Water Conservation, Harvesting, and Recycling at IIT Gandhinagar

IIT Gandhinagar follows an integrated water management approach that combines a dual-source water supply, extensive rainwater harvesting, a decentralized wastewater treatment and reuse system, and real-time digital monitoring — together enabling the campus to significantly reduce its dependence on fresh water and move towards water positivity.

1. Water Sourcing — A Dual-Source Strategy

The campus draws water from two primary sources:

- **Narmada Canal Supply:** The primary source, with **458.7 ML allocated for FY 2025–26**, providing reliable, high-volume surface water that feeds the campus's centralized treatment system.
- **Rainwater Harvesting (Jal Mandap Network):** A secondary but critical source, with borewells retained only as a backup.

This raw water — from both the canal and harvested rainwater — is processed through the campus's **4.6 MLD Water Treatment Plant (WTP)**, which is currently operating at approximately 1 MLD of **demand**. Treatment proceeds through four stages: a Clariflocculator (PAC dosing to settle turbidity), Rapid Sand Filters (graded sand/gravel media with periodic backwashing), Disinfection (ALOTC GP chlorination maintaining 0.2 mg/L residual chlorine), and Output, delivering BIS-compliant drinking water (turbidity < 1 NTU) to Water Service Centres across campus.

2. Rainwater Harvesting — The Jal Mandap Network

The rainwater harvesting system is culturally inspired by the traditional Gujarati *vav* (stepwell). Five underground storage reservoirs, called **Jal Mandaps**, are built across campus and double as prominent community landscape features.

- **Total storage capacity:** ~300 lakh litres of rainwater gets stored over three to four cycles during a monsoon season in the Jal Mandaps. (Jal Mandap 1, 2, 3 & 5 hold 14 lakh litres each; Jal Mandap 4 holds 6.28 lakh litres).
- **Rooftop catchment area:** About 251,000 sq. m., draining in the Jal Mandaps drastically cutting the municipal water requirement during the rainy season.
- **Annual collection (2025–26):** 289 lakh litres.
- **Use:** During the monsoon, harvested rainwater is deliberately mixed with the more turbid Narmada canal water to dilute it, optimizing the centralized treatment process. About **13.7 lakh litres** of this harvested water is also used directly for irrigation.

3. Wastewater Treatment — The DEWATS Ecosystem

All wastewater generated on campus is treated through a **Decentralised Wastewater Treatment System (DEWATS)** — a zero-energy, chemical-free, gravity-fed treatment ecosystem.

- **Capacity:** 1.2 MLD (two plants of 0.6 MLD each), currently treating ~0.8 MLD daily.

- **Process — a 4-stage biological engine:**
    1. **Settler (Primary):** Sedimentation removes heavy particles and lowers biological load.
    2. **Anaerobic Baffled Reactor (Secondary):** Wastewater moves through an alternating up/down flow; anaerobic microorganisms break down pollutants via methanogenesis, generating biogas.
    3. **Planted Gravel Filter (Polishing):** Water passes through a constructed wetland planted with *Canna indica*, where microbial biofilms on the roots degrade residual organics.
    4. **Pressure Sand Filter / Ultrafiltration (Tertiary):** Final pressurized filtration removes fine particulates and turbidity, preparing the water for safe reuse.

Canna indica plays a central phytoremediation role — its roots oxygenate the rhizosphere to boost microbial breakdown, absorb excess phosphorus and heavy metals (lead, cadmium, chromium), support nitrifying bacteria that convert ammonium to harmless nitrogen gas, and physically filter suspended solids through the dense root matrix.

The result: **zero liquid discharge** — no sewage lines run out to the municipality, and 100% of treated water is reused within the campus.

4. Dual Plumbing Infrastructure — Provisioned, Currently Prioritized for Irrigation

Campus buildings are equipped with a **dual plumbing network** designed for water circularity:

- **Blue Network (Domestic Supply):** Carries WTP-treated Narmada and Jal Mandap water to showers, taps, and drinking fountains.
- **Pink Network (Recycled Supply):** Designed to carry DEWATS-treated reclaimed water to toilet flush systems and HVAC makeup water.

While this dual-plumbing infrastructure is in place, given the scale of the 400-acre campus and its extensive green cover, **irrigation demand is currently very high — as a result, all DEWATS-treated water is presently directed entirely towards irrigation and horticulture, rather than being routed through the pink network for flushing.** The campus has also eliminated Reverse Osmosis (RO) systems campus-wide and installed low-flow fixtures to reduce demand on the freshwater (Blue Network) side.

5. Reuse for Horticulture — The Primary Use of Treated Water Today

Reclaimed water currently sustains the entirety of campus landscaping:

- **5.5 lakh litres/day (~1,975 lakh litres annually)** of STP-treated water is deployed entirely for horticulture and irrigation.
- Delivered through **precision drip and sprinkler irrigation networks** rather than open flooding, maximizing efficiency.
- This avoids drawing fresh Narmada water for greenery, saving an additional **450 lakh litres** through irrigation efficiency alone.

6. Natural Water Bodies and Stormwater Management

Two natural topographical depressions on campus have been developed into **seasonal surface water storage lakes**. Stormwater from surface runoff is collected by gravity into these ponds via intake wells, with overflow safely discharged into the Sabarmati River. These lakes have also become a habitat for migratory birds, enriching campus biodiversity.

7. Digital and Mechanical Monitoring

The campus employs a network of **real-time IoT-based flow meters and level indicators** that continuously track usage across the fresh, harvested, and recycled water lines via a centralized monitoring app. **Variable Frequency Drive (VFD) pumps** optimize pumping operations and reduce energy consumption, while **sensor-based motorized solenoid valves** automatically shut off supply to prevent overhead tank overflows. A campus-wide digital complaint system ensures immediate maintenance response to any reported pipeline leaks.

8. National Recognition

In recognition of its sustained efforts in the field of water sustainability, **IIT Gandhinagar won the National Water Award 2025**, affirming the impact of its integrated approach to water conservation, harvesting, and recycling.

Overall Impact (FY 2025–26)

Initiative	**Volume**
Treated sewage water reused for irrigation (DEWATS reclamation)	1,975 lakh litres
Water saved via RO-free campus initiative	150 lakh litres
Water saved via precision drip & sprinkler irrigation	450 lakh litres
WTP backwash water reused	90 lakh litres
Total water saved/reclaimed (projected 2025–26)	**2,500+ lakh litres**

Active Use of Energy Harvesting Concepts at IIT Gandhinagar

IIT Gandhinagar actively harnesses renewable and locally generated energy sources to reduce its dependence on grid electricity, drawing on both solar energy harvesting and waste-to-energy conversion.

1. Solar Energy Harvesting

- A **500 KWp solar power plant** has been commissioned on campus, actively contributing to the Institute's renewable energy portfolio and reducing reliance on grid electricity.
- **Further capacity expansion is under active planning**, to increase the share of solar energy in overall campus energy consumption going forward.
- **Solar water heating systems** have been installed across residential and institutional buildings on campus, harvesting solar thermal energy to substantially reduce the electrical load that would otherwise be required for water heating.

2. Waste-to-Energy Harvesting — Biogas Generation

- A dedicated **biogas plant** on campus converts wet/organic waste — including food waste and other biodegradable material collected through the campus-wide segregation system — into **biogas**, a renewable energy output.
- This is supported by a dedicated **SWM team stationed full-time at the biogas plant**, ensuring continuous, all-day operations for waste-to-energy conversion.
- The process also produces **compost** as a by-product through aerobic composting of the remaining wet waste, closing the loop between organic waste management and resource recovery.

3. Supporting Infrastructure

- A **Building Management System (BMS)** and **Automatic Power Factor Correction (APFC) panels** (maintaining a power factor of 0.99–1.0) work alongside these harvesting systems to ensure that the energy generated and drawn from the grid is used with maximum efficiency, minimizing transmission losses.

Together, these initiatives reflect IIT Gandhinagar's active, on-campus generation of renewable energy — from sunlight through solar PV and solar thermal systems, and from organic waste through biogas — rather than relying solely on demand-side conservation.