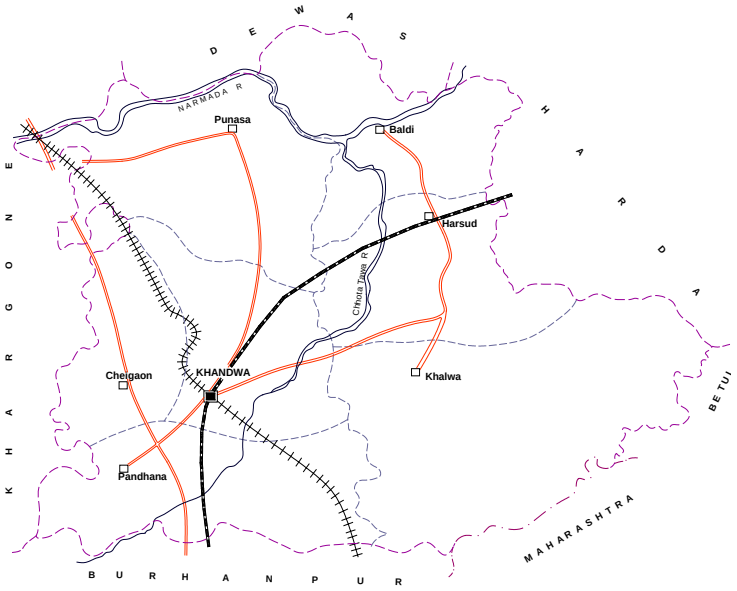
DISTRICT GROUND WATER INFORMATION BOOKLET

KHANDWA DISTRICT

MADHYA PRADESH



Ministry of Water Resources
Central Ground Water Board
North Central Region
Government of India

April, 2009

KHANDWA DISTRICT AT A GLANCE

S. No.	Items	Statistic	
1	**General Information**		
	(i) Geological Area	8307 km	
	(ii) Administrative Division : (As on 2006)		
	Number of Tehsils	3	
	Number of Blocks	7	
	Number of Panchay	419	
	Number of villages	715	
	(iii) Population	1078251	
	(iv) Average Annual Rainfall (mm)	916.6	
2	**Geomorphology**		
	Major Physiographic Units :	Structural hills of deccan traps flood plain, valley fills inter montane depression pediment (Volcanic)	
	Major Drainages	Narmada, Chhota Tawa, Sukta, Bhim Nadi	
3	**Land Use (2004-05)**		
	(a) Forest Area	269.5 Km^2	
	(b) Net area sown	3043.99 Km^2	
	(c) Cultivable area :	3046.29 Km^2	
4	**Major Soil Types**	Black Cotton	
5	**Area Under Principal Crops (As on 20004-05)**	Paddy, Wheat, Jowar, Maize, Gram & Soyabean,	
6	**Irrigation by Different Sources**	**Nos.**	**Irrigated Area (Sq.Km)**
	Dug wells	47224	772.50
	Tube well/Bore wells	4036	162.16
	Canala	23	10.11
	Tanks/Ponds	3	62.10
	Other Sources	-	132.11
	Net Irrigated Area	-	1138.98
	Gross Irrigated Area	-	-
7	**Number of Ground Water Monitoring Wells of CGWB. (As on 31.3.2007)**		
	No. of Dug Wells	18	
	No. of Piezometers	05	
8	**Predominant Geological Formations :**	Archaeans, Bijawars, Vindhyans, Baghbeds, Deccan Traps Alluvium	
9	**Hydrogeology**		
	Major Water Bearing Formation.	Vidhyans sandstone Deccan trap, Basalts	
	Pre-Monsoon Depth to water level during 2006 **Post-Monsoon** Depth to water level during 2006 Long Term water level trend in 10 years (1997-2006)	6.45-14.55 mbgl 1.05-7.20 mbgl +0.21 to 0.49 pre m/year +0.11 to -0.41 pot m/year	

10	**Ground Water Exploration by CGWB (As on 31.3.2007)**	
	No. of wells drilled EW	20 EW + 5 PZ
	Depth range (m)	-
	Discharge (lps)	0.41 + 15.86 lps
	Storativity (s)	-
	Transmissivity (m^2/day)	-
11	**Ground Water Quality**	
	Presence of chemical constituents more that permissible limit. (e.g.EC, F, As, Fe)	EC more than 1500 µ/Cm at Kahlari Borisaray and Pandhana Nitrate Chhegoan, Khandwa, Karoli, Amalpura, Kelwakalan, Borisaray, Khalwa, Pandhana
	Type of Water	Alkaline C_2 S_1 & C_3 S_1
12.	**Dynamic Ground Water Resources (2004)**	
	Annual Replenishable Ground Water Resources	695.60 MCM
	Net Annual Ground Water Draft	408.76 MCM
	Projected Demand for Domestic and Industrial uses upto 2025	41.75 MCM
	Stage of Ground Water Development	59%
	Semi – Critical Block	55.62 MCM
13	**Awareness and Training Activity**	
	Mass Awareness Programme organized No. of Participant	1 200 At Urja Vihar Autitoriun Omkareshwar
	Water Management Training Programme Number of Participants	1 At Samudayik Bhawan Narmada Sagar Punasa 150
14	**Major Ground Water Problems and Issues**	Depletion of Water levels
15	**Ground Water Control and Regulation**	
	No. of Over Exploited Blocks	Nil
	No. of Critical Blocks	One
	No. of Blocks notified	Nil

1.0 Introduction

Dhar district East Nimad is situated in the south – western part of Madhya Pradesh. The Indira Sagar Project on Narmada River near Punasa village in Khandwa district is unique project with the largest resviour on the country. The district is bounded by Devas in the north Harda And Burhanpur district in eastern, western & southern directions respectively. The district lies between north latitude 21^0 31' and east longitude of 75^0 57' 27" and 77^0 13" Falling in survey of India toposheet No. 55 B, 55C. E. The total tribal population percentage is 31.56% to the total population of the 1078251 district.

The area of the district is 8307 sq. km and it has been divided into three tehsil and seven blocks (fig. 1). There are 715 villages, 419 ;village panchayats seven Janpad Panchayat and five towns in the district. The details of Administrative divisions of the district are given in table – 1.

Table No. 1 : Administrative Division, Khandwa, District M.P.

S.No.	Tehsil & its Area in Sq. km	Block	Area in Sq. Km	No. of villages	No. of town
1	Khandwa 3507	Khandwa	640.63	92	21
		Punasa	803.60	142	-
		Chhegaon	620.86	88	-
2	Pandhana 674	Pandhana	982.43	124	2
3	Harsud 4126	Harsud	3770.75	74	-
		Khalwa	943.49	47	1
		Baldi	545.24	148	-

Drainage :

Entire Khandwa district falls under the Narmada basin Narmada and its trubitaries form the main source of surface water in the area. Narmada flows along the northern boundary of the district main rivers which drains the area of the dristrict which drains the area of the district are Chhota Tawa, Sukta & Bhim Nadi.

Irrigation:

Irrigation Facilities in the Khandwa district are under development;t stage and as on 2006 ;only 37.41% of netsown area was irrigated through all source & rest of the area is rainfed. Ground water in the main source of irrigation & out of total 1138.98 sq km irrigated la;nd 934.66 sq. km are irrigated form ground water sources which is about 82.06% of total irrigation in the district. These are 4036 to be wells & 47224 dug wells in the district.

2.0 Rainfall and Climate

The climate of Khandwa district, MP charactersized by hot summer and general dryness except during the south west monsoon season. The year may divided into four seasons. The cold season, December to February is followed by the hot season from March to about the middle of June. The period from the middle of June to September is the south west monsoon season. October and November form the post monsoon or transition period.

The normal annual rainfall of Khandwa District is 916.6 mm Khandwa district receives maximum rainfall during south – west monsoon period i.e. June to September. About 90.5% of the annual rainfall received during monsoon season. Only 9.5% of the annual rainfall takes place between October to May period. Thus surplus water for ground water recharge is available only during the south – west monsoon period. The maximum rainfall received at Khandwa is 987.3 mm and minimum at Burhanpur 824.6 mm.

The normal maximum temperature received during the month of May is 41.8^0 C and minimum during the month of January 11.2^0 C. The normal annual means maximum and minimum temperature of Khandwa district is 34^0 C & 19.5^0 C respectively.

During the south- west monsoon season the relative humidity generally exceeds 86% (July / August month). The rest of the year is drier. The driest part of the year is the summer season, when relative humidity is less than 33%. April is the driest month of the year.

The wined velocity is higher during the pre monsoon period as compared to post monsoon period. The maximum wind velocity is 15.6 km / hr. observed during the month of June and minimum 4.0 km/hr during the month of November. The average normal annual wind velocity of Khandwa district is 8.7 km / hr. Normal climatologically parameter of Khandwa District is given in Annexure below-

Normal Climatological Parameters for Khandwa District

S. No.	**Parameters**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
1	Maximum Temp (^{0}C)	29.5	32.6	36.8	40.5	41.8	37.6	31.7	29.9	31.8	34.0	31.9	29.7	34.0
2	Minimum Temp (^{0}C)	11.2	13.5	18.5	23.5	27.5	26.0	23.9	23.0	22.5	19.0	14.1	11.4	19.5
3	Relative Humidity (^{0}C)	57	45	36	33	45	68	82	86	81	63	58	60	60
4	Wind Velocity (Km/hr.)	5.3	6.0	7.2	9.1	14.0	15.6	13.2	12.0	9.1	5.0	4.0	4.1	8.7
5	Rainfall (m.m.)	5.4	1.7	7.9	2.2	13.0	128.5	260.4	264.8	175.8	29.2	17.2	10.5	916.6

3.0 Geomorphology and Soil Types

3.1 Geomorphology :

Structural hills of vindhyans, denudation hills of deccan traps are predominant in Khandwa district. Apart from these above geomorphic features like flood, plain, alluvial plain, valley fills, intermountain depressions, pediment (Volcanic) are also sees in the district.

3.2 Soils :

The nature & Charactersitics of soils is dependent primarily on Relief of the area which influences the variation in soil formation. The soil of Khandwa dist;rict are classified on medium black soils under the broad classification of soil of India & are low fertility soils. There are alluvial deposits constitute gravel sand, silt or clay sized unconsolidated alluvium found along the narrow strips of rivers.

4.0 Ground Water Scenario

4.1 Hydrogeology :

Khandwa district is underlain by various geological formation, forming different types of aquifers in the area. Main geological ;units of the area are Archaean, upper vindhyan, Bagh beds, Deccan traps and alluvium. Occurrence and movement ground water in hard rocks is mainly controlled by secondary porosity through joints and fractures. Primary porosity in Bagh sandstone and vesicular basalts in Deccan traps play an important role in ground water occurrence and movement bagh beds may also form potential aquifer made up of relatively loose and friable shale and sand stone. Ground water is general occurs under unconfined to semi confined. The occurrence and movement of ground water in different geological formation is described below :

a) Archaeans -

Weathered portions and fractured zones of granite and gneisses when saturated from moderate aquifers. The yield of wells in the formation, ranges from 1 to 3 lps these rocks are exposed in the north eastern part of the district falling in Baldi block.

b) Bijawars -

The Bijawars are exposed in the north eastern part of the district falling in Baldi blocks. Bijawar sandstone and shale breccia occupy and area of 85 sq. km in this block. Generally yield of wells in this formation in less than 1 lps. But if the formation is consists of limestone with well development solution opening the yield may be 2 to 5 lps.

c) Vindhyans-

The upper vindhyan sandstone shale and are exposed in northern part of the district all along the Narmada river falling in Punasa block. The total area occupied by the vindhyans formations, is about 1115 sq. km which included part of Baldi block in the district. The sandstone and shale of vindhyan formations are compact and having poor permeability. The jointed & fractures and bedding planes in sandstone and shales control the occurrence and movement of ground water in the areas located in favourable geomorphic and topographic conditions. The soil and weathered profile developed in this formation is generally thin and as a result ground water occurs at shallow depth under unconfined condition. The yield of well in formation ranges from 1 to 3 lps. The exploratory well drilled at Bir bad Nimarkheda trapping basalt and vindhyan sandstone has yield 3.28 and 8.16 lps discharge.

d) Bagh Beds-

Bagh beds are exposed in the north central part of the district falling in Punasa block. Bagh beds comprises of sandstone and shales are sedimentary formation but have a limited extent and poor to moderate permeability. The lime stone and calcareous clay when Certified form productivity aquifers.

e) Deccan Traps-

The Khandwa district is underlain by 13 basaltic flows, which are distinguished by either foresence of reg bole, vesicular zone or break in slope. Most of .the lava flow are Aa type bad thickness of flows varies from 7 to 35m. These flow are confined between 265 and 698 m amsl. The Deccan trap flow, basic intrusion and the calcite veins at some place constitutes the basaltic terrain ground water generally occure under pheratic condition in shallow weathered, jointed and fractured horizons. Basalt does not exhibit uniform nature, both vertically and laterally. Physiographic location, thickness of weathered, mantle, degree of joints, fractures or sheared zones, characteristic of vesicular horizons and their inter connections are important factors, that play a decisive role in the yield capacity of open wells tapping shallow aquifers. The deeper aquifer system appear to be under semi confined conditions. The deeper aquifer mainly governed by secondary porosity. Jointed fractured from of massive unit is creating possibility of their acting as heavy confining bed, consequently resulting into semi confined conditions for water bearing vesicular unit occurring beneath it on other hand is massive unit is compact and have not developed fractured porosity then they may act as a confining bed for water being vesicular horizon, occurring below it and thus leading to confined conditions dug wells in basaltic flows of deccan traps vary in depth from 6 to 15 mbgl. CGWB has drilled number of tube wells in deccan trap in Khandwa District water bearing capacities in deccan traps varies from flow to flow. The ground water in this formation occurs in weathered vesicular and fractured basalt. The yield of formation ranges from 0.41 lps (Khedi) to 15.86 lps (Shahpur).

f) Alluvium-

Alluvium consist of coarse grained sand to silty material, gravel and hard brownish soil and clay. The alluvium stretch comprise horizontal to sub horizontal thin horizons. Ground water occurs in the granular zones of sand and gravel the yield of formation depends upon the percentage of band and clay and thickness of alluvium. The yield of well in the formation ranges from 5 to 20 lps.

Depth to water level:

Central Ground Water Board is carrying out water level monitoring since year 1972 in the district. Water levels of these monitoring wells are being monitored four times in a year during the month of January, May, August and November. A hydrogeology hydrogeological map (Fig. – 2) of Khandwa district has been prepared on the bases of available data. To study ground water regime of the area pre monsoon and post monsoon depth to water level maps has been prepared. Southern and northern part of the district is highly undulating and forested.

Pre monsoon (May 2006):

In general depth to water level in the district ranges between 6.45 mbgl at Kusumbia in Chaigaon Makhan block and 14.55 mbgl at Khalwa in Khalwa block area. In general major part of the district dept to water level is ranging between 7 to 12 mbgl. (Fig. 3) deepest water level ranges between 12 to 15 mbgl recorded in eastern part of Baldi Block southern part of Khalwa block and central part of Chaigaon block.

Post Monsoon (November 2006):

During post monsoon season of year 2006 depth to water level varies from 1.05 mbgl at Kalamkalan to 10-10 mbgl at Amalpura (fig-4) Shallow water level less than 5 mbgl are observed in north central part of the district. Kusumbia, Pandhana, Roshia, (Chaigaon Makhau block), Chanora (Harsud block), Kalamkalan, Amalpura, Kalhari, Khandwa, (Khandwa block) & Kelwa kalan and mundi (Punasa block) and more than 5 mbgl water level in recorded at Chhegaon makhan, Karoli Chhegian wakhan block) and Jaswadi Jawar (Khandwa block).

Water level fluctuation between pre and post monsoon season (year 2006):

In entire Khandwa district, rise in water levels between pre and post monsoon season have been recorded rise in water level ranging from 3.15 m at Karoli in western part of the district to 9.10 m at Khalwa on Southern central part of the district. The general rise in water level in between 4 to 8 m. in the district.

Long term water level trend in last 10 years (year 1997 to 2006):

To study change in ground water regime of the area over last one decade from 1997 to 2006 water level data of CGWB, Ground water monitoring, wells have used. For long term trend analysis, pre and post monsoon trend analysis of these wells have been analyzed long term trend analysis are summarized below in table – 3.

Table -3: Long Term Trend Analysis of CGWB's Ground Water Monitoring of Wells

S. No.	Ground Water Monitoring Wells	Block	Pre Monsoon		Post Monsoon	
			Rise (m/year)	Fall (m/year)	Rise (m/year)	Fall (m/year)
1	Chhegaon	Chhegoan	-	0.217	0.039	-
2	Karoli	Chhegoan	-	0.109	-	0.102
3	Kushmbia	Chhegoan	0.027	-	0.074	-
4	Pandhana	Chhegoan	-	0.452	-	0.021
5	Roshiya	Chhegoan	0.215	-	-	0.008
6	Borisaray	Harsud	0.034	-	-	0.203
7	Chanera	Harsud	-	0.497	-	0.12
8	Harsud	Harsud	-	0.219	-	0.04
9	Kalam kalan	Khalwa	-	0.475	-	0.418
10	Khalwa	Khalwa	-	0.475	-	0.256
11	Amalpura	Khandwa	-	-	-	0.317
12	Jaswadi	Khandwa	-	0.459	-	0.316
13	Jawar	Khandwa	-	0.138	-	0.131
14	Kahlari	Khandwa	-	0.315	0.115	-
15	Khandwa	Khandwa	-	-	-	0.240
16	Balwara	Pandhana	-	0.280	-	0.190
17	Kelwakalan	Punasa	-	0.495	-	0.082
18	Mundi	Punasa	-	-	-	0.002

Perusal of above table indicate that, out of 18 ground water monitoring wells of the district, 12 are showing falling trend during pre monsoon season. Average rate of decline is varying from 0.109 m/year at Karoli to 0.497 m/year at Chanera.

During pre monsoon period 3 wells of the district are showing rising trend from 0.027 m/year at Kusumbia to 0.215 m/year it Roshiya. Post monsoon long term water level trend analysis reveals that out of 18 GWMW 15 are indicating falling trend & average rate of decline varies from 0.002 m/year at Mundi to 0.418 m/year at Kalamkalan. An average rate or rise in water level range from 0.039 m/year. At Chhegaon makhan to 0.115 m/year at Kalhari no change is observed at Amlapura, Khandwa and Mundi GWMW during pre monsoon period.

Aquifer parameters :

CGWB had drilled 20 exploratory well in the district. Hydrogeological data of exploratory well in the district is given in table 4. perusal of the table reveals that yield of Deccan traps, to 15.86 lps (Shahpur) and draw down ranges between 1.03 to 45.27 m. the depth of these exploratory bore wells ranges from 165 (Bir) to 266.42 (Deshgoan) mbgl. The location of exploratory sites have been showing in fig- 5.

Table-4 : Details of Exploratory bore holes

S. No.	Well Sites	Total Depth	D.D.	Aquifers	Discharge
1	Kalmukhi	220.77	39.86	Vesicular Basalt	1.30 lps
2	Raitalai	172.30	2.56	V.B.	10.0 lps
3	Haidarpur	200.80	45.27	M.B.	2.00 lps
4	Biroda	202.80	11.41	MB/VB	3.80 lps
5	Chinchala	232.48	9.49	MB/VB	2.50 lps
6	Chandans	154.00	11.61	MB/VB	10.00 lps
7	Doiphoria	202.80	36.68	MB/VB	2.00 lps
8	Dongargoan	203.4	10.285	MB/VB	3.28 lps
9	Bir	165.00	1.03	Clay/ Basalt	2.00 lps
10	Borgaon P_z	133.3		Basalt	0.45 lps
11	Deshgaon	266.42		Basalt	0.45 lps
12	Nagchun	205.82		Basalt	-
13	Nimarkheda	236.02		Sand and clay VB	0.50 lps
14	Shapur	128.95	1.44	Basalt	15.86 lps
15	Padaliya	243.52		Basalt	-
16	Khandwa	199.00		Basalt	1.90 lps
17	Sirpur	188.80		Basalt	0.41 lps
18	Khedi	201.85		Basalt	-
19	Saval kheda	205.72		Basalt	Abandoned
20	Bardia Sakna	228.6		Basalt	Dry.
21	Dhaba	251.32		Basalt	-

4.2 Ground Water Resources :

Ground Water Resource estimation of Khandwa district has been computed for base year 2004, on block wise basis. Except Chhegaon makan all block of Khandwa district. Are categorized a safe. Chheagoan blocks falls under semi critical category where stage of GW development is 89%.

As per ground water resourced estimate figures net ground water availability in Khandwa district is 695.60 MCM and ground water draft for all uses is 408.76 MCM making stage of ground water development 59% as a whole for district. After making allocation for future domestic and industrial supply for next 25 years balance available ground water for future irrigation would be 269.10 MCM. Block wise ground water resources estimation data of the district is given in table-5 and data is also presented in fig-6.

Table-5: Block Wise Ground Water Resource Estimation, Khandwa District, Base Year- 2004.

S. No.	Block	Command/ non commaon area	Net Ground Water Availability MCM	Gross annual ground water draft for all uses MCM	Current stage of ground water developmen t %	Allocate for domestic and Industrial supply for nest 25 yesr MCM	Balance draft water available for future irrigation MCM	Category
1	Khandwa	Comm No. Comm Block Total	4.21 87.22 91.43	0.64 68.07 68.71	15 78 75	0.47 10.48 10.94	3.31 13.46 16.77	Safe
2	Punasa	Comm No. Comm Block Total	- 93.41 93.41	- 63.75 63.75	- 68 68	- 3.95 3.95	- 28.63 28.63	Safe
3	Chhegaon Makan	Comm No. Comm Block Total	1.42 104.53 105.95	0.31 93.65 93.65	22 90 89	0.03 4.59 4.63	1.09 9.21 10.29	Semi critical
4	Pandhana	Comm No. Comm Block Total	10.90 113.68 124.59	0.52 73.89 74.41	5 65 60	0.08 3.27 3.35	10.37 38.98 49.34	Safe
5	Harsud	Comm No. Comm Block Total	- 107.26 107.26	- 52.88 52.88	- 49 49	- 11.75 11.75	- 46.34 46.34	Safe
6	Baldi	Comm No. Comm Block Total	- 80.32 80.32	- 17.62 17.62	- 22 22	- 3.29 3.29	- 62.64 62.64	Safe
7	Khalwa	Comm No. Comm Block Total	- 92.65 92.65	- 37.42 37.42	- 40 40	- 3.84 3.84	- 54.98 54.98	Safe
		District Total	695.60	408.76	59	41.75	269.01	Safe

4.3 Ground Water Quality of Khandawa District

Quality of Ground Water for Drinking:

Ground water quality in Khandwa district is accessed annually by CGWB on the basis of water samples collected from twenty-nine numbers of hydrographs stations in the district. Groundwater in the district is generally medium to high saline as electric conductivity values varies between 610 to 1702 /μs cm.

High EC of more than 1500 /is cm were found in dug well of Kahlari (1576 / μs cm), Bori saray (1689 / μs cm) and Pandhana (1702/ μs cm) villages. Constituents like chloride, fluoride, sulfate, calcium and magnesium were with-in the safe limits for drinking water as per BIS standards. Nitrate in the groundwater of Khandawa district is varying between 2 to 190 mgl. Nitrate more than 45 mgl was found in eight villages namely Chhegaonmakhan (56 mgl), Khandawa (69 mgl), Karoli (81 mgl), Amalpura (91 mgl), Kelwa kalan (97 mgl), Bori saray (125 mgl), Khalwa (155 mgl) and Pandhana (190 mgl). High nitrate in the village area is appears due to excessive use of fertilizers and agricultural waste. The total hardness of the groundwater in the district is generally safe as per BIS standards except Kahlari, Bori saray and Pandhana villages.

Quality of water for irrigation

High SAR is not good for irrigation as it leads to sodium hazard. Water samples in the district generally fall in C_2S_1 and C_3S_1 classes of US Salinity diagram. However ground water in the district generally is safe for irrigation but proper drainage system is required where EC is more than 1500 / μs cm .

Geogenic problems:

Fluoride in the district generally below 1.5 mgl' The groundwater in the generally district is safe for drinking. More than 1.5 mg1 fluoride responsible for bone deformation. No arsenic has been detected in the district.

4.4 Status of Ground Water Development:

Ground Water is the main source for drinking and irrigation in the Khandwa district. About 82% of irrigation in the district is from ground water sources and the level of irrigation in the district is 37.41%. There are 4036 tube wells and 47224 dug wells for irrigation in the district. In Khandwa district these are 369671 electric connections for agriculture purposes. Depth of dug well in the district ranges from 8 to 20 m. the yield of bore wells/tube wells vary from 0.41 lps to 15.86 lps, depending upon the hydro geological situations in the area.

High yielding tube wells have been found in deccan traps at Kalmukhi Doiphoria & Shahpur area and their yield was recorded 10 to 15-86 lps. Apart from private sources, hands pumps are main source of water supply which are 5680 in the district. Out of total population 1431662 about 394171 (27.53%) . population live in urban areas of the district. After the completion of Indira Sagar, Omkareshwar & Maheswar major project in the district the ;load on ground water source will be lesser as in the planning of ISP the 75 ham. Water is allocated for drinking purpose the district will also benefited through canal command area for irrigation.

5.00 Ground Water Management Strategy

5.1 Ground Water Development :

As per ground water resource estimation of Khandwa district for the year 2004 the available ground water resources and gross annual ground water draft are 695-60 MCM and 408.76 MCM respectively, stage of ground water development 59% as a whole for the district. Thus these is sufficient scope for future development of ground water resources in the district.

Six blocks namely Khandwa, Punasa, Pandhana, Harsud, Baldi and Khalwa are falling under safe category only chhegaon maken block is under semi critical category where the state of ground water development 89% decadal water level trend analysis reveals mixed trend of water levels during pre and post monsoon seasons. After allocation for further domestic and industrial supply up to next 25 years, balance available ground water in Khandwa district would be 269.01 MCM. If the 70% balance available ground water resources in to be development through dug wells and 30% through tube wells, then at suitable hydrogeological locations tentatively 18830 new dug wells and 3240 new tube wells for irrigation can be constructed in the district, considering unit draft of dug wells and tube wells 0.01 & 0.04 MCM respectively.

Area recommended for future development in given in fig. 7. Dug wells are feasible structures for granitic areas whereas shallow tube wells are recommended in weathered/jointed archeans. Deep tube wells with proper assembly are suitable in basalt overlying Bagh beds. Drilling may be Aakanub with DTH rigs. But further down drilling in Bagh bed formations becomes difficult due its loose & tribal nature if there rocks are occurring below a depth of 100m drilling technology is to be developed to negotiate these formations in deeper levels.

5.2 Water Conservation & Artificial Recharge :

Artificial Recharge is the process by which ground water reservoir is augmented by altering the natural condition of replenishment. Considering they hydrogelogical situation of the areas, there is tremendous scope for artificial recharge work, especially in ground water depleting areas of the district. Due to variation in annual rainfall year to year which has been creating drought situation over the past decades.

Artificial recharge in the district has to be done as to replenish the over exploited aquifers and also to store surplus run off plan may be adopted hill to valley approach in a water shed at origin of the stream structures like gully plugs and contour trenches may be constructed to arrest surface run off for soil moisture retention and development of vegetation cover in the area gabbion structure may be constructed at down stream of these structure across the stream using local boulders and wire mesh to check the velocity of the flowing water. Percolation tanks are recommended in second and third order streams on porous and permeable formations so that water should be allowed to seep below stream bad to recharge ground water body at sub surface. It is quite possible that in due course of time infiltration of water form percolation tank is reduced due to silt deposition in side structure.

To overcome this problem recharge shafts may be constructed inside percolation tank to allow continuous seepage of water towards ground water system. Recharge shafts can also be constructed in those places where impervious formations are occurring at surface and at shallow depths porous and permeable rocks are available for recharge properly designed tube wells also act as recharge shafts, if recharge of water is needed in deeper aquifers overlain by impervious rocks.

Sub surface dykes are water conservation structures constructed at suitable hydrogeological locations across the river beds at end of water shed to check sub surface flow of water long stream beds. Trench is dug down to impervious horizon across the stream and filled with local day ball over high density polythene act as sub surface barrier for flow of water from stream beds. Dug wells recharge is also applicable in rural areas. In this system water from field is diverted into recharge well through delivery pipe lowered below water level or of bottom of well to avoid chocking of aquifers by entry of air bubbles.

In the urban areas roof top rain water harvesting project should be implemented in Khandwa district.

6.0 Ground Water Related Issues and Problems

Long term water level trend analysis shows mixed results. Depletion is ground water levels is observed during both pre and post monsoon season in ground water monitoring wells. The problems of the area are the variation in rainfall year to year, which has been creating drought situation over the post decades.

Artificial recharge in the district has to be done so as to replenish the over exploited aquifers and also to store surplus run off so as to make use of it during the lean period. Second problem of the district is drilling in Deccan traps when collapsible red bole and weathered inter trappean beds encountered at deeper depth and because there beds are collapsible in nature, there fore required to be cased. Similarly in the vindhyan and Bagh beds there are weathered sandstone and shale etc which are also required to be cased by blank pipes when its is under constructions but if it gets saturated there it is required to be cased with slotted pipes depending upon fineness of the grain size and weathered materials. By deploying available rigs (DTH rotary combination) this situation can be tackled.)

7.0 Awareness and Training Activity

7.1 Mass Awareness Programme (MAP) and Water Management Training Programme (WMTP) by CGWB

CGWB, has carried out MAP and on WMTP in Khandwa district on 9th and 10th November 2006 respectively. The MAP was conducted at Urja Vihar Anditorium, Omkareshwar. Total 200 participant have participated and the theme was Rainwater Harvesting And Ground Water Recharge Techniques. The WMTP was conducted at Samudayik Bhawan, Narmada Sagar (Indira Sagar Project) Punaa. There were 150 participants from engineers of NHDC, students of Kendriya Vidyalaya and NGOS.

7.2 Participant in Exhibition :

During the MAP and WMTP the exhibitions were stalled in which working models, electronic displays and posters and chemical quality related models were displayed.

7.3 Presentation and Lectures Delivered in Public Form/Radio/TV etc.

The Lectures were delivered during the each programme by the scientists of CGWB, for participants.

8.0 Areas Notified by CGWA/SGWA

No area has been notified by CGWA/SGWA in Khandwa District.

9.0 Recommendations

- The stage of ground water development of Khandwa district as a whole is 59% which reveals that there is further scope for future development of ground water for irrigation.

- Indira Sagar and Omkareshwar major project for command area development are going to be start for canal command irrigation therefore it is recommended that conjunctive use of surface and ground water should be implemented to avoid possibility of water logging in low laying areas where frequent drainage is not available.

- After allocation for future domestic and industrial water supply upto next 25 yeas in the district balance available ground water at 50% stage of GW development safe limits would be 269 MCM. If 70% of balance available ground water is to be developed through dug wells and 30% through tube wells then tentatively 18830 new dug wells and 3240 new tube wells can be constructed for irrigation.

- Depletion of ground water levels is recorded almost in all the blocks of district due to continuous pumping for irrigation and variation in annual rainfall year to year, which has been creating drought situation over the past decades. Artificial recharge through proper scientific techniques in the areas has to be done so as to replenish the over exploited aquifers and also to store surplus run off so as to make use of it during the lean period.
- Drilling problem in Deccan traps is starts when collapsible red bore and weathered inter-trappean beds encountered at a deeper depth and because there are collapsible in nature it required casing.

- Drilling problem is also possible when below basalts, Bagh beds of sedimentary origin are occurring which are comparatively loos and friable in nature and need to cased by blank pipe by deploying available drilling

rigs (DTH Rotary combination) this problem can be handled but when than 100 mbgl if becomes very difficult because rotary system of these rigs are not operative below depth 100 m. to drill Baghs formation through hard & compact basalts.

- Roof Top Rain Water Harvesting Project should be implemented in Urban areas of Khandwa district.

Compiled by : A. K. Budhauliya, Scientist "D" under the able guidance of Shri R. N. Singh Regional Director.