SONIPAT DISTRICT HARYANA

CENTRAL GROUND WATER BOARD
Ministry of Water Resources
Government of India
North Western Region
CHANDIGARH
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Contributors

Rakesh Rana
Scientist-'B'

Prepared under supervision of

A.K.Bhatia
Regional Director

Our Vision

"Water Security Through Ground Water Management"

GROUND WATER INFORMATION BOOKLET
SONIPAT DISTRICT, HARYANA

C O N T E N T S

DISTRICT AT A GLANCE

SONIPAT DISTRICT AT A GLANCE

Sl.NO.	ITEMS	Statistics
1.	GENERAL INFORMATION	
	Geographical Area (sq. km.)	2122
	Administrative Divisions	
	Number Of Tehsils (4)	1. Sonipat 2. Ganaur 3. Gohana 4. Kharkhoda
	Number Of Blocks (7)	1. Sonipat 2. Ganaur 3. Gohana 4. Kharkhoda 5. Rai 6. Mundlana 7. Kathura
	Number Of Panchayats	316
	Number Of Villages	323
	Population (As per 2011Census)	1480080
	Average Annual Rainfall (mm)	567
2.	GEOMORPHOLOGY	
	Major Physiographic Units	Alluvial Plains
	Major Drainage	Yamuna River, Drain No.8
3.	LAND USE (Sq.Km.)	
	a. Forest Area:	10
	b. Net area sown:	1470
	c. Cultivable area:	1850
4.	MAJOR SOIL TYPES	Sandy loams to loamy sands
5.	AREA UNDER PRINCIPAL CROPS (Sq. Km.)	2780
6.	IRRIGATION BY DIFFERENT SOURCES (Areas and Number Of Structures) Sq.Km	
	Dug wells	-
	Tubewells/Bore wells	600 sq.km.(37,385)
	Tanks/ponds	-
	Canals	850 sq.km.
	Other sources	-

	Net Irrigated area	1440 sq.km.
	Gross irrigated area	2710 sq. km.
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB	
	No. of dug wells	25
	No of Piezometers	4
8.	PREDOMINANT GEOLOGICAL FORMATIONS	Alluvium
9.	HYDROGEOLOGY	
	*Major Water bearing formation	Alluvium (Sand & Gravel)
	*(Pre-monsoon depth to water level)	1.57-24.84
	*(Post-monsoon depth to water level)	0.64 m-22.46 m
	*Long term water level trend in 10 yrs in m /yr	0.05 to 0.32 (Rise) 0.05 to 0.97 (Fall)
10.	GROUND WATER EXPLORATION BY CGWB	
	No. of wells drilled	
	EW	8
	OW	-
	PZ	25
	SH	2
	Depth range (m)	69-462m
	Discharge (liters per minute)	4541 lpm
	Storativity (S)	$21.5 X10^{-2}$
	Transmissivity (m^2/day)	2340
11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than the permissible limit	
	EC, in micromhos at 25^0C (>3000)	10
	F, in mg/l (>1.5)	13
	As, in mg/l(>0.01)	2
	Fe, in mg/l(>1.0)	6
	Type of water	$Ca+Mg-HC0_3$ and Na-mixed anion
12	DYNAMIC GROUND WATER RESOURCES (2009)	
	Annual Replenish able Ground water Resources	774.24 MCM
	Net Annual Ground water Draft	1164.10 MCM
	Projected Demand for Domestic and industrial Uses upto 2025	41.68 MCM
	Stage of Groundwater Development	122 %
13	AWARENESS AND TRAINING ACTIVITY	-
	Mass Awareness Programmes organized	-
	Date	-

	Place	-
	No of participants	-
14.	EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING	-
	Projects completed by CGWB (No.& Amount spent)	-
	Projects under technical guidance of CGWB (Numbers)	-
15.	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks.	3
	No. Critical Blocks	2
	No. of blocks notified	-
16	MAJOR GROUND WATER PROBLEMS AND ISSUES.	Salinity and fluoride problem in Ground water

HYDROGEOLOGICAL INFORMATION BOOKLET OF SONIPAT DISTRICT, HARYANA

1.0 INTRODUCTION

The district of Sonipat is bounded by $28^0$48'15" to $29^0$17'10" North latitude and $76^0$28'40" to $77^0$12'45" East longitude. It falls in the survey of India topo sheets no.53C,53D, 53G & 53H covering an area of 2260.53 sq.km. Sonipat is one of the smallest district in Haryana State and covers 5.11 % area of the state. The district is surrounded by Panipat district in the north, Jind district in the west, Rohtak district in the S.W direction and Delhi in the South. The district headquarter, Sonipat is connected by metalled roads with important cities of the state and to Delhi. It is also connected by broad gouge railway line with Delhi and Chandigarh. Gohana, Ganaur, Rai & Kundli are the other important towns in the district.

Administrative setup

The district comes under Rohtak division administratively. It has the following administrative subdivisions:

Sub-Division	Tehsil	Block	Area of block (sq.km)
a. Sonipat	a. Sonipat	a. Ganaur	388.90
b. Gohana	b. Gohana	b. Kharkhoda	299.44
c. Ganour	c. Ganour	c. Rai	280.49
	d. Kharkhoda	d. Sonipat	397.89
		e. Mundalana	305.73
		f. Kathura	205.77
		g. Gohana	290.32

Sonipat district is one of the densely populated districts of the state. The total population of the district as per 2001 census is 12,79,175. The population density is 471 persons per sq.km against the state average of 372 persons per sq.km.

Drainage

The River Yamuna, which borders the district in the East, is the main river in the district. The district is drained by drain no.8, which was constructed to take out excess monsoon runoff from uplands to River Yamuna. The areas east of upland plains are more prone to flooding because of its low-lying nature.

Irrigation

Irrigation in the district is done by surface and ground water as well .Around 42% of the area is irrigated by tubewells and rest of the area is irrigated by canals. About 96% area has been irrigated with respect to net sown area in the district. The district has a high irrigation intensity of 159%. About 91% area of the district is gross area irrigated with respect to total cropped area. The area, which is irrigated by surface water lies towards west where ground water is mostly saline while ground

water irrigation is maximum in the eastern parts adjoining the Yamuna river. In this part of the district, ground water is fresh. The canal irrigation is mainly done by West Yamuna Canal system.

Studies carried out by CGWB

The district was covered under systematic hydrogeological studies in the field season 1962-63. The district was covered under re-appraisal hydrogeological surveys in 1980-81, 1985-86 and 1997-98. The Sonipat district formed a part of studies undertaken during upper Yamuna project by Central Ground Water Board. As part of the studies in the basin, the exploratory drilling was taken up in Sonipat district and 15 wells were constructed during the period 1971-76.

2.0 CLIMATE & RAINFALL

HYDROMETEOROLOGY

The climate of the district is characterized by the dryness of the air with an intensely hot summer and a cold winter. The cold season starts by late November and extends to about the middle of March. It is followed by hot season, which continues to about the end of June when the southwest monsoon arrives over the district. The period from July to September is the southwest monsoon season.

Rainfall: The normal annual rainfall of the district, based on the record for the period 1901-1980 is 567 mm recorded in 30 rainy days in a year. There is no meteorological observatory in the district, so the climatological data of the nearby observatory at Delhi has been taken as representative of the climatological conditions of the district. About 76% of the annual rainfall is recorded during the southwest monsoon from June-September. July is the wettest month of the year with 7.5 rainy days and 169 mm rainfall. During the period 1901-80, deficient to scanty rainfall was recorded in 18 years. The probability of occurrence of rainfall in the range 400-700 mm is 0.65.

January is the coldest month with mean daily maximum temperature 21.3^{o} C and mean daily minimum temp 7.3^{o}C. May is the hottest month with mean daily maximum temp 26.6^{o}C. In May and June, the maximum temperature sometimes reaches about 47^{o}C.

3.0 GEOMORPHOLOGY AND SOIL TYPES

3.1 Physiography

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.
5. Upland plains representing the relatively older river deposits. The western Yamuna canal has been roughly aligned along the ridge formed by upland plains

3.2 Soils Types

- **Psammaquents and Haplaquepts-** These soils are found in Yamuna Plains
- **Haplaquept-** These soils are non saline, alkalinity hazards are classified as typic ustochrepts but water logged soils with loam to clay loam texture showing the effect of glazing, are classified as aeric/ typic Haplaquepts. Areas as aeridic soil moisture have soils classified as camborthics and torropsamments.

4.0 GROUND WATER SCENARIO

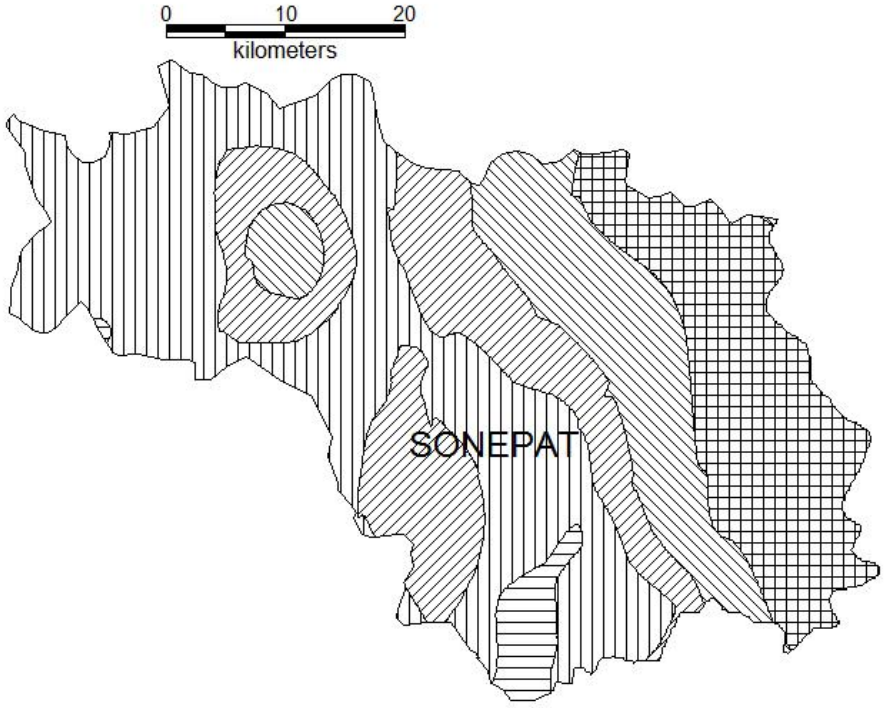
4.1 Hydrogeology

Ground water occurs in alluvial sand, silt, kankar and gravel, which form potential aquifer zones. Depth to water level during pre-monsoon varies from 1.57 - 24.84 mwhile during post-monsoon it varies from 0.64- 22.46 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 table is 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 oen 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, K harkhoda 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.

Central Ground Water Board has drilled 15 wells under ground water exploration programme; 8 are exploratory wells, 5 are piezometers and 2 are slim holes. Out of 8 boreholes drilled for ground water exploration, 7 were abandoned due to poor quality of ground water or due to inadequate thickness of permeable granular zones. Granular zones exist down to 460m depth i.e. to depth explored. However, the chemical quality of ground water is not fresh in deeper horizons in most parts of the district and in shallow horizons; in some parts. In general, the quality of ground water in shallow dugwell zones is fresh in the eastern and north, northwest parts and gradually gets deteriorated in the western and southwestern parts. Also the deep zones below 150m depth contain brackish / saline ground water. A number of shallow tubewells exist in all the blocks - more in number in Sonipat, Rai and Ganaur block and these tap water bearing zones in the shallow unconfined aquifer group. These tubewells yielded 300 to 600 lpm for moderate drawdowns. Detailed test drilling has established occurrence of three distinct aquifer groups, down to 450m depth in Upper Yamuna Basin which includes Sonipat district.

Aquifer group-I which was in unconfined state extends from water table down to 70m depth. A tubewell 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.

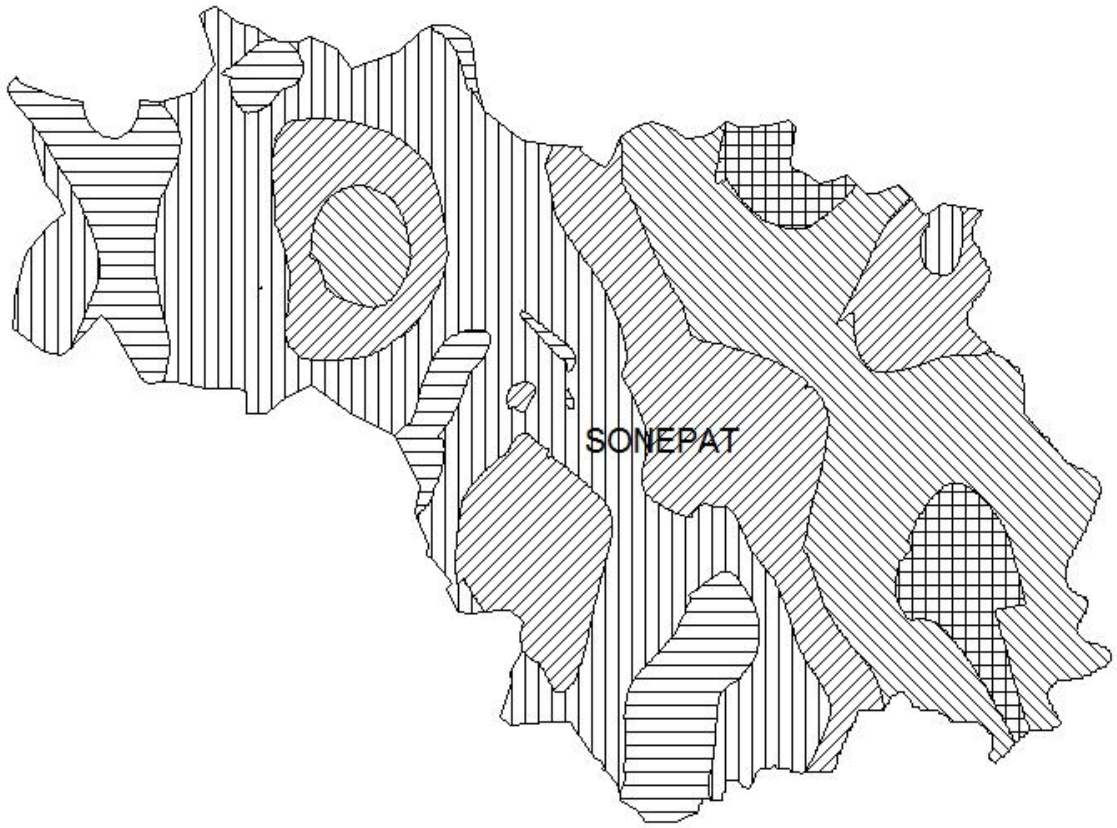
DEPTH TO WATER LEVEL MAP
SONEPAT
MAY 2011



LEGEND RANGE (MBGL)

- 2.0 to 5.0
- 5.0 to 10.0
- 10.0 to 20.0
- 20.0 to 30.0

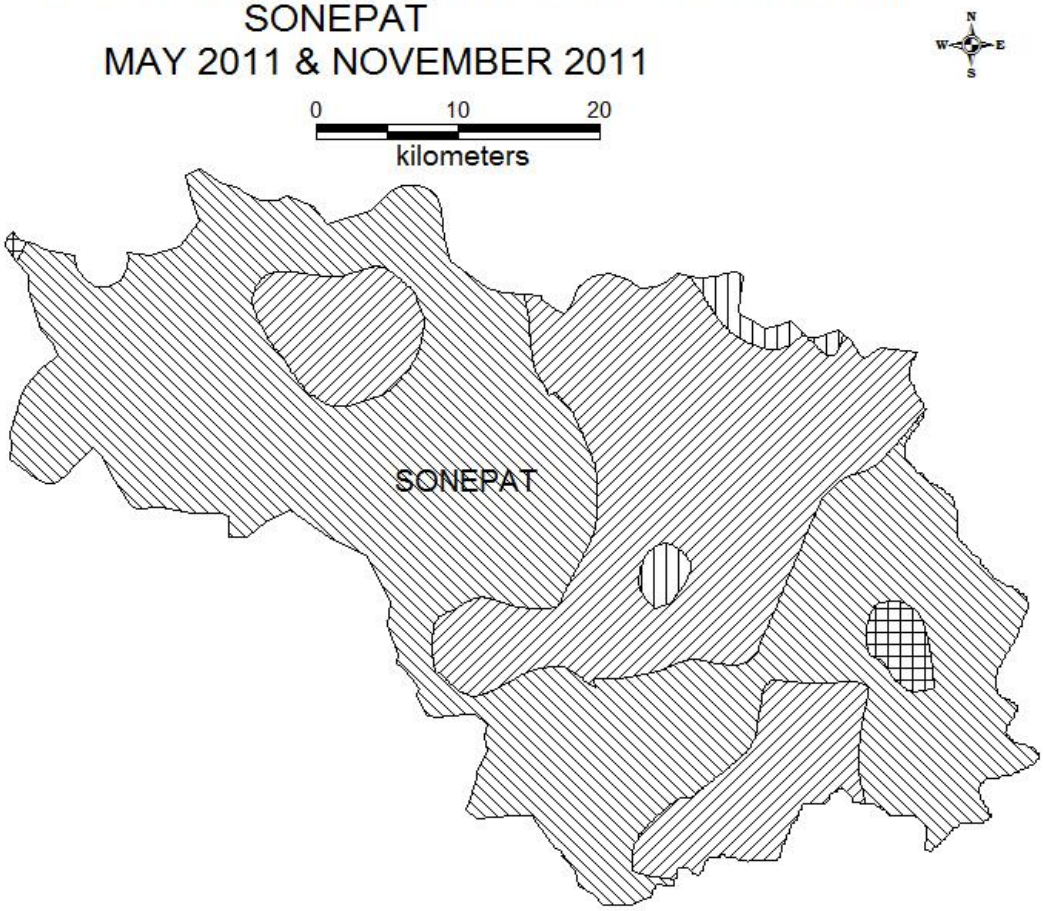
DEPTH TO WATER LEVEL MAP
SONEPAT
NOVEMBER 2011



LEGEND
RANGE (MBGL)

- 0.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 20.0
- 20.0 - 30.0

SEASONAL WATER LEVEL FLUCTUATION MAP
SONEPAT
MAY 2011 & NOVEMBER 2011



4.2 Ground Water Resources

The block wise ground water resource potential in the district has been assessed as per GEC-97 as on March 2009. The stage of ground water development ranges between 78% (block-Kathura) to 196% (block-Rai). The total replenish able ground water resource in the district is 774.26 mcm, of which the total existing ground water draft by all means is 945.35 mcm. The net utilizable ground water resources for future irrigation development are -173.64 MCM.

GROUND WATER RESOURCES OF SONIPAT DISTRICT, HARYANA STATE

Block	Net annual ground water availability (ham)	Existing gross ground water draft for irrigation (ham)	Existing gross ground water draft for all uses (ham)	Provision for domestic & industrial requirement supply to 2025 (ham)	Net annual ground water availability for future irrigation development (ham)	Stage of ground water development (%)	catagory
Ganaur	19778	22384	23711	1327	-3933	120	OVER EXPLOITED
Gohana	7609	10183	10282	99	-2673	135	CRITICAL
Kathura	5344	4187	4193	261	896	78	SAFE
Kharkhoda	8067	11420	11541	121	-3474	143	CRITICAL
Mundlana	15751	12566	12575	9	3176	80	SAFE
Rai	7902	14472	15526	1054	-7624	196	OVER EXPLOITED
Sonepat	12975	15410	16707	1297	-3732	129	OVER EXPLOITED
Total	**77426**	**90622**	**94535**	**4168**	**-17364**	**122**	

Discharge of the tubewells increases from west to east towards river Yamuna. Good aquifer exist 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, Sonipat and Rai blocks high discharge wells upto 20 lps have been reported.

4.3 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 597 to 6710µS/cm. at 25^0C . 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 waters 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

Type Of Water

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.

4.4 Status of Ground Water Development

Irrigation from ground water is being done in large parts of the district. Maximum number of minor irrigation units have been installed in Sonipat and Ganaur blocks. Density of MI units is also highest in these blocks, while it is lowest in Kathura block. A large number of pump sets have been installed at shallow depth in range of 5 -10m in Mundlana, Kathura, Gohana, Kharkhoda blocks. Deep tubewells are installed in Sonipat, Ganaur and Rai blocks. Ground water is relatively fresh in these blocks at deeper levels as compared to other areas. Generally the H.P. of Pump varies from 3 to 7.5 in large parts of the district. However, higher capacity pump having H.P. upto 20 are being used for lifting ground water from deep tubewells in Sonipat and Rai blocks. These areas are more or less parallel to the Yamuna River in the eastern part of the district.

The depth of shallow tubewells is mainly in the range of 20-30m with discharge in the range of 8-10lps. However in parts of Ganauour and Sonepat block the shallow tubewells upto 45m having discharge more than 12 lps are prevalent.

4.5 Geophysical Studies

The results of the surface geophysical studies in entire Sonepat district indicates that ground water is saline at all levels in some part of the Sonepat district. About 28% area is adversely affected with shallow ground water salinity. Such areas include few localities in Mundlana, Gohana, Kathurah and Kharkhauda blocks. Ground water is saline within 20m depth over half of the Sonepat district particularly in the areas lying in west, northwest, and south of the district. However, the impact of ground water salinity is less in the vicinity of river and canals. Part of the study area over northern eastern, northeastern, central and southeastern direction has fresh quality of ground water within a depth of 40 to 80 m b.g.l. Such areas include blocks of Sonepat, Rai, & Ganaur. Major area has saline quality of ground water in the depth range of 40 to 80m depth b.g.l. The prominent localities where considerable thickness of aquifer bearing fresh ground water has been inferred are Kheora, Ganaur, Chirasmi, Quamaspur, Kheri-gujar, Rajpura, Ghasauli, Murthal, Majri-mawai and Ahulana. Part of the area over southeast and small pockets in extreme north and northeast of Sonepat district has been identified bearing fresh ground water within a depth of 100 to 150m b.g.l. The prominent localities where fresh water available within 100 to 150m depth are around Simbalgarh and Jagdishpur lying in extreme northeast and southeast of the district adjacent to Yamuna river. Part of the district over northwest, west and south is water logged which is also one of the reason for ground water salinity. Preventive measures are suggested to stop water logging.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 Possibility Of Artificial Recharge

There are few isolated pockets located in the eastern part of the district where water levels are declining very fast. Fresh ground water at deeper level is being exploited by deep tubewells. Limited possibilities of artificial recharge exist in these areas during monsoon season, where excess runoff from upland areas can be utilized. Some of drains which were constructed to drain out excess water can be utilized for artificial recharge by constructing suitable recharge structures, such as injection wells, recharge shafts etc.

5.2 Water Conservation Structures

There is not much work carried out in the district. However, about 402 ponds exist in all the blocks, which act as fresh rainwater conservation structures. Out of these 75 ponds exist in Ganaur, 52 in Gohana, 30 in Kathura, 50 in Kharkhoda, 38 in mundlana, 65 in Rai and 92 in Sonepat block.

5.3 Ground Water Development

The hydrogeological data generated through exploratory drilling has proved a vital information regarding identification of aquifer systems, demarcation of their vertical and lateral extent, delineation of potential aquifer characteristics. These studies also provide information on well design and drilling techniques. A well assembly of 203mm dia, using about 20m to 30m long housing pipe and MS slot pipe with slots of 1.19 mm to 1.59 mm size would be ideal in the district area. "V" wires galvanized Screen having 0.50- 1.5mm slot can also be used as it can provide more open area thenconventional slotted pipes. Entrance velocity of water in the well has to be kept in mind while designing the well assembly.

6.0 GROUND WATER RELATED ISSUES & PROBLEMS

6.1 Declining water levels

There are certain areas in the district, which have recorded water level decline in recent past. Since ground water is the only source of irrigation in around 42% area of the district, ground water aquifers are under great stress due to increased demand in irrigation and industrial sector.

Necessary remedial measures need to taken to arrest further declining of water levels in the areas and suitable methodology to be adopted to recharge the aquifers.

6.2 Water logging & Ground Water Salinity

Parts of Kathura, Gohana, Mundlana and Kharkhoda blocks have problems of shallow water levels or water logged areas and soil and water salinity at shallow levels. CSSRI, Karnal had taken up pilot projects in the district. One project comprised of areas in Gohana block covering 5000 ha in 5 villages viz. Bali, Revlasa, Moj, Kot wali and Lath. Another project was in Mundlana covering 50 ha area. Horizontal subsurface drainage was installed in Mundlana in years 1985, 87. Soil in the area was sandy loam having hydraulic conductivity of 0.8m/day. Horizontal drains were laid at a depth of 1.75m having variable drain spacing of 50, 67 and 84m. It was found that salinity levels at the initial stages of project were of the range of 25,000 - 30,000 micromhos had reduced to below 5000 micromhos after a gap of about 5 years. Similar experiments were conducted in Ishapur Kheri (58 ha) and Mehlana (41 ha) where horizontal subsurface drainage was laid.

7.0 RECOMMENDATIONS

1. Construction of shallow tubewells in areas along active flood plains of river Yamuna, which have shallow water level can help in augmenting water supplies in the area

2. Areas witnessing decline of water levels have to be demarcated and rainwater harvesting to artificial recharge measures be taken up in a big way to reduce the impact.
3. Areas having shallow water levels and soil water salinity be improvised using subsurface drainage.
4. Improved agricultural practices like establishing good crop stand, sowing/planting practices, material management, Irrigation water management e.g. land leveling should be implemented in the shallow water levels areas.
5. Local farmers, NGOs be educated in water management, conjunctive use of saline and fresh water, rainwater harvesting and artificial recharge methods.