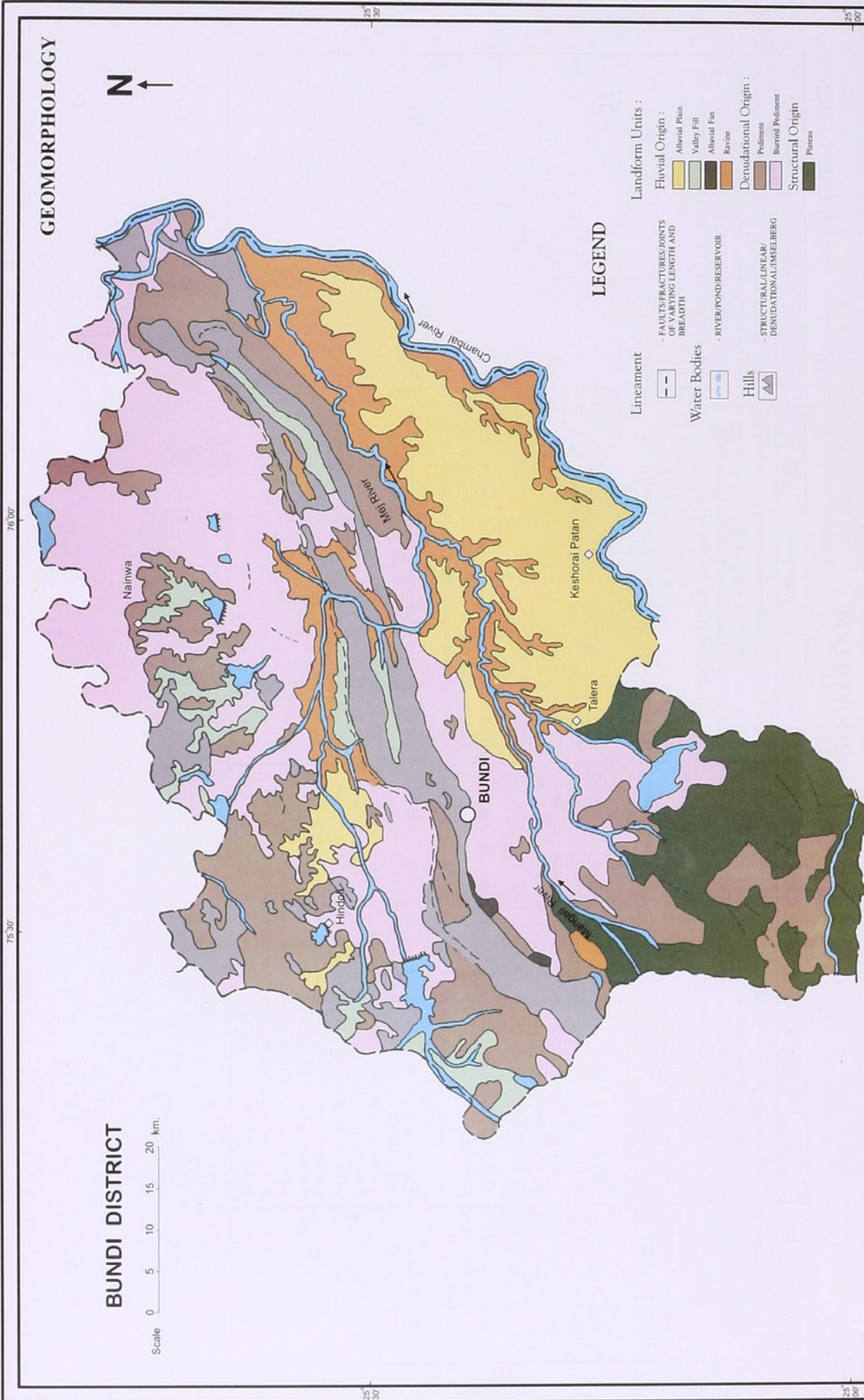


GEOMORPHOLOGY

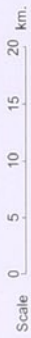
DISTRICT—BUNDI

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.	In between river Mej and river Chambal.	Double crop, single crop (Rabi / Kharif), fallow, 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.	Scattered in upper half of district.	Marginal double crop, single crop (Rabi).
Alluvial Fan	AF	A fan shaped mass of sediment deposited at a point along a Nallah, river where there is a decrease in gradient.	West of district.	Gravelly waste land.
Ravine	RV	Small, narrow, deep, depression, smaller than gorges, larger than gulley, usually carved by running water.	Along river Chambal & river Mej.	Open scrub.
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.	Scattered in north west, west, south west and north east.	Marginal single crop (Kharif), fallow & open scrub.
Burried Pediment	BP	Pediment covered essentially with relatively thicker alluvial, colluvial or weathered materials.	Covers northern and central part.	Marginal double crop, single crop (Kharif), fallow, open scrub.
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.	South west of district.	Marginal single crop, open scrub.
Hills Structural Hill	SH	Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc.	Trending south west to north east.	Marginal single crop (Kharif), fallow & open scrub.

GEOMORPHOLOGY



BUNDI DISTRICT



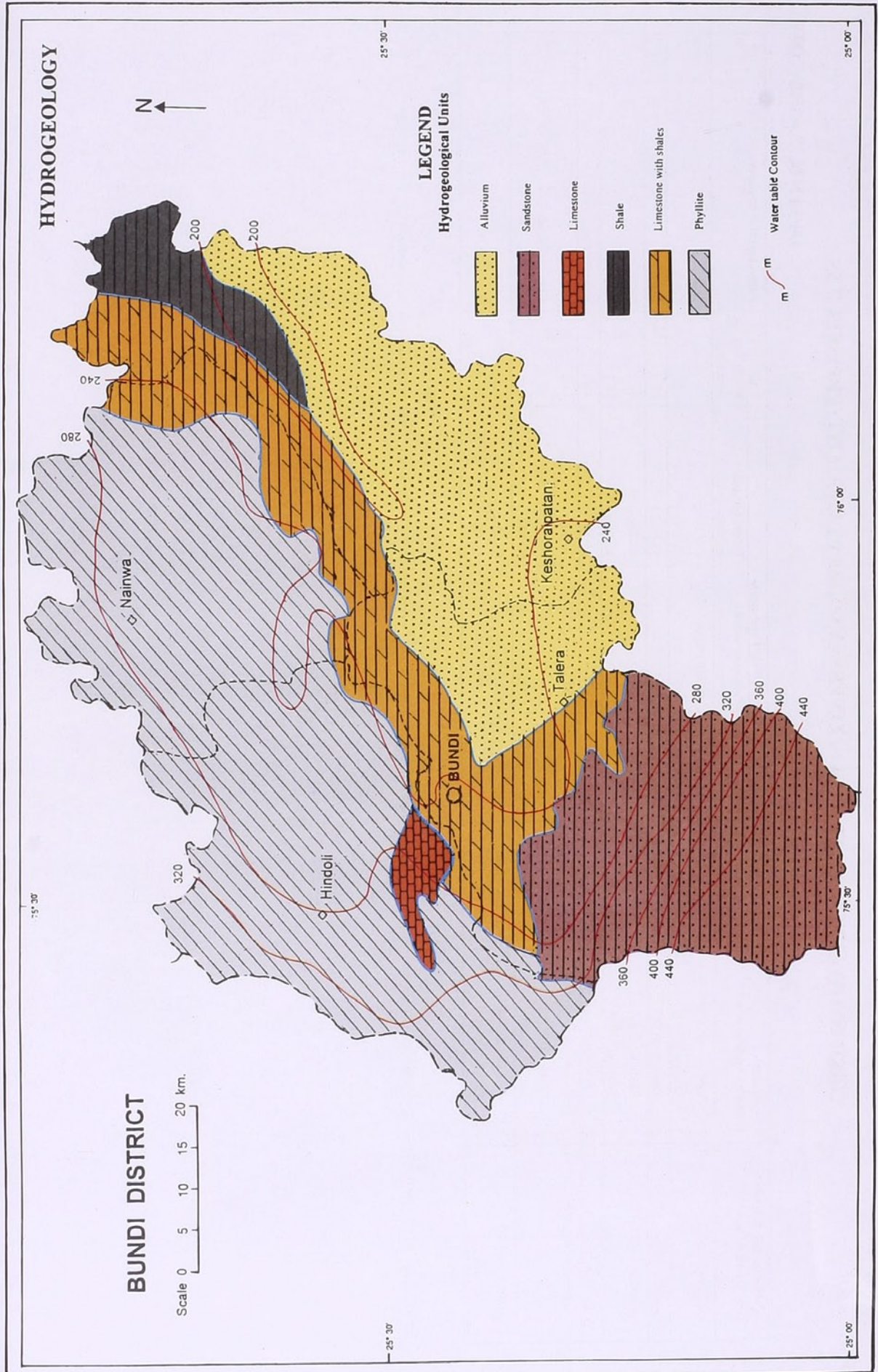
LEGEND

- Lineament**
 - - - FAULTS/FRACTURES/JUNCTIONS OF VARYING LENGTH AND BREADTH
- Water Bodies**
 - RIVER/POND/RESERVOIR
- Hills**
 - STRUCTURAL/LINEAR/DENUDATIONAL/IMSELBERG
- Landform Units :**
 - Fluvial Origin :**
 - Alluvial Plain
 - Valley Fill
 - Alluvial Fan
 - Ravine
 - Denudational Origin :**
 - Pediment
 - Buried Pediment
 - Structural Origin**
 - Plateau

HYDROGEOLOGY

DISTRICT—BUNDI

Hydrogeological units	Description of the unit/Geological section	Occurrence	Ground Water flow
Alluvium (Quaternary)	The litho unit comprises unconsolidated fine grained sand, silt, clay and kankar. Thickness of alluvium varies upto 38 m. Very thick alluvial sequences have been encountered in area between Chambal and Mej rivers.	Alluvium is mainly confined to central and south eastern part of the area where occupies drainage courses and flood plains of Chambal, Kural and Mej rivers. Alluvium encompasses nearly 27% potential area.	The general direction of ground water flow as inferred from water table contour is from south west to north east. Hydraulic gradient is steep in the southern part (2.0 m/km) moderate in the northern part (1.2 m/km) and gentle in the eastern part (1.0 m/km).
Sandstone (Vindhyan Super Group)	The litho unit belonging to Kaimur and Bhandar groups are fine grained, grey to red in colour, very hard and compact, at places appearing like quartzite.	It occupies southern part within the limit of Talera block. Sandstone covers nearly 9% potential area.	
Limestone (Vindhyan Super Group)	The litho unit mainly belongs to Bhandar groups. It is fine to medium grained, grey, red, yellowish, pink or buff coloured; Red and brick coloured varieties are non siliceous whereas grey bands being siliceous are very hard. In general Bhandar limestone is cavernous.	Litho unit occupy small area in part of Hindoli and Talera blocks. It covers nearly 6% potential area.	
Shale & Limestone with Shale (Vindhyan Super Group)	Shales are grey, light green and purple in colour. It is mostly splintery in nature.	These litho units cover extensive area in Talera, Keshorapatan and Nainwa blocks, shale and limestone with shale cover nearly 15% potential area.	
Phyllite (Bhilwara Super Group)	The super group in order of super position includes Jahazpur group, Hindoli group and mangalwar complex. Jahazpur group comprises dolomite, phyllites, carbonaceous phyllites, quartzite and basic metavolcanics. These rocks are intruded by sills and dyke of dolomite. Hindoli group of rocks are represented by shales, slates, phyllites, metagreywack, limestone, dolomite, marble, meta basic volcanics, quartzites and mica schists. Sills and dykes of dolomite often occurs. Mangalwar complex comprises megnetites greisses, feldspathic mica schist, gametiferrous mica schist, quartzite, impure marble and amphibolite.	These litho units belonging to Bhilwara Super Group occupies north western part of the area and share about 39% of the potential area.	

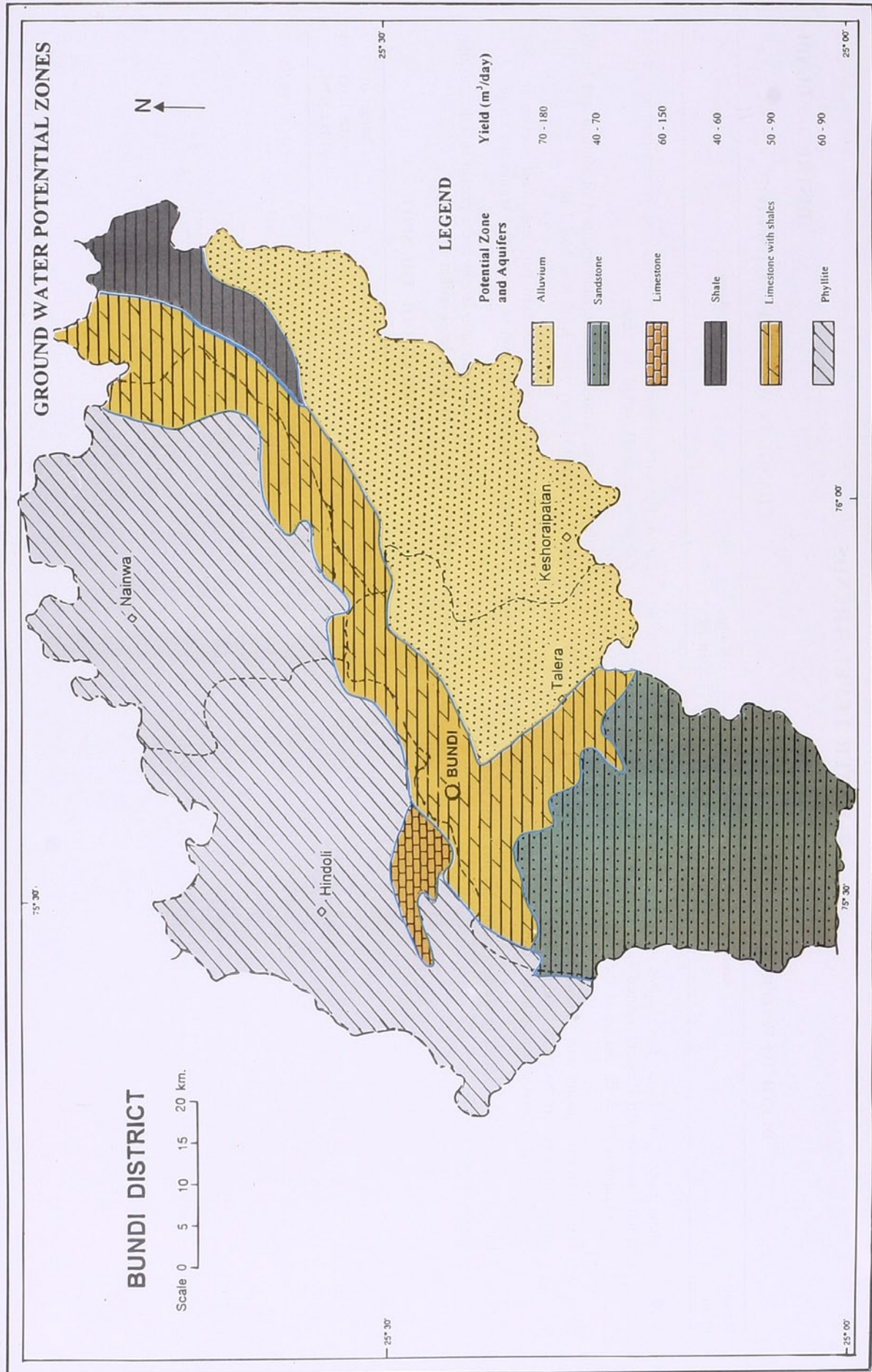


GROUND WATER POTENTIAL ZONES AND DEVELOPMENT PROSPECTS

DISTRICT - BUNDI

Aquifer in the Potential Zone (Area in Km ²)	Occurrence * Block (Area in Km ²)	Water Level (1997) in m.	Well Parameters			E.C. X10 ³ μ siem/cm	Development Prospects
			Type	Proposed depth in m	Discharge in m ³ /day		
Alluvium (1158.34)	* Keshoraipatan (819.41)	<25	TW/DW	80-100/25-30	65-150	<4	Safe
	* Talera (338.93)	<10	TW/DW	80-100/25-30	65-150	<2	Safe
Sandstone (404.38)	* Talera (404.38)	<15	DW	25-30	35-45	<2	Safe
Limestone (247.83)	* Hindoli (82.37)	<20	DW	25-30	45-65	<2	Safe
	* Talera (165.46)	<20	DW	25-30	30-65	<2	Safe
Shale (126.68)	* Keshoraipatan (126.68)	<20	DW	25-30	35-50	<4	Semi Critical
Limestone with Shale (635.44)	* Keshoraipatan (206.79)	<15	DW	25-30	30-50	<4	Safe
	* Nainwa (101.78)	<15	DW	25-30	30-50	<2	Over exploited
Phyllite (1667.51)	* Talera (326.87)	<10	DW	25-30	30-50	<2	Safe
	* Hindoli (802.44)	<20	DW	25-30	45-65	<2	Safe
	* Nainwa (865.07)	<30	-DW	25-30	45-65	<2	Safe

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



WATER LEVEL TRENDS

DISTRICT : BUNDI

CHANGE IN WATER LEVEL (1984-1997)

Range in m	Area
2 to 4	Part of Hindoli and Bundi blocks located along western periphery show rise in water level within the range.
0 to 2	Southeastern area around Keshoraipatan and part of Hindoli and Bundi exhibit marginal rise in water level less than 2 m.
0 to -2	Talera and Bundi blocks in southern part and small pockets in other blocks show marginal depletion in water level within the range.
-2 to -4	Northern periphery extending upto Bundi and a pocket in Talera exhibit moderate depletion in water level within the range.

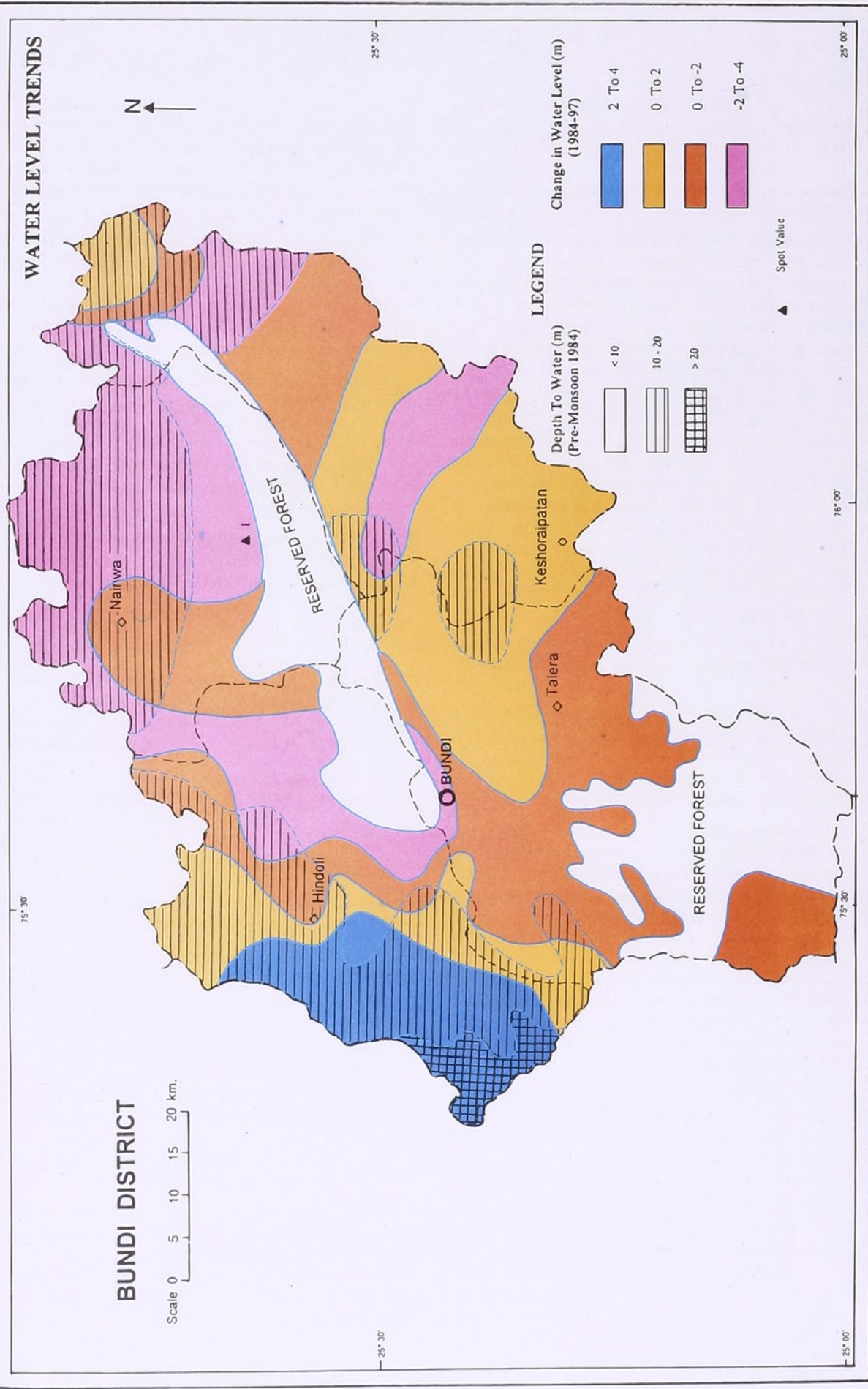
DEPTH TO WATER LEVEL

Range in m	Area
< 10	Major part of the district has shallow water level less than 10 m. Area around Nainwa and Hindoli situated in northern and western periphery are exception which do not lie in the range.
10 to 20	Part of Bundi, Hindoli and Nainwa blocks mainly situated along the northern and western boundary lie in the range. A pocket in Keshoraipatan has also been located with depth to water level between 10 to 20 m.
> 20	Part of Bundi block located in western periphery has deep water level ranging more than 20 m.

DETAILS OF THE SPOT

Spot code	Village (Block)	Change in water level in m (1984-97)
1.	Jaitpur (Nainwa)	(-) 10.75

WATER LEVEL TRENDS



GROUND WATER POTABILITY

DISTRICT BUNDI

The ground water in the district is fresh to saline in nature with an average EC of 1053 $\mu\text{S}/\text{cm}$ and TDS of 644 mg/L. Hindoli, Nainwa and Talera blocks are having fresh quality of ground water whereas moderately saline to saline groundwater occurs mainly in Keshoraipatan block.

Groundwater occurring in limestone, sandstone, shale, phyllite and schist is less mineralised with average TDS content below 700 mg/L and have low concentration of fluoride and nitrate whereas in shale and schist it has higher concentration of nitrate. Wells tapping alluvium yield moderately saline water and also have high nitrate and fluoride content.

The fresh bicarbonate type of water occurs where rainfall and infiltration are relatively high i.e. recharge area. This type of water is characterised by low TDS (<1000 mg/L) and low contents of Na and Cl. Nearly 64% well waters show bicarbonate type of character with either Ca + Mg (39.5%) or Na (24.5%) as dominating cations. The Ca+Mg - HCO_3 type of water occurs mainly in Hindoli, Nainwa and Talera blocks while that of Na- HCO_3 type of water being relatively more saline occurs normally away from recharge zone.

26.3% groundwater show mix type of character having TDS generally in the range of 1000-1500 mg/L.

Chloride type of water is characterised by high TDS having Ca+Mg in significant concentration. It is observed that most of the area of south east of the district (P.S. Keshoraipatan) has such waters having TDS mostly above 1500 mg/L.

Ionic concentration or salinity of water varies according to hydrogeological, geomorphological and climatic condition of the region. The lowest electrical conductivity of 260 $\mu\text{S}/\text{cm}$ and highest of 8500 $\mu\text{S}/\text{cm}$ has been observed in the district. The percentage of water samples in various electrical conductivity ranges observed as 88.8% below 2000 $\mu\text{S}/\text{cm}$ while 8.0% and 3.2% fall in the range of 2000-4000 and 4000-6000 $\mu\text{S}/\text{cm}$ respectively. The average EC observed in different blocks i.e. Hindoli, Nainwa, Talera and Keshoraipatan blocks is 905, 1053, 1154 and 1676 $\mu\text{S}/\text{cm}$ respectively.

The salinity map depicts that fresh ground water (EC less than 2000 $\mu\text{S}/\text{cm}$) is found almost in whole Hindoli and Nainwa blocks. The moderately saline water of EC above 2000 $\mu\text{S}/\text{cm}$ is observed in Keshoraipatan block (South-east) and a small part in Talera block (South-west).

The fluoride content in ground water varies from minimum of 0.13 mg/L to maximum of 5.96 mg/L with an average of 0.89 mg/L. The fluoride content remains within 1.5 mg/L in 86.8% of well water while 10.2% of well water falls in the range of 1.51 - 3.0 mg/L of fluoride concentration. Rest 2.99

per cent ground water have fluoride concentration above 3.0 mg/L. Alluvium, schist and lime stone are the source of fluoride in ground water which is evident from the fact that average fluoride content observed in the wells tapping these formations is above 1.0 mg/L.

On going through the fluoride distribution map, it is seen that most of the area in the district is free from fluoride problem ($F < 1.5$ mg/L). Only in Keshoraipatan and Talera blocks, some areas of fluoride concentration, more than 1.5 mg/L are observed.

Nitrate content in ground water varies from 1.0 mg/L to 395 mg/L with an average of 46 mg/L. 7.8% of well waters show nitrate content more than 100 mg/L. Water having high nitrate content generally have high content of potassium. Nitrate distribution map reveals that most of the area of the district is free from nitrate problem ($\text{NO}_3 < 100$ mg/L).

Calcium and magnesium in water are responsible for hardness. ICMR has proposed 300 mg/L as highest acceptable limit and 600 mg/L as maximum permissible limit. 32.9% of well waters are having TH in the range of 300-600 mg/L while only 4.2% well water show TH above the limit of 600 mg/L.

Salinity of ground water up to the limit of 2000 $\mu\text{S}/\text{cm}$ is observed in 88.8% of waters, whereas in the range of 2000-4000 $\mu\text{S}/\text{cm}$, 8.0% of well waters are covered. 3.2% of well waters show EC above 4000 $\mu\text{S}/\text{cm}$.

On going through the salinity map it is seen that in general, ground water of Hindoli and Nainwa blocks have low salinity as compared to that in Keshoraipatan and Talera blocks. Area of above 4000 $\mu\text{S}/\text{cm}$ is seen in the south-east (Keshoraipatan block) besides some patches of EC more than 2000 $\mu\text{S}/\text{cm}$ in Talera and Nainwa blocks.

Looking to the medium textured soils of the district the ground water barring some confined pockets in Keshoraipatan block is suitable for agriculture.

Sodium percentage above 70 is observed in nearly 15% of well waters which may create alkalinity hazard. RSC more than 2 meq/L is also responsible for alkalinity problem in soil. 22.2% of well waters show RSC above this limit. Use of gypsum to overcome hazardous effect of sodic water is therefore suggested for optimum utilisation of such water.

Only 1.8% well waters have TDS more than 3000 mg/L, 7.8% waters have nitrate more than 100 mg/L and 13.2% waters have fluoride more than 1.5 mg/L. On perusal of potability map it is seen that ground water in some parts of Nainwa, Talera and Keshoraipatan blocks have unpotable quality on account of TDS, fluoride or nitrate content.

