Study of Rainwater Harvesting in University of Petroleum and Energy Studies in Support of the Eco-Campus Initiative

Yash Soni¹, Durga Prasad Panday²

¹Student, B. Tech Civil+IFE, School of Engineering, UPES, Dehradun
²Assistant Professor, Sustainability CLuster. UPES, Dehradun

Abstract: Rainwater harvesting is a technique for collecting rainwater that would otherwise be wasted, mainly in metropolitan settings. There is essentially no infiltration and percolation due to the completely different land use compared to the metropolitan region. As a result, groundwater levels have been steadily depleted. Rainwater harvesting is nearly completely unknown among the general public. There is a lack of community planning that may result in widespread participation and so replenish the groundwater table. The current research looks at several rainwater gathering techniques and how they may be implemented at the chosen location. The research is being conducted on the Dehradun campus of UPES. The focus is mostly on the water collected on the rooftop, which will be filtered and used for cleaning and gardening. Because it is a hilly location, the region receives a lot of rain, which provides excellent opportunities for rainwater gathering. The total runoff from the entire rooftop is calculated using a rational formula and then distributed to various uses. The paper’s main goal is to advocate the wise use of this valuable resource while keeping in mind the economics of the method used.

Keywords: Rainwater harvesting, rational formula, groundwater.

I. INTRODUCTION

The provision of water is critical to a civilization's survival. Despite this important function, the World Water Council predicts that worldwide water consumption would rise in the next fifty years as a result of a 40-50 percent increase in population, aggravated by industrialization and urbanisation. The university is located in a hilly environment that receives approximately 600-650 mm of rainfall per year. If it is not conserved, it will be completely wasted and will flow downstream in valleys and rivers.
A. **Rainwater Harvesting Systems And Its Features**
Rainwater harvesting is a simple method of gathering and storing rainwater that falls. Depending on the situation, we can either store it in tanks or use it to recharge groundwater. Features of Rainwater Harvesting are:

1) It lowers the risk of floods in cities.
2) It is economically cheaper in construction than other sources, like as dams, diversion, etc. • Ease in constructing system in less time.
3) Rainwater collection is the appropriate solution for places with insufficient groundwater supplies or surface resources.
4) It aids in the efficient use of the primary source of water by preventing runoff from entering sewer or storm drains, lowering the load on treatment plants.
5) Dilution helps to improve the quality of existing groundwater by recharging water into aquifers.

B. **Components Of Rainwater Harvesting System**
A rainwater harvesting system comprises of components for - transporting rainwater through pipes or drains, filtration, and tanks for storage of harvested water. The common components of a rainwater harvesting system are and the sequence of process are shown in the flowchart is given below:

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II. **METHODOLOGY**
In general, a rainwater harvesting system is made up of five fundamental components:

1) The catchment zone (the surface area which catches the rainfall)
2) Transportation (to stream the harvested rainwater from the catchment area to a storage)
3) The initial flush (a filtering device to remove contaminants and debris washed during the initial period of a storm)
4) Tanks for storage (to store harvested rainwater)
5) Dispersion (to deliver the rainwater from the storage tanks to the point of use)

The first and most important step in rainwater harvesting is to determine the area of the tank where the water will be collected and processed. So, first and foremost, monthly average rainfall data were gathered. The rooftop area was then computed using Google Earth because we needed to know how much space was taken up. Water that will be collected each month from rainfall was calculated using the obtained data, rooftop area, monthly rainfall, and the runoff coefficient. Now, the runoff for all of the months can be easily acquired, allowing it to be determined which month had the most runoff. The ground area, or surface area, was computed so that water other than rooftops could be calculated using channels. Similarly, the water that will be gathered can be calculated by multiplying rooftop area. In a similar fashion, the maximum runoff can be calculated using the area, monthly rainfall, and the runoff coefficient. To analyse and estimate tank placement, an auto level instrument was used to level the entire area, and the results were collated. The maximum runoff for the rooftop and the surface were combined to determine which month has the most runoff. The rainfall for each day was calculated by dividing the runoff by 30. Because we need to build six tanks at different places to meet our requirements, the rainfall acquired for each day was divided for six tanks to estimate the capacity of each tank. In addition, four of the six tanks will have the same capacity, while the remaining two will have the same capacity. Rainwater must be filtered for a specific purpose, hence three filtration tanks will be required. Finally, all the tanks will be connected from top and bottom to one empty tank so that the overflow waster must not be wasted instead collected in the other tank.
### III. RESULTS

Table 1 Rooftop Water Collection and Estimation

| BLOCK       | PERIMETER | AREA | AVERAGE RAINFALL | TOTAL ANNUAL RAINFALL | RUNOFF FACTOR | TOTAL RUNOFF WATER (m³) | PEAK RUNOFF WATER (m³) |
|-------------|-----------|------|------------------|-----------------------|---------------|-------------------------|------------------------|
|             | JAN       | FEB  | MAR  | APR  | MAY  | JUNE | JULY | AUG  | SEPT | OCT  | NOV  | DEC |
| ENERGY BLOCK| 164       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 3128.411 | 0.875 | 2737.39625 | 867.48 |
| 1ST BLOCK   | 207       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 3457.894 | 0.875 | 4775.65725 | 1513.43 |
| 2ND BLOCK   | 150       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 1337.336 | 0.875 | 1170.6497 | 370.83 |
| 3RD BLOCK   | 126       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 1196.221 | 0.875 | 1046.490375 | 331.70 |
| 4TH BLOCK   | 124       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 1243.983 | 0.875 | 1098.485125 | 344.95 |
| 5TH BLOCK   | 151       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 1361.217 | 0.875 | 1191.064875 | 377.43 |
| 6TH BLOCK   | 133       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 1465.425 | 0.875 | 1282.246875 | 406.35 |
| 7TH BLOCK   | 120       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 1326.481 | 0.875 | 1160.670875 | 367.82 |
| 8TH BLOCK   | 106       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 703.404 | 0.875 | 615.478 | 195.05 |
| 9TH BLOCK   | 193       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 3139.266 | 0.875 | 2764.83775 | 870.49 |
| 10TH BLOCK  | 154       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 2309.944 | 0.875 | 2021.201 | 640.53 |
| 11TH BLOCK  | 283       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 5653.284 | 0.875 | 4946.6235 | 1567.61 |
| IT          | 74        | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 703.404 | 0.875 | 615.478 | 195.05 |
| R&D         | 108       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 1369.901 | 0.875 | 1198.663375 | 379.86 |
| LIBRARY     | 76        | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 683.865 | 0.875 | 598.381875 | 189.63 |
| FOOD COURT  | 109       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 1087.671 | 0.875 | 951.712125 | 301.60 |
| 2ND FOOD COURT| 58    | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 421.174 | 0.875 | 368.52725 | 116.79 |
| MAC AUDI    | 171       | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 3171.831 | 0.875 | 2775.32125 | 879.52 |
| PLACEMENT OFFICE | 64 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.023 | 466.765 | 0.875 | 408.419375 | 129.43 |

Graph 1 Annual Rainfall on Rooftop
### Table 2 1st Quarter Rainfall Data

| BLOCK            | AREA | JAN | FEB | MAR | 1st QUATER RAINFALL |
|------------------|------|-----|-----|-----|---------------------|
| ENERGY BLOCK     | 1441 | 0.07| 0.041| 0.06| 246.411             |
| 1ST BLOCK        | 2514 | 0.07| 0.041| 0.06| 429.894             |
| 2ND BLOCK        | 616  | 0.07| 0.041| 0.06| 105.336             |
| 3RD BLOCK        | 551  | 0.07| 0.041| 0.06| 94.221              |
| 4TH BLOCK        | 573  | 0.07| 0.041| 0.06| 97.983              |
| 5TH BLOCK        | 627  | 0.07| 0.041| 0.06| 107.217             |
| 6TH BLOCK        | 675  | 0.07| 0.041| 0.06| 115.425             |
| 7TH BLOCK        | 611  | 0.07| 0.041| 0.06| 104.481             |
| 8TH BLOCK        | 324  | 0.07| 0.041| 0.06| 55.404              |
| 9TH BLOCK        | 1446 | 0.07| 0.041| 0.06| 247.266             |
| 10TH BLOCK       | 1064 | 0.07| 0.041| 0.06| 181.944             |
| 11TH BLOCK       | 2604 | 0.07| 0.041| 0.06| 445.284             |
| IT               | 324  | 0.07| 0.041| 0.06| 55.404              |
| RND              | 631  | 0.07| 0.041| 0.06| 107.901             |
| LIBRARY          | 315  | 0.07| 0.041| 0.06| 53.865              |
| FOOD COURT       | 501  | 0.07| 0.041| 0.06| 85.671              |
| 2ND FOOD COURT   | 194  | 0.07| 0.041| 0.06| 33.174              |
| MAC AUDI         | 1461 | 0.07| 0.041| 0.06| 249.831             |
| PLACEMENT OFFICE | 215  | 0.07| 0.041| 0.06| 36.765              |

**TOTAL**: 2853.477
### Table 3 2nd Quarter Rainfall Data

| BLOCK             | AREA   | APR | MAY | JUNE | 2nd QUATER RAINFALL |
|-------------------|--------|-----|-----|------|---------------------|
| ENERGY BLOCK      | 1441   | 0.02| 0.045| 0.163| 328.548             |
| 1ST BLOCK         | 2514   | 0.02| 0.045| 0.163| 573.192             |
| 2ND BLOCK         | 616    | 0.02| 0.045| 0.163| 140.448             |
| 3RD BLOCK         | 551    | 0.02| 0.045| 0.163| 125.628             |
| 4TH BLOCK         | 573    | 0.02| 0.045| 0.163| 130.644             |
| 5TH BLOCK         | 627    | 0.02| 0.045| 0.163| 142.956             |
| 6TH BLOCK         | 675    | 0.02| 0.045| 0.163| 153.9               |
| 7TH BLOCK         | 611    | 0.02| 0.045| 0.163| 139.308             |
| 8TH BLOCK         | 324    | 0.02| 0.045| 0.163| 73.872              |
| 9TH BLOCK         | 1446   | 0.02| 0.045| 0.163| 329.688             |
| 10TH BLOCK        | 1064   | 0.02| 0.045| 0.163| 242.592             |
| 11TH BLOCK        | 2604   | 0.02| 0.045| 0.163| 593.712             |
| IT                | 324    | 0.02| 0.045| 0.163| 73.872              |
| RND               | 631    | 0.02| 0.045| 0.163| 143.868             |
| LIBRARY           | 315    | 0.02| 0.045| 0.163| 71.82               |
| FOOD COURT        | 501    | 0.02| 0.045| 0.163| 114.228             |
| 2ND FOOD COURT    | 194    | 0.02| 0.045| 0.163| 44.232              |
| MAC AUDI          | 1461   | 0.02| 0.045| 0.163| 333.108             |
| PLACEMENT OFFICE  | 215    | 0.02| 0.045| 0.163| 49.02               |
Table 4 3rd Quarter Rainfall Data

| BLOCK            | AREA  | JULY | AUG | SEPT | 3rd QUATER RAINFALL |
|------------------|-------|------|-----|------|---------------------|
| ENERGY BLOCK     | 1441  | 0.655| 0.688|      |                     |
| 1ST BLOCK        | 2514  | 0.655| 0.688| 0.291|                     |
| 2ND BLOCK        | 616   | 0.655| 0.688| 0.291|                     |
| 3RD BLOCK        | 551   | 0.655| 0.688| 0.291|                     |
| 4TH BLOCK        | 573   | 0.655| 0.688| 0.291|                     |
| 5TH BLOCK        | 627   | 0.655| 0.688| 0.291|                     |
| 6TH BLOCK        | 675   | 0.655| 0.688| 0.291|                     |
| 7TH BLOCK        | 611   | 0.655| 0.688| 0.291|                     |
| 8TH BLOCK        | 324   | 0.655| 0.688| 0.291|                     |
| 9TH BLOCK        | 1446  | 0.655| 0.688| 0.291|                     |
| 10TH BLOCK       | 1064  | 0.655| 0.688| 0.291|                     |
| 11TH BLOCK       | 2604  | 0.655| 0.688| 0.291|                     |
| IT               | 324   | 0.655| 0.688| 0.291|                     |
| RND              | 631   | 0.655| 0.688| 0.291|                     |
| LIBRARY          | 315   | 0.655| 0.688| 0.291|                     |
| FOOD COURT       | 501   | 0.655| 0.688| 0.291|                     |
| 2ND FOOD COURT   | 194   | 0.655| 0.688| 0.291|                     |
| MAC AUDI         | 1461  | 0.655| 0.688| 0.291|                     |
| PLACEMENT OFFICE | 215   | 0.655| 0.688| 0.291|                     |
|                  |       |      |      |      | TOTAL: 27266.558    |
### Graph 4 3rd Quarter Rainfall Data

![Graph showing 3rd Quarter Rainfall Data](image)

### Table 5 4th Quarter Rainfall Data

| BLOCK           | AREA | OCT  | NOV  | DEC  | 4th QUATER RAINFALL |
|-----------------|------|------|------|------|---------------------|
| ENERGY BLOCK    | 1441 | 0.095| 0.018| 0.025| 198.858             |
| 1ST BLOCK       | 2514 | 0.095| 0.018| 0.025| 346.932             |
| 2ND BLOCK       | 616  | 0.095| 0.018| 0.025| 85.008              |
| 3RD BLOCK       | 551  | 0.095| 0.018| 0.025| 76.038              |
| 4TH BLOCK       | 573  | 0.095| 0.018| 0.025| 79.074              |
| 5TH BLOCK       | 627  | 0.095| 0.018| 0.025| 86.526              |
| 6TH BLOCK       | 675  | 0.095| 0.018| 0.025| 93.15               |
| 7TH BLOCK       | 611  | 0.095| 0.018| 0.025| 84.318              |
| 8TH BLOCK       | 324  | 0.095| 0.018| 0.025| 44.712              |
| 9TH BLOCK       | 1446 | 0.095| 0.018| 0.025| 199.548             |
| 10TH BLOCK      | 1064 | 0.095| 0.018| 0.025| 146.832             |
| 11TH BLOCK      | 2604 | 0.095| 0.018| 0.025| 359.352             |
| IT              | 324  | 0.095| 0.018| 0.025| 44.712              |
| RND             | 631  | 0.095| 0.018| 0.025| 87.078              |
| LIBRARY         | 315  | 0.095| 0.018| 0.025| 43.47               |
| FOOD COURT      | 501  | 0.095| 0.018| 0.025| 69.138              |
| 2ND FOOD COURT  | 194  | 0.095| 0.018| 0.025| 26.772              |
| MAC AUDI        | 1461 | 0.095| 0.018| 0.025| 201.618             |
| PLACEMENT OFFICE| 215  | 0.095| 0.018| 0.025| 29.67               |
| TOTAL           |      |      |      |      | 2302.806            |
Graph 5 4th Quarter Rainfall Data

Table 6 Level Difference Between Two Points

| ROUTE                        | FLOW DIRECTION                | LEVEL DIFFERENCE (m) |
|------------------------------|-------------------------------|----------------------|
| 11th BLOCK RIGHT SIDE        | 11th FRONT TO 11th BACK       | 2.58                 |
| FRONT OF 11th BLOCK          | 11th TO 10th BLOCK            | 0.865                |
| B/W 9th & 10th               | 10th FRONT TO 10th BACK       | 0.6                  |
| GANDHI TO 10th               | GANDHI TO 10th                | 0.97                 |
| R&D TO GANDHI                | R&D TO GANDHI                 | 0.51                 |
| LIBRARY TO MAC               | LIBRARY TO MAC                | 0.255                |
| LIBRARY TO GANDHI            | LIBRARY TO GANDHI             | 0.31                 |
|                              | LIBRARY TO 2nd FOOD COURT     | 0.175                |
| 2nd FOOD COURT TO 8th BLOCK  | LIBRARY TO 8th BLOCK          | 0.265                |
|                              | MAIN ROAD TO 8th BLOCK        | 0.345                |
| FOOD COURT FRONT             | FOOD COURT FRONT TO 1st BLOCK | 0.245                |
| GANDHI TO FOOD COURT         | GANDHI TO FOOD COURT          | 3.985                |
| S.NO. | MONTH     | RAINFALL (in m) |
|-------|-----------|-----------------|
| 1     | JANUARY   | 0.07            |
| 2     | FEBRUARY  | 0.041           |
| 3     | MARCH     | 0.06            |
| 4     | APRIL     | 0.02            |
| 5     | MAY       | 0.045           |
| 6     | JUNE      | 0.163           |
| 7     | JULY      | 0.655           |
| 8     | AUGUST    | 0.688           |
| 9     | SEPTEMBER | 0.291           |
| 10    | OCTOBER   | 0.095           |
| 11    | NOVEMBER  | 0.018           |
| 12    | DECEMBER  | 0.025           |

Table 7 Rainfall Data

| LOCATION | PERIMETER | AREA | AVERAGE RAINFALL | TOTAL ANNUAL RAINFALL (M³) | RUNOFF FACTOR | TOTAL RUNOFF WATER (M³) | PEAK RUNOFF WATER OF Particular AREA (M³) |
|----------|-----------|------|------------------|----------------------------|---------------|------------------------|------------------------------------------|
|          | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |          |
| GROUND   | 84  | 13169 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 28589.899 | 0.275 | 7862.22 | 2491.57 |
| TOTAL PARK | 832.2 | 5533 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 12012.143 | 0.175 | 2102.13 | 666.17 |
| FROM PLACEMENT CELL, MDC TO GANDHI CHOWK | 845 | 2597 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 5638.087 | 0.875 | 4933.33 | 1563.39 |
| LIBRARY TO GANDHI CHOWK | 159 | 35 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 762.021 | 0.875 | 666.77 | 211.30 |
| LIBRARY TO MAC | 170 | 501 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 1087.671 | 0.875 | 951.71 | 301.60 |
| GANDHI CHOWK TO MAC (DOWNSIDE) | 322 | 889 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 1930.019 | 0.875 | 1688.77 | 535.18 |
| NEAR OLD AMphi | 234 | 765 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 1660.815 | 0.875 | 1453.21 | 460.53 |
| MAIN GATE, ENERGY HOUSE AND FIRST BLOCK FRONT | 418 | 1413 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 3067.623 | 0.875 | 2684.17 | 850.63 |
| R& D TO GANDHI CHOWK | 228 | 530 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 1150.63 | 0.875 | 1006.80 | 319.06 |
| 11TH BLOCK TO GANDHI CHOWK | 337 | 1304 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 2830.984 | 0.875 | 2477.11 | 785.01 |
| GANDHI CHOWK TO FOOD COURT | 187 | 416 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 903.136 | 0.875 | 519.30 | 164.57 |
| MAIN GATE TO FOOD COURT | 284 | 719 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 1560.949 | 0.875 | 1365.83 | 432.84 |
| BEHIND 11TH BLOCK | 293 | 908 | 0.07 | 0.041 | 0.06 | 0.02 | 0.045 | 0.163 | 0.655 | 0.688 | 0.291 | 0.095 | 0.018 | 0.025 | 1971.268 | 0.875 | 1724.86 | 546.62 |
|          | 4393.2 | | | | | | | | | | | | | | | | 63165.245 | 29436.21 | 9328.47 |
Graph 6 Annual Surface Water Collection

Graph 7 Peak Ground Runoff
Table 10 Different Tanks with Specifications

| Tank No. | Location | NEW INTERNAL DIMENSIONS OF TANK | Filtration/Storing /Borewell |
|----------|----------|--------------------------------|------------------------------|
|          |          | LENGTH (m) | BREADTH (m) | DEPTH (m) | EXACT VOLUME( m^3) |                            |
| 1        | Play Ground | 8          | 5           | 2.5       | 100                | Filtration+ Storing Tank  |
| 2        | Near MAC   | 8          | 5           | 2.5       | 100                | Filtration +Storing Tank  |
| 3        | Energy House's Backside | 8          | 5           | 2.5       | 100                | Filtration +Storing Tank  |
| 4        | Near Main Gate | 8          | 5           | 2.5       | 100                | Filtration +Storing Tank +Borewell |
| 5        | 11th Block Backside | 9          | 5.8         | 2.5       | 130.5              | Filtration +Borewell      |
| 6        | STP /FOOD COURT BACK | 9          | 5.8         | 2.5       | 130.5              | Filtration+ Storing Tank+ Borewell |

IV. DISCUSSIONS

The total area of the entire blocks of UPES is calculated and is shown in the above tables. Then runoff is calculated using Rational formula. After getting the total runoff, total potential of rainwater harvesting system became known. In order to use this water, filtration is required. After filtration, this water is fit for any use as the rain water itself is devoid of any impurity. But mainly, its use in UPES is confined to flushing, washing and gardening purposes.

V. CONCLUSION

Because the ground water table on the UPES Campus and in the surrounding area is steadily declining, it is required to plan, design, and build a rain water harvesting system on campus to capture rain water from roof surfaces and paved surface (Road Surface) catchment. For the University of Petroleum and Energy Studies in Dehradun, the goal of this study was to construct a rooftop and ground rainwater harvesting system. This will aid in the artificial recharging of groundwater in this area, as well as alleviate water scarcity. Because of the water demand and supply on university campuses, the entire campus was chosen as the required catchment area for rainwater collection. Different components of the RWH system were also designed. According to the analysis, installing a RWH system on the UPES campus can solve water scarcity issues during non-monsoon seasons by storing a large amount of water throughout the year.

This programme will help to boost water supply for building, gardening, and artificial ground water recharge, thus enhancing both surface and ground water resources. It is concluded that implementing a RWH system on a university campus would be the best strategy to dealing with the current situation of water scarcity and water storage. There are numerous processes in the recharging system for recharging rainwater into the ground, with recommendations based on the maximum rainfall. Based on UPES University's water needs, the area's groundwater conditions, and rainwater data, it is proposed that a rainwater gathering system be developed.

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- Utsav R. Patel1, Vikrant A. Patel2, Manjurali I. Balya3, Harshad M. Rajgor4
- Lecturer, Civil Engineering Department, SPCE, Visnagar, Gujarat, India.
- Assistant Professor, Civil Engineering Department, SPCE, Visnagar, Gujarat, India

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