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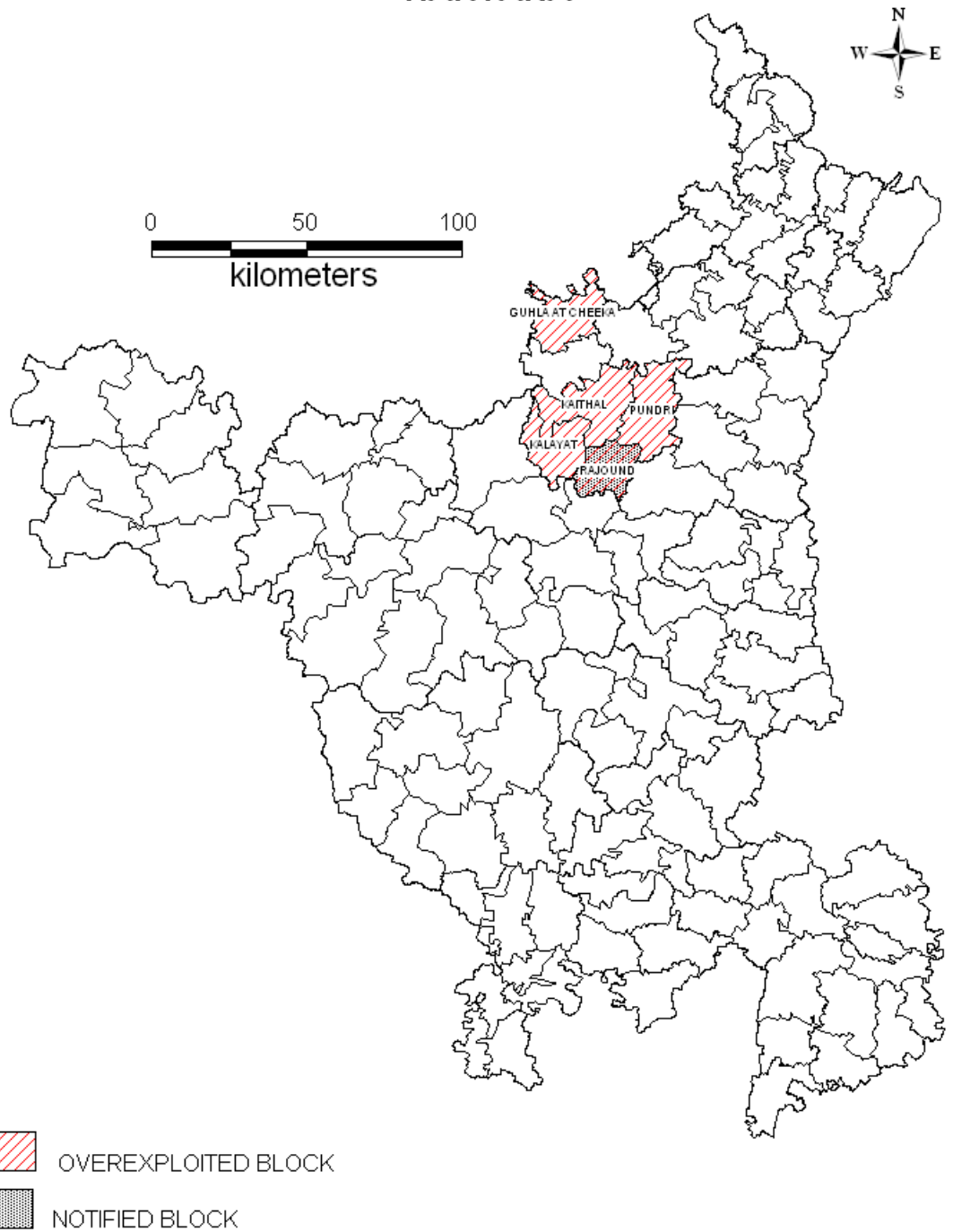
**Government of India
Ministry of Water Resources,
River Development & Ganga Rejuvenation
Central Ground Water Board**

PLAN ON

**ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION IN OVEREXPLOITED
BLOCKS OF
KAITHAL DISTRICT, HARYANA**

**Central Ground Water Board
North Western Region
Chandigarh**

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



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

INTRODUCTION

Administratively, the district is under control of Ambala division and it has four tehsils and divided into five development blocks namely Gulha, Kaithal, Pundari, Kalayat, Rajound. The district headquarter is at Kaithal. It has four towns namely Kaithal, Cheeka, Kalayat and Pundri. The district has 269 villages with a total population of 10,72,861 as per 2011 census.

HYDROMETEOROLOGY

The climate of Kaithal district can be classified as tropical steppe, semi-arid and hot which is mainly dry with very hot summer and cold winter except during monsoon season when moist air of oceanic origin penetrates into the district. There are four seasons in a year. The normal annual rainfall is about 511 mm which is spread over 30 rainy days. 85% of rainfall occurs during south-west monsoon.

GEOMORPHOLOGY

Physiographically, the district is characterised by distinct features i.e. upland plain, alluvial bed (flood plain) of river Ghaggar and Markanda. The area as a whole is almost flat with a gentle slope towards south west direction. The district is mainly drained by the river Ghaggar and Markanada. The district has two types of soils viz Sierozem and Desert soils. The sierozem soils are found in major parts of the district and desert soils are comparatively found in smaller part of the district especially in northern part of the district. Sierozem Soil are found in the areas where the normal annual rainfall varies from 300 to 500 mm. These soils vary from sandy loam to loamy sands in texture and are marginally fertile. Degree of salinity and alkali hazards is highly variable, though salinity is major hazard.

HYDROGEOLOGY:

The geological formations met within the district comprised unconsolidated alluvial deposits of Quaternary age. The alluvial deposits comprises of sand, silt, clay associated with kankar. Fine to medium grained sand horizon forms the potential aquifer in the area.

The area has both unconfined and confined aquifers. In general the unconfined aquifers occurs down to 60 m depth below ground level in the district and abstracted through hand pumps and shallow tubewells. The alluvium forms the principal ground water reservoir and the principal aquifer material comprises fine to medium sand and sand mixed with kankar. This aquifer is either in

the form of isolated lenses of sand embedded in clay beds or well connected granular zones that have a pinching and swelling disposition and are quite extensive in nature.

The ground water in confined condition is abstracted through medium and deep tubewells. In alluvium potential aquifer zone exists down to explored depth of 600 m. In the district, thickness of alluvial formation increases towards Southwest. Perusal of the data of the exploratory tubewell constructed in Ghaggar Basin indicate that tubewells tapping water bearing zone with in 100 to 200 m depth yield 1500 lpm to 3000 lpm for draw down of 5 to 17 m.

The quality of water has not been found fresh in shallow as well as deep aquifer in some parts of the district. Shallow aquifer zones contain fresh water in northern and eastern parts of the district covering Gulha, Kaithal, Pundari, Kalayat and Rajaound. Marginal to saline ground water occur in shallow zones in part of Kalayat and Rajaound blocks. In general deeper zone in Kalayat and Rajaound block contains brackish to saline ground water. A large number of shallow tubewells exists in all parts of the district having fresh water, however there number is significantly large in blocks of Gulha, Pundari, Kaithal Kalayat followed by Rajaound. Depth of these shallow tubewells ranges from 20 to 50 m and yield varies between 500 lpm to 1200 lpm for moderate drawdown. Deeper tubewells tap water bearing zones down to 120 m depth and yields 1500 to 3000 lpm for 4 to 7 m of draw down. In some parts of district i.e. surrounding Padla in Kaithal block a tubewell tapping unconfined aquifer group in the depth range 26 to 91 m yields a discharge of 1500 lpm for drawdown of 7.0m

Central Ground Water Board has drilled 07 exploratory wells, 01 Slim Holes and 06 piezometers to delineate and determine the potential aquifer zones, evaluation of aquifer characteristics etc. Besides, 09 piezometers have been constructed through outsourcing by M/s WAPCOS Ltd. The drilling has been done to a maximum depth of about 610 m and revealed the presence of 6 to 22 prominent permeable granular zones. Aquifer parameters as determined from exploratory activity of the Central Ground Water Board reveals that in the central part of the district transmissivity value $686 \text{ m}^2/\text{day}$, Lateral hydraulic conductivity of $11.45 \text{ m}/\text{day}$ and specific yield value 2.35×10^{-2} have been observed. In the north central part of the district covering part of Gulha block transmissivity value $1400 \text{ m}^2/\text{day}$, Lateral hydraulic conductivity of $25 \text{ m}/\text{day}$ and in the northern extreme part of the district transmissivity value $400 \text{ m}^2/\text{day}$, Lateral hydraulic conductivity of $22.2 \text{ m}/\text{day}$ and specific yield value 18.00×10^{-2} have been reported.

Water level behavior

Depth to water level in the district ranges from 3.73 to 39.40 m bgl during pre-monsoon period 2015 and 2.40 mbgl to 40.76 mbgl during post-monsoon period 2014. In major part of the district water level ranges between 10 m to 20 m bgl and spreads in part of Gulha, Kaithal, Pundri, Rajound and Kalayat Blocks. The ground water levels more than 30m bgl has been recorded in part of Goula and Kaithal Blocks. The shallow water level in the depth range of 3 m to 5 m bgl spreads in part of Kalayat Block. During post monsoon period the area under ground water table of depth range from 20to 30 m bgl gets spreads covering parts of Gulha, Kaithal and Pundri Blocks. Besides, the water logging condition is also gets existed in parts of Kalayat block.

Long-term net change of water levels during the period 2000-2011 reflected by ground water hydrograph are indicative of the change in groundwater storage in phreatic zone with time. The hydrograph indicates declining water level trend which may be due to over-exploitation of ground water. The rate of decline varies from 0.18 m/yr to 1.16 m/yr. The maximum rate of decline has been observed in piezometer at Gulha. In piezometer at Kalayat rising trend in ground water levels in the order of 0.05 m/yr has also observed. The district area require careful management of ground water and surface water through the practice of Conjunctive use of surface water and ground water. In general the ground water elevation varies from 209 to 219 a.m.s.l. and the regional ground water flow direction is from northeast to southwest.

GROUND WATER QUALITY:

Chemical data of ground water from shallow aquifer indicates that ground water is alkaline in nature and is fresh to moderately saline. The electrical conductivity (EC) values are generally less than 3000 $\mu\text{S}/\text{cm}$ at 25°C, except at Kalayat and Mataur whether these values are 3310 $\mu\text{S}/\text{cm}$ and 5990 $\mu\text{S}/\text{cm}$ respectively. Generally it is suitable for drinking purposes as chemical parameters are well within the permissible limits for safe drinking water set by Bureau of Indian standard (BIS) except at Kalayat and Mataur due to high salinity and nitrate and at Mundri and rajound due to high fluoride. The fluoride concentration is found to be higher thn the permissible limit at Rajound (1.85 mg/l), Mundri (1.89 mg/l) and Mataur (2.55 mg/l). Among Cations, sodium dominates in more than 73% wells where as among Anions, no single anion dominats and ground water is of mixed anion type in most wells.

Plot of USSL diagram used for classification o f irrigation water indicates that ground water fall under C_3S_1 , C_3S_2 , C_4S_2 and C_4S_3 classes. As 73% ground water sample falls under C_3S_1 and

C3S2 classes and thus are suitable for customary irrigation without any fear of salinity or sodium hazards. The remaining water, nevertheless, can be used on well drained soils on which semi-salt tolerant crops such as wheat, gram and rice etc are grown without any fear of sodium hazards.

Type of water: Na-Mixed Anion type.

GROUND WATER RESOURCES:

Block-wise ground water resource potential of the district has been assessed as per GEC-97 as on 31st March 2011. The ground water development in all the blocks has exceeded the available recharge, thus all the blocks have been categorized as over exploited. Stage of ground water development, ranges from 176% (block-Rajaund) to 234% (block-Kaithal). Net annual replenishable ground water availability in the district have been assessed as 587.02 MCM. The total ground water draft for all uses in the district is 1145.57 MCM, thus leaving short-fall (over draft) of 610.48 M C M . Stage of ground water development in the Kaithal district has been assessed to be 214%.

The ground water development in all the blocks of the district has exceeded the available recharge and thus all the blocks have been categorized as “over exploited”.

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 Tubewells According to Owner’s Holding Size

No. of 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)	Public	Group of Farmers	Total
1	Kaithal	0	164	2052	7763	1059	25622	36660

Distribution of Tubewells According to Depth of tube well

Sr.no	District	20-40 mts	40-60 mts	60-70 mts	70 -90 mts	90-110 mts	Total
1	Kaithal	0	29048	3195	848	3569	36660

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/kutchha	Total
1	Kaithal	28023	8637	36660

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 x 5mt x 3mt 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, 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.

Sr.no.	Type of Structure	No. of structures	Unit cost in Lakhs	Total cost of structure in Crore	Annual Recharge (MCM)
ROOF TOP RAIN WATER HARVESTING IN RURAL AND URBEN AREAS					
1	Artificial Recharge Plan For Urban Areas.	4626	0.25	11.57	0.452
2	Roof Top Rain Water Harvesting in Rural Areas	13913	0.25	34.78	1.453
	Total	18539	0.25	46.35	1.905
ARTIFICIAL RECHARGE IN FARMS					
1	Artificial Recharge Plan Through Recharge Pits.	14497	0.35	50.74	18.919
			Total	97.09	20.824

By the implementation of the proposed recharge structures there will be a reduction of 3.81% in stage of ground water development as tabulated below

Sr.no.	Total Draft (present) (mcm)	Recharge through different 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	1145.57	20.824	1124.746	214%	210.19%	3.81%

ARTIFICIAL RECHARGE PLAN THROUGH RECHARGE PITS IN OVER EXPLOITED BLOCKS OF KAITHAL DISTRICT

DISTRICT NAME	Block Name	Total area of the village (in hectares rounded up to one decimal place)	10%of village area taken for farm recharge(sq m)	Total number of recharge pits (1 recharge pit / hector) for 10% area	Annual recharge (MCM)= (Area*Runoff 15%*Rainfall in m/1000000)	Cost of Pit @Rs.0.35 lakh (in crore)
KAITHAL	Gulha	36032	36032000	3603	4.702	12.61
	Kaithal	48364	48364000	4836	6.312	16.93
	Kalayath	18499	18499000	1850	2.414	6.48
	Pundri	42078	42078000	4208	5.491	14.73
	Rajaund	28525	28525000	2853	3.723	9.99
	Total		173498	173498000	17350	18.919

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)

ROOF TOP RAINWATER HARVESTING IN RURAL AREAS OF KAITHAL DISTRICT OF HARYANA

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 10 house holds)	Total recharge in MCM	Cost @0.25 lack (in crore)
1	Gulha	36032	21718	2172	2172	0.227	5.43
2	Kaithal	51085	39252	3925	3925	0.410	9.81
3	Kalayath	31999	20990	2099	2099	0.219	5.25
4	Pundri	42078	34358	3436	3436	0.359	8.59
5	Rajaund	28525	22808	2281	2281	0.238	5.70
	Total	189719	139126	13913	13913	1.453	34.78

ARTIFICIAL RECHARGE PLAN FOR URBAN AREAS OF KAITHAL DISTRICT, HARYANA

District	Name of CD Block	Town Name	Total Households	Total Population of Town	Housholds taken for Atificial Recharge (10%)	Total Roof Top Area (sqm)	Vol of water available for recharge (MCM)	Cost of recharge st @0.25 lacs (in crore)
KAITHAL	GUHLA	Cheeka (MC)	7613	38952	761	152260	0.106	1.90
	KAITHAL	Kaithal (M CI)	28547	144915	2855	570940	0.259	7.14
	KALAYAT	Kalayath (MC)	3557	18660	356	71140	0.028	0.89
	PUNDRI	Pundri (MC + OG)	6538	33484	654	130760	0.059	1.64
	TOTAL				4626		0.452	11.57

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 8636 operated by farmers for irrigation through unlined/Katcha (23.56%) open channel system in Kaithal district where water from the tubewell is discharge to the agricultural field. In this process huge quantity of ground water is wasted in soil moisture and evaporation losses.

Dynamic ground water resources (2011) indicate that Gross ground water draft for irrigation in Kaithal district is estimated at 1145.57 MCM. It is expected that around 11.83% 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 63.8 MCM assuming there is no crop diversification by the farmers.

The benefit will lead to saving of precious ground water resources in overexploited blocks of Kaithal Districts. The measure if implemented will bring down the ground water overdraft from 214% to 202 %. The category of the blocks will also improve drastically 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 Haryana.** Heavy ground water overdraft can be reduced by these efforts. This will ensure **more crop per drop**.

POTENTIAL FOR REDUCTION IN OVERDRAFT BY ENHANCING THE GROUND WATER USE EFFICIENCY IN IRRIGATION TUBEWELLS, KAITHAL DISTRICT

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 0.30 [#])	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((Col 8/Col1)X100) (%)	Reduction in stage of development after constructing pucca channel (Col9-Col10) (%)
1	2	3	4	5	6	7	8	9	10	11
535.09	1145.57	1083.16	62.41	23.56	63.80	1019.4	1081.77	214	202	11.83

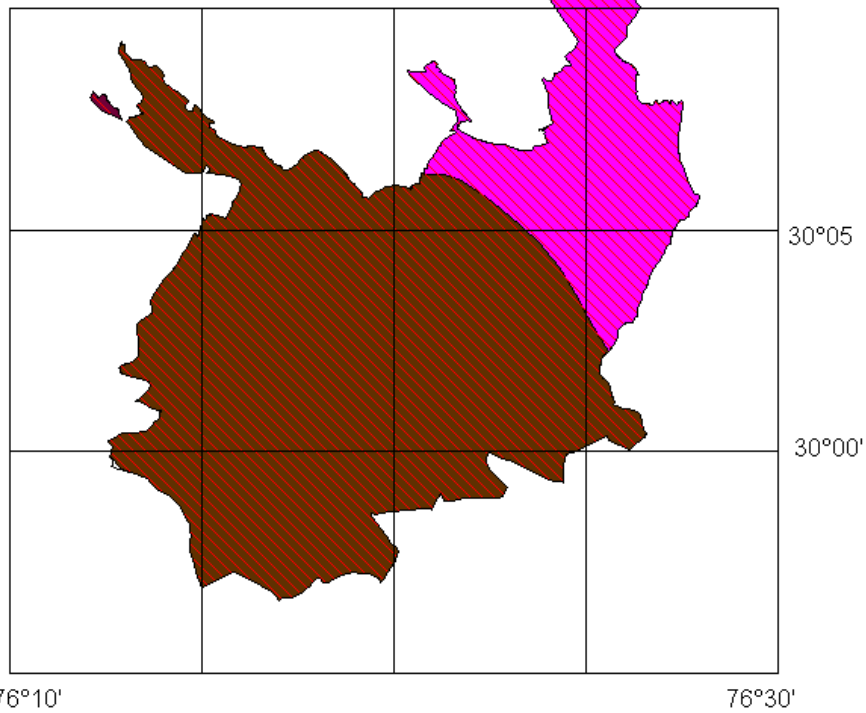
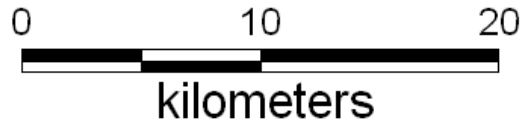
#losses from open kuchha channel are around 25%.

District	Block	Irrigated area by ground water scheme (ha)	Percentage of Unlined Channel (%)	Area under unlined Channels	Total cost @Rs.0.50 lack per hecter(in cr) Area *0.50/100 = Crores	Total Cost in Rs.Cr. District wise
Kaithal	Gulha	26812	23.56	6317	31.58	91.63
	Kaithal	22255	23.56	5243	26.22	
	Kalayath	5433	23.56	1280	6.40	
	Pundri	21822	23.56	5141	25.71	
	Rajound	1462	23.56	344	1.72	








***BLOCK
WISE PLAN OF
DISTRICT KAITHAL
HARYANA***

(5 OE BLOCKS)

**BLOCK-GULHA DISTRICT-KAITHAL STATE-HARYANA
 DEPTH TO WATER LEVEL GULHA, DECADAL MEAN POST MONSOON
 Vs
 DECADAL MEAN TREND POST MONSOON
 (2005-2014)**



LEGEND

Decadal Mean Water Level (m.bgl)		Decadal Mean Trend (m)			
	10.00 to 20.00		-0.10 to 0.00		No. of Recharge Structures in Rural Villages
	20.00 to 40.00				No. of Recharge Structures in Urban Towns
					No. of Recharge Pits in Agriculture land
					Thickness of Sand

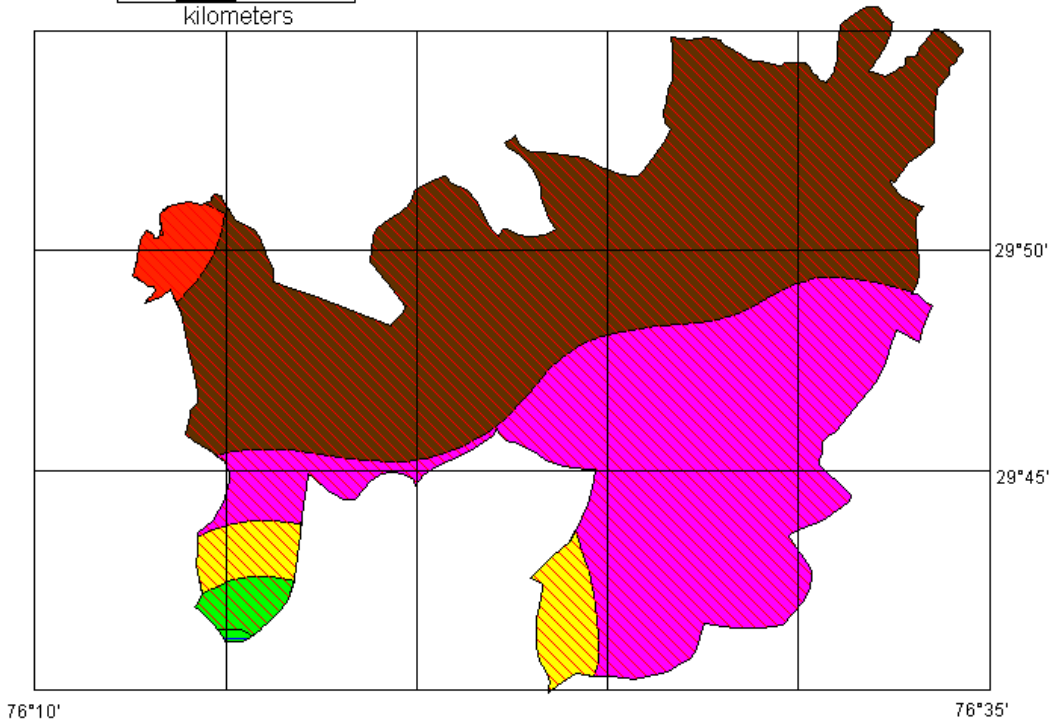
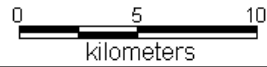
Ground Water Scenario of Block

Block Name :- Gulha District :-Kaithal State :- Haryana				
1.	GENERAL INFORMATION			
	i) Geographical area (sq km)		592.63	
	<ul style="list-style-type: none"> • Number of Villages inhabited • Un-inhabited 		72 0	
	ii) Average Annual Rainfall mm		870	
2.	GEOMORPHOLOGY			
	Major Physiographic		Alluvium Plain	
	Major drainages Basin Sub-Basin		Ganga Yamuna	
3.	LAND USE			
	• Current fallows (Sq.Km)		2	
	• Net Area Sown (Sq.Km)		303.74	
	• Area Sown More than Once (Sq.Km)		----	
	• Total Irrigated Area (Sq.Km)		302.30	
	• Total Unirrigated Area (Sq.Km)		144	
4.	PREDOMINANT GEOLOGICAL FORMATIONS		Younger alluvium	
5.	HYDROGEOLOGY			
	Major Water bearing Formation (Aquifer)		Fine to coarse Sand	
	Avg. Depth to water level (decadal)			
	• Pre- monsoon: (May 2015)		31.89-41.10 (mbgl)	
	• Post –monsoon: (Nov2014)		37.31-40.76 (mbgl)	
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)			
	• No of wells drilled		6	
	• Depth Range (m)		173-610.21	
	• Discharge (lpm)		1200-4656/3-14.52	
	Aquifer Parameters			
	• Transmissivity (m ² /day)		2200	
	• Storativity		0.12-2.35*10 ⁻² -4.5*10 ⁻⁴	
	• Soil infiltration rate mm/ hour		--	
		Min	Max	Avg.








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7.	GROUND WATER QUALITY	Min	Max	
	• EC in $\mu\text{S}/\text{cm}$ at 25°C	1107	1911	
	• NO_3 (mg/l)	0.9	7.7	
	• F (mg/l)	0.89	3.28	
	• Fe (mg/l)	--	--	
	• As (mg/l)	--	--	
8.	DYNAMIC GROUND WATER RESOURCES in MCM	2011		
	• Net Ground Water Availability (MCM)	110.97		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	222.67		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	17.71		
	• Existing Gross Ground Water Draft for all Uses (MCM)	240.38		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	17.71		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-129.41		
	• Stage of Ground Water Development / Over Draft (%)	217		
	• Category of Block	OE		
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	<i>Extensive Irrigation</i>		
9.	Percentage of sand thickness up to 50 m depth (Average)	<i>Thickness(m)</i> 16	Percentage % 32	
10	Volume of unsaturated zone available for recharge (MCM)	921		
11.	Volume of water required for recharge (MCM)	1238		
12.	Volume of surplus water available for recharge(MCM)	22.17		

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	3603	12.61	4.702
14	RWH Rural @ Rs. 25000/-	2172	5.43	0.227
15	RWH Urban@ Rs. 25000/-	761	1.9	0.106
16	Underground pipe line (area in hectares) @ Rs. 50000/-	6717	33.59	13.12
	TOTAL		53.53	18.155

**BLOCK-KAITHAL DISTRICT-KAITHAL STATE-HARYANA
 DEPTH TO WATER LEVEL KAITHAL, 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		-0.10 to 0.00	<table border="1" data-bbox="990 1344 1071 1396"><tr><td>3925</td></tr></table> No. of Recharge Structures in Rural Villages	3925
3925					
	5.00 to 10.00		0.00 to 0.1114	<table border="1" data-bbox="990 1407 1071 1459"><tr><td>2855</td></tr></table> No. of Recharge Structures in Urban Towns	2855
2855					
	10.00 to 20.00			<table border="1" data-bbox="990 1470 1071 1522"><tr><td>4836</td></tr></table> No. of Recharge Pits in Agriculture land	4836
4836					
	20.00 to 40.00			<table border="1" data-bbox="990 1533 1071 1585"><tr><td>25</td></tr></table> Thickness of Sand	25
25					
	> 40.00				

Ground Water Scenario of Block

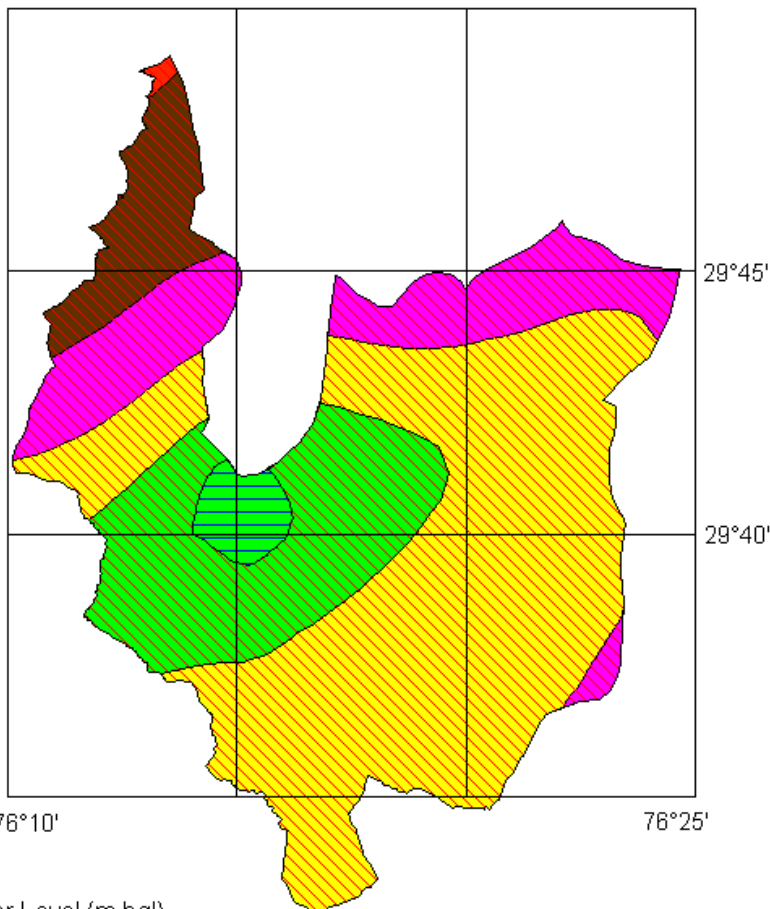
Block Name :- Kaithal District :-Kaithal State :- Haryana		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	635.05
	<ul style="list-style-type: none"> • Number of Villages inhabited • Un-inhabited 	60 0
	ii) Average Annual Rainfall (mm)	567
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	Ganga Yamuna
3.	LAND USE	
	• Current fallows (Sq.Km)	2.99
	• Net Area Sown (Sq.Km)	443.12
	• Area Sown More than Once (Sq.Km)	----
	• Total Irrigated Area (Sq.Km)	441.97
	• Total Unirrigated Area (Sq.Km)	115
4.	PREDOMINANT GEOLOGICAL FORMATIONS	Younger alluvium
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Avg. Depth to water level (decadal)	
	• Pre- monsoon: (May 2015)	12.72-39.40 (mbgl)
	• Post –monsoon: (Nov2014)	13.3537.25 (mbgl)
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	5
	• Depth Range (m)	173-610.21
	• Discharge (lpm)	1200-4656/3-14.52
	Aquifer Parameters	
	• Transmissivity (m ² /day)	2200
	• Storativity	0.12-2.35*10 ⁻² -4.5*10 ⁻⁴

	<ul style="list-style-type: none"> Soil infiltration rate mm/ hour 	--		
		<i>Min</i>	<i>Max</i>	<i>Avg.</i>
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	<ul style="list-style-type: none"> EC in $\mu\text{S}/\text{cm}$ at 25°C 	646	2373	
	<ul style="list-style-type: none"> NO₃ (mg/l) 	2.2	155	
	<ul style="list-style-type: none"> F (mg/l) 	0.5	3.28	
	<ul style="list-style-type: none"> Fe (mg/l) 	0.1	0.35	
	<ul style="list-style-type: none"> As (mg/l) 	0.0021	0.0063	
8.	DYNAMIC GROUND WATER RESOURCES in MCM	2011		
	<ul style="list-style-type: none"> Net Ground Water Availability (MCM) 	129.93		
	<ul style="list-style-type: none"> Existing Gross Ground Water Draft for Irrigation (MCM) 	279.83		
	<ul style="list-style-type: none"> Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM) 	24.60		
	<ul style="list-style-type: none"> Existing Gross Ground Water Draft for all Uses (MCM) 	304.43		
	<ul style="list-style-type: none"> Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM) 	24.60		
	<ul style="list-style-type: none"> Net Ground Water Availability for Future Irrigation Development (MCM) 	-174.50		
	<ul style="list-style-type: none"> Stage of Ground Water Development / Over Draft (%) 	234		
	<ul style="list-style-type: none"> Category of Block 	OE		
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	<i>Extensive Irrigation</i>		
9.	Percentage of sand thickness up to 50 m depth (Average)	<i>Thickness(m)</i> 25	Percentage % 50	
10	Volume of unsaturated zone available for recharge (MCM)	987		
11.	Volume of water required for recharge (MCM)	1327		
12.	Volume of surplus water available for	23.76		

	recharge(MCM)	
--	---------------	--

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	4836	16.93	6.312
14	RWH Rural @ Rs. 25000/-	3925	9.81	0.41
15	RWH Urban@ Rs. 25000/-	2855	7.14	0.259
16	Underground pipe line (area in hectares) @ Rs. 50000/-	5243	26	16.48
TOTAL			59.88	23.461

BLOCK-KALAYAT DISTRICT-KAITHAL STATE-HARYANA
DEPTH TO WATER LEVEL KALAYAT, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2005-2014)

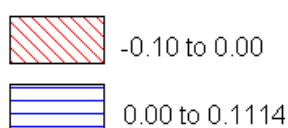


LEGEND

Decadal Mean Water Level (m.bgl)



Decadal Mean Trend (m)



2099	No. of Recharge Structures in Rural Villages
356	No. of Recharge Structures in Urban Towns
1850	No. of Recharge Pits in Agriculture land
23	Thickness of Sand

Ground Water Scenario of Block

Block Name :- Kalayat District :-Kaithal State :- Haryana		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	322.86
	<ul style="list-style-type: none"> • Number of Villages inhabited • Un-inhabited 	28 0
	ii) Average Annual Rainfall (mm)	494
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	Ganga Yamuna
3.	LAND USE	
	• Current fallows (Sq.Km)	--
	• Net Area Sown (Sq.Km)	284.02
	• Area Sown More than Once (Sq.Km)	----
	• Total Irrigated Area (Sq.Km)	284.02
• Total Unirrigated Area (Sq.Km)	--	
4.	PREDOMINANT GEOLOGICAL FORMATIONS	Younger alluvium
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Avg. Depth to water level (decadal)	
	• Pre- monsoon: (May 2015)	3.73-8.31 (mbgl)
	• Post –monsoon: (Nov2014)	2.40-8.38(mbgl)
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	1
	• Depth Range (m)	173-610.21
	• Discharge (lpm)	1200-4656/3-14.52
	Aquifer Parameters	
	• Transmissivity (m ² /day)	2200
	• Storativity	0.12-2.35*10 ⁻² -4.5*10 ⁻⁴
• Soil infiltration rate mm/ hour	--	

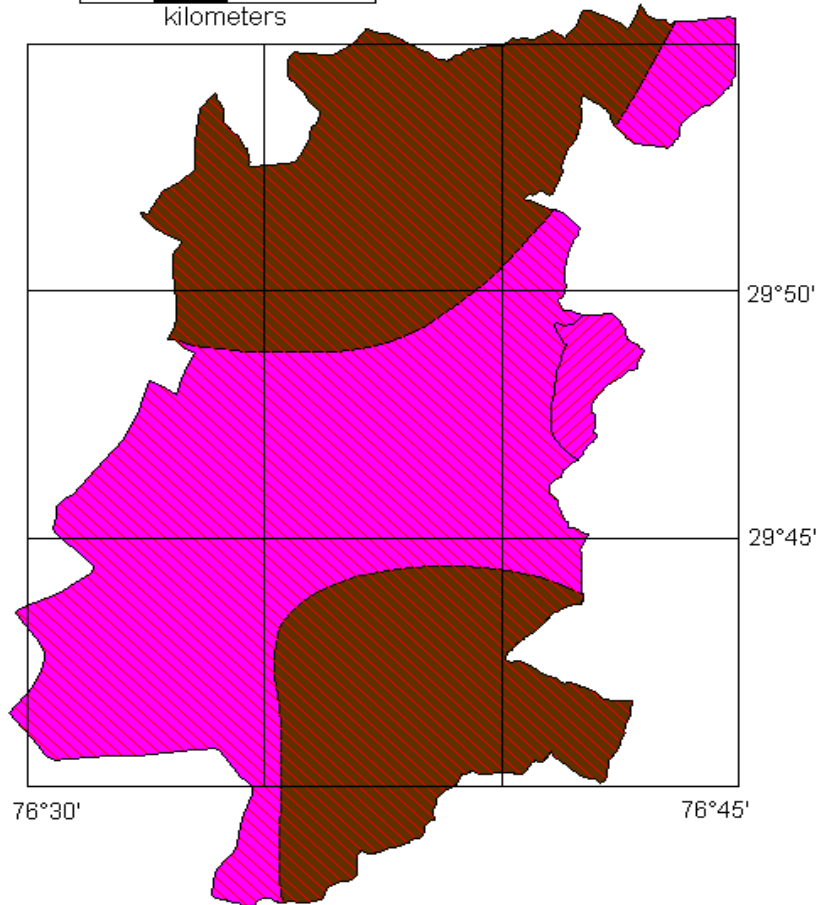
		<i>Min</i>	<i>Max</i>	<i>Avg.</i>
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	• EC in $\mu\text{S}/\text{cm}$ at 25°C	2628	6115	
	• NO_3 (mg/l)	2.9	642	
	• F (mg/l)	0.08	1.58	
	• Fe (mg/l)	0.07	0.51	
	• As (mg/l)	0.0023	0.0049	
8.	DYNAMIC GROUND WATER RESOURCES in MCM	2011		
	• Net Ground Water Availability (MCM)	81.03		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	165.90		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	1.50		
	• Existing Gross Ground Water Draft for all Uses (MCM)	167.40		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	1.50		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-80.37		
	• Stage of Ground Water Development / Over Draft (%)	192		
	• Category of Block	OE		
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	<i>Extensive Irrigation</i>		
	9.	Percentage of sand thickness up to 50 m depth (Average)	<i>Thickness(m)</i> 23	Percentage % 46
10	Volume of unsaturated zone available for recharge (MCM)	502		
11.	Volume of water required for recharge (MCM)	675		
12.	Volume of surplus water available for recharge(MCM)	12.08		

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	1850	6.48	2.414
14	RWH Rural @ Rs. 25000/-	2099	5.25	0.219
15	RWH Urban@ Rs. 25000/-	356	0.89	0.028
16	Underground pipe line (area in hectares) @ Rs. 50000/-	1280	6.4	9.77
	TOTAL		19.02	12.431

BLOCK-PUNDRI DISTRICT-KAITHAL STATE-HARYANA
DEPTH TO WATER LEVEL PUNDRI, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2005-2014)



0 5 10
kilometers




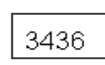
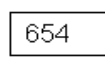
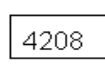
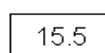
LEGEND

Decadal Mean Water Level (m.bgl)

-  10.00 to 20.00
-  20.00 to 40.00

Decadal Mean Trend (m)

-  -0.10 to 0.00

-  3436 No. of Recharge Structures in Rural Villages
-  654 No. of Recharge Structures in Urban Towns
-  4208 No. of Recharge Pits in Agriculture land
-  15.5 Thickness of Sand

Ground Water Scenario of Block

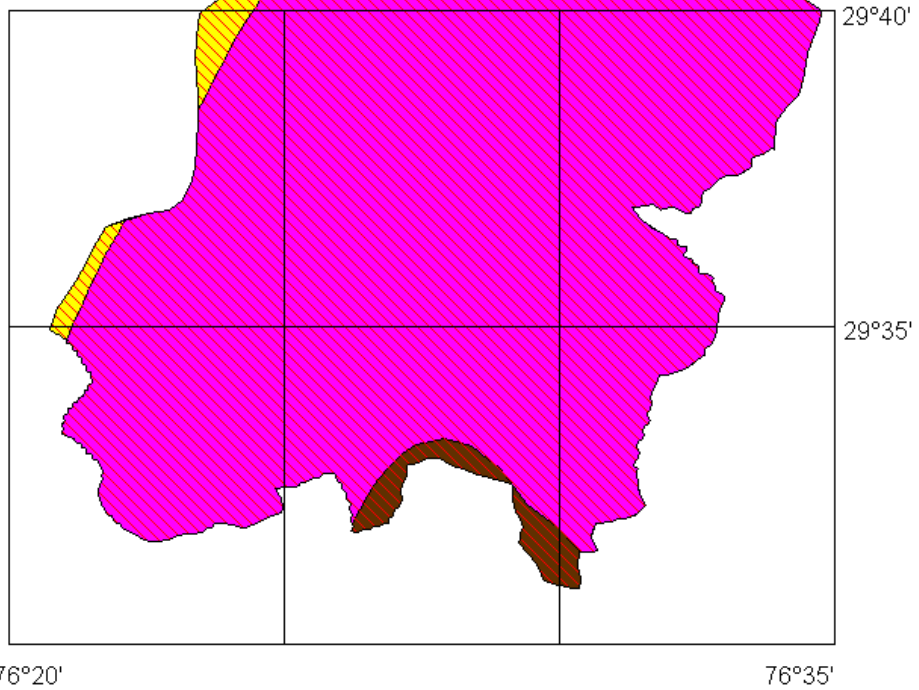
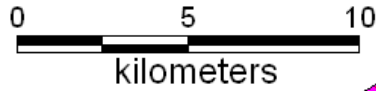
Block Name :- Pundri District :-Kaithal State :- Haryana		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	448.13
	<ul style="list-style-type: none"> • Number of Villages inhabited 45 • Un-inhabited 0 	
	ii) Average Annual Rainfall (mm)	567
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	Ganga Yamuna
3.	LAND USE	
	• Current fallows (Sq.Km)	--
	• Net Area Sown (Sq.Km)	373.05
	• Area Sown More than Once (Sq.Km)	----
	• Total Irrigated Area (Sq.Km)	373.05
	• Total Unirrigated Area (Sq.Km)	--
4.	PREDOMINANT GEOLOGICAL FORMATIONS	Younger alluvium
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Avg. Depth to water level (decadal)	
	• Pre- monsoon: (May 2015)	14.78-29.56(mbgl)
	• Post –monsoon: (Nov2014)	14.80-30.85 (mbgl)
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	6
	• Depth Range (m)	173-610.21
	• Discharge (lpm)	1200-4656/3-14.52
	Aquifer Parameters	

	<ul style="list-style-type: none"> • Transmissivity (m²/day) 	2200		
	<ul style="list-style-type: none"> • Storativity 	0.12-2.35*10 ⁻² -4.5*10 ⁻⁴		
	<ul style="list-style-type: none"> • Soil infiltration rate mm/ hour 	--		
		<i>Min</i>	<i>Max</i>	<i>Avg.</i>
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	<ul style="list-style-type: none"> • EC in $\mu\text{S}/\text{cm}$ at 25⁰c 	874	1384	
	<ul style="list-style-type: none"> • NO₃ (mg/l) 	7.1	41	
	<ul style="list-style-type: none"> • F (mg/l) 	0.7	1.1	
	<ul style="list-style-type: none"> • Fe (mg/l) 	0.12	0.94	
	<ul style="list-style-type: none"> • As (mg/l) 	0.008	0.0014	
8.	DYNAMIC GROUND WATER RESOURCES in MCM	2011		
	<ul style="list-style-type: none"> • Net Ground Water Availability (MCM) 	128.24		
	<ul style="list-style-type: none"> • Existing Gross Ground Water Draft for Irrigation (MCM) 	277.29		
	<ul style="list-style-type: none"> • Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM) 	17.55		
	<ul style="list-style-type: none"> • Existing Gross Ground Water Draft for all Uses (MCM) 	294.84		
	<ul style="list-style-type: none"> • Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM) 	17.55		
	<ul style="list-style-type: none"> • Net Ground Water Availability for Future Irrigation Development (MCM) 	-166.60		
	<ul style="list-style-type: none"> • Stage of Ground Water Development / Over Draft (%) 	230		
	<ul style="list-style-type: none"> • Category of Block 	OE		
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	<i>Extensive Irrigation</i>		
9.	Percentage of sand thickness up to 50 m depth (Average)	<i>Thickness(m)</i> 15.50	Percentage % 31	
10	Volume of unsaturated zone available for recharge (MCM)	697		

11.	Volume of water required for recharge (MCM)	936
12.	Volume of surplus water available for recharge(MCM)	16.76

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	4208	14.73	5.419
14	RWH Rural @ Rs. 25000/-	3436	8.59	0.359
15	RWH Urban@ Rs. 25000/-	654	1.64	0.059
16	Underground pipe line (area in hectares) @ Rs. 50000/-	5141	26	16.33
TOTAL			50.96	22.167

**BLOCK-RAJAUND DISTRICT-KAITHAL STATE-HARYANA
 DEPTH TO WATER LEVEL RAJAUND, DECADEAL MEAN POST MONSOON
 Vs
 DECADEAL MEAN TREND POST MONSOON
 (2005-2014)**



LEGEND

Decadal Mean Water Level (m.bgl)

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

Decadal Mean Trend (m)

- 0.10 to 0.00

- 2281 No. of Recharge Structures in Rural Villages
- 0 No. of Recharge Structures in Urban Towns
- 2853 No. of Recharge Pits in Agriculture land
- 15 Thickness of Sand

Ground Water Scenario of Block

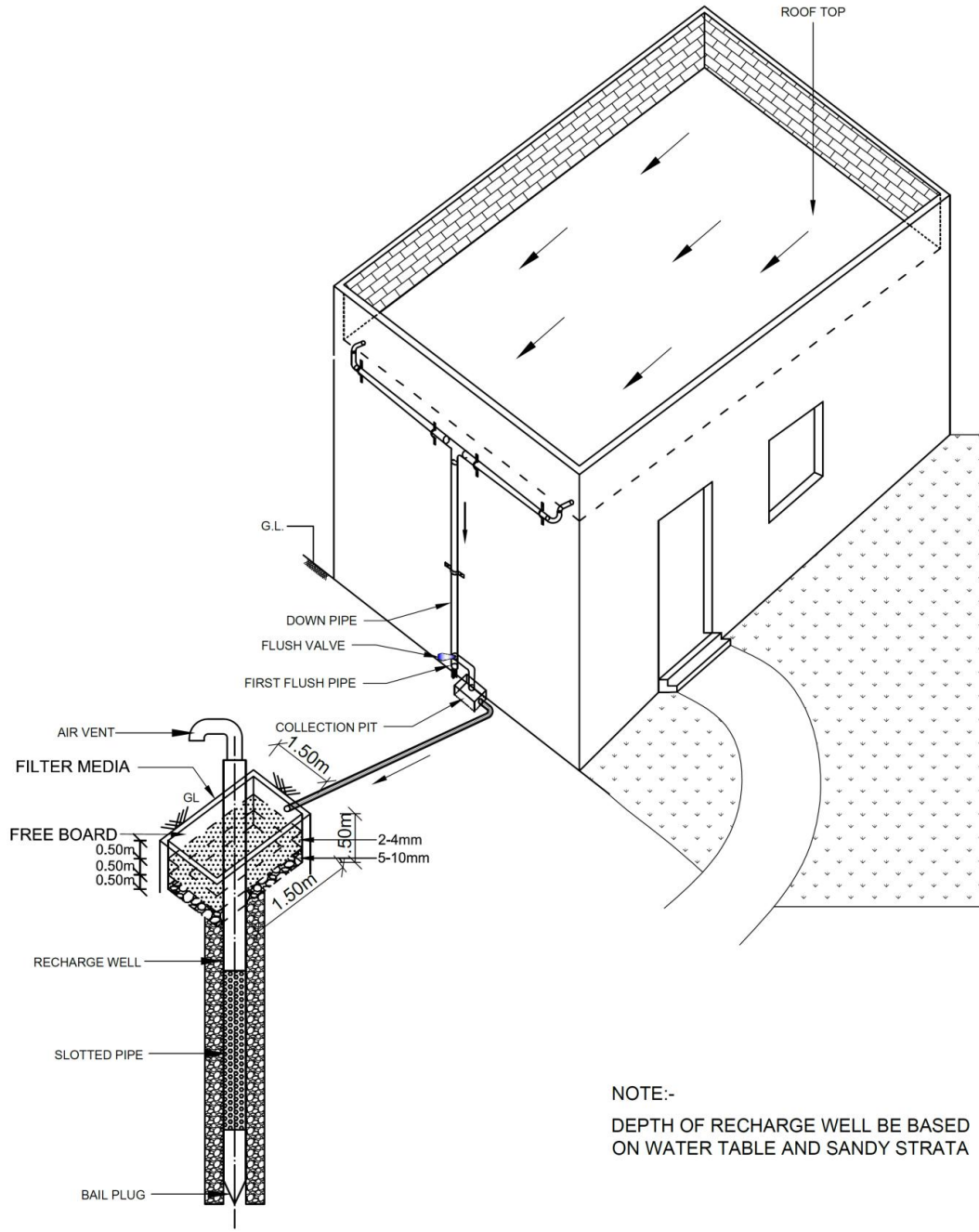
Block Name :- Rajaund District :-Kaithal State :- Haryana		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	285.39
	<ul style="list-style-type: none"> • Number of Villages inhabited • Un-inhabited 	25 0
	ii) Average Annual Rainfall (mm)	511
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	Ganga Yamuna
3.	LAND USE	
	• Current fallows (Sq.Km)	15
	• Net Area Sown (Sq.Km)	257.07
	• Area Sown More than Once (Sq.Km)	--
	• Total Irrigated Area (Sq.Km)	256.79
	• Total UnIrrigated Area (Sq.Km)	28
4.	PREDOMINANT GEOLOGICAL FORMATIONS	Younger alluvium
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Avg. Depth to water level (decadal)	
	• Pre- monsoon: (May 2015)	11.47-14.28 (mbgl)
	• Post –monsoon: (Nov2014)	12.55-14.70(mbgl)
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	--

	• Depth Range (m)	173-610.21		
	• Discharge (lpm)	1200-4656/3-14.52		
	Aquifer Parameters			
	• Transmissivity (m ² /day)	2200		
	• Storativity	$0.12-2.35*10^{-2}-4.5*10^{-4}$		
	• Soil infiltration rate mm/ hour	--		
		<i>Min</i>	<i>Max</i>	<i>Avg.</i>
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	• EC in $\mu\text{S}/\text{cm}$ at 25 ⁰ c	546	3835	
	• NO ₃ (mg/l)	2.6	132	
	• F (mg/l)	0.77	3.62	
	• Fe (mg/l)	0.31	0.5	
	• As (mg/l)	0.0015	0.0018	
8.	DYANMIC GROUND WATER RESOURCES in MCM	2011		
	• Net Ground Water Availability (MCM)	78.92		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	137.47		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	1.05		
	• Existing Gross Ground Water Draft for all Uses (MCM)	138.52		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	1.05		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-59.60		
	• Stage of Ground Water Development / Over Draft (%)	176		
	• Category of Block	OE		

	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	<i>Extensive Irrigation</i>	
9.	Percentage of sand thickness up to 50 m depth (Average)	<i>Thickness(m)</i> 15	Percentage % 30
10	Volume of unsaturated zone available for recharge (MCM)	444	
11.	Volume of water required for recharge (MCM)	596	
12.	Volume of surplus water available for recharge(MCM)	10.68	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	2853	9.99	3.72
14	RWH Rural @ Rs. 25000/-	2281	5.7	0.24
15	RWH Urban@ Rs. 25000/-	0	0	0
16	Underground pipe line (area in hectares) @ Rs. 50000/-	344	2	8.10
TOTAL			17.69	12.06

RECHARGE FROM ROOF TOP RAIN WATER HARVESTING (URBAN & RURAL HOUSEHOLDS)



NOTE:-
DEPTH OF RECHARGE WELL BE BASED
ON WATER TABLE AND SANDY STRATA

3-D VIEW

CGWB/NWR/Chandigarh

TYPICAL DESIGN FOR RECHARGE PIT IN FARM

