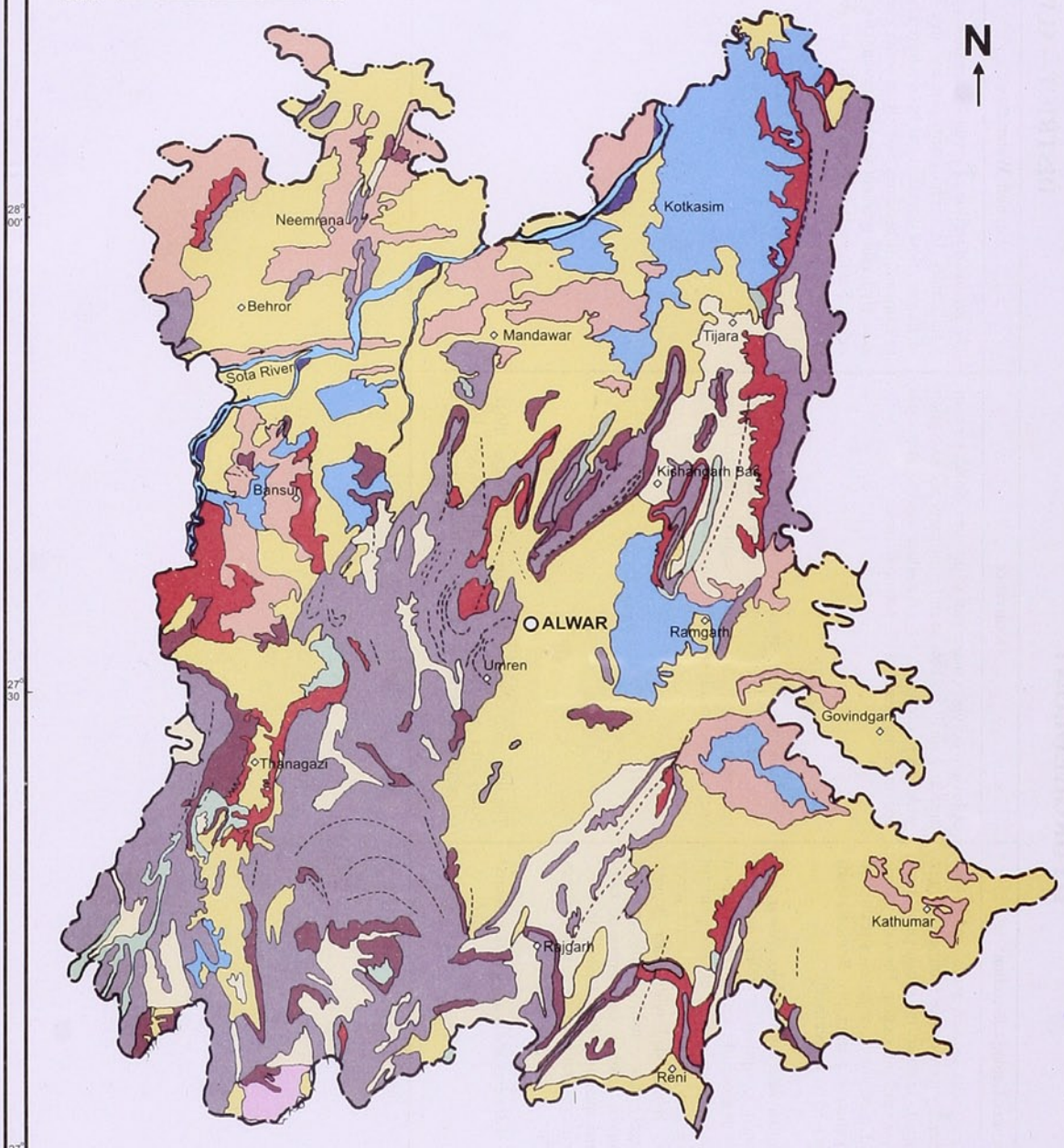
GEOMORPHOLOGY

DISTRICT—ALWAR

Landform Units	Symbol	Lithology / Material / Description	Occurrence in district	Land use/Land cover
Fluvial Origin				
Alluvial Plain	AP	Mainly undulating landscape formed due to fluvial activity, comprising of gravels, sand, silt and clay. Terrain mainly undulating, produced by extensive deposition of alluvium.	Scattered in entire district, main concentration in north west, east and south east.	Double crop, single crop (Rabi), fallow.
Alluvial Plain (Sandy)	AP (S)	Flat to gentle undulating plain formed due to fluvial activity, mainly consists of gravels, sand, silt and clay with unconsolidated material of varying lithology, predominantly sand along river Jojri.	North of Tijara, Ramgarh town, south of Borada village.	Marginal double crop, single crop (Kharif), open scrub.
Valley Fill	VF	Formed by fluvial activity, usually at lower topographic locations, comprising of boulders, cobbles, pebbles, gravels, sand, silt and clay. The unit has consolidated sediment deposits.	Negligible in south west of Thanagazi town & north west of Alwar town.	Marginal double crop, single crop (Rabi).
Ravine	RV	Small, narrow, deep, depression, smaller than gorges, larger than gulley, usually carved by running water.	Along river Sabi and wind ward side of hills in north east and south.	Single crop (Kharif), open scrub.
Flood Plain	FP	The surface or strip of relatively smooth land adjacent to a river channel formed by river and covered with water when river over flows its bank. Normally subject to periodic flooding.	Marginal along river Sabi and Sota.	Double crop, marginal single crop (Rabi).
Denudational Origin				
Pediment	P	Broad gently sloping rock flooring, erosional surface of low relief between hill and plain, comprised of varied lithology, criss crossed by fractures & faults.	Along forest hills.	Marginal kharif crop, land with or without scrub, fallow.
Burried Pediment	BP	Pediment covered essentially with relatively thicker alluvial, colluvial or weathered materials.	East of Kherthal town, around Gola Ka Bas.	Marginal double crop, single crop (Kharif), fallow, open scrub.
Intermontane Valley	IV	Depression between mountains, generally broad & linear, filled with colluvial deposit.	In between hills, main concentration in south and north east.	Marginal double crop, single crop (Rabi / Kharif), fallow.
Aeolian Origin				
Sandy Plain	SP	Formed of aeolian activity, wind blown sand with gentle sloping to undulating plain, comprising of coarse sand, fine sand, silt & clay.	Negligible in west and north east.	Single crop (Kharif), land with or without scrub.
Hills				
Linear Ridge	LR	Long narrow low-lying ridge usually barren, having high run off may form over varying lithology with controlled strike.	Marginal in south east.	Barren.
Denudational Hill	DH	Steep sided, relict hills undergone denudation, comprising of varying lithology with joints, fractures and lineaments.	North of Hamirpur, east of Musa Khara village.	Open scrub.
Structural Hill	SH	Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc.	Western boundry of district.	Forest, open scrub.

ALWAR DISTRICT

GEOMORPHOLOGY



LEGEND

Lineament

- FAULTS/FRACTURES/JOINTS OF VARYING LENGTH AND BREADTH

Water Bodies

- RIVER/POND/RESERVOIR

Hills

- STRUCTURAL/LINEAR/ DENUDATIONAL

Landform Units :

Fluvial Origin :

- Alluvial Plain
- Alluvial Plain (Sandy)
- Valley Fill
- Ravine
- Flood Plain

Denudational Origin :

- Pediment
- Burried Pediment
- Intermontane Valley

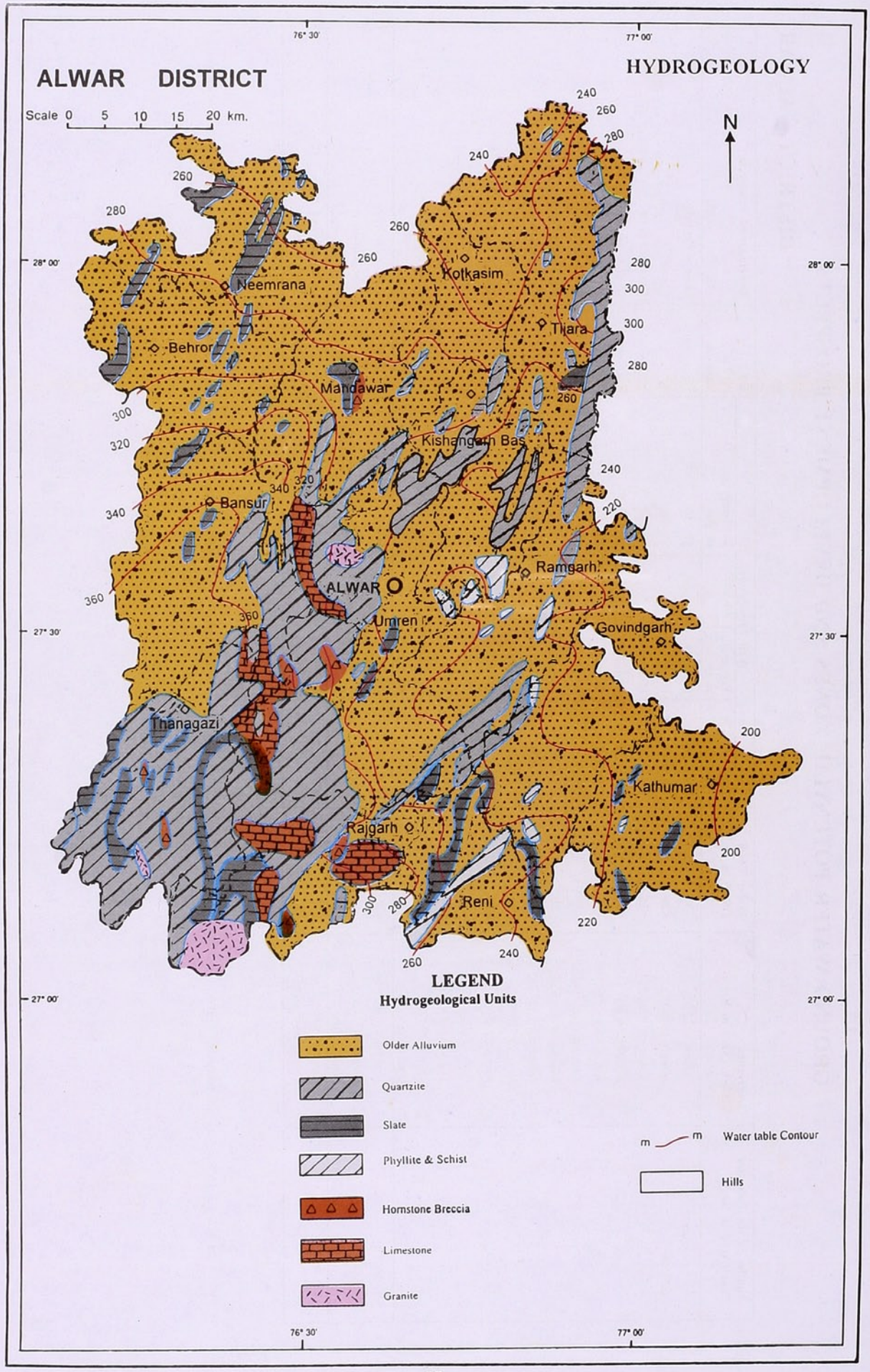
Aeolian Origin :

- Sandy Plain

HYDROGEOLOGY

DISTRICT—ALWAR

Hydrogeological units	Description of the unit/Geological section	Occurrence	Ground Water flow
Alluvium (Quaternary)	The litho unit comprises silt, clay with kanker, gravel and pebble beds. Intermontane valleys generally have coarse sediments. These include unconsolidated, unsorted, angular to sub-angular rock fragments intermixed with coarse sand and kankar. The valley floor of the major river basins and tributaries comprises stream laid deposits. The thickness of alluvium at Kathumber, Reni, Rajgarh have been recorded 99, 50 and 30 m respectively.	Alluvium occupies major part of the area. South western area and small pockets in different parts are exception which are occupied by crystalline rocks. Alluvium encompasses nearly 84% potential area.	The general direction of ground water flow varies significantly. In north eastern part and area west of Bansur, flow direction has been inferred north to eastward. It becomes easterly in south eastern area. Hydraulic gradient varies between 0.6 to 2.0 m/km. South eastern region generally has gentle gradient.
Quartzite (Delhi Super Group)	The super group has been subdivided into Raialo, Alwar and Ajabgarh groups. Raialo group comprises marble, dolomite, conglomerate and quartzite. Alwar group of rocks are characterised by the dominance of arenaceous facies and mainly include quartzite of varied types. Quartzites are grey, pink, pale and light green colour. These often occur as interbedded with other groups. Ajabgarh group of rocks are largely represented by argillaceous and calcareous facies. These comprise marble, calc gneisses, calc-schist, phyllite, mica schist and quartzite. Post Delhi intrusives, granite pegmatite and quartz veins generally occurs as sills or dykes in rocks of Delhi Super Group.	The litho unit covers most extensive area in Rajgarh block. Part of Umrain and Kishangarh blocks also have been demarcated with quartzite aquifer. The rock unit encompasses nearly 8% potential area.	
Slate (Bhilwara Super Group)	It represents argillaceous meta sediments and mainly dark coloured soft and friable rocks.	The litho units cover extensive area in Thanagazi block. Small area occupied by the rock unit has also been delineated in Reni block. Slate occupy nearly 8% potential area.	

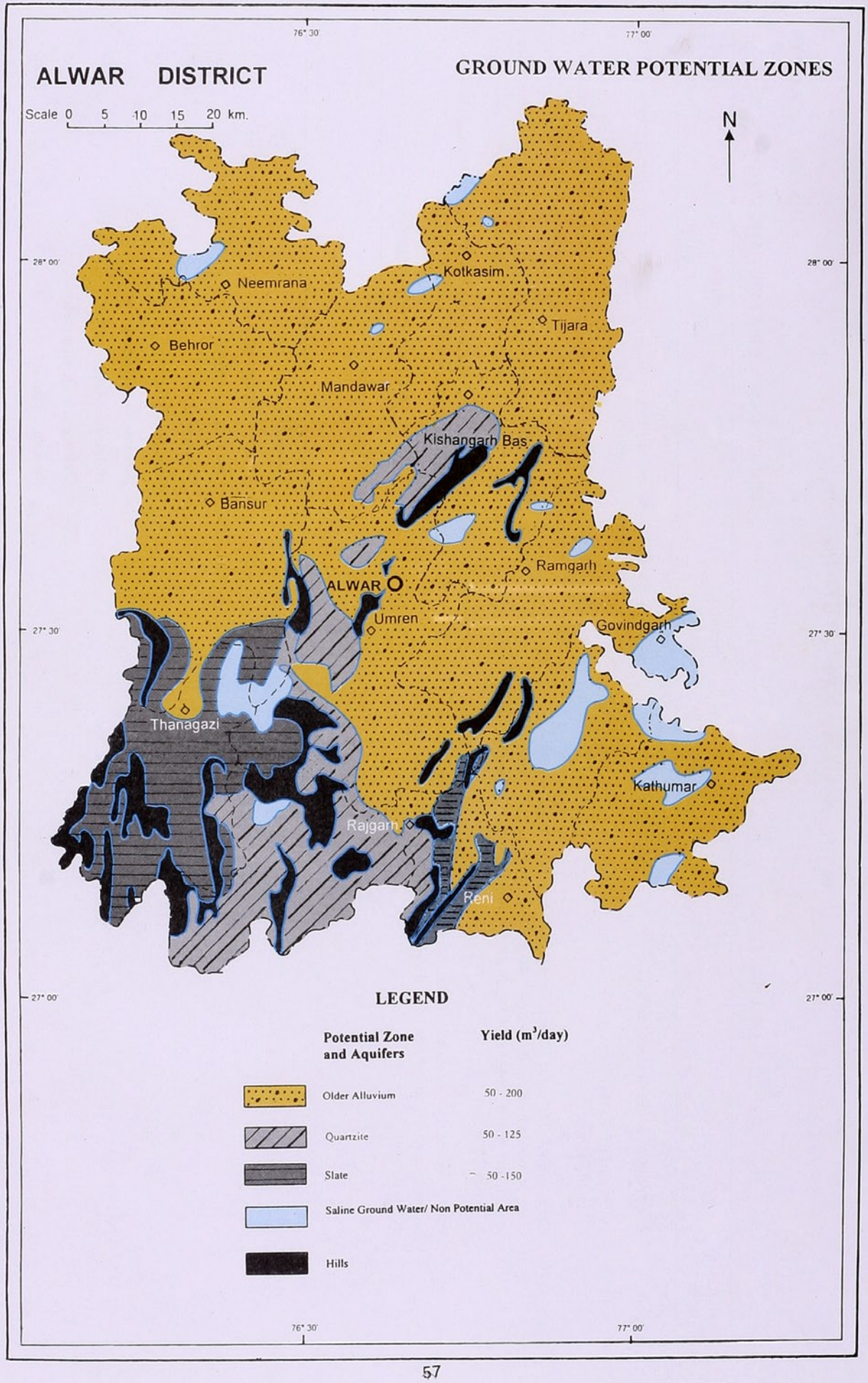

ALWAR DISTRICT
HYDROGEOLOGY
Scale 0 5 10 15 20 km.
N
76° 30'
77° 00'
28° 00'
27° 30'
27° 00'
Neemrana
Behror
Mandawar
Kotkasim
Tijara
Kishangarh Bas
Bansur
ALWAR
Umren
Ramgarh
Govindgarh
Thanagazi
Kathumar
Rajgarh
Reni
LEGEND
Hydrogeological Units
Older Alluvium
Quartzite
Slate
Phyllite & Schist
Hornstone Breccia
Limestone
Granite
Water table Contour
Hills

GROUND WATER POTENTIAL ZONES AND DEVELOPMENT PROSPECTS

DISTRICT - ALWAR

Aquifer in the Potential Zone (Area in Km²)	Occurrence * Block (Area in Km²)	Water Level (1997) in m.	Well Parameters			E.C. X10³µ siem/cm	Development Prospects
			Type	Proposed depth in m	Discharge in m³/day		
Older Alluvium	* Behror (352.63)	<30	TW/DCB	80-125/40-60	50-150	<2	Over exploited
(5820.68)	* Bansur (604.12)	<20	TW/DCB	80-100/40-60	50-150	<2	Critical
	* Kathumar (362.35)	<25	TW/DCB	80-125/40-60	50-150	<2, 2-4	Over exploited
	* Kishangarh Bas (351.76)	<25	TW/DCB	80-125/40-60	50-150	<2, 2-4	Over exploited
	* Kot Kasim (306.59)	<10	TW/DCB	80-100/30-50	50-150	<2, 2-6	Over exploited
	* Lachhmangarh (415.01)	<20	TW/DCB	80-125/30-50	50-150	<2	Over exploited
	* Mandawar (545.78)	<30	TW/DCB	80-125/40-60	50-150	<2	Over exploited
	* Neemrana (327.43)	<30	TW/DCB	80-125/40-60	50-150	<2	Over exploited
	* Rajgarh (78.80)	<30	TW/DCB	80-125/40-60	50-150	<2, 2-6	Over exploited
	* Ramgarh (568.46)	<15	TW/DCB	80-100/30-50	50-150	<2	Semi Critical
	* Reni (248.23)	<20	TW/DCB	80-100/30-50	50-150	<2	Semi Critical
	* Thanagazi (168.38)	<30	TW/DCB	80-125/40-60	50-150	<2	Over exploited
	* Tizara (611.52)	<25	TW/DCB	80-125/40-60	50-150	<2	Over exploited
	* Umrain (690.04)	<25	TW/DCB	80-125/40-60	50-150	<2	Safe
Quartzite	* Kishangarh (61.46)	<25	DW	40-60	50-80	<2, 2-6	Over exploited
(545.38)	* Rajgarh (377.15)	<35	DW	40-60	50-80	<2	Over exploited
	* Umrain (106.77)	<20	DW	40-60	50-80	<2	Over exploited
Slate (667.36)	* Reni (82.81)	<30	DW	40-60	40-60	<2	Over exploited
	* Thanagazi (584.55)	<30	DW	40-60	40-60	<2	Safe

TW - Tube wells **DCB** - Dug cum borewells **DW** - Dug wells **Safe** - <65% stage of development **Semi Critical** - 65-85% development **Critical** - 85-100% development **Over exploited** - >100% development


ALWAR DISTRICT
GROUND WATER POTENTIAL ZONES
Scale 0 5 10 15 20 km.
N
76° 30'
77° 00'
28° 00'
27° 30'
27° 00'
Neemrana
Kotkasim
Tijara
Behror
Mandawar
Kishangarh Bas
Bansur
Ramgarh
ALWAR
Umren
Govindgarh
Thanagazi
Kathumar
Rajgarh
Reni
LEGEND
Potential Zone and Aquifers
Yield (m³/day)
Older Alluvium
50 - 200
Quartzite
50 - 125
Slate
50 -150
Saline Ground Water/ Non Potential Area
Hills

WATER LEVEL TRENDS

DISTRICT : ALWAR

DEPTH TO WATER LEVEL

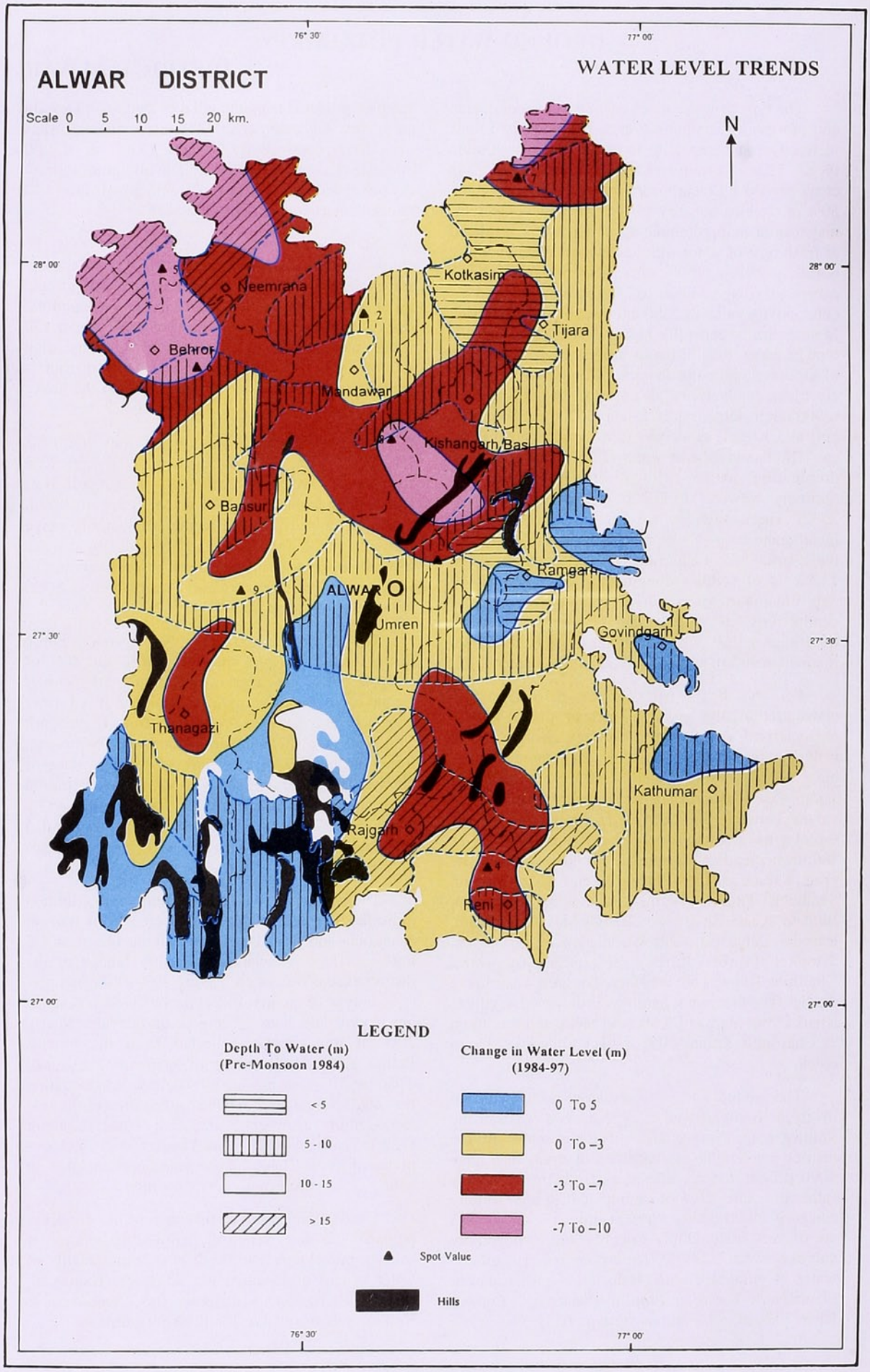
Range in m	Area
< 5	Area around Kotkasim has shallow water level ranging upto 5 m.
5 to 10	Major part of the district excluding few pockets located in different parts lie in the range.
10 to 15	Area around Thanagazi, Lachhmangarh, Mundawar and Behror have depth to water level in this range. As per the survey of '97, water level in this part has depleted and much of the area now lie in depth range of about 15 m.
> 15	Part of Neemrana, Rajgarh and Reni blocks situated in northwestern and southern part of the district have deep water level exceeding the range of 15 m.

CHANGE IN WATER LEVEL (1984-1997)

Range in m	Area
0 to 5	Southwestern part and small pockets situated on eastern periphery of the district show marginal rise in water level less than 5 m.
0 to -3	Major part of the district excluding some pockets in different parts show marginal depletion in water level i.e. less than 3 m.
-3 to -7	Area north of Alwar extending north westward upto Neemrana around Thanagazi, Reni and Rajgarh have depletion within the range.
-7 to -10	Area around Neemrana and small pocket north of Alwar exhibit steep depletion in water level ranging from 7 to 10m.

DETAILS OF THE SPOT

Spot code	Village (Block)	Change in water level in m (1984-97)
1.	Ajabpura (Thanagazi)	(-) 9.80
2.	Amoth (Mandawar)	(-) 16.14
3.	Chandoli (Umren)	(-) 8.20
4.	Dorali (Reni)	(-) 13.98
5.	Bandala (Behror)	(-) 13.05
6.	Jhalatala (Lachhmangarh)	(-) 8.51
7.	Makdawa (Kotkasim)	(-) 6.35
8.	Mehranpura (Kishangarh)	(-) 9.55
9.	Rampur (Bansur)	(-) 13.85


ALWAR DISTRICT
WATER LEVEL TRENDS
Scale 0 5 10 15 20 km.
N
76° 30'
77° 00'
28° 00'
27° 30'
27° 00'
Neemrana
Behror
Kotkasim
Tijara
Mandawar
Kishangarh Bas
Bansur
Ramgarh
ALWAR
Umren
Govindgarh
Thanagazi
Kathumar
Rajgarh
Reni
LEGEND
Depth To Water (m)
(Pre-Monsoon 1984)
< 5
5 - 10
10 - 15
> 15
Change in Water Level (m)
(1984-97)
0 To 5
0 To –3
-3 To –7
-7 To –10
Spot Value
Hills

GROUND WATER POTABILITY

DISTRICT ALWAR

The type of water gives an overall idea of degree and process of mineralisation as conductivity values increases from bicarbonate to mix and finally chloride type. 52.5% ground water of the district is characterised by bicarbonate type of water, in which 50% of the bicarbonate type water is having calcium-magnesium as predominating cation and considered as fresh type of water with low electrical conductivity normally below 1500 microsiemens/cm at 25°C, except at village Masani of Kotkasim block having conductivity value of 2250 microsiemens/cm at 25°C. Magnesium is generally higher than calcium in this type of water. Rest of the bicarbonate type waters are of sodium dominating character with higher values of electrical conductivity as observed at village Rani (2900 microsiemens/cm), Bhala (2600 microsiemens/cm) and Kherli and Sayad (2500 microsiemens/cm) etc. The mixed type of water (28.5%) are of sodium dominating nature with electrical conductivity normally between 1500-300 microsiemens/cm), at 25°C. These samples are more mineralised then bicarbonate type of water. Only 19% of samples of the district are of chloride type of water in which 15.5% is of sodium dominating while 3.5% is of calcium-magnesium character. The electrical conductivity of such water is more than 4000 microsiemens/cm with the highest value of 15300 microsiemens/cm at Dauli village of Thanagazi block.

On the basis of calcium & magnesium concentration, the ground water of the district is characterised as soft and hard water. Nearly 52% of water samples of the district are soft in nature as they have hardness values below 300 mg/L. 33% of samples are of moderately hard category with hardness values between 300-600 mg/L. Only 15% of the samples have hardness values exceeding 600 mg/L. and thus considered unsuitable for domestic use. The ground water of the villages Baroda Khan, Masani, Samochi, Titpuri, Tikani, Bahadurpur, Bambora, Bilaheri, Khari, Bhaisdawat, Baroda Mev, Govindgard, Harsana, Dabarwas, Tehla, Mandla Khurd, Pratapgarh, Silopka, Piproli Jhirri, Talvarikoh, Tulsiwara, Khalilpur, Rupwas are considered as hard water in the district. The maximum hardness is observed at village Khari (2390 mg/l.) of Kotkasim block and minimum at Chawandi Kallan (100 mg/L.) village of Tizara block.

The ground water of the district is characterised by fresh to slightly saline type as viewed from the salinity map. Nearly 83% of the samples in the district are having electrical conductivity less than 4000 µS/cm and considered as fresh to moderately saline in nature. 10% of samples fall in high salinity category (4000-6000) whereas only 5% of samples are of very high salinity category with conductivity values between 6000-8000 microsiemens. The ground water of villages Titpuri, Bahadurpura, Bhaisdawat, Govindgarh Karirya, Piproli, Pratapgarh, Rupwas Khari fall in this salinity group. Only two water samples collected from the villages Dauli and Dewara are of very high salinity (>8000 microsiemens/cm) as they have conductivity values 15300 & 12900 microsiemens/cm respectively. The minimum salinity is observed at village Garhi Swairan (440 microsiemens/cm) of Reni block.

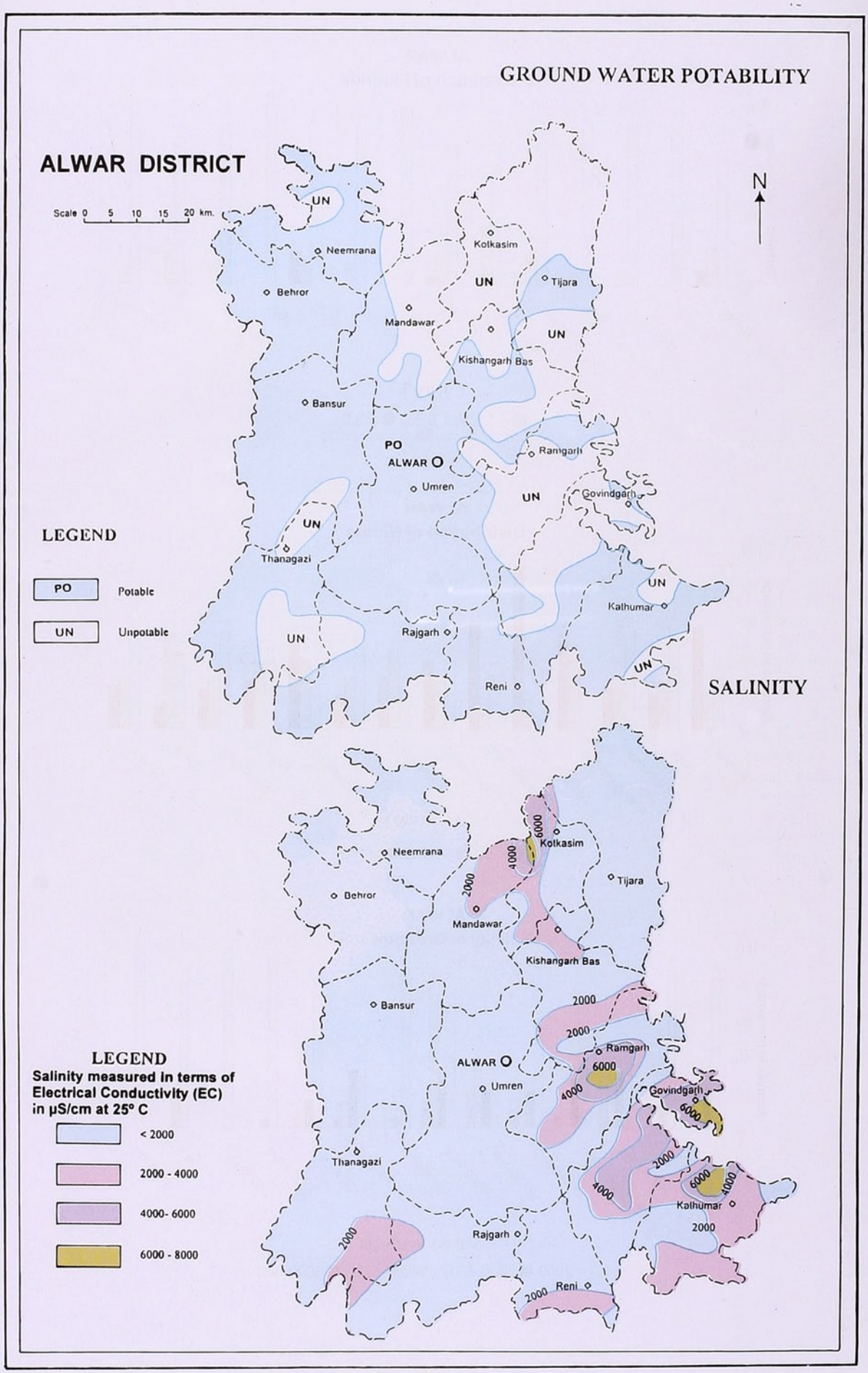
The ground water of the district may be considered suitable for irrigation with conductivity values below 4000 microsiemens/cm. The ground water with higher salinity values i.e. more than 4000 microsiemens/cm may only be used with proper soil water management. Ground water with very high salinity (>6000 microsiemens/cm) in the district is considered unsuitable for irrigation use on the heavy soils of the district.

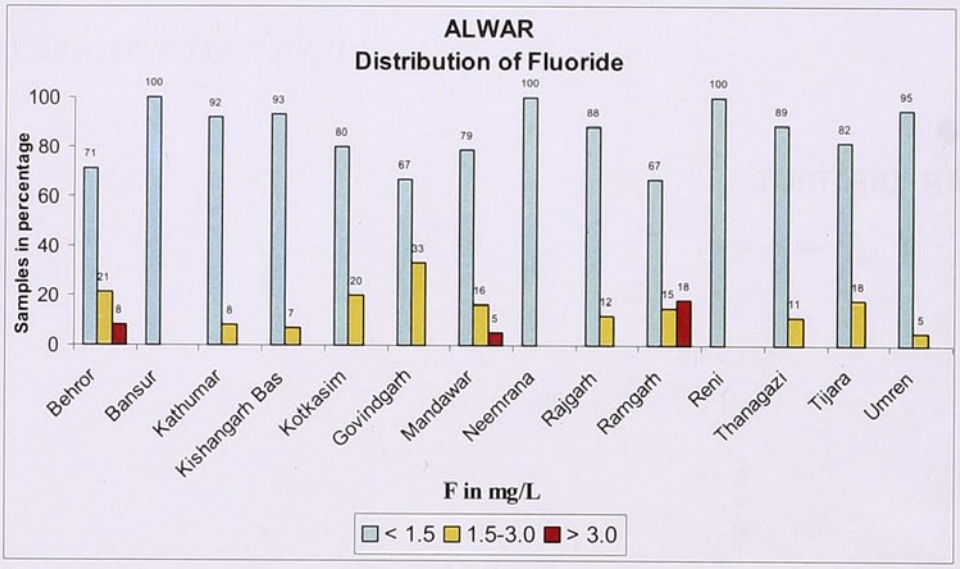
The bar diagram of salinity indicates that 33%, 7%, 20%, 53%, 14%, 24%, 18%, 30% and 12% samples of the block Kathumar, Kishangarh Bas, Kotkasim, Laxmangarh, Neemrana, Ramgarh, Reni, Thanagazi and Tizara are in the conductivity range between 4000-8000 µS/cm. Only 6% and 5% samples of Ramgarh and Thanagazi block respectively are of very high salinity values more than 8000 microsiemens/cm at 25°C.

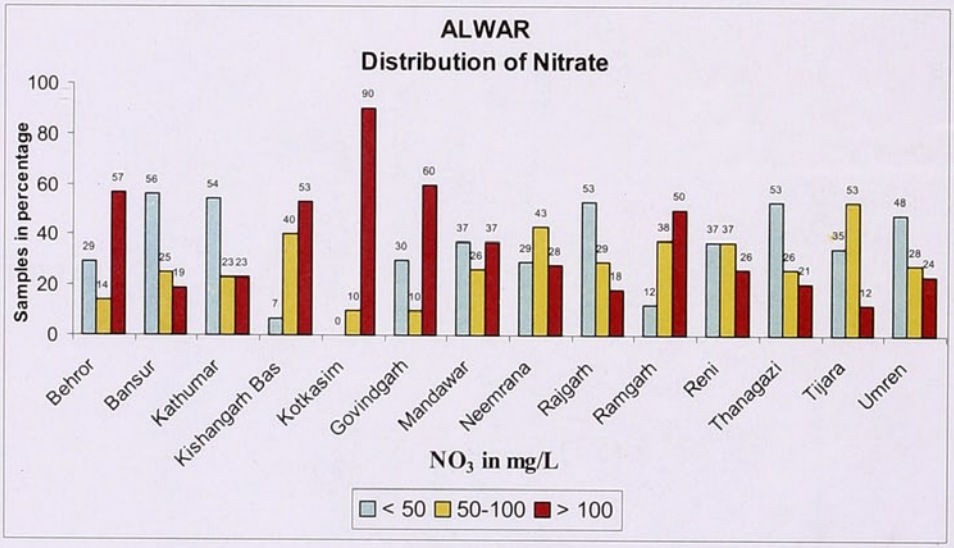
The bar diagram and map of Nitrate concentration in the district indicates that 30%, 30% and 40% of samples fall in the range of 0-50 mg/L, 50-100 mg/L. and more than 100 mg/l. respectively. It is further observed that samples collected from Kishangarh Bas, Kotkasim, Laxmangarh, Mandawar, Neemrana, Ramgarh and Tizara block are of higher values of Nitrate. The maximum value of Nitrate concentration is observed at Bahadarpur (1350 mg/L.) followed by Bambore (774 mg/L.), Baroda Mev (865 mg/L.) Silopka (586 mg/L.) and Rupwas (963 mg/L.) villages of the district.

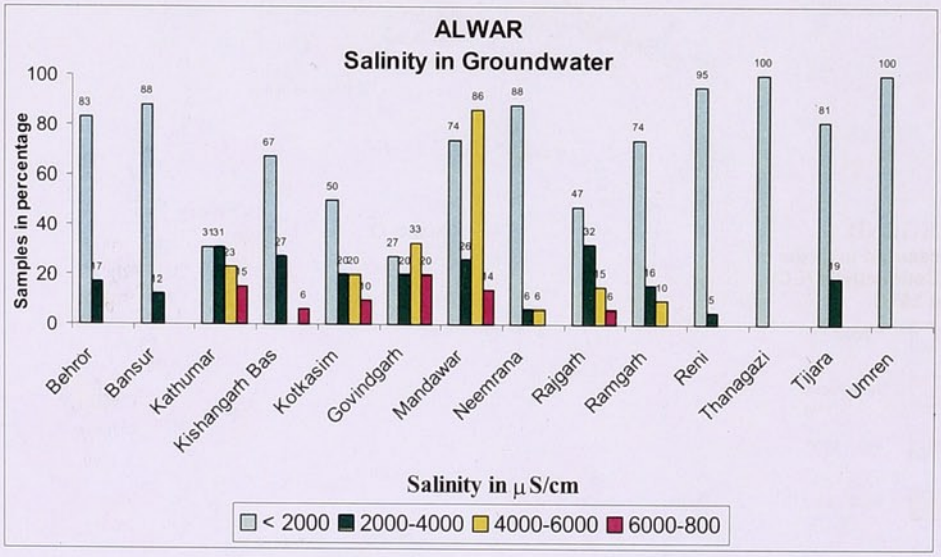
The bar diagram and map of fluoride distribution indicates that water samples collected from Bansur, Neemrana and Reni blocks are having less than 1.5 mg/l. of fluoride whereas the other blocks of the district except Behror are having 70% of the samples of such type of quality. In Behror block 43% samples are having less than 1.5 mg/L. of fluoride. Nearly 20% of the samples collected from the blocks; Behror, Kotkasim, Laxmangarh, Ramgarh, Thanagazi, Tijara and Umren are having fluoride concentration between 1.5-3.00 mg/L. High concentration of fluoride (>3.00 mg/L.) is observed at Behror (10%), Ramgarh (12%), Thanagazi (11%) and Mandawar (5%) blocks of the district. These higher values are isolated in nature & therefore not shown on map.

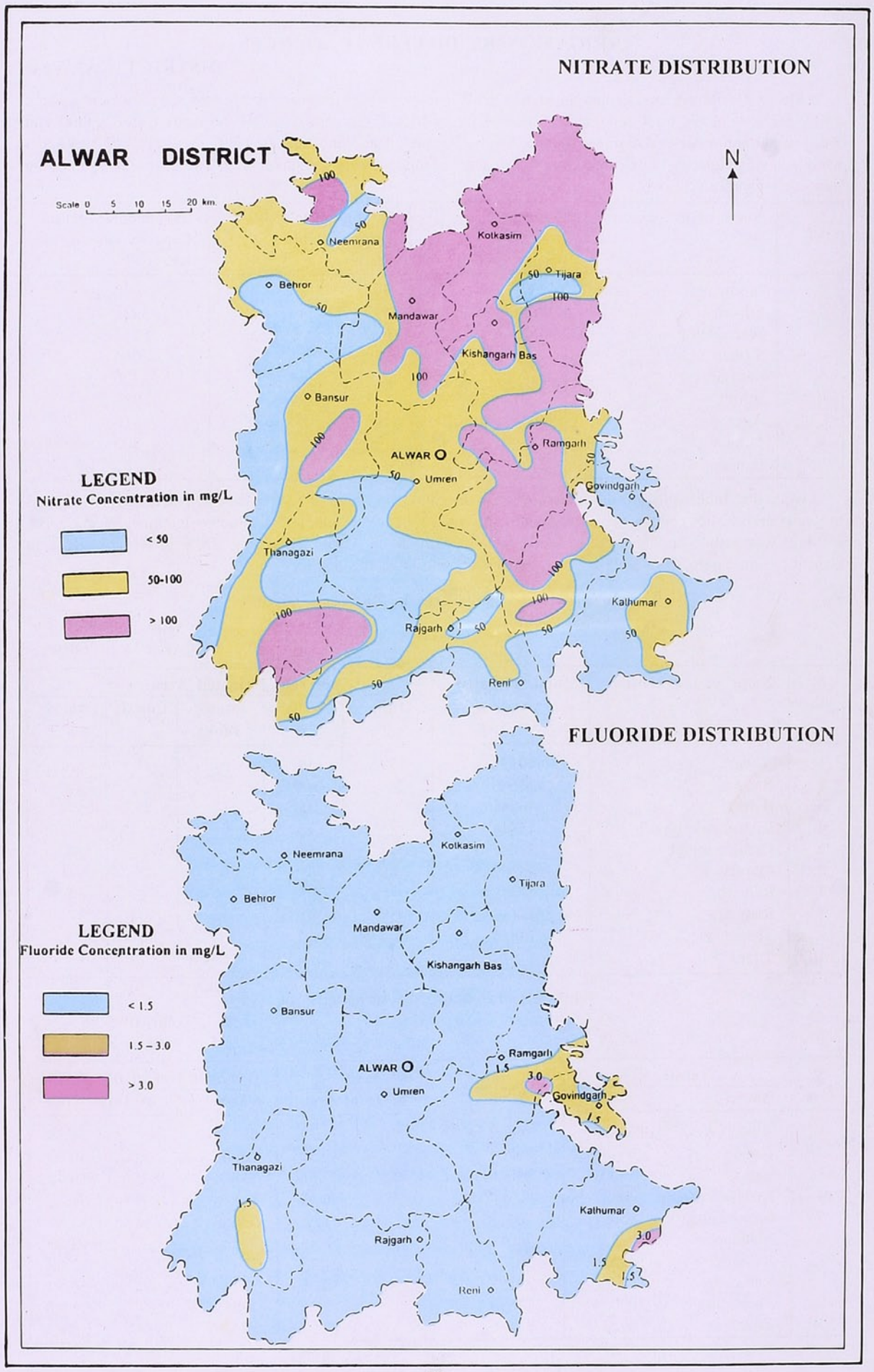
The drinking water quality map of the district is prepared on the basis of permissible values of salinity, nitrate and fluoride. It is seen that quality of water in part of Laxmangarh, Ramgarh, Thanagazi, Mandawar, Bansur, Kishangarh Bas, Neemrana & Kotkasim is unsuitable for drinking purpose.


GROUND WATER POTABILITY
ALWAR DISTRICT
Scale 0 5 10 15 20 km.
N
UN
Neemrana
Kotkasim
Behror
Tijara
Mandawar
Kishangarh Bas
Bansur
PO
ALWAR
Ramgarh
Umren
Govindgarh
Thanagazi
Kalhumar
Rajgarh
Reni
LEGEND
PO Potable
UN Unpotable
SALINITY
LEGEND
Salinity measured in terms of Electrical Conductivity (EC) in µS/cm at 25° C
< 2000
2000 - 4000
4000- 6000
6000 - 8000


ALWAR
Distribution of Fluoride
Samples in percentage
100
80
60
40
20
0
71 21 8
100
92 8
93 7
80 20
67 33
79 16 5
100
88 12
67 15 18
100
89 11
82 18
95 5
Behror
Bansur
Kathumar
Kishangarh Bas
Kotkasim
Govindgarh
Mandawar
Neemrana
Rajgarh
Ramgarh
Reni
Thanagazi
Tijara
Umren
F in mg/L
< 1.5
1.5-3.0
> 3.0


ALWAR
Distribution of Nitrate
Samples in percentage
100
80
60
40
20
0
29 14 57
56 25 19
54 23 23
7 40 53
0 10 90
30 10 60
37 26 37
29 43 28
53 29 18
12 38 50
37 37 26
53 26 21
35 53 12
48 28 24
Behror
Bansur
Kathumar
Kishangarh Bas
Kotkasim
Govindgarh
Mandawar
Neemrana
Rajgarh
Ramgarh
Reni
Thanagazi
Tijara
Umren
NO3 in mg/L
< 50
50-100
> 100


ALWAR
Salinity in Groundwater
Samples in percentage
100
80
60
40
20
0
83 17
88 12
31 31 23 15
67 27 6
50 20 20 10
27 20 33 20
74 26 86 14
88 6 6
47 32 15 6
74 16 10
95 5
100
81 19
100
Behror
Bansur
Kathumar
Kishangarh Bas
Kotkasim
Govindgarh
Mandawar
Neemrana
Rajgarh
Ramgarh
Reni
Thanagazi
Tijara
Umren
Salinity in µS/cm
< 2000
2000-4000
4000-6000
6000-800


NITRATE DISTRICT
ALWAR DISTRICT
Scale 0 5 10 15 20 km.
N
Neemrana
Kotkasim
Behror
Tijara
Mandawar
Kishangarh Bas
Bansur
ALWAR
Ramgarh
Umren
Govindgarh
Thanagazi
Kathumar
Rajgarh
Reni
LEGEND
Nitrate Concentration in mg/L
< 50
50-100
> 100
FLUORIDE DISTRIBUTION
LEGEND
Fluoride Concentration in mg/L
< 1.5
1.5 – 3.0
> 3.0