ANDHRA UNIVERSITY

VISHAKHAPATNAM

Green Campus Audit Report

2020-21

Date: 17/3/2021

AUDITED BY

1. Prof. _____
2. Prof. _____ (Lalitha Bhaskari, Coordinator, IQAC)
3. Independent Auditor _____

ANDHRA UNIVERSITY
WALTAIR

1. INTRODUCTION:

The environment audit aims to analyse environmental practices within and outside the university campuses, which will have an impact on the eco-friendly atmosphere. Environment audit can be defined as systematic identification, quantification, recording, reporting and analysis of components of university environment. It was initiated with the motive of inspecting the effort within the institutions whose exercises can cause threat to the health of inhabitants and the environment. Through the environment audit, a direction as how to improve the structure of environment and there are include several factors that have determined the growth of carried out the environment audit.

1.1. NEED FOR GREEN CAMPUS AUDITING

Environment auditing is the process of identifying and determining whether institutions practices are ecofriendly and sustainable. Traditionally, we are good and efficient users of natural resources. But over the period of time excess use of resources like water become habitual for everyone especially, in common areas. Now, it is necessary to check Whether we are handling resources carefully? Environment audit regulates all such practices and gives an efficient way of natural resource utilization. In the era of climate change and resource depletion it is necessary to verify the processes and convert it in to green and clean one. Environment audit provides an approach for it. It also increases overall consciousness among the people working in institution towards an environment. 1.2. GOALS OF ENVIRONMENT AUDIT University has conducted an environment audit with specific goals as: 1. Identification and documentation of environment practices followed by university. 2. Identify strength and weakness in environment practices. 3. Analyze and suggest solution for problems identified. 4. Assess facility of different types of waste management. 5. Increase environmental awareness throughout campus 6. Identify and assess environmental risk. 7. Motivates staff for optimized sustainable use of available resources. 8. The long-term goal of the environmental audit program is to collect baseline data of environmental parameters and resolve environmental issue before they become problem.

1.3. OBJECTIVES OF ENVIRONMENT AUDIT

1. To examine the current practices, which can impact on environment such as of resource utilization, waste management etc.
2. To identify and analyze significant environmental issues.
3. Setup goal, vision, and mission for environment practices in campus.
4. Establish and implement Environment Management in various departments.
5. Continuous assessment for betterment in performance in environment

1.4. BENEFITS OF ENVIRONMENT AUDIT TO EDUCATIONAL INSTITUTIONS

There are many advantages of environment audit to an Educational Institute:

1. It would help to protect the environment in and around the campus.

2. Recognize the cost saving methods through waste minimization and energy conservation. 3. Empower the organization to frame a better environmental performance.

4. It portrays good image of institution through its clean and green campus. Finally, it will help to build positive impression for through green initiatives the upcoming NAAC visit.

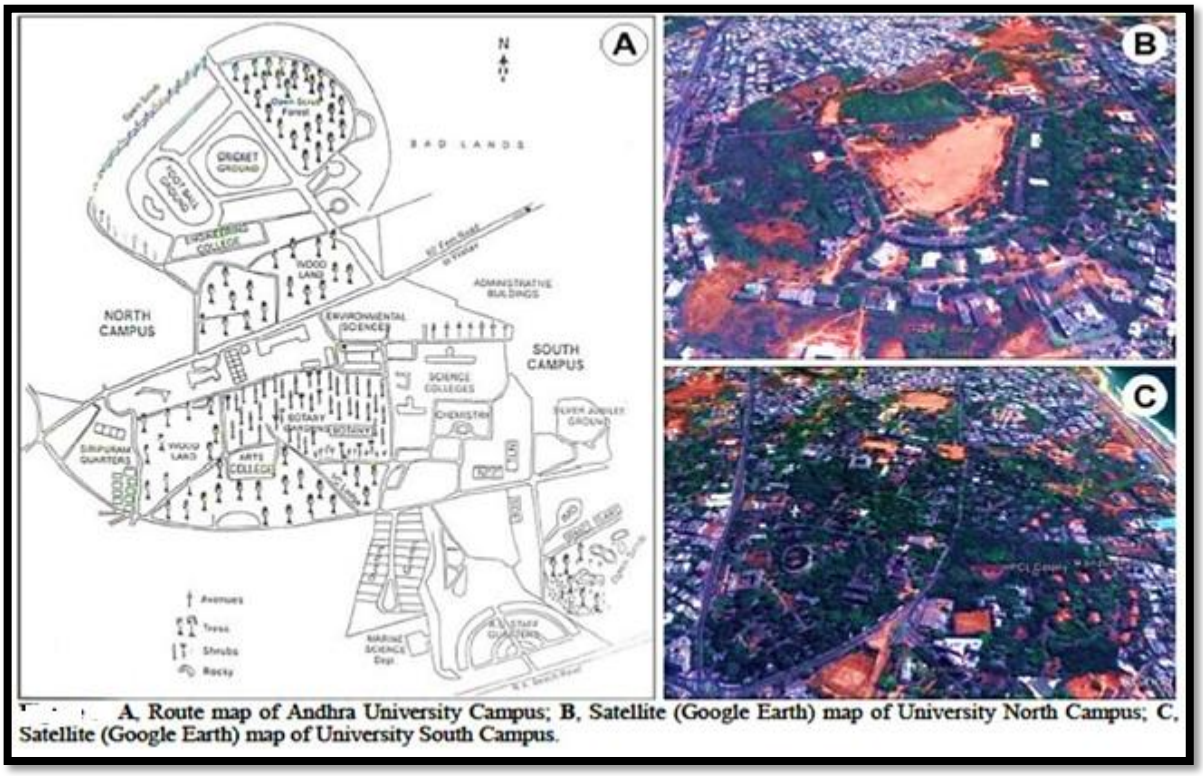
2. OBJECTIVE AND SCOPE

The broad aims/benefits of the eco-auditing system would be:

- Environmental education through systematic environmental management approach
- Improving environmental standards
- Benchmarking for environmental protection initiatives
- Sustainable use of natural resource in the campus.
- Financial savings through a reduction in resource use
- Curriculum enrichment through practical experience
- Development of ownership, personal and social responsibility for the College campus
- Enhancement of College profile
- Developing an environmental ethic and value systems in young people.

3. EXECUTIVE SUMMARY

An environmental audit is a snapshot in time, in which one assesses campus performance in complying with applicable environmental laws and regulations. Though a helpful benchmark, the audit almost immediately becomes outdated unless there is some mechanism in place to continue the effort of monitoring environmental compliance. This audit report contains observations and recommendations for improvement of environmental consciousness.



A, Route map of Andhra University Campus; B, Satellite (Google Earth) map of University North Campus; C, Satellite (Google Earth) map of University South Campus.

4. DETAILS OF BIODIVERSITY IN ANDHRA UNIVERSITY

4.1 DETAILS OF FLORA IN AU CAMPUS

4.1.1 GREEN AUDITING:

The college has adopted the 'Green Campus' system for environmental conservation and sustainability. There are main three pillars i.e. zero environmental foot print, positive impact on occupant health and performance and 100% graduates demonstrating environmental literacy. The goal is to reduce CO2 emission, energy and water use, while creating atmosphere where students can learn and be healthy.

4.1.2 TREE DIVERSITY OF ANDHRA UNIVERSITY, VISAKHAPATNAM, ANDHRA PRADESH:

Andhra University is within the geo-position between 17.729830N and 83.321495E. in Visakhaptnam, Andhra Pradesh, India. It encompasses an area of about 423.15 Acres. The area is immensely diverse with a variety of tree species performing a variety of functions. Most of these tree speciesare planted in different periods of time through various plantation programmes organized by theauthority and have become an integral part of the college. The trees of the college have increased
the quality of life, not only the college fraternity but also the people around of the college in termsof contributing to our environment by providing oxygen, improving air quality, climateamelioration, conservation of water, preserving soil, and supporting wildlife, controlling climateby moderating the effects of the sun, rain and wind. Leaves absorb and filter the sun's radiantenergy, keeping things cool in summer. Many spices of birds are dependent on these trees mainlyfor food and shelter. Nectar of flowers and plants is a favoriteof birds and many insects. Leaf covered branches keep many animals, such as birds and squirrels, out of reach of predators. Different species display a seemingly endless variety of shapes, forms, texture and vibrant colors. Even individual trees vary their appearance throughout the course of the year as the seasonschange. The strength, long lifespan and regal stature of trees give them a monument – like quality. They also remind us the glorious history of our institution in particular. We often make anemotional connection with these trees and sometime become personally attached to the ones thatwe see every day. A thick belt of large shady trees in the periphery of the college have found to bebringing down noise and cut down dust and storms. Thus, the college has been playing asignificant role in maintaining the environment in its surroundingareas. The following are the tree species with whom we are being attached.

Table: List of tree species of Andhra University, Visakhapatnam.

Sr. No.	Botanical Name	Family	Common name	Number of individuals
1	Mangiferaindica	Anacardiaceae	Mango	43
2	Anacardiumoxidentalis	Anacardiaceae	Cashew nut	60
3	Semicarpusanacardium	Anacardiaceae	-	3
4	Alstoniascholaris	Apocynaceae	Alstonia	5
5	Wrightiatictoria	Apocynaceae	-	72
6	Tabernaemontanadivaricata	Apocynaceae	Crape jasmine	38
7	Araucaria excelsa	Araucariaceae	Christmas Tree	20
8	Phyllanthusemblica	Phyllanthaceae	Usiri	20
9	Phyllanthusacidus	Phyllanthaceae	Usiri	10
10	Kigeliaafricana	Bignoniaceae	BalamKheera	20
11	Terminaliaarjuna	Combretaceae	Tellamaddi	32
12	Pterocarpusmarsupium	Fabaceace	aegisa	6
13	Pterocarpussantalinus	Fabaceace	Red sanders	20
14	Santalum album		Sandal wood	35
15	Adenantherapavonia	Fabaceace	-	60
16	Haldinacordifolia	Rubiaceae	Yellow teak	16
17	Anogeissusacuminata	Combretaceae	buttontree	10
18	Delonixregia	Royalpoinciana	Gulmohar	67
19	Saracaasoca	Fabaceae	Ashoka	10
20	Leucenaleucocephala	Fabaceae	-	566
21	Peltophorumpterocarpum	Fabaceae	-	600
22	Albizzialebbek	Fabaceae	-	100
23	Albizziasaman	Fabaceae	-	150
24	Sennasiamia	Fabaceae	-	402
25	Tamarindusindica	Fabaceae	Tamarind	30
26	Caryotaurens	Arecaceae	Jiluga	56

Sr. No.	Botanical Name	Family	Common name	Number of individuals
27	Punicagranatum	Lythraceae	Pomegranate	2
28	Pithecellobiumdulce	Legumes	Junglejalebi	12
29	Magnoliachampaca	Magnolia	Champa	21
30	Callistemon	Myrtle	Bottlebrush	14
31	Toonaciliate	Meliaceae	Tun	63
32	Spathodiacompanulata	Bignoniaceae	African Tulip Tree	205
33	Ficusbengalensis	moraceae	Ravi	150
34	Nyctanthesarbor-tristis	Olives	Harsingar	15
35	Schlecheraoleosa	Sapindaceae	Koylas	12
36	Sapindusimarginata	Sapindaceae	Soap nut	60
37	Browniacoccinia	fabaceae	-	8
38	Ficushispida	moraceae	Ficus	13
39	Psidiumgujava	Myrtaceae	Gauva	19
40	Canangaodorata	annonaceae	-	3
41	Moringaoleifera	Moringaceae	Sahjan	4
42	Araucariaaraucana	Araucariaceae	Arocaria	20
43	Roystoniaregium	royalpalm	Arecaceae	63
44	Crysalidigocarpusleuticense	-	Arecaceae	60
45	Citrussinensis	Rutaceae	Naurangi	4
46	Grevillearobusta	Proteaceae	SilverOak	5
47	Ziziphusmauritiana	Rhamnaceae	Ber	10
48	Putranjivaroxburghii	Putranjivaceae	-	15
49	Bauhinia purpuria	Fabaceae	-	60
50	Bauhinia vahlii	Fabaceae	-	45
51	Rosa	*Rosaceae*	Rose	90
52	Citruslimon	Rutaceae	Lemon	10
53	Elaeocarpusganitrus	Elaeocarpaceae	Rudraksha Tree	5

Sr. No.	Botanical Name	Family	Common name	Number of individuals
54	Murrayakoenigii	Rutaceae	CurryLeaf	2
55	Terminaliacatappa	Combretaceae	-	423
56	Litchichinensis	Sapindaceae	Litchi	4
57	Mimusopselengi	Sapotaceae	Maulsari	10
58	Terminaliamenta	Combretaceae	BugalBael	13
59	Shorearobusta	Combretaceae	Sal	5
60	Citrusreticulata	Rutaceae	Kinnow	14
61	Polyalthialogifolia	Annonaceae	ashoka	200
62	Azadirachtaindica	Meliaceae	Neem	35
63	Cocusneucifera	Arecaceae	coconut	120
64	Madhucalongifolia	Madhuca	Mahua	5
65	Borassusflabellifera	Arecaceae	-	320
66	Dalbergiasissoo	Dalbergia	Tahli	60
67	Hibiscus	Malvaceae	ChiriPhool	10
68	Syzygiumcumini	Myrtaceae	Jamun	11
69	Ficuscarica	Moraceae	Anjeer	3
70	Annonasquamosa	Annonaceae	SitaPhal	3
71	Ficuselastica	Moraceae	RubberPlant	1
72	Morusalba	Rubus	Shahtoot	15
73	Litchichinensis	Sapindaceae	Litchi	3
74	Artocarpusheterophyllus	Moraceae	Kathal	3
75	Solanumsurattense	Solanaceae	Koylas	85
76	Anthocephaluscadamba	Rubiaceae	-	62
77	Bombosabombos	Poaceae	Bomboo	200
78	Diospyrusmalabarica	Ebenaceae	-	4
79	Terminaliaarjuna	Terminalia	Arjun	12
80	Musaacuminata	Musaceae	Banana	10

Sr. No.	Botanical Name	Family	Common name	Number of individuals
81	Mythagynaparviflora	Rubiaceaer	-	2
82	Millettiapinnata	Pongamia	Sukhchain	4
83	Phoenixdactylifera	Arecaceae	Date	2
84	Elias guinensis	Arecaceae	Oil palm	10
85	Kouropteliaguinensis	Begoniaceae	-	10
86	Acasisaauriculiformis	Fabaceae	-	105
87	Acasianilotica	Fabaceae	-	60
88	Acasialeucoplea	Fabaceae	-	12
89	Cassiafistula	Fabaceae	Amaltas	34
90	Eucalyptus	Myrtaceae	Safeda	48
91	Syzygiumsamarangense	Myrtaceae	Water apple	2
92	Carissacarandas	Apocynaceae	Karunda	5
93	Prosophisjuliflora	Fabaceae	Sarkartumma	650
94	Prosophiscinnerari	Fabaceae	Jammi	12
95	Sterculiafoetida	Sterculiaceae	-	60
96	Sterculiaurens	Sterculiaceae		12
97	Oroxylanindica	Fabaceae	-	5
TOTAL of 2021				**6105**
Total of 2018, 2019, & 2020				**10527**
Total				**16632**

4.2 DETAILS OF FAUNA IN AU CAMPUS

Fauna is all of the animal life present in a particular region or time. The corresponding term for plants is flora, and for fungi, it is funga. Flora, fauna, funga and other forms of life are collectively referred to as biota. Zoologists and paleontologists use fauna to refer to a typical collection of animals found in a specific time or place, e.g. the "Sonoran Desert fauna" or the "Burgess Shale fauna". Paleontologists sometimes refer to a sequence of faunal stages, which is a series of rocks all containing similar fossils. The study of animals of a particular region is called faunistics.

Fauna of Andhra university campus 2020-2021

S. No	Common name	Scientific name	Family	Phylum
1	Butterfly	*Papilio gigon*	Papilionidae	Arthropoda
2	Chameleon	*Chamaeleo calyptratus*	Chamaeleonidae	Reptelia
3	Cobra	*Naja naja*	Elapidae	Reptelia
4	Crane	*Ardea alba modesta*	Ardeidae	Aves
5	Crow	*Corvus splendens*	Corvidae	Aves
6	Damselflies	*Calopteryx splendens*	Calopterygidae	Arthropoda
7	Dragon flies	*Diplacodes trivialis*	Libellulidae	Arthropoda
8	Eagle	*Clanga hastata*	Accipitridae	Aves
9	Earthworm	*Pheretima posthuma*	Megascolecidae	Annelida
10	Fruit fly	*Bactrocera cucurbitae*	Tephritidae	Arthropoda
11	Garden lizard	*Calotes versicolor*	Agamidae	Reptelia
12	Grasshopper	*Polyspilota aeruginosa*	Mantidae	Arthropoda
13	Hawk	*Buteo jamaicensis*	Accipitridae	Aves
14	Honeybee	*Apis indica*	Apidae	Arthropoda
15	Houseflies	*Calliphora vomitoria*	Calliphoridae	Arthropoda
16	Indian crane	*Ardeola grayii*	Ardeidae	Aves

17	Leeches	*Hirudo medicinalis*	Glossiphoniidae	Annelida
18	Lemon pansy	*Junonia lemonias*	Nymphalidae	Arthropoda
19	Monitor lizard	*Varanus varius*	Varanidae	Reptelia
20	Moths	*Micronia aculeata*	Uraniidae	Arthropoda
21	Parrot	*Psi1acula krameri*	Psittaculidae	Aves
22	Pigeons/Doves	*Columba livia domestica*	Columbidae	Aves
23	Rat	*Ra1us norvegicus*	Muridae	Mammal
24	Rat snake	*Ptyas mucosa*	Colubridae	Reptelia
25	Red ant fire ant	*Solenopsis*	Formicidae	Arthropoda
26	Scorpion	*Ho1ento1a tamulus*	Scorpionidae	Arthropoda
27	Snails	*Helixpomatia molluscus*	Gastropoda	Mollusca
28	Sparrows	*Passer domesticus*	Passeridae	Aves

Types of Phylum in 2021

Sr. No.	Phylum	Total of 2021
1	Annelida	2
2	Arthropoda	13
3	Aves	10
4	Mammal	2
5	Mollusca	1
6	Reptelia	5
Total		**33**

Total Phylum in 2018, 2019, 2020 & 2021

Sr. No.	Types of Phylum	No. of Phylum in 2018	No. of Phylum in 2019	No. of Phylum in 2020	No. of Phylum in 2021	Total
1	Annelida	2	2	2	2	8
2	Arthropoda	13	11	10	13	47
3	Aves	10	10	10	10	40
4	Mammal	2	1	1	2	6
5	Mollusca	1	1	1	1	4
6	Reptelia	6	5	3	5	19
Total						**124**

5 Water Report of Andhra University

Andhra University is reducing water usage and benefits through its water efficiency measures. To that end, it is hoped that the results of the study would benefit the policy and planning authorities in Andhra University in optimizing the existing water resources for campus development.

The Critical factors in green design, construction, and product selection, according to McGraw-Hill Construction's latest Smart Market Report, are water efficiency and onservation over the next five years. According to reports released, of the all other aspects of green building, water efficiency is rapidly becoming a higher priority over energy efficiency and waste [Water's Role in Green Building, 2009]. According to the United Nations Environmental Program, on the ongoing basis buildings are responsible

for 30-40 % of energy use and 15-20 % of water use worldwide [Sumateja Reddy.V, 2016& Levine, A.D., and T. Asano, 2004], a resource that becomes scarcer each year.

Per capita water availability as per the National Commission of Integrated Water Resources Development (NCIWRD) projection, the urban water demand in 2025 and 2050 has been assessed at 200 and 220 lpcd [GRIHA manual, 2017]. The requirement of a total daily supply of about 8 gallons per person for a day is essential for good health and cleanliness, according to the World Health Organization (WHO) [UNESCO 2003 & Bahar Zoghi Moghadam, 2009]. Water efficiency strategies in green building practices are becoming paramount to new and existing construction efforts.

5.1 The Energy, Water and Global Warming Connection

The collection, distribution, and treatment of drinking water and wastewater citywide consume tremendous amounts of energy and release carbon dioxide (Co). The energy-water connection is particularly strong in the driest regions 2 where significant amounts of energy are used to import water. Solutions exist to cut both water and energy use. Nationwide, about 4% [Water facts, 2009] of power generation is used for water supply and treatment, reducing water consumption saves energy because less water needs to be treated and pumped to end users.

The University is spread in a sprawling lush green campus of 423.15 acres dotted with 121 buildings of Academic, Administrative and support services with a plinth area of about 20 lakhs sq. ft., and 324 staff quarters. Approximately strength of student and staff is 50,000.

Water usage can be defined as water used for all activities which are carried out on campus from different water sources. This includes usage in all residential halls, academic buildings, on-campus, and on-grounds. Wastewater is referred to as the water which is transported off the campus. The wastewater includes sewerage; residence water used in cooking, showering, clothes washing as well as wastewater from chemical and biological laboratories which ultimately go down in the sink or drainage system.

5.2 Water Quality

Primary Water Quality Criteria for Bathing Waters, in a water body or its part, water is subjected to several types of uses. Depending on the types of uses and activities, water quality criteria have been specified to determine its suitability for a particular purpose. Among the various types of uses there is one use that demands highest level of water quality or purity and that is termed as "Designated Best Use" in that stretch of water body. Based on this, water quality requirements have been specified for different uses in terms of primary water quality criteria. The primary water quality criteria for bathing water are specified along with the rationale in table 1. PRIMARY WATER QUALITY CRITERIA FOR BATHING WATER (Water used for organized outdoor bathing) CRITERIA.

1. Fecal Coliform MPN/100 ml:
2. Fecal Streptococci MPN/100 ml:
3. pH
4. Dissolved Oxygen:
5. Biochemical Oxygen

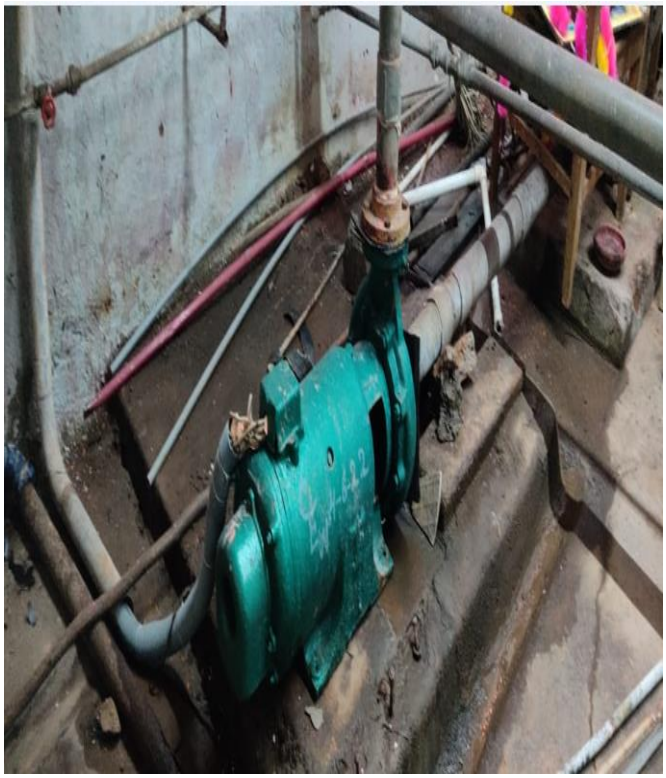
The desirable and permissible limits are suggested to allow for fluctuation in environmental conditions such as seasonal change, changes in flow conditions etc. The range provides protection to the skin and delicate organs like eyes, nose, ears etc. which are directly exposed during outdoor bathing. The minimum dissolved oxygen concentration of 5 mg/1 ensures reasonable freedom from oxygen consuming organic pollution immediately upstream which is necessary for preventing production of anaerobic gases (obnoxious gases) from sediment. The Biochemical Oxygen Demand of 3 mg/1 or less of the water ensures reasonable freedom from oxygen demanding pollutants and prevent production of obnoxious gases.

5.3 Drinking Water Quality

The ground water of Indore contains Designated Best Use Water Quality Criteria Designated-Best-Use Class of water Criteria Drinking Water Source without conventional treatment but after disinfection

- Total Coli Forms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20C 2mg/l or less Outdoor bathing (Organized)

- Total Coli Forms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less Drinking water source after conventional treatment and disinfection
- Total Coli Forms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less Propagation of Wild life and Fisheries
- pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less Irrigation, Industrial Cooling, Controlled Waste disposal
- pH between 6.0 to 8.5 Electrical Conductivity at 25C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l.



5.4 Electrical Conductivity:

The lowest value of E.C (µS/cmat 250C) was recorded at Gudem village as 110. Higher values of E.C more than 3,000 recorded as 3,263 at Addaroad village, 3,202 at Pudimadaka village, and 3,150at Revupolavaram village. The EC increases from north to south i.e. towards Coast. Higher values of E care recorded at Addaroad, Pudimadaka, and Revupolavaram.

The lowest value of chloride recorded as 7 mg/l at Kottur and higher value was recorded at Pudimadaka village as 674 mg/l. The concentrations of Nitrates in the district range from a minimum of 0.4 mg/l at Lotugadda village, to maximum value of 249 mg/l at Pudimadaka. Fluoride in the area ranges from 0.04 to 1.6mg/l, by and largethearea is free from fluoridehazards. The lowest value of 0.04 mg/lisre corded at Gudem village and maximum value of1.6mg/lre corded at Narsipatnam.

5.5 GROUND WATER RELATED ISSUES AND PROBLEMS

Overall, there is no significant change in water levels in the district. However, at few places decline in water table exists, which suggests that suitable preventive steps to be taken. However, the magnitude of the decline is less. Water logging does not exist in University campus area.

Ground water pollution is not significant in the non-industrial area of the district. However, localized Nitrate pollution in the district is due to excess use of fertilizers, urban sewerage disposal and improper drainage system. Though district has a coastline of 132 km, no significant sea water intrusion/ ingress is reported. Heavy metal pollution of ground water exists in the Mindi-Chukkavanipalem industrial area due to the industrial effluents. In old city area of Visakhapatnam i.e. Kotaveedhi, Gnanapuram etc. ground water is already contaminated due to the marshy nature. In such areas well should be limited to shallow zones only.

Mass awareness programmes may be conducted to aware the people to adopt for construction of roof top water harvesting in a large scale so that rainwater can be harvested, and it will increase ground water resource. In Visakhapatnam Urbanarea it is evident from the investigations carried out by various agencies and scientific scholars the groundwater has also polluted within the vicinity of industries due to industrial effluents released without proper treatment. It is also reported the polluted ground water affecting adversely the human health of the people who are living in the industrial areas. So, it is recommended industry wise systematic micro level ground water quality studies may be taken up immediately and remedial measures may be taken up by the Government organizations and also the agencies involved in water related issues. Strict measures should be implemented to ensure the industrial effluents are properly treated before discharging into canals/surface drainage.

Total hardness includes both temporary and permanent hardness caused by the calcium and magnesium, based on which water is categorized as soft or hard and very hard. Several epidemiological investigations have demonstrated the relation between risk for cardiovascular disease, growth retardation, reproductive failure, and other health problems and hardness of drinking water or its content of magnesium and calcium. A good percentage of people who consumes hard water, which is considered to be a significant etiological factor around the globe causing many diseases such as cardiovascular problems, diabetes, reproductive failure, neural diseases, and renal dysfunction and so on.

Table 1 Concentrations of dissolved calcium and magnesium in soft and hard water.

Dissolved calcium and magnesium		
Water	**Milligrams per liter (mg/l)**	**Grains per US gallon (gpg)**
Soft	0-60	0-3.5
Moderate	61-120	3.5-7.0
Hard	121-180	7.0-10.5
Very hard	>180	>10.5
1 ppm=0.058 grains/US gallon		

5.5.1 pH value:

A pH of 7 is considered neutral. That “seven” number is considered neutral or balanced between acidic and alkaline. If water is below 7 on the pH scale, it's "acidic." If it's higher than 7, it's "alkaline." EPA guidelines state that the pH of tap water should be between 6.5 and 8.5.

Acidic water with a pH of less than 6.5 is more likely to be contaminated with pollutants, making it unsafe to drink. It can also corrode (dissolve) metal pipes.

Many municipal water suppliers voluntarily test the pH of their water to monitor for pollutants, which may be indicated by a changing pH. When pollutants are present, water companies treat their water to make it safe to drink again.

5.5.2 Alkaline water

Alkaline water has become a popular drinking water choice over the past few years. Some people say that drinking slightly alkaline water — with a pH between 8 and 9 — can improve your health. They say it may make you age more slowly, maintain a healthy pH in your body, and block chronic disease.

5.5.3 Electrical Conductivity of Water

Pure water is not a good conductor of electricity. Ordinary distilled water in equilibrium with carbon dioxide of the air has a conductivity of about 10 x 10-6 W-1*m-1 (20 dS/m). Because the electrical current is transported by the ions in solution, the conductivity increases as the concentration of ions increases.
Electrical conductivity (EC) is a measurement of water's ability to conduct electricity. EC is related to water temperature and the total concentration, mobility, valence and relative concentration of ions. Higher EC means more electrolytes in the water.
The reason that the conductivity of water is important is because it can tell you how much dissolved substances, chemicals, and minerals are present in the water. Higher amounts of these impurities will lead to a higher conductivity.

Types of water	Conductivity Value
Pure distilled and Deionized water	0.05 µS/cm
Seawater	50 mS/cm
Drinking water	200 to 800 µS/cm.
Rain or Snow water	2 to 100 µS/cm

Water Consumption in Andhra University, Visakhapatnam, Andhra Pradesh

WATER CONSUMPTION				
Sr. No.	**PUMP LOCATION**	**PUMPING HOURS (IN HOURS)**	**PUMPING CAPACITY IN HP**	**OVERHEAD TANK CAPACITY**
1	Main Pump House(Near A.U. Health Centre)	10 Hours	35 HP	350 KL
2	Victory Tank (Near C.A.O. Office)	7 Hours	15 HP	60 KL
3	Library Pump House	8 Hours	35 HP	200 KL
4	Seasand Pump House	5 Hours	15HP	30 KL
5	Pithapuram Pump Hosue	5 Hours	15HP	25 KL
6	Bhagiradha Pump House	4 Hours	15HP	40KL
7	Ladies Hostel (Maharanipeta)	6 Hours	30 hp	100 KL
8	Main Pump House (Near Gandhi Bhavan)	10 Hours	15 HP	140 KL
9	4,5, Pump House (Ladies Hostel Backside)	10 Hours	15 HP	160 KL
10	Near Mechanical Engineering Pump House	4 Hours	15 HP	150 kl
11	Vidya Hostel Pump shed	6 Hours	7.5 HP	100 KL

5.6 Rain Water Harvesting Andhra University Campus, Visakhapatnam

The Andhra University is one of the oldest premier educational institutions in the country, constituted in the year 1926 by the Madras Act of 1926. The 93-year-old institution works with the vision of creating new frontiers of knowledge in quest for development of a humane and just society. The University has more than 66 academic departments and centres as part of the constituent colleges: Arts, Commerce & Management, Law, Science & Technology and Engineering & Pharmacy. Institute of Yoga & Consciousness, a world class yoga village, caters to the emotional and physical health of the citizens of Visakhapatnam. The University promotes Fine Arts and Performing Arts through the Department of Fine Arts, Music, Dance and Theatre. Center of Environment, Sustainable Development and climate Change

is the recent addition to extend the academic and extensive services to the government and society. The University is spread in a sprawling campus of 422 acres dotted with 170 buildings of academic, administrative and support services and 258 staff quarters with a roof top area of about 20 lakhs sq.ft.

More than 7000 students and 600 staff with their family members are residing in the campus. The area comprises of North and South campuses of the Andhra University which is surrounded by several residential colonies viz., Pithapuram Colony, Naukanagar, Chinna Waltair, HPCL Colony, Panduranga Puram, Siripuram, BalajiNagar, Resuvanipalem and Maddilapalem with a population of approximately 3,00,000. The layout of the Andhra University is depicted in the Figure 1. The Google Earth image of the Andhra University campus is shown in Figure 2.

Total number of rain water harvesting pits made upto 2020 was 34 in north campus & 15 RWH in south campus. This year RWH in whole campus with approximate area captured for every department in south and north campus including hostels (100 Acres in south campus and 80 Acres in north campus) are equipped with rain water harvesting system. Thus Andhra University has provieded whole campus area with rain water harvesting.

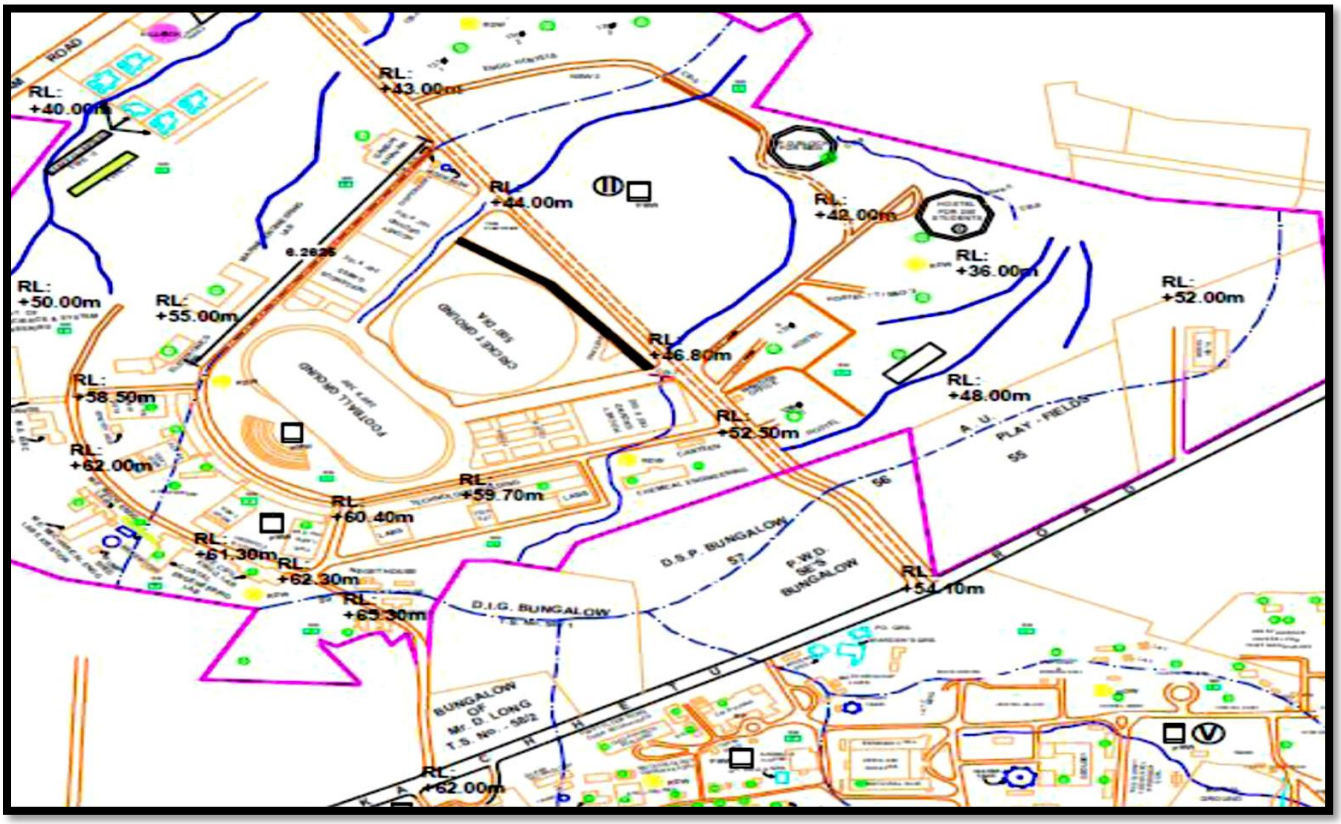


Figure 1: Andhra University Campus Layout along with the adjoining areas.

Figure 2: Google Image of the Andhra University Campus

5.6.1 THE ANDHRA UNIVERSITY: RAIN WATER HARVESTING

The campus is located in an upland area on the east coast and the ground levels vary from + 72.00 m to +10.00 m making it a sloppy terrain. The contour differences are about 30 m in the northern portion and 50m in the southern portion of the campus. The contour map is presented in the Figure 3. The entire university area is covered with red loamy, laterite and sandy soils with high porosity and infiltration capacity. Red soils are formed from the parent khondalite rock whereas the sandy soils are confined to sea coast. Uneven land topography with gullied nature is observed. The hilly terrain contains a thin veneer of hydrophilic soils which supports luxuriant forest vegetation. The hilly terrain contains a thin layer of hydrophilic soils supporting forest vegetation. Table 1 shows the results of the geophysical studies conducted at different locations in the university campus. The details of the geological strata of the Andhra University area along with its immediate neighbourhood are shown pictorially in Figure 4 and Figure 5. The ground water pathways are shown in Figure 6. The micro watersheds in the university campus are shown in Figure 7.

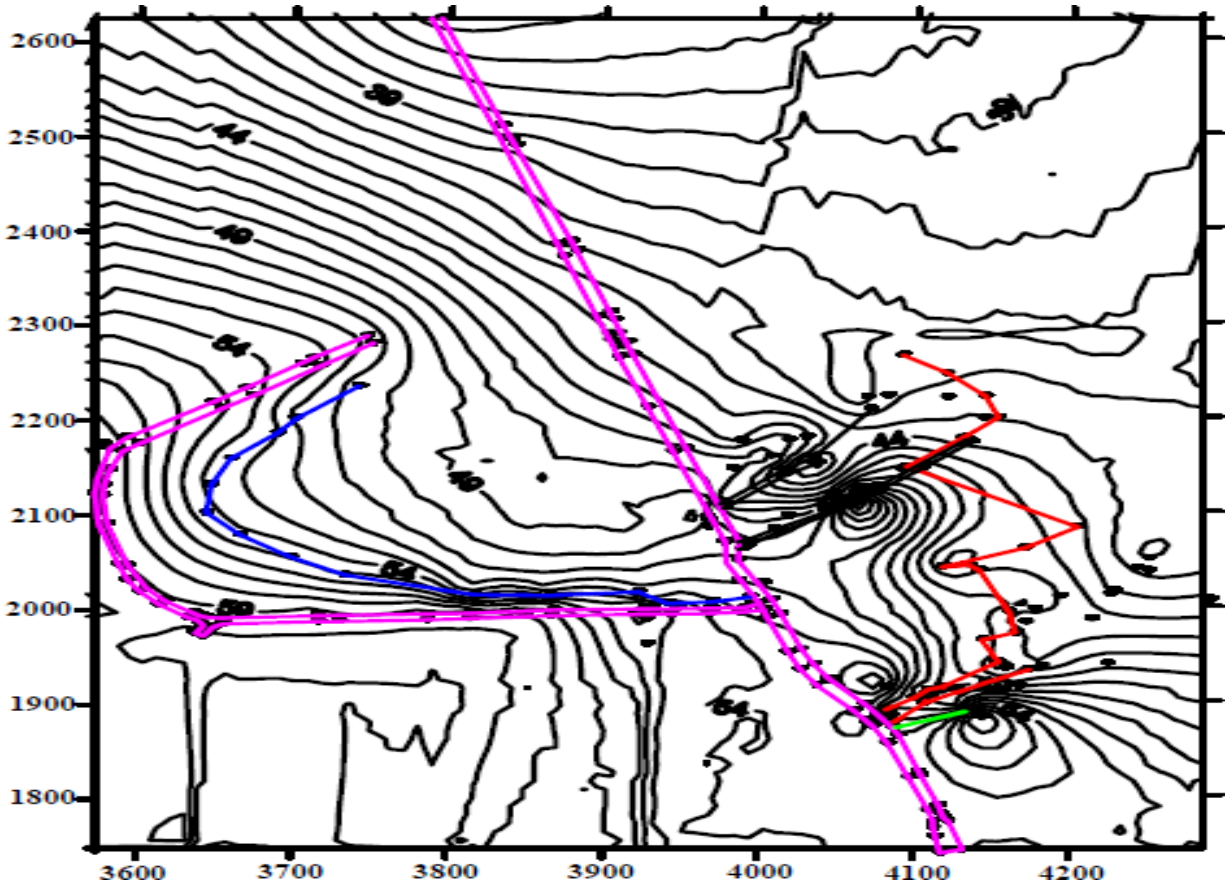


Figure 3: The Contour Map of Andhra University, Visakhapatnam.

The campus receives a total rainfall of 1121.60 mm per year on an average. The rainfall is distributed over 118 rainy days with maximum amount of rainfall occurring during months July to October every year. Owing to the varied topographical features most of the rainfall goes without tapped and utilized properly. On the other hand, to support the needs of nearly 9000 students, faculty and supporting staff residing in the campus and for other activities the university requires approximately 20 lakh litres of water per day. The groundwater sources of the university at present are able to supply only 7 to 9 lakh litres per day, the remaining amount of water being supplied by the municipal corporation at a specified rate. The university is

located on a dome like geological terrain surrounded by number of residential colonies on all sides; the effective recharging of rainwater in the campus may enrich the groundwater table in the surrounding colonies benefiting two to three lakhs of people residing there. Therefore, keeping in view of the above cited figures, there is a necessity to adopt and implement suitable rainwater harvesting systems through systematic study to tap the groundwater recharge potential at the campus. Hence, the Andhra University implemented the 'Catch the Rain' program through an effective RWH system in its campus.

The RWH systems in place in the Andhra University campus are i) Construction of suitable rainwater harvesting structures of different types like recharge wells, pits, check dams etc. throughout the campus; ii) Providing monitoring wells in the area of influence to study the water level fluctuations at regular intervals of time; and iii) dissemination of the knowledge gained through the RWH project and creating awareness in the society for proper management of groundwater resources.

Table 1: Results of Geophysical Studies Conducted at Different Places in Andhra University Campus.

Depth (ft)	Type of Soil/Rock				
	NCC Camp Office	**CSE Department**	**Samatha Hostel**	**Dispensary, AU South Campus**	**Assembly Hall**
0-10	Gravel	Gravel	Gravel	Gravel	Gravel
10-20	Gravel	Gravel	Gravel	Gravel	Gravel
20-30	Weathered Charnockite	Gravel	Gravel	Gravel	Weathered Liptinite
30-40	Weathered Charnockite	Loamy RedSoil	Gravel	Highly Weathered Liptinite	Weathered Liptinite
40-50	Weathered Charnockite	Loamy RedSoil	Red Loamy	Highly Weathered Liptinite	Weathered Liptinite
50-60	Weathered Charnockite	Highly Weathered Khondalite	Red Loamy	Weathered Liptinite	Weathered Liptinite
60-70	Fractured Charnockite	Highly Weathered Khondalite	Red Loamy	Weathered Liptinite	Fractured Liptinite
70-80	Fractured Charnockite	Highly Weathered Khondalite	Red Loamy	Weathered Liptinite	Fractured Liptinite
80-90	Fractured Charnockite	Highly Weathered Khondalite	Highly Weathered Khondalite	Fractured Liptinite	Fractured Liptinite
90-100	Fractured Charnockite	Weathered Khondalite	Highly Weathered Khondalite	Fractured Liptinite	Fractured Liptinite

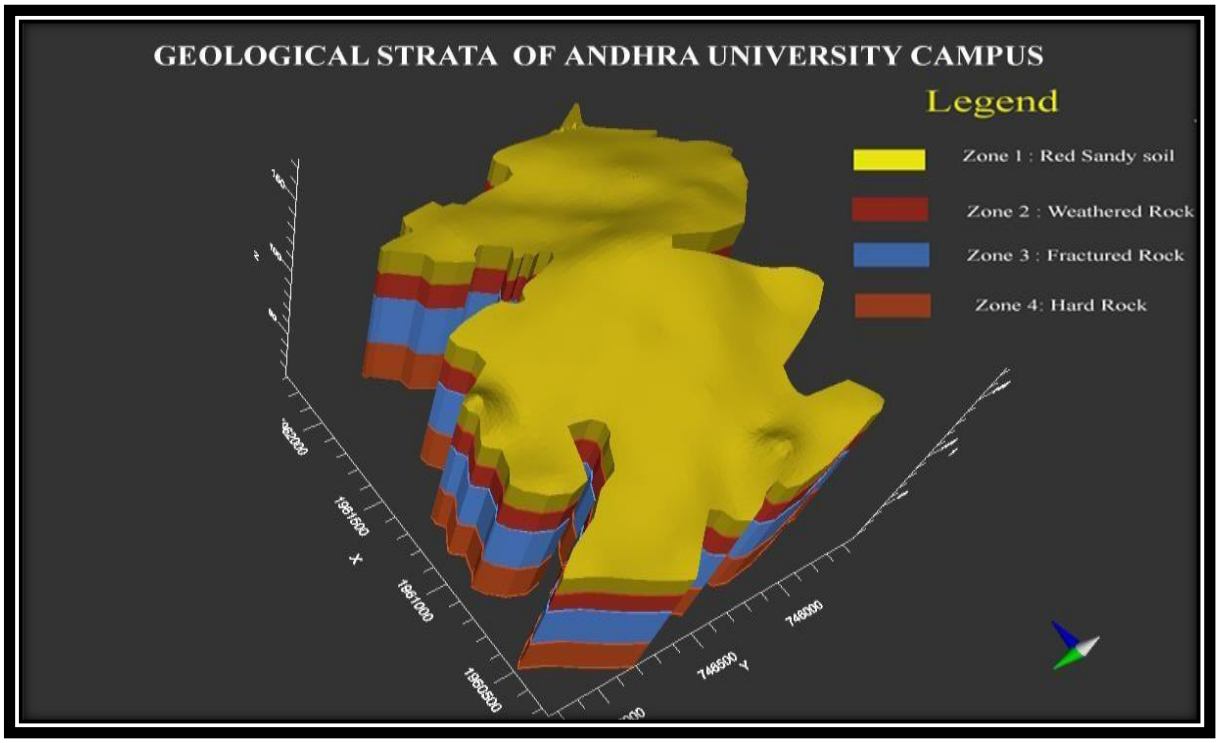


Figure 4: Geological Strata of Andhra University Campus

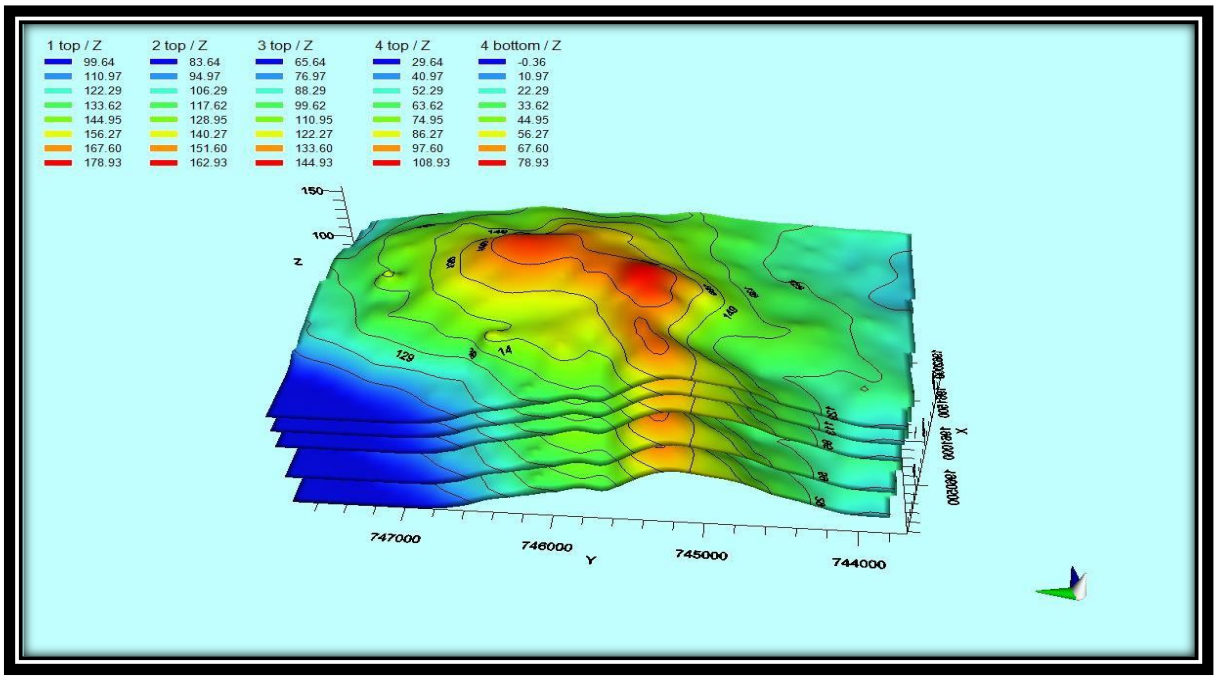


Figure 5: Geological Strata of the Andhra University along with its Neighbourhood

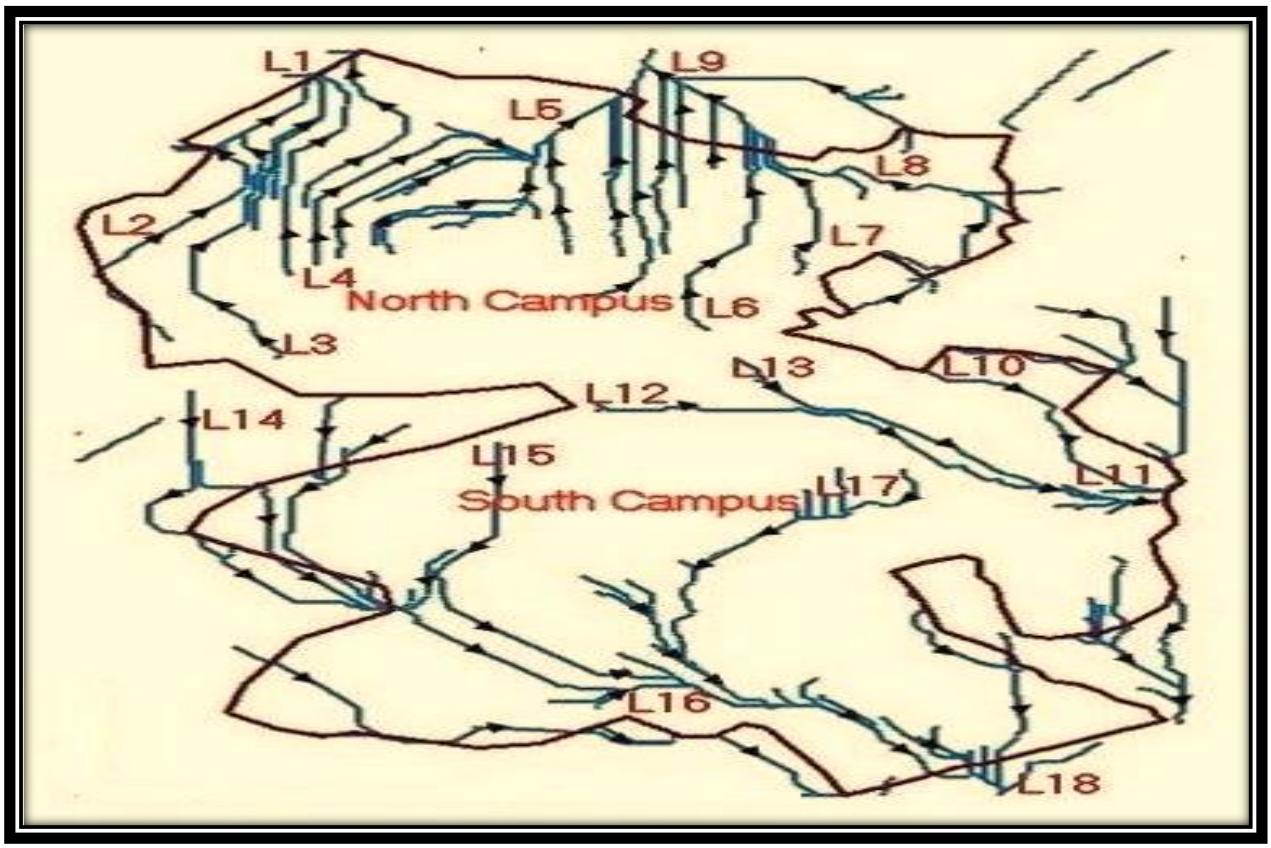


Figure 6: Groundwater Flow Pathways in the Andhra University, Visakhapatnam

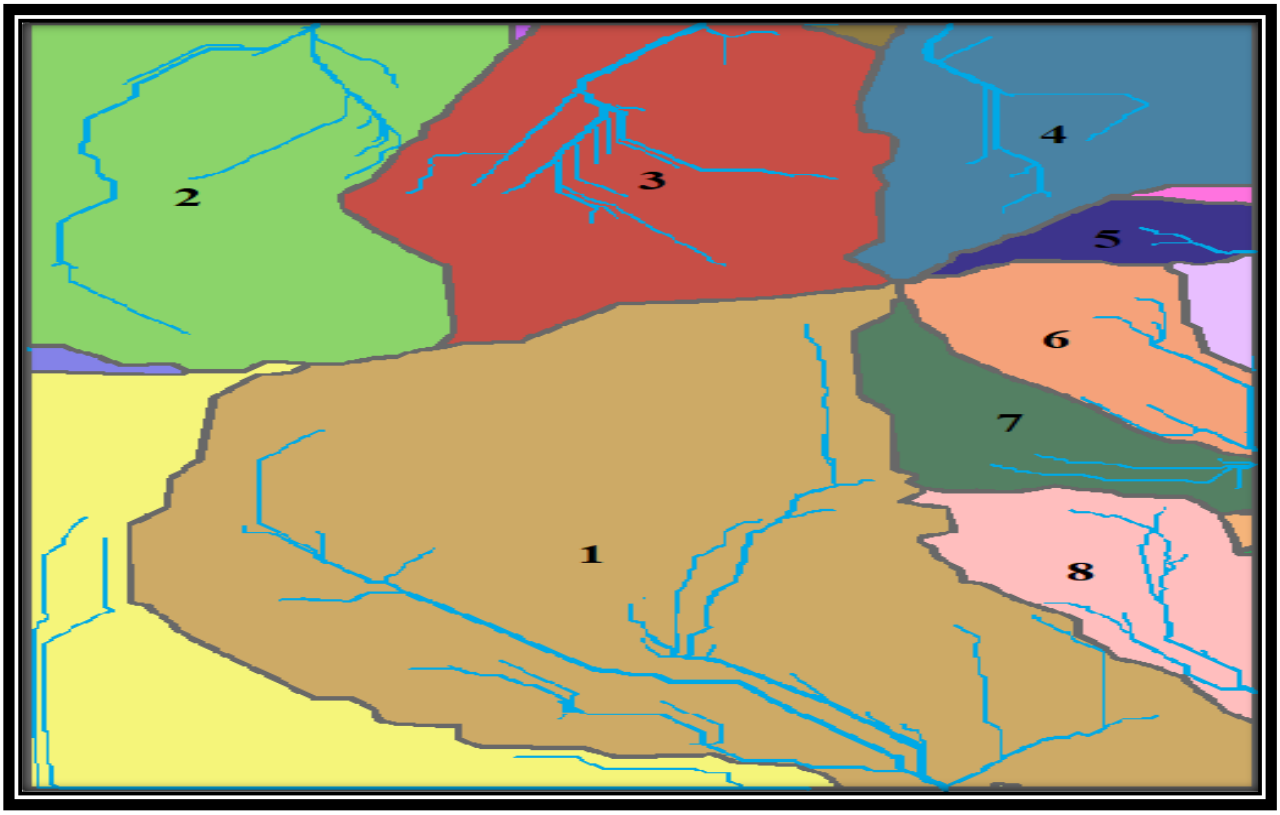


Figure 7: Delineation of Micro Watersheds in the University Campus

The major buildings in each of the watershed of the Andhra University campus are identified for placing the RWH systems. The topographical characteristics of the micro-watersheds are shown in Table 3. The details of identified major buildings in each of the watersheds are given in Table 4. The order of the channels or water courses or streams passing through the campus are presented in Table 5.

Table 3: Topographic Characteristics of the Micro-Watersheds

Micro watershed	*Area(km^2)*	*Minimum elevation (m MSL)*	*Maximumelevation (m MSL)*
MW1	0.781	8	75
MW2	0.306	38	75
MW3	0.282	38	75
MW4	0.182	38	60
MW5	0.005	45	60
MW6	0.089	30	60
MW7	0.031	30	60
MW8	0.100	8	45

Table 4: Major buildings/areas in Micro-watershed of the Andhra University, Visakhapatnam

Water shedNo.	**Buildings / Areas covered**	**Watershed No.**	**Buildings / Areas covered**
1	Central administrative office	2	Maddilapalem Gate
	Avula Sambasiva Rao women'shostel		N.C.C. Building
	South Campus Post office		N.C.C. Opposite ground
	Commerce and Managementdepartment		Y.V.S. Murthy auditorium
	Sir CR Reddy convocation hall		Marine Department
	Nagarjuna hostel		ECE Department
	Officer's colony		CSE Department
	HPCL waltair park		CSE new class rooms
	Resident quarters		EEE Department
	A.U. Yoga village		Engineering Exams cell
	Department of Marine LivingResources		Mechanical Department
	A.U. High school		Civil Department
3	P.G. Girls hostel	4	A.U Samatha hostel
	A.U. Engineering boys hostel		A.U International studenthostel
	A.U. Engineering girls hostel		A.U Mamatha law hostel
	A.U. Engineering college ground		
5	Vidya Research Scholars hostel	6	Siddardha hostel
			Sathavahana hostel
			Sri Krishna Devarayahostel
			AU Health centre
7	G.M.C. Balayogi Researchscholars hostels	8	A.U. Platinum Jubilee GuestHouse
	A.U. South Campus Ground		School of Distance Education
	Dept. of Physical Sciences		APCET Office
	Dept. of fine arts		AU International StudentHostel (South Campus)
	T.L.N. Sabha Hall		
	Dept. of Physical education		

Table 5: Stream Order and Number of Streams in the Study Area in each of the Watersheds

Water Shed No.	1 Order Streams	2 Order Streams	3 Order Stream	4 Order Streams	Total Streams
1	32	6	2	1	41
2	11	2	1	0	14
3	15	5	1	1	22
4	8	2	1	0	11
5	2	1	0	0	3
6	6	2	0	0	8
7	4	1	0	0	5
8	6	2	1	0	9
Total	84	21	6	2	113

Renewable Energy

Renewable energy is energy derived from natural sources that are replenished at a higher rate than they are consumed. Sunlight and wind, for example, are such sources that are constantly being replenished. Renewable energy sources are plentiful and all around us.

Solar Saving in AU Campus

Solar Saving for the Year 2021-22				
Month/Year	**048 saving (South Campus)**	**265 saving (North Campus)**	**601 Saving (School of Distance Education)**	**TOTAL SAVING**
Mar-21	565275.3	151101.6	59939.787	776316.707
Apr-21	521581.7	130303.3	62965.6976	714850.6966
May-21	775581.9	214802.1	77507.23	1067891.3
Jun-21	467329.3	146667.4	54786.317	668783.067
Jul-21	455696	125532.3	51248.374	632476.665
Aug-21	519335.5	133087.2	50494.52	702917.217
Sep-21	384796.5	197628.8	46777.849	629203.189
Oct-21	527836.4	125349.2	51112.23	704297.78
Nov-21				
Dec-21				
Jan-22				
Feb-22				
Total of 2021				**Rs. 58,96,736.62**
Total of 2020				**58,96,736.62**
Tolal of 2020 & 2021				**1,63,61,787.17**

Solar units Generated and Utlised by Andhra University 2021-22				
Month& Year	**048 KWH**	**265 KWH**	**601 KWH**	**TOTAL KWH**
Mar-21	110587.7	36149.3	11843.7	158580.7
Apr-21	93390.3	32494.6	11430.76	137315.66
May-21	104708.2	32579.8	11978	149266
Jun-21	84119.1	27860.9	10596.7	122576.7
Jul-21	95228.4	30045.7	11017.4	136291.5
Aug-21	100934.2	29825.5	10507	141266.7
Sep-21	87735	49284	10184.9	147203.9
Oct-21	103225	29771	10083	143079
Nov-21				
Dec-21				
Jan-22				
Feb-22				
Total	**779927.9**	**268010.8**	**87641.46**	**1135580.16**

Energy Consumption Details

2021													
		048 (SOUTH)			265 (NORTH)			601 (SDE)			TOTAL		
SR. NO.	MONTHS	ELECTRICITY EXPENSE AMOUNT	SOLAR INCOME AMOUNT	SAVING AMOUNT	ELECTRICITY EXPENSE AMOUNT	SOLAR INCOME AMOUNT	SAVING AMOUNT	ELECTRICITY EXPENSE AMOUNT	SOLAR INCOME AMOUNT	SAVING AMOUNT	ELECTRICITY EXPENSE AMOUNT	SOLAR INCOME AMOUNT	SAVING AMOUNT
1	JAN	18,58,395	11,92,453	6,65,942	10,97,777	9,46,101	1,51,676	2,95,333	2,32,866	62,467	32,51,505	23,71,420	8,80,085
2	FEB	20,10,916	13,39,289	6,71,627	12,00,620	10,52,098	1,48,522	2,78,790	2,12,018	66,772	34,90,326	26,03,405	8,86,921
3	MAR	25,05,453	19,40,178	5,65,275	13,94,755	12,43,653	1,51,102	2,74,842	2,14,902	59,940	41,75,050	33,98,733	7,76,317
4	APR	19,95,746	14,74,164	5,21,582	10,09,258	8,78,955	1,30,303	3,02,443	2,39,478	62,966	33,07,447	25,92,596	7,14,851
5	MAY	18,03,164	10,27,582	7,75,582	7,74,420	5,59,618	2,14,802	3,00,028	2,22,520	77,507	28,77,612	18,09,720	10,67,891
6	JUN	17,78,882	13,11,553	4,67,329	8,46,300	6,99,633	1,46,667	2,94,999	2,40,213	54,786	29,20,181	22,51,399	6,68,783
7	JUL	22,42,383	17,86,687	4,55,696	11,28,025	10,02,493	1,25,532	3,20,540	2,69,292	51,248	36,90,948	30,58,472	6,32,476
8	AUG	23,39,092	18,19,757	5,19,335	11,11,255	9,78,168	1,33,087	3,47,289	2,96,795	50,495	37,97,636	30,94,719	7,02,917
9	SEP	23,93,375	20,08,579	3,84,796	15,37,517	13,39,888	1,97,629	3,28,615	2,81,837	46,778	42,59,507	36,30,304	6,29,203
10	OCT	23,98,248	18,70,412	5,27,836	12,78,258	11,52,909	1,25,349	3,41,766	2,90,654	51,112	40,18,272	33,13,975	7,04,297
11	NOV	25,32,047	20,71,972	4,60,075	13,31,410	12,11,772	1,19,638	3,23,337	2,74,715	48,622	41,86,794	35,58,459	6,28,335
12	DEC	23,39,092	18,19,757	5,19,335	11,11,255	9,78,168	1,33,087	3,47,289	2,96,795	50,495	37,97,636	30,94,719	7,02,917
TOTAL		**2,61,96,793**	**1,96,62,383**	**65,34,410**	**1,38,20,850**	**1,20,43,454**	**17,77,396**	**37,55,272**	**30,72,084**	**6,83,188**	**4,37,72,915**	**3,47,77,921**	**89,94,993**
AVERAGE		**21,83,066**	**16,38,532**	**5,44,534**	**11,51,738**	**10,03,621**	**1,48,116**	**3,12,939**	**2,56,007**	**56,932**	**36,47,743**	**28,98,160**	**7,49,583**