



# NRW REDUCTIONS AND MANAGEMENT IN WATER SUPPLY DISTRIBUTION SYSTEM

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MOUD, New Delhi



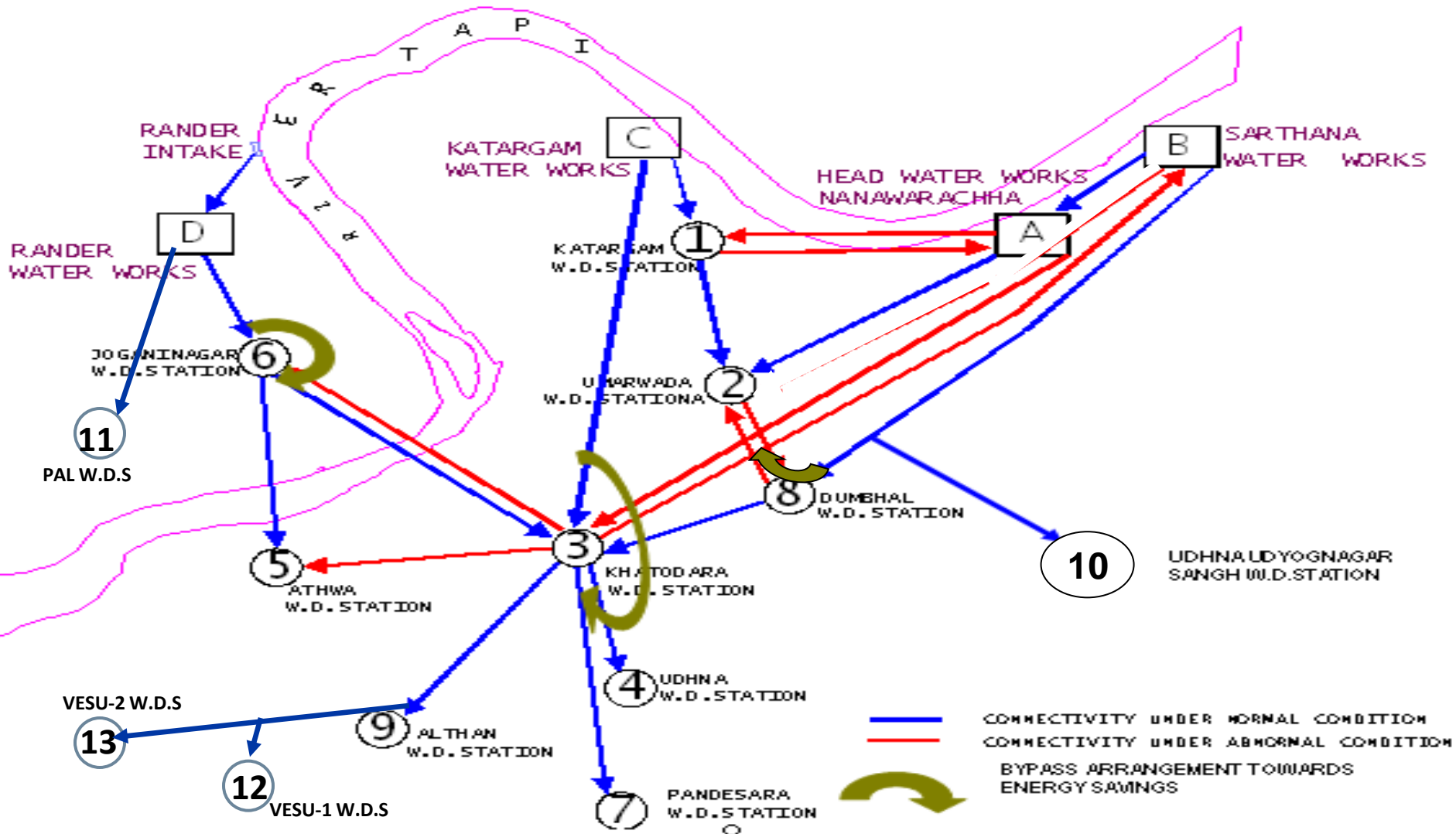
Surat Municipal Corporation

# Water Supply - Present Status at a glance

- Source of Water: **Surface Water of River Tapti**
- Population covered under piped network:- **87 % of population 44 .61Lacs**
- Total numbers of Water Works:- **4**
- Total Installed capacity of all WTP:- **1178 MLD**
- Total numbers of Water Distribution Stations: **17**
- Present gross daily average water supply: **770 MLD**
- Frequency of water supply: **Average 3-4 hours daily**
- Total Storage capacity of all UGSR & ESR:- **630 ML**
- Total Approx. length of all water supply pipelines:- **2750 Km.**



# Water Works and WDS





## Projected Water Supply Demand

<b>Year</b>	<b>2026</b>	<b>2041</b>
<b>Population</b>	87.48 Lac	123.04 Lac
<b>Water demand</b>	1682.63 MLD	2331.67 MLD



# Service Level Benchmarks

Performance Indicator	Benchmark	Status 10-11	Reliability
Coverage	100%	87.32%	B
Per Capita Supply of Water	135 lpcd	147 lpcd	D
Extent of Metering	100%	1.08%	B
Extent of Non-revenue Water	15%	20%	D
Continuity of water supply	24x7	3 Hours/ Day	B
Eff. in redressal of customer complaints	80%	94.82%	B
Quality of Water Supplied	100%	99.80%	A
Cost Recovery	100%	92.27%	A
Eff. In Collection of Water Charges	90%	93.95%	A



# NRW reduction initiatives

- Establishment of NRW Cell
- Comprehensive Water Audit
- Metering
  - Generations
  - Distribution Stations
  - Consumer metering
- Leakage Mapping



# Establishment of NRW Cell



# NRW Cell: Objectives

- Efficiency enhancement in transmission and distribution network :To reduce physical losses
  - To analyze leakage data by mapping
  - To carry out study for rehabilitation of network and suggest rehabilitation projects
  - To introduce system for leakage detection
  - To prepare pipeline maps on GIS
  
- To achieve Equity in distribution : To regulate quantity and pressure over various regions and uses
  - To analyze data of low pressure complaints
  - To periodically check the correctness of valve operations
  - To analyze data of consumption by various regions, various users
  - To install pressure gauges to collect data on leakages / malfunctioning
  - To suggest re-routing, re-structuring of transmission / distribution network or rehabilitation of pumping equipment





# NRW Cell: Objectives

## □ **To achieve Financial recovery**

- To move towards volumetric billing by increasing the metered connection
- To suggest metering policy, meter types, metering methodology etc.
- To analyze efficiency and correctness of meters
- To analyze use versus payment and suggest modification of tariff structure

## □ **Awareness for water conservation**

- To develop content for water conservation campaign
- To devise communication strategy (target groups, methods etc.)
- To conduct seminar/workshops etc. with the help of NGOs, schools, colleges, etc. – competition and events relating to water conservation
- To create poster, pamphlets, radio jingles, TV scrolls, hoarding designs related to water conservation



# NRW Cell: Objectives

- **Periodic water audit (Every 3 years)**
  - To float EOI / RFP
  - To evaluate bids and award work of water audit
  - To liaise between auditor and department / zones
  - To follow up action on water audit reports
  
- **Implementation of efficiency and equity measures as per requirement**
  - Rehabilitation / augmentation of network (Replacement of pipelines, increase or modify valves, re-route distribution network, introduce ESRs etc.)
  - Rehabilitation of pumping equipments (in co-ordination with EEC)



# Composition of NRW Cell

- Civil Engineers
- Instrumentation Engineers
- Electrical / Mechanical Engineers

Moreover,

- Deputy Engineer heading NRW Cell
- NRW Committee comprising of City Engineer, Additional City Engineer – Civil, Additional City Engineer – Electrical for supervising and guiding NRW cell activities



# Comprehensive Water Audit



# Assessment of water loss in water supply system through water audit

- Present scenario:
  - ▣ Intermittent based water supply scheme
  - ▣ 100% residential consumer metering is not there.
- Resulting in:
  - ▣ No loss measurement in terms of NRW / UFW (*Extent of loss, which should be less than 15%*)
  - ▣ Quantity of water being received at consumer end is not quantifiable. (*LPCD is not measured*)
  - ▣ The above parameters are essential to move towards 24X7 basis Water supply scheme



# Activities to be taken up

- Identification of District Metered Areas (DMAs)
  - DMA planning, designing, constructing and DMA flow data analysis shall be as per guideline given in AWWA manual.
  - approx 50 DMAs comprising 1500 to 2500 consumers each
  - detailed water audit study shall be carried out in representative areas of appx. 150-250 connections each
- Installation of bulk meters, flow meters, valves and related accessories.
- All the above can be covered in Comprehensive Water Audit

# Proposed Methodology of conducting Water Audit



- Water Audit Study in line with AWWA / IWA Guideline
  - Before Audit:-
    - Establish a worksheet
    - Set up a study period
  - Audit Process:
    - Task 1 - Identify and map the sources, measure the water from each source, measure the supply, check total water supply
    - Task 2 – Measure authorized metered uses.
    - Task 3 – Measure authorized un-metered use.
    - Task 4 – Measure water losses.
    - Task 5 - Analyze audit results (Recoverable leakages, cost and value of recoverable leakages, cost of leak detection etc.)
  - After Audit
    - Analyze value of losses and corrective measures
    - Evaluate potential corrective measures
    - Financial analysis for calculation of payback period & cost benefit ratio



# Scope of Work for Water Audit

- Field Work for Consumer Survey:
  - Covering details of consumption of water usage by different beneficiaries, illegal connections by matching data collected during the survey and billing record of SMC, the level of awareness of promotional water conservation initiatives,
  - Number of consumer properties need to be covered under survey shall be 1,00,000 (approx.)
  - Also, it includes,
    - All household Consumers in DMA
    - Data to capture in this section are type of building, location, also information about number of water closet, number of total taps use in house, uses of water like whether they use water for gardening.
    - Requirement of water for daily activities in liters from various sources.





# Scope of Work for Water Audit

- Consultancy services for Preparation of comprehensive Water Audit report for Water Supply System includes Study for District Metering Area (DMA), leak detection and reduction study and suggest leak reduction plan.
- Field Work for DMA Water Loss Study including Leak detection
  - Assessment of losses in distribution network through Installation of Bulk meters, flow meters, valves, etc. in identified DMAs
  - For above study, SITC of bulk meters, flow meters, valves and related accessories shall be done by consultant. Tentative 4 sets meters shall be utilized by consultant such that 4 DMAs shall be studied at a time. Repetitive use of such meters will be done while conducting total water audit study

# Important Conditions / Clauses of Water Audit Tender



- TIME LIMIT:- 18 months (including monsoon)
  - ▣ Collection of data, Identification and demarcation of each DMA in field.
  - ▣ Water audit study includes leak detection & Submission of draft Water audit / water loss report for each DMA and detailed scenario of leak reduction strategy.
  - ▣ Submission of final comprehensive Water audit/water loss report after repairs and preparation of leak reduction strategy report for all the DMA with detailed scenario of leak reduction strategy with necessary practical suggestion.

# Important Conditions / Clauses of Water Audit Tender



- Leakages shall be repaired by SMC in all Main DMAs and Sub DMAs with in seven (7) days time period as indentified by the consultant.
- Leakage repair work shall be inspected by the consultant.
- The consultant shall repeat the leak assessment/ water audit for all the repaired Sub-district of a DMA till the NRW comes within the limit specified by the MoUD, GOI, service level benchmarking of water supply.



# Present Status : Water Audit Consultancy

Sr. No.	Description of Work	Progress Status
1	Appointment of adviser – Dr. Sanjay Dahasahasra (Ph.D in Water Supply) •Member Secretary – Maharashtra Jivan Pradhikaran •Ex-chairman, IWWA.	Appointed
2	EOI for receiving offers from consultants for conducting Comprehensive Water Audit.	Already Received
3	15 Participants have shown their interest for water audit and short listing was made based on experience in related field of water audit	7 Participants have been short listed
4	Offer Received : 02 Multimedia – Rs.11.35 Crore Shah Technical Consultant 4.47 Crore	Under Scrutiny



# Metering



# Metering

## METERING OF WATER CONNECTIONS

- Total numbers of Connections:- 3,35,572
  - 0.5” – 3,29,322
  - Above 0.5” – 6250
- As per metering policy w.e.f. 01.04.2008,
  - All commercial connections having **size of 0.5”** need to be metered.
  - all residential connections having **sizes more than 0.5”** need to be metered
- As per revised metering policy w.e.f. 01.04.2011, all residential connections having connection sizes including 0.5” shall be metered.
- Increase in metered connections
  - Numbers of metered connection (residential, commercial, industrial) have increased from **1453 (FY 2008-09)** to **6000 (FY 2010-11)**



# Meters – Technology

- **Water Works and Water Distribution stations**
  - Open channel and insertion type Ultrasonic flow meters
  
- **Industrial Connections – Electromagnetic meters**
  - Type/ Technology: Electro Magnetic, AMR Compatible
  - Installation: In line Full bore
  - Power: Inbuilt Lithium Batteries (Self Powered)
  - Battery Life: Minimum 2 Years
  - Accuracy: +/- 0.5 %
  - Standard: ISO 4064 Class B
  - Approval: EEC
  - Protection Class: IP68
  
- **Commercial Connections – Mechanical meters**
  - Type: Multi Jet
  - Technology: Magnetically Coupled, AMR Compatible
  - Installation: In line
  - Accuracy: +/- 2 %
  - Standard: ISO 4064 Class B
  - Approval: EEC
  - Protection Class: IP68



# Leakage Mapping

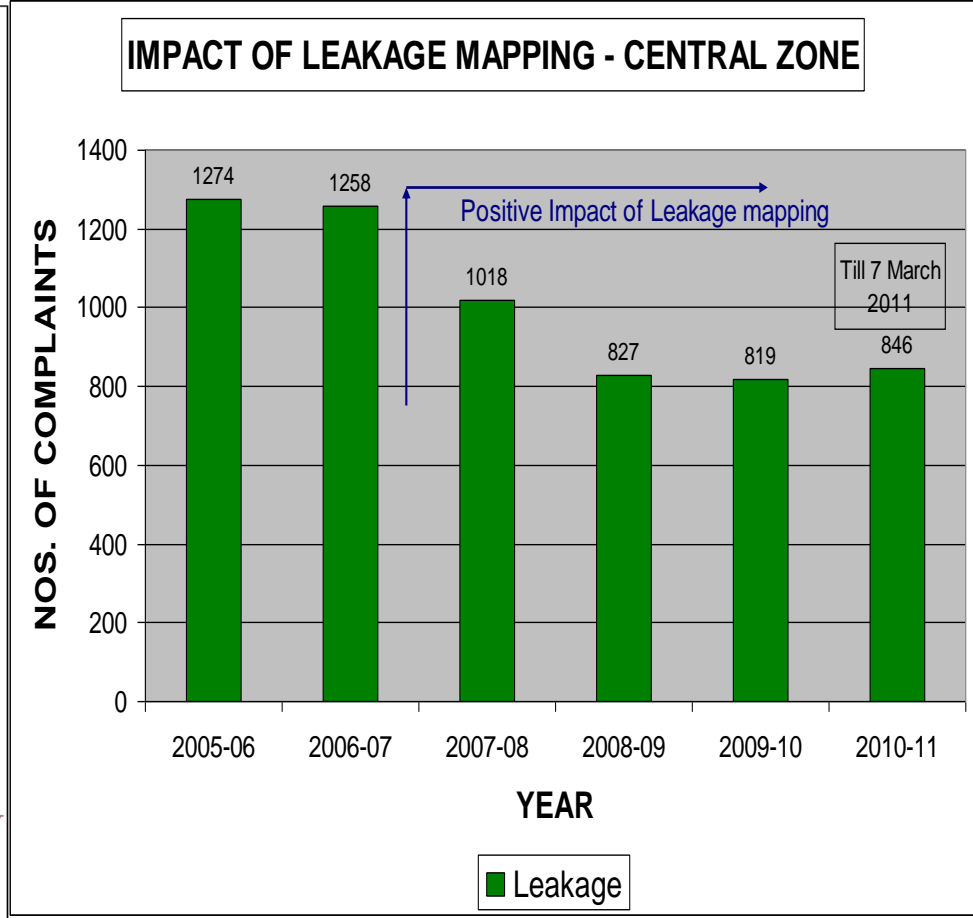
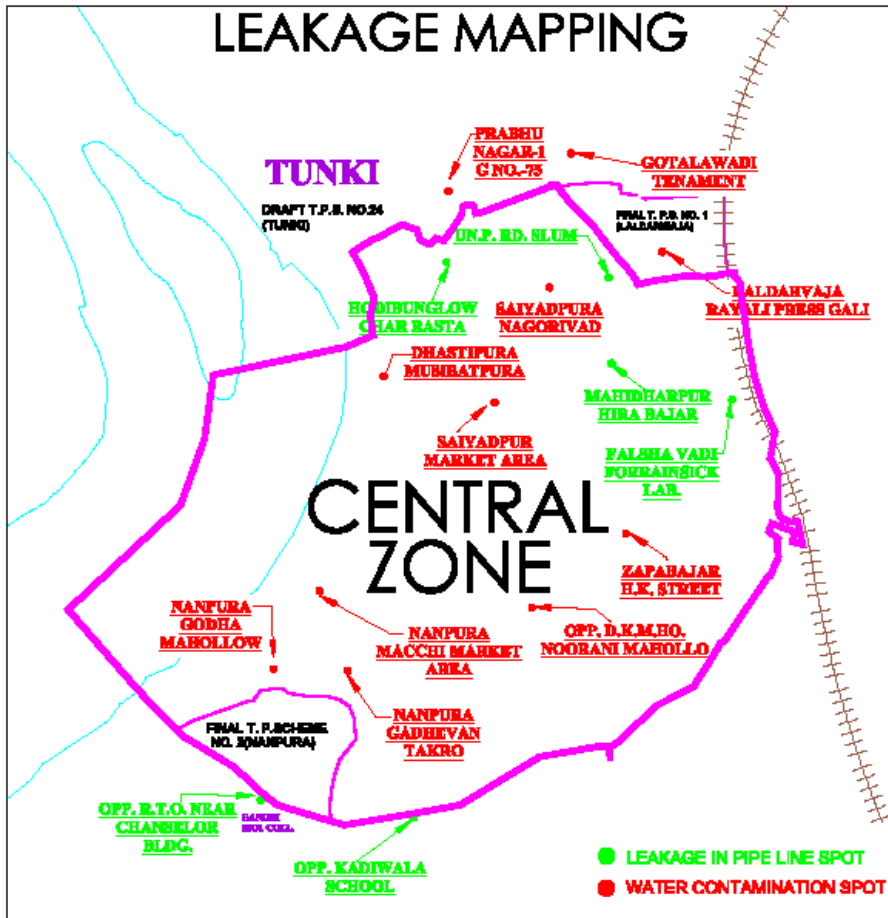




# LEAKAGE MAPPING

- Leakages & remedial measures are reviewed daily at zone & departmental level.
- Action taken is reviewed in weekly meeting.
- Locations of frequent water leakages identified.
- Maps showing such locations prepared to study and find out solution.
- Central zone of the city was found more leakage, compared to other Zone, due to age old pipeline.
- In last 5 years, about 25000 meters of pipeline of size 100 to 200 mm dia. are replaced.

# LEAKAGE MAPPING – CENTRAL ZONE

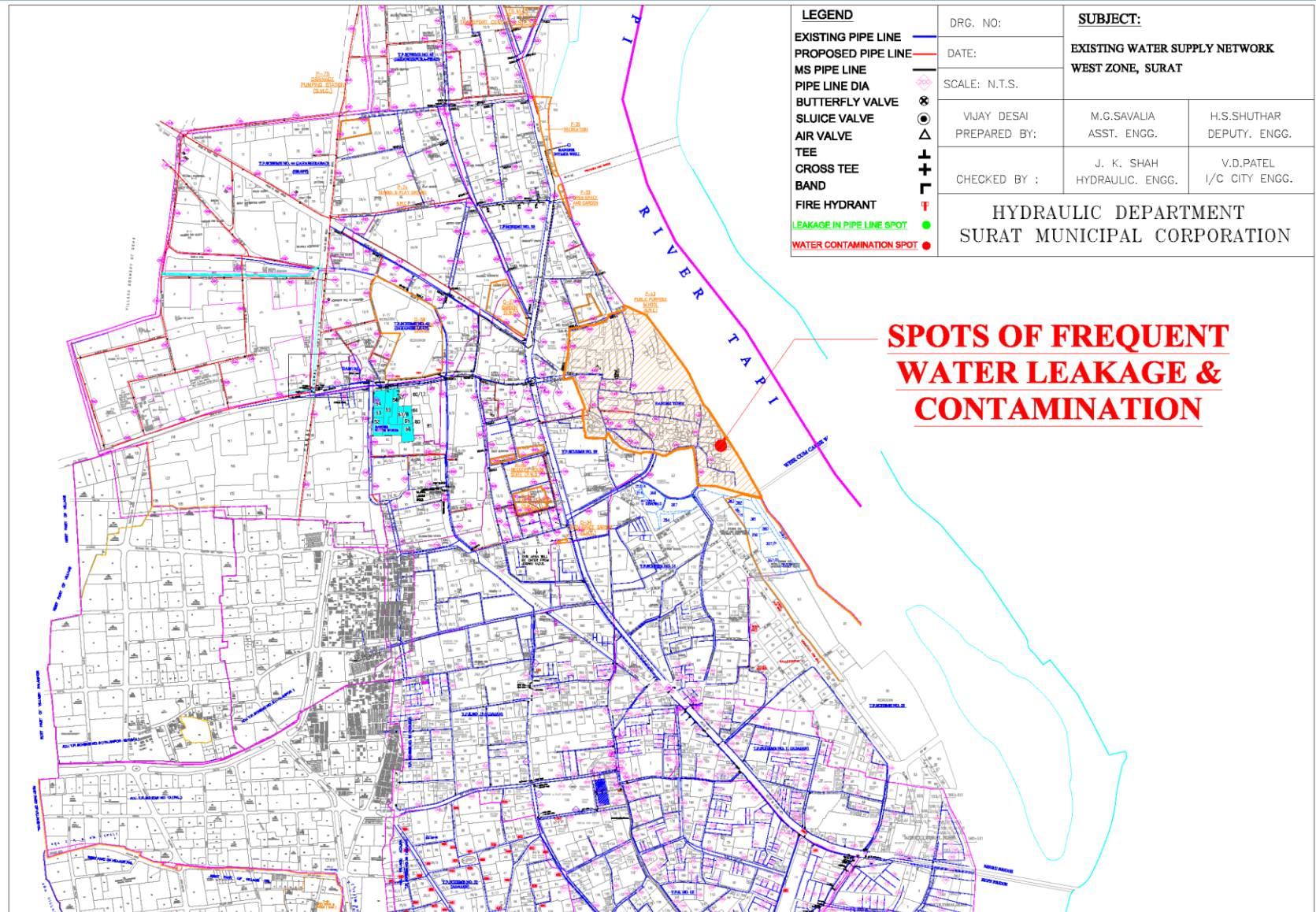


# NEED FOR LEAKAGE MAPPING IN RANDEK GAMTAL

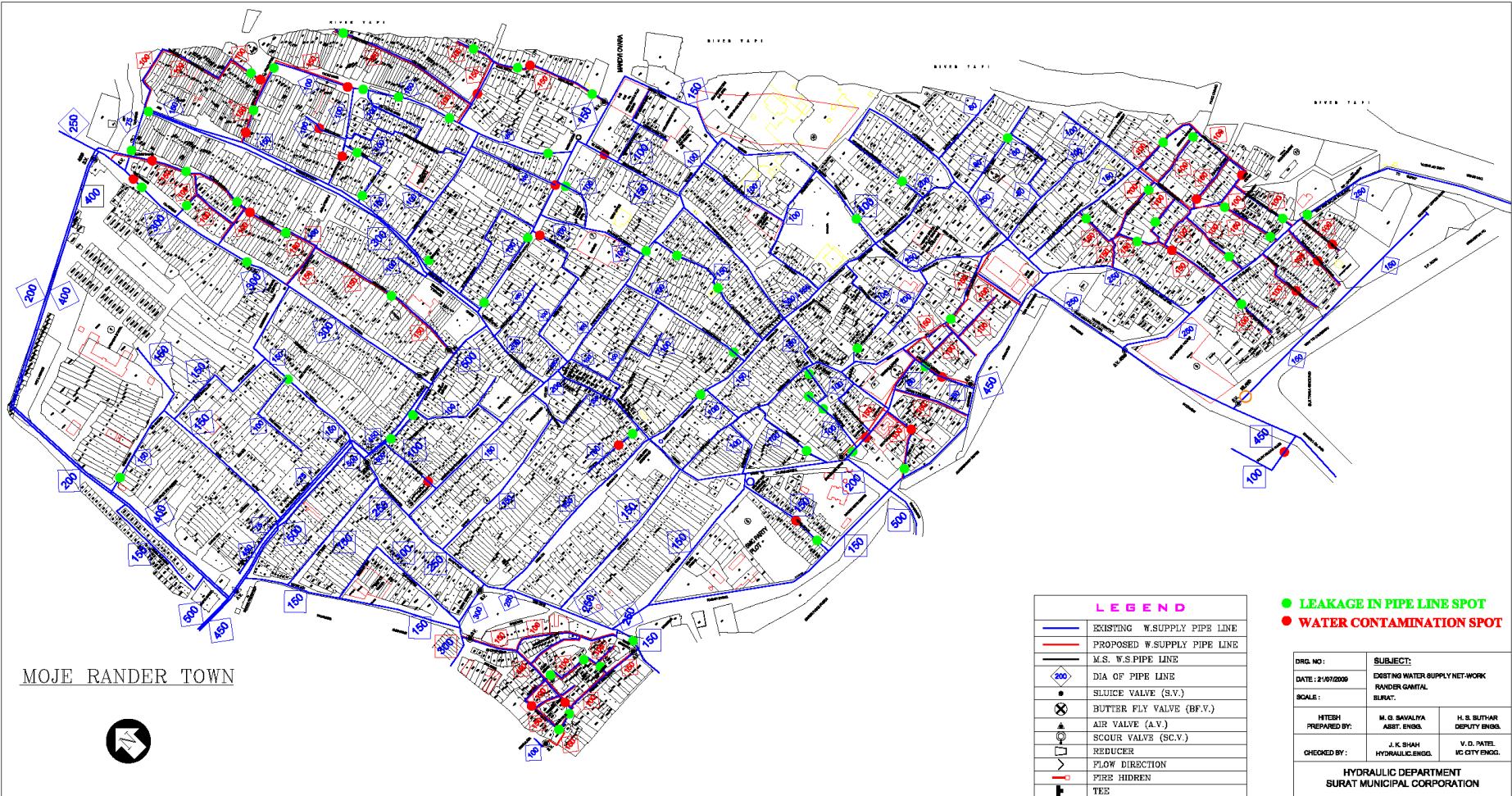


- Rander gamtal is old city area of Surat and water network is more than 50 years old.
- In last 3 years, 274 complaints of leakages & 38 complaints for contamination of water were attended in Rander Gamtal area.
- Leakage Mapping was carried out for Rander Gamtal area and specific spots were identified.
- As per Leakage Mapping, 2380 mts and 2105mtrs were replaced in year 2010-11 and 2011-12.

# Leakage Mapping - For Rander Gamtal area



# Leakage Mapping – Rander Gamtal



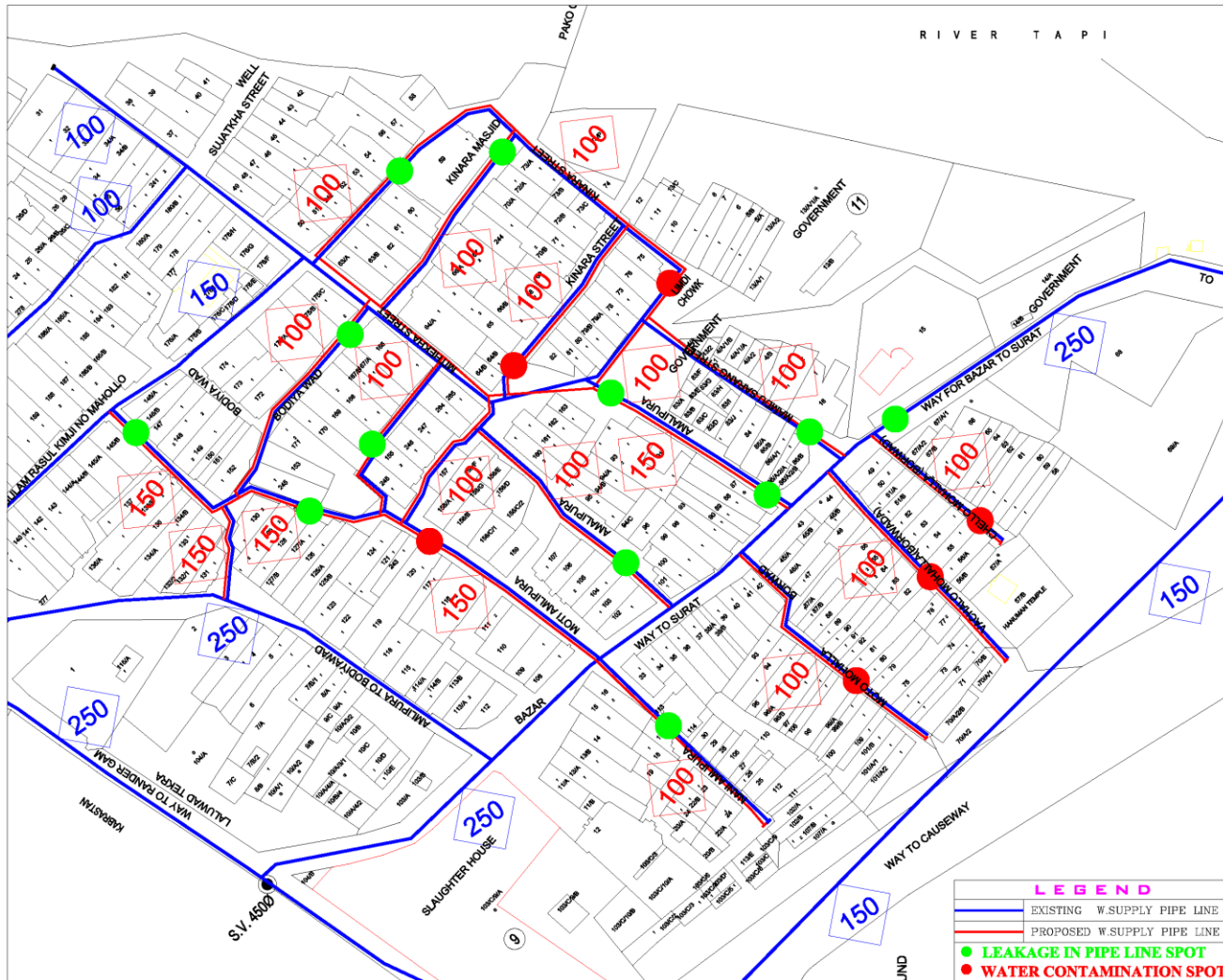
MOJE RANDE TOWN

LEGEND	
	EXISTING W.SUPPLY PIPE LINE
	PROPOSED W.SUPPLY PIPE LINE
	M.S. W.S PIPE LINE
	DIA OF PIPE LINE
	SLUISE VALVE (S.V.)
	BUTTER FLY VALVE (BF.V.)
	AIR VALVE (A.V.)
	SCOUR VALVE (SC.V.)
	REDUCER
	FLOW DIRECTION
	FIRE HYDRANT
	TEE

- LEAKAGE IN PIPE LINE SPOT
- WATER CONTAMINATION SPOT

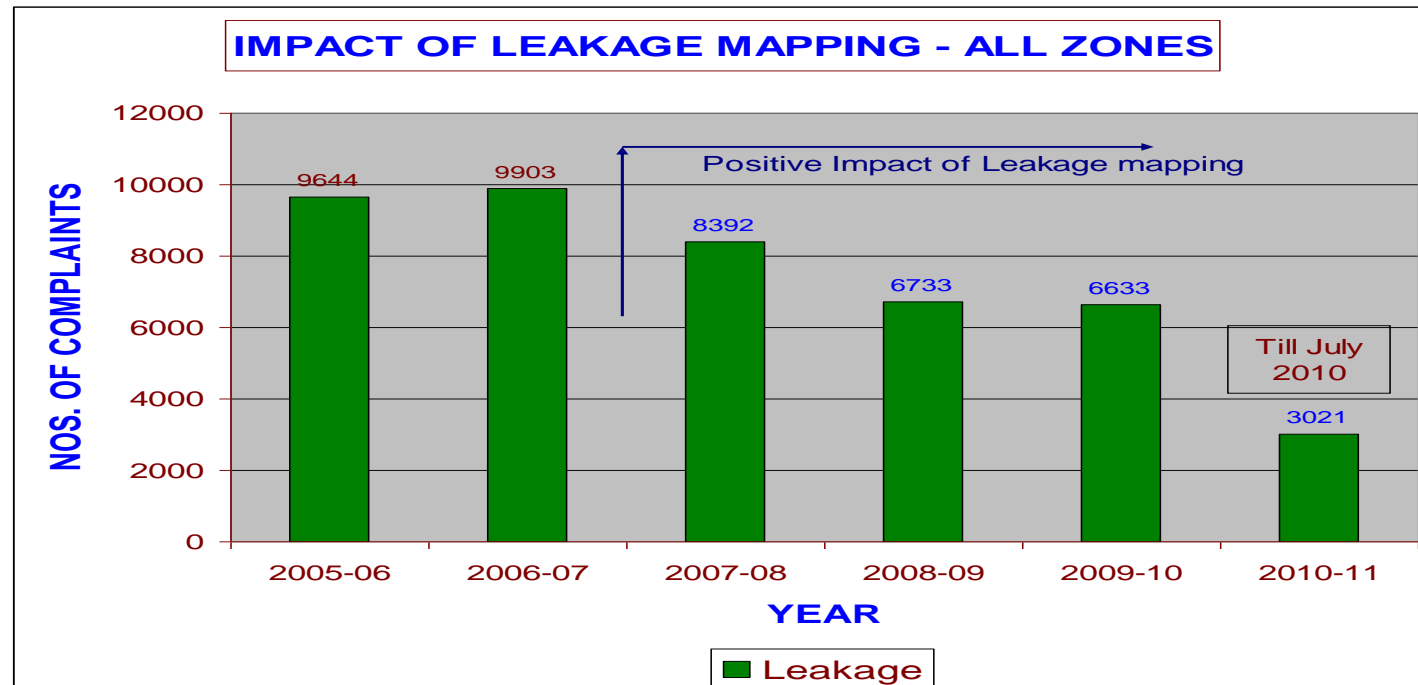
DRG. NO.:	SUBJECT:	
DATE: 21/07/2009	EXISTING WATER SUPPLY NET-WORK RANDE GAMTAL	
SCALE:	SURAT.	
HTERH PREPARED BY:	M. G. SAVALYA ASST. ENGR.	H. S. BUTHAR DEPUTY ENGR.
CHECKED BY:	J. K. SHAH HYDRAULIC ENGR.	V. D. PATEL IC. CITY ENGR.
HYDRAULIC DEPARTMENT SURAT MUNICIPAL CORPORATION		

# Leakage Mapping - Details



# OUTCOME : LEAKAGE MAPPING

- Having inspired by Central Zone and Rander Gam Tal, leakage mapping have been taken up in all zones
- After mapping leakages in all zones, corrective action of changing the required pipelines, faulty valves etc. has been started.
- Positive impact : Reduction in number of leakages to the extent of almost 32% per year for Surat City.





# OUTCOME : LEAKAGE MAPPING

- Saving of precious potable water & energy cost
- Frequent digging of roads avoided – saving in cost.
- Chances of outbreak of water borne diseases avoided
- Improved water distribution efficiency
- Improved overall service delivery





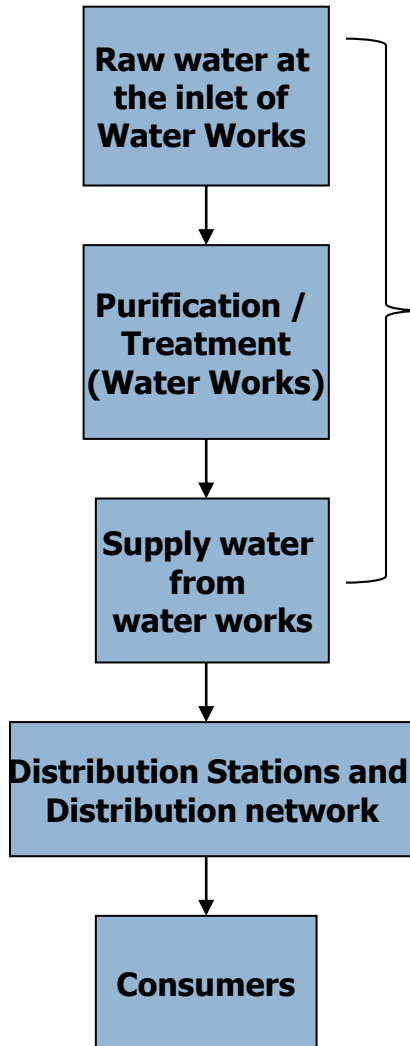
# Best Practices / Initiatives in Water Supply Management of Surat City

- O&M Practices in Water Supply
- Water Quality Monitoring
- Energy Efficiency



# O&M Practices in Water Supply

# Operation & Maintenance Practices Quality Management System



ISO 9001-2008  
Certification  
obtained by SMC

- Established Departments as per Quality Management System in water supply
  - Production
  - Water Quality Control
  - Design & Development
  - Project
  - Engineering & Maintenance – Electrical
  - Engineer & Maintenance – Mechanical
  - Instrumentation & Control
  - Administration and Housekeeping
  - Purchase and Store
  - Quality Control Engineering



# Operation & Maintenance Practices

## Quantity Measurement:

Sr. No.	Instruments (at various Water Works, Water Distribution Stations)	Numbers already installed
1	Flowmeter	53
2	Pressure Transmitters	27
3	Level Indicators	18

- All industrial connection are equipped with highly accurate and self – powered Electro – Magnetic flow meters which were earlier fitted with ordinary mechanical meters. This had given a revenue jump from Rs.16 Crore to Rs.24 Crore.
- All treatment plants are equipped with Loss of Head and Rate of Flow meters. This helps department to analyze and reduce the water loss during treatment.

# Operation & Maintenance Practices



- SCADA (Supervisory Control and Data Acquisition)
  - ▣ Intake well machinery operations
  - ▣ Booster / Pump House in water works
  - ▣ Water Treatment Plant – Plant unit operations
    - 200 MLD capacity WTP at Rander Water Works
    - 200 MLD capacity WTP at Sarthana Water Works
    - 150 MLD capacity WTP at Katargam Water Works
    - 150 MLD capacity WTP at Sarthana Water Works

# Operation & Maintenance Practices



## Engineering & Maintenance

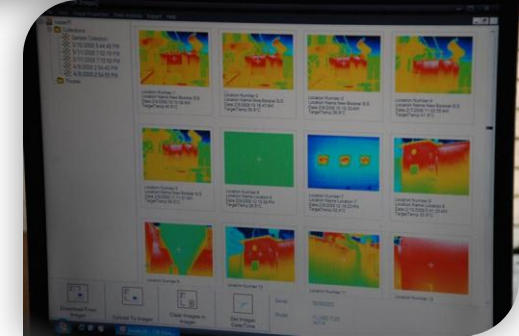
### Electrical maintenance

- Power analyzer, AC / DC clamp meters, Insulation tester, Meggers, Digital multimeters, Thermal imager etc.



### Mechanical maintenance

- Vibration meter, Pneumatic Operated tool sets, Other spanners of different sizes etc.
- Maintenance team for preventive and predictive maintenance work each for water works and distribution stations
- Preventive maintenance as per schedules



# Operation & Maintenance Practices



## □ **Material Management System**

- Inventory of critical Inputs for water supply
- All materials are stored as per good engineering practices.
- Fully computerized inventory management system

## □ **Instrumentation and Control**

- Supported with In-house laboratory for testing, service, maintenance and calibration of critical instruments .
- Calibration is also carried out from Third Party at prescribed interval.
- Department is also supported by Qualified Instrumentation personnel.

# Safe Operation & Maintenance Practices



## Safer Conditions

- ❑ Cl<sub>2</sub> leakage detectors and Scrubber systems
- ❑ Centralized Chlorination system under execution as per Guidelines of “Chief Controller of Explosive”
- ❑ Storage License for Chlorine containers.
- ❑ Safety road maps for Electrical, Mechanical and Chlorination Safety



## Safety Awareness and Training Programs

- ❑ Mock drills
- ❑ Organizing various safety competitions and awards
- ❑ All safety measures are devised and designed in consultation with National Safety Council, Gujarat Safety Council, Gujarat Aalkalies & Chemicals Ltd., Department of Industrial Safety & health, Various Corporate houses like L&T, ESSAR, Torrent Power, Shell etc., DPMC (Disaster Prevention And Management Centre), Various motivators like Bramhakumaries,







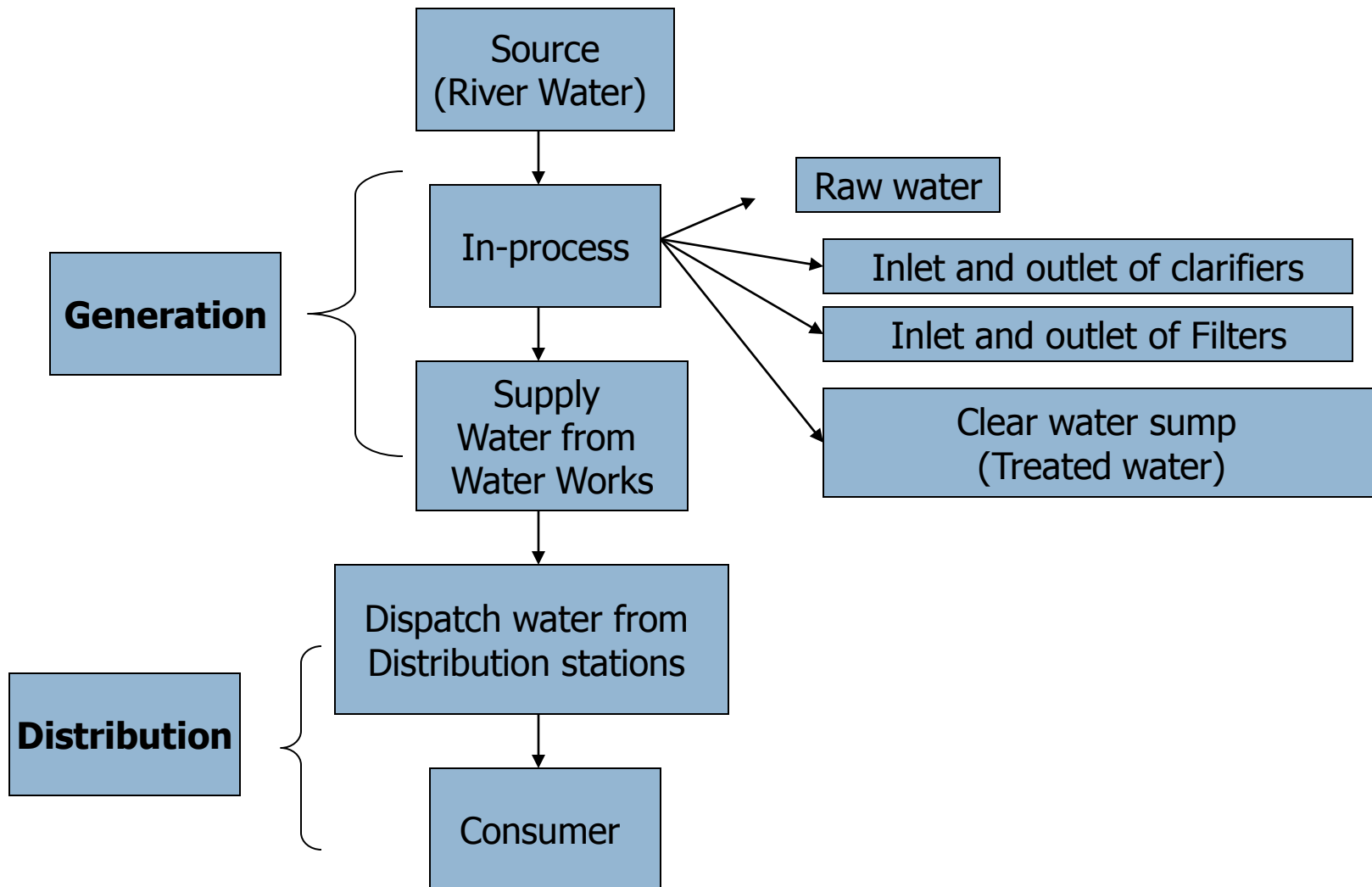
# Operation & Maintenance Practices

- **Annual Disinfection Programs**
  - **Cleaning and Sterilization of Water Treatment Units as per Disinfection programs**
- **GRID System**
  - **All Water Works and Water Distribution Stations are interlinked**
  - **Any water works can feed water to any water distribution station**
  - **Helped to restore entire water supply system within 36 hours during the floods of August 2006**
  - **Various Energy Saving measures reduced specific energy consumption in water supply (*Specific Energy Consumption is reduce from 355 KWH/ML to 279 KWH/ML*)**



# Water Quality Monitoring System

# Water Quality Monitoring “Stages”



# Monitoring of Water Quality



Sr.	Location	Frequency	Parameter	Stage
1	Generation	Round the Clock	pH, Turbidity, TDS, Free Residual Chlorine (FRC), Dissolved Oxygen (DO)	Raw Water, Treated / Supply Water from Water Works
2		Hourly	pH, Turbidity, Free Residual Chlorine (FRC)	Raw Water, Treated Water
3		Shift wise	pH, Turbidity, Colour Index, Taste, FRC, TDS, Alkalinity, DO	Raw Water, Treated Water, Supply Water
4		Weekly	pH, Turbidity, Colour Index, Taste, FRC, TDS, Alkalinity, DO, Total Hardness, Nitrate, Iron, Fluoride, Ammonical Nitrogen, Chloride, Chlorine Demand, BOD, COD, MPN Index (17 parameters)	Raw Water, Treated Water, Supply Water
5		Quarterly	All heavy metals as per IS 10500 including above 17 parameters	Raw Water, Treated / Supply water
1	WDS	Twice in Supply hour	Turbidity, FRC	Supply water to consumer from WDS
2		Weekly	pH, Turbidity, Colour Index, Taste, FRC, TDS, Alkalinity, DO, Total Hardness, Nitrate, Iron, Fluoride, Ammonical Nitrogen, Chloride, MPN Index (17 parameters)	Supply water to consumer from WDS
1	Consumer samples	Daily	Odour, pH, TDS, Ammonical Nitrogen, FRC	Consumer samples



# Total Sample Management

Stages under monitoring	Total number of samples per day
<b>Generation:-</b>	Raw Water:- 12 In-process (inlet / Outlet of clarifiers and filter beds):- More than 390 Treated Water:- 21 Supply Water:-12 } <b>&gt; 445</b>
<b>Consumer / households</b>	180 – 190 – for lab testing, 480 – 490 – Onsite FRC testing } <b>&gt; 660</b>

**100% compliance to the CPHEEO and WHO Guidelines**



# Energy Efficiency

# Energy



- ❖ Installation of thyristor based APFC panels
- ❖ Coating for Energy Saving to various pumps
- ❖ Rationalisation of contract demand at water works/ distribution stations, etc.
- ❖ Replacement of pumps at various Water Works and Water Distribution Stations after energy audit.
- ❖ Replacement and trimming of impellers of pumpsets installed at Head Water Works
- ❖ Replacement of Zero Velocity Valve

Total Energy Saving Realized: **52.17 Lacs KWH/ annum**

Saving Amount: **Rs. 2.52 Crores/ annum**

# Energy - Re-engineering of Water Supply Routes



Re-engineered Route	Location	Ordinary routes before initiative (2003-04)	Specific Energy Cons. (KWH/ ML)	Energy Cons. (KWH/ Day)	Re-engineered route	Specific Energy Cons. (KWH/ ML)	Expected Energy Cons. (KWH/ Day)	Net Saving (KWH/ Day)
I	Umarwada WDS	SWW→HWW→ UMR WDS	<b>315.59</b> <b>{40.11 MLD}</b>	12,658	SWW→ DUM-UMR WDS	<b>165.67</b> <b>{53 MLD}</b>	8,781	7,992
		HWW→UMR WDS	<b>319.27</b> <b>{12.89 MLD}</b>	4,115				
II	Athawa WDS	RWW→JOG WDS→ATH WDS	<b>240.7</b> <b>{32 MLD}</b>	7,702	RWW→ATH WDS	<b>207.28</b> <b>{32 MLD}</b>	6,633	1,069
	Khatodara WDS	RWW→JOG WDS→KHT WDS	<b>240.7</b> <b>{20.8 MLD}</b>	5,007	RWW→KHT WDS	<b>207.28</b> <b>{15.96}</b>	3,308	1007
		KWW→KHT WDS	<b>142.88</b> <b>{53.20 MLD}</b>	7,601	KWW→KHT WDS	<b>142.88</b> <b>{58.04}</b>	8,293	
III	Udhana WDS	KWW→KHT WDS→UDH WDS	<b>183.84</b> <b>{31 MLD}</b>	5,699	KWW→UDH WDS	<b>128.05</b> <b>{32 MLD}</b>	4,098	1,601
	Pandesara WDS	KWW→KHT WDS→PAN WDS	<b>183.84</b> <b>{27 MLD}</b>	4,964	KWW→PAN WDS	<b>128.07</b> <b>{27 MLD}</b>	3,458	1,506
**	<b>Total</b>			<b>47,746</b>			<b>34,571</b>	<b>13,175</b>



# Energy:- Re-engineering of Water Supply Routes – Summary



Sr. No.	Brief Description of Activity	Savings			Investment
		Envisaged Lacs KWH/ annum	Actual Lacs KWH/ annum	Lacs Rs./ annum	Rs. In Lac
(1)	Change in UGT Filling Route for Umarwada WDS	29.17	40.48	163.75	13.67
(2)	Change in UGT Filling Route for Khatodara & Athawa WDS from Rander Water Works	7.57	21.34	85.37	46.37
(3)	Change in UGT Filling Route (Partial) for Udhana & Pandesara WDS from Katargam Water Works	11.34	5.51	22.32	45.32
<b>Sub Total 1</b>		<b>48.08</b>	<b>67.34</b>	<b>271.45</b>	<b>105.37</b>

# Energy:- Other implemented initiatives

## Wind Power Generation: -

- Installed 2nos. of 1.5 MW Wind Power Plant in Nov.-10
- Total Expected energy generation: -6.40 GWH/ annum
- Total Expected energy saving : -Rs.2.83 Cr. per annum
- Total Capital Investment: - Rs.18.43 Cr.
- Total O & M cost up to 10 years: - Rs.3.76 Cr.
- Actual energy generated till April -2011: - 3.19 GWH
- Effective energy saving till April -2011: - Rs. 1.40 Cr.





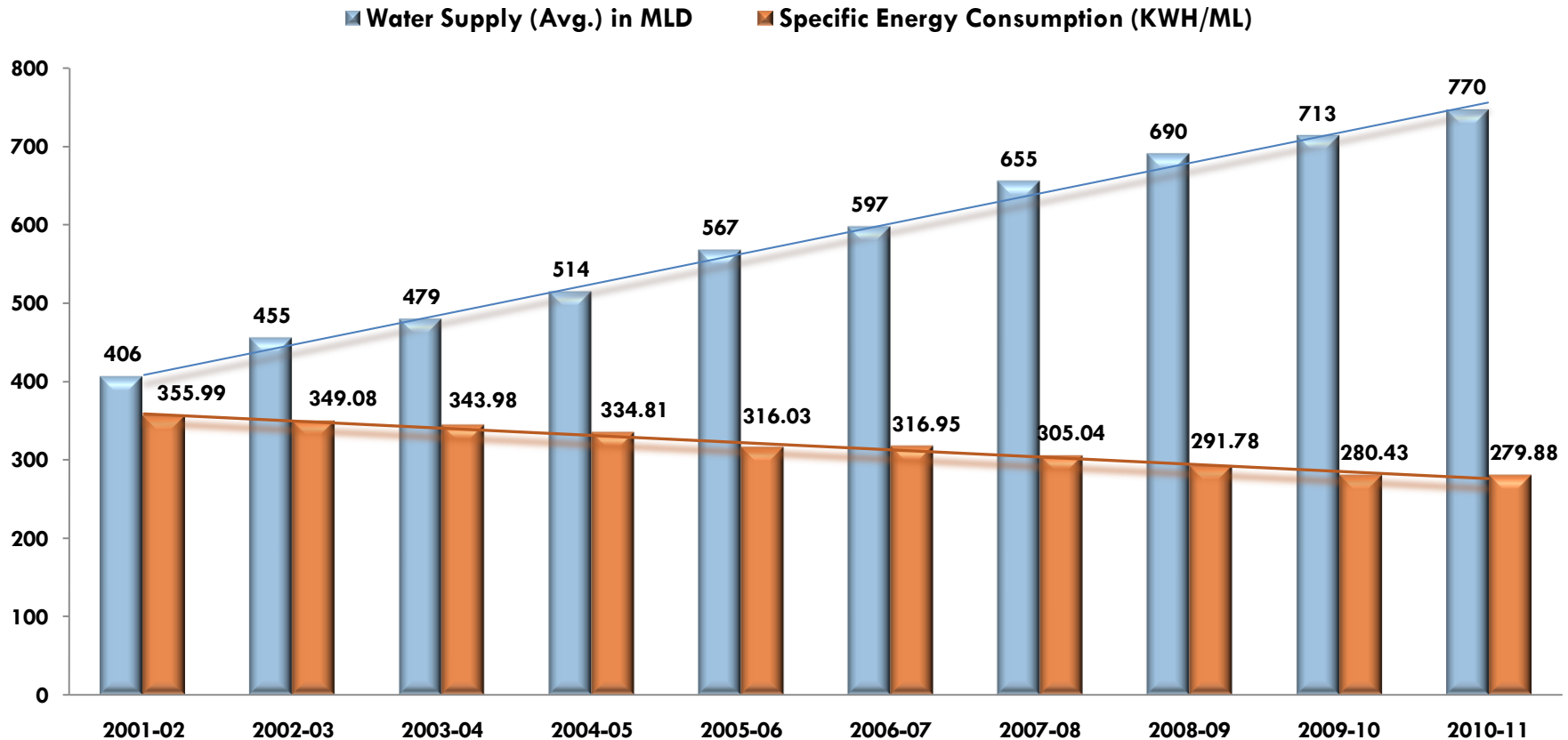
# Total Energy Savings in Water Supply

- ◇ Thus from conventional energy efficiency measures, route re-engineering and wind energy generation, the total savings have reached a level of :
  - ◇ 138.63 Lacs KWH/ annum
  - ◇ Rs. 6.36 Crores/ annum

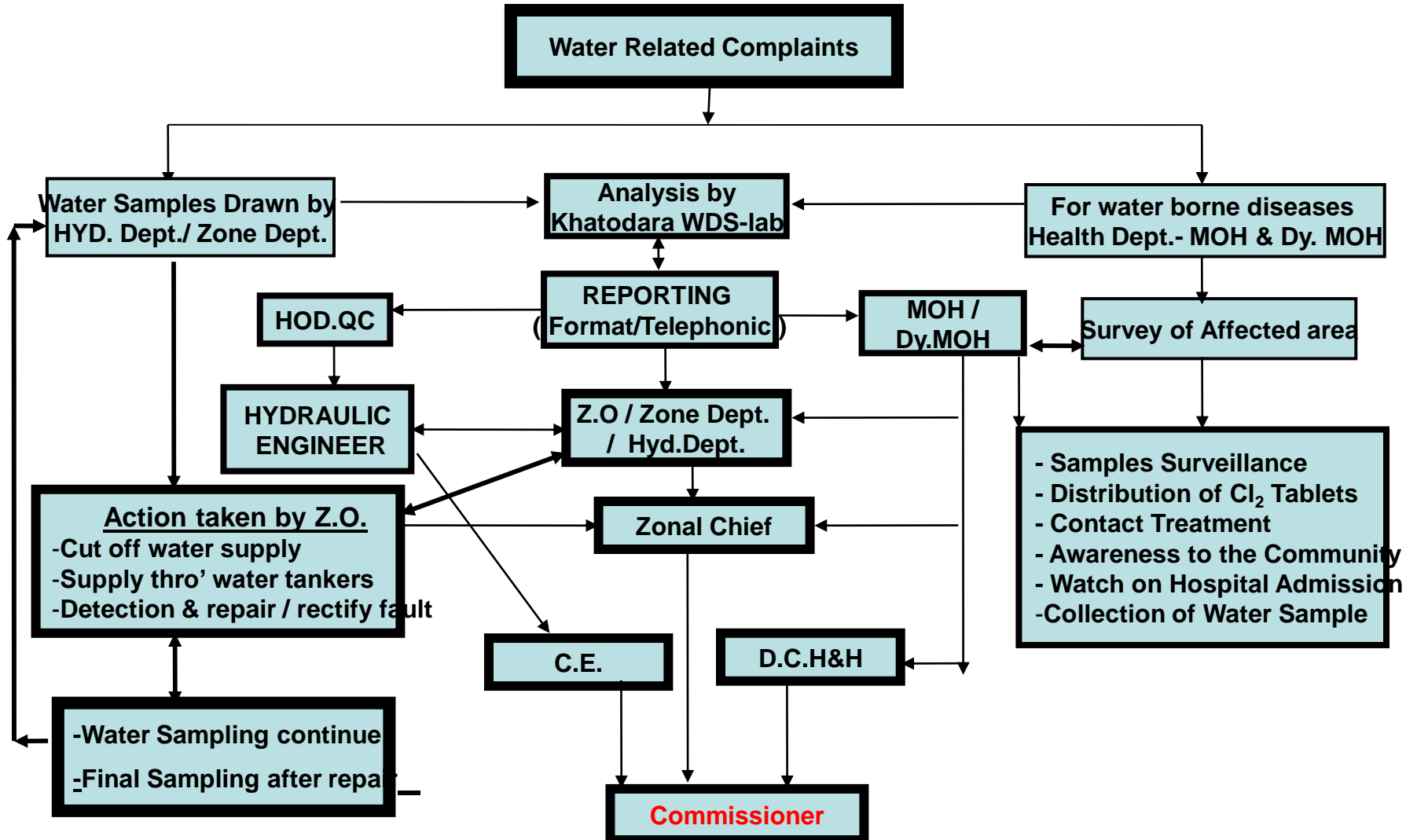
# Effect of Energy Conservation Activities in Water Supply

Energy conservation is continuous activity & constantly going on. With the efforts made, results achieved are as below: -

## Water Supply Vs. Specific Energy Consumption Trend From 2001-02 to 2010-11



# Complain System – Water Quality





# Appreciations / Recognitions

- **National Urban Water Awards – 2008** for implementation of water quality monitoring system and O&M Practices in water supply.
- **National Urban Water Awards – 2009** for Energy Savings measures in Water Supply Management
- **Government of Gujarat** for Quick Restoration of water supply during the floods of Aug 2006
- Enlistment of water testing Laboratory of SMC in the “Directory of water testing laboratory” – Published by WHO in association with NICD and NEERI
- **Letter of appreciation for quick restoration of water supply after flood of Aug. 2006 by**
  - **Indian Water Works Association**
  - **The Institute of Engineers, India**



Thank You