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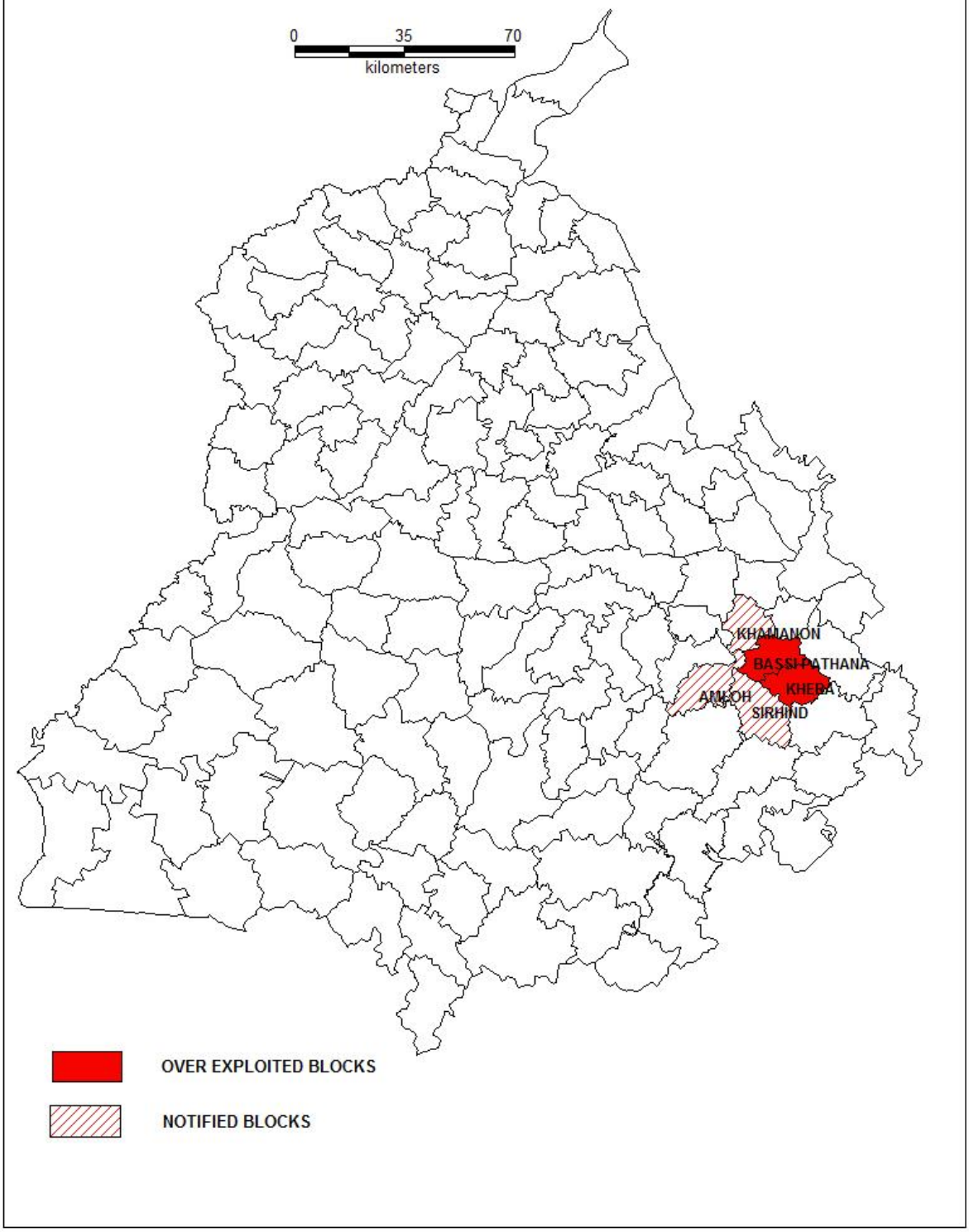
Government of India
Ministry of Water Resources,
River Development & Ganga Rejuvenation
Central Ground Water Board

PLAN ON

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION IN OVEREXPLOITED BLOCKS OF FATEHGARH SAHIB DISTRICT, PUNJAB

Central Ground Water Board
North Western Region
Chandigarh

PLAN OF ARTIFICIAL RECHARGE TO GROUND WATER IN OVER EXPLOITED BLOCKS DISTRICT FATEHGARH SAHIB, PUNJAB



PLAN OF ARTFICIAL RECHARGE TO GROUND WATER IN OVER EXPLOITED BLOCKS, DISTRICT FARIDKOT PUNJAB

INTRODUCTION

Fatehgarh Sahib District is located in southeastern part of Punjab state and lies between 30^0 25' 00" to 30^0 45' 45" north latitude & 76^0 04' 30" to 76^0 35' 00" east longitude covering an area 1147 sq km. The district comprises of Fatehgarh sahib, Amloh, Khamanon & Bassi Pathana are four teshils of the district. Gobindgarh is the only Sub Tehsil in the district. There are five development blocks namely Fatehgarh Sahib, Amloh, Khamanon, Khera & Bassi Pathana.

The total population of the district is 5,99,814 as per 2011 census which constitutes 2.20 % total population of the state. Total population of Fatehgarh sahib district in 2001 was 5,38,041 which shows that there has been 11.39 % decennial growth (2001-2011) in the district.

In 2011 total tubewells energized in the district was 22,820 whereas in 2005 the number of energized tubewells was 24,350 which show an increase of energized tubewells @ of 306 per year.

Four major canals passing through the district are Sirhind canal, Bhakara canal (Main Line), Narwana branch and Satluj Yamuna Link (SYL) canal. Sirhind canal passes through western part of the district from North West to south east direction where as Narwana branch bifurcates from Bhakra main canal in the central part of the district and runs from North West to south east direction. Satluj Yamuna Link canal is not in operational. The irrigation is provided by distributaries and minors of Bhakra canal only.

RAINFALL & CLIMATE

The climate of the district is classified as tropical steppe, hot and semi arid which is mainly dry with very hot summer and cold winter except during monsoon season. The normal annual rainfall of the district is 692 mm distributed over 28 days. Monsoon rainfall contributes 79 % of annual rainfall in the district. The rainfall increases from southwest to northeast in the district

GEOMORPHOLOGY & SOIL

Fatehgarh sahib district falls in Satluj Doab between river Satluj & Yamuna. The Doab form part of Indo - Gangetic alluvial plains. Elevation of land surface ranges from 285 m amsl in the north east to 246 m amsl in south to south west direction. The general slope in the district is towards south to

south west direction with an average gradient of 0.4 m per km. There are two streams which drains the area. Patiali Rao drains the eastern part of the district whereas Sirhind Choe drains central and western part of the district. River Satluj flowed through the district in the past. The paleo channels of river Satluj exists in the district.

Soils in the district are loamy sand at the surface and calcareous sandy loam in subsurface layers. Sand constitutes 80% in the soil profile. Silt constitutes 11% and clay 9% in the soils.

HYDROGEOLOGY

The district is underlain by formations of Quaternary age comprising of alluvium deposits belonging to vast Indus alluvial plains. Sub surface geological formations comprise of fine to coarse grained sand, silt, clay and kankar.

Central Ground Water Board has carried out ground water exploration up to a depth of 550 meters at village Rasulpur in Khera block. Total thickness of alluvium is expected to be more than 550 m as bed rock has not been encountered up to that depth. Subsurface geological formations show the existence of a top layer of 10 to 15 m of clay, kankar with sand lenses. This layer is followed by granular zones of 20 to 30 m in thickness and under laid by clay bed of 10 to 20 m in thickness. At a depth of 90 to 120 m another clay bed of 25 to 30 m in thickness exists. In general, the thickness of finer sediments increases below 100 m in the eastern part of the district.

Depth to water level in the district ranges from 7.65 to 27.24 m bgl during pre monsoon period and between 7.02 to 30.06 m bgl during post monsoon period. In the south eastern part of the district in east of Khera block water level is less than 10 mbgl. In the northeast of Khera block water level is in the range of 20-40 m bgl. Depth to water level in rest of the district ranges between 10 to 20 m bgl.

Long term water level fluctuation (10 Years) shows a decline of 2.2 m to 6.6 m in whole of he district. Water levels have declined in the range of 5 to 6.6 m in the central & southern part of the district in Sirhind, Amloh, western part of Bassi Pathana and Khera blocks. In the eastern parts of Khera, Bassi Pathana and southern part Khamanon blocks the decline in water levels is in the range of 4 to 5 m. Minimum fall of 2 to 3 m has been observed in the northern parts of Khamanon district.

Water level elevation in the district ranges from 246 m to 266 m amsl. The ground water flow direction is from north east to south west. The gradient of water table elevation is steeper in the north east part and gentle in the south west part of the district. The gradient of ground water table is 1.36 m/km in the north east and 0.45 m/km in the south west.

GROUND WATER RESOURCES

The block wise ground water resource potential of the district has been assessed as per GEC-97. The stage of ground water development ranges from 198 % (block Sirhind) to 240% (block Khamanon).

Net Replenishable ground water availability in the district has been assessed as 53919 ham. Gross ground water draft for all uses in the district is 113256 ham, leaving a shortfall (over draft) of 59963 ham. The stage of ground water development in the district has been assessed as 210 %.

GROUND WATER QUALITY

Chemical quality of groundwater of shallow aquifer shows that all parameters are within the permissible limits for drinking purpose set by the BIS, 1991. Salinity, Chloride, Nitrate and Flouride are the important parameters that are normally considered for evaluating the suitability of ground water for drinking uses. Ground water occurs with in desirable levels with respect to EC (less than 1000 micromohos/cm at 25^0C), Chloride (<250 mg/l), Nitrate (< 45mg/l) and Flouride (< 1 mg/l) in all samples. As per geo-chemical classification, the shallow ground water is Ca-Mg-HCO_3 type with few exception where water is Na-HCO_3 type.

Micro level ground water regulation and protection studies were carried out in Mandi Gobindgarh city the "Steel Town" of north India. Hydrochemistry of urban area of Mandi Gobindgarh reveals that ground water from shallow and deep aquifers, in general is suitable for domestic, drinking and irrigation purposes and all chemical constituents (major cations and anions) are within the permissible limit set by BIS, 1991. However at few places shallow groundwater is polluted by heavy metals like Fe, Cu, Pb & Zn. In deeper aquifers the concentration of heavy metals is low as compared to shallow aquifers. The presence of heavy metals is due to the industrial pollution.

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)	Big (>=10 ha)	Total
1	**Fatehgarh Sahib**	**1559**	**4265**	**13092**	**13165**	**3259**	**35340**

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)	Big (>=10 ha)	Total
1	**Fatehgarh Sahib**	**7**	**14**	**106**	**201**	**104**	**432**

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	**Fatehgarh Sahib**	**75**	**8930**	**2882**	**23495**	**0**	**35382**

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**	**Under ground pipe**
1	**Fatehgarh Sahib**	**125**	**32685**	**2992**

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 Crores	Annual Recharge (MCM)
ROOF TOP RAIN WATER HARVESTING IN RURAL AND URBEN AREAS					
1	**Artificial Recharge Plan For Urban Areas.**	3911	0.25	**9.777**	**0.425**
2	**Roof Top Rain Water Harvesting in Rural Areas**	7866	0.25	**19.665**	**0.665**
	Total	**11777**	**0.25**	**29.442**	**1.09**
ARTIFICIAL RECHARGE IN FARMS					
1	**Artificial Recharge Plan Through Recharge Pits.**	11186	0.35	39.151	11.816
			Total	**39.151**	**11.816**

By the implementation of the proposed recharge structures there will be a reduction of 2.15 % in stage of ground water development as tabulated below

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	**1132.56**	**-599.63**	**11.816**	**1120.744**	**210%**	**207.85%**	**2.15 %**

ARTIFICIAL RCEHARGE PLAN THROUGH RECHARGE PITS IN OVER EXPLOITED BLOCKS FATEHGARH SAHIB DISTRICT

Block Name	Total area of the village (in hectares)	10% of village area taken for farm recharge (in hectares)	Total number of recharge pits	Annual recharge (MCM)= (Area*Runoff 15%*)	Cost of Pit @Rs.35000/- (Crores)
KHAMANON	**18688**	**1869**	**1869**	**2.102**	**6.54**
AMLOH	**24936**	**2540**	**2540**	**2.549**	**8.89**
SIRHIND	**28625**	**2863**	**2863**	**2.821**	**10.02**
BASSI PATHANA	**18641**	**1864**	**1864**	**2.097**	**6.52**
KHERA	**20497**	**2050**	**2050**	**2.247**	**7.17**
			11186	**11.816**	**39.14**

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 FATEHGARH SAHIB DISTRICT OF PUNJAB								
Name of District	**Sr.no**	**Name of CD Block**	**Total area of the village (in hectares)**	**Number of households (2011 census)**	**No of Houses taken for Artificial Recharge (10% of total households)**	**Total No of AR Structures**	**Total recharge in MCM**	**Cost @ Rs. 25000/- per structure (Crores)**
FATEHGARH SAHIB	1	**KHAMANON**	**18688**	**15243**	**1530**	**1530**	**0.138**	**3.82**
	2	**AMLOH**	**24936**	**20006**	**2001**	**2001**	**0.161**	**5.00**
	3	**SIRHIND**	**28625**	**18379**	**1838**	**1838**	**0.145**	**4.59**
	4	**BASSI PATHANA**	**18641**	**11685**	**1169**	**1169**	**0.105**	**2.92**
	5	**KHERA**	**20497**	**13296**	**1330**	**1330**	**0.117**	**3.32**
		Total	**111387**	**78609**	**7868**	**7866**	**0.666**	**19.67**

ARTIFICIAL RECHARGE PLAN FOR URBAN AREAS OF DISTRICT FATEHGARH SAHIB PUNJAB

District	Block	Town Name	Total Households	Total Population of Town	Households taken for Artificial Recharge (10%)	Total Roof Top Area (sqm)	Vol of water available for recharge (MCM)	Cost @Rs 25000/- (Crores)
FATEH GARH SAHIB	BASSI PATHANA	BASSI PATHANA (MCL)	4274	20288	427	85480	0.051	1.0675
	SIRHIND	SIRHIND (MCL)	11899	58097	1190	237980	0.125	2.975
	AMLOH	AMLOH (MCL)	3065	14696	307	61300	0.033	0.7675
	AMLOH	GOBINDGARH (MCL + OG)	17780	82266	1778	355600	0.190	4.445
	KHAMANON	KHAMANON (NP)	2085	10135	209	41700	0.025	0.5225
		TOTAL	39103	185482	3911	782060	0.424	9.7775

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 Punjab, particularly in overexploited blocks. There are around 41219 operated by farmers for irrigation through unlined/Katcha (91.26%) open channel system in 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 Fatehgarh Sahib district is estimated at 1111.80 MCM. It is expected that around 47.37% 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 162.63 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 Fatehgarh Sahib Districts. The measure if implemented will bring down the ground water overdraft from 210% to 162.63 %. 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 Punjab**. 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, FATEHGARH SAHIB DISTRICT

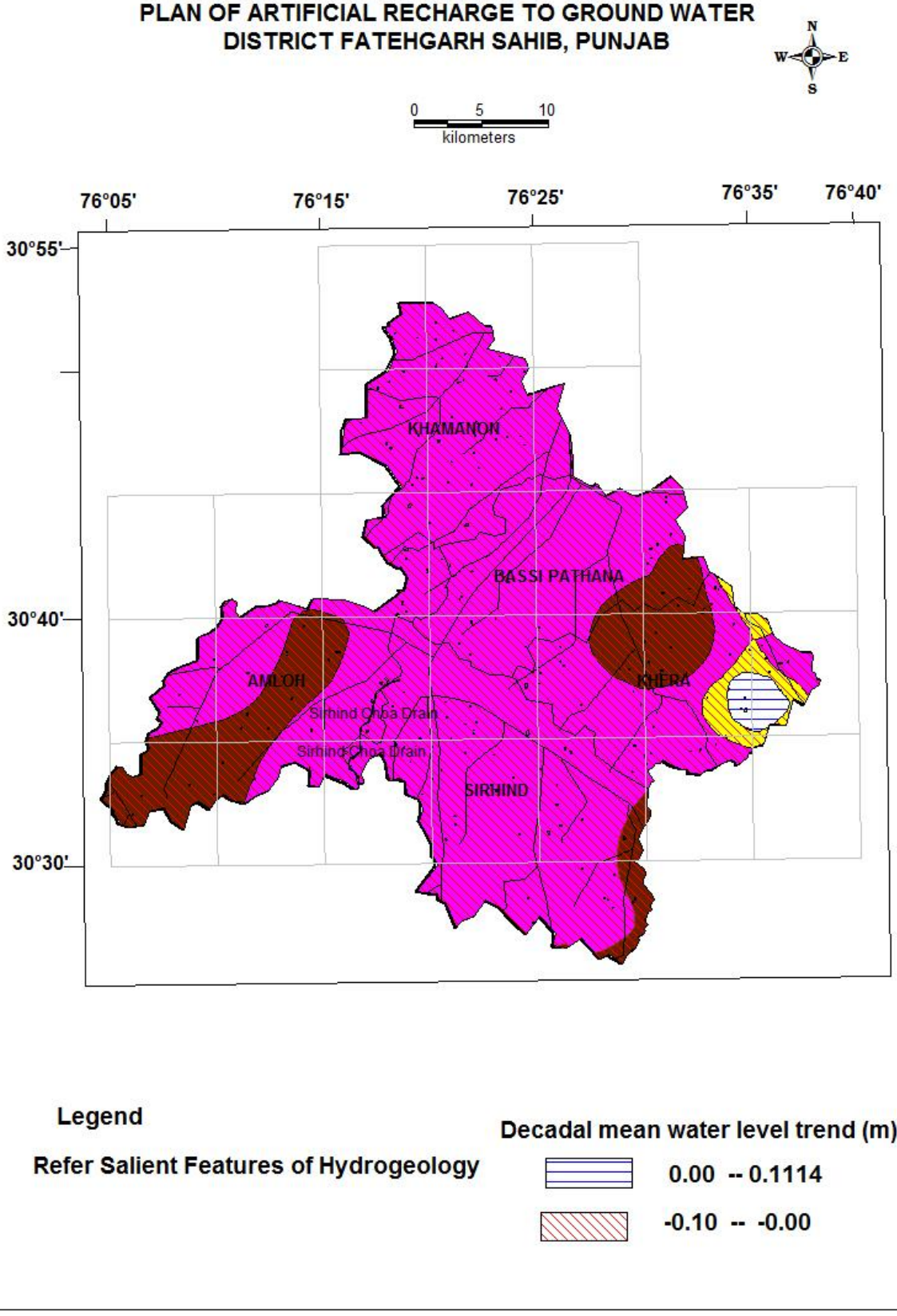
Net Annual Ground Water Availability (mcm)	Total Draft (present) (mcm)	Gross Irrigation Draft (present) (mcm)	Gross Ground Water Draft for Domestic and industrial supply (mcm)	Pecentage of unlined channel	Wastage through unlined channel, (mcm) (Col 3 X Col5 X 0.30#)	Potential of Reduced irrigation overdraft (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 canal (Col9-Col10) (%)
1	2	3	4	5	6	7	8	9	10	11
539.19	1132.56	1111.80	20.76	91.26	255.69	856.11	876.87	210	162.63	47.37

 # losses from open kuchha channel are around 30%.

COST ESTIMATE OF UNDERGROUND PIPE LINE

District	Block	Irrigated area by ground water scheme (ha)	Percentage of Unlined Channel (%)	Area under unlined Channels	Total cost @Rs.0.50 lack per hector(in cr) =Total irrigated area (by ground water scheme) of the block *0.5*Col 5	Total Cost in Rs.Cr. District wise
1	2	3	4	5	6	7
FATEHGARH SAHIB	Khamanon	16583	91.26	15134	76	433
	Amloh	22094	91.26	20163	101	
	Sirhind	23667	91.26	21599	108	
	Bassi Pathana	15442.7	91.26	14093	70	
	Khera	17049	91.26	15559	78	

PLAN OF ARTIFICIAL RECHARGE TO GROUND WATER
DISTRICT FATEHGARH SAHIB, PUNJAB



Legend

Refer Salient Features of Hydrogeology

Decadal mean water level trend (m)

0.00 -- 0.1114

-0.10 -- -0.00

BLOCK WISE PLAN OF DISTRICT FATEHGARH SAHIB PUNJAB

(5 OE BLOCKS)

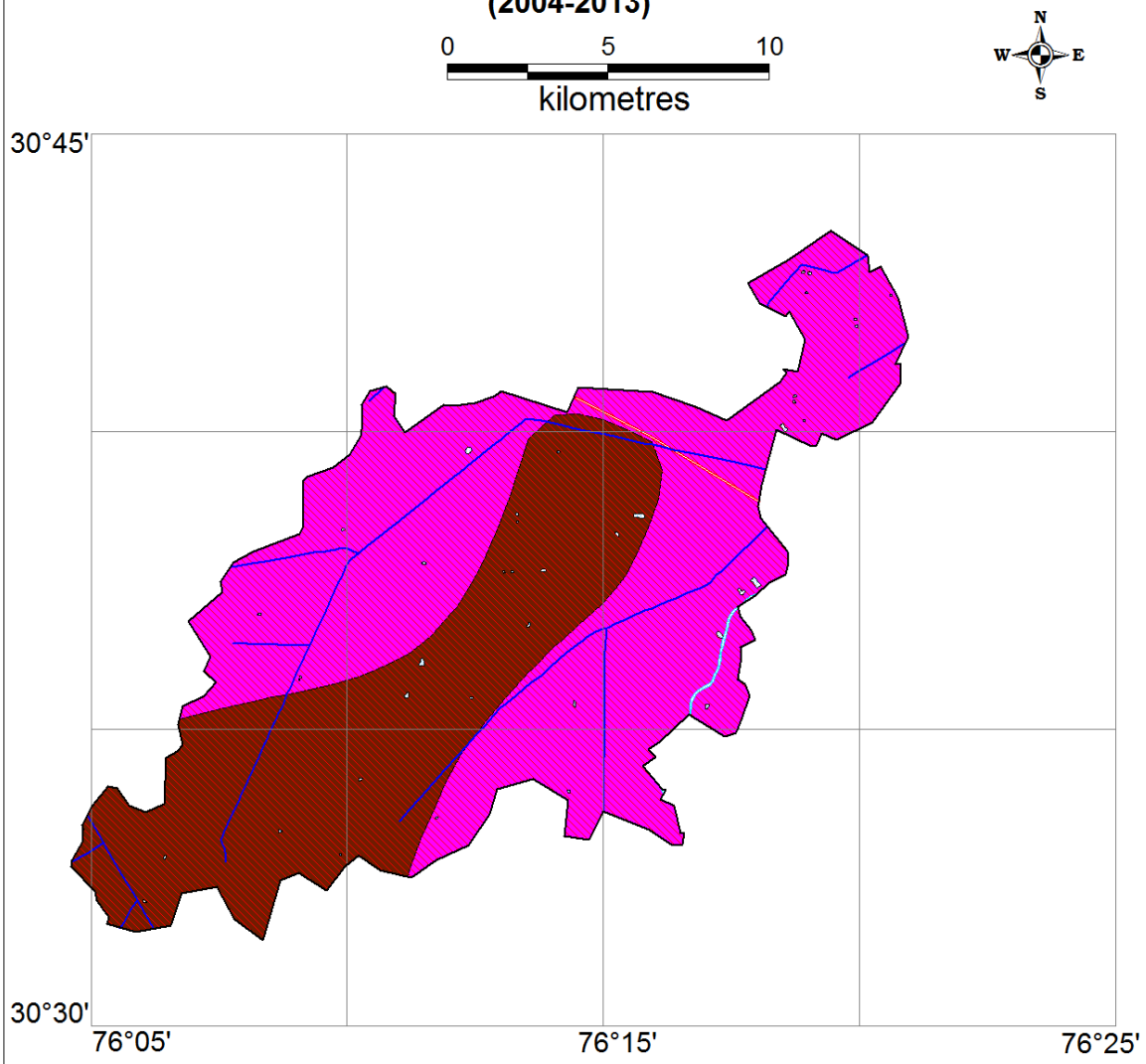
BLOCK: AMLOH DISTRICT:FATEHGARH SAHIB STATE: PUNJAB

DEPTH TO WATER LEVEL AMLOH, DECADAL MEAN POST MONSOON

Vs

DECADAL MEAN TREND POST MONSOON

(2004-2013)



LEGEND

Decadal Mean Water Level (m.bgl)

- 10.00 to 20.00
- 20.00 to 40.00
- NH Road
- Canals

Decadal Mean Trend (m)

- -0.10 to 0.00
- Drain
- Water Bodies

2001	No. of Recharge Structures in Rural Villages
2085	No. of Recharge Structures in Urban Towns
2540	No. of Recharge Pits in Agriculture land
40	Thickness of Sand

Ground Water Scenario of Block

Block Name:- Amloh **District:- Fateh Garh Sahib**		**State:- PUNJAB**
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*222*
	• Number of Villages inhabited • Un-inhabited	*95* *2*
	ii) Average Annual Rainfall (mm)	*676*
	iii) Area feasible for Artificial Recharge	*222*
	iv) Village identified under scarcity of Water?	*97*
	v) Village covered under water supply	*94*
	vi) Water Tank exists in the village	*51*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	*Ghaggar 100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	254.98
	• Net Area Sown (Sq.Km)	219.69
	• Area Sown More than Once (Sq.Km)	2.01
	• Total Cropped Area (Sq.Km)	221.70
	• Cropping Intensity	101
	• Area under Thur and Sem (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Recent alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Avg. Depth to water level (decadal)	Depth to water level (May 2015)

	• Pre- monsoon: (May 2015) 20.45- 23.35 (mbgl)	*10.00 – 40.00 (mbgl)*	
	• Post –monsoon: (Nov2014) 20.95 – 23.45 (mgbl)		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	*1*	
	• Depth Range (m)	*299.50-550.47*	
	• Discharge (Ipm)	*25.00*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*1790*	
	• Storativity	*$1.26*10^{-3}$*	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	*995*	*995*
	• NO3 (mg/l)	*187*	*187*
	• F (mg/l)	*0.38*	*0.38*
	• As (mg/l)	---	---
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (MCM)	*120.11*	
	• Existing Gross Ground Water Draft for Irrigation (MCM)	241.86	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	9.43	
	• Existing Gross Ground Water Draft for all Uses (MCM)	251.28	
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	10.65	
	• Net Ground Water Availability for Future Irrigation Development (MCM)	*-132.40*	
	• Stage of Ground Water Development / Over Draft (%)	*209*	
	• Category of Block	OE	
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*	*Extensive Irrigation*

9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *40*	Percentage % 80
10	Volume of unsaturated zone available for recharge (MCM)	337.27	
11.	Volume of water required for recharge (MCM)	448.57	
12.	Volume of surplus water available for recharge(MCM)	4.31	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge @Rs. 35000/-	2540	15.645	4.009
14	RWH Rural @ Rs. 25000/-	2001	7.255	0.208
15	RWH Urban@ Rs. 25000/-	2085	2.05	0.079
16	Under ground pipe line (area in hectares)	20163	101	55.62
	TOTAL		**125.95**	**59.916**

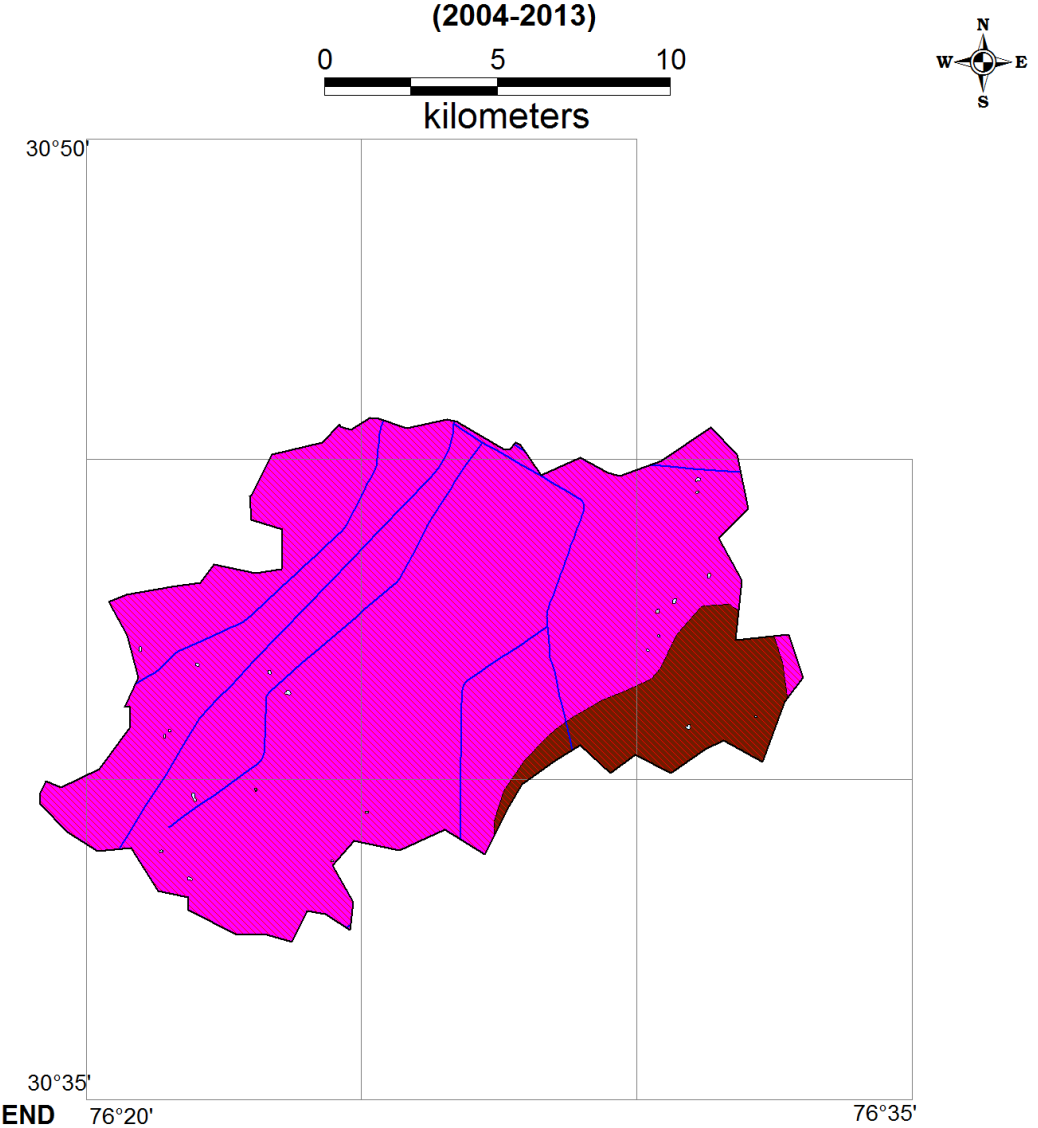
BLOCK: BASSI PATHANA DISTRICT: FATEHGARH SAHIB STATE: PUNJAB

DEPTH TO WATER LEVEL BASSI PATHANA, DECADAL MEAN POST MONSOON

Vs

DECADAL MEAN TREND POST MONSOON

(2004-2013)



LEGEND

Decadal Mean Water Level (m.bgl)

- 10.00 to 20.00
- 20.00 to 40.00
- Canals
- Water Bodies

Decadal Mean Trend (m)

- -0.10 to 0.00

- 1169 — No. of Recharge Structures in Rural Villages
- 427 — No. of Recharge Structures in Urban Towns
- 1864 — No. of Recharge Pits in Agriculture land
- 32 — Thickness of Sand

Ground Water Scenario of Block

Block Name:- Bassi Pathana **District:- Fateh Garh Sahib**		**State:- PUNJAB**
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*186.5*
	• Number of Villages inhabited • Un-inhabited	*80* *0*
	ii) Average Annual Rainfall (mm)	*759*
	iii) Area feasible for Artificial Recharge	*186.5*
	iv) Village identified under scarcity of Water?	*87*
	v) Village covered under water supply	*83*
	vi) Water Tank exists in the village	*42*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	*Ghaggar 100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	190.94
	• Net Area Sown (Sq.Km)	161.11
	• Area Sown More than Once (Sq.Km)	1.61
	• Total Cropped Area (Sq.Km)	162.72
	• Cropping Intensity	101
	• Area under Thur and Sem (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Recent alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Avg. Depth to water level (decadal)	Depth to water level (May 2015)

	• Pre- monsoon: (May 2015) 16.55 – 23.35 (mbgl)	*10.00 – 40.00 (mbgl)*	
	• Post –monsoon: (Nov2014) 16.75 – 31.42 (mbgl)		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	--	
	• Depth Range (m)	*299.50-550.47*	
	• Discharge (Ipm)	*25.00*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*1790*	
	• Storativity	*$1.26*10^{-3}$*	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	*435*	*575*
	• NO3 (mg/l)	*0.3*	*26*
	• F (mg/l)	*0.06*	*0.15*
	• As (mg/l)	0.002	0.002
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (MCM)	*92.03*	
	• Existing Gross Ground Water Draft for Irrigation (MCM)	179.33	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	3.54	
	• Existing Gross Ground Water Draft for all Uses (MCM)	*182.87*	
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	5.16	
	• Net Ground Water Availability for Future Irrigation Development (MCM)	*-92.46*	
	• Stage of Ground Water Development /Over Draft (%)	*199*	
	• Category of Block	OE	
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*	*Extensive Irrigation*

9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *32*	Percentage % 64
10	Volume of unsaturated zone available for recharge (MCM)	283.34	
11.	Volume of water required for recharge (MCM)	376.84	
12.	Volume of surplus water available for recharge(MCM)	3.62	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge @Rs. 35000/-	1864	6.524	2.097
14	RWH Rural @ Rs. 25000/-	1169	2.922	0.105
15	RWH Urban@ Rs. 25000/-	427	1.067	0.051
16	Underground pipe line (area in hectares)	14093	70	41.24
	TOTAL		**80.513**	**43.493**

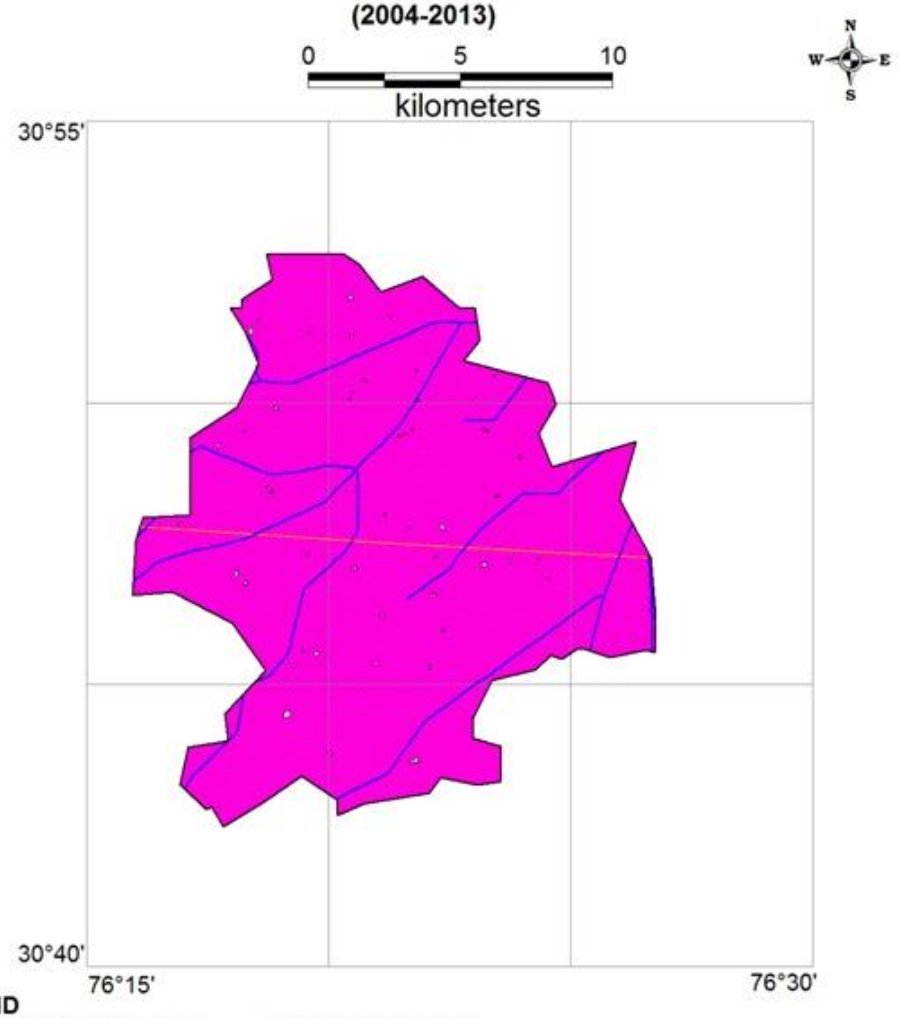
BLOCK: KHAMANON DISTRICT:FATEHGARH SAHIB STATE: PUNJAB

DEPTH TO WATER LEVEL KHAMANON, DECADAL MEAN POST MONSOON

Vs

DECADAL MEAN TREND POST MONSOON

(2004-2013)



LEGEND

Decadal Mean Water Level (m.bgl)

10.00 to 20.00

NH Road

Canals

Decadal Mean Trend (m)

-0.10 to 0.00

Water Bodies

1530 No. of Recharge Structures in Rural Villages

209 No. of Recharge Structures in Urban Towns

1869 No. of Recharge Pits in Agriculture land

28 Thickness of Sand

Ground Water Scenario of Block

Block Name:- Khamanon **District:- Fateh Garh Sahib**		**State:- PUNJAB**
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*155*
	• Number of Villages inhabited • Un-inhabited	*71* *1*
	ii) Average Annual Rainfall (mm)	*760*
	iii) Area feasible for Artificial Recharge	*155*
	iv) Village identified under scarcity of Water?	*72*
	v) Village covered under water supply	*71*
	vi) Water Tank exists in the village	*36*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Satluj 45 %* *Ghaggar 55 %*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	186.73
	• Net Area Sown (Sq.Km)	171.13
	• Area Sown More than Once (Sq.Km)	1.49
	• Total Cropped Area (Sq.Km)	172.80
	• Cropping Intensity	101
	• Area under Thur and Sem (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Recent alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Avg. Depth to water level (decadal)	Depth to water level (May 2015)

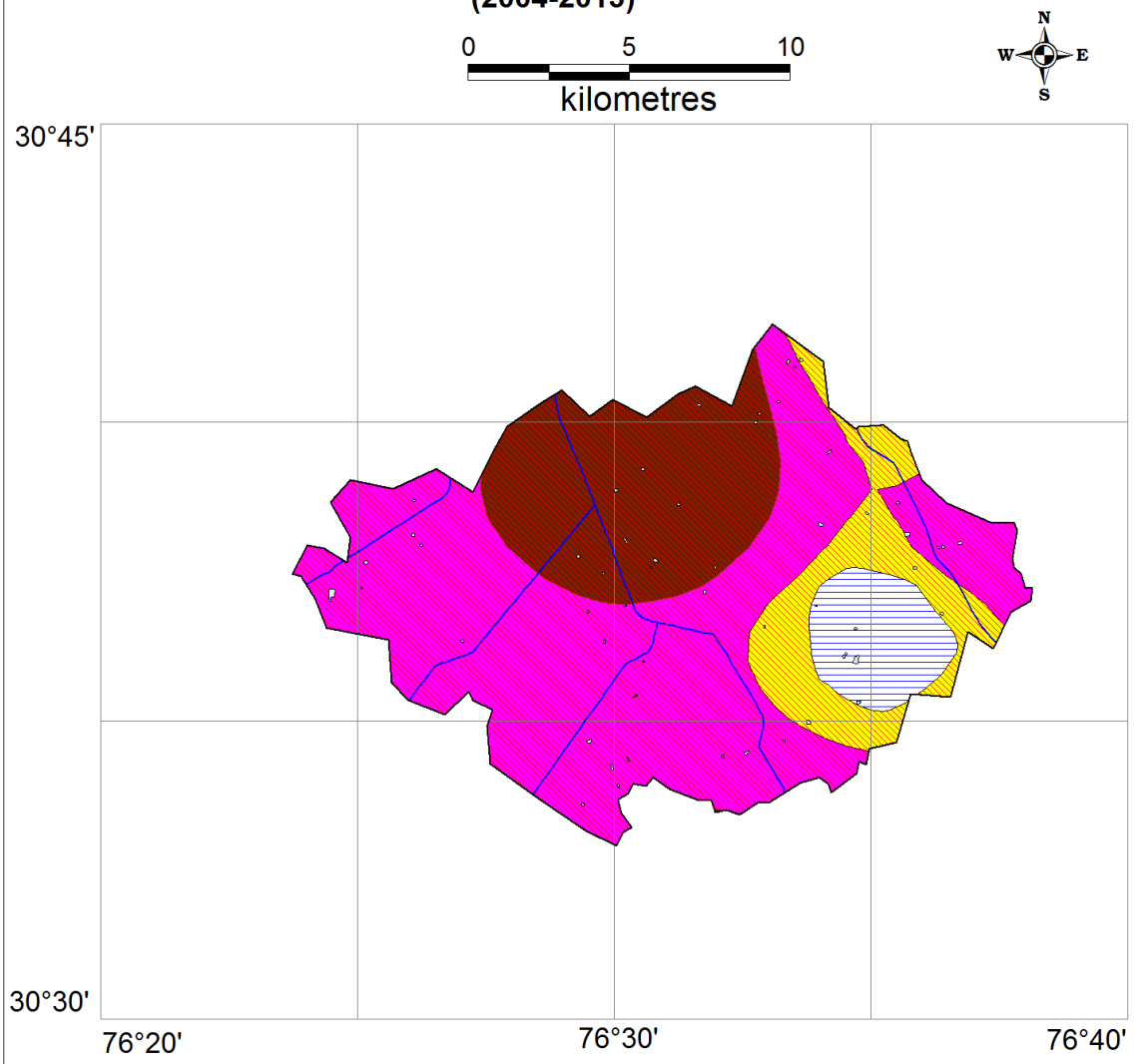
	• Pre- monsoon: (May 2015) 16.95 – 18.50 (mbgl)	*10.00 – 40.00 (mbgl)*	
	• Post –monsoon: (Nov2014) 17.65 -		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	--	
	• Depth Range (m)	*299.50-550.47*	
	• Discharge (Ipm)	*25.00*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*1790*	
	• Storativity	*$1.26*10^{-3}$*	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	--	--
	• NO3 (mg/l)	--	--
	• F (mg/l)	--	--
	• As (mg/l)	--	--
8	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (MCM)	*79.62*	
	• Existing Gross Ground Water Draft for Irrigation (MCM)	188.64	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	2.38	
	• Existing Gross Ground Water Draft for all Uses (MCM)	*191.02*	
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	3.38	
	• Net Ground Water Availability for Future Irrigation Development (MCM)	*-112.40*	
	• Stage of Ground Water Development / Over draft (%)	*240*	
	• Category of Block	OE	
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*	*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)	235.48	
11.	Volume of water required for recharge (MCM)	313.19	
12.	Volume of surplus water available for recharge(MCM)	3.01	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge @Rs. 35000/-	1869	6.541	2.102
14	RWH Rural @ Rs. 25000/-	1530	3.825	0.138
15	RWH Urban@ Rs. 25000/-	209	0.522	0.025
16	Underground pipe line (area in hectares)	15134	76	43.38
	TOTAL		**86.888**	**45.645**

BLOCK: KHERA DISTRICT:FATEHGARH SAHIB STATE: PUNJAB

DEPTH TO WATER LEVEL KHERA, DECADAL MEAN POST MONSOON Vs DECADAL MEAN TREND POST MONSOON (2004-2013)



LEGEND

Decadal Mean Water Level (m.bgl)

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

Decadal Mean Trend (m)

- -0.10 to 0.00
- 0.00 to 0.1114
- Water Bodies

- 1330 — No. of Recharge Structures in Rural Villages
- 2050 — No. of Recharge Pits in Agriculture land
- 37 — Thickness of Sand

Ground Water Scenario of Block

Block Name:- Khera **District:- Fateh Garh Sahib**		**State:- PUNJAB**
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*180.8*
	• Number of Villages inhabited • Un-inhabited	*84* *1*
	ii) Average Annual Rainfall (mm)	*741*
	iii) Area feasible for Artificial Recharge	*180.8*
	iv) Village identified under scarcity of Water?	*83*
	v) Village covered under water supply	*83*
	vi) Water Tank exists in the village	*45*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	*Ghaggar 100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	205.01
	• Net Area Sown (Sq.Km)	181.48
	• Area Sown More than Once (Sq.Km)	1.67
	• Total Cropped Area (Sq.Km)	183.15
	• Cropping Intensity	101
	• Area under Thur and Sem (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Recent alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Avg. Depth to water level (decadal)	Depth to water level (May 2015)

	• Pre- monsoon: (May 2015) • *5.22-33.56(mbgl)*	*10.00 – 40.00 (mbgl)*	
	• Post –monsoon: (Nov2014) • *5.25-35.88(mbgl)*		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	*1*	
	• Depth Range (m)	*299.50-550.47*	
	• Discharge (Ipm)	*25.00*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*1790*	
	• Storativity	*$1.26*10^{-3}$*	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	*570*	*2120*
	• NO3 (mg/l)	*1*	*55*
	• F (mg/l)	*0.22*	*1.03*
	• As (mg/l)	--	--
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (MCM)	89.96	
	• Existing Gross Ground Water Draft for Irrigation (MCM)	194.29	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	1.73	
	• Existing Gross Ground Water Draft for all Uses (MCM)	196.02	
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	2.52	
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-106.85	
	• Stage of Ground Water Development / Over Draft (%)	218	
	• Category of Block	OE	
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*	*Extensive Irrigation*

9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *37*	Percentage % 74
10	Volume of unsaturated zone available for recharge (MCM)	274.65	
11.	Volume of water required for recharge (MCM)	365.32	
12.	Volume of surplus water available for recharge(MCM)	3.51	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge @Rs. 35000/-	2050	6.541	2.247
14	RWH Rural @ Rs. 25000/-	1330	3.825	0.117
15	RWH Urban@ Rs. 25000/-	-	-	-
16	Underground pipe line (area in hectares)	15559	78	44.68
	TOTAL		**88.366**	**47.044**

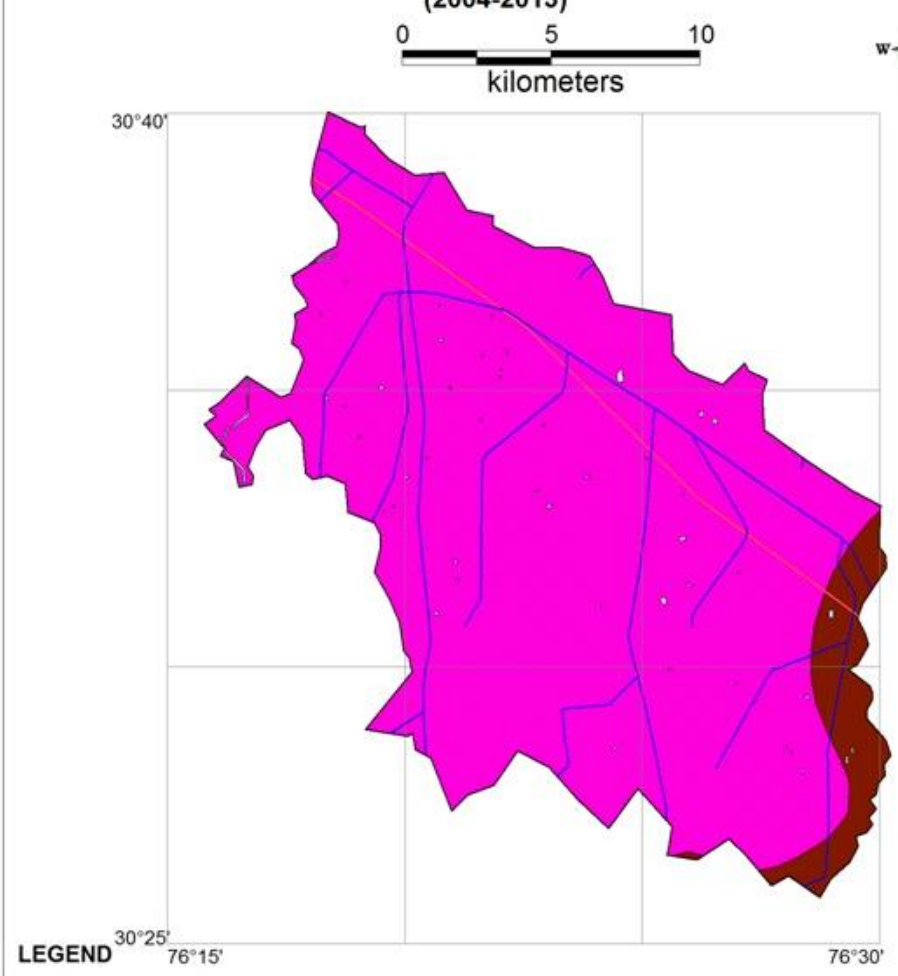
BLOCK: SIRHIND DISTRICT:FATEHGARH SAHIB STATE: PUNJAB

DEPTH TO WATER LEVEL SIRHIND, DECADAL MEAN POST MONSOON

Vs

DECADAL MEAN TREND POST MONSOON

(2004-2013)



LEGEND

Decadal Mean Water Level (m.bgl)

- 10.00 to 20.00
- 20.00 to 40.00
- NH Road
- Canals

Decadal Mean Trend (m)

- -0.10 to 0.00
- Water Bodies

1838	No. of Recharge Structures in Rural Villages
1190	No. of Recharge Structures in Urban Towns
2863	No. of Recharge Pits in Agriculture land
32	Thickness of Sand

Ground Water Scenario of Block

Block Name:- Sirhind **District:- Fateh Garh Sahib**		**State:- PUNJAB**
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*372.4*
	• Number of Villages inhabited • Un-inhabited	*100* *0*
	ii) Average Annual Rainfall (mm)	*741*
	iii) Area feasible for Artificial Recharge	*372.4*
	iv) Village identified under scarcity of Water?	*103*
	v) Village covered under water supply	*102*
	vi) Water Tank exists in the village	*51*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	*Ghaggar 100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	282.90
	• Net Area Sown (Sq.Km)	264.82
	• Area Sown More than Once (Sq.Km)	2.13
	• Total Cropped Area (Sq.Km)	266.95
	• Cropping Intensity	101
	• Area under Thur and Sem (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Recent alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Avg. Depth to water level (decadal)	Depth to water level (May 2015)

	• Pre- monsoon: (May 2015) • *17.00-24.40(mbgl)*	*10.00 – 40.00 (mbgl)*	
	• Post –monsoon: (Nov2014) • *20.15-25.50(mbgl)*		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	*1*	
	• Depth Range (m)	*299.50-550.47*	
	• Discharge (Ipm)	*25.00*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*1790*	
	• Storativity	*$1.26*10^{-3}$*	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	*590*	*590*
	• NO3 (mg/l)	*16*	*16*
	• F (mg/l)	*0.06*	*0.06*
	• As (mg/l)	0.0031	0.0037
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (MCM)	*157.74*	
	• Existing Gross Ground Water Draft for Irrigation (MCM)	307.69	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (Ham)	3.68	
	• Existing Gross Ground Water Draft for all Uses (MCM)	311.37	
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	5.32	
	• Net Ground Water Availability for Future Irrigation Development (MCM)	*153.53*	
	• Stage of Ground Water Development/ Over Draft (%)	*198*	
	• Category of Block	OE	
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*	*Extensive Irrigation*

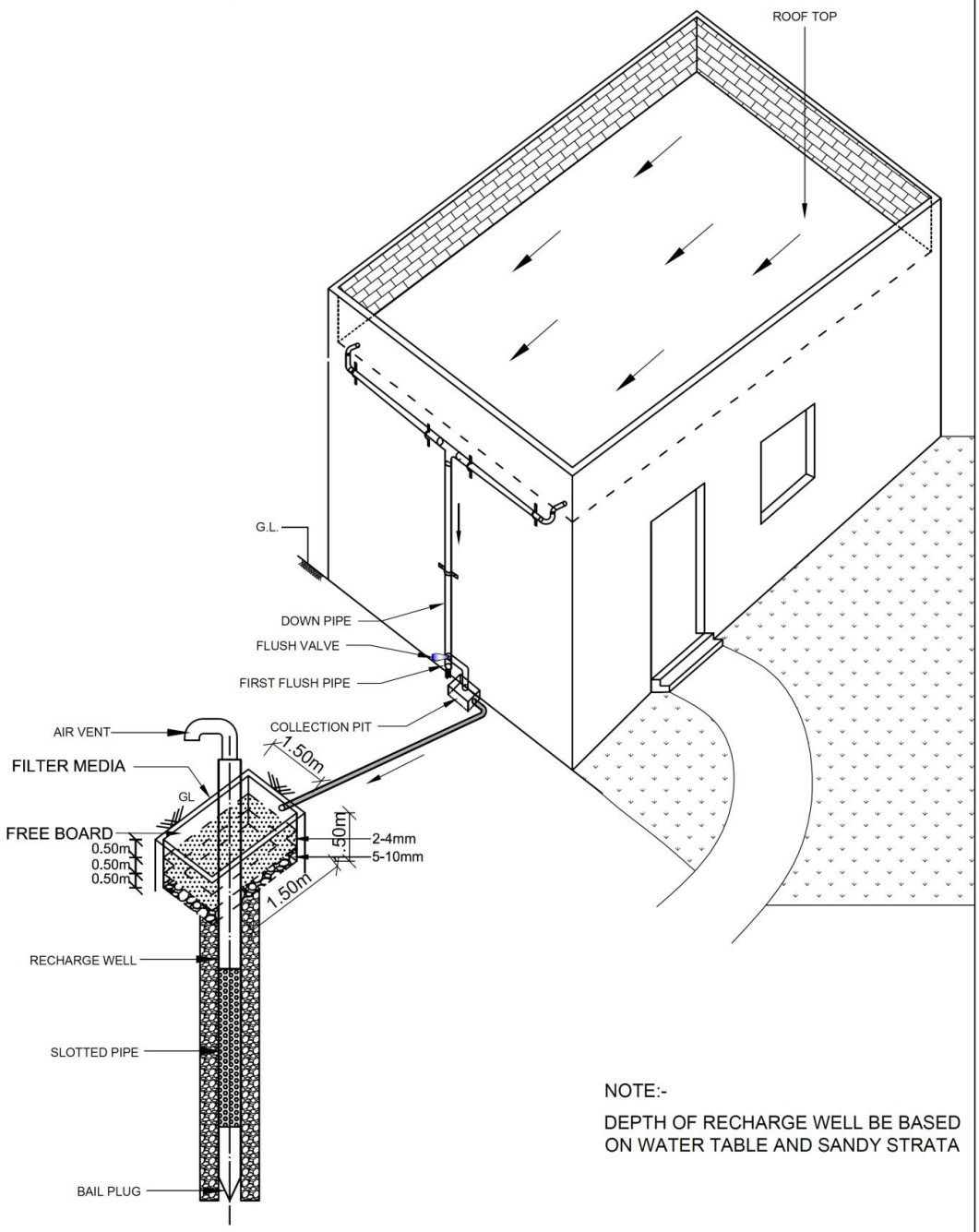
9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *29*	Percentage % 58
10	Volume of unsaturated zone available for recharge (MCM)	565.77	
11.	Volume of water required for recharge (MCM)	752.47	
12.	Volume of surplus water available for recharge(MCM)	7.23	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge @Rs. 35000/-	2863	10.020	2.821
14	RWH Rural @ Rs. 25000/-	1838	4.595	0.145
15	RWH Urban@ Rs. 25000/-	1190	2.975	0.125
16	Underground pipe line (area in hectares)	21599	108	70.76
	TOTAL		**125.59**	**73.851**

Annexure-I

RECHARGE FROM ROOF TOP RAIN WATER HARVESTING

(URBAN & RURAL HOUSEHOLDS)



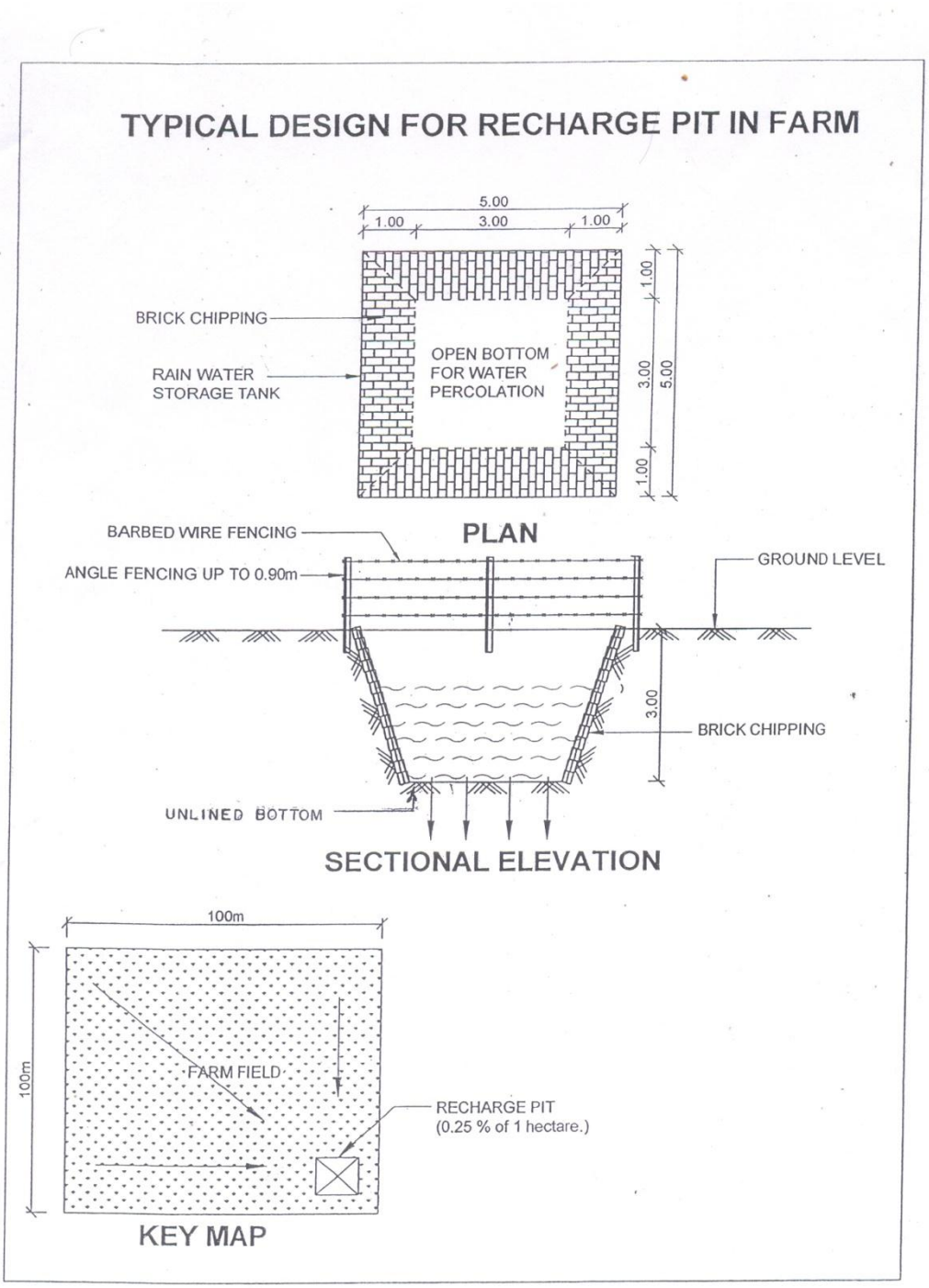
NOTE:-

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

3-D VIEW

CGWB/NWR/Chandigarh

Annexure-II


TYPICAL DESIGN FOR RECHARGE PIT IN FARM
5.00
1.00
3.00
1.00
1.00
3.00
5.00
1.00
BRICK CHIPPING
RAIN WATER
STORAGE TANK
OPEN BOTTOM
FOR WATER
PERCOLATION
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