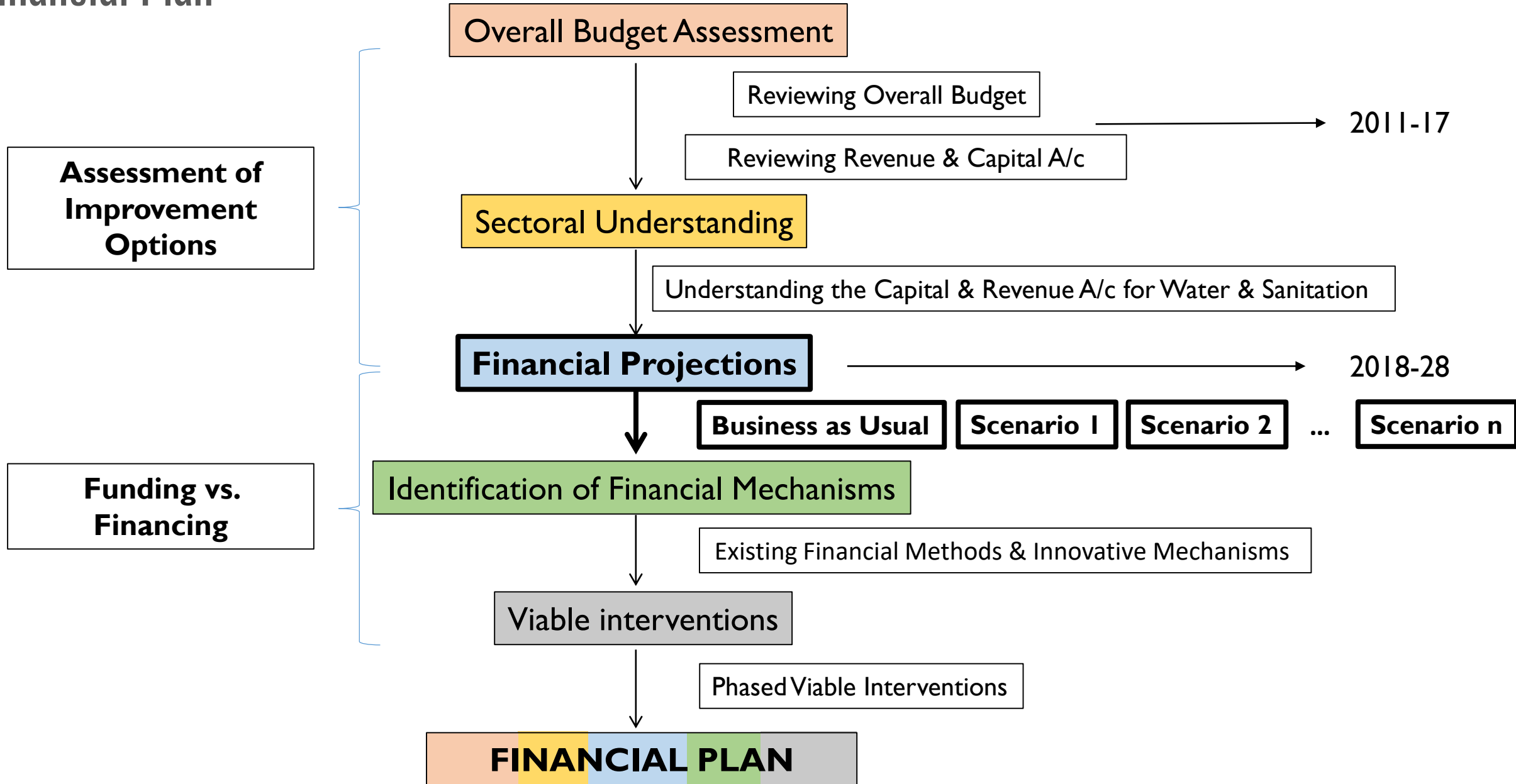
Sarkhej Roja Committee

WAKF Board

Finance & Governance

Overall Budget

Financial Plan

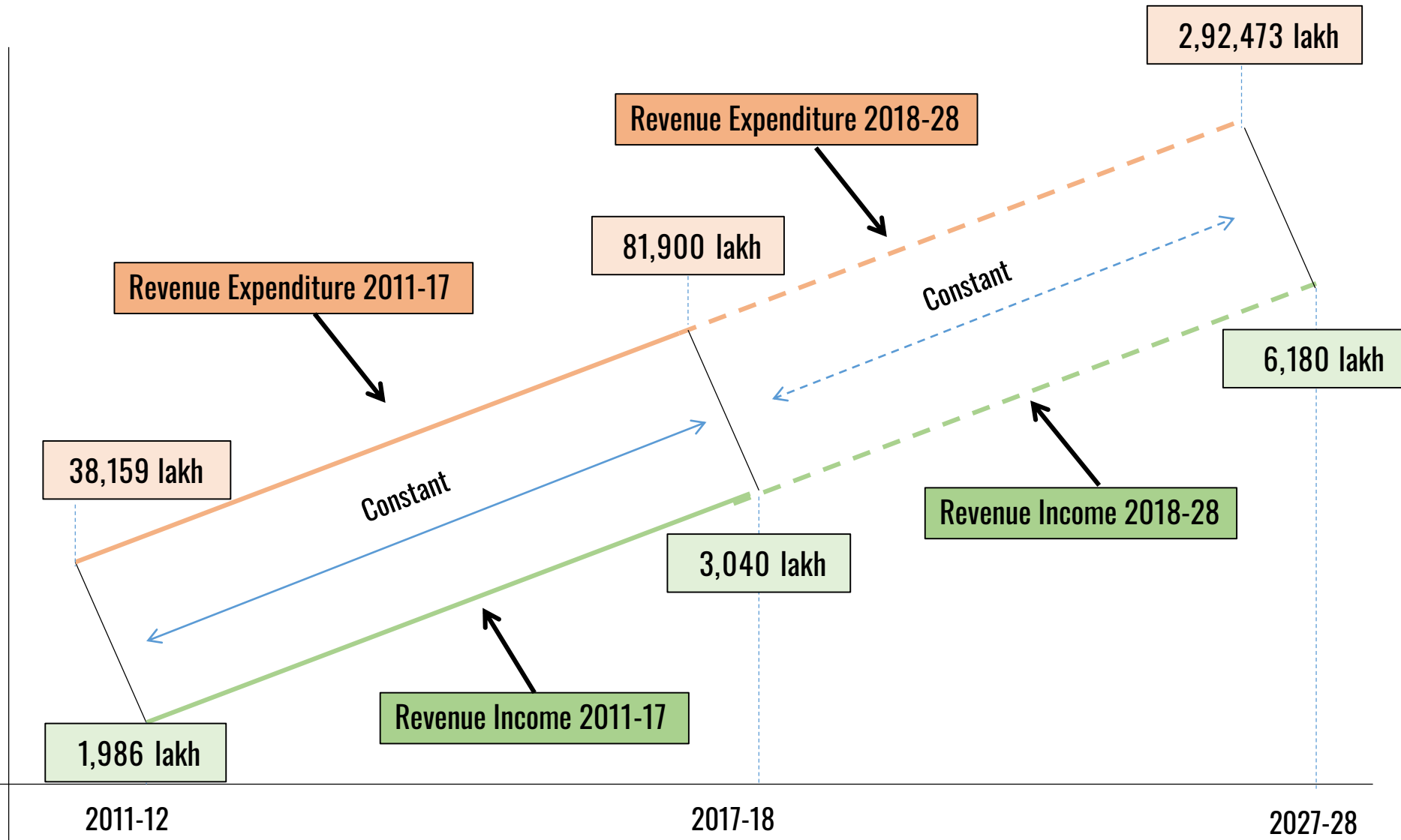


Revenue Account – Actuals

Particulars	2011-12(A)	2012-13 (A)	2013-14 (A)	2014-15 (A)	2015-16 (A)	2016-17 (A)	2017-18(BE)
Opening Balance	11	17	17	11	13	11	11
Revenue Account							
WSS							
Revenue Income	1,986	1,819	1,809	1,976	2,043	2,645	3,040
Revenue Expenditure	38,159	49,254	53,021	62,932	67,371	77,250	81,900
Surplus/Deficit	-36,173	-47,435	-51,211	-60,956	-65,327	-74,605	-78,860
Non-WSS							
Revenue Income	212,234	209,897	252,007	287,091	341,157	443,855	490,360
Revenue Expenditure	118,223	126,801	139,351	147,398	164,181	209,550	242,200
Surplus/Deficit	94,011	83,096	112,655	139,693	176,975	234,305	248,160
Total Surplus	57,838	35,661	61,444	78,737	111,648	159,700	169,300

*All the values above are in Rs. lakh

Projections – Scenario 1 – Business As Usual



For Water & Sanitation

Here, the Revenue Income of the ULB is less than its Expenditure but as the ULB has other sources of Revenue income, it is Cross-Subsidising the difference.

Revenue Account - Projected

Particulars	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28
Revenue Account										
WSS										
Revenue Income	3,263	3,503	3,761	4,037	4,334	4,653	4,995	5,362	5,756	6,180
Revenue Expenditure	93,017	1,05,644	1,19,984	1,36,271	1,54,769	1,75,778	1,99,639	2,26,738	2,57,516	2,92,473
Surplus/Deficit	-89,754	-1,02,140	-1,16,223	-1,32,234	-1,50,435	-1,71,125	-1,94,644	-2,21,376	-2,51,760	-2,86,293
	-0.96	-0.97	-0.97	-0.97	-0.97	-0.97	-0.97	-0.98	-0.98	-0.98
Non-WSS										
Revenue Income	5,63,809	6,48,259	7,45,359	8,57,002	9,85,369	11,32,962	13,02,663	14,97,783	17,22,128	19,80,078
Revenue Expenditure	2,72,952	3,07,609	3,46,666	3,90,682	4,40,287	4,96,191	5,59,192	6,30,192	7,10,208	8,00,383
Surplus/Deficit	2,90,856	3,40,650	3,98,692	4,66,320	5,45,081	6,36,772	7,43,471	8,67,590	10,11,921	11,79,695

WSS	
RI	7%
RE	14%

NON-WSS	
RI	15%
RE	13%

*All the values above are in Rs. lakh

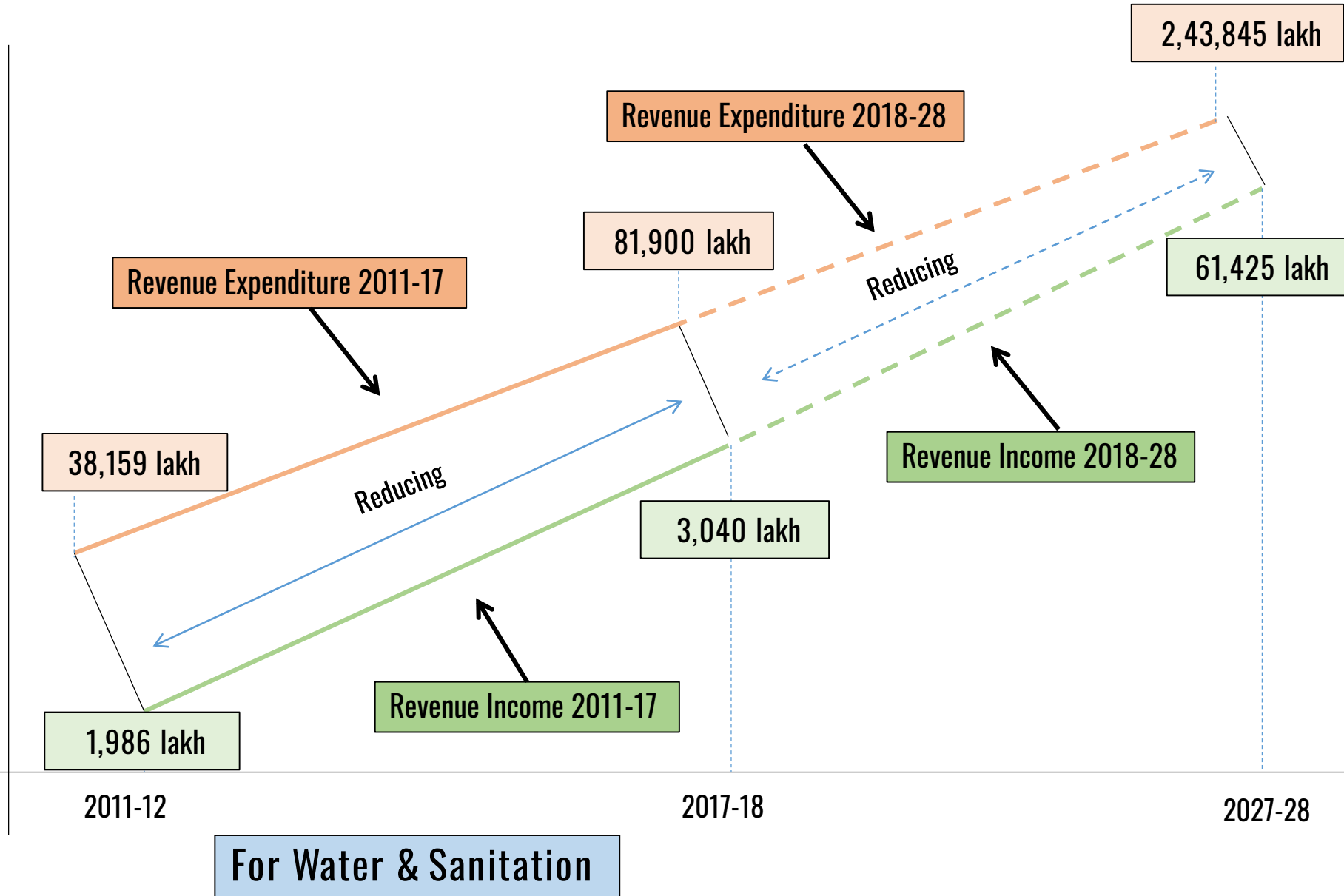
*the formula used for above projections - **CAGR**

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Total Surplus	57,838	35,661	61,444	78,737	111,648	159,700	169,300

*All the values above are in Rs. lakh

Projections – Scenario 2 – Collection Efficiency Improvement



Property Tax Collection Efficiency is **70%**

The collection efficiency of the Property tax can be improved through:

- a) Awareness Drive
- b) Capacity Building

Let's say if we improve it by 10%, then we can see the Revenue Income improving to cater to the Expenses, the ULB is incurring. Cross Subsidising will still be required.

Revenue Account - Projected

Particulars	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28
Revenue Account										
WSS										
Revenue Income	35,535	37,763	40,130	42,647	45,320	48,162	51,182	54,391	57,801	61,425
Revenue Expenditure	91,341	101,871	113,614	126,711	141,318	157,609	175,778	196,041	218,640	243,845
Surplus/Deficit	-55,806	-64,108	-73,484	-84,065	-95,998	-109,447	-124,596	-141,651	-160,840	-182,420
	-0.61	-0.63	-0.65	-0.66	-0.68	-0.69	-0.71	-0.72	-0.74	-0.75
Non - WSS										
Revenue Income	552,678	622,916	702,080	791,305	891,869	1,005,213	1,132,962	1,276,946	1,439,229	1,622,135
Revenue Expenditure	268,331	297,281	329,354	364,888	404,256	447,870	496,191	549,724	609,033	674,741
Surplus/Deficit	284,347	325,635	372,726	426,417	487,613	557,343	636,772	727,222	830,195	947,393

So, along with the improvement in the collection efficiency of Property Tax, Increase in the Non Revenue Tax Income and other Interventions can contribute on reduction of the Revenue Expenditure.

*All the values above are in Rs. lakh

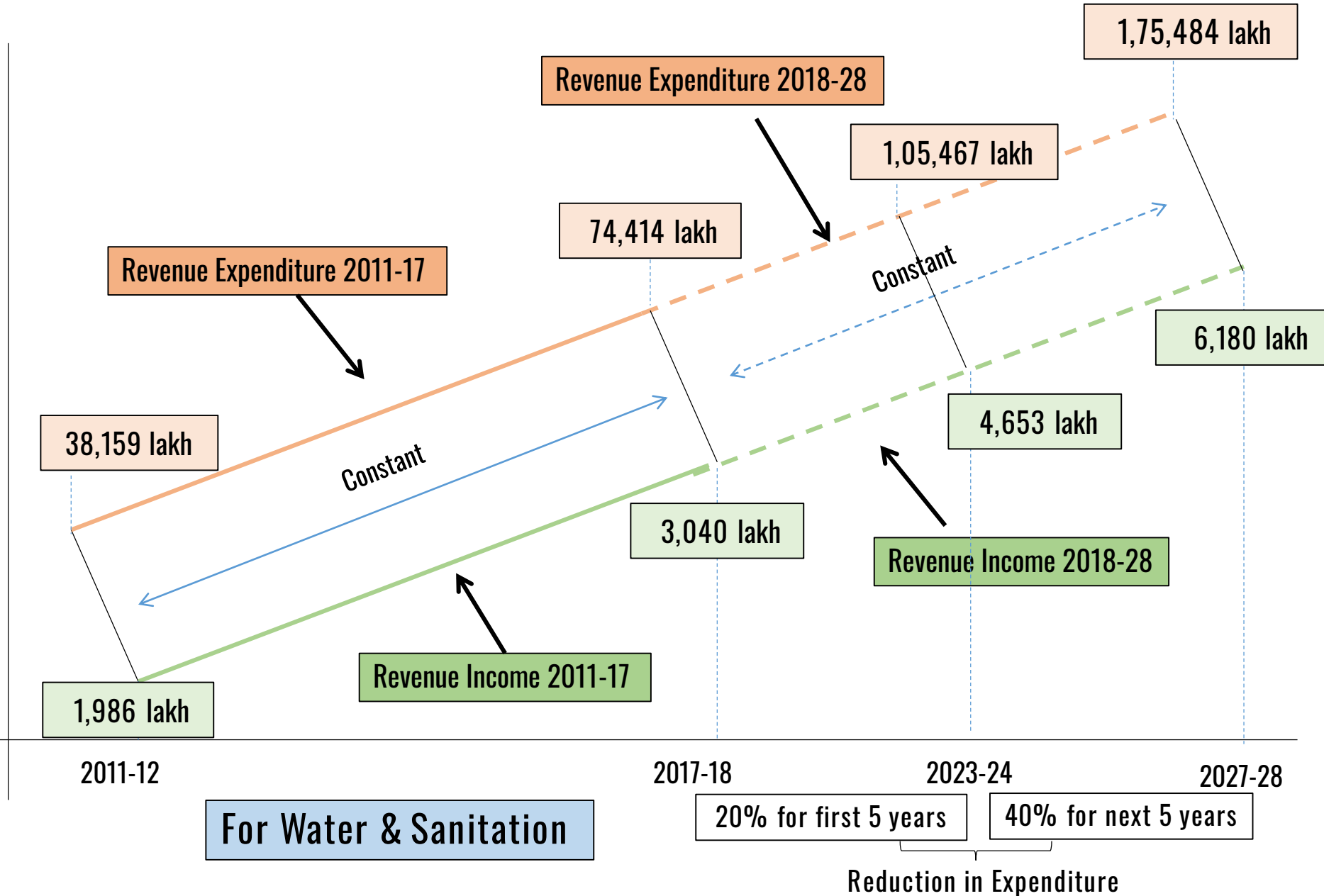
*the formula used for above projections - **CAGR**

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Total Surplus	57,838	35,661	61,444	78,737	111,648	159,700	169,300

*All the values above are in Rs. lakh

Projections – Scenario 3 – Reduction in the Expenditure



If the expenditure is reduced by
 a) 20% for first 5 years
 b) 40% for next 5 years
 then also, we don't see much reduction in the expenditure of the

For Water & Sanitation

Reduction in Expenditure

Revenue Account - Projected

Particulars	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28
Revenue Account										
WSS										
Revenue Income	3,263	3,503	3,761	4,037	4,334	4,653	4,995	5,362	5,756	6,180
Revenue Expenditure	74,414	84,515	95,987	1,09,017	1,23,815	1,05,467	1,19,783	1,36,043	1,54,510	1,75,484
Surplus/Deficit	-71,150	-81,012	-92,226	-1,04,979	-1,19,481	-1,00,814	-1,14,788	-1,30,681	-1,48,753	-1,69,304
	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96
Non-WSS										
Revenue Income	5,63,809	6,48,259	7,45,359	8,57,002	9,85,369	11,32,962	13,02,663	14,97,783	17,22,128	19,80,078
Revenue Expenditure	2,72,952	3,07,609	3,46,666	3,90,682	4,40,287	4,96,191	5,59,192	6,30,192	7,10,208	8,00,383
Surplus/Deficit	2,90,856	3,40,650	3,98,692	4,66,320	5,45,081	6,36,772	7,43,471	8,67,590	10,11,921	11,79,695

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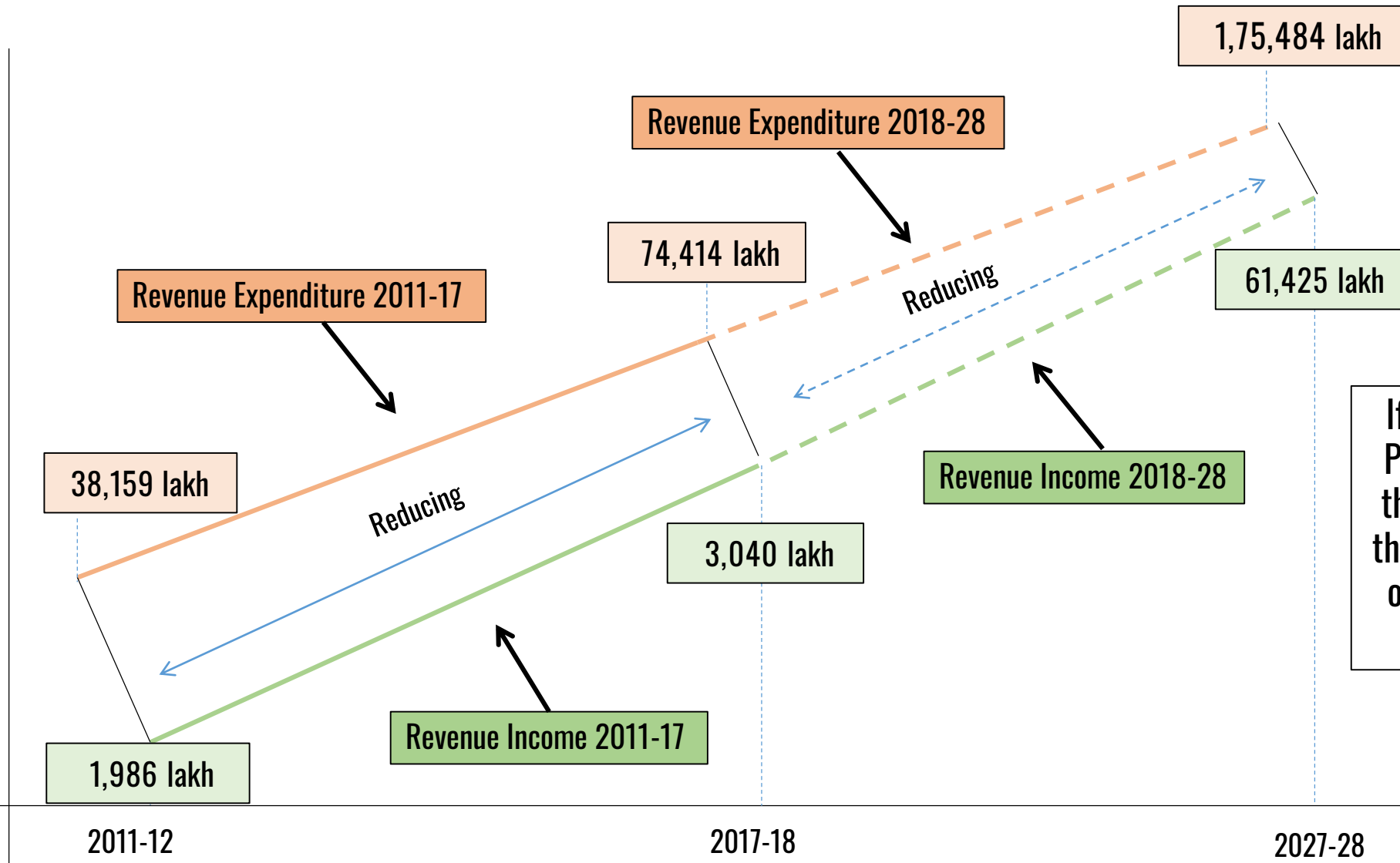
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Total Surplus	57,838	35,661	61,444	78,737	111,648	159,700	169,300

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Projections – Scenario 4 – CE Improvement + Reduction in Expenditure



If the collection efficiency of the Property tax is improved along-with the reduction in the expenditure then we see a huge shift in the ability of WSS sector to meet its expenses from its own income.

For Water & Sanitation

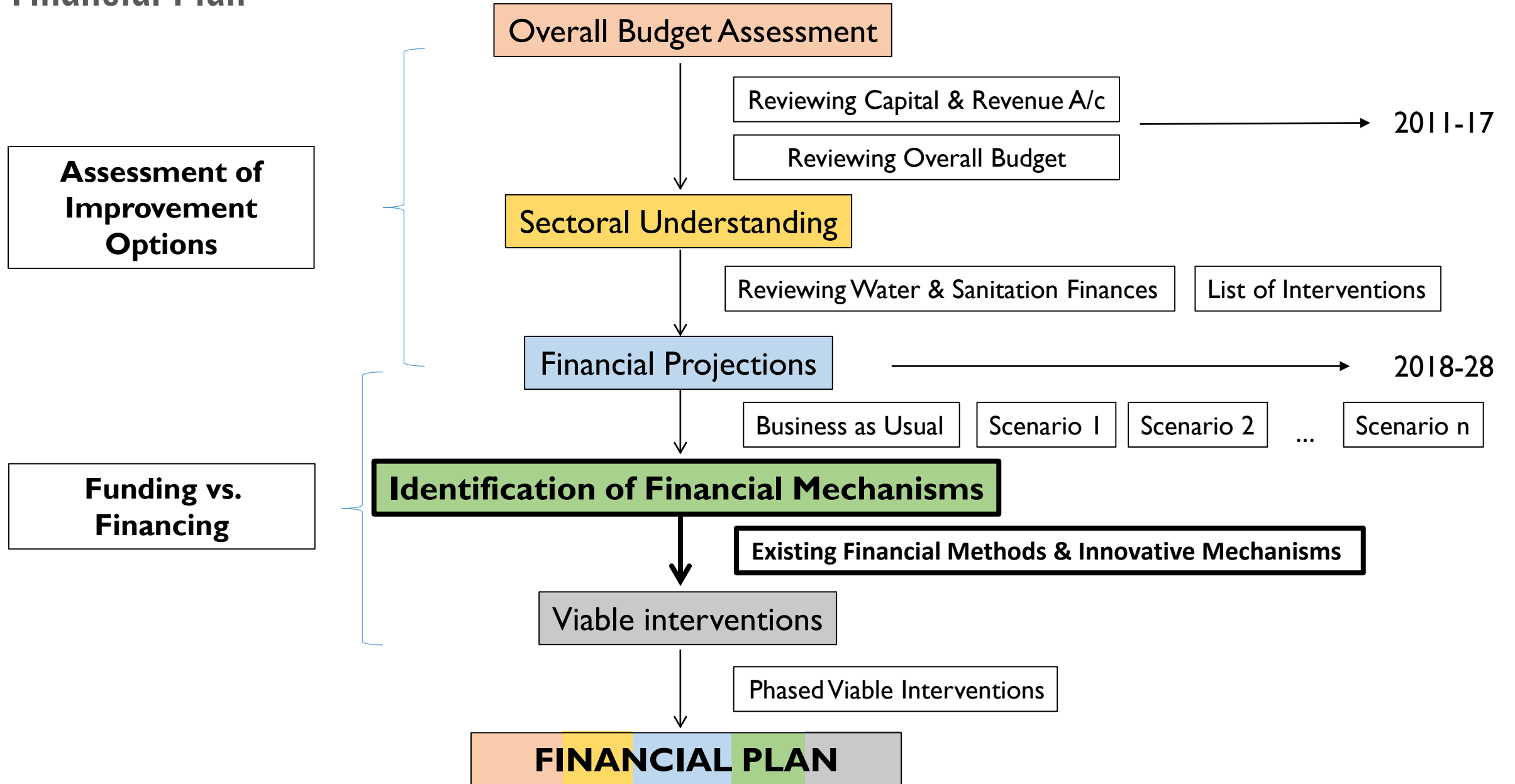
Revenue Account - Projected

Particulars	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28
Revenue Account										
WSS										
Revenue Income	35,535	37,763	40,130	42,647	45,320	48,162	51,182	54,391	57,801	61,425
Revenue Expenditure	74,414	84,515	95,987	1,09,017	1,23,815	1,05,467	1,19,783	1,36,043	1,54,510	1,75,484
Surplus/Deficit	-38,879	-46,752	-55,857	-66,370	-78,495	-57,305	-68,602	-81,652	-96,709	-1,14,059
	-0.52	-0.55	-0.58	-0.61	-0.63	-0.54	-0.57	-0.60	-0.63	-0.65
Non-WSS										
Revenue Income	5,63,809	6,48,259	7,45,359	8,57,002	9,85,369	11,32,962	13,02,663	14,97,783	17,22,128	19,80,078
Revenue Expenditure	2,72,952	3,07,609	3,46,666	3,90,682	4,40,287	4,96,191	5,59,192	6,30,192	7,10,208	8,00,383
Surplus/Deficit	2,90,856	3,40,650	3,98,692	4,66,320	5,45,081	6,36,772	7,43,471	8,67,590	10,11,921	11,79,695

*All the values above are in Rs. lakh

*the formula used for above projections - **CAGR**

Financial Plan



Funding vs. Financing

Primary Funding Sources for an ULB

Grants/Subsidies

26 %

Local Taxes

More Sustainable Funding Sources

26 %

User Charges

Value Capture Finance

Indirect Funding Solutions

Reducing Funding needs by Cost Savings/Efficiency Gains

Primary "Financing" Methods for Cities

Public Sector Financing

8 %

Municipal Bonds

Loans

Alternative "Financing" Methods

Private Sector Financing

3 %

Privatization

8 %

PPP

New Emerging "Financing" Methods

Social Responsible Financing

1 %

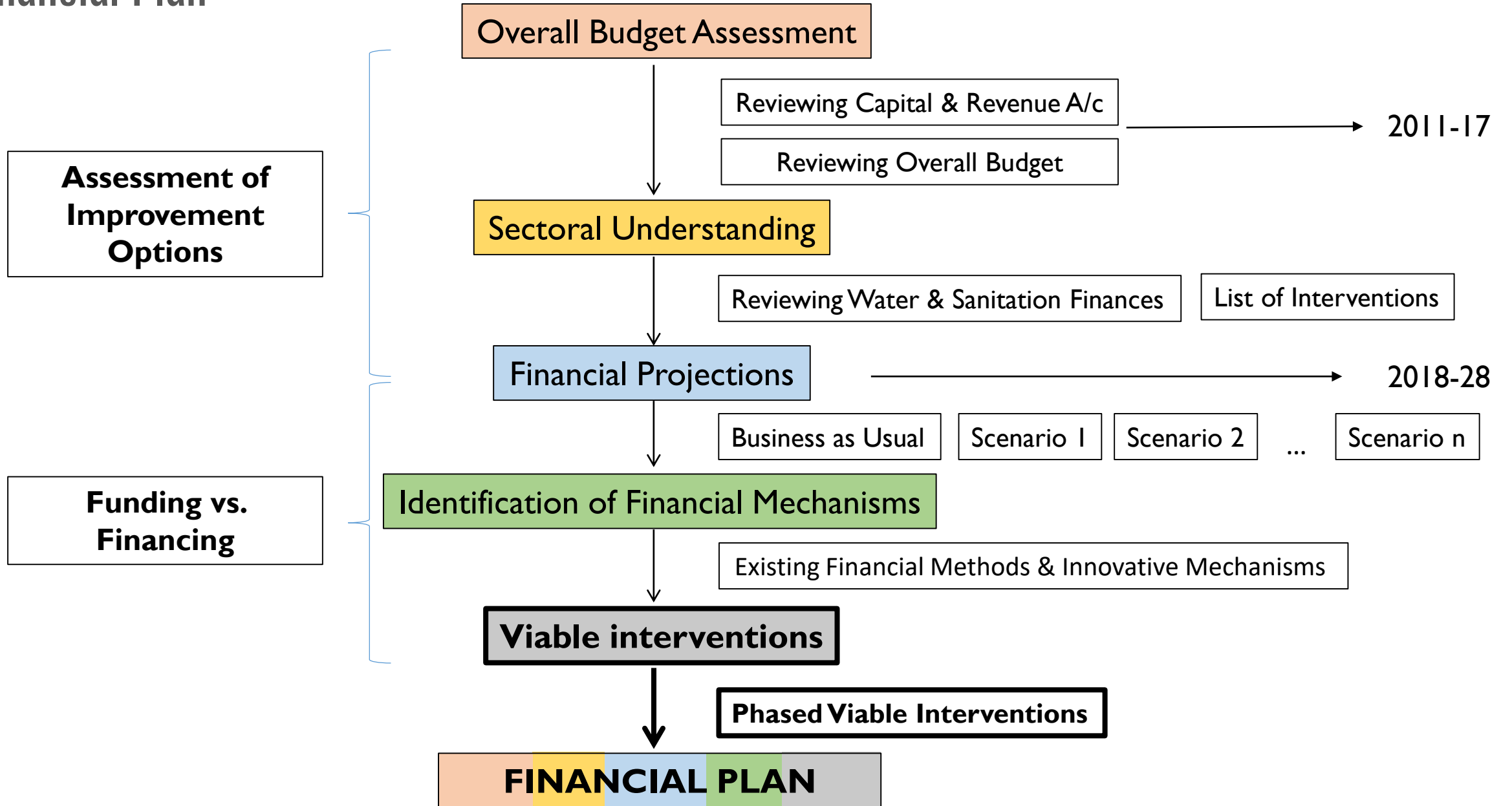
Social Impact Bonds

CEPAC Bonds

CSR

Crowdfunding

Financial Plan



Project Phasing and Cost

WATER



COST (INR)



FUNDING

₹ 43.5
Cr.

Automation of Water Treatment Plant

18 Cr.

Rain Water Harvesting Structures

0.408 Cr.

CSR + Ahmedabad Janmarg Ltd

Recharge Wells in lakes

0.781 Cr.

CSR

Recharge Wells in parks

0.592 Cr.

CSR

RWH in Townships, Commercials and Industries

6 Cr.

Central + AMC

Automation of Water Distribution Stations

3.74 Cr.

AMC

24*7 Water Supply and Metering

14 Cr.

AMC (VGF) + Private

WASTEWATER

Two 1.5 MLD Treatment Plant at Sabarmati Riverfront

12 Cr.

AMC + O&M contract (Private Player)

0.5 MLD Treatment Plant at SP Stadium, Navrangpura

4 Cr.

AMC + PPP

Tertiary Treatment Plant at Vinzol STP

58.95 Cr.

PPP

Parks/Gardens- Ten 1 MLD STP & Seven 0.5 MLD STP

60.66 Cr.

AMC + PPP

Automation of SCADA in SPS

0.52 Cr

AMC

Retrofitting trunk lines in Central Zone

97 Cr.

AMC

₹ 233.1
Cr.

Project Phasing and Cost

WATER



TYPE



PHASING

Automation of Water Treatment Plant

PHYSICAL

Rain Water Harvesting Structures

POLICY, PHYSICAL

Recharge Wells in lakes

POLICY, PHYSICAL

Recharge Wells in parks

POLICY, PHYSICAL

RWH in Townships, Commercials and Industries

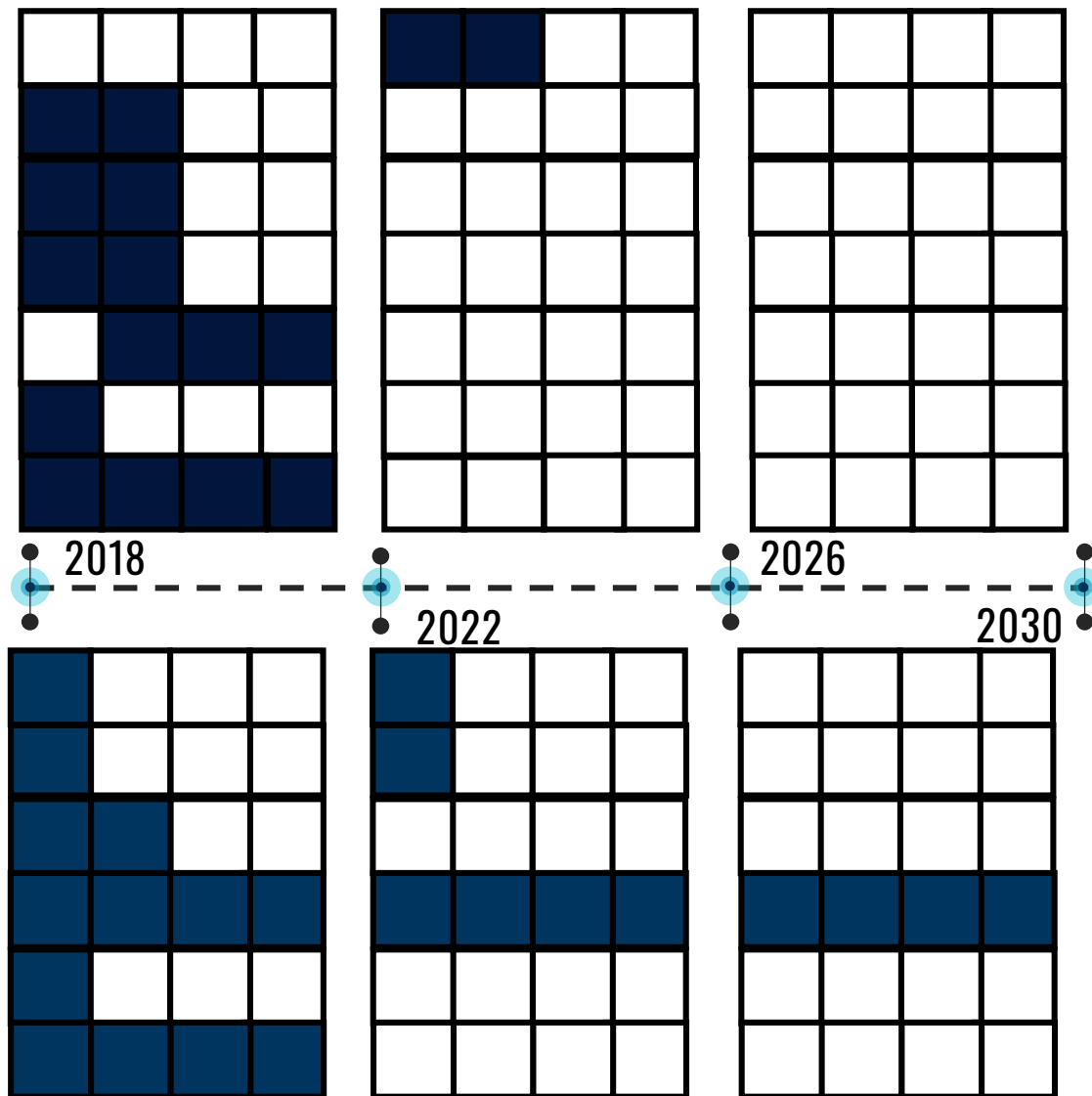
POLICY, PHYSICAL

Automation of Water Distribution Stations

PHYSICAL

24*7 Water Supply and Metering

POLICY, PHYSICAL



WASTEWATER

Two 1.5 MLD Treatment Plant at Sabarmati Riverfront

POLICY, PHYSICAL

0.5 MLD Treatment Plant at SP Stadium, Navrangpura

POLICY, PHYSICAL

Tertiary Treatment Plant at Vinzol STP

PHYSICAL

Parks/Gardens- Ten 1 MLD STP & Seven 0.5 MLD STP

POLICY, PHYSICAL

Automation of SCADA in SPS

PHYSICAL

Retrofitting trunk lines in Central Zone

PHYSICAL

Project Phasing and Cost



WASTEWATER

0.5 MLD DEWATs packaged plant at Satyagrah Chhavani
1 MLD DEWATs civil Plant at GHB Housing Shahstri Nagar
2.5 MLD Soil Bio-Technology Plant at Bopal-2 TP Scheme
FSM Project



COST

1.65 Cr.
2.2 Cr.
2 Cr.
1.05 Cr.



FUNDING

Bank + Private Player
Gujarat Housing Board
AMC + State + Central
AMC

₹ 5.85 Cr.



SOLIDWASTE

Zero Waste Management
Pirana Dumpsite Closure
Community based Sanitation System – Ramapir No Tekro
SWM at Community level- Ramapir No Tekro
Community based Water Kiosks - Ramapir no tekro
Community Managed Toilet
ICT based Monitoring of Public Toilet
E-toilet and Waterless Urinal Installations

1.25 Cr
355 Cr.
1.39 Cr.
14 Cr.
12 Cr.

ULB, SBM, Beneficiaries, Royalty
AMC, SBM (VGF) , Green Climate Fund
SBM, ULB, Beneficiaries, NGO (Donor)
AMC, Beneficiaries
AMC, Beneficiaries, NGO (Donor)
Beneficiaries, NGO (Donor)
SBM
MGSM, SJMSVY

₹ 384 Cr.

Project Phasing and Cost



WASTEWATER

- 0.5 MLD DEWATs packaged plant at Satyagrah Chhavani
- 1 MLD DEWATs civil Plant at GHB Housing Shahstri Nagar
- 2.5 MLD Soil Bio-Technology Plant at Bopal-2 TP Scheme
- FSM Project

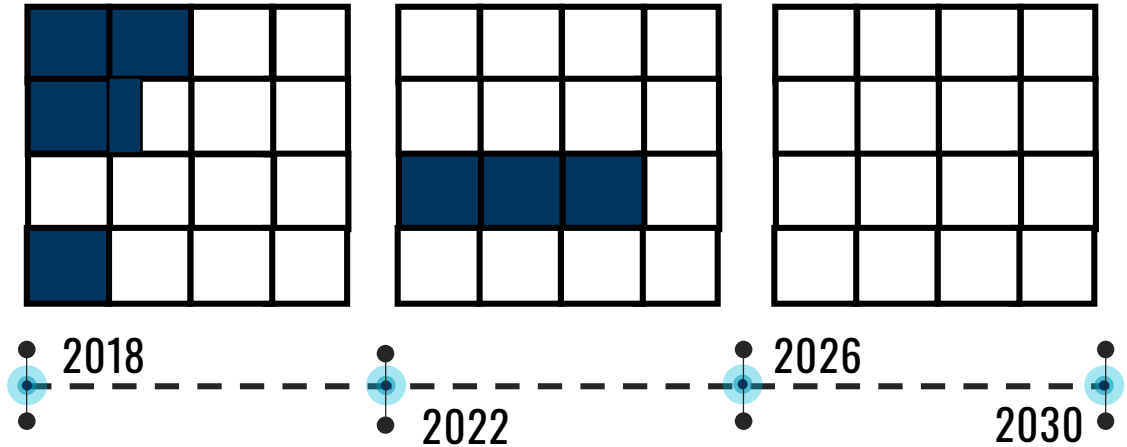


TYPE

PHYSICAL
PHYSICAL
PHYSICAL
POLICY, PHYSICAL



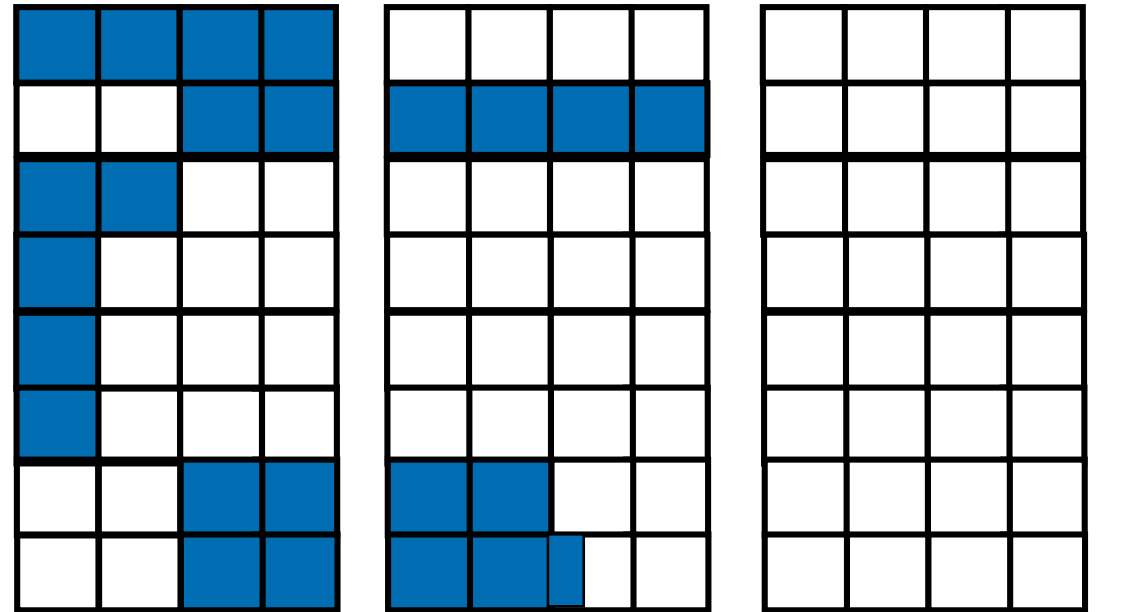
PHASING



SOLIDWASTE

- Zero Waste Management
- Pirana Dumpsite Closure
- Community based Sanitation System – Ramapir No Tekro
- SWM at Community level- Ramapir No Tekro
- Community based Water Kiosks - Ramapir no tekro
- Community Managed Toilet
- ICT based Monitoring of Public Toilet
- E-toilet and Waterless Urinal Installations

POLICY, PHYSICAL
PHYSICAL
POLICY, PHYSICAL
POLICY, PHYSICAL
POLICY, PHYSICAL
POLICY, PHYSICAL
PHYSICAL
PHYSICAL



Project Phasing and Cost



HERITAGE



COST



AGENCIES

Awareness Campaign for Clean Heritage Precincts	.10 Cr.	ASI, AMC, SBM, Community, CSR, Trust/Board
Segregation and Reuse of Organic/Kitchen Waste	2 Cr.	AMC, Private, Community
Design Intervention for Unhygienic Nuisance points in Heritage Precincts	.002 Cr.	Competition Based Funded by AMC, Private, CSR
Performance based Contract and Monitoring	--	AMC, Private
Rainwater Harvesting in StepWells	.075 Cr.	ASI, AMC, Community
Lake Water Rejuvenation for Monuments with Waterbody	16 Cr.	ASI, AMC, Sarkhej Roja Committee
Promotion and Branding of Stepwells as Water Heritage	--	ASI, AMC, CSR, Private, Trust/Boards
Revival of Tankas as Water Heritage	.10 Cr.	AMC, Community, Trust/Boards
Retrofitting of Public Toilet in Heritage Precincts	--	CSR, AMC (PPP)
Water Heritage Walk in Old City	.015 Cr.	AMC, Community, Trust/Board, MG Group

₹ 18.3
Cr.

Total Cost of all Interventions
₹ 684.75 Cr.

₹ 333 Cr.

₹ 331 Cr.

₹ 20 Cr.

Funding vs. Financing

Primary Funding Sources for an ULB

Grants/Subsidies

26 % -> 36 %

Local Taxes

More Sustainable Funding Sources

26 % -> 30 %

User Charges

Value Capture Finance

Indirect Funding Solutions

Reducing Funding needs by Cost Savings/Efficiency Gains

Primary "Financing" Methods for Cities

Public Sector Financing

8 % -> 10 %

Municipal Bonds

Loans

Alternative "Financing" Methods

Private Sector Financing

3 % -> 7 %

Privatization

8 % -> 15 %

PPP

New Emerging "Financing" Methods

Social Responsible Financing

0 % -> 1 %

Social Impact Bonds

1 % -> 5 %

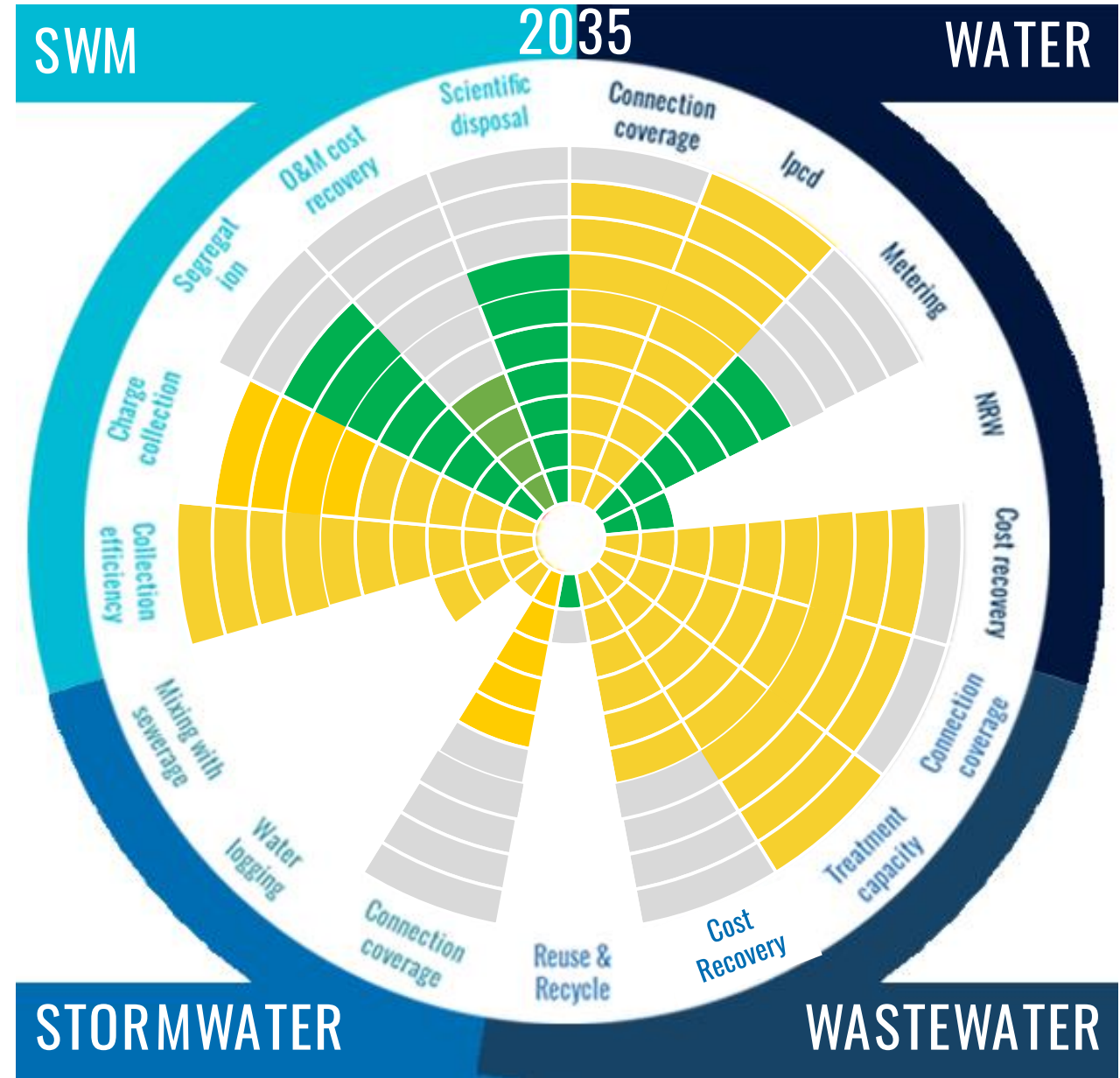
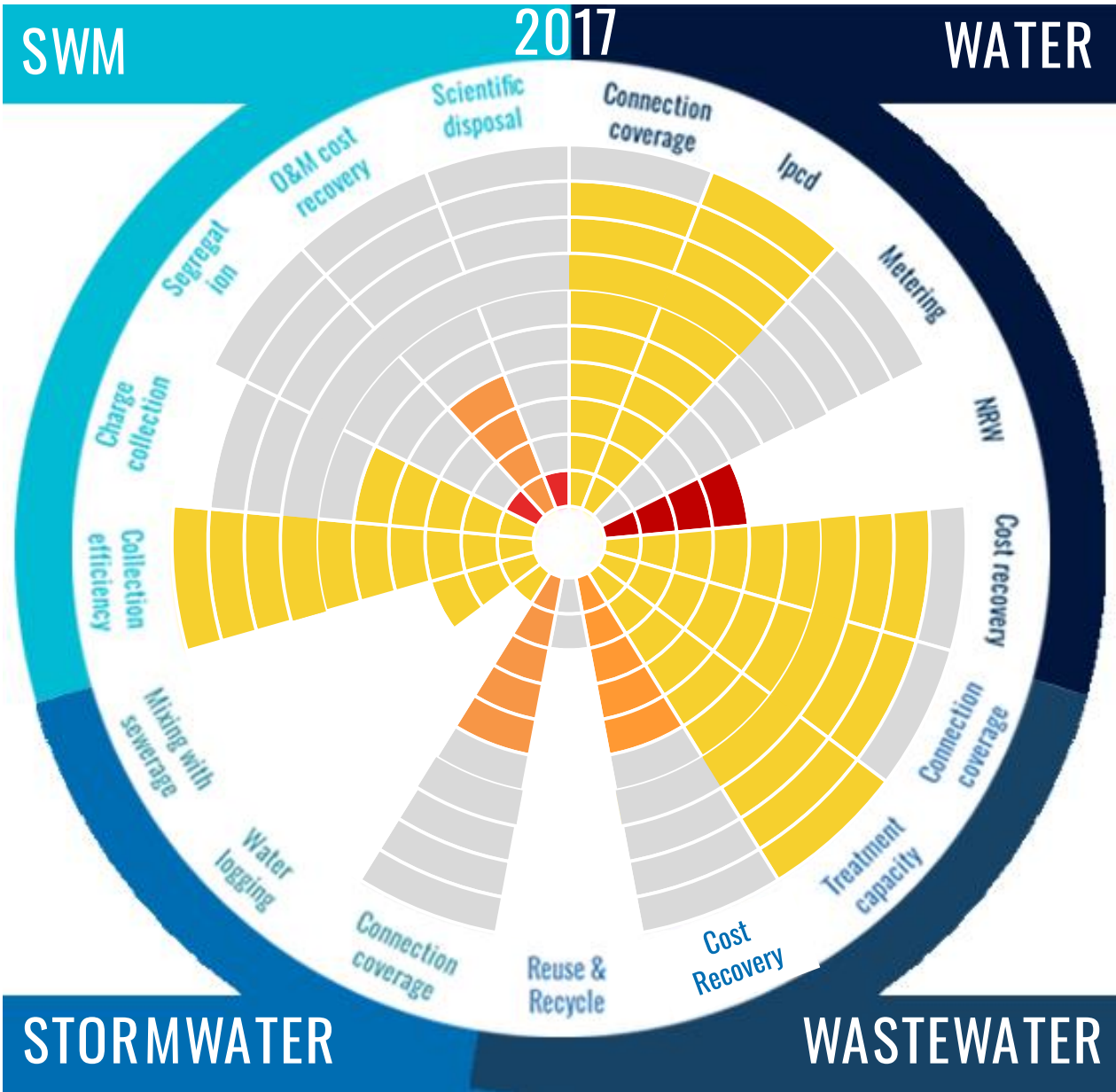
CEPAC Bonds

CSR

0 % -> 2 %

Crowdfunding

Service Improvement



5

Sectors

3

Pillars

SERVICE
RESOURCE
FINANCE

35

Projects

685

Cr. Investment

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1

Aim

Water Sensitive and Sanitised Ahmedabad

**Thank
You**

- Integrate the interventions into the financial plan.
- Identification of **Innovative Funding Mechanisms**.
- Check the Projections for other scenario and other possibilities.