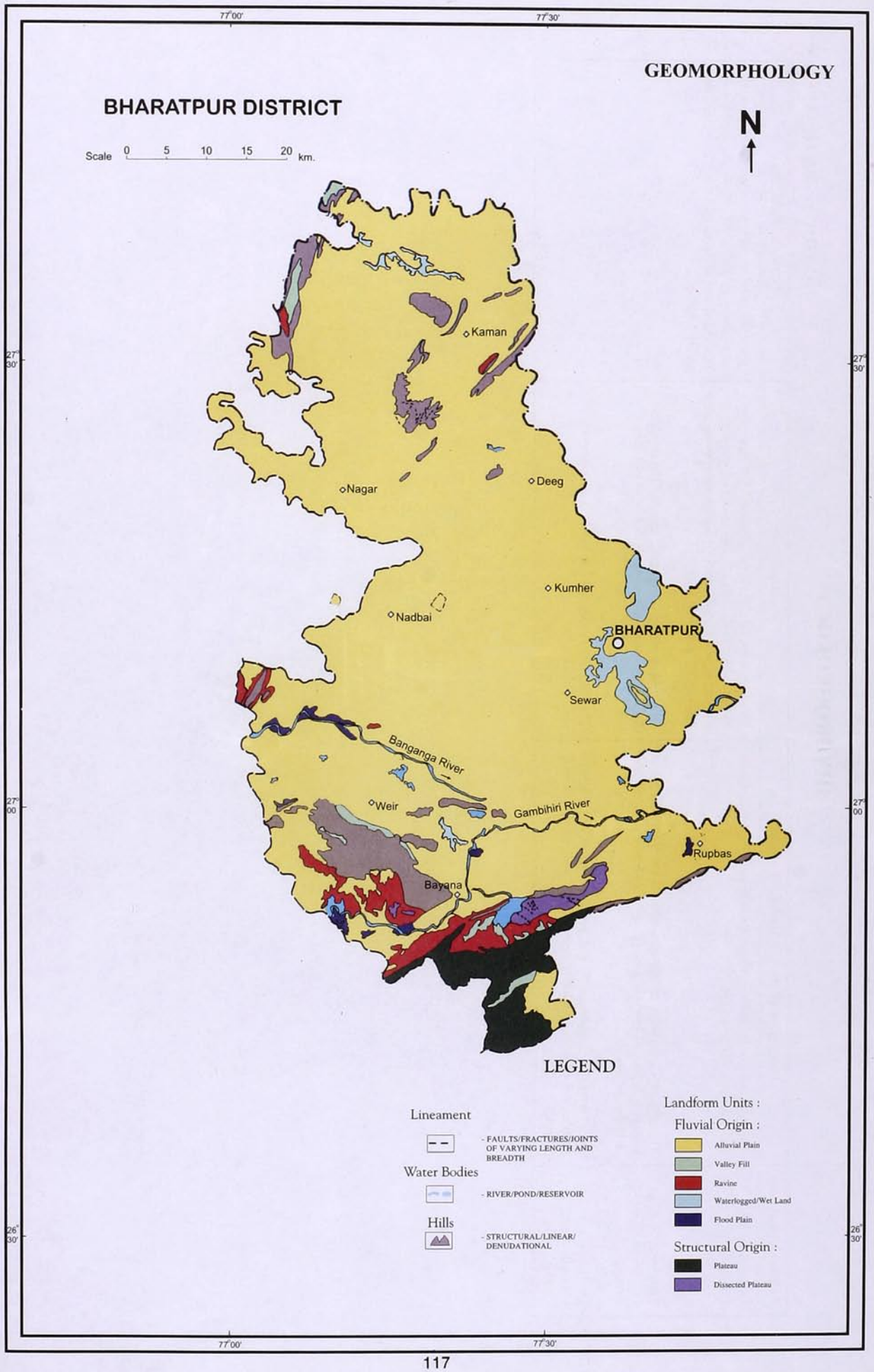
GEOMORPHOLOGY

DISTRICT—BHARATPUR

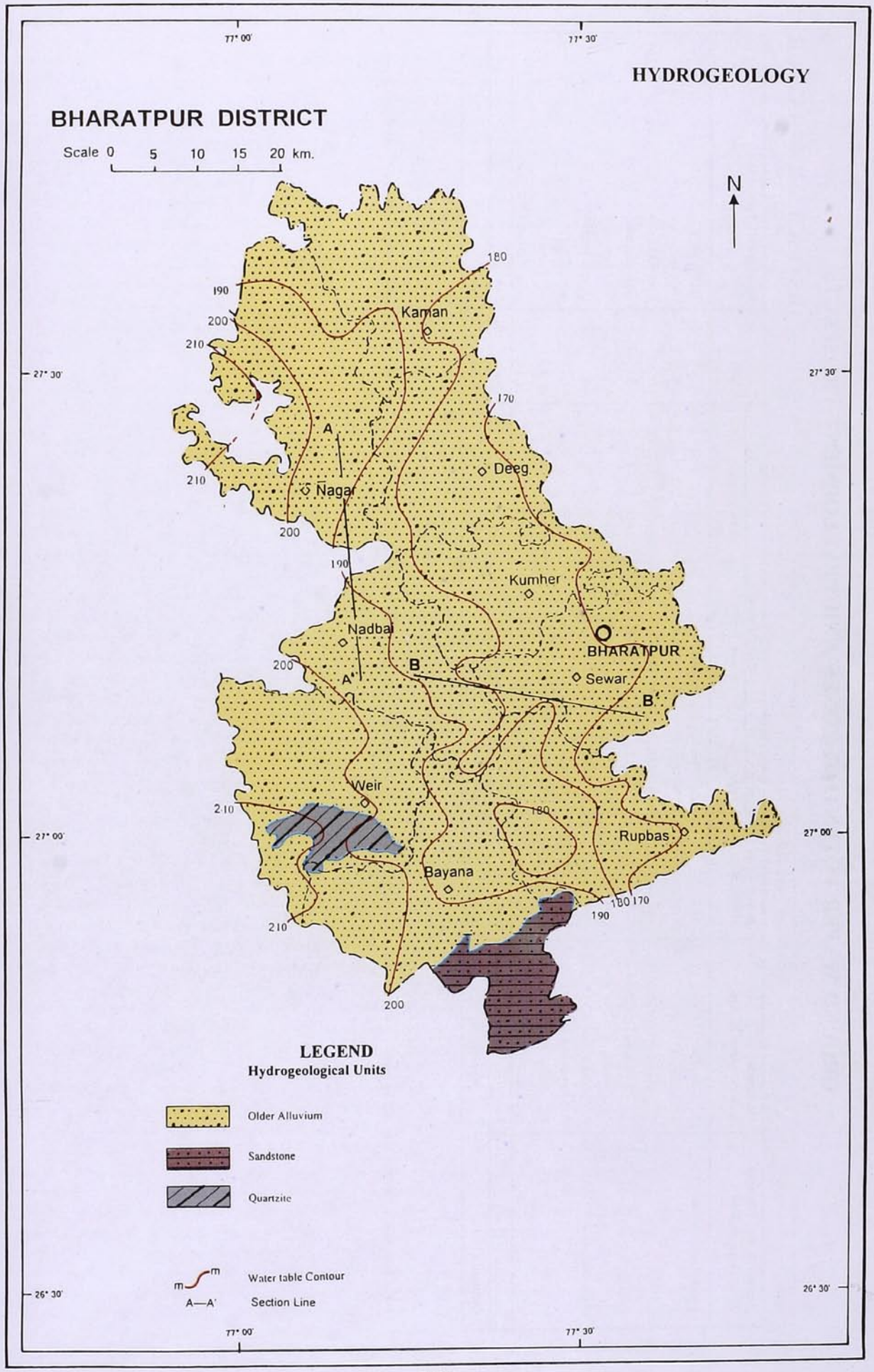
Landform Units	Symbol	Lithology / Material / Description	Occurrence in district	Land use/Land cover
Fluvial Origin				
Alluvial Plain	AP	Mainly undulating land scape formed due to fluvial activity, consisting of gravels, sand, silt and clay. Terrain mainly undulating, produced by extensive deposition of alluvium by river system.	Entire district except southern part and few local patches near Bharatpur, Kaman and Pahari town.	Double crop, single crop (Rabi / Kharif) fallow, salt affected land.
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.	In southern part of district, i.e., south of Bayana town.	Marginal double crop, single crop (Rabi), open scrub.
Ravine	RV	Small, narrow, deep, depression, smaller than gorge, larger than gulley, usually carved by running water.	On banks of river Gambhiri and foot hills in south west.	Open scrub.
Water logged/ Wetland	WL/WL	Area submerged in water or area having very shallow water table. So that it submerges in water during rainy season.	Near Bharatpur town and south east of Bayana town.	Marginal Rabi crop, marshy land, forest.
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.	On banks of river Gambhir.	Marginal double crop, single crop (Rabi) salt affected lands, degraded pasture around villages.
Structural Origin				
Plateau	PT	Formed over varying lithology with extensive, flat, landscapes, bordered by escarpment on all sides. Essentially formed over horizontally layered rocky marked by extensive flat top and steep slopes. It may be criss crossed by lineament.	Southern most tip.	Marginal single crop (Kharif), fallow, land with or without scrub.
Dissected Plateau	DP	Plateau, criss-crossed by fractures forming deep valleys.	In south east part near Naglatula village.	Marginal single crop (Kharif), fallow, 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.	In south east boundary i.e. south of Roopbas and in small patches near Suhera and Chhapra.	Land with or without scrub.
Structural Hill	SH	Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc.	North east of Nagar town and west of Suhera village.	Forest, mining and open scrub.
Denudational Hill	DH	Steep sided, relict hills undergone denudation, comprising of varying lithology with joints, fractures and lineaments.	North west of Bayana and west of Kaman.	Forest, open scrub.


GEOMORPHOLOGY
BHARATPUR DISTRICT
N
Scale 0 5 10 15 20 km.
77°00'
77°30'
27°30'
27°00'
26°30'
Kaman
Nagar
Deeg
Kumher
Nadbai
BHARATPUR
Sewar
Banganga River
Weir
Gambhiri River
Rupbas
Bayana
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
Valley Fill
Ravine
Waterlogged/Wet Land
Flood Plain
Structural Origin :
Plateau
Dissected Plateau

HYDROGEOLOGY

DISTRICT—BHARATPUR

Hydrogeological units	Description of the unit/Geological section	Occurrence	Ground Water flow
Older Alluvium (Quaternary)	The litho unit comprises heterogeneous mixture of fine to medium grained sand, silt and kankar.	It occupies major part of the district. Small pockets in Bayana and Weir blocks are exception which are covered by other litho units. Older alluvium encompasses nearly 93% potential area.	The direction of ground water flow can be generalised as SW to NE. Hydraulic gradient in the central part of the district has been worked out as 0.86 m/km.
Sandstone (Vindhyan Super Group)	The litho unit represents youngest member of the Vindhyan Super Group. It is fine to medium grained, red colour and compact and at places porous.	It covers southern peripheral area in Bayana block. Sandstone encompasses nearly 4% potential area.	
Quartzites (Aravalli Super Group)	These comprise conglomeratic and gritty quartzites and contains pebbles and cobbles apparently derived from member of Gneissic complex.	The litho unit occurs in Weir block. It covers nearly 2% potential area.	

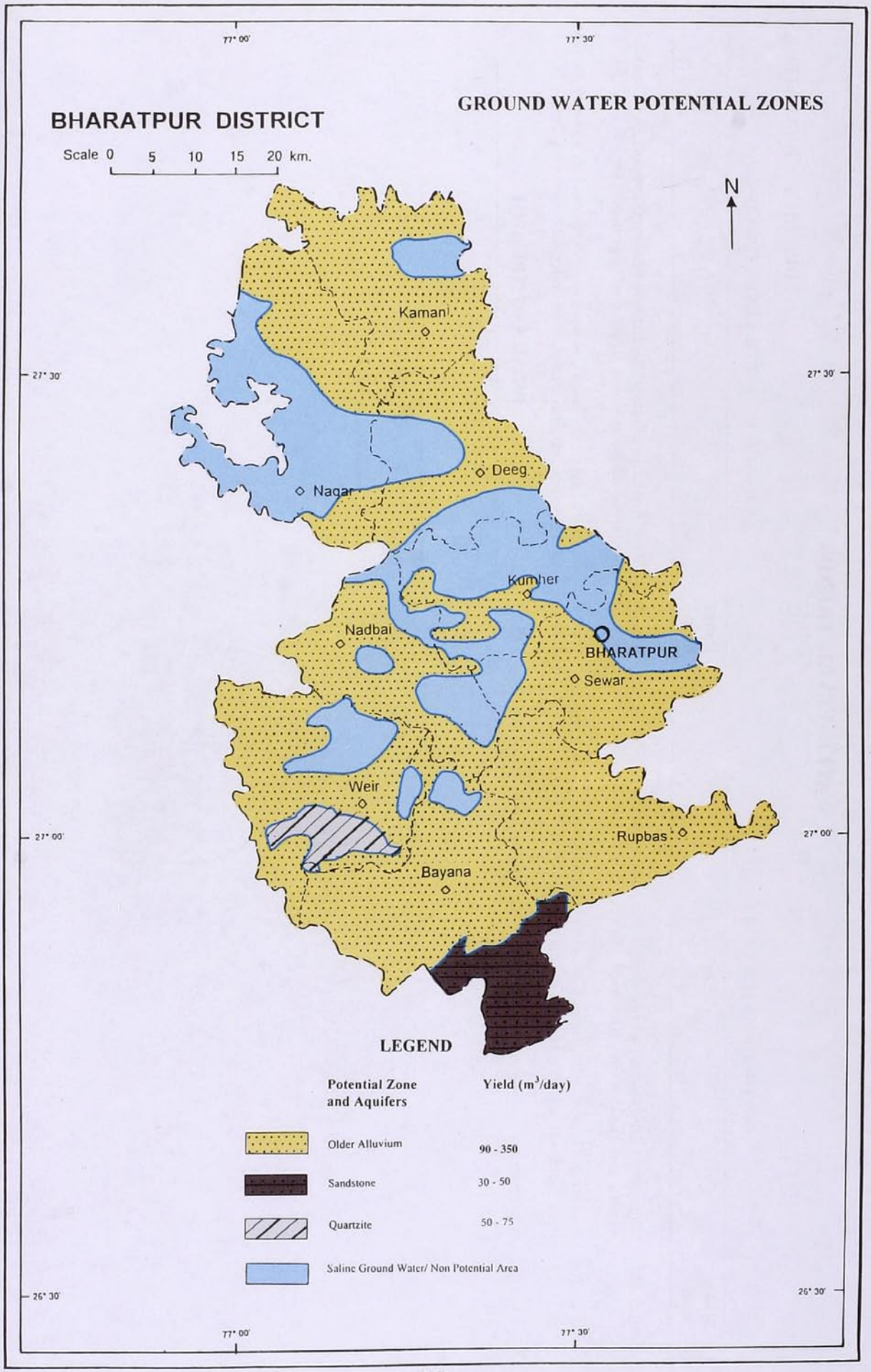

HYDROGEOLOGY
BHARATPUR DISTRICT
Scale 0 5 10 15 20 km.
N
77° 00'
77° 30'
27° 30'
27° 00'
26° 30'
Kaman
Deeg
Nagar
Kumher
Nadbai
BHARATPUR
Sewar
Weir
Rupbas
Bayana
A
A'
B
B'
180
190
200
210
170
LEGEND
Hydrogeological Units
Older Alluvium
Sandstone
Quartzite
Water table Contour
Section Line
A—A'

GROUND WATER POTENTIAL ZONES AND DEVELOPMENT PROSPECTS

DISTRICT - BHARATPUR

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 (3187.12)	* Bayana (527.86)	<20	TW/DCB	100-135/30-40	150-450	<4,4-6	Semi Critical
	* Deeg (338.91)	<10	TW/DCB	80-125/30-40	150-450	4-8	Over exploited
	* Kaman (459.42)	<20	TW/DCB	100-135/30-40	150-450	4-8	Semi Critical
	* Kumher (119.08)	<10	TW/DCB	80-125/30-40	150-450	4-8	Over exploited
	* Nadbai (281.34)	<20	TW/DCB	100-135/30-40	150-450	4-8	Over exploited
	* Nagar (324.87)	<10	TW/DCB	100-135/30-40	150-450	4-8	Over exploited
	* Roopwas (501.10)	<15	TW/DCB	100-125/30-40	150-450	<4,4-6	Semi Critical
	* Sewar (281.10)	<10	TW/DCB	80-125/30-40	150-450	<4,4-6	Over exploited
	* Weir (353.44)	<20	TW/DCB	100-135/30-40	150-450	<4,4-6	Semi Critical
Sandstone (148.45)	* Bayana (148.45)	<20	DW	30-40	50-75	<4,4-6	Safe
Quartzite (76.95)	* Weir (76.95)	<20	DW	30-40	40-60	<4,4-6	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


GROUND WATER POTENTIAL ZONES
BHARATPUR DISTRICT
Scale 0 5 10 15 20 km.
N
77° 00'
77° 30'
27° 30'
26° 30'
Kamani
Deeg
Nagar
Kumher
Nadbai
BHARATPUR
Sewar
Weir
Rupbas
Bayana
LEGEND
Potential Zone and Aquifers
Yield (m³/day)
Older Alluvium
90 - 350
Sandstone
30 - 50
Quartzite
50 - 75
Saline Ground Water/ Non Potential Area

WATER LEVEL TRENDS

DISTRICT : BHARATPUR

DEPTH TO WATER LEVEL

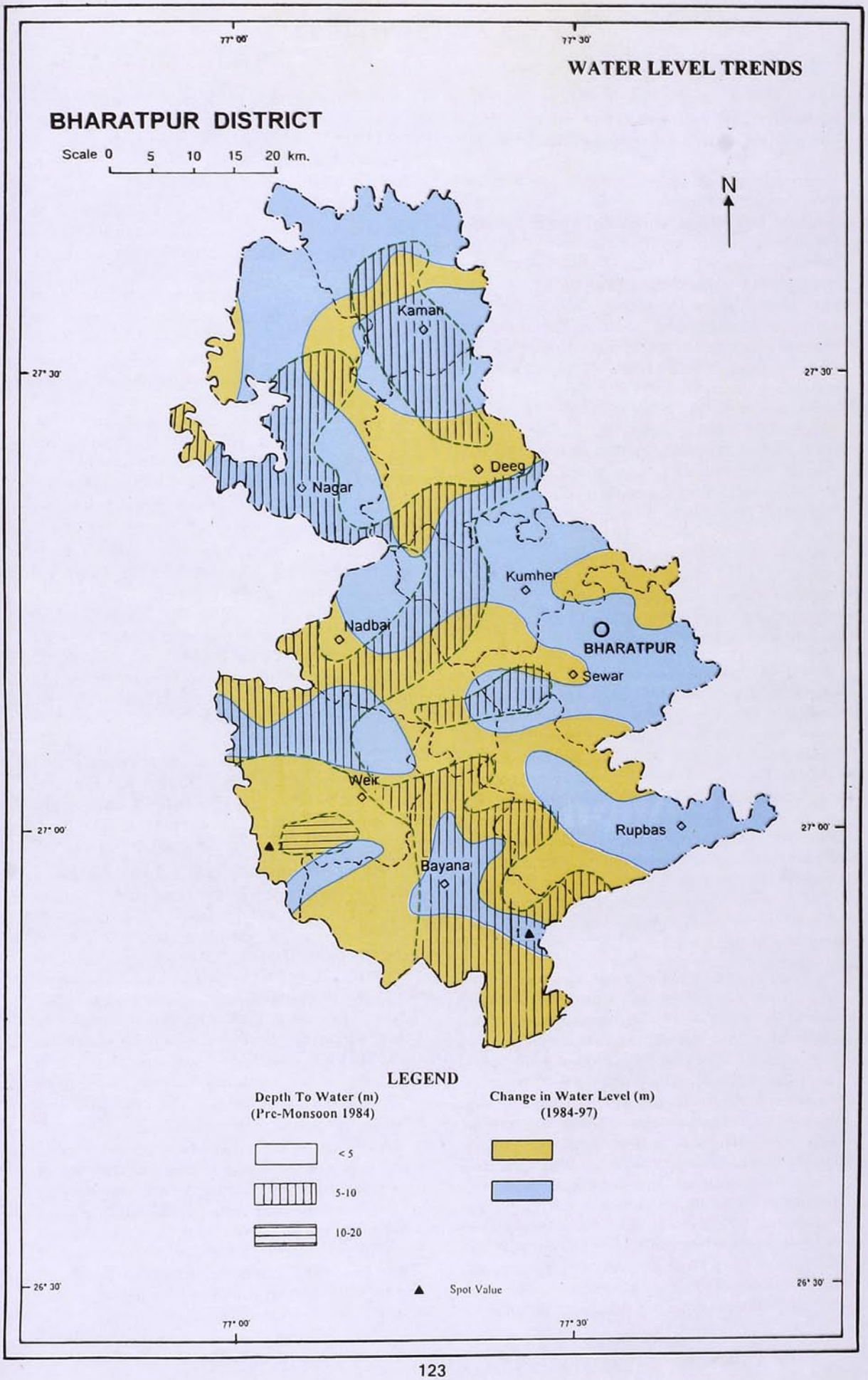
Range in m	Area
< 5	Major part of the district, leaving aside some pockets mainly located in western part has shallow water level less than 5 m.
5 to 10	Area around Nadbai, Weir, Bayana in western part and Nagar, Kaman and Deeg blocks in northern part lie in this range.
10 to 20	Small pocket west of Weir has deep water level ranging from 10 to 20m.

CHANGE IN WATER LEVEL (1984-1997)

Range in m	Area
0 to 2	Major part of area north of Nadbai, and Bharatpur and pockets in southern part show marginal rise in water level less than 2 m.
0 to -2	Southern part of the district, leaving aside some pockets and area around Deeg exhibit marginal depletion in water level less than 2m.

DETAILS OF THE SPOT

Spot code	Village (Block)	Change in water level in m (1984-97)
1.	Tarbeejpura (Bayana)	(-) 12.70
2.	Vallabhgarh (Weir)	(-) 10.40


WATER LEVEL TRENDS
BHARATPUR DISTRICT
Scale 0 5 10 15 20 km.
N
77° 00'
77° 30'
27° 30'
27° 00'
26° 30'
Kaman
Deeg
Nagar
Kumher
Nadbai
BHARATPUR
Sewar
Weir
Rupbas
Bayana
LEGEND
Depth To Water (m)
(Pre-Monsoon 1984)
< 5
5-10
10-20
Change in Water Level (m)
(1984-97)
Spot Value

GROUND WATER POTABILITY
DISTRICT BHARATPUR

25.9% of ground water in the district is characterised as bicarbonate type while 11.1% is characterised as calcium-magnesium bicarbonate type of water. The electrical conductivity (EC) of bicarbonate type of water is generally less than 1500 µS/cm at 25°C. However, the EC of these water is between 1500-3000 at some places such as Birampur, Pubaikhera, Tarsuman (Bayana block), Tilakpuri (Kaman block), Karei, Unch (Nadbai block), Jaluki (Nagar block), Bansi Paharpur, Bhaut (Roopwas block) and Khairora (Weir block). This type of water is fresh to slightly saline in nature. The mixed type of water constitutes 26.4% of ground water in which 16.4% is sodium mixed and 10.1% is calcium-magnesium mixed type of water. This type of water generally have EC between 1500-3000 µS/cm. Sometimes it may exceed to 4000 µS/cm at some places such as Didawali, Seu (Deeg block), Manapuri (Nagar), Khansurajpur (Roopwas) etc. Mix type of ground water is more mineralised than fresh water. Nearly 48% ground water in the district is characterised by chloride type of water. The EC of such water is between 4000-8000 µS/cm and sometimes it may exceed 10,000 µS/cm. Villages Anchara Baori, Talphaira (Kumher block), Gandsora & Gulpada (Nagar block) and Kanjauli (Weir block) are having such type of water.

On the basis of hardness the ground water samples of the district are categorised into soft and hardwater. 38.6% of ground water are characterised as soft water and have hardness between 0-300 mg/L. Bayana block has maximum number of such samples. The next range of hardness is 301-600 mg/L and constitutes 25.7% samples of the district. The last range of hard water i.e. 600 mg/L or more is found in 35.4% of the samples. The Kaman and Nagar blocks are having maximum number of such samples. The maximum hardness of water is observed as 2279 mg/L in village Sikripatti of Nagar block whereas its minimum values (43mg/L) is obsered at Ajau in Kumher block.

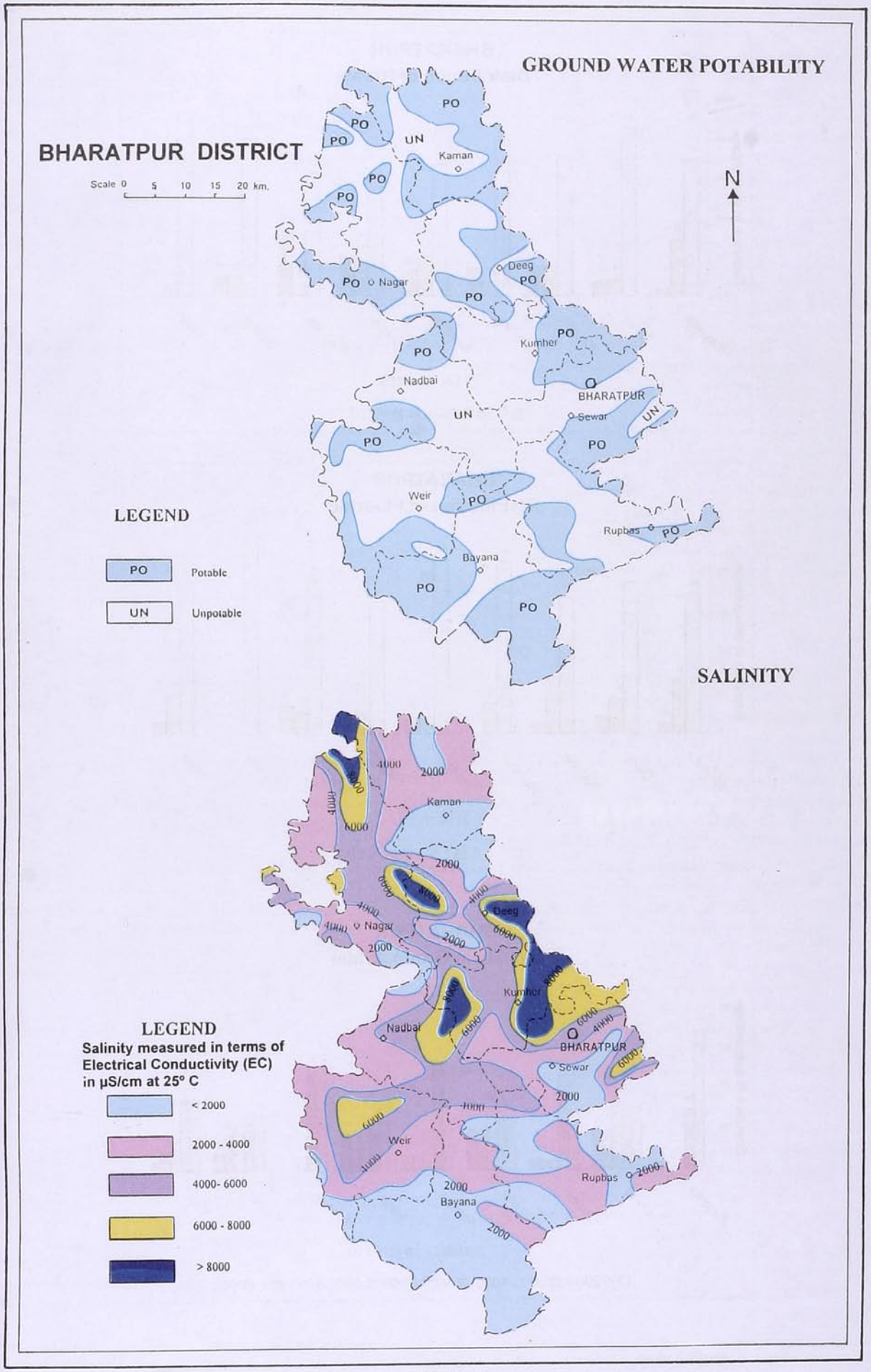
Fresh to slightly saline water having EC below 2000 µS/cm occurs mostly in Bayana block and some parts of Roopwas block. The ground water of the district is characterised as moderately saline to saline water having EC ranging from 2000 to 8000 µS/cm. The higher range of salinity (EC 2000-4000 µS/cm) is observed mostly in Kumher, Nadbai and Weir blocks. The villages Fatehpur, Dhilawati, Dhiman, Garh Ajan, Naugaon in Kaman block, Gazipur, Baraulichhar in Nadbai block, Ajau, Dhanwara, Rarh etc. in Kumher block and Bansichak, Bharsauni, Hingota in Weir block also fall in this range. The medium to high salinity (EC 4000-6000 µS/cm) water is observed in villages - Januthar, Mabai, Malipura of Deeg block and Awar, Pichumar, Saint etc. of Kumher block. The next range of saline water (EC 6000-8000) is observed at Gopalgarh, Nakatpur, Pahari villages of Nagar block and Dhurmai, Rampura, Unchnagla of Sewar block. The maximum salinity (EC 15000 µS/cm) is observed at Kanjauli village of Sewar block and the minimum value (EC 390 µS/cm) occurs at Thanasong of Bayana block.

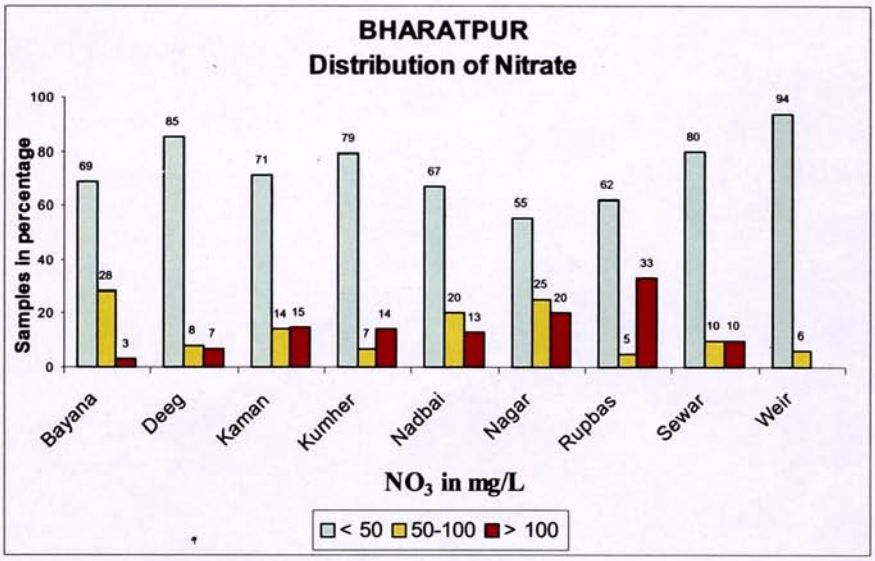
The bar diagram of salinity distribution in ground water shows that ground water of EC 0-2000 µS/cm range is available in 68% in Bayana block, 38% in Kaman, 48% in Roopwas and 35% in Weir block. Similarly, the medium to high salinity of water (EC 2000-4000 µS/cm) is seen in 47% samples in Kaman, 53% in Nadbai and 50% in Roopwas block. The ground water of next range i.e. 4000-6000 µS/cm occurs in 33% in Deeg block and 30% in Kumher block. High to very high salinity i.e. EC 6000-8000 µS/cm is seen only in 10% samples of Deeg block, 10% of Kumher block, 11% of Nagar block and 18% samples of Sewar block. The ground water of highest salinity range i.e. more than 8000 µS/cm is represented by 19% samples in Deeg, 20% in Kumher and 18% in Nagar block.

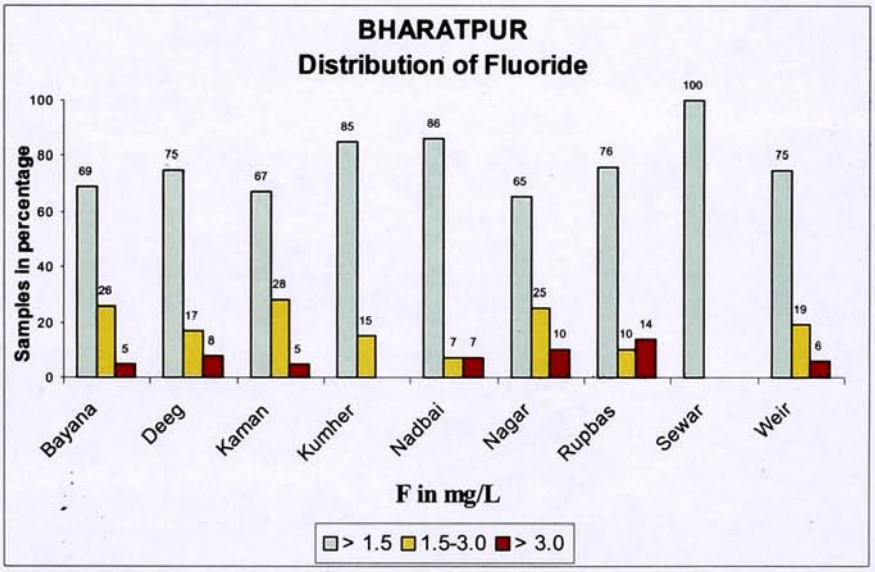
The bar diagram for nitrate concentration shows that 57%, 85%, 75%, 77%, 64%, 60%, 62%, 80% and 94% ground water samples in Bayana, Deeg, Kaman, Kumher, Nadbai, Nagar, Roopwas, Sewar and Weir blocks respectively represent good quality of water having nitrate upto 50 mg/L. In general, 70% of total number of samples in the district have nitrate upto 50 mg/L. The bar diagram also shows other range i.e. 51-100 mg/L of nitrate as 36%, 29% and 20% in ground water of Bayana, Nadbai and Nagar blocks respectively. The high values of nitrate more than 100 mg/L are observed in Nagar, Kaman and Roopwas blocks in 15%, 20% and 33% samples respectively. The maximum nitrate concentration is 825 mg/L which is observed at village Sikripatti in Nagar block.

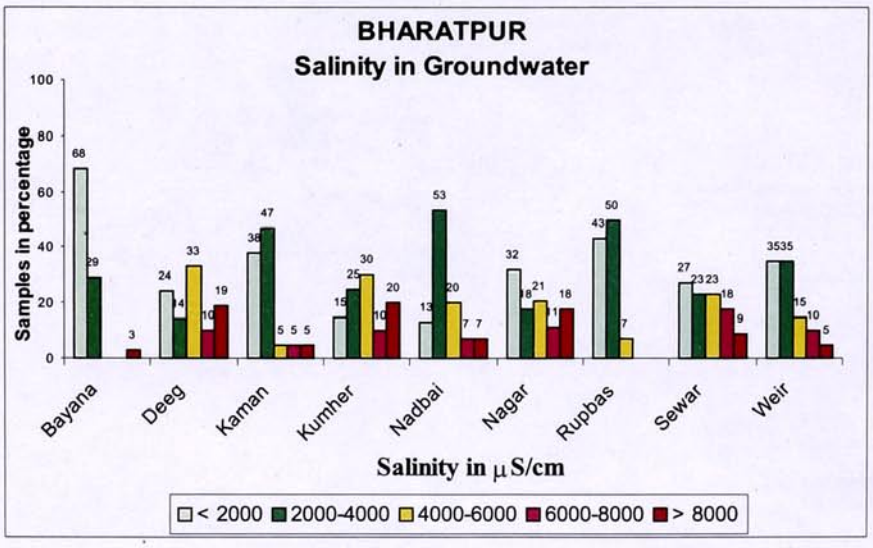
The bar diagram of fluoride distribution indicates that 73% samples fall in the range of 0-1.5 mg/L whereas only 18% samples fall in the range of 1.5-3.0 mg/L of fluoride. Only 9% samples fall in the higher range of fluoride more than 3.0 mg/L and observed at villages Birampur (4.0 mg/L), Brahmbad (4.4 mg/L), Salabad (4.0 mg/L) of Bayana block, Seu (3.6 mg/L) of Deeg block, Tilakpuri (6.0 mg/L) of Kaman block, Baraulichhar (5.3 mg/L) of Nadbai block, Matuki (5.6 mg/L) of Nagar block, Baseri (4.0 mg/L), Naylatulsi (3.6 mg/L), Nekpur (5.6 mg/L) of Roopwas block and Dharsauni (5.6 mg/L) of Weir block.

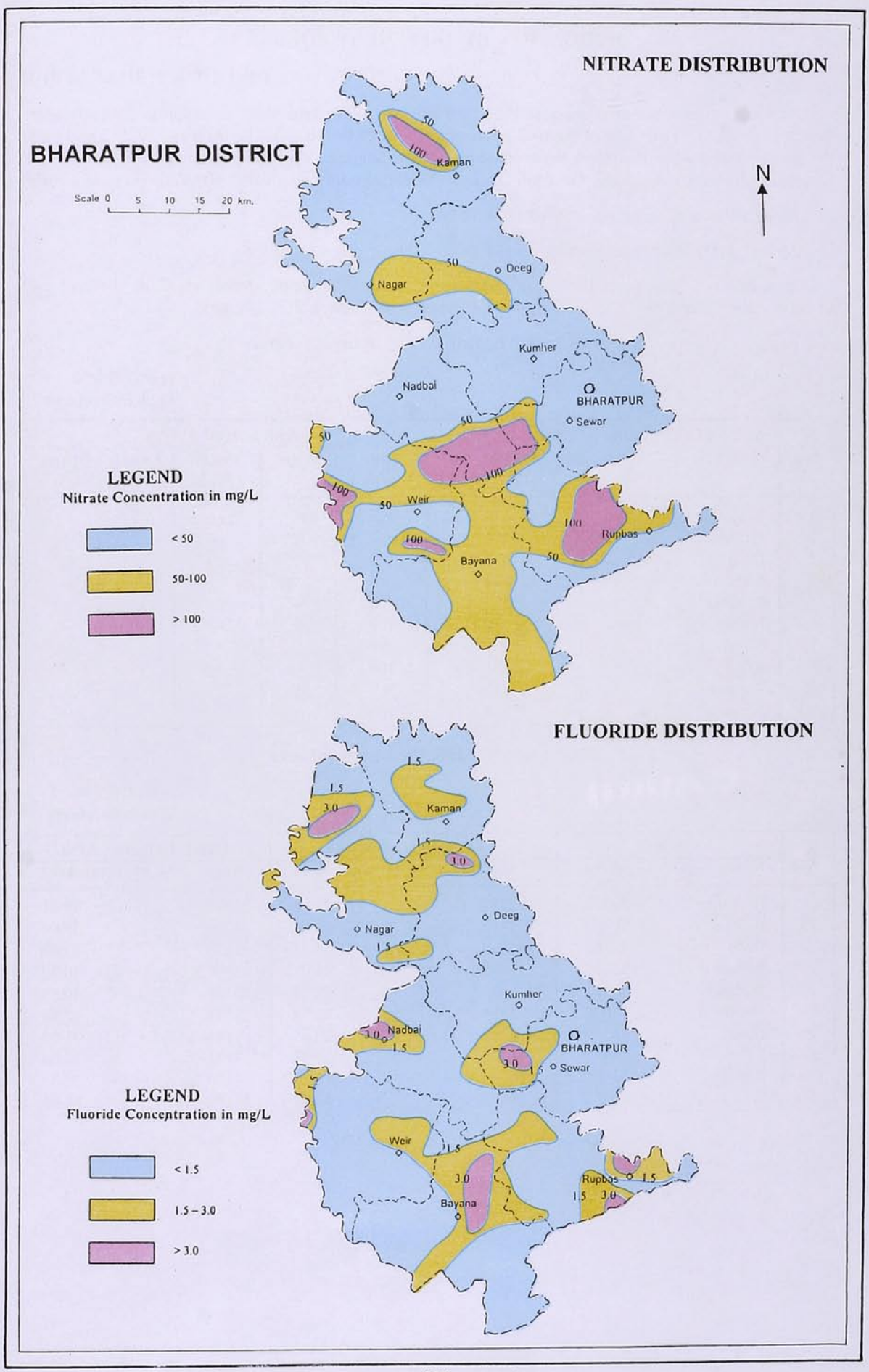
An integrated map prepared to show the drinking water quality of the district assessed on the basis of permissible limits of salinity, nitrate and fluoride indicates that the area including the north part of Bayana, major part of Weir, Roopwas, Nadbai and Nagar block, western part of Kumher, northwest of Sewar and some confined pockets in Deeg and Kaman block of the district are having unsuitable quality of ground water for drinking purpose.


GROUND WATER POTABILITY
BHARATPUR DISTRICT
Scale 0 5 10 15 20 km.
N
PO
UN
Kaman
Deeg
Nagar
Kumher
Nadbai
BHARATPUR
Sewar
Weir
Rupbas
Bayana
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
> 8000


BHARATPUR
Distribution of Nitrate
Samples in percentage
Bayana
Deeg
Kaman
Kumher
Nadbai
Nagar
Rupbas
Sewar
Weir
NO3 in mg/L
< 50
50-100
> 100


BHARATPUR
Distribution of Fluoride
Samples in percentage
Bayana
Deeg
Kaman
Kumher
Nadbai
Nagar
Rupbas
Sewar
Weir
F in mg/L
> 1.5
1.5-3.0
> 3.0


BHARATPUR
Salinity in Groundwater
Samples in percentage
Bayana
Deeg
Kaman
Kumher
Nadbai
Nagar
Rupbas
Sewar
Weir
Salinity in μS/cm
< 2000
2000-4000
4000-6000
6000-8000
> 8000


NITRATE DISTRICT
BHARATPUR DISTRICT
Scale 0 5 10 15 20 km.
N
Kaman
Deeg
Nagar
Kumher
Nadbai
BHARATPUR
Sewar
Weir
Rupbas
Bayana
50
100
LEGEND
Nitrate Concentration in mg/L
< 50
50-100
> 100
FLUORIDE DISTRICT
1.5
3.0
LEGEND
Fluoride Concentration in mg/L
< 1.5
1.5 – 3.0
> 3.0