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Government of India
Ministry of Water Resources,
River Development & Ganga Rejuvenation
Central Ground Water Board

PLAN ON

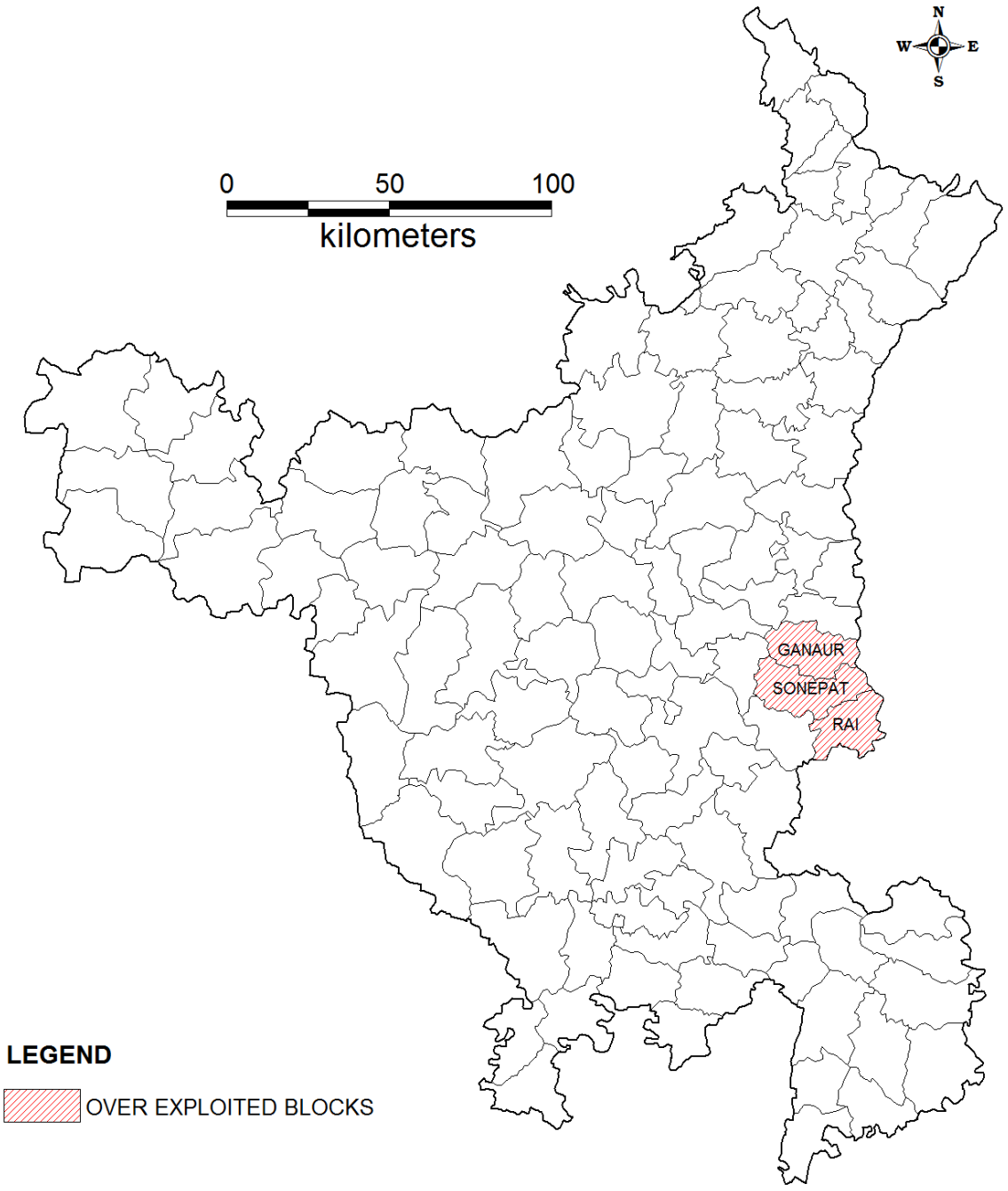
ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION

IN OVEREXPLOITED BLOCKS OF

SONEPAT DISTRICT, HARYANA

Central Ground Water Board
North Western Region
Chandigarh

PLAN FOR ARTIFICIAL RECHARGE TO GROUND WATER IN OVER EXPLOITED BLOCKS OF SONEPAT DISTRICT, HARYANA



PLAN OF ARTFICIAL RECHARGE TO GROUND WATER IN OVER EXPLOITED BLOCKS, DISTRICT SONEPAT HARYANA

INTRODUCTION

Administratively, the district is under control of Rothak division and is divided into 3 sub-divisions/tehsils namely Sonepat, Gohana and Ganour. Further, the district has been sub-divided into seven development blocks i.e. Ganaur, Kharkhoda, Rai, Sonepat, Mundalana, Kathura and Gohana. Sonepat district has 7 towns and 343 villages with a total population of 14,50,001 as per 2011 census.

HYDROMETEOROLOGY

The climate of the district can be classified as tropical and dry sub humid. The normal annual rainfall is about 567 mm which is spread over 30 rainy days. 76% of rainfall occurs during south-west monsoon.

GEOMORPHOLOGY

The area forms a part of the Indo-Gangetic plains and exhibits flat terrain with general slope from North to South. The area is devoid of any prominent topographic features. However, a natural depression exists in North & Northwest of Gohana ($29^0$08'22"N & $76^0$42'55"E). The maximum elevation of the plain is 230m above msl. Topographically the district can be divided into the following units.

1. Active flood plains along the present day course of the river Yamuna in eastern part of the district.
2. Abandoned flood plains of recent past. These are generally bordering the active flood plains and are wider, low lying flat tracts.
3. Upland plains representing the relatively older river deposits. The western Yamuna canal has been roughly aligned along the ridge formed by upland plains.

HYDROGEOLOGY:

Ground water occurs in alluvial sand, silt, kankar and gravel, which form potential aquifer zones. Depth to water level during pre-monsoon varies from 1.54 - 36.20 m while during post-monsoon it varies from 1.07- 34.10 m. The depth to water level lies within 5 – 20 m below the land surface in most parts of the district. It rests between 2 to 25m deep in the eastern side and 2 to 10m in the north western parts of the district. Only in small patches in the Rai block, water tables are deeper having range of 20m to 40m. Water table elevations range from 230 to 220m amsl and the general ground water flow is from northwest to southeast. In general, the water table has declined all over the district over the past decade. During past one decade the district has recorded a fall of less than 1m to 7m .The decline was 2 to 4m in most parts of the district. Long term water level fluctuations indicate rise of water level over a period of last one decade in Mundlana, Kathura, Kharkhoda and Rari blocks. The trend of rise of water level is in the range of 0.05 to 0.32m/year. The trend of decline of water level is 0.05 to 0.95m/year. Aquifer group-I which was in unconfined state extends from water table down to 70m depth. A tube well located at Khera in the eastern part of the district and tapping this aquifer group-I, yielded 4540 lpm for about 7.5m of drawdown. Aquifer characteristics at Khera site were - Transmissivity: 2340m^2/day; Lateral Hydraulic conductivity - 36m/day and specific yield - 2.15 x 10^{-1} (21.4□). This aquifer group-I contains fresh water in eastern parts of the district. Aquifer group-II which is under semi-confined / confined state occurs in the depth range of 90 to 200m and has not been tested for its yield and aquifer characteristics since the formation water is saline. Aquifer group-III which too is under confined state occurs in the depth range of 250 to 400m and contains brackish saline ground water.

Discharge of the tubewells increases from west to east towards river Yamuna. Good aquifer exists in the flood plain of Yamuna River. The discharge of tubewells constructed in Mundlana, Gohana, Kathura, Kharkoda blocks is generally upto 10 lps(86.4_m^3/day). However, in the eastern parts of Ganaur, Sonepat and Rai blocks high discharge wells upto 20 lps have been reported.

GROUND WATER QUALITY:

The shallow ground water of the district is generally alkaline in nature and is moderate to highly mineralized with EC ranging from 438 to 6660µS/cm. at 25^{0}C. Ground water occurring

in the southern and N-W parts of the district is more saline as compared to ground water occurring in the rest of the district. Among anions, either bicarbonate predominates or none of the anion dominates. Similarly, among cations, sodium predominates in 50% of the samples and in the remaining calcium + magnesium combined dominates. On comparing the ionic concentration of major ions with the recommended limits prescribed by Bureau of Indian standards for drinking waters, it is found that more than half (68%) the ground waters are not suitable for drinking purposes mainly due to salinity and fluoride contents that exceed the maximum permissible limits of these chemical parameters, which are 3000µS/cm. and 1.5mg/l respectively. Plot of USSL diagram used for the determination of irrigation rating of ground water indicates that ground waters at several places fall under C_2S_1, C_3S_1, C_3S_2, C_4S_2 classes of irrigation rating. These waters are, therefore, suitable for customary irrigation for salt tolerant crops like wheat, rice, maize, gram etc without any fear of salinity hazards to the crops. Waters falling under C_4S_3 and C_4S_4 classes are likely to cause salinity as well as sodium hazards. It would be better if such waters are used for irrigating salt tolerant crops along with appropriate amount of gypsum on well drained soils. The shallow ground water is of Ca +Mg-HCO_3 and Na-mixed Anion type and mixed facies type of water also occur in the district. The fluoride concentration ranges from 0.25 to 2.75 mg/l. Iron concentration ranges from 0.03 to 9.84 mg/l and arsenic concentration ranges from 0.0011 in Kharkhoda Block to 0.0285 mg/l in Ganaur Block.

GROUND WATER RESOURCES:

Ground Water Resources estimation of the district was done as on 31.03.2011 as per GEC-1997 for each individual block. Stage of ground water development in the district is 139%. The ground water development in three blocks (viz., Ganaur, Rai, Sonepat) of the district has exceeded the available recharge and thus all the blocks have been categorized as “over exploited”. Gohana block is “Critical”, Kharkhoda is “Semi-Critical” and the remaining two blocks are “Safe”. Net ground water availability of the district is 769.98 million cubic meter (mcm), ground water draft for all users is 1026.17 mcm, whereas net ground water availability for future irrigation development is -302.58 mcm.

GROUND WATER IRRIGATION SCENARIO

As per the data available from minor irrigation census 2006-07 the detailed number of shallow, deep, tubewells, lined, unlined water distribution system, land holdings of wells are given below for reference

Distribution of Shallow Tubewells According to Owner's Holding Size

No. of shallow tube wells by size class of individual owner							
Sr.no	District	Marginal (0-1 ha)	Small (1-2 ha)	Semi-Medium (2-4 ha)	Medium (4-10ha)	Others	Total
1	Sonepat	128	366	3212	12884	19262	34952

Distribution of Deep Tubewells According to Owner's Holding Size

No. of deep tube wells by size class of individual owner							
Sr.no	District	Marginal (0-1 ha)	Small (1-2 ha)	Semi-Medium (2-4 ha)	Medium (4-10ha)	Others	Total
1	Sonepat	10	97	219	317	1892	2535

Distribution of Shallow Tubewells According to Depth of tube well

No. by the depth of shallow Tube well							
Sr.no	District	(0-20 mts)	(20-40 mts)	(40-60 mts)	(60-70 mts)	(>70 mts)	Total
1	Sonepat	0	0	31410	3505	37	34952

Number of Ground Water Schemes and Potential Utilized by water distribution device

Ground Water Schemes according to water Distribution System				
	Open Water Channel			
Sr.no	District	Lined/pucca	Unlined/kutcha	Total
1	Sonepat	28144	9343	37487

PLAN OF THIS REPORT

In this plan 2 types of the recharge structures are proposed such as Roof Top Rain water harvesting in rural & urban areas and Recharge pits in agriculture lands of 5mt x5mt x3mt size. The pit will be surrounded by angle irons and barbed fencing. The size and depth depend on the availability of the land. The extra water available on the field will be stored in the pit and that will also be recharged to the ground water.

A summery outline of the artificial recharge plan for the entire district of each block is given at the beginning in tabular forms. This is followed by the salient features of each block along with the detailed structure-wise recharge plan and cost estimates.

Details of the block wise type of suitable recharge structures and volume of water assured for annual recharge for each block, schematic design of recharge structures are annexed at annexure I & II.

This plan is focusing on the technical aspects of the ground water recharge through various means so that various implementing agencies may get the appropriate technical guidelines. The existing/ongoing schemes of the central or state govt. like MANERGA, IWSP, PMKVY and NABARD funded schemes, Urban Development schemes, departmentally funded projects etc. may be benefitted from the recharge plan by incorporating the input in the operational guidelines/ design and for locating the specific sites.

Agriculture University, engineering Collages, Academic and Research Institution, NGO may also take up the pilot or demonstrative projects in the blocks suitable to them to plan at local level as per local conditions.

A. A.POTENTIAL FOR REDUCTION IN OVERDRAFT AFTER RAINWATER HARVESTING AND ARTIFICIAL RECHARGE

Sr.no.	Type of Structure	No. of structures	Unit cost in Lakhs	Total cost of structure in Crores	Annual Recharge (MCM)
ROOF TOP RAIN WATER HARVESTING IN RURAL AND URBEN AREAS					
1	Artificial Recharge Plan For Urban Areas.	7305	0.25	18.28	0.87
2	Roof Top Rain Water Harvesting in Rural Areas	10038	0.25	25.09	0.87
	Total	**17343**	**0.25**	**43.35**	**1.74**
ARTIFICIAL RECHARGE IN FARMS					
1	Artificial Recharge Plan Through Recharge Pits.	4297	0.35	15.04	4.55
			Grand Total	**58.39**	**6.29**

A1.ARTIFICIAL RECHARGE PLAN FOR URBAN AREAS OF SONEPAT DISTRICT							
Block	**Town Name**	**Total Households**	**Total Population of Town**	**Households taken for AR 10%**	**Total Roof Top Area (200 sqm) in cluster of 4-6 houses**	**Cost of recharge at @0.25lacs (Crores)** **(4*0.25/100)**	**Vol of water available for recharge (MCM)**
1	3	2	3	4	5	6	7
GANAUR	Ganaur (MC)	6863	35603	686	137260	1.72	0.064
SONEPAT	Sonepat (M Cl + OG)	57740	289333	5774	1154800	14.44	0.696
SONEPAT	Fazalpur (81) (CT)	717	3692	72	14340	0.18	0.009
SONEPAT	Bayyanpur (207) (CT)	1068	5406	107	21360	0.27	0.013
RAI	Badh Malak (68) (CT)	1657	6938	166	33140	0.42	0.022
RAI	Kundli (55) (CT)	5001	21633	500	100020	1.25	0.066
				7305	**1460920**	**18.28**	**0.87**

A2.ROOFROP RAINWATER HARVESTING IN RURAL AREAS OF SONEPAT DISTRICT

Name of District	Sr.no	Name of CD Block	Total area of the village (in hectares rounded up to one decimal place)	Number of households (2011 census)	No of Houses taken for Artificial Recharge (10% of total households)	Total No of AR Structures (one structure for each house)	Total recharge in MCM	Cost @rs.0.25 lakhs
SONEPAT	1	Ganaur	30386	32126	3213	3213	0.224	8.03
	2	Rai	26908	32010	3201	3201	0.289	8.00
	3	Sonepat	37453	36240	3624	3624	0.357	9.06
		Total	**94747**	**100376**	**10038**	**10038**	**0.87**	**25.09**

A3.ARTIFICIAL RCEHARGE PLAN THROUGH RECHARGE PITS IN OVER EXPLOITED BLOCKS OF SONEPAT DISTRICT

Block Name	Total area of the village (in hectares rounded up to one decimal place)	5%of village area taken for farm recharge (sq m)	Total number of recharge pits (1 recharge pit / hector) for 5% area	Annual recharge (MCM)= (Area*Runoff 15%*Rainfall in m/1000000)	Cost of Pit @Rs.0.35 lakh
Ganaur	33712	16856000	1686	1.472	5.90
Rai	24906	12453000	1245	1.535	4.36
Sonepat	27315	13657500	1366	1.543	4.78
Total	**85933**	**42966500**	**4297**	**4.550**	**15.04**

Number of Recharge pits are based on following factors:

Availability of Irrigation wells In the farmer land

Area of sandy strata at shallow depth identified

Type of structure will be recharge pit/ Recharge well (where top three meters is clay)

QUANTITATIVE IMPACT

Sr. No.	Total Draft (present) (mcm)	Overdraft (mcm)	Additional Recharge through proposed structures (mcm)	Draft Reduced due to Recharge (mcm)	Stage of development (present)	Stage of development after recharge	Reduction in stage of development after recharge
1	**1072.47**	**-302.58**	**6.29**	**1066.18**	**139%**	**138.46%**	**0.54%**

By the implementation of the proposed recharge structures there will be a reduction of 0.48% in stage of ground water development as tabulated below

B. POTENTIAL FOR REDUCTION IN OVERDRAFT BY ENHANCING THE GROUND WATER USE EFFICIENCY OF IRRIGATION TUBE WELLS

The micro level transformation in the ground water management have vast impact potential to counter extensive ground water depletion faced by the state of Haryana, particularly in overexploited blocks.

There are around 9343 (out of 37487) tubewells (24.92%) operated by farmers for irrigation through unlined/Katcha open channel system in Sonepat district where water from the tubewell is discharge to the agricultural field. In this process huge (upto 25 %) quantity of ground water is wasted in soil moisture and evaporation losses.

Around 93 % of the tube wells are of shallow depth (< 70m) and remaining are deeper (70-110 m) depth. Thus majority of wells are tapping shallow aquifer which is under stress due to overexploitation.

Dynamic ground water resources (2011) indicate that Gross ground water draft for irrigation in Overexploited Blocks of Sonepat district is estimated at 658.26 MCM. It is expected that around 25% of over draft can be brought down by switching over to underground/surface pipeline based distribution from the prevailing unlined open channels. Thereby gross draft will be reduced to the tune of 38.32 MCM assuming there is no crop diversification by the farmers.

The benefit will lead to saving of precious ground water resources in OE Blocks of the district where all three blocks are categorized as overexploited. The measure if implemented will bring down the ground water overdraft from 159 % to 149.85 %. The category of the blocks will also improve resulting in boosting of agriculture and industrial development otherwise not sustainable in majority of the blocks in the state.

The tubewells also consume enormous electricity which is subsidized and government incurs significant revenue on this account. The measures therefore will result in saving of energy and money. Pollution impact will be reduced whenever diesel engines are used by the farmers. The environmental and ecological condition in the irrigated land will improve. Unwanted weed growth will also be controlled inside the farm land.This will also be useful in the waterlogged/ shallow water table areas as the seepage losses in these areas also

aggravate the water logging. **Government should make/launch a mission mode program for installing the underground pipe lines instead of having *katcha* channel in the entire State**. Heavy ground water overdraft can be reduced by these efforts. This will ensure **more crop per drop**.

QUANTITATIVE REDUCTION IN OVERDRAFT AFTER ENHANCING GROUND WATER USE EFFICIENCY IN WATER DISTRIBUTION SYSTEM

Net Annual Ground Water Availability (mcm)	Total Draft (present) (mcm)	Gross Irrigation Draft (present) (mcm)	Gross Ground Water Draft for Domestic and industrial supply (mcm)	Percentage of unlined channel	Wastage through unlined channel, (mcm) (Col 3 X Col5 X 0.25#)	Potential of Reduced irrigation overdraft (Col3-col6) (mcm)	Gross draft after saving of water (mcm) (Col 7+Col4)	Present Stage of Development (%)	Stage of development afterwards((Col8/Col1)X100) (%)	Reduction in stage of development after constructing pucca canal (Col9-Col10) (%)
1	2	3	4	5	6	7	8	9	10	11
413.72	658.26	615.07	43.19	24.92	38.32	576.75	619.94	159	149.85	9.25

#losses from open kuchha channel are around 25%.

COST ESTIMATE OF UNDERGROUND PIPE LINE

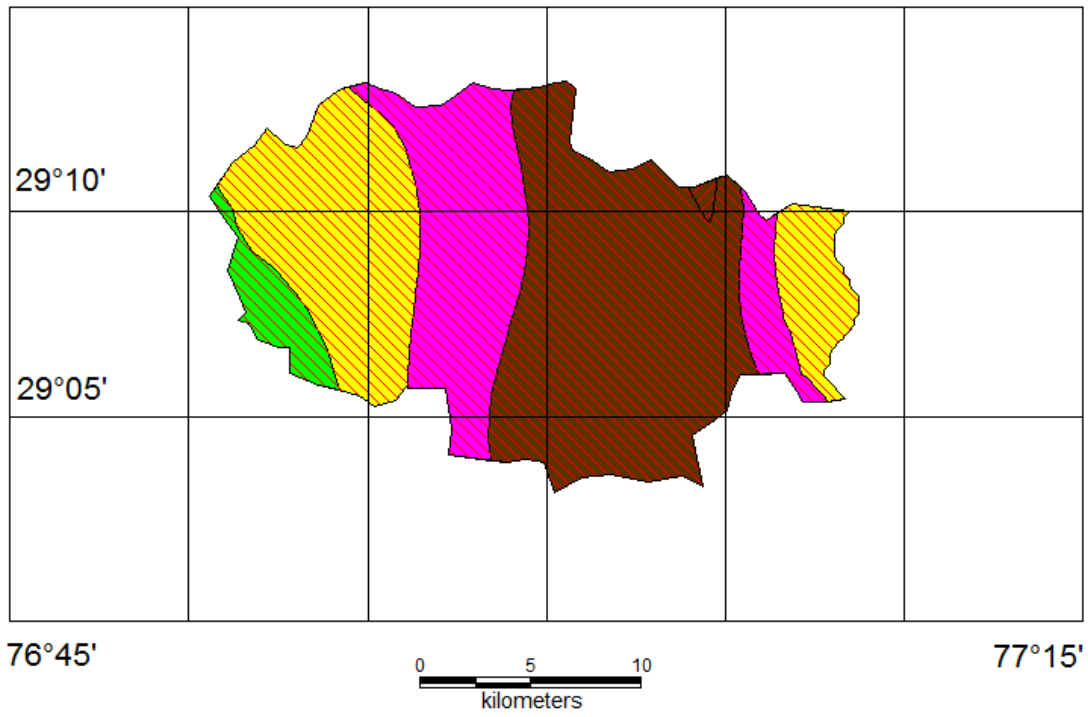
District	Block	Irrigated area by ground water scheme (ha)	Percentage of Unlined Channel (%)	Area under unlined Channels (ha)	Total cost @Rs.0.50 lack per hector(in Cr) =Total irrigated area (by ground water scheme) of the block *0.5 *Col5	Total Cost in Rs. Cr. District wise
1	2	3	4	5	6	7
Sonepat	Ganaur	17992	24.92	4484	22.42	59.02
	Rai	15927	24.92	3969	19.85	
	Sonepat	13447	24.92	3351	16.75	

BLOCK WISE PLAN OF DISTRICT SONEPAT HARYANA

(3 OE BLOCKS)

BLOCK: GANAUR DISTRICT: SONEPAT STATE: HARYANA

DEPTH TO WATER LEVEL GANAUR, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2005-2014)



LEGEND

Decadal Mean Water Level (m.bgl)	Decadal Mean Trend (m)		
0.00 to 5.00	0.256 to -0.20	3213	No. of Recharge Structures in Rural Villages
5.00 to 10.00	-0.20 to -0.10	686	No. of Recharge Structures in Urban Towns
10.00 to 20.00	-0.10 to 0.00	1686	No. of Recharge Pits in Agriculture land
20.00 to 40.00	0.00 to 0.1114	18	Thickness of Sand

NH Road Canals River Water Bodies

Ground Water Scenario of Block

Block Name :- Ganaur **District :- Sonepat** **State :- Haryana**		
1.	GENERAL INFORMATION	
	Geographical area (sq km)	*356.68*
	Number of Villages inhabited Un-inhabited	*72*
	Average Annual Rainfall (mm)	*582*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Ganga* *Yamuna*
3.	LAND USE	
	• Current fallows (Sq.Km	11.65
	• Net Area Sown (Sq.Km)	266.41
	• Area Sown More than Once (Sq.Km)	----
	• Total Irrigated Area (Sq.Km)	264.76
	• Total Unirrigated Area (Sq.Km)	1.65
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Younger alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Depth to water level	
	• Pre- monsoon: (May 2015)	*3.84-23.45 (mbgl)*
	• Post –monsoon: (Nov2014)	*3.66-25.30 (mbgl)*
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	*2*
	• Depth Range (m)	*69-462*
	• Discharge (Ipm)	*4541*
	Aquifer Parameters	

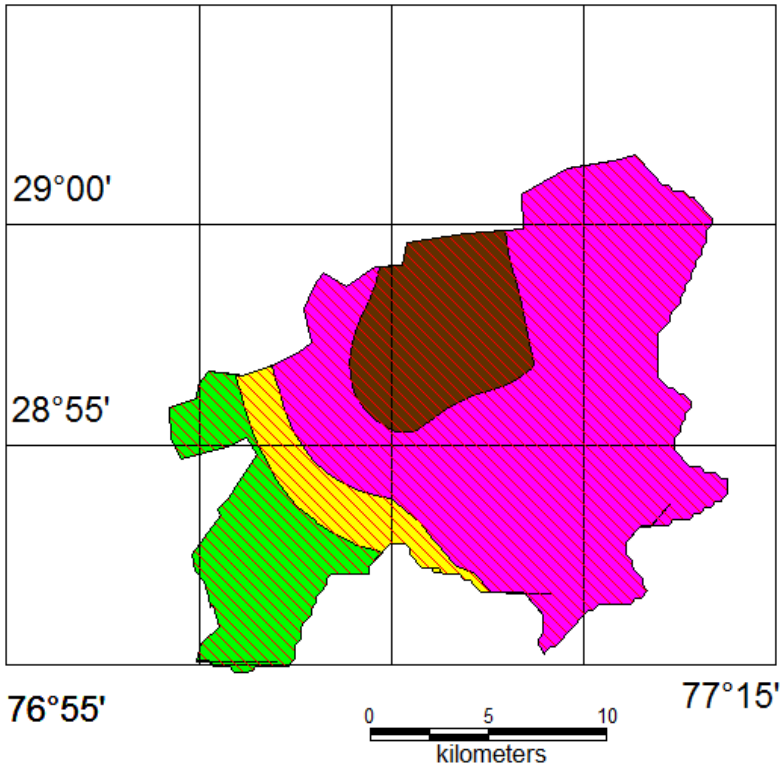
	• Transmissivity (m2/day)	*2340*		
	• Storativity	*21.5* × 10^{-2}		
	• Soil infiltration rate mm/ hour	*17*		
		Min	*Max*	*Avg.*
		3	*84*	*17*
7.	GROUND WATER QUALITY	Min	Max	
	• EC in µS/cm at 25^0c	*990*	*6660*	
	• NO3 (mg/l)	*2.05*	*192*	
	• F (mg/l)	*0.25*	*1.87*	
	• Fe (mg/l)	*0.04*	*0.49*	
	• As (mg/l)	*0.0031*	*0.0285*	
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**		
	• Net Ground Water Availability (MCM)	202.26		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	267.57		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	17.02		
	• Existing Gross Ground Water Draft for all Uses (MCM)	284.59		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	17.02		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-82.33		
	• Stage of Ground Water Development / Over Draft (%)	141		
	• Category of Block	OE		
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in	*Extensive Irrigation*		

	ground water level		
9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *18*	Percentage % 36
10	Volume of unsaturated zone available for recharge (MCM)	155	
11.	Volume of water required for recharge (MCM)	206	
12.	Volume of surplus water available for recharge(MCM)	2.72	

RECHARGE/ CONSERVATION STRUCTURES		**Total Number of Recharge Structures**	**Total Cost (Rs. in crores)**	**Total Recharge/Water saving in MCM**
13	Farm Recharge @Rs. 35000/-	1686	5.90	1.472
14	RWH Rural @ Rs. 25000/-	3213	8.03	0.224
15	RWH Urban@ Rs. 25000/-	686	1.72	0.064
16	Underground pipe line (area in hectares) @ Rs. 50000/-	4484	22.42	16.67
TOTAL			**38.07**	**18.43**

BLOCK: RAI DISTRICT: SONEPAT STATE: HARYANA

DEPTH TO WATER LEVEL RAI, DECADAL MEAN POST MONSOON Vs DECADAL MEAN TREND POST MONSOON (2005-2014)



LEGEND

Decadal Mean Water Level (m.bgl)

- 0.00 to 5.00
- 5.00 to 10.00
- 10.00 to 20.00
- 20.00 to 40.00

Decadal Mean Trend (m)

- 0.256 to -0.20
- -0.20 to -0.10
- -0.10 to 0.00
- 0.00 to 0.1114

- 3201 No. of Recharge Structures in Rural Villages
- 666 No. of Recharge Structures in Urban Towns
- 1245 No. of Recharge Pits in Agriculture land
- 25 Thickness of Sand

NH Road, Canals, River, Water Bodies

Ground Water Scenario of Block

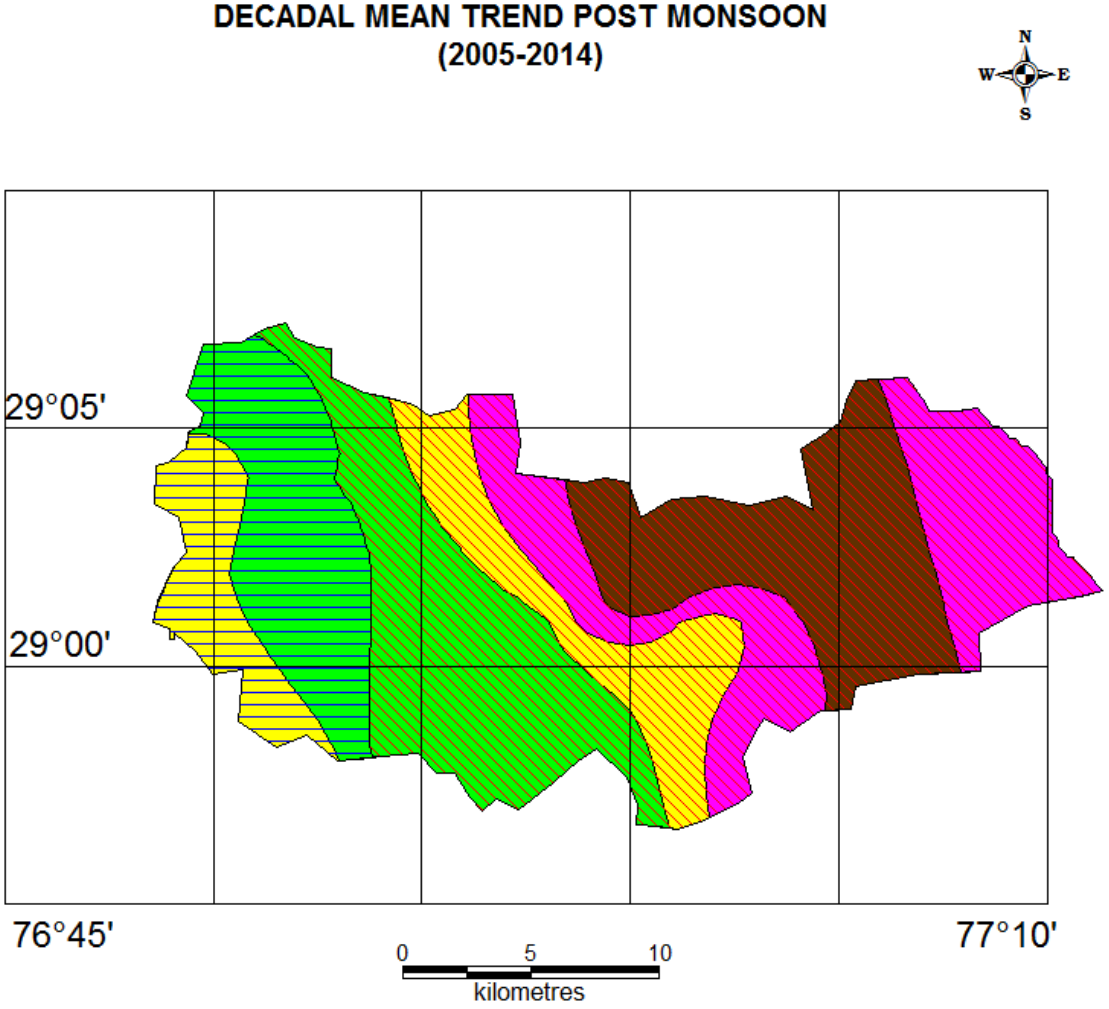
Block Name :-Rai **District :-SONEPAT** **State :- Haryana**		
1.	1 GENERAL INFORMATION	
	Geographical area (sq km)	*279.59*
	Number of Villages inhabited Un-inhabited	*62*
	Average Annual Rainfall (mm)	*822*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Ganga* *Yamuna*
3.	LAND USE	
	• Current fallows (Sq.Km	16.12
	• Net Area Sown (Sq.Km)	200.68
	• Area Sown More than Once (Sq.Km)	----
	• Total Irrigated Area (Sq.Km)	198.98
	• Total Unirrigated Area (Sq.Km)	1.70
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Recent alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Depth to water level	
	• Pre- monsoon: (May 2015)	*5.38-26.20 (mbgl)*
	• Post –monsoon: (Nov2014)	*4.21-34.10 (mbgl)*
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	*6*
	• Depth Range (m)	*69-462*
	• Discharge (Ipm)	*4541*
	Aquifer Parameters	

	• Transmissivity (m2/day)	*2340*		
	• Storativity	*21.5* × 10^{-2}		
	• Soil infiltration rate *mm/hour*	*17*		
		Min	*Max*	*Avg.*
		3	*84*	*17*
7.	GROUND WATER QUALITY	Min	Max	
	• EC in µS/cm at 25^0c	--	--	
	• NO3 (mg/l)	--	--	
	• F (mg/l)	--	*2.25*	
	• Fe (mg/l)	--	--	
	• As (mg/l)	--	*0.01348*	
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**		
	• Net Ground Water Availability (MCM)	80.38		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	170.54		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	13.20		
	• Existing Gross Ground Water Draft for all Uses (MCM)	183.74		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	13.20		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-103.36		
	• Stage of Ground Water Development / Over Draft (%)	229		
	• Category of Block	OE		
	Any specific reasons for high stress on ground water leading	*Extensive Irrigation*		

	to Overexploitation and decline in ground water level			
9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *25*	Percentage % 50	
10	Volume of unsaturated zone available for recharge (MCM)	121		
11.	Volume of water required for recharge (MCM)	161		
12.	Volume of surplus water available for recharge(MCM)	2.13		
RECHARGE/ CONSERVATION STRUCTURES		**Total Number of Recharge Structures**	**Total Cost (Rs. in crores)**	**Total Recharge/ Water saving in MCM**
13	Farm Recharge @Rs. 35000/-	1245	4.36	1.535
14	RWH Rural @ Rs. 25000/-	3201	8.00	0.289
15	RWH Urban@ Rs. 25000/-	666	1.67	0.088
16	Underground pipe line (area in hectares) @ Rs. 50000/-	3969	19.85	10.62
	TOTAL		**33.88**	**12.532**

BLOCK: SONEPAT DISTRICT: SONEPAT STATE: HARYANA

DEPTH TO WATER LEVEL SONEPAT, DECADAL MEAN POST MONSOON Vs DECADAL MEAN TREND POST MONSOON (2005-2014)



LEGEND

Decadal Mean Water Level (m.bgl)	Decadal Mean Trend (m)		
0.00 to 5.00	0.256 to -0.20	3624	No. of Recharge Structures in Rural Villages
5.00 to 10.00	-0.20 to -0.10	5953	No. of Recharge Structures in Urban Towns
10.00 to 20.00	-0.10 to 0.00	1366	No. of Recharge Pits in Agriculture land
20.00 to 40.00	0.00 to 0.1114	28	Thickness of Sand

NH Road Canals River Water Bodies

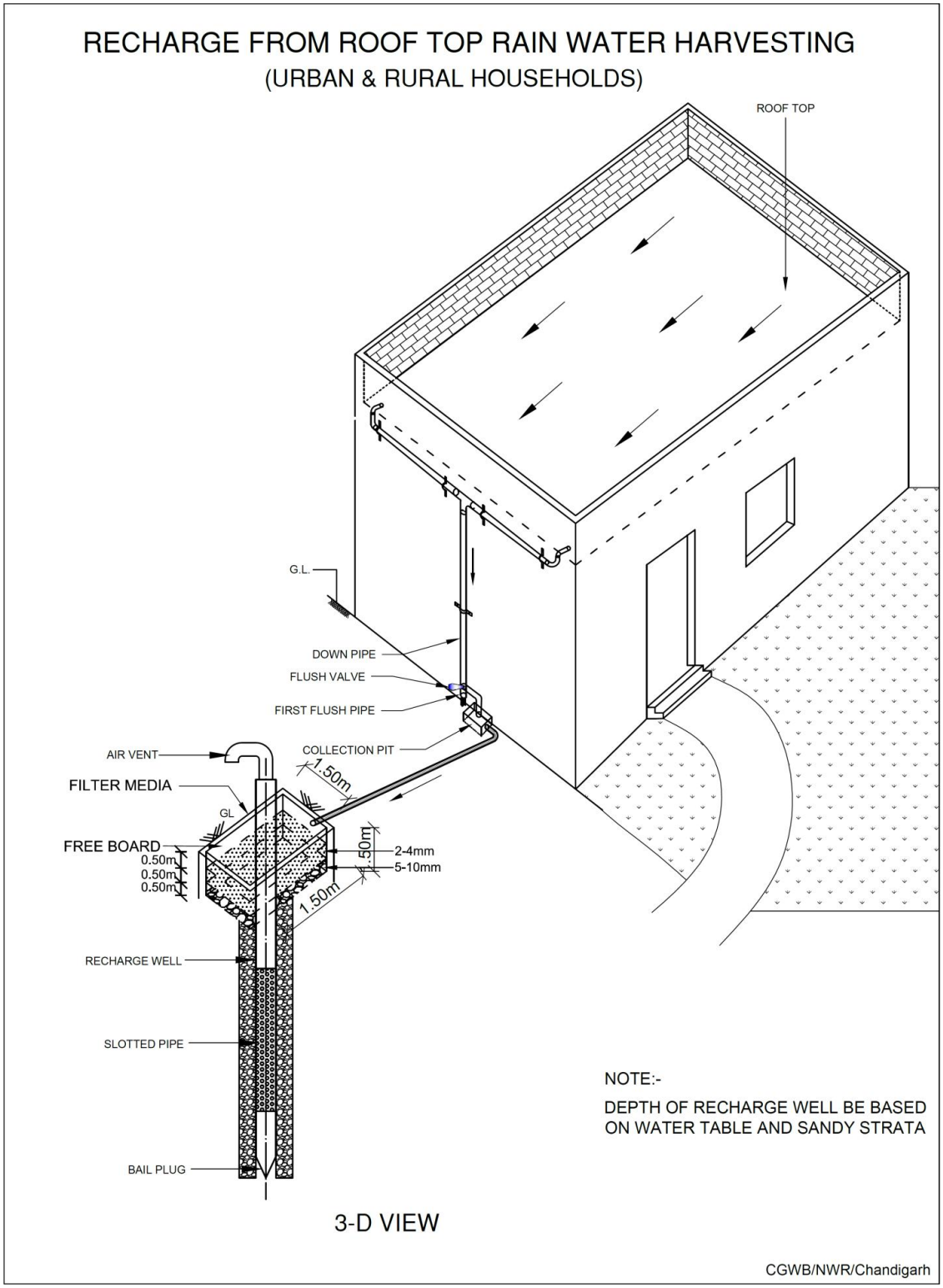
Ground Water Scenario of Block

	Block Name:-Sonepat **District :-SONEPAT** **State :-Haryana**	
1.	GENERAL INFORMATION	
	Geographical area (sq km)	*403.59*
	Number of Villages inhabited Un-inhabited	*70*
	Average Annual Rainfall (mm)	*753*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Ganga* *Yamuna*
3.	LAND USE	
	• Current fallows (Sq.Km	.22
	• Net Area Sown (Sq.Km)	306.27
	• Area Sown More than Once (Sq.Km)	----
	• Total Irrigated Area (Sq.Km)	303.85
	• Total Unirrigated Area (Sq.Km)	2.42
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Younger alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Depth to water level	
	• Pre- monsoon: (May 2015)	*3.32-36.20 (mbgl)*
	• Post –monsoon: (Nov2014)	*1.44-34.10 (mbgl)*
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	*12*
	• Depth Range (m)	*69-462*
	• Discharge (Ipm)	*4541*
	Aquifer Parameters	
	• Transmissivity (m2/day)	*2340*

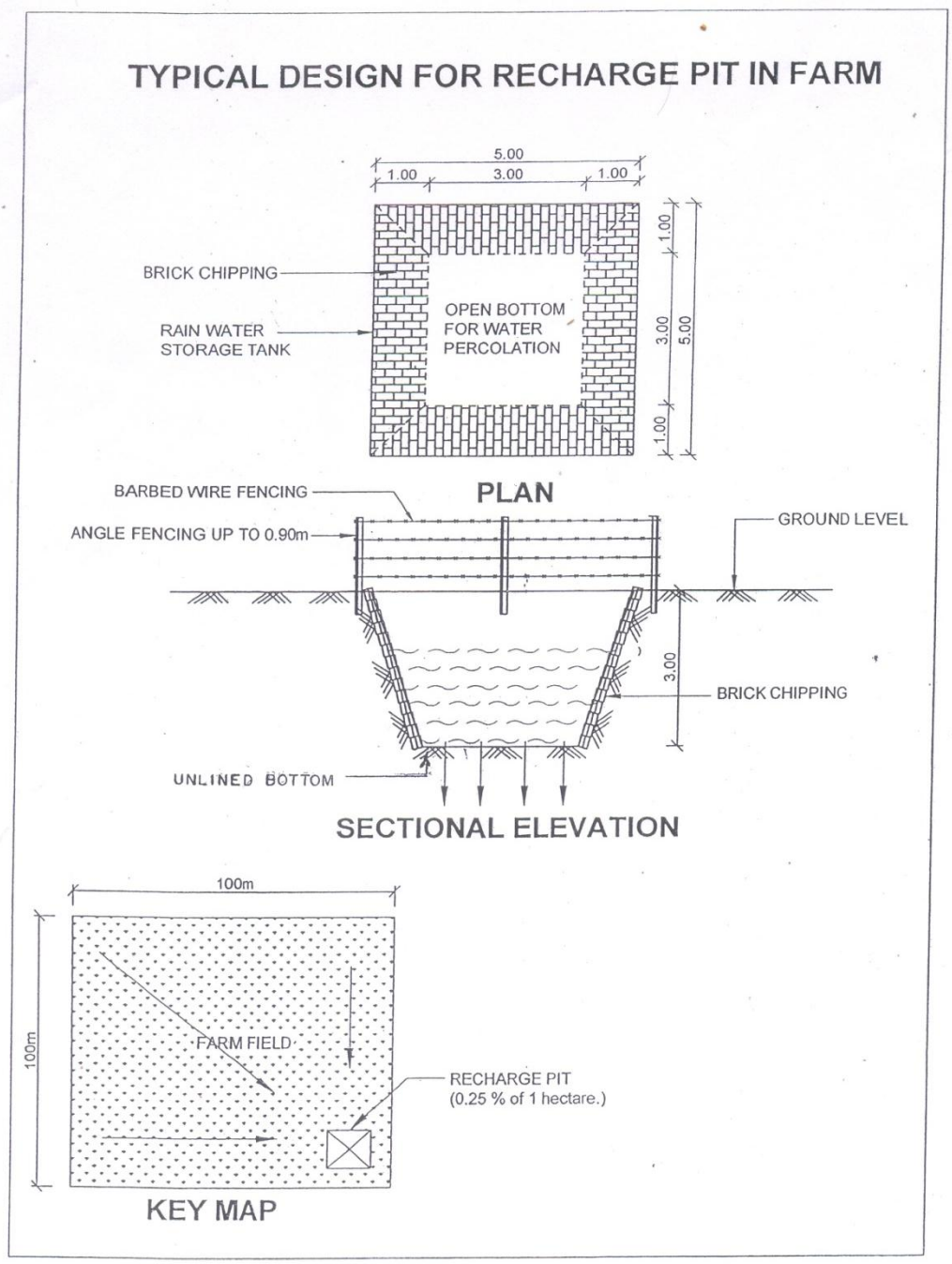
	• Storativity	*21.5* × 10^{-2}		
	• Soil infiltration rate *mm/hour*	*17*		
		Min	*Max*	*Avg.*
		3	*84*	*17*
7.	GROUND WATER QUALITY	Min	Max	
	• EC in µS/cm at 25^{0}c	--	--	
	• NO3 (mg/l)	--	--	
	• F (mg/l)	--	*2.25*	
	• Fe (mg/l)	--	--	
	• As (mg/l)	--	*0.03922*	
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**		
	• Net Ground Water Availability (MCM)	131.08		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	176.96		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	12.97		
	• Existing Gross Ground Water Draft for all Uses (MCM)	189.93		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	12.97		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-58.85		
	• Stage of Ground Water Development / Over Draft (%)	145		
	• Category of Block	OE		
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*		
9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *28*	Percentage % 56	
10	Volume of unsaturated zone available for recharge (MCM)	175		

11	Volume of water required for recharge (MCM)	233
12	Volume of surplus water available for recharge(MCM)	3.08

RECHARGE/ CONSERVATION STRUCTURES		**Total Number of Recharge Structures**	**Total Cost (Rs. in crores)**	**Total Recharge/ Water saving in MCM**
13	Farm Recharge @Rs. 35000/-	1366	4.78	1.543
14	RWH Rural @ Rs. 25000/-	3624	9.06	0.357
15	RWH Urban@ Rs. 25000/-	5953	14.89	0.718
16	Underground pipe line (area in hectares) @ Rs. 50000/-	3351	16.75	11.02
	TOTAL		**45.48**	**13.638**


RECHARGE FROM ROOF TOP RAIN WATER HARVESTING
(URBAN & RURAL HOUSEHOLDS)
ROOF TOP
G.L.
DOWN PIPE
FLUSH VALVE
FIRST FLUSH PIPE
COLLECTION PIT
AIR VENT
FILTER MEDIA
GL
FREE BOARD
0.50m
0.50m
0.50m
1.50m
1.50m
2-4mm
5-10mm
RECHARGE WELL
SLOTTED PIPE
BAIL PLUG
NOTE:-
DEPTH OF RECHARGE WELL BE BASED ON WATER TABLE AND SANDY STRATA
3-D VIEW
CGWB/NWR/Chandigarh

Annexure-II


TYPICAL DESIGN FOR RECHARGE PIT IN FARM
5.00
1.00
3.00
1.00
BRICK CHIPPING
RAIN WATER
STORAGE TANK
OPEN BOTTOM
FOR WATER
PERCOLATION
1.00
3.00
5.00
1.00
PLAN
BARBED WIRE FENCING
ANGLE FENCING UP TO 0.90m
GROUND LEVEL
3.00
BRICK CHIPPING
UNLINED BOTTOM
SECTIONAL ELEVATION
100m
100m
FARM FIELD
RECHARGE PIT
(0.25 % of 1 hectare.)
KEY MAP