

## CERTIFICATE OF COMPLETION

*This is to certify that*

*NRI INSTITUTE OF TECHNOLOGY*

*has successfully completed*

ENVIRONMENTAL AUDIT

(WATER & WASTE MANAGEMENT)

The study was completed by Rekhapalli Environmental Solutions &  
Technologies Pvt Ltd

Dr Rekhapalli Srinivasa Rao

*Green, Eco & Energy Lead Auditor*

*Certified ISO-14001 Auditor*



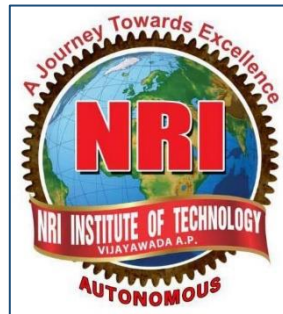
Issued by

**Rekhapalli Environmental Solutions & Technologies Pvt Ltd**

August 2022

# NRI INSTITUTE OF TECHNOLOGY

Pothavarappadu (V), Agiripalli (M), Eluru District, A.P.,  
India-521212



## Environmental Audit (Water & Waste Management)

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# Acknowledgements

REST Pvt Ltd



**Dr Rekhapalli Srinivasa Rao**  
Green, Eco & Energy Lead Auditor  
Certified ISO-14001 Auditor

22 August 2022

## Environmental Audit (Water & Waste Management)

The REST Pvt Ltd acknowledges with thanks the cooperation extended to our team for completing the study at NRI Institute of Technology (NRIIT).

The interactions and deliberations with NRIIT team were exemplary and the whole exercise was thoroughly a rewarding experience for us. We deeply appreciate the interest, enthusiasm, and commitment of NRIIT team towards environmental sustainability.

We are sure that the recommendations presented in this report will be implemented and the NRIIT team will be further improve their environmental performance.

Kind regards

Your sincerely

**Dr Rekhapalli Srinivasa Rao**  
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# Executive Summary

The growth of countries across the world is leading to increased consumption of natural resources. There is an urgent need to establish environmental sustainability in every activity we do. In a modern economy, environmental sustainability will play a critical role in the very existence of an organization.

An educational institution is no different. Built environment, especially an educational institution, has a considerable footprint on the environment. Impact on the environment due to energy Consumption, water usage and waste generation in an educational institute is prominent. Therefore, there is an imminent need to reduce the overall environmental footprint of the institution.

As an Institution of higher learning, NRI Institute of Technology (NRIIT) firmly believes that there is an urgent need to address the environmental challenges and improve their environmental footprint.

True to its belief, NRIIT has implemented rainwater harvesting in the campus. Continuing with rainwater harvesting, the college can also investigate the following recommendations:

- **Attain water positive status:** NRIIT should focus on capturing the harvested rainwater to substitute freshwater consumption, work on sustainable groundwater beyond the fence and create a framework towards attaining water positive status over a period. Presently, NRIIT is consuming nearly 2400 lt of fresh water per day. Since metering is not available, the water consumption is calculated rather than measure value. The first step is to increase the water conservation activities in the campus to reduce water consumption at source. The next step is to increase the rainwater harvesting capacity to completely offset the freshwater requirements of the plant. NRIIT can also explore adopting lakes, desilting of ponds and restoration of water bodies in localities surrounding the campus. Water getting harvested in those structures can offset the freshwater consumption of the college.
- **Install water efficient fixtures:** The best way to conserve water is at the source. Therefore, NRIIT will have to install water efficient fixtures to reduce water consumption. Some of the water efficient fixtures are:
  - Waterless urinals
  - Electronic taps (e-taps)
  - Electronic flush urinals (e-flush)
  - Foam taps
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  - Low flush cistern
- **Install sewage treatment plant / rootzone treatment:** NRIIT uses more than 2400 lt of fresh water per day. Considering that wastage of water 1000 lt is being let to drain without treatment, good opportunity exists to reduce freshwater consumption by treating the sewage water and using

the recycled water for gardening and flushing application. Install biogas plant and phytoremediation in series to recycle water and reduce freshwater consumption.

- **Install water flow meters:** Water flow meters are vital in understating the water consumption patterns of the campus. Presently, the water consumption is calculated rather than being measured. Water flow meters gives an accurate status if water consumption in the campus and from the water consumption values, the roadmap for water conservation activities can be prepared.

- **Segregate waste at source:** NRIIT has provided bins for waste collection. NRIIT must embark on awareness creation methods to increase the effectiveness of collection and provide more bins for proper waste segregation.

- **Maintenance of waste management yard:** The waste management yard is to be maintained just like raw materials storage room. Waste is nothing but a resource in wrong place. Therefore, by maintaining the waste management yard, quality of wastes can be maintained.





# Environmental Audit

NRIIT and REST are working together to identify opportunities for improvement in water management, and waste management. This report highlights all the potential proposals for improvement through the audit and analysis of the data provided by NRIIT for water consumption and waste management. The report details the process conducted for the analysis such as on ground surveys performed for listing the type of water consumers with consumption per year, types of waste generated and disposal mechanisms.

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## Note

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# Water Conservation

To achieve a water positive status by continuous reduction of freshwater consumption should be the ultimate focus of NRIIT. Increased and focused attention should be given to attain water sustainability in future by inculcating the discipline of water conservation.

Fresh water consumption of NRIIT : 2400 lt per day

Rainwater harvesting : Carried out for roof area

According to the report, 'Water in India: Situation & Prospects', India is the largest consumer of groundwater in the world with an estimated usage of 230 km<sup>3</sup> per year. Approximately 60 per cent of the demand from agriculture and irrigation, and about 80 per cent of the domestic water demand, is met through groundwater. As per the Department of Drinking Water and Sanitation nearly 90 per cent of the rural water supply is from groundwater sources. This has led to an increased pressure on aquifers and the resulting hydrological imbalance.



## Recommendations for water conservation

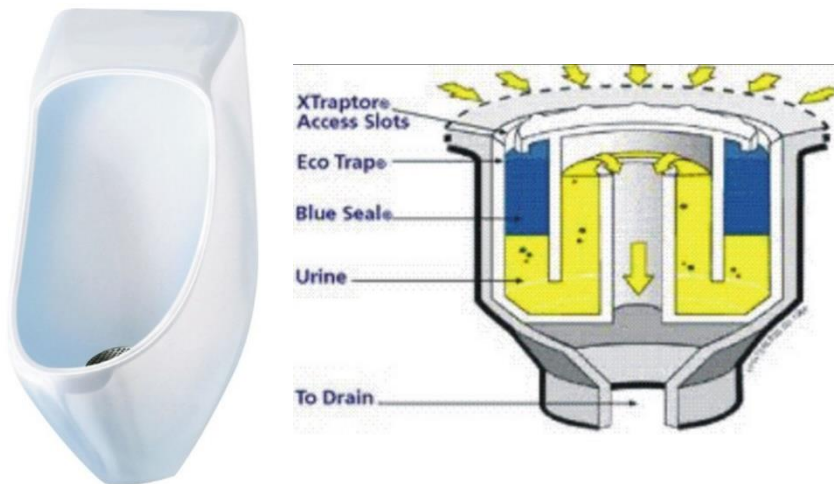
**1) Waterless urinals:** Waterless urinals look like regular urinals without a pipe for water intake. Men use them normally, but the urinals don't flush. Instead, they drain by gravity. Their outflow pipes conduits to a building's conventional plumbing system. In other words, unlike a composting toilet, which leaves you to deal with your waste, these urinals send the urine to a water treatment plant.

a. Urine flows into the drain insert of the Eco Trap.

b. Inside of the Eco Trap the urine moves through a floating layer of proprietary immiscible Blue Seal liquid, which creates a barrier, preventing sewer gases and urine odours from entering the restroom area.

c. The urine below the Blue Seal barrier overflows into the central tube and travels down into the drain line.

Waterless Urinal



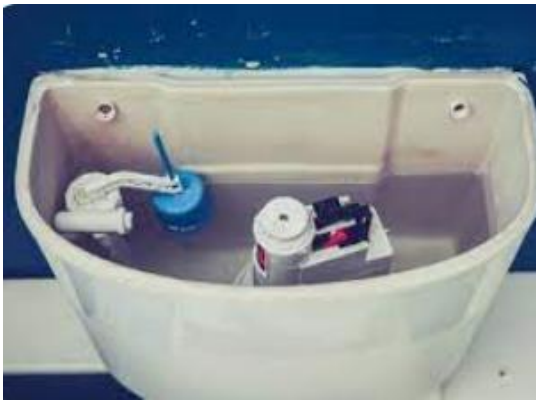
d. Approximately 1500 sanitary uses are possible with just 3 ounces of Blue Seal. When the Blue Seal liquid is gone, it is simply replenished. This only takes about 20 seconds to perform and the Eco Trap is not touched.

e. Urine sediments are retained within the Eco Trap. Replacement is easy and need only be done 2 to 4 times per year depending on traffic to the urinal. As tool called the X-Traptor must be used to remove the Eco Trap. The use of the special tool helps to minimize vandalism. The entire process of replacement only takes 3 to 4 minutes.



Waterless urinals are available for women. Indian manufacturers are supplying waterless urinals technology. Ekameco is one such company providing solution for women waterless urinals. You may visit [www.ekameco.com](http://www.ekameco.com) and mail [info@ekameco.com](mailto:info@ekameco.com) for more details on waterless urinals for women.

2) Volume reduction in flush tanks: One simple method is to add a one-liter equivalent water bottle in the flush tank thereby reducing its consumption majorly. One-liter savings in the tank will help to save approximately by 20% and doesn't require any investment.



3) Rainwater harvesting: Water harvesting or more precisely rainwater harvesting is the technique of collection and storage of rainwater at surface or in subsurface aquifer, before it is lost as surface run off. In artificial recharge, the ground water reservoirs are recharged at a rate higher than natural conditions of replenishment. According to a report by the Central Groundwater Board published in 2007, the selection of a suitable technique for artificial recharge of ground water depends on various factors. They include:

- a) Quantum of non-committed surface runoff available
- b) Rainfall pattern
- c) Land use and vegetation
- c) Topography and terrain profile
- d) Soil type and soil depth
- e) Thickness of weathered / granular zones
- f) Hydrological and hydrogeological characteristics
- g) Socio-economic conditions and infrastructural facilities available
- h) Environmental and ecological impacts of artificial recharge scheme proposed

## Rainwater Harvesting Techniques in Urban Area

In urban areas rainwater is available from roof tops of buildings, paved and unpaved areas. This water could be stored and used to replace freshwater as well as used for recharging the aquifer.



4) Display water balance/conservation status at entrance of all blocks for overall involvement of all students & staff.

It is suggested to display specific water consumption numbers in terms of domestic use at the entrance of each blocks to create awareness among all students and stakeholders visiting the facility. This daily/continuous awareness creation will ultimately help in reduction of water consumption by students.

## Water Saving Gadgets

It is suggested to display specific water consumption numbers in terms of domestic use at the entrance of each block to create awareness among all students and stakeholders visiting the facility. This

### Electronic Taps (e-taps)

The latest trend in industries is to install electronic taps (e-taps). The advantages of using e-taps are as mentioned below:

- Unlike conventional taps, there is no twisting or turning in e-taps. They have a sensor, which cuts off water supply completely when not in use. This helps in saving up to 70% water during hand wash.

E-taps enable hands free operation. No fear of cross contamination or contact with germs. E taps score very high on hygiene. It is the most ideal choice for multipurpose and multi-user washrooms.

- E-taps can work efficiently up to raw water TDS of 1,800 ppm.

The touch free electronic taps, available in AC and DC models consume minimal power only. The AC model has an efficient battery back-up, while the DC model runs on just 4 alkaline batteries.



### **Operation of Electronic Taps**

This has been successfully implemented in several hotels & restaurants. Of late, several industries have also started implementing this proposal. Thus, there is a good potential to optimize the Fresh water consumption by replacing the existing taps with e-taps.

## Electronic flush (e-flush) urinals

The latest trend in industries is to install e-flush urinals. The advantages of using e-flush urinals are as mentioned below:

- E-flush urinals are fitted with a sensor, which senses the usage and flush with water for few seconds after use. This helps in saving 70% water during urinal flush.
- E-flush urinals enable hands-free operation and score very high on hygiene. It is the most ideal choice for multipurpose and multi-user washrooms.
- E-flush urinals can work efficiently up to raw water TDS of 1,800 ppm.
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Electronic flush urinals



## Hand wash

### Foam taps

Conventional taps are used in the hand wash areas which results in wastage of large quantities of fresh water. Foam taps are a better fit in these high consumption areas. They consume 25-30% less water than conventional taps.

### Foam taps



### **Spring loaded Push taps**

Spring loaded push type tap is an alternate device for minimizing hand wash water. The spring-loaded push taps operate with the simple mechanism of pressing the knob for water. The knob is automatically released back to close position in 5-7 seconds. This saves about 30-40% of water compared to the conventional taps.

Spring loaded push taps



### **Low flush cistern**

The latest model closets are water efficient and operate in dual mode, with a single flush releasing 2 litres of water and the dual flush releasing 4 litres per flush. This results in excellent water savings.

Low flush cisterns



### **Install sewage treatment plant - Rootzone treatment:**

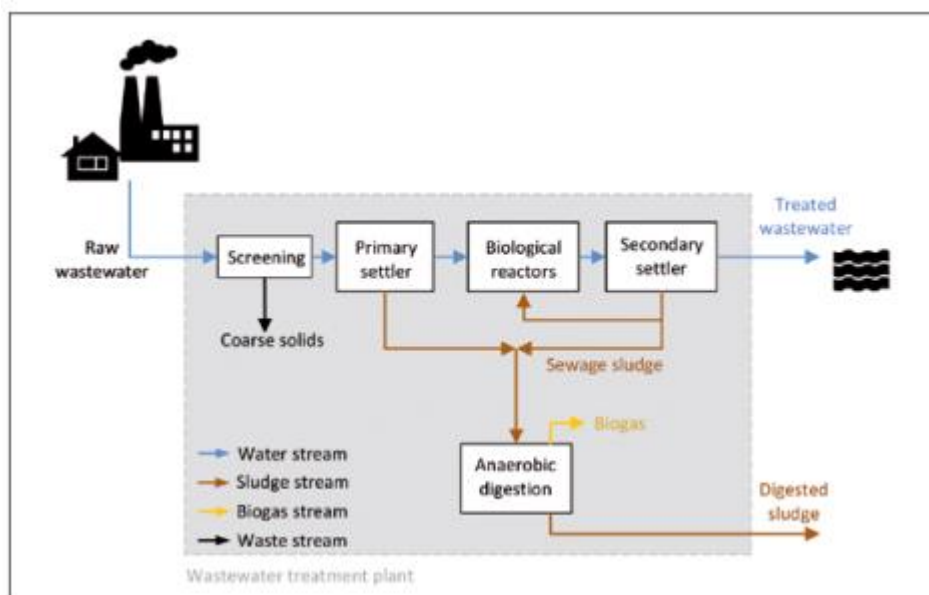
NRIT uses more than 2400 lt of fresh water per day. Considering minimum wastage of water 1000 lt is being let to drain without treatment, good opportunity exists to reduce freshwater consumption by treating the sewage water and using the recycled water for gardening and flushing application. Install biogas plant and phytoremediation in series to recycle water and reduce freshwater consumption. Presently, sewage water is being let out to the drain without treatment.

An opportunity exists to generate biogas from the untreated sewage water and use the generated biogas to substitute LPG used (600cylinders/year) in the college.

### Biogas Production Potential of Wastewater

The sewage water is a useful waster as 1% of it in any quantity is a sludge which when subjected to anaerobic digestion will produce biogas. Wastewater is the effluent from household, commercial establishments and institutions, hospitals, industries and so on. Sewage water source contains large amount of organic material which can be efficiently recovered in as sludge which and when subjected to anaerobic digestion, the sludge produces methane gas (biogas).

Biogas is a mixture of gases containing 50-75% Methane, and 25-50% Carbon dioxide while 0-10% Nitrogen, 0-3% Hydrogen disulphide and 0-2% Hydrogen may be present as impurities which is produced by anaerobic digestion of organic material i.e. a sequential enzymatic breakdown of biodegradable organic



material (Biomass) in the absence of oxygen. The process is usually carried out in a digester tank known as biodigester. Biogas is an important energy source used as cooking gas, to generate electricity, etc. thus producing biogas from wastewater is an efficient and sustainable waste management and renewable energy technique. One of the major environmental problems of the world today is waste management and wastewater constitutes a huge environmental problem to the society thus the need for wastewater treatment to recover and also recycle the recovered water for usage.

**The physical process:** this is the mechanical treatment of the water that involves removal of debris from the raw wastewater right from the point it enters the plant. The screening and primary settling of debris. Wastewater enters the treatment plant through the inlet chamber from where it is channelled to the coarse screen that removes solid waste.

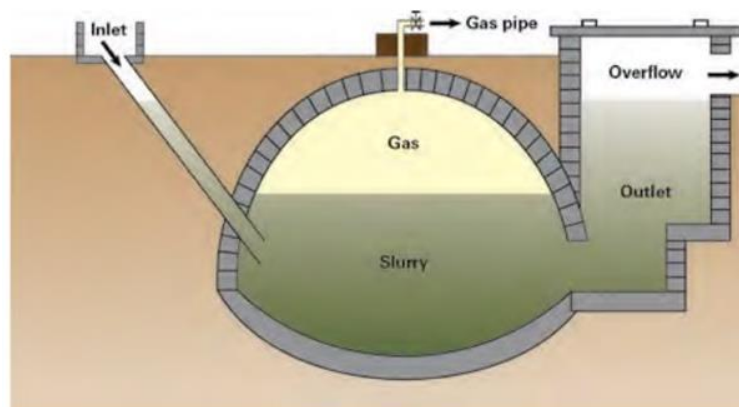
**The biological process:** this involve the biotreatment of the sewage in the bioreactors. It is the heart of the treatment plant where a biological process takes place. The bioreactors of a treatment plant are usually large tanks consisting of several mammoth rotors and submersible mixers. While the rotor introduces atmospheric oxygen into the sewage, the submersible mixers keep the biomass in suspension thus several reactions take place in the bioreactors.

From the bioreactor, the sewage enters the sedimentation tank. Here the biological process ends and sludge is separated from water such that the clean water is passed to the disinfection tank for



disinfection and onward discharge for use while the sludge is removed by the returned activation sludge (RAS) pump that removes and sends part to the anaerobic digestion chamber while some e return to the anaerobic bioreactor for reactivation.

Production of biogas is an anaerobic digestion whereby microorganisms break down biodegradable material in the absence of oxygen to produce methane/carbon dioxide used to generate electricity and heat. Sludge from the treatment plant (primary and activated sludge) is the main feedstock (biodegradable organic matter) in the biogas production plant of a wastewater treatment plant and the biogas production process involves series of steps. The combine sludge resulting from primary and secondary water treatment is gathered, sieved and thickened to a dry solids content of up to 7% before entering the digesters. Optionally, the sludge can be pre-treated by disintegration technologies with the aim to improve the gas yield. In the anaerobic digestion process, the sludge is pumped into the anaerobic continuously stirred tank reactors where digestion takes place. In the process, microorganisms break down part of the organic matter that is contained in the sludge and produce biogas, which is composed of methane, carbon dioxide and trace gases. The raw biogas produced is dried and hydrogen sulphide and other trace substances removed and burned in burners after treatment. The digested sludge is dewatered, and the water reintroduce into the treatment plant while the remaining undigested matter used for organic fertilizer.



### Rootzone treatment:

Root Zone' is a scientific term used to cover all the biological activity among different types of microbes, the roots of plants, water soil and the sun. It consists planted filter-beds containing ravel, sand and soil. The RZWT system utilises nature's way of biologically processing domestic & industrial effluents. This effective technology called Decentralised Wastewater Systems (DEWATS) was developed in 1970s in Germany and has been successfully implemented in different countries mainly in Europe and America.

The root zone wastewater treatment system makes use of biological and physical-treatment processes to remove pollutants from wastewater. Due to its natural process, there is no need to add any input such as chemicals, mechanical pumps or external energy. This reduces both the maintenance and energy costs.

- To accomplish this, the root zone wastewater treatment undertakes the following steps:

- Pre-treatment done in a Settler - a device that separates the liquid from the solid First treatment takes place in a Anaerobic Baffled Reactor - a device with several identical chambers through which the effluent moves from top to bottom.
- Second treatment happens in an Anaerobic Filter - a device filled with a filter material (cinder), through which the effluent moves from top to bottom.

Third treatment takes place in a Planted Gravel Filter - a structure filled with gravel material and planted with water-resistant reed plants, which provide oxygen to the passing effluent.

The Root Zone Wastewater Treatment system takes into account the natural slope of the ground, so that water flows from one device to another without any ternal energy input such as motor pump. Once the reed plants create an established stand, usually after the first growing season, the reed bed requires little or no maintenance. The plant foliage will soon blend naturally into the landscape, ever changing with the seasons and creating a pleasing sight as well!



### **Install water flow meter:**

Water flow meters are vital in understating the water consumption patterns of the campus. Presently, the water consumption is calculated rather than being measured. Water flow meters gives an accurate status if water consumption in the campus and from the water consumption values, the roadmap for water conservation activities can be prepared.

Water Meters would have many advantages:

- Encourage water conservation - important given strain on water resources
- Encourage allocatively efficient distribution. People would consume to where the marginal cost = marginal utility

- In long term lower overall water consumption would reduce leading to even lower water bills.



## Waste Management

India has drawn world's attention with its high paced urbanization and industrialization. Over the last decade, India has emerged as the fastest growing country with rapid economic growth. A renewed focus on sustainable growth and development is imperative as India strives to maintain its high GDP growth rate in its pursuit of achieving developed country status by the year 2022. However, the flip side of higher economic growth has resulted in increased consumption of the natural resources, increased waste generation and hence ecological degradation.

Present status: NRIIT has initiated waste management activities inside its facility. Separate bins have been provided for different types of wastes. Waste bins are provided throughout the campus and students are being urged to use the bins effectively.

Recommendation: The waste management yard must be maintained in a similar fashion as that of a raw material storage room. Therefore, a total revamp of the waste storage yard is to be carried out. By doing so, the quality of the materials stored in the yard will not deteriorate and can be used as a raw material for a subsequent process.

Enhance awareness creation, training and capacity building

NRIIT should focus on implementing sustainable waste management practices. NRIIT should regularly interact with Pollution Control Board and TSDF operators to enhance knowledge on waste management. The team should also take efforts to communicate the waste management and other policies and activities to all students in the college.

Achieve zero liquid discharge status

NRIIT may install a STP to treat and recycle water. The treated water from STP can be used to substitute freshwater by utilizing the treated water in both high end and low-end applications.

# Conclusion

Environmental sustainability is a continuous process and there is always a scope for improvement. NRIIT has displayed itself as an advocate of environmental sustainability by getting environmental audit carried out. The organization has implemented several initiatives and measures to enhance efficiency and to optimize resource intensity. The journey ahead in the path towards environmental excellence has immense scope for improvement as brought out by this report.

NRIIT needs to focus and work on areas efficiency levels needs to be enhanced. For example: waste management. The observations and suggestions put forth by the report would help the facility in improving its environmental performance and pave way for ecologically sustainable growth.

This report may be taken as a guide and roadmap for achieving higher performance rating in environmental stewardship. As one of the pioneers and leaders NRIIT shoulder the task of further 'learning-teaching-learning' to improve, excel, and continue the innovative efforts for success of their students and associates.

# SUSTAINABLE LIVING INC

## *Certificate of Completion*

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Environmental audit (Water conservation and  
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Hiran Prashanth  
Environmental Sustainability Auditor  
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*Issued by Sustainable Living Inc*

July 2021  
GA - 02 - 21 - NRIIT

# Sustainable Living Inc



**NRI** An AUTONOMOUS Institute  
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Environmental Sustainability Auditor  
Sustainable Living Inc

## About Auditor

Hiran Prashanth is a sustainability consultant based in London. He has over 14 years of experience in climate change and environmental sustainability. He was working with the Confederation of Indian Industry (CII) before moving to London to pursue a master's degree at King's College, London.

Hiran Prashanth has helped more than 150 organizations around the world to achieve carbon neutrality. Apart from carbon neutrality, Hiran Prashanth has also facilitated organizations to achieve net-zero energy, water neutrality, and zero waste to landfill. He has audited more than 500 companies for their sustainability performance.

Hiran Prashanth was awarded the 'Best Sustainability Assessor' by the Honorable Minister for HRD, Mr. Prakash Javadekar. Hiran Prashanth is a CII certified carbon footprint expert and a resource efficiency expert. He has trained more than 1000 industry personnel across the world on climate change and sustainability. He is a guest faculty at IIM Lucknow and SIBM, Pune. His credentials can be found on [Hiran Prashanth | LinkedIn](#). Sustainable Living Inc provides services on carbon footprint, energy audit, resource management and embodied carbon.

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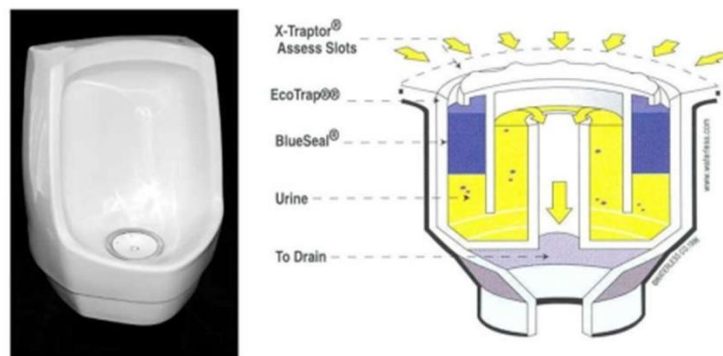
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f. Waterless urinals are available for women. Indian manufacturers are supplying waterless urinals technology. Ekameco is one such company providing solution for women waterless urinals. You may visit [www.ekameco.com](http://www.ekameco.com) and mail [info@ekameco.com](mailto:info@ekameco.com) for more details on waterless urinals for women.

**2) Volume reduction in flush tanks:** One simple method is to add a one-liter equivalent water bottle in the flush tank thereby reducing its consumption majorly. One-liter savings in the tank will help to save approximately by 20% and doesn't require any investment.



**3) Rainwater harvesting:** Water harvesting or more precisely rainwater harvesting is the technique of collection and storage of rainwater at surface or in subsurface aquifer, before it is lost as surface run off. In artificial recharge, the ground water reservoirs are recharged at a rate higher than natural conditions of replenishment.

According to a report by the Central Groundwater Board published in 2007, the selection of a suitable technique for artificial recharge of ground water depends on various factors. They include:

- a) Quantum of non-committed surface runoff available
- b) Rainfall pattern
- c) Land use and vegetation
- c) Topography and terrain profile
- d) Soil type and soil depth
- e) Thickness of weathered / granular zones
- f) Hydrological and hydrogeological characteristics

g) Socio-economic conditions and infrastructural facilities available

h) Environmental and ecological impacts of artificial recharge scheme proposed

### **Rainwater Harvesting Techniques in Urban Area**

In urban areas rainwater is available from roof tops of buildings, paved and unpaved areas. This water could be stored and used to replace freshwater as well as used for recharging the aquifer.



**4)** Display water balance/conservation status at entrance of all blocks for overall involvement of all students & staff

It is suggested to display specific water consumption numbers in terms of domestic use at the entrance of each blocks to create awareness among all students and stakeholders visiting the facility. This daily/continuous awareness creation will ultimately help in reduction of water consumption by students.

## Water Saving Gadgets

It is suggested to display specific water consumption numbers in terms of domestic use at the entrance of each blocks to create awareness among all students and stakeholders visiting the facility. This

### Electronic Taps (e-taps)

The latest trend in industries is to install electronic taps (e-taps). The advantages of using e-taps are as mentioned below:

- Unlike conventional taps, there is no twisting or turning in e-taps. They have a sensor, which cuts off water supply completely when not in use. This helps in saving up to 70% water during hand wash.
- E-taps enable hands free operation. No fear of cross contamination or contact with germs. E taps score very high on hygiene. It is the most ideal choice for multipurpose and multi-user washrooms.
- E-taps can work efficiently up to raw water TDS of 1,800 ppm.
- The touch free electronic taps, available in AC and DC models consume minimal power only. The AC model has an efficient battery back-up, while the DC model runs on just 4 alkaline batteries.



### **Operation of Electronic Taps**

This has been successfully implemented in several hotels & restaurants. Of late, several industries have also started implementing this proposal. Thus, there is a good potential to optimize the freshwater consumption by replacing the existing taps with e-taps.

## Electronic flush (e-flush) urinals

The latest trend in industries is to install e-flush urinals. The advantages of using e-flush urinals are as mentioned below:

- E-flush urinals are fitted with a sensor, which senses the usage and flush with water for few seconds after use. This helps in saving 70% water during urinal flush.
- E-flush urinals enable hands-free operation and score very high on hygiene. It is the most ideal choice for multipurpose and multi-user washrooms.
- E-flush urinals can work efficiently up to raw water TDS of 1,800 ppm.
- The touch free e-flush urinals available in AC and DC models consume minimal power only. The AC model has an efficient battery back-up, while the DC model runs on just 4 alkaline batteries.



*Photographs: Electronic flush urinals*

## Hand wash

### Foam taps

Conventional taps are used in the hand wash areas which results in wastage of large quantities of fresh water. Foam taps are a better fit in these high consumption areas. They consume 25-30% less water than conventional taps.



**Photographs: Foam taps**

### Spring loaded Push taps

Spring loaded push type tap is an alternate device for minimizing hand wash water. The spring-loaded push taps operate with the simple mechanism of pressing the knob for water. The knob is automatically released back to close position in 5-7 seconds. This saves about 30-40% of water compared to the conventional taps.



**Photographs:** Spring loaded push taps

### Low flush cistern

The latest model closets are water efficient and operate in dual mode, with a single flush releasing 2 litres of water and the dual flush releasing 4 litres per flush. This results in excellent water savings.

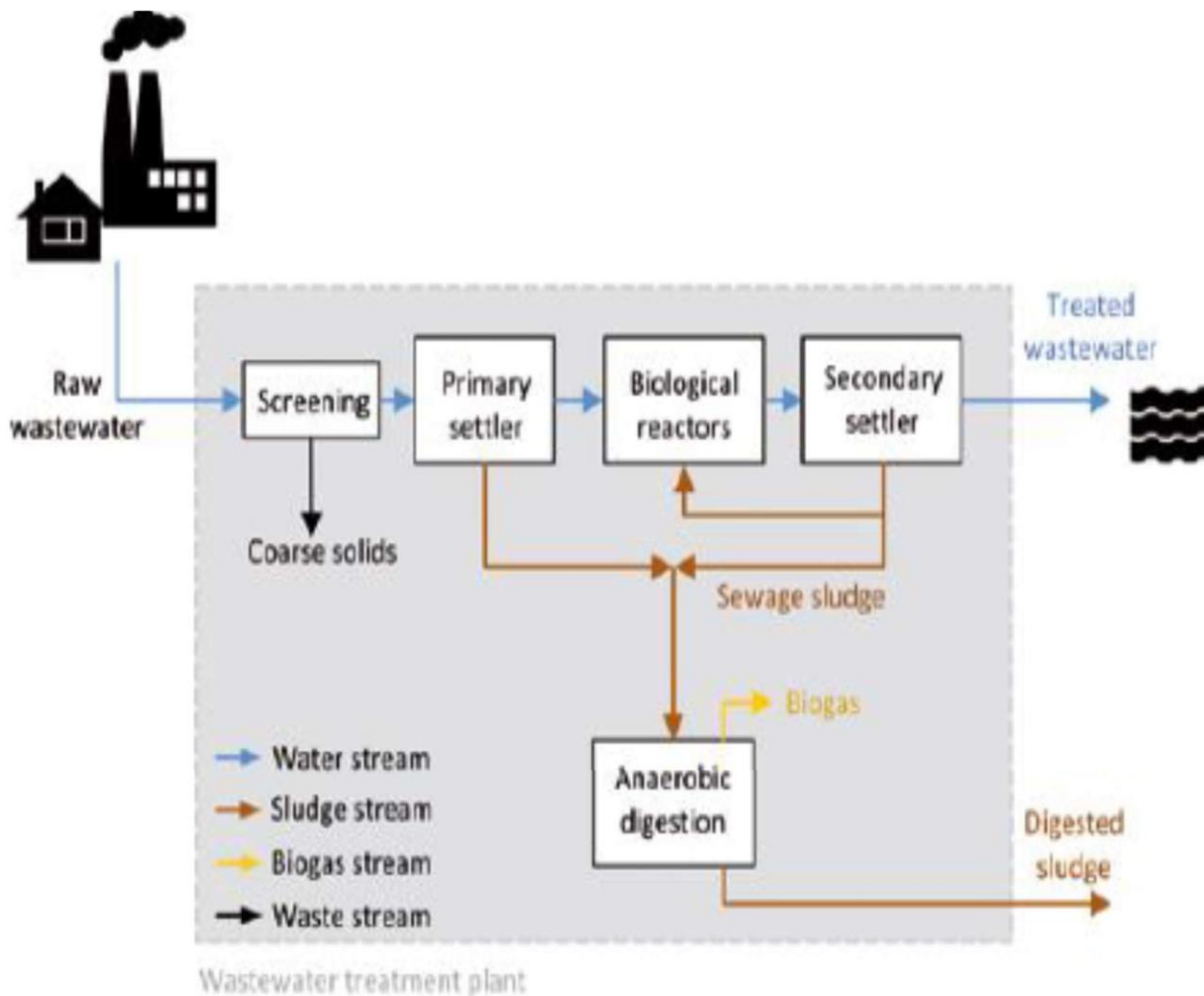


**Photographs:** Low flush cisterns

## **Biogas Production Potential of Wastewater**

The sewage water is a useful waster as 1% of it in any quantity is a sludge which when subjected to anaerobic digestion will produce biogas. Wastewater is the effluent from household, commercial establishments and institutions, hospitals, industries and so on. Sewage water source contains large amount of organic material which can be efficiently recovered in as sludge which and when subjected to anaerobic digestion, the sludge produces methane gas (biogas).

Biogas is a mixture of gases containing 50-75% Methane, and 25-50%Carbon dioxide while 0-10% Nitrogen, 0-3% Hydrogen disulphide and 0-2% Hydrogen may be present as impurities which is produced by anaerobic digestion of organic material i.e. a sequential enzymatic breakdown of biodegradable organic material (Biomass) in the absence of oxygen. The process is usually carried out in a digester tank known as biodigester. Biogas is an important energy source used as cooking gas, to generate electricity, etc. thus producing biogas from wastewater is an efficient and sustainable waste management and renewable energy technique. One of the major environmental problems of the world today is waste management and wastewater constitutes a huge environmental problem to the society thus the need for wastewater treatment to recover and also recycle the recovered water for usage.



**The physical process:** this is the mechanical treatment of the water that involves removal of debris from the raw wastewater right from the point it enters the plant. The screening and primary settling of debris. Wastewater enters the treatment plant through the inlet chamber from where it is channeled to the coarse screen that removes solid waste.

**The biological process:** this involve the biotreatment of the sewage in the bioreactors. It is the heart of the treatment plant where a biological process takes place. The bioreactors of a treatment plant are usually large tanks consisting of several mammoth rotors and submersible mixers. While the rotor introduces atmospheric oxygen into the sewage, the submersible mixers keep the biomass in suspension thus several reactions takes place in the bioreactors.

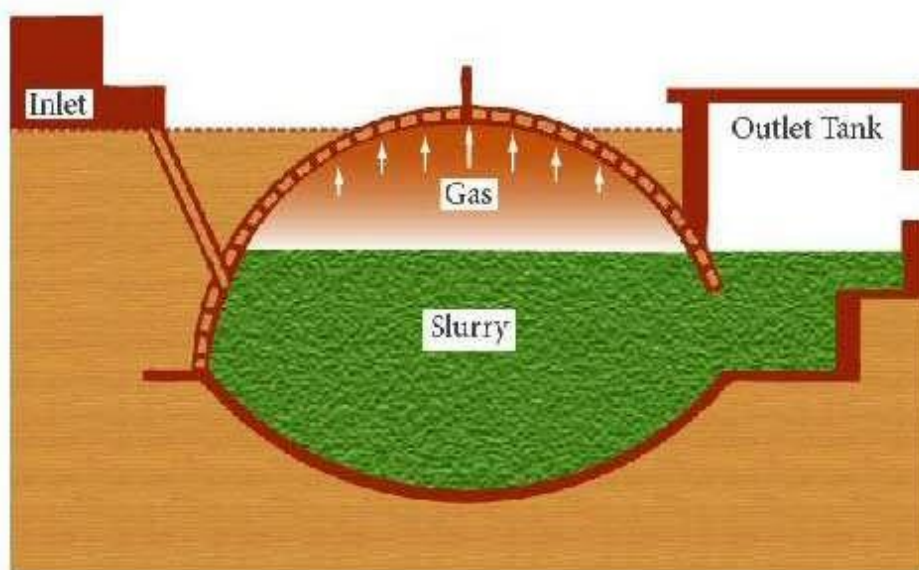
From the bioreactor, the sewage enters the sedimentation tank. Here the biological process ends and sludge is separated from water such that the clean water is passed to the disinfection tank for



disinfection and onward discharge for use while the sludge is removed by the returned activation sludge (RAS) pump that removes and sends part to the anaerobic digestion chamber while some are return to the anaerobic bioreactor for reactivation.

Production of biogas is an anaerobic digestion whereby microorganisms break down biodegradable material in the absence of oxygen to produce methane/carbon dioxide used to generate electricity and heat. Sludge from the treatment plant (primary and activated sludge) is the main feedstock (biodegradable organic matter) in the biogas production plant of a wastewater treatment plant and the biogas production process involves series of steps. The combine sludge resulting from primary and secondary water treatment is gathered, sieved and thickened to a dry solids content of up to 7% before entering the digesters. Optionally, the sludge can be pretreated by disintegration technologies with the aim to improve the gas yield. In the anaerobic digestion process, the sludge is pumped into the anaerobic continuously stirred tank reactors where digestion takes place.

In the process, microorganisms break down part of the organic matter that is contained in the sludge and produce biogas, which is composed of methane, carbon dioxide and trace gases. The raw biogas produced is dried and hydrogen sulphide and other trace substances removed and burned in burners after treatment. The digested sludge is dewatered, and the water reintroduce into the treatment plant while the remaining undigested matter used for organic fertilizer.



### **Rootzone treatment:**

Root Zone' is a scientific term used to cover all the biological activity among different types of microbes, the roots of plants, water soil and the sun. It consists planted filter-beds containing gravel, sand and soil. The RZWT system utilises nature's way of biologically processing domestic & industrial effluents. This effective technology called Decentralised Wastewater Systems (DEWATS) was developed in 1970s in Germany and has been successfully implemented in different countries mainly in Europe and America.

The root zone wastewater treatment system makes use of biological and physical-treatment processes to remove pollutants from wastewater. Due to its natural process, there is no need to add any input such as chemicals, mechanical pumps or external energy. This reduces both the maintenance and energy costs.

- To accomplish this, the root zone wastewater treatment undertakes the following steps:
- Pre-treatment done in a Settler – a device that separates the liquid from the solid First treatment takes place in a Anaerobic Baffled Reactor – a device with several identical chambers through which the effluent moves from top to bottom.
- Second treatment happens in an Anaerobic Filter – a device filled with a filter material (cinder), through which the effluent moves from top to bottom.
- Third treatment takes place in a Planted Gravel Filter – a structure filled with gravel material and planted with water-resistant reed plants, which provide oxygen to the passing effluent.

The Root Zone Wastewater Treatment system takes into account the natural slope of the ground, so that water flows from one device to another without any external energy input such



as motor pump. Once the reed plants create an established stand, usually after the first growing season, the reed bed requires little or no maintenance. The plant foliage will soon blend naturally into the landscape, ever changing with the seasons and creating a pleasing sight as well!

### **Install water flow meter:**

Water flow meters are vital in understating the water consumption patterns of the campus. Presently, the water consumption is calculated rather than being measured. Water flow meters gives an accurate status if water consumption in the campus and from the water consumption values, the roadmap for water conservation activities can be prepared.



Water Meters would have many advantages:

- Encourage water conservation – important given strain on water resources
- Encourage allocatively efficient distribution. People would consume to where the marginal cost = marginal utility
- In long term lower overall water consumption would reduce leading to even lower water bills.

# Waste Management

India has drawn world's attention with its high paced urbanization and industrialization. Over the last decade, India has emerged as the fastest growing country with rapid economic growth. A renewed focus on sustainable growth and development is imperative as India strives to maintain its high GDP growth rate in its pursuit of achieving developed country status by the year 2022. However, the flip side of higher economic growth has resulted in increased consumption of the natural resources, increased waste generation and hence ecological degradation.

**Present status:** NRIIT has initiated waste management activities inside its facility. Separate bins have been provided for different types of wastes. Waste bins are provided throughout the campus and students are being urged to use the bins effectively.

Recommendation: The waste management yard must be maintained in a similar fashion as that of a raw material storage room. Therefore, a total revamp of the waste storage yard is to be carried out. By doing so, the quality of the materials stored in the yard will not deteriorate and can be used a raw material for a subsequent process.

## **Enhance awareness creation, training and capacity building**

NRIIT should focus on implementing sustainable waste management practices. NRIIT should regularly interact with Pollution Control Board and TSDF operators to enhance knowledge on waste management. The team should also take efforts to communicate the waste management and other policies and activities to all students in the college.

## **Achieve zero liquid discharge status**

NRIIT may install a STP to treat and recycle water. The treated water from STP can be used to substitute freshwater by utilizing the treated water in both high end and low-end applications.

# Conclusion

Environmental sustainability is a continuous process and there is always a scope for improvement. NRIIT has displayed itself as an advocate of environmental sustainability by getting environmental audit carried out. The organization has implemented several initiatives and measures to enhance efficiency and to optimize resource intensity. The journey ahead in the path towards environmental excellence has immense scope for improvement as brought out by this report.

NRIIT needs to focus and work on areas efficiency levels needs to be enhanced. For example: waste management. The observations and suggestions put forth by the report would help the facility in improving its environmental performance and pave way for ecologically sustainable growth.

This report may be taken as a guide and roadmap for achieving higher performance rating in environmental stewardship. As one of the pioneers and leaders NRIIT shoulder the task of further 'learning – teaching – learning' to improve, excel, and continue the innovative efforts for success of their students and associates.