



Smart Water Supply Measurement and Quality Monitoring System



Amrit is an IoT-based system for real-time monitoring of quality and quantity for potable water. The system has an interactive dashboard for data visualization with node's hierarchy. A user can manage the faults in water distribution network, demands, bills and supply schedules.



Challenges & Requirements

	Raw water intake well	Water treatment plant	ELSR/GLSR	DMA	House hold
					
CHALLENGES	Sessional variation of water quantity & quality needs different filtration needs	Varying raw water quality needs different filtration/chemical mixing needs	<ul style="list-style-type: none"> Timely filling & distribution Ensure water quality before distribution 	<ul style="list-style-type: none"> Timely distribution Leakages/Theft Water pollution 	<ul style="list-style-type: none"> Timely distribution Leakages Water pollution End mile availability
PARAMETERS TO MONITOR	<ol style="list-style-type: none"> Turbidity pH Water Level at source Out flow Pressure Pump Efficiency 	<ol style="list-style-type: none"> Turbidity pH Chlorine Level at filter beds Out flow Pressure Pump Efficiency 	<ol style="list-style-type: none"> Water Level Inflow/Out Flow Chlorine 	(at strategic points) <ol style="list-style-type: none"> Flow Pressure Chlorine 	(at strategic points) <ol style="list-style-type: none"> Flow Pressure Chlorine
CONTROLS REQUIRED	<ol style="list-style-type: none"> Pump ON/OFF Valves automatic Open/Close 	<ol style="list-style-type: none"> Filter bed Valve open/close Backwash Pump ON/OFF Chlorine Dozing 	Valves automatic Open/Close	Valves automatic Open/Close	Valves automatic Open/Close

Smart Water Management

- Aims to provide Quality and Quantity by effective management of water distribution network.
- System monitors & controls water distribution network from central place using IoT based Sensors, (i.e flow, level, water quality, valve actuators..etc) deployed along distribution and household connections.

Objectives:

- Right quantity at Right time of water distribution
- Right quality of water
- Reduce Wastage of Water

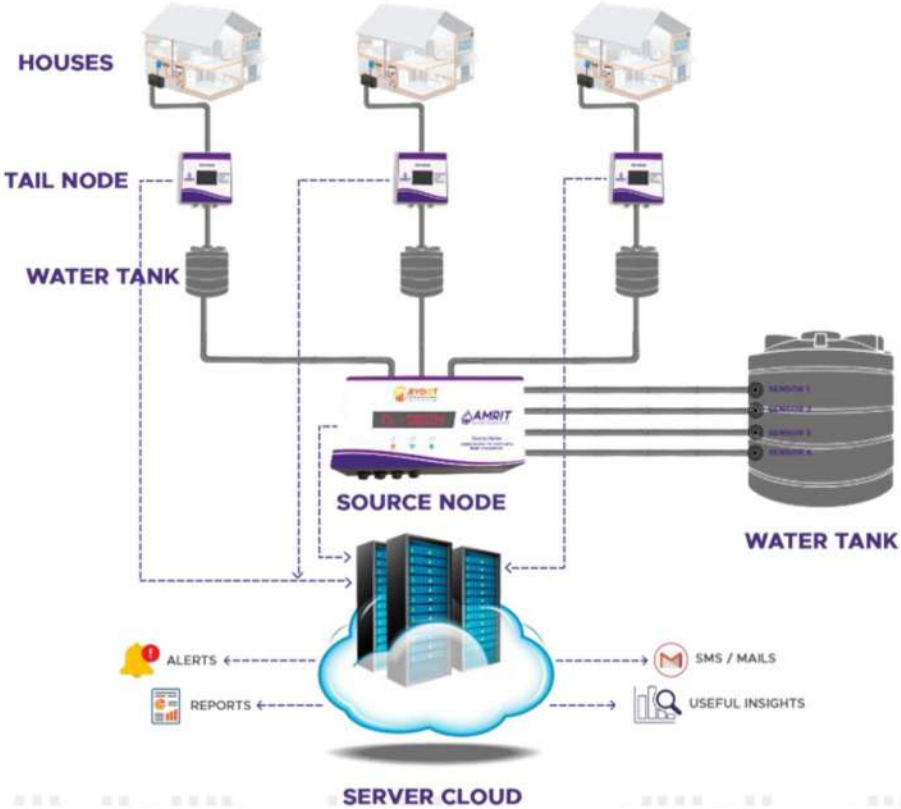


Water Measurement and Quality Monitoring System



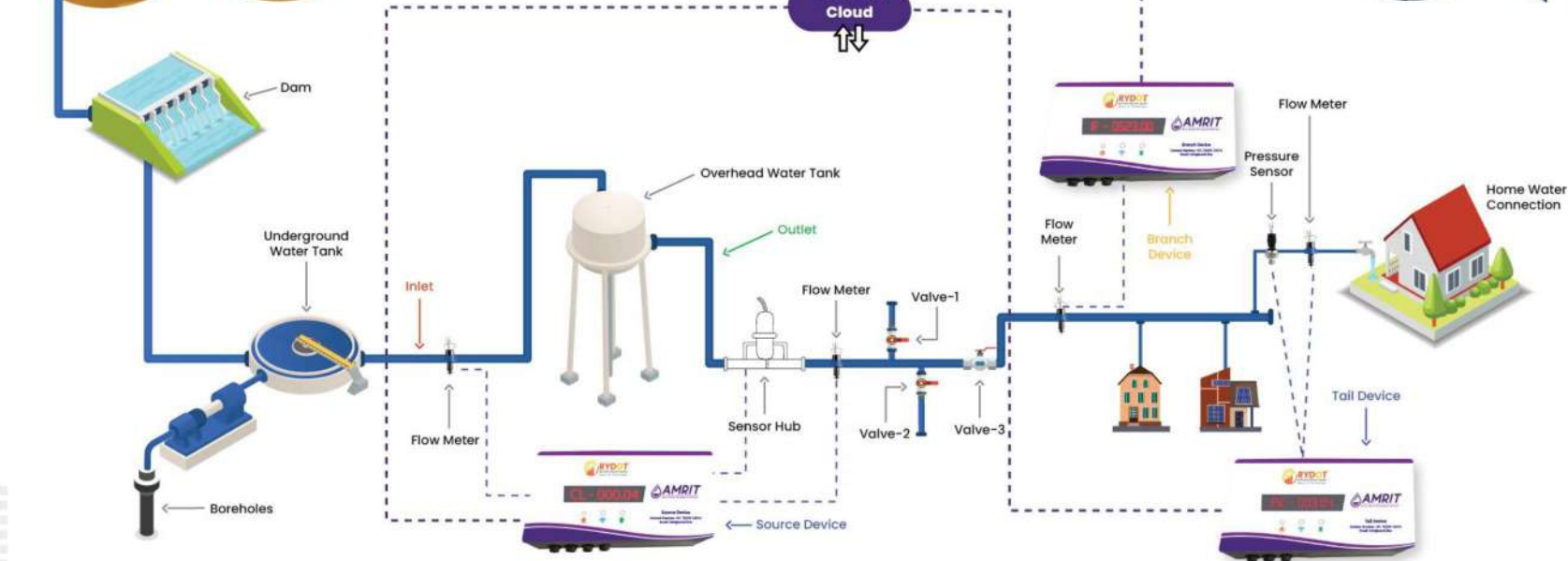
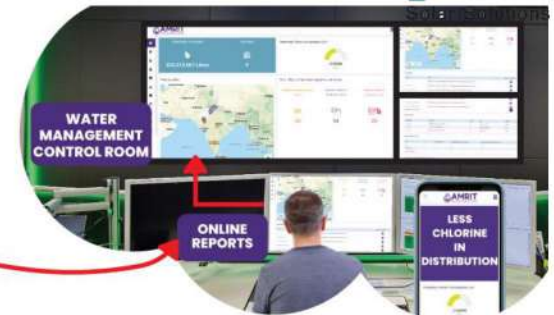
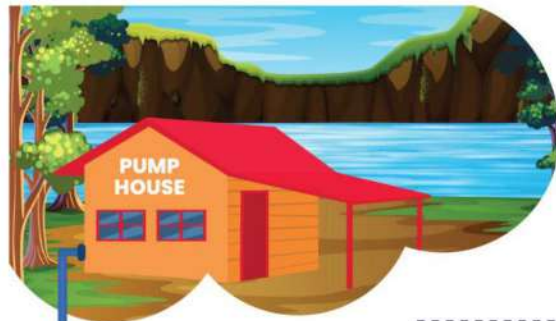
- Collecting real-time water quality and quantity parameters using IoT and harnessing data for generating valuable insights.
- The insights will be used to ensure “Har Ghar Jal” mission and will help taking decisions regarding predictive, maintenance and schedule optimization.
- The system will help monitoring real-time water consumption and quality.
- Insights can be visualize in an easy to understand way using interactive dashboard.
- The system is based on cutting edge technology's like IoT, AI and Bigdata analytics and will improve water distribution.

Commercial House/ Design Scheme Architecture



Village Design Scheme Architecture

SMART WATER MANAGEMENT SYSTEM



Amrit IoT Device

AMRIT IoT Device



Device Features



Multiple Connectivity Options



Remote Data Access



Standalone Sensors



Monitor Multiple Equipment's



Customizable



Battery Backup



GSM / LoRa Technology



Water Flow Sensor



Local Live Monitoring Solution



Flow Totalizer Display



Local Software Access



Water Control/Pump Control



E-mails, SMS, Report



Global Live Monitoring Solution

Key Features



- Users can download all kinds of analytical graphs anytime, anywhere with just a single click.
- Receive SMS and email notifications
- Real time pH, TDS, Nitrate, Residual Chlorine, Fluoride monitoring system
- Full visibility of your system's technical and financial performance, including interactive charts and site layout
- Visualization of Sensor Data, Future Predictions, Leakage detection, Water flow etc.
- Data presentation at the module-level, string-level and system level
- Comparative analysis diagnostics
- Mobile and web-based monitoring
- Ease of use and control from anywhere in the world
- Easy control over complex systems like pump control, water level control
- Remote Connectivity
- Water level indicator system

USP

- Low cost
- Quick installation
- Tampered detection
- Low power (15-20 ma idle consumption)
- Plug & play sensor connectivity
- 2g/4g / lora / wi-fi connectivity ip65 standard
- 48 hrs to 180 days power backup
- Microcontroller
- Portable
- Remote calibration and device management
- Compact size
- Data communication as per user define
- Live display of data on led screen
- Power on solar
- Data storage till 1 year on device



Specifications

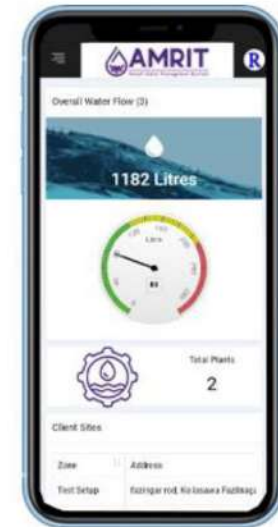
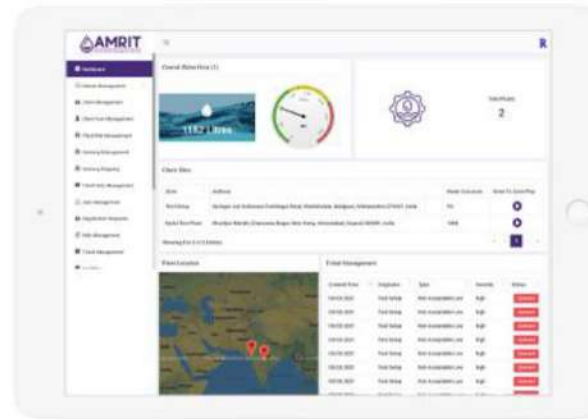
Category				Connectivity Options
Voltage	12-24V DC			<ul style="list-style-type: none"> • GSM Enabled • GPRS Enabled • 4G Volte Enabled
Current	2A			
Battery capacity	12V 3500mAh			
Quality Sensors	Range	Resolution	Accuracy	Features <ul style="list-style-type: none"> • Wi-Fi Enabled • LORA Enabled • LAN Enabled • Up to 8 sensors can be attached • Upto 5 solenoid Valve control • 3.5 inch LCD Display • Cortex A-5 ARM processor • Linux OS Enabled • IP68 housing
pH	0-14	0.01	(+)-1	
TDS	0-5000 mg/litre	1	(+)-2	
Chlorine	0-5 mg/litre	0.01	(+)-0.05	
Nitrate	0-500 mg/litre	0.1	(+)-5	
Fluoride	0-20.0 mg/litre	0.1	(+)-0.5	
Quality Sensors				
Flow Meter	Bulk Flow Meter			
Pressure Sensor	Upto 5 bar			



The background of the slide features a high-angle view of a dense urban skyline with numerous skyscrapers. A semi-transparent purple rectangular box is centered over the image. In the upper left corner, there is a white network diagram consisting of interconnected nodes and lines. The text 'Amrit Platform' is written in white, bold, sans-serif font within the purple box, with a thin white horizontal line positioned directly below it.

Amrit Platform

Platform Independent System

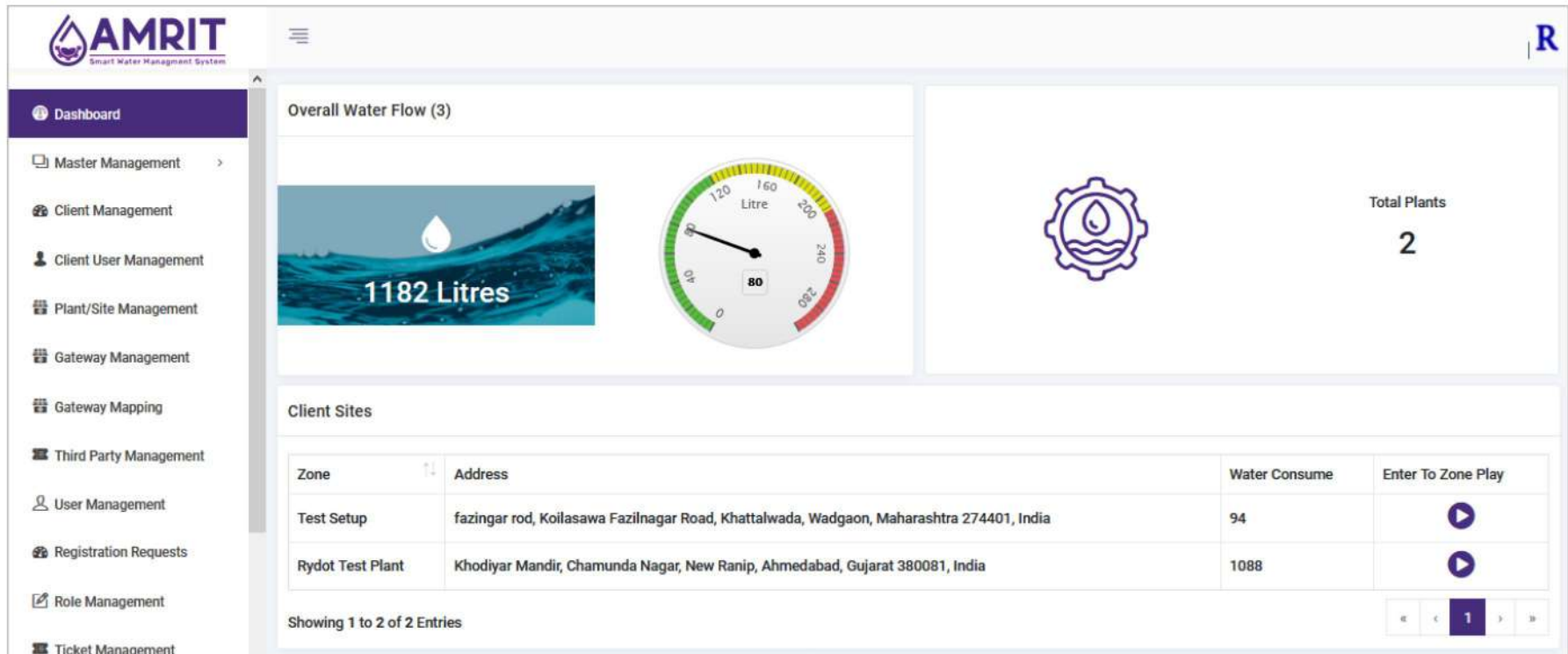


USP

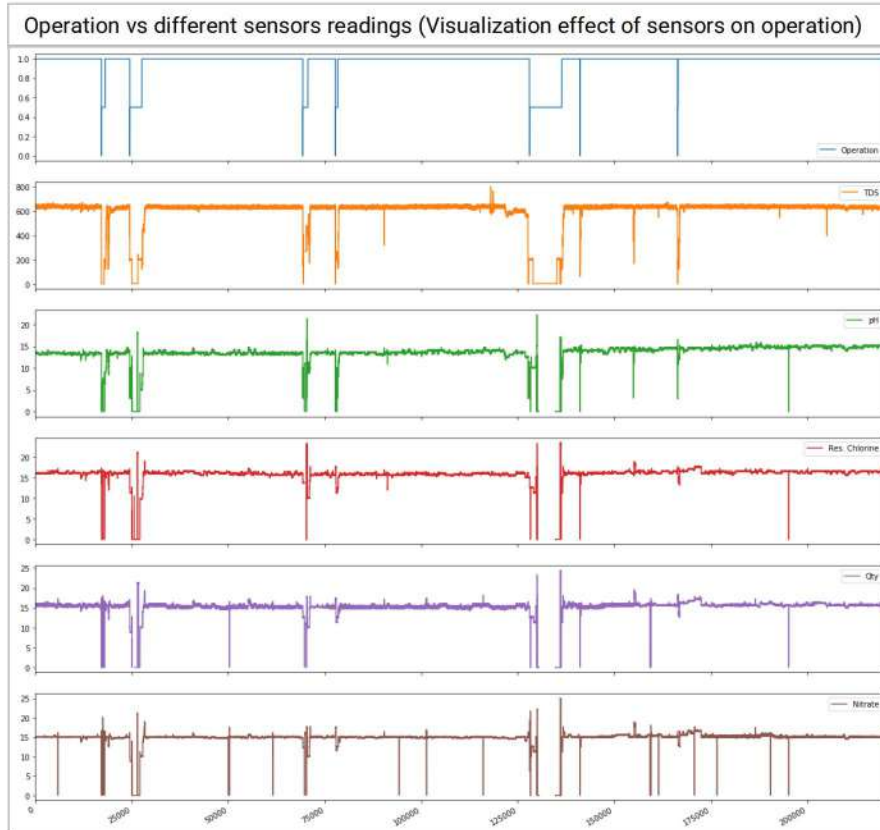
- Analytics & insights of raw data
- Real-time device and data monitoring
- Remote calibration and device management
- IoT configuration
- Alert ticket management about quality control and flow control
- Email, SMS alert
- Reports
- Compare plant performance
- Security user wise and role wise.
- Device health (Battery, Power) monitoring
- Remote device configuration and control.
- Dashboard with various KPI.
- Deploy on any cloud or on premises data center.
- Container base.
- Onboarding user or device using RPA in auto mode.
- AI chatbot support for ticket, information etc.
- Geo tagging of device display



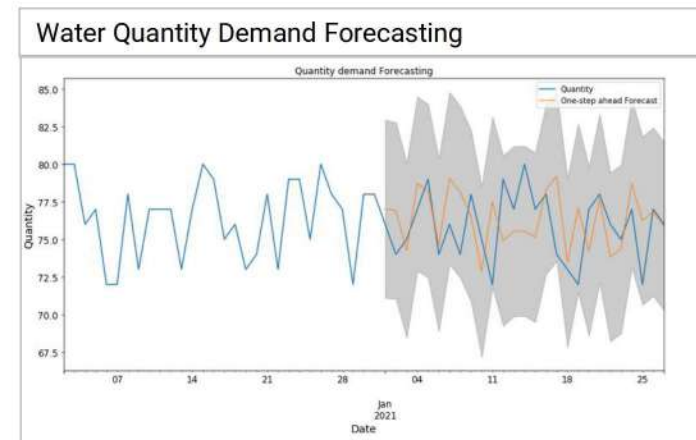
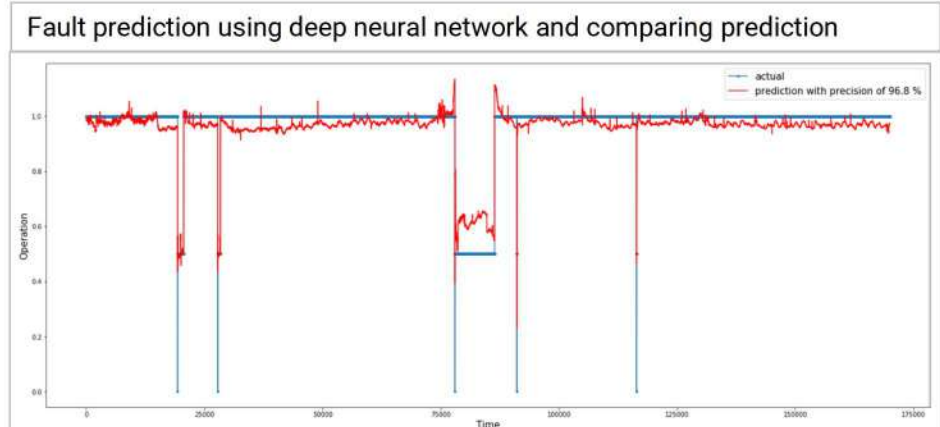
Monitoring Dashboard



Analytics Dashboard



Note: These plots are generated with synthetic data for displaying the fault detection using real time and historical data.



Billing, SMS, Email & Real Time Ticket Generation For Error Detection



Billing Management

Plant: Rydot Test Plant

Tail Node 1 | Source Node |

Meter Bill Generate (Tail Node 1)

From Date: 02/05/2021 To Date: Delimeter

Previous:	0
Current:	13
Total Consumption:	13
Rate:	2.5
Bill Amount:	32.5

Generate

SMS and EMAIL Notification

Show 100 entries

Type	Client Admin	Send To	Subject	Message
✉	NA	karanp@dot.com	Registration approved	Sir, I on behalf of all the members of this society, am writing this letter to you to complain about the current issue of
✉	NA	rajt@dot.com	OTP	Sir, I on behalf of all the members of this society, am writing this letter to you to complain about the current issue of
✉	NA	amrk001@mailnesia.com	Registration approved	Sir, I on behalf of all the members of this society, am writing this letter to you to complain about the current issue of
✉	NA	amrk001@mailnesia.com	Signup Successful	Sir, I on behalf of all the members of this society, am writing this letter to you to complain about the current issue of
✉	NA	rajt@dot.com	OTP	Sir, I on behalf of all the members of this society, am writing this letter to you to complain about the current issue of
📱	NA	9726938737	No Subject	The OTP to reset your password is: 697959
✉	NA	rajt@dot.com	OTP	Sir, I on behalf of all the members of this society, am writing this letter to you to complain about the current issue of
📱	NA	9726938737	No Subject	The OTP to reset your password is: 343892

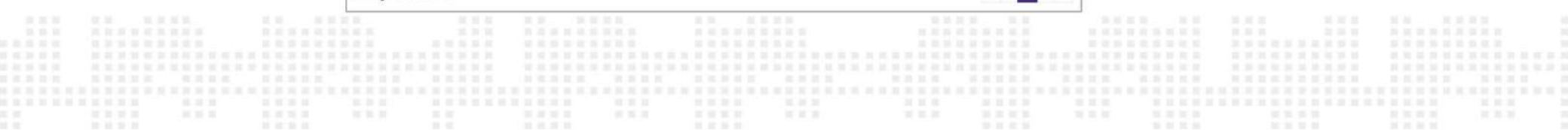
Showing 1 to 8 of 8 Entries

Ticket Management

Show 10 entries

Title	Plant	Ticket Assigned To	Resolved Date	Priority	Ticket Status	Created At	Actions
Sensor Residual Chlorine value detected lower	Test Setup	NA	N/A	High	Opened	05/02/2021	
Sensor pH value detected lower	Test Setup	NA	N/A	High	Opened	05/02/2021	

Showing 1 to 2 of 2 Entries



Analysis Reports



SENSOR RAW REPORT

Plant: Test Setup | Gateway: Source Node | Select a Date Range: 02/04/2021 - 02/05/2021 | [Generate Report](#)

Reports | Plant: Test Setup | Gateway: Source Node | +7 | [Download](#)

Plant	Gateway	Flow Total	Flow	pH	Nitrate (Milligram/Litre)	Residual Chlorine (Milligram/Litre)	TDS (Milligram/Litre)	Created At
Test Setup	Source Node	0	0	3.88	5.15	3.79	6.33	05/02/2021, 09:57 PM
Test Setup	Source Node	0	0	3.76	5.14	3.8	6.33	05/02/2021, 09:57 PM
Test Setup	Source Node	0	0	3.36	5.15	3.79	6.33	05/02/2021, 09:56 PM
Test Setup	Source Node	0	0	2.8	5.11	3.76	6.42	05/02/2021, 09:39 PM
Test Setup	Source Node	0	0	2.7	4.82	3.55	6.06	05/02/2021, 09:38 PM
Test Setup	Source Node	0	0	1.33	2.57	1.89	3.23	05/02/2021, 09:38 PM











































Showing 1 to 6 of 6 Entries



Configuration

Gateway Management

Show 100 entries

Gateway Name	Assign Plant	Serial Number	Created At	On Boarding	Status	Actions
 Tail Node	Test Setup	b8:27:eb:6b:be:7c	05/02/2021	On Boarded	<input checked="" type="checkbox"/>	    
 End Tail Node	Test Setup	b8:27:eb:b6:77:bb	05/02/2021	On Boarded	<input checked="" type="checkbox"/>	    
 Source Node	Test Setup	b8:27:eb:aa:47:b1	01/02/2021	On Boarded	<input checked="" type="checkbox"/>	    
 Source Node	Test Plant	b8:27:eb:aa:47:b2	09/01/2021	On Boarded	<input checked="" type="checkbox"/>	    
 Tail Node	Test Plant	b8:27:eb:6b:be:7d	09/01/2021	On Boarded	<input checked="" type="checkbox"/>	    
 Source Node	Test Plant	dc:a6:32:25:12:ad	01/01/2021	On Boarding	<input type="checkbox"/>	    
 Source Node	Test Plant	asd087a0s8f0a9s8f	01/01/2021	On Boarding	<input type="checkbox"/>	    

Showing 1 to 7 of 7 Entries

Key Benefits

Key Benefits and Social Impact



- The system provides real time monitoring which is far better than offline quality check in laboratories.
- Water contamination cause serious conditions such as cholera, diarrhea, typhoid, amebiasis, hepatitis, gastroenteritis, giardiasis, campylobacteriosis, scabies, and worm infections.
- Water contamination can be monitored in real time and authorities can take necessary action.
- Better policies and planning can be done by using the insights from data captured through the system.
- Good quality of drinking water available to citizens.
- No disturbance to present inventory.
- No distribution or manpower charges

Key Benefits and Social Impact



- Improved success rate of water supply schemes due to end-to-end visibility of water supply to village, district, state, and national level at near real-time (for quick response corrective actions)
- Equitable access to all sections of the society by monitoring water delivery across habitations
- Alleviation of issues (social, economic and health) in village resulting from in-accessibility to potable water in adequate quantity; improved transparency and accountability
- Reduced cost of operations and improved life of water supply schemes (e.g., leak detection, preventive maintenance, optimising resource requirements)
- Better customer satisfaction with improved service levels through faster response time and lesser number outages (e.g., remote dashboards across levels and preventive maintenance)
- Data-driven and evidence-based planning for new schemes/ modifications through advanced analytics (e.g., demand patterns, electricity reliability, source reliability, temporal water quality variation etc.)
- Long term sustainability of water sources through improved source monitoring
- Efficient and responsible use of water by end customers by measuring quantity consumed

Recognition

Recognition



*We are heartily thankful to Shri Gajendra Singh Shekhawat
Minister of Jal Shakti and Team for providing us valuable guidance
during the challenge journey.*

Rydot Infotech Private Limited
Winner of the
ICT Grand Challenge 2020

"Smart Water Supply Measurement and Monitoring System"
As part of this challenge
Successfully deployed 25 Villages in Gujarat, Rajasthan,
Uttar Pradesh and Ladakh

Source Node
AMRIT

- 100% Water Loss Reduction
- 50% Energy Savings
- 100% Leak Detection
- 100% Non-Revenue Water Reduction
- 100% Customer Satisfaction

The award certificate features a gold medal with the number 1, logos of the Ministry of Jal Shakti, National Water Mission, and various partners like CDC, STPI, and IIT Bombay. It also includes a screenshot of the AMRIT Source Node interface.

*We are heartily thankful to Mr. Pradeep Singh, Director of
NJJM and Team for providing us valuable guidance
during the challenge journey.*

Recognition



We are heartily thankful to Mr. Mahendra Mahour Rural Infrastructure Consultant, National Jal Jeevan Mission and Team (NJJM) for providing us valuable guidance during the challenge journey.

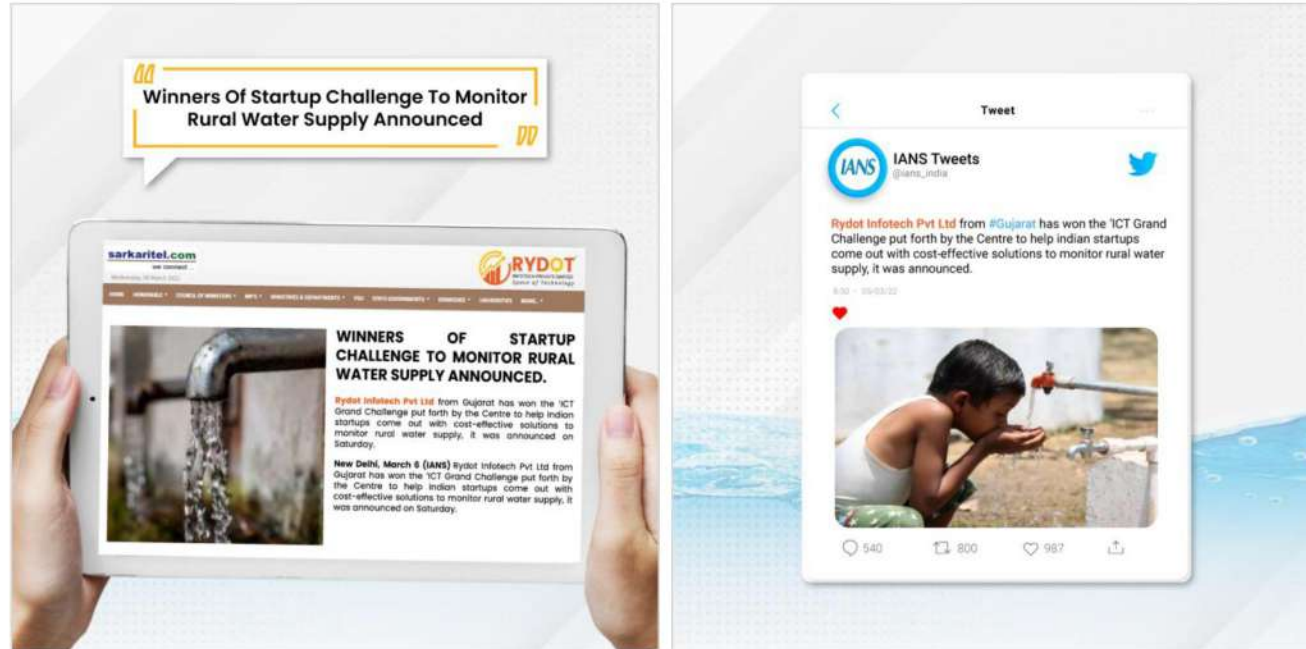


We are heartily thankful to Mr. Sanjeev & Mr. Abhishek (MeiTY) and Team for providing us valuable guidance during the challenge journey.



We are heartily thankful to Ms Annie Joyce, Mr. Haribabu, Mr. S D Sudarsan and Team for providing us valuable guidance during the challenge journey.

Recognition

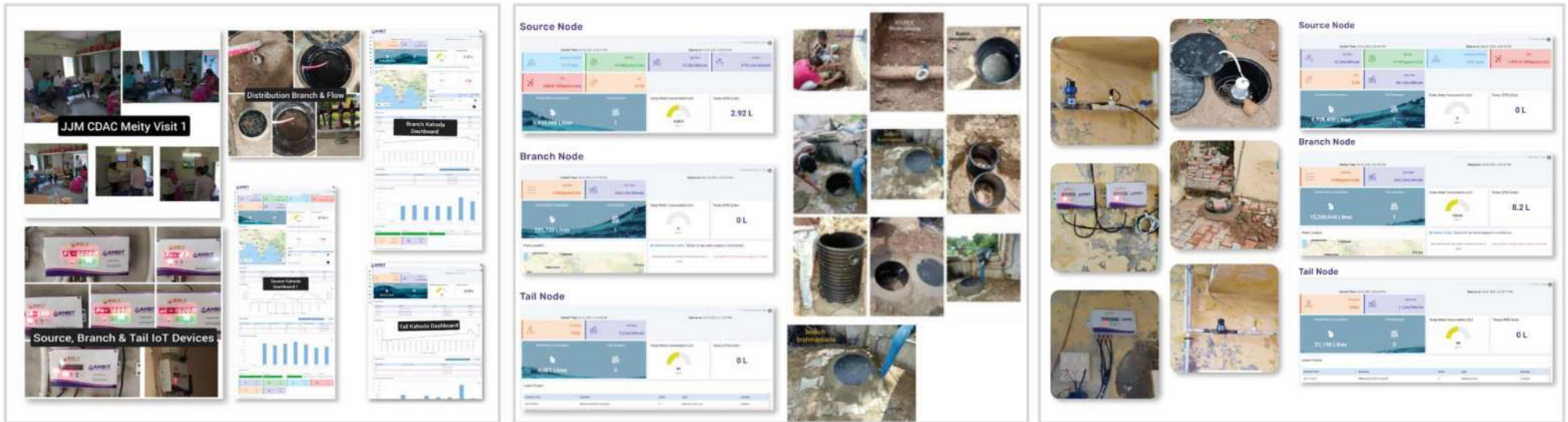


The background of the slide is a high-angle photograph of a dense cityscape with numerous skyscrapers. A semi-transparent purple rectangular box is centered over the image, containing the main title. A network of thin grey lines with small circular nodes is overlaid on the top half of the image, suggesting a digital or interconnected theme.

Amrit Till Date Installations

Gujarat

Gujarat – Mahesana 10 Village's



Gujarat – Mahesana 10 Village's



Source Node
5.36 L

Branch Node
0.24 L

Tail Node
0 L

Branch sipor

Source IN sipor

Tail sipor

Source Node
0.6 L

Branch Node
0.7 L

Tail Node
16,730 Litres
Total Water Consumption (24): 0 L
Total (24): 0 L

Source Node
0 L

Branch Node
0.25 L

Tail Node
0.84 L

Branch UMATA

Source out UMATA



Rajasthan

Rajasthan – Jaipur 4 Village's



Source Node
8.57 L

Branch Node
0.03 L

Tail Node
0.01 L

Source Node
Toonga - RJ

Source Node
10.93 L

Branch Node
6.39 L

Tail Node
0.18 L

Source In
Kotkhavda - RJ

Source Out
Kotkhavda - RJ

Branch Node
Kotkhavda - RJ

Tail Node
Kotkhavda - RJ

Branch Jatwara

Source Node
11.64 L

Branch Node
0.33 L

Tail Node
0.03 L

Branch
Jatwara

Tail Node - Jatwara - RJ

Source
Jatwara


Branch
Jatwara

Tail Node
Jatwara



Uttar Pradesh

Uttar Pradesh 10 Village's



Branch UP - Bogra

Source Node


Flow	35.74 L
Pressure	1.2 bar
Speed	1500 RPM
Power	1.5 kW

Branch Node

Flow	11.62 L
Pressure	1.2 bar
Speed	1500 RPM
Power	1.5 kW

Tail Node

Flow	8.36 L
Pressure	1.2 bar
Speed	1500 RPM
Power	1.5 kW



Tail UP chirchita

Source Node

Flow	9.2 L
Pressure	1.2 bar
Speed	1500 RPM
Power	1.5 kW

Branch Node

Flow	5.77 L
Pressure	1.2 bar
Speed	1500 RPM
Power	1.5 kW

Tail Node

Flow	0 L
Pressure	1.2 bar
Speed	1500 RPM
Power	1.5 kW



Source Node

Flow	18.92 L
Pressure	1.2 bar
Speed	1500 RPM
Power	1.5 kW

Branch Node

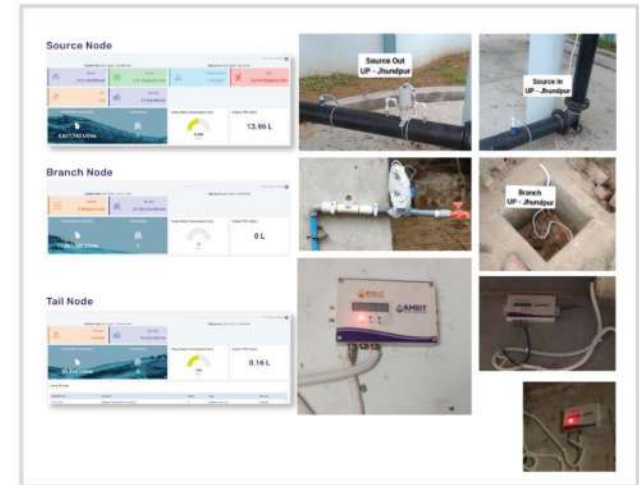
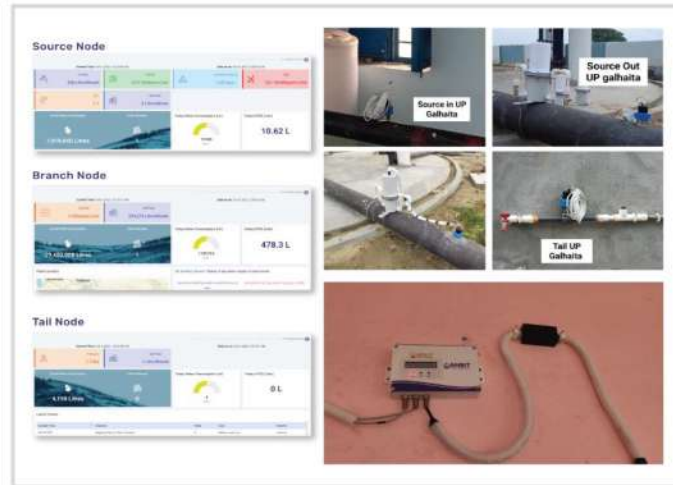
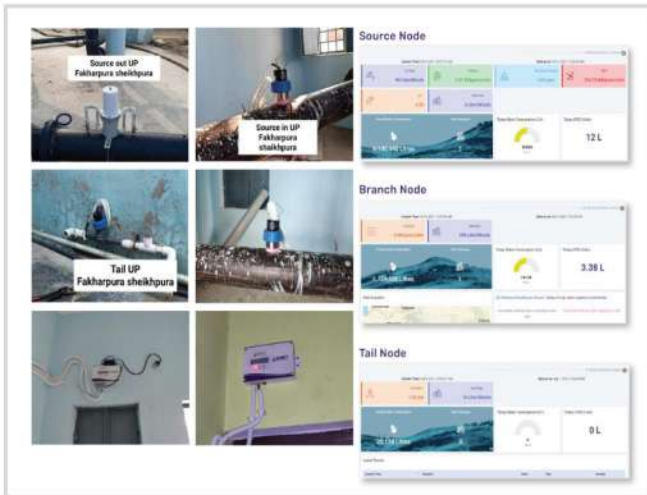
Flow	13.84 L
Pressure	1.2 bar
Speed	1500 RPM
Power	1.5 kW

Tail Node

Flow	0 L
Pressure	1.2 bar
Speed	1500 RPM
Power	1.5 kW




Uttar Pradesh 10 Village's





Ladakh

Ladakh 1 Village


Source Node






Source Node dashboard showing flow rate of 1.6 Ltr/Minute, total flow of 290,874.33 Litres, and today's water consumption of 455.05 L.




Branch Node





Branch Node dashboard showing flow rate of 3.0 Ltr/Minute, total flow of 342,796 Litres, and today's water consumption of 582 L.



Tail Node



Tail Node dashboard showing flow rate of 2.4 Ltr/Minute, total flow of 522,586.33 Litres, and today's water consumption of 305.1 L.



Device ID	Agency	Area	Type	Status
10010001	HRD (Srinagar) branch	HRD	Control Valve	Active
10010002	HRD (Srinagar) branch	HRD	Submersible Pump	Active

Benefits

Benefits



Smart Water Billing Systems



Smart Water Leakage And
Flow Schedule Prediction



Sewage Treatment
Plant Automation



Smart Water Distribution



Smart Water
Level Controller



Water Level
Indicator

Cost Benefit Analysis

(Based on survey conducted in pilot villages)



- System is cost effective and it cost less than 0.2 rupee (20 paise) per capita per day for real time drinking water quality and quantity monitoring.

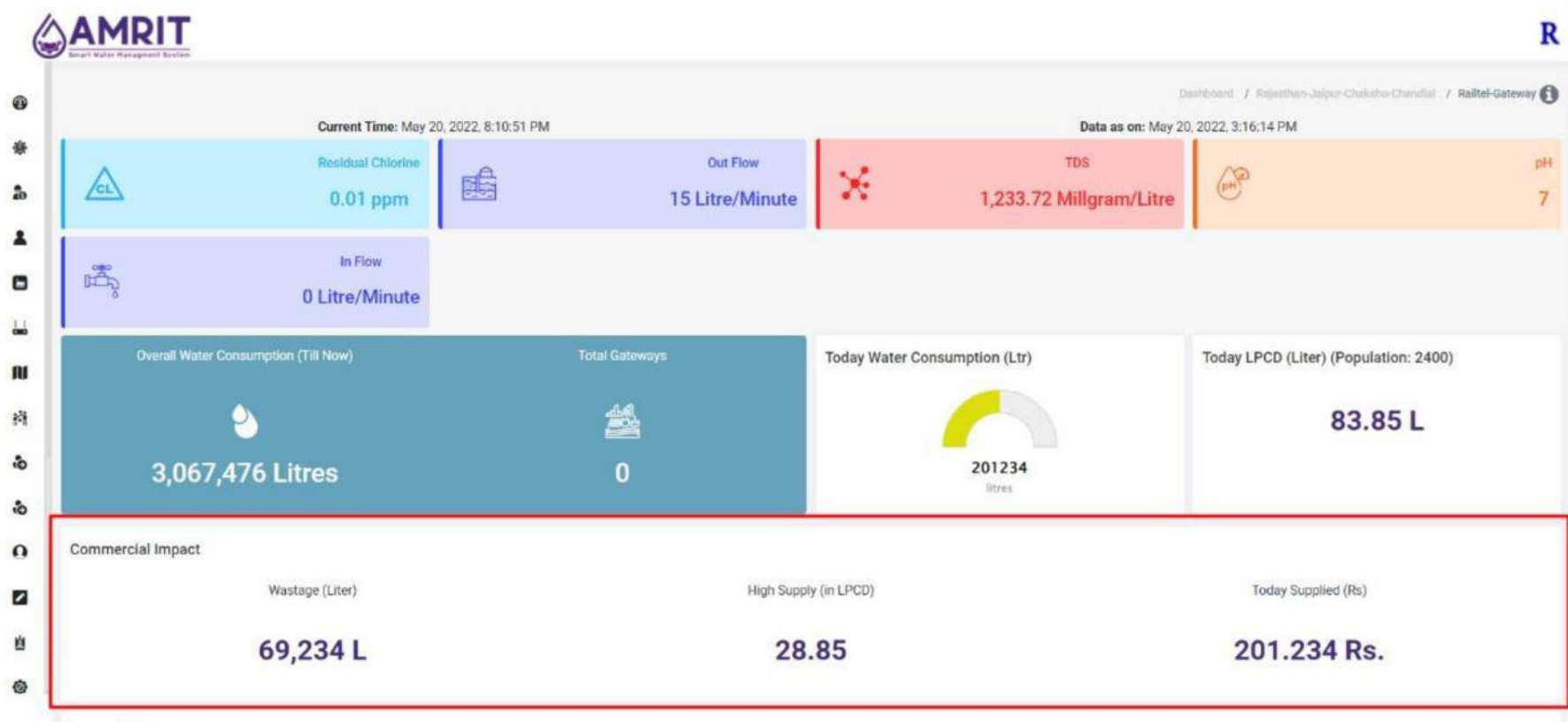
Cost per capita per day = (Installation cost + Maintenance cost + Computation cost)/ 3* Population Coverage

- We have analyzed the cost per capita based on observations from 25 villages.
- Water wastage can be monitored and corrective actions can be taken by concerned authorities.
- The average saving on medicines will be more than the cost of system installation (Based on the survey from 25 villages where we installed the system, regarding drinking water and expenses on health). We have used the statistical techniques for hypothesis testing on survey data.
- System has 100% ROI within one year.

ROI = Water saved + Saving on medicines and health care + Saving electricity bill (Auto cutoff)

Cost Benefit Analysis

(Based on survey conducted in pilot villages)



Features



- Centralized monitoring & controls powered by advanced data analytics for effective water management.



Continuous monitoring



High accuracy measurements



High Sampling rate



1 million events storage



Advanced Analytics



Interactive Dashboards



3G/4G/LTE, Wi-Fi



Real time alerts



GIS representation



Automatic Valve Control



Automatic Pump Control

Project Outcomes

ROI

- Over Flow cost of 1 Reservoir / Year
= Rs 3.38 lakhs (~5K USD)
- Line Leakage cost of 1 Reservoir /
Year = Rs 9.45 lakhs (~14K USD)
- Total Revenue loss due to leakage
= Rs 12.83 lakhs (~19K USD)

Note : Production cost per Kilo liter is considered as Rs 6/-

Estimated revenue loss for total 59
reservoirs = 59 x 12.83 Lakhs
= Rs. 757 lakhs

**Total Solution Cost is 25 % less than revenue
loss of one year**



Objectives Achieved

- Schedule and duration adherence is improved > **90%**
- **150 LPCD** supplied as per standards
- Actual water supply which was **24 MGD** before installation improved to **33 MGD** within couple of months with net **9 MGD increase**

Smart Water Case Study



Results

- Over Flow cost of 1 Reservoir / Year
= Rs 3.38 lakhs (~5K USD)
- Line Leakage cost of 1 Reservoir / Year
= Rs 9.45 lakhs (~14K USD)
- Total Revenue loss due to leakage
= Rs 12.83 lakhs (~19K USD)

Note : Production cost per Kilo liter is considered as Rs 6/-

Estimated revenue loss for total 59 reservoirs = 59 x 12.83 Lakhs = Rs. 757 lakhs (~1.12 million USD)

Total Solution Cost is 25 % less than the revenue loss for one year

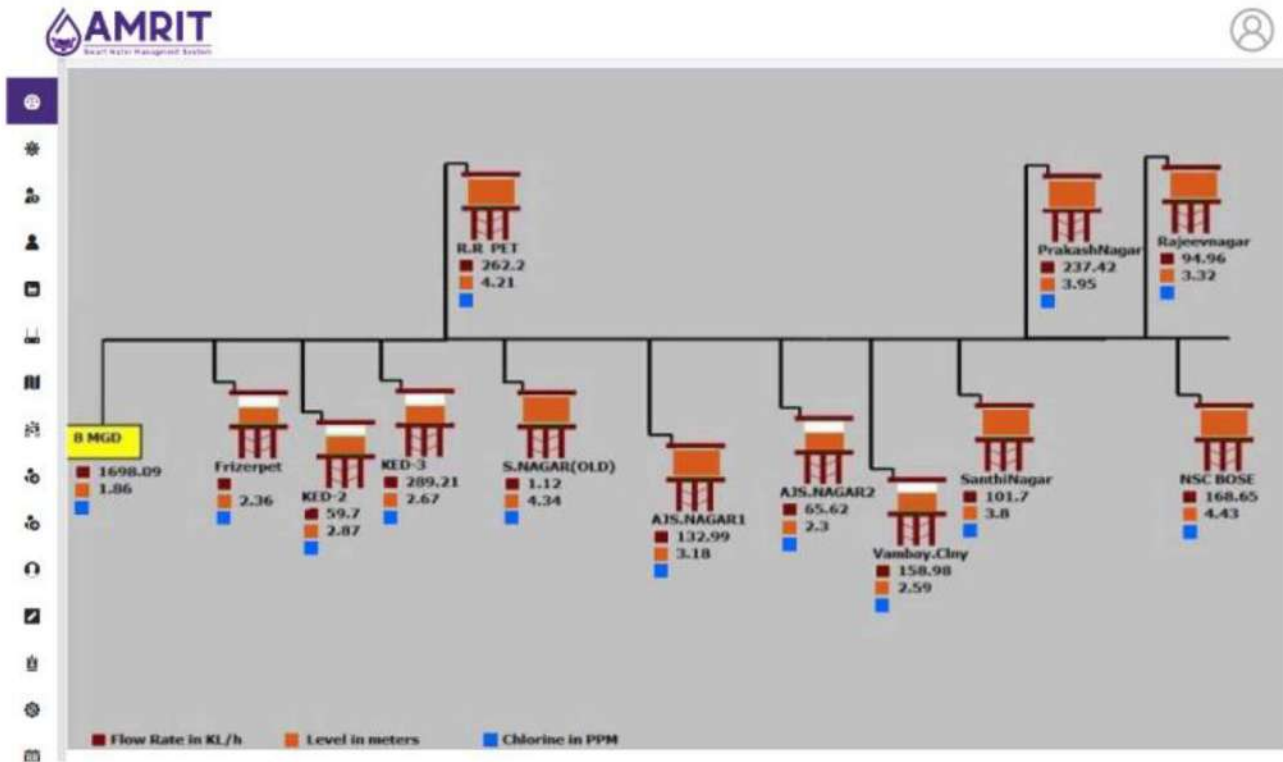
Case Study

- Schedule and duration adherence is improved **> 90%**
- **150 LPCD** supplied as per standards
- Actual water supply which was **24 MGD** before installation improved to **33 MGD** within couple of months with net **9 MGD increase**

Live Simulation at WTP



- Operations engineering team can view and live status during filling and distribution and real time alerts trigger immediate actions.



Pump Efficiency

- O&M engineering can continuously monitor, energy efficiency of motors along with power factor, active, reactive power. Accordingly, decisions of maintenance can be taken.



Live Dashboard



- Administration can view status from remote location via PC/Tab/Mobile



UGT - 1 (Underground Tank)



Last updated time

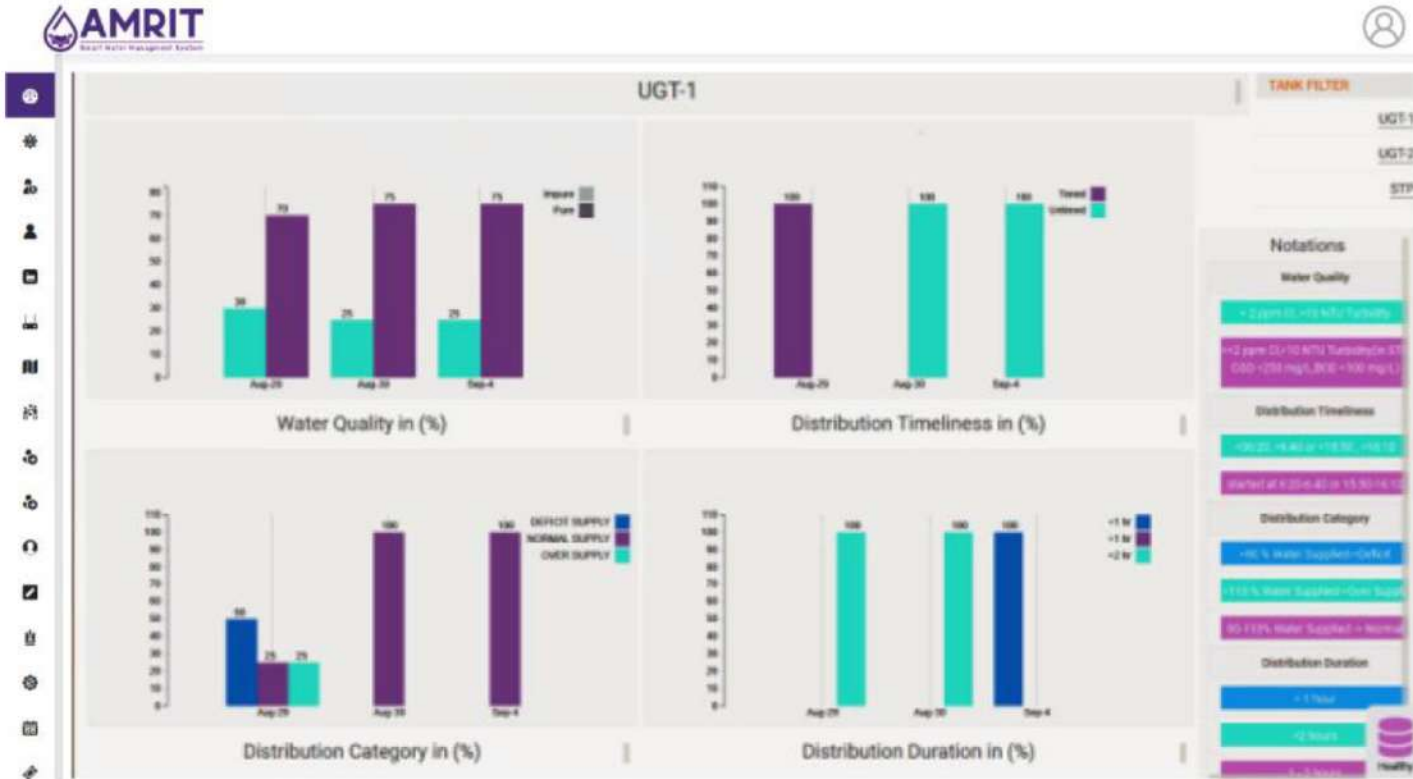
2022-10-22 18:10:27

Notations			
Level	> 2.5 m = High	< 0.1 m = 2.5 m = Normal	< 0.5 m = Low
Chlorine	> 3 ppm = High	< 2.5 ppm = Normal	< 1 ppm = Low
Turbidity	> 10 NTU = High	< 10 NTU = Normal	

Daily/Weekly/Monthly Reports



- Administration can view reports on Water Quality, Timeliness, Duration from remote location via PC/Tab/Mobile



Arresting Overflows

- Real time monitoring of reservoir overflow actuate the alarm such that timely action is being taken by personnel or automatic controls



Ultrasonic Level Meter
Installation at NTPC, at
KAHODA, GJ

Live Chlorination Status

- With distance, condition of pipes chlorine gets decayed. Hence O&M team need to mix chlorine at ELSR/GLSR before water is distributed to public



pH, TDS, Chlorine, Nitrate
Fluoride Installation at KAHODA,
GJ

Cleaning of Reservoirs

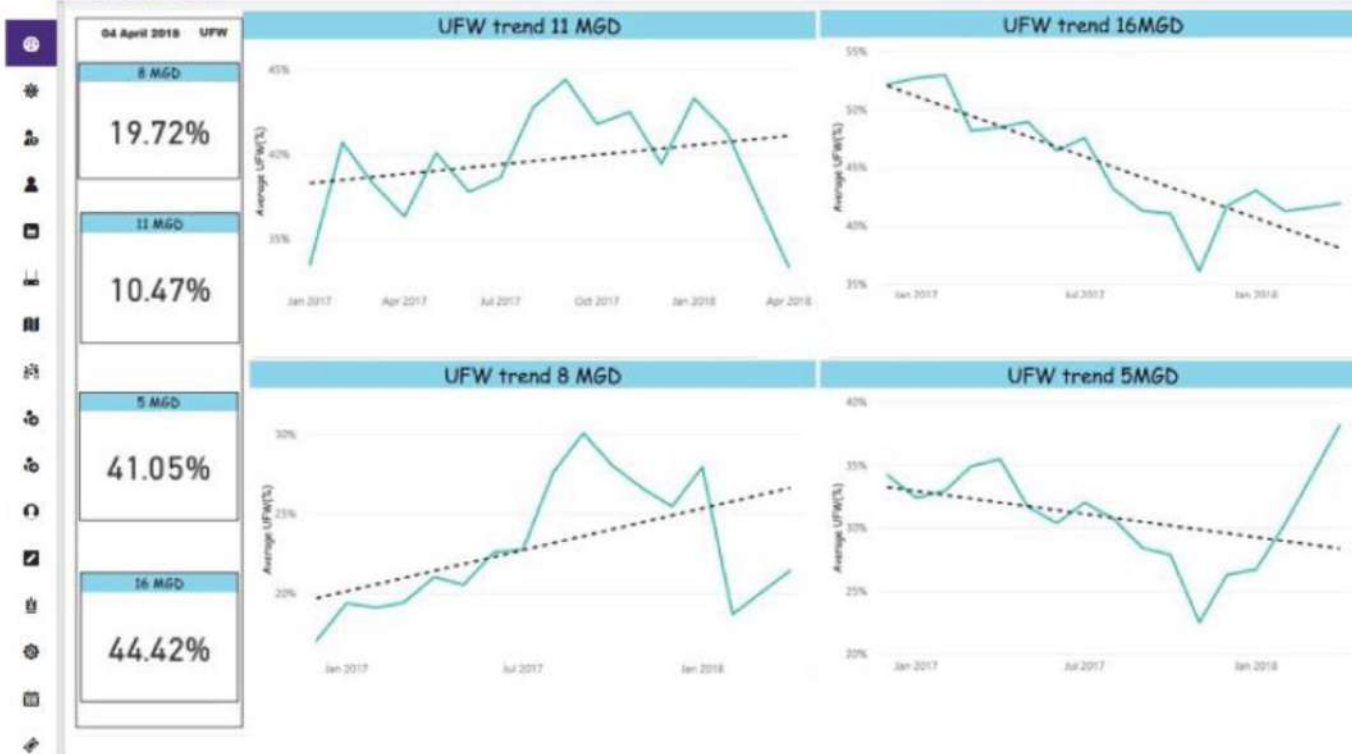
- Periodically , O&M team need to clean reservoirs(ELSR/GLSR) by opening drain valve. Using level sensor data, this can be monitored



Installation at KAHODA, GJ

NRW-Estimation

- Based on inflow and out flows at WTP, ELSR and DMA areas, Non-Revenue Water is estimated



Paddle Wheel Flow meter Installation at KAHODA, GJ

NRW-Reduction



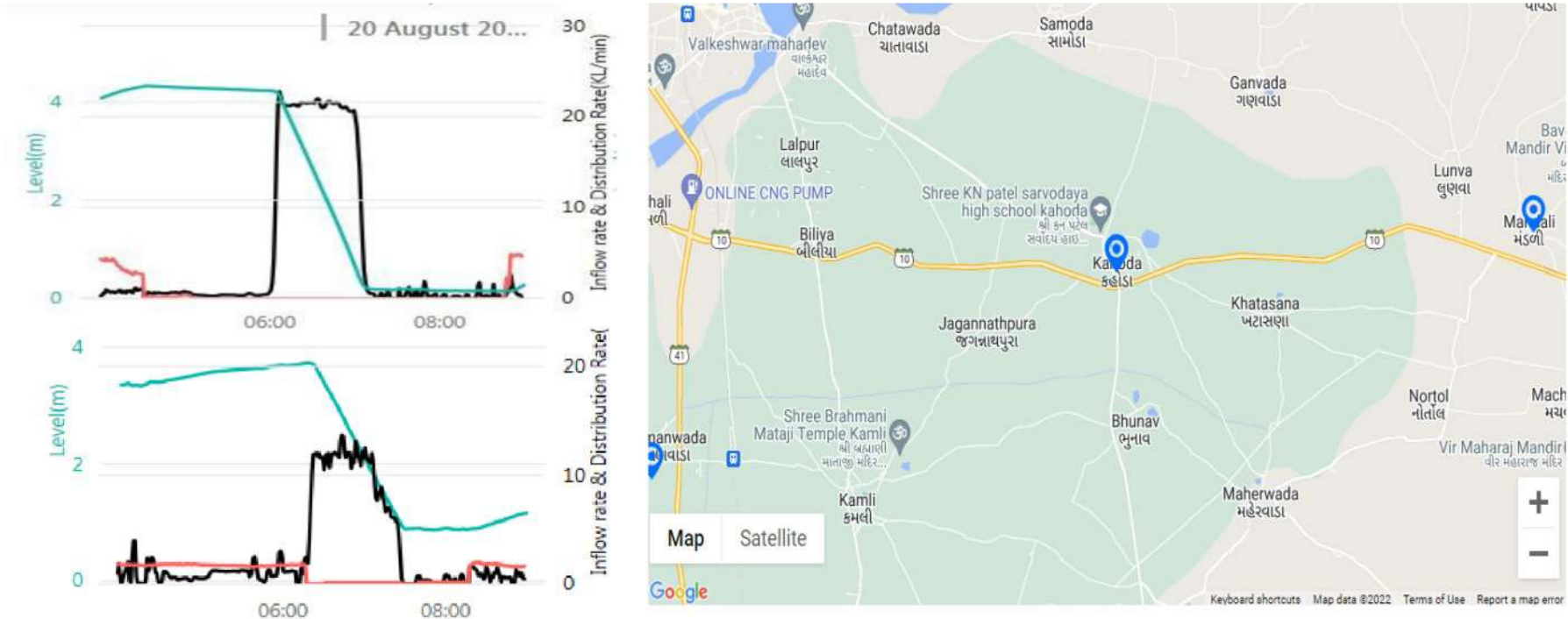
- After NRW was estimated, O&M engineering team took measures to close leaks and reduce wastage

Plant Outflow (MGD)	Sum of all the reservoirs	UFW per day (MGD)	UFW
8.52	5.77	2.75	32.3 %
8.41	5.96	2.45	29.1 %
9.15	7.24	1.91	20.9 %
8.80	7.07	1.73	19.7 %
9.13	7.33	1.80	19.8 %
8.01	6.59	1.42	17.7 %
5.10	4.27	0.83	16.3 %
8.15	7.39	0.76	9.4 %
7.51	7.09	0.42	5.5 %



ML Based Demand Estimation

- Machine Learning Algorithms based on past data, identified reservoirs with high and low demand. Based on this information, balancing of reservoirs is being done



Crisis Management

- During floods, with 50% of treatment capacity , total city was provided with drinking water



4 OCT 2009 TO 7 OCT 2009

Objective under flood situation :

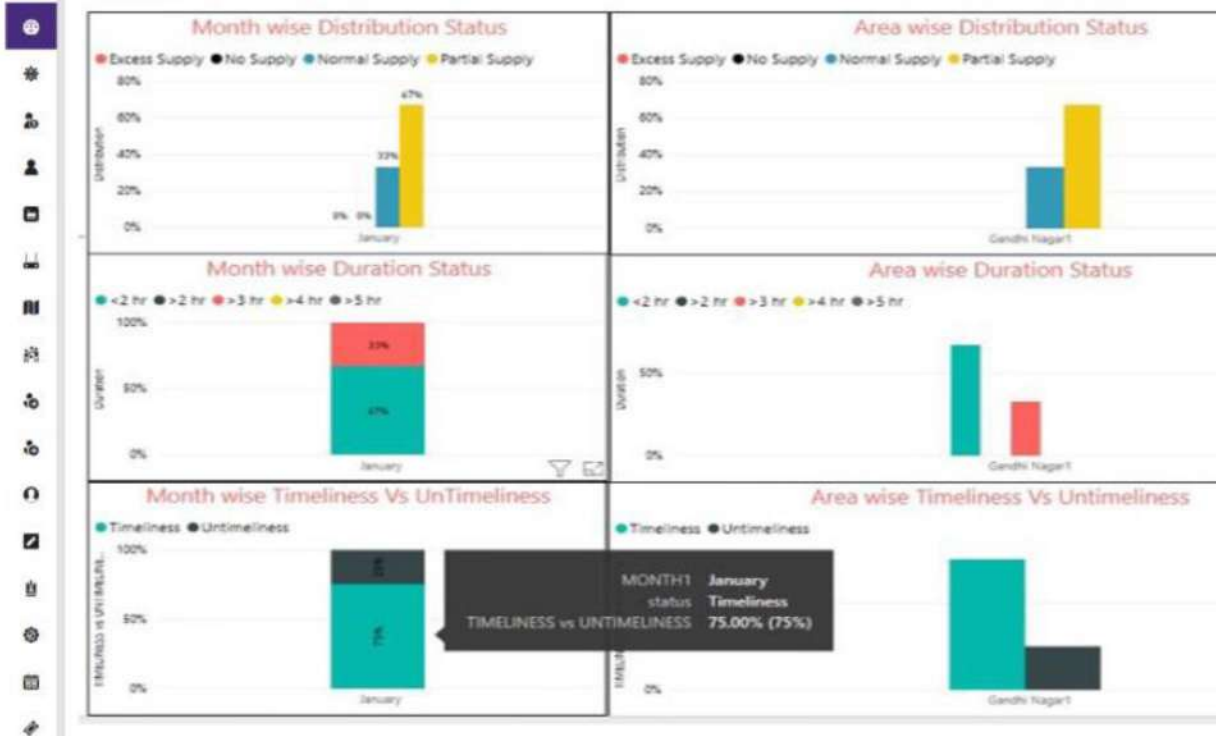
- To provide safe drinking water
- To provide minimum water equally to everyone



- Total installed capacity of Head Water Works - 40 MGD
- Treatment Plants shutdown due to flood - 19 MGD
- Operational capacity - 21 MGD
- Acute shortfall – ~50%

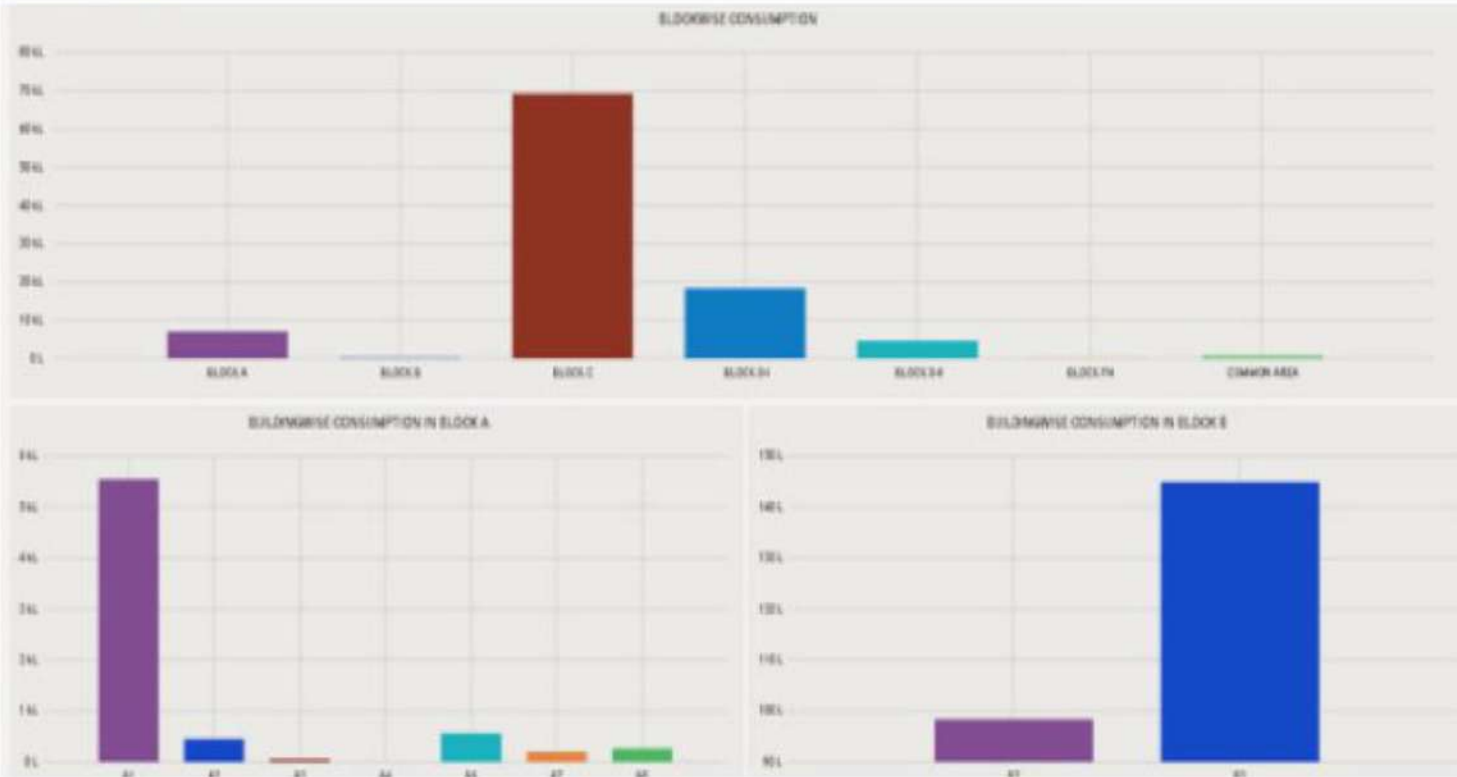
Timeliness Reports

- Based on filling and distribution data, system analyzes KPI of timeliness of delivery (WTP wise, ELSR wise, DMA wise)



Area Wise Supply Reports

- Based on flow data, area/village wise quantity of water supplied and LPCD reports



Job Card

- O&M head, supervisor can assign works to concern and track their activity, automatically calculate MTTR, MTBF



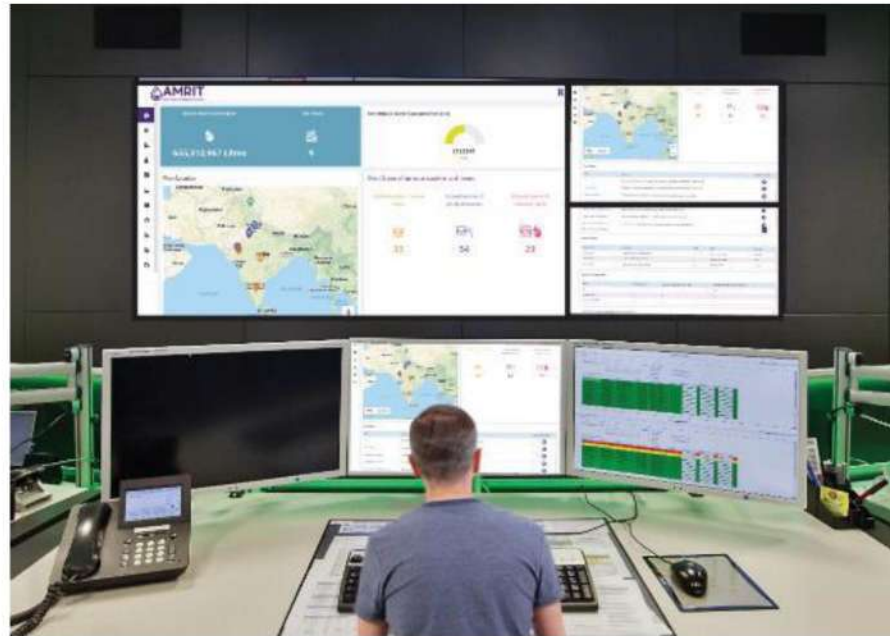
Alarms



LOCATION TYPE	LOCATION	ALARM TYPE	ALARM NAME	OCCUREDTIME	ASSIGNEDTO	PRIORITY	STATUS	SAVE
AMR Meter	BS-302-AMRIT	Quantity	Leakage in Flat	21 Oct, 2020 09:15:50	<input type="text"/>		<input type="text"/>	<input type="button" value="Save"/>

Command Centers

- Centralized Control & Commands enable effective management of water distribution with minimal effort.
- Advanced analytics and data visualization provide transparency to administration



Command Centre