



RAIN WATER HARVESTING REPORT

(April 2022 To March 2023)

FOR

KRISHNA VISHWA VIDYAPEETH

(DEEMED TO BE UNIVERSITY), KARAD

(Formerly known as KRISHNA INSTITUTE OF MEDICAL SCIENCES, "DEEMED TO BE UNIVERSITY", KARAD)



SUBMITTED TO

Krishna Vishwa Vidyapeeth
(Deemed to be University)
Karad

PREPARED BY

EASE Technology, Kolhapur

DATE

18th April, 2023



सं. IG29-93229
No.

अनुसंधान 146094962
Enrollment No.

इन्दिरा गांधी राष्ट्रीय मुक्त विश्वविद्यालय
INDIRA GANDHI NATIONAL OPEN UNIVERSITY

प्रमाणित किया जाता है कि *Murkute Pragatya Prakash*
This is to certify that

को निर्धारित पाठ्यक्रमों को पूरा करने और
after having passed the prescribed courses of study in the

June 2015

की परीक्षा उत्तीर्ण करने पर
examination is hereby awarded

Certificate in Water Harvesting and Management

प्रदान किया जाता है।

नई दिल्ली / New Delhi
दिनांक / Dated August 7, 2015


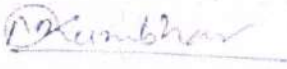
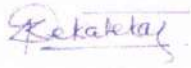


[Signature]
पुनराधिक
Registrar





Rain Water Harvesting Completion Certificate

Name of the Institute	Krishna Vishwa Vidyapeeth "Deemed to Be University", Karad, Satara - 415539 (Formerly known as Krishna Institute of Medical Sciences "Deemed to Be University", Karad)
Details of facility Audited	Campus of the Krishna Vishwa Vidyapeeth including all the Faculties, Hostels, Hospital, Lab and all Allied Utilities.
Report prepared by	Ms. Pragatee P. Murkute Mr. Milind M. Kumbhar Mr. Dhiraj A. Kekalekar
Company	EASE Technology C-1, 250/B2, E Ward, Panchratna Apartment, Nagala Park, Kolhapur, MH - 416003
<p> Ms. Pragatee Murkute</p> <p> Mr. Milind Kumbhar</p> <p> Mr. Dhiraj Kekalekar</p>	


REGISTRAR
Krishna Vishwa Vidyapeeth
(Deemed to be University),
Karad





Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023 Year :

CONTENTS

CHAPTER - 1 INTRODUCTION.....	5
CHAPTER - 2 PROJECT SUMMARY.....	11
CHAPTER - 3 METHODS OF RAIN WATER HARVESTING	16
CHAPTER - 4 RECHARGING SUBSURFACE AQUIFERS	25
CHAPTER - 5 KVV(DU) - CASE STUDY.....	29
CHAPTER - 6 WATER QUALITY.....	38
CHAPTER - 7 OPERATION AND MAINTENANCE OF RWH.....	40
CHAPTER - 8 RECOMMENDATIONS FOR EXISTING RWH.....	45



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

CHAPTER - 1 INTRODUCTION

1.1 INTRODUCTION – KVV(DU)

Krishna Vishwa Vidyapeeth (Deemed to Be University) (Formerly known as Krishna Institute of Medical Sciences “Deemed To Be University” Karad. (Herein referred as KVV(DU)) is located at Karad, Maharashtra. KVV(DU) is accredited by NAAC 'A+' grade and has been conferred with ISO 9001:2015 certification. The constituent faculties of the University include Medical, Dental, Nursing, Physiotherapy, Pharmacy and Allied Sciences offering undergraduate and postgraduate courses in the respective faculties. It also runs Ph.D. programs and Post-Doctoral Fellowships in various subjects.

The medical college is about 35 years old and is recognized by the National Medical Commission of India, Medical Council of Malaysia and is listed in the WHO's World Directory of Medical Schools. Medical Council of India recognizes MBBS and postgraduate degree/ diploma courses in clinical and basic sciences.

It has state-of-the-art museums with large collection of specimens and models. National Accreditation Board has accredited the KVV(DU) diagnostic laboratory for Testing and Calibration Laboratories (NABL). It's been conferred with ISO 9001:2015 and ISO 14001:2015 certification. The Lead Referral Laboratory is the first of its kind in Maharashtra state. The well-equipped NABL accredited Department of Molecular Biology and Genetics is a feather in the cap.

National Accreditation Board recognizes the teaching hospital KH&MRC (Krishna Hospital and Medical Research Centre) for Hospitals & Healthcare Providers (NABH).

The teaching hospital is 1125 bedded multispecialty tertiary care hospital with facilities for Critical Care, Endoscopic Surgeries, Dialysis, Cardiology, Cardio-vascular-thoracic-surgery, Oncology, Urology, Neurosurgery, Plastic surgery, Oral and Maxillofacial Surgery and a recognized Renal Transplant Unit. It has fully equipped major operation theaters, minor theaters, labour rooms, blood bank accredited by NABH, radio diagnosis and radiotherapy, computerized medical records, counseling services etc. There are separate intensive care units like Medical,

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Surgical, Coronary care, Pediatric, Neonatal (accredited by Neonatology Forum of India), Respiratory and Obstetrics. Neonatology Forum of India recognizes the neonatal ICU. The Radio-Diagnosis Department has facilities for MRI, Color Doppler, Mammography, DSA etc. It also actively participates in national healthcare programs and various extensions and outreach community programs initiated by the institute.

The University has been ranked 5th amongst the cleanest higher Educational Institutions in the category of 'Technical Institutions - Universities (Residential)' in the year 2018. The University has also received certificate for 'Maintaining, Promoting and Encouraging the Culture of Swachhta in Higher Education Institutions in the country'.

The institute has also received recognitions as below:

1. Commendation Award (Green Institutional Mentor Award) – Letter dated 08.03.2020
2. Krishna Hospital and Medical Research Centre was ranked 1st as a Clean Hospital in “Swachh Sarvekshan 2020 & Swachh Sarvekshan 2021” among the Hospitals in Malkapur Nagarparishad, Tal. Karad, Dist. Satara.
3. Recognized Social Entrepreneurship, Swachhata & Rural Engagement Cell - Certificate dated 30th August 2020.
4. KVV(DU) is recognized as District Green Champion for Satara district for the academic year 2021-22 awarded by Mahatma Gandhi National Council of Rural Education, Ministry of Education, Govt. of India.
5. KVV(DU) is an Annual member of Indian Green Building Council (IGBC).
6. KVV(DU)'s Swachhta team has completed the activity-based program “Showcase! The Success of Sustainability” The program is organized by Mahatma Gandhi National Council of Rural Education, Hyderabad.
7. Krishna Vishwa Vidyapeeth (Deemed to be University), Karad has awarded by International Green University Award 2022 in Green School Conference 2022 held at SUNY Maritime College, New York on 24th September, 2022.
8. Krishna Vishwa Vidyapeeth (Deemed to be University), Karad has received Gold Rating in IGBC Green Building Standard as per Green Campus Rating System from Indian Green Building Council for 5 Years from the Date of Certification on 07th October, 2022.



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

1.2 INTRODUCTION – RWH

Water is the most common or major substance on earth, covering more than 70% of the planet's surface. All living things consist mostly of water. For example, the human body is about 2/3rd water. Worldwide allocation, of water is given in following table.

Table 1.1 Worldwide Distribution of Water

Sr. No.	Water Type	Volume (1000 Km ³)	% of Total Global volume
1	Ocean	1,370,323	94.200
2	Ground water (fresh & saline)	60,000	4.100
3	Glaciers	24,000	1.650
4	Lakes and reservoirs	280	0.019
5	Soil moisture	85	0.006
6	Atmospheric water	14	0.001
7	River water	1.2	0.001
	Total	1,454,703.2	100.000

Only 2 percent of the total volume of water (over 28,000,000 Km³) is fresh water, which can be used for consumption and for agriculture as given in table 1.2.

Table 1.2 Worldwide Distribution of Fresh Water

Sr. No.	Water Type	Volume (1000 Km ³)	% of Total Global volume
1	Glaciers	24,000	85.000
2	Ground water	4,000	14.000
3	Lakes and reservoirs	155	0.600
4	Soil moisture	83	0.300
5	Atmospheric water	14	0.050
6	River water	1.2	0.004
	Total	28,253.2	100.000

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

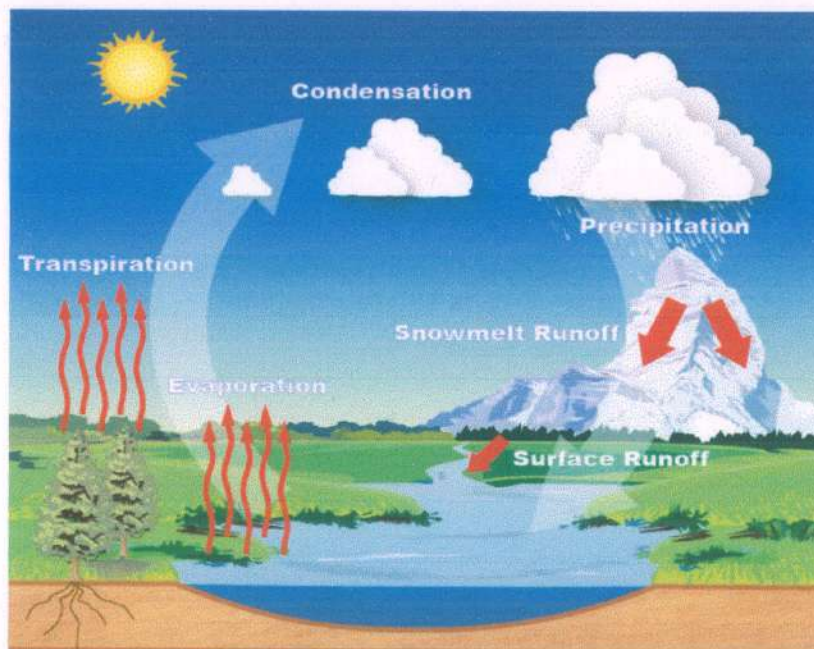
Year :

The average runoff in the river system of India has been assessed as 1869 km^3 . The quantum that can be utilized of this traditional storage and diversion is about 690 km^3 . In addition, there is significant rechargeable ground water potential in the country estimated at about 432 km^3 . For improving proportionately water availability in the country, revamping of ground water resources is a necessity which can be done very effectively through rain water harvesting. The harvested rain water can also be used directly for various purposes, which will ameliorate per capita water availability substantially.

1.2.1 Hydrological cycle

The limitless exchange of water from the atmosphere to the oceans and back is known as the hydrological cycle (Fig. 1.1). This cycle is the source of all forms of precipitation (hail, rain, sleet, and snow), and thus of all the water. Precipitation stored in streams, lakes and soil evaporates while water stored in plants takes place to form clouds which store the water in the atmosphere.

Fig. 1.1 Hydrological Cycle



[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Currently, about 75% to 80% of conventional water supply is from lakes, rivers and wells. Making the most efficient use of these limited and precious resources is necessary. Otherwise, scarcity of water will be faced by our future generations. This includes using appliances and plumbing fixtures that sustain water, not wasting water, and taking advantage of alternative water sources such as grey water reuse and rain water harvesting.

The National Water Policy – 2012 focuses on the demand for publishing water accounts and water audit reports indicating leakages and pilferages. The policy endorse systems to emerge benchmarks for water uses for different functions, i.e., water footprints, and water auditing to ensure efficient use of water.

National Water Mission (NWM) has been constituted by the Government of India with the objective of “preserval of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources development and management”.

The Government of India has also launched a centrally fostered scheme for Repair, Renovation and Restoration (RRR) of water bodies, which has numerous objectives like comprehensive improvement and restoration of water bodies thereby increasing tank storage capacity, enhanced water use efficiency and increased availability of drinking water.

1.2.2 Advantages of Rain Water

The rain water’s environmental leverage and purity over other water options makes it the first choice, even though the precipitation cycle may fluctuate from year to year.

Environmental advantage

Collecting the drizzle that falls on a building and used for various functions is a simple concept. Since the rain you harvest is independent of any centralized system, you are promoting self-sufficiency and helping to cultivate an appreciation for this vital and precious resource. The collection of rain water not only leads to conservation of water but also energy since the energy input required to operate an cohesive water system designed to treat and pump water over a vast service area is bypassed.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Rain water harvesting also lessens local attrition and flooding caused by runoff from impenetrable cover such as pavement and roofs, as some rain is as a substitute captured and stored. Thus, the storm water run-off, the normal consequence of rain fall, which picks up contaminants and disgrace our water ways, becomes captured rainfall which can then fulfill a number of productive uses.

Policymakers would have to reconsider present assumptions regarding impervious cover and consequent run-off management strategies when rain water harvesting systems are installed.

Qualitative advantage

An appealing convenience of rain water over other water sources is that it is one of the purest forms of water available. In fact, the quality of rain water is an overriding incentive for people to choose rain water as their primary water source, or for specific uses such as watering houseplants and gardens. Rain water quality almost always exceeds that of ground or surface water as it does not come into contact with soil and rocks where it dissolves salts and minerals. Rain water has not exposed too many of the pollutants that are often discharged into surface water such as rivers, lakes and which can pollute groundwater. However, rain water quality can be influenced by characteristics of area where it falls, since localized industrial emissions affect its purity. Thus, rain water falling in non-industrialized areas can be superior to that in cities dominated by heavy industry or in agricultural regions where crop dusting is prevalent.

Rain water is soft and can significantly reduce the quantity of detergents and soaps needed for cleaning, as compared to typical municipal water. In addition, soap scum and hardness deposits disappear and the need for a water softener, often an expensive requirement for well water systems, is eliminated. Water heaters and pipes will be free of deposits caused by hard water and will last longer. Rain water's purity also makes it an attractive water source for certain industries for which pure water is a requirement. Thus, industries such as computer microchip manufacturing and photographic processing would certainly benefit from this source of water.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

CHAPTER - 2 PROJECT SUMMARY

Particulars	Details
Name of Institute	Krishna Vishwa Vidyapeeth ("Deemed to be University") Karad, (KVV(DU), Karad)
Address	Near Dhebewadi phata, NH4, Pune - Bangalore Highway, Agashivnagar, Malkapur Karad, Maharashtra
Latitude	17°26'09.34"N,
Longitude	74°17'63.25"E
Nearest City	Karad: 3 Km (NE)
Nearest River /Water Body	Krishna River: 1.89 Km
Nearest Highway	NH 4: 0.2 Km
Nearest Railway Station	Karad - 8 Km
Nearest Air Port	Pune international Airport - 170 Km
Water Resources	1. Malkapur Nagar parishad (M.N.P.) 2. Irrigation (Koyna river water) 3. Ground Water (Bore Well-for Emergency condition)
Water Permission	753.4 m3/day from Koyna river
Average Water Consumption per day by Institute	500 m3/day
Waste Water going to STP	410 m3/day
Total Water Recycle/Reuse	350 m3/day
Average annual rainfall	632 mm
Total rooftop and surface area	20930 Sq. Ft.
Proposed rooftop and surface area	1000 Sq. Ft.
Water Storage Tank	19 lacs lit (Tanks with different capacities in various buildings of the campus)

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

2.1 Brief About Rain Water Harvesting

2.1.1 Need for Rain Water Harvesting

For our water requirement we entirely depend upon rivers, lakes and ground water. However, rain is the eventual source that feeds all these sources. Rain water harvesting means to make most appropriate use of rain water at the place where it falls i.e., conserve it and don't allow it to drain away and cause flood elsewhere.

Water is most essential for existence of living beings. Surface water and ground water are two major sources of water. Due to ever growing population and higher usage levels of water in urban areas, water supply agencies are unable to cope up demand from surface sources like dams, reservoirs, rivers etc. This has led to digging of individual tube wells by home owners. Restoration of ground water is drastically reduced due to paving of open areas. Ungoverned manipulation of ground water results in lowering of water table turning many bore-wells dry. This further lowers the water table and, in some areas, this leads to higher concentration of hazardous chemicals such as fluorides, nitrates and arsenic. In coastal areas like Chennai, over exploitation of ground water resulted in seawater intrusion converting ground water bodies saline. In rural areas also, government policies on subsidized power supply for agricultural pumps and piped water supply through bore wells are resulting into decline in ground water table. The solution to all these problems is to replenish ground water bodies with rain water by man-made means.

2.1.2 Advantages of Rain Water Harvesting

- (a) Promotes adequacy of underground water
- (b) Mitigates the effect of drought
- (c) Reduces soil attrition as surface run-off is reduced
- (d) Decreases load on storm water management system
- (e) Reduces flood hazards
- (f) Improves ground water quality / decreases salinity (by dilution)
- (g) Prevents ingress of sea water in subsurface aquifers in coastal areas.
- (h) Improves ground water table, thus saving energy (to lift water)

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023 Year :

- (i) The cost of recharging subsurface aquifer is lower than surface reservoirs
- (j) The subsurface aquifer also serves as storage and allocation system
- (k) No land is wasted for storage purpose and no population displacement is involved
- (l) Storing water underground is environment friendly

2.1.3 Disadvantages of Rain Water Harvesting

- (a) Supplies can be contaminated by bird/animal droppings on catchment surfaces and guttering structures unless they are cleaned/flushed before use.
- (b) Poorly constructed water jars/containers can suffer from algal growth and invasion by insects, lizards and rodents. They can act as a breeding ground for disease vectors if they are not properly maintained.

2.2 Rain Water Harvesting potential

The total amount of water received in the form of rainfall over an area is called the rain water bequest of that area. Out of this, the amount that can be effectively harvested is called rain water harvesting potential.

Area of catchment X Amount of Rainfall = Rain Water Endowment

All the water which is falling over an area cannot be purposely harvested, due to various losses on account of evaporation, spillage etc. Because of these factors the quantity of rain water which can advantageously be harvested is every time less than the rain water subsidizing. The collection efficiency is mainly peripheral on factors like runoff coefficient and first flush wastage etc.

Runoff is the term applied to the water that flows away from catchments after falling on its surface in the form of rain. Runoff from a particular area is dependent on various factors i.e., rainfall pattern and quantity, catchment area characteristics etc. For determining rainfall quantity, the rainfall data preferably for a period of at least 10 years is required. This data can be collected from meteorological department. For determining the pattern of rainfall, the information may be collected either from meteorological department or locally. The pattern of rainfall in a unique catchment area influences the design of rain water harvesting system.



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023 Year :

In areas where rainfall is more but limited to very short period in a year, big storage tanks would be required to store rain water, if we are collecting rain water in storage tanks for direct use. In such areas, it is preferable to use rain water for recharging of ground water aquifers, if feasible, to decrease the cost of rain water harvesting system.

Runoff depends upon the area and type of catchment over which it falls as well as surface features. Runoff can be generated from both paved and unpaved catchment areas. Paved surfaces have a greater capacity of retaining water on the surface and runoff from unpaved surface is less in collation to paved surface. In all calculations for runoff approximation, runoff coefficient is used to account for losses due to spillage, leakage, infiltrations catchment surface wetting and evaporation, which will eventually result into reduced runoff. Runoff coefficient for any catchment is the ratios of the volume of water that runoff a surface to the total volume of rainfall on the surface. The runoff coefficient for various surfaces is given in table 2.1.

Table 2.1 Runoff Coefficient for Various Surfaces

Sr. No.	Type of Catchment	Coefficients
	Roof catchments	
1	Tiles	0.8-0.9
2	Corrugated Metal Sheets	0.7-0.9
	Ground Surface Coverings	
3	Concrete	0.6-0.8
4	Brick Pavement	0.5-0.6
	Untreated Ground Catchments	
5	Soil on Slopes Less than 10%	0.0-0.3
6	Rocky Natural Catchments	0.2-0.5

Source: Pacey, Arnold and Cullis, Adrian 1989, Rain water Harvesting: The collection of rainfall and runoff in rural areas, Intermediate Technology Publications, London p 55.

Handwritten signature

Handwritten signature

Handwritten signature



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023 Year :

Based on the above factors, the water harvesting potential of site could be estimated using the following equation:

Rain Water harvesting potential = Amount of Rainfall x Area of catchment x Runoff coefficient

The calculation for runoff can be illustrated using the following example:

Suppose a building with flat terrace area (A) of 100 sqm. in KVV(DU). The average annual rainfall (R) in Karad is approximately 632 mm. (Ref - Gov. of Satara (Karad) District Average rainfall year -2002 to 2018 & Abhijit M, Zende, R. Nagarajan and K. R. Atal 2012: Rainfall Trend in Semi-arid region –Yerala River Basin, Western Maharashtra, India, International Journal of Advancement in Technology, Vol. 3, No. 3, pp: 137-145).

The runoff coefficient (C) for a flat terrace may be considered as 0.8.

$$\begin{aligned}\text{Annual water harvesting potential from } 100 \text{ m}^2 \text{ roof} &= A \times R \times C \\ &= 100 \times 0.632 \times 0.8 \\ &= 50.56 \text{ cum i.e. } 50,560 \text{ liters.}\end{aligned}$$

Handwritten signature

Handwritten signature

Handwritten signature



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023 Year :

CHAPTER - 3 METHODS OF RAIN WATER HARVESTING

3.1 Ways of Harvesting Rain Water

- Surface Runoff Harvesting
- It is a method in which rainwater flowing as surface runoff is caught and used for recharging aquifers by adopting appropriate methods.
- Roof Top Rain Water Harvesting
- In rooftop harvesting, the roof becomes the catchment, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system.
- Techniques of Rain Water Harvesting (RWH)

a) Storing rain water for direct use

In place where the precipitation occurs throughout the year, rain water can be stored in tanks (Fig. 3.1). However, at places where rainfall continues for 3 to 4 months, huge volume of storage tanks needs to be provided. In such places, it will be more appropriate to use rain water to recharge ground water aquifers rather than to store. If the stratum is nonporous, then storing rain water in storage tanks for direct use is a better method.

Fig. 3.1 Storing rain water for direct use





Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023 Year :

Similarly, if the ground water is saline/unfit for human consumption or ground water table is very deep, this method of rain water harvesting is preferable.

b) Recharging ground water aquifers, from Roof top runoff.

Rain water that is collected from roof top of the building may be diverted by drain pipes to a filtration tank (for bore well, through settlement tank) from which it flows into the recharge well, as shown in Fig.3.2. The recharge well should preferably be shallower than the water table. This method of rain water harvesting is preferable in the areas where the rainfall occurs only for a short period in a year and water table is at a shallow depth.

Fig. 3.2 Recharging Ground water from Roof top runoff



c) Recharging ground water aquifers with runoff from ground area.

The rain water that is collected from the open areas may be diverted by drain pipes to a recharge dug well / bore well through filter tanks as shown in Fig.3.3. The abandoned bore well/dug well can be used cost effectively for this purpose.

H. B.

R. B.

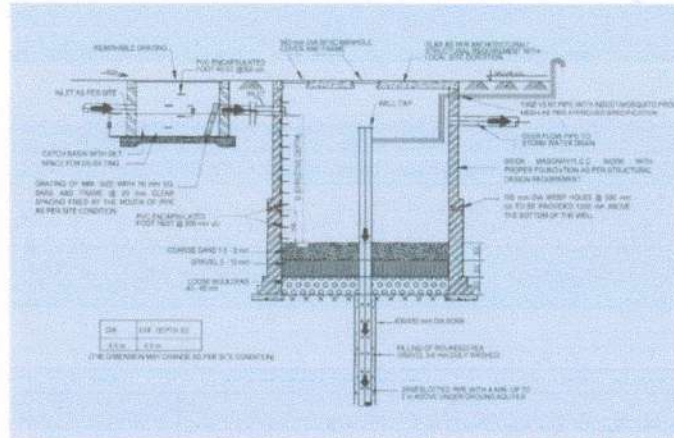
K. K.



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

Fig. 3.3 Recharging Ground water with runoff from Ground areas



3.2 Components of Rain Water Harvesting

The rain water harvesting system consists of following basic components –

a) Catchment area

The catchment area is the surface on which the drizzle falls. This may be a roof top or open area around the building. The quality of water collected from roof top is comparatively much better than collection from the ground. Rain water harvested from catchment surfaces along the ground should be used for lawn watering, flushing etc., because of increased risk of contamination. This water can also be used for recharging ground aquifers after proper filtration.

The rain water yield varies with the size and texture of the catchment area. A smooth, cleaner and more improvised roofing material contributes to better water quality and greater quantity with higher value of runoff coefficient. (Refer table 2.1 for runoff coefficient)

When roof of the building is used as the catchment for collecting the rain water, the type of roof and the construction material affect the runoff coefficient and quality of collected water. Roofs made of RCC, GI sheets, corrugated sheets; tiles etc. are preferable for roof top collection. But thatched roofs are not preferred as these add colour and dissolved impurities to water.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



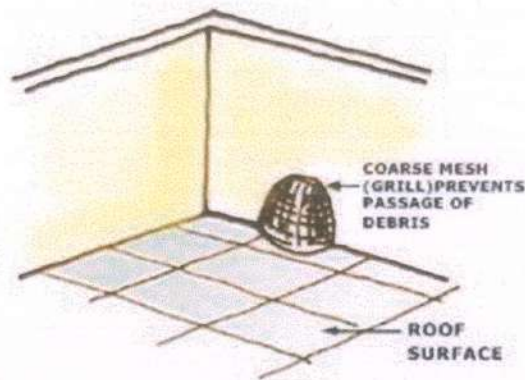
Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023 Year :

Water to be used for drinking purpose should not be collected from roof with damaged AC sheets or from roofs covered with asphalt and lead flashing or lead based paints as the lead contamination may occur in the collected water.

b) Coarse mesh / leaf screen

To prevent the entry of leaves and other debris in the system, the coarse mesh should be provided at the mouth of inflow pipe for flat roofs as shown in Fig. 3.4.

Fig. 3.4. Coarse Mesh



For slope in roofs where gutters are provided to collect and divert the rain water to downspout or ducts, the gutters should have a continuous leaf screen, made of ¼ inch wire mesh in a metal frame, installed along their entire length, and a screenor wire basket at the head of the downspout.

Fig. 3.5. Leaf Screen



[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023 Year :

c) Gutter

Gutter is required to be used for collecting water from sloping roof and to divert it to downspout. These are the channels all around the edge of a sloping roof to collect and transport rain water to the storage tank. Gutters can be of semi-circular, rectangular or trapezoidal shape. Gutters must be properly sized, sloped and installed in order to maximize the quantity of harvested rain. Gutter can be made using any of the following materials:

- a) Galvanized iron sheet
- b) Aluminum sheet
- c) Semi-circular gutters of PVC material which can be readily prepared by cutting these pipes into two equal semi-circular channels
- d) Bamboo or betel trunks cut vertically in half (for low cost housing projects)

The size of the gutter should be according to the flow during the highest intensity rain. The capacity of the gutters should be 10 to 15% higher. The gutters should be supported properly so that they do not sag or fall off when loaded with water. The connection of gutters and down spouts should be done very carefully to avoid any leakage of water and to maximize the yield. For jointing of gutters, the lead based materials should not be used, as it will affect the quality of water.

d) Down spout or Ducts

The rain water collected on the roof top is transported down to storage facility through down spouts / ducts. ducts can be of any material like PVC, GI or cast iron. The ducts should be free of lead and any other treatment which could contaminate the water. Table 2.1 gives an idea about the diameter of pipe required for draining out rain water based on rainfall intensity and roof area.

e) First flushing device

Roof washing or the collection and disposal of the first flush of water from a roof, is very important if the collected rain water is to be used directly for human consumption. All the debris, dirt and other contaminants especially bird dropping etc. accumulated on the roof during dry season are washed by the first rain and if this water will enter into storage tank or recharge system it will contaminate the water.



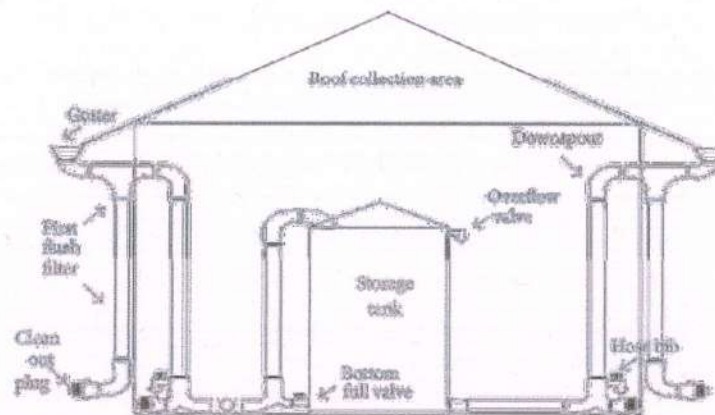
Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

Therefore, to avoid this contamination a first flush system is incorporated in the roof top rain water harvesting system. The first flushing device, dispose off the first spell of rain water so that it does not enter the system.

If the roof is of sloping type, then the simplest system consists of a pipe and a gutter down spout located ahead of the down spout from the gutter to the storage tank. (Fig. 3.6)

Fig. 3.6 Image of First flushing device



The pipe is usually 6 or 8 inch PVC pipe which has a valve and cleanout at the bottom, most of these devices extend from the gutter to the ground where they are supported. The gutter down spout and top of the pipe are fitted and sealed so that water will not flow out of the top. Once the pipe has filled, the rest of the water flows to the downspout connected to storage tank.

The alternate scheme for sloping roof involves a very simple device which is required to be operated manually. In down take pipe at the bottom one plug/ valve is provided. When the rainy season start, this plug should be removed, and initial collection of roof top water should be allowed to drain. After 15 – 20 minutes, plug / valve should be closed so that collected rain water can be diverted to storage tank.

Handwritten signature

Handwritten signature

Handwritten signature



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

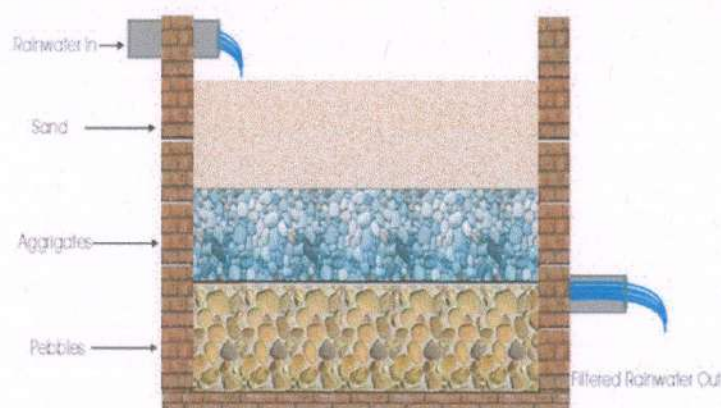
f) Filter

If the collected water from roof top is to be used for human consumption directly, a filter unit is required to be installed in RWH system before storage tank. The filter is used to remove suspended pollutants from rain water collected over roof. The filter unit is basically a chamber filled with filtering media such as fiber, coarse sand and gravel layers to remove debris and dirt from water before it enters the storage tank. The filter unit should be placed after first flush device but before storage tank. There are various type of filters which have been developed all over the country. The type and selection of filters is governed by the final use of harvested rain water and economy. Depending upon the filtering media used and its arrangements, various types of filters available are described below.

Sand filter

In the sand filters, the main filtering media is commonly available sand sandwiched between two layers of gravels. The filter can be constructed in a galvanized iron or Ferro cement tank. This is a simple type of filter which is easy to construct and maintain. The sand fillers are very effective in removing turbidity, colour and microorganism. In a simple sand filter that can be constructed domestically, filter media are placed as shown in Fig. 3.7.

Fig. 3.7 - Sand Filter



[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



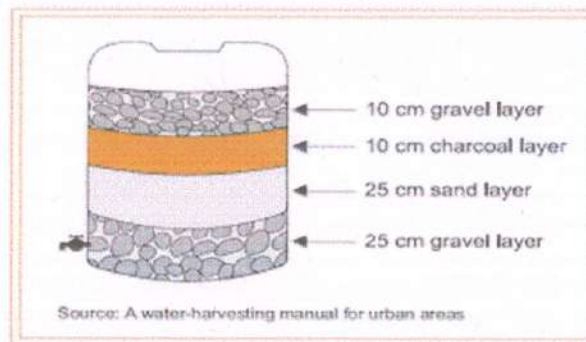
Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

Charcoal filter

This is almost similar to sand filter except that a 10-15 cm thick charcoal layer placed above the sand layer. Charcoal layer inside the filter results into better filtration and purification of water. The commonly used charcoal water filter is shown in Fig. 3.8.

Fig. 3.8 Charcoal Filter



There are several other types of filters available for rain water filtration in the market.

g) Storage tank

Whenever the rain water collected from roof top is used directly for various purposes, storage tank is required. The storage tank can be cylindrical, rectangular or square in shape. The material of construction can be RCC, Ferro-cement, masonry, PVC or metal sheets. Depending upon the availability of space, the storage tank can be above ground, partially underground or fully underground.

The design of storage tank is dependent on many factors which are listed below:

- Number of persons in the household – The greater the number of persons, more will be requirement of water.
- Per capita requirement – varies from household to household, based on standard of living. The requirement also varies with season. In summer the requirement is more in comparison to winter. Similarly, the per capita requirement is more in urban areas in comparison to rural areas.
- Average annual rainfall

Handwritten signature

Handwritten signature

Handwritten signature



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023 Year :

- d) Rainfall pattern – It has a significant impact on capacity of storage tank. If the rainfall is uniformly spread throughout the year, the requirement of storage capacity will be less. But if the rainfall is concentrated to a limited period in a year, the storage tanks of higher capacity will be required.
- e) Type and size of catchment – Depending upon the type of roofing material, the runoff coefficient varies which affect the effective yield from a catchment area. The size of the catchment also has a bearing on tank size. The more the catchment area, larger the size of storage tank.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



CHAPTER - 4 RECHARGING SUBSURFACE AQUIFERS

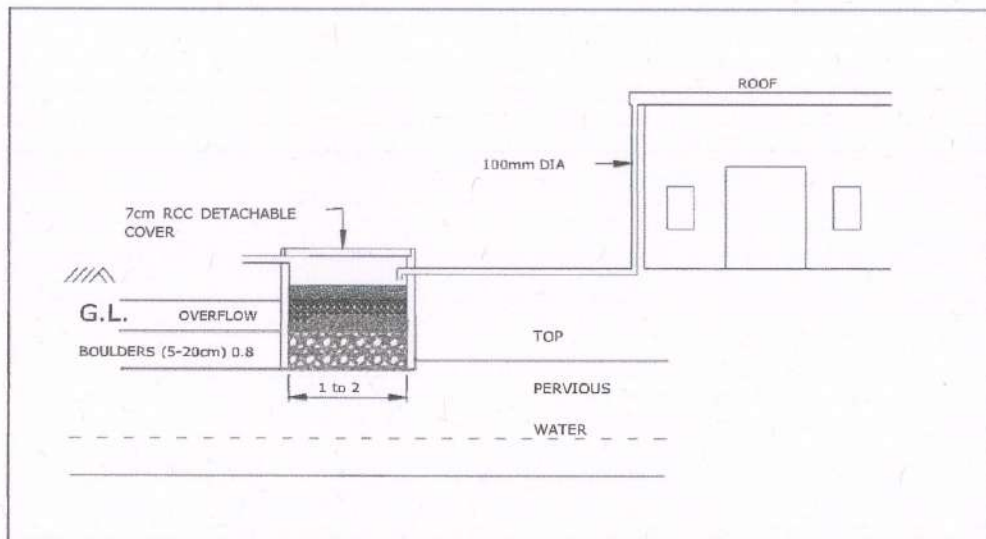
4.1 Methods of recharging subsurface aquifers

The various methods of recharging subsurface aquifers are:

1. Through recharge pit.

This method is suitable where a permeable stratum is available at shallow depth. It is adopted for buildings having roof area up to 100 Sqm. Recharge pit of any shape is constructed generally 1-2 m wide and 2-3 m deep. The pit is filled with boulders, gravel and sand for filtration of rain water. Water entering in to RWH structure should be silt free. Top layer of sand of filter should be cleaned periodically for better ingress of rain water in to the sub soil. Details are shown in Fig. 4.1.

Fig 4.1 Through Recharge Pit



2. Recharge through abandoned hand pump.

In this method, an abandoned hand pump is used as recharging structure. It is suitable for building having roof top area up to 150 Sqm. Roof top rain water is fed to the hand pump through 100 mm dia. pipe as shown in Fig. 4.2. Water fed in the Rain water harvesting structure should be silt free. Water from first rain should be diverted to drain through suitable arrangement. If water is not clear then

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]

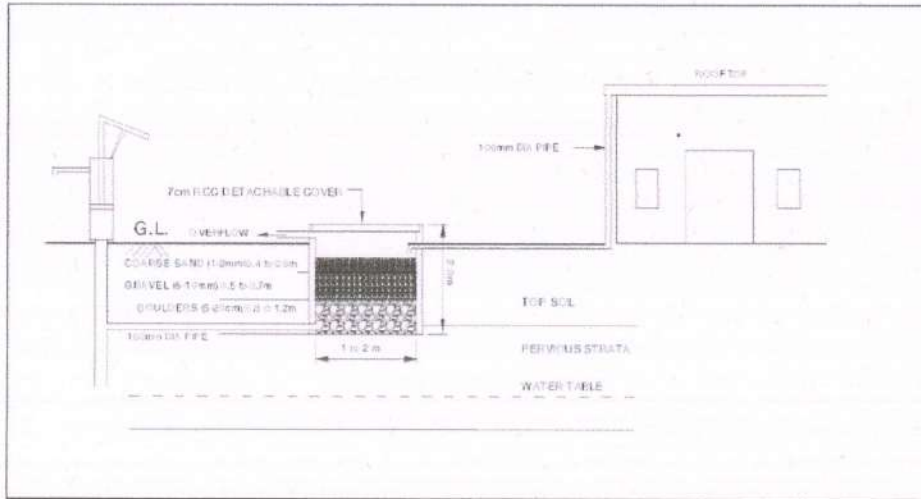


Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

filter should be provided.

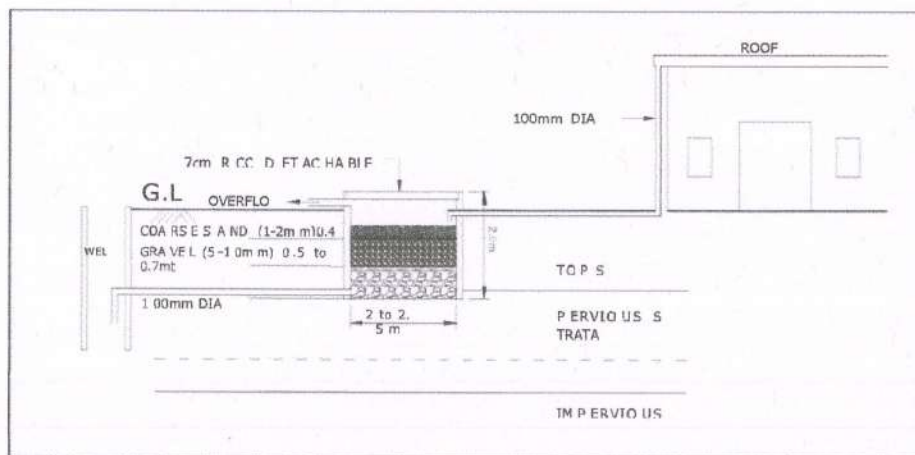
Fig. 4.2 Recharge through Abandoned Hand Pump



3. Recharge through abandoned dug well/open well.

In this method, a dry / unused dug well can be used as a recharge structure. It is suitable for buildings having a roof top area more than 100 sqm. Recharge water is guided through a pipe of 100 mm to the bottom of the well as shown in Fig. 4.3. Well cleaning and desilting is imperative before using it. Recharge water guided should be silt free, otherwise filter should be provided as shown in Fig. 4.3. Well should be cleaned periodically and chlorinated to control bacteriological contamination.

Fig 4.3 Recharge through Abandoned Open Well



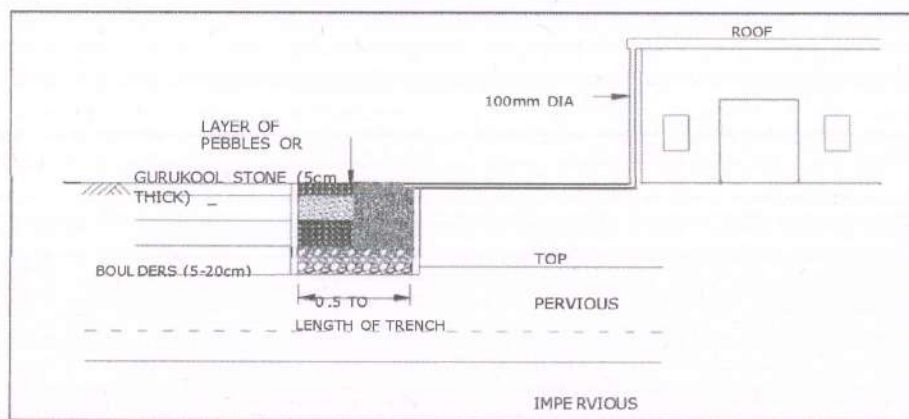
Handwritten signatures and initials: H, D, K.



4. Through recharge trench.

This method is used where permeable strata is available at shallow depth. It is suitable for buildings having roof top area between 200 & 300 sqm. In this method, trench of 0.5-1.0 m wide, 1-1.5 m deep and of adequate length depending upon roof top area and soil/subsoil characteristics should be constructed and filled with boulders, gravel and sand as shown in Fig. 4.4. Cleaning of filter media should be done periodically.

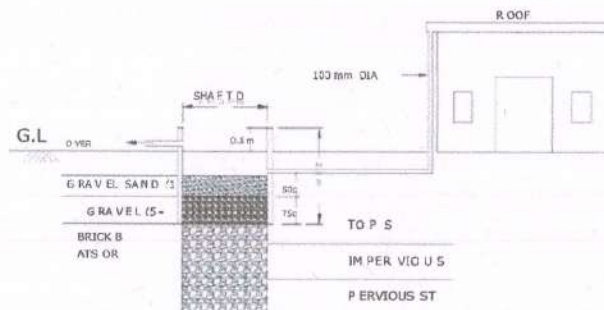
Fig. 4.4 Through Recharge Trench



5. Recharge through shaft.

This method is suitable where shallow aquifer is located below clayey surface. It is used for buildings having roof top area between 2000 & 5000 sqm. Recharge shaft of diameter 0.5-3 m and 10-15 m deep is excavated mechanically. The shaft should end in impermeable strata. The shaft should be filled with boulders, gravel and sand for filtration of recharge water. Top sand layer should be cleaned periodically. Recharge shaft should be constructed 10-15 m away from the buildings for the safety of the buildings. The details are given in Fig. 4.5.

Fig. 4.5 Recharge through Shaft





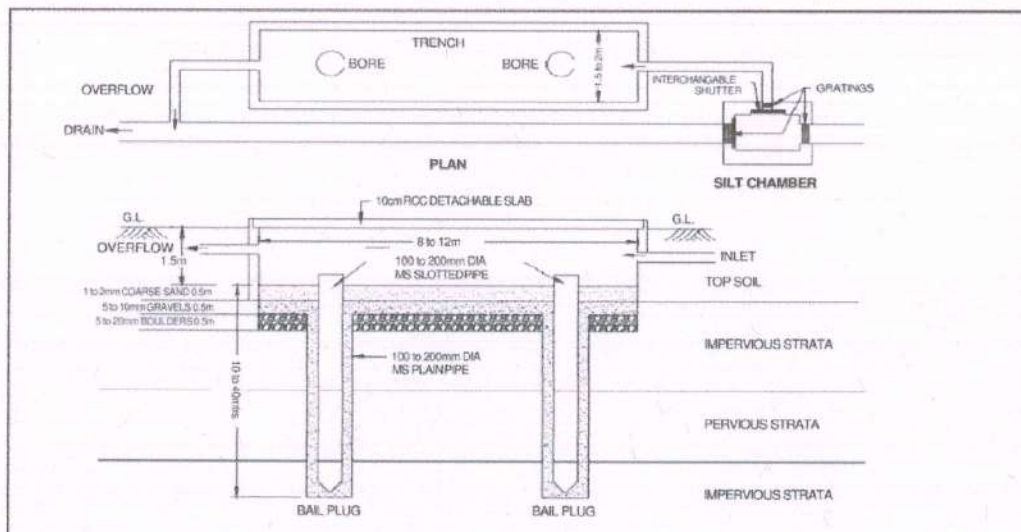
Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

6. Recharge trench with bore

This method is used where sub-soil is impervious and large quantity of roof water/ surface run off is available. In this, trench is made 1.5-3 m wide and 10-30 m length depending upon water availability. Wells of 150-300 mm dia. and 3-5 m deep (below previous layer) are constructed in the trench. Numbers of wells to be dug are decided in accordance to water availability and rate of ingress. Trench is filled with filtration media as shown in Fig. 4.6. A suitable silt chamber is also inserted with grating for water diverting arrangements as shown in the figure.

Fig. 4.6 Recharge Trench with Bore



Handwritten signature

Handwritten signature

Handwritten signature



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

CHAPTER - 5 KVV(DU) - CASE STUDY

5.1 Introduction

Krishna Vishwa Vidyapeeth (Deemed To Be University), (Herein after referred to be KVV(DU)) is located at Karad, Maharashtra. KVV(DU) is accredited by NAAC 'A+' grade and has been conferred with ISO 9001:2015 and ISO 14001:2015 certification. The constituent faculties of the University include Medical, Dental, Physiotherapy, Nursing, Pharmacy and Allied Sciences offering undergraduate and postgraduate courses in the respective faculties. It also runs Ph.D. programs and Post-Doctoral Fellowships in various subjects.

The medical college is about 35 years old and is recognized by the Medical Council of India, Medical Council of Malaysia and is listed in the WHO's World Directory of Medical Schools. Medical Council of India recognizes MBBS and postgraduate degree/ diploma courses in clinical and basic sciences.

Location of KVV(DU) –

KVV(DU) is located at NH4, Pune - Bangalore Highway, Agashivnagar, Malkapur, Karad, Maharashtra.

Figure – 5.1 Google Image of KVV(DU)





Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

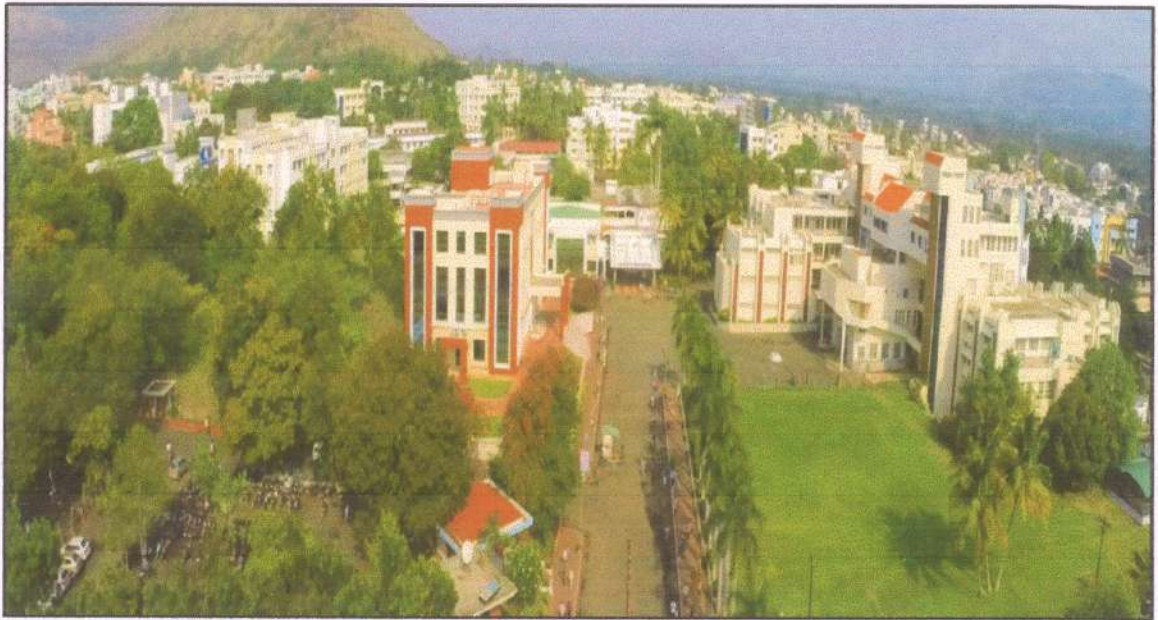
Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Figure – 5.2 Photographs of KVV(DU) Campus

Figure – 2 Photographs of KVV(DU)



[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023 Year :

5.2 Rain Water Harvesting in KVV(DU)

As a primary data collected by survey, Sources of water for KVV(DU) as follows;

Primary Source –

1. Koyana river (7,50,000 Lit/Day) Gov. of Maharashtra Sangli path-bandhare vibhag, Sangli.
2. Malkapur Nagarparishad - 40000 Lit./day
3. There are seven submersible pumps of 750 Ipm capacity and Two in spare for emergency.

Secondary / Alternate Source –

1. Bore wells act as an alternate source in the case of supply failure from river water.
Presently the bore well water is being used for domestic use.

Rain water harvesting has been already installed in the campus area and used to recharge/increase ground water level. Following are the details of RWH system in KVV(DU).

Rain water harvesting in 2019-20

Sr. No.	Building Name	Terrace Area Sq. M.	Water Collection lac lit./year	Recharge pit near Bore
1	Krishna Institute of Allied Sciences	1600	8.08	Bore No. 2
2	Hostel No. 4 & 7	1740	8.79	Bore No. 5
3	Hostel No. 5 & 6	1700	8.59	Bore No. 6
4	Admin office, OPD Building & Cobalt Unit	1300	6.57	Bore No. 3
5	Ladies Hostel No. 1	1300	6.57	Bore No. 4
6	Ward No. 3 & 18	1000	5.05	Bore No. 4



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

Rain water harvesting in 2020-21 (In addition)

Sr. No.	Building Name	Terrace Area Sq. M.	Water Collection lac lit./year	Recharge pit near Bore
1	D type staff quarter	640	3.23	Bore No. 3 & 4
2	IHR Hostel (New)	450	2.27	Bore No. 3 & 4
3	NRI Hostel	500	2.52	Bore No. 3 & 4

Rain water harvesting in 2021-22

Sr. No.	Building Name	Terrace Area Sq. M.	Water Collection lac lit./year	Recharge pit near Bore
1	Krishna Institute of Medical Sciences (North West)	2000	10.11	Bore No. 1
2	School of Dental Sciences	1750	8.84	Bore No. 7
3	Krishna Institute of Medical Sciences (East Side)	1115	5.63	Bore No. 7
4	Ward No. 38,39,40	1500	7.58	Bore No. 7
5	Parking Building	3000	15.16	Bore No. 1
6	Krishna Institute of Pharmacy & Gym Hall	1335	6.74	Bore No. 7

Rain water harvesting proposed in 2023

Sr. No.	Building Name	Terrace Area Sq. M.	Water Collection lac lit./year	Recharge pit near Bore
1	IHR Hostel (New)	1000	5.05	Bore No. 3 & 4

NOTE – A total of 15 RWH sites have been generated near 7 bore wells, covering a total of 20930.0 Sq/M of terrace area. Based on the annual average rainfall at Karad and terrace area available, total of 105.82 Lac/Lit/Yr water harvested.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023 Year :

Monitoring of ground water level of Bore No. 2 - Manual method

March 2019	Water level (Ft.)
March	28
April	30
May	32
June	30
July	29
August	25
September	16

Monitoring of ground water level at Bore No. 5 - By Piezometer

Date	Water Level (above sensor)	Date	Water Level (above sensor)
08-Jun-2021	10.10 meter	05-Nov-2021	9.70 meter
10-Jun-2021	12.60 meter	10-Nov-2021	9.60 meter
15-Jun-2021	11.10 meter	15-Nov-2021	9.80 meter
20-Jun-2021	12.10 meter	20-Nov-2021	10.60 meter
25-Jun-2021	10.00 meter	25-Nov-2021	11.10 meter
30-Jun-2021	9.10 meter	30-Nov-2021	11.50 meter
01-Jul-2021	7.70 meter	01-Dec-2021	10.90 meter
05-Jul-2021	6.70 meter	05-Dec-2021	10.50 meter
10-Jul-2021	6.20 meter	10-Dec-2021	10.40 meter
15-Jul-2021	10.40 meter	15-Dec-2021	10.20 meter
20-Jul-2021	10.90 meter	20-Dec-2021	9.90 meter
25-Jul-2021	11.10 meter	25-Dec-2021	10.10 meter
30-Jul-2021	19.60 meter	30-Dec-2021	10.40 meter
01-Aug-2021	19.30 meter	01-Jan-2022	10.30 meter
05-Aug-2021	16.40 meter	05-Jan-2022	9.80 meter
10-Aug-2021	12.90 meter	10-Jan-2022	7.50 meter
15-Aug-2021	11.10 meter	15-Jan-2022	7.00 meter
20-Aug-2021	11.70 meter	20-Jan-2022	8.20 meter



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Date	Water Level (above sensor)	Date	Water Level (above sensor)
25-Aug-2021	9.30 meter	25-Jan-2022	8.00 meter
30-Aug-2021	8.40 meter	07-Jan-2022	8.10 meter
01-Sep-2021	11.00 meter	30-Jan-2022	8.30 meter
05-Sep-2021	11.40 meter	01-Feb-2022	8.20 meter
10-Sep-2021	11.90 meter	05-Feb-2022	8.10 meter
15-Sep-2021	12.10 meter	10-Feb-2022	7.60 meter
20-Sep-2021	11.80 meter	15-Feb-2022	7.10 meter
25-Sep-2021	10.90 meter	20-Feb-2022	8.00 meter
30-Sep-2021	11.60 meter	25-Feb-2022	6.10 meter
01-Oct-2021	12.30 meter	01-Mar-2022	6.30 meter
05-Oct-2021	12.20 meter	05-Mar-2022	8.10 meter
10-Oct-2021	12.10 meter	10-Mar-2022	5.00 meter
15-Oct-2021	11.80 meter	15-Mar-2022	4.80 meter
20-Oct-2021	12.60 meter	20-Mar-2022	5.00 meter
25-Oct-2021	11.10 meter	25-Mar-2022	8.50 meter
30-Oct-2021	10.80 meter	30-Mar-2022	9.70 meter
01-Nov-2021	10.00 meter		

Date	Water Level (above sensor)	Date	Water Level (above sensor)
05-Apr-2022	11.10 meter	05-Oct-2022	12.30 meter
10-Apr-2022	11.60 meter	10-Oct-2022	12.80 meter
15-Apr-2022	10.16 meter	15-Oct-2022	12.40 meter
20-Apr-2022	11.20 meter	20-Oct-2022	13.90 meter
25-Apr-2022	9.60 meter	25-Oct-2022	13.10 meter
30-Apr-2022	9.40 meter	30-Oct-2022	13.80 meter
01-May-2022	8.70 meter	01-Nov-2022	12.40 meter
05-May-2022	7.70 meter	05-Nov-2022	11.70 meter
10-May-2022	7.20 meter	10-Nov-2022	10.60 meter
15-May-2022	9.40 meter	15-Nov-2022	10.80 meter
20-May-2022	9.90 meter	20-Nov-2022	10.30 meter



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

Date	Water Level (above sensor)	Date	Water Level (above sensor)
25-May-2022	10.10 meter	25-Nov-2022	12.10 meter
30-May-2022	10.50 meter	30-Nov-2022	12.50 meter
05-Jun-2022	10.90 meter	01-Dec-2022	11.90 meter
10-Jun-2022	10.60 meter	05-Dec-2022	11.50 meter
15-Jun-2022	10.40 meter	10-Dec-2022	11.40 meter
20-Jun-2022	10.30 meter	15-Dec-2022	11.60 meter
25-Jun-2022	10.00 meter	20-Dec-2022	10.90 meter
30-Jun-2022	9.80 meter	25-Dec-2022	10.50 meter
01-Jul-2022	8.50 meter	30-Dec-2022	10.40 meter
05-Jul-2022	9.70 meter	01-Jan-2023	9.10 meter
10-Jul-2022	10.20 meter	05-Jan-2023	9.70 meter
15-Jul-2022	10.40 meter	10-Jan-2023	8.90 meter
20-Jul-2022	10.90 meter	15-Jan-2023	8.50 meter
25-Jul-2022	11.10 meter	20-Jan-2023	8.20 meter
30-Jul-2022	12.60 meter	25-Jan-2023	8.00 meter
01-Aug-2022	14.30 meter	07-Jan-2023	8.10 meter
05-Aug-2022	16.40 meter	30-Jan-2023	8.30 meter
10-Aug-2022	13.90 meter	01-Feb-2023	8.20 meter
15-Aug-2022	12.60 meter	05-Feb-2023	7.90 meter
20-Aug-2022	11.70 meter	10-Feb-2023	7.60 meter
25-Aug-2022	10.80 meter	15-Feb-2023	7.10 meter
30-Aug-2022	9.90 meter	20-Feb-2023	8.00 meter
01-Sep-2022	11.00 meter	25-Feb-2023	8.10 meter
05-Sep-2022	11.40 meter	01-Mar-2023	8.40 meter
10-Sep-2022	11.90 meter	05-Mar-2023	8.60 meter
15-Sep-2022	12.70 meter	10-Mar-2023	7.70 meter
20-Sep-2022	11.90 meter	15-Mar-2023	7.10 meter
25-Sep-2022	11.30 meter	20-Mar-2023	6.60 meter
30-Sep-2022	11.90 meter	25-Mar-2023	7.30 meter
01-Oct-2022	12.50 meter	30-Mar-2023	8.40 meter

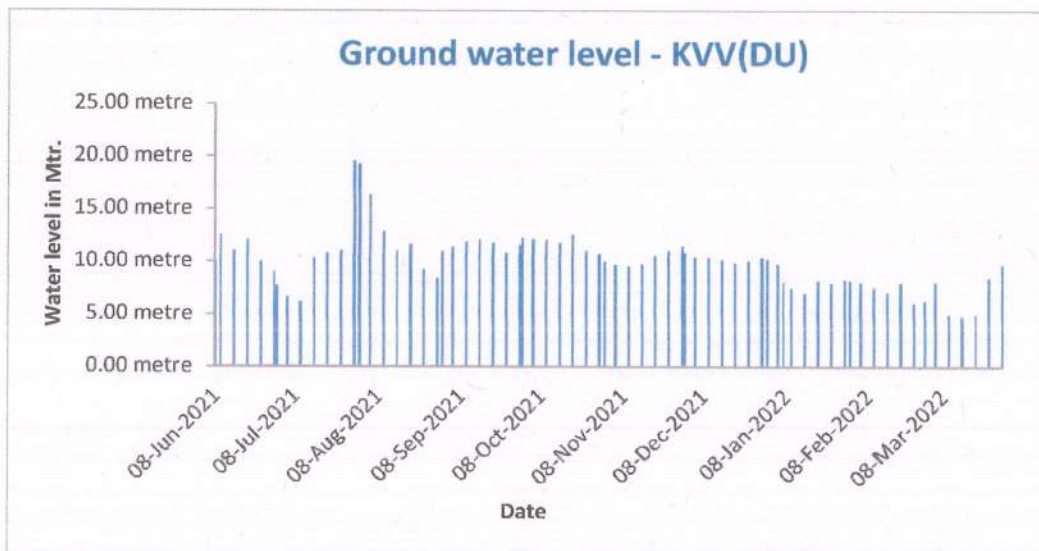
(The photographs of Piezometer installed near Bore well No.5 enclosed as **Annexure IV** in this report).



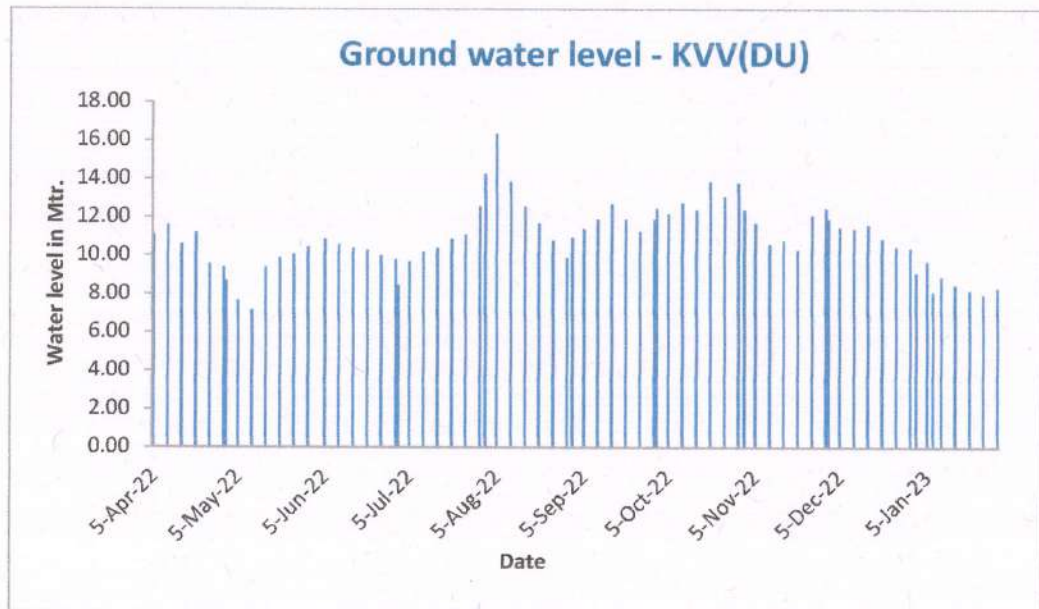
Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

Ground water level measured by the Piezometer in year 2021-22 –



Ground water level measured by the Piezometer in year 2022-23 -



[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Completed RWH Recharge Pits



Handwritten signature

Handwritten signature

Handwritten signature



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

CHAPTER - 6 WATER QUALITY

Rainwater is one of the purest forms of water and does not contain suspended/dissolved impurities. However, when this water is collected through rainwater harvesting, it gets contaminated because of contact with the roof surface/ground and some of the impurities get mixed in it. These impurities are required to be removed before collecting the harvested rainwater in the storage tank or diverting it or recharging groundwater aquifers.

The following precautions should be taken to ensure the quality of water:

1. Roof, over which waterfalls, should be cleaned before rainfall.
2. The suitable type of first flushing device to be installed and the initial 10 to 15 minutes of runoff should be diverted.
3. The water collected from the rooftop only should be stored in a storage tank for direct use.
4. The runoff from the surface/ground should preferably be used for recharging groundwater aquifers after proper filtration.
5. The rainwater collected from the rooftop should pass through a suitable type of filter and only then it should be stored in a storage tank / used for recharging groundwater aquifers.

The harvested rainwater may contain some toxic substances which may affect our health. The water collected from the rooftop after filtration can be used directly for lawn watering, washing, etc. But if this water has to be used directly for drinking purposes, then the quality of the water must be ascertained before use. The water used for drinking should comply with the provisions of IS-10500:2012 i.e. Indian Standard "DRINKING WATER – SPECIFICATION".

Some important test characteristics for drinking water as given in the following table:

Sr. No.	Substance or Characteristics	Desirable Limit	Test Methods (Ref. to IS)	Remarks
Essential Characteristics				
i)	Colour, Hazen units,		3025 (Part-4): 1984	Extended to 25 only if
ii)	Odour	Unobjectionable	3025 (Part 5) : 1983	a) Test cold and when heated b)Test at several dilutions
iii)	Taste	Agreeable	3025 (Part 7&8):	Test to be conducted only



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

Sr. No.	Substance or Characteristics	Desirable Limit	Test Methods (Ref. to IS)	Remarks
			1984	after safety has been established
iv)	Turbidity NTU, Max	5	3025 (Part 10): 1984	-
v)	pH Value	6.5 to 8.5	3025 (Part 11): 1984	-
vi)	Total hardness (as CaCO ₃) mg/l, Max	300	3025 (Part 21): 1983	-
vii)	Chloride (as Cl) mg/l, Max	250	3025 (Part 32): 1988	-
viii)	Dissolved solids mg/l, Max	500	3025 (Part 16): 1984	-
ix)	Calcium (as Ca) mg/l, Max	75	3025 (Part 40): 1991	-

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

CHAPTER - 7 OPERATION AND MAINTENANCE OF RWH

The initial start of a system involves testing whether or not the system works and if each component is performing to the manufacturer's specifications. The operation and maintenance of a system is the continuous process of checking to see if individual system components are functioning **accurately**, observing storage volume, and monitoring water usage. Routine maintenance and proper upkeep are directly related to water quality for potable water systems. erroneous or deficient maintenance of equipment results in lower water quality and increased health risks. Regular testing for contaminants is a key determinant of system function. Each system is unique and has subtle variations in performance and functionality.

A system operator learns these nuances and keeps the system operating at an acceptable level. System Operator Responsibilities One person, the system operator, must be responsible for the upkeep of an RWH system. In a case where multiple individuals share the responsibility of maintaining a system, eventually, a breakdown will occur as a result of unattended maintenance. This lack of communication or miscommunication is often mention to as the "he said, she said" scenario. The burden of maintaining a system should rest with a sole individual who takes a keen interest in sustaining the highest quality of water and is capable of recognizing a declining level of mention.

Gutters

Gutters are designed to catch all the runoff water from a roof. This clever but simple design also results in trapping debris and eventually blocking the flow of water. Monthly inspections of the gutter and removal of all materials, mainly organic matter, are necessary to maximize water quality. Additionally, the gutters should be inspected after high-intensity storms that include powerful wind gusts.

At least once a year, gutters should be flushed to remove sediment and debris lodged in corners, transitions, and internal hangers. New gutters may need to be washed with soap and water to remove oil residue deposited due to the manufacturing process; be sure to divert this water.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023 Year :

When inspecting and cleaning gutters on ladders be cautious and have someone ensure that the bottom of the ladder is stable. Injuries as a result of falling off ladders are common and dangerous. Use the following list as a reminder when inspecting a gutter.

- Leaves
- Organic matter
- Twigs
- Feces
- Dead animals
- Sagging gutter sections
- Puddled water
- Loose hardware, connections
- Peeling paint
- Corrosion
- Leaks
- Sealer on transitions
- Ants • Sediment
- Asphalt particles
- Children's toys
- Algae, mold

Debris Screens

Devices used to prevent leaves; twigs, carcasses, and other large debris from entering the storage tank are the first line of defence against contamination.

Leaf screens and gutter filters should be inspected every month and after each major rainfall event, especially those that include high winds. The devices are designed to trap or stop debris; periodic inspections and cleaning result in blockage of wasted water and increased chances that decomposing debris will eventually enter the storage tank.

For example, a gutter clogged with leaves creates pooled water (Figure 17.2). The pressure from this pooled water is exerted on the decomposing debris and may force smaller debris particles into the downspout.

Debris screens should be go through for the following items:

- Leaves
- Carcasses
- Decomposed organic matter
- Loose hardware
- Evidence of blockage
- Proper fitting components



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Downspouts

Downspouts should be regularly inspected for debris, loose hardware, and obstruction to flow. Unpainted PVC downspouts should be inspected for algae growth, leaks, and cracks. Over time, exposed PVC can become brittle and yellowish. Dented or crushed sections of downspouts hamper flow or may cause leakage.

Roof Washers and First Flush Diverters Roof washers, some box filters, and first flush diverters are considered a second defence against contamination after debris screens. Like a gutter, blockage in this device has negative consequences that result in less-than-optimal system performance and water quality.

These devices are natural traps for sediment and organic matter; weekly inspection is necessary. Monthly cleaning is suggested, depending on the volume of debris encountered.

The drains should be kept clear to prevent the puddling of water. Roof washers and first flush diverters should be inspected for the following:

- Clogged drain outlet
- Plugged screen
- Corrosion, leaks
- Animals
- Debris
- Mosquitoes
- Sediment
- Algae

Piping and Connections

Piping and connections should be checked every month. Plastic pipes should be checked for cracks and deformation. PVC plastic that is exposed to sunlight can degrade, turn yellowish color, and become brittle. A visual inspection of outdoor components and piping should be conducted in the event of an abrupt temperature change. Repairs that involve the replacement and reconnecting of system components should be inspected more often until it is determined that there are no leaks.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Filters

Filters are designed to stop particles of a specific size, preventing them from continuing in the water stream. As the surface of the filter becomes clogged with particles, the flow is hampered and a drop in pressure results. A water pressure gauge installed on both the upstream and downstream sides of a filter or bank of filters can indicate a dropping pressure. This indicates required maintenance. Some filters can be cleaned while others, especially charcoal, must be replaced. Charcoal filters are replaced after a certain quantity of water has passed through them.

Pumps

Most pumps are maintenance-free until they malfunction. Electric motors provide a little warning before failure, and under most circumstances, they last for years without the need for replacement. Multiple starts within a short period and lack of water in the pump housing contribute to premature failure. Contrary to popular belief, pumps are not damaged when the flow is restricted or prevented unless the water in this case becomes hot to the touch. The pressure switch that indirectly turns the pump on and off is the first to fail because it contains moving parts and electrical contacts that become worn or dirty.

Water Testing

Before consuming the water, an initial water quality assessment should be completed. The evaluation should be made by an individual with adequate knowledge and experience. Baseline test results provide a benchmark to compare subsequent results. At a minimum, the water should be tested for bacteria, cryptosporidium, and giardia. The original analysis should be kept on file. The system should be retested after major repairs or the replacement of sanitation equipment. If an unexpected or unexplained change in water quality occurs, testing for contamination may be appropriate. Yearly testing for total coliform (TC) and faecal coliform (FC) should be completed to serve as an indicator that the system is continuing to work properly. Testing may be viewed by a client as expensive and unnecessary, but it ensures that the water that is being delivered remains at an acceptable quality.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Maintenance Worksheet

A good maintenance worksheet aids in collecting all the relevant information in one place for ease of evaluation. The worksheet ensures that every component of the system is adequately evaluated. An example worksheet is provided as **Annexure I** in this report. All worksheets should be saved in a secure location with all other system information.

Inspection Accessibility

Regular inspection and cleaning of RWH components is a key maintenance activity. Impediments that reduce the accessibility to serviceable components of an RWH system result in fewer inspections and cleanings. Devices such as filters, UV lights, leaf screens, and roof washers should be located to facilitate safe and easy inspection and cleaning.

Summary

An RWH system that is properly operated and maintained will provide a higher quality of water with lower levels of risk than a comparable system that is neglected. Regular inspection and maintenance will aid the operator in fixing minor problems before they escalate. Operators should keep all records of operation and maintenance in case someone becomes ill after consuming the water. These records will aid in conveying the message that the system is performing at its designed level.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

CHAPTER - 8 RECOMMENDATIONS FOR EXISTING RWH

The campus of Krishna Vishwa Vidyapeeth (Deemed to be University) , Karad is suitable for large scale Rain water harvesting system. The Institute has already implemented the RWH system in the campus and also proposing new buildings/Departments for RWH (The layout of proposed building for RWH system enclosed as **Annexure II** in this report).

The existing RWH system is well executed in the campus. For proposed RWH plan we are suggesting some points that could be implemented for better results.

1. Existing RWH system is used for recharging Ground water. Existing storm water system should also be used for RWH/Ground water recharge.
2. RWH devices such as Coarse mesh; Leaf Screen, First flushing device etc. can be used for better results in proposed RWH system.

H. S. S.

Rajendra

Retakata



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Annexure I

Maintenance Worksheet

Format



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

Annexure I

Maintenance Worksheet

Date - --/--/----

System Location: _____

Operator: _____

Location of Records: _____

Filters: _____

Pump: _____

Pressure Tank: _____

UV System: _____

Chlorine Application System: _____

1) Catchment Surface: Free of Debris? Yes No

2) Gutters:

a) Clean?: Yes No

i) Leaf Screens: Yes No

ii) Gutter Filters: Yes No

iii) Inspection: Yes No

iv) Confined space (O2 testing): Yes No

b) Downspouts

i) Intact: Yes No

ii) First flush diverters- drained and clean: Yes No

3) Tanks

a) Piping intact: Yes No

i) Covers/lids/lock outs in place: Yes No

ii) Overflow/vents properly screened: Yes No

iii) Basket screens cleaned: Yes No



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

4) Pressure Tank

i) Leaks: Yes No

ii) Pump (cycle on)

(1) Leaks: Yes No

5) Filters: Yes No

(1) Rinse filters: Yes No

(2) Change filters: Yes No

6) Water Quality Testing

a) Sample taken: Yes No

b) Location from which sample was taken: _____

c) Testing Location: _____

d) Test to be run: _____

Handwritten signature

Handwritten signature

Handwritten signature



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Annexure II

KVV(DU) - Layout Plan



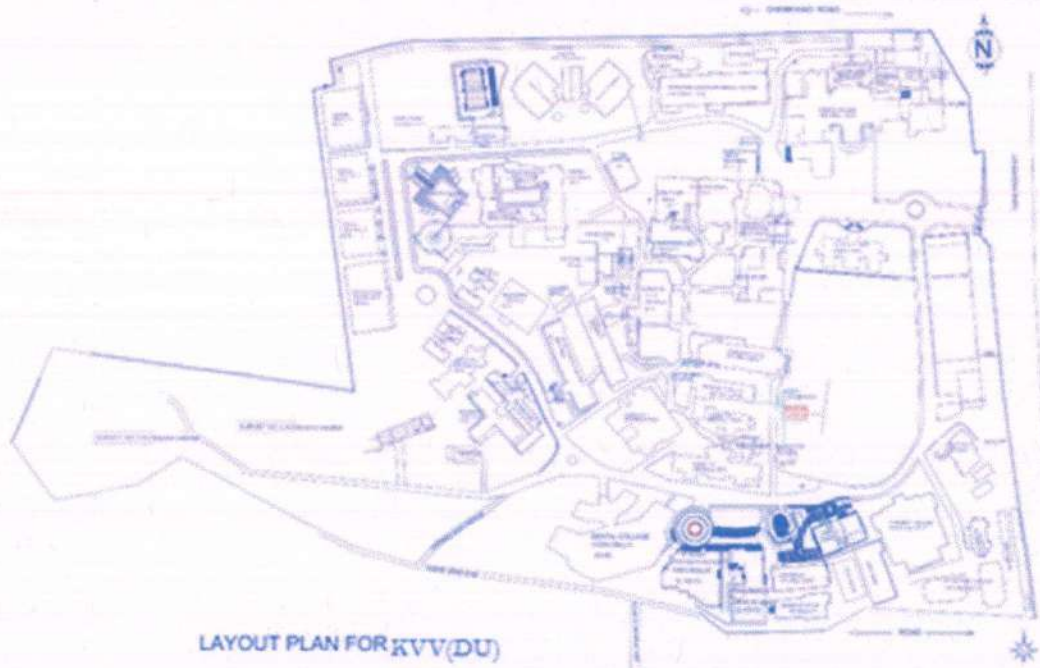
Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Annexure II



LAYOUT PLAN FOR KVV(DU)

SITE PLAN AT GAT NO./S.NO 3A/2, KOYANA VASAHAT GRAMPANCHAYAT & S. NO. 144/B, 145, 266/B, 261/3C/B & 262
AT- MALKAPUR, TAL.- KARAD, DIST.- SATARA. FOR Krishna Vishwa Vidyapeeth (Deemed to be University), Karad.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Annexure III

KVV(DU) – RWH at Campus

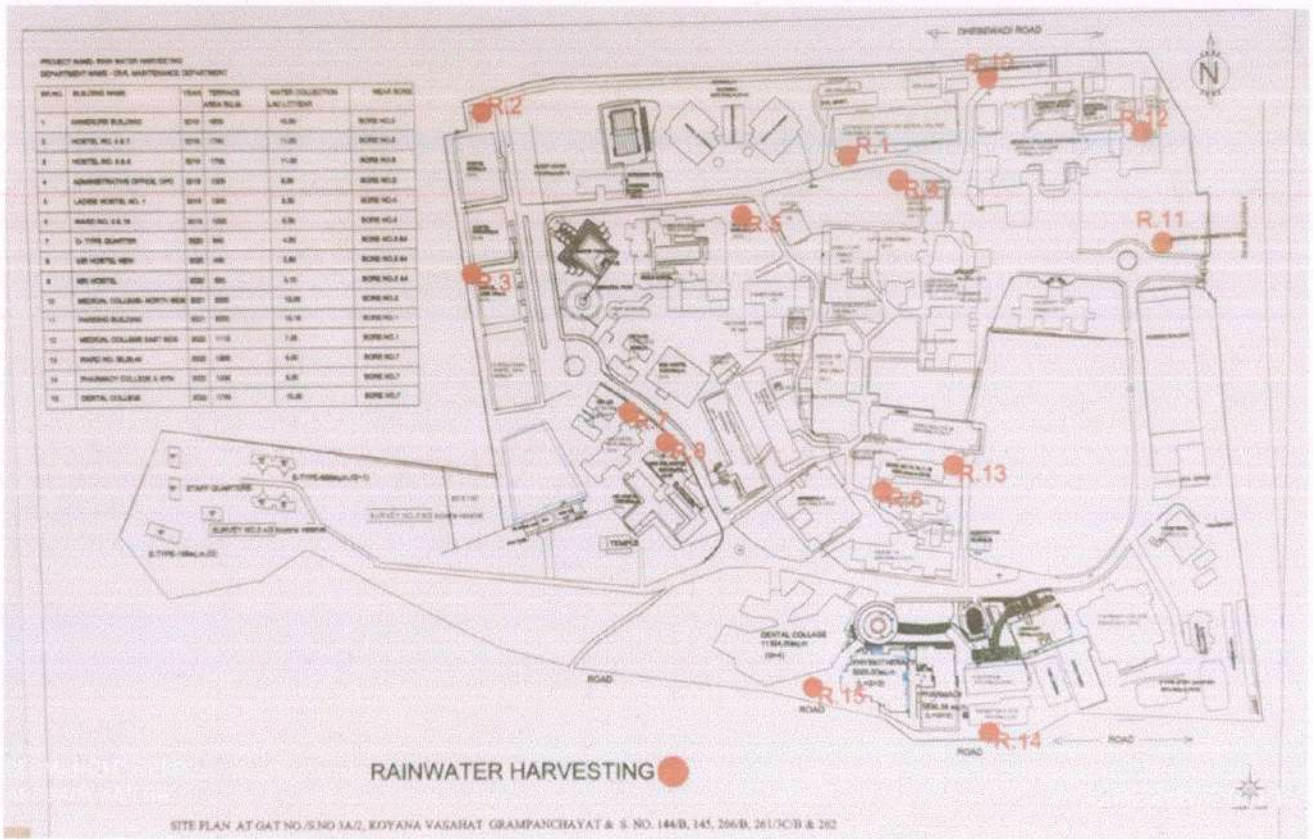


Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
 Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023 Year :

Annexure III



[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Annexure IV

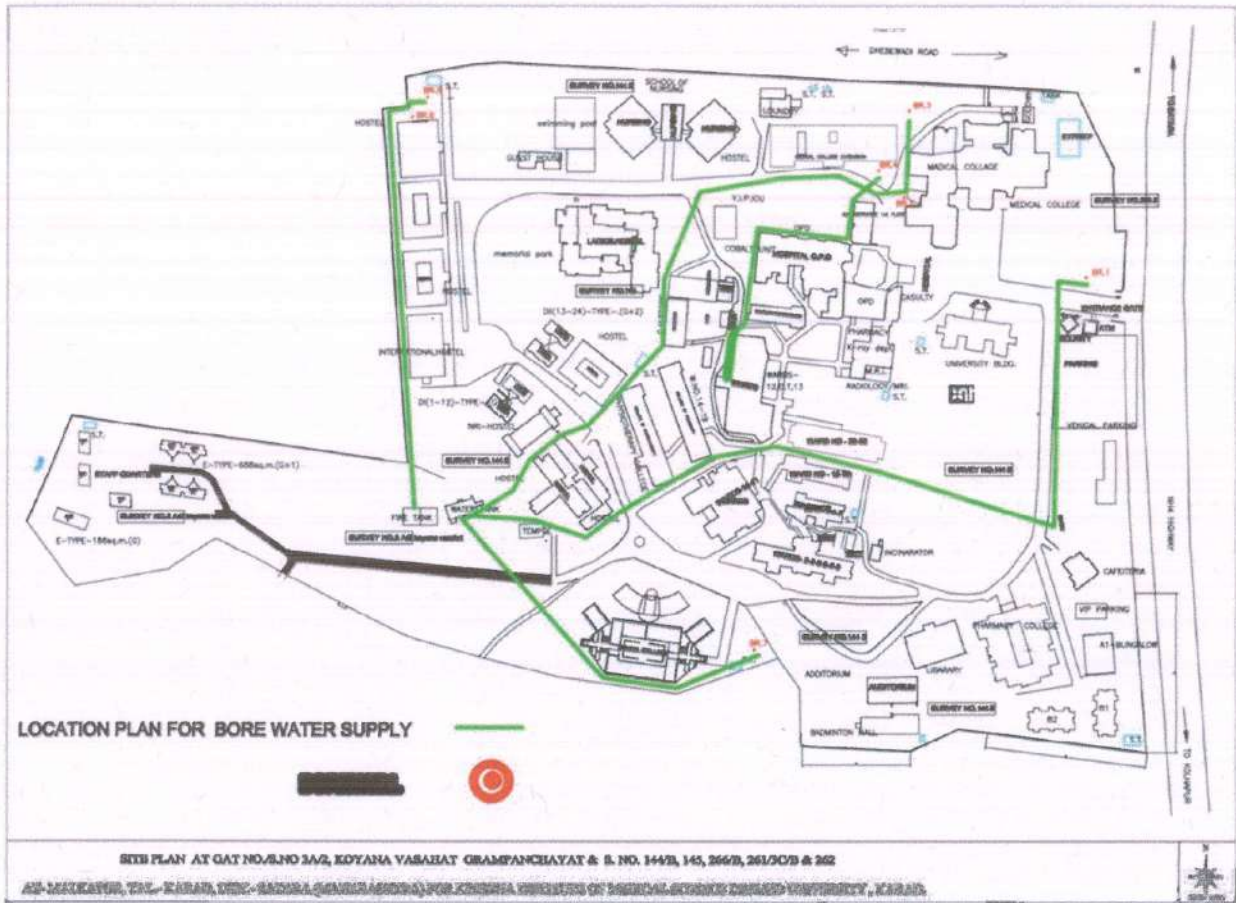
KVV(DU) - Bore well Details



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

Year :

Annexure IV



Handwritten signature

Handwritten signature

Handwritten signature



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023 Year :

Annexure V

KVV(DU) - Piezometer Details



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad

Project : Rain Water Harvesting Report

Year : 2022-2023

Year :

Annexure V

Piezometer installed at Borewell No. 5



Piezometer



One line filter system provided for Rain Water Harvesting.

[Handwritten signature]

[Handwritten signature]

[Handwritten signature]



Institute Name : Krishna Vishwa Vidyapeeth (Deemed to be University), Karad
Formerly known as a Krishna Institute of Medical Sciences (Deemed to Be University) Karad
Project : Rain Water Harvesting Report
Year : 2022-2023

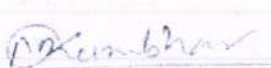
Year :

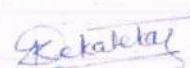
Project – Rain Water Harvesting

Sr. No.	Building Name	Year	Terrace Area Sq. M.	Water Collection lac lit./year	Recharge pit near Bore
1	Krishna Institute of Allied Sciences	2019	1600	8.08	Bore No. 2
2	Hostel No. 4 & 7	2019	1740	8.79	Bore No. 5
3	Hostel No. 5 & 6	2019	1700	8.59	Bore No. 6
4	Admin office, OPD Building & Cobalt Unit	2019	1300	6.57	Bore No. 3
5	Ladies Hostel No. 1	2019	1300	6.57	Bore No. 4
6	Ward No. 3 & 18	2019	1000	5.05	Bore No. 4
7	D type staff quarter	2020	640	3.23	Bore No. 3 & 4
8	IHR Hostel (New)	2020	450	2.27	Bore No. 3 & 4
9	NRI Hostel	2020	500	2.52	Bore No. 3 & 4
10	Medical College (North West Side)	2021	2000	10.11	Bore No. 1
11	Parking Building	2021	3000	15.16	Bore No. 1
12	School of Dental Sciences	2022	1750	8.84	Bore No. 7
13	Krishna Institute of Medical Sciences (East Side)	2022	1115	5.63	Bore No. 7
14	Ward No. 38,39,40	2022	1500	7.58	Bore No. 7
15	Krishna Institute of Pharmacy & Gym Hall	2022	1335	6.74	Bore No. 7

Note - A total of 15 RWH sites have been generated near 7 bore wells, covering a total of 20930.0 Sq/M of terrace area. Based on the annual average rainfall (632 mm) at Karad and terrace area available, total of 105.82 Lac/Lit/Yr water harvested through this project.


Ms. Pragatee Murkute


Mr. Milind Kumbhar


Mr. Dhiraj Kekalekar