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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

MOGA DISTRICT, PUNJAB

Central Ground Water Board
North Western Region
Chandigarh

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

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

INTRODUCTION

Administratively, the district is under control of Ferozpur division and is divided into 3 sub-divisions/ tehsils namely Moga, Bhagapurana and Nihal Singhwala. Dharamkot and Bhadhani Kalan are 2 sub-tehsils of district Moga. Further, the district has been sub-divided into five development blocks i.e. Moga I, Moga - II, Dharamkot, Bhagapurana and Nihal Singhwala. Moga district has 4 towns and 329 villages with a total population of 9,92,289 as per 2011 census.

HYDROMETEOROLOGY

The climate of the district can be classified as tropical and dry sub humid. The normal annual rainfall is about 498 mm which is spread over 24 rainy days. 78% of rainfall occurs during south-west monsoon.

GEOMORPHOLOGY

The district area forms a part of Indo-Gangetic plain and Sutlej sub-basin of Indus basin. The area as a whole is almost flat with a gentle slope towards the Western and Northwesterly direction. The physiography of the district is broadly classified from south to north into four distinct features i.e. Upland plain , Sand dune tract , younger flood pain and active flood plain of Sutlej. The Sutlej is an important perennial river, which forms major drainage of the area and runs parallel to the Northern border of the district. There are two types of soils viz Sierozem and Desert soils in Moga District. The sierozem soils are found in major parts of the district and desert soils are comparatively found in a relatively smaller area towards western part of the district.

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

Hydrogeology:

Geological formation encountered within the district comprises of unconsolidated alluvial deposits of Quaternary age. Aquifer material comprises chiefly of fine to medium grained sand. In general shallow aquifers in the area can be grouped into two classes; one unconfined/ semi confined aquifer down to depth of 80.0 m in the district and being in the depth range of 100.0 to 111.0m. These two aquifers are separated by a clay layer almost uniformly present in the district. The aquifer down to depth of 50.0 m is being tapped by shallow tubewells for purpose of irrigation and drinking. However, few deeper tubewells down to depth of 125 m are being tapped by Government agencies for drinking purpose and by some farmers for irrigation purpose. Two ground water regime in the district can be identified which are separated by ground water divide running North of Northeast and South of Southwest direction. Elevation of ground water table varies from 198.0 to 212.0 m amsl. In the Northern part of the district ground water gradient is 0.30m/km in comparison to southern part of the district, where it is more than a meter per km. Most of the observation stations in Moga district show decline with varying degree of decline over last three decades .Rate of decline varies from 53 cm/year (Samal sari) to 79 cm/year (Damru Khurd). Depth to water level in the district varies from 15.78 mbgl to 21.17 mbgl during pre-monsoon and 17.13 to 22.15 mbgl in post-monsoon period.

GROUND WATER QUALITY:

Ground water qualities of shallow aquifers indicate that ground water quality is fresh to marginally saline. Concentrations of different chemical parameters are within permissible limits for safe drinking water as per BIS norms 2007. Flouride concentration is higher than permissible limit in most of the area. Iron concentrations have been found in shallow ground water at some places to be higher than permissible limits in South Eastern, North Western and in areas adjoining river Satluj. By and large, the quality of ground water is suitable for domestic /irrigation purposes in major part of the district.

GROUND WATER RESOURCES:

Ground Water Resources estimation of the district was done as on 31.03.2011 as per GEC-1997 for each individual block. Stage of ground water development in the district is 202%. The ground water development in all the blocks of the district has exceeded the available recharge and thus all the blocks have been categorized as "over exploited". Moga-I, Moga-II and Nihal Singhwala are showing more than 200% of ground water development and have been Notified by CGWA. Block Bhaga Purana has relatively less

development of ground water among all blocks i.e. 167%.

Net ground water availability of the district is 1205.72 million cubic meter (mcm), ground water draft for all users is 2439.49 mcm, whereas net ground water availability for future irrigation development is -1239.53 mcm.

GROUND WATER IRRIGATION SCENARIO

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

Distribution of Shallow Tubewells According to Owner's Holding Size

No. of shallow tube wells by size class of individual owner							
Sr.no	district	Marginal (0-1 ha)	Small (1-2 ha)	Semi-Medium (2-4 ha)	Medium (4-10ha)	Big (>=10 ha)	Total
1	**Moga**	**423**	**1858**	**7721**	**9671**	**2680**	**22353**

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	**Moga**	**751**	**4478**	**14172**	**17029**	**5449**	**41879**

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	**Moga**	**35**	**690**	**8259**	**13369**	**0**	**22353**

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	**Moga**	**45**	**64136**	**35**

PLAN OF THIS REPORT

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

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

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

This plan is focusing on the technical aspects of the ground water recharge through various means so that various implementing agencies may get the appropriate technical guidelines. The existing/ongoing schemes of the central or state govt. like MANERGA, IWSP, PMKVY, 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.**	4596	0..25	**11.49**	**0.342**
2	**Roof Top Rain Water Harvesting in Rural Areas**	14560	0..25	**36.40**	**0.815**
	Total	**19156**	**0.25**	**47.89**	**1.157**
ARTIFICIAL RECHARGE IN FARMS					
1	**Artificial Recharge Plan Through Recharge Pits.**	21878	0.35	76.573	15.361
			Total	**76.573**	**15.361**

By the implementation of the proposed recharge structures there will be a reduction of 1.37% 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	**2439.49**	**-1239.53**	**16.518**	**2422.972**	**202%**	**200.63%**	**1.37%**

ARTIFICIAL RCEHARGE PLAN THROUGH RECHARGE PITS IN OVER EXPLOITED BLOCKS MOGA 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%*Rainfall)**	**Cost of Pit @Rs.35000/- (crores)**
KOT ISE KHAN (DHARAMKOT)	**54520**	**5452**	**5452**	**4.424**	**19.082**
MOGA-I	**36320**	**3632**	**3632**	**2.572**	**12.712**
MOGA-II	**32800**	**3280**	**3280**	**2.342**	**11.48**
BAGHAPURANA	**55780**	**5578**	**5578**	**3.456**	**19.523**
NIHAL SINGHWALA	**39350**	**3935**	**3935**	**2.568**	**13.7725**
			21878	**15.361**	**76.5695**

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 MOGA DISTRICT OF PUNJAB								
Name of District	**Sr.no**	**Name of CD Block**	**Total area of the village (in hectares rounded up to one decimal place)**	**Number of households (2011 census)**	**No of Houses taken for Artificial Recharge (10% of total households)**	**Total No of AR Structures (one structure for each house)**	**Total recharge in MCM**	**Cost @ Rs.25000/-/structure (crores)**
MOGA	1	KOT ISE KAHN (DHARAMKOT)	**54520**	**33418**	**3342**	**3342**	**0.217**	**8.355**
	2	MOGA-I	**36320**	**27819**	**2782**	**2782**	**0.158**	**6.955**
	3	MOGA-II	**32800**	**19854**	**1985**	**1985**	**0.113**	**4.9625**
	4	BAGHAPURANA	**55780**	**37065**	**3707**	**3707**	**0.184**	**9.2675**
	5	NIHAL SINGHWALA	**39350**	**29125**	**2745**	**2745**	**0.143**	**6.8625**
		Total	**218780**	**147281**	**14561**	**14561**	**0.815**	**36.4025**

ARTIFICIAL RECHARGE PLAN FOR URBAN AREAS OF DISTRICT MOGA 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.0.25 lakh
MOGA	**NIHAL SINGH WALA**	**BADHNI KALAN (NP)**	**1309**	**6786**	**131**	**26180**	**0.009**	**0.3275**
	BAGHA PURANA	**BAGHA PURANA (MCL)**	**4815**	**25206**	**482**	**96300**	**0.032**	**1.205**
	MOGA	**MOGA (MCL + OG)**	**33642**	**163397**	**3364**	**672840**	**0.254**	**8.41**
	KOT ISE KAHN	**DHARAMKOT (MCL)**	**3694**	**19057**	**369**	**73880**	**0.028**	**0.9225**
	KOT ISE KAHN	**KOT ISE KAHN**	**2498**	**12800**	**250**	**49960**	**0.019**	**0.625**
		TOTAL	**45958**	**227246**	**4596**	**919160**	**0.342**	**11.49**

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 64232 tubewells operated by farmers for irrigation through unlined/Katcha (99.84%) open channel system in Moga district where water from the tube-well 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 Moga district is estimated at 2421.48 MCM. It is expected that around 50.20% 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 609.24 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 Moga Districts. The measure if implemented will bring down the ground water overdraft from 202% to 151.80 %. 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, MOGA 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
1205.72	2439.49	2421.48	18.02	99.84	609.24	1812.24	1830.26	202	151.80	50.20

 # 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 *Col4	Total Cost in Rs. Crores. District wise
1	**2**	**3**	**4**		**5**	**6**
MOGA	Dharamkot	36604.8	99.84	**36546**	**182.73**	**779.53**
	Moga-I	21921.6	99.84	**21887**	**109.43**	
	Moga-II	18402.6	99.84	**18373**	**91.87**	
	Baghapurana	22585.4	99.84	**22549**	**112.75**	
	Nihalsinghwala	20036.7	99.84	**20005**	**100.02**	
	Dharamkot	36604.8	99.84	**36546**	**182.73**	

SALIENT FEATURES OF HYDROGEOLOGY OF DISTRICT MOGA

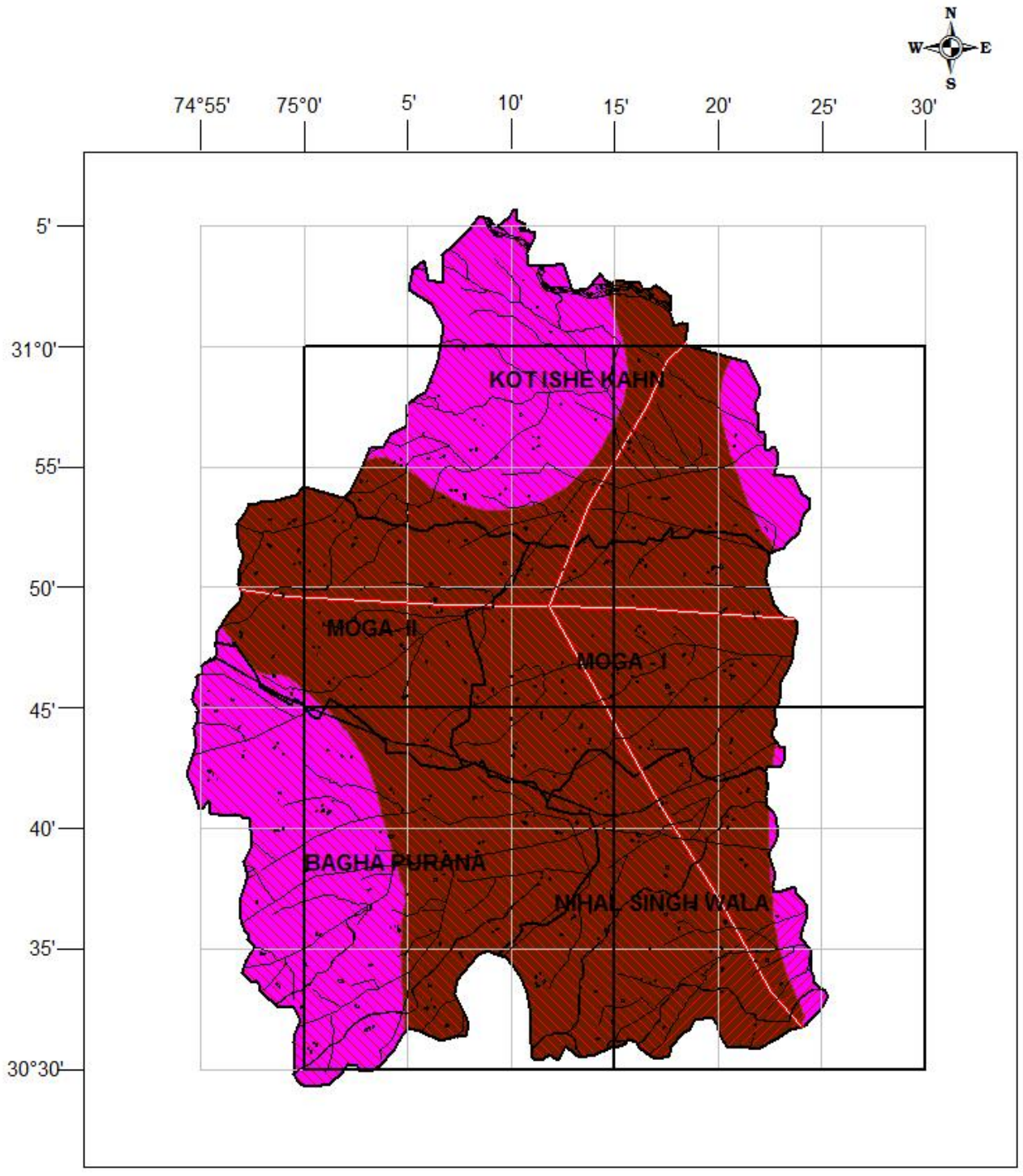
Wells Feasible	Rigs Suitable	Depth of Well (m)	Discharge (lpm)	Suitable Artificial Recharge Structures
Tube Wells	Direct and Reverse Rotary	40- 145	1300 - 3000	Recharge Shaft And Recharge Trench
Tube Wells	Direct and Reverse Rotary	45 - 80	1000 - 1300	Recharge Shaft And Recharge Trench
Tube Wells	Direct and Reverse Rotary	40 - 50	600 - 1000	Recharge Shaft And Recharge Trench

Decadal Mean Water Level	National Highway	International Boundary
	Canals	State Boundary
10.00 - 20.00 mbgl	Water Bodies	Block Boundary
20.00 - 40.00 mbgl	Major Drainage	Block Headquarters

OTHER INFORMATION

Name of State	Punjab
Name of District	Ropar
Geographical Area	2071 sq.km.
Major Geological Formation	Alluviam
Major Drainage System	Sutlej
Population (as on 2011)	9,92,289
Total Number of Blocks	5
Existing Major/Medium Irrigation Projects	Sirhind Canal
Utillizable Ground Water Resources 2011	1205.72 (mcm)
Net Ground Water Draft	2439.49 (mcm)
Stage of Ground Water Development	202 %
Average Annual Rainfall	498 mm
Range of Mean Daily Temperature	7- 48°C
Over Exploted Blocks	BAGHA PURANA MOGA-II MOGA-II NIHAL SINGH WALA KOT ISE KHAN

PLAN OF ARTIFICIAL RECHARGE TO GROUND WATER
DISTRICT MOGA, PUNJAB



Legend

Refer Silent features of Hydrogeology Moga

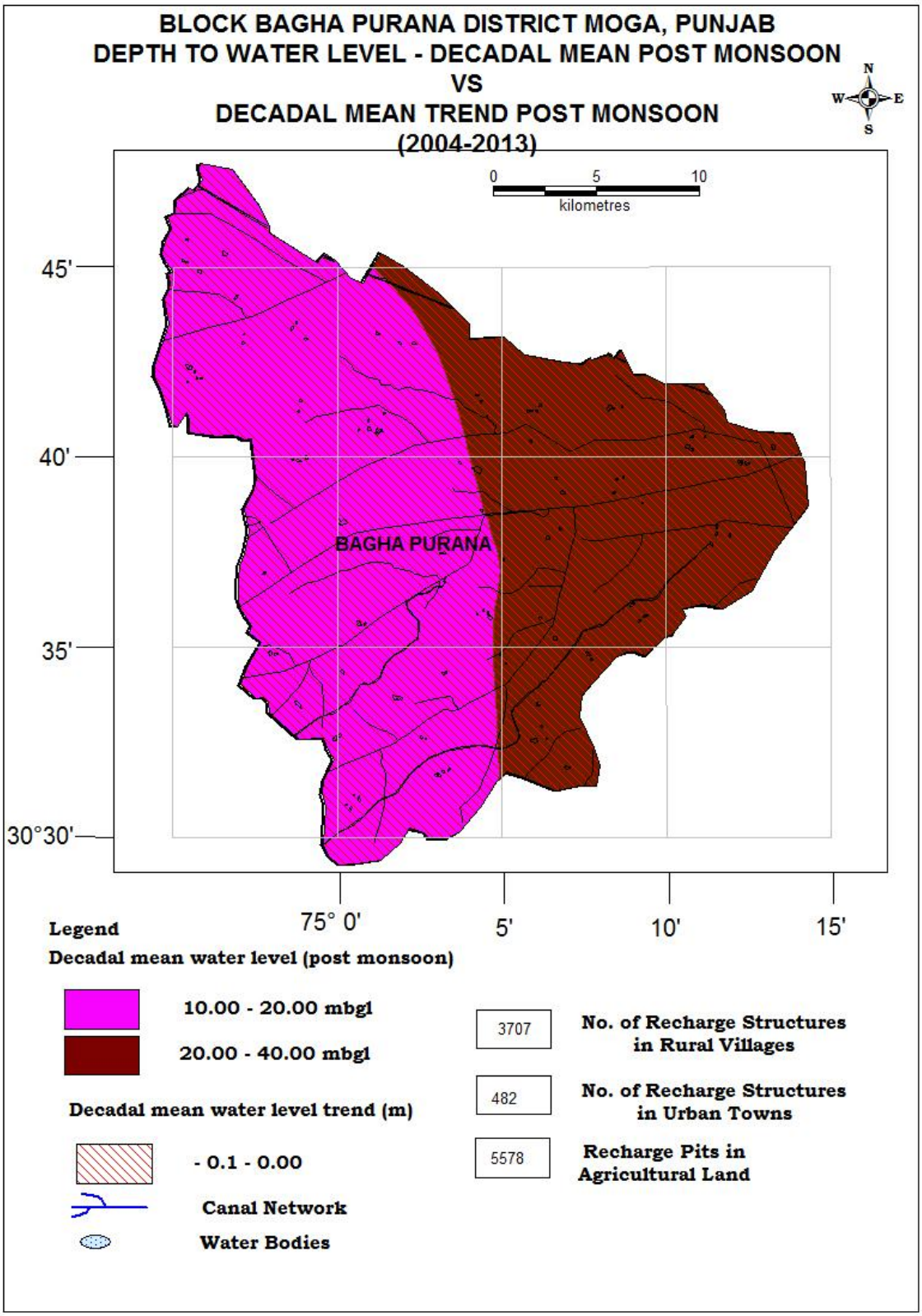
Decadal mean water level trend (m)

- 0.1 - 0.00

- 0.2 .. - 0.1

BLOCK WISE PLAN OF DISTRICT MOGA PUNJAB

(5 OE BLOCKS)


BLOCK BAGHA PURANA DISTRICT MOGA, PUNJAB
DEPTH TO WATER LEVEL - DECADAL MEAN POST MONSOON
VS
DECADAL MEAN TREND POST MONSOON
(2004-2013)
N
W
E
S
0
5
10
kilometres
45'
40'
35'
30°30'
BAGHA PURANA
75° 0'
5'
10'
15'
Legend
Decadal mean water level (post monsoon)
10.00 - 20.00 mbgl
20.00 - 40.00 mbgl
Decadal mean water level trend (m)
- 0.1 - 0.00
Canal Network
Water Bodies
3707
No. of Recharge Structures in Rural Villages
482
No. of Recharge Structures in Urban Towns
5578
Recharge Pits in Agricultural Land

Ground Water Scenario of Block

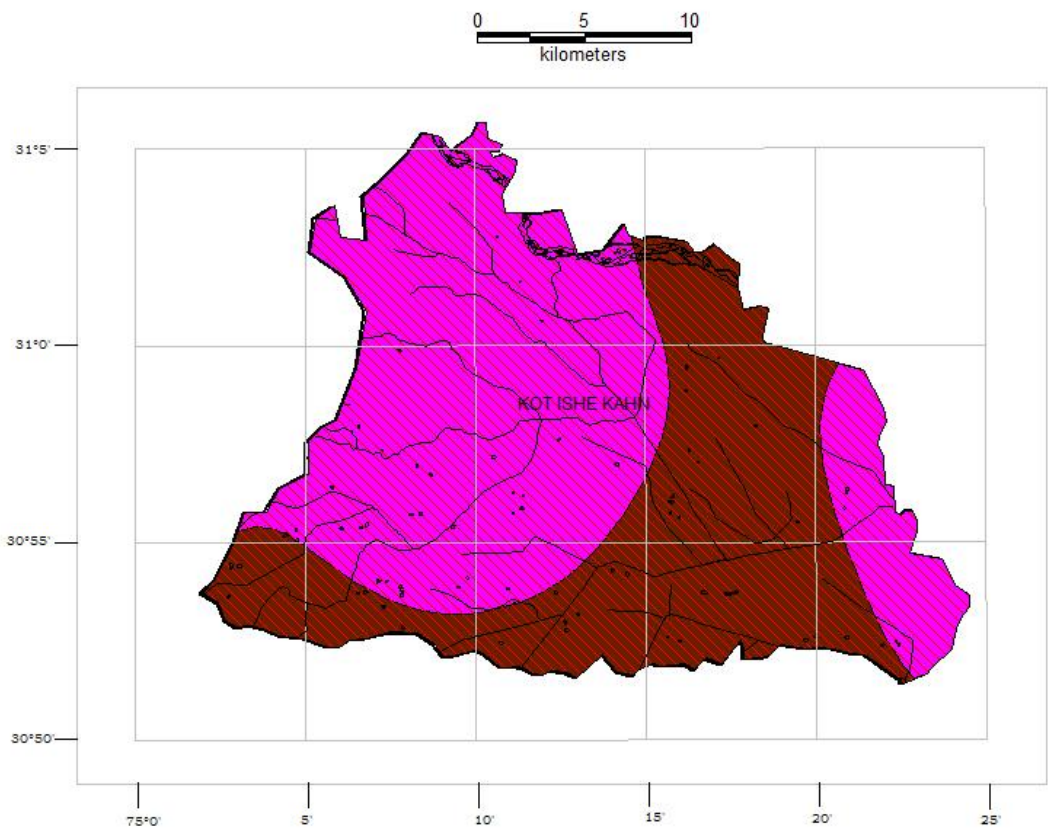
Block Name:- Bhagapurana **District:- Moga** **State:- PUNJAB**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*465.8*
	• Number of Villages inhabited • Un-inhabited	*57* *0*
	ii) Average Annual Rainfall (mm)	*415*
	iii) Area feasible for Artificial Recharge	*465.8*
	iv) Village identified under scarcity of Water	*47*
	v) Village covered under water supply	*47*
	vi) Water Tank exists in the village	*47*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Satluj 100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	556.83
	• Net Area Sown (Sq.Km)	494.68
	• Area Sown More than Once (Sq.Km)	4.81
	• Total Cropped Area (Sq.Km)	499.49
	• 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) 16.00-20.45(mbgl)	10.00-40.00 (mbgl)	
	• Post –monsoon: (Nov2014) 17.50-21.19(mbgl)		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	*1*	
	• Depth Range (m)	*350.0-350.30*	
	• Discharge (Ipm)	*5670*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*5750*	
	• Storativity	$6.0*10^{-3}$	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	*1675*	*1675*
	• NO3 (mg/l)	--	--
	• F (mg/l)	--	--
	• As (mg/l)	--	0.0072
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (Mcm)	369.17	
	• Existing Gross Ground Water Draft for Irrigation (Mcm)	613.78	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (Mcm)	4.22	
	• Existing Gross Ground Water Draft for all Uses (Mcm)	618.01	

	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (Mcm)	5.81	
	• Net Ground Water Availability for Future Irrigation Development (Mcm)	-250.42	
	• Stage of Ground Water Development / Over Draft(%)	167	
	• 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)* --	Percentage % --
10	Volume of unsaturated zone available for recharge (MCM)	890.42	
11.	Volume of water required for recharge (MCM)	1184.23	
12.	Volume of surplus water available for recharge(MCM)	4.45	

RECHARGE/ CONSERVATION STRUCTURES		**Total Number of Recharge Structures**	**Total Cost (Rs. in crores)**	**Total Recharge/Water saving in MCM**
13	Farm Recharge @Rs. 35000/-	5578	19.523	3.456
14	RWH Rural @ Rs. 25000/-	3707	9.267	0.184
15	RWH Urban@ Rs. 25000/-	482	1.205	0.032
16	Underground pipe line (area in hectares) @ Rs. 50000/-	22549	112.75	154.43
	TOTAL		**142.74**	**158.102**

BLOCK KOT ISHE KAHN DISTRICT MOGA, PUNJAB
DEPTH TO WATER LEVEL - DECADAL MEAN POST MONSOON
VS
DECADAL MEAN TREND POST MONSOON
(2004-2013)



Legend

Decadal mean water level (post monsoon)

10.00 - 20.00 mbgl

20.00 - 40.00 mbgl

Decadal mean water level trend (m)

- 0.1 - 0.00

Canal Network

Water Bodies

3342 **No. of Recharge Structures in Rural Villages**

619 **No. of Recharge Structures in Urban Towns**

5452 **Recharge Pits in Agricultural Land**

15 **Thickness of Sand**

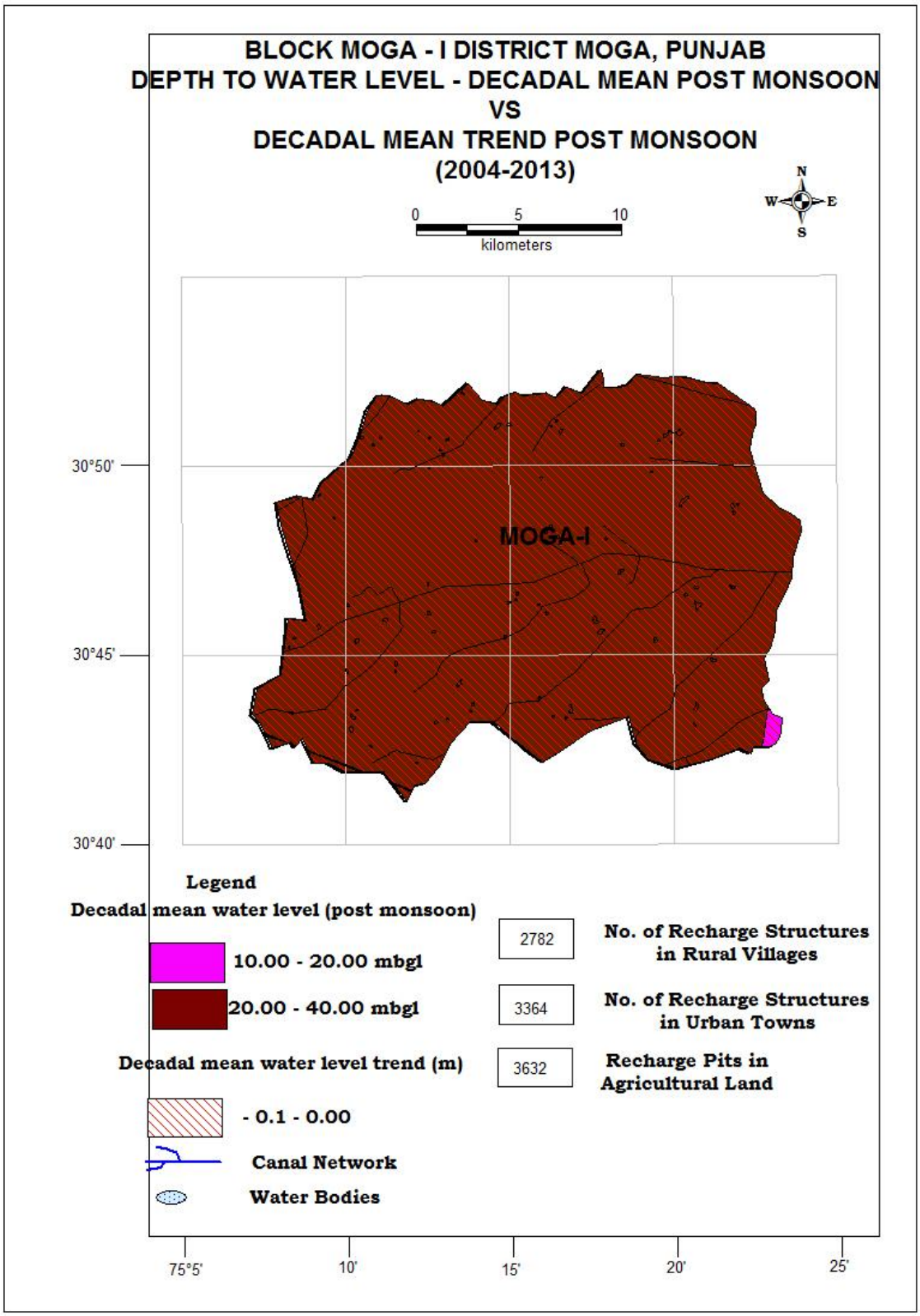
Ground Water Scenario of Block

Block Name:- DHARAMKOT (KOT ISA KHAN) **District:- Moga** **State:- PUNJAB**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*549*
	• Number of Villages inhabited • Un-inhabited	*130* *3*
	ii) Average Annual Rainfall (mm)	*545*
	iii) Area feasible for Artificial Recharge	*549*
	iv) Village identified under scarcity of Water	*149*
	v) Village covered under water supply	*149*
	vi) Water Tank exists in the village	*67*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	*Satluj 100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	542.21
	• Net Area Sown (Sq.Km)	459.91
	• Area Sown More than Once (Sq.Km)	4.54
	• Total Cropped Area (Sq.Km)	464.45
	• 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) 8.88-27.60 (mbgl)	10.00 – 40.00 (mbgl)	
	• Post –monsoon: (Nov2014) 16.53-16.53 (mbgl)		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
1	• No of wells drilled	*1*	
a	• Depth Range (m)	*350.0-350.30*	
	• Discharge (Ipm)	*5670*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*5750*	
	• Storativity	$6.0*10^{-3}$	
	• 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)	315.58	
	• Existing Gross Ground Water Draft for Irrigation (Mcm)	576.16	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (Mcm)	3.43	
	• Existing Gross Ground Water Draft for all Uses (Mcm)	579.59	

	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (Mcm)	4.72	
	• Net Ground Water Availability for Future Irrigation Development (Mcm)	-265.29	
	• Stage of Ground Water Development / Over Draft (%)	184	
	• 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) 15*	Percentage % 30
10	Volume of unsaturated zone available for recharge (MCM)	1049.47	
11.	Volume of water required for recharge (MCM)	1395.75	
12.	Volume of surplus water available for recharge(MCM)	5.25	

RECHARGE/ CONSERVATION STRUCTURES		**Total Number of Recharge Structures**	**Total Cost (Rs. in crores)**	**Total Recharge/Water saving in MCM**
13	Farm Recharge @Rs. 35000/-	5452	19.082	4.424
14	RWH Rural @ Rs. 25000/-	3342	8.355	0.217
15	RWH Urban@ Rs. 25000/-	619	1.547	0.047
16	Underground pipe line (area in hectares) @ Rs. 50000/-	36546	182.73	144.96
	TOTAL		**212.714**	**149.648**


BLOCK MOGA - I DISTRICT MOGA, PUNJAB
DEPTH TO WATER LEVEL - DECADAL MEAN POST MONSOON
VS
DECADAL MEAN TREND POST MONSOON
(2004-2013)
N
W
E
S
0
5
10
kilometers
MOGA-I
30°50'
30°45'
30°40'
75°5'
10'
15'
20'
25'
Legend
Decadal mean water level (post monsoon)
10.00 - 20.00 mbgl
20.00 - 40.00 mbgl
Decadal mean water level trend (m)
- 0.1 - 0.00
Canal Network
Water Bodies
2782
No. of Recharge Structures in Rural Villages
3364
No. of Recharge Structures in Urban Towns
3632
Recharge Pits in Agricultural Land

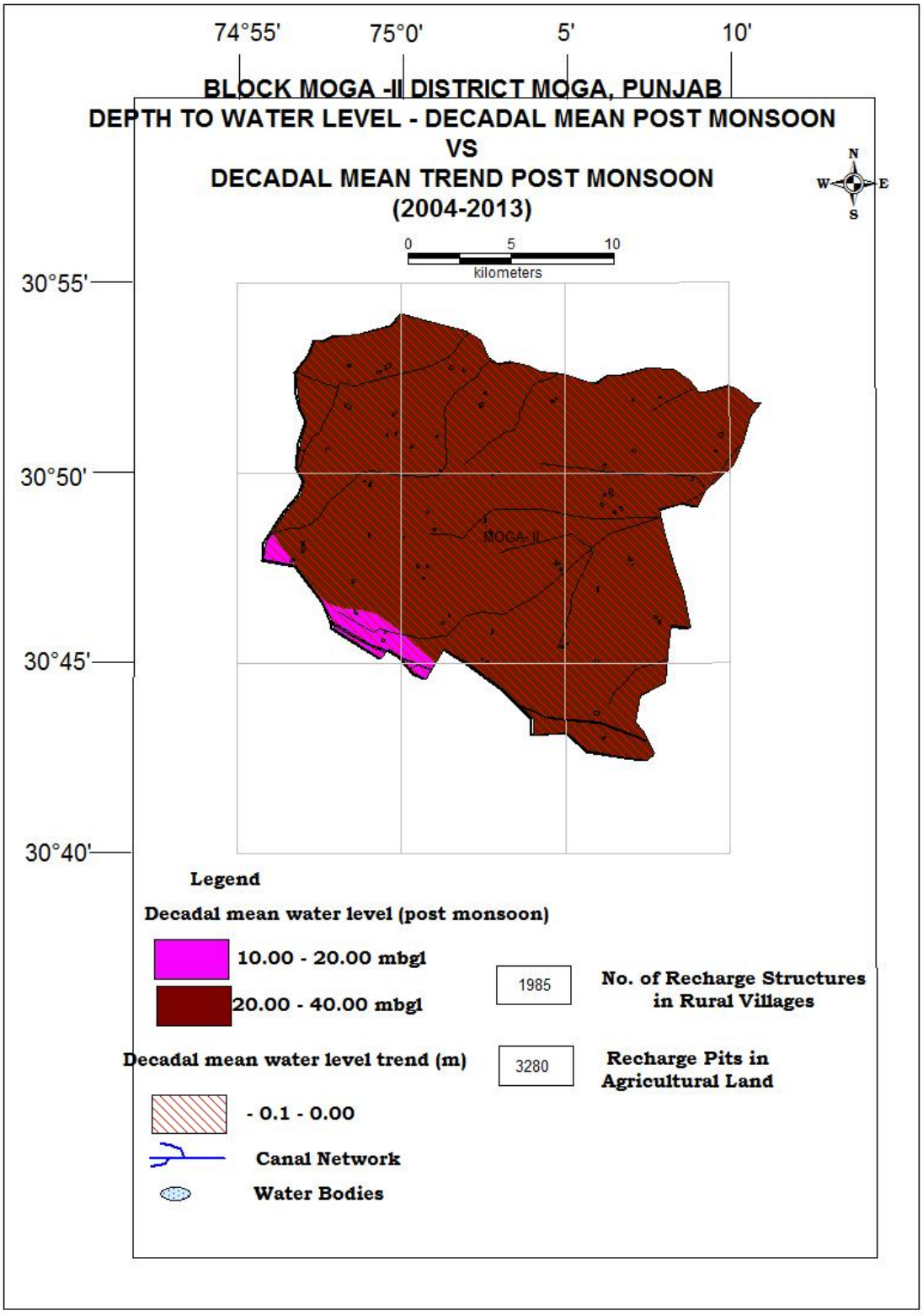
Ground Water Scenario of Block

Block Name:- Moga 1 **District:- Moga** **State:- PUNJAB**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*445*
	• Number of Villages inhabited • Un-inhabited	*52* *0*
	ii) Average Annual Rainfall (mm)	*472*
	iii) Area feasible for Artificial Recharge	*445*
	iv) Village identified under scarcity of Water	*46*
	v) Village covered under water supply	*43*
	vi) Water Tank exists in the village	*43*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	*Satluj 100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	370.92
	• Net Area Sown (Sq.Km)	324.39
	• Area Sown More than Once (Sq.Km)	3.12
	• Total Cropped Area (Sq.Km)	327.51
	• 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) 20.80-30.10(mbgl)	20.00- 40.00 (mbgl)	
	• Post –monsoon: (Nov2014) 22.50-31.35(mbgl)		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	*1*	
	• Depth Range (m)	*350.0-350.30*	
	• Discharge (Ipm)	*5670*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*5750*	
	• Storativity	*$6.0*10^{-3}$*	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	*771*	*2330*
	• NO3 (mg/l)	*8*	*23*
	• F (mg/l)	*0.32*	*1.38*
	• As (mg/l)	--	--
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (Mcm)	195.55	
	• Existing Gross Ground Water Draft for Irrigation (Mcm)	457.92	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (Mcm)	--	
	• Existing Gross Ground Water Draft for all Uses (Mcm)	463.57	
	• Allocation for Domestic and Industrial Requirement Supply up	7.77	

	to next 25 years (Mcm)		
	• Net Ground Water Availability for Future Irrigation Development (Mcm)	-270.14	
	• Stage of Ground Water Development / Over Draft(%)	167	
	• 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)* --	Percentage % --
10	Volume of unsaturated zone available for recharge (MCM)	850.66	
11.	Volume of water required for recharge (MCM)	1131.35	
12.	Volume of surplus water available for recharge(MCM)	4.25	

	RECHARGE/ CONSERVATION STRUCTURES	**Total Number of Recharge Structures**	**Total Cost (Rs. in crores)**	**Total Recharge/Water saving in MCM**
13	Farm Recharge @Rs. 35000/-	3632	12.712	2.572
14	RWH Rural @ Rs. 25000/-	2782	6.955	0.158
15	RWH Urban@ Rs. 25000/-	3364	8.41	0.254
16	Underground pipe line (area in hectares) @ Rs. 50000/-	21887	109.43	144.96
	TOTAL		**137.50**	**147.944**

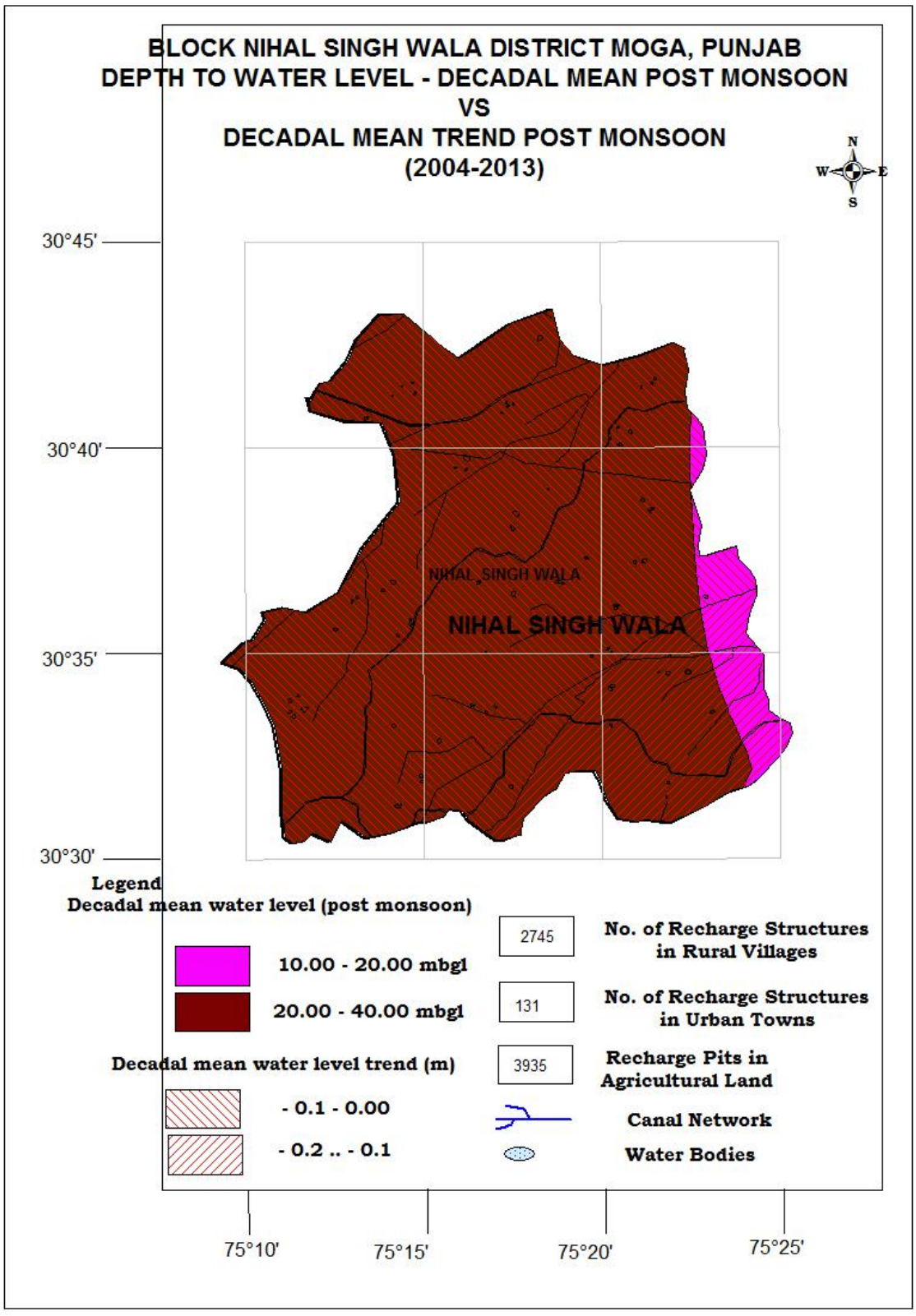

74°55'
75°0'
5'
10'
BLOCK MOGA -II DISTRICT MOGA, PUNJAB
DEPTH TO WATER LEVEL - DECADAL MEAN POST MONSOON
VS
DECADAL MEAN TREND POST MONSOON
(2004-2013)
N
W
E
S
0
5
10
kilometers
30°55'
30°50'
30°45'
30°40'
MOGA-II
Legend
Decadal mean water level (post monsoon)
10.00 - 20.00 mbgl
20.00 - 40.00 mbgl
1985
No. of Recharge Structures in Rural Villages
Decadal mean water level trend (m)
3280
Recharge Pits in Agricultural Land
- 0.1 - 0.00
Canal Network
Water Bodies

Ground Water Scenario of Block

Block Name:- Moga II **District:- Moga** **State:- PUNJAB**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*334.6*
	• Number of Villages inhabited • Un-inhabited	*44* *1*
	ii) Average Annual Rainfall (mm)	*477*
	iii) Area feasible for Artificial Recharge	*334.6*
	iv) Village identified under scarcity of Water	*44*
	v) Village covered under water supply	*43*
	vi) Water Tank exists in the village	*43*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Satluj 100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	311.03
	• Net Area Sown (Sq.Km)	274.16
	• Area Sown More than Once (Sq.Km)	2.66
	• Total Cropped Area (Sq.Km)	277.30
	• 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(mbgl)	
	• Pre- monsoon: (May 2015) 21.10-30.52(mbgl)	20.00- 40.00(mbgl)	
	• Post –monsoon: (Nov2014) 23.30-32.10(mbgl)		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	*2*	
	• Depth Range (m)	*350.0-350.30*	
	• Discharge (Ipm)	*5670*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*5750*	
	• Storativity	$6.0*10^{-3}$	
	• 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)	0.0065	0.0065
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (Mcm)	157.46	
	• Existing Gross Ground Water Draft for Irrigation (Mcm)	344.13	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (Mcm)	2.03	
	• Existing Gross Ground Water Draft for all Uses (Mcm)	346.16	
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (Mcm)	2.79	

	• Net Ground Water Availability for Future Irrigation Development (Mcm)		-189.46	
	• Stage of Ground Water Development Over draft (%)		220	
	• 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)* --	Percentage % --
10	Volume of unsaturated zone available for recharge (MCM)		639.62	
11.	Volume of water required for recharge (MCM)		850.67	
12.	Volume of surplus water available for recharge(MCM)		3.20	
	RECHARGE/ CONSERVATION STRUCTURES	**Total Number of Recharge Structures**	**Total Cost (Rs. in crores)**	**Total Recharge/Water saving in MCM**
13	Farm Recharge @Rs. 35000/-	3280	11.48	2.572
14	RWH Rural @ Rs. 25000/-	1985	4.962	0.158
15	RWH Urban@ Rs. 25000/-	-	-	-
16	Underground pipe line (area in hectares) @ Rs. 50000/-	18373	91.87	86.58
	TOTAL		**108.312**	**89.564**


BLOCK NIHAL SINGH WALA DISTRICT MOGA, PUNJAB
DEPTH TO WATER LEVEL - DECADAL MEAN POST MONSOON
VS
DECADAL MEAN TREND POST MONSOON
(2004-2013)
N
W
E
S
30°45'
30°40'
30°35'
30°30'
NIHAL SINGH WALA
NIHAL SINGH WALA
Legend
Decadal mean water level (post monsoon)
10.00 - 20.00 mbgl
20.00 - 40.00 mbgl
Decadal mean water level trend (m)
- 0.1 - 0.00
- 0.2 .. - 0.1
2745
No. of Recharge Structures in Rural Villages
131
No. of Recharge Structures in Urban Towns
3935
Recharge Pits in Agricultural Land
Canal Network
Water Bodies
75°10'
75°15'
75°20'
75°25'

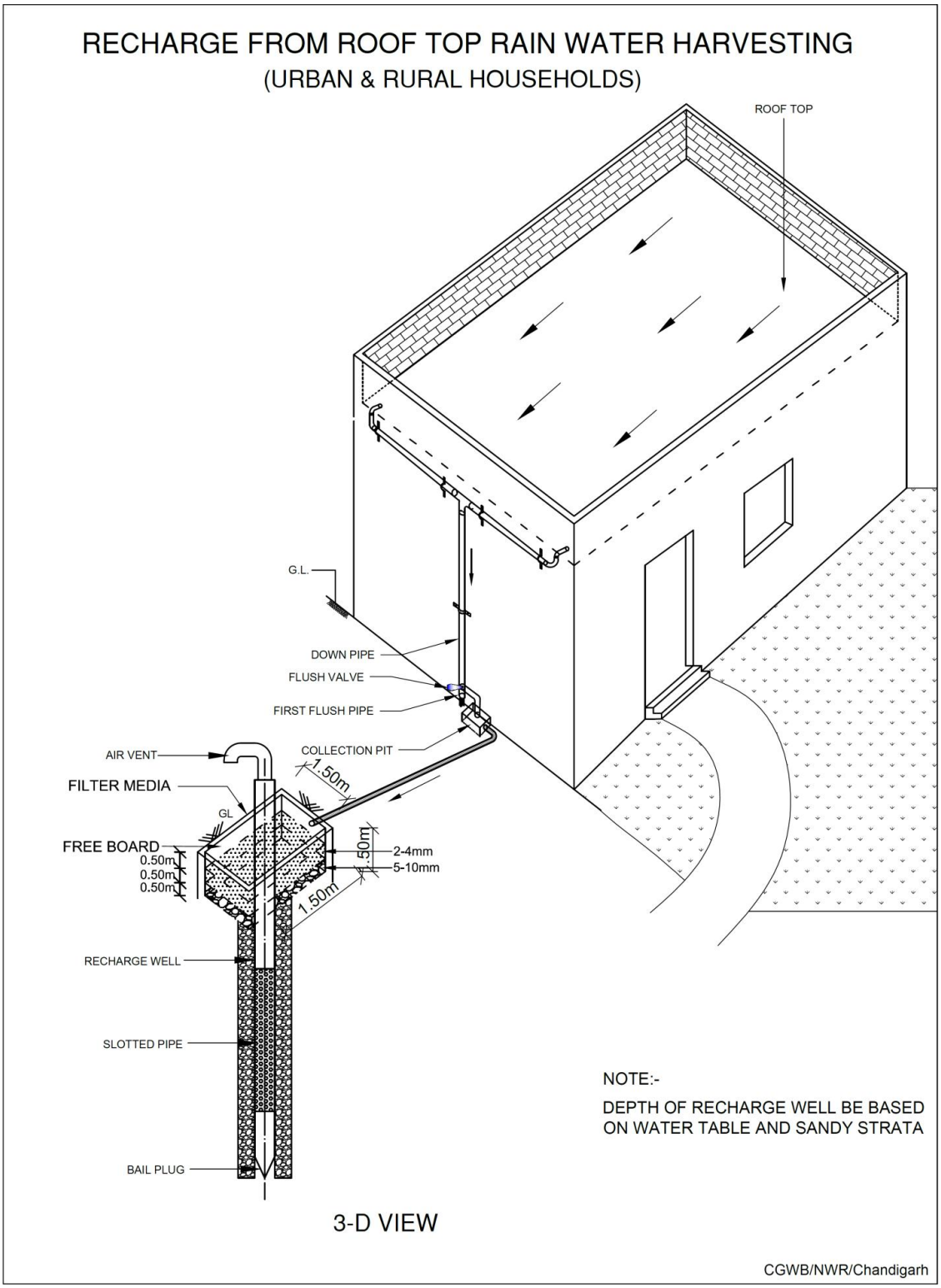
Ground Water Scenario of Block

Block Name:- Nihal Singhwala **District:- Moga** **State:- PUNJAB**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*377.8*
	• Number of Villages inhabited • Un-inhabited	*39* *1*
	ii) Average Annual Rainfall (mm)	*439*
	iii) Area feasible for Artificial Recharge	*377.8*
	iv) Village identified under scarcity of Water	*37*
	v) Village covered under water supply	*37*
	vi) Water Tank exists in the village	*36*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	*Satluj 100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	355.36
	• Net Area Sown (Sq.Km)	214.99
	• Area Sown More than Once (Sq.Km)	3.01
	• Total Cropped Area (Sq.Km)	318.00
	• Cropping Intensity	101
	• Area under Thur and Sem (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Recent alluvium*

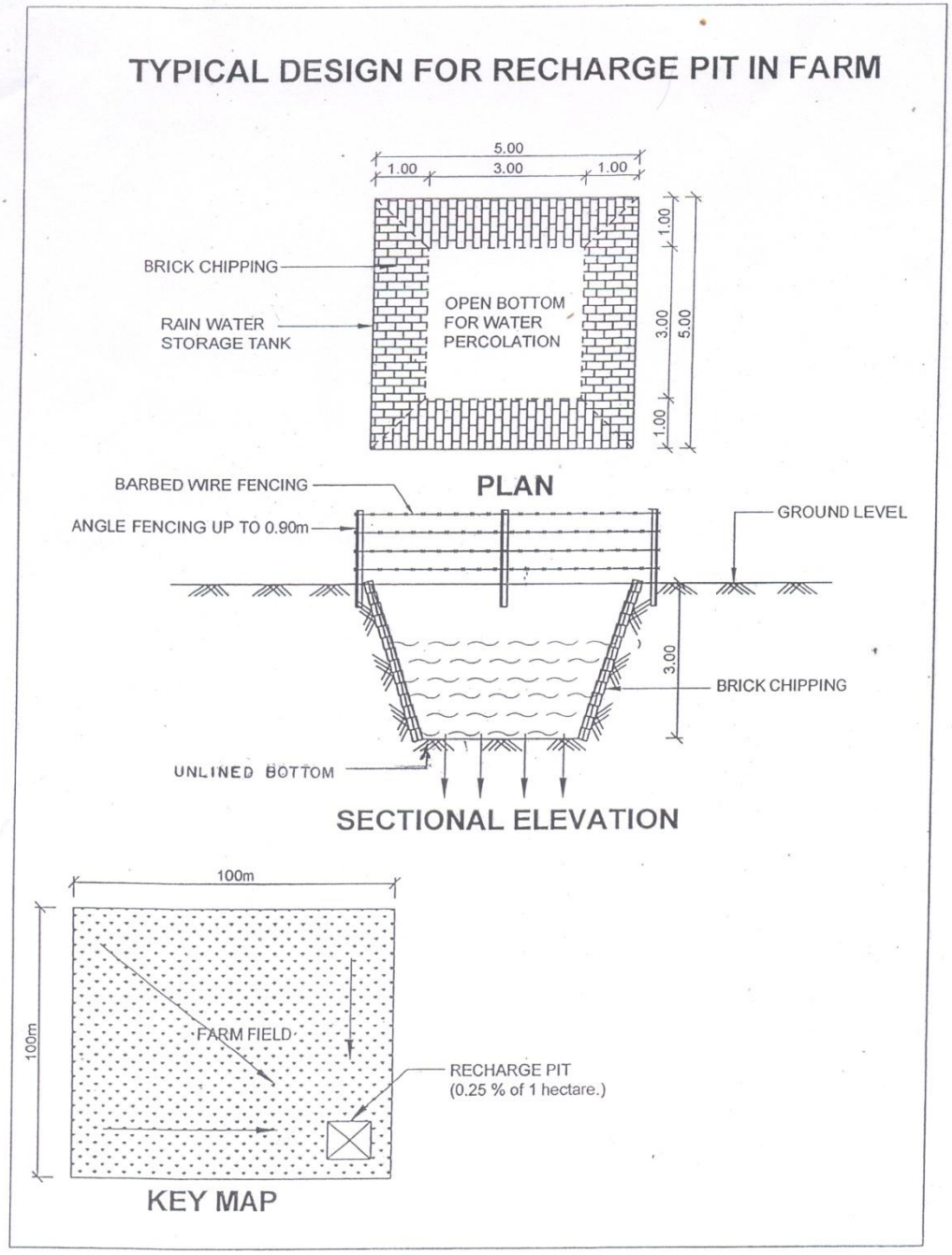
5.	HYDROGEOLOGY		
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand	
	Avg. Depth to water level (decadal)	Depth to water level(May 2015)	
	• Pre- monsoon: (May 2015) 17.60-30.50 (mbgl)		
	Post –monsoon: (Nov2014) 28.20-31.21(mbgl)	20.00-40.00 (mbgl)	
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	*6*	
	• Depth Range (m)	*350.0-350.30*	
	• Discharge (Ipm)	*5670*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*5750*	
	• Storativity	*$6.0*10^{-3}$*	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	*871*	*871*
	• NO3 (mg/l)	*26*	*26*
	• F (mg/l)	*0.26*	*0.26*
	• As (mg/l)	0.0022	0.0033
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (Mcm)	167.96	
	• Existing Gross Ground Water Draft for Irrigation (Mcm)	429.48	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (Mcm)	2.69	
	• Existing Gross Ground Water Draft for all Uses (Mcm)	432.17	
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (Mcm)	2.69	

	• Net Ground Water Availability for Future Irrigation Development (Mcm)	-264.22	
	• Stage of Ground Water Development / Over Draft(%)	257	
	• 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)* --	Percentage % --
10	Volume of unsaturated zone available for recharge (MCM)	722.20	
11.	Volume of water required for recharge (MCM)	960.50	
12.	Volume of surplus water available for recharge(MCM)	3.61	

RECHARGE/ CONSERVATION STRUCTURES		**Total Number of Recharge Structures**	**Total Cost (Rs. in crores)**	**Total Recharge/Water saving in MCM**
13	Farm Recharge @Rs. 35000/-	3935	13.772	2.568
14	RWH Rural @ Rs. 25000/-	2745	6.862	0.143
15	RWH Urban@ Rs. 25000/-	131	0.327	0.009
16	Underground pipe line (area in hectares) @ Rs. 50000/-	20005	100.02	108.06
	TOTAL		**120.686**	**110.78**


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

Annexure-II


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