Integrating Micro Watershed Harvesting Project Case Study: Central University of Rajasthan Bandarsindri

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Water Shed

- Watershed is a natural system which functions in a manner to collect, store, and discharge water to a common outlet, such as a large stream, lake, or ocean.

Study Area: Central University of Rajasthan Bandarsindri, Kishangarh

Land Area

- 209 Ha

Location

- State: Rajasthan
- District: Ajmer
- Tehsil: Kishangarh
- Panchayat: Bandar Sindri
- Falls in DMIC (Delhi Mumbai Industrial Corridor)

Accessibility

- Distance from Bandarsindri bus stand at NH 8: 1.3 km
- Distance From Kishangarh:22 Km
- Distance From Ajmer: 45 Km
- Distance From Jaipur: 80 Km

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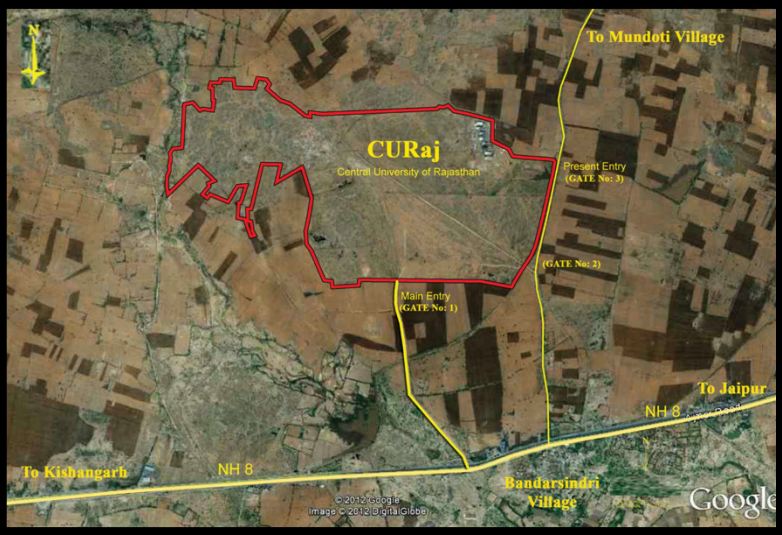


Study Area: Central University of Rajasthan Bandarsindri, Kishangarh

Site Geology

- Weathered Rock formation from 0.4 to 3.0 m and then there is hard rock strata. In some places there are outcrops also.

Soil Profile

- Soil Typology: loose sandy soil with little clay
- Soil Depth: In general 0.4 m to 1.5 m in some pockets this is till 2.5 m

Vegetation

Minimum vegetation due to less soil cover and scarcity of water

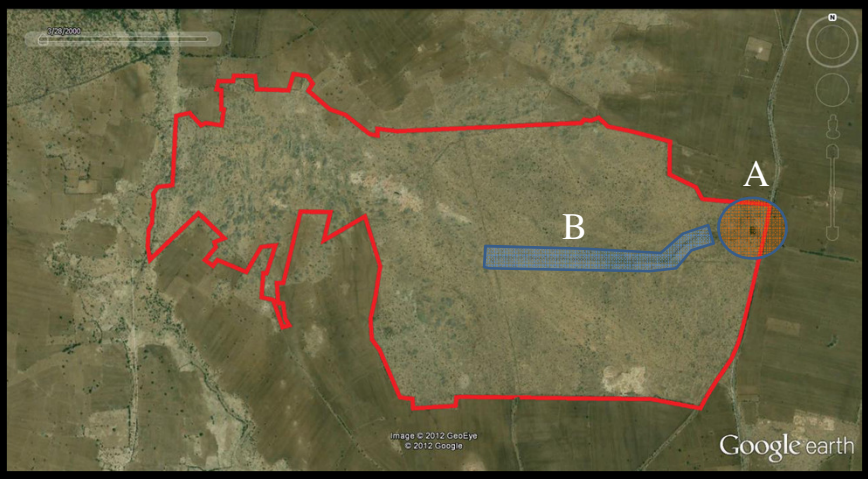
- At the time of acquisition only four trees were there in this campus (one Neem tree and three Khejdi trees)
- Entire landscape is covered by low height shrubs, vilayati babool and other desert flora.

Study Area: Central University of Rajasthan Bandarsindri, Kishangarh

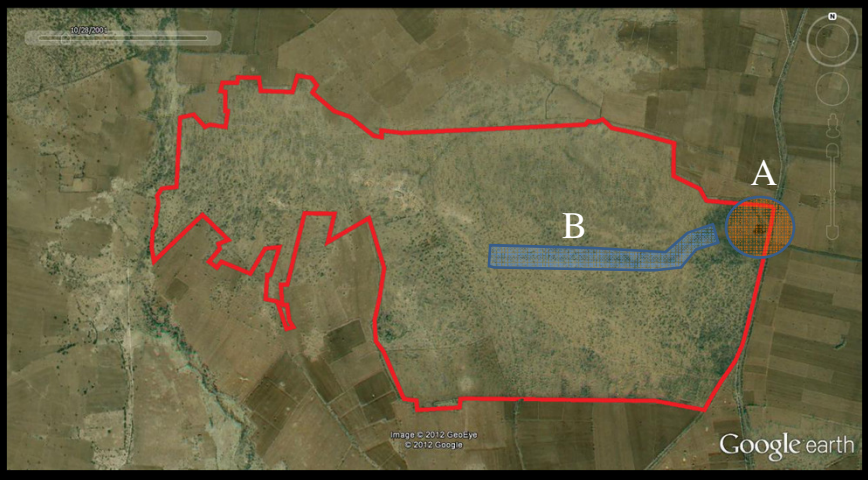
Climatic Data

Month	Period	No. of Years	Mean Temperature Deg. C		Mean Rainfall in mm	Evapo-Transpiration (mm/day)	Wet Spell ET (mm/ month)	Dry Spell ET (mm/ month)
			Max	Min				
January	1901-2000	100	22.9	7.6	7.3	5.1		158.1
February	1901-2000	100	25.7	10.3	6	5.8		162.4
March	1901-2000	100	31.3	16	5	7		217
April	1901-2000	100	36.5	22.2	4	8.1		243
May	1901-2000	100	39.7	26.8	15.7	8.6		266.6
June	1901-2000	100	38.4	27.5	58.1	8.15		244.5
July	1901-2000	100	33.6	25.6	181.5	6.6	204.6	
August	1901-2000	100	31.3	24.4	157.5	5.6	173.6	
September	1901-2000	100	32.6	23.7	73	6.4	192	
October	1901-2000	100	33.5	18.8	13.1	7		217
November	1901-2000	100	29.2	12.3	4	6		180
December	1901-2000	100	24.7	8.4	3.8	5.2		161.2
Total					529		570.2	1849.8

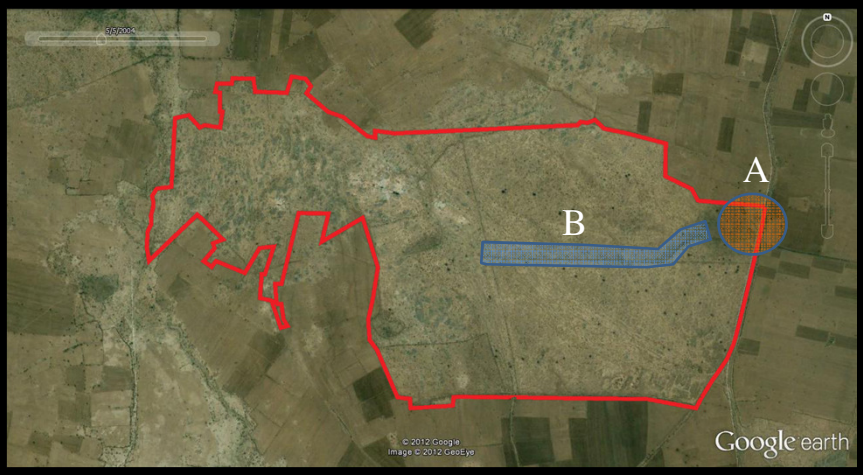
Site History (3/28/2000)



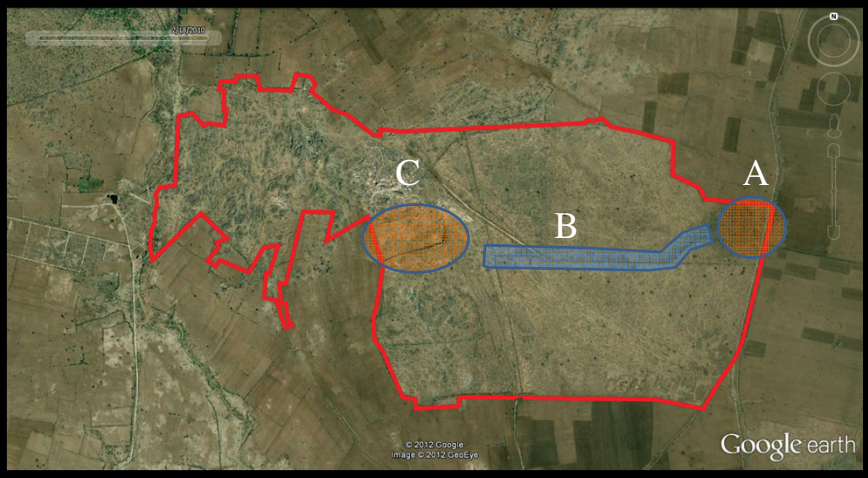
Site History (10/28/2001)



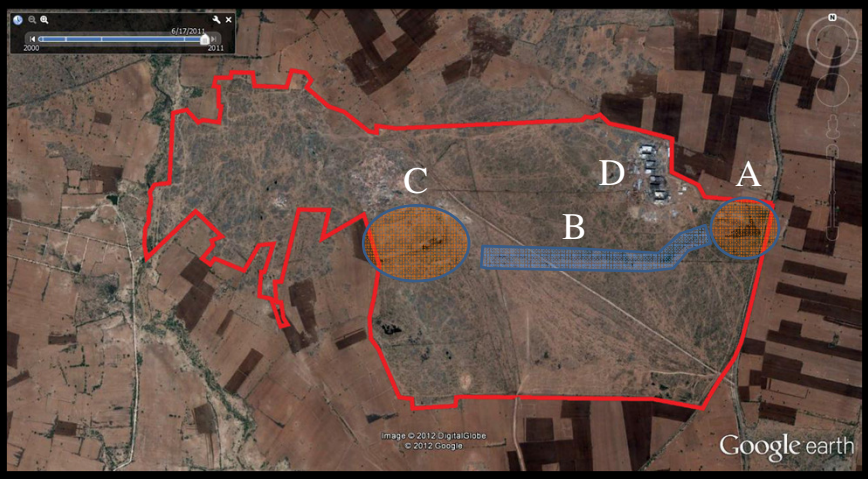
Site History (5/5/2004)



Site History (2/18/2010)



Site History (6/17/2011)



Study Area: Central University of Rajasthan Bandarsindri, Kishangarh

Existing Physical Development (2011)

- Out of 209 Ha of land 10 ha of land has been developed as a residential academic campus which includes
- Three Boy' Hostel
- One Girl's Hostel
- Three Semi Permanent Structures for Academics
- One Semi Permanent Structure for Auditorium and all other facilities

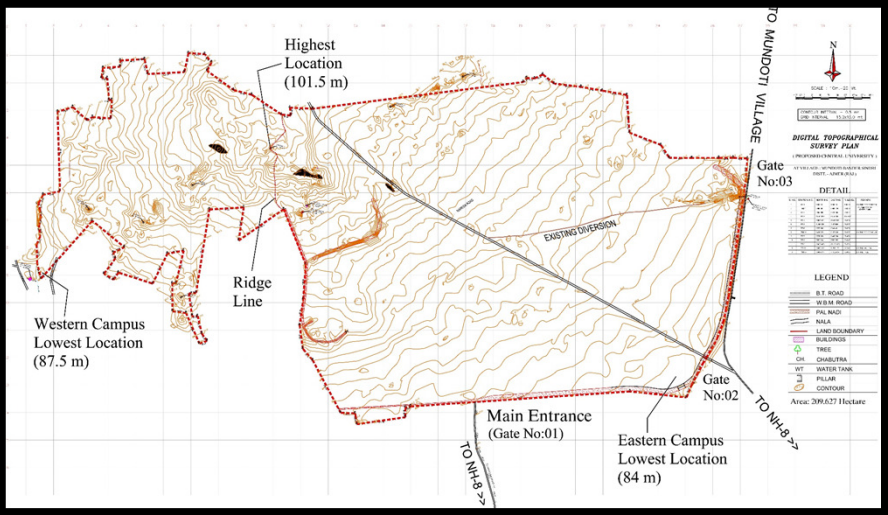
Proposed Physical Development (2025)

- University Administration
- Academic Zone
- Residential Zone
- Recreational zone
- Commercial Area
- Ecological Infrastructure
- Physical Infrastructure

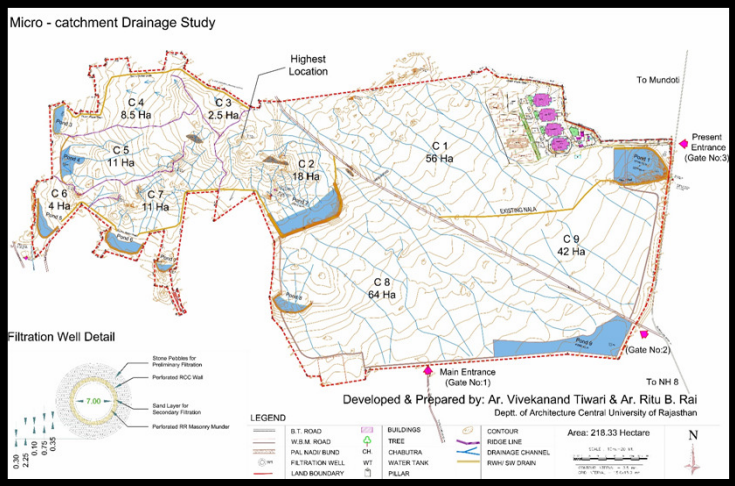
Site Challenges and Potential

- The site is located in hot and semi arid region of the Rajasthan state, where water is a scarce natural resource.
- Because of hard rocky strata the availability of Potable Ground Water is very less. In such case the collection of surface runoff (during rain) is much essential.
- Rain water collection is possible by micro watershed management strategy within the site boundary.
- For the development of micro watershed management plan, drainage analysis is required to understand the volume and flow pattern of rain water.

Site Topography



Site Drainage



- **Based on the site dynamics we adopted the Decentralize & Channelized water collection system which consists small Earthen Bunds, RR masonry and RCC reservoir**

Surface Runoff, ground water recharge and ET losses at Micro Watershed Level

- Only 80% of annual average rainfall will generate surface runoff
- The surface water bodies as well as the vegetative cover will lose 60% of surface water as evaporation and transpiration respectively.

Catchment	Area (Ha)	Runoff Coefficient	Surface Runoff (Cum)	GW Recharge during rain (Cu m)	Evaporation + Transpiration Loss (Expected 60 %)
	A	C	R = A x 80% RF x C	GW_R = A x 80% RF x (1-C)	ET = R x 60/100
C1	56	0.40	94796.80	142195.20	56878.08
C2	18	0.50	38088	38088	22852.80
C3	3	0.60	7617.6	5078.40	4570.56
C4	9.5	0.60	24122.4	16081.60	14473.44
C5	9.5	0.60	24122.4	16081.60	14473.44
C6	5	0.60	12696	8464	7617.60
C7	14	0.60	35548.8	23699.20	21329.28
C8	70	0.40	118496	177744	71097.60
C9	24	0.40	40627.2	60940.80	24376.32
Total	209		396115.2	488372.8	237669.12
Net Harvesting			R + GW_r – ET = 6,46,818.88 Cum		

Net water availability and optimal population size

Water harvested in surface water bodies and as ground water will be supplied for various usages considering the following practicality.

- Only 80% of the ground water can be possible yield
- The system losses in the supply of water from the surface water bodies and ground water exploration wells are 20%.

Thus the net available water (fresh water) **= 80% of (R+ 0.8GW_R - ET)** **= 439315.45 Cum**

Scenario1: Using 100% fresh water

- As per National Building Code 2005 the per capita per day consumption of water is 135 litters. Ensuring this standard and on the basis of net availability of water the optimum population of the campus will be,

Optimum population$_{(1)}$ **=** **Available water x 1000/ (135lpcd x 365)** **=** **8915 person**

Net water availability and optimal population size

Scenario2: Using fresh water &Recycled water

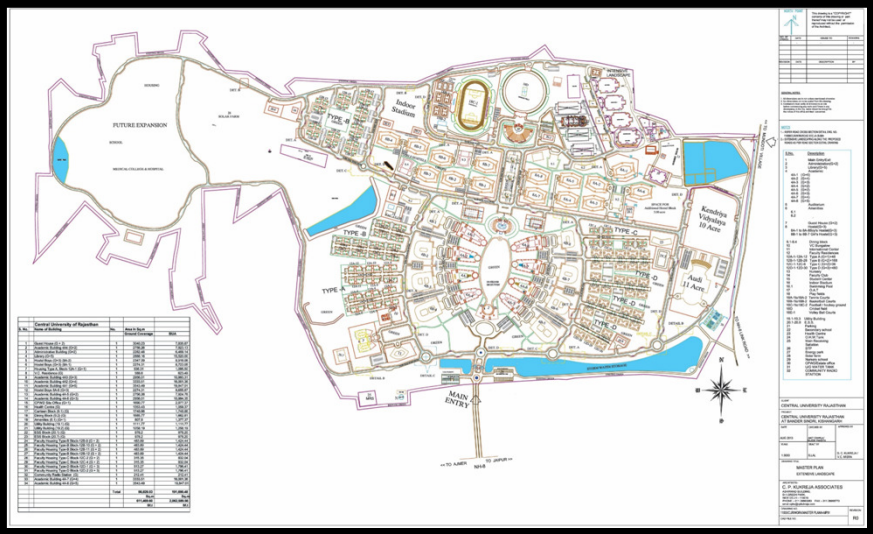
- The optimum population of the campus can be increased by using the treated water which will be supplied through the separate line from the waste water treatment plant.
- To meet the National Building Code 2005 standards, conventionally 45 litres per capita per day fresh water has been used in flushing if water is supplied at 135 litres per capita per day (lpcd).
- If recycled water is being used in flushing then the fresh water demand can be reduced to 90 lpcd from 135 lpcd. Thus the optimum population of the campus will be

Optimum population$_{(2)}$ **=** **Available water x 1000/ (90lpcd x 365)** **=** **13373 person**

Water Perceptive Campus Master Plan

- To instrument the concept of integrated micro-watershed management plan as a base layer of development plan of the University the three large and five small surface water bodies were conceptualized to ensure the maximum surface runoff collection during the rain.
- Three of these eight water bodies proposed in zone C1, C2 and C8 were planned to develop with the help of earthen embankment. One of these reservoirs in zone C8 was conceptualized to develop by deepening the already existing depression.
- Rest four comparatively small surface water bodies were proposed in zone C4, C5, C6 and C7. The water bodies have been planned and developed with the cost effective practices.

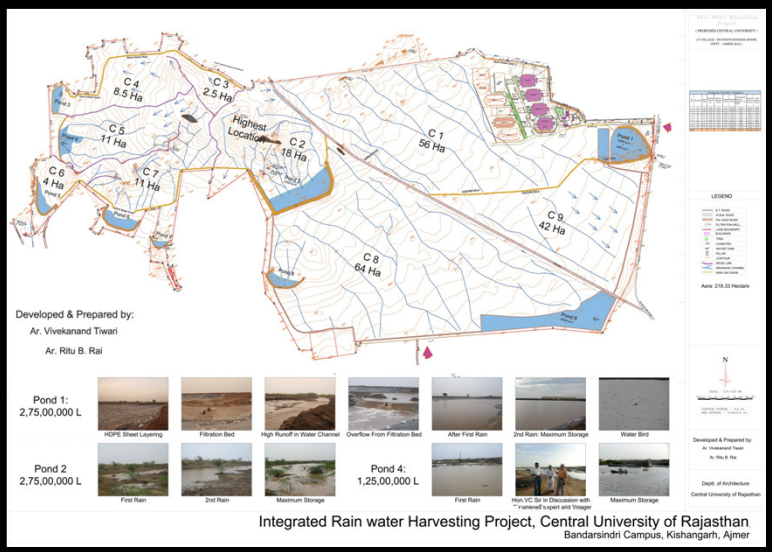
Evolution of Water Perceptive Campus Master Plan



Development of storm water storage infrastructure

- On the basis of Micro Catchment Drainage Analysis the storm water drainage plan has been developed to channelize the inland drainage to capture the maximum possible surface runoff during the rains.
- Initially the existing water channels were enhanced, channelized and directed to feed the water bodies. Later on these channels were replaced by the underground storm water drainage system.
- The water bodies are designed with filtration bed to ensure the quality of surface runoff reaching to the main reservoir.
- The average depth of three major water bodies is 3.0 to 3.5 m to increase the holding capacity and minimise the evaporation losses of these water bodies with less surface area.
- In principle all the water bodies are developed without base lining. The logic behind this is to ensure the continuous ground water recharge.
- As inspired by traditional practice in Rajasthan the Bentonite or the similar quality soil which is locally known as Murud has been identified as unique material to avoid any seepage from these water bodies.

Development of storm water storage infrastructure



Results & Conclusion

- The Integrated Micro Watershed Management Plan has been used as a tool to hold the surface runoff, augment the ground water table and enhance the overall ecological and environmental condition of the campus. The exercise enhanced the carrying capacity of the earmarked campus and also ensures the water availability for upcoming generations.
- Deepening the water bodies has increased the ground water recharge rate as well as reduced the direct evaporative losses due to reduction in the surface area of the stored water.
- The traditional knowledge in the form of age long successful practices should be adopted for the construction of medium scale water bodies. Traditionally the earthen embankments have been used for the construction of the water bodies. To line these water bodies the Bentonite like soil which is known as Murud (locally) is used in various parts of Rajasthan.

Results & Conclusion

- The revival of confined aquifers is positively helping the vegetation to grow and also ensures the availability of ground water during the dry months. Because of such revival the water bodies have attracted many bird species of this region.

Pond 1 at Gate No 3: Earthen Structure

- Pond Area: 17500 Sq m
- Maximum Height of the bund : 3.5 m
- Average Depth: 2.5 m
- Sedimentation Tank for siltation
- Pond surface : Hard Rock
- To prevent any seepage through crakes formed in weathered or hard rock HDPE sheet has been spread on bottom with 6 inch of soil cover

Pond 1 Sedimentation Tank

Water Channel Feeding to Pond 1

Surface Runoff

- Due to inefficient depth of top soil and its sandy typology, soil saturates immediately which results in high surface runoff

High Flow of water in main channel

Water Spillage from Sedimentation Basin

Challenge: Soil Management

- Heavy siltation due to high runoff of water which is not good for the pond capacity as well for the vegetative cover. So the Soil management should be the integral part of watershed management for the sustainable site planning.

- To prevent such siltation the native species should get incorporated in Landscape scheme.

Filled Water body with the backdrop of Built form: An Approach to Water Urbanism

Filled Water body with the backdrop of Built form:
An Approach to Water Urbanism

View of water body from the Dept. of Architecture:
An Approach to Water Urbanism

Pond 2: Earthen Bund

- Bund has been constructed through MNAREGA fund. Seepage is the major problem in this earthen bund which causes huge loss of water. Respecting the community effort we are maintaining this structure.

- Pond surface : Hard Rock
- Pond Area: 20500 Sq m
- Maximum Height of the bund : 3.5 m
- Average Depth: 2.5 m

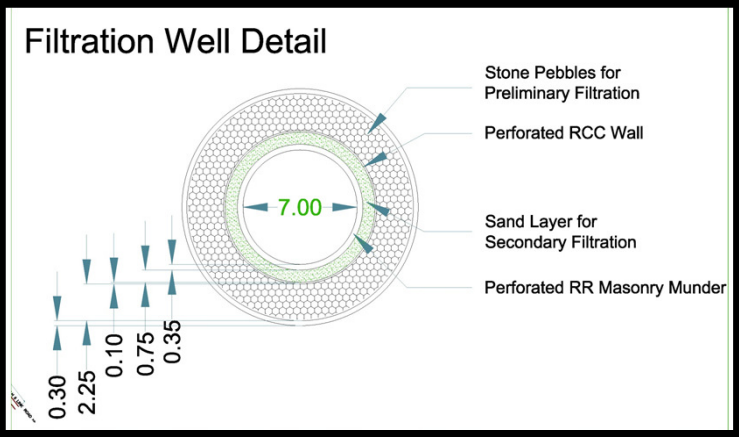
Post monsoon

Pond 4: Runoff Collection by Enhancing the Natural Channel

- Pond surface : Hard Rock
- Pond Area: 4500 Sq m
- Maximum Height of the RCC Retaining Wall : 2.5 m
- Average Depth: 2.0 m
- A filtration well is integrated for the collection of potable water

Post monsoon

Filtration Well Conceptual Sketch



Ecological Changes

- **The Water body has become the natural habitat for many birds**

Project Team

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Thank You