1. Introduction

Water is a critical natural resource, and its sustainable management is essential for ensuring environmental protection, public health, and long-term institutional resilience. Higher education institutions play a vital role in promoting responsible water use by integrating conservation practices, efficient infrastructure, recycling systems, and technology-driven monitoring mechanisms within campus operations.

Vignan's Foundation for Science, Technology and Research (VFSTR), India, recognizes the importance of sustainable water management and has adopted a comprehensive and systematic approach to optimize water utilization, minimize wastage, and prevent pollution. The university implements structured water conservation programs, wastewater recycling initiatives, water-efficient technologies, and regulatory compliance mechanisms across its academic, residential, and administrative facilities.

This report presents an overview of VFSTR's water management practices in alignment with the **National and International rankings.** It highlights the university's initiatives related to water conservation, reduction of consumption, reuse of treated wastewater, pollution control, and the integration of Information and Communication Technology (ICT) for planning, implementation, monitoring, and evaluation. The report also demonstrates VFSTR's contribution to the **United Nations Sustainable Development Goals (SDGs)**, particularly **SDG 6 (Clean Water and Sanitation)**, **SDG 12 (Responsible Consumption and Production)**, and **SDG 13 (Climate Action)**, reflecting the institution's commitment to environmental sustainability and green campus development.

2. Water Conservation Program Implementation

VFSTR University (Vignan's Foundation for Science, Technology & Research) has prioritized water conservation and sustainable management as a key part of its environmental initiatives. The university implements engineering, administrative, and ICT-based strategies to manage and conserve water effectively throughout the campus.

3. Objectives

• Reduce freshwater consumption across campus facilities.

• Implement wastewater recycling and reuse systems.

• Harvest and recharge rainwater for sustainable groundwater management.

• Promote awareness and behavioural change among students and staff.

• Align institutional practices with SDG 6 (Clean Water & Sanitation) and SDG 13 (Climate Action).

4. Key Water Conservation Initiatives

Program	Implementation	Impact	Evidence
Rainwater Harvesting	Lake , Recharge wells and collection pits established across campus.	Improved groundwater table and reduced surface runoff.	  

Sewage Treatment Plant (STP)	A 700 KLD STP treats wastewater for reuse in gardening.	Reduction in fresh water demand by 30%.	
Smart Water Metering	IoT-enabled sensors track usage and detect leakages.	Efficient water usage and quick maintenance response.	
Recycling & Reuse	Recycled greywater used for flushing and irrigation.	Saves approximately 450,000 liters per day.	
Awareness Campaigns	Posters, training sessions, and student events on water conservation.	Enhanced awareness among campus residents.	https://www.linkedin.com/posts/vignan-s-foundation-of-science-technology-research_waterday-environment-environtmentscience-activity-7307951348518465536-UC81/

5. ICT Integration

Technology	Purpose
IoT Water Meters	Automated measurement and leak detection.
SCADA Systems	Real-time control and monitoring of STP and pipelines.
GIS Mapping	Identification of recharge points and pipeline networks.
ERP Water Data Entry	Digital logging of daily consumption and reuse volumes.

6. Water Conservation Summary (VFSTR University – 2024–25)

Parameter	Before	After	Change
Total Water Consumption	2.5 MLD	1.2 MLD	52% Reduction
Wastewater Recycled	0.7 MLD	0.7 MLD (Installed Capacity: 700 KLD)	Full Capacity Utilization
Rainwater Harvested	0.8 ML/Yr.	1.5 ML/Yr.	87.5% Increase

Overall Water Conservation Estimate

Water Conserved (%) = (2.5−1.2 / 2.5) ×100=52%

VFSTR has conserved approximately 52% of total water usage over the past three years due to rainwater harvesting, wastewater reuse, and smart metering initiatives.

7. Water Recycling Program Implementation

VFSTR University (Vignan's Foundation for Science, Technology & Research) has implemented a comprehensive water recycling program as part of its sustainability initiatives.

This program focuses on wastewater treatment and reuse, reducing dependence on freshwater sources and promoting environmental sustainability. The initiative supports Sustainable Development Goals (SDG) 6 and 13 by ensuring clean water management and contributing to climate action.

7.1. Objectives

• Treat and reuse wastewater generated from hostels, canteens, and laboratories.

• Reduce freshwater consumption through greywater reuse.

• Ensure compliance with environmental and pollution standards.

• Integrate ICT-based monitoring and automation systems.

• Promote awareness and training on sustainable water use.

7.2. Key Water Conservation Initiatives

Component	**Description**	**Outcome**	**Evidence**
Sewage Treatment Plant (STP)	0.7 MLD capacity treating wastewater from hostels and buildings.	Treated water reused for gardening and flushing.	
Effluent Treatment Unit (ETU)	Treats laboratory wastewater for safe discharge.	Ensures chemical pollutants are removed.	https://www.vignan.ac.in/pdf/Waste%20Management.pdf
Greywater Reuse Network	Separate plumbing for non-potable reuse.	Reduces fresh water consumption by 25%.	

Smart Monitoring	IoT and SCADA systems for real-time data.	Improves efficiency and compliance.	
Sludge Composting	STP sludge converted to manure.	Achieves zero-waste recycling.	

7.3. Quantitative Data (2024–25)

Parameter	Before	After (Adjusted to 700 KLD STP)	Improvement (%)
Wastewater Treated (MLD)	0.50	0.54	+8%
Wastewater Reused (MLD)	0.30	0.54	+80%
Freshwater Consumption (MLD)	1.80	1.20	–33%
Treated Water Used for Gardening/Flushing (%)	35%	100%	+186%

7.4. Water Recycling Summary – VFSTR University (2024–25)

Parameter	Value	Description
Total Water Consumed (Fresh + Recycled)	1.20 MLD	Combined daily water consumption for academic blocks, hostels, and residential facilities.
Treated Wastewater from STP + ETU	0.54 MLD	Generated wastewater treated through 700 KLD STP (ETU acts as backup/sectoral treatment).
Reused Water	0.54 MLD (100%)	Fully reused for gardening, flushing, landscaping, and utilities.
Discharged Treated Effluent	0.00 MLD	No treated wastewater discharged outside campus (Closed-loop reuse system).

7.5. Percentage of Water Recycled and Reused

Percentage Recycled= (0.54× 1.2) ×100=45%

Therefore, approximately 45% of total campus water consumption is recycled and reused within VFSTR through its **STP, ETU, and water management systems.**

Breakdown of Reuse Applications

Reuse Category	Adjusted Volume (MLD)	Share (%)
Gardening & Landscaping	0.30	55%
Toilet Flushing (Hostels + Academic Blocks)	0.19	35%
Cleaning & Maintenance	0.05	10%
Total Reused Water	0.54 MLD	100%

7.6. ICT-Enabled Monitoring

Technology	Function
SCADA System	Tracks treatment quality, pH, and flow in real-time.
IoT Water Meters	Detect leaks and monitor inflow/outflow.
ERP Reporting	Digital record of water treated and reused.

GIS Mapping	Tracks water reuse network locations.

7.7. Awareness and Training

- Workshops on wastewater reuse and green technologies.
- Student innovation projects on IoT-based water systems.
- Awareness drives on ‘Save Every Drop’.
- Participation of NSS volunteers in STP maintenance.

7.8. Outcomes and Impact

- 24% reduction in freshwater use through recycling initiatives.
- 1.4 MLD wastewater treated and reused daily.
- Compliance with Andhra Pradesh Pollution Control Board norms.
- Improved campus sustainability performance under SDG 6 and SDG 13.

8. Water Efficient Appliances Usage

VFSTR University has implemented a comprehensive Water Efficiency Program aimed at minimizing freshwater usage through the adoption of water-efficient appliances, fixtures, and smart monitoring systems. This initiative supports SDG 6 (Clean Water and Sanitation) and SDG 12 (Responsible Consumption and Production) by promoting sustainable water management practices across the campus.

8.1. Objectives

- To reduce water wastage through efficient appliances and automated systems.
- To promote water conservation awareness among staff and students.
- To monitor real-time consumption via IoT-based systems.
- To align VFSTR’s campus operations with national “Jal Shakti Abhiyan” guidelines.

8.2. Water-Efficient Appliances Installed

Category	Type of Appliance / Fixture	Quantity Installed	Efficiency Gain / Water Saved	Evidence
Washrooms	Dual Flush Toilets	550 units	30–40% reduction per flush	
Washrooms	Sensor-based Faucets	320 units	60% less water per use	
Laboratories	Flow-regulated Nozzles	75 units	20% reduction	

Hostels	Low-flow Shower Heads	210 units	35% reduction	
Canteen & Kitchens	High-efficiency Dish Washers	10 units	25% less water use	
Landscaping	Drip Irrigation Systems	8 acres coverage	40–50% saving over sprinklers	

Breakdown of Water-Efficient Appliances

Category	Total Fixtures (Approx.)	Water-Efficient Units Installed	Percentage Installed (%)	Remarks
Toilets (Flush Systems)	610	550 (Dual-Flush)	**91.7%**	Dual-flush toilets across hostels and admin blocks
Faucets (Taps & Basins)	507	320 (Sensor-based / Aerators)	**64.0%**	Mostly sensor taps in academic & admin blocks
Showers (Hostel & Guest House)	258	210 (Low-flow)	**84.0%**	Installed in all hostels during 2023–24
Lab Water Outlets	102	75 (Flow-Regulated)	**75.0%**	Flow-control nozzles installed in chemistry & biotech labs
Kitchen & Canteen	20	10 (High-efficiency Dishwashers)	**50.0%**	Upgraded during 2024 Green Initiative

Irrigation Systems	10 acres equivalent	8 acres (Drip Irrigation)	**80.0% coverage**	Landscapes use drip and recycled water
Smart Water Meters	20 buildings	18 (IoT-enabled)	**90.0%**	Real-time monitoring of usage and leaks

8.3. Overall Efficiency Adoption

Total Installed Appliances (%)= (550+320+210+75+10)/ (610+507+258+102+20) ×100=81.1%

Therefore, approximately 81% of all water-related appliances in VFSTR are water-efficient systems.

8.4. Implementation Highlights

- **IoT-based Water Monitoring:** Installed across academic and hostel blocks for continuous tracking of consumption and leakage detection.
- **Automatic Shutoff Systems:** Integrated into restrooms and labs to prevent wastage during non-use hours.
- **Awareness Campaigns:** Conducted under *"Save Every Drop"* program during 2024 Water Conservation Week.
- **Integration with Recycled Water Systems:** Toilets and irrigation areas connected to recycled water **supply from STP and ETU.**

8.5. Impact Assessment

Year	Average Water Consumption (MLD)	Reduction Achieved (%)
2021–22	2.2	–
2023–24	1.9	13.6%
2024–25	1.6	**27.3% total reduction**

8.6. Contribution to Sustainable Development Goals (SDGs)

SDG	Goal Title	VFSTR Contribution through Efficient Appliances
SDG 6	Clean Water and Sanitation	Reduces water wastage and enhances resource efficiency
SDG 9	Industry, Innovation, and Infrastructure	Incorporates IoT-based smart water systems
SDG 12	Responsible Consumption and Production	Promotes sustainable water use and circular practices
SDG 13	Climate Action	Lowers energy and carbon footprint related to water pumping and treatment

8.7 Green Building Standards & Technology Integration for Water and Energy Efficiency

VFSTR University integrates green building principles and advanced technological systems into campus infrastructure to minimize water consumption, reduce energy usage, and enhance overall resource efficiency. The institution adopts sustainable construction standards aligned with national green building guidelines and incorporates smart technologies to ensure long-term environmental performance.

1. Integration of Green Building Standards

All newly constructed and renovated buildings at VFSTR incorporate sustainable design principles focusing on:

- Reduction of potable water demand
- Optimization of energy consumption
- Use of resource-efficient materials
- Lifecycle-based infrastructure planning

Design features such as dual plumbing systems, low-flow fixtures, rainwater harvesting integration, insulated water pipelines, and natural lighting optimization are embedded at the planning stage. This ensures that water and energy efficiency are not add-on features but structural components of campus development.

2. Water Efficiency Through Building Design

Water conservation is achieved through a combination of structural design and technological systems:

- **Dual Plumbing Network:** Separate pipelines for potable and recycled water ensure that treated water from the STP is utilized for flushing, gardening, and maintenance, thereby reducing freshwater demand.
- **Low-Flow and Sensor-Based Fixtures:** Automated faucets, dual-flush toilets, and low-flow shower systems reduce water wastage significantly.
- **Drip Irrigation Systems:** Landscaped areas are supported by drip irrigation connected to recycled water supply, minimizing evaporation losses.

- **Rooftop Rainwater Harvesting:** Buildings are equipped with rainwater diversion systems connected to recharge pits to enhance groundwater replenishment.
- **Smart Water Meters:** IoT-enabled meters' monitor building-level water consumption and detect leakages in real time.

These measures collectively reduce dependency on groundwater and improve overall water-use efficiency across academic and residential blocks.

3. Energy Optimization in Water Systems

Energy consumption related to water pumping, treatment, and distribution is minimized through technological integration:

- **Energy-Efficient Pumps and Motors:** High-efficiency motors are installed in borewell pumping systems and STP operations to reduce electricity consumption.
- **PLC-Based Pump Automation:** Programmable Logic Controllers regulate pumping schedules based on tank levels, preventing unnecessary energy usage.
- **Solar Integration:** Selected utility systems incorporate rooftop solar power support, reducing carbon emissions associated with water infrastructure.
- **Building Management System (BMS):** Centralized dashboards monitor water flow, pump performance, and energy consumption, enabling data-driven decision-making.
- **Gravity-Based Distribution Wherever Feasible:** Reduces dependence on mechanical pumping.

These strategies significantly lower operational energy costs and contribute to climate mitigation efforts.

4. ICT-Enabled Monitoring and Control

VFSTR integrates Information and Communication Technology (ICT) to ensure efficient planning, implementation, and performance evaluation:

- Real-time monitoring of tank levels and flow rates
- Automated alerts for leak detection
- Data analytics for consumption pattern analysis
- Centralized reporting for sustainability benchmarking

This digital integration ensures transparency, compliance with regulatory standards, and continuous improvement in resource management.

5. Environmental and Institutional Impact

The integration of green building standards and smart technologies has resulted in:

- Substantial reduction in freshwater consumption
- Lower energy demand for pumping and treatment
- Decreased carbon footprint associated with water infrastructure
- Improved compliance with environmental norms
- Enhanced sustainability performance under SDG 6, SDG 9, SDG 12, and SDG 13

By embedding sustainability into building design and campus operations, VFSTR ensures that infrastructure development aligns with long-term environmental stewardship and global sustainability benchmarks.

Quantitative Impact of Green Building Standards & Smart Technologies

Parameter	Before Green Integration	After Implementation (2024–25)	Improvement Achieved	% Change
Total Water Consumption (MLD)	2.2 MLD	1.6 MLD	0.6 MLD reduction	**27.3% ↓**
Freshwater Extraction (MLD)	1.8 MLD	1.2 MLD	0.6 MLD reduction	**33% ↓**
Treated Water Reuse (%)	35%	61%	+26% efficiency gain	**+74% increase**
Water Leakage Incidents (per year)	12	2	10 incidents reduced	**83% ↓**
Energy Consumption for Water Pumping	Baseline 100%	82%	18% reduction	**18% ↓**
Rainwater Harvested (ML/year)	0.8 ML	1.5 ML	0.7 ML increase	**87.5% ↑**

Water-Efficient Fixtures Installed (%)	40%	81%	+41% coverage	**102% improvement**
Treated Water Discharge Outside Campus	0.40 MLD	0.00 MLD	Achieved zero discharge	**100% elimination**

Energy–Water Nexus Impact

Component	Annual Energy Saved	Environmental Benefit
Reduced Borewell Pumping	~30–35% electricity savings	Lower carbon emissions
PLC-Based Pump Automation	Optimized runtime	Reduced mechanical wear & energy waste
Solar-Assisted Utilities	Partial renewable substitution	Reduced grid dependency
Gravity-Based Distribution	Reduced pump hours	Operational cost savings

Overall Sustainability Gains (Integrated Impact)

- 27% overall reduction in campus water demand
- 33% reduction in freshwater dependency
- 61% treated water reuse efficiency
- 83% reduction in leakage-related losses
- Zero untreated discharge
- 18% reduction in pumping energy consumption

The quantitative assessment demonstrates that integration of green building standards and smart technologies has significantly improved water-use efficiency, reduced energy consumption, minimized environmental impact, and strengthened VFSTR's sustainability performance under SDG 6, SDG 9, SDG 12, and SDG 13.

8.7.7 Three-Year Performance Trend Analysis (2022–2025)

Three-Year Trend Comparison: Water & Energy Efficiency

A. Water Consumption & Recycling Trends

Parameter	2022–23	2023–24	2024–25	3-Year Trend	Overall Improvement

Total Water Consumption (MLD)	2.2	1.9	1.6	Consistent Reduction	**27.3% ↓**
Freshwater Extraction (MLD)	1.8	1.5	1.2	Gradual Decline	**33% ↓**
Wastewater Treated (MLD)	0.50	0.52	0.54	Increased Capacity Utilization	**+8% ↑**
Treated Water Reused (%)	35%	45%	61%	Strong Upward Trend	**+26% Gain**
Treated Water Discharged (MLD)	0.20	0.05	0.00	Eliminated Discharge	**Zero Discharge Achieved**
Rainwater Harvested (ML/Year)	0.8	1.2	1.5	Continuous Improvement	**87.5% ↑**

B. Water Efficiency Infrastructure Adoption

Indicator	2022–23	2023–24	2024–25	Growth
Water-Efficient Fixtures Installed (%)	55%	68%	81%	+26% Coverage Increase
IoT Water Meters Coverage	50% Buildings	75% Buildings	90% Buildings	+40% Expansion
Leakage Incidents (per year)	12	6	2	83% Reduction
Dual Plumbing Coverage	Partial	Expanded to Hostels	Campus-Wide Major Blocks	Progressive Integration

C. Energy Efficiency in Water Systems

Parameter	2022–23	2023–24	2024–25	Overall Impact
Energy Consumption for Pumping	Baseline	10% Reduction	18% Reduction	Significant Efficiency Gain
PLC/Automation Coverage	Limited	Moderate	Campus-Wide	Smart Control Achieved

Solar Integration for Utilities	Pilot Phase	Expanded	Operational Support	Reduced Grid Dependence

Over the past three academic years (2022–2025), VFSTR has demonstrated measurable and consistent improvement in water conservation, wastewater recycling, energy efficiency, and green infrastructure integration. The data indicates a clear transition from partial recycling and moderate efficiency to a digitally monitored, zero-discharge, and resource-optimized water management system. This sustained progress strengthens the institution's compliance with environmental norms and enhances its performance under SDG 6, SDG 9, SDG 12, and SDG 13.

9. Water Consumption Reduction Program

The university continuously monitors water consumption trends and implements reduction strategies based on data analysis. Leak detection mechanisms, timely repair of pipelines, and controlled water distribution schedules help minimize losses. These measures have resulted in a **significant reduction in water leakage incidents** and improved overall water-use efficiency, contributing to long-term conservation goals.

VFSTR University follows a structured water management system integrating **Sewage Treatment Plant (STP)** and **Effluent Treatment Unit (ETU)** to treat and reuse wastewater. The initiative ensures that a major share of the campus's daily water demand is met through **treated and recycled water**, significantly reducing dependency on fresh groundwater.

This program directly supports **SDG 6 (Clean Water and Sanitation)** and **SDG 12 (Responsible Consumption and Production)**.

9.1. Water Treatment Infrastructure

System	Capacity	Treatment Technology	Usage Area
Sewage Treatment Plant (STP)	1.5 MLD	Biological treatment with tertiary filtration	Hostels, toilets, and gardening
Effluent Treatment Unit (ETU)	0.5 MLD	Physico-chemical + biological treatment	Laboratories and canteens
Rainwater Harvesting & Recharge	1.5 ML annually	Collection and percolation pits	Groundwater recharge zones

9.2. Annual Water Balance Summary (2024–25)

Category	Volume (MLD)	Annual Estimate (ML)	Remarks
Total Water Consumption	1.6	584 ML	From bore wells and recycled sources
Water Treated (STP + ETU)	0.54	197.1 ML	Treated through 700 KLD STP
Treated Water Reused	0.54	197.1 ML	100% reused for gardening, flushing & maintenance
Treated Water Discharged	0.00	0 ML	No treated discharge

9.3. Percentage of Treated Water Consumed

Percentage of Treated Water Consumed= (0.54/1.6) ×100=33.75%

Therefore, VFSTR consumes approximately 33.75% of its total water requirement through treated and recycled sources.

9.4. Area-wise Distribution of Treated Water Use

Application	Volume Used (MLD)	Share (%)
Gardening & Landscaping	0.30	55%
Toilet Flushing (Hostels + Academic Blocks)	0.19	35%
Cleaning & Maintenance	0.05	10%
Total Reused Water	0.54 MLD	100%

9.5. Environmental and Economic Benefits

Impact Type	Benefit (2024–25 Data)
Water Conservation	**34% of total water demand met through treated water reuse**, significantly reducing groundwater extraction by ~0.54 MLD.
Energy Savings	Reduced freshwater pumping requirement by approximately **30–35%**, lowering electricity consumption for borewell pumping.
Cost Efficiency	Estimated annual savings of **₹5–7 lakh/year** due to reduced freshwater extraction, tanker dependency, and optimized reuse.
Carbon Reduction	Lowered carbon emissions due to reduced groundwater pumping energy and minimized external water procurement transport.

9.6. Alignment with Sustainable Development Goals (SDGs)

SDG No.	Goal Title	VFSTR Contribution
SDG 6	Clean Water and Sanitation	Reuse of treated wastewater ensures sustainable water management.
SDG 12	Responsible Consumption and Production	Efficient recycling and reuse systems.
SDG 13	Climate Action	Reduced emissions through optimized water management.

10. Treated Water Utilization

Treated wastewater from STPs and ETUs is systematically utilized for non-potable purposes. Landscaping and irrigation activities primarily rely on treated water, ensuring that potable water is reserved for essential domestic and laboratory use. This practice has led to a measurable increase in treated water reuse efficiency and supports sustainable campus operations.

VFSTR University has implemented comprehensive water pollution control measures to ensure a safe, sustainable, and eco-friendly campus environment. The initiatives aim to minimize contamination of surface and groundwater sources, promote reuse of treated water, and comply with national pollution control regulations. These efforts contribute to SDG 6 (Clean Water and Sanitation) and SDG 12 (Responsible Consumption and Production).

10.1 Objectives

- Prevent discharge of untreated or contaminated water into natural streams or groundwater.
- Treat wastewater generated from hostels, laboratories, and canteens.
- Implement monitoring systems to ensure water quality compliance.
- Promote awareness among students, staff, and stakeholders on water pollution and conservation.
- Integrate water pollution control measures with campus landscaping, irrigation, and sanitation systems.

10.2. Water Pollution Control Infrastructure

Component	Description	Purpose

Sewage Treatment Plant (STP)	700 KLD capacity biological treatment system with tertiary filtration	Treats wastewater from hostels and academic blocks; ensures safe reuse within campus
Effluent Treatment Unit (ETU)	500 KLD physio-chemical + biological treatment	Treats laboratory and canteen wastewater before integration with reuse system
Sedimentation & Filtration Tanks	Multi-chamber sedimentation, pressure sand filters & activated carbon filters	Removes suspended solids, turbidity, colour, and residual pollutants
Recycled Water Distribution Network	Dedicated pipeline network covering major landscape & flushing points	Supplies treated water for irrigation, toilet flushing, and maintenance uses
Rainwater Harvesting Structures	Rooftop diversion, recharge pits, and storm water infiltration structures	Reduces storm water runoff contamination and enhances groundwater recharge
Water Quality Monitoring System	Periodic lab testing for pH, BOD, COD, TSS (as per APPCB norms)	Ensures treated water quality compliance and safe reuse standards

10.3. Water Quality Monitoring

Parameter	Permissible Limit (APPCB)	VFSTR Campus Avg.	Status
pH	6.5–8.5	6.8–7.5	Compliant
Biological Oxygen Demand (BOD, mg/L)	<30	18	Compliant
Chemical Oxygen Demand (COD, mg/L)	<250	110	Compliant
Total Suspended Solids (TSS, mg/L)	<100	45	Compliant
Dissolved Solids (TDS, mg/L)	<2100	900	Compliant

10.4. Pollution Control Measures Implemented

• Segregation at Source: Wastewater from hostels, labs, and kitchens directed to separate treatment streams.

• Treatment & Reuse: Over 33.37% of treated water reused for toilets, gardening, and cleaning.

• Leakage Prevention: IoT sensors detect leaks in pipelines to prevent contaminant spread.

• Sludge Management: ETU/STP sludge converted into compost for landscaping, preventing soil contamination.

10.5. Environmental Impact

Aspect	Before Implementation (2020)	After Implementation (2024–25)
Untreated Water Discharged (MLD)	~0.40 MLD	0.00 MLD (Zero discharge)
Waterborne Contamination Incidents	3–4 reported cases	0 incidents reported
Reuse of Treated Water	Minimal / Partial reuse	0.54 MLD (~34% of total demand)
Compliance with APPCB Norms	Partial compliance	100% compliance with prescribed discharge standards

10.6. Alignment with Sustainable Development Goals (SDGs)

SDG No.	Goal Title	Campus Contribution
SDG 6	Clean Water and Sanitation	Ensures treated water reuse and pollution-free campus water systems
SDG 12	Responsible Consumption and Production	Promotes sustainable wastewater treatment and reuse
SDG 13	Climate Action	Reduces energy and resource consumption through efficient water systems

10.7 Source Protection & Emergency Water Contamination Prevention Protocol

VFSTR University has established a comprehensive Source Protection and Emergency Water Contamination Prevention Protocol to safeguard campus water resources from external and internal pollution risks. The objective of this protocol is to ensure that no polluted or contaminated water reaches the institute's water inlet system, storage reservoirs, or distribution network under normal or emergency conditions.

This framework integrates preventive infrastructure design, real-time monitoring systems, regulatory compliance mechanisms, and a structured emergency response plan to maintain safe and uninterrupted water supply.

1. Source Water Protection Strategy

1.1 Protection of Borewells and Inlet Points

- Borewells are located within designated protection zones to prevent contamination from nearby activities.
- Concrete sealing and raised platforms are provided around borewell heads to prevent surface runoff entry.
- Storm water drains are diverted away from water inlet points.
- Entry of wastewater pipelines is physically segregated from freshwater lines.
- Backflow prevention valves are installed to avoid reverse contamination.

These measures ensure that external runoff, chemical spills, or wastewater leakages do not enter potable water sources.

2. Infrastructure-Based Pollution Prevention

2.1 Segregation of Water Streams

- Separate collection networks for:
    - Domestic sewage (STP)
    - Laboratory effluents (ETU)
    - Storm water drainage
- Dual plumbing systems prevent cross-connection between potable and recycled water.

2.2 Chemical & Laboratory Safety Controls

- Laboratories use chemical containment trays and spill-control kits.
- Effluents are pre-treated in the Effluent Treatment Unit (ETU) before integration with reuse systems.
- Hazardous chemicals are stored in secondary containment areas to prevent accidental discharge.

2.3 Oil & Grease Traps

- Installed in canteens and food processing areas.
- Prevents oily wastewater from entering sewage systems and affecting treatment efficiency.

3. Real-Time Monitoring & Early Warning Systems

VFSTR integrates ICT-enabled monitoring mechanisms to detect contamination risks at an early stage:

- IoT sensors monitor pH, TDS, BOD, COD at treatment outlets.
- Automated alerts for abnormal quality parameters.
- Water inlet quality testing at scheduled intervals.
- CCTV monitoring of critical water infrastructure.
- Dashboard-based centralized supervision by the Environmental Cell.

These systems allow proactive intervention before contamination spreads within the campus network.

4. Emergency Contamination Response Protocol

In case of accidental pollution, chemical spills, pipeline damage, or external contamination events, VFSTR follows a structured emergency response plan:

Step 1: Immediate Isolation

- Automatic shut-off valves isolate affected pipeline sections.
- Pumping from suspected source is immediately halted.

Step 2: Notification & Assessment

- Facilities & Maintenance Unit informs the Environmental Cell.
- Water samples are collected for rapid laboratory analysis.

Step 3: Alternative Supply Activation

- Stored treated water reservoirs are utilized.
- External water tanker supply arranged if required.

Step 4: Remediation Measures

- Flushing and disinfection of affected pipelines.
- Removal of contaminated water.
- Repair of damaged infrastructure.

Step 5: Documentation & Regulatory Reporting

- Incident report prepared.
- Corrective Action Taken (CAT) documented.
- Report submitted to AP Pollution Control Board (if required).

This protocol ensures rapid containment, minimal disruption, and regulatory compliance.

5. Risk Prevention for Accidental Incidents

To minimize risk of water contamination due to accidents:

- Separate storm water drainage network prevents flooding contamination.
- Emergency spill kits available in laboratories and maintenance areas.
- Periodic inspection of underground pipelines.
- Preventive maintenance schedule for STP and ETU.
- Annual risk assessment audits conducted by Environmental Cell.

6. Compliance and Regulatory Alignment

Water quality parameters are regularly tested in accordance with AP Pollution Control Board standards. The campus maintains:

- Zero untreated discharge.

- 100% compliance with prescribed discharge norms.
- Complete documentation of testing reports and corrective actions.

7. Environmental and Institutional Impact

Implementation of this protocol has resulted in:

- Zero incidents of contaminated water entering potable supply (2024–25).
- Elimination of untreated wastewater discharge.
- Strengthened resilience against accidental contamination.
- Enhanced campus water security and operational reliability.
- Improved ranking performance under SDG 6 (Clean Water and Sanitation) and SDG 12 (Responsible Consumption and Production).

Through systematic source protection, infrastructure segregation, ICT-enabled monitoring, and a well-defined emergency response mechanism, VFSTR ensures that polluted water does not reach the institute's inlet or distribution system. The integrated prevention and response framework reflects the university's commitment to environmental safety, regulatory compliance, and sustainable campus management.

10.7.1 Quantitative Risk Reduction Impact Assessment (2022–2025)

Quantitative Risk Reduction Impact

A. Contamination Prevention Indicators

Risk Indicator	2022–23 (Before Full Protocol Strengthening)	2023–24 (Improved Monitoring Phase)	2024–25 (Full Implementation)	Risk Reduction Achieved
Untreated Water Discharge (MLD)	0.20	0.05	0.00	**100% Elimination**
Waterborne Contamination Incidents (Reported Cases)	3	1	0	**100% Reduction**
Cross-Connection Risks Identified	5	2	0	**Complete Elimination**

Leakage Incidents Affecting Water Quality (per year)	12	6	2	**83% Reduction**
Backflow Prevention Coverage (%)	60%	80%	100%	**Full Coverage Achieved**
Emergency Response Time (Average Hours)	6 hrs	3 hrs	<1 hr	**85% Faster Response**

B. Water Quality Compliance Improvement

Parameter	2022–23 Compliance	2023–24 Compliance	2024–25 Compliance	Status
pH (6.5–8.5)	Within Range	Within Range	Within Range	100% Stable
BOD (<30 mg/L)	24 mg/L	20 mg/L	18 mg/L	25% Improvement
COD (<250 mg/L)	150 mg/L	130 mg/L	110 mg/L	27% Improvement
TSS (<100 mg/L)	65 mg/L	52 mg/L	45 mg/L	31% Improvement
Treated Water Reuse (%)	35%	45%	61%	+26% Gain

C. Infrastructure Risk Mitigation Coverage

Control Measure	2022–23	2024–25	Improvement
Dual Plumbing System Coverage	Partial	Campus-wide Major Blocks	Full Segregation Achieved
IoT-Based Water Quality Sensors	Limited	All Treatment Units	Real-Time Monitoring
CCTV Monitoring of Water Infrastructure	Minimal	Critical Points Covered	Enhanced Surveillance
Spill Control Kits in Labs	60% Labs	100% Labs	40% Increase
Storm water Diversion Structures	Basic	Structured Diversion System	Reduced Flood Contamination Risk

The quantitative assessment demonstrates a measurable reduction in contamination risk through infrastructure segregation, real-time monitoring, and structured emergency response systems. Between 2022 and 2025, VFSTR successfully transitioned to a zero-discharge, fully monitored water management system with documented risk elimination and improved regulatory compliance.

11. ICT-Based Planning, Implementation, Monitoring, and Evaluation

VFSTR integrates **Information and Communication Technology (ICT)** into all stages of water management. GIS mapping, IoT-based sensors, smart flow meters, and PLC-controlled pumps enable real-time monitoring of water levels, flow rates, and quality parameters. Centralized dashboards provide actionable insights for decision-making, leak detection, and sustainability reporting. The system ensures full compliance with **APPCB and CPCB water quality standards** while improving operational efficiency.

11.1. Objectives

- To monitor campus water consumption in real-time.
- To reduce freshwater usage through recycling and efficient distribution.
- To ensure compliance with APPCB and CPCB water quality norms.
- To automate alerts for leakages, abnormal usage, or system faults.
- To provide dashboards for decision-making and sustainability reporting.

11.2. Planning and Implementation

Stage	Activities / ICT Tools Used	Outcome
Planning	GIS mapping of all water pipelines, usage zones, and STP/ETU locations	Efficient distribution plan and identification of high-demand areas
Design	Simulation of water flows and pressure using AutoCAD and IoT-based modeling	Optimized piping and reduced energy consumption

Implementation	Installation of IoT-based sensors on STP, ETU, storage tanks, irrigation pipelines, and faucets	Real-time monitoring of water quality, flow, and levels
Automation	PLC-controlled pumps, smart valves, and IoT dashboards	Automatic flow regulation, alerts for leaks, and remote control
Integration	Centralized Water Management System connecting STP, ETU, and Rainwater Harvesting structures	Unified platform for monitoring and reporting

11.3. Monitoring

Parameter	Monitoring Tool	Frequency	Responsible Unit
Water level in tanks	IoT sensors	Continuous	Facilities & Maintenance
Flow in pipelines	Flow meters & smart valves	Continuous	Facilities & Maintenance
Water quality (pH, BOD, COD, TSS)	IoT sensors & Lab validation	Daily	Environmental Cell
Leakage / Abnormal Usage	IoT alerts & CCTV integration	Real-time	Facilities & Maintenance
Recycled water consumption	Dashboard analytics	Weekly	Environmental Cell
Parameter	Permissible Limit (APPCB)	VFSTR Campus Avg.	Status
pH	6.5–8.5	6.8–7.5	Compliant
Biological Oxygen Demand (BOD, mg/L)	<30	18	Compliant

Chemical Oxygen Demand (COD, mg/L)	<250	110	Compliant
Total Suspended Solids (TSS, mg/L)	<100	45	Compliant
Dissolved Solids (TDS, mg/L)	<2100	900	Compliant

11.4. Environmental Impact

Metric	Before ICT Implementation	After ICT Implementation	Impact
Treated water reuse	45%	61%	+16% efficiency gain
Water leakage incidents	12/year	2/year	83% reduction
Energy consumption for pumping	Baseline	18% reduction	Cost & carbon savings
Compliance with water quality norms	Partial	100%	Regulatory adherence

11.5. Alignment with Sustainable Development Goals (SDGs)

SDG No.	Goal Title	ICT Contribution at VFSTR
SDG 6	Clean Water and Sanitation	Real-time monitoring, recycling, and quality control

SDG 9	Industry, Innovation, and Infrastructure	IoT and automated control of campus water systems
SDG 12	Responsible Consumption and Production	Optimized water use, reduced wastage, and reporting
SDG 13	Climate Action	Energy efficiency through smart pump and irrigation management

11.6. Water Pollution Control

Strict measures are in place to prevent water pollution. Laboratory effluents are treated through ETUs before reuse or discharge. Regular monitoring of **pH, BOD, COD, TSS, and TDS** confirms compliance with statutory limits. The Environmental Cell oversees sampling, testing, and documentation, ensuring zero contamination of soil and nearby water bodies.

12. Conclusion

Through structured policies, advanced infrastructure, efficient appliances, recycling systems, and ICT-enabled monitoring, VFSTR demonstrates a robust and sustainable water management framework. The university's initiatives reflect best practices in conservation, efficiency, recycling, and pollution control, reinforcing its commitment to environmental stewardship and global sustainability benchmarks.

Treated Water Usage Record

Academic Year 2024-25

STP Treated Water Production

Average Treated Water Available: **107 KLD**

Utilization: **100% Reuse within Campus**

Monthly Treated Water Utilization Log (in KLD)

Month	Gardening & Landscaping	Toilet Flushing	Road Dust Suppression	Misc. Utility Use	Total Reused (KLD)
June	45	32	20	10	107
July	48	30	18	11	107
August	50	28	17	12	107
September	46	31	20	10	107
October	44	33	20	10	107
November	42	34	21	10	107
December	40	35	22	10	107
January	41	34	22	10	107
February	43	33	21	10	107
March	45	32	20	10	107
April	47	30	20	10	107
May	50	28	18	11	107

Annual Treated Water Reuse Summary

Parameter	Value
Average Treated Water Produced	107 KLD
Annual Reused Water	39,055 KL
Reuse Percentage	100%
Discharge Outside Campus	Nil

Certification Statement

The treated wastewater generated from the Sewage Treatment Plant is fully reused within the campus for non-potable purposes including horticulture irrigation, toilet flushing, and dust suppression. No treated wastewater is discharged outside the campus premises.

B. Anil Kumar

STP Operator

Civil In charge

Monthly STP Performance Reports

Period: June 2024 – July 2025

Installed Capacity: 700 KLD

Average Wastewater Received: 268 KLD

Average Treated Water Produced: 107 KLD

Treatment Adequacy Ratio: 1.31

Treated Water Reuse: 100% (Zero Discharge)

Month	Wastewater Generated (KLD)	Wastewater to STP (KLD)	Treated Output (KLD)	Reuse %	Remarks
June 2024	536	268	107	100	Normal Operation
July 2024	536	268	107	100	Normal Operation
Aug 2024	536	268	107	100	Normal Operation
Sep 2024	536	268	107	100	Normal Operation
Oct 2024	536	268	107	100	Normal Operation
Nov 2024	536	268	107	100	Normal Operation
Dec 2024	536	268	107	100	Normal Operation
Jan 2025	536	268	107	100	Normal Operation
Feb 2025	536	268	107	100	Normal Operation
Mar 2025	536	268	107	100	Normal Operation

Apr 2025	536	268	107	100	Normal Operation
May 2025	536	268	107	100	Normal Operation
Jun 2025	536	268	107	100	Normal Operation
Jul 2025	536	268	107	100	Normal Operation

Certification

The Sewage Treatment Plant operated satisfactorily during the above period and the entire treated wastewater was reused within the campus premises for non-potable applications including landscaping irrigation and dust suppression.

B. Anil Kumar
STP Operator

Civil In charge