ANDHRA UNIVERSITY

VISHAKHAPATNAM

Green Campus Audit Report

2019-20

Date: 18/9/2019

AUDITED BY

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ANDHRA UNIVERSITY * WALTAIR *

1. INTRODUCTION:

The Green Campus Audit aims to analyse Green Campus practices within and outside the university campuses, which will have an impact on the eco-friendly atmosphere. Green Campus audit can be defined as systematic identification, quantification, recording, reporting and analysis of components of university Green Campus. 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 Green Campus. Through the Green Campus audit, a direction as how to improve the structure of Green Campus and there are include several factors that have determined the growth of carried out the Green Campus audit.

1.1. NEED FOR GREEN CAMPUS AUDITING

Green campus auditing is the process of identifying and determining whether institutions practices are eco-friendly 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? Green campus 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. Green campus audit provides an approach for it. It also increases overall consciousness among the people working in institution towards a Green campus.

1.2. GOALS OF GREEN CAMPUS AUDIT

University has conducted a Green campus audit with specific goals as: 1. Identification and documentation of Green campus practices followed by university. 2. Identify strength and weakness in Green campus practices. 3. Analyze and suggest solution for problems identified. 4. Assess facility of different types of waste management. 5. Increase Green campus awareness throughout campus 6. Identify and assess Green campus risk. 7. Motivates staff for optimized sustainable use of available resources. 8. The long-term goal of the Green campus audit program is to collect baseline data of Green campus parameters and resolve Green campus issue before they become problem.

1.3. OBJECTIVES OF GREEN CAMPUS AUDIT

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

1.4. BENEFITS OF GREEN CAMPUS AUDIT TO EDUCATIONAL INSTITUTIONS

There are many advantages of Green campus audit to an Educational Institute:

1. It would help to protect the Green campus 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 Green campus 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:

- Green campus education through systematic Green campus al management approach
- Improving Green campus al standards
- Benchmarking for Green campus 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 a Green campus ethic and value systems in young people.

3. EXECUTIVE SUMMARY

A Green campus audit is a snapshot in time, in which one assesses campus performance in complying with applicable Green campus 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 Green campus compliance. This audit report contains observations and recommendations for improvement of Green campus consciousness.

4. DETAILS OF FLORA IN AU CAMPUS

4.1 GREEN AUDITING

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

4.1.1 TREE DIVERSITY OF ANDHRA UNIVERSITY

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 species are planted in different periods of time through various plantation programmes organized by the authority and have become an integral part of the campus. 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 terms of contributing to our Green campus by providing oxygen, improving air quality, climate amelioration, conservation of water, preserving soil and supporting wildlife, controlling climate by moderating the effects of the sun, rain and

wind. Leaves absorb and filter the sun's radiant energy, keeping things cool in summer. May spices of birds are dependent on these trees mainly for food and shelter. Different species display a seemingly endless variety of shapes, forms, texture and vibrant colours. Even individual trees vary their appearance throughout the course of the year as the seasons change. The strength, long life spade regal stature of trees give them a monument – like quality. Thus, the college has been playing a significant role in maintaining the Green campus in its surrounding areas. 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

Sr. No	Botanical name	Family	Common name	Number of individuals
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	-	200
21	*Peltophorumpterocarpum*	Fabaceae	-	300
22	*Albizzialebbek*	Fabaceae	-	100
23	*Albizziasaman*	Fabaceae	-	150
24	*Sennasiamia*	Fabaceae	-	300
25	*Tamarindusindica*	Fabaceae	Tamarind	30
26	*Caryotaurens*	Arecaceae	Jiluga	56
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	120
33	*Ficusbengalensis*	moraceae	Ravi	56
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

Sr. No	Botanical name	Family	Common name	Number of individuals
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
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

Sr. No	Botanical name	Family	Common name	Number of individuals
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
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
98	*Tectona grandis*	Verbanaceae	Teak	100
100	*Morinda tinctoria*	Rubiaceae	Thogaru	150
101	*Swetenia mahaghony*	Meliaceae	Mohagony tree	45
102	*Lagerstromia parviflora*	Lythraceae	--	23
TOTAL OF 2020				**5476**
TOTAL OF 2018 & 2019				**5051**
TOTAL OF 2018, 2019 & 2020				**10527**


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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**.

Faunal diversity of Andhra university campus 2019-2020

S.No	Scientific name	Common name	Family	Phylum
1	Ardea alba modesta	Crane	Ardeidae	Aves
2	Corvus splendens	Crow	Corvidae	Aves
3	Calopteryx splendens	Damselflies	Calopterygidae	Arthropoda
4	Diplacodes trivialis	Dragon flies	Libellulidae	Arthropoda
5	Clanga hastate	Eagle	Accipitridae	Aves
6	Pheretima posthuma	Earthworm	Megascolecidae	Annelida
7	Bactrocera cucurbitae	Fruit fly	Tephritidae	Arthropoda
8	Calotes versicolor	Garden lizard	Agamidae	Reptelia
9	Polyspilota aeruginosa	Grasshopper	Mantidae	Arthropoda
10	Buteo jamaicensis	Hawk	Accipitridae	Aves
11	Apis indica	Honeybee	Apidae	Arthropoda
12	Calliphora vomitoria	Houseflies	Calliphoridae	Arthropoda
13	Ardeola grayii	Indian crane	Ardeidae	Aves
14	Acridotheres tristis	Indian myna	Sturnidae	Aves
15	Halcyon smyrnensis	Kingfisher	Alcedinidae	Aves
16	Hirudo medicinalis	Leeches	Glossiphoniidae	Annelida
17	Junonia lemonias	Lemon pansy	Nymphalidae	Arthropoda
18	Varanus varius	Monitor lizard	Varanidae	Reptelia
19	Micronia aculeate	Moths	Uraniidae	Arthropoda
20	Psi1acula krameri	Parrot	Psittaculidae	Aves
21	Columba livia domestica	Pigeons/Doves	Columbidae	Aves
22	Ra1us norvegicus	Rat	Muridae	Mammal
23	Ptyas mucosa	Rat snake	Colubridae	Reptelia
24	Solenopsis	Red ant fire ant	Formicidae	Arthropoda
25	Ho1ento1a tumulus	Scorpion	Scorpionidae	Arthropoda
26	Helixpomatia molluscus	Snails	Gastropoda	Mollusca
27	Passer domesticus	Sparrows	Passeridae	Aves

Types of Phylum in AU in 2020		
Sr. No.	**Phylum**	**Total of 2020**
1	Annelida	2
2	Arthropoda	10
3	Aves	10
4	Mammal	1
5	Mollusca	1
6	Reptelia	3
Total		**27**

Total Phylum in AU in 2018, 2019 & 2020					
Sr. No.	**Types of Phylum**	**No. of Phylum in 2018**	**No. of Phylum in 2019**	**No. of Phylum in 2020**	**Total**
1	Annelida	2	2	2	6
2	Arthropoda	13	11	10	34
3	Aves	10	10	10	30
4	Mammal	2	1	1	4
5	Mollusca	1	1	1	3
6	Reptelia	6	5	3	14
Total					**91**

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 on servation 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 Green Campus Program, on the ongoing basis buildings are responsible for 30-40 % of energy use ad 15-20 % of water use worldwide [Sumateja Reddy.V, 2016 & Levine, A.D., and T. Asao, 2004], are source 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 waste water city wide consume tremendous amounts of energy and release carbon dioxide (CO_2). The energy-water connection is particularly strong in the driest regions where significant amounts of energy are used to import water. Solutions exist to cut both water and energy use Nation wide, 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 waste water 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 Water, 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 ad 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:
2. pH
3. Dissolved Oxygen:
4. 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 AD 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.

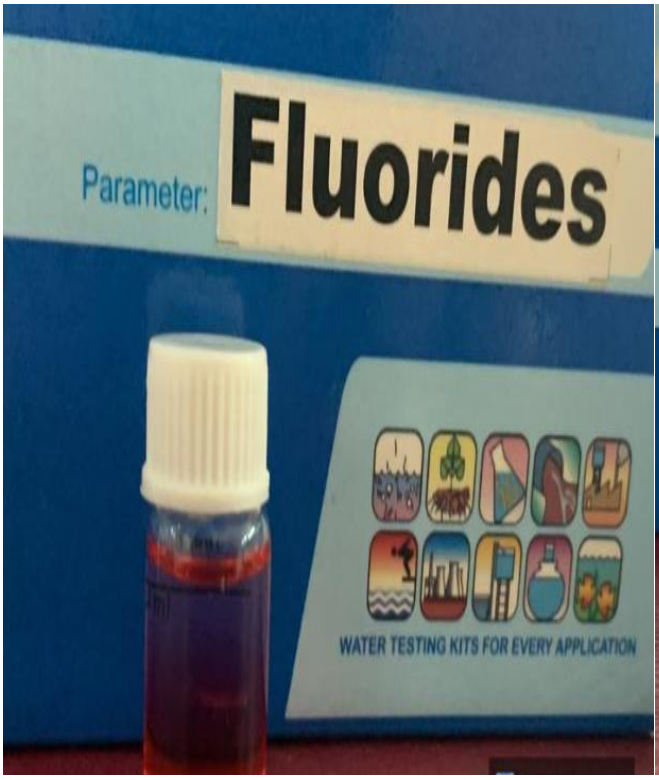
5.5.3 Electrical Conductivity of Water

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 ad 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 TAK CAPACITY**
1	Main Pump House(Near A.U. Health Centre)	10 Hours	35 HP	350 KL
2	Victory Tak (Near C.A.O. Office)	7 Hours	15 HP	60 KL
3	Library Pump House	8 Hours	35 HP	200 KL
4	Seasad 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 (Maharaipeta)	6 Hours	30 hp	100 KL
8	Main Pump House (Near Gadhi Bhava)	10 Hours	15 HP	140 KL
9	4,5, Pump House (Ladies Hostel Backside)	10 Hours	15 HP	160 KL
10	Near Mechaical 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 2019 was 34 in north campus, and this year additional RWH made in south campus was 15. Thus total number of RWH for recharging ground water is now 49.

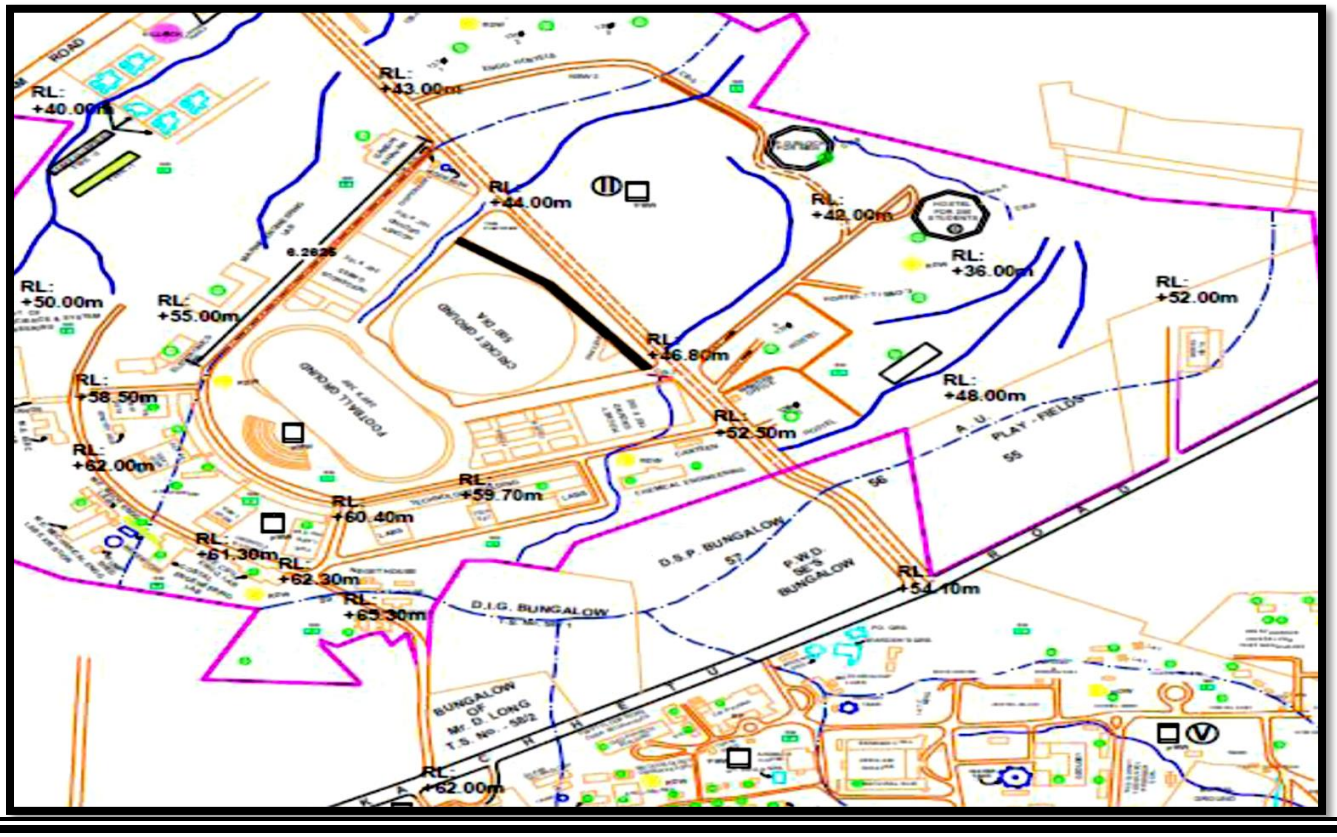


Figure1: Andhra University Campus Layout along with the adjoining areas.

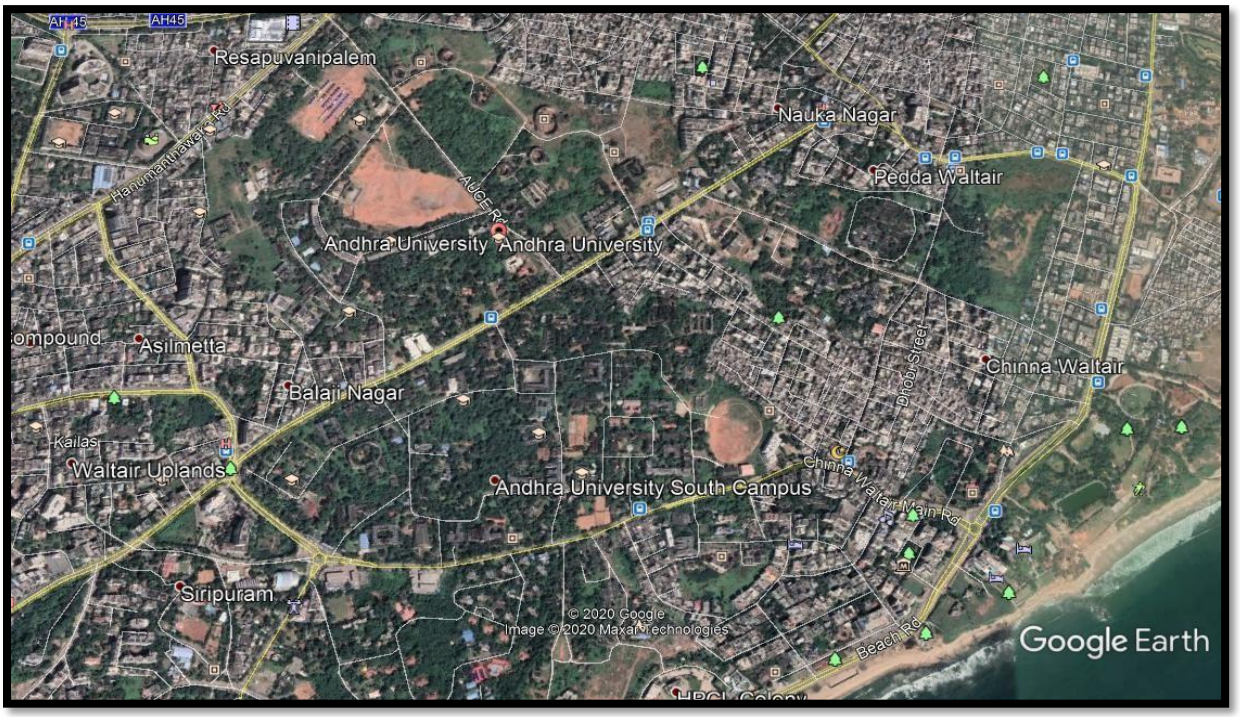


Figure2: Google Image of the Andhra University Campus

5.6.1 THE ANDHRAUNIVERSITY: RAIN WATER HARVESTING

The campus is locating dinanupland area on the east coast and the ground levels vary from+72.00m to+ 10.00m making it a sloppy terrain. The contour difference sare about 30 min the northern portion and 50 min 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 geo physical studies conducted at different locations in the university campus. The details of the geological strata of the Andhra University area along with its immediate neighborhood 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 Figure7.

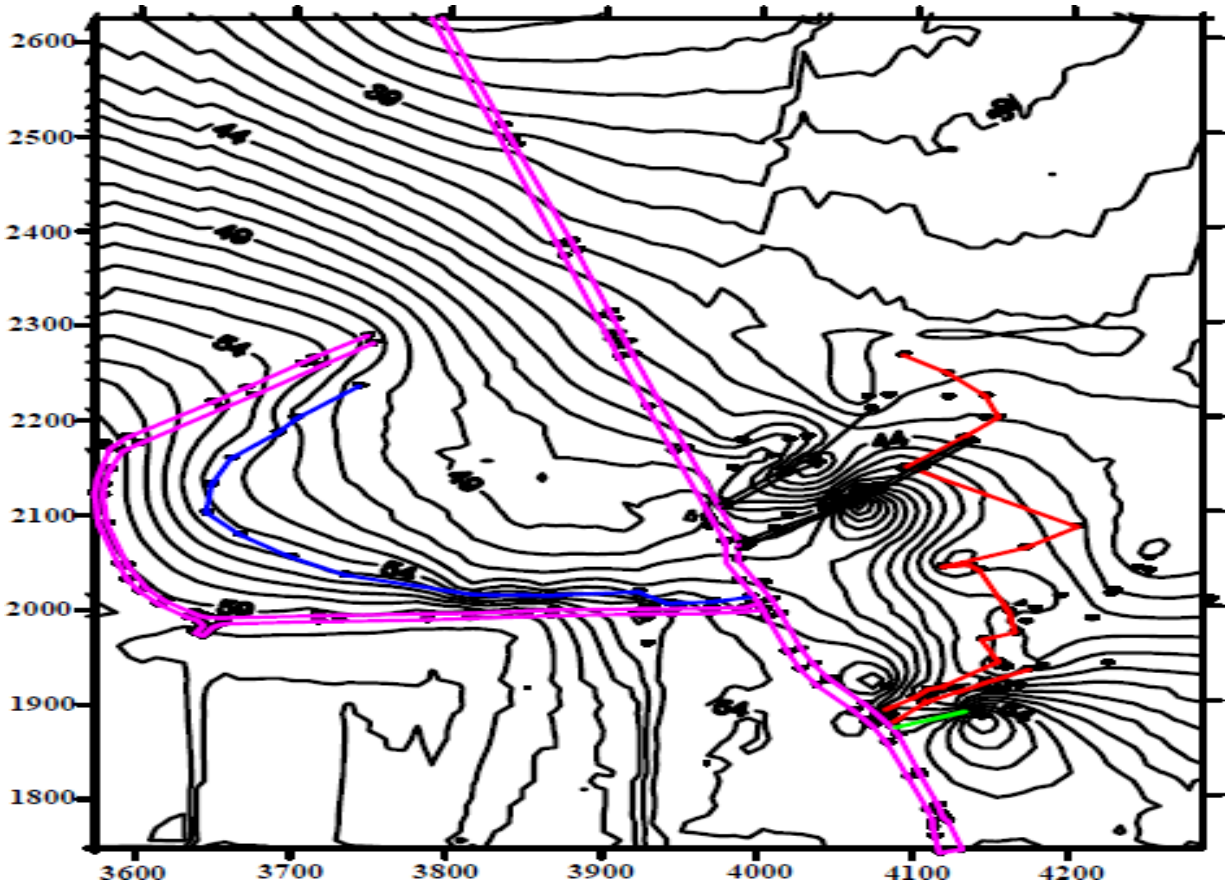


Figure3: The Contour Map of Andhra University, Visakhapatnam.

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 rain fall 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 rain water in the campus may enrich the ground water 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 rain water harvesting systems through systematic study to tap the ground water 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 rain water 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 ground water 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	WeatheredCharnockite	Gravel	Gravel	Gravel	WeatheredLiptinite
30-40	WeatheredCharnockite	LoamyRedSoil	Gravel	HighlyWeatheredLiptinite	WeatheredLiptinite
40-50	WeatheredCharnockite	LoamyRedSoil	RedLoamy	HighlyWeatheredLiptinite	WeatheredLiptinite
50-60	WeatheredCharnockite	HighlyWeatheredKhondalite	RedLoamy	WeatheredLiptinite	WeatheredLiptinite
60-70	FracturedCharnockite	HighlyWeatheredKhondalite	RedLoamy	WeatheredLiptinite	FracturedLiptinite
70-80	FracturedCharnockite	Highly WeatheredKhondalite	RedLoamy	WeatheredLiptinite	FracturedLiptinite
80-90	FracturedCharnockite	HighlyWeatheredKhondalite	HighlyWeatheredKhondalite	FracturedLiptinite	FracturedLiptinite
90-100	FracturedCharnockite	Weathered Khondalite	HighlyWeatheredKhondalite	FracturedLiptinite	FracturedLiptinite

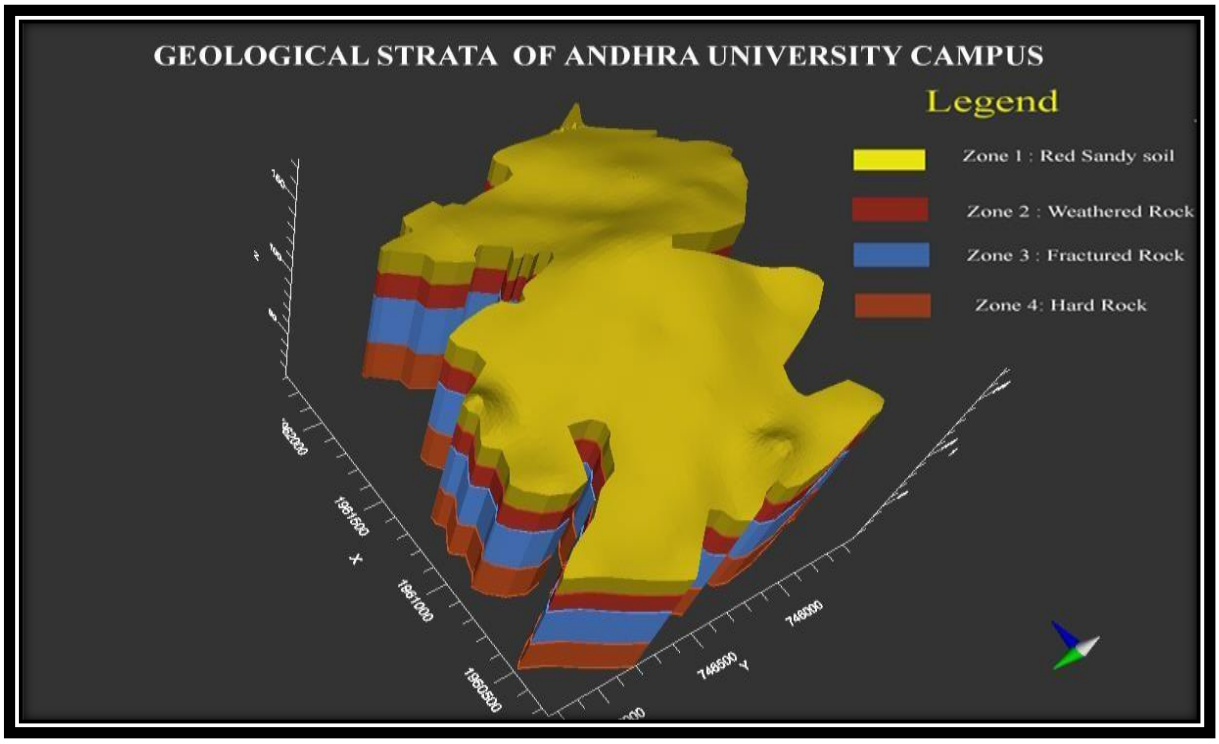


Figure4:Geological StrataofAndhraUniversityCampus

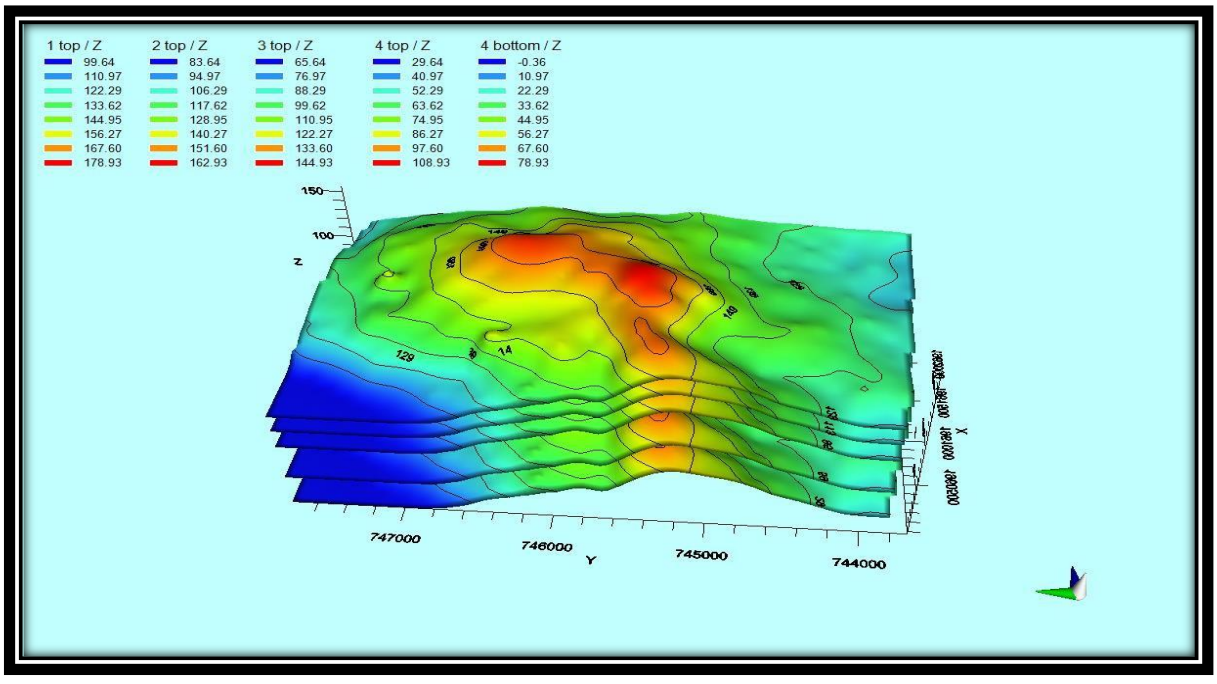


Figure5: Geological Strata of the Andhra University along with its Neighbourhood

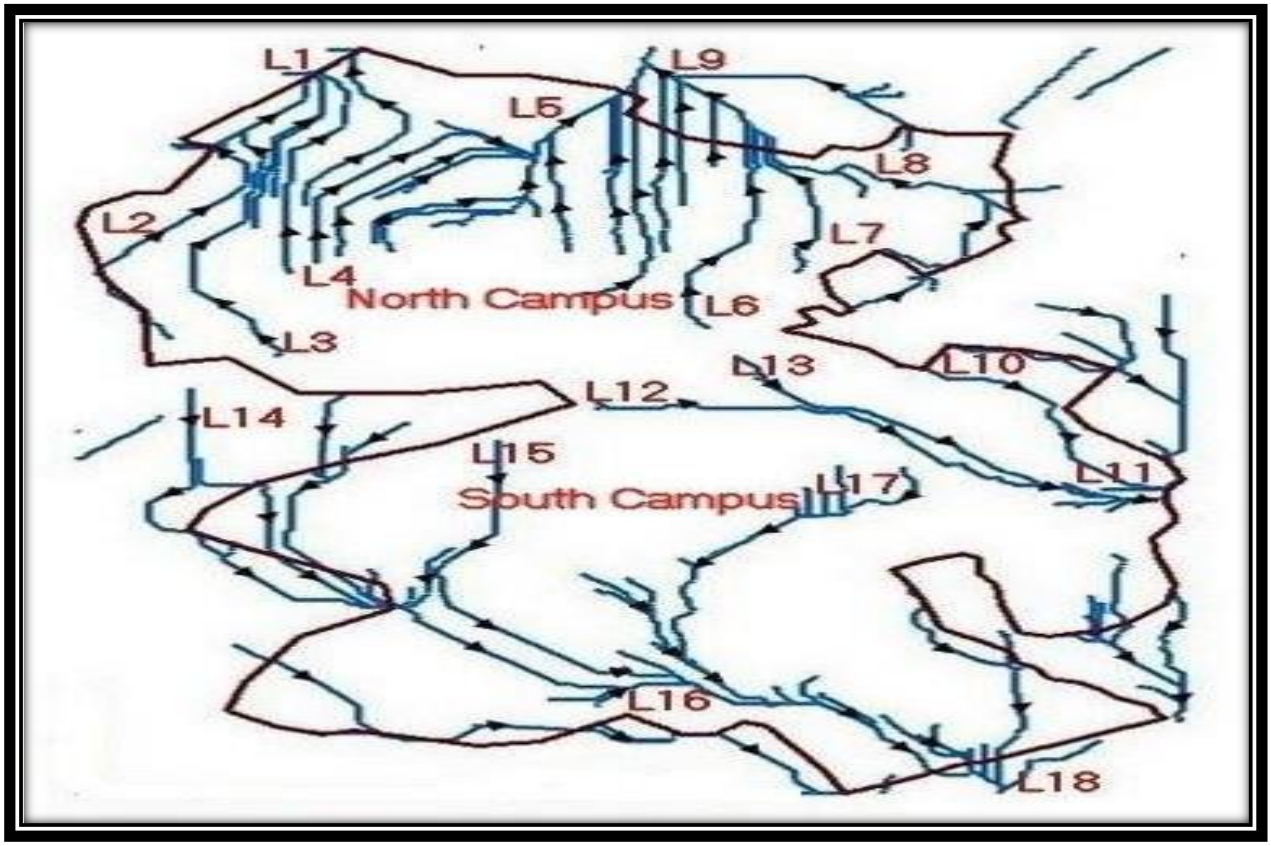


Figure6: Ground water Flow Path ways in the Andhra University, Visakhapatnam

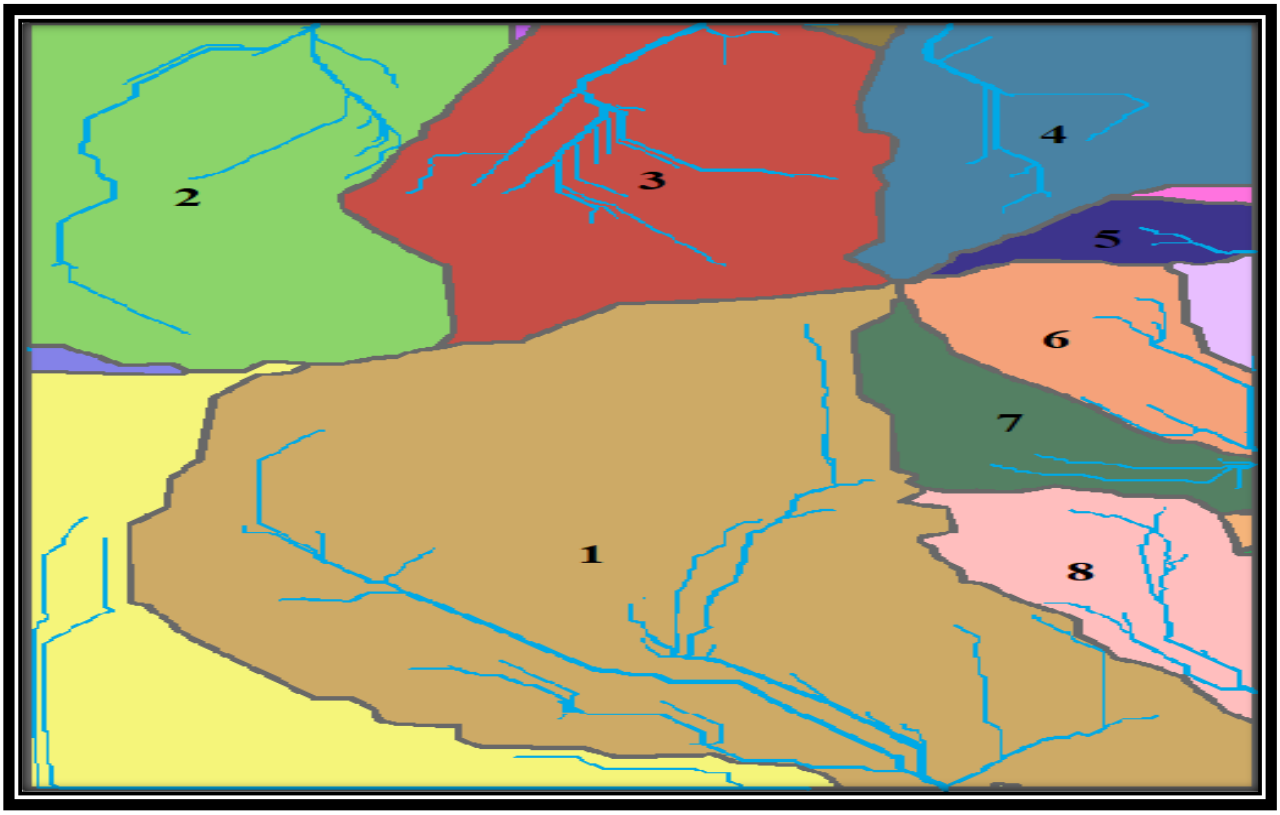


Figure7: Delineation of Micro Water sheds in the University Campus

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.

Table3: Topographic Characteristics of the Micro-Watersheds

Microwatershed	***Area(km^2)***	***Minimumelevation(mMSL)***	***Maximumelevation (mMSL)***
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

Table4: Major buildings/areas in Micro-watershed of the Andhra University, Visakhapatnam

WatershedNo.	**Buildings/Areascovered**	**Watershed No.**	**Buildings/ Areascovered**
1	Centraladministrativeoffice	2	MaddilapalemGate
	Avula Sambasiva Rao women'shostel		N.C.C.Building
	SouthCampusPost office		N.C.C.Oppositeground
	Commerce ad Maagementdepartment		Y.V.S.Murthyauditorium
	Sir CRReddyconvocationhall		MarineDepartment
	Nagarjunahostel		ECEDepartment
	Officer'scolony		CSEDepartment
	HPCLwaltairpark		CSEnew classrooms
	Residentquarters		EEEDepartment
	A.U.Yogavillage		EngineeringExamscell
	DepartmentofMarineLiving Resources		MechaicalDepartment
	A.U.Highschool		CivilDepartment
3	P.G.Girlshostel	4	A.USamatha hostel
	A.U.Engineeringboyshostel		A.UInternationalstudenthostel
	A.U.Engineeringgirlshostel		A.UMamatha lawhostel
	A.U.Engineeringcollegeground		
5	VidyaResearchScholarshostel	6	Siddardhahostel
			Sathavahaahostel
			Sri Krishna Devarayahostel
			AUHealthcentre
7	G.M.C. Balayogi Researchscholarshostels	8	A.U.PlatinumJubileeGuestHouse
	A.U.SouthCampusGround		School of DistaceEducation
	Dept.ofPhysicalSciences		APCETOffice
	Dept.offinearts		AUInternationalStudentHostel (SouthCampus)
	T.L.N.Sabha Hall		
	Dept.ofPhysical education		

Table5: Stream Orderad Number of Streams in the Study Area in each of the Watersheds

Water Shed No.	1 Orderstreams	2 Orderstreams	3 Orderstream	4 Orderstreams	TotalStreams
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 2020-21				
Month/Year	**048 Saving (South Campus)**	**265 Saving (North Campus)**	**601 Saving (School of Distance Education)**	**TOTAL SAVING**
Mar-20	726273.6	206505.8	96565.6604	1029344.982
Apr-20	638588.4	259792	90265.534	988645.9567
May-20	996241.6	212097.4	64387.024	1272726.019
Jun-20	521499.7	112603.7	41632.914	675736.266
Jul-20	545900.1	41244.67	118889.929	706034.706
Aug-20	487676.4	104350.5	46757.61	638784.558
Sep-20	603724.3	27081.92	67822.389	698628.6408
Oct-20	603385.7	133144.5	65886.27	802416.52
Nov-20	634385.1	145095.2	67615.643	847095.919
Dec-20	787218.3	167445.1	83968.4	1038631.804
Jan-21	665941.3	151676	62467.193	880084.509
Feb-21	671626.9	148522.1	66771.668	886920.673
Total				**Rs. 1,04,65,050.55**

Solar units Generated and utlised by AU for year 2020-21				
Month & Year	048 KWH	265 KWH	601 KWH	TOTAL KWH
Mar-20	113227.1	38176.01	17820.04	169223.15
Apr-20	114330.5	52342.58	14068.4	180741.47
May-20	157233	32481.31	13042.4	202756.67
Jun-20	94045.2	27165	9821.4	131031.6
Jul-20	89175.9	8396.8	27362.9	124935.6
Aug-20	84803.5	21686.3	8316	114805.8
Sep-20	87735	49284	10184.9	147203.9
Oct-20	107987	31593	11127	150707
Nov-20	101277.9	31089.7	10234.3	142601.9
Dec-20	125094.4	38136	12685	175915.4
Jan-21	101277.9	31078.7	10234.3	142590.9
Feb-21	112236.3	34634.2	11471.8	158342.3
Total	1288424	396063.6	156368.44	1840855.69

Energy Consumption Details

2020													
		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	JA	22,88,481	16,26,059	6,62,422	12,36,241	10,56,914	1,79,327	2,99,989	2,28,102	71,887	38,24,711	29,11,075	9,13,636
2	FEB	26,81,245	20,80,617	6,00,628	16,85,988	15,50,909	1,35,079	3,37,826	2,71,590	66,236	47,05,059	39,03,116	8,01,943
3	MAR	24,65,906	17,39,632	7,26,274	15,30,303	13,23,797	2,06,506	3,65,175	2,68,610	96,566	43,61,384	33,32,039	10,29,346
4	APR	17,68,818	11,30,229	6,38,589	9,09,135	6,49,343	2,59,792	3,19,087	2,28,821	90,266	29,97,040	20,08,393	9,88,647
5	MAY	21,78,655	11,82,413	9,96,242	8,04,817	5,92,720	2,12,097	3,68,552	3,04,165	64,387	33,52,024	20,79,298	12,72,727
6	JUN	19,22,749	14,01,249	5,21,500	10,61,381	9,48,777	1,12,604	3,84,525	3,42,892	41,633	33,68,655	26,92,918	6,75,737
7	JUL	19,72,640	14,26,740	5,45,900	9,76,380	9,35,135	41,245	4,60,310	3,41,420	1,18,890	34,09,330	27,03,295	7,06,035
8	AUG	18,74,977	13,87,300	4,87,677	8,48,262	7,43,911	1,04,351	2,67,882	2,21,125	46,758	29,91,121	23,52,336	6,38,785
9	SEP	20,39,925	19,40,178	99,747	6,62,768	6,35,686	27,082	2,74,109	2,06,286	67,822	29,76,802	27,82,150	1,94,651
10	OCT	21,83,238	14,74,164	7,09,074	11,71,219	10,38,075	1,33,144	2,80,666	2,14,779	65,886	36,35,123	27,27,018	9,08,104
11	NOV	11,92,776	11,48,878	43,898	5,41,836	6,09,411	(67,575)	1,73,293	2,02,204	(28,911)	19,07,905	19,60,493	(52,588)
12	DEC	21,52,013	13,64,795	7,87,218	10,81,997	9,14,552	1,67,445	2,79,755	1,95,787	83,968	35,13,765	24,75,134	10,38,631
TOTAL		**2,47,21,423**	**1,79,02,254**	**68,19,169**	**1,25,10,327**	**1,09,99,230**	**15,11,096**	**38,11,168**	**30,25,780**	**7,85,388**	**4,10,42,918**	**3,19,27,265**	**91,15,653**
AVERAGE		**20,60,119**	**14,91,855**	**5,68,264**	**10,42,527**	**9,16,603**	**1,25,925**	**3,17,597**	**2,52,148**	**65,449**	**34,20,243**	**26,60,605**	**7,59,638**