# Environmental & Green Audit Report 2017-2018

## Punyashlok Ahilyadevi Holkar Solapur University

Solapur Pune National Highway, Kegaon, Solapur, Maharashtra - 413255

By
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## Acknowledgement

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We would like to thank each and every staff member at the university who helped us collect the resourceful data. Last but not the least; we thank our team for their unwavering support.

- Greenex Environmental

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# 1.0 Introduction

## 1.1 PAH Solapur University

Punyashlok Ahilyadevi Holkar Solapur University is a young state University of Maharashtra state and was established as 'Solapur University' on 1st August 2004. The formation of the University at Solapur was a long cherished desire of the people of this region and the people of the district have an emotional attachment to the University since its inception. The name of Solapur University was extended to as Punyashlok Ahilyadevi Holkar Solapur University by the state government on March 2019. The University has been recognized by University Grants Commission (UGC) u/s 2(F) and 12(B) of its Act. It is also been recognized by All India Council for Technical Education (AICTE), National Council for Teacher Education (NCTE) and other apex bodies. National Assessment and Accreditation Council (NAAC) has awarded B++ Grade to the university in its second cycle.

Earlier to the formation of Solapur University, Solapur city had a P. G. Center of Shivaji University, Kolhapur since 1984. The center for P. G. Studies had three postgraduate science departments housed in two buildings and a central Library building on its campus that spread over a total area of 37 acres. Seven postgraduate courses were offered in that P.G. centre. Eventually, this PG Centre was transformed in to the new University and separated from Shivaji University in 2004.

Punyashlok Ahilyadevi Holkar Solapur University is now located on the outskirts of Solapur city, about 10 km from the main city, on the national highway NH-09 towards Pune side. The proximity with the national highway provides good connectivity. It is a matter of great pride that the university has made big strides within a short span. Nine new buildings, for School of Computational Sciences, School of Social Sciences, School of Earth Sciences, Central Instrumentation centre, Girls' hostel with an accommodation facility for 80 girls; Boys' hostel with accommodation for 200 boys, Rector's bungalow, University Guest House and VIP Bungalow have been added to the existing buildings of School of Chemical Sciences, School of Physical Sciences and Library cum administrative building.

The University is relentlessly putting its endeavours in enhancing the standards in teaching, research, skill based programs, extra-curricular and sports activities. The University has introduced new schools like School of Commerce and Management, School of Languages and Literature, School of Performing Arts and Fine Arts, School of Allied Health Sciences, School of Technology, School of Life Sciences and many new courses in recent times. At the same time, some of the existing courses are modified so as to strike the right balance between the theoretical and applied components in the curriculum. Bridge courses are initiated by the schools to admit students from other faculties to the main stream courses. There is a strong research pursuance and publications carried out by each

school. The University is committed to the all-round developments of students. As a result, a number of students have been bringing laurels at the state and national youth festivals, sports and research events.

The University has been regularly organizing State level, inter University level and international seminars, conferences, sports and research events. The University has developed its sports facilities and health centre in the extended campus. Construction of the new Administrative and examination building has started at the state Government allocated approx. 500 acre land near to the old campus. The installation of an impressive Horse riding statue of Punyashlok Ahilyadevi and development of a museum centre work are in progress at the new campus too.


**Figure 1: Punyashlok Ahilyadevi Holkar Solapur University**

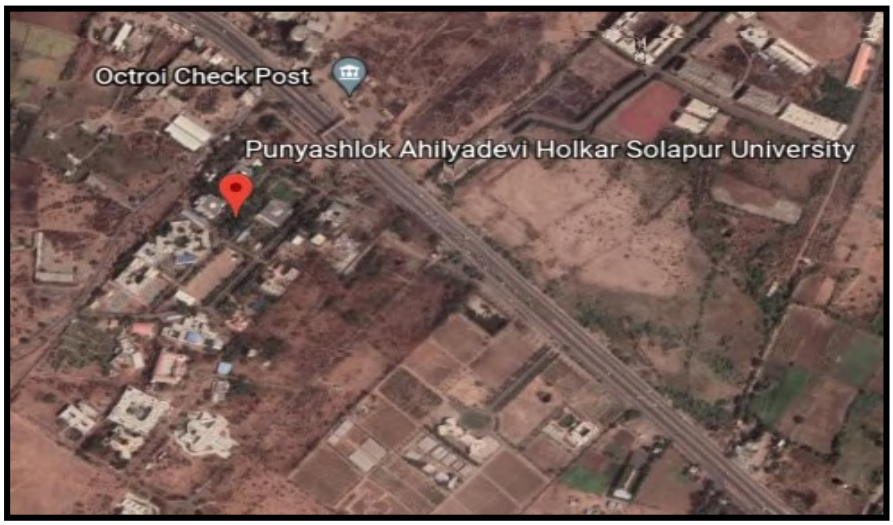



**Figure 2: Satellite image of Punyashlok Ahilyadevi Holkar Solapur University**

### 1.2 Infrastructure

There are 20 buildings in the University Campus. Areas of these buildings are as below:

**Table No. 1: Area Bifurcation of the University**

| Sr. No. | Particulars | Total Area in Sq. m |
|---|---|---|
| **1.** | Computational Science | 2,460.03 |
| **2.** | Social Sciences | 3,151.07 |
| **3.** | Physical Sciences | 2,307.25 |
| **4.** | Earth Sciences | 2,163.59 |
| **5.** | Chemical Sciences | 2,054.63 |
| **6.** | Admin - Library | 1,015.04 |
| **7** | Instrumentation Centre | 190.16 |
| **8.** | Boys Hostel | 1,376.00 |
| **9.** | Mess | 492.50 |
| **10.** | Rector Quarters | 81.86 |
| **11.** | Ladies Hostel | 9,987.96 |
| **12.** | Mess – I | 261.15 |
| **13.** | Mess – II | 261.15 |
| **14.** | VIP Guest House | 1,866.59 |
| **15.** | Stage | 402.98 |
| **16.** | Canteen Area | 363.00 |
| **17.** | **Total Free space in the 32.5 acres campus** | 18,500.00 |
| | **Total** | **28,497.33** |

All the buildings in the University are well-spaced and well constructed to provide proper illumination and ventilation. More than 40% of the campus area is covered with vegetation, giving it an aesthetic view and providing a healthy environment. All the buildings in the campus have open courtyards which consist of various plants and skylights.

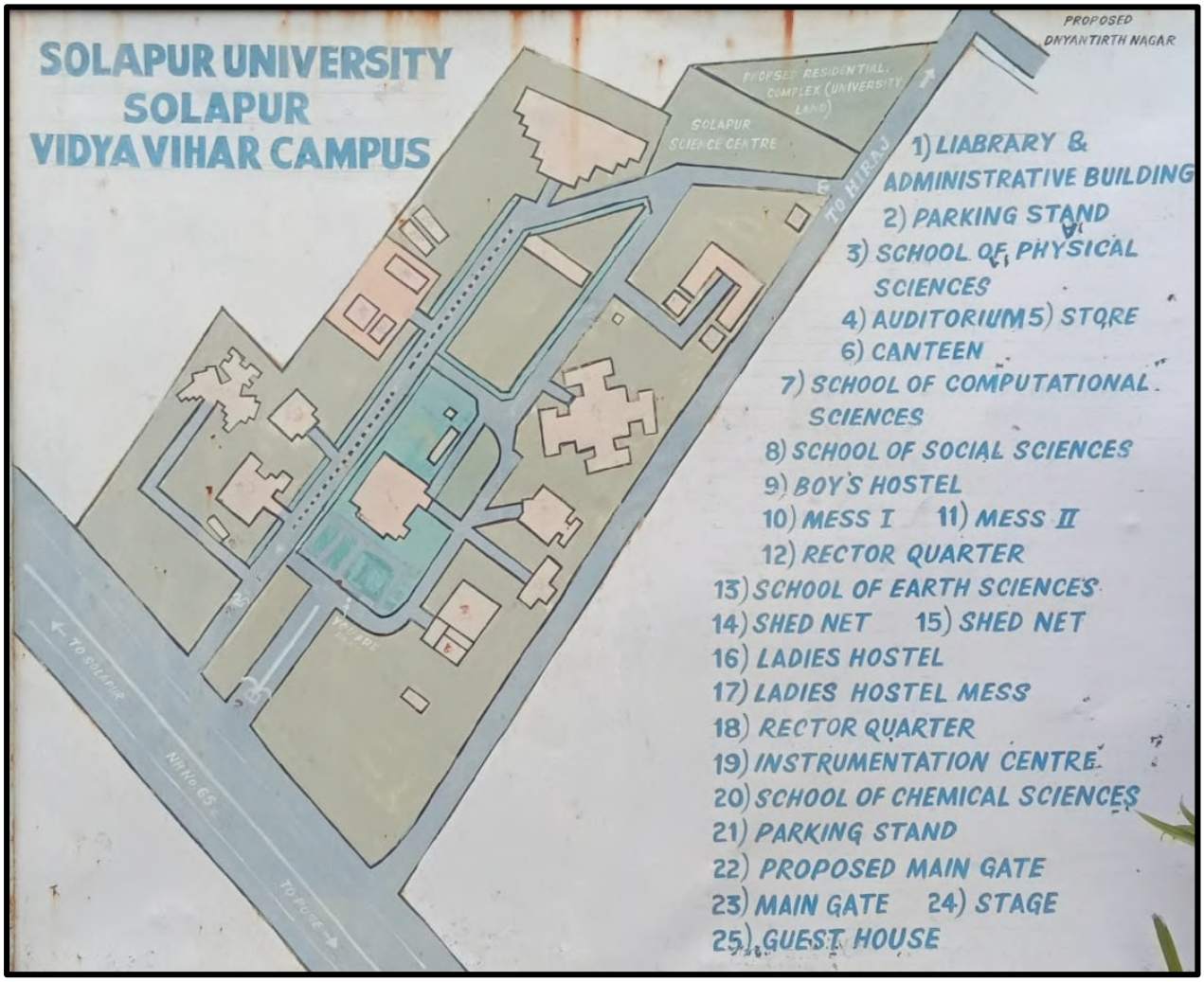



**Figure 3: Layout of PAH Solapur University**


**Figure 4: School of Physical Sciences**

**Figure 5: School of Chemical Sciences**


**Figure 6: School of Earth Sciences**


**Figure 7: School of Social Sciences and Commerce & Management**

**Figure 8: School of Computational Sciences**

## 1.3 Vision and Mission of the University

**Vision**

Enrich research, teaching skill and employability of the students with execution of best practices.

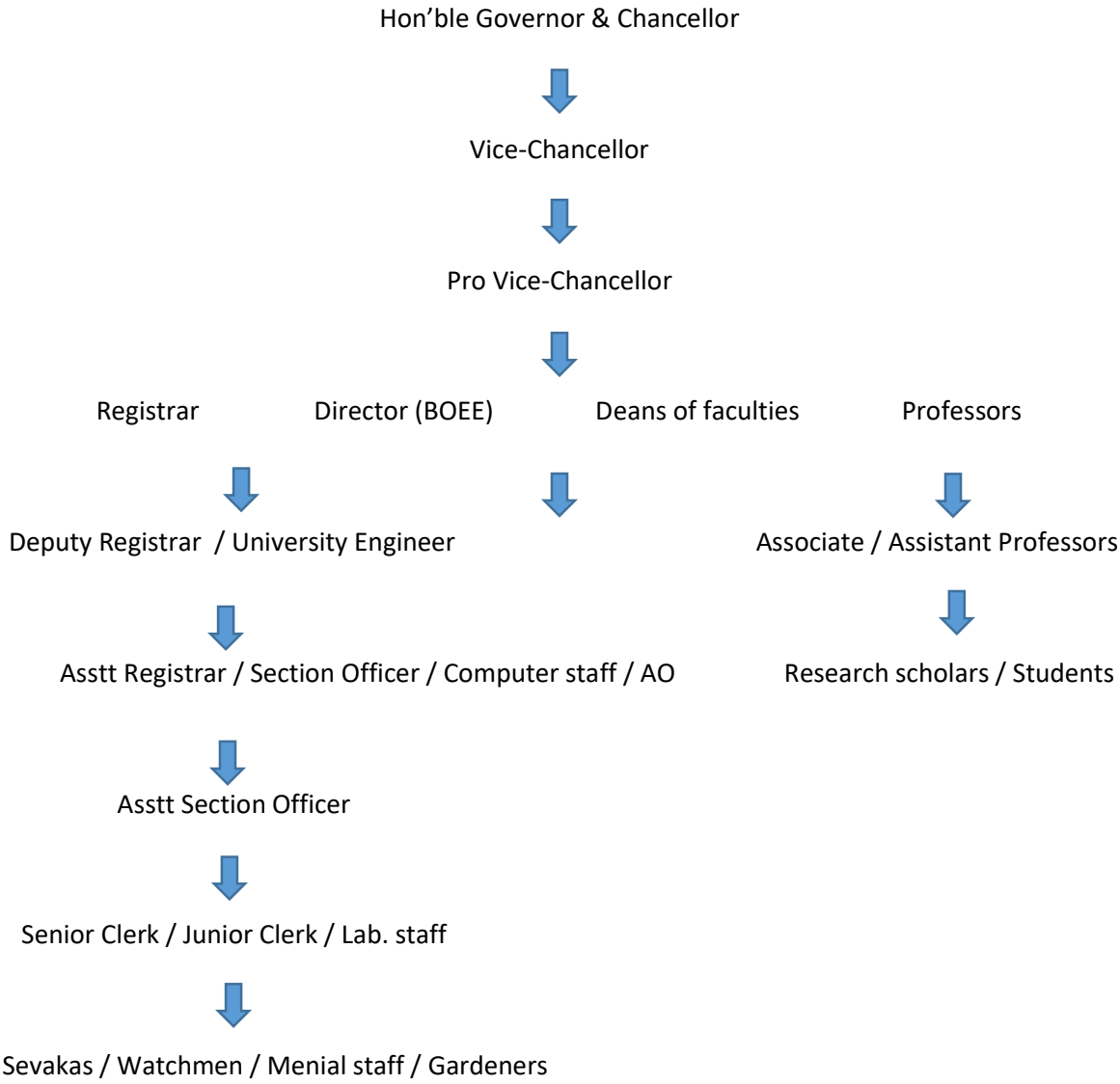
**Mission**

Empower students and teachers in various fields on the basis of global and local resources by enriching power within them.

**Goals of the institution**

- To continue to improve the quality of the undergraduate and postgraduate courses that prepares the students for professional life, leadership and citizenship in a changing world.
- To make special efforts to provide access to higher education to economically challenged and underprivileged sections of the society.
- To optimize the usage of resources and infrastructure in an integrated fashion to improve, enhance and strengthen the students' faculties.
- To produce global students with Indian ethos.
- To inculcate self-discipline and high ethical standards, among students, staff, faculty and societal individuals.
- To create a pool of self-motivated and dedicated researchers.
- To provide facilities and support to the staff to take up innovative methods of teaching in accordance with the developments in the academic world and also take care of the development in industry and commerce.
- To transform the 'Student' into "Knowledge Professional" empowered with scientific intellect, entrepreneurial skills, and innovation, who have learnt their skills in a highly competent environment under the guidance of research oriented and skilled Professors.
- To create an ambience for learning and scholarship.
- To become a nationally renowned Centre of Excellence in teaching - learning, research and extension activities, beneficial to the current and forth coming generations.

## 1.4 Organizational Structure of the University




**UNIVERSITY STATUTORY AUTHORITIES**

**The Senate, Academic Council, Management Council, Board Of Examinations, Board of Deans** and many other bodies as per Maharashtra Public University Act 2016

# 2.0 Environmental and Green Audit – A Preview

## 2.1 Environmental Audit

An environmental audit is a type of evaluation intended to identify environmental compliance and management system implementation gaps, along with related corrective actions. In this way, environmental audit performs an analogous (similar) function to financial audit. There are generally two different types of environmental audits: compliance audits and management systems audits. ISO 14001 is a voluntary international standard for environmental management systems ("EMS"). ISO 14001:2004 provides the requirements for an EMS and ISO 14004gives general EMS guidelines.

The Supreme Audit Institution (SAI) in India is headed by the Comptroller and Auditor General (CAG) of India which is a constitutional authority. The audit conducted by CAG is broadly classified into Financial, Compliance and Performance Audit. Environmental audit by SAI India is conducted within the broad framework of compliance and performance audit.

Environmental auditing is a systematic, documented, periodic and objective process in assessing an organization's activities and services in relation to:

- Assessing compliance with relevant statutory and internal requirements
- Facilitating management control of environmental practices
- Promoting good environmental management
- Maintaining credibility with the public
- Raising staff awareness and enforcing commitment to departmental environmental policy
- Exploring improvement opportunities
- Establishing the performance baseline for developing an Environmental Management System (EMS)


**Figure 9: Aspects of Environmental Audit**

**Figure 10: Green Campus Illustration**

## 2.2 Green Audit

Green Audit is a part of Environmental Audit. Green Audit is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of various establishments. It aims at analyzing environmental practices within and outside of the concerned sites, which will have an impact on the eco-friendly ambience.

Green audit can be a useful tool for an academic institution to determine how and where the institutions using the energy or water or resources more than requirements.. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan. It can create health consciousness and promote environmental awareness, values and ethics. It provides staff and students a better understanding of Green impact on campus. Thus it is imperative that the institute evaluates its own contributions towards a sustainable future. As environmental sustainability is becoming an increasingly important issue for the nation and for the world, the role of higher educational institutions in relation to environmental sustainability is more significant.

The rapid urbanization and economic development at local, regional and global level has led to several environmental and ecological crises. On this background, it becomes essential to adopt the system of the Green Campus for the institutes which will lead towards sustainable development and at the same time reduce a sizable amount of atmospheric carbon-dioxide from the environment. **Green Audit is assigned to the Criteria 7 of NAAC (National Assessment and Accreditation Council)evaluation** that declares the institutions as Grade A, Grade B or Grade C according to the scores gained at the time of accreditation. Moreover, it is a part of the responsibility of the Higher Educational Institutions to ensure that there is reduction of global warming through Carbon Footprint reduction measures.

Therefore, the need or purpose of the green audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards.

## 3.0 Objectives of Green audit

The overall objectives of green auditing are to help safeguard the environment and minimize risks to human health. The key objectives of an environmental audit therefore are:

- To determine how well the environmental management systems and equipment are performing
- To verify compliance with the relevant national, local or other laws and regulations
- To minimize human exposure to risks from environmental, health and safety problems.
- More efficient resource management
- To provide basis for improved sustainability
- To enable waste management through reduction of waste generation, solid- waste and water recycling
- To create plastic free campus and evolve health consciousness among the stakeholders
- To recognize the cost saving methods through waste minimizing processes
- To point out the prevailing and forthcoming complications
- Impart environmental education through systematic environmental management approach and improving environmental standards
- Financial savings through a reduction in resource use
- Enhancement of University profile
- To develop an environmental ethics and value system amongst students

## 4.0 Goals of Green Audit

- To achieve compliance standards and establish a report with regulatory bodies
- To identify needs, strengths, and weaknesses of the educational institute
- To review management systems and identify liabilities
- To assess environmental performance of the educational institute with the help of direct assessment.
- To promote environmental awareness among the staff and students
- To conserve non-renewable resources for betterment of future
- The long term goal is to collect the baseline data in terms of environmental parameters, calculate its impact on the environment and recommend measures to reduce them

## 5.0 Target Areas of Green Auditing

- **Energy Conservation and Management:** This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles.
- **Water Quality and Conservation**: This indicator addresses water consumption, water sources, irrigation, storm water, appliances and fixtures.
- **Biodiversity Conservation**: All plant and animal species - including microorganisms - are a part of biodiversity. All types of gardens, lawns and trees are considered in this aspect.
- **Waste Management**: This indicator addresses all types of waste from the University and associated amenities. The minimization, safe handling, and ultimate elimination of these materials are essential to the long-term health of the planet.
- **Carbon Footprint:** This aspect is for quantifying the carbon emissions from all the parts of the institution and quantifying how much of it is sequestrated with the help of landscape.
- **Air quality and monitoring:** The ambient air quality w.r.t. different parameters are to be observed and measured as per the standard.
- **Noise pollution and measures:** The quantum of noise generated inside the working campus needs to be observed and measured for appropriate monitoring.

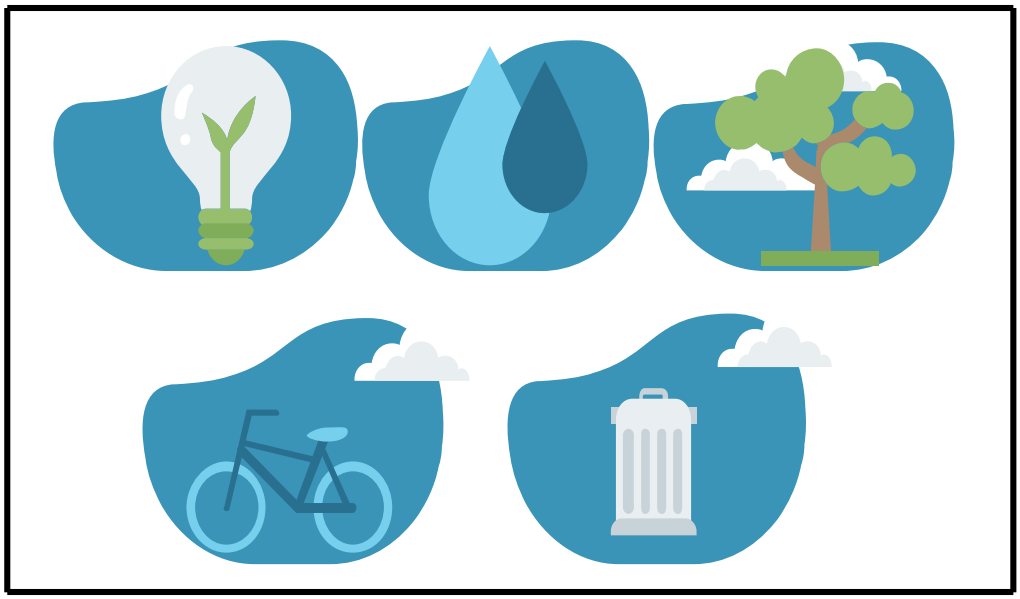


**Figure 11: Target Areas of Green Audit**

# 6.0 Methodology

## 6.1 Data Collection

In preliminary data collection phase, exhaustive data collection is performed using different tools such as preparation of questionnaire, physical inspection of the campus, observation and review of the documentation, interviewing key persons, etc. Focus groups, if practiced, can also be a vital part of data collection stage to acquire qualitative information.

## 6.2 Survey by Questionnaire

Baseline data for green audit report preparation was collected by questionnaire survey method. Most of the guidelines and formats are based on broad aspects. Therefore, using these guidelines and formats, combinations, modifications and restructuring was done and sets of questionnaires were prepared as solid waste, energy, water, biodiversity, carbon footprint.

## 6.3 Data Analysis

The data required for the analysis is taken from the data collection, it includes: calculation of energy consumption, analysis of latest electricity bill of the campus, measuring water consumption, carbon foot printing, etc. The data from questionnaire and survey forms is tabulated for the convenience of data availability; Recommendations and Environmental Management Plan is built according to the analysis done in this step.

## 6.4 Recommendations and Reporting

Based on the data analysis step, some recommendations in the target areas are made. Specific measures are suggested to reduce water and energy consumption. Proper treatments of waste are suggested with respect to waste collection, waste disposal and recycling. Recommendations to reduce the use of fossil fuels are made for the betterment of community health. Proper disposal of hazardous waste is suggested to prevent mishaps. Management also takes into account the suggestions related to reducing their carbon footprint. Similarly, the status of air and noise quality is to be reported for improvement.

# 7.0 Detailed Analysis

## 7.1 Water quality and conservation

This indicator addresses water consumption, water sources, irrigation, storm water, appliances and fixtures. The data collected from all the sections is examined and verified.

### a) Water Consumption:

**Table No. 2: Total Water Consumption per day of the University**

| Department | Water consumption per day (liters) |
|---|---|
| Social Sciences | 7875 |
| Computational Sciences | 15225 |
| Physical Sciences | 11550 |
| Instrumentation | 315 |
| Earth Sciences | 11550 |
| Chemical Sciences | 42000 |
| Girls' Hostel | 65100 |
| Boys' Hostel | 30450 |
| Mess (All) | 2100 |
| Gardening | 42000 |
| Nursery | 15750 |
| Guest House | 9450 |
| Solar Hot Water | 8400 |
| **Total** | 261765 |

All the water used in the campus is supplied by the **Municipal Corporation** of the Solapur city as well as from the bore-wells present. This water is then supplied to each unit in the campus. There are separate tanks on each building for the building's water requirement as follows:

**Table No. 3:No. of tanks and its capacity**

| Department | Number of tanks | Capacity (liters) |
|---|---|---|
| Computational Sciences (Overhead) | 1 | 1000 |
| Computational Sciences (Underground) | 2 | 7000 |
| Social Sciences (Overhead) | 2 | 2000 |
| | 1 | 1000 |
| Social Sciences (Underground) | 2 | 12000 |
| Chemical Sciences (Overhead) | 6 | 5000 |
| | 1 | 2000 |
| Chemical Sciences (RWH) | 1 | 10000 |
| Earth Sciences (Overhead) | 6 | 2000 |
| | 2 | 5000 |
| Physical Sciences (Overhead) | 4 | 5000 |
| | 1 | 1000 |
| Instrumentation | 1 | 10000 |
| Administrative Building | 3 | 5000 |
| | 1 | 2000 |

**Table No. 4:No. of tanks and its capacity**

| Department | Number of tanks | Capacity (liters) |
|---|---|---|
| Girls' Hostel | 1 | 5000 |
| Rector Quarters | 2 | 2000 |
| Girls' Hostel Mess 1 and 2 | 2 | 3000 |
| | 2 | 2000 |
| Guest House | 2 | 5000 |
| | 2 | 1000 |
| | 1 | 500 |
| Boys' Hostel | 1 | 23000 |
| | 1 | 11500 |

| | | |
|---|---|---|
| | 2 | 7500 |
| Boys' Hostel Mess | 2 | 15000 |
| | 5 | 1000 |
| Tank near Auditorium | 1 | 81000 |
| Tank behind Girls' Hostel | 1 | 10000 |
| Tank beside Computational Science | 1 | 11000 |
| | 1 | 2000 |
| Solar Hot Water – Girls' Hostel | 1 | 4000 |
| Solar Hot Water – Boys' Hostel | 1 | 3000 |
| Solar Hot Water – Guest House | 1 | 2000 |

**Figure 12: Overhead Water Tank of Chemical Sciences Building**

**b) Current practices of water management:**

- **Rain Water Harvesting** is practiced by the School of Chemical Sciences to save 10 $m^3$ per year and is being used as distilled water for experiments. It is in process for other buildings in collaboration with Maharashtra Jeevan Pradhikaran Department and will be in use soon.
- **Rain Water Harvesting** is also laid down for admin Building and School of Earth sciences Building
- **Drip Irrigation** is practiced in the campus for watering the plants and gardens
- The average **student to washroom ratio** for girls is **17:1** and for boys is **19:1**
- **Waste water Management:** All the waste water generated i.e. 639765 liters is disposed to the Central Drainage System on daily basis

### 7.2 Energy Conservation and Management

This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles.

**a) Electricity consumption:**

**Total Energy Consumption of the University is 23412 KWH per month**

**Solar Power Generation by the University is 14642 KWH per month**

**Table No. 5: Energy Consumption by University**

| Sr. No. | Electricity Consumption (KWH per month) | Source |
|---|---|---|
| **1.** | 23412 | MSEDCL |
| **2.** | 14642 | Solar Panels |

**b) Current practices for energy management**

Conserving energy produces a higher quality of life. In addition, it helps to create a healthier planet, or at least helps to sustain the resources already have.

- The institution has installed **solar panels** on the roof of the main administrative building that produces renewable energy to try to meet the increased electricity demand. Currently, the institute has solar panels that contribute to **62.54%** of the monthly electricity consumption.
- **Solar Panels** of 50 KWP are installed on the buildings of Physical, Computational and Chemical Sciences and will be in operation soon.
- The University has also installed 46 **solar street light panels** to meet the electricity demand.
- **Solar energy** is also used for hot water generation in Hostels and Guest House

**Figure 13: Solar Street Light panels**

**Figure 14: Solar Panels installed on Chemical Sciences, yet to be in operation**

### 7.3 Waste Management

This indicator addresses waste generation, collection, segregation and treatment

**a) Generation of waste:**

**Total Waste Generation of the University is 1246.4 kg/month**

**Table No. 6: Category Wise Waste Generation (kg/month)**

| Department | Paper waste | Plastic Waste | Biodegradable waste | Hazardous Waste | Glass waste | Garden Waste |
|---|---|---|---|---|---|---|
| Instrumentation | 2.5 | - | - | 0.5 | - | 650 |
| Physical Sciences | 5.5 | - | - | - | - | |
| Computational Sciences | 9 | | - | - | - | |
| Chemical Sciences | 5.5 | - | - | 100 | 2 | |
| Earth Sciences | 89 | | - | 25 | 0.5 | |
| Girls' Hostel | 160 | | | - | - | |
| Boys' Hostel | 45 | | | - | - | |
| Guest House | 18 | | - | - | - | |
| Administration | 129 | 4.9 | - | - | - | |

**Table No. 7: E-Waste Generation (kg/year)**

| Type of Waste | Generation Quantity | E-waste treated and disposed (kg) |
|---|---|---|
| **E-waste** | 182 | 182 |


**Figure 15: Waste Collection yard**


**Figure 16: Waste Collection**

**b) Current practices of solid waste management**

- All the University waste - biological waste, paper waste, plastic waste and remaining garden waste - to be disposed **is collected and transported together** by the trolley to the 500 acres area
- The plastic and paper waste is collected and **disposed** together in the 500 acres land sanctioned to the University
- E-waste is collected from every department and is sent to the **authorized vendor** every 10 years
- Hazardous Waste is **sterilized** in autoclave and then buried in the building premises
- Solid chemical compounds are **reused** for the experimental practical purposes
- Glass Waste is **land filled** in the 500 acres area sanctioned to the University

### 7.4 Biodiversity Conservation

This aspect addresses all the flora and fauna of the campus. The list below has the name and quantity of trees as well as bird species.

**Table No. 8: Plant Species in the University**

| Sr. no | Common name of plant | Botanical name | Quantity |
|---|---|---|---|
| 1. | Palm | *Roystonea regia* | 758 |
| 2. | Fan Palm | *Washingtonia* | 13 |
| 3. | Ashok | *Saruca asoca* | 48 |
| 4. | Sagwan | *Tectona grandis* | 72 |
| 5. | Peepal | *Ficus religiosa* | 33 |
| 6. | Gulmohar | *Delonix regia* | 45 |
| 7. | Badam | *Terminalia katappa* | 49 |
| 8. | Limbu | *Citrus aurantifolia* | 04 |
| 9. | Tamarind | *Tamarindus indica* | 75 |
| 10. | Mango | *Mangifera indica* | 17 |
| 11. | Bamboo | *Bambusoideae* | 06 |
| 12. | Sururu | *Casuarina equisetifolia* | 758 |
| 13. | Jaswand | *Hibiscus rosasinensis* | 15 |
| 14. | Umbar | *Ficus racemosa* | 08 |
| 15. | Pongame Oiltree | *Millettia pinnata* | 10 |
| 16. | Chafa | *Plumeria rubra* | 04 |
| 17. | Drumstick | *Moringa oleifera* | 08 |
| 18. | Neem | *Azadirachta indica* | 169 |
| 19. | Coconut | *Cocos nucifera* | 126 |
| 20. | Parijatak | *Nyctanthes arbor-tristis* | 3 |
| 21. | Jamun | *Syzygium cumini L.* | 14 |
| 22. | Pomegranate | *Punica granatum* | 7 |
| 23. | Awala | *Phyllanthus emblica* | 39 |

| | | | |
|---|---|---|---|
| 24. | Chikoo | *Manilkara zapota* | 11 |
| 25. | Banyan | *Ficus benghalensis* | 14 |
| 26. | Nilgiri | *Eucalyptus* ***globulus*** | 40 |
| 27. | Guava | *Psidium guajava* | 42 |
| 28. | Bel | *Aegle marmelos* | 03 |
| 29. | Weeping Fig | *Ficus benjamina* | 40 |
| 30. | Christmas Tree | *Araucaria columnaris* | 1 |
| 31. | Sitafal | *Annona reticulate* | 11 |
| 32. | Mauritius Hemp | *Furcraea foetida* | 7 |
| 33. | Mehndi | *Lawsonia inermis* | 1 |
| 34. | Baheda | *Terminalia bellirica* | 50 |
| 35. | Wattle | *Acacia* | 11 |
| 36. | Yellow Oleander | *Thevetia peruviana* | 435 |
| 37. | Kaner | *Nerium oleander* | 16 |
| 38. | Kachnar | *Bauhinia variegate* | 22 |
| 39. | Jungle Flame | *Ixora* | 352 |
| 40. | Indian Senna | *Cassia angustifolia* | 80 |
| 41. | Brahmakamal | *Saussurea obvallata* | 1 |
| 42. | Lotus | *Nelumbo* | 4 |
| 43. | Mogra | *Jasminum sambac* | 1 |
| 44. | African Daisy | *Arctotis* | 13 |
| 45. | Tiger Lily | *Lilium lancifolium* | 62 |
| 46. | Copper Leaf | *Acalypha wilkesiana* | 31 |
| 47. | Fireball Lily | *Scadoxus multiflorus* | 1 |
| 48. | Pink Lily | *Zephyranthes carinata* | 4 |
| 49. | Papaya | *Carica papaya* | 1 |
| 50. | Purple Heart | *Peltogyne purpurea* | 2 |
| 51. | Tulsi | *Ocimum tenuiflorum* | 54 |

| | | | |
|---|---|---|---|
| 52. | Amaltas | *Cassia fistula* | 5 |
| 53. | Jujube | *Ziziphus mauritiana* | 2 |
| 54. | Lemon Grass | *Cymbopogon citrates* | 3 |
| 55. | Fig | *Ficus carica* | 18 |
| 56. | Shatavari | *Asparagus racemosus* | 71 |
| 57. | Morpankhi | *Platycladus orientalis* | 73 |
| 58. | Crepe Jasmine | *Tabernaemontana divaricata* | 6 |
| 59. | Trumpet | *Tecoma grandiflora* | 4 |
| 60. | Devil's Backbone | *Euphorbia tithymaloides* | 4 |
| 61. | Dwarf Umbrella Tree | *Schefflera arboricola* | 3 |
| 62. | Spanish Cherry | *Mimusops elengi* | 3 |
| 63. | Krishna Kanta | *Clitoria Ternatea* | 5 |
| 64. | Periwinkle | *Catharanthus roseus* | 18 |
| 65. | Rudraksh | *Elaeocarpus ganitrus* | 2 |
| 66. | Rui | *Calotropis Gigantea* | 4 |
| 67. | Indian mulberry | *Morinda citrifolia* | 5 |
| 68. | Crown of Thorns | *Euphorbia milii* | 5 |
| 69. | Crotons | *Codiaeum variegatum* | 22 |
| 70. | Blackboard Tree | *Alstonia Scholaris* | 42 |
| 71. | Senegal Mahogany | *Khaya senegalensis* | 31 |
| 72. | Golden Arrow | *Plumeria Pudica* | 7 |
| 73. | False Indigo | *Baptisia australis* | 2 |
| 74. | Stinking Passion Flower | *Passiflora foetida* | 1 |
| 75. | Peregrina | *Jatropha integerrima* | 2 |
| 76. | Reetha | *Sapindus mukorossi* | 3 |
| 77. | Gorakhchincha | *Kigelia Africana* | 1 |
| 78. | West Indian Elm | *Guazuma ulmifolia* | 5 |
| 79. | Kapok | *Ceiba pentandra* | 2 |

| | | | |
|---|---|---|---|
| 80. | Rosy Trumpet | *Tabebuia rosea* | 1 |
| 81. | 4 o'clock Plant | *Mirabilis jalapa* | 1 |
| 82. | Lantana | *Lantana camara* | 1 |
| 83. | Aloevera | *Aloe barbadensis miller* | 1 |
| 84. | Snake plant | *Sansevieria trifasciata* | 1 |
| 85. | Agave | *Agave Americana* | 4 |
| | | **Total** | 3908 |

**Some of the onsite pictures of the plants:**


UEST HOUSE

**Fauna in the University campus**

**Table No. 9: Fauna observed in the University**

| Sr. No. | Specie Name | Scientific Name |
|---|---|---|
| **Birds** | | |
| **1.** | Asian koel | *Eudynamys scolopaceus* |
| **2.** | Common hawk cuckoo | *Hierococcyx varius* |
| **3.** | House crow | *Corvus splendens* |
| **4.** | Red vented bulbul | *Pycnonotus cafer* |
| **5.** | Common myna | *Acridotheres tristis* |
| **6.** | Brahmany starling | *Sturnia pagodarum* |
| **7.** | Shikra | *Accipiter badius* |
| **8.** | Green bee-eater | *Merops orientalis* |
| **9.** | Greater coucal | *Centropus sinensis* |
| **10.** | Blue rock pigeon | *Columba livia* |
| **11.** | Large grey babbler | *Argya malcolmi* |
| **12.** | Barn swallow | *Hirundo rustica* |
| **13.** | Indian peafowl | *Pavo cristatus* |
| **14.** | Eurasian collared dove | *Streptopelia decaocto* |
| **15.** | Red collared dove | *Streptopelia tranquebarica* |
| **16.** | Black kite | *Milvus migrans* |
| **17.** | White throated kingfisher | *Halcyon smyrnensis* |
| **18.** | Tailor bird | *Orthotomus sutorius* |
| **Animals** | | |
| **19.** | Indian palm squirrel | *Funambulus palmarum* |
| **20.** | Indian grey mongoose | *Herpestes edwardsi* |
| **Reptiles** | | |
| **21.** | Bengal monitor lizard | *Varanus bengalensis* |
| **Butterflies** | | |
| **22.** | Common grass yellow | *Eurema hecabe* |

| | | |
|---|---|---|
| **23.** | Common emigrant | *Catopsilia Pomona* |
| **24.** | Mottled emigrant | *Catopsilia pyranthe* |
| **25.** | Common crow | *Euploea core* |
| **26.** | Tawny coster | *Acraea terpsicore* |
| **27.** | Danaid Eggfly | *Hypolimnas misippus* |
| **28.** | Rounded pierrot | *Tarucus extricates* |
| **29.** | Pioneer | *Belenois aurota* |
| **30.** | Tailed jay | *Graphium Agamemnon* |
| **31.** | Grass jewel | *Freyeria trochylus* |
| **32.** | Crimson rose | *Pachliopta hector* |

**Some of the onsite pictures of fauna are as follows:**



COMMON HAWK CUCKOO


PURPLE RUMPED SUNBIRD


RED COLLARED DOVE


BRAHMINY MYNA


WHITE THROATED KINGFISHER


BARN SWALLOW


Grey mongoose


BLACK KITE


INDIAN PALM SQUIRREL

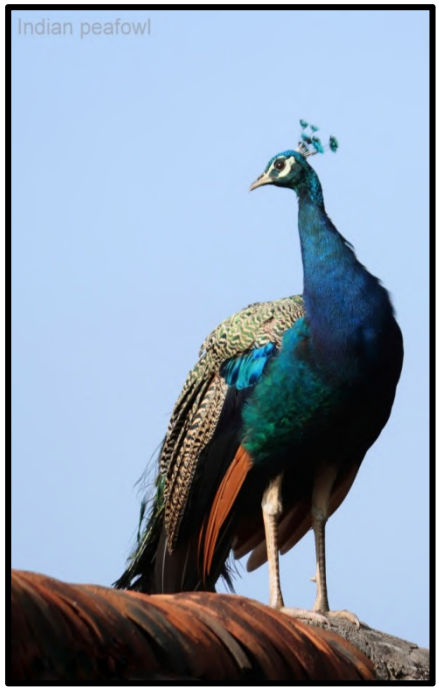

BLUE ROCK PIGEON


CRIMSON ROSE


RED VENTED B


TAILED JAY


DANAID EGGFLY


Indian peafowl


ASIAN KOEL


LARGE GREY BABBLER


asian Collared Dove


COMMON MYNA


COMMON CROW


TAWNY COSTER


COMMON GRASS YELLOW


MOTTLED EMMIGRANT


ROUNDED PIERRIOT


Greater coucal


SOUTHERN GRASS JEWEL

### 7.5 Air and Noise Quality

Air quality of an academic institute is very important for health of students, faculty and staff of university. The air pollution sources in the university campus are wind storm, pollen grains, natural dust, vehicular emissions, generators, laboratory fumes, etc. The air pollutants monitored on regular basis are Sulphur dioxide ($SO_2$), Oxides of Nitrogen as NOx, Suspended Particulate Matter (SPM) and Repairable Suspended Particulate Matter (RSPM) by High Volume Sample (HVS) as well as records of temperature, relative humidity are also been recorded for comparison. All the air quality parameters are within the standard limits of MPCB except SPM, suggesting ambient air quality of university campus is moderate and might cause minor breathing discomfort to sensitive people.

**Table 10: Air Quality Monitoring**

| | $SO_2$ ($\mu g/m^3$) | $NO_x$ ($\mu g/m^3$) | RSPM ($\mu g/m^3$) | SPM ($\mu g/m^3$) | Air Quality Index |
|---|---|---|---|---|---|
| **Standard** | 80 | 80 | 100 | 100 | |
| **Average for 2017-2018** | 18.91 | 67.5 | 97.666 | 290.85 | 82 |

The above table shows that Sulphur dioxide ($SO_2$), Oxides of Nitrogen as NOx, and Repairable Suspended Particulate Matter (RSPM) are within limits; however, Suspended Particulate Matter (SPM) is above limits. The Total Air Quality Index is 82 which is satisfactory.

The University has also set up the device for air monitoring; however, due to power cuts at times, the procedure cannot be completed.

As an academic institute comes under silent zone, noise should be below 50 dB during day time. Therefore, the noise on the campus is also measured and found within the standard limits. Sometimes construction activities and road traffic increases the noise level on the campus.

PAH Solapur University is located on the Pune-Solapur National Highway. The major source of noise at university is due to automobile use. Building construction and D.G. Sets can also cause considerable noise emissions. Hence, overall air and noise quality within the campus is good and within the prescribed limits of MPCB.

**Ambience of the campus:** The ambience of the University is calm, spacious with good amenities and utilities in a visually appealing landscape. The building footprint of the University is 25% whereas green area is more than 40% of the total plot area. Various trees are planted at the periphery of roads which in turn reduces the University's Heat Island Effect and due to reduction of concrete pathways; rain water harvesting has been managed efficiently. The University has retained a huge amount of natural topography which aids in plenty of water percolation and ground water recharging.

Moreover, every department has its representative paintings at the entrances, which gives those an artistic and representative atmosphere. Also, maintenance of natural topography has led to the innovative way of retention of various species of flora and fauna, which can be extremely advantageous for academic purposes. Being out of the city limits, the University has flourished in maintaining the faunal habitat effectively.

### 7.6 Carbon Footprint

**Carbon footprint (CF)** is the total amount of **greenhouse gases** (including carbon dioxide and methane) that are generated by human actions.

**a)Carbon Emissions:**

**Table No. 11: Scopes of carbon emissions**

| Classification/Scope | Sources | Description |
|---|---|---|
| **Scope 1 (Direct)** | Resource usage | Emissions from LPG Cylinder, D.G. Set, University owned vehicles, Air Conditioners |
| **Scope 2 (Indirect)** | Electricity Use | Emissions from Purchased Electricity and Renewable Energy |
| **Scope 3 (Indirect)** | Personnel commuting And raw materials transportation | Emissions from Personnel commutation and raw materials transportation |
| | Wastewater treatment | Emissions from waste water treatment |
| | Solid Waste treatment | Emissions from solid waste management |

**Emission Data and Calculations:**

- **Scope 1 –** All Direct Emissions from the activities of an institution or under its control. Including fuel combustion on site such as gas, etc.

**Table No. 12: Scope 1 Emissions**

| Type of Fuel | Quantity per month | Emission Factor | Kg $CO_2$/month |
|---|---|---|---|
| **Fuel used for DG set** | 190 liters | 2.653 | 504.07 |
| **LPG** | 1059 Kg | 2.983 | 3158.997 |
| **University owned vehicles - Petrol** | 3700 liters | 0.13 | 481 |

| | | | |
|---|---|---|---|
| **University Owned Vehicles – Diesel** | 10750 liters | 0.230 | 2472.5 |
| **TOTAL SCOPE 1 EMISSIONS** | | | **6616.567** |

- **Scope 2 –** Indirect Emissions from electricity purchased and used by the institution.

**Emissions from Purchased electricity:**

**Table No. 13: Scope 2 emissions**

| Type of Emission | Quantity (KWH per month) | Emission Factor | Kg $CO_2$ / month |
|---|---|---|---|
| **Emissions from Purchased electricity** | 23412 | 0.97 | 22709.4945 |
| **Renewable Energy** | 14642 | 0.97 | 14202.74 |
| **TOTAL SCOPE 2 EMISSIONS** | | | **22709.4945** |

- **Scope 3 – All Other Indirect Emissions** from activities of the institution, occurring from sources that they do not own or control

1. **Delivery/Construction Transportation:** Travelling distance, mode of transportation and type of fuel used for transportation are other major factors associated with carbon emission.

**Table No. 14: Fuel Consumption through Raw Material Transportation**

| Type Of Transportation | Distance Travelled In One Month (Km) | Emission Factor | Kg $CO_2$/month |
|---|---|---|---|
| Auto | 96 | 0.1135 | **10.896** |

2. **Employee Transportation:** This unit seeks to identify the impact on global climate change through its emissions of greenhouse gases (GHGs), notably carbon dioxide ($CO_2$).

**Table No. 15: Fuel Consumption through staff Transportation**

| Mode of transportation | Daily Count | Travelling distance (Km/Vehicle) (to and fro) | Total Km | Emission Factor | Kg $CO_2$/day |
|---|---|---|---|---|---|
| **2 wheeler** | 360 | 24 | 8640 | 0.0319 | 275.616 |
| **4 Wheeler (Cars)** | 20 | 24 | 480 | 0.13 | 62.4 |
| **Auto** | 40 | 24 | 960 | 0.1135 | 108.96 |
| **Bus** | 20 | 24 | 480 | 0.0151 | 7.248 |
| **TOTAL** | | | | | **454.224** |

**Table No. 16: Fuel Consumption through students Transportation**

| Mode of transportation | Daily Count | Travelling distance (Km/Vehicle) (to and fro) | Total Km | Emission Factor | Kg $CO_2$/day |
|---|---|---|---|---|---|
| **2 wheeler** | 309 | 24 | 7416 | 0.0319 | 236.5704 |
| **Auto** | 485 | 24 | 11640 | 0.1135 | 1321.14 |
| **Bus** | 221 | 24 | 5304 | 0.0151 | 80.0904 |
| **TOTAL** | | | | | **1637.80** |

**Table No. 17: Fuel Consumption through visitors' Transportation**

| Mode of transportation | Daily Count | Travelling distance (Km/Vehicle) (to and fro) | Total Km | Emission Factor | Kg $CO_2$per day |
|---|---|---|---|---|---|
| **2 wheeler** | 80 | 30 | 2400 | 0.0319 | 76.56 |
| **Car – Petrol** | 30 | 30 | 900 | 0.13 | 117 |
| **Car - Diesel** | 30 | 30 | 900 | 0.230 | 207 |
| **Auto** | 30 | 30 | 900 | 0.1135 | 102.15 |
| **Bus** | 30 | 30 | 900 | 0.0151 | 13.59 |
| **TOTAL** | | | | | **529.89** |

### 3. Waste Water Generation:

**Table No. 18: Waste Water Generation**

| Wastewater generated (liters per month) | Emission Factor | Total |
|---|---|---|
| 261765 per day | 0.21 | **54970.65 Kg$CO_2$/day** |
| **Total** | | **1649119.5 Kg$CO_2$/month** |

### 4. Solid Waste Generation:

**Table No. 19: Dry Solid Waste Generation**

| Solid waste generated (Kg) | Emission factor | Total |
|---|---|---|
| 1108.4 per month | 0.21 | **232.764 Kg $CO_2$ /month** |

- **Total emissions throughout a year**

**Table No. 20: Total emissions throughout the year**

| Reporting Year | Total Emissions (kg $CO_2$ per month) | Total Emissions (Kg $CO_2$ per year) |
|---|---|---|
| **2017-2018** | **1757346.642** | **21088159.7** |

**Carbon Sequestration**

**Table 21: Carbon Sequestration of Trees**

| Sr. no | Category of Trees | Quantity | Kg $CO_2$ sequestration/year | Total Kg $CO_2$ sequestration |
|---|---|---|---|---|
| 1. | Trees | 3908 | 25 | 97700 |

**Total carbon Emissions: 21088159.7Kg $CO_2$ per year**

**Avoided Emissions by Renewable Energy: 170432.88 Kg $CO_2$ per year**

**Carbon Sequestration: 97700 Kg $CO_2$ per year**

**Percentage of carbon reduced: 1.27%**

**b) Carbon Emissions Management:**

The University has planted 3908 plants in the campus to sequestrate carbon emissions.

## 8.0 Innovative Strides

- University organizes campus cleaning drive

**Figure 17: Campus Cleaning Drive**

- NSS Club of PAH Solapur University also organizes Tree Plantation on various occasions to maintain greenery in the campus
- Activities like plantation and Swachh Bharat Abhiyan are carried out by faculty members and students of Environmental Sciences department
- Herbal garden is maintained in the institution by Environmental Sciences Department
- Celebration of environmental day and water day by Environmental Sciences department
- International Conference on 28–30 September 2017 on Clean Energy Futures, Solapur, Maharashtra State, India
- Environmental Sciences have painted the entrance of the building with Fauna diversity for awareness purposes


**Figure 18: Tree Plantation Drive by NSS Club**

## 9.0 Recommendations from the audit

1. **Water Quality and Conservation**
    - Installation of **Sewage Treatment Plant** for waste water management of whole campus is recommended on priority basis
    - Installation of **low flow plumbing fixtures like aerators and water regulators** for water conservation
    - Installation of **water meters** is suggested to track water consumption of various entities
    - Implementation of **separate water treatment** process for hazardous waste water from Chemical Sciences and Earth Sciences Department
    - Installation of **Rain Water Harvesting** for the whole campus to reduce municipal water consumption
    - Performing internal **water audits** every six months
    - Checking **potability of water** every month is recommended
    - Installation of **motion sensed sprinklers** is advised for gardening purposes
2. **Energy Conservation and Mangaement**
    - Installation of **energy meters** for every department to track electricity consumption is suggested
    - **Improving Solar PV** effectiveness and **installing solar panels** for every building to reduce electricity consumption from MSEDCL is recommended
    - Installing **5-star energy efficient appliances** wherever possible is encouraged
    - Installation of **LED lamps** instead of TL and CFLs is a smart way of energy saving
    - Installation of **energy efficient fans** in the new as well as old buildings
    - Installation of **IE 4 motors** for less energy usage
    - Setting **Yearly Performance targets**
    - Putting up **sign boards** to spread awareness for electricity consumption
    - University has many areas where lighting is not required at all times. Installing **sensor based lighting** in such areas can generate massive rewards

- Planning **workshops** on energy conservation to educate students, faculty and staff can generate huge results of awareness
- Establishing a **purchase policy** that is energy saving and eco-friendly is needed
- Performing **internal energy audits** every year is advised

3. **Waste Management**
   - Installing a composting pit for wet waste is recommended to reduce the disposal of waste
   - Installation of **separate dustbins** for wet and dry waste
   - Maintenance of separate **waste segregation yard** for separating waste into various categories for further treatment is advised
   - Install composting units for the biodegradable waste
   - Install **sanitary incineration** system to reduce sanitary waste and convert the waste to energy
   - **Separate waste collection and segregation** is advised for every building
   - **Separate waste transportation** is recommended for different types of waste
   - Hazardous waste from Chemical Sciences and Earth Sciences should be **sterilized and sent to composting**
   - One of the suggested methods for garden waste disposal is **Mulching**
   - Plastic and paper waste should be sold to **authorized vendors for recycling**
   - One of the preferred methods to treat paper waste is **shredding and composting**
   - Maintain **waste collection record** on daily basis for future convenience
   - Try to inculcate the concept of **'Plastic free Campus'**
   - To cut down the waste and carbon footprint, the university should follow **paperless methods of communication** and use emails, that too as minimum as possible
   - Installation of **biogas plant** can convert wet waste into energy
4. **Biodiversity Conservation**
   - Maintain **natural topography** wherever possible
   - Planting more **fruit-bearing** trees can attract birds
   - Displaying **boards of fauna diversity** in the campus can generate enthusiasm for learners

- Form a **botanical and medicinal garden** in the campus for academic as well as awareness purposes
- Develop a **butterfly garden** that arouses appreciation towards flora and fauna diversity in the university
- Plant more **native trees**

5. **Carbon Footprint**
   - Maintain **'No Vehicle Day'** at least once a month
   - Use **CFC free** equipments
   - Encourage **car pooling or ride share** program
6. **Air and Noise Quality**
   - Use of **bicycles** for transportation in the campus
   - Avoid using **diesel generators**
   - Use of **BS-4 vehicles**
7. **General Recommendations**
   - Maintain **EMP plan** to ensure positive benefits
   - Activate **Environmental management committee** to look after the compliance of EMP plan
   - Conducting **internal environmental audits** can help understand grey points
   - Putting up **posters related to Environment, Health and Safety** (No Smoking Policy, Saving Electricity, Water Conservation, etc.) is an easiest way to spread awareness
   - Adopting **IGBC Green campus** rating system will help boost the University Profile

## 10.0 Conclusions

Green Audit is the most efficient way to identify the strength and weakness of environmental sustainable practices and to find a way to solve problems. Green Audit is one kind of a professional approach towards a responsible way in utilizing economic, financial, social and environmental resources. Green audit can "add value" to the management approaches being taken by the University and is a way of identifying, evaluating and managing environmental risks (known and unknown). There is scope for further improvement, particularly in relation to waste, energy, and carbon footprint and water management. The University considers the environmental impacts from most of its actions and makes a concerted effort to act in an environmentally responsible manner. Even though the University does perform fairly well, the recommendations in this report highlight many ways in which the University can work to improve its actions and become a more sustainable institution.

## 11.0 Environmental Management Plan

By keeping in mind the current scenario of consumption of various entities and the current practices of the management, Greenex Environmental has prepared an 'Environmental Management Plan' for the University. This plan will reveal strengths and weaknesses of the University as well as suggestions on how to tackle the issues and develop green and clean campus. It also gives suggestion for the priority of work to carry out.

| Water | | | | | |
|---|---|---|---|---|---|
| **Details** | **Daily** | **Monthly** | **Quarterly** | **Yearly** | **Remarks** |
| Analysis of STP inlet and outlet water | | √ | | | |
| Perform in-house water analysis of drinking water | | | √ | | |
| Installing water meter and keeping its record | √ | | | | |
| Maintenance of Rain water Harvesting System | | | √ | | |
| Perform water audits | | | | √ | |
| Cleaning of water tanks | | √ | | | |
| Quarterly drip irrigation maintenance | | | √ | | |
| **Energy** | | | | | |
| Performing energy audits | | | | √ | |
| Installing energy meters for various entities and maintaining its record | | √ | | | |
| **Waste** | | | | | |
| Disposal of E-waste to authorized vendors | | | | √ | |
| Maintaining waste quantity record | √ | | | | |
| **Biodiversity** | | | | | |
| Monthly checking of labels on trees | | √ | | | |
| Maintain quarterly tree count | | | √ | | |
| **Carbon footprint** | | | | | |
| Recording usage of | √ | | | | |

| | | | | | |
|---|---|---|---|---|---|
| University owned vehicles | | | | | |
| Recording of diesel usage in D.G. sets | √ | | | | |
| Recording LPG gas refilling frequency | | √ | | | |
| Recording of number of visitors | √ | | | | |

## 12.0 References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# Annexure

## Energy Conservation and Management

| Prerequisites | Affirmation | Response | Capacity | Documentary Evidence |
|---|---|---|---|---|
| Total Energy Consumption | Yes/No | | | Light Bills |
| Renewable Energy | Yes/No | | | Technical Specifications |
| Energy Audit Report | Yes/No | | | Report |
| Energy use breakup | Yes/No | | | Report/Documents |
| Energy Meter | Yes/No | | | Photos |
| Outdoor Bulb Directions | -- | | | Photos |

## Water Quality and Conservation

| | |
|---|---|
| Total number of water users | |
| Number of Employee | |
| Number of visitors (daily) | |
| Number of Students | |
| Rain water harvesting system availability | |
| Is rain water harvesting system working? | |
| Daily water supply (liters) | |
| Source of water | |
| Water Meter | |

**Water Storage:**

Details of the storage structures -

| Storage tanks | Capacity (Liters) | Number | Number of times it is topped (or filled) daily |
|---|---|---|---|
| Overhead | | | |
| Underground | | | |
| Total | | | |

## Waste Management

| Type of Waste | Quantity | Method of Disposal |
|---|---|---|
| Paper | | |
| Plastic | | |
| Garden Waste | | |
| Glass | | |
| Wood | | |
| Biodegradable | | |
| Cloth | | |
| Hazardous | | |
| Clinical | | |
| E-Waste | | |
| Metal | | |

## Carbon Footprint

**Prerequisites**

| | | | |
|---|---|---|---|
| Scope I | University Owned Vehicles | Transportation per month: | No. - |
| | D.G. Set | Diesel consumed per month: | No. - |
| | LPG | Consumption per month: | No. - |
| | $CO_2$ Extinguishers | | No. - |
| | AC | Capacity: Make up: | No. – |

| | | | | |
|---|---|---|---|---|
| Scope III | Staff Commuting | Distance: | Type of Vehicle: | No. - |
| | Students | Distance: | Type of Vehicle: | No. - |
| | Business Travel | Distance: | Type of Vehicle: | No. - |
| | Other Material Deliveries | Distance: | Type of Vehicle: | No. of trips- |

## Biodiversity

| Sr. no | Common name | Quantity |
|---|---|---|
| Plants | | |
| **1.** | | |
| **2.** | | |
| **3.** | | |
| Animals | | |
| **4.** | | |
| **5.** | | |
| **6.** | | |

# Our Team

## 1. Arati Bhosale

M. Sc. Environment, PGDISHE
Director, Greenex Environmental
IGBC AP, GRIHA CP, LEED GA, EMS lead Auditor, CII certified Carbon Footprint Professional

**Work Experience:**

Rich experience of 10 + years in Environment field. Expertise in Life cycle assessment study, carbon footprint, water footprint & IGBC GRIHA, LEED Certifications. She has successfully accomplished 150 + Products LCA study and 50 + Green building projects.

## 2. Dr. Ganesh Kadam

PhD (Environmental Science & Technology), M.Sc. (Env. Sci.), RIO +20 India (2013), PGDISHE (Post Graduate Diploma in Industrial Safety Health & Environment), PGDGIS (Post Graduate Diploma in Geo informatics)

**Work Experience:**

More than 12 yrs of experience in the Environmental research field with 6 years' experience of Institutional Green Auditing. Conducted more than 10 audits for various Colleges and University. Total 6 National and International Publications published in reputed journals.

## 3. Ruturaj Patil

MBA, B.Sc. Zoology
Manager and Naturalist

**Work Experience:**

More than 8 yrs of experience as Naturalist and Manager.

## 4. Anjella Patel

M.Sc. (Environment Science), B.Sc. (Environment Science), Diploma (Remote Sensing and Geographic Information System)

**Work Experience:**

Working as Jr. Environmental Executive with Green Solution. Completed internships with Suzlon Foundation and Gujarat Pollution Control Board.

## 5. Lakshika Kotak

B.E. Chemical
Environmental Executive, Greenex Environmental

**Work Experience:**

Working on LCA, Carbon Footprint, Green Building certification and Green Audit Projects since 6 months. Completed internships in Gharda Chemicals Ltd. And Evonik Catalysts India Pvt. Ltd.

# Environmental & Green Audit Report 2018-2019

## Punyashlok Ahilyadevi Holkar Solapur University

Solapur Pune National Highway, Kegaon, Solapur, Maharashtra - 413255

By
**GREENEX ENVIRONMENTAL**
T-71,- 1A/2, Telco Road, General Block, Near Indrayani Corner, above Kotak Mahindra bank, MIDC, Bhosari, Pune – 411026

## Acknowledgement

We would like to express our sincere gratitude towards all who made it possible for us to complete the Green Audit of Punyashlok Ahilyadevi Holkar Solapur University smoothly. We would like to extend our gratitude to PAH Solapur University, for offering us the opportunity to perform Green Audit of PAH Solapur University. We also thank Dr. Vinayak Dhulap, Head of Environmental Sciences department for his timely support.

We acknowledge Dr. Mrunalini Fadnavis, Vice Chancellor, PAH Solapur University, for taking out time from her busy schedule and meeting with us. We would like to thank each and every staff member at the university who helped us collect the resourceful data. Last but not the least; we thank our team for their unwavering support.

- Greenex Environmental

# INDEX

# 1.0 Introduction

## 1.1 PAH Solapur University

Punyashlok Ahilyadevi Holkar Solapur University is a young state University of Maharashtra state and was established as 'Solapur University' on 1st August 2004. The formation of the University at Solapur was a long cherished desire of the people of this region and the people of the district have an emotional attachment to the University since its inception. The name of Solapur University was extended to as Punyashlok Ahilyadevi Holkar Solapur University by the state government on March 2019. The University has been recognized by University Grants Commission (UGC) u/s 2(F) and 12(B) of its Act. It is also been recognized by All India Council for Technical Education (AICTE), National Council for Teacher Education (NCTE) and other apex bodies. National Assessment and Accreditation Council (NAAC) has awarded B++ Grade to the university in its second cycle.

Earlier to the formation of Solapur University, Solapur city had a P. G. Center of Shivaji University, Kolhapur since 1984. The center for P. G. Studies had three postgraduate science departments housed in two buildings and a central Library building on its campus that spread over a total area of 37 acres. Seven postgraduate courses were offered in that P.G. centre. Eventually, this PG Centre was transformed in to the new University and separated from Shivaji University in 2004.

Punyashlok Ahilyadevi Holkar Solapur University is now located on the outskirts of Solapur city, about 10 km from the main city, on the national highway NH-09 towards Pune side. The proximity with the national highway provides good connectivity. It is a matter of great pride that the university has made big strides within a short span. Nine new buildings, for School of Computational Sciences, School of Social Sciences, School of Earth Sciences, Central Instrumentation centre, Girls' hostel with an accommodation facility for 80 girls; Boys' hostel with accommodation for 200 boys, Rector's bungalow, University Guest House and VIP Bungalow have been added to the existing buildings of School of Chemical Sciences, School of Physical Sciences and Library cum administrative building.

The University is relentlessly putting its endeavors in enhancing the standards in teaching, research, skill based programs, extra-curricular and sports activities. The University has introduced new schools like School of Commerce and Management, School of Languages and Literature, School of Performing Arts and Fine Arts, School of Allied Health Sciences, School of Technology, School of Life Sciences and many new courses in recent times. At the same time, some of the existing courses are modified so as to strike the right balance between the theoretical and applied components in the curriculum. Bridge courses are initiated by the schools to admit students from other faculties to the main stream courses. There is a strong research pursuance and publications carried out by each school. The

University is committed to the all-round developments of students. As a result, a number of students have been bringing laurels at the state and national youth festivals, sports and research events.

The University has been regularly organizing State level, inter University level and international seminars, conferences, sports and research events. The University has developed its sports facilities and health centre in the extended campus. Construction of the new Administrative and examination building has started at the state Govt allocated approx. 500 acre land near to the old campus. The installation of an impressive Horse riding statue of Punyashlok Ahilyadevi and development of a museum centre work are in progress at the new campus too.


**Figure 1: Punyashlok Ahilyadevi Holkar Solapur University**


**Figure 2: Satellite image of Punyashlok Ahilyadevi Holkar Solapur University**

### 1.2 Infrastructure

There are 20 buildings in the University Campus. Areas of these buildings are as below:

**Table No. 1: Area Bifurcation of the University**

| Sr. No. | Particulars | Total Area in Sq. m |
|---|---|---|
| **1.** | Computational Science | 2,460.03 |
| **2.** | Social Sciences | 3,151.07 |
| **3.** | Physical Sciences | 2,307.25 |
| **4.** | Earth Sciences | 2,163.59 |
| **5.** | Chemical Sciences | 2,054.63 |
| **6.** | Admin - Library | 1,015.04 |
| **7** | Instrumentation Centre | 190.16 |
| **8.** | Boys Hostel | 1,376.00 |
| **9.** | Mess | 492.50 |
| **10.** | Rector Quarters | 81.86 |
| **11.** | Ladies Hostel | 9,987.96 |
| **12.** | Mess – I | 261.15 |
| **13.** | Mess – II | 261.15 |
| **14.** | VIP Guest House | 1,866.59 |
| **15.** | Stage | 402.98 |
| **16.** | Canteen Area | 363.00 |
| **17.** | **Total Free space in the 32.5 acres campus** | 18,500.00 |
| | **Total** | **28,497.33** |

All the buildings in the University are well-spaced and well constructed to provide proper illumination and ventilation. More than 40% of the campus area is covered with vegetation, giving it an aesthetic view and providing a healthy environment. All the buildings in the campus have open courtyards which consist of various plants and skylights.

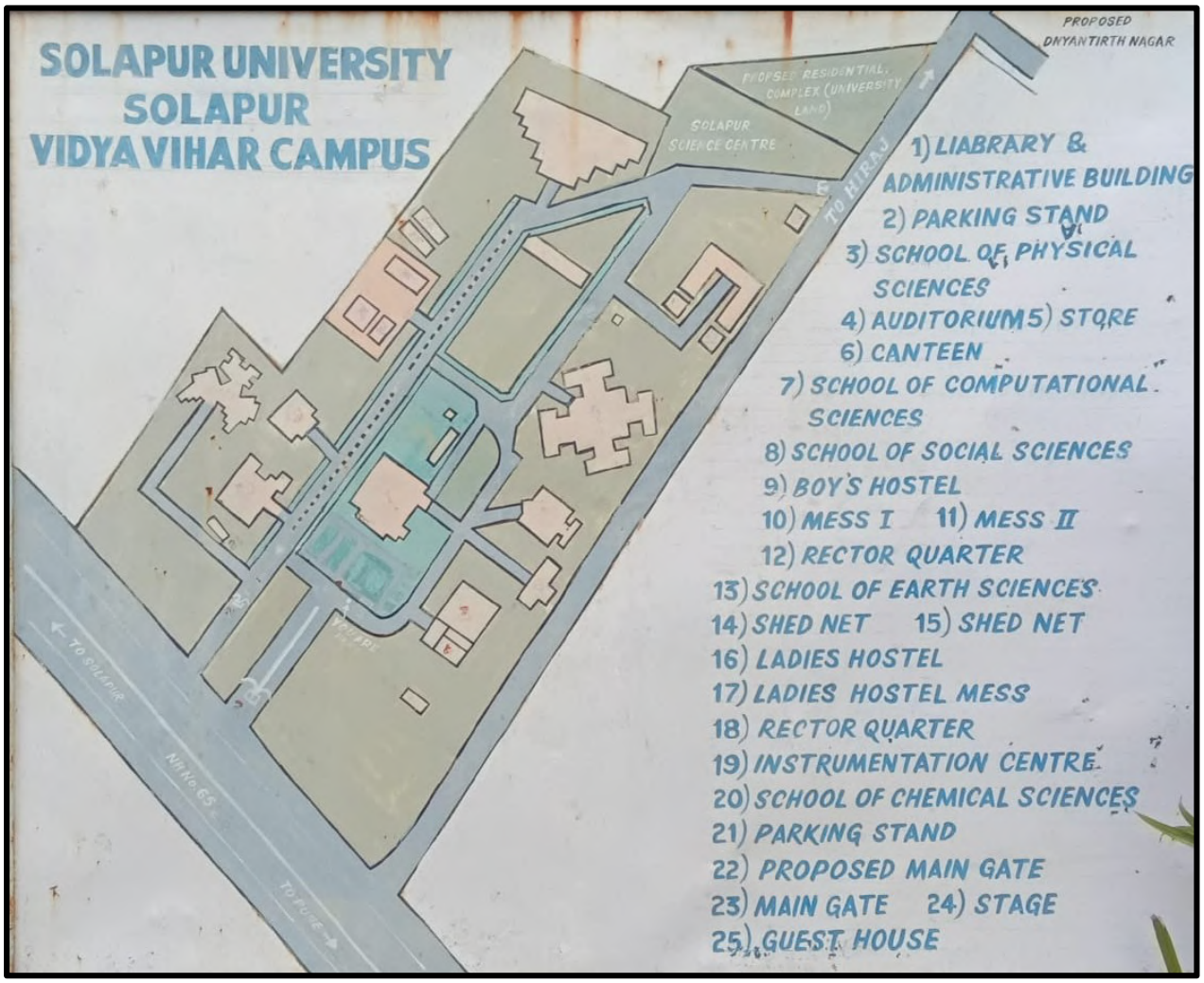



**Figure 3: Layout of PAH Solapur University**


**Figure 4: School of Physical Sciences**

**Figure 5: School of Chemical Sciences**


**Figure 6: School of Earth Sciences**


**Figure 7: School of Social Sciences and Commerce & Management**

**Figure 8: School of Computational Sciences**

## 1.3 Vision and Mission of the University

**Vision**

Enrich research, teaching skill and employability of the students with execution of best practices.

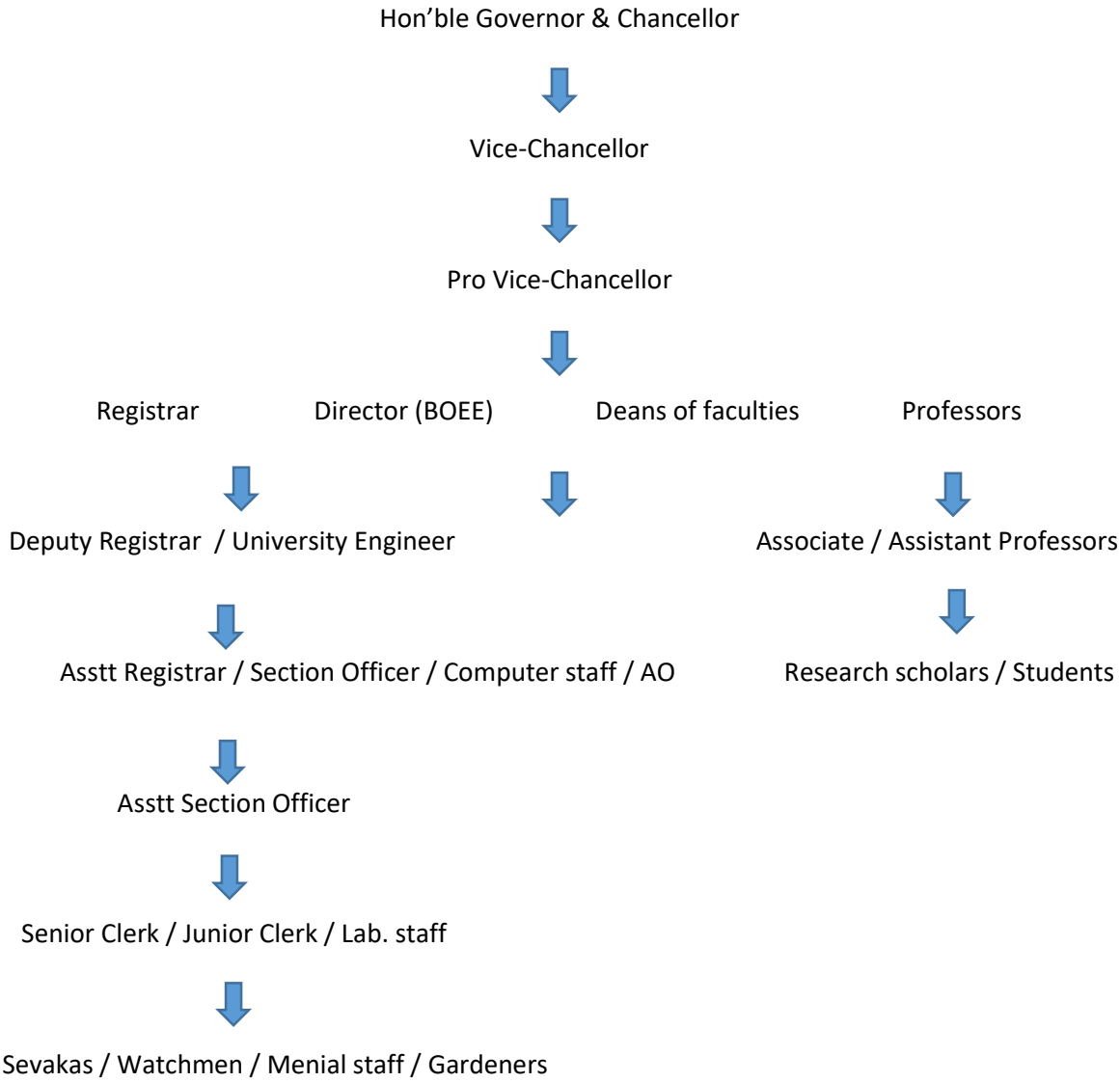
**Mission**

Empower students and teachers in various fields on the basis of global and local resources by enriching power within them.

**Goals of the institution**

- To continue to improve the quality of the undergraduate and postgraduate courses that prepares the students for professional life, leadership and citizenship in a changing world.
- To make special efforts to provide access to higher education to economically challenged and underprivileged sections of the society.
- To optimize the usage of resources and infrastructure in an integrated fashion to improve, enhance and strengthen the students' faculties.
- To produce global students with Indian ethos.
- To inculcate self-discipline and high ethical standards, among students, staff, faculty and societal individuals.
- To create a pool of self-motivated and dedicated researchers.
- To provide facilities and support to the staff to take up innovative methods of teaching in accordance with the developments in the academic world and also take care of the development in industry and commerce.
- To transform the 'Student' into "Knowledge Professional" empowered with scientific intellect, entrepreneurial skills, and innovation, who have learnt their skills in a highly competent environment under the guidance of research oriented and skilled Professors.
- To create an ambience for learning and scholarship.
- To become a nationally renowned Centre of Excellence in teaching - learning, research and extension activities, beneficial to the current and forth coming generations.

## 1.4 Organizational Structure of the University




**UNIVERSITY STATUTORY AUTHORITIES**

**The Senate, Academic Council, Management Council, Board Of Examinations, Board of Deans** and many other bodies as per Maharashtra Public University Act 2016

# 2.0 Environmental and Green Audit – A Preview

## 2.1 Environmental Audit

An environmental audit is a type of evaluation intended to identify environmental compliance and management system implementation gaps, along with related corrective actions. In this way, environmental audit performs an analogous (similar) function to financial audit. There are generally two different types of environmental audits: compliance audits and management systems audits. ISO 14001 is a voluntary international standard for environmental management systems ("EMS"). ISO 14001:2004 provides the requirements for an EMS and ISO 14004 gives general EMS guidelines.

The Supreme Audit Institution (SAI) in India is headed by the Comptroller and Auditor General (CAG) of India which is a constitutional authority. The audit conducted by CAG is broadly classified into Financial, Compliance and Performance Audit. Environmental audit by SAI India is conducted within the broad framework of compliance and performance audit.

Environmental auditing is a systematic, documented, periodic and objective process in assessing an organization's activities and services in relation to:

- Assessing compliance with relevant statutory and internal requirements
- Facilitating management control of environmental practices
- Promoting good environmental management
- Maintaining credibility with the public
- Raising staff awareness and enforcing commitment to departmental environmental policy
- Exploring improvement opportunities
- Establishing the performance baseline for developing an Environmental Management System (EMS)


**Figure 9: Aspects of Environmental Audit**

**Figure 10: Green Campus Illustration**

## 2.2 Green Audit

Green Audit is a part of Environmental Audit. Green Audit is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of various establishments. It aims at analyzing environmental practices within and outside of the concerned sites, which will have an impact on the eco-friendly ambience.

Green audit can be a useful tool for an academic institution to determine how and where the institution is using the energy or water or resources more than requirements.. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan. It can create health consciousness and promote environmental awareness, values and ethics. It provides staff and students a better understanding of Green impact on campus. Thus it is imperative that the institute evaluates its own contributions towards a sustainable future. As environmental sustainability is becoming an increasingly important issue for the nation and for the world, the role of higher educational institutions in relation to environmental sustainability is more significant.

The rapid urbanization and economic development at local, regional and global level has led to several environmental and ecological crises. On this background, it becomes essential to adopt the system of the Green Campus for the institutes which will lead towards sustainable development and at the same time reduce a sizable amount of atmospheric carbon-di-oxide from the environment. **Green Audit is assigned to the Criteria 7 of NAAC (National Assessment and Accreditation Council) evaluation** that declares the institutions as Grade A, Grade B or Grade C according to the scores gained at the time of accreditation. Moreover, it is a part of the responsibility of the Higher Educational Institutions to ensure that there is reduction of global warming through Carbon Footprint reduction measures.

Therefore, the need or purpose of the green audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards.

## 3.0 Objectives of Green audit

The overall objectives of green auditing are to help safeguard the environment and minimize risks to human health. The key objectives of an environmental audit therefore are:

- To determine how well the environmental management systems and equipment are performing
- To verify compliance with the relevant national, local or other laws and regulations
- To minimize human exposure to risks from environmental, health and safety problems.
- More efficient resource management
- To provide basis for improved sustainability
- To enable waste management through reduction of waste generation, solid- waste and water recycling
- To create plastic free campus and evolve health consciousness among the stakeholders
- To recognize the cost saving methods through waste minimizing processes
- To point out the prevailing and forthcoming complications
- Impart environmental education through systematic environmental management approach and improving environmental standards
- Financial savings through a reduction in resource use
- Enhancement of University profile
- To develop an environmental ethics and value system amongst students

## 4.0 Goals of Green Audit

- To achieve compliance standards and establish a report with regulatory bodies
- To identify needs, strengths, and weaknesses of the educational institute
- To review management systems and identify liabilities
- To assess environmental performance of the educational institute with the help of direct assessment.
- To promote environmental awareness among the staff and students
- To conserve non-renewable resources for betterment of future
- The long term goal is to collect the baseline data in terms of environmental parameters, calculate its impact on the environment and recommend measures to reduce them

## 5.0 Target Areas of Green Auditing

- **Energy Conservation and Management:** This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles.
- **Water Quality and Conservation**: This indicator addresses water consumption, water sources, irrigation, storm water, appliances and fixtures.
- **Biodiversity Conservation**: All plant and animal species - including microorganisms - are a part of biodiversity. All types of gardens, lawns and trees are considered in this aspect.
- **Waste Management**: This indicator addresses all types of waste from the University and associated amenities. The minimization, safe handling, and ultimate elimination of these materials are essential to the long-term health of the planet.
- **Carbon Footprint:** This aspect is for quantifying the carbon emissions from all the parts of the institution and quantifying how much of it is sequestrated with the help of landscape.
- **Air quality and monitoring:** The ambient air quality w.r.t. different parameters are to be observed and measured as per the standard.
- **Noise pollution and measures:** The quantum of noise generated inside the working campus needs to be observed and measured for appropriate monitoring.

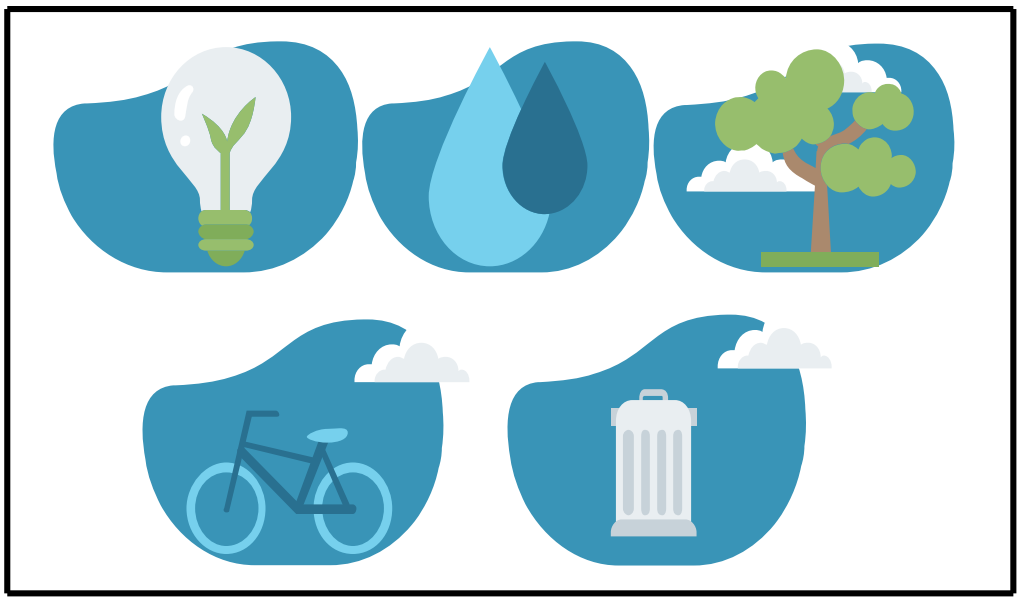


**Figure 11: Target Areas of Green Audit**

# 6.0 Methodology

## 6.1 Data Collection

In preliminary data collection phase, exhaustive data collection is performed using different tools such as preparation of questionnaire, physical inspection of the campus, observation and review of the documentation, interviewing key persons, etc. Focus groups, if practiced, can also be a vital part of data collection stage to acquire qualitative information.

## 6.2 Survey by Questionnaire

Baseline data for green audit report preparation was collected by questionnaire survey method. Most of the guidelines and formats are based on broad aspects. Therefore, using these guidelines and formats, combinations, modifications and restructuring was done and sets of questionnaires were prepared as solid waste, energy, water, biodiversity, carbon footprint.

## 6.3 Data Analysis

The data required for the analysis is taken from the data collection, it includes: calculation of energy consumption, analysis of latest electricity bill of the campus, measuring water consumption, carbon foot printing, etc. The data from questionnaire and survey forms is tabulated for the convenience of data availability; Recommendations and Environmental Management Plan is built according to the analysis done in this step.

## 6.4 Recommendations and Reporting

Based on the data analysis step, some recommendations in the target areas are made. Specific measures are suggested to reduce water and energy consumption. Proper treatments of waste are suggested with respect to waste collection, waste disposal and recycling. Recommendations to reduce the use of fossil fuels are made for the betterment of community health. Proper disposal of hazardous waste is suggested to prevent mishaps. Management also takes into account the suggestions related to reducing their carbon footprint. Similarly, the status of air and noise quality are to be reported for improvement.

# 7.0 Detailed Analysis

## 7.1 Water quality and conservation

This indicator addresses water consumption, water sources, irrigation, storm water, appliances and fixtures. The data collected from all the sections is examined and verified.

### a) Water Consumption:

**Table No. 1: Total Water Consumption per day of the University**

| Department | Water consumption per day (liters) |
|---|---|
| Social Sciences | 7500 |
| Computational Sciences | 14500 |
| Physical Sciences | 11000 |
| Instrumentation | 300 |
| Earth Sciences | 11000 |
| Chemical Sciences | 40000 |
| Girls' Hostel | 62000 |
| Boys' Hostel | 29000 |
| Mess (All) | 2000 |
| Gardening | 40000 |
| Nursery | 15000 |
| Guest House | 9000 |
| Solar Hot Water | 8000 |
| **Total** | **249300** |

All the water used in the campus is supplied by the **Municipal Corporation** of the Solapur city as well as from the bore-wells present. This water is then supplied to each unit in the campus. There are separate tanks on each building for the building's water requirement as follows:

**Table No. 2: No. of tanks and its capacity**

| Department | Number of tanks | Capacity (liters) |
|---|---|---|
| Computational Sciences (Overhead) | 1 | 1000 |
| Computational Sciences (Underground) | 2 | 7000 |
| Social Sciences (Overhead) | 2 | 2000 |
| | 1 | 1000 |
| Social Sciences (Underground) | 2 | 12000 |
| Chemical Sciences (Overhead) | 6 | 5000 |
| | 1 | 2000 |
| Chemical Sciences (RWH) | 1 | 10000 |
| Earth Sciences (Overhead) | 6 | 2000 |
| | 2 | 5000 |
| Physical Sciences (Overhead) | 4 | 5000 |
| | 1 | 1000 |
| Instrumentation | 1 | 10000 |
| Administrative Building | 3 | 5000 |
| | 1 | 2000 |

**Table No. 3: No. of tanks and its capacity**

| Department | Number of tanks | Capacity (liters) |
|---|---|---|
| Girls' Hostel | 1 | 5000 |
| Rector Quarters | 2 | 2000 |
| Girls' Hostel Mess 1 and 2 | 2 | 3000 |
| | 2 | 2000 |
| Guest House | 2 | 5000 |
| | 2 | 1000 |
| | 1 | 500 |
| Boys' Hostel | 1 | 23000 |
| | 1 | 11500 |

| | | |
|---|---|---|
| | 2 | 7500 |
| Boys' Hostel Mess | 2 | 15000 |
| | 5 | 1000 |
| Tank near Auditorium | 1 | 81000 |
| Tank behind Girls' Hostel | 1 | 10000 |
| Tank beside Computational Science | 1 | 11000 |
| | 1 | 2000 |
| Solar Hot Water – Girls' Hostel | 1 | 4000 |
| Solar Hot Water – Boys' Hostel | 1 | 3000 |
| Solar Hot Water – Guest House | 1 | 2000 |

**Figure 12: Overhead Water Tank of Chemical Sciences Building**

**b) Current practices of water management:**

- **Rain Water Harvesting** is practiced by the School of Chemical Sciences to save 10 $m^3$ per year and is being used as distilled water for experiments. It is in process for other buildings in collaboration with Maharashtra Jeevan Pradhikaran Department and will be in use soon.
- **Rain Water Harvesting** is also laid down for admin Building and School of Earth sciences Building
- **Drip Irrigation** is practiced in the campus for watering the plants and gardens
- The average **student to washroom ratio** for girls is **17:1** and for boys is **19:1**
- **Waste water Management:** All the waste water generated i.e. **249300** liters is disposed to the Central Drainage System on daily basis

### 7.2 Energy Conservation and Management

This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles.

**a) Electricity consumption:**

**Total Energy Consumption of the University is 22297 KWH per month**

**Solar Power Generation by the University is 14642 KWH per month**

**Table No. 4: Energy Consumption by University**

| Sr. No. | Electricity Consumption (KWH per month) | Source |
|---|---|---|
| **1.** | 22297 | MSEDCL |
| **2.** | 14642 | Solar Panels |

**b) Current practices for energy management**

Conserving energy produces a higher quality of life. In addition, it helps to create a healthier planet, or at least helps to sustain the resources already have.

- The institution has installed **solar panels** on the roof of the main administrative building that produces renewable energy to try to meet the increased electricity demand. Currently, the institute has solar panels that contribute to **65.66%** of the monthly electricity consumption.
- **Solar Panels** of 50 KWP are installed on the buildings of Physical, Computational and Chemical Sciences and will be in operation soon.
- The University has also installed 46 **solar street light panels** to meet the electricity demand.
- **Solar energy** is also used for hot water generation in Hostels and Guest House

**Figure 13: Solar Street Light panels**

**Figure 14: Solar Panels installed on Chemical Sciences, yet to be in operation**

### 7.3 Waste Management

This indicator addresses waste generation, collection, segregation and treatment

**a) Generation of waste:**

**Total Waste Generation of the University is 1157.6 kg/month**

**Table No. 5: Category Wise Waste Generation (kg/month)**

| Department | Paper waste | Plastic Waste | Biodegradable waste | Hazardous Waste | Glass waste | Garden Waste |
|---|---|---|---|---|---|---|
| Instrumentation | 1.5 | - | - | 0.1 | - | 600 |
| Physical Sciences | 4.5 | - | - | - | - | |
| Computational Sciences | 7 | | - | - | - | |
| Chemical Sciences | 4.5 | - | - | 92 | 2 | |
| Earth Sciences | 84 | | - | 23 | 0.5 | |
| Girls' Hostel | 154 | | | - | - | |
| Boys' Hostel | 38 | | | - | - | |
| Guest House | 16 | | - | - | - | |
| Administration | 126 | 4.5 | - | - | - | |

**Table No. 6: E-Waste Generation (kg/year)**

| Type of Waste | Generation Quantity | E-waste treated and disposed (kg) |
|---|---|---|
| **E-waste** | 182 | 182 |


**Figure 15: Waste Collection yard**


**Figure 16: Waste Collection**

**b) Current practices of solid waste management**

- The garden waste is sent to the **vermicomposting,** which then produces organic manure. This organic manure is used for trees in the campus.

**Figure 17: Vermi Composting**

- There are **two Vermicompost pits of 400 kg each** besides the Physical Sciences building and the cycle of composting is 4 months. **33.33%** of the garden waste is composted; however, remaining garden waste is then dumped in the 500 acres area.
- All the University waste - biological waste, paper waste, plastic waste and remaining garden waste - to be disposed **is collected and transported together** by the trolley to the 500 acres area
- The plastic and paper waste is collected and **disposed** together in the 500 acres land sanctioned to the University
- E-waste is collected from every department and is sent to the **authorized vendor** every 10 years
- Hazardous Waste is **sterilized** in autoclave and then buried in the building premises
- Solid chemical compounds are **reused** for the experimental practical purposes
- Glass Waste is **land filled** in the 500 acres area sanctioned to the University

### 7.4 Biodiversity Conservation

This aspect addresses all the flora and fauna of the campus. The list below has the name and quantity of trees as well as bird species.

**Table No. 7: Plant Species in the University**

| Sr. no | Common name of plant | Botanical name | Quantity |
|---|---|---|---|
| 1. | Palm | *Roystonea regia* | 760 |
| 2. | Fan Palm | *Washingtonia* | 13 |
| 3. | Ashok | *Saruca asoca* | 48 |
| 4. | Sagwan | *Tectona grandis* | 72 |
| 5. | Peepal | *Ficus religiosa* | 33 |
| 6. | Gulmohar | *Delonix regia* | 45 |
| 7. | Badam | *Terminalia katappa* | 49 |
| 8. | Limbu | *Citrus aurantifolia* | 04 |
| 9. | Tamarind | *Tamarindus indica* | 75 |
| 10. | Mango | *Mangifera indica* | 17 |
| 11. | Bamboo | *Bambusoideae* | 06 |
| 12. | Sururu | *Casuarina equisetifolia* | 767 |
| 13. | Jaswand | *Hibiscus rosasinensis* | 15 |
| 14. | Umbar | *Ficus racemosa* | 08 |
| 15. | Pongame Oiltree | *Millettia pinnata* | 10 |
| 16. | Chafa | *Plumeria rubra* | 04 |
| 17. | Drumstick | *Moringa oleifera* | 08 |
| 18. | Neem | *Azadirachta indica* | 175 |
| 19. | Coconut | *Cocos nucifera* | 126 |
| 20. | Parijatak | *Nyctanthes arbor-tristis* | 3 |
| 21. | Jamun | *Syzygium cumini L.* | 14 |
| 22. | Pomegranate | *Punica granatum* | 7 |
| 23. | Awala | *Phyllanthus emblica* | 39 |

| | | | |
|---|---|---|---|
| 24. | Chikoo | *Manilkara zapota* | 11 |
| 25. | Banyan | *Ficus benghalensis* | 14 |
| 26. | Nilgiri | *Eucalyptus **globulus*** | 40 |
| 27. | Guava | *Psidium guajava* | 42 |
| 28. | Bel | *Aegle marmelos* | 03 |
| 29. | Weeping Fig | *Ficus benjamina* | 44 |
| 30. | Christmas Tree | *Araucaria columnaris* | 1 |
| 31. | Sitafal | *Annona reticulate* | 11 |
| 32. | Mauritius Hemp | *Furcraea foetida* | 7 |
| 33. | Mehndi | *Lawsonia inermis* | 1 |
| 34. | Baheda | *Terminalia bellirica* | 50 |
| 35. | Wattle | *Acacia* | 11 |
| 36. | Yellow Oleander | *Thevetia peruviana* | 438 |
| 37. | Kaner | *Nerium oleander* | 16 |
| 38. | Kachnar | *Bauhinia variegate* | 22 |
| 39. | Jungle Flame | *Ixora* | 355 |
| 40. | Indian Senna | *Cassia angustifolia* | 80 |
| 41. | Brahmakamal | *Saussurea obvallata* | 1 |
| 42. | Lotus | *Nelumbo* | 4 |
| 43. | Mogra | *Jasminum sambac* | 1 |
| 44. | African Daisy | *Arctotis* | 13 |
| 45. | Tiger Lily | *Lilium lancifolium* | 62 |
| 46. | Copper Leaf | *Acalypha wilkesiana* | 31 |
| 47. | Fireball Lily | *Scadoxus multiflorus* | 1 |
| 48. | Pink Lily | *Zephyranthes carinata* | 4 |
| 49. | Papaya | *Carica papaya* | 1 |
| 50. | Purple Heart | *Peltogyne purpurea* | 2 |
| 51. | Tulsi | *Ocimum tenuiflorum* | 54 |

| | | | |
|---|---|---|---|
| 52. | Amaltas | *Cassia fistula* | 5 |
| 53. | Jujube | *Ziziphus mauritiana* | 2 |
| 54. | Lemon Grass | *Cymbopogon citrates* | 3 |
| 55. | Fig | *Ficus carica* | 18 |
| 56. | Shatavari | *Asparagus racemosus* | 71 |
| 57. | Morpankhi | *Platycladus orientalis* | 76 |
| 58. | Crepe Jasmine | *Tabernaemontana divaricata* | 6 |
| 59. | Trumpet | *Tecoma grandiflora* | 4 |
| 60. | Devil's Backbone | *Euphorbia tithymaloides* | 4 |
| 61. | Dwarf Umbrella Tree | *Schefflera arboricola* | 3 |
| 62. | Spanish Cherry | *Mimusops elengi* | 3 |
| 63. | Krishna Kanta | *Clitoria Ternatea* | 5 |
| 64. | Periwinkle | *Catharanthus roseus* | 18 |
| 65. | Rudraksh | *Elaeocarpus ganitrus* | 2 |
| 66. | Rui | *Calotropis Gigantea* | 4 |
| 67. | Indian mulberry | *Morinda citrifolia* | 5 |
| 68. | Crown of Thorns | *Euphorbia milii* | 5 |
| 69. | Crotons | *Codiaeum variegatum* | 22 |
| 70. | Blackboard Tree | *Alstonia Scholaris* | 42 |
| 71. | Senegal Mahogany | *Khaya senegalensis* | 31 |
| 72. | Golden Arrow | *Plumeria Pudica* | 7 |
| 73. | False Indigo | *Baptisia australis* | 2 |
| 74. | Stinking Passion Flower | *Passiflora foetida* | 1 |
| 75. | Peregrina | *Jatropha integerrima* | 2 |
| 76. | Reetha | *Sapindus mukorossi* | 3 |
| 77. | Gorakhchincha | *Kigelia Africana* | 1 |
| 78. | West Indian Elm | *Guazuma ulmifolia* | 5 |
| 79. | Kapok | *Ceiba pentandra* | 2 |

| | | | |
|---|---|---|---|
| 80. | Rosy Trumpet | *Tabebuia rosea* | 1 |
| 81. | 4 o'clock Plant | *Mirabilis jalapa* | 1 |
| 82. | Lantana | *Lantana camara* | 1 |
| 83. | Aloevera | *Aloe barbadensis miller* | 1 |
| 84. | Snake plant | *Sansevieria trifasciata* | 1 |
| 85. | Agave | *Agave Americana* | 4 |
| | | **Total** | 3979 |

**Some of the onsite pictures of the plants:**


GUEST HOUSE

**Fauna in the University campus**

**Table No. 8: Fauna observed in the University**

| Sr. No. | Specie Name | Scientific Name |
|---|---|---|
| **Birds** | | |
| 1. | Asian koel | *Eudynamys scolopaceus* |
| 2. | Common hawk cuckoo | *Hierococcyx varius* |
| 3. | House crow | *Corvus splendens* |
| 4. | Red vented bulbul | *Pycnonotus cafer* |
| 5. | Common myna | *Acridotheres tristis* |
| 6. | Brahmany starling | *Sturnia pagodarum* |
| 7. | Shikra | *Accipiter badius* |
| 8. | Purple rumped sunbird | *Leptocoma zeylonica* |
| 9. | Green bee-eater | *Merops orientalis* |
| 10. | Greater coucal | *Centropus sinensis* |
| 11. | Blue rock pigeon | *Columba livia* |
| 12. | Large grey babbler | *Argya malcolmi* |
| 13. | Barn swallow | *Hirundo rustica* |
| 14. | Indian peafowl | *Pavo cristatus* |
| 15. | Indian robin | *Saxicoloides fulicatus* |
| 16. | Eurasian collared dove | *Streptopelia decaocto* |
| 17. | Black kite | *Milvus migrans* |
| 18. | White throated kingfisher | *Halcyon smyrnensis* |
| 19. | Tailor bird | *Orthotomus sutorius* |
| Mammals | | |
| 20. | Indian palm squirrel | *Funambulus palmarum* |
| 21. | Indian grey mongoose | *Herpestes edwardsi* |
| Reptiles | | |
| 23 | Garden lizard | *Calotes versicolor* |
| 24 | Bengal monitor lizard | *Varanus bengalensis* |

| Butterflies | | |
|---|---|---|
| 22. | Common grass yellow | *Eurema hecabe* |
| 23. | Common emigrant | *Catopsilia Pomona* |
| 24. | Common crow | *Euploea core* |
| 25. | Danaid Eggfly | *Hypolimnas misippus* |
| 26. | Common pierrot | *Castalius rosimon* |
| 27. | Plain Tiger | *Danaus chrysippus* |
| 28. | Lemon pansy | *Junonia lemonias* |
| 29. | Pioneer | *Belenois aurota* |
| 30. | Tailed jay | *Graphium Agamemnon* |
| 31. | Crimson rose | *Pachliopta hector* |



COMMON HAWK CUCKOO


PURPLE RUMPED SUNBIRD


Grey mongoose


BRAHMINY MYNA


BLACK KITE


INDIAN PALM SQUIRREL

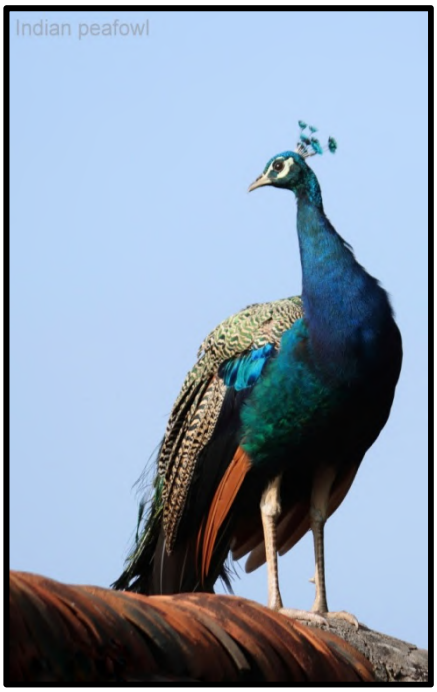

BLUE ROCK PIGEON


CRIMSON ROSE


RED VENTED BU


PIONEER


TAILED JAY


Indian peafowl


ASIAN KOEL


LARGE GREY BABBLER

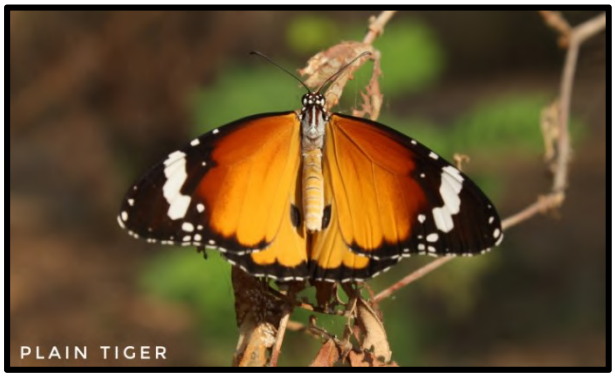

COMMON PIERRIOT


DANAID EGGFLY


asian Collared Dove


WHITE THROATED KINGFISHER


BARN SWALLOW


PLAIN TIGER


COMMON MYNA


COMMON CROW


Greater coucal


COMMON GRASS YELLOW


LEMON PANSY

### 7.5 Air and Noise Quality

Air quality of an academic institute is very important for health of students, faculty and staff of university. The air pollution sources in the university campus are wind storm, pollen grains, natural dust, vehicular emissions, generators, laboratory fumes, etc. The air pollutants monitored on regular basis are Sulphur dioxide ($SO_2$), Oxides of Nitrogen as NOx, Suspended Particulate Matter (SPM) and Repairable Suspended Particulate Matter (RSPM) by High Volume Sample (HVS) as well as records of temperature, relative humidity are also been recorded for comparison. All the air quality parameters are within the standard limits of MPCB except SPM, suggesting ambient air quality of university campus is moderate and might cause minor breathing discomfort to sensitive people.

**Table 9: Air Quality Monitoring**

| | $SO_2$ ($\mu g/m^3$) | $NO_x$ ($\mu g/m^3$) | RSPM ($\mu g/m^3$) | SPM ($\mu g/m^3$) | Air Quality Index |
|---|---|---|---|---|---|
| **Standard** | 80 | 80 | 100 | 100 | |
| **Average for 2018-2019** | 16.56 | 33.73 | 68.98 | 285.94 | 76 |

The above table shows that Sulphur dioxide ($SO_2$), Oxides of Nitrogen as NOx, and Repairable Suspended Particulate Matter (RSPM) are within limits; however, Suspended Particulate Matter (SPM) is above limits. The Total Air Quality Index is 69 which is satisfactory.

The University has also set up the device for air monitoring; however, due to power cuts at times, the procedure cannot be completed.

As an academic institute comes under silent zone, the noise should be below 50 dB during day time. Therefore, the noise on the campus is also measured and found within the standard limits. Sometimes construction activities and road traffic increases the noise level on the campus.

PAH Solapur University is located on the Pune-Solapur National Highway. The major source of noise at university is due to automobile use. Building construction and D.G. Sets can also cause considerable noise emissions. Hence, overall air and noise quality within the campus is good and within the prescribed limits of MPCB.

**Ambience of the campus:** The ambience of the University is calm, spacious with good amenities and utilities in a visually appealing landscape. The building footprint of the University is 25% whereas green area is more than 40% of the total plot area. Various trees are planted at the periphery of roads which in turn reduces the University's Heat Island Effect and due to reduction of concrete pathways; rain water harvesting has been managed efficiently. The University has retained a huge amount of natural topography which aids in plenty of water percolation and ground water recharging.

Moreover, every department has its representative paintings at the entrances, which gives those an artistic and representative atmosphere. Also, maintenance of natural topography has led to the innovative way of retention of various species of flora and fauna, which can be extremely advantageous for academic purposes. Being out of the city limits, the University has flourished in maintaining the faunal habitat effectively.

### 7.6 Carbon Footprint

**Carbon footprint (CF)** is the total amount of **greenhouse gases** (including carbon dioxide and methane) that are generated by human actions.

**a) Carbon Emissions:**

**Table No. 10: Scopes of carbon emissions**

| Classification/Scope | Sources | Description |
|---|---|---|
| **Scope 1 (Direct)** | Resource usage | Emissions from LPG Cylinder, D.G. Set, University owned vehicles, Air Conditioners |
| **Scope 2 (Indirect)** | Electricity Use | Emissions from Purchased Electricity and Renewable Energy |
| **Scope 3 (Indirect)** | Personnel commuting And raw materials transportation | Emissions from Personnel commutation and raw materials transportation |
| | Wastewater treatment | Emissions from waste water treatment |
| | Solid Waste treatment | Emissions from solid waste management |

**Emission Data and Calculations:**

- **Scope 1 –** All Direct Emissions from the activities of an institution or under its control. Including fuel combustion on site such as gas, etc.

**Table No. 11: Scope 1 Emissions**

| Type of Fuel | Quantity per month | Emission Factor | $KgCO_2$/month |
|---|---|---|---|
| **Fuel used for DG set** | 190 liters | 2.653 | 504.07 |
| **LPG** | 1059.1 Kg | 2.983 | 3158.997 |
| **University owned vehicles - Petrol** | 3700 liters | 0.13 | 481 |

| | | | |
|---|---|---|---|
| **University Owned Vehicles – Diesel** | 10750 liters | 0.230 | 2386.5 |
| **TOTAL SCOPE 1 EMISSIONS** | | | **6512.667** |

- **Scope 2 –** Indirect Emissions from electricity purchased and used by the institution.

**Emissions from Purchased electricity:**

**Table No. 12: Scope 2 emissions**

| Type of Emission | Quantity (KWH per month) | Emission Factor | $KgCO_2$ / month |
|---|---|---|---|
| **Emissions from Purchased electricity** | 22297 | 0.97 | 21628.09 |
| **Renewable Energy** | 14642 | 0.97 | 14202.74 |
| **TOTAL SCOPE 2 EMISSIONS** | | | **21628.09** |

- **Scope 3 – All Other Indirect Emissions** from activities of the institution, occurring from sources that they do not own or control

1. **Delivery/Construction Transportation:** Travelling distance, mode of transportation and type of fuel used for transportation are other major factors associated with carbon emission.

**Table No. 13: Fuel Consumption through Raw Material Transportation**

| Type Of Transportation | Distance Travelled In One Month (Km) | Emission Factor | $KgCO_2$/month |
|---|---|---|---|
| Auto | 96 | 0.1135 | **10.896** |

2. **Employee Transportation:** This unit seeks to identify the impact on global climate change through its emissions of greenhouse gases (GHGs), notably carbon dioxide ($CO_2$).

**Table No. 14: Fuel Consumption through staff Transportation**

| Mode of transportation | Daily Count | Travelling distance (Km/Vehicle) (to and fro) | Total Km | Emission Factor | $KgCO_2$/day |
|---|---|---|---|---|---|
| **2 wheeler** | 360 | 24 | 8640 | 0.0319 | 275.616 |
| **4 Wheeler (Cars)** | 20 | 24 | 480 | 0.13 | 62.4 |
| **Auto** | 40 | 24 | 960 | 0.1135 | 108.96 |
| **Bus** | 20 | 24 | 480 | 0.0151 | 7.248 |
| **TOTAL** | | | | | **454.224** |

**Table No. 15: Fuel Consumption through students Transportation**

| Mode of transportation | Daily Count | Travelling distance (Km/Vehicle) (to and fro) | Total Km | Emission Factor | $KgCO_2$/day |
|---|---|---|---|---|---|
| **2 wheeler** | 309 | 24 | 7416 | 0.0319 | 236.5704 |
| **Auto** | 485 | 24 | 11640 | 0.1135 | 1321.14 |
| **Bus** | 221 | 24 | 5304 | 0.0151 | 80.0904 |
| **TOTAL** | | | | | **1637.80** |

**Table No. 16: Fuel Consumption through visitors' Transportation**

| Mode of transportation | Daily Count | Travelling distance (Km/Vehicle) (to and fro) | Total Km | Emission Factor | Kg $CO_2$ per day |
|---|---|---|---|---|---|
| **2 wheeler** | 80 | 30 | 2400 | 0.0319 | 76.56 |
| **Car – Petrol** | 30 | 30 | 900 | 0.13 | 117 |
| **Car - Diesel** | 30 | 30 | 900 | 0.230 | 207 |
| **Auto** | 30 | 30 | 900 | 0.1135 | 102.15 |
| **Bus** | 30 | 30 | 900 | 0.0151 | 13.59 |
| **TOTAL** | | | | | **529.89** |

### 3. Waste Water Generation:

**Table No. 17: Waste Water Generation**

| Wastewater generated (liters) | Emission Factor | Total |
|---|---|---|
| 249300 per day | 0.21 | **52353 Kg $CO_2$/day** |
| **Total** | | **1570590 Kg $CO_2$/month** |

### 4. Solid Waste Generation:

**Table No. 18: Dry Solid Waste Generation**

| Solid waste generated (Kg) | Emission factor | Total |
|---|---|---|
| 1019.5 per month | 0.21 | **214.095 Kg$CO_2$ /month** |

- **Total emissions throughout a year**

**Table No. 19: Total emissions throughout the year**

| Reporting Year | Total Emissions (kg $CO_2$ per month) | Total Emissions (Kg $CO_2$ per year) |
|---|---|---|
| **2018-2019** | **1601577.662** | **19218931.94** |

**Carbon Sequestration**

**Table 20: Carbon Sequestration of Trees**

| Sr. no | Category of Trees | Quantity | Kg $CO_2$ sequestration/year | Total Kg $CO_2$ sequestration |
|---|---|---|---|---|
| 1. | Trees | 3979 | 25 | 99475 |

**Total carbon Emissions: 19218931.94 Kg $CO_2$ per year**

**Avoided Emissions by Renewable Energy: 1, 70, 432.88 Kg $CO_2$ per year**

**Carbon Sequestration: 99475 Kg $CO_2$ per year**

**Percentage of carbon reduced: 1.40%**

**b) Carbon Emissions Management:**

The University has planted 3979 plants in the campus to sequestrate carbon emissions.

## 8.0 Innovative Strides

- University had organized campus cleaning drive for maintaining cleanliness in the campus

**Figure 18: Campus Cleaning Drive**

- NSS Club of PAH Solapur University also organizes Tree Plantation on various occasions to maintain greenery in the campus
- Activities like plantation and Swachh Bharat Abhiyan are carried out by faculty members and students of Environmental Sciences department
- Herbal garden is maintained in the institution by Environmental Sciences Department
- Celebration of environmental day and water day by Environmental Sciences department
- International Conference on 28–30 September 2017 on Clean Energy Futures, Solapur, Maharashtra State, India
- Environmental Sciences have painted the entrance of the building with Fauna diversity for awareness purposes

**Figure 19: Tree Plantation Drive by NSS Club**

- Eco friendly seating bench was made from the plastic bags, bottles and fly ash bricks outside the School of Physical Sciences by the students


**Figure 20: Eco friendly seating bench**

## 9.0 Recommendations from the audit

1. **Water Quality and Conservation**
    - Installation of **Sewage Treatment Plant** for waste water management of whole campus is recommended on priority basis
    - Installation of **low flow plumbing fixtures like aerators and water regulators** for water conservation
    - Installation of **water meters** is suggested to track water consumption of various entities
    - Implementation of **separate water treatment** process for hazardous waste water from Chemical Sciences and Earth Sciences Department
    - Installation of **Rain Water Harvesting** for the whole campus to reduce municipal water consumption
    - Performing internal **water audits** every six months
    - Checking **potability of water** every month is recommended
    - Installation of **motion sensed sprinklers** is advised for gardening purposes
2. **Energy Conservation and Mangaement**
    - Installation of **energy meters** for every department to track electricity consumption is suggested
    - **Improving Solar PV** effectiveness and **installing solar panels** for every building to reduce electricity consumption from MSEDCL is recommended
    - Installing **5-star energy efficient appliances** wherever possible is encouraged
    - Installation of **LED lamps** instead of TL and CFLs is a smart way of energy saving
    - Installation of **energy efficient fans** in the new as well as old buildings
    - Installation of **IE 4 motors** for less energy usage
    - Setting **Yearly Performance targets**
    - Putting up **sign boards** to spread awareness for electricity consumption
    - University has many areas where lighting is not required at all times. Installing **sensor based lighting** in such areas can generate massive rewards

- Planning **workshops** on energy conservation to educate students, faculty and staff can generate huge results of awareness
- Establishing a **purchase policy** that is energy saving and eco-friendly is needed
- Performing **internal energy audits** every year is advised

3. **Waste Management**
   - Installation of **separate dustbins** for wet and dry waste
   - Maintenance of separate **waste segregation yard** for separating waste into various categories for further treatment is advised
   - Install **sanitary incineration** system to reduce sanitary waste and convert the waste to energy
   - **Separate waste collection and segregation** is advised for every building
   - **Separate waste transportation** is recommended for different types of waste
   - Hazardous waste from Chemical Sciences and Earth Sciences should be **sterilized and sent to composting**
   - One of the suggested methods for garden waste disposal is **Mulching**
   - Plastic and paper waste should be sold to **authorized vendors for recycling**
   - One of the preferred methods to treat paper waste is **shredding and composting**
   - Maintain **waste collection record** on daily basis for future convenience
   - Try to inculcate the concept of **'Plastic free Campus'**
   - To cut down the waste and carbon footprint, the university should follow **paperless methods of communication** and use emails, that too as minimum as possible
   - Installation of **biogas plant** can convert wet waste into energy
4. **Biodiversity Conservation**
   - Maintain **natural topography** wherever possible
   - Planting more **fruit-bearing** trees can attract birds
   - Displaying **boards of fauna diversity** in the campus can generate enthusiasm for learners
   - Form a **botanical and medicinal garden** in the campus for academic as well as awareness purposes

- Develop a **butterfly garden** that arouses appreciation towards flora and fauna diversity in the university
- Plant more **native trees**

5. **Carbon Footprint**
   - Maintain **'No Vehicle Day'** at least once a month
   - Use **CFC free** equipments
   - Encourage **car pooling or ride share** program
6. **Air and Noise Quality**
   - Use of **bicycles** for transportation in the campus
   - Avoid using **diesel generators**
   - Use of **BS-4 vehicles**
7. **General Recommendations**
   - Maintain **EMP plan** to ensure positive benefits
   - Activate **Environmental management committee** to look after the compliance of EMP plan
   - Conducting **internal environmental audits** can help understand grey points
   - Putting up **posters related to Environment, Health and Safety** (No Smoking Policy, Saving Electricity, Water Conservation, etc.) is an easiest way to spread awareness
   - Adopting **IGBC Green campus** rating system will help boost the University Profile

## 10.0 Conclusions

Green Audit is the most efficient way to identify the strength and weakness of environmental sustainable practices and to find a way to solve problems. Green Audit is one kind of a professional approach towards a responsible way in utilizing economic, financial, social and environmental resources. Green audit can "add value" to the management approaches being taken by the University and is a way of identifying, evaluating and managing environmental risks (known and unknown). The institution has incorporated most of the recommendation from Green Audit 2017-2018. There is scope for further improvement, particularly in relation to waste, energy, and carbon footprint and water management. The University considers the environmental impacts from most of its actions and makes a concerted effort to act in an environmentally responsible manner. Even though the University does perform fairly well, the recommendations in this report highlight many ways in which the University can work to improve its actions and become a more sustainable institution.

## 11.0 Environmental Management Plan

By keeping in mind the current scenario of consumption of various entities and the current practices of the management, Greenex Environmental has prepared an 'Environmental Management Plan' for the University. This plan will reveal strengths and weaknesses of the University as well as suggestions on how to tackle the issues and develop green and clean campus. It also gives suggestion for the priority of work to carry out.

| **Water** | | | | | |
|---|---|---|---|---|---|
| **Details** | **Daily** | **Monthly** | **Quarterly** | **Yearly** | **Remarks** |
| Analysis of STP inlet and outlet water | | √ | | | |
| Perform in-house water analysis of drinking water | | | √ | | |
| Installing water meter and keeping its record | √ | | | | |
| Maintenance of Rain water Harvesting System | | | √ | | |
| Perform water audits | | | | √ | |
| Cleaning of water tanks | | √ | | | |
| Quarterly drip irrigation maintenance | | | √ | | |
| **Energy** | | | | | |
| Performing energy audits | | | | √ | |
| Installing energy meters for various entities and maintaining its record | | √ | | | |
| **Waste** | | | | | |
| Disposal of E-waste to authorized vendors | | | | √ | |
| Maintaining waste quantity record | √ | | | | |
| **Biodiversity** | | | | | |
| Monthly checking of labels on trees | | √ | | | |
| Maintain quarterly tree count | | | √ | | |
| **Carbon footprint** | | | | | |
| Recording usage of | √ | | | | |

| | | | | | |
|---|---|---|---|---|---|
| University owned vehicles | | | | | |
| Recording of diesel usage in D.G. sets | √ | | | | |
| Recording LPG gas refilling frequency | | √ | | | |
| Recording of number of visitors | √ | | | | |

## 12.0 References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# Annexure

## Energy Conservation and Management

| Prerequisites | Affirmation | Response | Capacity | Documentary Evidence |
|---|---|---|---|---|
| Total Energy Consumption | Yes/No | | | Light Bills |
| Renewable Energy | Yes/No | | | Technical Specifications |
| Energy Audit Report | Yes/No | | | Report |
| Energy use breakup | Yes/No | | | Report/Documents |
| Energy Meter | Yes/No | | | Photos |
| Outdoor Bulb Directions | -- | | | Photos |

## Water Quality and Conservation

| | |
|---|---|
| Total number of water users | |
| Number of Employee | |
| Number of visitors (daily) | |
| Number of Students | |
| Rain water harvesting system availability | |
| Is rain water harvesting system working? | |
| Daily water supply (liters) | |
| Source of water | |
| Water Meter | |

**Water Storage:**

Details of the storage structures -

| Storage tanks | Capacity (Liters) | Number | Number of times it is topped (or filled) daily |
|---|---|---|---|
| Overhead | | | |
| Underground | | | |
| Total | | | |

## Waste Management

| Type of Waste | Quantity | Method of Disposal |
|---|---|---|
| Paper | | |
| Plastic | | |
| Garden Waste | | |
| Glass | | |
| Wood | | |
| Biodegradable | | |
| Cloth | | |
| Hazardous | | |
| Clinical | | |
| E-Waste | | |
| Metal | | |

## Carbon Footprint

**Prerequisites**

| | | | |
|---|---|---|---|
| Scope I | University Owned Vehicles | Transportation per month: | No. - |
| | D.G. Set | Diesel consumed per month: | No. - |
| | LPG | Consumption per month: | No. - |
| | $CO_2$ Extinguishers | | No. - |
| | AC | Capacity: Make up: | No. – |

| | | | | |
|---|---|---|---|---|
| Scope III | Staff Commuting | Distance: | Type of Vehicle: | No. - |
| | Students | Distance: | Type of Vehicle: | No. - |
| | Business Travel | Distance: | Type of Vehicle: | No. - |
| | Other Material Deliveries | Distance: | Type of Vehicle: | No. of trips- |

## Biodiversity

| Sr. no | Common name | Quantity |
|---|---|---|
| Plants | | |
| 1. | | |
| 2. | | |
| 3. | | |
| Animals | | |
| 4. | | |
| 5. | | |
| 6. | | |

# Our Team

## 1. Arati Bhosale

M. Sc. Environment, PGDISHE
Director, Greenex Environmental
IGBC AP, GRIHA CP, LEED GA, EMS lead Auditor, CII certified Carbon Footpront Professional

**Work Experience:**

Rich experience of 10 + years in Environment field. Expertise in Life cycle assessment study, carbon footprint, water footprint & IGBC GRIHA, LEED Certifications. She has successfully accomplished 150 + Products LCA study and 50 + Green building projects.

## 2. Dr. Ganesh Kadam

PhD (Environmental Science & Technology), M.Sc. (Env. Sci.), RIO +20 India (2013), PGDISHE (Post Graduate Diploma in Industrial Safety Health & Environment), PGDGIS (Post Graduate Diploma in Geoinformatics)

**Work Experience:**

More than 12 yrs of experience in the Environmental research field with 6 years' experience of Institutional Green Auditing, conducted more than 10 audits for various Colleges and University. Total 6 National and International Publications published in reputed journals.

## 3. Ruturaj Patil

MBA, B.Sc. Zoology
Manager and Naturalist

**Work Experience:**

More than 8 yrs of experience as Naturalist and Manager.

## 4. Anjella Patel

M.Sc. (Environment Science), B.Sc. (Environment Science), Diploma (Remote Sensing and Geographic Information System)

**Work Experience:**

Working as Jr. Environmental Executive with Green Solution. Completed internships with Suzlon Foundation and Gujarat Pollution Control Board.

## 5. Lakshika Kotak

B.E. Chemical
Environmental Executive, Greenex Environmental

**Work Experience:**

Working on LCA, Carbon Footprint, Green Building certification and Green Audit Projects since 6 months. Completed internships in Gharda Chemicals Ltd. and Evonik Catalysts India Pvt. Ltd.

# Environmental & Green Audit Report

## Punyashlok Ahilyadevi Holkar Solapur University

Solapur Pune National Highway, Kegaon, Solapur, Maharashtra - 413255

By
**GREENEX ENVIRONMENTAL**
T-71,- 1A/2, Telco Road, General Block, Near Indrayani Corner, above Kotak Mahindra bank, MIDC, Bhosari, Pune – 411026

# Acknowledgement

We would like to express our sincere gratitude towards all who made it possible for us to complete the Green Audit of Punyashlok Ahilyadevi Holkar Solapur University smoothly. We would like to extend our gratitude to Dr. D. N. Mishra, Pro-Vice Chancellor, PAH Solapur University, for offering us the opportunity to perform Green Audit of PAH Solapur University. We would also like to thank Mr. Pankaj and Mrs. Smita Pore for making time and assisting us throughout the audit. We also thank Dr. Vinayak Dhulap, Head of Environmental Sciences department for his timely support.

We acknowledge Dr. Mrunalini Fadnavis, Vice Chancellor, PAH Solapur University, for taking out time from her busy schedule and meeting with us. We would like to thank each and every staff member at the university who helped us collect the resourceful data. Last but not the least; we thank our team for their unwavering support.

- Greenex Environmental

# INDEX

# 1.0 Introduction

## 1.1 PAH Solapur University

Punyashlok Ahilyadevi Holkar Solapur University is a young state University of Maharashtra state and was established as 'Solapur University' on 1st August 2004. The formation of the University at Solapur was a long cherished desire of the people of this region and the people of the district have an emotional attachment to the University since its inception. The name of Solapur University was extended to as Punyashlok Ahilyadevi Holkar Solapur University by the state government on March 2019. The University has been recognized by University Grants Commission (UGC) u/s 2(F) and 12(B) of its Act. It is also been recognized by All India Council for Technical Education (AICTE), National Council for Teacher Education (NCTE) and other apex bodies. National Assessment and Accreditation Council (NAAC) has awarded B++ Grade to the university in its second cycle.

Earlier to the formation of Solapur University, Solapur city had a P. G. Center of Shivaji University, Kolhapur since 1984. The center for P. G. Studies had three postgraduate science departments housed in two buildings and a central Library building on its campus that spread over a total area of 37 acres. Seven postgraduate courses were offered in that P.G. centre. Eventually, this PG Centre was transformed in to the new University and separated from Shivaji University in 2004.

Punyashlok Ahilyadevi Holkar Solapur University is now located on the outskirts of Solapur city, about 10 km from the main city, on the national highway NH-09 towards Pune side. The proximity with the national highway provides good connectivity. It is a matter of great pride that the university has made big strides within a short span. Nine new buildings, for School of Computational Sciences, School of Social Sciences, School of Earth Sciences, Central Instrumentation centre, Girls' hostel with an accommodation facility for 80 girls; Boys' hostel with accommodation for 200 boys, Rector's bungalow, University Guest House and VIP Bungalow have been added to the existing buildings of School of Chemical Sciences, School of Physical Sciences and Library cum administrative building.

The University is relentlessly putting its endeavours in enhancing the standards in teaching, research, skill based programs, extra-curricular and sports activities. The University has introduced new schools like School of Commerce and Management, School of Languages and Literature, School of Performing Arts and Fine Arts, School of Allied Health Sciences, School of Technology, School of Life Sciences and many new courses in recent times. At the same time, some of the existing courses are modified so as to strike the right balance between the theoretical and applied components in the curriculum. Bridge courses are initiated by the schools to admit students from other faculties to the main stream courses. There is a strong research pursuance and publications carried out by each

school. The University is committed to the all-round developments of students. As a result, a number of students have been bringing laurels at the state and national youth festivals, sports and research events.

The University has been regularly organizing State level, inter University level and international seminars, conferences, sports and research events. The University has developed its sports facilities and health centre in the extended campus. Construction of the new Administrative and examination building has started at the state Govt allocated approx. 500 acre land near to the old campus. The installation of an impressive Horse riding statue of Punyashlok Ahilyadevi and development of a museum centre work are in progress at the new campus too.


**Figure 1: Punyashlok Ahilyadevi Holkar Solapur University**


**Figure 2: Satellite image of Punyashlok Ahilyadevi Holkar Solapur University**

### 1.2 Infrastructure

There are 20 buildings in the University Campus. Areas of these buildings are as below:

**Table No. 1: Area Bifurcation of the University**

| Sr. No. | Particulars | Total Area in Sq. m |
|---|---|---|
| **1.** | Computational Science | 2,460.03 |
| **2.** | Social Sciences | 3,151.07 |
| **3.** | Physical Sciences | 2,307.25 |
| **4.** | Earth Sciences | 2,163.59 |
| **5.** | Chemical Sciences | 2,054.63 |
| **6.** | Admin - Library | 1,015.04 |
| **7** | Instrumentation Centre | 190.16 |
| **8.** | Boys Hostel | 1,376.00 |
| **9.** | Mess | 492.50 |
| **10.** | Rector Quarters | 81.86 |
| **11.** | Ladies Hostel | 9,987.96 |
| **12.** | Mess – I | 261.15 |
| **13.** | Mess – II | 261.15 |
| **14.** | VIP Guest House | 1,866.59 |
| **15.** | Stage | 402.98 |
| **16.** | Canteen Area | 363.00 |
| **17.** | **Total Free space in the 32.5 acres campus** | 18,500.00 |
| | **Total** | **28,497.33** |

All the buildings in the University are well-spaced and well constructed to provide proper illumination and ventilation. More than 40% of the campus area is covered with vegetation, giving it an aesthetic view and providing a healthy environment. All the buildings in the campus have open courtyards which consist of various plants and skylights.

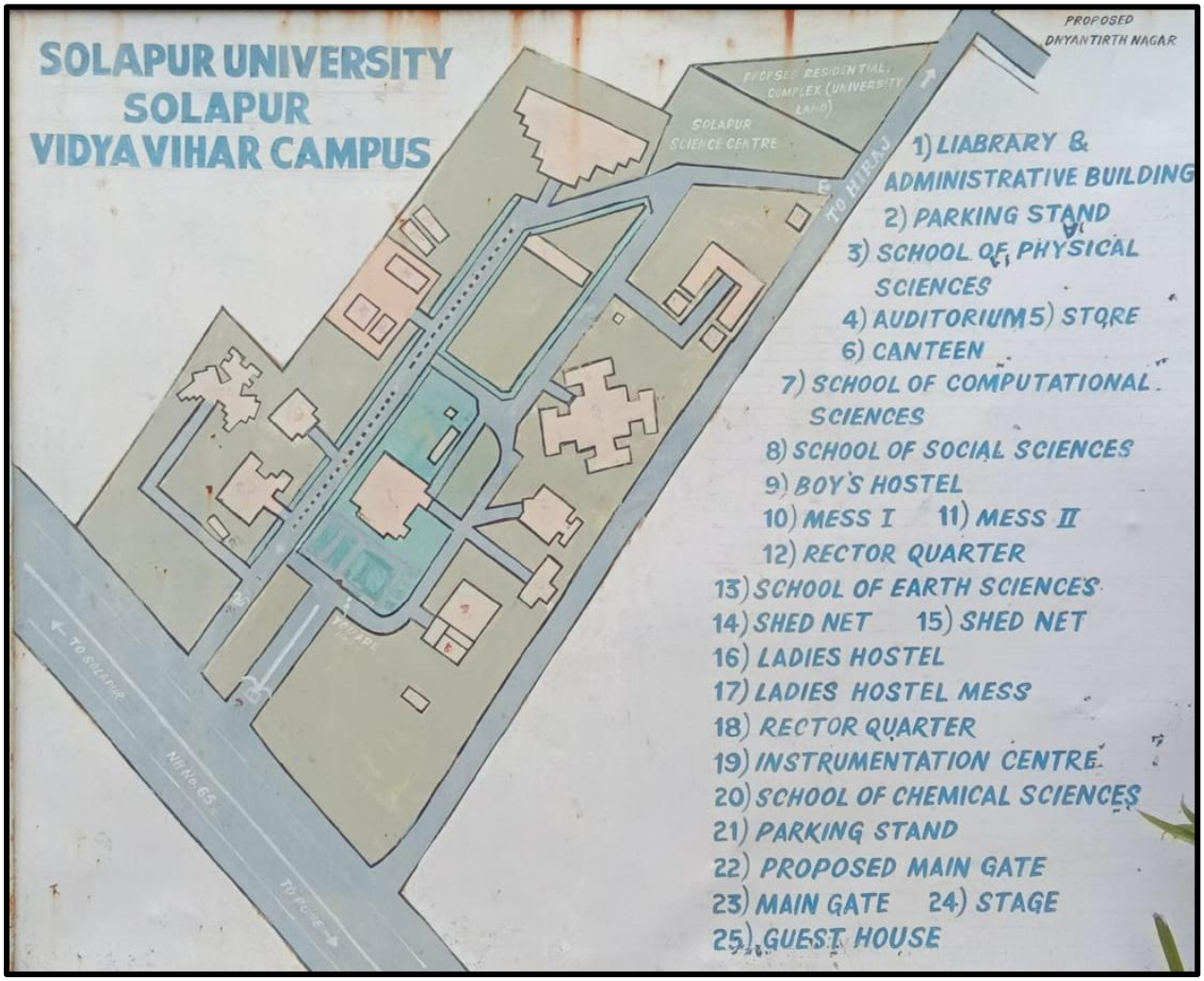



**Figure 3: Layout of PAH Solapur University**


**Figure 4: School of Physical Sciences**

**Figure 5: School of Chemical Sciences**


**Figure 6: School of Earth Sciences**


**Figure 7: School of Social Sciences and Commerce & Management**

**Figure 8: School of Computational Sciences**

## 1.3 Vision and Mission of the University

**Vision**

Enrich research, teaching skill and employability of the students with execution of best practices.

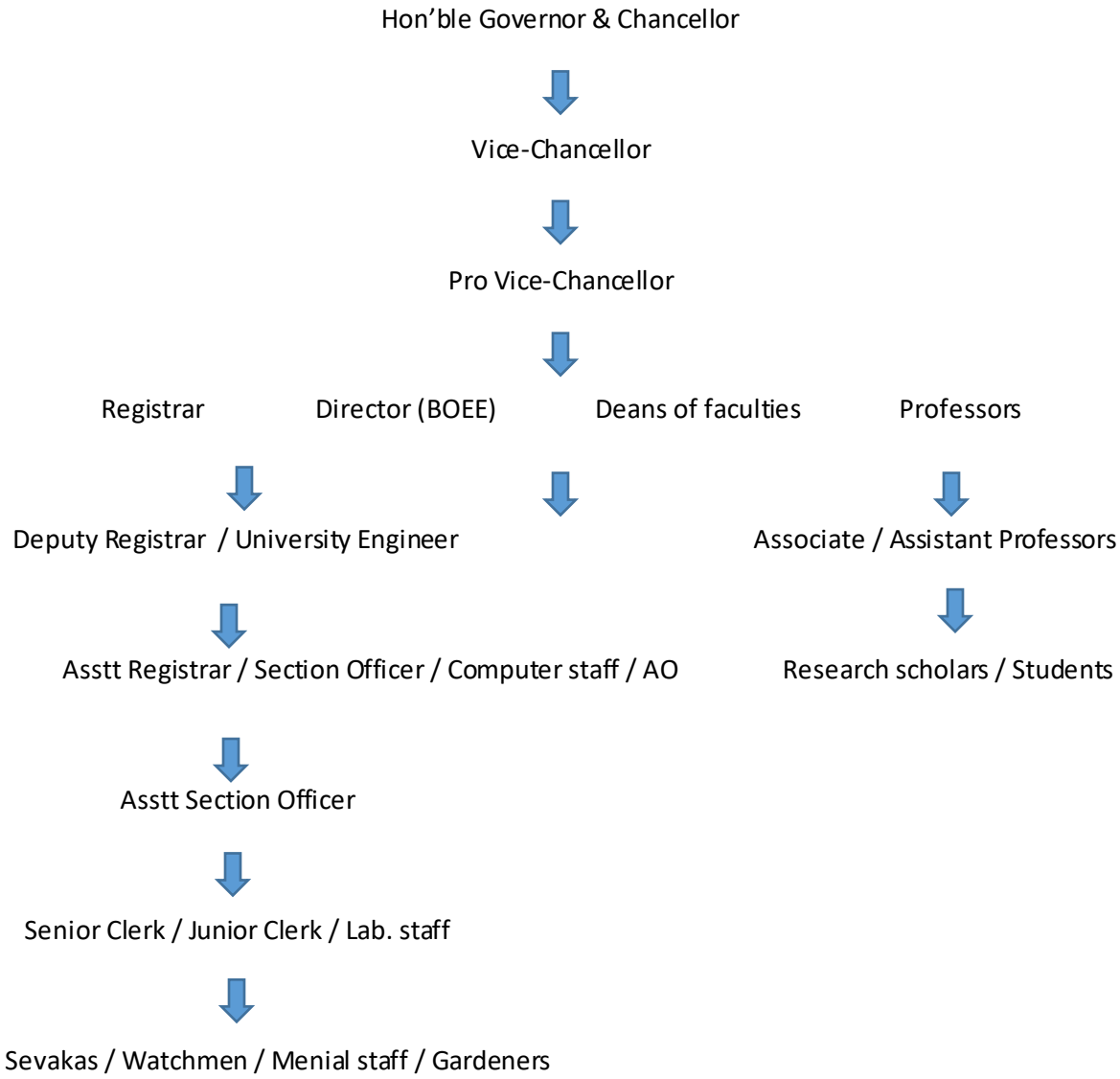
**Mission**

Empower students and teachers in various fields on the basis of global and local resources by enriching power within them.

**Goals of the institution**

- To continue to improve the quality of the undergraduate and postgraduate courses that prepares the students for professional life, leadership and citizenship in a changing world.
- To make special efforts to provide access to higher education to economically challenged and underprivileged sections of the society.
- To optimize the usage of resources and infrastructure in an integrated fashion to improve, enhance and strengthen the students' faculties.
- To produce global students with Indian ethos.
- To inculcate self-discipline and high ethical standards, among students, staff, faculty and societal individuals.
- To create a pool of self-motivated and dedicated researchers.
- To provide facilities and support to the staff to take up innovative methods of teaching in accordance with the developments in the academic world and also take care of the development in industry and commerce.
- To transform the 'Student' into "Knowledge Professional" empowered with scientific intellect, entrepreneurial skills, and innovation, who have learnt their skills in a highly competent environment under the guidance of research oriented and skilled Professors.
- To create an ambience for learning and scholarship.
- To become a nationally renowned Centre of Excellence in teaching - learning, research and extension activities, beneficial to the current and forth coming generations.

## 1.4 Organizational Structure of the University




**UNIVERSITY STATUTORY AUTHORITIES**

**The Senate, Academic Council, Management Council, Board Of Examinations, Board of Deans** and many other bodies as per Maharashtra Public University Act 2016

# 2.0 Environmental and Green Audit – A Preview

## 2.1 Environmental Audit

An environmental audit is a type of evaluation intended to identify environmental compliance and management system implementation gaps, along with related corrective actions. In this way, environmental audit performs an analogous (similar) function to financial audit. There are generally two different types of environmental audits: compliance audits and management systems audits. ISO 14001 is a voluntary international standard for environmental management systems ("EMS"). ISO 14001:2004 provides the requirements for an EMS and ISO 14004 gives general EMS guidelines.

The Supreme Audit Institution (SAI) in India is headed by the Comptroller and Auditor General (CAG) of India which is a constitutional authority. The audit conducted by CAG is broadly classified into Financial, Compliance and Performance Audit. Environmental audit by SAI India is conducted within the broad framework of compliance and performance audit.

Environmental auditing is a systematic, documented, periodic and objective process in assessing an organization's activities and services in relation to:

- Assessing compliance with relevant statutory and internal requirements
- Facilitating management control of environmental practices
- Promoting good environmental management
- Maintaining credibility with the public
- Raising staff awareness and enforcing commitment to departmental environmental policy
- Exploring improvement opportunities
- Establishing the performance baseline for developing an Environmental Management System (EMS)


**Figure 9: Aspects of Environmental Audit**

## 2.2 Green Audit

Green Audit is a part of Environmental Audit. Green Audit is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of various establishments. It aims at analyzing environmental practices within and outside of the concerned sites, which will have an impact on the eco-friendly ambience.

Green audit can be a useful tool for an academic institution to determine how and where the institution is using the energy or water or resources more than requirements. The institution can then consider how to implement changes and make savings. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan. It can create health consciousness and promote environmental awareness, values and ethics. It provides staff and students a better understanding of Green impact on campus. Thus it is imperative that the institute evaluates its own contributions towards a sustainable future. As environmental sustainability is becoming an increasingly important issue for the nation and for the world, the role of higher educational institutions in relation to environmental sustainability is more significant.

The rapid urbanization and economic development at local, regional and global level has led to several environmental and ecological crises. On this background, it becomes essential to adopt the system of the Green Campus for the institutes which will lead towards sustainable development and at the same time reduce a sizable amount of atmospheric carbon-di-oxide from the environment. **Green Audit is assigned to the Criteria 7 of NAAC (National Assessment and Accreditation Council) evaluation** that declares the institutions as Grade A, Grade B or Grade C according to the scores gained at the time of accreditation. Moreover, it is a part of the responsibility of the Higher Educational Institutions to ensure that there is reduction of global warming through Carbon Footprint reduction measures.

Therefore, the need or purpose of the green audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards.

**Figure 10: Green Campus Illustration**

## 3.0 Objectives of Green audit

The overall objectives of green auditing are to help safeguard the environment and minimize risks to human health. The key objectives of an environmental audit therefore are:

- To determine how well the environmental management systems and equipment are performing
- To verify compliance with the relevant national, local or other laws and regulations
- To minimize human exposure to risks from environmental, health and safety problems.
- More efficient resource management
- To provide basis for improved sustainability
- To enable waste management through reduction of waste generation, solid- waste and water recycling
- To create plastic free campus and evolve health consciousness among the stake holders
- To recognize the cost saving methods through waste minimizing processes
- To point out the prevailing and forthcoming complications
- Impart environmental education through systematic environmental management approach and improving environmental standards
- Financial savings through a reduction in resource use
- Enhancement of University profile
- To develop an environmental ethics and value system amongst students

## 4.0 Goals of Green Audit

- To achieve compliance standards and establish a report with regulatory bodies
- To identify needs, strengths, and weaknesses of the educational institute
- To review management systems and identify liabilities
- To assess environmental performance of the educational institute with the help of direct assessment.
- To promote environmental awareness among the staff and students
- To conserve non-renewable resources for betterment of future
- The long term goal is to collect the baseline data in terms of environmental parameters, calculate its impact on the environment and recommend measures to reduce them

## 5.0 Target Areas of Green Auditing

- **Energy Conservation and Management:** This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles.
- **Water Quality and Conservation**: This indicator addresses water consumption, water sources, irrigation, storm water, appliances and fixtures.
- **Biodiversity Conservation**: All plant and animal species - including microorganisms - are a part of biodiversity. All types of gardens, lawns and trees are considered in this aspect.
- **Waste Management**: This indicator addresses all types of waste from the University and associated amenities. The minimization, safe handling, and ultimate elimination of these materials are essential to the long-term health of the planet.
- **Carbon Footprint:** This aspect is for quantifying the carbon emissions from all the parts of the institution and quantifying how much of it is sequestrated with the help of landscape.
- **Air quality and monitoring:** The ambient air quality w.r.t. different parameters are to be observed and measured as per the standard.
- **Noise pollution and measures:** The quantum of noise generated inside the working campus needs to be observed and measured for appropriate monitoring.

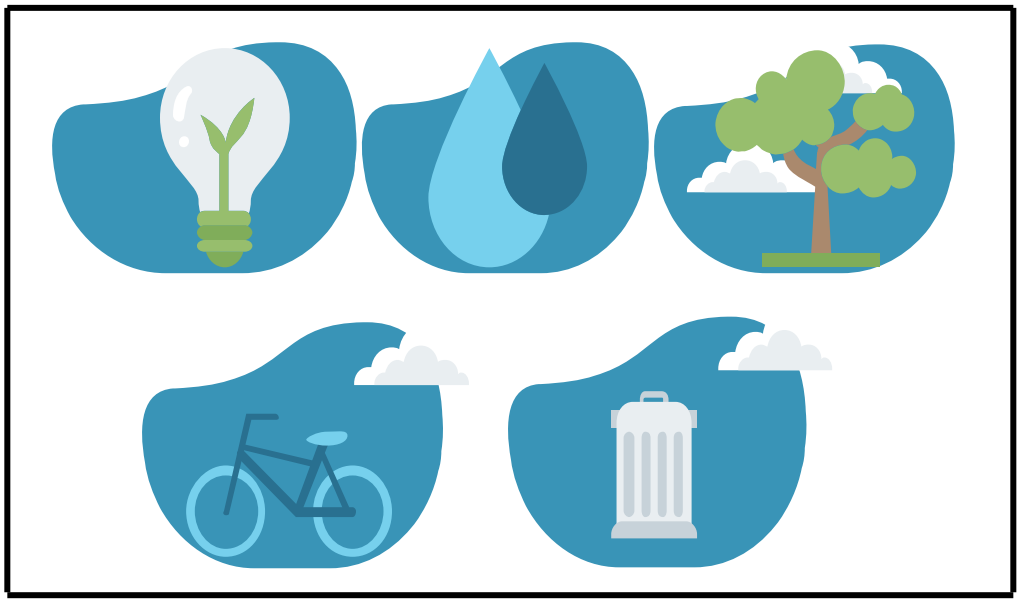


**Figure 11: Target Areas of Green Audit**

# 6.0 Methodology

## 6.1 Data Collection

In preliminary data collection phase, exhaustive data collection is performed using different tools such as preparation of questionnaire, physical inspection of the campus, observation and review of the documentation, interviewing key persons, etc. Focus groups, if practiced, can also be a vital part of data collection stage to acquire qualitative information. The discussion should be focused on identifying the attitudes and awareness towards environmental issues at the institutional and local level. Questionnaire (Annexure) prepared to conduct the green audit in the campus is in accordance with the guidelines, rules, acts and formats prepared by Ministry of Environment and Forest, New Delhi, Central Pollution Control Board and other statutory organizations. The data covers the target areas to summarize the present status of environment management in the campus.

## 6.2 Survey by Questionnaire

Baseline data for green audit report preparation was collected by questionnaire survey method. Most of the guidelines and formats are based on broad aspects. Therefore, using these guidelines and formats, combinations, modifications and restructuring was done and sets of questionnaires were prepared as solid waste, energy, water, biodiversity, carbon footprint. All the questionnaires comprises of group of modules. The first module is related to the general information of the concerned department, which broadly includes name of the department, month and year, total number of students and employees, visitors of the department, average working days and office timings etc. The next module is related to the present consumption of resources like water, energy, or the handling of solid and hazardous waste. One separate module is based on the questions related to the losses. Another module is related to maintaining records, like records of disposal of solid waste, records of solid waste recovery etc.

### 6.3 Data Analysis

The data required for the analysis is taken from the data collection, it includes: calculation of energy consumption, analysis of latest electricity bill of the campus, measuring water consumption, carbon foot printing, etc. The data from questionnaire and survey forms is tabulated for the convenience of data availability; Recommendations and Environmental Management Plan is built according to the analysis done in this step.

### 6.4 Recommendations and Reporting

Based on the data analysis step, some recommendations in the target areas are made. Specific measures are suggested to reduce water and energy consumption. Proper treatments of waste are suggested with respect to waste collection, waste disposal and recycling. Recommendations to reduce the use of fossil fuels are made for the betterment of community health. Proper disposal of hazardous waste is suggested to prevent mishaps. Management also takes into account the suggestions related to reducing their carbon footprint. Similarly, the status of air and noise quality are to be reported for improvement.

# 7.0 Detailed Analysis

## 7.1 Water quality and conservation

The overall objective of conducting a water audit is to identify opportunities to make system or building water use more efficient to balance the demand and supply of water.

This indicator addresses water consumption, water sources, irrigation, storm water, appliances and fixtures. The data collected from all the sections is examined and verified.

Water consumption data of PAH Solapur university is tabulated below and then used for analysis and reporting.

### a) Water Consumption:

**Table No. 2: Total Water Consumption per day of the University**

| Department | Water consumption per day (liters) |
|---|---|
| Social Sciences | 7500 |
| Computational Sciences | 14500 |
| Physical Sciences | 11000 |
| Instrumentation | 300 |
| Earth Sciences | 11000 |
| Chemical Sciences | 32027.4 |
| Girls' Hostel | 61290 |
| Boys' Hostel | 29160 |
| Mess (All) | 2000 |
| Gardening | 40000 |
| Nursery | 15000 |
| Guest House | 9000 |
| Solar Hot Water | 8000 |
| **Total** | **240777.4** |

All the water used in the campus is supplied by the **Municipal Corporation** of the Solapur city as well as from the bore-wells present. This water is then supplied to each unit in the campus. There are separate tanks on each building for the building's water requirement as follows:

**Table No. 3: No. of tanks and its capacity**

| Department | Number of tanks | Capacity (liters) |
|---|---|---|
| Computational Sciences (Overhead) | 1 | 1000 |
| Computational Sciences (Underground) | 2 | 7000 |
| Social Sciences (Overhead) | 2 | 2000 |
| | 1 | 1000 |
| Social Sciences (Underground) | 2 | 12000 |
| Chemical Sciences (Overhead) | 6 | 5000 |
| | 1 | 2000 |
| Chemical Sciences (RWH) | 1 | 10000 |
| Earth Sciences (Overhead) | 6 | 2000 |
| | 2 | 5000 |
| Physical Sciences (Overhead) | 4 | 5000 |
| | 1 | 1000 |
| Instrumentation | 1 | 10000 |
| Administrative Building | 3 | 5000 |
| | 1 | 2000 |

**Table No. 4: No. of tanks and its capacity**

| Department | Number of tanks | Capacity (liters) |
|---|---|---|
| Girls' Hostel | 1 | 5000 |
| Rector Quarters | 2 | 2000 |
| Girls' Hostel Mess 1 and 2 | 2 | 3000 |
| | 2 | 2000 |

| | | |
|---|---|---|
| Guest House | 2 | 5000 |
| | 2 | 1000 |
| | 1 | 500 |
| Boys' Hostel | 1 | 23000 |
| | 1 | 11500 |
| | 2 | 7500 |
| Boys' Hostel Mess | 2 | 15000 |
| | 5 | 1000 |
| Tank near Auditorium | 1 | 81000 |
| Tank behind Girls' Hostel | 1 | 10000 |
| Tank beside Computational Science | 1 | 11000 |
| | 1 | 2000 |
| Solar Hot Water – Girls' Hostel | 1 | 4000 |
| Solar Hot Water – Boys' Hostel | 1 | 3000 |
| Solar Hot Water – Guest House | 1 | 2000 |

**Figure 13: Overhead Drinking Water Tank**

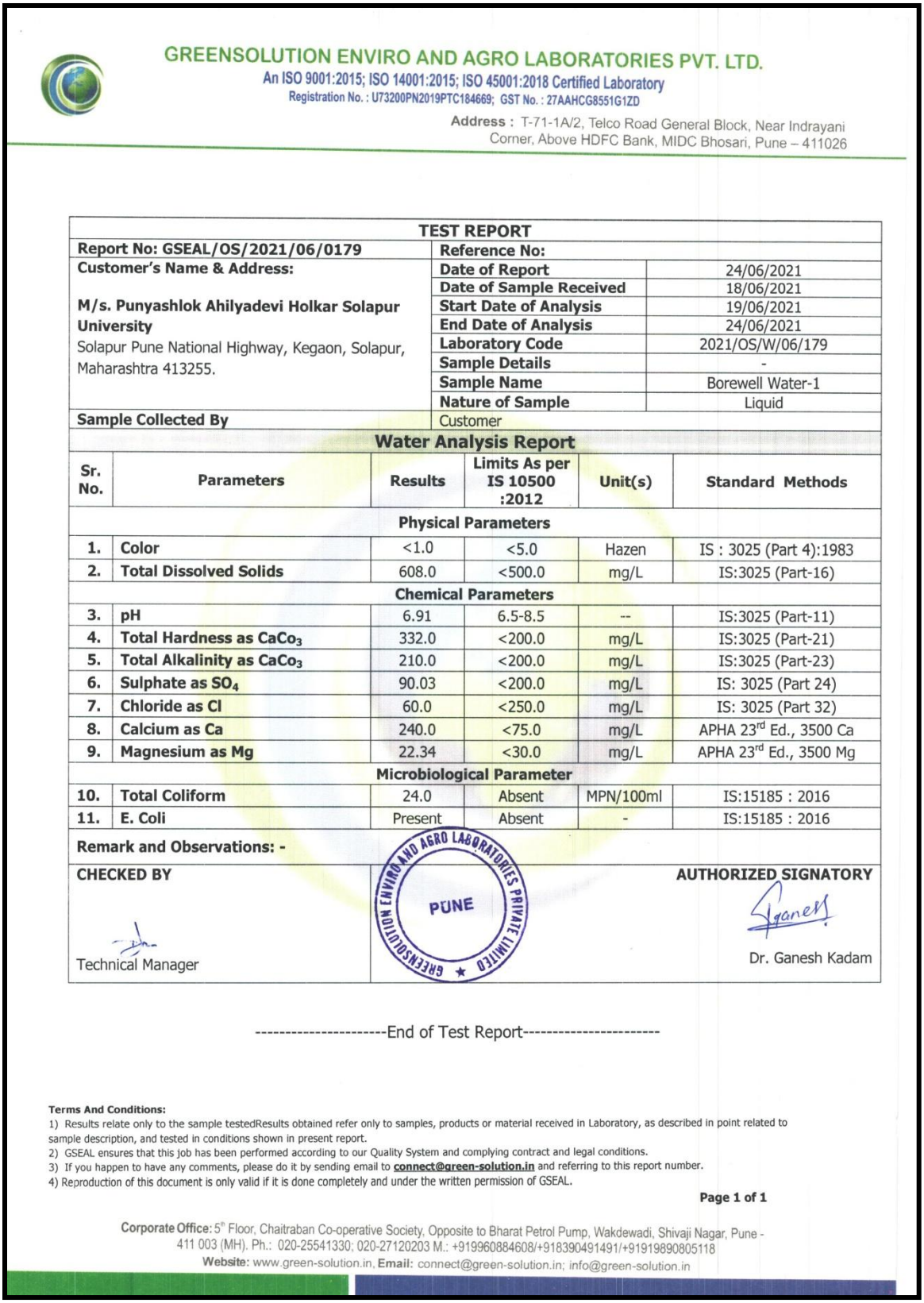
**Figure 14: Overhead Water Tank of Chemical Sciences Building**

**Figure 15: Water Outlet for Gardening near Physical Sciences Building**

**b) Current practices of water management:**

- **Rain Water Harvesting** is practiced by the School of Chemical Sciences to save 10 $m^3$ per year and is being used as distilled water for experiments. It is in process for other buildings in collaboration with Maharashtra Jeevan Pradhikaran Department and will be in use soon.
- **Rain Water Harvesting** is also laid down for admin Building and School of Earth sciences Building
- **Drip Irrigation** is practiced in the campus for watering the plants and gardens
- The average **student to washroom ratio** for girls is **17:1** and for boys is **19:1**
- **Waste water Management:** All the waste water generated i.e. **240777.4** liters is disposed to the Central Drainage System on daily basis

  **The chemical analysis reports of water in use are given below:**



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**TEST REPORT**

| | | |
|---|---|---|
| **Report No: GSEAL/OS/2021/06/0179** | **Reference No:** | |
| **Customer's Name & Address:** | **Date of Report** | 24/06/2021 |
| | **Date of Sample Received** | 18/06/2021 |
| **M/s. Punyashlok Ahilyadevi Holkar Solapur University** | **Start Date of Analysis** | 19/06/2021 |
| | **End Date of Analysis** | 24/06/2021 |
| Solapur Pune National Highway, Kegaon, Solapur, Maharashtra 413255. | **Laboratory Code** | 2021/OS/W/06/179 |
| | **Sample Details** | - |
| | **Sample Name** | Borewell Water-1 |
| | **Nature of Sample** | Liquid |
| **Sample Collected By** | Customer | |

**Water Analysis Report**

| Sr. No. | Parameters | Results | Limits As per IS 10500 :2012 | Unit(s) | Standard Methods |
|---|---|---|---|---|---|
| | **Physical Parameters** | | | | |
| 1. | **Color** | <1.0 | <5.0 | Hazen | IS : 3025 (Part 4):1983 |
| 2. | **Total Dissolved Solids** | 608.0 | <500.0 | mg/L | IS:3025 (Part-16) |
| | **Chemical Parameters** | | | | |
| 3. | **pH** | 6.91 | 6.5-8.5 | -- | IS:3025 (Part-11) |
| 4. | **Total Hardness as $CaCo_3$** | 332.0 | <200.0 | mg/L | IS:3025 (Part-21) |
| 5. | **Total Alkalinity as $CaCo_3$** | 210.0 | <200.0 | mg/L | IS:3025 (Part-23) |
| 6. | **Sulphate as $SO_4$** | 90.03 | <200.0 | mg/L | IS: 3025 (Part 24) |
| 7. | **Chloride as Cl** | 60.0 | <250.0 | mg/L | IS: 3025 (Part 32) |
| 8. | **Calcium as Ca** | 240.0 | <75.0 | mg/L | APHA 23rd Ed., 3500 Ca |
| 9. | **Magnesium as Mg** | 22.34 | <30.0 | mg/L | APHA 23rd Ed., 3500 Mg |
| | **Microbiological Parameter** | | | | |
| 10. | **Total Coliform** | 24.0 | Absent | MPN/100ml | IS:15185 : 2016 |
| 11. | **E. Coli** | Present | Absent | - | IS:15185 : 2016 |

**Remark and Observations: -**

**CHECKED BY**

Technical Manager

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Dr. Ganesh Kadam

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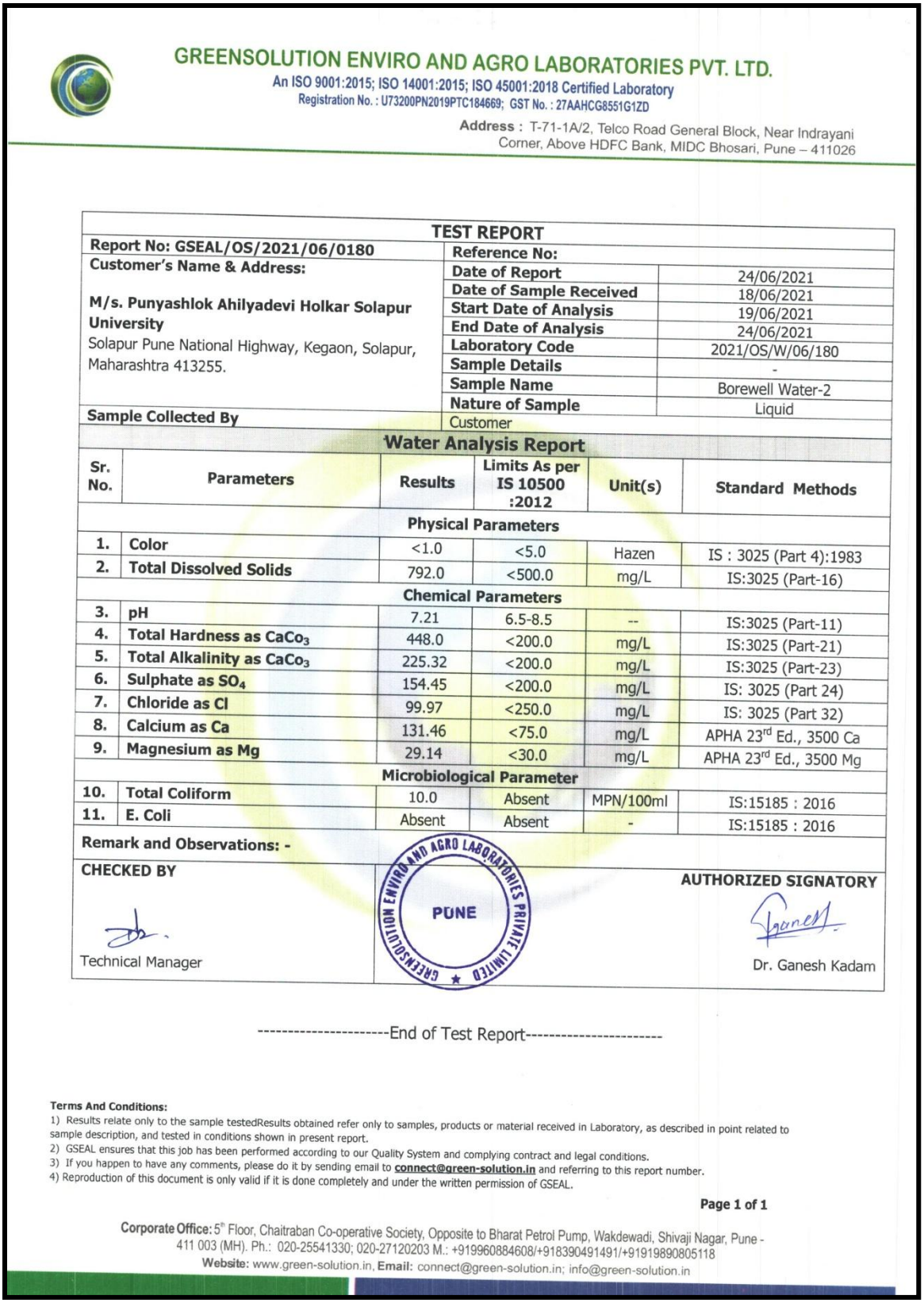
**Figure 16: Water analysis of Bore-well -1**



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**TEST REPORT**

| | | |
|---|---|---|
| **Report No: GSEAL/OS/2021/06/0180** | **Reference No:** | |
| **Customer's Name & Address:** | **Date of Report** | 24/06/2021 |
| | **Date of Sample Received** | 18/06/2021 |
| **M/s. Punyashlok Ahilyadevi Holkar Solapur University** | **Start Date of Analysis** | 19/06/2021 |
| | **End Date of Analysis** | 24/06/2021 |
| Solapur Pune National Highway, Kegaon, Solapur, Maharashtra 413255. | **Laboratory Code** | 2021/OS/W/06/180 |
| | **Sample Details** | - |
| | **Sample Name** | Borewell Water-2 |
| | **Nature of Sample** | Liquid |
| **Sample Collected By** | Customer | |

**Water Analysis Report**

| Sr. No. | Parameters | Results | Limits As per IS 10500 :2012 | Unit(s) | Standard Methods |
|---|---|---|---|---|---|
| | **Physical Parameters** | | | | |
| 1. | **Color** | <1.0 | <5.0 | Hazen | IS : 3025 (Part 4):1983 |
| 2. | **Total Dissolved Solids** | 792.0 | <500.0 | mg/L | IS:3025 (Part-16) |
| | **Chemical Parameters** | | | | |
| 3. | **pH** | 7.21 | 6.5-8.5 | -- | IS:3025 (Part-11) |
| 4. | **Total Hardness as $CaCo_3$** | 448.0 | <200.0 | mg/L | IS:3025 (Part-21) |
| 5. | **Total Alkalinity as $CaCo_3$** | 225.32 | <200.0 | mg/L | IS:3025 (Part-23) |
| 6. | **Sulphate as $SO_4$** | 154.45 | <200.0 | mg/L | IS: 3025 (Part 24) |
| 7. | **Chloride as Cl** | 99.97 | <250.0 | mg/L | IS: 3025 (Part 32) |
| 8. | **Calcium as Ca** | 131.46 | <75.0 | mg/L | APHA 23rd Ed., 3500 Ca |
| 9. | **Magnesium as Mg** | 29.14 | <30.0 | mg/L | APHA 23rd Ed., 3500 Mg |
| | **Microbiological Parameter** | | | | |
| 10. | **Total Coliform** | 10.0 | Absent | MPN/100ml | IS:15185 : 2016 |
| 11. | **E. Coli** | Absent | Absent | - | IS:15185 : 2016 |

**Remark and Observations: -**

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Technical Manager

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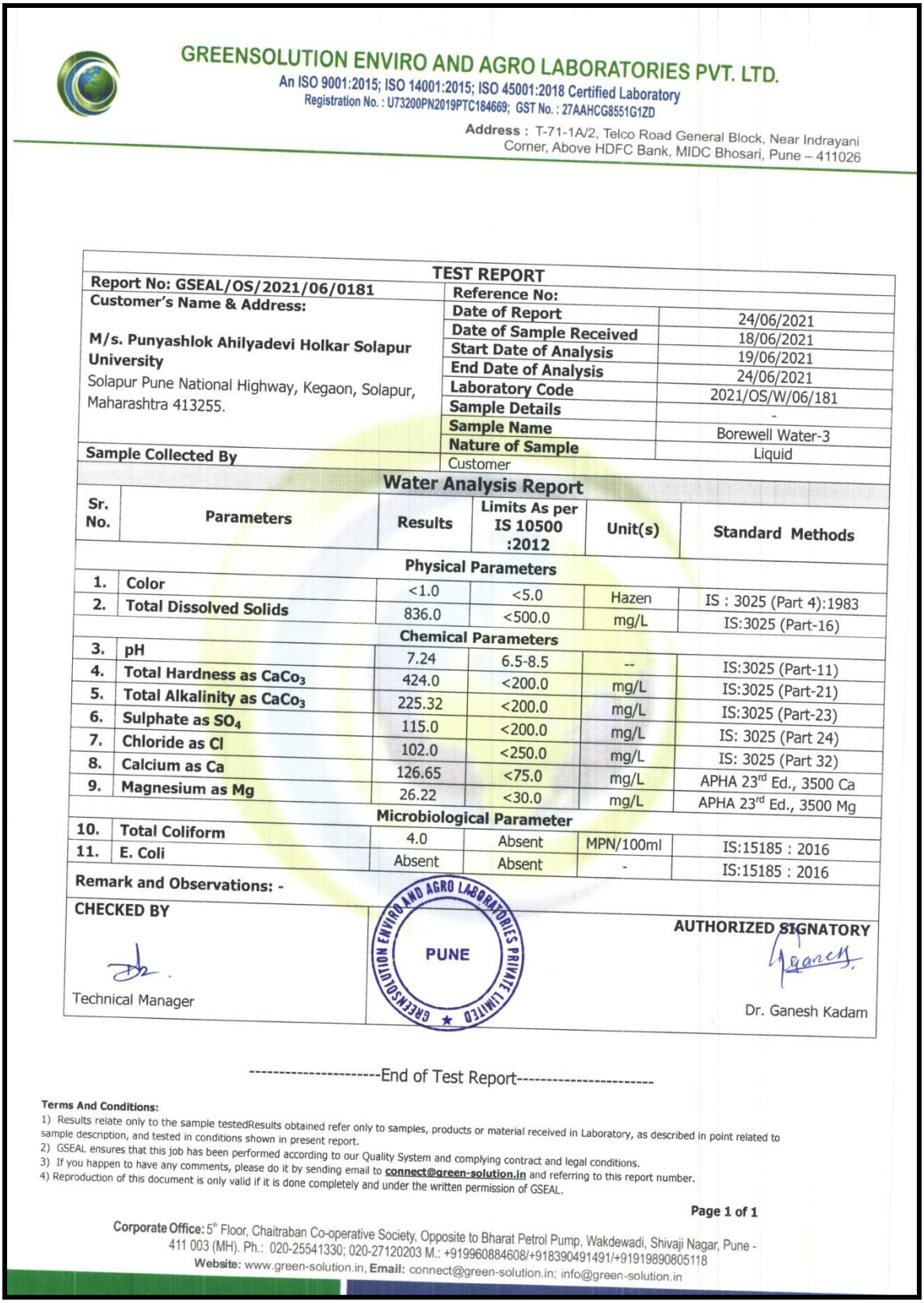
**Figure 17: Water analysis of Bore-well -2**



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|---|---|---|
| **Report No: GSEAL/OS/2021/06/0181** | **Reference No:** | |
| **Customer's Name & Address:** | **Date of Report** | 24/06/2021 |
| **M/s. Punyashlok Ahilyadevi Holkar Solapur University** | **Date of Sample Received** | 18/06/2021 |
| Solapur Pune National Highway, Kegaon, Solapur, Maharashtra 413255. | **Start Date of Analysis** | 19/06/2021 |
| | **End Date of Analysis** | 24/06/2021 |
| | **Laboratory Code** | 2021/OS/W/06/181 |
| | **Sample Details** | - |
| | **Sample Name** | Borewell Water-3 |
| **Sample Collected By** | **Nature of Sample** | Liquid |
| | Customer | |

**Water Analysis Report**

| Sr. No. | Parameters | Results | Limits As per IS 10500 :2012 | Unit(s) | Standard Methods |
|---|---|---|---|---|---|
| | **Physical Parameters** | | | | |
| 1. | Color | <1.0 | <5.0 | Hazen | IS : 3025 (Part 4):1983 |
| 2. | Total Dissolved Solids | 836.0 | <500.0 | mg/L | IS:3025 (Part-16) |
| | **Chemical Parameters** | | | | |
| 3. | pH | 7.24 | 6.5-8.5 | -- | IS:3025 (Part-11) |
| 4. | Total Hardness as $CaCo_3$ | 424.0 | <200.0 | mg/L | IS:3025 (Part-21) |
| 5. | Total Alkalinity as $CaCo_3$ | 225.32 | <200.0 | mg/L | IS:3025 (Part-23) |
| 6. | Sulphate as $SO_4$ | 115.0 | <200.0 | mg/L | IS: 3025 (Part 24) |
| 7. | Chloride as Cl | 102.0 | <250.0 | mg/L | IS: 3025 (Part 32) |
| 8. | Calcium as Ca | 126.65 | <75.0 | mg/L | APHA 23rd Ed., 3500 Ca |
| 9. | Magnesium as Mg | 26.22 | <30.0 | mg/L | APHA 23rd Ed., 3500 Mg |
| | **Microbiological Parameter** | | | | |
| 10. | Total Coliform | 4.0 | Absent | MPN/100ml | IS:15185 : 2016 |
| 11. | E. Coli | Absent | Absent | - | IS:15185 : 2016 |

**Remark and Observations: -**

**CHECKED BY**

Technical Manager

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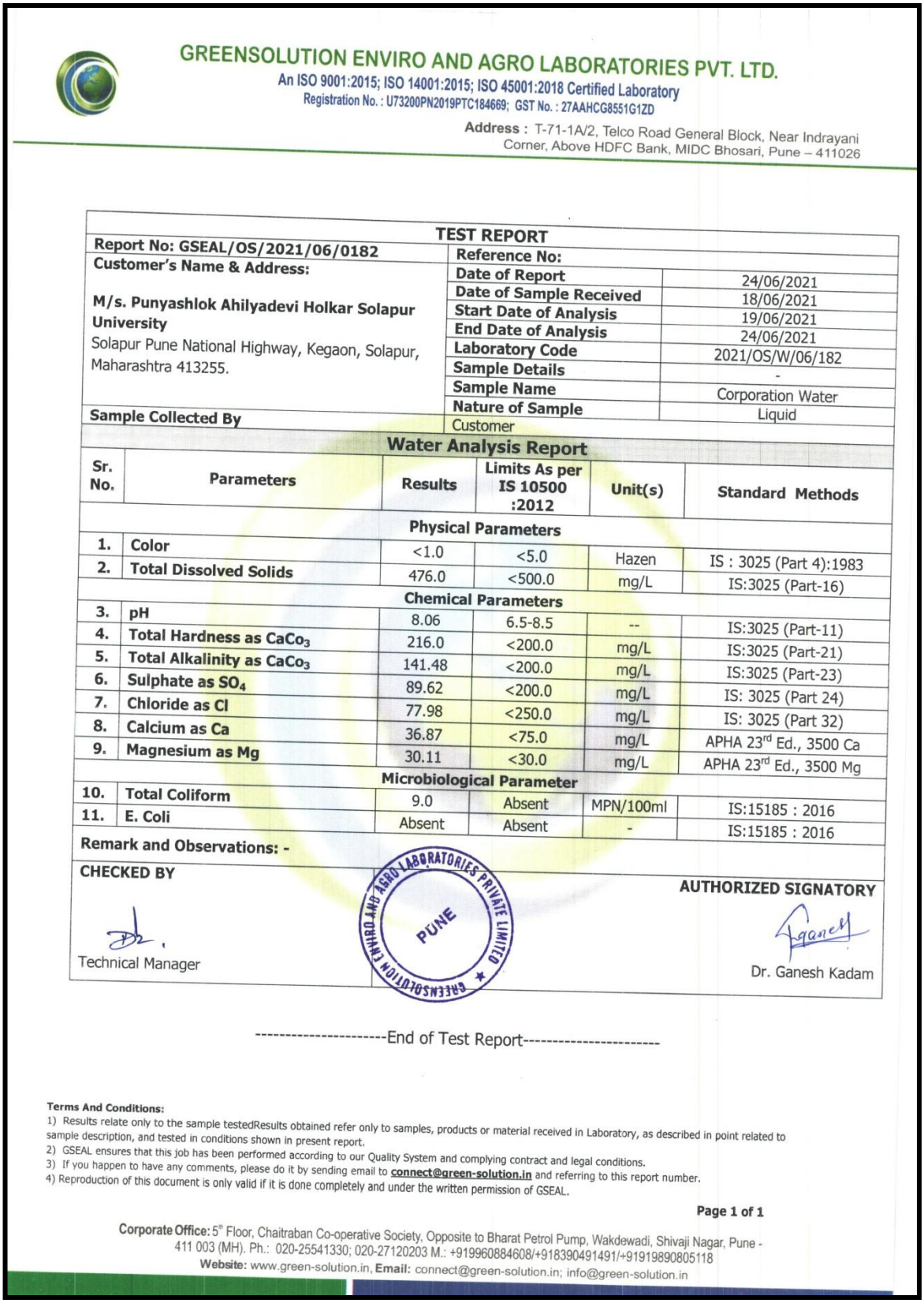
**Figure 18: Water analysis of Bore-well -3**



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| **Customer's Name & Address:** | **Date of Report** 24/06/2021 |
| **M/s. Punyashlok Ahilyadevi Holkar Solapur University** | **Date of Sample Received** 18/06/2021 |
| Solapur Pune National Highway, Kegaon, Solapur, Maharashtra 413255. | **Start Date of Analysis** 19/06/2021 |
| | **End Date of Analysis** 24/06/2021 |
| | **Laboratory Code** 2021/OS/W/06/182 |
| | **Sample Details** - |
| | **Sample Name** Corporation Water |
| **Sample Collected By** | **Nature of Sample** Liquid |
| Customer | |

**Water Analysis Report**

| Sr. No. | Parameters | Results | Limits As per IS 10500 :2012 | Unit(s) | Standard Methods |
|---|---|---|---|---|---|
| | **Physical Parameters** | | | | |
| 1. | Color | <1.0 | <5.0 | Hazen | IS : 3025 (Part 4):1983 |
| 2. | Total Dissolved Solids | 476.0 | <500.0 | mg/L | IS:3025 (Part-16) |
| | **Chemical Parameters** | | | | |
| 3. | pH | 8.06 | 6.5-8.5 | -- | IS:3025 (Part-11) |
| 4. | Total Hardness as $CaCo_3$ | 216.0 | <200.0 | mg/L | IS:3025 (Part-21) |
| 5. | Total Alkalinity as $CaCo_3$ | 141.48 | <200.0 | mg/L | IS:3025 (Part-23) |
| 6. | Sulphate as $SO_4$ | 89.62 | <200.0 | mg/L | IS: 3025 (Part 24) |
| 7. | Chloride as Cl | 77.98 | <250.0 | mg/L | IS: 3025 (Part 32) |
| 8. | Calcium as Ca | 36.87 | <75.0 | mg/L | APHA 23rd Ed., 3500 Ca |
| 9. | Magnesium as Mg | 30.11 | <30.0 | mg/L | APHA 23rd Ed., 3500 Mg |
| | **Microbiological Parameter** | | | | |
| 10. | Total Coliform | 9.0 | Absent | MPN/100ml | IS:15185 : 2016 |
| 11. | E. Coli | Absent | Absent | - | IS:15185 : 2016 |

**Remark and Observations: -**

**CHECKED BY**

Technical Manager

GREENSOLUTION ENVIRO AND AGRO LABORATORIES PRIVATE LIMITED PUNE

**AUTHORIZED SIGNATORY**

Dr. Ganesh Kadam

----------End of Test Report----------

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**Figure 19: Water analysis of Corporation Water**

**Figure 20: Drip Irrigation Pipeline Layout near Guest House**

**Figure 21: Rain Water Harvesting Storage Tank of Chemical Sciences**

### 7.2 Energy Conservation and Management

This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy sources utilized by all the departments and services of University include electricity, liquid petroleum and LPG.

Data for electricity consumption of the University for Various Departments was collected and is listed below.

**a) Electricity consumption:**

**Total Energy Consumption of the University is 21235 KWH per month**

**Solar Power Generation by the University is 14642 KWH per month**

**Table No. 5: Energy Consumption by University**

| Sr. No. | Electricity Consumption (KWH per month) | Source |
|---|---|---|
| **1.** | 21235 | MSEDCL |
| **2.** | 14642 | Solar Panels |

**b) Current practices for energy management**

Conserving energy produces a higher quality of life. In addition, it helps to create a healthier planet, or at least helps to sustain the resources already have.

- The institution has installed **solar panels** on the roof of the main administrative building that produces renewable energy to try to meet the increased electricity demand. Currently, the institute has solar panels that contribute to **68.95%** of the monthly electricity consumption.
- **Solar Panels** of 50 KWP are installed on the buildings of Physical, Computational and Chemical Sciences and will be in operation soon.
- The University has also installed 46 **solar street light panels** to meet the electricity demand.
- **Solar energy** is also used for hot water generation in Hostels and Guest House

**Figure 22: Solar Street Light panels**

**Figure 23: Solar panels for hot water generation on Girls' Hostel**

**Figure 24: Solar Panels installed on Chemical Sciences, yet to be in operation**

### 7.3 Waste Management

Solid waste can be divided into three categories: bio-degradable, non-biodegradable and hazardous waste. Bio-degradable wastes include food wastes, canteen waste, wastes from toilets etc. Non-biodegradable wastes include what is usually thrown away in homes and schools such as plastics, tins and glass bottles, etc. E-waste is among the fastest growing solid waste classes and represents a serious hazard to the environment too.

The details of solid waste generation using questionnaires and observations are tabulated below.

**a) Generation of waste:**

**Total Waste Generation of the University is 1134.6 kg/month**

**Table No. 6: Category Wise Waste Generation (kg/month)**

| Department | Paper waste | Plastic Waste | Biodegradable waste | Hazardous Waste | Glass waste | Garden Waste |
|---|---|---|---|---|---|---|
| Instrumentation | 1 | - | - | 0.1 | - | 600 |
| Physical Sciences | 4 | - | - | - | - | |
| Computational Sciences | 6 | | - | - | - | |
| Chemical Sciences | 4 | - | - | 92 | 2 | |
| Earth Sciences | 80 | | - | 23 | 0.5 | |
| Girls' Hostel | 147 | | | - | - | |
| Boys' Hostel | 36 | | | - | - | |
| Guest House | 15 | | - | - | - | |
| Administration | 120 | 4 | - | - | - | |

**Table No. 7: E-Waste Generation (kg/year)**

| Type of Waste | Generation Quantity | E-waste treated and disposed (kg) |
|---|---|---|
| **E-waste** | 182 | 182 |


**Figure 25: Waste Collection yard**


**Figure 26: Waste Collection**

**b) Current practices of solid waste management**

- The garden waste is sent to the **vermicomposting,** which then produces organic manure. This organic manure is used for trees in the campus.

**Figure 27: Vermi Composting**

- There are **two Vermicompost pits of 400 kg each** besides the Physical Sciences building and the cycle of composting is 4 months. **33.33%** of the garden waste is composted; however, remaining garden waste is then dumped in the 500 acres ar ea.
- All the University waste - biological waste, paper waste, plastic waste and remaining garden waste - to be disposed **is collected and transported together** by the trolley to the 500 acres area
- The plastic and paper waste is collected and **disposed** together in the 500 acres land sanctioned to the University
- E-waste is collected from every department and is sent to the **authorized vendor** every 10 years
- Hazardous Waste is **sterilized** in autoclave and then buried in the building premises
- Solid chemical compounds are **reused** for the experimental practical purposes
- Glass Waste is **land filled** in the 500 acres area sanctioned to the University

**Figure 28: Combined waste transportation for disposal**


**Figure 29: Paper and Plastic Dumping**

### 7.4 Biodiversity Conservation

This aspect addresses all the flora and fauna of the campus. The list below has the name and quantity of trees as well as bird species.

**Table No. 8: Plant Species in the University**

| Sr. no | Common name of plant | Botanical name | Quantity |
|---|---|---|---|
| 1. | Palm | *Roystonea regia* | 768 |
| 2. | Fan Palm | *Washingtonia* | 13 |
| 3. | Ashok | *Saruca asoca* | 53 |
| 4. | Sagwan | *Tectona grandis* | 72 |
| 5. | Peepal | *Ficus religiosa* | 33 |
| 6. | Gulmohar | *Delonix regia* | 45 |
| 7. | Badam | *Terminalia katappa* | 49 |
| 8. | Limbu | *Citrus aurantifolia* | 04 |
| 9. | Tamarind | *Tamarindus indica* | 79 |
| 10. | Mango | *Mangifera indica* | 17 |
| 11. | Bamboo | *Bambusoideae* | 06 |
| 12. | Sururu | *Casuarina equisetifolia* | 767 |
| 13. | Jaswand | *Hibiscus rosasinensis* | 15 |
| 14. | Umbar | *Ficus racemosa* | 08 |
| 15. | Pongame Oiltree | *Millettia pinnata* | 10 |
| 16. | Chafa | *Plumeria rubra* | 04 |
| 17. | Drumstick | *Moringa oleifera* | 08 |
| 18. | Neem | *Azadirachta indica* | 171 |
| 19. | Coconut | *Cocos nucifera* | 126 |
| 20. | Parijatak | *Nyctanthes arbor-tristis* | 3 |
| 21. | Jamun | *Syzygium cumini L.* | 14 |
| 22. | Pomegranate | *Punica granatum* | 7 |
| 23. | Awala | *Phyllanthus emblica* | 39 |

| | | | |
|---|---|---|---|
| 24. | Chikoo | *Manilkara zapota* | 11 |
| 25. | Banyan | *Ficus benghalensis* | 14 |
| 26. | Nilgiri | *Eucalyptus **globulus*** | 40 |
| 27. | Guava | *Psidium guajava* | 42 |
| 28. | Bel | *Aegle marmelos* | 03 |
| 29. | Weeping Fig | *Ficus benjamina* | 44 |
| 30. | Christmas Tree | *Araucaria columnaris* | 1 |
| 31. | Sitafal | *Annona reticulate* | 11 |
| 32. | Mauritius Hemp | *Furcraea foetida* | 7 |
| 33. | Mehndi | *Lawsonia inermis* | 1 |
| 34. | Baheda | *Terminalia bellirica* | 50 |
| 35. | Wattle | *Acacia* | 11 |
| 36. | Yellow Oleander | *Thevetia peruviana* | 440 |
| 37. | Kaner | *Nerium oleander* | 16 |
| 38. | Kachnar | *Bauhinia variegate* | 22 |
| 39. | Jungle Flame | *Ixora* | 355 |
| 40. | Indian Senna | *Cassia angustifolia* | 80 |
| 41. | Brahmakamal | *Saussurea obvallata* | 1 |
| 42. | Lotus | *Nelumbo* | 4 |
| 43. | Mogra | *Jasminum sambac* | 1 |
| 44. | African Daisy | *Arctotis* | 13 |
| 45. | Tiger Lily | *Lilium lancifolium* | 62 |
| 46. | Copper Leaf | *Acalypha wilkesiana* | 31 |
| 47. | Fireball Lily | *Scadoxus multiflorus* | 1 |
| 48. | Pink Lily | *Zephyranthes carinata* | 4 |
| 49. | Papaya | *Carica papaya* | 1 |
| 50. | Purple Heart | *Peltogyne purpurea* | 2 |
| 51. | Tulsi | *Ocimum tenuiflorum* | 54 |

| | | | |
|---|---|---|---|
| 52. | Amaltas | *Cassia fistula* | 5 |
| 53. | Jujube | *Ziziphus mauritiana* | 2 |
| 54. | Lemon Grass | *Cymbopogon citrates* | 3 |
| 55. | Fig | *Ficus carica* | 18 |
| 56. | Shatavari | *Asparagus racemosus* | 71 |
| 57. | Morpankhi | *Platycladus orientalis* | 76 |
| 58. | Crepe Jasmine | *Tabernaemontana divaricata* | 6 |
| 59. | Trumpet | *Tecoma grandiflora* | 4 |
| 60. | Devil's Backbone | *Euphorbia tithymaloides* | 4 |
| 61. | Dwarf Umbrella Tree | *Schefflera arboricola* | 3 |
| 62. | Spanish Cherry | *Mimusops elengi* | 3 |
| 63. | Krishna Kanta | *Clitoria Ternatea* | 5 |
| 64. | Periwinkle | *Catharanthus roseus* | 18 |
| 65. | Rudraksh | *Elaeocarpus ganitrus* | 2 |
| 66. | Rui | *Calotropis Gigantea* | 4 |
| 67. | Indian mulberry | *Morinda citrifolia* | 5 |
| 68. | Crown of Thorns | *Euphorbia milii* | 5 |
| 69. | Crotons | *Codiaeum variegatum* | 22 |
| 70. | Blackboard Tree | *Alstonia Scholaris* | 42 |
| 71. | Senegal Mahogany | *Khaya senegalensis* | 31 |
| 72. | Golden Arrow | *Plumeria Pudica* | 7 |
| 73. | False Indigo | *Baptisia australis* | 2 |
| 74. | Stinking Passion Flower | *Passiflora foetida* | 1 |
| 75. | Peregrina | *Jatropha integerrima* | 2 |
| 76. | Reetha | *Sapindus mukorossi* | 3 |
| 77. | Gorakhchincha | *Kigelia Africana* | 1 |
| 78. | West Indian Elm | *Guazuma ulmifolia* | 5 |
| 79. | Kapok | *Ceiba pentandra* | 2 |

| | | | |
|---|---|---|---|
| 80. | Rosy Trumpet | *Tabebuia rosea* | 1 |
| 81. | 4 o'clock Plant | *Mirabilis jalapa* | 1 |
| 82. | Lantana | *Lantana camara* | 1 |
| 83. | Aloevera | *Aloe barbadensis miller* | 1 |
| 84. | Snake plant | *Sansevieria trifasciata* | 1 |
| 85. | Agave | *Agave Americana* | 4 |
| | | **Total** | 3994 |

**Some of the onsite pictures of the plants:**


REDMI NOTE 5 PRO

**Fauna in the University campus**

**Table No. 9: Fauna observed in the University**

| Sr. No. | Specie Name | Scientific Name |
|---|---|---|
| **Birds** | | |
| 1. | Asian koel | *Eudynamys scolopaceus* |
| 2. | Common hawk cuckoo | *Hierococcyx varius* |
| 3. | House crow | *Corvus splendens* |
| 4. | Red vented bulbul | *Pycnonotus cafer* |
| 5. | Common myna | *Acridotheres tristis* |
| 6. | Brahmany starling | *Sturnia pagodarum* |
| 7. | Shikra | *Accipiter badius* |
| 8. | Purple rumped sunbird | *Leptocoma zeylonica* |
| 9. | Green bee-eater | *Merops orientalis* |
| 10. | Greater coucal | *Centropus sinensis* |
| 11. | Blue rock pigeon | *Columba livia* |
| 12. | Large grey babbler | *Argya malcolmi* |
| 13. | Barn swallow | *Hirundo rustica* |
| 14. | Indian peafowl | *Pavo cristatus* |
| 15. | Indian robin | *Saxicoloides fulicatus* |
| 16. | Eurasian collared dove | *Streptopelia decaocto* |
| 17. | Red collared dove | *Streptopelia tranquebarica* |
| 18. | Black kite | *Milvus migrans* |
| 19. | White throated kingfisher | *Halcyon smyrnensis* |
| 20. | Tailor bird | *Orthotomus sutorius* |
| Mammals | | |
| 21 | Indian palm squirrel | *Funambulus palmarum* |
| 22 | Indian grey mongoose | *Herpestes edwardsi* |
| Reptiles | | |

| | | |
|---|---|---|
| 23 | Garden lizard | *Calotes versicolor* |
| 24 | Bengal monitor lizard | *Varanus bengalensis* |
| Butterflies | | |
| 25 | Common grass yellow | *Eurema hecabe* |
| 26 | Common emigrant | *Catopsilia Pomona* |
| 27 | Mottled emigrant | *Catopsilia pyranthe* |
| 28 | Common crow | *Euploea core* |
| 29 | Tawny coster | *Acraea terpsicore* |
| 30 | Danaid Eggfly | *Hypolimnas misippus* |
| 31 | Common pierrot | *Castalius rosimon* |
| 32 | Rounded pierrot | *Tarucus extricates* |
| 33 | Plain Tiger | *Danaus chrysippus* |
| 34 | Lemon pansy | *Junonia lemonias* |
| 35 | Pioneer | *Belenois aurota* |
| 36 | Tailed jay | *Graphium Agamemnon* |
| 37 | Grass jewel | *Freyeria trochylus* |
| 38 | Crimson rose | *Pachliopta hector* |



INDIAN ROBIN


COMMON HAWK CUCKOO


INDIAN PALM SQUIRREL


RED COLLARED DOVE


PURPLE RUMPED SUNBIRD


BLACK KITE


onitor lizard

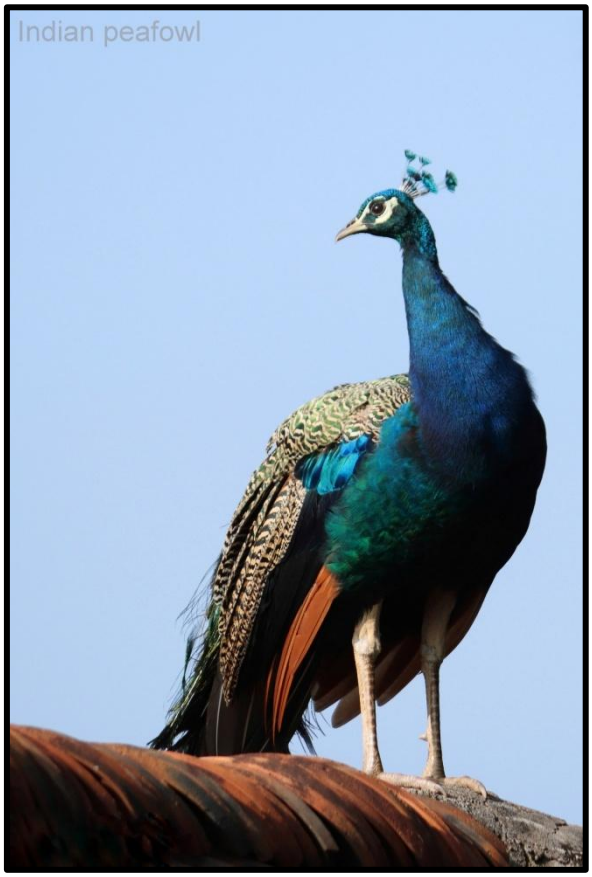

Grey mongoose


BRAHMINY MYNA


CRIMSON ROSE


RED VENTED BULBUL


PIONEER


Indian peafowl


ASIAN KOEL


PURPLE SUNBIRD


TAILED JAY


LARGE GREY BABBLER


COMMON PIERRIOT


DANAID EGGFLY


WHITE THROATED KINGFISHER


BARN SWALLOW


Eurasian Collared Dove


BLUE ROCK PIGEON


TAWNY COSTER


COMMON CROW


COMMON GRASS YELLOW


LEMON PANSY


MOTTLED EMMIGRANT


ROUNDED PIERRIOT


Greater coucal


SOUTHERN GRASS JEWEL


PLAIN TIGER


COMMON MYNA

### 7.5 Air and Noise Quality

Air quality of an academic institute is very important for health of students, faculty and staff of university. The air pollution sources in the university campus are wind storm, pollen grains, natural dust, vehicular emissions, generators, laboratory fumes, etc. Monitoring helps in assessing the level of pollution in relation to the ambient air quality standards. Standards are a regulatory measure to set the target for pollution reduction and achieve clean air. The air pollutants monitored on regular basis are Sulphur dioxide ($SO_2$), Oxides of Nitrogen as NOx, Suspended Particulate Matter (SPM) and Repairable Suspended Particulate Matter (RSPM) by High Volume Sample (HVS) as well as records of temperature, relative humidity are also been recorded for comparison. All the air quality parameters are within the standard limits of MPCB except SPM, suggesting ambient air quality of university campus is moderate and might cause minor breathing discomfort to sensitive people. The data is collected for Ambient Air Quality Monitoring under the program of NAMP by Maharashtra Pollution Control Board (MPCB).

**Table 10: Air Quality Monitoring**

| | $SO_2$ ($\mu g/m^3$) | $NO_x$ ($\mu g/m^3$) | RSPM ($\mu g/m^3$) | SPM ($\mu g/m^3$) | Air Quality Index |
|---|---|---|---|---|---|
| **Standard** | 80 | 80 | 100 | 100 | |
| **Average for 2019-2020** | 12.22 | 29.30 | 63.39 | 151.25 | 69 |

The above table shows that Sulphur dioxide ($SO_2$), Oxides of Nitrogen as NOx, and Repairable Suspended Particulate Matter (RSPM) are within limits; however, Suspended Particulate Matter (SPM) is above limits. The Total Air Quality Index is 69 which is satisfactory.

The University has also set up the device for air monitoring; however, due to power cuts at times, the procedure cannot be completed.

As an academic institute comes under silent zone where noise should be below 50 dB during day time. Therefore, the noise on the campus is also measured and found within the standard limits. Sometimes construction activities and road traffic increases the noise level on the campus.

PAH Solapur University is located on the Pune-Solapur National Highway. The major source of noise at university is due to automobile use. Building construction and D.G. Sets can also cause considerable noise emissions. Hence, overall air and noise quality within the campus is good and within the prescribed limits of MPCB.

**Ambience of the campus:** The ambience of the University is calm, spacious with good amenities and utilities in a visually appealing landscape. The building footprint of the University is 25% whereas green area is more than 40% of the total plot area. Various trees are planted at the periphery of roads which in turn reduces the University's Heat Island Effect and due to reduction of concrete pathways; rain water harvesting has been managed efficiently. The University has retained a huge amount of natural topography which aids in plenty of water percolation and ground water recharging.

Moreover, every department has its representative paintings at the entrances, which gives those an artistic and representative atmosphere. Also, maintenance of natural topography has led to the innovative way of retention of various species of flora and fauna, which can be extremely advantageous for academic purposes. Being out of the city limits, the University has flourished in maintaining the faunal habitat effectively.

### 7.6 Carbon Footprint

**Carbon footprint (CF)** is the total amount of **greenhouse gases** (including carbon dioxide and methane) that are generated by human actions.

Carbon footprint is an estimate of the climate change impact of activities – such as making a product, living a lifestyle or running a company.

There are many existing and evolving standards for calculating carbon footprints.

**a) Carbon Emissions:**

**Table No. 11: Scopes of carbon emissions**

| Classification/Scope | Sources | Description |
|---|---|---|
| **Scope 1 (Direct)** | Resource usage | Emissions from LPG Cylinder, D.G. Set, University owned vehicles, Air Conditioners |
| **Scope 2 (Indirect)** | Electricity Use | Emissions from Purchased Electricity and Renewable Energy |
| **Scope 3 (Indirect)** | Personnel commuting And raw materials transportation | Emissions from Personnel commutation and raw materials transportation |
| | Wastewater treatment | Emissions from waste water treatment |
| | Solid Waste treatment | Emissions from solid waste management |

**Emission Data and Calculations:**

- **Scope 1 –** All Direct Emissions from the activities of an institution or under its control. Including fuel combustion on site such as gas, etc.

**Table No. 12: Scope 1 Emissions**

| Type of Fuel | Quantity per month | Emission Factor | $KgCO_2$/month |
|---|---|---|---|
| **Fuel used for DG set** | 190 liters | 2.653 | 504.07 |
| **LPG** | 1059.1 Kg | 2.983 | 3158.997 |
| **University owned vehicles - Petrol** | 3700 liters | 0.13 | 481 |
| **University Owned Vehicles – Diesel** | 10750 liters | 0.230 | 2386.5 |
| **TOTAL SCOPE 1 EMISSIONS** | | | **6512.667** |

- **Scope 2 –** Indirect Emissions from electricity purchased and used by the institution. Emissions are created during the production of the energy and eventually used by the organisation.

**Emissions from Purchased electricity:**

**Table No. 13: Scope 2 emissions**

| Type of Emission | Quantity (KWH per month) | Emission Factor | $KgCO_2$ / month |
|---|---|---|---|
| **Emissions from Purchased electricity** | 22401.66 | 0.97 | 21729.616 |
| **Renewable Energy** | 14642 | 0.97 | 14202.74 |
| **TOTAL SCOPE 2 EMISSIONS** | | | **21729.616** |

- **Scope 3 – All Other Indirect Emissions** from activities of the institution, occurring from sources that they do not own or control

1. **Delivery/Construction Transportation:** Carbon footprints through transportation also come into major consideration when whole picture has to be taken care of. Travelling distance, mode of transportation and type of fuel used for transportation are other major factors associated with carbon emission.

**Table No. 14: Fuel Consumption through Raw Material Transportation**

| Type Of Transportation | Distance Travelled In One Month (Km) | Emission Factor | $KgCO_2$/month |
|---|---|---|---|
| Auto | 96 | 0.1135 | **10.896** |

2. **Employee Transportation:** Increase in student intake can lead to increased greenhouse gas (GHG) pollution caused by the resulting growth in vehicular traffic, energy use, and other activities. This unit seeks to identify the impact on global climate change through its emissions of greenhouse gases (GHGs), notably carbon dioxide (CO2).

**Table No. 15: Fuel Consumption through staff Transportation**

| Mode of transportation | Daily Count | Travelling distance (Km/Vehicle) (to and fro) | Total Km | Emission Factor | $KgCO_2$/day |
|---|---|---|---|---|---|
| **2 wheeler** | 360 | 24 | 8640 | 0.0319 | 275.616 |
| **4 Wheeler (Cars)** | 20 | 24 | 480 | 0.13 | 62.4 |
| **Auto** | 40 | 24 | 960 | 0.1135 | 108.96 |
| **Bus** | 20 | 24 | 480 | 0.0151 | 7.248 |
| **TOTAL** | | | | | **454.224** |

**Table No. 16: Fuel Consumption through students Transportation**

| Mode of transportation | Daily Count | Travelling distance (Km/Vehicle) (to and fro) | Total Km | Emission Factor | $KgCO_2$/day |
|---|---|---|---|---|---|
| **2 wheeler** | 309 | 24 | 7416 | 0.0319 | 236.5704 |
| **Auto** | 485 | 24 | 11640 | 0.1135 | 1321.14 |
| **Bus** | 221 | 24 | 5304 | 0.0151 | 80.0904 |
| **TOTAL** | | | | | **1637.80** |

**Table No. 17: Fuel Consumption through visitors' Transportation**

| Mode of transportation | Daily Count | Travelling distance (Km/Vehicle) (to and fro) | Total Km | Emission Factor | Kg $CO_2$ per day |
|---|---|---|---|---|---|
| **2 wheeler** | 80 | 30 | 2400 | 0.0319 | 76.56 |
| **Car – Petrol** | 30 | 30 | 900 | 0.13 | 117 |
| **Car - Diesel** | 30 | 30 | 900 | 0.230 | 207 |
| **Auto** | 30 | 30 | 900 | 0.1135 | 102.15 |
| **Bus** | 30 | 30 | 900 | 0.0151 | 13.59 |
| **TOTAL** | | | | | **529.89** |

### 3. Waste Water Generation:

**Table No. 18: Waste Water Generation**

| Wastewater generated (liters per month) | Emission Factor | Total |
|---|---|---|
| 240777.4 per day | 0.21 | **50563.254 Kg $CO_2$/day** |
| **Total** | | **1516897.62 Kg $CO_2$/month** |

### 4. Solid Waste Generation:

**Table No. 19: Dry Solid Waste Generation**

| Solid waste generated (Kg) | Emission factor | Total |
|---|---|---|
| 1019.5 per month | 0.21 | **214.095 Kg$CO_2$ /month** |

- **Total emissions throughout a year**

**Table No. 20: Total emissions throughout the year**

| Reporting Year | Total Emissions (kg $CO_2$ per month) | Total Emissions (Kg $CO_2$ per year) |
|---|---|---|
| **2018-2019** | **1624022.314** | **19488267.77** |

**Carbon Sequestration**

**Table 21: Carbon Sequestration of Trees**

| Sr. no | Category of Trees | Quantity | Kg $CO_2$ sequestration/year | Total Kg $CO_2$ sequestration |
|---|---|---|---|---|
| 1. | Trees | 3995 | 25 | 99875 |

**Total carbon Emissions: 1, 94, 88, 267.77 Kg $CO_2$ per year**

**Avoided Emissions by Renewable Energy: 1, 70, 432.88 Kg $CO_2$ per year**

**Carbon Sequestration: 99,875 Kg $CO_2$ per year**

**Percentage of carbon reduced: 1.38%**

**Carbon Emissions after reduction: 1, 92, 17,959.89Kg $CO_2$ per year**

**b) Carbon Emissions Management:**

The University has planted 3994 plants in the campus to sequestrate carbon emissions.

## 8.0 Innovative Strides

- University organizes campus cleaning drive

**Figure 30: Campus Cleaning Drive**

- PAH Solapur University also conducted an activity to develop in-house nursery

**Figure 31: Nursery Development Activity**

- NSS Club of PAH Solapur University also organizes Tree Plantation on various occasions to maintain greenery in the campus
- Activities like plantation and Swachh Bharat Abhiyan are carried out by faculty members and students of Environmental Sciences department
- Herbal garden is maintained in the institution by Environmental Sciences Department
- Celebration of environmental day and water day by Environmental Sciences department
- International Conference on 28–30 September 2017 on Clean Energy Futures, Solapur, Maharashtra State, India
- Environmental Sciences have painted the entrance of the building with Fauna diversity for awareness purposes


**Figure 32: Tree Plantation Drive by NSS Club**

## 9.0 Recommendations from the audit

### 1. Water Quality and Conservation

- Installation of **Sewage Treatment Plant** for waste water management of whole campus is recommended on priority basis
- Installation of **low flow plumbing fixtures like aerators and water regulators** for water conservation

**Figure 33: Difference between normal and low flow plumbing fixtures**

- Installation of **water meters** is suggested to track water consumption of various entities
- Implementation of **separate water treatment** process for hazardous waste water from Chemical Sciences and Earth Sciences Department
- Installation of **Rain Water Harvesting** for the whole campus to reduce municipal water consumption
- Performing internal **water audits** every six months
- Checking **potability of water** every month is recommended
- Installation of **motion sensed sprinklers** is advised for gardening purposes

2. **Energy Conservation and Mangaement**
   - Installation of **energy meters** for every department to track electricity consumption is suggested
   - **Improving Solar PV** effectiveness and **installing solar panels** for every building to reduce electricity consumption from MSEDCL is recommended
   - Installing **5-star energy efficient appliances** wherever possible is encouraged

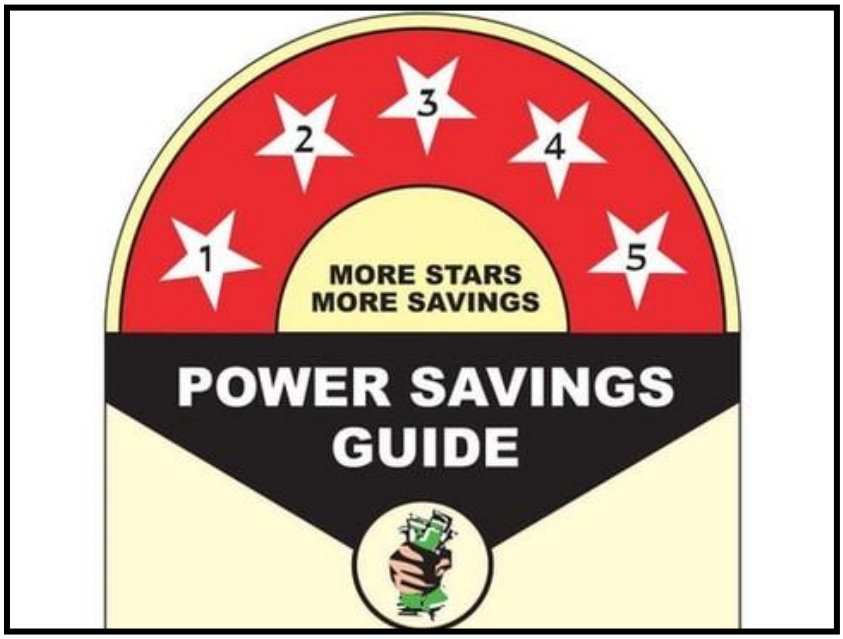



**Figure 34: 5 star rating label**

   - Installation of **LED lamps** instead of TL and CFLs is a smart way of energy saving
   - Installation of **energy efficient fans** in the new as well as old buildings
   - Installation of **IE 4 motors** for less energy usage
   - Setting **Yearly Performance targets**
   - Putting up **sign boards** to spread awareness for electricity consumption
   - University has many areas where lighting is not required at all times. Installing **sensor based lighting** in such areas can generate massive rewards
   - Planning **workshops** on energy conservation to educate students, faculty and staff can generate huge results of awareness
   - Establishing a **purchase policy** that is energy saving and eco-friendly is needed
   - Performing **internal energy audits** every year is advised

### 3. Waste Management

- Installation of **separate dustbins** for wet and dry waste
- Maintenance of separate **waste segregation yard** for separating waste into various categories for further treatment is advised
- Install **sanitary incineration** system to reduce sanitary waste and convert the waste to energy


**Figure 35: Sanitary Napkin Disposal Machine**

- **Separate waste collection and segregation** is advised for every building
- **Separate waste transportation** is recommended for different types of waste
- Hazardous waste from Chemical Sciences and Earth Sciences should be **sterilized and sent to composting**
- One of the suggested methods for garden waste disposal is **Mulching**
- Plastic and paper waste should be sold to **authorized vendors for recycling**
- One of the preferred methods to treat paper waste is **shredding and composting**

**Figure 36: Paper shredding machine**

- Maintain **waste collection record** on daily basis for future convenience
- Try to inculcate the concept of **'Plastic free Campus'**
- To cut down the waste and carbon footprint, the university should follow **paperless methods of communication** and use emails, that too as minimum as possible
- Installation of **biogas plant** can convert wet waste into energy

[Biogas typically refers to a gas produced by the anaerobic digestion of organic matter including manure, sewage sludge, municipal solid waste, biodegradable waste or any other biodegradable feedstock, under anaerobic conditions. Biogas is comprised primarily of methane and carbon dioxide. It also contains smaller amounts of hydrogen sulphide, nitrogen, hydrogen, methylmercaptans and oxygen.]

Below is the biogas equivalent to different fuels:

- 1 Kg firewood = 0.2 $m^3$ biogas
- 1 Kg dried cow dung = 0.1 $m^3$ biogas
- 1 Kg Charcoal = 0.5 $m^3$ biogas
- 1 Liter Kerosene = 2.0 $m^3$ biogas

Well-functioning biogas systems can yield a whole range of benefits for its users, the society and the environment in general.

4. **Biodiversity Conservation**
    - Maintain **natural topography** wherever possible
    - Planting more **fruit-bearing** trees can attract birds
    - Displaying **boards of fauna diversity** in the campus can generate enthusiasm for learners
    - Form a **botanical and medicinal garden** in the campus for academic as well as awareness purposes
    - Develop a **butterfly garden** that arouses appreciation towards flora and fauna diversity in the university
    - Plant more **native trees**
5. **Carbon Footprint**
    - Maintain **'No Vehicle Day'** at least once a month
    - Use **CFC free** equipments
    - Encourage **car pooling or ride share** program
6. **Air and Noise Quality**
    - Use of **bicycles** for transportation in the campus
    - Avoid using **diesel generators**
    - Use of **BS-4 vehicles**
7. **General Recommendations**
    - Maintain **EMP plan** to ensure positive benefits
    - Activate **Environmental management committee** to look after the compliance of EMP plan
    - Conducting **internal environmental audits** can help understand grey points
    - Putting up **posters related to Environment, Health and Safety** (No Smoking Policy, Saving Electricity, Water Conservation, etc.) is an easiest way to spread awareness
    - Adopting **IGBC Green campus** rating system will help boost the University Profile

## 10.0 Conclusions

Green Audit is the most efficient way to identify the strength and weakness of environmental sustainable practices and to find a way to solve problems. Green Audit is one kind of a professional approach towards a responsible way in utilizing economic, financial, social and environmental resources. Green audit can "add value" to the management approaches being taken by the University and is a way of identifying, evaluating and managing environmental risks (known and unknown). There is scope for further improvement, particularly in relation to waste, energy, carbon footprint and water management. The University considers the environmental impacts from most of its actions and makes a concerted effort to act in an environmentally responsible manner. Even though the University does perform fairly well, the recommendations in this report highlight many ways in which the University can work to improve its actions and become a more sustainable institution.

## 11.0 Environmental Management Plan

By keeping in mind the current scenario of consumption of various entities and the current practices of the management, Greenex Environmental has prepared an 'Environmental Management Plan' for the University. This plan will reveal strengths and weaknesses of the University as well as suggestions on how to tackle the issues and develop green and clean campus. It also gives suggestion for the priority of work to carry out.

| Water | | | | | |
|---|---|---|---|---|---|
| **Details** | **Daily** | **Monthly** | **Quarterly** | **Yearly** | **Remarks** |
| Analysis of STP inlet and outlet water | | √ | | | |
| Perform in-house water analysis of drinking water | | | √ | | |
| Installing water meter and keeping its record | √ | | | | |
| Maintenance of Rain water Harvesting System | | | √ | | |
| Perform water audits | | | | √ | |
| Cleaning of water tanks | | √ | | | |
| Quarterly drip irrigation maintenance | | | √ | | |
| **Energy** | | | | | |
| Performing energy audits | | | | √ | |
| Installing energy meters for various entities and maintaining its record | | √ | | | |
| **Waste** | | | | | |
| Disposal of E-waste to authorized vendors | | | | √ | |
| Maintaining waste quantity record | √ | | | | |
| **Biodiversity** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Monthly checking of labels on trees | | √ | | | |
| Maintain quarterly tree count | | | √ | | |
| **Carbon footprint** | | | | | |
| Recording usage of University owned vehicles | √ | | | | |
| Recording of diesel usage in D.G. sets | √ | | | | |
| Recording LPG gas refilling frequency | | √ | | | |
| Recording of number of visitors | √ | | | | |

## 12.0 References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# Annexure

## Energy Conservation and Management

| Prerequisites | Affirmation | Response | Capacity | Documentary Evidence |
|---|---|---|---|---|
| Total Energy Consumption | Yes/No | | | Light Bills |
| Renewable Energy | Yes/No | | | Technical Specifications |
| Energy Audit Report | Yes/No | | | Report |
| Energy use breakup | Yes/No | | | Report/Documents |
| Energy Meter | Yes/No | | | Photos |
| Outdoor Bulb Directions | -- | | | Photos |

## Water Quality and Conservation

| | |
|---|---|
| Total number of water users | |
| Number of Employee | |
| Number of visitors (daily) | |
| Number of Students | |
| Rain water harvesting system availability | |
| Is rain water harvesting system working? | |
| Daily water supply (liters) | |
| Source of water | |
| Water Meter | |

**Water Storage:**

Details of the storage structures -

| Storage tanks | Capacity (Liters) | Number | Number of times it is topped (or filled) daily |
|---|---|---|---|
| Overhead | | | |
| Underground | | | |
| Total | | | |

## Waste Management

| Type of Waste | Quantity | Method of Disposal |
|---|---|---|
| Paper | | |
| Plastic | | |
| Garden Waste | | |
| Glass | | |
| Wood | | |
| Biodegradable | | |
| Cloth | | |
| Hazardous | | |
| Clinical | | |
| E-Waste | | |
| Metal | | |

## Carbon Footprint

**Prerequisites**

| | | | |
|---|---|---|---|
| Scope I | University Owned Vehicles | Transportation per month: | No. - |
| | D.G. Set | Diesel consumed per month: | No. - |
| | LPG | Consumption per month: | No. - |
| | $CO_2$ Extinguishers | | No. - |
| | AC | Capacity:<br>Make up : | No. – |

| | | | | |
|---|---|---|---|---|
| Scope III | Staff Commuting | Distance: | Type of Vehicle: | No. - |
| | Students | Distance: | Type of Vehicle: | No. - |
| | Business Travel | Distance: | Type of Vehicle: | No. - |
| | Other Material Deliveries | Distance: | Type of Vehicle: | No. of trips- |

## Biodiversity

| Sr. no | Common name of plant | Quantity |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |
| 6. | | |
| 7. | | |
| 8. | | |
| 9. | | |
| 10. | | |

| Sr. No. | Local Name | Scientific Name |
|---|---|---|
| Birds | | |
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |
| 6. | | |
| 7. | | |
| 8. | | |
| 9. | | |
| 10. | | |

# Our Team

## 1. Arati Bhosale

M. Sc. Environment, PGDISHE

Director, Greenex Environmental

IGBC AP, GRIHA CP, LEED GA, EMS lead Auditor, CII certified Carbon Footpront Professional

**Work Experience:**

Rich experience of 10 + years in Environment field. Expertise in Life cycle assessment study, carbon footprint, water footprint & IGBC GRIHA, LEED Certifications. She has successfully accomplished 150 + Products LCA study and 50 + Green building projects.

## 2. Dr. Ganesh Kadam

PhD (Environmental Science & Technology), M.Sc. (Env. Sci.), RIO +20 India (2013), PGDISHE (Post Graduate Diploma in Industrial Safety Health & Environment), PGDGIS (Post Graduate Diploma in Geoinformatics)

**Work Experience:**

More than 12 yrs of experience in the Environmental research field with 6 years' experience of Institutional Green Auditing. Conducted more than 10 audits for various Colleges and University. Total 6 National and International Publications published in reputed journals.

## 3. Ruturaj Patil

MBA, B.Sc. Zoology

Manager and Naturalist

**Work Experience:**

More than 8 yrs of experience as Naturalist and Manager.

## 4. Anjella Patel

M.Sc. (Environment Science), B.Sc. (Environment Science), Diploma (Remote Sensing and Geographic Information System)

**Work Experience:**

Working as Jr. Environmental Executive with Green Solution. Completed internships with Suzlon Foundation and Gujarat Pollution Control Board.

## 5. Lakshika Kotak

B.E. Chemical

Environmental Executive, Greenex Environmental

**Work Experience:**

Working on LCA, Carbon Footprint, Green Building certification and Green Audit Projects since 6 months. Completed internships in Gharda Chemicals Ltd. And Evonik Catalysts India Pvt. Ltd.