सिंचाई एवं जल संसाधन विभाग
हरियाणा

"Guidelines for construction and maintenance of Rooftop Rainwater Harvesting Structure"

STANDARD OPERATING PROCEDURE

Prepared by
Technical Branch
Ground Water Cell
Irrigation & Water Resources Department
Haryana

&

Published by
Haryana Water Resources Authority
Rear Building, 3rd Floor, HSVP, Sector-6,
Haryana, Panchkula

Haryana Water Resources Authority
Rear Building, 3rd Floor, HSVP, Sector-6, Panchkula
Website: www.hwra.org.in

MESSAGE

Water is scarce natural resources and very precious for life, livelihood, food security and sustainable development. Ground water has emerged as the backbone of India's Agriculture and drinking water security. Over the years, increasing dependence on ground water has created imbalance in availability vis-à-vis its recharge potential leading to over-exploitation of the resources. In Haryana, about 67% of Agriculture sector depends on ground water. This situation calls for immediate action for prudent management of ground water resources of the state to ensure its sustainability. Management of ground water resources requires a structured scientific approach.

For management of ground water resources a standard operating procedure (SOP) regarding "Guideline for construction and maintenance of Rooftop Rainwater Harvesting Structure (RTRWHS) has been prepared on the basis of depth to ground water level, occurrence of aquifer, Geohydrological conditions and rainfall by Ground Water Cell, Irrigation & Water Resources Department, Haryana. Thus, the SOP on construction and maintenance of Rooftop Rainwater Harvesting Structure (RTRWHS) of the state assumes added significance. This document will seem as a broad guideline for implementation of water conservation techniques & recharge to ground water in a big way. The efforts made by Ground Water Cell, Irrigation & Water Resources Department and Hon'ble Members of Haryana Water Resources Authority in bringing out this document are highly commendable.

I am sure the SOP will go a long way in proper management of ground water resources and empowering the general public and all stakeholders.

(Keshni Anand Arora, IAS (Retd.))
Chairperson, HWRA

Dr. Satbir Singh Kadian
(Engineer-in-Chief)
Irrigation & W.R. Deptt., Haryana, Panchkula
MICADA & National Programmes,
Phone No.: 0172-2582548

PREFACE

Ground Water is considered to be a dependable source for meeting the requirement of Irrigation & drinking water in the State. Ground water levels are declining in some regions/ areas due to excessive withdrawal. This situation calls for a prudent management of ground water resources of the state to ensure its sustainability. Management of ground water resources requires a structured scientific approach.

A standard operating procedure (SOP) regarding "Guideline for construction and maintenance of Rooftop Rainwater Harvesting Structure (RTRWHS) has been prepared on the basis of depth to ground water level, occurrence of aquifer, Geohydrological conditions and rainfall by Ground Water Cell, Irrigation & Water Resources Department, Haryana. The main objective of the document is to artificially ground water recharge by construction and maintenance of RTRWHS to arrest sharp declining of ground water in the state.

I laud the efforts made by the Ground Water Cell, Irrigation & Water Resources Department and Hon'ble Members of Haryana Water Resources Authority in bringing out document.

I firmly believe that this document would serve as an excellent guideline for all stakeholders involved in ground water management.

(Dr. Satbir Singh Kadian)

Haryana Water Resources Authority
Rear Building, 3rd Floor, HSVP, Sector-6, Panchkula
Website: www.hwra.org.in

CONTRIBUTORS

Ground Water Cell, Irrigation & Water Resources Department, Govt. of Haryana

1. Sh. Rakesh Kumar, Chief Hydrologist, Ground Water Cell, Panchkula, Haryana
2. Sh. Pankaj Mahala, Hydrologist, Ground Water Cell, Panchkula, Haryana.
3. Sh. Abhinav Giri, Technical Assistant, Ground Water Cell, Panchkula, Haryana.
4. Sh. Rakesh Kumar, Divisional Head Draftsman, Drawing Branch, Ground Water Cell, Panchkula, Haryana.
5. Sh. Sudhir Kumar, Ground Water Expert, Ground Water Cell, Panchkula, Haryana.

Under the Supervision & guidance of:

1. Sh. Dharampal Singh Beniwal, Hon'ble Member, Haryana Water Resources Authority, Panchkula
2. Sh. Mukhtyar Singh Lamba, Hon'ble Member, Haryana Water Resources Authority, Panchkula
3. Sh. Sanjay Marwaha, Hon'ble Member, Haryana Water Resources Authority, Panchkula

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1 Introduction

Rooftop Rain Water Harvesting Structure (RTRWHS) is the technique through which rain water is captured from the roof catchments and used to recharge groundwater aquifer artificially. Government departments/offices who is constructing roof top rain water harvesting structures for ground water recharge in Govt. buildings should give priority for construction of rainwater harvesting structures in Over-exploited & critical blocks in the State and those villages where depth to ground water level is >10m bgl.

In view of the importance and utility of ground water, attempt has been made to prepare a guideline to standardize the procedures and methodology for maintenance of RTRWHS. Generally, maintenance of RTRWHS can be defined as an effort to maintain RTRWHS for recharging groundwater by capturing maximum rainwater during monsoon season. This Standard Operating Procedure (SOP) has been prepared to help field offices of Ground Water Cell, I&WRD to identify defunct RTRWHS and for undertaking maintenance work of already constructed RTRWHS in routine manner.

2. Need for Rooftop Rain Water Harvesting Structure:

1. To meet the ever-increasing demand for water
2. To reduce the runoff which chokes storm drains
3. To avoid flooding of roads
4. To augment the ground water storage and control decline of water levels
5. To reduce ground water pollution
6. To improve the quality of ground water
7. To reduce the soil erosion
8. To supplement domestic water requirement during summer, drought etc.

3. Instructions for construction of Roof Top Rainwater Harvesting Structure (RTRWHS)

1. **Preference for construction of recharge structures** will be given in following order:
   a) Notified area.
   b) Highest decline in water table area.
   c) Over-exploited blocks.
   d) Villages where depth to ground water level is >10m bgl.
   e) Where quality of groundwater is fresh/marginal.
2. It must be ensured that the **contaminated water should not reach the site** in any manner.

3. **No recharge structure will be constructed in water logged area** where water level is less than or equals to 10 metres, as per the guidelines of Central ground Water Board, GOI. Also avoid the construction of recharge structure in saline area.

4. **The Roof-top area** where recharge structure is to be constructed should be more than 100 square metres.

5. Obtain **undertaking from the Head/Officer-in-charge** of the premises prior to the construction of recharge structure.

7. After completion of construction of the structure, **handing-over the structure** to Officer-in-charge of the premises/building.

8. The **size of recharge pit/ tank** should be, for uniformity, of 3.0*3.0*3.0 m3 dimensions. However, its shape will be square covered with Iron-Jal in order to have better display in pictures. The laying of filter-material should be 0.6m, 0.50m and 0.40m thickness, comprising of respectively the rounded (not broken) boulders, pebbles and gravels from bottom to top, leaving at least 1.50m free-board in the pit/tank. Availability of rainfall for artificial recharging of groundwater for RTRWHS is given at page no. 7 at Annexure-I.

9. The **depth of Recharge/Injection well** should not be less than 10 mtrs. and not more than the first aquifer encountered after water level at the site. It should have maximum possible length of perforated/slotted pipe or filter pipe. For uniformity, the size of pipe should be of 125-150 mm or 5"- 6" dia. In order to have sufficient gravel-packing, boring of 10" dia should be undertaken. The PVC pipes should be ISI-marked of at least 10 kg/cm^2 strength. The well-cap should have some small holes for passage of air during water-intake.

10. **Number of recharging sites can be more than one** if the catchment area is more than 2000 sq. mtrs or aquifer acceptance is less to recharge one day average rainfall in 48 hours.

11. **Rate of recharge** also be checked after completion of the site for 48 hours.

12. **Rates/ NOC** of pipes be collected from the Supplies & Disposal department.

13. A **display board** with dimensions 120*100 cm made of Iron must be placed/ installed on every site, displaying following information:
    a) Design of structure along-with general lithology in 1/4th part vertically.
    b) Year of construction.
    c) Depth of Injection well.
    d) Water table at the time of its construction.
    e) Name of the constructing department along with designation of officer.
    f) Particulars of the responsible person for maintenance, i.e. Head/Officer-in-charge of the premises/building.

g) Display board on the sites constructed last year and could not be mounted due to any reason must also be install during this year.

h) For any information regarding the site, contact the constructing department

i) Anybody destroying this site shall invite prosecution.

*** The instructions and design of RTRWHS may vary according to the topography and Hydrology of the area.

3.1 Calculation for determining volume of ground water recharge by each structure:

It is assumed that the total catchment area in the school is about 2000 sq.m which includes ground water collected from roof-top (pucca) and ground surface (kacha) of the school. And average rainfall during last 5 year is 500 mm. Let us assume Total Water available through rainfall for recharge in premises as X, the X will be calculated as under: -

X= Rainfall*catchment area

X= (500/1000) m*2000Sq.m=1000 cubic meter

Average Annual Recharge (AAR) = X*Coefficient factor

Coefficient Factor:

Sr. No.	Area	% of Coefficient factor
1	Rooftop	80-85
2	Road/Paved	65-75
3	Green belt/Open land	15-25

(Source: Manual on Artificial Recharge of Ground Water 2007 by CGWB)

AAR available from Rooftop Area=600*0.85 = 510 cubic meters

AAR available from Road/paved area: 245*0.65 = 159.25 cubic meters

AAR available from Green belt/open land: 155*0.20 = 31 cubic meters

Total AAR =700 cubic meter

Or ~700000 litres (~7.00 lakh litre)

(For detailed design please see section 3.3)

**Many losses seepage, evaporation etc. occur on roof top and ground surface before reaching the RWH structure pit. Therefore about 85% of the rain water gets recharged from rooftop area, 65% of the rain water gets recharged from road/paved area and 20% of the rain water gets recharged from green belt/open land area.

Cost of per litter water recharge annually is as under:

- The tentative expenditure on construction of unit RWH structure is about 2.20 lakh.
- One time expenditure cost for 1 litre water recharged:

$$\frac{\text{Cost of System (in Rs)}}{\text{Annual Ground Water Recharged (in Litter)}}$$

≈ 220000/700000

Estimated life of one structure ≈ 15 years

≈ 0.021Rs/litre

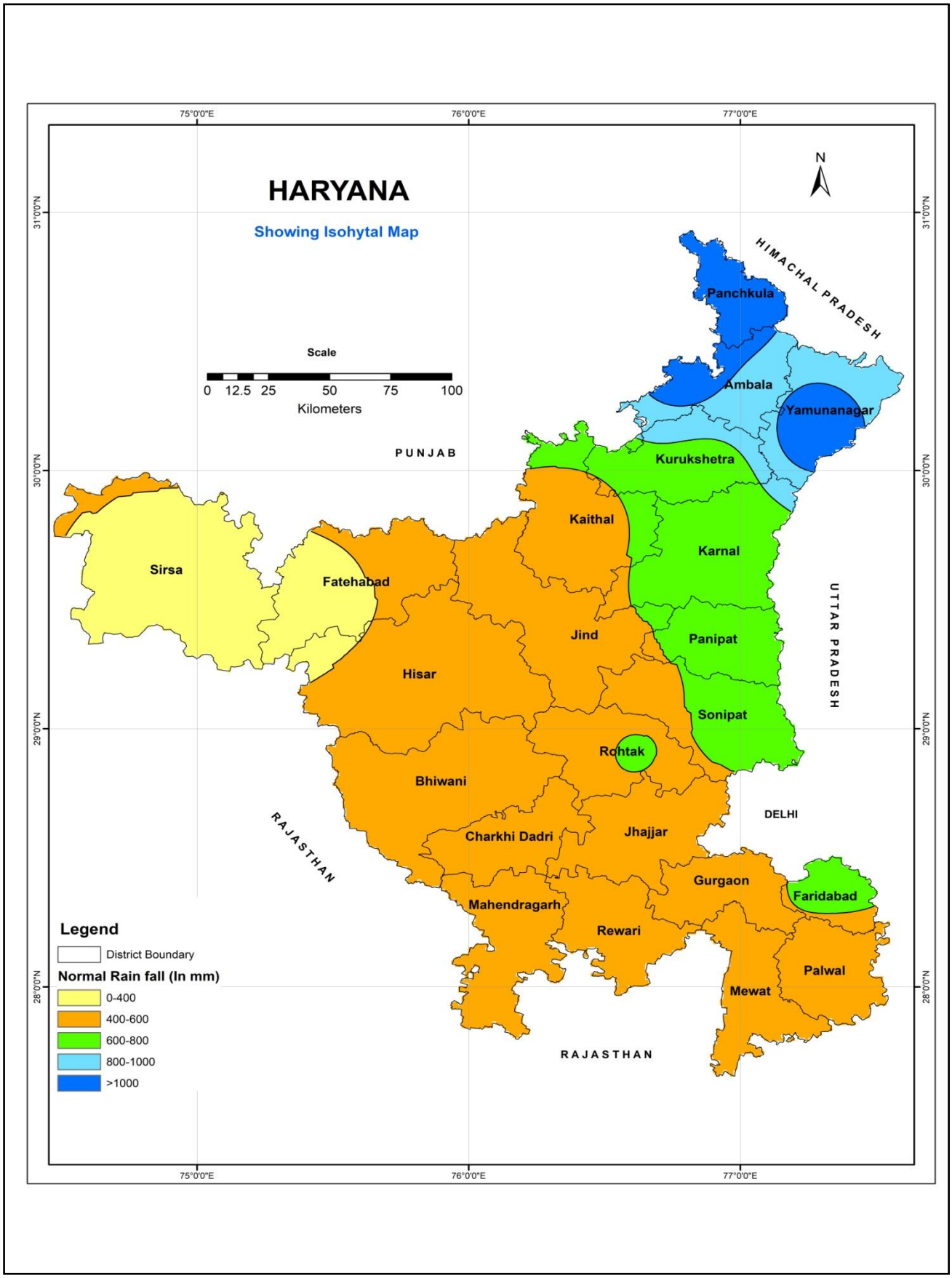
≈ 02 Paisa/litre

3.2 District-wise Normal Rainfall in Haryana in 2020

Sr. No.	District Name	Normal Rainfall (mm) 2020
1.	Ambala	1104.7
2.	Bhiwani	419.5
3.	Charkhi Dadri	418.6
4.	Faridabad	697.6
5.	Fatehabad	364.6
6.	Gurugram	544
7.	Hisar	401.4
8.	Jhajjar	489
9.	Jind	509.1
10.	Kaithal	466.5
11.	Karnal	714.4
12.	Kurukshetra	691.4
13.	Mahendergarh	476.2
14.	Mewat	572
15.	Palwal	508.1
16.	Panchkula	1148.2
17.	Panipat	624.1
18.	Rewari	492.2
19.	Rohtak	618
20.	Sirsa	313.5
21.	Sonepat	644.2
22.	Yamuna Nagar	1107

(Source: Year Book 2020-21 published by CGWB)

Map of Normal Rainfall of Haryana-2020 PLATE-I

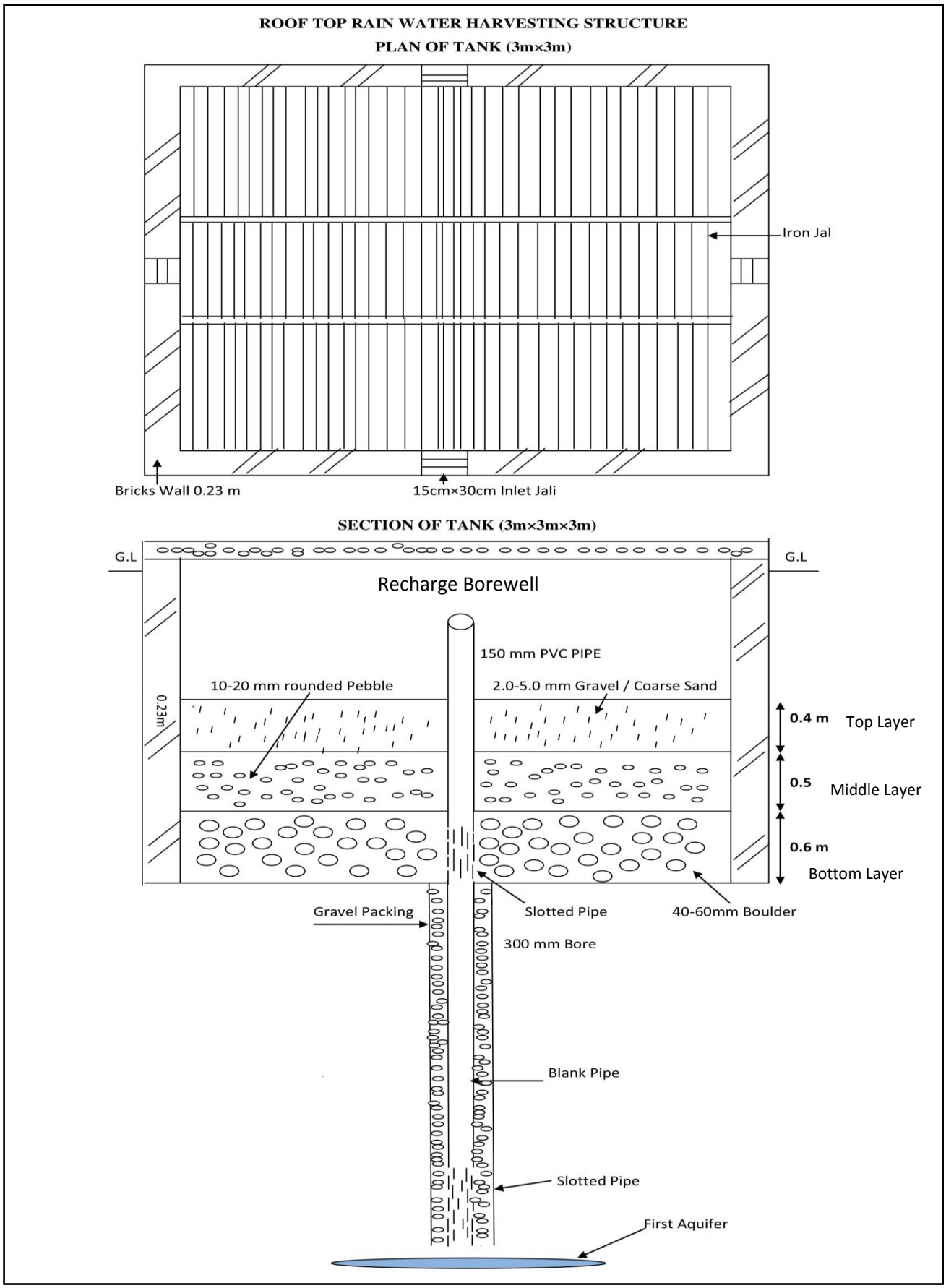


(Annexure-I)

Availability of Rainfall for Roof Top Rainwater Harvesting

Name of District with Avg. Annual Normal Rainfall	-	Sirsa	Fatehabad, Hisar, Ch. Dadri & Bhiwani	Kaithal, M.Garh, Jhajjar, Palwal, Jind Gurugram & Rewari	Mewat, Rohtak, Panipat, Sonepat	Kurukshetra, Faridabad, Karnal	Ambala & Yamuna Nagar	Panchkula
Rainfall (mm)	200	300	400	500	600	800	1000	1200
Roof top Area (Sq.m)	Harvested Water from Roof top (cu.m)							
10	1.7	2.55	3.4	4.25	5.1	6.8	8.5	10.2
20	3.4	5.1	6.8	8.5	10.2	13.6	17	20.4
30	5.1	7.65	10.2	12.75	15.3	20.4	25.5	30.6
40	6.8	10.2	13.6	17	20.4	27.2	34	40.8
50	8.5	12.75	17	21.25	25.5	34	42.5	51
60	10.2	15.3	20.4	25.5	30.6	40.8	51	61.2
70	11.9	17.85	23.8	29.75	35.7	47.6	59.5	71.4
80	13.6	20.4	27.2	34	40.8	54.4	68	81.6
90	15.3	22.95	30.6	38.25	45.9	61.2	76.5	91.8
100	17	25.5	34	42.5	51	68	85	102
200	34	51	68	85	102	136	170	204
300	51	76.5	102	127.5	153	204	255	306
400	68	102	136	170	204	272	340	408
500	85	127.5	170	212.5	255	340	425	510
600	102	153	204	255	306	408	510	612
700	119	178.5	238	297.5	357	476	595	714
800	136	204	272	340	408	544	680	816
900	153	229.5	306	382.5	459	612	765	918
1000	170	255	340	425	510	680	850	1020
2000	340	510	680	850	1020	1360	1700	2040
3000	510	765	1020	1275	1530	2040	2550	3060
4000	680	1020	1360	1700	2040	2720	3400	4080
5000	850	1275	1700	2125	2550	3400	4250	5100

3.3 Design of Rooftop Rain Water Harvesting Structure (Approved by Irrigation & Water Resources Department, Haryana)



4. O & M of Existing Rooftop Rainwater Harvesting Structure:

Periodic maintenance of artificial recharge structures is essential because infiltration capacity reduces rapidly as a result of silt deposits. In the case of injection wells, periodic maintenance of the system consists of development of recharge well by air compressor or with the help of 2 inches dia boki. Structural maintenance, if required, is normally carried out either by government agencies or through initiatives of stakeholders.

Success of artificial recharge schemes and related developmental activities primarily depend on the cooperation of the community and hence, should be managed at the local level.

5. Identification of defunct RTRWH Structure

The first and foremost task is to assess the present defunct structure which would essentially require mapping /survey of all the structures which are not working properly through well inventory/google sheet. The parameters to be captured under this exercise are depth of recharge borewell, condition of filter media, condition of surrounding surface, condition of rooftop etc. The Survey is to be carried out by the staff of concerned department/office before monsoon i.e. last week of April. Preferably, a register/record can also be maintained by the concern department/Office.

6. Schedule of Maintenance of Roof Top Rainwater Harvesting Structure

Maintenance of roof top rainwater harvesting structure (RTRWHS) is simple and costs are given in *Annexure-III*. It requires continuous care and maintenance as per check list (***Annexure-II***).

A. <u>Maintenance of RTRWHS should be completed before monsoon i.e. upto first week of June of every year.</u>

1. Date of reporting is 10^{th} June of every year.
2. This includes cleaning of inlet & outlets, surrounding of the filter chamber clean and hygienic.
3. After opening of Iron Jal leaves and other unwanted materials should be removed from filter chamber.
4. Washing of top layer of filter media i.e. 0.40m thick gravel/coarse sand. During washing of filter chamber there is loss of filter chamber material hence approx. 20% of filter chamber material additional requirement.
5. 02 water tanker also required for washing filter chamber ($3.6m^3$)
6. Development of injection well through boki/air compressor is required time to time once in every 03 years.

B. 1st to 15th August of every year

1. Date of reporting is 10th Sept. of every year.
2. Cleaning of inlet & outlets, surrounding of the filter chamber clean and hygienic.
3. After opening of Iron Jal, leaves and other unwanted materials should be removed from filter chamber.

C. 1st to 15th December of every year

1. Date of reporting is 25th December of every year.
2. Cleaning of inlet & outlets, surrounding of the filter chamber clean and hygienic.
3. After opening of Iron Jal, leaves and other unwanted materials should be removed from filter chamber.

D. After every 03 years

1. Reporting date is 10th June of every year
2. Cleaning of borewell through 2 inches dia boki or development of bore through air compressor machine.
3. Re-painting and re-writing works on Sign board should be done.

7. Tips for Maintenance of the RTRWHS

- Always keep the surroundings of the tank clean and hygienic
- Remove algae from the roof tiles and asbestos sheets before the monsoon
- Clean the water channels often during rainy season and definitely before the first monsoon rain
- Avoid first 15 or 20 minutes of rainfall depending on the intensity of rain. Use the first flush arrangement to drain off this first rainwater.
- Cover all inlet and outlet pipes with closely knit nylon net or fine cloth or cap during non-rainy season to avoid entry of insects, worms and mosquitoes
- Water should not be allowed to stagnate in the filtration chamber.
- The top layer of filter material should be washed thoroughly before replacing in the filter chamber.

People may be educated by providing the above tips for maintenance of the system through pictures, handouts and wall posters.

Example:

Rooftop Rainwater Harvesting Structure (RTRWHS) constructed by the O/o Hydrologist, Ground Water Cell, Irrigation & Water Resources Department (I&WRD), Ambala in the premises of Govt. Model Sanskriti Primary School, Kesri, Block-Saha, District-Ambala during 2021-2022. The basic details of the Structure are as under:

1.	Name of district/ block	Ambala
2.	Name of block	Saha
3.	Name of Village with location of site	Govt. Model Sanskriti Primary School, Kesri
4.	Coordinates	Lat. 30.234497
		Long. 76.908637
5.	Status (working or non-working)	Working
6.	Total Catchment Area (Sq.m)	4000
7.	Rooftop Area (Sq.m)	1200
8.	Open/Green Belt Area (Sq.m)	2800
9.	Avg. Annual Rainfall (mm)	1000
10.	Total Available Annual Recharge (cub.m)	1580
11.	Total Available Annual Recharge (litter)	1580000

Fig. 1 Govt. Model Sanskriti Primary School, Kesri

Fig.-2 Rooftop Rainwater Harvesting Structure (RTRWHS)

Fig. 3 Display Board

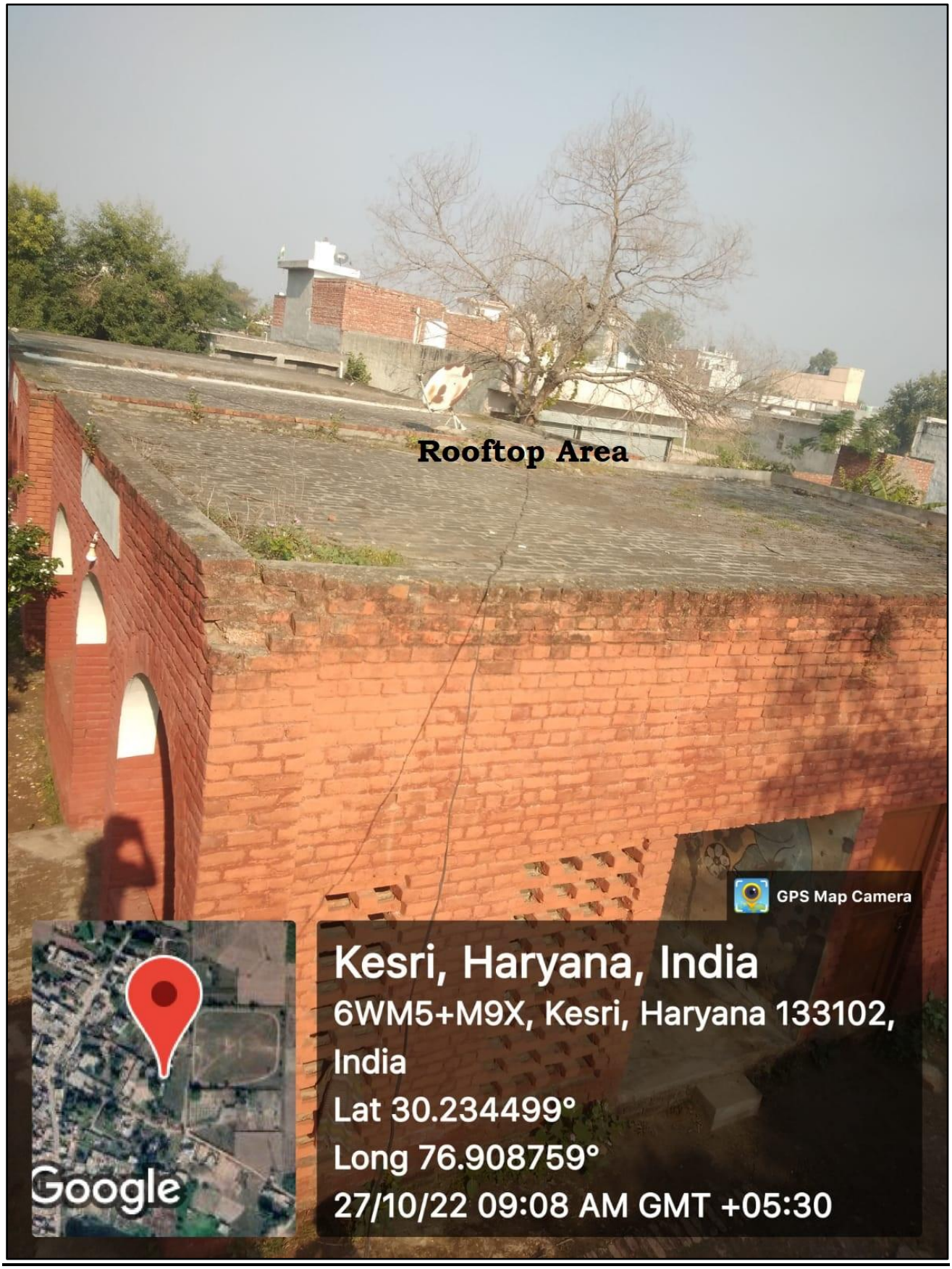


Fig.-4 Rooftop Area

Fig.-5 Open Area/Green Belt Area

Fig. 6 Road/Paved Area

(Annexure-II)

Check List of Activities

Sr. No.	Activity completion duration	Activities	Status	
			Achieved (✓)	Not-Achieved (×)
1	1st week of June every year (Reporting date is 10th June of every year)	1. Cleaning of inlet & outlets, surrounding of the filter chamber clean and hygienic. 2. After opening of Iron Jal leaves and other unwanted materials should be removed from filter chamber. 3. Washing of top layer of filter media i.e. 0.40m thick gravel/coarse sand.		
2	1st to 15th August of every year (Reporting date is 10th Sept. of every year)	1. Cleaning of inlet & outlets, surrounding of the filter chamber clean and hygienic. 2. After opening of Iron Jal leaves and other unwanted materials should be removed from filter chamber.		
3	1st to 15th December of every year. (Reporting date is 25th December of every year)	1. Cleaning of inlet & outlets, surrounding of the filter chamber clean and hygienic. 2. After opening of Iron Jal leaves and other unwanted materials should be removed from filter chamber.		
4	After every 3 years (Reporting date is 10th June of every year)	1. Development of site through boki / air compressor. 2. Painting and writing works on Sign board after every three years.		

(Annexure-*III*)

TENTATIVE REPAIR COST COMPONENT-WISE OF RAIN WATER HARVESTING STRUCTURE

Sr. No.	Description of Activities	No. of Labour	No. of working days	Amount (In Rs)	GST	Total including GST (In Rs.)
A	**Activities upto 1st week of June every year (Before Monsoon)**					
	1. Cleaning of inlet & outlets, surrounding of the filter chamber clean and hygienic. 2. After opening of Iron Jal leaves and other unwanted materials should be removed from filter chamber.	02	1	500.00	-	1000.00
	Washing of top layer of filter media i.e. 0.40m thick gravel/coarse sand.	02	02	500.00	-	2000.00
	Filter material 20% to add after washing Pebble, Gravel & Boulder (Especially top layer of filter media).	-	-	2000.00	5%	2100.00
	02 Nos. of Water Tanker.	-	-	1500.00 each	5%	3150.00
B	**1st to 15th August of every year**					
	1. Cleaning of inlet & outlets, surrounding of the filter chamber clean and hygienic. 2. After opening of Iron Jal leaves and other unwanted materials should be removed from filter chamber.	02	1	500.00	-	1000.00
C	**1st to 15th December of every year**					
	1. Cleaning of inlet & outlets, surrounding of the filter chamber clean and hygienic. 2. After opening of Iron Jal leaves and other unwanted materials should be removed from filter chamber.	02	1	500.00	-	1000.00
D	**After every 3 years**					
	Development of site through boki / air compressor.	-	-	6000.00/4hr	18%	7080.00
	Painting and writing works including Primer & Painting on Iron Net with labour on Sign	-	-	2000.00	18%	2360.00

	board after every three years (NS Item).					
	02 Nos. of Water Tanker.	-	-	1500.00 each	5%	3150.00
	Miscellaneous for repair (RTRWHS)	-	-	3000.00	-	3000.00

** Maintenance Cost of Structure may be vary from district to district on the basis of hydro-geology and availability of resources.*