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# ASSESSMENT OF ENERGY AND WATER AUDIT OF SELECTED SCHOOL OF AHMEDABAD

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## *ABSTRACT:*

Climate change is one of the most significant environmental and societal issues of our time. This increase in temperature would have catastrophic consequences for the planet. To mitigate the impacts of climate change, urgent action is required at both the individual and societal levels. Energy audit is an essential process of identifying, analyzing, and evaluating the energy consumption patterns of a building or facility. Water audit is the process of analyzing water usage and identifying opportunities for conservation and efficiency improvements. A water audit can help individuals and organizations understand how much water they are using, this general structure of the energy assessment has undergone a few changes, It includes collecting data on water usage, identifying leaks and inefficiencies, and implementing measures to reduce water waste Which Was Created By American Water Works Association (AWWA) And International Water Association (IWA) In 2000.

**Key word**: Energy Audit, Energy conservation, Water Audit, Save Water

## INTRODUCTION:

Climate change is one of the most significant environmental and societal issues of our time. It refers to the long-term changes in the Earth's climate system, including rising temperatures, sea level, and changes in precipitation patterns. These changes are primarily driven by human activities, such as the burning of fossil fuels, deforestation, and agricultural practices. Climate change poses a significant threat to the planet's ecosystems and human civilization, as it can lead to more frequent and severe natural disasters, food and water insecurity, and the displacement of populations.

The Intergovernmental Panel on Climate Change (IPCC) has warned that global temperatures could rise by up to 4.8 degrees Celsius by the end of this century if greenhouse gas emissions are not significantly reduced (IPCC, 2014). This increase in temperature would have catastrophic consequences for the planet, including melting glaciers and polar ice caps, rising sea levels, and more frequent extreme weather events, such as droughts, floods, and hurricanes.

Climate change effects are already being seen globally. For example, rising sea levels are threatening the existence of island nations, while droughts and heat waves are reducing crop yields and causing food shortages in many parts of the world. In addition, the frequency and intensity of natural disasters, such as hurricanes and wildfires, have increased in recent years, causing widespread devastation and loss of life.

To mitigate the impacts of climate change, urgent action is required at both the individual and societal levels. This entails encouraging sustainable land use practices, enhancing energy efficiency, and lowering greenhouse gas emissions via the use of renewable energy sources. It also requires adaptation measures, such as developing early warning systems and building infrastructure to withstand extreme weather events.

Energy audit is an essential process of identifying, analyzing, and evaluating the energy consumption patterns of a building or facility. It helps to understand the energy usage, identify areas of energy wastage, and recommend measures to improve energy efficiency. Energy audits are necessary to reduce energy consumption, lower energy bills, and reduce

the carbon footprint. The process involves assessing the lighting, HVAC, electrical systems, and building envelope to identify areas of improvement.

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has developed a comprehensive procedure for energy audits known as ASHRAE Level I, II, and III energy audits. These audits provide a standardized approach to evaluate energy usage and recommend measures to reduce energy consumption. Energy audits are becoming increasingly popular in the building industry due to the need to reduce energy consumption and comply with energy codes and standards.

Energy audits are essential for any building owner or facility manager seeking to reduce energy consumption and costs. The process helps to identify potential energy savings and provides a roadmap to achieve energy efficiency goals. In addition, energy audits contribute to reducing greenhouse gas emissions, thus protecting the environment.
Water audit is the process of analyzing water usage and identifying opportunities for conservation and efficiency improvements. A water audit can help individuals and organizations understand how much water they are using, where it is being used, and how it can be better managed to save money, reduce water waste, and protect the environment.

The water audit process typically involves gathering data on water consumption, identifying leaks and inefficiencies, evaluating water-using equipment and fixtures, and recommending strategies for reducing water usage. Water audits can be conducted on a residential, commercial, or industrial scale and can be performed by individuals or specialized companies.

Water conservation is increasingly important in the face of growing water scarcity and climate change. By conducting regular water audits and implementing conservation strategies, individuals and organizations can play a vital role in protecting water resources and promoting sustainability.

## RESEARCH & METHODOLOGY:

**ENERGY AUDIT:**

The methodology of Energy Audits used in this study has been constant in order to achieve the intended findings suitable for the project location. The stages methodology for performing an energy audit at the field level is described below in more detail. This general structure of the energy assessment has undergone a few changes, including energy management potential research is necessary at the school level.

**Pre-audit phase**

- Organize your plans. Auditing on the move a casual conversation with an energy controller.
- Conduct of a series of quick meetings with all department leaders.

**Audit phase**

- The process of collecting data straight from the source.
- Watch and conduct surveys.
- Detailed testing and experimentation with the equipment with the greatest energy usage.
- Study of electricity consumption.
- Finding and developing chances for energy saving.
- The cost-benefit study.
- Finally, a well-executed cost-benefit analysis provides decision-makers with the data they need to make informed choices about which energy-saving measures to engage in and which to postpone or avoid.
- Reporting to senior management and making presentations to them.

**post-audit phase**

- Implementation and follow-up.

- Awareness programme.

**Research questioner:**

Name of school: _____

No of Rooms: _____

No of students: _____

**Table 1: Energy appliance data table**

| Appliance | No of appliance. | Capacity [watt] | Durations [hr/day] | Daily consumptions [Kwh/day] |
|---|---|---|---|---|
| Fan | | | | |
| Incandescent | | | | |
| Lamps | | | | |
| CFLs | | | | |
| LEDs | | | | |
| Halogen Lamps | | | | |
| Tube light | | | | |
| CCTV | | | | |
| R.O | | | | |
| WATER PUMP | | | | |
| COMPUTER LAB | | | | |
| A.C | | | | |
| Printer | | | | |
| Speaker & mics | | | | |
| Refrigerator | | | | |
| Other | | | | |

**WATER AUDIT:**

Water audit methodology involves analyzing the water consumption and losses within a system or facility to identify areas where water efficiency can be improved. It includes collecting data on water usage, identifying leaks and inefficiencies, and implementing measures to reduce water waste. Regular water audits can help conserve water resources and save money on water bills.

The standard water balance or the framework for categorising and measuring all water consumption in the water audit is called methodology. It is known as a balance because, when finished, Water input from the sources is equal to all water consumption in the system [18].In Figure 1. This is the most popular approach to understanding the often-used water balance, which was created by American Water Works Association (AWWA) and International Water Association (IWA) in 2000. It can also be shown as individual equations or as a spread sheet. It's critical to realise that each category's vertical height corresponds to a certain volume of water. Thus, the volume of water pumped by the system over a specific period is represented by the height of the System Input category. Authorized Use and Water Losses are two other categories that apply to this amount of water. Therefore, Authorized Use + Water Losses = System Input. The whole standard water balance uses this vertical height water measurement.

- Water Losses = Apparent Losses + Real Losses.
- Nonrevenue Water = Water Losses + Unbilled Authorized Use.
- Apparent Losses = Metering Inaccuracies + Unauthorized U

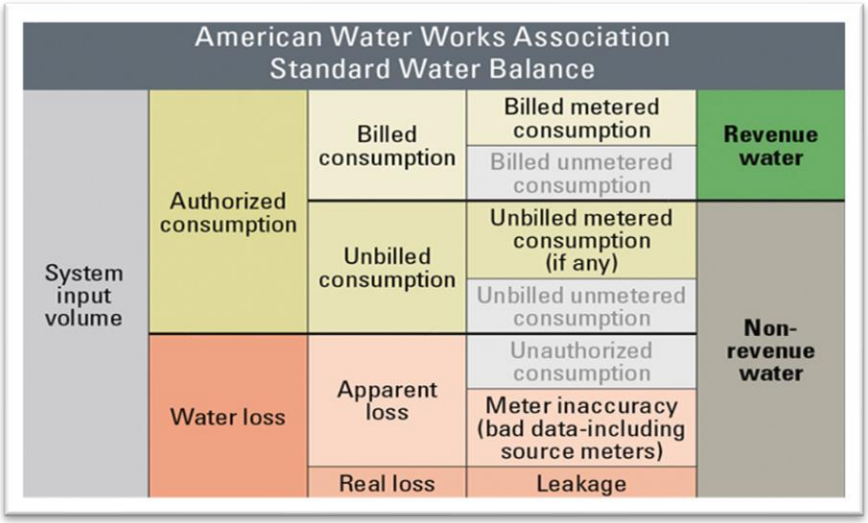


Figure https://www.leakssuitelibrary.com/iwa-water-balance/

Thus, solving these equations requires following the five-step procedure listed below.

- Source Evaluation.
- Calculation of Authorized Consumption.
- Evaluation of Apparent Losses.
- Evaluation of Real Losses.
- Performance Measurement.

Source Evaluation:

When conducting a water audit, it is important to consider the quality and reliability of the data sources used. Here are some factors to consider when evaluating sources of data for a water audit

1. Accuracy:
2. Timeliness:
3. Completeness:
4. Accessibility:
5. Consistency:
6. Transparency:
7. Expertise:

By carefully evaluating the quality and reliability of data sources, a water audit can provide accurate and actionable information to improve water efficiency and reduce water loss.

Calculation of Authorized Consumption:

Authorized consumption is the amount of water that is expected to be used by a customer or facility, based on their water usage history and other factors. Here are the steps to calculate authorized consumption for a water audit:

1) Gather historical water usage data:
2) Determine the billing period:
3) Calculate the average daily consumption:
4) Calculate the authorized consumption:
5) Compare actual consumption with authorized consumption:

Evaluation of Apparent Losses:

Apparent losses refer to water losses that are not related to physical leaks or other visible causes but are due to factors such as inaccurate metering, data handling errors, or unauthorized consumption. Here are the steps to evaluate apparent losses for a water audit:

1) Gather data:
2) Calculate the actual losses:
3) Calculate the expected losses:
4) Compare actual and expected losses:
5) Analyse the causes of apparent losses:

6) Develop strategies to reduce apparent losses:

By evaluating apparent losses, water users can identify areas for improvement and take steps to reduce water waste and promote sustainable water management practices.

Evaluation of Real Losses:

Real losses refer to water losses that occur due to physical leaks or other visible causes in the water distribution system. Here are the steps to evaluate real losses for a water audit:

1. Conduct a leakage detection survey:
2. Measure the amount of water lost:
3. Calculate the real loss index:
4. Identify the causes of real losses:
5. Develop strategies to reduce real losses:
6. Monitor and evaluate the effectiveness of the strategies:

By evaluating real losses and taking steps to reduce them, water users can save water, reduce water waste, and promote sustainable water management practices.

Performance Measurement:

Performance measurement is an essential component of water auditing to track progress towards improving water efficiency and reducing water losses. Here are some key performance indicators (KPIs) that can be used for performance measurement in a water audit:

1. Non-revenue water (NRW):.
2. Water consumption per capita:
3. Water loss reduction rate:
4. Water efficiency ratio:
5. Water balance:
6. Water audit implementation rate

By tracking these KPIs over time, water users can identify areas for improvement and take steps to reduce water waste and promote sustainable water management practices. The data collected through performance measurement can also be used to evaluate the effectiveness of water management strategies and initiatives and to make informed decisions about future investments in water infrastructure and technology.

**Research questioner:**

**Table 2: water loss data table**

| | system input | Total litter consumed | Total customers | Use per person | total real losses | Percentage of water loss % |
|---|---|---|---|---|---|---|
| System 1 | | | | | | |
| System 2 | | | | | | |
| System 3 | | | | | | |
| System 4 | | | | | | |

SOURCE OF WATER: AMC/ BOREWELL

_____

IF BOREWELL IS THERE, HOW MANY?

_____

HOW MANY UNDERGROUND TANKS ARE THERE?

_____

STORAGE CAPACITY OF UGT?

_____

HOW MANY OVER HEAD TANKS ARE THERE?

_____

STORAGE CAPACITY OF OHT?

_____

HOW MANY TIME FILLED AND TIME?

_____

LEAKAGE TAP, HOW MANY?

_____

WASHING CAR, BIKE …

_____

WATERING GARDENS, LAWNS

_____

DRINKING WATER?

_____

OTHER WASTE WATER

_____

**Study area:**

The largest metropolis in the Gujarat province of India is Ahmedabad. It serves as both the Gujarat High Court's location and the executive centre for the Ahmedabad region. According to the 2011 census, Ahmedabad had a population of 5,570,585, making it the fifth most populous city in India. The surrounding metropolitan agglomeration had a population of 6,357,693, making it the seventh most popular city in India. Ahmedabad is situated close to the Sabarmati River's shores, 25 kilometres (16 miles) from Gandhinagar the capital and neighbouring city of Gujarat.

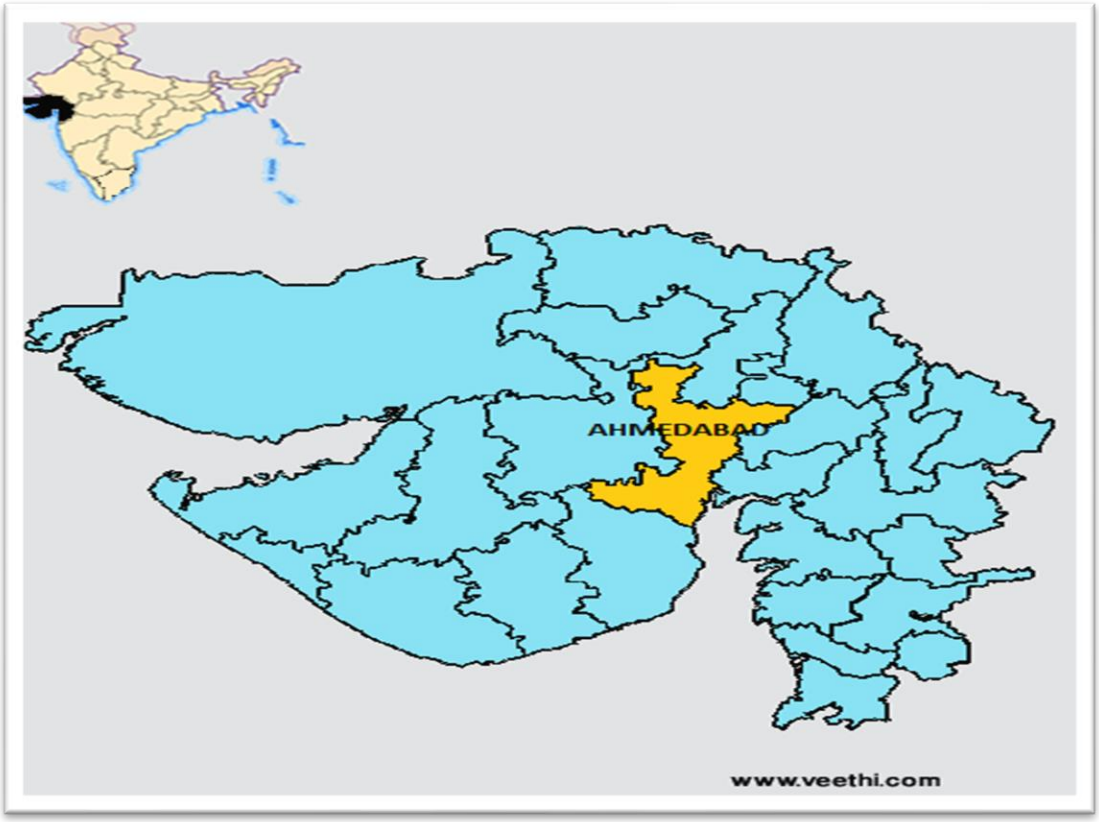


Figure 1: Ahmedabad location in Gujarat map

**PRANAM SCHOOL:**

Our Pranam School is in the Sarkhej zone. Sarkhej is accessible through National Highways NH 8A and NH 8C and the Sardar Patel Ring Road. Sarkhej is an important godown area for Ahmedabad. Warehousing and Distribution for entire Gujarat is done from Sarkhej. Sarkhej has a meter gauge Railway Station.

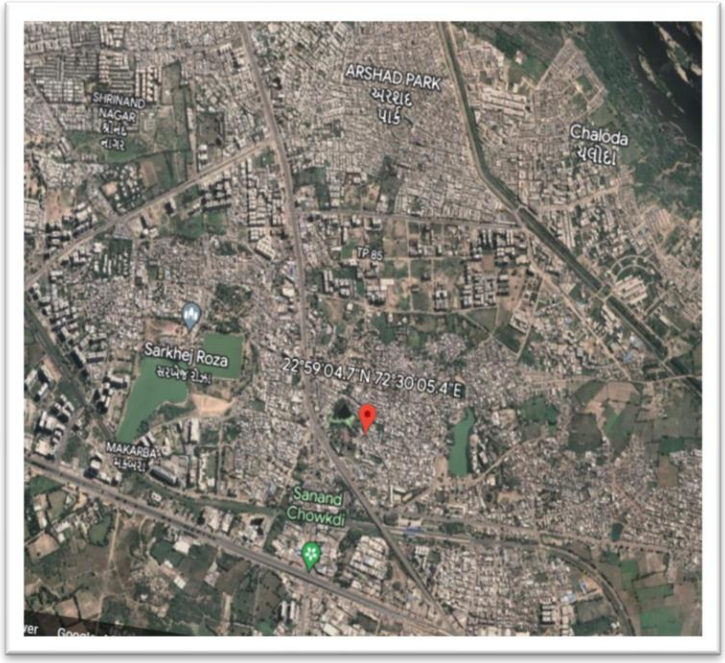


Figure 2: SATELLIETE IMAGE OF PRANAM SCHOOL

Figure1:https://earth.google.com/web/search/22.984639380844673,+72.5015112102999/@22.98622443,72.50663315,61.75019907a,5560.35429582d,35y,93.50472823h,0t,0r/data=CmgaPhI4GWJa5VMR_DZAIfmkbsIYIFJAKiQyMi45ODQ2MzODA4NDQ2NzMsIDcyLjUwMTUxMTIxMDI5OTkYASABIiYKJAk1Sms20Pw2QBGfQNFsUvs2QBlJMuyKhCBSQCGtF_H5rB9SQA

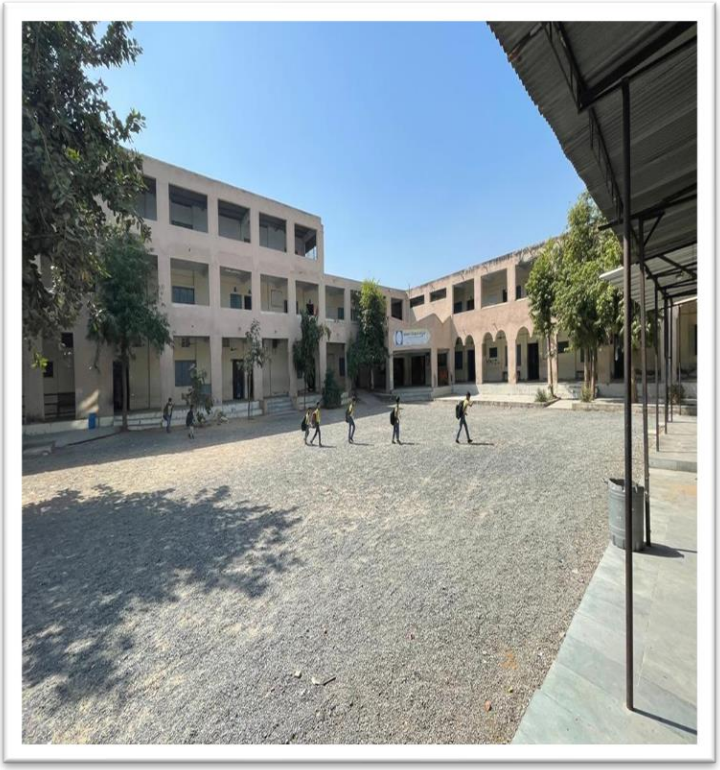

Figure 3: IMAGE OF PRANAM SCHOOL

ANKUR SCHOOL:

Our Ankur School is in the paldi zone. Paldi is an area located in South Western Ahmedabad, India. Corporate offices and city centres of many national and international companies like ICICI Bank, Royal Bank of Scotland, Reigate, Claris, and Gujarat Gas are located within Paldi. It accommodates the Shankar Kendra museum by the renowned architect Le Corbusier as well as Tagore Memorial Hall. The National Institute of Design is located in Paldi. M K Gandhi's first ashram in India, Kochrab Ashram is also located in Paldi. This area has many houses of the Art Deco period.


Figure 3: satellite image of Ankur School

Figure4:https://earth.google.com/web/search/23.00877028620027,+72.56000916446213/@23.00914432,72.5600727,71.56915252a,775.05104221d,35y,129.47366891h,44.99880358t,-0r/data=CmgaPhI4GRWtN8UAjdAIWLd0zDXI1JAKiQyMy4wMDg3NzAyODYyMDAyNywgNzIuNTYwMDA5MTY0NDYyMTMYASABIiYKJAmLUwrFuwI3QBHXqSDxdAE3QBk80O1qISRSQCF5pvlKgiNSQA

**Figure 5: image of Ankur School**

## RESULT AND DISCUSSION:

**Energy audit:**

Name of school: Pranam School, Sarkhej.
No of Rooms: 33
No of students: 350

**Table 3: energy audit appliance data**

| Appliance | No of appliance. | Capacity [watt] | Durations [hr/day] | Daily consumptions [Kwh/day] |
|---|---|---|---|---|
| Fan | 80 | 75 | 06 | 36 |
| Incandescent | 00 | 00 | 00 | 00 |
| Lamps | 00 | 00 | 00 | 00 |
| CFLs | 00 | 00 | 00 | 00 |
| LEDs | 05 | 15 | 06 | 0.45 |
| Halogen Lamps | 00 | 00 | 00 | 00 |
| Tube light | 40 | 40 | 06 | 9.60 |
| CCTV | 45 | 10 | 24 | 10.8 |
| R.O | 0 2 | 500 | 04 | 04 |
| WATER PUMP | 02 | 150 | 01 | 0.3 |
| COMPUTER LAB | 15 | 300 | 03 | 13.5 |
| A.C | 04 | 1500 | 03 | 18 |
| Printer | 01 | 20 | 01 | 0.002 |
| Speaker & mics | 01 | 50 | 01 | 0.002 |
| Refrigerator | 01 | 600 | 12 | 7.2 |
| Other | 00 | 00 | 00 | 00 |

**Formula for calculation:**

Energy consumption (in kilowatt-hours, kWh) = no of appliance x Power rating (in watts, W) x Operating time (in hours, h) / 1,000

**Water audit:**

**Table 4: water losses data**

| | system input | Total litter consumed | Total customers | Use per person | total real losses | Percentage of water loss % |
|---|---|---|---|---|---|---|
| System 1 | 6000 | 5990 | 350 | 05 | 10 | 10% |
| System 2 | 1500 | 1500 | 350 | 05 | 00 | 00 |
| System 3 | 1500 | 1490 | 350 | 05 | 10 | 10% |
| System 4 | 00 | 00 | 00 | 00 | 00 | 00 |

SOURCE OF WATER: AMC / BOREWELL

IF BOREWELL IS THERE, HOW MANY?

HOW MANY UNDERGROUND TANKS ARE THERE?
Ans: No
STORAGE CAPACITY OF UGT?
Ans: 00
HOW MANY OVER HEAD TANKS ARE THERE?

Ans: 12
STORAGE CAPACITY OF OHT?
Ans: 9000 litre
HOW MANY TIME FILLED AND TIME?
Ans: 1 time
LEAKAGE TAP, HOW MANY?
Ans: 00
WASHING CAR, BIKE …
Ans: 2 litres
WATERING GARDENS, LAWNS
Ans: 500 litres
DRINKING WATER?
Ans: 200 litres

**Energy audit:**

Name of school: Ankur School, Paldi.
No of Rooms: 40
No of students: 3000

**Table 5: energy appliance data**

| Appliance | No of appliance. | Capacity [watt] | Durations [hr/day] | Daily consumptions [Kwh/day] |
|---|---|---|---|---|
| Fan | 160 | 40 | 10 | 64 |
| Incandescent | 00 | 00 | 00 | 00 |
| Lamps | 00 | 00 | 00 | 00 |
| CFLs | 00 | 00 | 00 | 00 |
| LEDs | 00 | 00 | 00 | 00 |
| Halogen Lamps | 05 | 150 | 03 | 2.25 |
| Tube light | 160 | 20 | 10 | 32 |
| CCTV | 75 | 10 | 24 | 18 |
| R.O | 0 2 | 500 | 04 | 4 |
| WATER PUMP | 01 | 300 | 1.5 | 0.9 |
| COMPUTER LAB | 35 | 300 | 06 | 63 |
| A.C | 10 | 1500 | 05 | 90 |
| Printer | 02 | 20 | 02 | 0.004 |
| Speaker & mics | 01 | 50 | 02 | 0.1 |
| Refrigerator | 02 | 1000 | 24 | 48 |
| Other | 00 | 00 | 00 | 00 |

**Water audit:**

**Table 6: water losses data**

| | system input | Total litter consumed | Total customers | Use per person | total real losses | Percentage of water loss % |
|---|---|---|---|---|---|---|
| System 1 | 10000 | 10000 | 3000 | 03 | 00 | 00% |
| System 2 | 2000 | 1990 | 3000 | 03 | 10 | 10% |
| System 3 | 2000 | 1995 | 3000 | 03 | 05 | 05% |
| System 4 | 1000 | 995 | 3000 | 03 | 05 | 05% |

SOURCE OF WATER: AMC / BOREWELL

IF BOREWELL IS THERE, HOW MANY?

Ans: 01

HOW MANY UNDERGROUND TANKS ARE THERE?
Ans: 01
STORAGE CAPACITY OF UGT?
Ans: 10,000 litres
HOW MANY OVER HEAD TANKS ARE THERE?
Ans: 06
STORAGE CAPACITY OF OHT?
Ans: 6000 litre
HOW MANY TIME FILLED AND TIME?
Ans: 1 time, 1.5 hour
LEAKAGE TAP, HOW MANY?
Ans: 00
WASHING CAR, BIKE …
Ans: 00
WATERING GARDENS, LAWNS
Ans: 50 litres
DRINKING WATER?
Ans: 200 litres

OTHER WASTE WATER

## CONCLUSION:

- In conclusion, an energy audit is a valuable tool for identifying areas where energy is being wasted and for finding opportunities to improve energy efficiency. The audit process involves a thorough review of energy consumption patterns, equipment usage, and building systems to identify inefficiencies and areas for improvement. Based on the findings of the audit, energy-saving measures can be implemented, such as upgrading equipment, implementing energy management systems, and improving maintenance practices. These measures can help reduce energy consumption, save costs, and reduce greenhouse gas emissions. Overall, an energy audit can provide significant benefits to both the environment and the bottom line of businesses and organizations. By reducing energy waste and improving energy efficiency, an energy audit can help contribute to a more sustainable future and a cleaner environment.
- In conclusion, conducting a water audit can help identify ways to reduce water usage, save money, and conserve our precious natural resources. By examining the water usage patterns of a facility and identifying areas for improvement, a water audit can help identify and implement water conservation measures that can make a significant difference. Some tips to save water based on the water audit findings may include fixing leaks, installing low-flow fixtures, using water-efficient appliances, changing water use behaviour, and spreading awareness about the importance of water conservation. These tips, when implemented, can help reduce water usage, save money on water bills, and protect the environment. Overall, a water audit is a valuable tool in identifying opportunities for water conservation and should be considered an essential part of any water management plan. By working together to conserve water, we can ensure that this vital resource is available for generations to come.

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