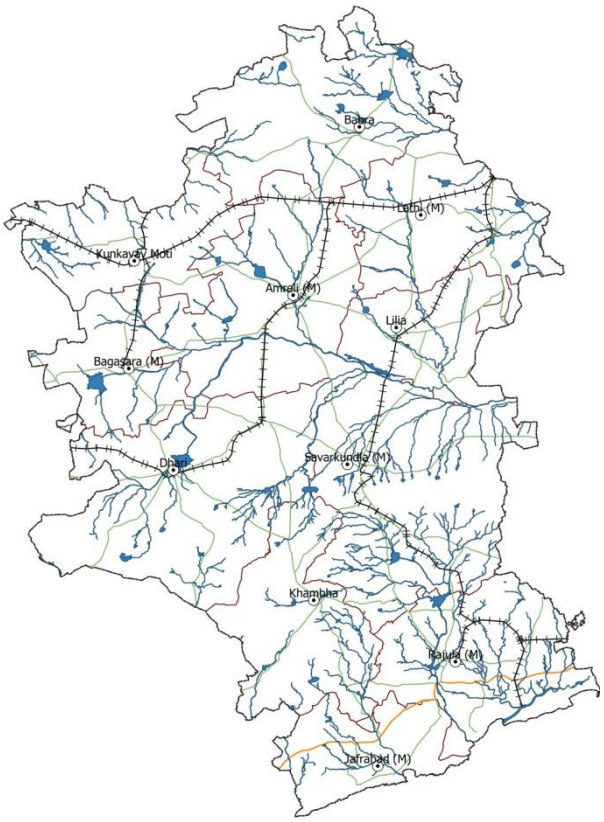
भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास एवम् गंगा संरक्षण विभाग
केंद्रीय भूमिजल बोर्ड

GOVERNMENT OF INDIA
MINISTRY OF JAL SHAKTI
DEPARTMENT OF WATER RESOURCES, RIVER DEVELOPMENT
AND
GANGA REJUVENATION

AQUIFER MAPPING AND MANAGEMENT PLAN, AMRELI DISTRICT, GUJARAT STATE



CENTRAL GROUND WATER BOARD
WEST CENTRAL REGION
GUJARAT
DECEMBER-2022

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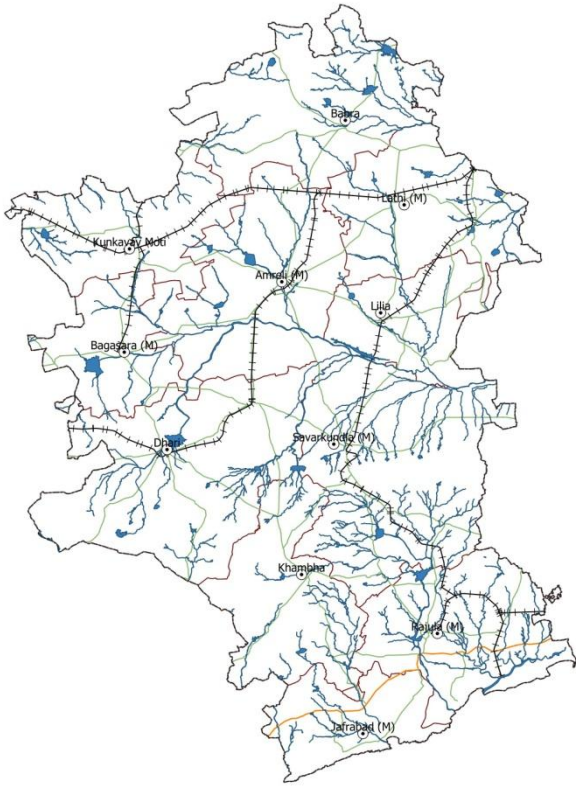

Avinash Chandra,
Senior Technical Assistant (HG)

CENTRAL GROUND WATER BOARD
WEST CENTRAL REGION
GUJARAT
DECEMBER-2022

AQUIFER MAPPING AND MANAGEMENT PLAN, AMRELI DISTRICT GUJARAT STATE

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Avinash Chandra
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FIGURES

TABLE

AQUIFER MAP AND MANAGEMENT PLAN
AMRELI DISTRICT

1. Introduction

Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical field and laboratory analyses are applied to characterize the quantity, quality and sustainability of ground water in aquifers. There has been a paradigm shift from "groundwater development" to "groundwater management". An accurate and comprehensive micro-level picture of groundwater in India through aquifer mapping indifferent hydrogeological settings will enable robust groundwater management plans at the appropriate scale to be devised and implemented for this common-pool resource. This will help achieving drinking water security, improved irrigation facility and sustainability in water resources development in large parts of rural India, and many parts of urban India as well. The aquifer mapping program is important for planning suiTABLE adaptation strategies to meet climate change also. Thus the crux of NAQUIM is not merely mapping, but reaching the goal – that of ground water management through community participation.

1.1 Objective:

The primary objective of the Aquifer Mapping Exercise can be summed up as "Know your Aquifer, Manage your Aquifer". Demystification of Science and thereby involvement of stake holders is the essence of the entire project. The involvement and participation of the community will infuse a sense of ownership amongst the stakeholders. This is an activity where the Government and the Community work in tandem. Greater the harmony between the two, greater will be the chances of successful implementation and achievement of the goals of the Project. As per the Report of the Working Group on Sustainable Ground Water Management, "It is imperative to design an aquifer mapping programme with a clear-cut groundwater management purpose. This will ensure that aquifer mapping does not remain an academic exercise and that it will seamlessly flow into a participatory groundwater management programme. The aquifer mapping approach can help integrate ground water availability with ground water accessibility and quality aspects.

1.2 Methodology:

Methodology involves creation of database for each of the principal aquifer and delineation of aquifer extent (vertical and lateral). Standard output for effective presentation of scientific integration of Hydrogeological, geophysical, geological, hydro chemical data facts and on GIS platform, identification of issues, manifestation of issues and formulation of strategies to address the issues by possible interventions at local and regional level.

The activities of the Aquifer Mapping can be grouped as follows.

1.3 Data Compilation & Data Gap Analysis:

One of the important aspect of the aquifer mapping programme was the synthesis of the large volume of data already collected during specific studies carried out by Central Ground Water Board and various Government organizations with a new data set generated that broadly describe an aquifer system. The data were assembled from the available sources, analyzed, examined, synthesized and interpreted. These sources were predominantly non-computerized data, which was converted into computer based GIS data sets and on the basis of available data, data gaps were identified.

1.4 Data Generation:

There a strong need for generating additional data to fill the data gaps to achieve the task of aquifer mapping. This was achieved by multiple activities such as exploratory drilling, geophysical techniques, hydro-geochemical analysis, remote sensing, and hydro-geological surveys to delineate multi aquifer system to bring out the efficacy of various geophysical techniques and a protocol for use of geophysical techniques for aquifer mapping in different hydro-geological environments.

1.5 Aquifer Map Preparation:

On the basis of integration of data generated from various studies of hydrogeology & geophysics, aquifers have been delineated and characterized in terms of quality and potential. Various maps have been prepared bringing out details of Aquifers; these are termed as Aquifer maps providing spatial variation (lateral & vertical) in reference to aquifer extremities (i.e. quality & quantity).

1.6 Aquifer Management Plan Formulation:

Aquifer response Model has been utilized to identify a suiTABLE strategy for sustainable development of the aquifer in the area.

All the above activities under the ground National Aquifer Mapping programme is depicted/elaborated in Annexure –I and presented in FIGURE 1.

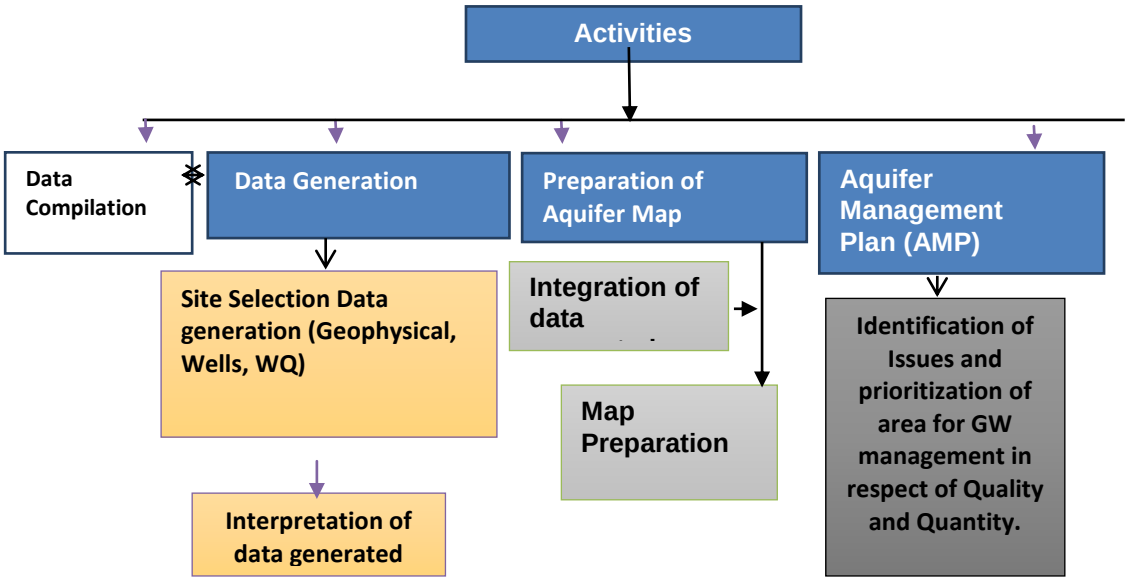

Figure 1- Activity under National Aquifer Mapping Programme

1.7 ABOUT THE AREA

Amreli is one of the oldest districts in the state of Gujarat in India. Amreli district derive its name from the town of Amreli, which is the headquarters of the district. Amreli district is situated in south central part of Saurashtra peninsula in Gujarat between 20.45° to 22.15° latitude and 70.13° to 71.45° longitude. The geographical area of the district is 7240.84 square km. It is surrounded by Bhavnagar district in east, in north Rajkot district, in west Junagadh district and Arabian Sea in the south. It has a coastal line of about 62 km. TABLE No-1 District bounds Latitudes and Longitudes. The Administrative map of the study area is presented in **Fig 2**.

TABLE 1- AMRELI DISTRICT BOUNDARY LOCATION

District Name	Latitude	Longitude
Amreli	20.45° to 22.15°	70.13° to 71.45°

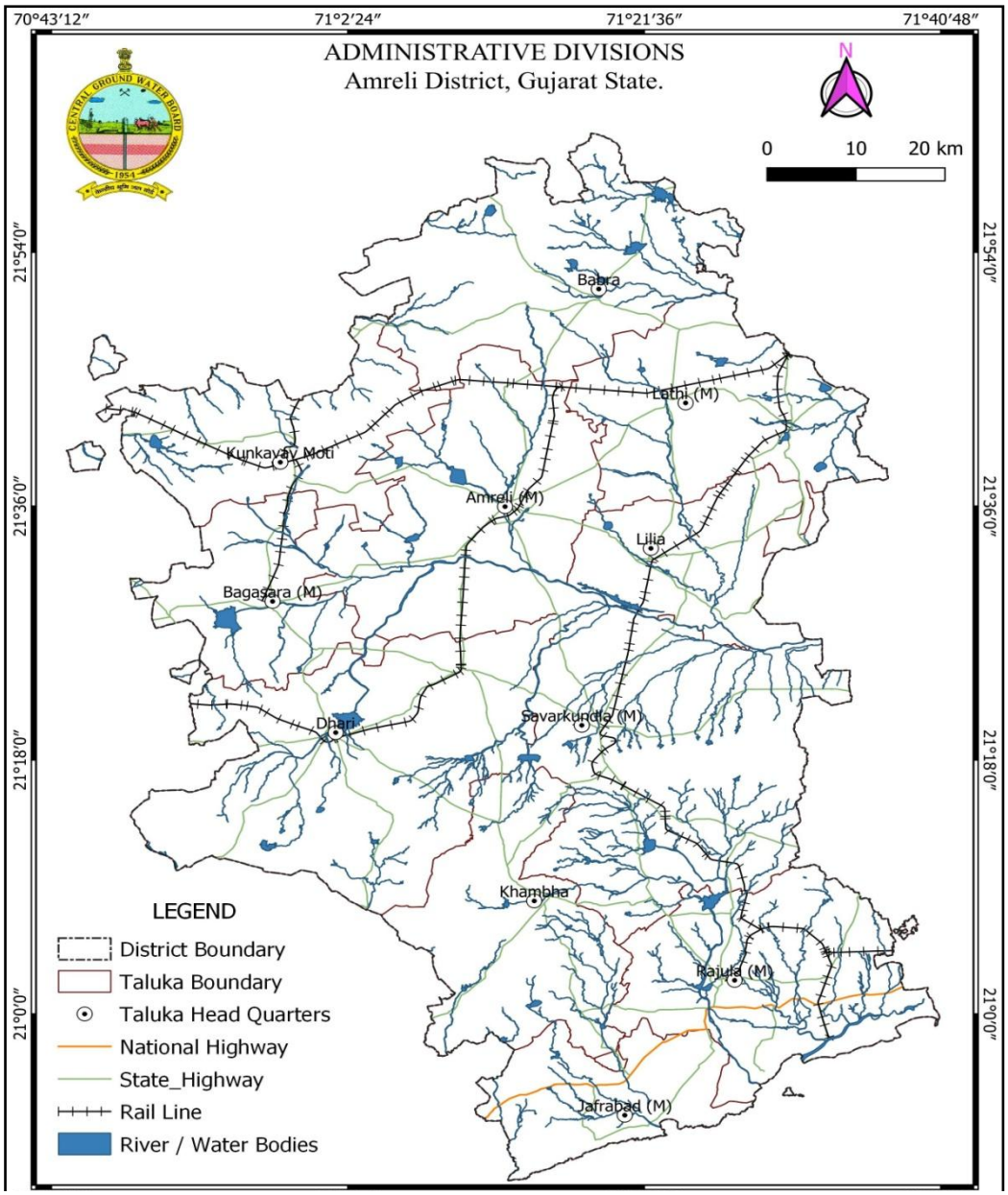

FIGURE 2- ADMINISTRATIVE MAP OF AMRELI DISTRICT

The district headquarters is located at Amreli Town. For administrative convenience, the district is divided into 11 blocks viz., Amreli, Babra, Bagasara, Dhari, Jafarabad, Khambha, Kunkavav (Vadiya), Lathi, Liliya, Rajula and Savarkundla. It has a total population of 15,14,190 as per 2011 census. The district has ten towns and nine municipalities. The major part of the district comes under Shetrunji River basin. The major river flowing through this district is Shetrunji, Thebi and Shel.

Amreli district has been taken up under NAQUIM study during the year 2021-22.The total area of the district is about 7240.84 sq km. The district is categorized as safe as per Ground Water Resources Estimation as on March 2020. The Index map of the study area is presented in **Fig 3**.

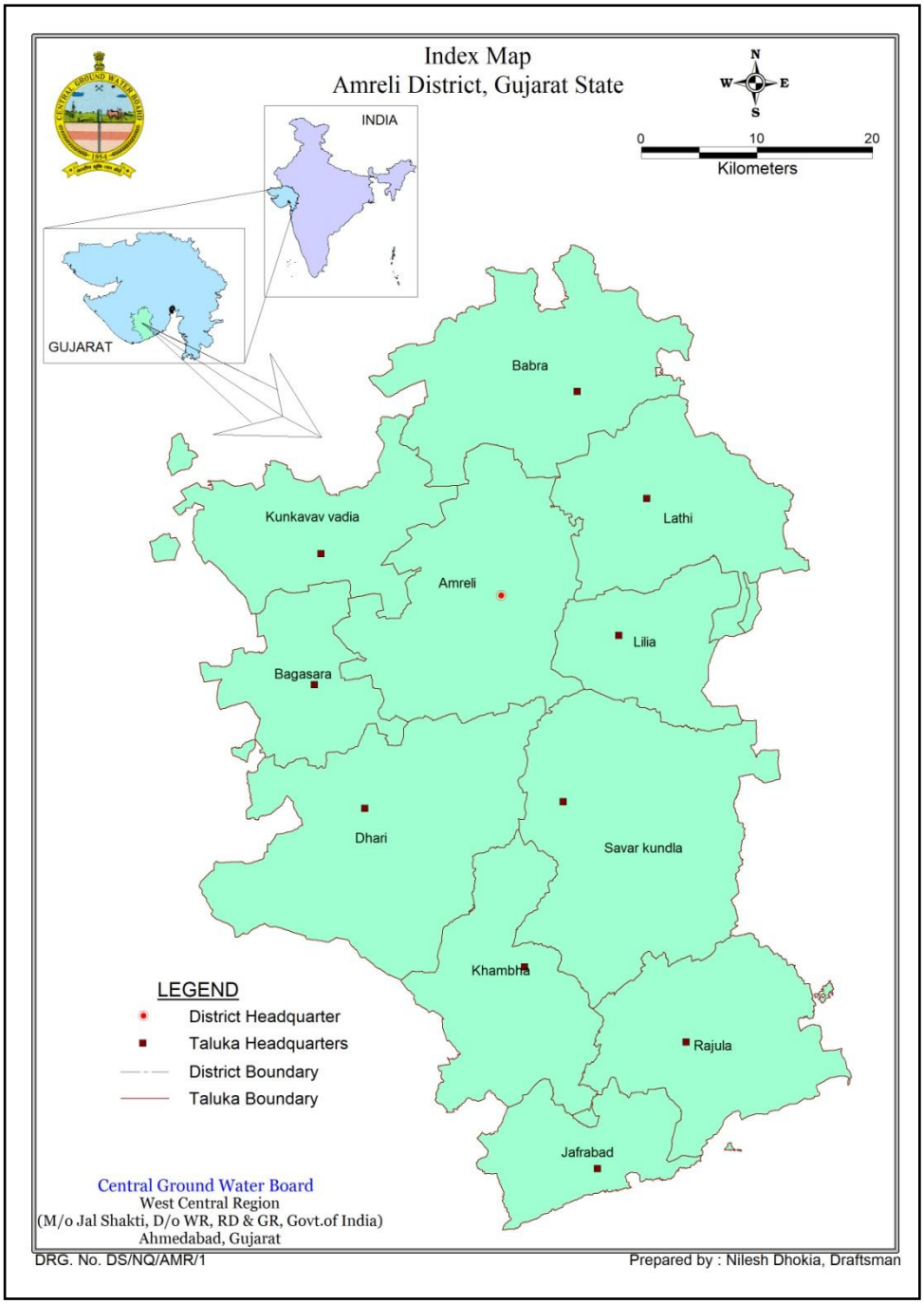

FIGURE 3- INDEX MAP OF AMRELI DISTRICT

1.8 DEMOGRAPHY:

As per the 2011 census, the population of the district was 15,141,90 out of which number of males and females were 7,71,049 and 7,43,141, respectively. The district has a population density of 205 inhabitants per square kilometre. Its population growth rate over the decade 2001-2011 was 8.59%. Amreli has a sex ratio of 964 females for every 1000 males and a literacy rate of the district is 74.49%. The current literacy rate is around 74.25%, out which male literacy rate is 82.21% and Female literacy rate is 66.09%. The demographic profile of the district (block wise) is indicated in below **TABLE no. 2**.

TABLE 2- DISTRICT POPULATION FIGURE (AS PER 2011)

Sl No	Taluka	Male	Female	Total	Sex Ratio
1	AMRELI	122893	118386	241279	963

2	BABRA	71923	68598	140521	954
3	BAGASARA	42469	40585	83054	956
4	DHARI	71281	68526	139807	961
5	JAFRABAD	55238	52764	108002	955
6	KHAMBHA	47214	46217	93431	979
7	KUNKAVAV(VADIA)	50438	49356	99794	979
8	LATHI	67654	65260	132914	965
9	LILIYA	30520	29903	60423	980
10	RAJULA	89454	86239	175693	964
11	SAVARKUNDLA	121965	117307	239272	962
Total		**771049**	**743141**	**1514190**	**964**

1.9 PHYSIOGRAPHY AND GEOMORPHOLOGY:

Physiographically the Amreli district is perhaps the most elevated land in the Saurashtra Region rising to an average elevation of about 335m AMSL. It is mainly plain except for a few isolated small hill ranges. Five small hills namely Sakarla(648m), Rajmal(495m), Chakrosar(442m), Nandivala(531m) and Lapla (471mAMSL) are located in this part. The master slope in the district in the northern, central and southern parts is towards south, north east and south east respectively. The drainage in the district is controlled by the topography and the lineaments. The major river draining the district is 1. The main tributaries of this river are Sotali, Vadi, Thebi, and Shell. The Shetrunji originates in the Dhundi hills of Gir Forest in Junagadh district and follows a northerly direction for about 50 km, and then it takes an easterly course and enters the adjoining Bhavnagar. The northern part of the district is mainly drained by two small ephemeral streams. Southern part, south of Shetrunji River basin is drained by small ephemeral streams which debauch in Arabian Sea.

Geomorphologically, the district can be divided into two major units, (A) Those formed by Quaternary/ Tertiary formation (includes alluvial plain, salt flat, valley fill, coastal plain, Coastal ridge, Coastal depression and pedimount Zone. (B) Those formed by Deccan Trap (includes pediment, dissected hilly terrain, moderately dissected pediplain and denundation hill).

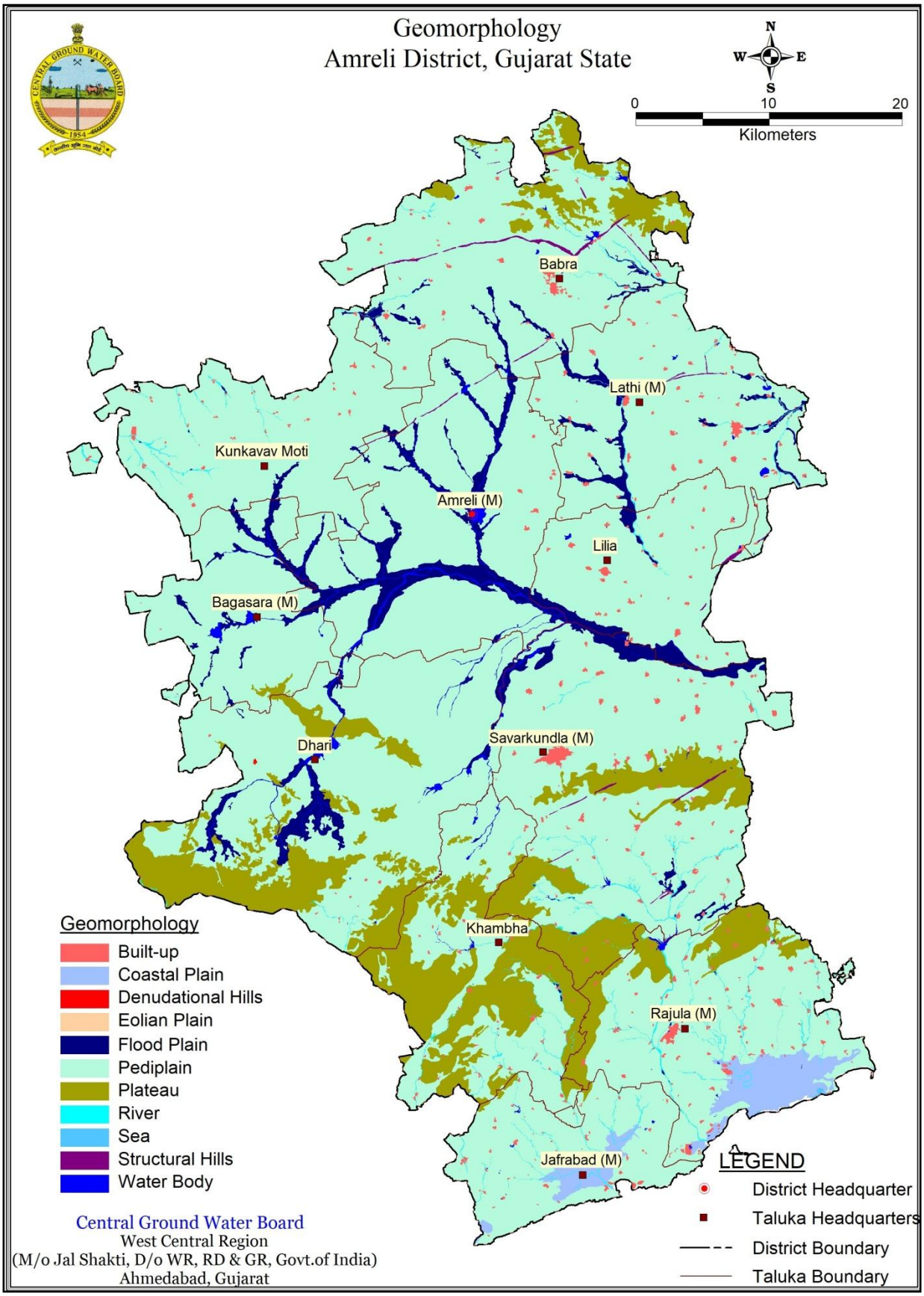

FIGURE 4- GEOMORPHOLOGIC MAP OF AMRELI DISTRICT

1.10 DRAINAGE PATTERN:

The drainage in the district is controlled by the topography and the lineaments. The major river draining the district is 1. The main tributaries of this river are Sotali, Vadi, Thebi, and Shell. The Shetrunji originates in the Dhundi hills of Gir Forest in Junagadh district and follows a northerly direction for about 50 km, and then it takes an easterly course and enters the adjoining Bhavnagar. The northern part of the district is mainly drained by two small ephemeral streams. Southern part, south of Shetrunji River basin is drained by small ephemeral streams which debauch in Arabian Sea.

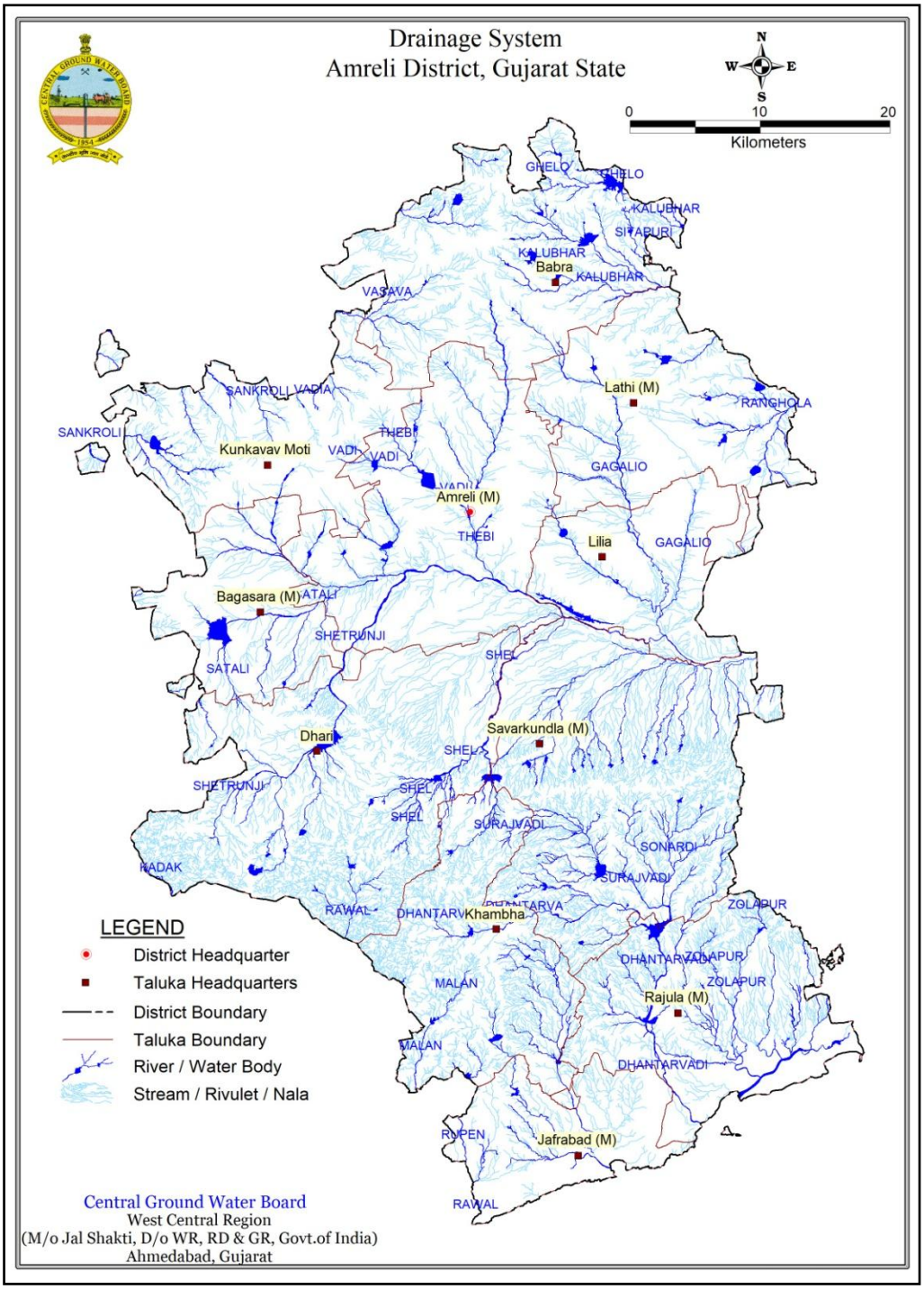

FIGURE 5- DRAINAGE MAP OF AMRELI DISTRICT

1.11 SOIL TYPE:

The Soils of Amreli district may be classified into four main categories viz. i) Medium black soils. ii) Coastal alluvial soils. iii) Rocky Soils. iv) Alkaline soils.

i) Medium black Soils

Medium black soils are very wide spread and are found almost in all taluka. They are more productive and are rich in lime, magnesia and alumna and poor in phosphorous, nitrogen and organic matters. They can retain considerable moisture and are much suitable for agriculture. Certain areas in Amreli taluka known as Kharapat are poor in cultivation but this taluka, which is almost covered by medium black soils, possesses the best land along the north and South bank of Shetrunji River.

TABLE 3- Major Soil Features

Major Soil features		
Sl No	**Particulars**	**Name of the Blocks**
1	Saline alkaline (Heavy texture) soils with 500 -600 mm rainfall- Productive and Non Productive	Amreli, Lathi, Liliya
2	Medium black soils with 400-700 mm rainfall	Savarkudla, Rajula and part of Jafrabad
3	Shallow black soils with 600 to 700 mm rainfall	Kukavav, Bagasara
4	Rocky soils with 300-600 mm rainfall- non-productive	Babra, Dhari, Khambha
5	Coastal alluvial soils with 750-1000 mm rainfall-Productive	Jafrabad and part of Rajula

Source: SREP Report, ATMA, Amreli, 2006

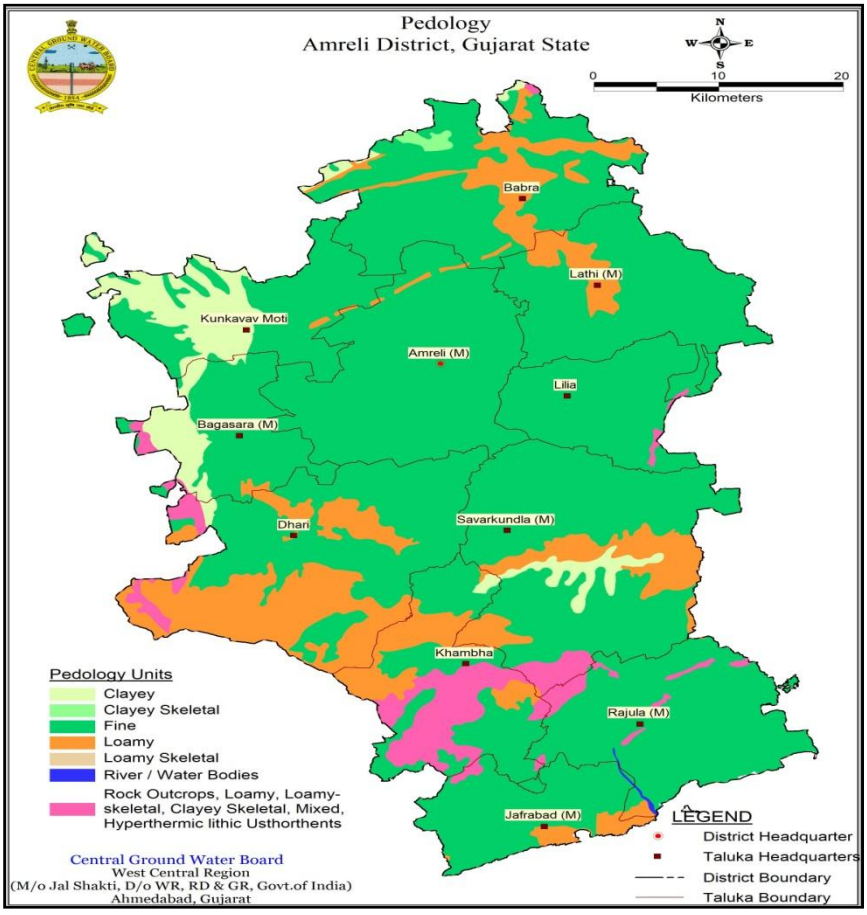

FIGURE 6- SOIL MAP OF AMRELI DISTRICT

1.12 LANDUSE PATTERN:

The Total Geographical Area (TGA) of Amreli is 691955.2 hectare. The largest block of the district is Savarkundla which comprises TGA of 110050.7 hectare i.e. about 16% of the TGA of the district. The Gross Cropped Area of the district is 655376.3 hectare out of which 104218.8 hectare i.e.16% of the area falls in Savarkundla Block followed by Dhari block having GCA of 93861.04 ha i.e. 14% of the district. Savarkundla Block also has the maximum net sown area of 82040.05 hectare i.e. 16% of the net sown area of the district. The cropping intensity in Khamba block is 133% and ranks second in the district after Dhari block where cropping intensity is 147%. In the blocks of Kukavav and Savarkundla, cropping intensity is 127% each. The taluka with the least cropping intensity is Liliya with 108%. Cropping intensity of the district is 125%.

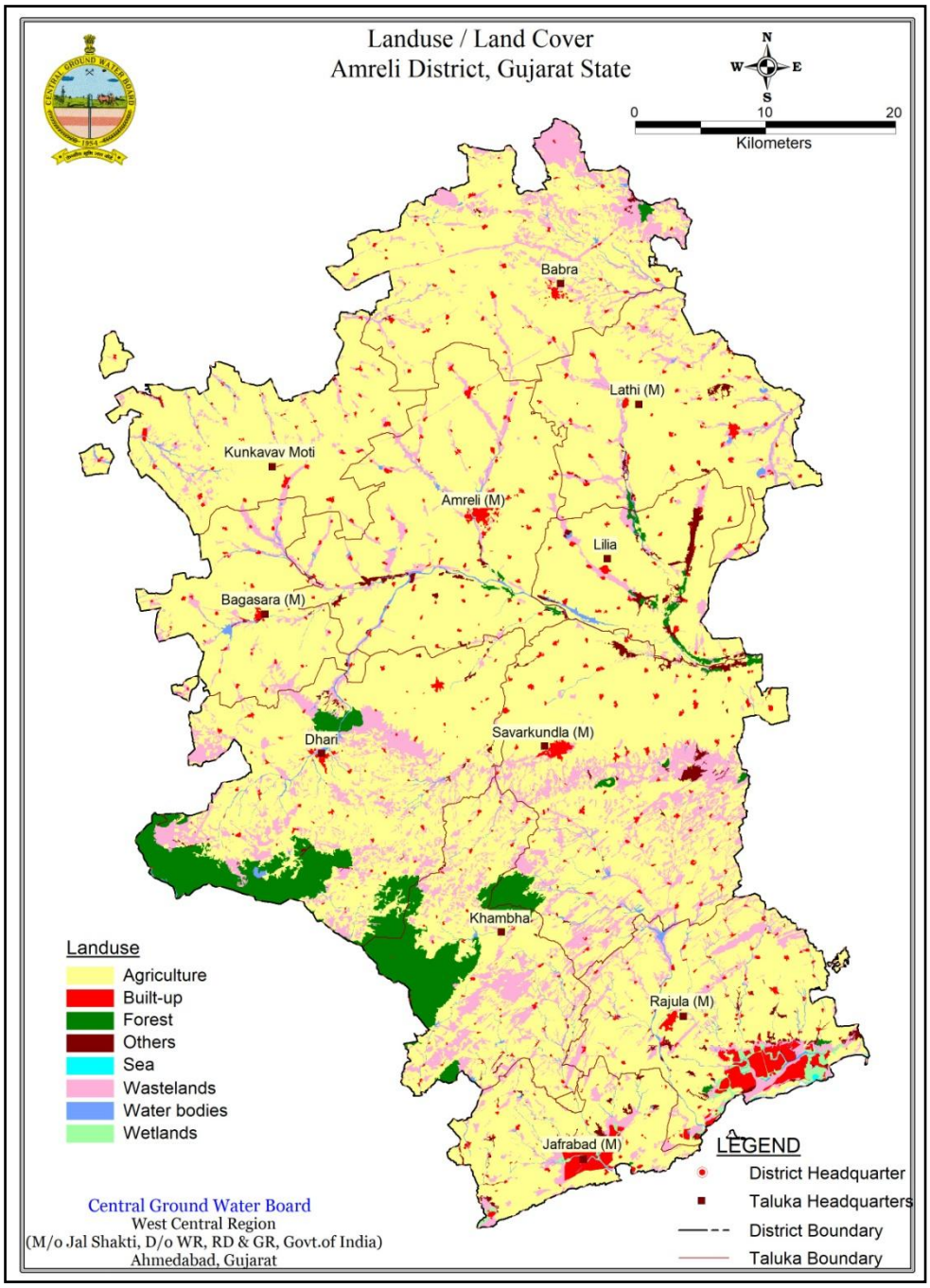

FIGURE 7- LAND USE MAP OF AMRELI DISTRICT

1.13 HYDROMETEOROLOGY

General climate of the district is sub-tropical and is characterized by three well defined seasons i.e. summer– From April to June, Monsoon- from July to September, and winter- From October to March. Mean maximum daily temperatures ranges from 28 to 40ºC and mean minimum daily temperatures ranges from 11 to 26ºC. April and May are the hottest months. The winters are generally pleasant with minimum temperatures around 12ºC. The relative humidity ranges from 81% during the monsoon season to 40% during winter. Mean wind speed ranges from 188 km/d during winter to more than 500 km/d during summer and monsoon. Potential evaporate transpiration (PET) is maximum during summer months. It ranges from 4.6 mm/d during December to 10. mm/d during May. The average monthly PET is about 6.4 mm/d. The average annual normal rainfall is 607.69 mm for the 50 years (1967-2007).

1.14 RAINFALL ANALYSIS:

Amreli district receives much of its rainfall from the south-west monsoon during the period between June & October; its maximum intensity being in the month of July & August. Total rainy days ranges from 30 to 40 days/year. Long term annual rainfall data of 11 rain-gauge stations of the district from year 1991-2021 are statistically analyzed and presented below in TABLE No 5.

TABLE 4- STATISTICAL ANALYSIS OF RAINFALL DATA

Sr.No.	District	Taluka	Year	Average Annual Rainfall (mm)	Minmum Rainfall (mm)		Maximum Rainfall (mm)	
					Year	Rainfall	Year	Rainfall
1	Amreli	Amreli	1991-2021	661	2000	234	2007	1357
2	Amreli	Babra	1991-2021	643	1991	252	2007	1213
3	Amreli	Bagasra	1991-2021	679	2000	290	2020	1223
4	Amreli	Dhari	1991-2021	606	2000	189	2010	1223
5	Amreli	Jafrabad	1991-2021	692	1999	244	2005	1148
6	Amreli	Khambha	1991-2021	640	2000	216	2005	1432
7	Amreli	Kunkavav Vadia	1991-2021	644	2012	258	2020	1128
8	Amreli	Lathi	1991-2021	631	1991	251	2005	1048
9	Amreli	Lilia	1991-2021	658	1999	280	2020	1093
10	Amreli	Rajula	1991-2021	690	2000	195	2005	1490
11	Amreli	Savarkundla	1991-2021	678	1991	338	1998	1175

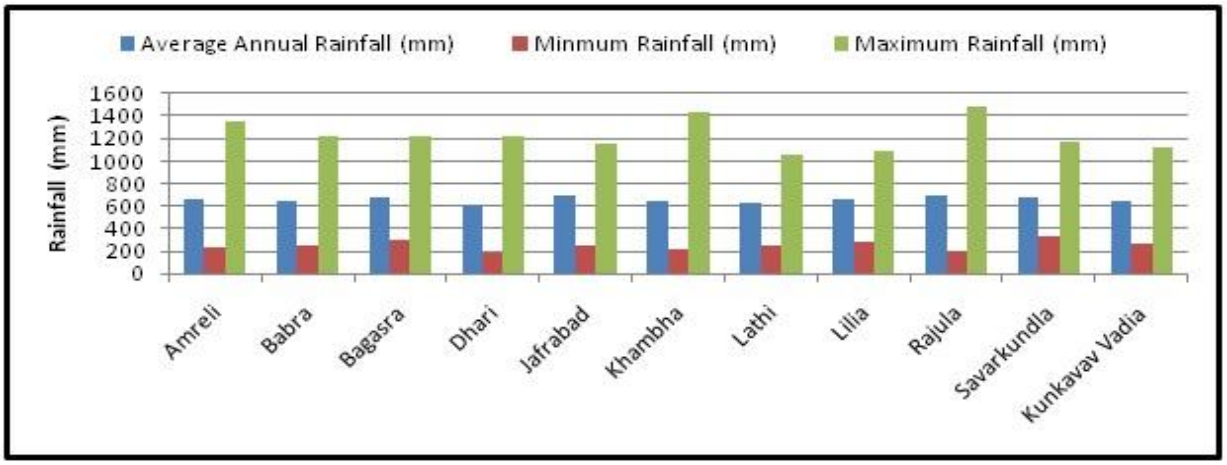

FIGURE 8- Rainfall Analysis Chart

1.15 STUDIES / ACTIVITY BY CGWB

Previous work has been carried out in the district and the Groundwater explorations were first taken by ETO under all India Ground Water Exploration programmed (1956-62), the boreholes were drilled at Vadhera, Donger and Dobasa villages.

Detailed & Systematic ground water exploration in parts of district was taken up in between 1979 and 1984 when the area occupied by the Shetrungi river basin was systematically explored during this programme and 20 EW and 140 OW were drilled in Amreli district.

Subsequently an exploration in draught prone villages of the district was taken up during 1991-93, with a view to provide drinking water. Nos. of Piezometers were also constructed during the period 2010-11, for periodically ground water level monitoring.

1.16 STATUS OF IRRIGATION:

The Gross Irrigated Area of Amreli district is 189171.3 hectare which is around 28.86% of the 629067hectare of gross cropped area. The percentage of Gross Irrigated Land to Gross Cropped Area is maximum in Bagasara (55.39%) followed by Rajula (52.35%) and the percentage of Gross Irrigated Land to Gross Cropped Area is minimum in Amreli (5.96%).

TABLE 5- Irrigation Status in Amreli District

Sl No	District	Taluka	Gross Irrigated Area (Ha)	Rainfed Area (Ha)	Total Irrigated Area (Ha)
1	AMRELI	AMRELI	4593.6	64575.4	69169
2	AMRELI	BABRA	10744.6	58749.4	69494
3	AMRELI	BAGASARA	16513.3	21390.7	37904
4	AMRELI	DHARI	17086.3	61530.2	78616.5
5	AMRELI	JAFRABAD	6217.9	19264.1	25482
6	AMRELI	KHAMBHA	18849.4	22095.1	40944.5
7	AMRELI	KUNKAVAV(VADIA)	23869.3	31969.7	55839
8	AMRELI	LATHI	9698.6	49068.4	58767
9	AMRELI	LILIYA	7579.9	27050.1	34630
10	AMRELI	RAJULA	27228.7	29846.8	57075.5
11	AMRELI	SAVARKUNDLA	46789.7	54355.8	101145.5
Total			189171.3	439895.7	629067

Source: Department of Agriculture, Amreli

1.17 STATUS OF WATER AVAILIBILITY

Water available in the district is mostly sourced from ground water. The surface irrigation availability for agriculture is lower than the availability of ground water Irrigation. Grossly, 239.38 mcm water through surface irrigation and 767.96 mcm through ground water is available in the district for growing crops in three crop seasons.

TABLE 6- Water Availability in Amreli District

Source	Kharif	Rabi	Summer	Total
Surface Water Irrigation	99.28	140.1	0	239.38
Ground Water Irrigation	713.22	54.74	0	767.96
Total	812.5	194.84	0	1007.34

Source: State and Panchayat Irrigation Dept.

1.18 STATUS OF SURFACE WATER AVAILBILTY (BLOCK WISE)

The glance at the intra-district variations reveals that Dhari taluka has the highest water availability (50.13 mcm). Area under irrigation is the highest in Savarkundla taluka which has the third highest water availability with 35.76 mcm (15%). The least water for crops is available in Liliya taluka (1%).

TABLE 7- STATUS OF SURFACE WATER AVAILBILTY

Block wise status of Surface water availability in Amreli District (MCM)						
Sl No	District	Taluka	**Kharif**	**Rabi**	**Summer**	**Total**
1	AMRELI	AMRELI	7.62	10.41	0	18.03
2	AMRELI	BABRA	13.19	36.94	0	50.13
3	AMRELI	BAGASARA	3.06	13.6	0	16.66
4	AMRELI	DHARI	6.2	43.43	0	49.63
5	AMRELI	JAFRABAD	4.97	5.09	0	10.06
6	AMRELI	KHAMBHA	24.42	11.34	0	35.76
7	AMRELI	KUNKAVAV(VADIA)	12.64	10.38	0	23.02
8	AMRELI	LATHI	4.24	1.31	0	5.55
9	AMRELI	LILIYA	1.41	0.0	0	1.41
10	AMRELI	RAJULA	9.5	0.6	0	10.1
11	AMRELI	SAVARKUNDLA	12.03	7.0	0	19.03
Total			99.28	140.1	0	239.38

Source: District Irrigation Plan 2016-20

1.19 STATUS OF COMMAND AREA:

Total area developed through canal command is 36623 Ha in the district. Dhari block has the maximum area with 12898 hectares of land which is irrigated through canal command. Of the total area 53% of the area has been developed with canal command while 47% is developed through other service command as specified in the TABLE below.

TABLE 8- STATUS OF COMMAND AREA

Sl No	District	Taluka	**Canal Command Area (Ha)**	**Other Services Command (Ha)**	**Total Command Area (Ha)**
1	AMRELI	AMRELI	3592	2018	5610
2	AMRELI	BABRA	797	1844	2641
3	AMRELI	BAGASARA	3481	726	4207
4	AMRELI	DHARI	4608	1060	5668
5	AMRELI	JAFRABAD	12898	3660	16558
6	AMRELI	KHAMBHA	5500	8718	14218
7	AMRELI	KUNKAVAV(VADIA)	3100	2970	6070
8	AMRELI	LATHI	1250	5818	7068
9	AMRELI	LILIYA	808	4146.0	4954
10	AMRELI	RAJULA	235	703.0	938
11	AMRELI	SAVARKUNDLA	354	1006.0	1360
Total			36623	32669	69292

Source: State irrigation department

2. GEOLOGY

Deccan Trap lava flows, Supratrappeans, Gaj Beds, Miliolite limestones and recent unconsolidated deposits encountered in the district have been stratigraphically classified as in the TABLE 6 below, after (G.S.I.): -

TABLE 9- STRATIGRAPHY OF AMRELI DISTRICT.

Eon	Epoch	Formation	Lithology	Thickness
Quaternary	Recent to Sub Recent	Unconsolidated Deposits	Alluvium, loose sand, conglomerate	20 to 48
	Pleistocene	Miliolite limestone	Lime Stones, sandy limestone, calcareous boulder bed	75
Erosional Unconformity				
Mesozoic Tertiary	Lower Miocene	Gaj Beds	Limestones, Marl and gypseous clay	300
Unconformity				
Mesozoic Tertiary	Eocene	Supratrappeans	Sand stone, Sand and Conglomerate	20
Unconformity				
Mesozoic Tertiary	Lower Eocene to Upper Cretaceous	Deccan Traps	Massive Basalt and amygdaloidal basalt	Not Known

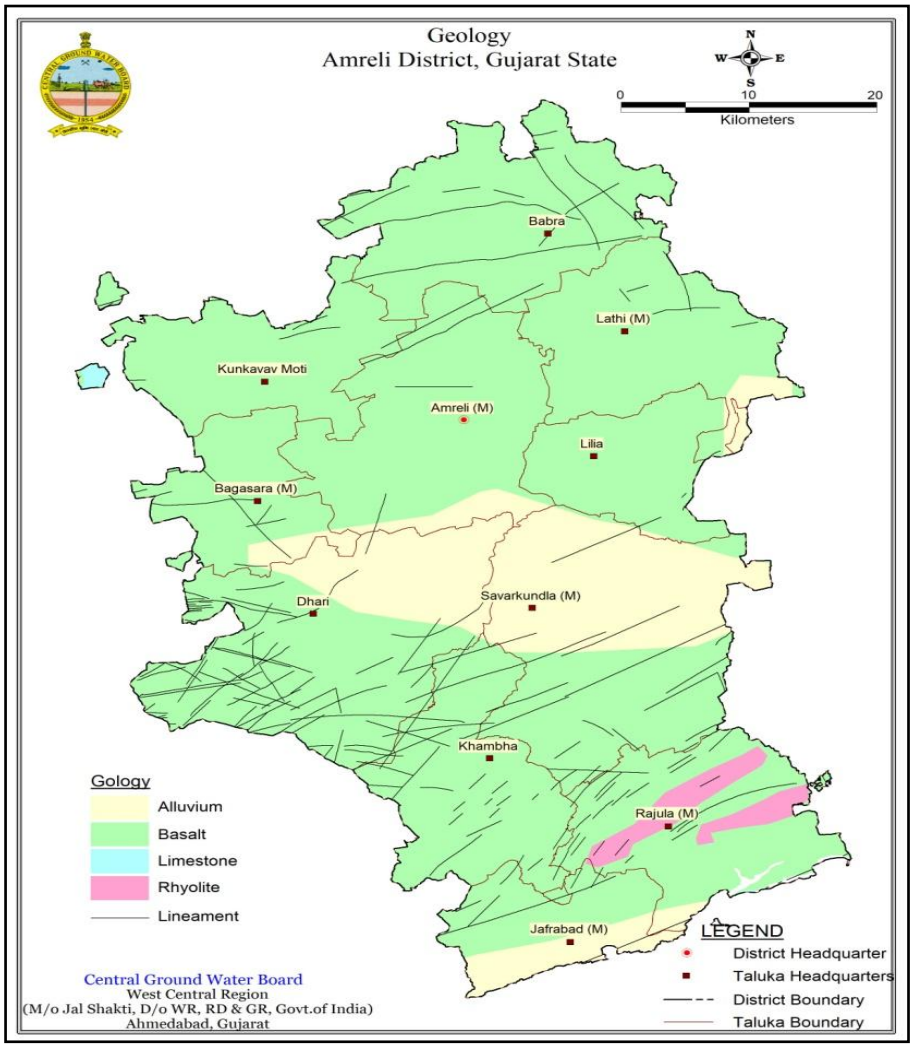

FIGURE 9- GEOLOGICAL MAP OF AMRELI DISTRICT

3. HYDROGEOLOGY- OCCURRENCE & DISTRIBUTION OF GROUND WATER

Hydrogeologically the district can be broadly grouped under hard rock comprising “Deccan Traps” and soft rocks comprising “Tertiaries Alluvium”. Nearly 70% of the district is underlain by DecccanTraps. The Deccan trap is the most extensive aquifers in the district. Millioite limestone and Alluvium forms a potential aquifer but limited in the coastal and the central parts of the district respectively. The ground water development in all these formations are mainly by dugwells.

Deccan Trap:

Deccan trap basalt occupies a major part of the district and forms the most important aquifer system. It generally forms a poor aquifer due to compactness and poor primary porosity. However, the upper weathered parts, which at places are up to 15-20m thick, form good aquifer. At deeper levels, the secondary porosity developed as a result of tectonic activities, in the form of joints, fractures, and shear zones form repository of ground water at many places. Amygdaloidal horizons with in basalt also form potential aquifers at places. The dykes, both basaltic and dolerite play an important role in occurrence and movement of ground water. At places, the dykes are highly weathered and themselves forms potential aquifers. At other places where the dykes are more compact, they act as subsurface barrier for the ground water flow and well constructed up stream of these dykes have good yields.

The ground water in basalt occurs under phreatic to confined conditions. The ground water is mainly tapped by dugwells varying in depth from 5 to 50m. About 90% of the dugwells have 2 to 3 side bore wells, each side bore wells ranges between 50 and 100 feet in length.

Supratrappean

The Supratrappean formations generally form limited aquifers with wells ranging in depth from 5 to 20m. The yield of wells ranges between 20 and 300m3/day.

Gaj Beds:

Gaj Beds form potential but limited aquifers at places, particularly in the coastal areas. The wells tapping this aquifer generally range in the depth from 5 to 15m and the yield of wells ranges between15 and150m3/day.

Miliolite Limestone:

Miliolites form potential aquifers in the coastal areas. The depth of the dug well in this formation ranges between 4 and 65m bgl, however, most of the wells are less than 25m deep. Horizontal bore wells increase the yield of the dug wells, the yields ranges between 15 and 800m3/day. At places, very high yields are observed due to karstic nature of this formation.

Alluvium Formation:

The Alluvium forms very potential aquifer particularly in the central part. The wells in alluvium range in depth from 4 to 50 m bgl. Drilling of horizontal bores in the wells to increase the yields is quite common. Such horizontal bores generally have 2.5 to 5cm of diameter and extend laterally to10 to 15m. The yield of wells ranges between 10 and 820 m3/day.

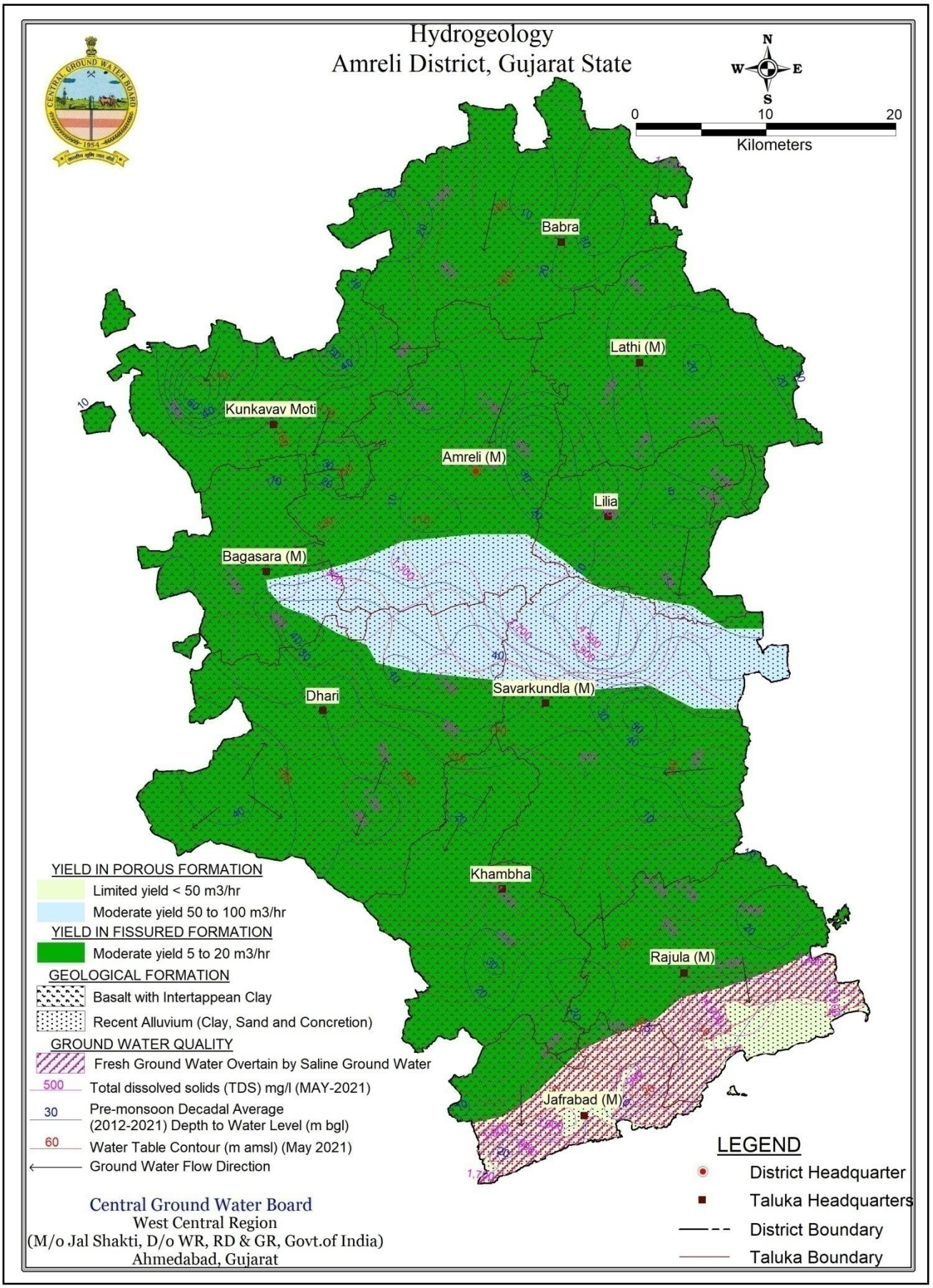

FIGURE 10- HYDRO-GEOLOGICAL MAP OF AMRELI DISTRICT

3.1 AQUIFER PARAMETERS:

Aquifer parameters are available from ground water exploration carried out in the Alluvium formation and Hard rock area of the district as well as from the pumping tests carried out on exploratory wells in Meta-sedimentary, Basaltic and Alluvial terrain.

TABLE 10- AQUIFER CHARACTERISTICS

Aquifer Characteristics and Disposition										
Stratigraphy	Aquifer	Lithological character	Depth of occurrence	Thickness	Water Level	TDS	Discharge	Transmissivity	Nature of Aquifer	Quality
			Aquifer (mbgl)	Range (m)	Range (m)	Mg/l	lps	m2/day		
Holocene	Alluvium	Alluvium,loosesand, conglomerate	0 to 40	0 to 20	2 to 20	700 to 4000	1.0 to 3.0		Phreatic	Good
Cretaceous	Weathered Basalt	Basalts	0 to 35	2 to 22	5 to 30	500 to 3500	0.5 to 9.0	1.2 to 56	Phreatic	Good
	Fractured Basalt	Basalts	20 to 125	5 to 125	5 to 15	500 to 7000	2.0 to 10.0	3.88 to 178	Fractured	Good

3.2 DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING:

In order to establish the three-dimensional disposition of aquifer system in the area, the existing data of litho logical logs and Electrical logs of Exploratory wells studies carried out by CGWB and state Ground water Departments (GWRDC & GWSSB) were used to prepare a hydro geological cross section, Fence diagram and 3D Model. The data has been analyzed using Rockworks 16 software and is presented below in the Hydro-geological cross sections A-A' to H-H' and Solid Model of the district showing the depiction of Alluvium Aquifer, weathered aquifers and fractured aquifers up to 200m (300m at few places). Map showing section lines are presented in Fig. 11. The stratigraphic sections depicting weathered aquifer, fractured aquifer for Hard rock formations and unconfined aquifer for alluvium formation are placed at Figs 12-19. 3D Solid Model and Fence Diagram of Amreli district is depicted in Fig. 20 and 21 respectively.

TABLE 11- DATA INTEGRATION FOR AMRELI DISTRICT

S.No.	Data	Aquifer	Total Data Points	Source	
				CGWB	GWRDC
1	3D Aquifer Disposition Map	1 no	35	Expl:16	-
2	Hydrogeological Cross Sections	8 no	35	Expl:16	-
3	Fence Diagrams	1 no	35	Expl:16	-
4	Depth of weathering	1 no	7	Expl:16	-
5	Depth of fracturing	1 no	7	Expl:16	-
7	Depth to Water Level Maps (2021)	Combined	65	15	39
8	Long term water	Combined	34	16	45
9	Water quality pre-2021	Combined	52	7	45

3.3 CONCEPTUALIZATION OF AQUIFER SYSTEM IN 2D AND 3D MAP:

Based on litho logical formation, electrical Log and local ground water survey, eight hydro-geological sections have been prepared along section lines shown in below FIGURE to understand the subsurface disposition of aquifer system. Also 3-D Aquifer disposition map and Fence diagram is prepared to know the aquifer geometry in the district.

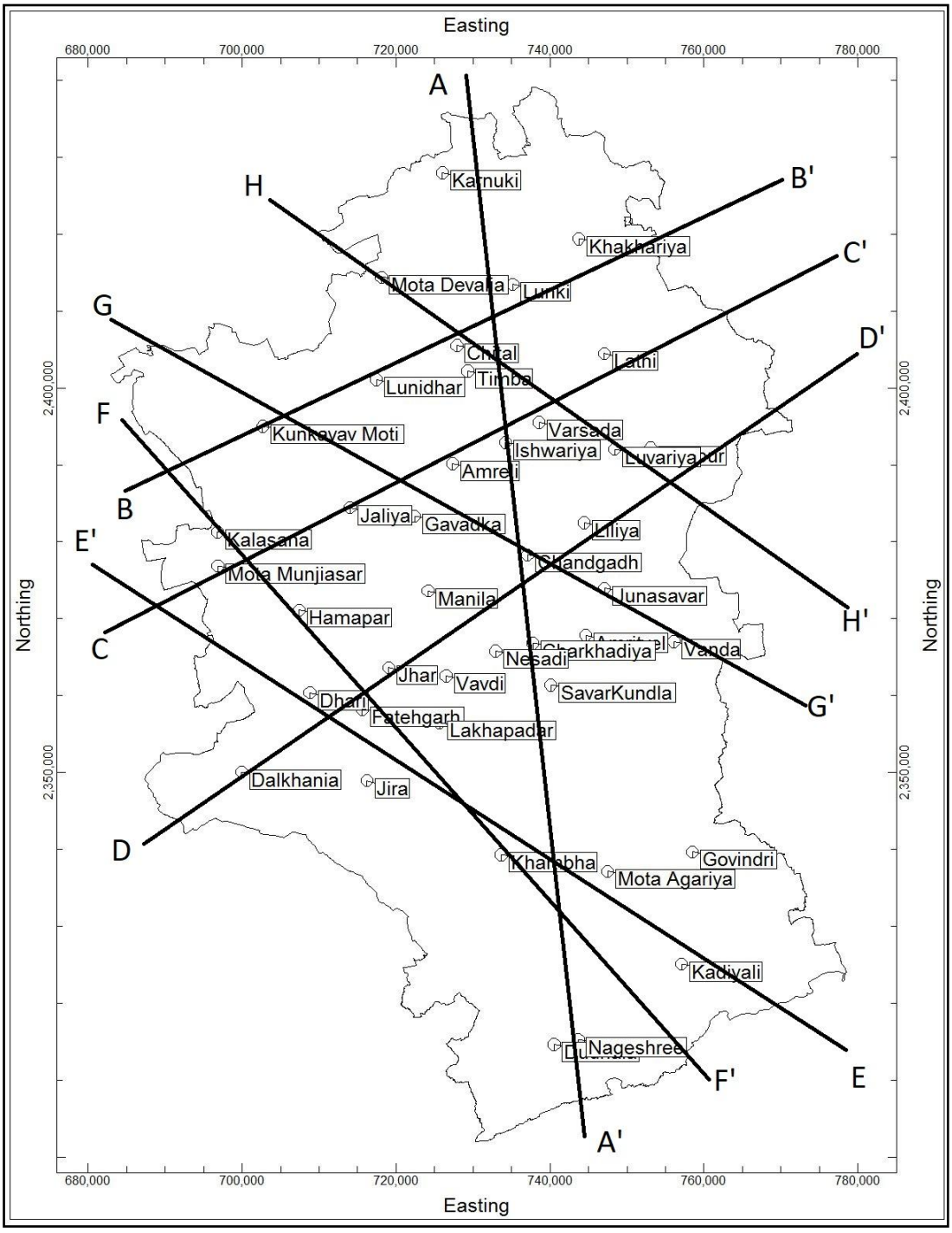

FIGURE 11- CROSS-SECTION LINE MAP OF AMRELI DISTRICT

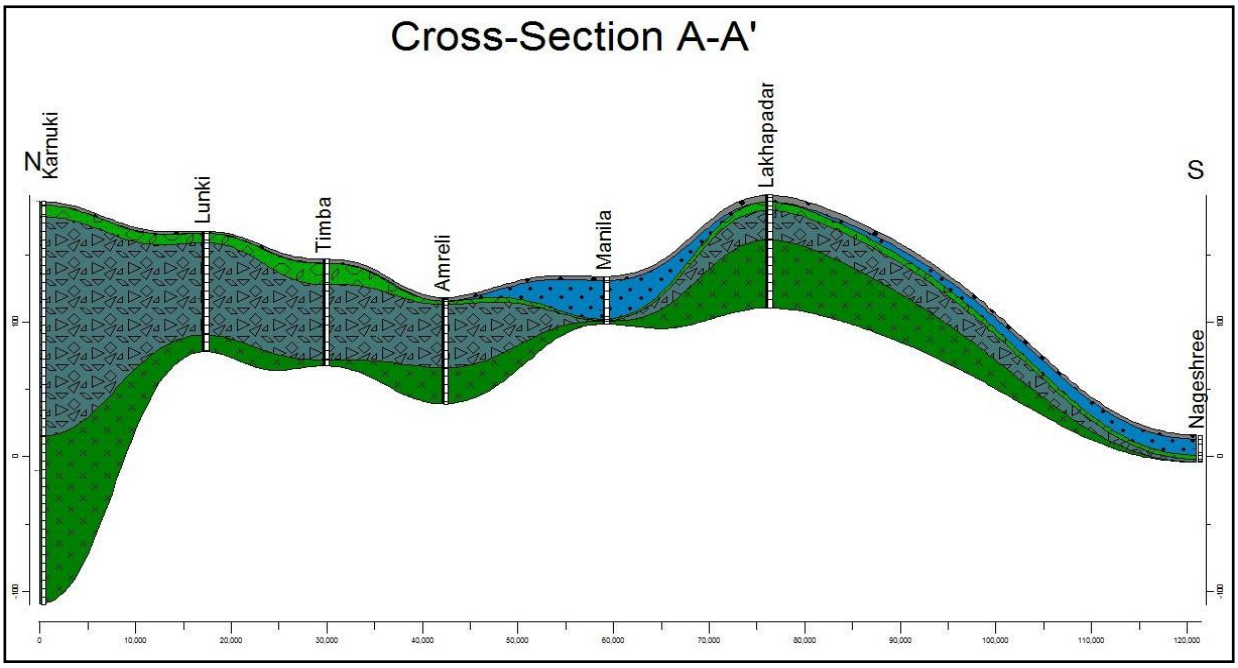

FIGURE 12- 2D AQUIFER CROSS-SECTION (A-A') MAP OF AMRELI DISTRICT

Cross-Section is drawn roughly N-S direction and start from Karnuki to Nageshree passing through Lunki, Timba, Amreli, Manila and Lakhapadar. Section is represented geologically; Geological formation encountered more or less same as except centre and Southern part where alluvium formation encountered at village Manila and Nageshree (towards coastal area).

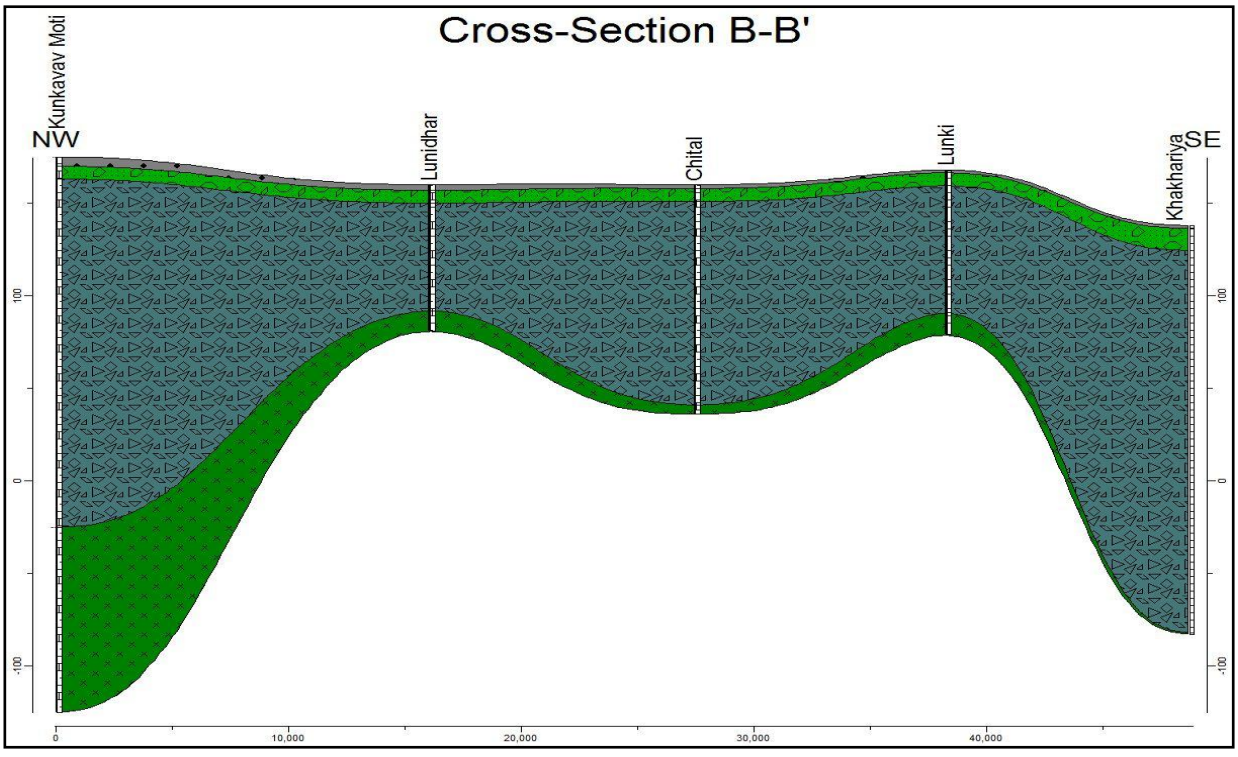

FIGURE 13- 2D AQUIFER CROSS-SECTION (B-B') MAP OF AMRELI DISTRICT

Cross-Section is drawn roughly NW-SE direction and start from Kunkavav Moti to Khakhariya passing through Lunidhar, Chital and Lunki. Section is represented geologically; Geological formation encountered more or less same as except variation of thickness and position of out crops.

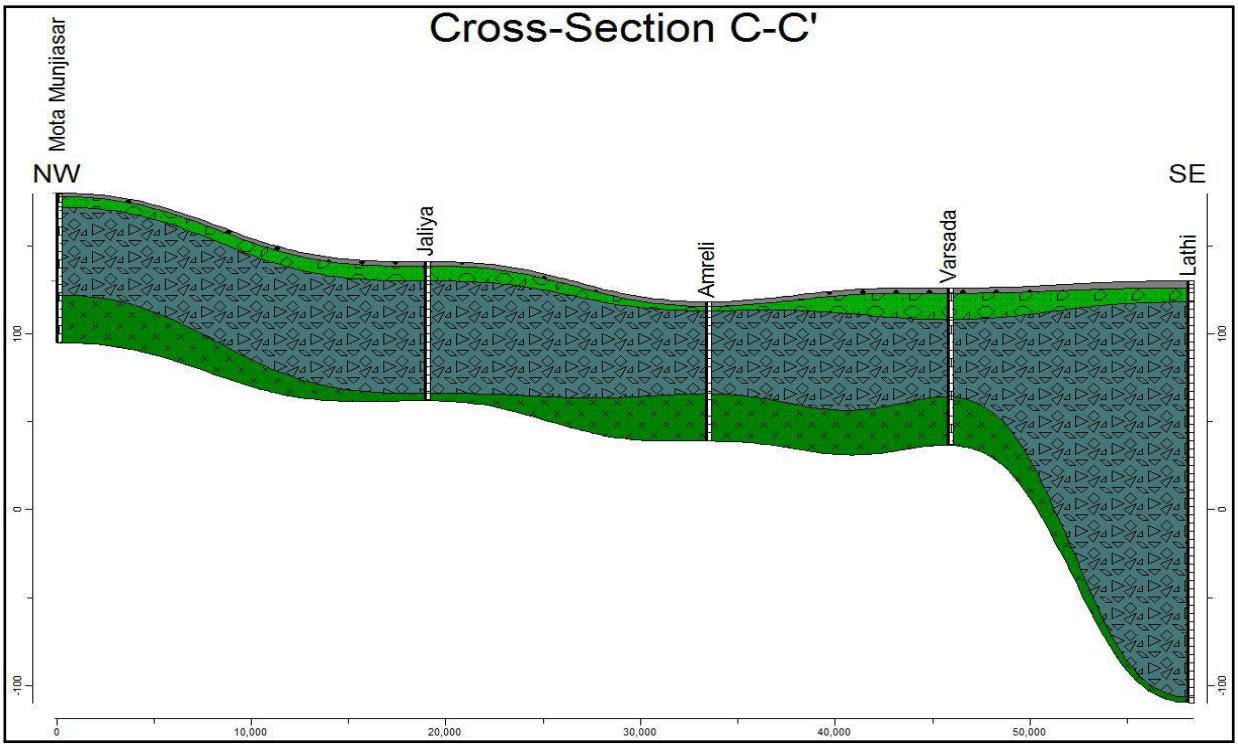

FIGURE 14- 2D AQUIFER CROSS-SECTION (C-C') MAP OF AMRELI DISTRICT

Section is drawn roughly SW-NE direction and start from Mota Munjisar to Lathi passing through Jaliya, Amreli and Varasada. Geological formation encountered more or less same as except variation of thickness and position of out crops.

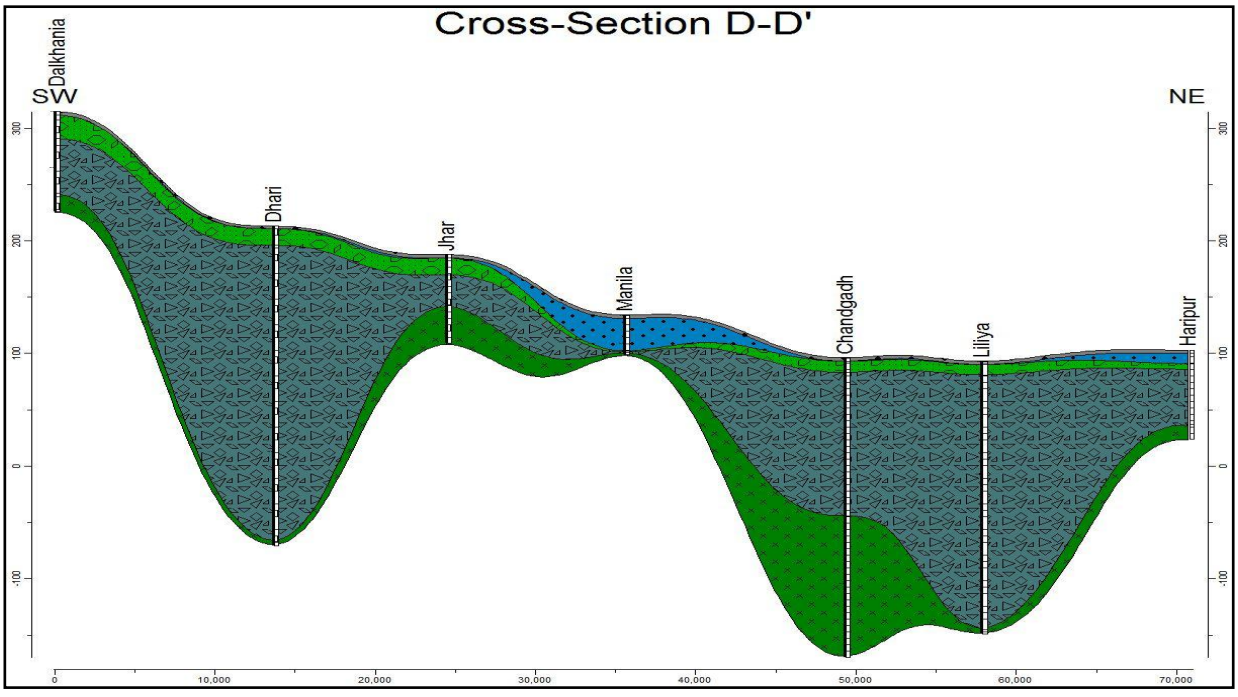

FIGURE 15- 2D AQUIFER CROSS-SECTION (D-D') MAP OF AMRELI DISTRICT

Section is drawn roughly SW-NE direction and start from Dalkhania to Haripur passing through Dhari, Jhar, Manila, Chandgadh and Liliya. Geological formation encountered more or less same as except centre and NE part where alluvium formation encountered at village Manila and Haripur.

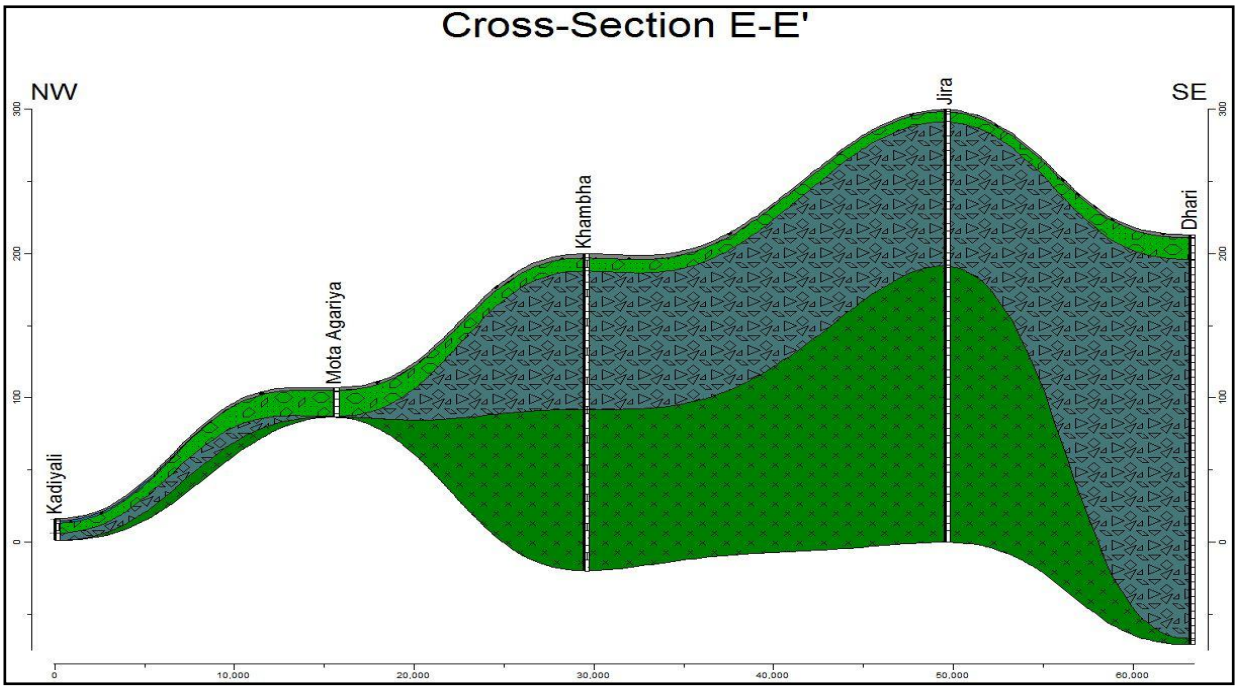

FIGURE 16- 2D AQUIFER CROSS-SECTION (E-E') MAP OF AMRELI DISTRICT

Cross-Section is drawn roughly NW-SE direction and start from Kadiyali to Dhari passing through Mota Agariya, Khambha and Jira. Section is represented geologically; Geological formation encountered more or less same as except variation of thickness and position of out crops.

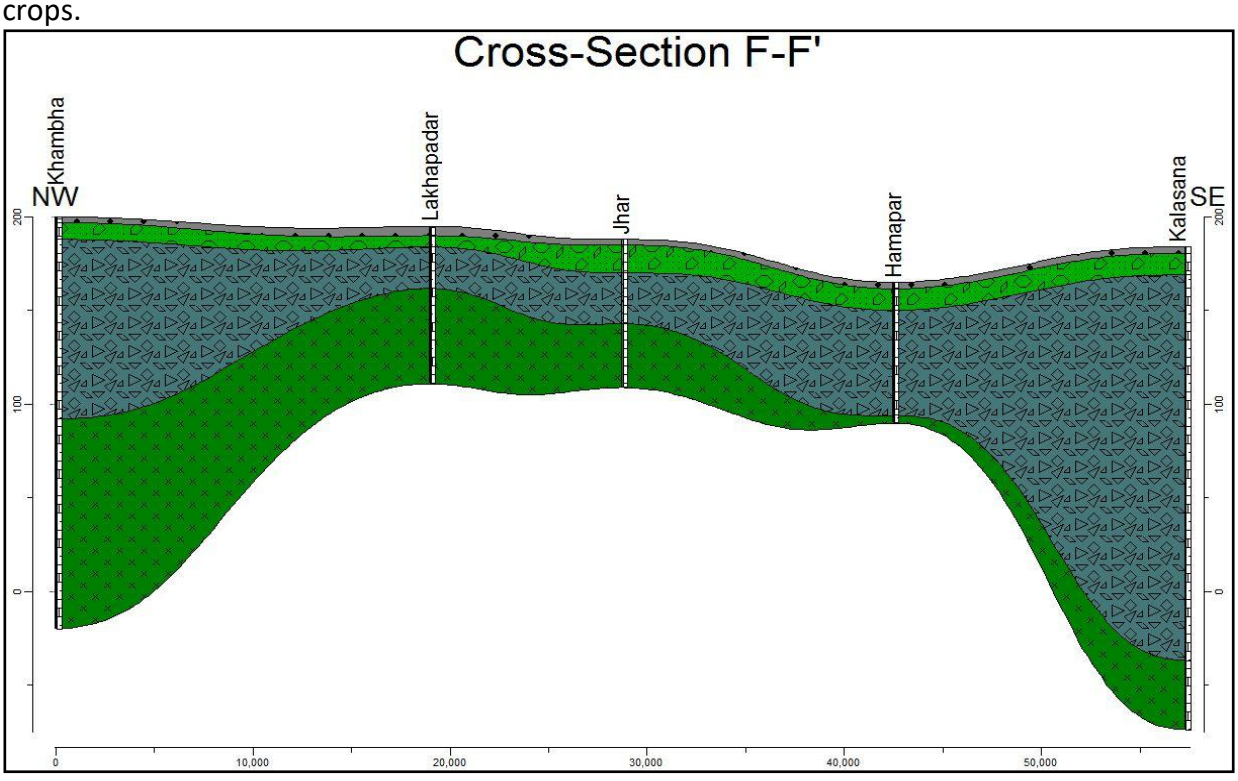

FIGURE 17- 2D AQUIFER CROSS-SECTION (F-F') MAP OF AMRELI DISTRICT

Cross-Section is drawn roughly NW-SE direction and start from Khambha to Kalasana passing through Lakhapadar, Jhar and Hamapar. Section is represented geologically; Geological formation encountered more or less same as except variation of thickness and position of out crops.

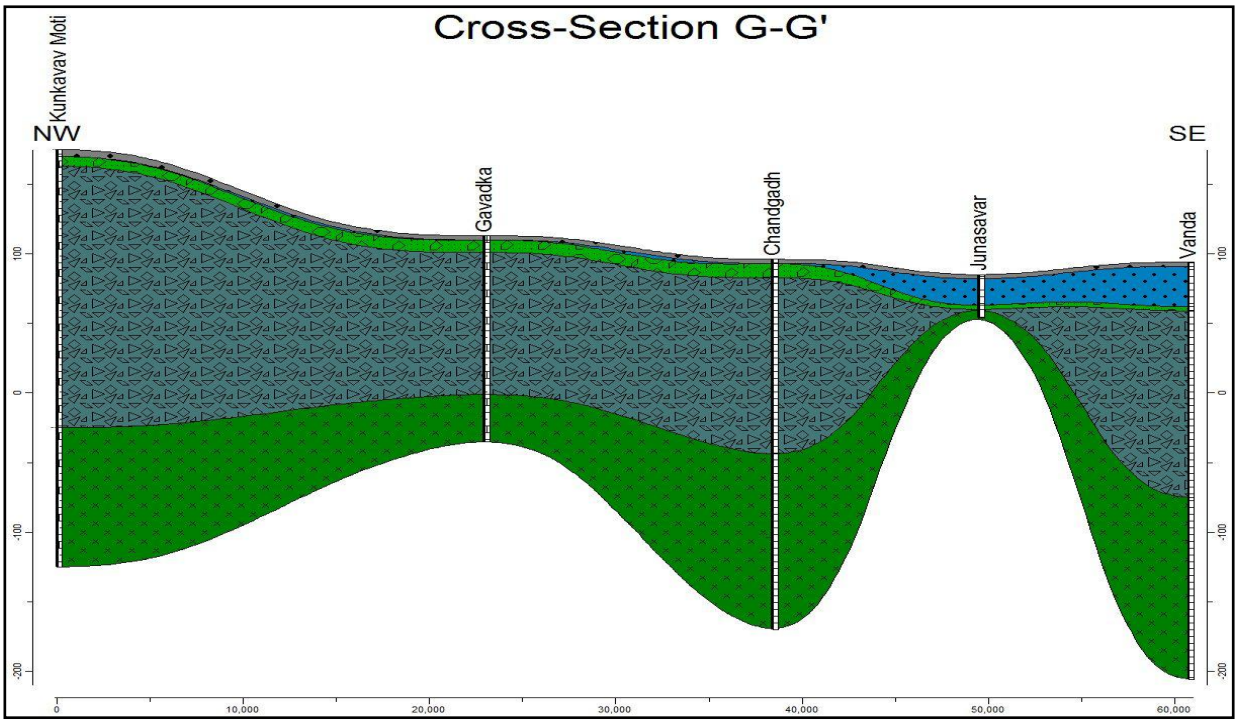

FIGURE 18- 2D AQUIFER CROSS-SECTION (G-G') MAP OF AMRELI DISTRICT

Cross-Section is drawn roughly NW-SE direction and start from Kunkavav Moti to Vanda passing through Gavadka, Chandgadh and Junasavar. Section is represented geologically; Geological formation encountered more or less same as except SE part where alluvium formation encountered at village Junasavar and Vanda.

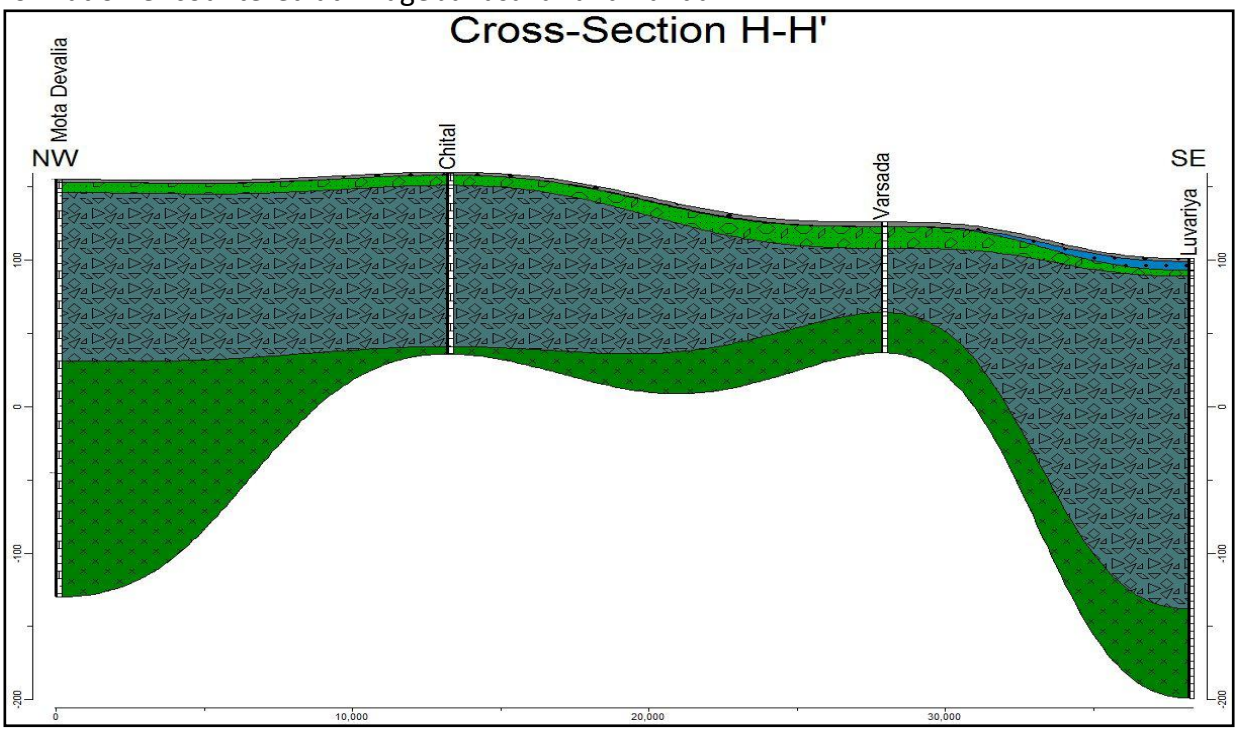

FIGURE 19- 2D AQUIFER CROSS-SECTION (H-H') MAP OF AMRELI DISTRICT

Cross-Section is drawn roughly NW-SE direction and start from Mota Devalia to Luvariya passing through Chital and Varsada. Section is represented geologically; Geological formation encountered more or less same as except SE part where alluvium formation encountered at village Luvariya.

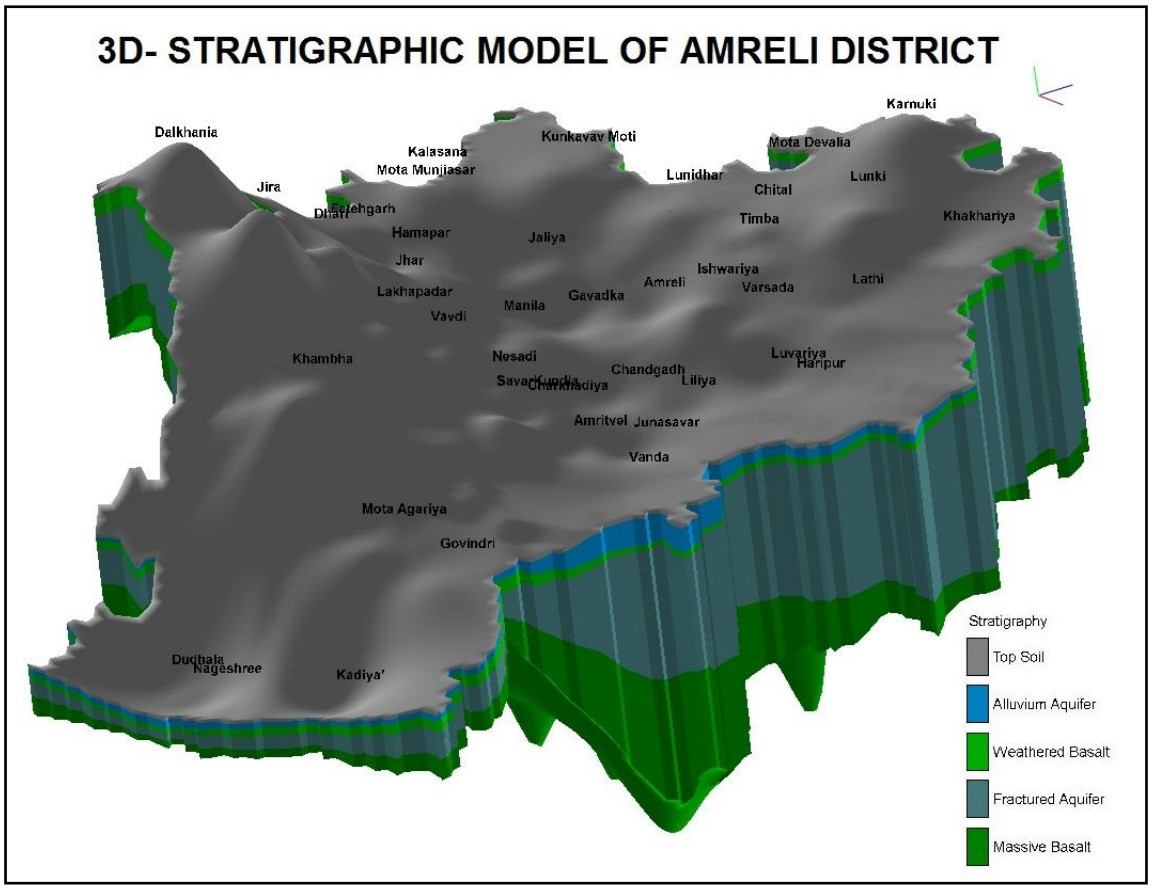

FIGURE 20- 3D AQUIFER DISPOSITION DIAGRAMOF AMRELI DISTRICT

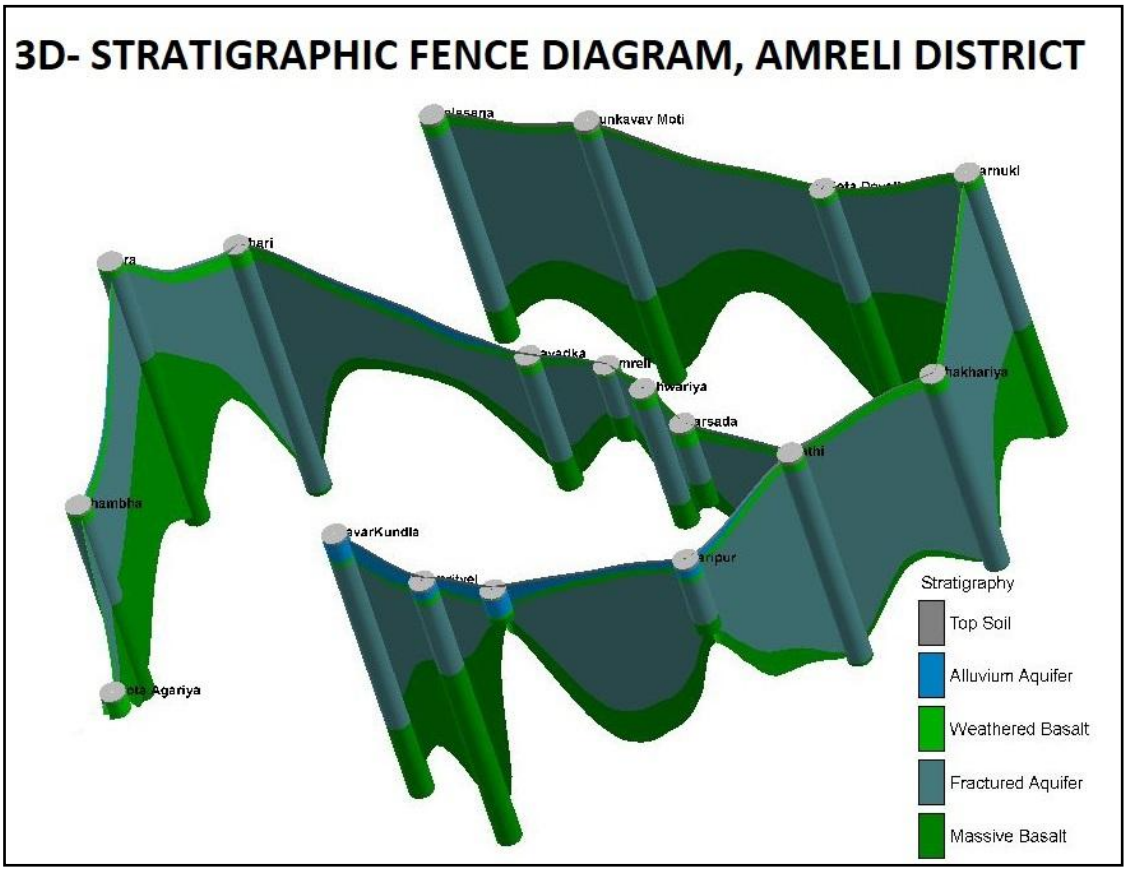

FIGURE 21- 3D FENCE/PANEL DIAGRAM OF AMRELI DISTRICT

4. GROUNDWATER REGIME MONITORING:

Central Ground Water Board periodically monitors 65 Ground Water monitoring wells in the Amreli district, four times a year i.e. in January, May (Pre-monsoon), August and November (Post-monsoon). Ground water regime monitoring is the basic component of groundwater management and it is carried out in parts of Amreli district through National Hydrograph Stations (NHS). These hydrograph stations comprised of dug wells and Piezometers and Observation wells. There are 52 Dug wells and 13 Piezometers as part of the NHS from CGWB. These water level data have been used for preparation of depth to water level maps of the district to understand the behavior of ground water regime.

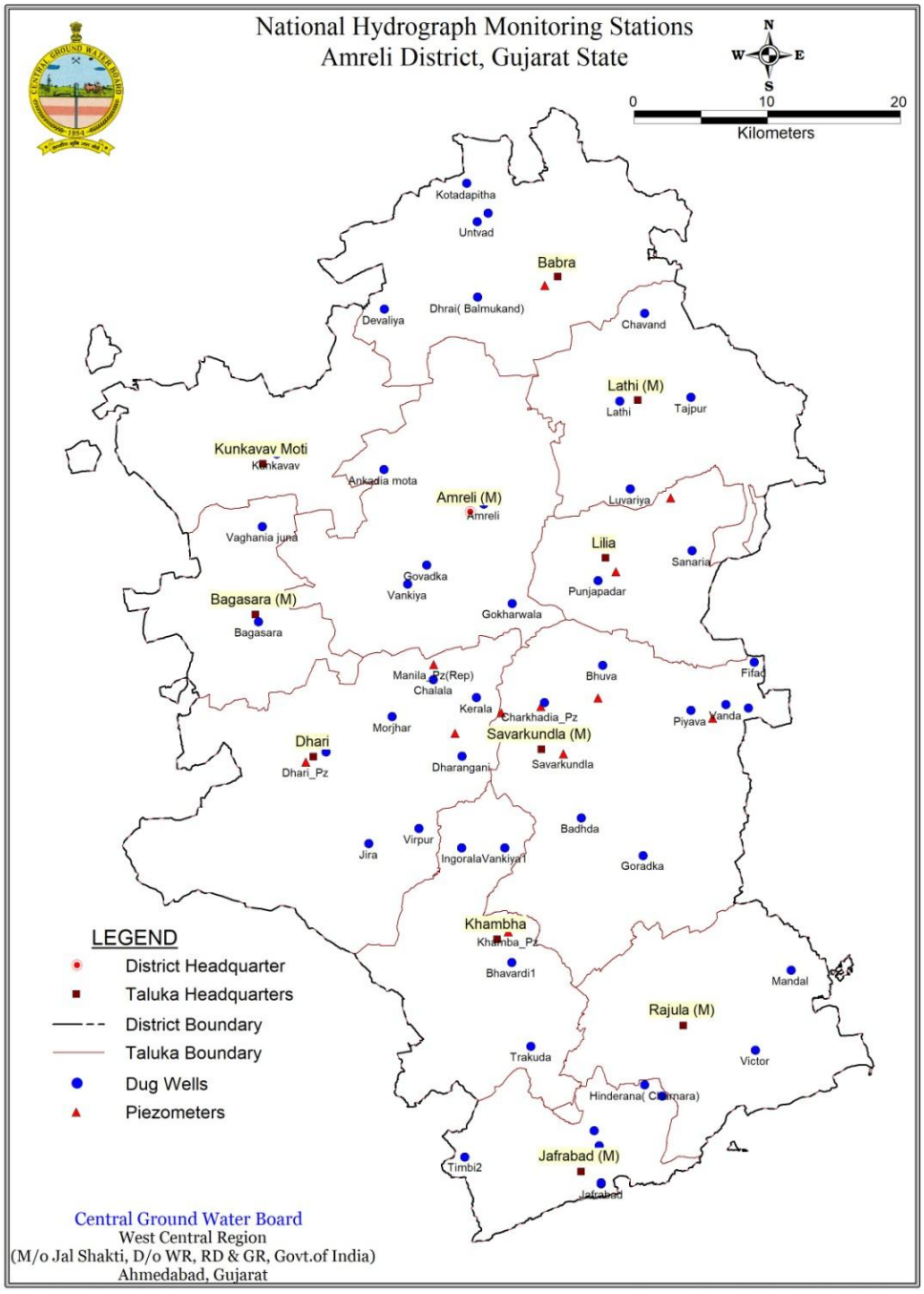

FIGURE 22- NATIONAL HYDROGRAPH STATIONS IN AMRELI DISTRICT

4.1 Depth to Water Level Pre monsoon (May 2021)

The depth to water levels in Amreli district during May 2021 ranges between 0.68 (Bherai, Jafrabad block) and 43.77 mbgl (Morjhar, Dhari block). The depth to water levels less than 5 mbgl are observed near Major/medium irrigation projects/canal command areas. In general, the depth to Water levels ranges between 2-20 mbgl is observed in the district. The Deeper water levels greater than 20 mbgl are observed in isolated patches in Dhari and Kunkavav block. The pre-monsoon depth to water level map is depicted in **Fig. 23**

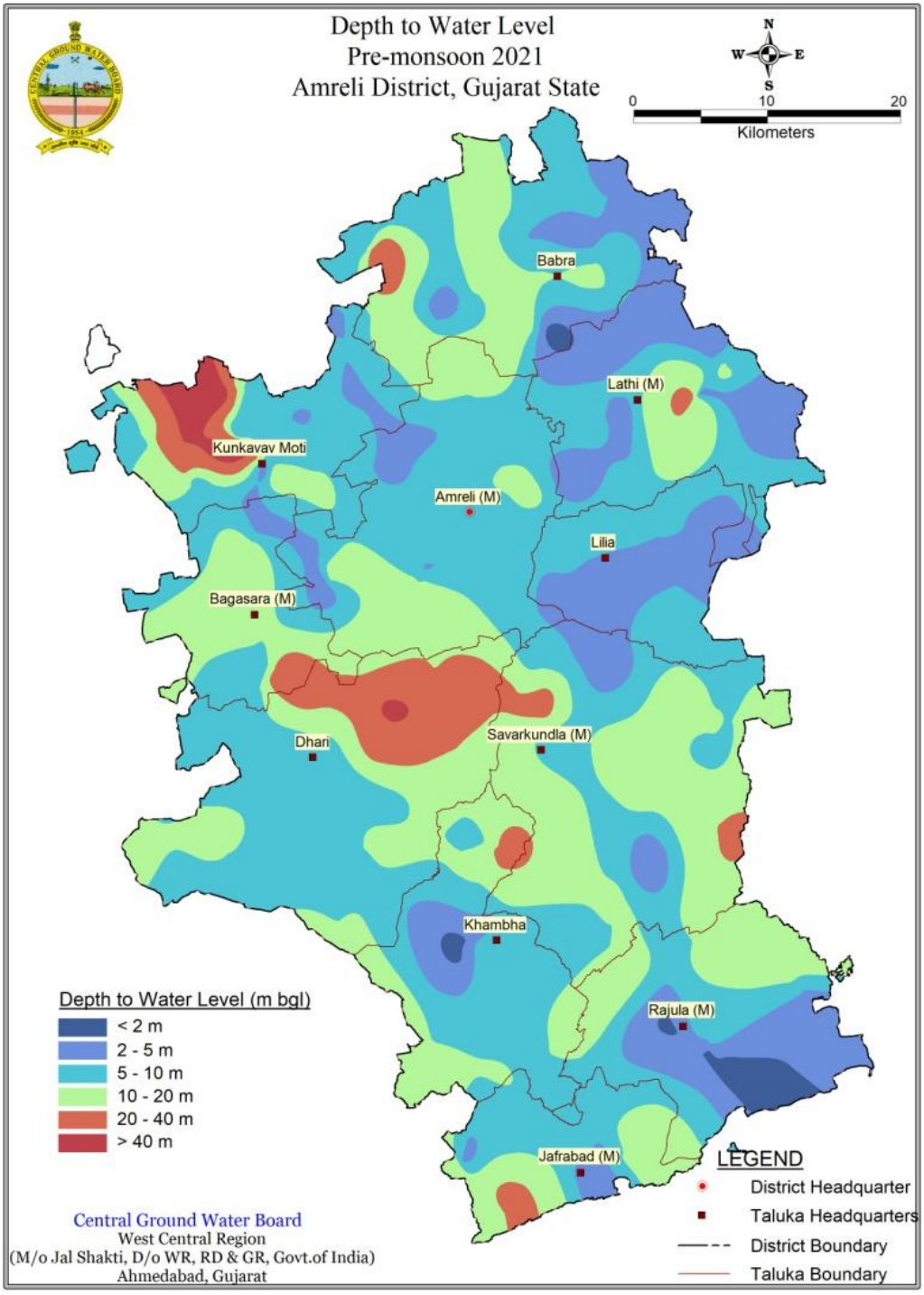

FIGURE 23- DEPTH TO WATER LEVEL MAP PRE MONSOON (MAY 2021)

4.2 Depth to Water Level Post monsoon (November 2021)

The depth to water levels in Amreli district during November 2021 ranges between 0.50 mbgl (Govadka, Amreli block) and 29.75 mbgl (Kerala, Dhari block). The depth to water levels less than 10 mbgl are observed near Major/medium irrigation projects/canal command areas. In general, the depth to Water levels between 0-10 mbgl is observed in the district. The Deeper water levels greater than 10 mbgl are observed in isolated patches in Dhari, Savarkundala and Kunkavav etc block. The post-monsoon depth to water level map is depicted in **Fig. 24**

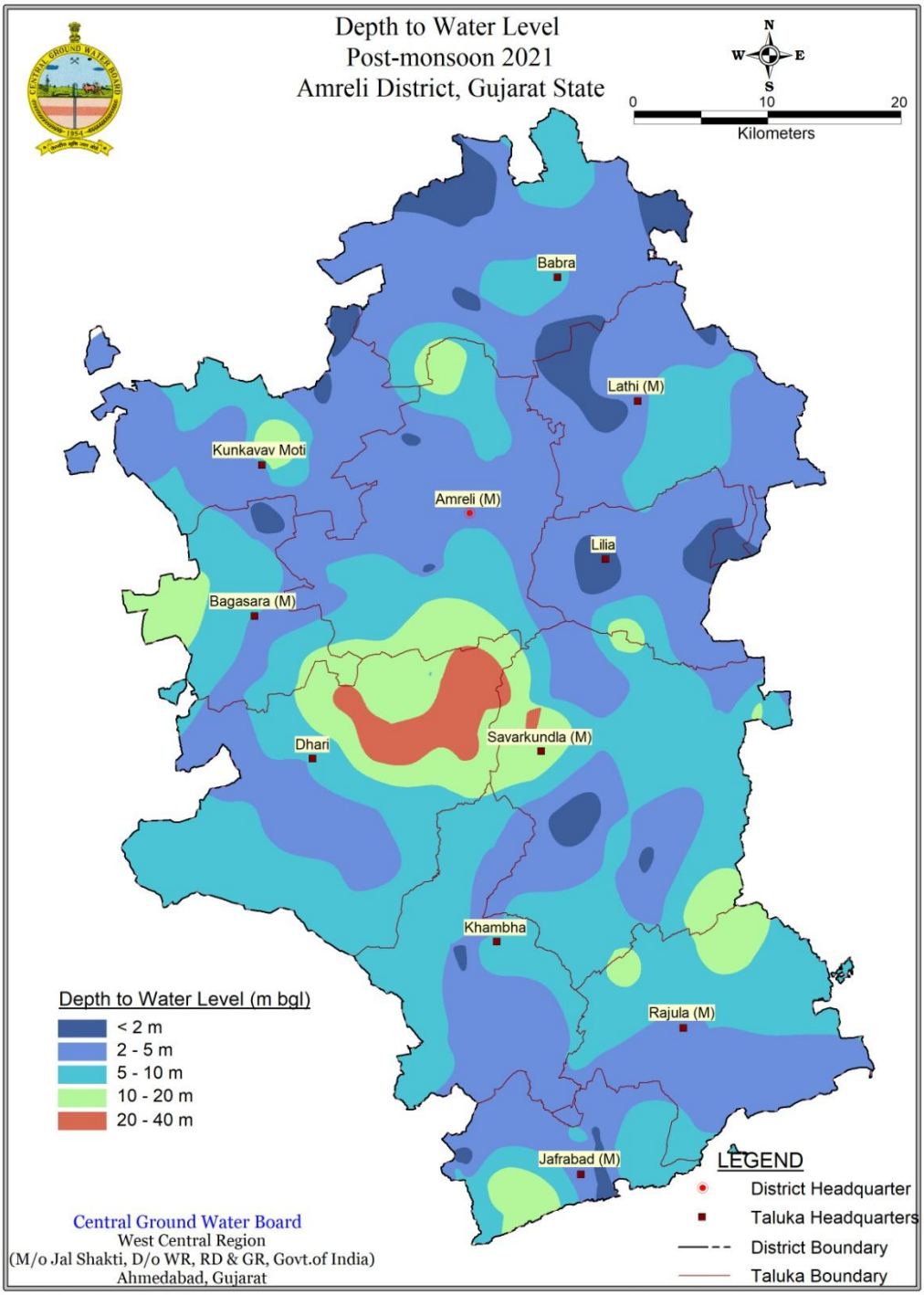

FIGURE 24- DEPTH TO WATER LEVEL MAP POST MONSOON (NOV 2021)

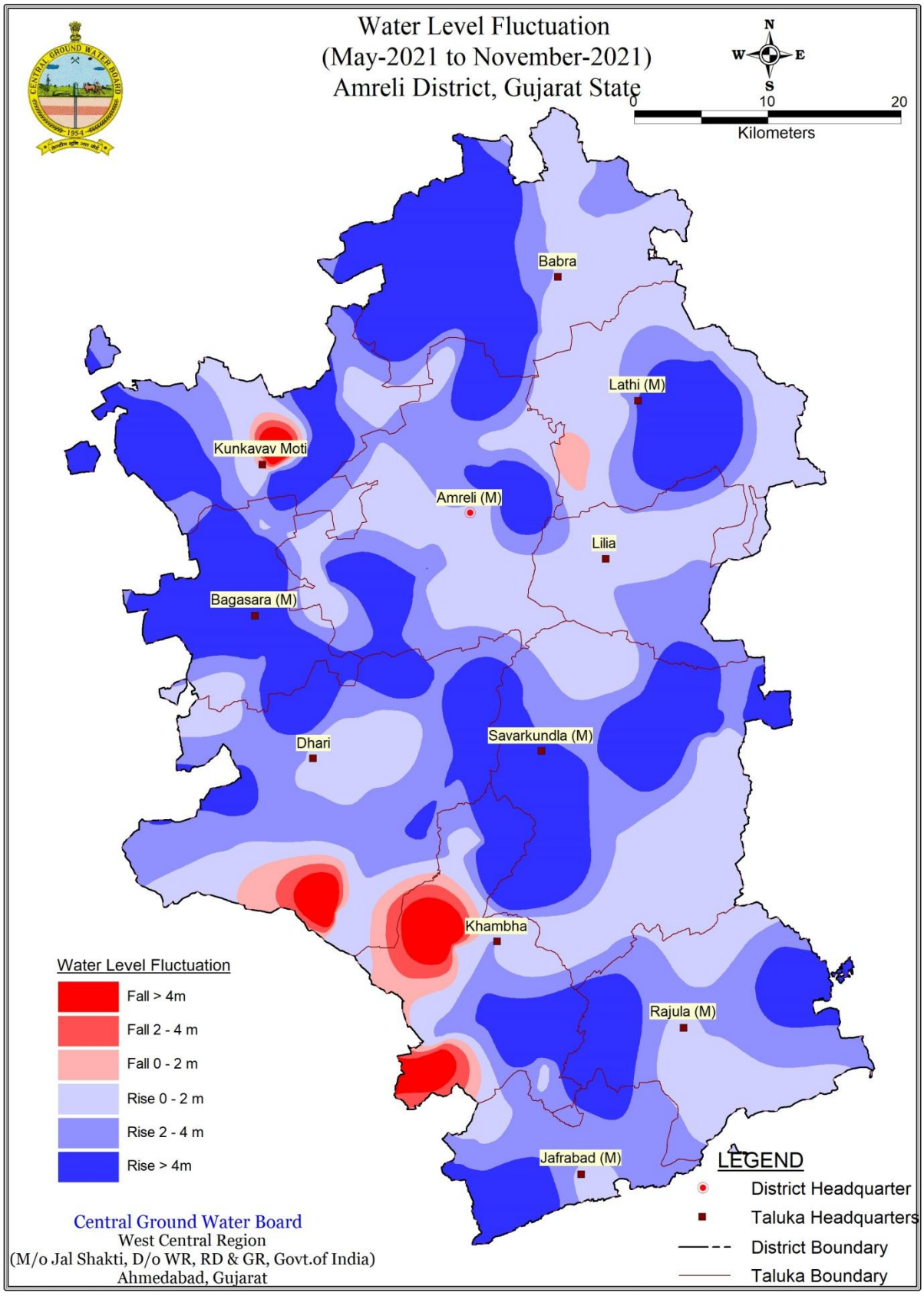

FIGURE 25- WATER LEVEL FLUCTUATION MAP MAY-NOVEMBER -2021

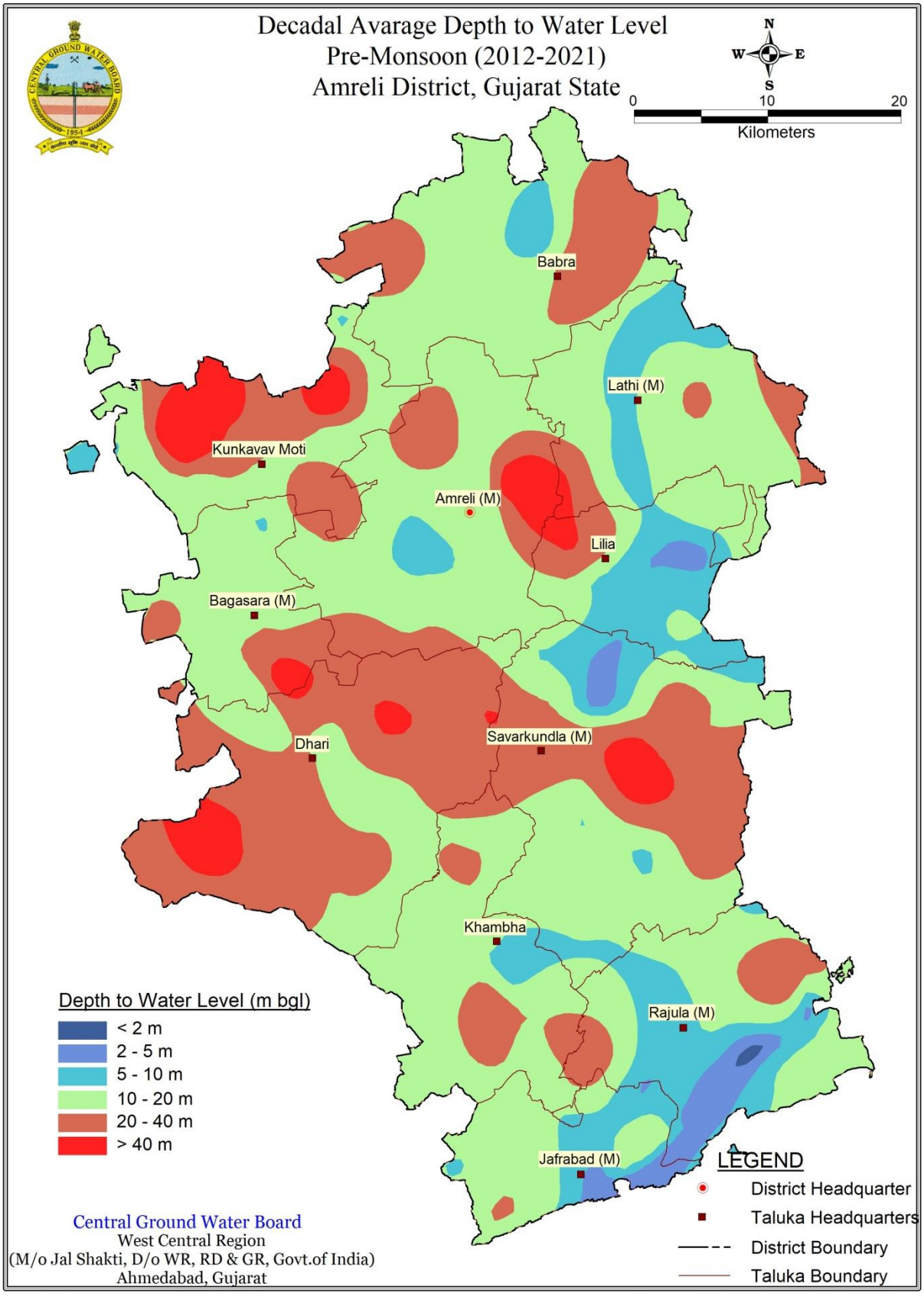

FIGURE 26- DECADAL AVERAGE DEPTH OF WATER LEVEL PRE-MONSOON (2012-21)

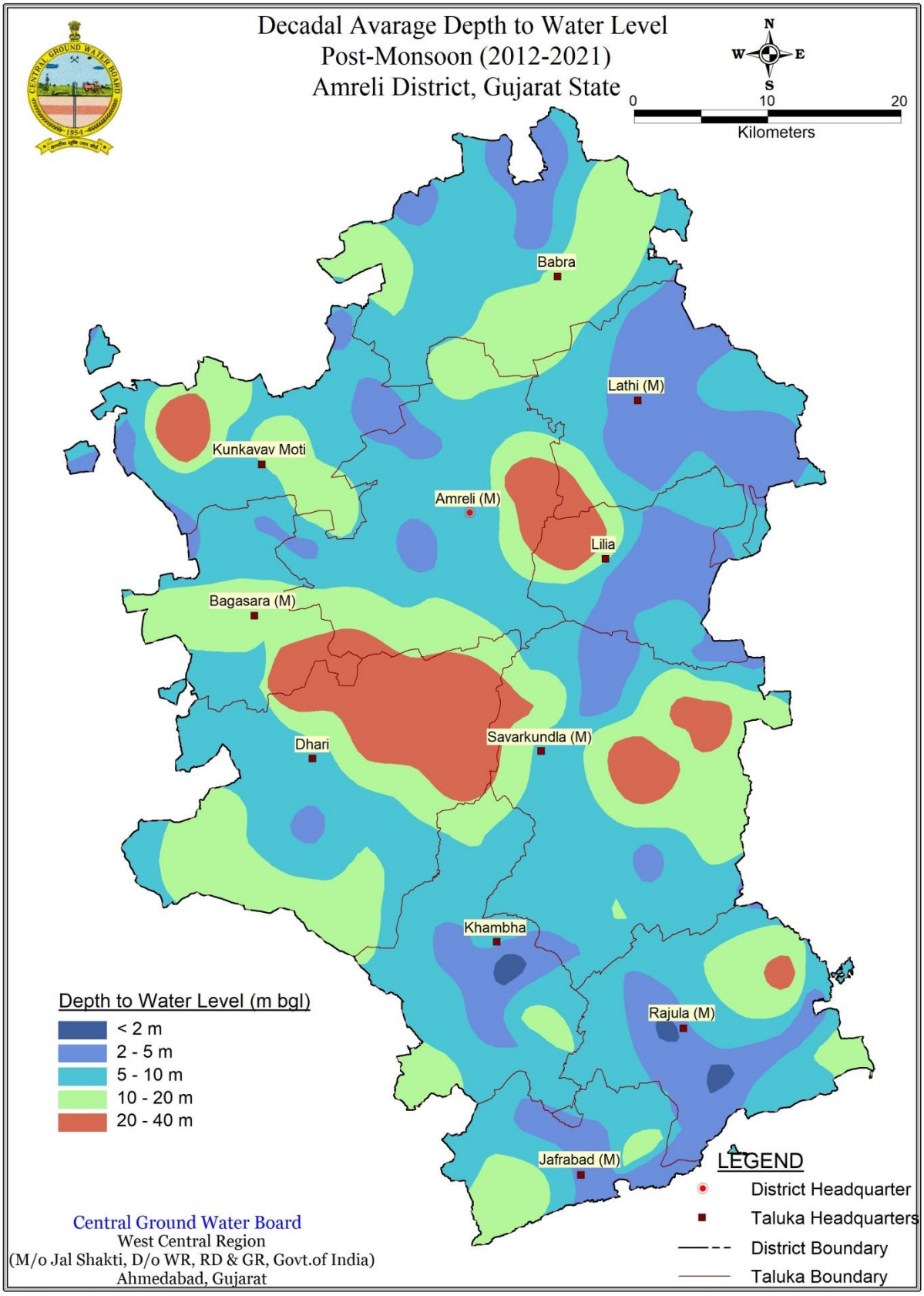

FIGURE 27- DECADAL AVERAGE DEPTH OF WATER LEVEL POST-MONSOON (2012-21)

5. GROUND WATER QUALITY:

Water sampling is being done every year from Ground Water Monitoring wells during pre-monsoon period (May). The data gap analysis has been carried out to find out the adequacy of information on water quality and identified 27 additional locations for unconfined aquifers. Ground water quality data of 23 monitoring wells of CGWB representing unconfined aquifer have been utilised to decipher the quality scenario of shallow aquifer.

TABLE 12- RANGES OF BASIC CHEMICAL ANALYSIS

Sl No	Parameter	Unit	Minimum	Maximum	Average
1	**pH**		7.5	8.3	7.9
2	**EC**	µS/cm	446.0	3701.0	1532.0
3	**TDS**	mg/l	299.0	5532.9	1169.4
4	**CO3**	mg/l	0.0	0.0	0.0
5	**HCO3**	mg/l	85.0	635.0	289.7
6	**Cl**	mg/l	14.0	1995.1	318.8
7	**NO3**	mg/l	1.3	308.0	73.0
8	**SO4**	mg/l	11.0	487.0	106.6
9	**F**	mg/l	0.1	1.4	0.6
10	**Alk**	mg/l	70.0	520.0	237.4
11	**Ca**	mg/l	28.0	176.0	76.0
12	**Mg**	mg/l	5.0	233.0	60.7
13	**TH**	mg/l	110.0	1401.0	440.0
14	**Na**	mg/l	24.0	701.0	160.7
15	**K**	mg/l	0.2	15.3	1.9
16	**SiO2**	mg/l	7.0	63.0	38.8
17	**SAR**		0.6	16.4	3.5

TABLE 13- RANGES OF HEAVY METAL CHEMICAL ANALYSIS

Parameters	Unit	Minimum (2021)		Maximum (2021)		Average (2021)	
		Pre-Monsoon	Post Monson	Pre-Monsoon	Post Monson	Pre-Monsoon	Post Monson
Cr	[mg/l]	0	0	0.013	0.000	0.001	0.000
Cu	[mg/l]	0	0	0.008	0.003	0.002	0.001
Fe	[mg/l]	0.011	0.004	1.123	0.344	0.293	0.100
Mn	[mg/l]	0	0.0042	0.072	0.228	0.018	0.024
Zn	[mg/l]	0.001	0.000	0.106	0.282	0.018	0.014

5.1 TOTAL DISSOLVED SOLIDS (TDS)

The concentration of TDS in shallow aquifer varies between 299 (Mayapadar, Kunkavav block) and 5532 (Bhuva, Savarkundla block). Out of 50 samples collected from dug wells and shallow tube wells, three samples are having TDS in range of 3000µS/cm. Concentration of EC >3000 µS/cm has been observed in three wells ones each in Savarkundla, Rajula, and Jafarbad block. In general the ground water is potable in entire part of district except coastal area. The distribution of TDS in shallow aquifers during Pre-monsoon is shown in **Fig. 28**.

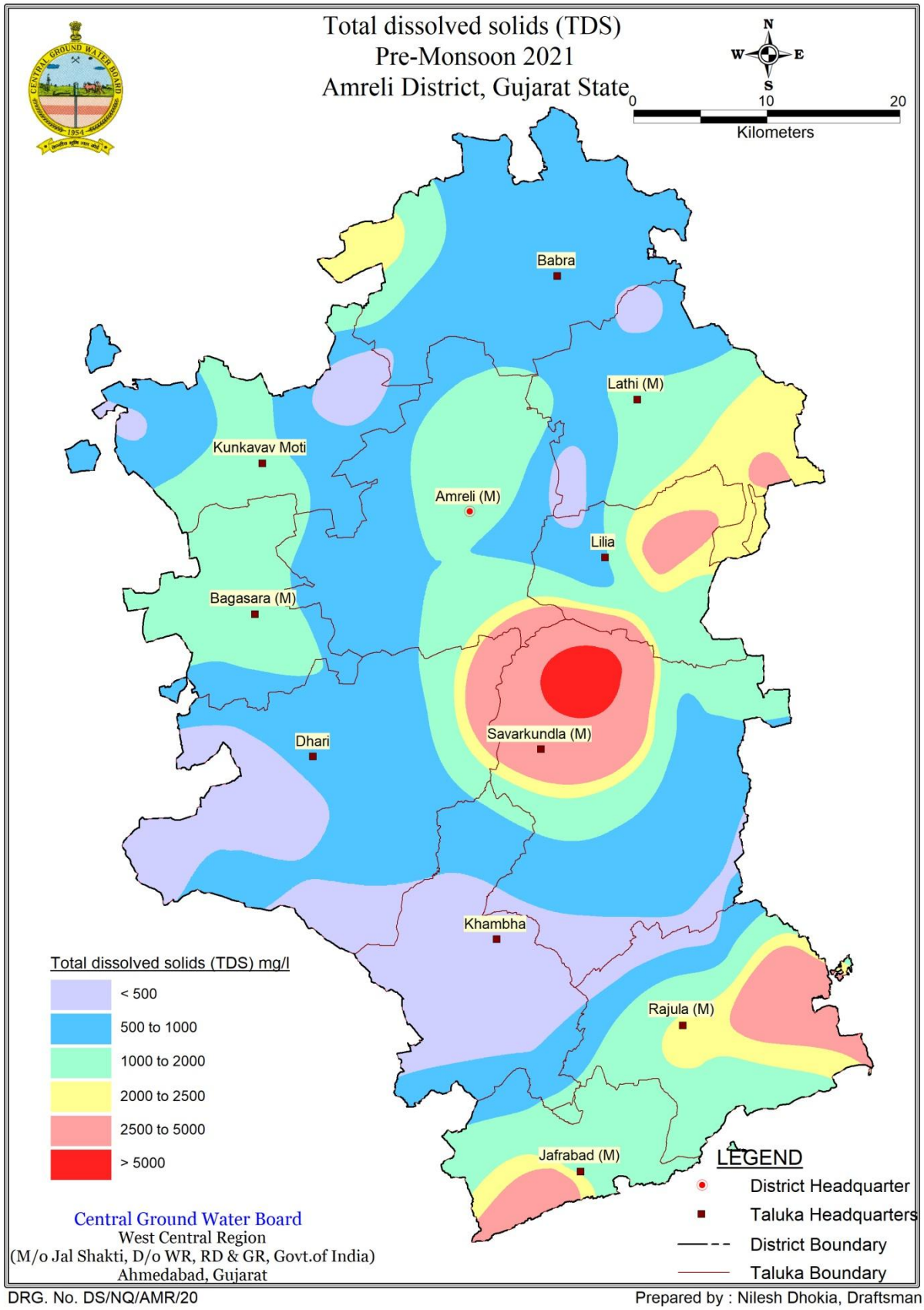

FIGURE 28- TDS MAP OF AMRELI DISTRICT.

5.2 NITRATE (NO_3^-):

Nitrogen in the form of dissolved nitrate nutrient for vegetation, and the element is essential to all life. The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter. The concentration of nitrate concentration in shallow aquifer varies between 1.3 (Ambardi, Lathi block) and 308 (Tori, Kunkavav block). In shallow aquifer, 50 samples were analyzed; out of this 22 water samples show the nitrate concentrations exceeding the desirable limit of 45 mg/l. The distribution of nitrate in shallow aquifers is shown in **Fig. 29**.

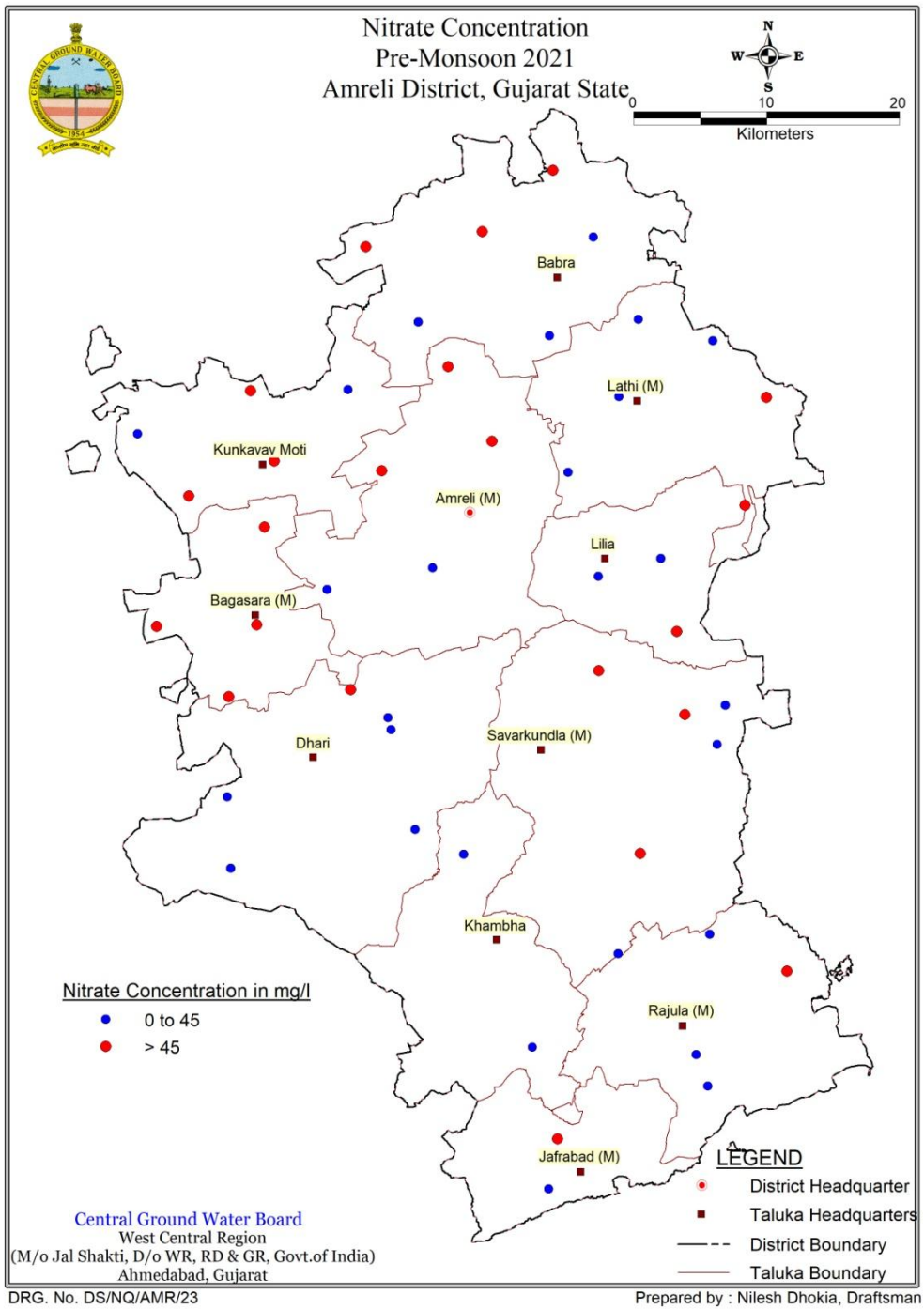

FIGURE 29- NITRATE CONCENTRATION MAP OF AMRELI DISTRICT

5.3 FLUORIDE (F):

The major contribution in ground water is from geogenic sources by weathering of meta-sediments in Hard rock terrain. The concentration of fluoride concentration in shallow aquifer varies between 0.06 (Tori, Kunkavav block) and 1.43 (kankot, Liliya block). In shallow aquifer, 50 samples were analyzed; not a single water samples show the fluoride concentrations exceeding the permissible limit of 1.5 mg/l. The distribution of fluoride in shallow aquifers is shown in **Fig. 30**.

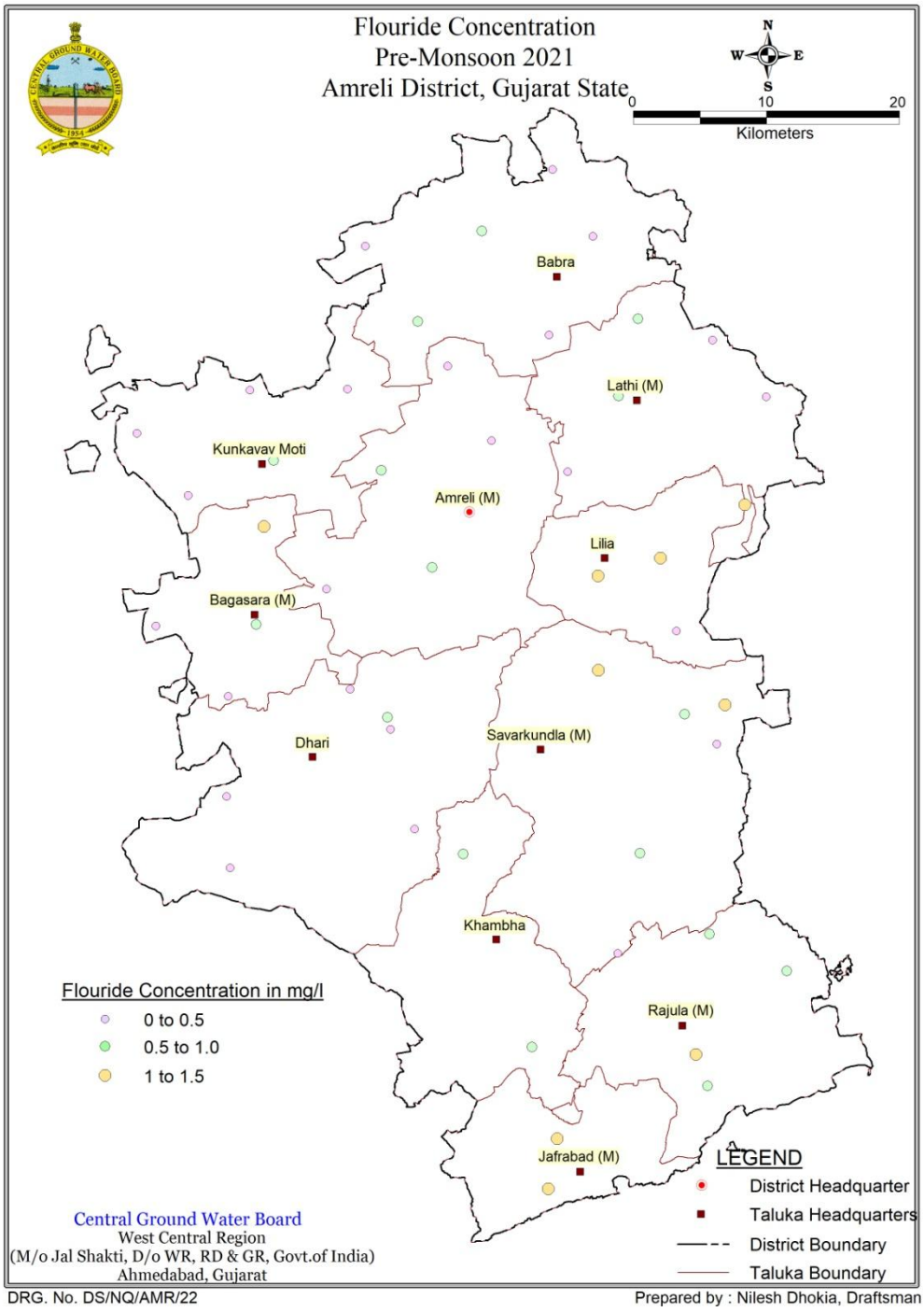

FIGURE 30- FLUORIDE CONCENTRATION MAP OF AMRELI DISTRICT

5.4 CHLORIDE (Cl):

The major contribution in ground water is from geogenic sources by weathering of meta-sediments in Hard rock terrain. The concentration of fluoride concentration in shallow aquifer varies between 14 (Boradi, Dhari block) and 1995 (Bhuva, Savarkundla block). In shallow aquifer, 50 samples were analyzed; only three water samples show the fluoride concentrations exceeding the permissible limit of 1000 mg/l. The distribution of fluoride in shallow aquifers is shown in **Fig. 31**.

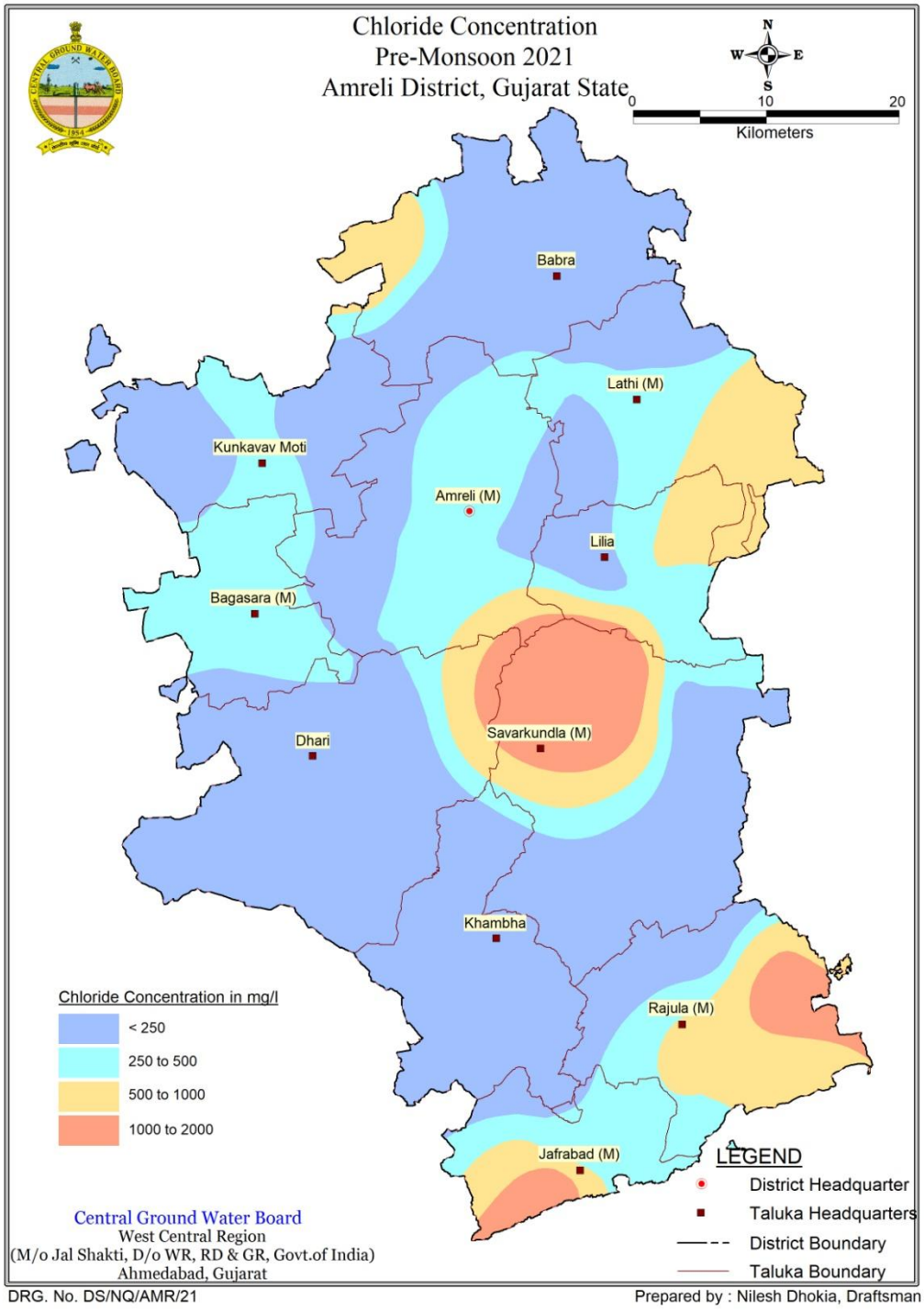

FIGURE 31- CHLORIDE CONCENTRATION MAP OF AMRELI DISTRICT

5.5 IRON (Fe):

The most common sources of iron in groundwater are naturally occurring, for example from weathering of iron bearing minerals and rocks. Industrial effluent, acid-mine drainage, sewage and landfill leachate may also contribute iron to local groundwater. The concentration of Iron in shallow aquifer varies between 0.0106 (Dudhala, Jafarabad block) and 1.1229 (Mota Machiyala, Babra block). In shallow aquifer, 50 samples were analyzed; there are 10 water samples show the iron concentrations exceeding the permissible limit of 0.3 mg/l. The distribution of Iron in shallow aquifers is shown in **Fig. 32**.

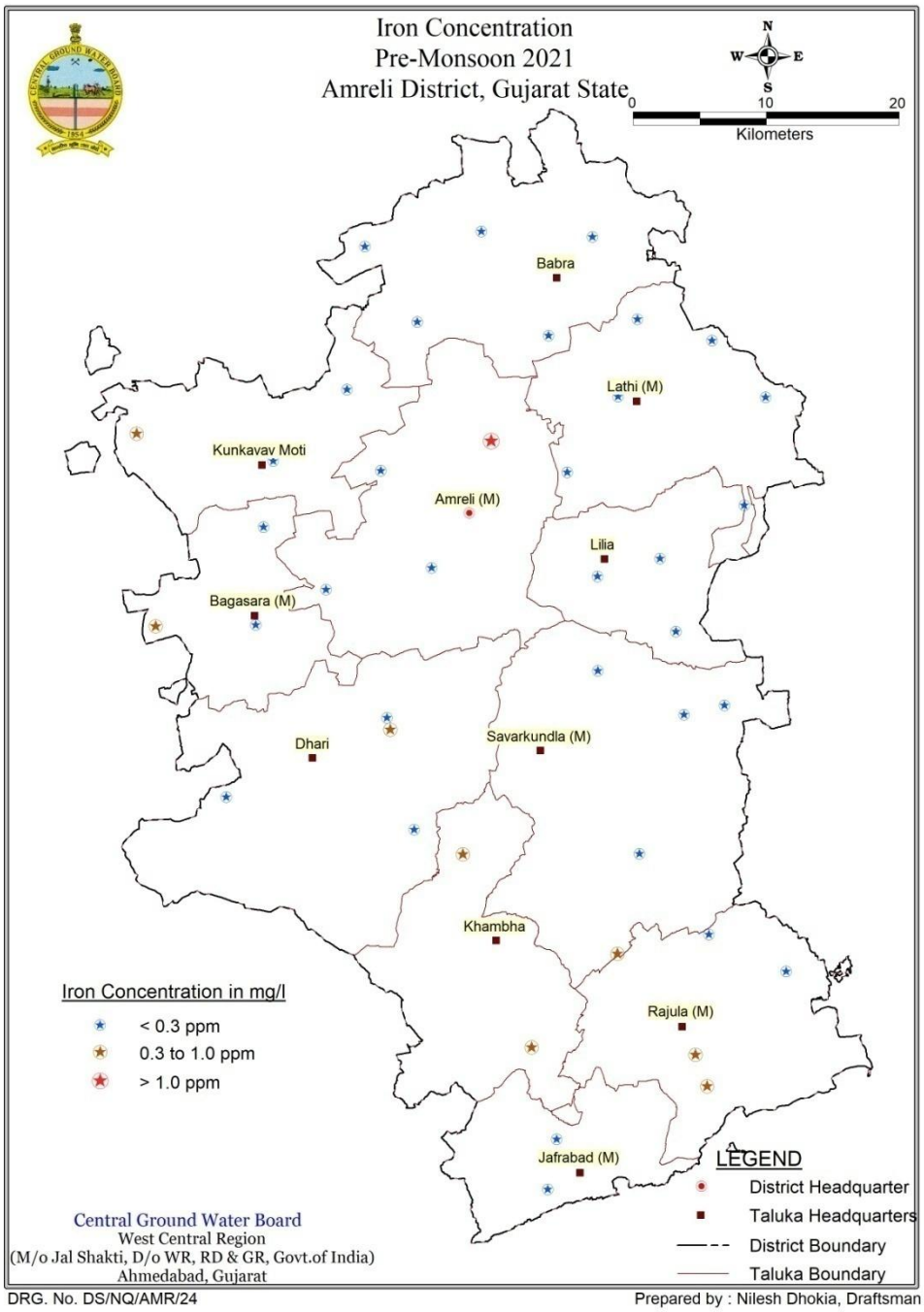

FIGURE 32- IRON CONCENTRATION MAP OF AMRELI DISTRICT

6. GROUND WATER RESOURCES FOR AMRELI DISTRICT

Central Ground Water Board and Gujarat water Resources Development Corporation Limited (GWRDC) have jointly estimated the ground water resources of Amreli district based on GEC-15 methodology in GWRA-2020. Block wise ground water resources are given in TABLE 14.

As per the Ground Water Resources estimation 2020, the annual replenishable ground water is 1560.04 MCM and the net annual ground water availability comes to be 1482.04 MCM. The gross draft for all uses is estimated at 748.48 MCM with irrigation sector being the major consumer having a draft of 1482.04 MCM. The domestic and industrial water requirements are worked at 16.52 MCM. The net ground water availability for future irrigation is estimated at 746.40 MCM. Stage of ground water development varies from 36.17 % (Dhari) to 88.61 % (Rajula). The overall stage of ground water development for the district is 50.50 %. Block wise assessments indicate that all the blocks in the district fall under “Safe” category.

TABLE 14- GROUND WATER RESOURCES ESTIMATION AS PER GWRA 2020

Ground Water Resources of Amreli District 2020															
Sl. No	State	District	Assessment Unit Name	Recharge from Rainfall-Monsoon Season	Recharge from Other Sources-Monsoon Season	Recharge from Other Sources-Non Monsoon Season	Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)	Annual ExtracTABLE Ground Water Resource (Ham)	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Stage of Ground Water Extraction (%)	Categorization
1	Gujarat	Amreli	Amreli	13787.09	1418.86	1635.2	16841.15	842.06	15999.09	9501.8	5.26	0.00	9507.06	59.42	safe
2	Gujarat	Amreli	Babra	16595.46	942.2	1175.02	18712.68	935.63	17777.05	10481.1	0	0.00	10481.1	58.96	safe
3	Gujarat	Amreli	Bagasara	7357.58	328.09	454.75	8140.42	407.02	7733.4	4160.1	0	0.00	4160.1	53.79	safe
4	Gujarat	Amreli	Dhari	26727.58	569.06	585.3	27881.94	1394.1	26487.84	9434	0	146.24	9580.24	36.17	safe
5	Gujarat	Amreli	Jafrabad	2361.09	250.13	409.67	3020.89	151.04	2869.85	1857.6	0	0.00	1857.6	64.73	safe
6	Gujarat	Amreli	Khambha	7931.1	630.56	647.22	9208.88	460.44	8748.44	4640.9	0	56.58	4697.48	53.70	safe
7	Gujarat	Amreli	Kunkavav Vadia	18594	618.15	567.57	19779.72	988.99	18790.73	9861.7	0	0.00	9861.7	52.48	safe
8	Gujarat	Amreli	Lathi	14840.64	1167.97	1538.11	17546.72	877.34	16669.38	6588.3	0	0.00	6588.3	39.52	safe
9	Gujarat	Amreli	Lilia	5458.03	336.86	523.99	6318.88	315.94	6002.94	2963.6	0	0.00	2963.6	49.37	safe
10	Gujarat	Amreli	Rajula	3045.85	674.48	901.53	4621.86	231.1	4390.76	3890.6	0	0.00	3890.6	88.61	semi_critical
11	Gujarat	Amreli	Savar Kundla	21269.62	1107.62	1553.37	23930.61	1196.53	22734.08	11260.7	0	0.00	11260.7	49.53	safe
				137968.04	**8043.98**	**9991.73**	**156003.75**	**7800.19**	**148203.56**	**74640.4**	**5.26**	**202.8273975**	**74848.48**	50.50	safe

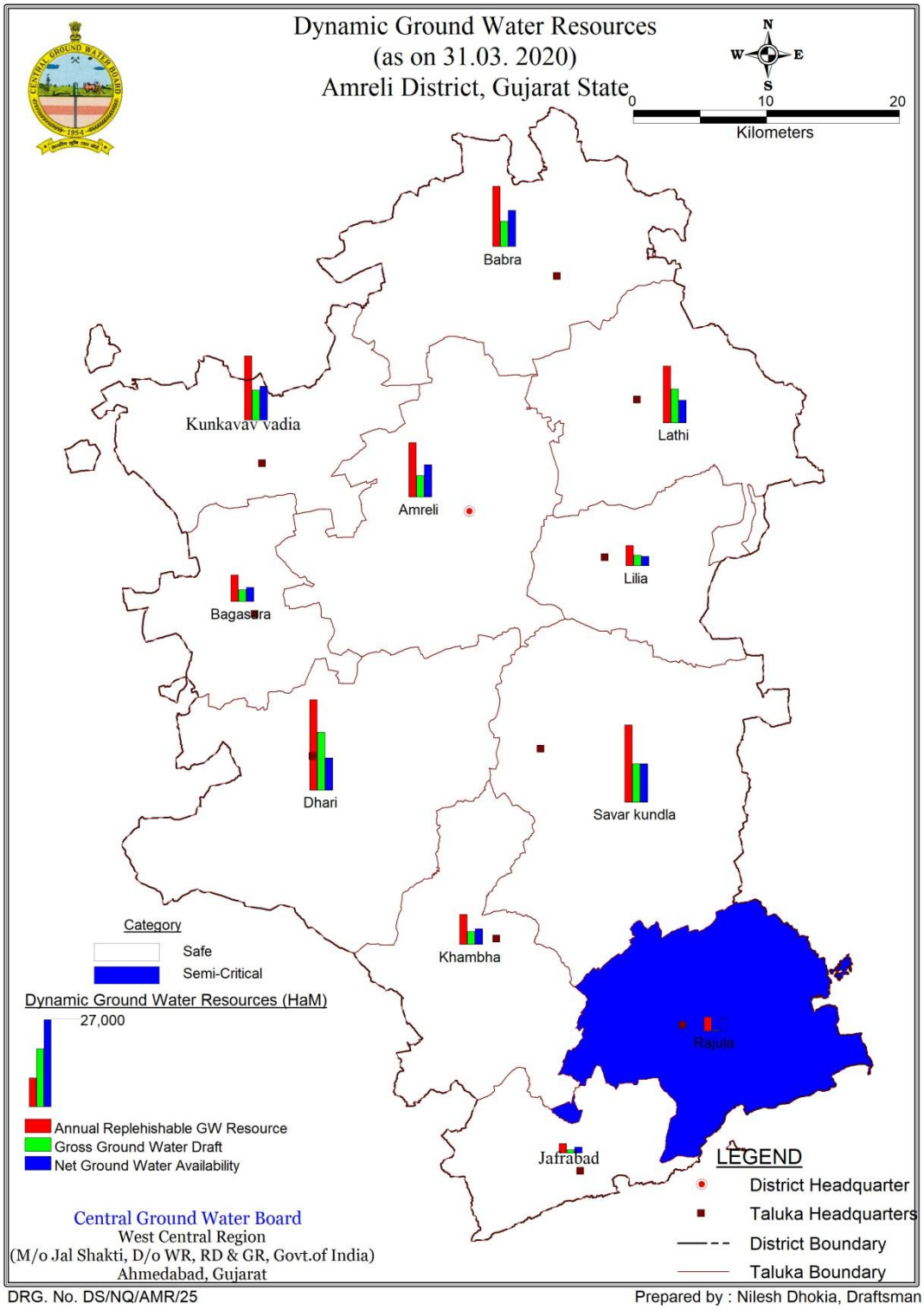

FIGURE 33- GROUND WATER RESOURCES 2020 REPRESENTATION

7. GROUND WATER MANAGEMENT PLAN AND SUSTAINABLE DEVELOPMENT:

The management plan has been proposed to manage the ground water resources and to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management. The supply side managements proposed based on surplus surface water availability and the unsaturated thickness of aquifer whereas the demand side management is proposed by use of micro irrigation techniques and change in cropping pattern.

7.1 GROUND WATER RELATED ISSUES:

1. **Low Yield and Sustainability of the Wells:** Low yield and Sustainability of hard rock Aquifers and Non Availability of sufficient Surface Water for Irrigation.
2. **Ground water Quality:** Ground water in both Phreatic and confined Aquifers is potable and fit for domestic, drinking, irrigation and other industrial purposes but higher concentration of Fluoride and Nitrate is observed in shallow aquifer at localised pockets. In coastal regions, Ground water in phreatic aquifer is potable and fit for domestic, irrigation and other industrial purposes but below the phreatic depth of 15-20 m bgl the ground water is saline.
3. **Groundwater management plan:** Ground water management plan (Both supply side and Management side) needs to be prepared with an aim to enhance the groundwater usage for creation of additional irrigation potential for the district for uplifting the economic condition of the farmers.

7.2 SUPPLY SIDE MANAGEMENT

The supply side management of ground water resources can be done through the artificial recharge of surplus runoff available within river sub basins and micro watersheds. Also, it is necessary to understand the unsaturated aquifer volume available for recharge. The unsaturated volume of aquifer was computed based on the area feasible for recharge, unsaturated depth below 5 m bgl and the specific yield of the aquifer. The TABLE no 15 gives the block wise volume available for the recharge.

TABLE 15- AREA FEASIBLE AND VOLUME AVAILABLE FOR ARTIFICIAL RECHARGE

Block	Area (KM^2)	Surplus water available for AR (MCM)	No Recharge Shaft (From Artificial Recharge Plan)	Defunct Well (From Artificial Recharge Plan
AMRELI	831.66	1.72	69	3
BABRA	800.75	1.66	63	0
BAGASARA	349.87	0.72	32	0
DHARI	1044.23	2.16	99	2
JAFRABAD	322.82	0.67	21	0
KHAMBHA	601.41	1.25	41	0
KUNKAVAV VADIA	553.76	1.15	39	0
LATHI	637.27	1.32	17	0
LILIA	396.50	0.82	12	0
RAJULA	651.77	1.35	20	0
SAVARKUNDLA	1050.81	2.18	80	2
Total	**7240.84**	**15**	**493**	**7**

7.3 GROUND WATER DEVELOPMENT PLAN

As per GWRE 2020, 10 blocks of Amreli district are under safe category and one block (Rajula) is under semi critical category. Ground water stage of development ranges from 36.17 % (Dhari) to 88.61 % (Rajula). To elevate the stage of ground water development in under developed blocks, 13740 nos. of Dug wells (20m depth) and 1545 no Bore wells (100m depth) are proposed as feasible extraction structures. The extraction structures will result in additional ground water draft of 8017.80 hams which will create 16035 ha additional irrigation potential for the district.

TABLE 16- PROPOSED GROUND WATER DEVELOPMENT PLAN INTERVENTIONS

Block	Feasible Extraction structures to elevate the Stage of GW development (Hard Rock)	
	DW	TW
Amreli	1100	505
Babra	487	50
Bagasara	970	105
Dhari	2030	150
Jafrabad	245	0
Khambha	1095	50
Kunkavav Vadia	2550	285
Lathi	1752	100
Lilia	1200	100
Rajula	0	0
Savakundla	2311	200
Total	13740	1545

7.4 DEMAND SIDE MANAGEMENT

Even though the stage of ground water development in the district is low, however to manage the resources perceiving the future demand, following water use efficiency interventions are proposed.

- 14150 Ha area is proposed for on farm activities (Laser levelling/Bench terracing/Contour banding) and 660 no of farm ponds are recommended which will serve dual purpose of irrigation and recharge to ground water.
- Ground water recharge of 1125.27 ham (through on farm activities and GW return flow) is expected for the district.
- 2122.63 hams saving of ground water through WUE measures & farm ponds activities are expected for the district.

TABLE 17- PROPOSED WUE INTERVENTIONS IN AMRELI DISTRICT

Block	On farm Activities (Area in ha)	Water Use Efficiency Measures (Area in ha)	Farm Pond (Nos.)
Amreli	2500	2050	300
Babra	1000	500	50
Bagasara	500	110	100
Dhari	600	200	220
Jafrabad	515	115	150
Khambha	110	50	50
Kunkavav Vadia	675	100	100
Lathi	800	300	80
Lilia	2000	250	120
Rajula	3300	1500	550
Savakundla	2150	500	100
Total	14150	5675	1820

7.5 EXPECTED BENEFITS:

The impact of groundwater management plans on the groundwater system in the district after its implementation is evaluated and the outcome shows significant improvement in groundwater scenario in all blocks as given in the TABLE 18.

TABLE 18- PROJECTED STATUS OF GROUNDWATER RESOURCE AFTER IMPLEMENTATION OF GW MANAGEMENT PLAN

Block	Net G.W. Availability (Ham)	Additional Recharge from Recharge interventions (ham)	Additional Recharge from Return flow of GW Irrigation	Total Net G.W. Availability after intervention (Ham)	Existing G.W Draft for all purpose (ham)	Conservation of Ground water through WUE, on farm activity & farm ponds (ham)	G.W Draft from Extraction structures (ham)	Net GW draft after interventions (ham)	Present stage of G.W. Development (%)	Projected stage of G.W. Development after construction of extraction structures (%)	Projected stage of GW development after construction of extraction structures & implementation of conservation & Recharge measures (in %)	Additional Irrigation Potential Created (Ha)
Amreli	15999.09	466.00	95.40	16560.49	9507.06	525.45	954.00	9935.61	59.42	65.00	60.00	1908
Babra	17777.05	289	57.148	18123.20	10481.1	140.49	219.8	10560.41	58.96	60.00	58.27	439.6
Bagasara	7733.4	146	147.94	8027.34	4160.1	72.48	569	4656.62	53.79	60.00	58.01	1138
Dhari	26487.84	363	295.1	27145.94	9580.24	128.16	1135	10587.08	36.17	40.01	39.00	2270
Jafrabad	2869.85	114.5	25.48	3009.83	1857.6	89.47	98	1866.13	64.73	67.54	62.00	196
Khambha	8748.44	134	58.75	8941.19	4697.48	28.49	587.5	5256.49	53.70	60.01	58.79	1175
Kunkavav Vadia	18790.73	184.5	150.3	19125.53	9861.7	79.73	1503	11284.97	52.48	60.00	59.00	3006
Lathi	16669.38	131	95.6	16895.98	6588.3	109.79	956	7434.51	39.52	45.00	44.00	1912
Lilia	6002.94	236	68	6306.94	2963.6	174.68	680	3468.92	49.37	60.02	55.00	1360
Rajula	4390.76	390	0	4780.76	3890.6	560.40	0	3330.20	88.61	88.61	69.66	0
Savakundla	22734.08	461	131.55	23326.63	11260.7	213.48	1315.5	12362.72	49.53	55.00	53.00	2631
Total	**148203.56**	**2915.00**	**1125.27**	**152243.83**	**74848.48**	**2122.63**	**8017.80**	**80743.65**	**50.5**	**60.11**	**56.07**	**16035.6**

8. Sum Up:

- A thorough study was carried out based on data gap analysis, data generated in-house; data acquired from State Government departments and GIS maps prepared for various themes. All the available data was brought on GIS platform and an integrated approach was adopted for preparation aquifer maps and aquifer management plans of Amreli district.
- Amreli district covering an area of 7240.84 sq km. Geologically, the area is occupied by Deccan Trap lava flows, Supratrappeans, Gaj Beds, Miliolite limestones and recent unconsolidated deposits. The stage of ground water development is 50.50%. The district has witnessed low stage of Ground Water Development and low yield potential aquifers, which are the major issues.
- The management plan has been proposed to manage the ground water resources and to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management.
- As a part of Supply side Management, a total 493 recharge shaft and 7 defunct tube wells are proposed, which will augment ground water resources to the tune of 15.00 MCM. Even though the stage of ground water development in the district is low, however to manage the resources perceiving the future demand, 14150 Ha area is proposed for on farm activities (Laser levelling/Bench terracing/Contour banding) and 1820 nos. of farm ponds are recommended which will serve dual purpose of irrigation and recharge to ground water.
- The ground water development plan has been proposed in view of the developing additional ground water resources available after supply side interventions to bring the stage of ground water development up to 70%. The 80.18 MCM volume of ground water generated can bring 160.35 sq km additional area under assured ground water irrigation by constructing 13740 Dug wells and 1545 borewell.
- Present supply side interventions are suggested based on availability 15 MCM non committed source of water is referred by State Government (Reference Master Plan of Artificial recharge 2020). Proposed enhancements of present Groundwater development stage is subjected to implementation of recharge interventions, availability of cultivable land and yield of Groundwater structures.
- These interventions also need to be supported by regulation, so that the ground water resources are protected for future generation and also serve as ground water sanctuary in times of distress/drought. IEC activities and capacity building activities needs to be aggressively propagated to establish the institutional framework for participatory ground water management.