



# GROUND WATER YEAR BOOK 2019-20

## JAMMU & KASHMIR



**CENTRAL GROUND WATER BOARD**  
**North Western Himalayan Region**  
**Jammu**  
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**Ministry of Jal Shakti  
Department of Water Resources  
River Development and Ganga Rejuvenation**

**GROUND WATER YEAR BOOK 2019 – 20  
JAMMU & KASHMIR**

**CENTRAL GROUND WATER BOARD**

**NORTH WESTERN HIMALAYAN REGION**

**3rd Floor, Jal Ayog Bhawan, Rajinder Nagar, Phase 1,**

**Ban Talab Jammu – 181 223**

**Jammu**

## FOREWORD

WATER is one of the essential natural resources for sustaining life on blue planet “Earth”. The demand of fresh / usable water has increased manifold globally due to rapid growth in population, which in turn caused change in agricultural pattern and increase in industrial activities. To meet the demand of fresh water of various sectors, there is an enormous stress on ground water resources as the surface water pollution is increasing day by day. This has resulted in the water level decline in many parts of the country.

Central Ground Water Board, the apex organization under the Ministry of Water Resources River Development & Ganga Rejuvenation, Government of India, monitors the behaviour of the ground water regime through a network of ground water monitoring wells spread across the country. The water level data collected from such observation wells in each state are compiled, processed and the salient features brought out as a “Ground Water Year Book” every year. This report pertains to the scenario of ground water regime in the UT of Jammu and Kashmir for the year 2019-2020.

Central Ground Water Board, North Western Himalayan Region, Jammu is monitoring the groundwater regime under various hydrogeological setting through Dug wells and Piezometers in valley areas of U.T. of Jammu and Kashmir, viz. Jammu, Kathua, Rajouri, Reasi, Samba and Udhampur districts four times in a year (January, May, August and November) and Anantnag, Bandipora, Baramulla, Budgam, Ganderbal, Kupwara, Pulwama and Srinagar Districts three times in a year (May, August and November). Due to the snowfall monitoring of January month is not feasible. The effect of rainfall/snowfall on the ground water regime is studied through the fluctuations between pre and post monsoon. Similarly, water level fluctuations between the two consecutive seasons are studied and comparisons of water level for the year are done with the long-term mean of at least one decade. The spatial and temporal variations in the chemical quality of the formation water are studied through chemical analysis of water samples collected from the ground water monitoring wells during the month of May each year.

The present report of Ground Water Year Book, 2019 – 2020 is the hard work & outcome of the efforts made by **Sh. Parvej Ahamad, Scientist-B** and **Rayees Ahmad Pir, Assistant Hydrogeologist**. The efforts in depicting the groundwater scenario of Jammu & Kashmir U.T. through maps and giving proper shape to this report, is highly appreciable.

The information and data presented in this report will serve as a database to the user agencies, ground water planners and managers and will be of immense use to understand the regional picture on the quantitative and qualitative aspects of ground water regime in UT of Jammu & Kashmir.

Place: Jammu  
Date: 20.09.2021

Sd-  
M L Angurala  
Regional Director I/C

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## EXECUTIVE SUMMARY

The present report discusses the behaviour of water levels and chemical quality of groundwater in the phreatic aquifers of outer plains of Jammu region, extending between River Ravi in the east to Munawar Tawi in west covering parts of Jammu, Samba and Kathua districts J&K, India. Dun Belt covering alluvium areas of Kathua, Samba, Udhampur, Reasi and Rajouri district. In this area, the water supply mainly depends on groundwater either from the springs, shallow/ or deep aquifer systems. The groundwater also forms the main source to the surface water bodies through base flow. Monitoring of groundwater levels is carried out four times in a year during the months of May, August, November 2019 and January 2020. Further, in order to understand the spatiotemporal fluctuations of groundwater in response to ground water recharge and/or discharge, the groundwater level contour maps were generated. The chemical quality evaluation of the groundwater was also carried out on the basis of 314 number of water samples collected from shallow aquifers during pre-monsoon season (May 2019). The groundwater level maps showed that the water levels in Kandi formation is deeper than areas in Sirowal formation and is significantly controlled by the monsoons. At certain places particularly in urban and industrial areas the groundwater levels are showing declining trend in response to over exploitation. The chemical analysis indicated overall a good quality of the groundwater that is suitable for drinking and other domestic purposes. The EC was generally low indicating groundwater as fresh and potable. The pH showed the neutral to alkaline nature of water. The total hardness was found to be within the acceptable limits (BIS-2012) for drinking purposes. The chloride and fluoride concentrations were found within the maximum permissible limits of BIS standards. The calcium and magnesium, concentration in general is low with the exception of certain places where the concentration of each ion was found to be high. The chemical quality analysis shows that the ion concentration is within the permissible ranges. Thus, proper protection measures are required to be taken to avoid contamination of groundwater in the area. For instance, proper monitoring for ions and other trace elements in urban & industrial areas like Bari-Brahmana, Gangyal etc. shall be taken up and monitoring network stations need to be established all along the nalas and drains carrying industrial effluents and municipal wastes in the area.

## 1. INTRODUCTION

Jammu and Kashmir is the northern most UT of India after Ladakh. It lies within latitudes of 32°17' and 36°08' N and longitudes of 73°23' and 76°47' E. The UT has a total geographical area of 42,241 Sq. Km. The Union Territory has international border with Pakistan in the west. The States of Punjab and Himachal Pradesh form its southern border and UT of Ladakh forms the northern and north eastern border. Major parts of the J&K UT represent high and rugged mountainous terrain. The Jammu & Kashmir is divided into two administrative divisions viz. Kashmir Division and Jammu division. NHS monitoring is being done for valley parts (Alluvium area) of 6 districts in Jammu region (Jammu, Samba, Kathua, Rajouri, Reasi and Udhampur) and 6 districts of Kashmir Region (Kupwara, Baramulla, Budgam, Srinagar, Pulwama, Anantnag). Therefore, the ground water estimation is computed by the rainfall infiltration method only. There are total 22 districts in J&K UT. The administrative map of the state is shown in figure.1.

The Central Ground Water Board started monitoring of ground water regime through All India network of hydrograph stations from 1969 onwards. The density of observation wells was increased year after year. Earlier ground water monitoring was carried out through a network of open wells, generally dug wells for drinking purpose tapping shallow aquifers. Keeping in view the importance of future ground water development, the network was subsequently strengthened by construction of purpose built piezometers. Presently in Jammu and Kashmir, a total of 317 dug wells are being monitored for this purpose. The Central Ground Water Board, North Western Himalayan Region is monitoring water levels in observation wells in UT of Jammu and Kashmir four times a year viz. May, August, November and January. Water samples from observation wells are collected once in a year during May to assess groundwater quality. The water level and chemical analysis data thus collected is analyzed and interpreted by GEMS and Map Info software and Ground Water Regime Monitoring Bulletin is prepared and issued seasonally with interpreted data and thematic maps depicting ground water scenario of J&K UT.

The total number of active ground water monitoring wells are 298 (as on January 2020) which are located in alluvial areas of Jammu, Kathua, Samba, Rajouri, Reasi, Udhampur, Srinagar, Baramulla, Anantnag, Kupwara and Pulwama Districts. Most of monitoring stations fall in valley areas of these districts.

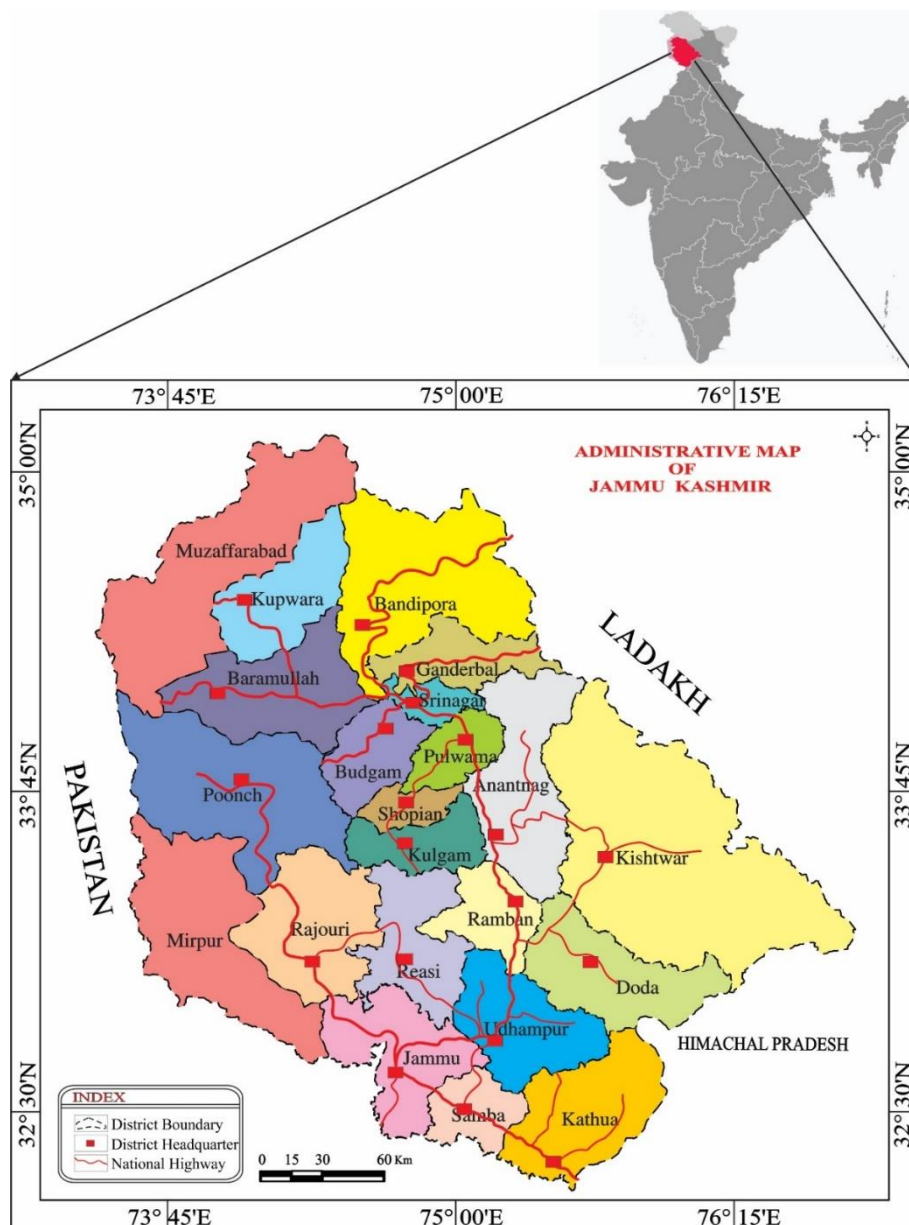
The present report discusses regional behaviour of water levels in phreatic aquifers for the period May, August, November 2019 and January 2020 which will enable user agencies to plan development strategies. The results of chemical analysis of water samples collected in May 2019



from observation wells established by Central Ground Water Board, North Western Himalayan Region are also discussed.

The main objectives of ground water regime monitoring in Jammu and Kashmir may be summarised as follows:

1. To study fluctuation of water levels both spatially and temporally in response to ground water recharge and/or discharge.
2. To evaluate changes in ground water level with respect to preceding year for the same period.
3. To evaluate changes in ground water levels with respect to a long term average water level such as decadal mean.
4. To study fluctuation of water level during different seasons.
5. To study hydro-chemical behaviour of phreatic aquifers.



**Figure. 1 Administrative Map of J&K**

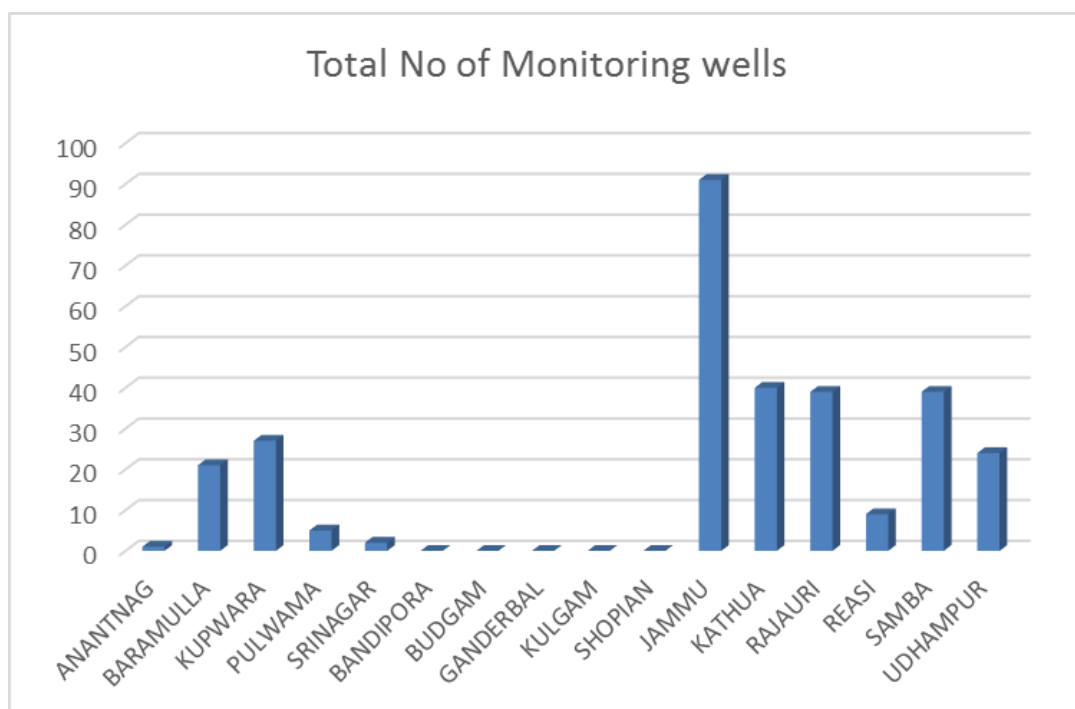
## 1.1 Status of Hydrograph Network Stations

In Jammu & Kashmir, at present there are 242 Hydrograph Network Stations which are being monitored every year during pre-monsoon and post-monsoon periods. 242 NHS exist in Jammu Region and 56 stations in Kashmir Region. District-wise number of hydrograph network stations as on 31.03.2020 is given in table-1 and their locations are shown in Figure 2.

**Table: 1 Ground Water Monitoring Wells in Alluvial Aquifers in J&K UT (as on January 2020)**

Sl. No.	Region	District	Total No of Monitoring wells	Number of Active Ground Water Monitoring Wells			
				May-19	Aug-19	Nov-19	Jan-20
1	KASHMIR	Anantnag	1	1			
2		Baramulla	19	15			
3		Kupwara	27	25			
4		Pulwama	5	2			
5		Srinagar	2	1			
6		Bandipora	0	0			
7		Budgam	2	2			
8		Ganderbal	0	0			
9		Kulgam	0	0			
10		Shopian	0	0			
	<b>Total</b>		<b>56</b>	46			
11	JAMMU	Jammu	91	90	91	90	87
12		Kathua	40	40	40	38	41
13		Rajouri	39	38	38	37	38
14		Reasi	9	9	9	9	9
15		Samba	39	37	39	39	40
16		Udhampur	24	24	23	24	23
	<b>Total</b>		<b>242</b>	<b>238</b>	<b>240</b>	<b>237</b>	<b>238</b>
	<b>TOTAL J&amp;K</b>		<b>298</b>	<b>284</b>	<b>240</b>	<b>237</b>	<b>238</b>

**Graph Showing District-wise Graphical representation of Ground Water Monitoring Wells in Alluvial Aquifers of J&K UT (as on January 2020)**



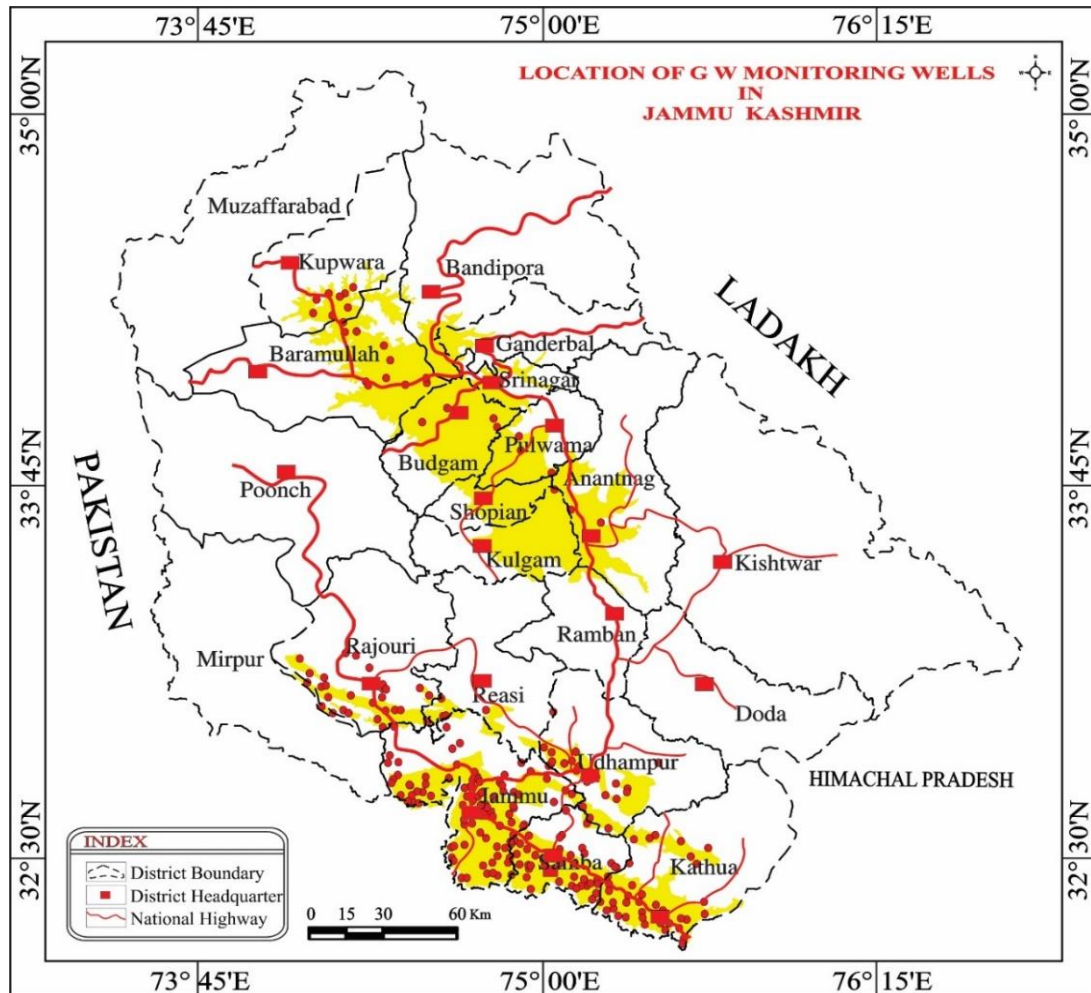


Figure 2. Location Map of Ground Water monitoring wells in Alluvial Aquifers in J&K

## 1.2 PHYSIOGRAPHY

Physiography of the Jammu & Kashmir UT is highly varied with highest mountain ranges of the world, extensive plateau, enormous valleys, deep gorges and large canyons in Middle and Trans-Himalayan Regions. The individual ranges have characteristic steep slopes towards south and much gentle slope towards north. The northern slopes are covered with thick and dense growth of vegetation. While the southern slopes are mostly bare, with thin sparse forest cover. The Zaskar range separates Ladakh Region with Kashmir Valley while Pir Panjal range divides Jammu Region and Kashmir Valley (Figure 3). The UT can be divided into six distinct physiographic units as discussed below.

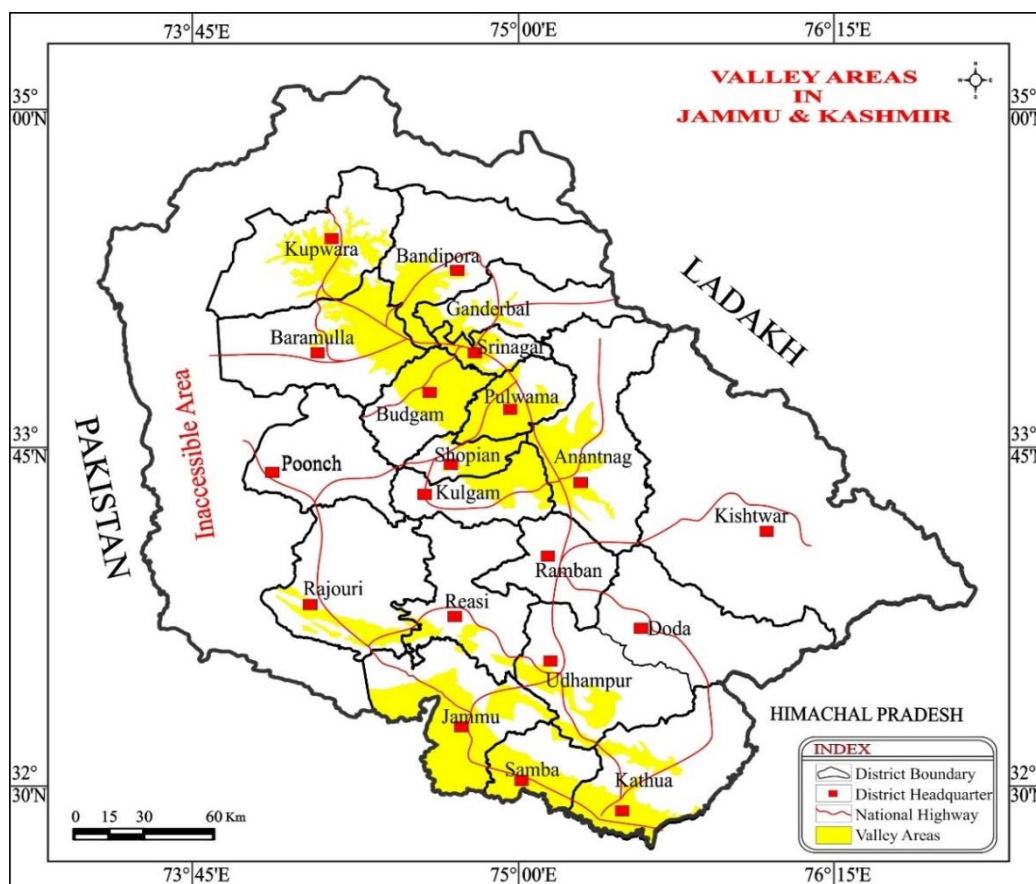
**Sirowal Belt:** The Sirowal belt covers an area of about 1000 km<sup>2</sup> and has an average topographic gradient of 1:250 to 1:300 in southwest direction. The land elevation of Sirowal belt above mean sea level is normally within 320 m. Southern parts of Jammu, Samba and Kathua Districts fall in this belt.

**Kandi Belt:** The elevation of Kandi belt ranges between 320 m and 400 m above mean sea level (m amsl). The average topographic gradient varies between 1:60 and 1:100. Kandi belt covers an area of about 1500 km<sup>2</sup> and occupies parts of Jammu, Samba and Kathua Districts imperceptibly north of Sirowal belt. Kandi belt in Jammu & Kashmir UT runs in northwest - southeast direction as a narrow strip between rivers Munnawar Tawi in the west and Ravi in the east. The belt is occupied by reworked Siwalik debris, which has master slope towards south-west.

**Siwalik Region:** Land elevation of Siwalik region ranges between 400 m and 750 m above mean sea level. Ridges and small independent valleys are the prominent features of Siwalik region which covers parts of Kathua, Jammu, Udhampur and Rajouri Districts.

**Kashmir Valley:** The elevation of valley floor above mean sea level ranges between 1500 m and 2000 m. Kashmir valley is spread over an area of 5600 km<sup>2</sup> and covered all 10 districts in Kashmir valley parts of Budgam, Pulwama, Srinagar, Anantnag, Baramulla, Kupwara, Ganderbal, Shopian, Kulgam and Bandipora..

**Hilly Mountains:** The high mountain ranges have the elevation between 2000 m and 5000 m above mean sea level and form parts of Udhampur, Anantnag, Baramulla, Srinagar and Kupwara Districts.



**Figure 3. Map showing Valley areas in J&K**

### 1.3 GEOLOGY

Geological formations ranging in age from Pre-Cambrian to Recent are found in the UT. These formations can broadly be classified into three categories. Hard or consolidated- rocks comprising granites, slates, quartzite, Panjal traps, limestone etc. Semi-consolidated rocks comprising of claystone, siltstone, sandstone etc. Unconsolidated formations from Quaternary to Recent age are comprised of Clay, Silt, Sand, Gravel, pebbles, Boulder etc. The brief geological setting of the UT is given in Table-2.

**Table 2 Geological Setting in UT of J&K**

Age	Formation
Recent to Sub-recent	Alluvium
Pleistocene	Karewas
Middle Pliocene to Pleistocene	Siwaliks
Miocene	Murrees
<b>Unconformity</b>	
Eocene	Subathu Formation
Cretaceous/ Eocene	Volcanics/ Basic Intrusives
Cretaceous	Flysch Beds
Jurassic	Punch-Mandi Formations
Triassic	Mandi & Infra-Triassic Formations
Palaeozoic	Panjal Traps/ Tanwal
Carboniferous / Permian	Agglomeratic Slates Fenestella Shales Gondwana Formations Zewan Beds
Silurian-Devonian	Muth Quartzites
Upper Pre-Cambrian to Lower Cambrian	Dogra Slates
Lower Pre-Cambrian	Salkhala Series
Pre-Cambrian	Granite & Basic Intrusives

The Salkhala outcrops have been traced in the form of hairpin bend around the northwestern end of the Kashmir Valley. The Salkhala group comprises of succession of Carbonaceous Shales, Schists, graphitic phyllites, carbonaceous limestones, dolomites, marbles, quartzites. The Salkhala group is stratigraphically overlain by Dogra Slates, which conformably grades into the lower paleozoic succession. In southern part of Kashmir, the Dogra Slates are conformably overlain by a succession of phyllites, sand stones, massive quartzites, grits and conglomerates known as Tanawals and suggested that the succession bridges the gap between Dogra Slates and upper Paleozoic rocks in south and south western Kashmir.

The Palaeozoic formations of Kashmir exposed along the Pir-Panjal range and great Himalayan ranges rest either over Dogra slates or pre Cambrian crystalline rocks of the Salkhala group. A succession of white quartzites, Shales, siltstones and dolomitic limestones exposed around

Kashmir synclinorium has been referred as Muth formation. In Northern part of the Kashmir, the Muth Quartzites is conformably overlain by Syringothris limestone, a succession of Grey and dark blue limestone with a few interbedded shales, quartzites and traps. The formation exposed along the southern slopes of Pirpanjal near Banihal.

Agglomeratic slate series is well exposed in the Pir Panjal range Baramulla district, Liddar valley, Anantnag District and Kishtwar in Doda district. The polymictites consists of rock fragments derived from glacial erosion as well as from volcanic outburst. It is a succession of slates, sandstone, quartzite and with a few bands of conglomerates. The Agglomeratic slate series is overlain and often intermixed with thick succession of Andesitic and basaltic traps known as Panjal volcanics. The volcanics occupy the steep slopes and high peaks of the pir panjal ranges and higher reaches of liddar valley. The volcanic activity seems to have persisted in Kashmir from late carboniferous to late Triassic epochs.

Permian rocks of Kashmir are conformably overlain by thick succession of limestones and shales known as Zewan formation.

The out crops of Jurassic rock have restricted distribution in Kashmir. A major part of the rock is buried beneath the quaternary sediments and reported in northern slopes of Pir Panjal range Baltal and Joji-la areas. The cretaceous rocks have not been reported from the Kashmir Himalayas.

The Murrees extensively exposed on the Jammu-Srinagar highway around Batote consists of basal conglomerate bed overlain by intercalations of bright red purple clay and green sand stones and is overlain by Siwalik group rock formations.

Most of the Kashmir valley is occupied by this gravel-sand and mud succession known in Indian Stratigraphy as 'Karewa formation'. There are different opinions about the deposition of Karewa formations. But based on detailed geological mapping Bhatt (1978, 1982) proposed that sedimentation of Karewa deposits took place in a lake basin, but suggested that during deposition of Lower Karewa lake occupied the whole Kashmir valley floor, but during Upper Karewa time the lake was localized only in the north-eastern flank of the basin.

Karewas cover an area of about 5600 Sq. Km in Kashmir Valley. Karewa group is defined to include the more or less unconsolidated layered sedimentary succession deposited in fluvio-lacustrine environments in the Kashmir valley, overlying the Precambrian-Mesozoic basement and overlain by Holocene alluvium of modern rivers etc. Karewa group is divided into two formations viz., Lower Karewa and Upper Karewa. The Lower Karewa formation is characterized by plastic grey to bluish

grey clay, light grey sandy clay, lignite and lignitic-clay, coarse to medium grained sand and conglomerates. It is about 1200-meter-thick formations.

The Upper Karewa formation is characterized by brown, grey sandy clay, medium to coarse-grained sand, cream coloured marl, conglomerate and loam (loess) sediments. In this upper Karewas lignitic shale and grey bluish shale are absent. Thickness of this formation is about 50 to 200 meter. The loamy sediments are present throughout the valley making the top of the Karewa Plateau. The Upper Karewa formation sediments are exposed extensively on the Pir Panjal flank due to uplift of Pir Panjal range along with its Karewa sediments.

The top of Karewa terraces are capped by a fine grained mostly silty succession without any bedding structures. These mainly loam or loess formation. The formation is in some places extremely muddy, silty or rather sandy. In some cases, sand layers are intercalated.

#### **1.4 DRAINAGE**

Major sub-basins of Indus System in Jammu & Kashmir UT are the Jhelum Sub-basin, the Chenab Sub-basin and the Ravi Sub-basin. A brief account of these three sub-basins is given as under: -

##### ***Jhelum Sub-Basin***

The Jhelum is known in Kashmir as the Veth River. Most parts of Kashmir valley are drained by Jhelum River, which flows in north-westerly direction. The Jhelum River (Sanskrit-Vitasta, Greek-Hydaspes, Latin-Bipaspes) originates from Verinag Spring. The River has various tributaries in the valley, several of which come from the everlasting snows of the Liddar valley. Near Srinagar it is received by the Sind River, and then forms the Wular Lake in Baramulla District which, in fact, is a delta of Jhelum River. Below Baramulla, the river leaves the fertile banks of the valley and rushes headlong down a deep gorge at Khadnayar and joins the Chenab River at Trimmu in Pakistan.

##### ***Chenab Sub-Basin***

The Chenab River or Asikin, as it was known in Vedic times, is formed by two important tributaries, the Chandra and the Bhaga, which join near Keylong in Himachal Pradesh to form Chandra-Bhaga or the Chenab River in Himachal Pradesh.

The River then flows through the Kashmir Himalayas to emerge into the plains at Akhnoor in Jammu District, at about 250 km from its source. Ranbir canal takes off from its left bank in Akhnoor tehsil.

##### ***Ravi Sub-Basin***

Very small parts of the state, mainly the extreme south-eastern parts, fall in the Ravi Sub-basin. The Ravi River rises from the northern face of Rohtang Pass in Himachal Pradesh at an elevation of 4116 m. After passing through Dhaula dhar hill ranges, the river emerges from the foothills near Madhopur

where the head works of the Upper Bari Doab Canal exist. It has the smallest catchment area among the rivers of the Indus System. An important tributary of Ravi River, the Ujh River Which originates from the Basohli hills of Kathua District joins the mainstream to its right at Lassian.

## **1.5 HYDROMETEOROLOGY**

The UT of Jammu and Kashmir has great diversity in its temperature and precipitation. Excluding the plain, south of the Siwaliks of the Jammu Division, the climate over the greater parts of the state resembles that of the mountainous and continental parts of the temperate latitudes.

### **1.5.1. Climate of Jammu Division**

Climate of Jammu division is sub-humid to sub-tropical. It is divisible into two parts namely (i) the plain region, lying to the south of the Siwaliks and (ii) the mountainous region, stretching over the Middle and the Greater Himalayas in the districts of Doda, Rajouri, Poonch and Udhampur. The climate of the plain region and Middle Himalayas including the Pir Panjal is characterized by a rhythm of seasons which is caused by the reversal of winds in the form of south-west and north-east monsoons. The reversal of pressure takes place regularly twice a year. This region has sub-tropical climate with hot and dry climate in summer and cold climate in winter. It lies in the northern hemisphere above the tropic of Cancer. The Minimum and Maximum temperature of the district varies between 4°C to 47°C and the monsoon starts from the beginning of July to the first week of September. From October to June the precipitation and temperature patterns resemble closely the valley temperature zones. However, the summer rainfall and temperature resemble the precipitation pattern in the sub-tropical zone. The region receives an average annual precipitation of 1070 mm mainly in the form of rainfall. Snowfall occurs in high mountainous parts of Jammu region due to south-west monsoon from July to September and contributes about 80% of the total rainfall. The temperature in plain areas of Jammu region goes up to 45°C during summer and drops to as low as 3° C during winter season. Average number of Annual rainy days in Jammu region is 59.

### **1.5.2. Climate of Kashmir Division**

The weather and climate of Kashmir Division are intrinsically linked with the weather mechanism of the subcontinent in general. The location of the Kashmir Valley at a high altitude (about 1600m amsl) in the north-western corner of the subcontinent, surrounded by high mountains on all sides, gives it a unique geographical character with distinctive climatic characteristics. It experiences Temperate-cum-Mediterranean type of climate. The average annual precipitation is 660 mm. In winters, rainfall occurs from the western disturbances (temperate cyclones). These disturbances have their origin in the Mediterranean Sea. The rainfall generated by these cyclones is fairly widespread locally known as *Alamgir*. About 65% of the precipitation occurs in the form of



snow during winter season, i.e. December to February. March and April are the months of rainfall. May to September are relatively dry months. The mercury drops between -8°C and 12°C during winter and attains a moderate temperature of around 35°C during summer.

## 1.6 SOILS

The soils of J&K UT have been classified into the undermentioned 8 groups:

**Brown Earth/Brown Forest Soils:** These soils have been spotted in parts of Kathua, Udhampur, Doda, Poonch, Rajouri, Anantnag and Baramulla District. Their water holding capacity exceeds 40%. They belong to groups Haplustalfs, Ochraualfs, Eustrochrepts, Hapludolls, Udorthrents, Cryothrents and Udifluvents.

**Degraded or Grey Brown Podzolic Soils:** These soils occur in parts of Baderwah, Ramnagar, Poonch, Gulmarg, Pahalgam and are of loam to clay texture at their surface and clay loam to clay texture at their sub-surface and of fine granular well developed angular block structure. They belong to great groups Hapludalfs, Hapludolls, Eutrochrepts and Haplumbrepts.

**Red and Yellow Podzolic Soils:** These soils occur in parts of Udhampur, Kathua, Rajouri and Poonch. They are of coarse texture, Water holding capacity is 40%. They belong to great group hapludalfs, haplustalfs.

**Hill or Mountain Forest Soils:** These are sandy loam to loamy, fine to weakly granular soils. They occur at lower elevations and have 32-41% water holding capacity. They belong great group cryoboralfs and hapludolls.

**Mountain Meadow Soils:** Sandy loam to clay loam fine to coarse granular mountain meadow soils occur in Gulmarg, Pahalgam, Sonamarg, Lolab, Gurez, and Changthang. Water holding capacity of (51-61%) They belong to great groups Cryoboralfs and Argiudolls.

**Lithosols:** Gravelly loam to gravelly silty loam, coarse to weak granular soils. Lithosols occur on steep slopes in the forest hills of 400 to 600 meters above sea level Jammu, Udhampur, Kathua, Rajouri, and Poonch Districts. They contain 33 to 38% water holding capacity. They belong to great group Ustorthrents.

**Saline Alkali Soils:** These soils occur in alluvial belt of Jammu (RS Pura/Bishna), Kathua (Ramkol/Challain). They belong to Ustifluvents, Hapluaquents and Ustorthents great groups.

**Alluvial Soils:** These soils cover plains of Kathua, Jammu Rajouri, Poonch, Udhampur in Jammu, Valleys in Kashmir. They are situated in the flood plains of Ravi, Chenab, Jhelum and their

tributaries. They are old and new alluvial soils. They belong to great group Ustifluvents and Udifluvents

### **Based on the Kashmiri Nomenclature**

**Nambal (Peaty Soils):** Near the banks of the Jhelum River and in the vicinity of the Wular, Manasbal and Anchar lakes is found the rich peaty soil, locally known as Nambal.

**Tand (Mountainous Soils):** The land on the slopes of mountains, reclaimed from the forests is called Tand soil. After reclamation the tand gives good productivity, but declines by accelerated soil erosion as land loses its natural strength and after many years the land acquires the shape of a pasture and culturable waste.

**Zabelzamin (Alkaline Soils):** Patches of irrigated land if excessively irrigated lose their fertility and develop alkaline formations. Such adversely affected patches of saline and alkaline formations are known as zabelzamin. These soils are unproductive from the agricultural point of view unless especially treated with gypsum, water and manures. There are numerous other types of soils recognized by the Kashmiri farmers, such soils are Kharzamin, Tresh, Limb, Ront, Shath and Tats.

**Karewa Soil (Wudur):** Karewas are fresh-water (fluvial and lacustrine) deposits found as low flat mounds or elevated plateaus in the Valley of Kashmir and the Kishtwar and Bhadarwah tracts of the Jammu Division. The important Karewas are found in Kulgam, Shopian, Budgam, Qazigund, Tangmarg, Gulmarg, Baramulla, Laithpora, Chandhara, Pampore, Bijbehara, Awantipora, Islamabad (Anantnag), Mattan, Tral and Ganderbal. The Karewa soils are composed of fine, silty clays with sand boulder gravel, the coarse detritus being as a rule, restricted to the peripheral parts of the valley, while the finer variety prevails towards the central parts.

**Clayey Soil (Gurti):** This soil is found in the flood plains of Jhelum in the southern parts of Srinagar city and is subjected to annual fresh silt deposition. Gurti soil contains a large proportion of clay. Its water retaining capacity is high.

**Loamy Soil (Bahil):** This soil is found above the level of flood plain, on the right bank of Jhelum, is highly fertile and suitable for paddy cultivation. The humus content is high which enriches the soil fertility.

**Sandy Loam (Sekil):** It has usually been found to the Sind valley in the north west of the city. In the Sekil soil, if field is artificially irrigated, good crops of rice are harvested in summer season.

**Sandy Silt (Dazanlad):** This soil is the mixture of sand and clay. A peculiar characteristic of Dazanlad is that the field turns red in colour when irrigation water stands in the fields. This soil is

generally found in the low lying areas in the west of the city and also occurs at the hilly areas also in the north (Husain, 2000).

## **2. HYDROGEOLOGY**

The hydrogeological set up in the UT is very complicated owing to varied geological settings and ground water conditions. All the three regions of Jammu & Kashmir UT represent entirely different ground water regimes. Based on geology and aquifer characteristics, the area of the UT can be divided into two broad hydrogeological units. These are Porous and Fissured formations.

### **Porous Formation**

Porous formations are best suitable for the exploration and development of groundwater. Potential zones are encountered in these formations. Region wise porous formations are described hereunder: -

#### ***Jammu Region***

In Outer Plains of Jammu Region, extending between River Ravi in the east to Munawar Tawi in the west, the ground water occurs in piedmont deposits belonging to upper Pleistocene to Recent age. The deposits comprise unconsolidated sediments in the form of terraces and coalescent alluvial fans developed by the streams debauching out of Siwalik Hills. The sediments consist of coarse clastics ranging in size from boulder to gravel in the loose clay matrix and occasionally alternating bands of clay of varying thickness. Kankar is also intercalated with these sediments at different intervals and in variable quantity.

These deposits are graded into finer sediments from north to south in that order. Down south it comprises alternate bands of sands of all grades and clay with subordinate peck of gravels and pebbles.

#### **➤ *Kandi Formation***

Kandi formation comprises very coarse material with little clay but in the Outer Plain of Jammu & Kashmir UT, the typical Kandi formations are not seen. Instead, they comprise boulders, gravels, pebbles and coarse sand with substantial amount of clay sometimes hard and sticky of varying thickness. The clay proportion increases towards southwest. Occurrence of perched water bodies is a common phenomenon in the Kandi belt of Jammu & Kashmir UT. The ground water generally occurs under unconfined conditions in Kandi formation.

#### **➤ *Sirowal Formation***

The Kandi formation coalesces into Sirowal formation in the south, finer outwash of Siwalik debris, brought by streams. Ground water occurs under both confined as well as unconfined conditions in Sirowal formation. A spring line demarcates the contact between Kandi and Sirowal formations because the ground water oozes out along this line causing marshy conditions. The spring

line has undergone deformation due to decline of water level resulting from development of ground water in Sirowal area. However, the base flow could be seen in streams south of this line, which also in the Sirowal formation is the existence of auto-flow conditions in the deeper aquifer system.

The Dun Belt separates the Siwalik hills from the middle Himalayas and runs as a series of river terraces between Basohli (32°30', 76°49'30") in the east to Reasi (33°05', 74°50') and beyond in the west. The sediments are in the form of isolated Sub-Recent to Recent valley fill deposits ranging in thickness between a few metres to a few tens of metres. These deposits are often dissected as a result of the present day drainage pattern. The deposits comprise of coarse clastics such as boulders, cobbles, pebbles etc. inter-bedded with lenticular clays.

#### ➤ ***Isolated Valley Fills in Middle Himalayas***

There exist a number of isolated valleys in middle Himalayas where ground water occurs in valley fill deposits comprising of lacustrine to fluvio-glacial sediments. A few meter-thick layer of loess overlies these deposits, which is windblown.

Ground water in such valleys generally occurs under confined conditions. One of the prominent isolated valleys in middle Himalayas is Kishtwar valley in Kishtwar district of Jammu Region.

#### ***Kashmir Region***

Kashmir valley covers an area of 5600 km<sup>2</sup> and is occupied by Karewas that consist of a huge pile of alternating bands of sand, silt and clay interspersed by glacial boulder beds. The sands are mostly fine to very fine grained and it is very rare that they are medium to coarse grained. There is considerable lateral facies variation in the nature of sediments. The aggregate thickness of these sediments is of the order of 2500-3000 m. Ground water in the Karewas of Kashmir valley occurs under both confined as well as unconfined conditions.

#### **Fissured Formation**

About 15000 sq. km. area in Jammu Region is occupied by hilly terrain. It comprises rocks ranging in age from Precambrian (Salkhala series) to Miocene or even Pliocene (Murees and upper-middle Siwaliks). The rock types range from soft or friable sandstones, Clays, Shales, crystalline limestone, Conglomerates to hard traps and metamorphics such as quartzite. In the Siwalik terrain, where groundwater is tapped, it comes mainly either from the weathered mantle or from the joints or cracks of these rocks. Friable Siwalik sandstones do possess primary porosity but are not very potential aquifers.

### **2.1. BEHAVIOUR OF WATER LEVELS**

The water levels in Ground Water Monitoring Wells of Jammu and Kashmir UT were measured four times during the period 2019 – 2020 (May 2019, August 2019, November 2019 and January 2020). The water levels observed are shown in Annexures – I & II. The ground water levels

in different seasons were analysed to evaluate the temporal behaviour of water level. The behaviour of water levels during the period May 2019 to January 2020 has been compared with the previous water levels as well as with the average water level for the last decade (decadal behaviour) to ascertain the changes in the ground water regime. All the data has been put in the GIS format and the data has been analysed. After analysis, the contours of water levels below the ground surface have been created by joining the areas with same water levels and the areas have been demarcated with uniform contour intervals. The contouring has been done by Natural Neighbourhood Interpolation method. District wise categorization of water levels observed during May, August, November 2019 and January, 2020 is given in Annexure – I & II.

### **2.1.1. Depth to Water Level -May 2019**

**Jammu Region:** The water level data in respect of 216 wells for the month of May 2019 were analysed. The depth to water level varied from 0.85m bgl (Dalser in Udhampur District) to 38.78 m bgl (Taryai in Jammu district).

29 wells (13.43%) have recorded the water level less than 2.0 m bgl. About 49.54% of the total wells (107 wells) analysed have shown depth to water level in the range 2-5 m bgl. Whereas 56 wells (25.93%) have shown water levels in the range of 5-10 m bgl. 09 (4.17%) wells have registered deeper water levels, in the range of 10-15 m bgl. Another 15 wells (6.94%) of the total wells analysed have shown water levels in the range of >15 m bgl.

Valley areas of Jammu, Samba and Kathua districts below the contact of Kandi Sirowal show water level between 2-10 m bgl except for a few patches that show water levels between 0-2m bgl. In Sirowal area of Outer Plains, most of the water levels have been recorded between 2 and 10 m bgl except for a few small patches that show water levels from 0 to 2 m & above 10 m bgl. In Kandi Belt, the water levels are deeper ranging between 5 and 10 m bgl and a few patches (northern and north western Jammu, north-eastern parts of Samba & north western parts of Kathua respectively) having water levels more than 15 m bgl.

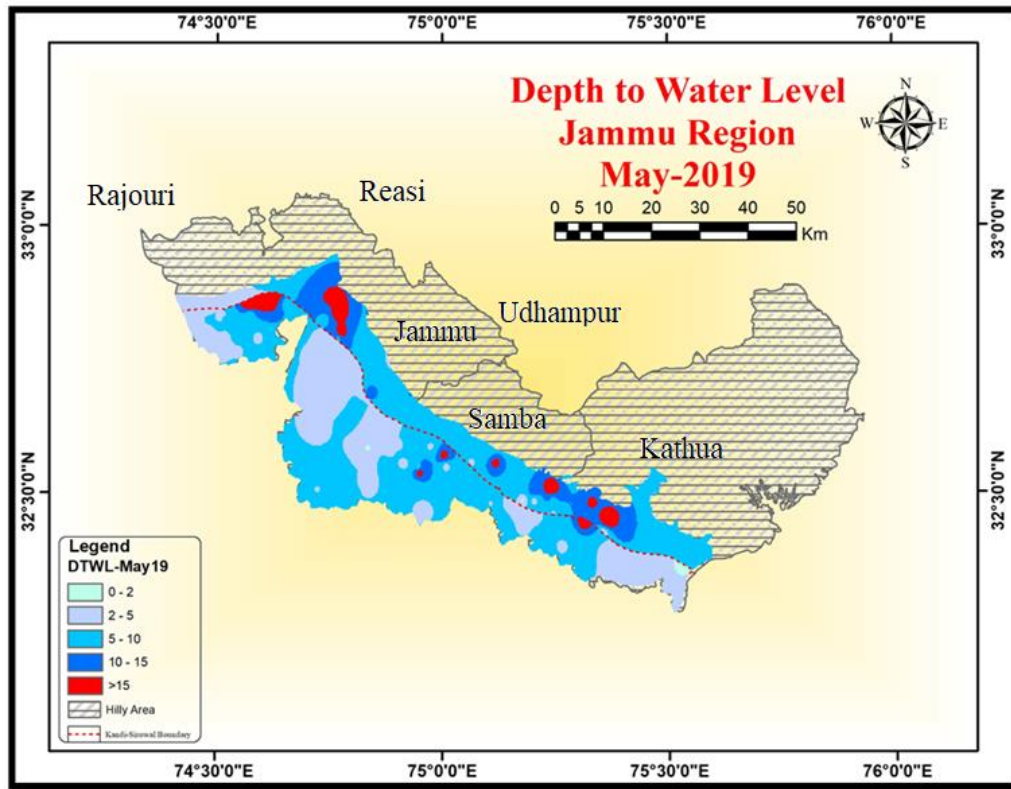
**Kashmir Region:** The water level data in respect of 46 wells for the month of May 2019 were analysed. The depth to water level varied from 0.50m bgl to 15.10 m bgl.

29 wells (63.04%) have recorded the water level less than 2.0 m bgl. About 30.43% of the total wells (14 wells) analysed have shown depth to water level in the range 2-5 m bgl. Whereas 02 wells (4.35%) have shown water levels in the range of 5-10 m bgl. 0 (0%) wells have registered deeper water levels, in the range of 10-15 m bgl. Another 01 wells (2.17%) of the total wells analysed have shown water levels in the range of >15 m bgl.

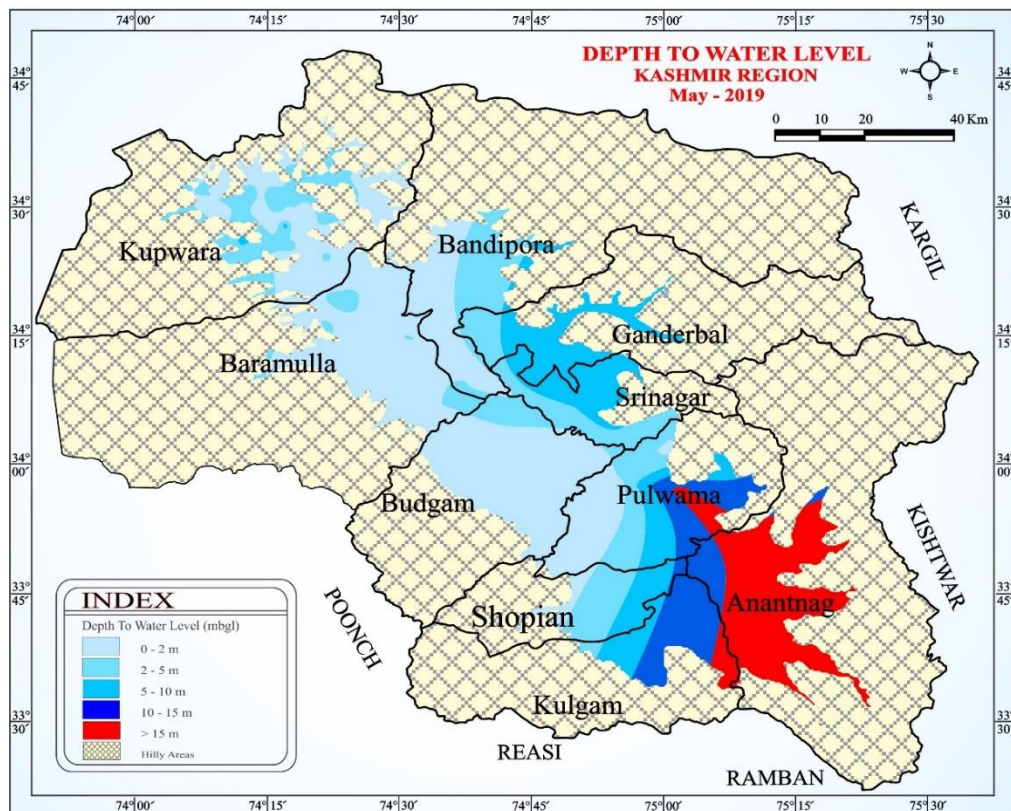
Valley areas of Kashmir Region have shown water levels in all ranges. Major portion has shown within 2m bgl. In Kupwara and Baramulla districts, water levels above 2m but under 5 m have been

shown in the northern parts of Baramulla few patches in Kupwara and Srinagar and Pulwama districts. The water level is deeper towards northern and north-eastern parts of Anantnag and Pulwama districts.

**Figure:4**



**Figure 4B**



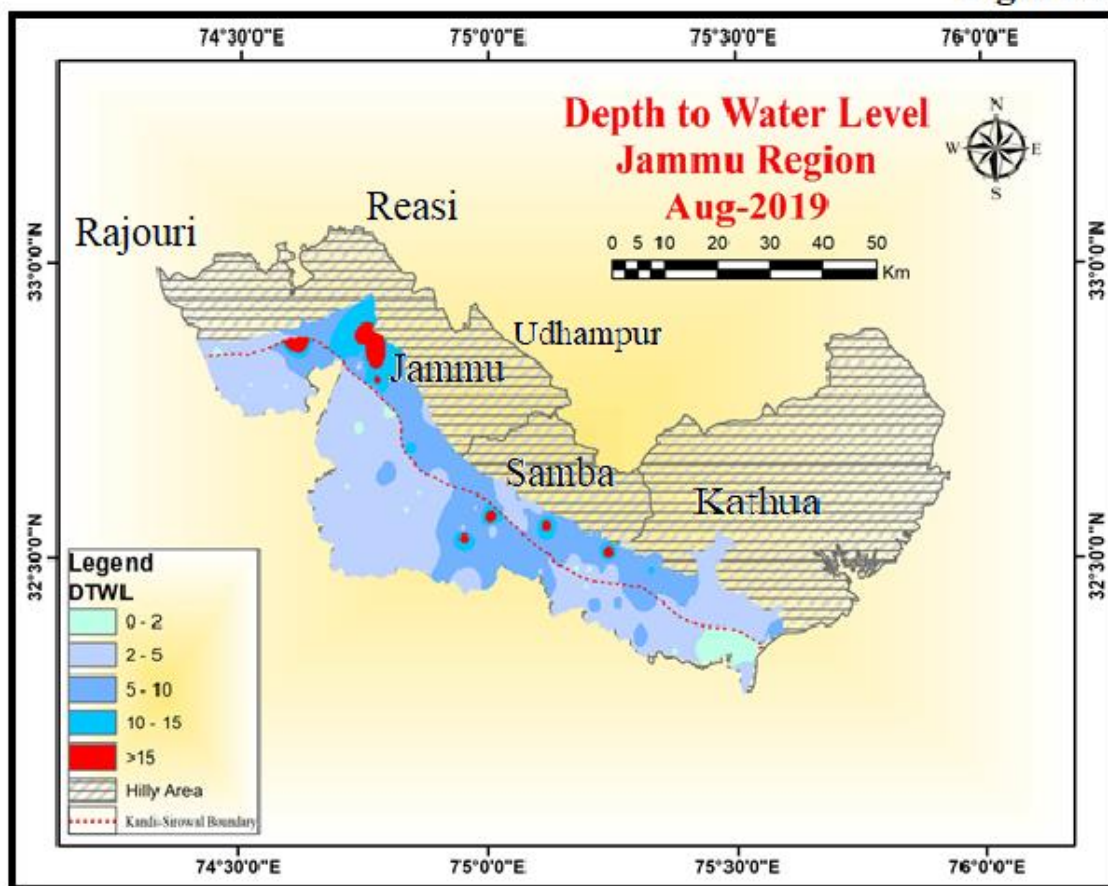
### 2.1.2. Depth to Water Level -August 2019

**Jammu Region:** The water level data in respect of 204 wells for the month of August 2019 were analysed. The depth to water levels varied from 0.41 m bgl (in Surinsar of Jammu District) to a maximum of 34.83 m bgl (Taryai in Jammu District).

The water level less than 2 meters below ground level was recorded in 60 wells (29.41%). 99 wells (48.53%), have shown water level in the range of 2 to 5 m bgl, whereas 28 wells (13.73%) have shown water level in the range of 5 to 10 m bgl. 6 wells (2.94%) have shown deeper water levels i.e. in the range of 10 to 15 m bgl. 11 wells (5.39%) have shown very deep water level of >15 m bgl.

In Sirowal formation of Jammu, Samba and Kathua, water levels varied between 0 to 5 in major portion and 5-10 m bgl at a few places. The transition part of Sirowal belt and Kandi belt of both Jammu and Kathua Districts shows varied water levels. Water levels deeper than 15m bgl were observed in the extreme north-western portion of Jammu district in Kandi belt and middle and N-Eastern areas in Samba district.

**Figure:5**



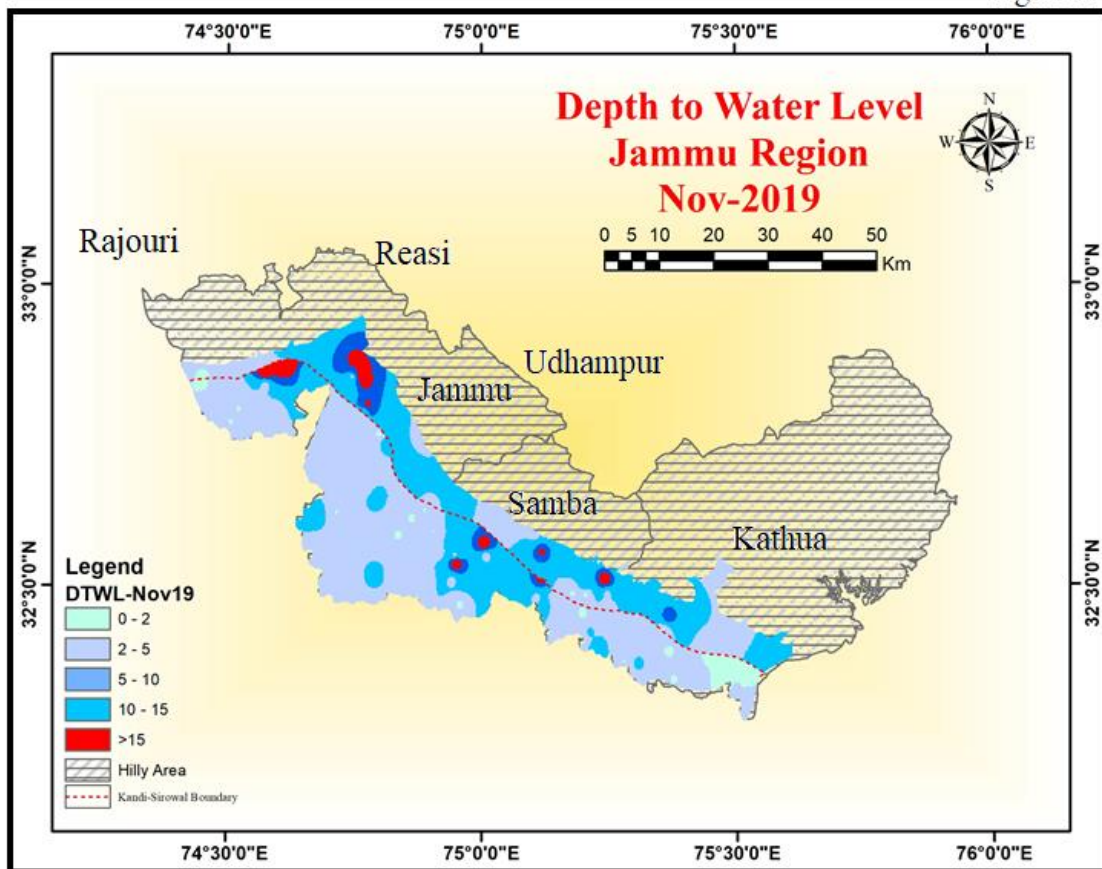
### 2.1.3. Depth to Water Level -November 2019

**Jammu Region:** The water level data in respect of 222 wells for the month of November 2019 were analysed. The depth to water level ranges from 0.10 m bgl (Chhani Mansar Samba district) to 36.10 m bgl (Taryai in Jammu district).

A total of 76 numbers of wells (34.23%) have recorded the water level less than 2.0 m bgl. Majority of the wells (95 wells, 42.79% of the total wells) analysed have shown depth to water level in the range of 2-5 m bgl. Whereas 35 wells (15.77%) have shown water levels in the range of 5-10 m bgl. 4 (1.80%) wells have registered deeper water levels, in the range of 10-15 m bgl. Another 12 wells (5.41%) of the total wells analysed have shown water levels in the range of >15 m bgl.

In Sirowal formation of Jammu, Samba and Kathua, water levels varied between 0 to 5 in major parts and 0-2 m bgl at a few parts. Major part of Sirowal belt in all the three Districts shows water levels between 2 and 5 m bgl and water levels in the range of 0-2 m & 5 – 10 m bgl have been observed at a few patches. In Kandi belt, the water levels generally found are within the range of 5-10 and 10 - 15 mbgl at few portions. Water levels deeper than 15m bgl were observed in the extreme north & north-western portion of Jammu district in Kandi belt and central parts in Samba district

Figure:6



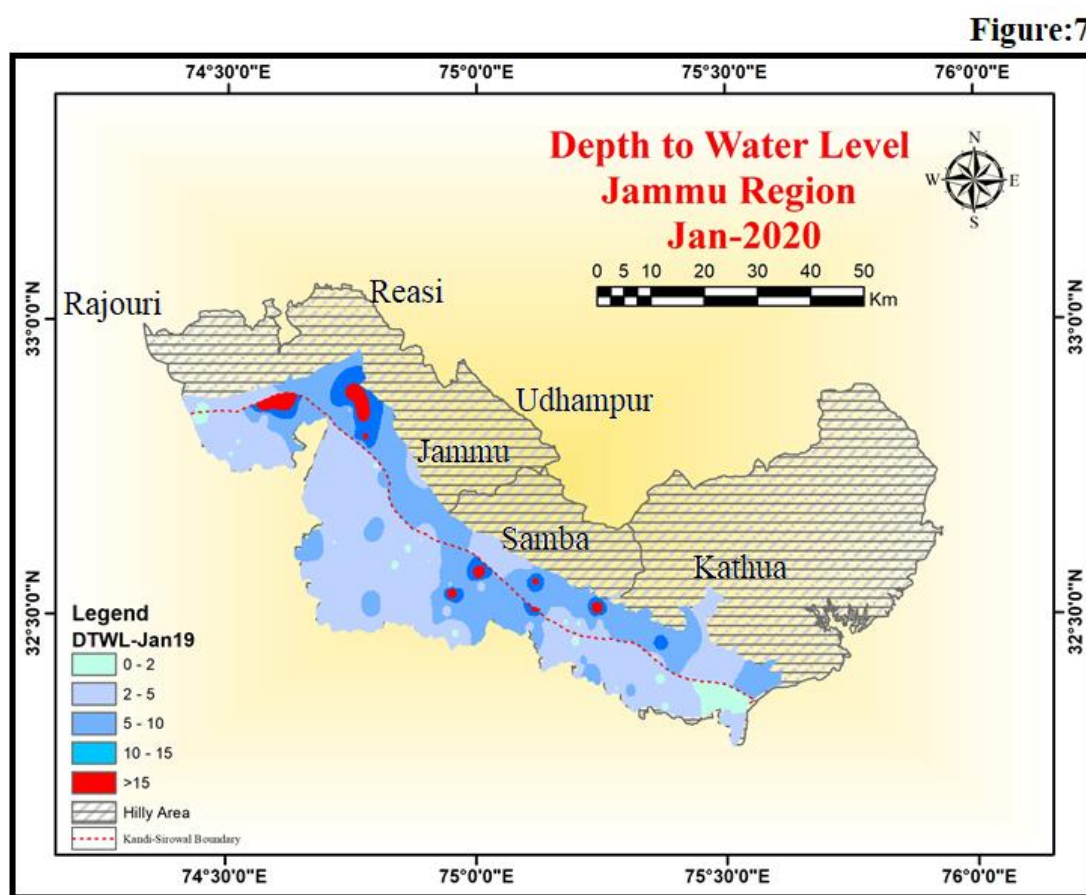
#### 2.1.4. Depth to Water Level -January 2020

**Jammu Region:** The water level data in respect of 228 wells for the month of January 2020 were analysed. The depth to water levels varied from 0.11 at Jagti Jammu District to 31.35 m bgl in Taryai Jammu District.



A total of 92 wells (40.35% of the total wells analysed) have recorded the water level less than 2.0 m bgl. 89 wells (39.04%) have shown depth to water level in the range 2-5 m bgl, whereas 29 wells (12.72%) wells have shown water levels in the range of 5-10 m bgl, 7 (3.07%) wells have shown the deeper water levels i.e. 10-15 m bgl and 11 (4.82%) wells have shown water level more than 15 m bgl.

In entire Sirowal area, the water levels varied between 2 to 5 m bgl with few small patches of 0-2 and 5-10 m. Besides, small portions of all the three districts recorded water level in the range of 5 to 10 mbgl. The Kandi belt in Jammu, Samba and Kathua Districts shows deeper water levels between 5 to 10 & 10 to 15 m bgl. In parts of Kandi Belt of all the three districts, the deeper water levels deeper i.e. more than 15 m bgl were also observed in north & north western part of Jammu, central & north eastern parts of samba and north western parts of Kathua districts.



**Table 3. CATEGORIZATION OF DEPTH TO WATER LEVEL (Jammu Region) - MAY 2019**

District	No. Of wells Analyzed	Depth to Water Level (mbgl)		Number of Wells Showing Depth to Water Level (mbgl) in the Range of					Percentage of Wells Showing Depth to Water Level (mbgl) in the Range of				
		Min	Max	0-2	2-5	5-10	10-15	> 15	0-2	2-5	5-10	10-15	> 15
Jammu	79	1.24	38.78	5	40	23	5	6	6.33	50.63	29.11	6.33	7.59
Kathua	34	1.7	23.44	5	11	12	2	4	14.71	32.35	35.29	5.88	11.76
Rajauri	36	0.95	7.4	9	19	8	0	0	25.00	52.78	22.22	0.00	0.00
Reasi	8	2.06	25.54	0	6	1	0	1	0.00	75.00	12.50	0.00	12.50
Samba	35	1.7	28.7	2	18	9	2	4	5.71	51.43	25.71	5.71	11.43
Udhampur	24	0.85	8.05	8	13	3	0	0	33.33	54.17	12.50	0.00	0.00
<b>Total</b>	<b>216</b>	<b>0.85</b>	<b>38.78</b>	<b>29</b>	<b>107</b>	<b>56</b>	<b>9</b>	<b>15</b>	<b>13.43</b>	<b>49.54</b>	<b>25.93</b>	<b>4.17</b>	<b>6.94</b>

District	Table 4. CATEGORIZATION OF DEPTH TO WATER LEVEL (Kashmir Region) - MAY 2019												
	No. Of wells Analyzed	Depth to Water Level (mbgl)		Number of Wells Showing Depth to Water Level (mbgl) in the Range of					Percentage of Wells Showing Depth to Water Level (mbgl) in the Range of				
		Min	Max	0-2	2-5	5-10	10-15	>15	0-2	2-5	5-10	10-15	>15
Anantnag	1		15.10	0	0	0	0	1	0.00	0.00	0.00	0.00	100.00
Baramulla	17	0.55	4.13	14	3	0	0	0	82.35	17.65	0.00	0.00	0.00
Kupwara	25	0.50	6.05	14	9	2	0	0	56.00	36.00	8.00	0.00	0.00
Pulwama	2	0.75	2.96	1	1	0	0	0	50.00	50.00	0.00	0.00	0.00
Srinagar	1		2.37	0	1	0	0	0	0.00	100.00	0.00	0.00	0.00
<b>Total</b>	<b>46</b>	<b>0.50</b>	<b>15.10</b>	<b>29</b>	<b>14</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>63.04</b>	<b>30.43</b>	<b>4.35</b>	<b>0.00</b>	<b>2.17</b>

Table 5. CATEGORIZATION OF DEPTH TO WATER LEVEL (Jammu Region) - AUG 2019													
District	No. Of wells Analyzed	Depth to Water Level (mbgl)		Number of Wells Showing Depth to Water Level (mbgl) in the Range of					Percentage of Wells Showing Depth to Water Level (mbgl) in the Range of				
		Min	Max	0-2	2-5	5-10	10-15	>15	0-2	2-5	5-10	10-15	>15
Jammu	75	0.41	34.83	14	41	9	5	6	18.67	54.67	12.00	6.67	8.00
Kathua	35	0.5	10.65	12	15	7	1	0	34.29	42.86	20.00	2.86	0.00
Rajauri	35	1.15	7.61	14	18	3	0	0	40.00	51.43	8.57	0.00	0.00
Reasi	8	1.2	25.6	3	4	0	0	1	37.50	50.00	0.00	0.00	12.50
Samba	31	1.02	22.74	5	15	7	0	4	16.13	48.39	22.58	0.00	12.90
Udhampur	20	0.69	7.5	12	6	2	0	0	60.00	30.00	10.00	0.00	0.00
<b>Total</b>	<b>204</b>	<b>0.41</b>	<b>34.83</b>	<b>60</b>	<b>99</b>	<b>28</b>	<b>6</b>	<b>11</b>	<b>29.41</b>	<b>48.53</b>	<b>13.73</b>	<b>2.94</b>	<b>5.39</b>

Table 6. CATEGORIZATION OF DEPTH TO WATER LEVEL (Jammu Region) - NOV 2019													
District	No. Of wells Analyzed	Depth to Water Level (mbgl)		Number of Wells Showing Depth to Water Level (mbgl) in the Range of					Percentage of Wells Showing Depth to Water Level (mbgl) in the Range of				
		Min	Max	0-2	2-5	5-10	10-15	>15	0-2	2-5	5-10	10-15	>15
Jammu	85	0.14	36.1	17	42	17	3	6	20.00	49.41	20.00	3.53	7.06
Kathua	37	0.19	13.04	13	14	9	1	0	35.14	37.84	24.32	2.70	0.00
Rajauri	31	0.7	4.99	15	16	0	0	0	48.39	51.61	0.00	0.00	0.00
Reasi	8	0.83	28.07	3	4	0	0	1	37.50	50.00	0.00	0.00	12.50
Samba	37	0.1	26.71	9	15	8	0	5	24.32	40.54	21.62	0.00	13.51
Udhampur	24	0.18	5.03	19	4	1	0	0	79.17	16.67	4.17	0.00	0.00
<b>Total</b>	<b>222</b>	<b>0.1</b>	<b>36.1</b>	<b>76</b>	<b>95</b>	<b>35</b>	<b>4</b>	<b>12</b>	<b>34.23</b>	<b>42.79</b>	<b>15.77</b>	<b>1.80</b>	<b>5.41</b>

Table 7. CATEGORIZATION OF DEPTH TO WATER LEVEL (Jammu Region) - JAN 2020													
District	No. Of wells Analyzed	Depth to Water Level (mbgl)		Number of Wells Showing Depth to Water Level (mbgl) in the Range of					Percentage of Wells Showing Depth to Water Level (mbgl) in the Range of				
		Min	Max	0-2	2-5	5-10	10-15	>15	0-2	2-5	5-10	10-15	>15
Jammu	84	0.11	31.35	19	44	13	3	5	22.62	52.38	15.48	3.57	5.95
Kathua	38	0.46	19.48	15	13	6	3	1	39.47	34.21	15.79	7.89	2.63
Rajauri	36	0.12	5.30	25	10	1	0	0	69.44	27.78	2.78	0.00	0.00
Reasi	8	0.65	29.50	4	2	1	0	1	50.00	25.00	12.50	0.00	12.50
Samba	39	0.37	26.74	12	15	7	1	4	30.77	38.46	17.95	2.56	10.26
Udhampur	23	0.25	5.57	17	5	1	0	0	73.91	21.74	4.35	0.00	0.00
<b>Total</b>	<b>228</b>	<b>0.11</b>	<b>31.35</b>	<b>92</b>	<b>89</b>	<b>29</b>	<b>7</b>	<b>11</b>	<b>40.35</b>	<b>39.04</b>	<b>12.72</b>	<b>3.07</b>	<b>4.82</b>

## 2.2 SEASONAL FLUCTUATION OF WATER LEVEL

### 2.2.1. November 2019 with respect to May 2019

**Jammu Region:** The seasonal water level fluctuation between November 2019 & May 2019 in respect of 199 National Hydrograph Stations are analysed. It is observed that 181 stations have shown rise in water level where as only 18 stations have shown fall in water levels. Categorization of changes in water level between May 2019-November 19 (Jammu Region) is given in Table 8. Out of 181 stations showing rise in water levels, 119 wells (59.80%) have shown rise less than 2 m. 46 wells (23.12%) and 16 wells (8.04%) have shown rise in the range of 2-4 m and >4 m respectively. 16 wells (8.04%) have shown decline between 0-2 m and 1 well (0.50%) have shown fall between 2-4 and 1 well (0.50%) have shown decline of >4 m.

Effect of rainfall is directly reflected in the area. Almost all the valley areas are showing rise in the water levels except for small patches in all districts. A few locations of Jammu, Samba and Kathua Districts have registered fall of water level within 0-5 m bgl (Figure 8).

Figure 8

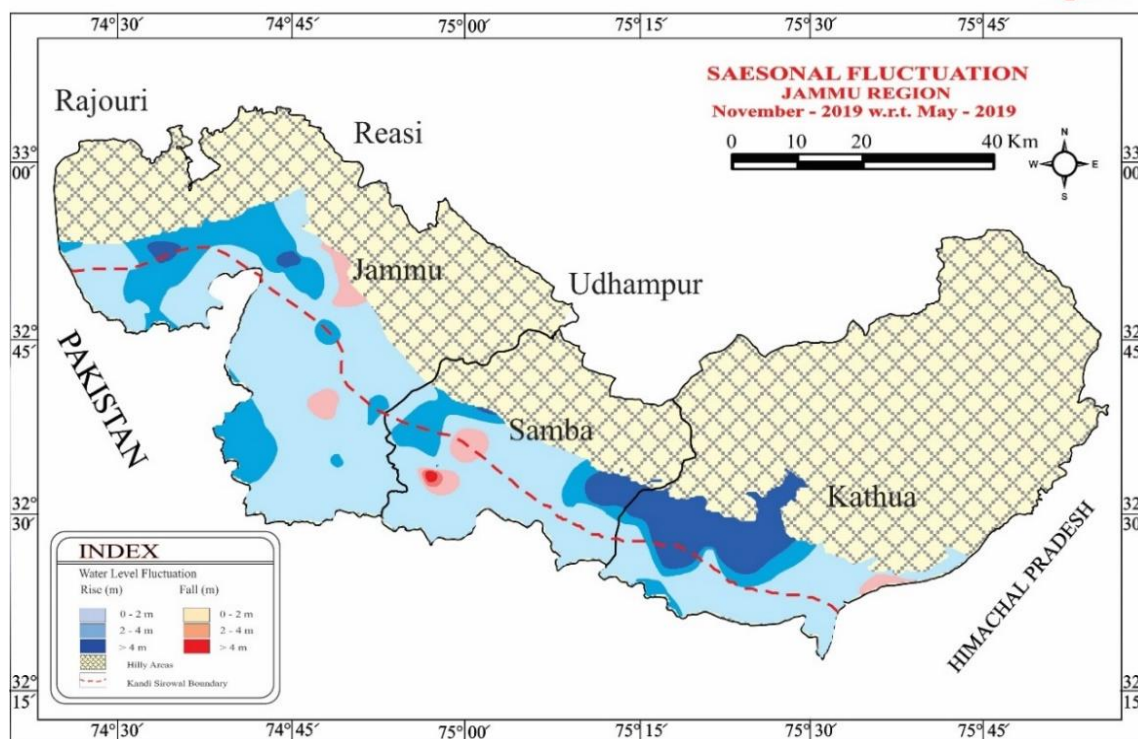


Table 8. CATEGORIZATION OF CHANGES IN WATER LEVEL BETWEEN MAY 2019-NOVEMBER 19 - JAMMU DIVISION																			
District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	74	0.12	8.16	0.41	1.29	43	21	3	7	0	0	58.11	28.38	4.05	9.46	0.00	0.00	67	7
Kathua	29	0.31	11.86	0.40	0.40	20	3	5	1	0	0	68.97	10.34	17.24	3.45	0.00	0.00	28	1
Rajauri	29	0.30	4.72	0.15	0.85	18	2	3	6	0	0	62.07	6.90	10.34	20.69	0.00	0.00	23	6
Reasi	8	0.48	2.50	2.53	2.53	5	2	0	0	1	0	62.50	25.00	0.00	0.00	12.50	0.00	7	1
Samba	35	0.06	6.54	1.82	7.12	22	7	4	1	0	1	62.86	20.00	11.43	2.86	0.00	2.86	33	2
Udhampur	24	0.11	5.04	0.35	0.35	11	11	1	1	0	0	45.83	45.83	4.17	4.17	0.00	0.00	23	1
<b>Total</b>	<b>199</b>	<b>0.06</b>	<b>11.86</b>	<b>0.15</b>	<b>7.12</b>	<b>119</b>	<b>46</b>	<b>16</b>	<b>16</b>	<b>1</b>	<b>1</b>	<b>59.8</b>	<b>23.12</b>	<b>8.04</b>	<b>8.04</b>	<b>0.50</b>	<b>0</b>	<b>181</b>	<b>18</b>

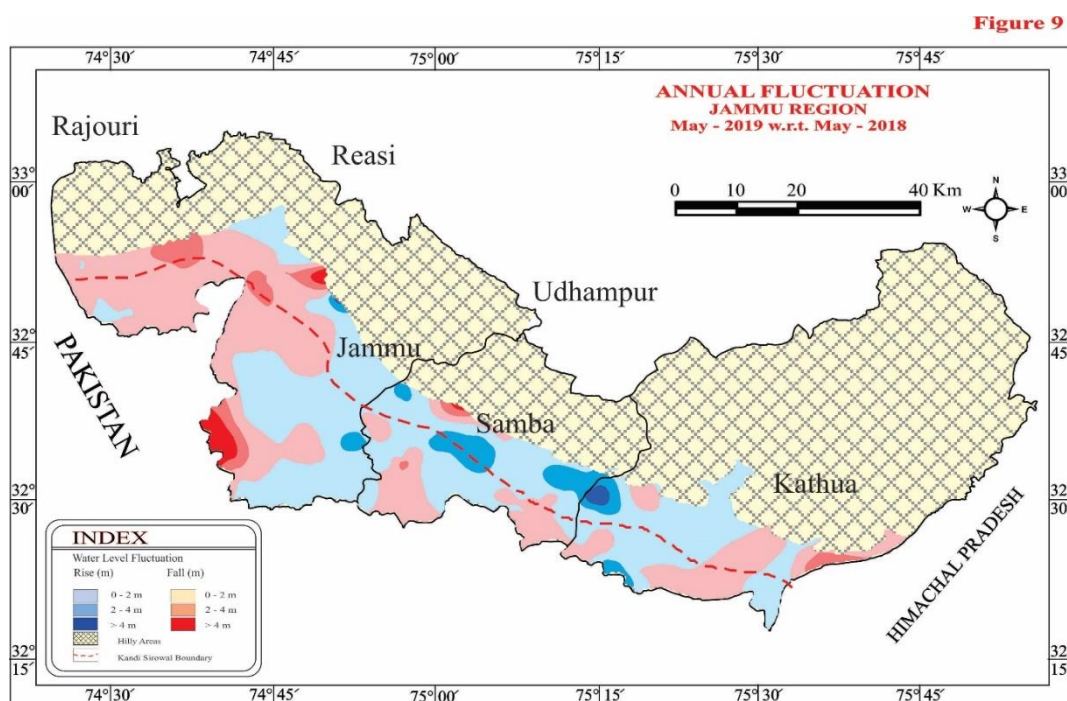
### 2.3 ANNUAL FLUCTUATION OF WATER LEVEL

#### 2.3.1. May 2019 with respect to May 2018

**Jammu Region:** The water level data in respect of 177 National Hydrograph Stations for the month of May 2019 was analysed. It was compared with those monitored during May 2018. Majority of the wells have shown rise in water levels. A total of 115 wells have shown rise and 62 wells have shown fall in water levels in the range of 0-2 m, 2-4 m and >4 m. Categorization of changes in water level between May 2019 and May 18 is given in table 9.

Rise is shown by 94 wells (53.11%) in the range of 0-2 m. 17 wells (9.60%) have registered rise from 2-4 m bgl and 4 wells (2.26%) are showing rise of >4 m. Among 53 wells showing fall, 6 wells (29.94%) have shown fall in water level in the range of 0-2 m, 3 wells (3.39%) have shown fall between 2-4 m, and 6 (1.69%) wells have shown fall of >4 m.

Major parts of all the districts, i.e., Jammu, Kathua and Samba, have shown rise in water levels in



all range where as a significant portion have shown decline in water level. Decline in water levels in the range of 0-2 m is observed in major portions in all the districts. All the districts have registered rise in water levels at few locations, few parts in all districts have shown decline >4m i.e western and southern parts of Jammu, southern parts of Samba and eastern and southern parts of Kathua district (Figure 9).

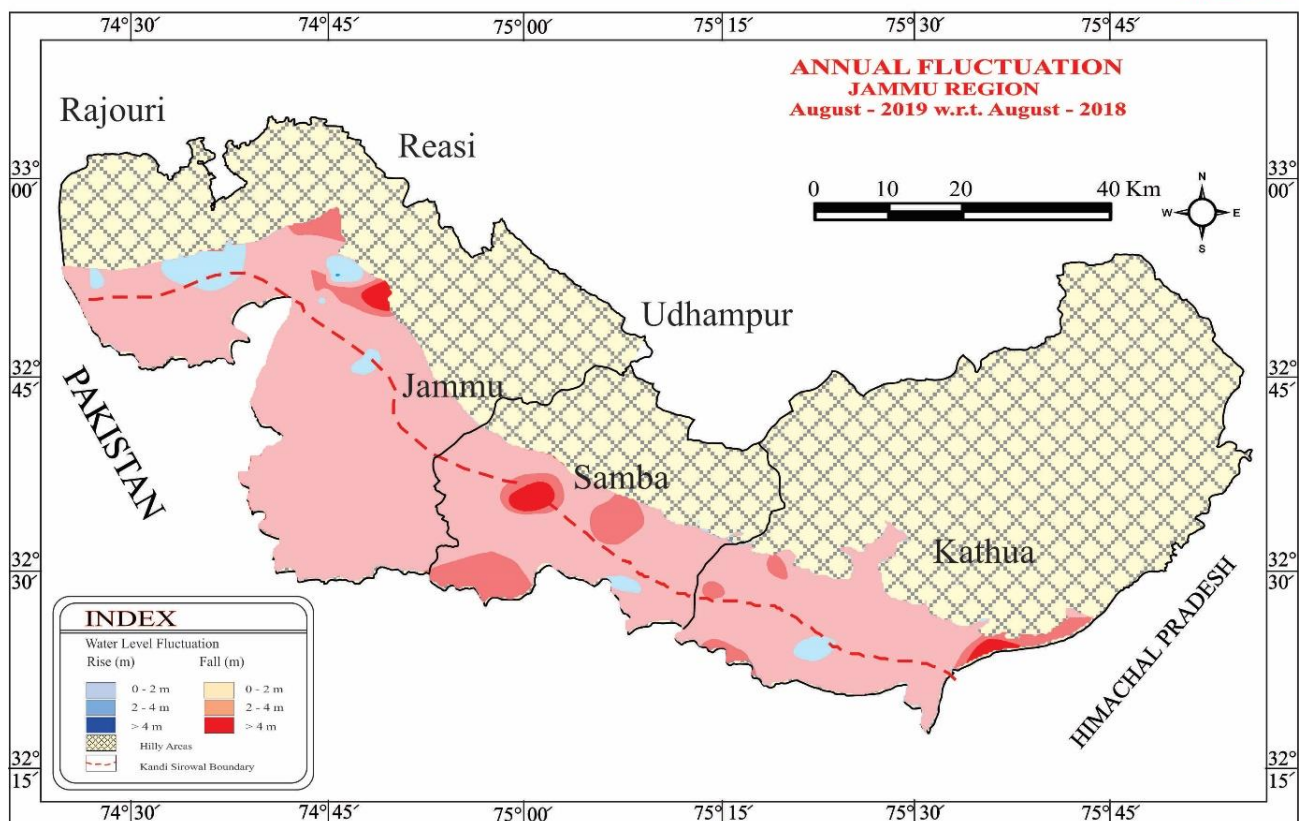
### 2.3.2. August 2019 with respect to August 2018

**Jammu Region:** For analysing the annual fluctuation, the water level data in respect of 164 National Hydrograph Network Stations for the month of August 2019 were analysed and compared with the water levels of August 2018. Categorization of changes in water level between August 2019 and August 18 is given in table 10.

A total of 21 wells have shown rise and 143 wells have shown fall in water levels. Rise is shown by 19 wells (11.59%) in the range of 0-2 m, 2 wells (1.22%) in the range of 2-4 m bgl and 0 wells (0%) have registered rise of >4 m. Among 143 wells showing decline, a total of 123 wells (75%) have registered fall in the range of 0-2 m, 16 well (9.76%) have shown fall between 2-4 m and 4 wells (2.44%) have shown fall of >4 m.

Jammu Region is showing decline in water levels in all districts. The decline in the range of 0 – 2 m has been observed in major parts in Jammu, Kathua and Samba districts. A few portions of all the districts have shown rise in water levels in north western areas of Jammu, central areas of Samba and Kathua districts (Figure 10).

**Figure 10**



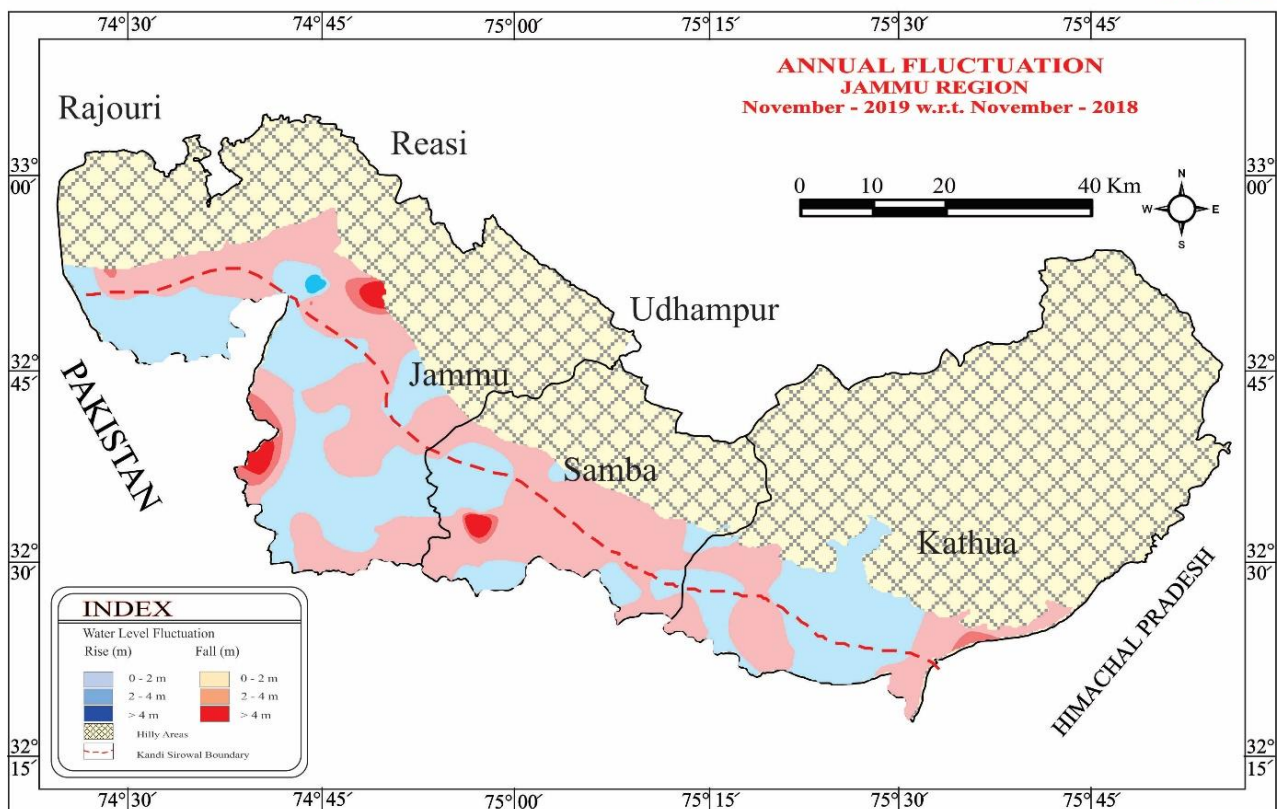
### 2.3.3. November 2019 with respect to November 2018

**Jammu Region:** The water level data, in respect of 204 National Hydrograph Stations for the month of November 2019 was analysed. It was compared with those monitored during November 2018. Majority of the wells have shown rise in water levels. A total of 137 wells have shown rise and 67 wells have shown fall in water levels. Categorization of changes in water level between November 2019 and November 18 is given in table 11.

Rise is shown by 131 wells (64.22%) in the range of 0-2 m. 5 wells (2.45%) have recorded rise in the range of 2-4 m bgl and only 1 well (0.49%) has shown rise of >4 m. Among 67 wells showing fall, 60 wells (29.41%) have shown fall in the range of 0-2 m. 4 wells (1.96%) have shown fall between 2-4 m, and 3 (1.47%) wells have shown fall of >4 m.

Major parts of all the districts have shown decline in water levels in the range of 0-2 m and some areas have shown rise in water level in Jammu Region. Rise & Fall of water levels in the range of 0-2 m has been equally observed in major portion of Jammu and Kathua. Major parts of Samba and Kathua district have shown decline in 0-2m with few exceptions in northern and western Samba and central parts of Kathua. (Figure 11).

**Figure 11**



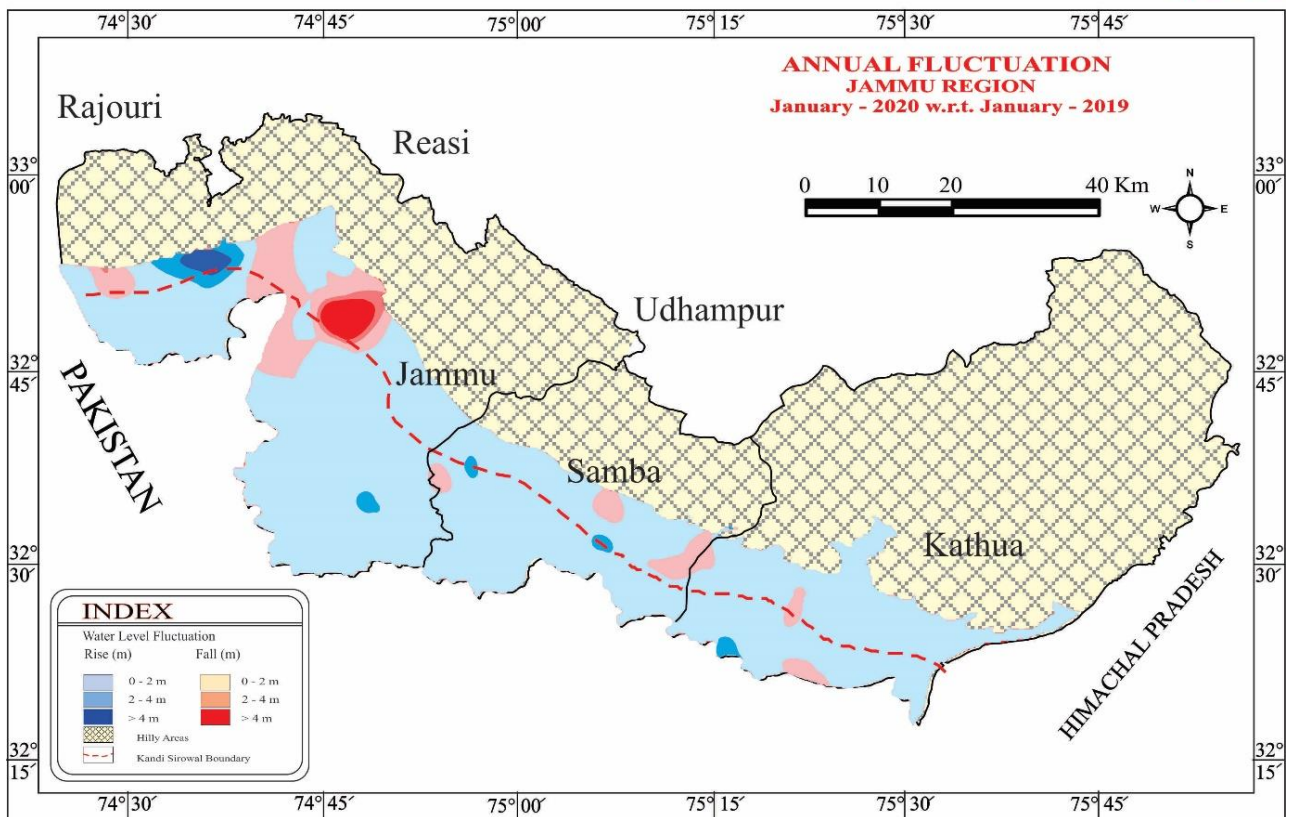
### 2.3.4. January 2020 with respect to January 2019

**Jammu Region:** The water level data, in respect of 170 National Hydrograph Stations for the month of January 2020 was analysed. It was compared with those monitored during January 2019. Majority of the wells have shown rise in water levels. A total of 144 wells have shown rise and 26 wells have shown fall in water levels. Categorization of changes in water level between January 2019 and January 18 is given in table 12.

Rise is shown by 116 wells (68.24%) in the range of 0-2 m. 23 wells (13.53%) have recorded rise in the range of 2-4 m bgl and 5 wells (2.94%) have shown rise of >4 m. Among 26 wells showing fall, 24 wells (14.129%) have shown fall in the range of 0-2 m, 1 wells (0.59%) have shown fall between 2-4m, and 1 well (0.59%) has shown fall of >4 m.

In Jammu district, decline as well as rise in water levels in the range of 0-2 m has been observed equally in entire areas except few portions. Some pockets have shown rise in water level > 2 m whereas major parts in Samba district has registered decline in range of 0-2m. In southern and north eastern parts of Jammu district, decline of more than 2m was also observed. Major parts including central and northern areas of Kathua district has registered decline within range of 0-2m with few patches above 2m rise i.e. in southern and north western areas of Kathua district. In northern and western parts of samba decline of 0-2 m was observed (Figure 12)

**Figure 12**



**Table 9. Categorization of Changes In Water Level Between May 2019 And May 18**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	66	0.02	6.91	0.09	6.48	30	3	1	26	3	3	45.45	4.55	1.52	39.39	4.55	4.55	34	32
Kathua	31	0.02	5.65	0.08	3.36	16	2	1	11	1	0	51.61	6.45	3.23	35.48	3.23	0.00	19	12
Rajauri	22	0.13	4.00	0.02	0.65	15	4	0	3	0	0	68.18	18.18	0.00	13.64	0.00	0.00	19	3
Reasi	6	0.40	1.29			6	0	0	0	0	0	100.0	0.00	0.00	0.00	0.00	0.00	6	0
Samba	35	0.07	4.42	0.12	2.63	18	5	1	10	1	0	51.43	14.29	2.86	28.57	2.86	0.00	24	11
Udhampur	17	0.15	4.60	0.47	3.58	9	3	1	3	1	0	52.94	17.65	5.88	17.65	5.88	0.00	13	4
<b>Total</b>	<b>177</b>	<b>0.02</b>	<b>6.91</b>	<b>0.02</b>	<b>6.48</b>	<b>94</b>	<b>17</b>	<b>4</b>	<b>53</b>	<b>6</b>	<b>3</b>	<b>53.11</b>	<b>9.60</b>	<b>2.26</b>	<b>29.94</b>	<b>3.39</b>	<b>1.69</b>	<b>115</b>	<b>62</b>

**Table 10. Categorization of Changes In Water Level Between August 2019 And August 18**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	49	0.12	2.10	0.07	8.75	4	1	0	37	6	1	8.16	2.04	0.00	75.51	12.24	2.04	5	44
Kathua	28	0.01	0.10	0.02	5.55	3	0	0	21	3	1	10.71	0.00	0.00	75.00	10.71	3.57	3	25
Rajauri	32	0.04	3.27	0.06	3.83	5	1	0	21	5	0	15.63	3.13	0.00	65.63	15.63	0.00	6	26
Reasi	8	0.75	0.75	0.07	0.33	1	0	0	7	0	0	12.50	0.00	0.00	87.50	0.00	0.00	1	7
Samba	27	0.82	1.51	0.04	8.69	3	0	0	21	2	1	0.00	0.00	0.00	77.78	7.41	3.70	3	24
Udhampur	20	0.03	0.66	0.07	6.93	3	0	0	16	0	1	15.00	0.00	0.00	80.00	0.00	5.00	3	17
<b>Total</b>	<b>164</b>	<b>0.01</b>	<b>3.27</b>	<b>0.02</b>	<b>8.75</b>	<b>19</b>	<b>2</b>	<b>0</b>	<b>123</b>	<b>16</b>	<b>4</b>	<b>11.59</b>	<b>1.22</b>	<b>0.00</b>	<b>75.00</b>	<b>9.76</b>	<b>2.44</b>	<b>21</b>	<b>143</b>

**Table 11. Categorization of Changes in Water Level Between November 2019 and November 18**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	80	0.04	3.94	0.03	8.61	50	1	0	25	2	2	62.50	1.25	0.00	31.25	2.50	2.50	51	29
Kathua	30	0.01	1.54	0.03	2.47	18	0	0	11	1	0	60.00	0.00	0.00	36.67	3.33	0.00	18	12
Rajauri	29	0.06	4.90	0.05	0.95	24	1	1	3	0	0	82.76	3.45	3.45	10.34	0.00	0.00	26	3
Reasi	8	0.05	1.55	2.62	2.62	7	0	0	0	1	0	87.50	0.00	0.00	0.00	12.50	0.00	7	1
Samba	33	0.09	1.01	0.03	14.45	13	0	0	19	0	1	39.39	0.00	0.00	57.58	0.00	3.03	13	20
Udhampur	24	0.02	2.21	0.05	0.38	19	3	0	2	0	0	79.17	12.50	0.00	8.33	0.00	0.00	22	2
<b>Total</b>	<b>204</b>	<b>0.01</b>	<b>4.90</b>	<b>0.03</b>	<b>14.45</b>	<b>131</b>	<b>5</b>	<b>1</b>	<b>60</b>	<b>4</b>	<b>3</b>	<b>64.22</b>	<b>2.45</b>	<b>0.49</b>	<b>29.41</b>	<b>1.96</b>	<b>1.47</b>	<b>137</b>	<b>67</b>

**Table 12 Categorization of Changes in Water Level Between January 2020 And January 2019**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	65	0.05	5.08	0.01	10.16	47	2	1	13	1	1	72.31	3.08	1.54	20.00	1.54	1.54	50	15
Kathua	31	0.02	2.62	0.02	0.97	23	3	0	5	0	0	74.19	9.68	0.00	16.13	0.00	0.00	26	5
Rajauri	30	0.32	5.47			15	12	3	0	0	0	50.00	40.00	10.00	0.00	0.00	0.00	30	0
Reasi	6	0.36	6.52	0.57	0.57	3	1	1	1	0	0	50.00	16.67	16.67	16.67	0.00	0.00	5	1
Samba	36	0.07	2.41	0.05	0.81	27	4	0	5	0	0	75.00	11.11	0.00	13.89	0.00	0.00	31	5
Udhampur	2	0.28	2.47			1	1	0	0	0	0	50.00	50.00	0.00	0.00	0.00	0.00	2	0
<b>Total</b>	<b>170</b>	<b>0.02</b>	<b>6.52</b>	<b>0.01</b>	<b>10.16</b>	<b>116</b>	<b>23</b>	<b>5</b>	<b>24</b>	<b>1</b>	<b>1</b>	<b>68.24</b>	<b>13.53</b>	<b>2.94</b>	<b>14.12</b>	<b>0.59</b>	<b>0.59</b>	<b>144</b>	<b>26</b>



## 2.4 DECADAL FLUCTUATION OF WATER LEVEL

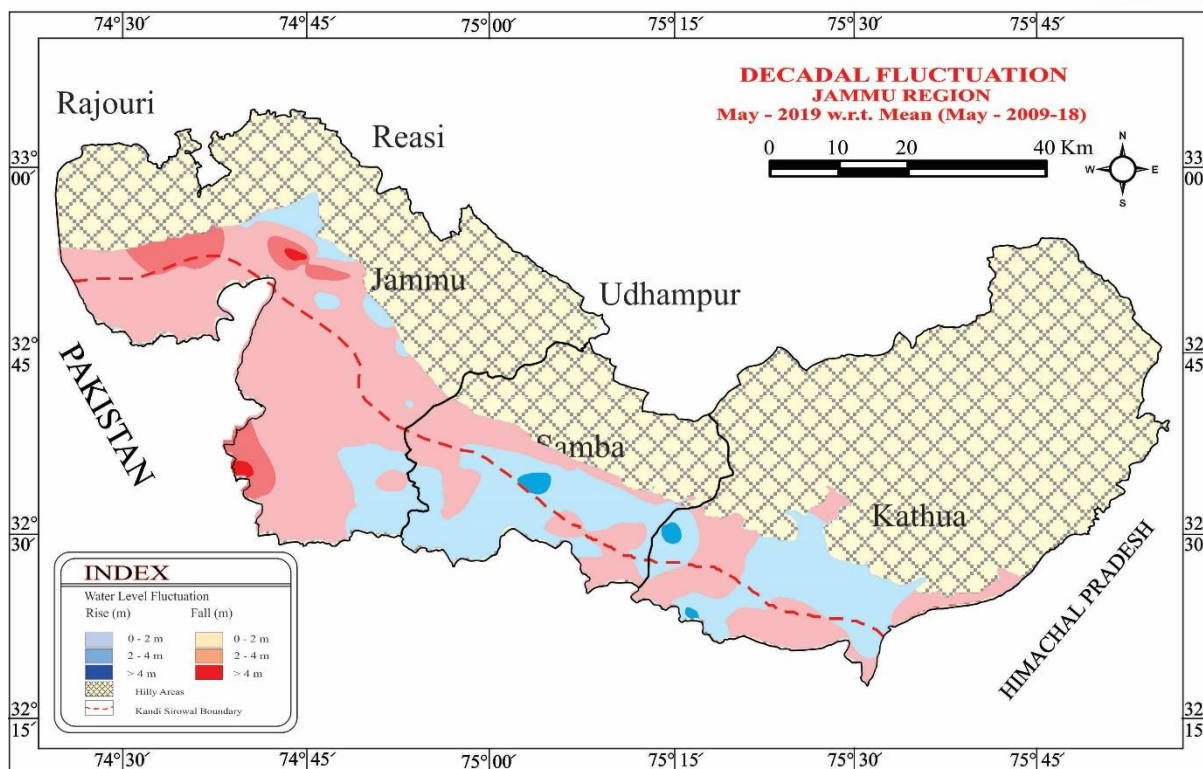
### 2.4.1. May 2019 with respect to mean of May 2009 – May 2018

The water level fluctuation for the month of May 2019 Vs. Mean of May 2009 – May 2018 has been worked out in respect of 163 observation wells. It is observed that a total of 60 wells have shown rise and 103 wells have shown decline in water level. Categorisation of changes in water level between May 2019 to decadal mean (May 2009- May 2018) is given in table 13.

Out of 60 number of wells showing rise, 51 wells (31.29%) have shown rise less than 2 m, 9 wells (5.52%) have shown rise from 2-4 m whereas 0 well (0.00%) shown rise of > 4 m. Out of 103 wells showing fall, 94 wells (57.67%) have shown fall in the range of 0-2 m, 7 well (4.29%) has shown fall between 2-4 m and 2 well (1.23%) has shown fall of >4 m bgl.

All of the areas monitored have shown rise as well as decline in water levels in all ranges in Jammu Region. In Jammu district, the rise in range of 0-2m was found in eastern and northern parts, where as in rest areas declining trend is shown in all rage. In Samba district, the rise of 0-2 m was observed in northern and southern parts except few patches of north western were decline of 0-2m was recorded. In Kathua western areas and eastern parts shows decline while rest of the area shows rise in water levels. (Figure 13)

**Figure 13**



### 2.4.2. August 2019 with respect to mean of August 2009– August 2018

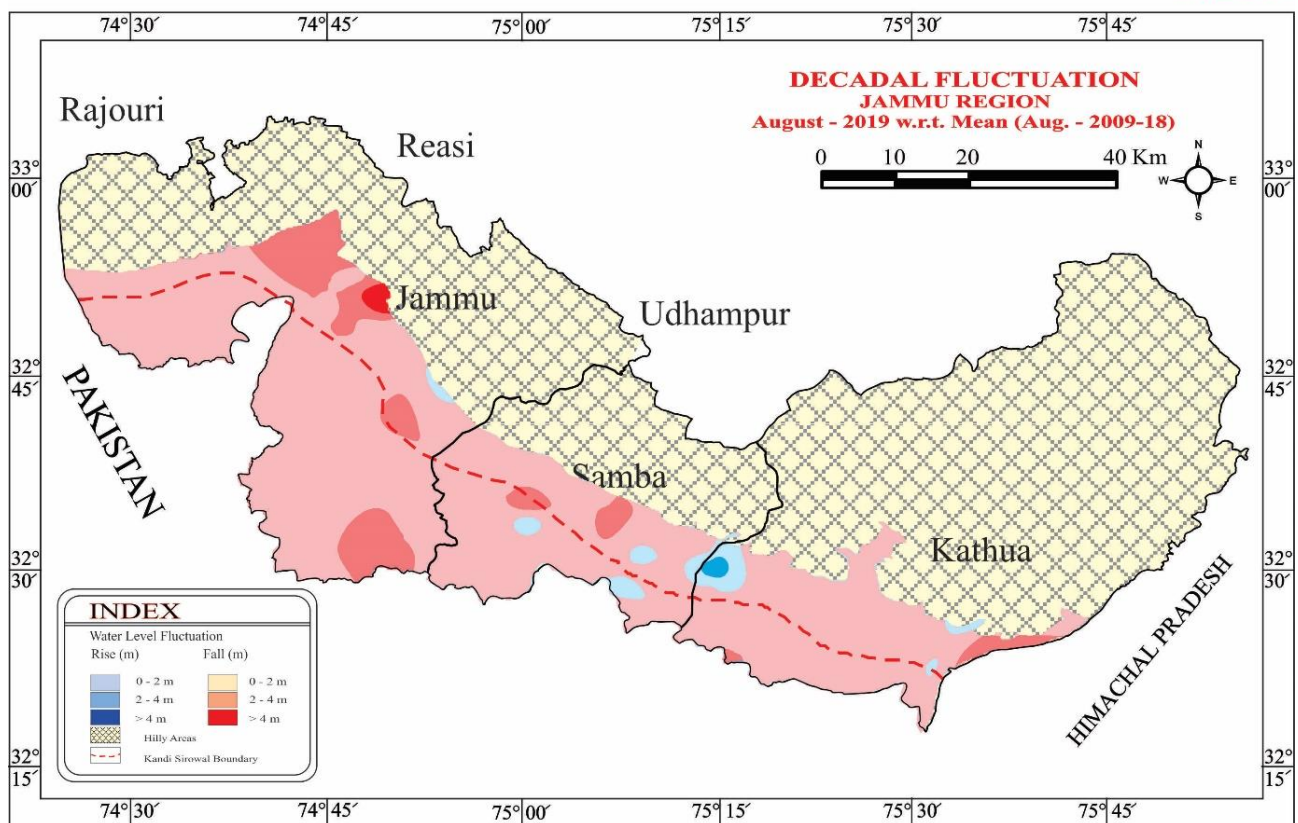
The water level fluctuation for the month of August 2019 Vs. (Mean of August 2009 – August 2018) has been worked out in respect of 150 observation wells. It is observed that a total of 20 wells have

shown rise and 130 wells have shown decline in water level. Categorisation of changes in water level between August 2019 to decadal mean (Aug. 2009-Aug. 2018) is given in table 14.

Out of 20 number of wells showing rise, 19 wells (12.67%) have shown rise less than 2 m, 1 wells (0.67%) have shown rise from 2-4 m whereas 0 well (0.00%) shown rise of > 4 m. Out of 130 wells showing fall, 110 wells (73.33%) have shown fall in the range of 0-2 m, 19 well (12.67%) has shown fall between 2-4 m and 1 well (0.67%) has shown fall of >4 m bgl.

Very less portions in Jammu Region have shown rise within 0-2m range. Rest of the area shows decline in the range of 0-2m with a few exceptions where fall of more than 2m was also observed. Rise in the range of 0-2m mostly in central parts in Samba and western and extern parts of Kathua districts. Almost all the areas in all districts have shown decline but above 2m decline is shown in northern and southern parts of Jammu, central and eastern parts of samba and Kathua districts respectively. (Figure 14).

**Figure 14**



#### 2.4.3. November 2019 with respect to mean of November 2009 – November 2018

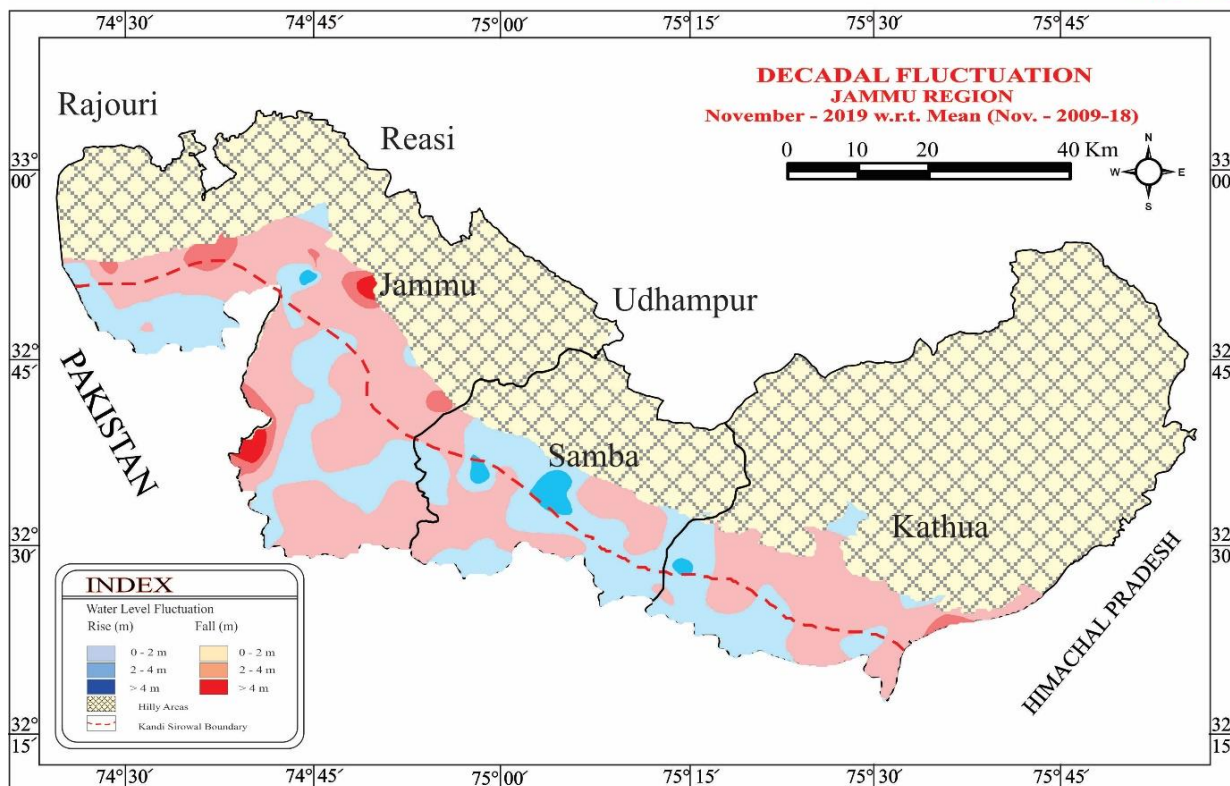
The water level fluctuation for the month of November 2019 w.r.t. (mean of November 2009 to November 2018) has been worked out in respect of 183 observation wells. It is observed that a total of 104 wells (have shown rise and 79 wells have shown decline in water levels. Categorisation of changes in water level between November 2019 to decadal mean is given in table 15.

Out of 104 number of wells showing rise, 95 wells (51.91%) are showing rise less than 2 m, 8 wells (4.37%) have shown rise from 2-4 m and 1 well (0.55%) have shown rise of more than 4 m. Out of 79

wells, which are showing fall, 70 wells (38.25%) have shown fall in water levels in the range of 0-2 m, 6 wells (3.28%) have shown fall between 2-4 m and 3 well (1.64%) have shown fall of >4 m.

Decline in water levels was observed in major portions of all the districts of Jammu Region. A few areas have shown rise in water levels above 0- 2m i.e. in south western and central areas of Jammu district. Rise in the range of 0 – 2 m is shown in central, eastern Samba and western parts of Kathua. Decline above 2m is shown in a major portion in all districts. (Figure 15).

**Figure 15**

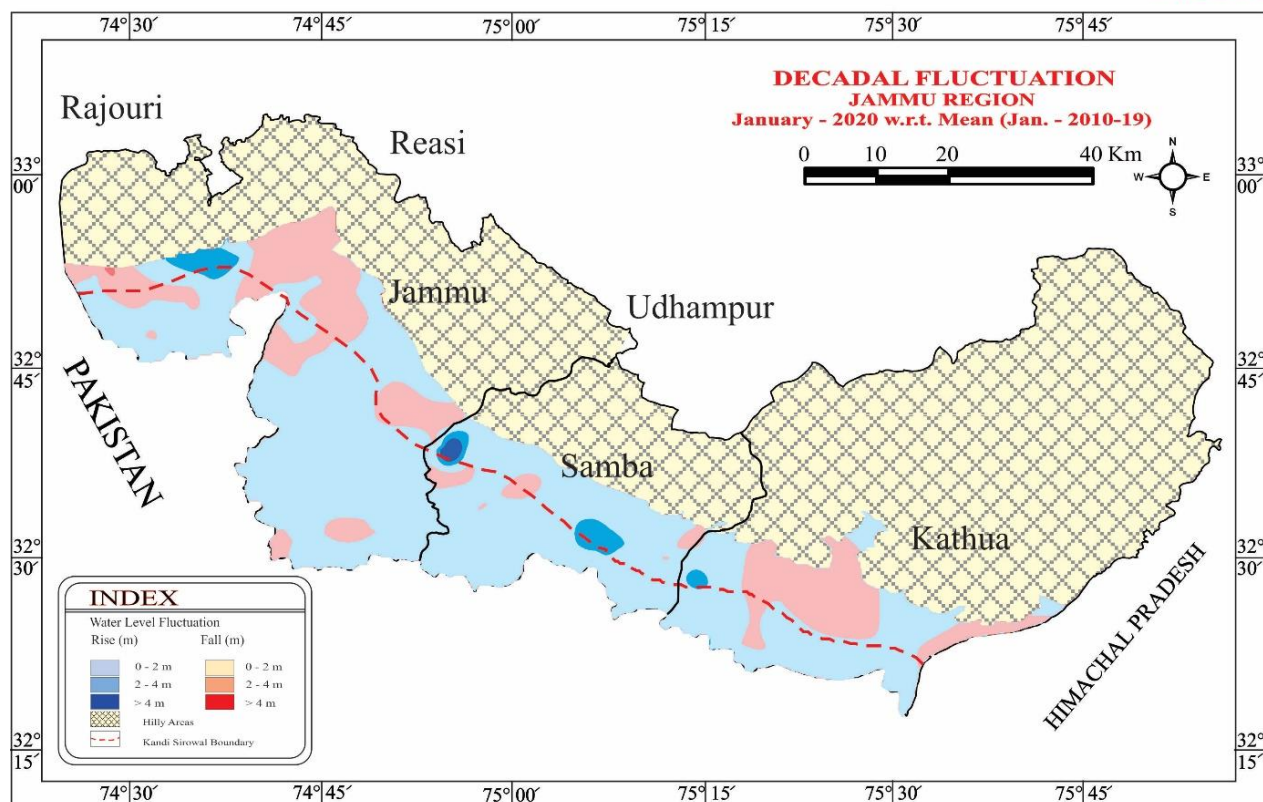


#### 2.4.4. January 2020 with respect to mean of January 2010 – January 2019

The water level fluctuation for the month of January 2020 w.r.t. (mean of January 2010 to January 2019) has been worked out in respect of 186 observation wells. It is observed that a total of 142 wells have shown rise and 44 wells have shown decline in water levels. Categorisation of changes in water level between January 2020 to decadal mean (January 2010-January 2019) is given in table 16.

Out of 142 number of wells showing rise, 118 wells (63.44%) have shown rise less than 2 m, 22 wells (11.83%) have shown rise from 2-4 m and 2 well (1.08 %) have shown rise of more than 4 m. Out of 44 wells showing fall in water levels, 43 wells (23.12%) have shown fall in the range of 0-2 m, 1 wells (0.54%) has shown fall between 2-4 m and 0 well (0%) has shown fall of >4 m. In Jammu Region, Decline as well as rise is in water levels observed in all the districts of Jammu Region. Decline of 0-2m has been registered in western parts of Jammu and Samba and major portions in central and western areas of Kathua district. Rise of 0-2m was registered in entire Jammu except few parts, western areas of samba district and central and small portion of north eastern area in Kathua district (Figure 16).

**Figure 16**



**Table 13. CATEGORISATION OF CHANGES IN WATER LEVEL BETWEEN MAY 2019 TO DECADAL MEAN (MAY 2009-MAY 2018)**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	63	0.03	3.24	0.02	5.28	10	1	0	45	5	2	15.87	1.59	0.00	71.43	7.94	3.17	11	52
Kathua	25	0.06	2.49	0.45	2.00	12	2	0	11	0	0	48.00	8.00	0.00	44.00	0.00	0.00	14	11
Rajauri	25	0.01	3.52	0.03	3.06	10	3	0	10	2	0	40.00	12.00	0.00	40.00	8.00	0.00	13	12
Reasi	7	0.78	0.83	0.02	1.48	2	0	0	5	0	0	28.57	0.00	0.00	71.43	0.00	0.00	2	5
Samba	31	0.05	2.59	0.02	0.61	13	1	0	17	0	0	41.94	3.23	0.00	54.84	0.00	0.00	14	17
Udhampur	12	0.01	2.45	0.05	0.95	4	2	0	6	0	0	33.33	16.67	0.00	50.00	0.00	0.00	6	6
<b>TOTAL</b>	<b>163</b>	<b>0.01</b>	<b>3.52</b>	<b>0.02</b>	<b>5.28</b>	<b>51</b>	<b>9</b>	<b>0</b>	<b>94</b>	<b>7</b>	<b>2</b>	<b>31.29</b>	<b>5.52</b>	<b>0.00</b>	<b>57.67</b>	<b>4.29</b>	<b>1.23</b>	<b>60</b>	<b>103</b>

**Table 14. CATEGORISATION OF CHANGES IN WATER LEVEL BETWEEN AUGUST 2019 TO DECADAL MEAN (AUGUST 2009-AUGUST 2018)**

District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	49	0.13	0.48	0.18	7.83	3	0	0	36	9	1	6.12	0.00	0.00	73.47	18.37	2.04	3	46
Kathua	29	0.09	3.20	0.08	3.80	3	1	0	23	2	0	10.34	3.45	0.00	79.31	6.90	0.00	4	25
Rajauri	28	0.20	0.60	0.05	3.97	2	0	0	20	6	0	7.14	0.00	0.00	71.43	21.43	0.00	2	26
Reasi	7	0.35	0.54	0.51	0.97	2	0	0	5	0	0	28.57	0.00	0.00	71.43	0.00	0.00	2	5
Samba	24	0.11	1.00	0.13	2.95	5	0	0	17	2	0	20.83	0.00	0.00	70.83	8.33	0.00	5	19
Udhampur	13	0.04	0.75	0.10	1.36	4	0	0	9	0	0	30.77	0.00	0.00	69.23	0.00	0.00	4	9
<b>TOTAL</b>	<b>150</b>	<b>0.04</b>	<b>3.20</b>	<b>0.05</b>	<b>7.83</b>	<b>19</b>	<b>1</b>	<b>0</b>	<b>110</b>	<b>19</b>	<b>1</b>	<b>12.67</b>	<b>0.67</b>	<b>0.00</b>	<b>73.33</b>	<b>12.67</b>	<b>0.67</b>	<b>20</b>	<b>130</b>

Table 15. CATEGORISATION OF CHANGES IN WATER LEVEL BETWEEN NOVEMBER 2019 TO DECADAL MEAN (NOVEMBER 2009-NOVEMBER 2018)																			
District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	72	0.02	3.49	0.01	6.49	28	1	0	35	5	3	38.89	1.39	0.00	48.61	6.94	4.17	29	43
Kathua	29	0.02	2.34	0.24	2.71	19	1	0	8	1	0	65.52	3.45	0.00	27.59	3.45	0.00	20	9
Rajauri	28	0.07	4.65	0.12	1.13	17	3	1	7	0	0	60.71	10.71	3.57	25.00	0.00	0.00	21	7
Reasi	7	0.25	0.80	0.31	0.55	5	0	0	2	0	0	71.43	0.00	0.00	28.57	0.00	0.00	5	2
Samba	33	0.05	3.76	0.01	0.82	15	2	0	16	0	0	45.45	6.06	0.00	48.48	0.00	0.00	17	16
Udhampur	14	0.22	2.05	0.45	0.75	11	1	0	2	0	0	78.57	7.14	0.00	14.29	0.00	0.00	12	2
<b>TOTAL</b>	<b>183</b>	<b>0.02</b>	<b>4.65</b>	<b>0.01</b>	<b>6.49</b>	<b>95</b>	<b>8</b>	<b>1</b>	<b>70</b>	<b>6</b>	<b>3</b>	<b>51.91</b>	<b>4.37</b>	<b>0.55</b>	<b>38.25</b>	<b>3.28</b>	<b>1.64</b>	<b>104</b>	<b>79</b>

Table 16. CATEGORISATION OF CHANGES IN WATER LEVEL BETWEEN JANUARY 2020 TO DECADAL MEAN (JANUARY 2010-JANUARY 2019)																			
District	No. Of wells Analyzed	Range of Fluctuation (m)				No. of Wells Showing Fluctuation (m)						Percentage of wells Showing Fluctuation						Total No. Of Wells	
		Rise		Fall		Rise			Fall			Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4	0-2	2-4	>4		
Jammu	71	0.09	3.33	0.07	2.33	43	2	0	25	1	0	60.56	2.82	0.00	35.21	1.41	0.00	45	26
Kathua	29	0.03	3.25	0.07	1.77	19	4	0	6	0	0	65.52	13.79	0.00	20.69	0.00	0.00	23	6
Rajauri	29	0.16	4.08	0.60	0.60	19	8	1	1	0	0	65.52	27.59	3.45	3.45	0.00	0.00	28	1
Reasi	8	0.16	3.30	0.00	4.00	3	3	0	2	0	0	37.50	37.50	0.00	25.00	0.00	0.00	6	2
Samba	35	0.02	6.90	0.02	1.03	25	2	1	7	0	0	71.43	5.71	2.86	20.00	0.00	0.00	28	7
Udhampur	14	0.58	2.94	0.20	0.30	9	3	0	2	0	0	64.29	21.43	0.00	14.29	0.00	0.00	12	2
<b>TOTAL</b>	<b>186</b>	<b>0.02</b>	<b>6.90</b>	<b>0.00</b>	<b>4.00</b>	<b>118</b>	<b>22</b>	<b>2</b>	<b>43</b>	<b>1</b>	<b>0</b>	<b>63.44</b>	<b>11.83</b>	<b>1.08</b>	<b>23.12</b>	<b>0.54</b>	<b>0.00</b>	<b>142</b>	<b>44</b>

### 3. HYDROCHEMISTRY

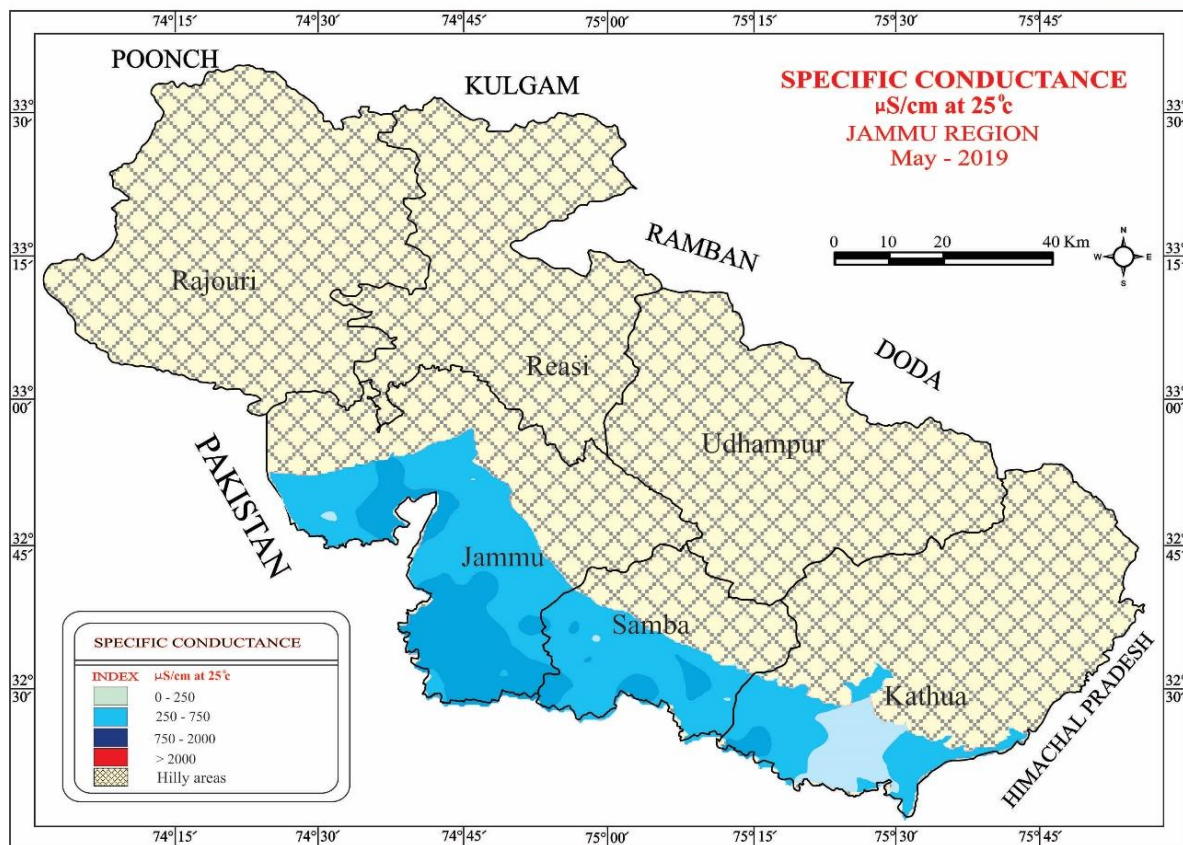
The quality of shallow ground water in UT of Jammu & Kashmir has been evaluated on the basis of 314 number of water samples collected from shallow aquifers during pre-monsoon season. All the collected samples were analysed by adopting standard methods of analysis (APHA). Chemical analysis data of ground water samples collected during May 2019 monitoring in valley portions of Jammu & Kashmir UT is given in Annexure – III & IV.

#### Ground Water Quality Characterization of J&K

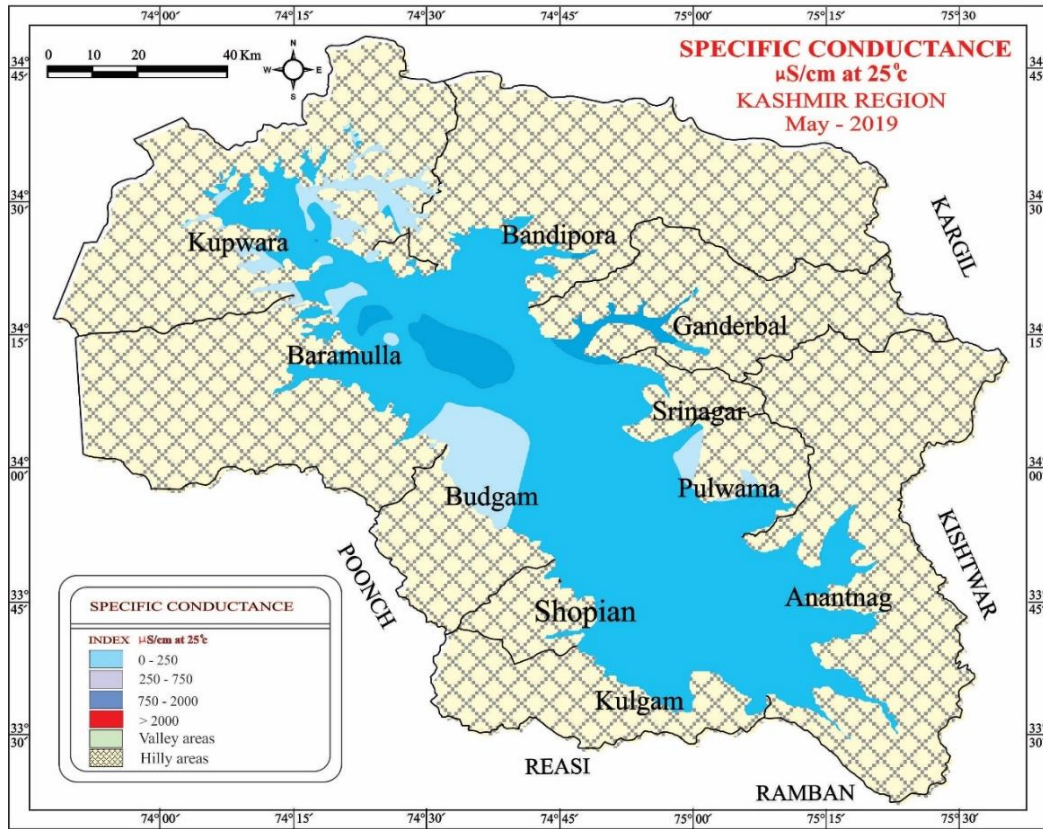
##### 3.1 Specific Conductance

Electrical Conductivity of ground water is generally low. Majority of samples (71.33%) are found to have specific conductance between 250 to 750  $\mu\text{S}/\text{cm}$  at 25°C (Table 16). Hence the ground water is fresh and potable. In Jammu and Kashmir, specific conductance varies between 70 and 2100  $\mu\text{S}/\text{cm}$  at 25°C. More than 3000  $\mu\text{S}/\text{cm}$  is not observed in any sample.

Figure 17



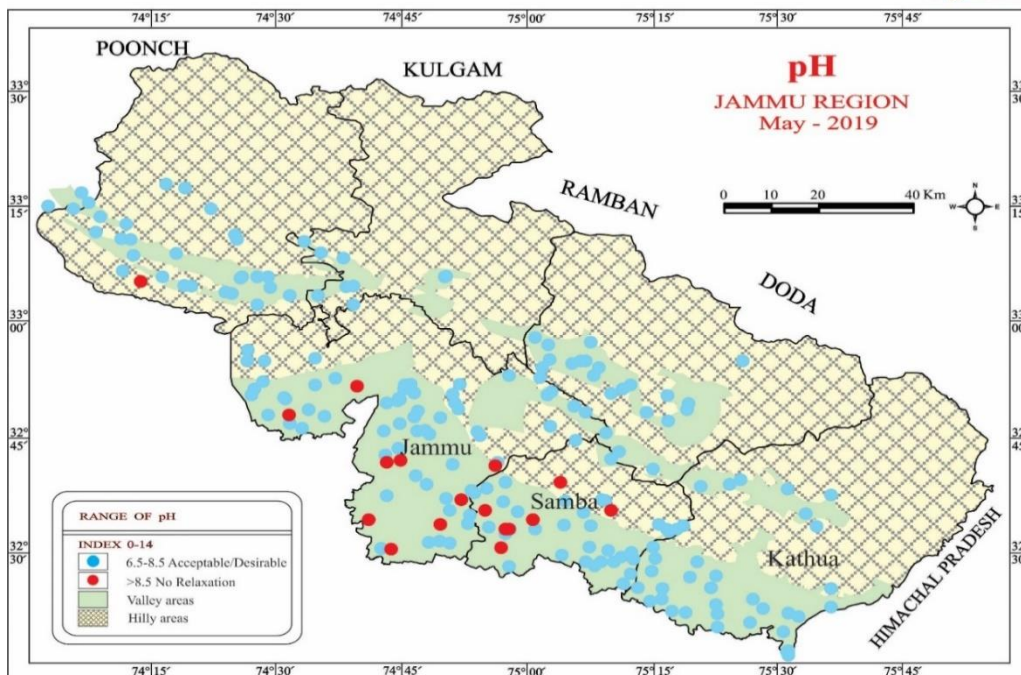
**Figure 18**



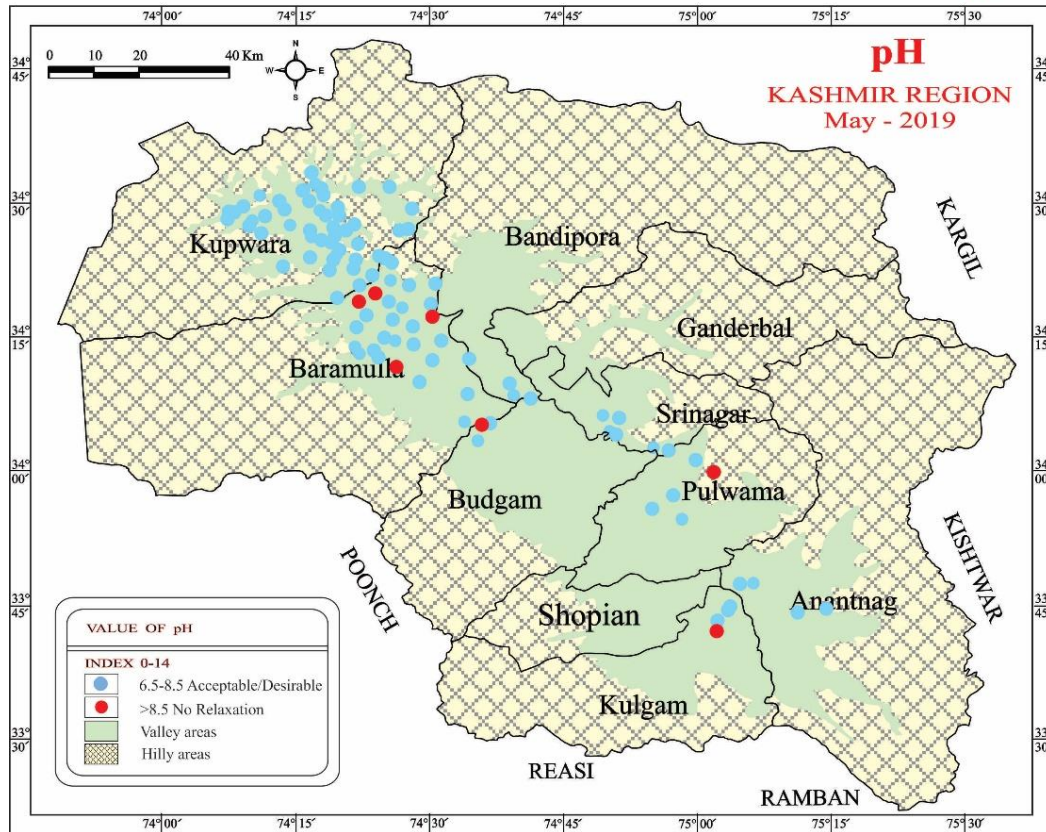
### 3.2 pH

In Jammu and Kashmir UT, water is neutral to alkaline in nature. Most of the samples collected from shallow ground water of Jammu district are alkaline in nature. In Jammu Region, pH values vary between 6.75 (Kachrial) and 9.99 (Swankha) and in Jammu Region.

**Figure 19**



**Figure 20**



### 3.3 Chloride

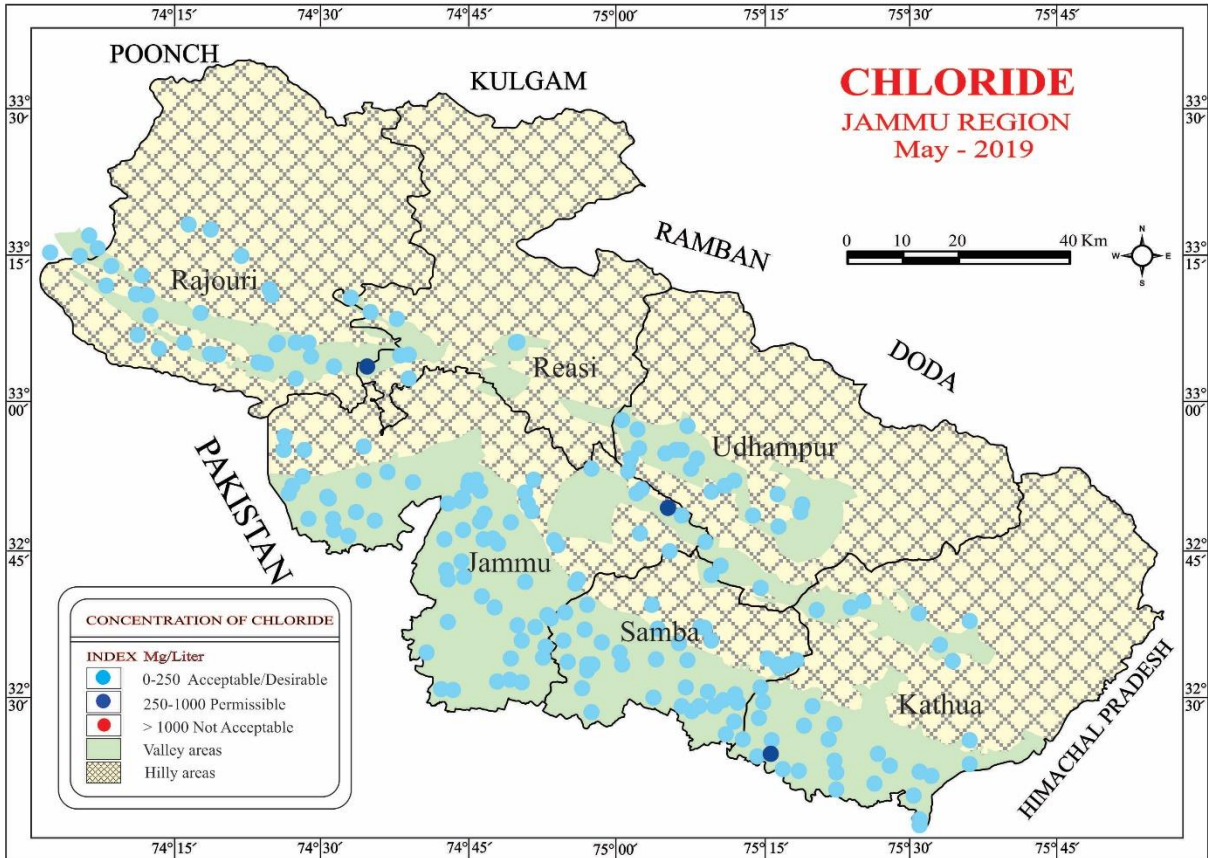
The Chloride concentration varies from 7 to 354 mg/l. The Chloride concentrations in all the wells are within the maximum permissible limit 1000 mg/l as prescribed by BIS for drinking water purpose. In majority of samples 310 (98.72%) chloride concentration are less than 250, but a few places high values (but < 300) are also observed. None of the samples has shown Chloride concentration >1000 mg/l (Table 17).

**Table 17 Ground Water Quality of Hydrograph Stations during May 2019**

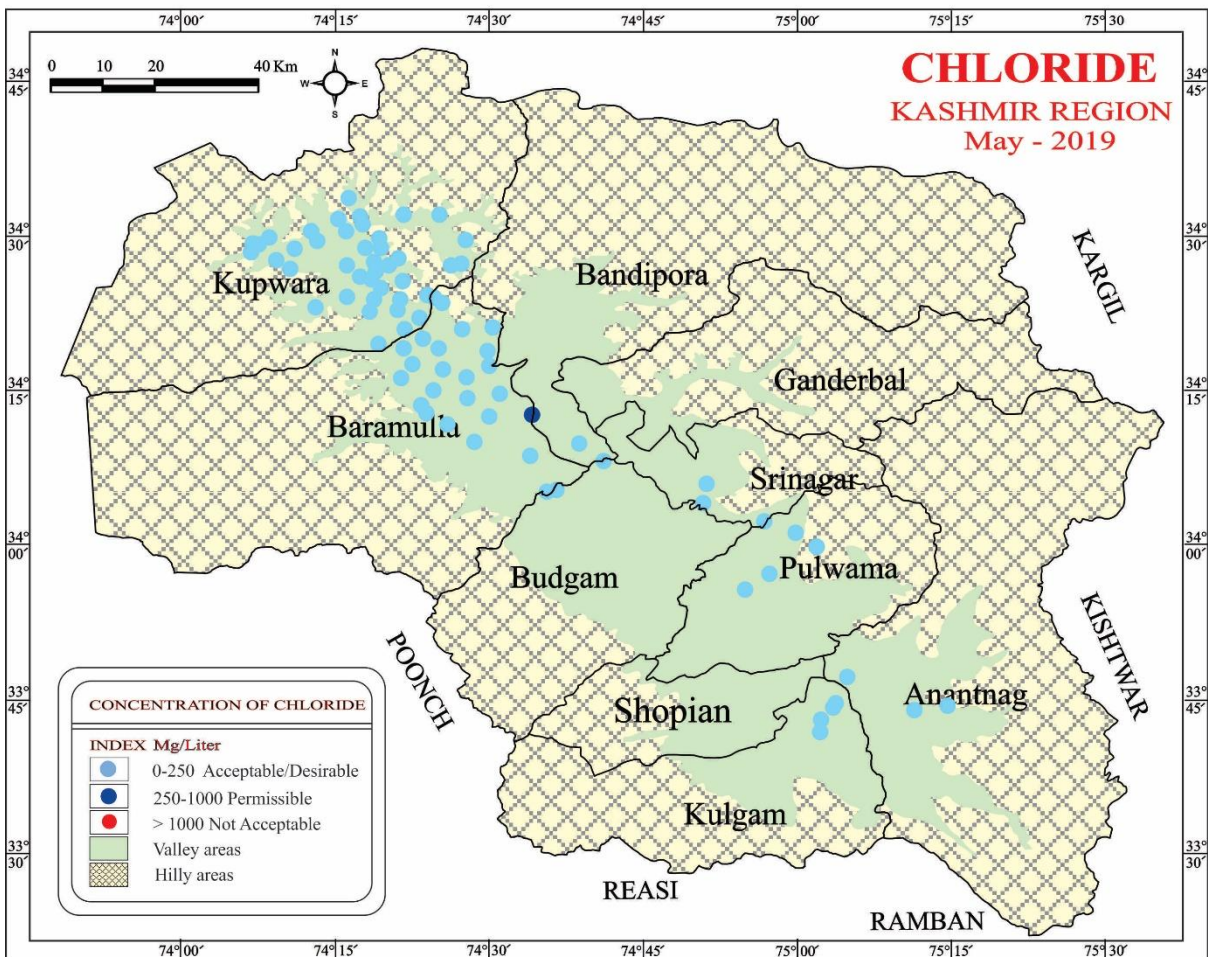
S. No.	Parameters	samples analysed	Permissible limit	Ranges	No. of Samples	Percentage %
1	Sp. Conductance µs/cm at 25°C	314	--	<250	51	16.24
				250-750	224	71.33
				750-2000	38	12.10
				>2000	01	0.031
2	Chloride (mg/l)	314	250-1000	<250	310	98.72
				>250	04	1.27



**Figure 21**



**Figure 22**



### 3.4 Calcium

Calcium concentration varies from 4 to 217 mg/. The Calcium concentrations in all the wells are within the maximum permissible limit upto 200 mg/l as prescribed by BIS for drinking water purpose except few locations. In majority of samples 290 calcium concentration are less than 75 i.e. within acceptable limits whereas 23 samples with high values (but < 200 within permissible limits) are also observed. None of the samples has shown calcium concentration >250 mg/l

Figure 23

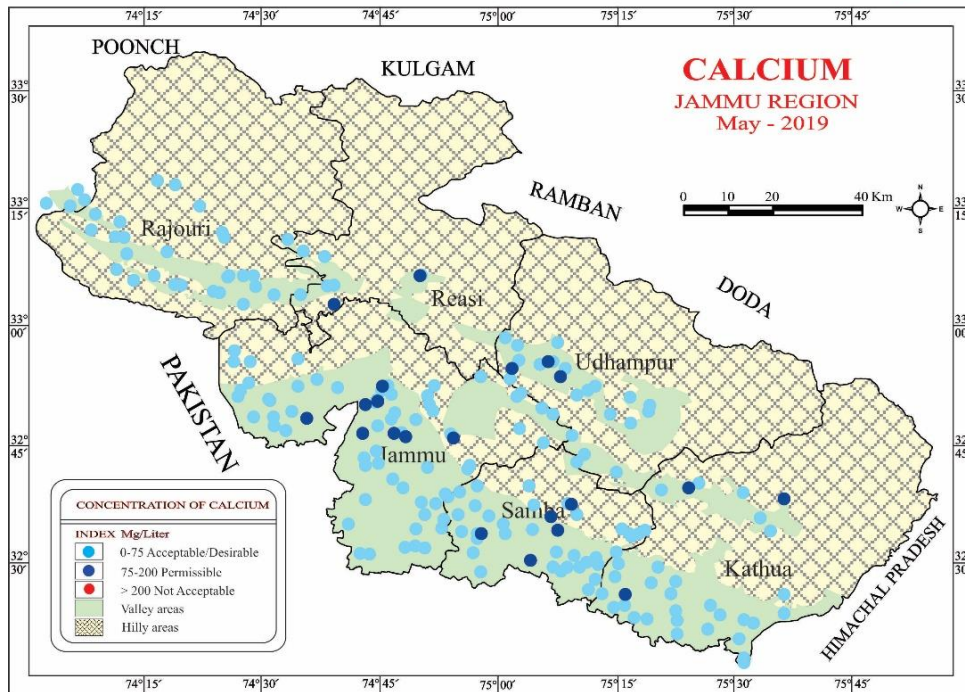
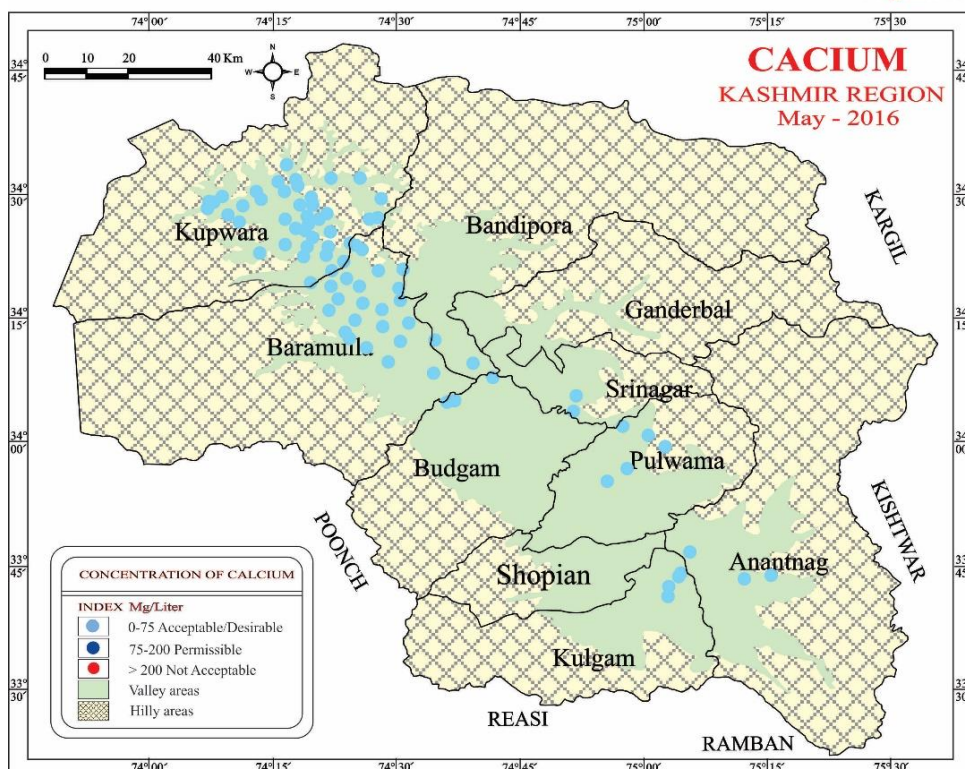


Figure 24



### 3.5 Magnesium

The Magnesium concentration varies from 3 to 129 mg/. The magnesium concentrations in 192 locations are within the maximum permissible limit up to 30 mg/l as prescribed by BIS for drinking water purpose. Rest of the wells shows >30mg/l. In majority of samples 122 magnesium concentration are greater than 30 i.e. above desirable limits and 3 samples with high values >100 mg/l are also observed.

Figure 25

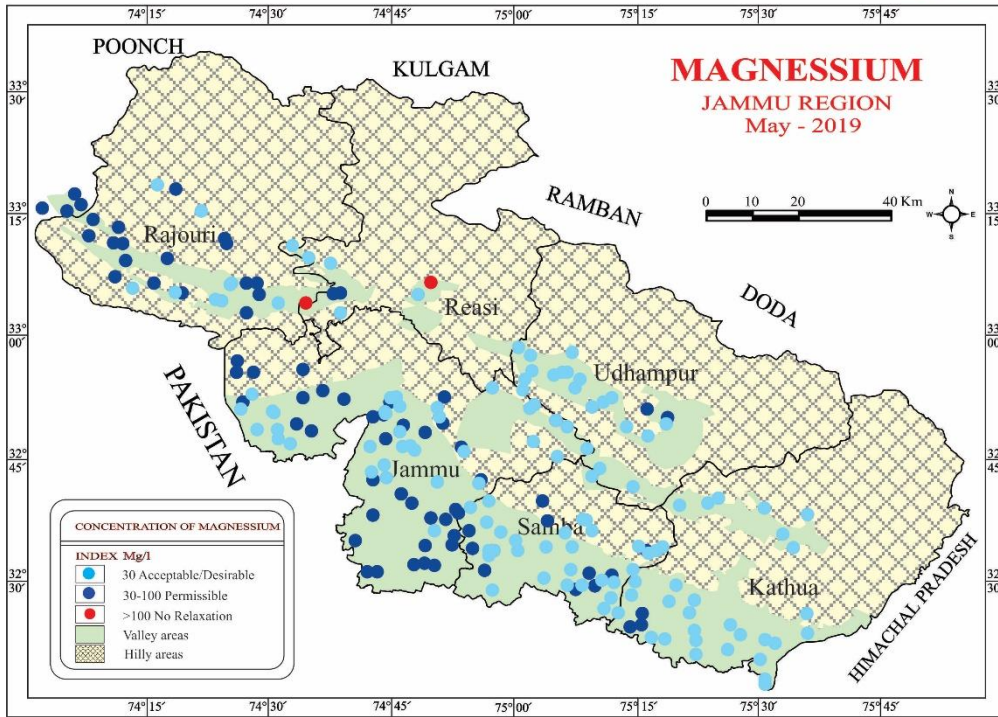
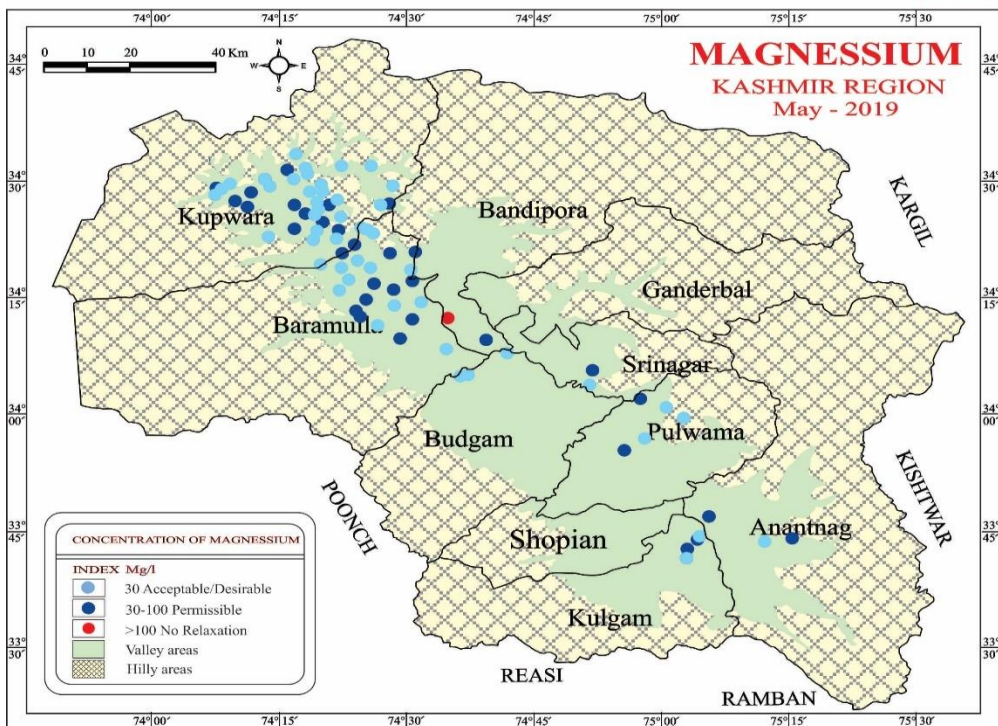


Figure 26



### 3.6 Sodium

The Sodium concentration varies from 0.1 to 462 mg/l. In majority of samples 305 Sodium concentration are below 100mg/l. However, 7 samples have shown >100 but less than 250mg/l. Only 2 wells have shown value of > 250mg/l.

### 3.7 Potassium

The Potassium concentration varies from 2.1 to 450 mg/l. In majority of samples 289 Sodium concentration are below 100mg/l. However, 24 samples have shown >100 but less than 250mg/l. Only 1 well has shown higher value of 450mg/l.

### 3.8 Total Hardness

High concentration of carbonates, bicarbonates of calcium and magnesium, in ground water causes hardness. It causes scaling in water supply lines. High concentration of hardness in ground water is social economic problem; hence it is also an important water quality parameter.

#### *Classification of Hardness*

As per the classification of hardness, majority of samples 217 falls under very hard category and 56 wells fall in hard category. Rest Samples 2 and 39 samples are soft and moderately hard in Category.

As per the BIS norms 200 and 600 mg/l is the acceptable and maximum permissible limit respectively for drinking water purposes. It is clear that all samples are within the maximum permissible limit (i.e. 600 mg/l), except few locations (02) where high value of total Hardness > 600 mg/l is observed.

Figure 27

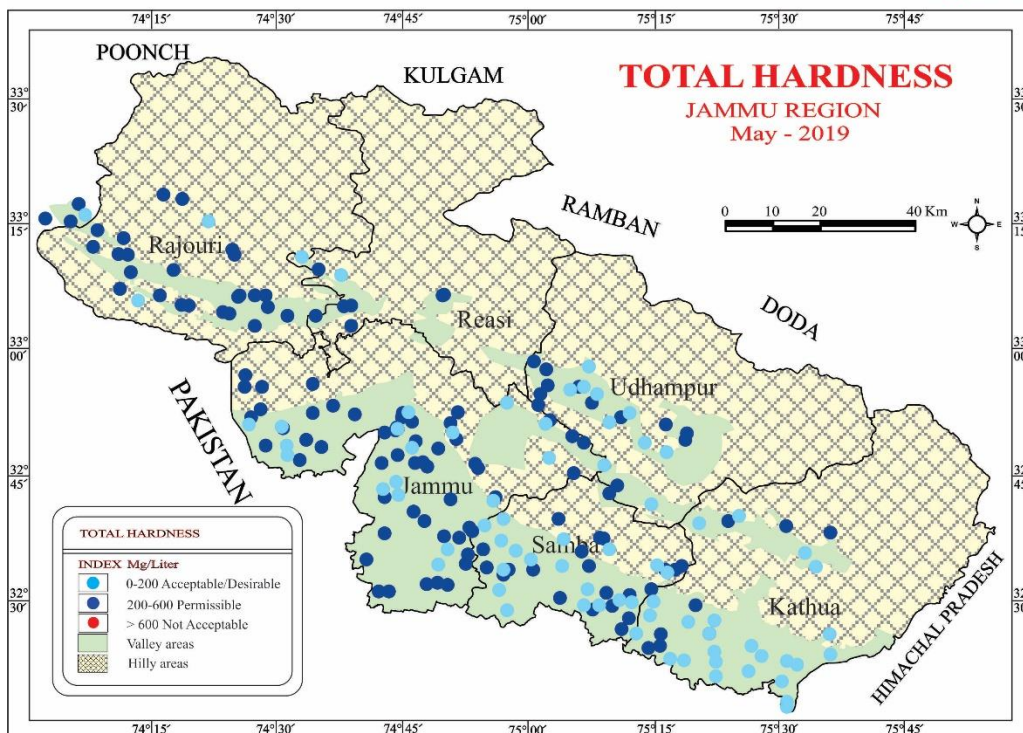
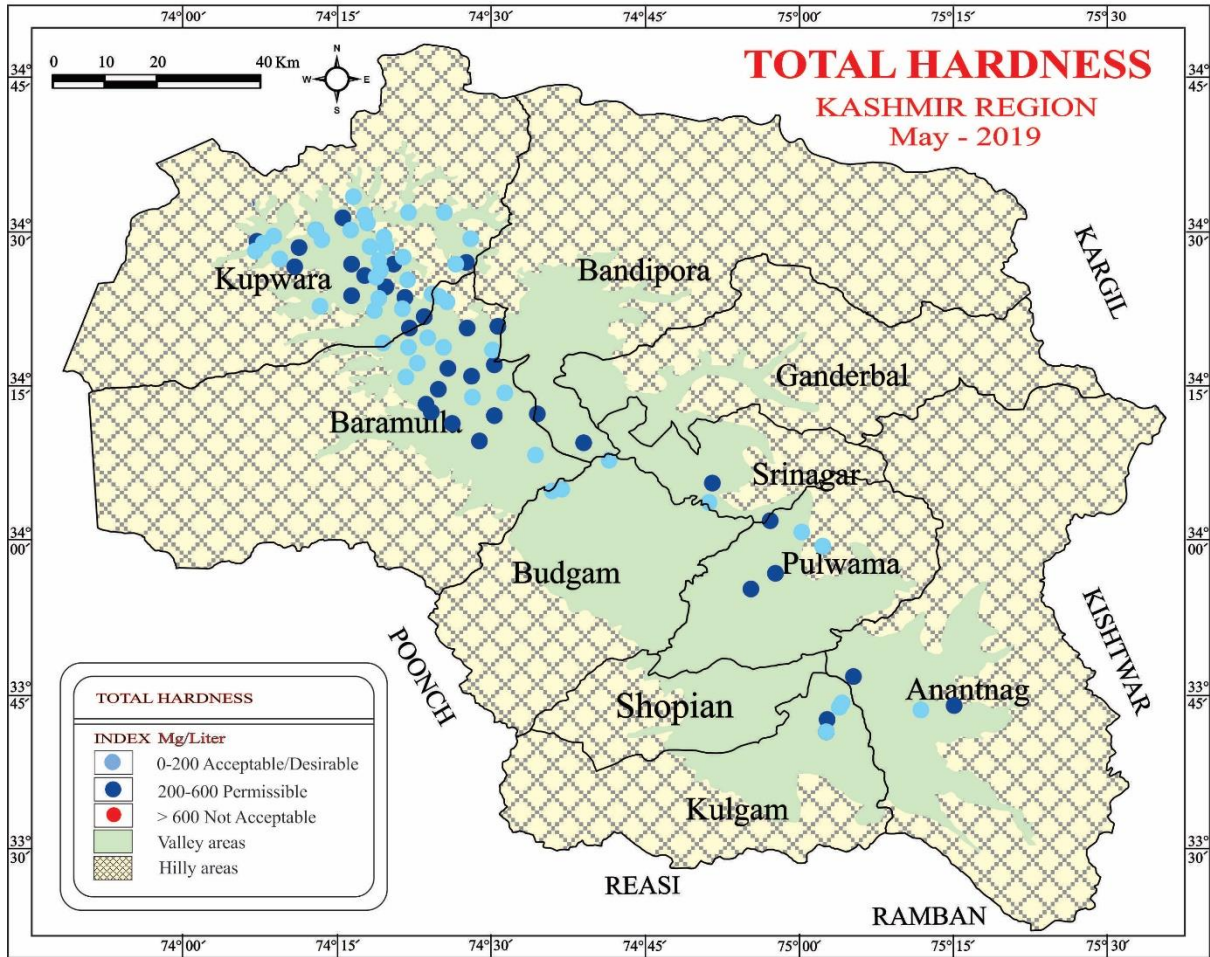


Figure 28



#### 4. RECOMMENDATIONS

- Ground water in Jammu and Kashmir UT is fresh and potable in most of the areas. Water supply in this UT is mainly dependant on ground water whether it is spring source, shallow ground water or deep ground water. Ground water is the main source for surface water bodies in the form of base flow in lean periods. Proper protection measures need to be taken to avoid contamination of ground water.
- Even though salinity is not a major concern in the state, there are problems of ground water contamination like iron (Fe) (in Tertiary belt and in Kashmir valley) marshy gases (in shallow and deep aquifers of Kashmir valley), Fluoride in localized areas like in parts of Doda district. Nitrate contamination, Bacteriological contaminations, ground water pollution is due to pesticides/ fertilizers in agriculture and horticulture. The quality surveillance needs to be increased by State Government Organisations. Ground water quality shall be monitored once in a year for all major elements, trace metals and bacteriological contaminations.
- Most of the ground water is hard to very hard category causing gastro-intestinal problems. This type of water may be treated properly before supplying the water for drinking purposes.
- Deeper aquifers in both Jammu region and Kashmir valley can be developed for mitigating the water supply requirements. Micro-level planning is required to develop these aquifers based on the available data of aquifer geometry, parameters and water resources. Groundwater from deeper aquifers in Kashmir valley consists of iron and marshy gasses which need to be treated properly before supplying the water. It is better to identify the iron free aquifers through scientific ground water exploration techniques couples with modern techniques of geophysics so that iron problem can be mitigated. Tube wells shall be constructed by tapping only iron free aquifers and avoiding iron rich aquifers through cement sealing and putting gravel pack only around the iron free aquifers.
- The reality of climate change is the most significant long term threat to water resources. In hilly region water supply is still based on springs, where discharges of springs are drastically being reduced. Systematic enumeration/inventory of springs including its quality, snow water harvesting techniques and other available techniques is required to develop ground water resources on sustainable basis need to be adopted.
- Fast developing urban & industrial areas need special attention/quality surveillance by the State government authorities. Proper monitoring for trace elements in industrial areas like Bari-Brahmana, Gangyal and other industrial areas located in Kashmir valley shall be taken

up. Monitoring network stations shall be established all along the nallahs and drains carrying industrial effluents.

- As the water supplies in Jammu city and parts of areas in Srinagar city are ground water based, proper well head protection measures need to be taken to avoid bacteriological contamination like coliform bacteria and E-coli.
- There is lack of proper sewage and sanitation in all over the state resulting into ground water and surface water contaminations. This issue need to be addressed immediately by the authorities. Village sewages shall be disposed off properly after proper treatment. In water logging areas, where ground water is being contaminated by polluted surface water, proper drainage shall be created for avoiding the water logging conditions.
- Ground water contamination by improper disposal of domestic and industrial solid wastes is of another concern. Special efforts shall be made to address this problem.
- There is an urgent need to take-up comprehensive studies on ground water quality of both shallow and deep ground waters analysing major elements, heavy metals, pesticides, microbial contamination is the need of the hour. Areas identified in this report where higher concentrations of heavy metals, nitrates and fluorides need to be given special attentions.
- The existing data base on quality with different organizations like CGWB, PHED, State pollution control board, academic institutions like Jammu university and Kashmir university need to be integrated and a comprehensive data base need to be established.
- Scientific research projects on ground water contamination especially geo-genic contamination like Iron, gasses and fluoride need to be taken up immediately
- Proper management strategies need to be drawn up to combat the problems of geo-genic contamination. Cost effective community level treatment plants need to be established. The treatment plants as recommended in this report shall be constructed with trained manpower as in charges so that these treatment plants may work efficiently for longer periods.
- As the ground water is hard to very hard type and consists of iron, proper treatment shall be followed before using this water for irrigation through modern irrigation methods like sprinkler and drip irrigation systems. This type of water may choke the sprinklers and drips.

## ANNEXURE – I

## Depth to Water Level Data of Dug Wells (in mbgl) for all Seasons (Kashmir Region)

S. No.	Location	District	May- 19
1	Rambarpora	Anantnag	15.8
2	Badran	Baramulla	3.55
3	Binner	Baramulla	3.07
4	Bomai	Baramulla	1.09
5	Mirgund	Baramulla	1.17
6	Sangrama	Baramulla	1.47
7	Waripora	Baramulla	0.6
8	Zambodzpora	Baramulla	1.48
9	Cherkut	Kupwara	3.58
10	Chowgal	Kupwara	0.77
11	Dolipora	Kupwara	0.6
12	Drugmulla	Kupwara	2.96
13	Gulgam	Kupwara	1.16
14	Guse	Kupwara	2.39
15	Handwara al Mustafa Colony	Kupwara	2.25
16	Khanpora	Kupwara	5.66
17	Kupwara Main chowk	Kupwara	0.75
18	Magam	Kupwara	1.35
19	Trehgam	Kupwara	1.64
20	Sambura Kokapura	Pulwama	2.96
21	Regal Chowk	Srinagar	2.37
22	Dusilpora	Baramulla	1.23
23	Lolipora	Baramulla	1.95
24	Authoora	Baramulla	0.6
25	Mazbugh	Baramulla	0.55
26	Ibrahim Colony	Baramulla	1.22
27	Said pora	Baramulla	0.67
28	Nazar Mohalla (Dangerpora)	Baramulla	1.45
29	Mandji	Baramulla	0.9
30	Uplna	Baramulla	0.7
31	Hadipora	Baramulla	4.13
32	Palpora	Kupwara	0.9
33	Hampora	Kupwara	1.05
34	Wadipora	Kupwara	2.45
35	Zachaldara	Kupwara	6.05
36	Chanjmul	Kupwara	3.95
37	Radbug	Kupwara	0.67
38	Tarich	Kupwara	1.78
39	Bramri	Kupwara	1.43
40	Lassipora	Kupwara	3.9
41	Mir Mohalla (Katyan Wali)	Kupwara	2.15
42	Wasar Khoto	Kupwara	2.15
43	Batpora Bala	Kupwara	1.13
44	Taratpora	Kupwara	0.5
45	Dohama	Kupwara	2
46	Urwan (Warwan)	Pulwama	0.75



**ANNEXURE – II**

**Depth to Water Level Data of Dug Wells (in m) for all Seasons (Jammu Region)**

Sl. No.	Location	District	May-19	Aug-19	Nov-19	Jan-20
1	Agre Chak	JAMMU	3.72	1.88	1.89	2.31
2	Akhnoor (Batera)	JAMMU	17.4	13.7	13.76	14.94
3	Alla	JAMMU	3.48		2.94	2.92
4	Arnia	JAMMU	9.82		8.22	8.81
5	Badsoo	JAMMU	2.01	1.03	0.67	0.45
6	Bakore	JAMMU	5.44	3.78	3.25	3.40
7	Baradow	JAMMU	8.8	5.78	5.74	7.28
8	Batera	JAMMU	11.75	8.6	3.59	9.30
9	Bega	JAMMU			7.67	2.57
10	Bera	JAMMU			6.69	
11	Bhagwanachak	JAMMU	33		28.26	
12	Bishnah	JAMMU	3.61	1.83	1.55	1.55
13	Chatta	JAMMU	7.59	4.7	4.85	4.36
14	Chowki chowra	JAMMU			1.95	1.29
15	Devipur	JAMMU	7.94	5.33	6.76	7.52
16	Dhanpur	JAMMU	7.45	4.53	3.78	4.12
17	Dharam Khu	JAMMU	24	22.5	23.81	24.78
18	Dhora	JAMMU	3.52	2.51	2.67	2.50
19	Garhi (Jammu)	JAMMU	8.88	6.49	7.49	7.77
20	Gajansoo	JAMMU	4.1	2.8	2.9	3.05
21	Gho-Manhasan	JAMMU	2.76	1.18	2.05	1.96
22	Gigrial	JAMMU	4.22	3.66	2.98	3.15
23	Greater Kailash	JAMMU	10.45	10.69	9.59	8.94
24	Gura	JAMMU	15	11.86	11.93	12.88
25	Hamirpur Kohna	JAMMU	4.49	3.47	2.4	2.84
26	Hamirpur Sidhar	JAMMU	4	3.94	2.98	3.33
27	Hazuribag	JAMMU			7.73	
28	Jagati	JAMMU	1.24		0.17	0.11
29	Jaswan	JAMMU	4.6		4.4	2.83
30	Jhiri	JAMMU	7.76	4.75	5.99	6.13
31	Jogwan	JAMMU	4.6	6.34	5.66	5.78
32	Jourian	JAMMU	6.25	2.38	2.71	3.91
33	Kachrial	JAMMU	3.68	3.78	3.25	3.69
34	Kalah	JAMMU	4.09		1.95	1.78
35	Kaluchak	JAMMU	5.12			4.60
36	Kamila	JAMMU	6.3	5.06	4.56	4.57
37	Kana Chak	JAMMU		3.00	3.35	3.45
38	Kangar	JAMMU	12.57	11.23	13.86	8.96
39	Karnaile Chak	JAMMU	7.7	6.66	8.11	
40	Katcha-Pind Dansal	JAMMU	1.73	4.62	2.15	2.10

Sl. No.	Location	District	May-19	Aug-19	Nov-19	Jan-20
41	Khairi (Raipur)	JAMMU	3.4	3.4	4.28	4.68
42	Khanpur Nagrota	JAMMU	5.4	0.54		1.73
43	Khour	JAMMU	5.92	2.53	2.74	3.32
44	Kot Kaswal	JAMMU	1.94	1.02	0.55	0.33
45	Kothey Saini	JAMMU	4.2	4.56	3.63	3.57
46	Kotli Charkan	JAMMU	4	2.68	2.76	2.59
47	Kunihala	JAMMU	2.01	2.06	1.64	1.59
48	Lalyal	JAMMU	3.91	3.34	3.03	2.84
49	Lam	JAMMU	3.05	2.46	2.18	2.31
50	Laswara	JAMMU	1.44	1.68	1.32	1.54
51	Leherian	JAMMU			9.03	9.80
52	Lower Barnai	JAMMU				0.32
53	Makwal	JAMMU	4.21	2.39	3.36	2.19
54	Marh	JAMMU	3.5	3.4	2.36	2.45
55	Marjholi	JAMMU		25.75		
56	Mothlian Kalan	JAMMU			5.09	4.35
57	Miran Sahib	JAMMU	7.3	7.85	8.2	6.35
58	Muthi	JAMMU	3.6	0.94	1.39	1.37
59	Nagbani	JAMMU	4.9	3.36	2.9	3.45
60	Nagrota (Sittlei)	JAMMU			3.2	2.91
61	Nagrota (Uttarbani)	JAMMU	6.5	5.62	5.49	5.15
62	Nagrota (Kandoli)	JAMMU	4.29	3.34		
63	Nandpur	JAMMU		3.84	2.6	2.37
64	Nikowal	JAMMU	5.42	4.76	4.3	4.23
65	Pallanwala	JAMMU	2.35	1.55	1.3	1.38
66	Palatan	JAMMU	3.19	2.04	1.61	1.81
67	Pangli Colony	JAMMU	4.12	1.75	1.63	2.20
68	Pata Khu	JAMMU	24.9	21.5	21.53	22.05
69	Patyale Chak	JAMMU	4.68	3.6	3.22	3.34
70	Purkhoo	JAMMU	20.14	17.37	16.91	17.51
71	Poal	JAMMU	3.55	3.8	2.22	2.48
72	Rangoora	JAMMU	2.55	1.3	1.01	0.86
73	Rehal	JAMMU	5.83	4.53	4.13	3.59
74	Sajwal	JAMMU	3.66	1.81	2.41	2.56
75	Salehar	JAMMU	4.4	3.45	2.33	2.24
76	Sandhwan	JAMMU	4.2	3.6	3.29	3.10
77	Satwari	JAMMU	11.37	10.93	9.93	10.38
78	Sei Khurd	JAMMU	4.93	4.45	4.08	3.66
79	Senth	JAMMU	3.56	1.91	1.8	1.44
80	Shame Chak	JAMMU	7.55	3.15	5.06	6.06
81	Sidhra	JAMMU	4.7	3.46	2.77	3.80
82	Sobka	JAMMU		22.31	21.31	22.20

Sl. No.	Location	District	May-19	Aug-19	Nov-19	Jan-20
83	Sohanjana	JAMMU	3.85	3.17	3.16	2.86
84	Suchetgarh-II	JAMMU	6.08	3.38	2.18	1.65
85	Sugetar	JAMMU	5.12	2.26	3	2.65
86	Sumah	JAMMU	3	3.54	3.64	3.49
87	Surinsar	JAMMU	1.35	0.41	0.14	0.22
88	Tanda Sheoda	JAMMU	5.9	4.65	1.6	1.60
89	Taryai	JAMMU	38.78	34.83	36.1	31.35
90	Upperla kanhal	JAMMU	4.93	3.05	2.49	2.30
91	Barni	KATHUA	6.6	3	5.72	4.70
92	Bhagwal	KATHUA	23.44	8.35	13.04	19.48
93	Billawar	KATHUA			1.03	
94	Chak hariya	KATHUA	3	2	1.5	1.64
95	Chann Khatrian	KATHUA	9	1.73	3.98	6.80
96	Chan ranga	KATHUA	16.46	10.65	8.79	11.01
97	Chapki Kalan	KATHUA	19.5	8.45	7.64	11.72
98	Chakara	KATHUA	4.72			2.48
99	Feru chak	KATHUA	5.23	4.22	1.91	2.44
100	Gond More	KATHUA			2.1	1.58
101	Gangu chak	KATHUA	3.23	2.26	2.17	1.99
102	Hore	KATHUA	2.58	0.85	0.85	0.94
103	Jandi	KATHUA	4.55	4.35	2.79	2.79
104	Jindore	KATHUA	12.23	4.13		9.43
105	Karol Krishna	KATHUA	9.26		7.51	6.75
106	Kathua	KATHUA	1.7	0.63	1.02	0.99
107	Kerian Gandyal-II	KATHUA		2.8	3.54	2.88
108	Kerian Ramnagar	KATHUA		2.37	2.76	2.02
109	Khanpur	KATHUA	2	2.2	1.57	1.63
110	Khukhial	KATHUA		1.22	1.48	1.20
111	Konthal	KATHUA	6.08	5.41	4.68	4.30
112	Kote punnu	KATHUA	3.25	1.8	1.83	1.47
113	Kothian	KATHUA	2	0.5	0.19	0.98
114	Lakhanpur	KATHUA	6	6.15	6.4	6.20
115	Lakri	KATHUA	3.78	2.85	2.32	2.32
116	Londi	KATHUA	6.02	5.65	5.27	4.67
117	Mandli	KATHUA	3.1	1.8	1.82	1.91
118	Mukandpur	KATHUA	5	4.3	3.92	3.76
119	Nagri	KATHUA	3.4	1.52	2.39	1.72
120	Nagrota-Gujaroo	KATHUA	8.73	4.17	5.06	1.21
121	Nanke Chak (Sherpur)	KATHUA	2		0.67	4.52
122	Pallan	KATHUA	1.87	0.65	0.46	0.46
123	Pansar	KATHUA	6.11	6.1	5.8	5.72
124	Patyari	KATHUA		3.65	4.13	6.37

Sl. No.	Location	District	May-19	Aug-19	Nov-19	Jan-20
125	Patyari II	KATHUA	3.9	2	2.15	1.92
126	Phinter	KATHUA	7.4	2.7	4.39	4.96
127	Ramkot	KATHUA	6.5	3.62	4.9	4.64
128	Rehian	KATHUA	21.68	2.09		
129	Saida	KATHUA	7.09	1.65	1.75	0.46
130	Sumwan	KATHUA	13.42	7.97	8.81	10.05
131	Ainpur	RAJOURI	3.6	2.07	1.9	0.70
132	Bagnoti	RAJOURI	7.4	7.18	4.99	5.30
133	Bajabain	RAJOURI	3.32	1.76	3.5	1.77
134	Bakhar	RAJOURI	2.08	1.43	1.41	0.50
135	Banpari	RAJOURI	3.87	3.1	1.8	1.01
136	Bareri	RAJOURI	3.3	3.3	2.4	1.44
137	Bhatta Mohra	RAJOURI	2	2.46	0.7	0.58
138	Channi Parat	RAJOURI	3.81	3.47	2.15	2.20
139	Chittiar	RAJOURI	1.95	2.68	2.1	0.48
140	Chowki Handa	RAJOURI	3.87	3.8	2.2	2.05
141	Darhal Quila	RAJOURI	3.2	3.73	2.48	2.50
142	Dharamsal	RAJOURI	5.92	3	1.8	1.02
143	Dhok Baniar	RAJOURI	3.98	2.44	2.6	2.00
144	Ding	RAJOURI	2.9	1.97	3.68	3.00
145	Dyala	RAJOURI	3.18	2.87	2.5	2.13
146	Gagrote	RAJOURI	4.01	4.59	4.6	3.70
147	Jabah	RAJOURI	6.27	7.61	1.55	0.80
148	Jhangar	RAJOURI	5.21	4.94		4.74
149	Kalal	RAJOURI	5.75	5.45		1.25
150	Kalsian	RAJOURI	2.16	1.88	1.1	0.93
151	Kangri (Grid Station)	RAJOURI	7	3.54	2.85	1.13
152	Lam	RAJOURI	6.04	3.96		3.95
153	Laroka	RAJOURI	2	1.88		0.84
154	Lower Kharak	RAJOURI	0.95	1.93	1.8	0.42
155	Marchola	RAJOURI	1.77	1.5	1.47	1.10
156	Narian	RAJOURI			4.9	4.60
157	Naunihal	RAJOURI		3	2.22	0.91
158	Panja	RAJOURI	1.77	1.7	1.31	1.10
159	Pukharni	RAJOURI	1.94	1.15		
160	Potha	RAJOURI	2.38	2.43	1.83	1.38
161	Rumli Dara	RAJOURI	4.19	2.09		
162	Salote	RAJOURI	2.3	1.96	1.3	1.04
163	Seri	RAJOURI	3.07		3.3	2.60
164	Sial	RAJOURI	1.32	1.85	0.7	0.12
165	Siot	RAJOURI	4.35	1.96	2.55	0.82
166	Solki	RAJOURI	2.23	1.42	1.79	1.30

Sl. No.	Location	District	May-19	Aug-19	Nov-19	Jan-20
167	Thanda Paani	RAJOURI	1.72	1.4	1.03	0.75
168	Aliyah	REASI	2.06	1.87	1.55	1.42
169	Bhamla	REASI	4.5	1.64	2.25	1.50
170	Dadua	REASI	4.35	2.4	1.85	1.72
171	Garan Jagir	REASI	3.99	3.55	2.3	2.40
172	Nanora	REASI	3.47	2.37	2.1	2.20
173	Riasi	REASI	25.54	25.6	28.07	29.50
174	Talwara	REASI	5.18	3.77	4.7	5.03
175	Thangrot	REASI	2.22	1.2	0.83	0.65
176	Bassi Kalan	SAMBA	5	2.68	3.59	3.95
177	Bengular	SAMBA	7.6	7.55	6.69	6.21
178	Birpur	SAMBA	19.59	22.74	26.71	12.74
179	Channi Mansar	SAMBA	1.8		0.1	0.37
180	Daboh	SAMBA	5.32	3.47	3.7	3.67
181	Didyal	SAMBA	2.23	2.45	1.47	1.41
182	Gho-Rakwalan	SAMBA	4.61	3.07	3.23	2.64
183	Gho-Brahamna	SAMBA	8.6	6.35	7.58	6.65
184	Gudwal	SAMBA	3.24	2.51	2.8	1.40
185	Kainthpur	SAMBA	3.95	4.75		3.19
186	Khairi (Bishnah)	SAMBA	4.48		1.92	3.43
187	Mahal Shah Kalandrian	SAMBA	5.03		3.75	3.02
188	Maheen Charkan	SAMBA	9.7	7.89	7.83	7.23
189	Majua Laxmi	SAMBA	3.41		2.85	2.45
190	Nud	SAMBA	4.91	2.84	2.28	2.00
191	Palli	SAMBA	2.62	2.24	1.86	1.68
192	Painthi	SAMBA	7.13		6.04	4.39
193	Patli	SAMBA	9.7		6.29	6.68
194	Raiyan	SAMBA			17.08	16.10
195	Sadoh	SAMBA	8.8	8.24	6.79	6.93
196	Sagoon	SAMBA	2.7	2.42	1.85	1.98
197	Samba	SAMBA	17.6	19	16.8	15.90
198	Supwal	SAMBA	4.6	3.5		4.25
199	Swankha More	SAMBA	18.62	21.35	20.44	19.99
200	Dulme Chak	SAMBA	4.67	3.9	2.97	2.74
201	Jasath	SAMBA	14.36	9.57	7.82	8.93
202	Kootah	SAMBA	28.7	22.6	23.22	26.74
203	Lale Chak	SAMBA	2.6	1.75	1.32	1.57
204	Lokli	SAMBA	7.23	1.75	3.08	3.12
205	Madun	SAMBA	3.67	2.24	2.17	1.78
206	Nagrota	SAMBA			3.2	2.91
207	Naran	SAMBA	7.18	5.15	4.87	4.77
208	Nauni	SAMBA	3.67	2.15	2.43	1.14

<b>Sl. No.</b>	<b>Location</b>	<b>District</b>	<b>May-19</b>	<b>Aug-19</b>	<b>Nov-19</b>	<b>Jan-20</b>
209	Nilcha	SAMBA	12.47	9.07	8.79	8.55
210	Pangdour	SAMBA	4.79	4.8	4.03	3.48
211	Phalora	SAMBA	3.41	2.5	1.95	1.64
212	Raghu chak	SAMBA	3.5	1.02	1.46	2.01
213	Sanoora	SAMBA	1.7	1.37	1.64	0.81
214	Uttarbani	SAMBA	8.35	1.72	2.06	1.68
215	Badola	UDHAMPUR	4.52	1.78	1.58	1.60
216	Battal Ballian	UDHAMPUR	4.9	4.08	3.58	3.49
217	Birmah	UDHAMPUR	3.1	3.04	2.26	2.26
218	Dalsar	UDHAMPUR	0.85	0.69	0.18	0.32
219	Dehari	UDHAMPUR	3.8	1.86	0.45	0.85
220	Dhanu Kanal	UDHAMPUR	1.35		0.6	0.50
221	Eastern Mand	UDHAMPUR	3.58	1.9	1.15	2.02
222	Garhi (Udh)	UDHAMPUR	1.15	2.14	1.5	0.74
223	Jallow	UDHAMPUR	1.6	1.4	0.8	0.52
224	Jhakkar	UDHAMPUR	4.81	2.64	1.74	1.60
225	Kahpotha	UDHAMPUR	2.2		0.81	0.75
226	Kotli Pain Megaini	UDHAMPUR	1.07	1.82	0.72	0.60
227	Kuperlah	UDHAMPUR	3.05	1.02	0.66	1.03
228	Manwall	UDHAMPUR	8.05	5.82	5.03	5.57
229	Nagrota Panjgarain	UDHAMPUR	1.8	1.45	1.46	1.48
230	Phangyal	UDHAMPUR	3.88	1.65	1.6	1.49
231	Ramnagar	UDHAMPUR	5.75	3.9	3.52	4.51
232	Ritti	UDHAMPUR	1.38	0.92	0.27	0.25
233	Salabra	UDHAMPUR	3.32	1.82	1.25	1.31
234	Seen Thakaran	UDHAMPUR	3.05	2.44	2.94	2.92
235	Sunal	UDHAMPUR	3.52	1.38	0.95	0.97
236	Talpad	UDHAMPUR	1.9		0.58	0.66
237	Rakh Badali	UDHAMPUR	4.24		1.46	1.29
238	Upper Ban	UDHAMPUR	6.29	7.5	1.25	1.45

## ANNEXURE – III

**Result of Chemical Analysis of water samples of National Hydrograph Stations collected during  
May 2019 Jammu & Kashmir**

Sr. No.	Location	District	Site type	pH	EC (µs/cm) at 25° C	TDS	CO <sub>3</sub> (mg/l)	HCO <sub>3</sub> (mg/l)	Total alkalinity	Cl (mg/l)	TH as CaCO <sub>3</sub> (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)
1	Rambarpora	Anantnag	DW	8.11	370	222	0	212	174	34	206	22	37	11	1.2
2	Sarwal Anantnag	Anantnag	SP	8.25	290	174	0	185	152	27	119	22	16	55	1.4
3	Bomai	Baramulla	DW	7.76	670	402	0	291	239	41	293	17	61	66	5.6
4	Binner	Baramulla	DW	7.85	530	318	0	265	217	61	282	43	42	24	2.3
5	Zambodzpora	Baramulla	DW	7.82	520	312	0	291	239	48	239	35	37	44	2.7
6	Mazbugh	Baramulla	DW	7.67	760	456	0	371	304	82	369	26	74	53	3.5
7	Ibrahim Colony	Baramulla	DW	8.87	510	306	14	159	154	82	206	22	37	58	1.3
8	Said pora	Baramulla	DW	8.13	350	210	0	212	174	27	184	26	29	13	1.6
9	Mandji	Baramulla	DW	7.71	290	174	0	252	206	177	412	43	74	63	3.6
10	Hadipora	Baramulla	DW	7.60	980	588	0	159	130	197	456	39	87	57	2.6
11	Uplna	Baramulla	DW	8.60	700	420	42	278	298	54	250	70	18	71	27
12	Sangrama	Baramulla	DW	7.24	160	96	0	119	98	7	109	22	13	4.1	2
13	Authoora	Baramulla	DW	7.70	450	270	0	278	228	34	217	13	45	43	1.2
14	Lolipora	Baramulla	DW	8.28	1390	834	0	278	228	293	586	22	129	134	4.4
15	Dusilpora	Baramulla	DW	8.15	960	576	0	119	98	136	347	57	50	111	15
16	Mirgund	Baramulla	DW	8.22	450	270	0	252	206	27	163	26	24	48	7.9
17	Waripora	Baramulla	DW	9.40	160	96	14	66	78	14	87	17	11	6.7	2.1
18	Badran	Budgam	DW	8.27	190	114	0	106	87	20	98	30	5	8.6	3.4
19	Gho Manhasan	Jammu	DW	7.43	300	180	0	172	141	7	184	52	13	4.7	3.1
20	Sandhwan	Jammu	DW	8.29	450	270	0	159	130	34	195	57	13	16.1	36.0
21	Muthi	Jammu	DW	7.64	420	252	0	225	185	27	228	87	3	6.5	1.3
22	Lower Barnai	Jammu	DW	7.82	310	186	0	172	141	14	206	35	29	5.8	2.3
23	Patyale Chak	Jammu	DW	7.40	660	396	0	331	271	34	336	87	29	37.6	2.3
24	Nagbani	Jammu	DW	7.42	1100	660	0	212	174	102	608	117	76	35	1.8
25	Gajansoo	Jammu	DW	8.23	740	444	0	516	423	41	401	130	18	44	21.0
26	Marh	Jammu	DW	7.75	480	288	0	305	250	14	347	70	42	5.7	2.6
27	Purkhoo	Jammu	DW	7.94	440	264	0	199	163	34	304	43	47	41	3.4
28	Garhi (Jammu)	Jammu	DW	7.95	420	252	0	159	130	41	184	39	21	29.7	2.3
29	Jaswan	Jammu	DW	7.59	550	330	0	384	315	14	380	91	37	19.7	2.9
30	Shama Chak	Jammu	DW	7.30	2100	1260	0	278	228	225	792	217	61	172	166.0
31	Jahiri	Jammu	DW	7.76	820	492	0	503	412	68	477	57	82	56	5.7
32	Kanachak	Jammu	DW	7.84	940	564	0	530	434	34	532	161	32	20	94.0
33	Sajwal	Jammu	DW	7.22	1300	780	0	318	260	136	597	91	90	97	33.2
34	Hamirpur Kohna	Jammu	DW	7.55	350	210	0	212	174	14	228	43	29	5	2.8
35	Akhnoor	Jammu	DW	7.40	420	252	0	278	228	27	282	87	16	6.1	5.6
36	Batera	Jammu	DW	7.51	280	168	0	146	119	27	206	22	37	8.3	1.1
37	Patakhu	Jammu	DW	7.12	500	300	0	212	174	34	250	74	16	23.8	4.7
38	Dharamkhu	Jammu	DW	7.75	244	146	0	106	87	14	119	35	8	4.8	8.3
39	Khour	Jammu	DW	7.45	450	270	0	238	195	27	217	74	8	23.9	4.5
40	Lam	Jammu	DW	7.56	290	174	0	159	130	27	174	35	21	2.8	5.7
41	Gigrial	Jammu	DW	7.71	260	156	0	159	130	20	206	35	29	7.9	3.2
42	Hamirpur sidhar	Jammu	DW	7.59	370	222	0	278	228	14	184	35	24	27.7	2.3
43	Senth	Jammu	DW	7.27	520	312	0	252	206	27	260	65	24	16.3	6.5
44	Pangli Colony	Jammu	DW	8.60	210	126	7	132	120	20	87	13	13	7.5	14.6
45	Dhanpur	Jammu	DW	8.28	510	306	0	358	293	20	304	83	24	8	34.0
46	Jourian	Jammu	DW	7.75	500	300	0	172	141	54	250	39	37	36.1	3.0
47	Bakora	Jammu	DW	7.34	750	450	0	397	326	48	412	70	58	42.9	7.6
48	Devipura	Jammu	DW	8.80	720	432	7	384	326	48	260	13	55	42.9	8.0
49	Gura (Akhnoor)	Jammu	DW	7.38	410	246	0	225	185	27	217	52	21	24.2	3.5
50	Pallanwala	Jammu	DW	7.60	280	168	0	132	109	27	260	26	47	13.4	4.1
51	Palatan	Jammu	DW	7.44	350	210	0	199	163	27	76	57	3	14.7	5.4
52	Kachrial	Jammu	DW	6.75	410	246	0	265	217	14	228	52	24	7.2	3.7
53	Baradow	Jammu	DW	7.00	730	438	0	530	434	41	326	35	58	93.9	1.2
54	Jogwan	Jammu	DW	7.03	430	258	0	278	228	20	250	48	32	15.8	1.1
55	Kalah	Jammu	DW	6.92	400	240	0	278	228	14	293	52	40	6.1	3.0
56	Sumah	Jammu	DW	7.17	270	162	0	199	163	20	163	35	18	9.7	1.3
57	Taryai	Jammu	DW	7.75	880	528	0	252	206	102	304	52	42	71.9	112.3
58	Bhagwana Chak	Jammu	DW	7.30	350	210	0	199	163	34	228	35	34	14.6	1.0
59	Kangar	Jammu	DW	7.15	340	204	0	265	217	14	239	52	26	7.7	1.4
60	Khairi (Raipur)	Jammu	DW	6.90	470	282	0	238	195	27	293	35	50	14.2	1.5
61	Bengular	Jammu	DW	7.75	1060	636	0	516	423	68	358	96	29	76	7.2
62	Chakara	Jammu	DW	7.95	1510	906	0	463	380	225	521	57	92	195	24
63	Nud	Jammu	DW	7.60	560	336	0	212	174	68	260	83	13	49	8
64	Dabho	Jammu	DW	7.75	580	348	0	225	185	68	293	91	16	39	4.2
65	Rehian (Raiyan)	Jammu	DW	7.71	330	198	0	252	206	14	195	57	13	15	2
66	Samba	Jammu	DW	7.50	760	456	0	371	304	82	282	109	3	81	7.9
Sr.	Location	District	Site	pH	EC	TDS	CO <sub>3</sub>	HCO <sub>3</sub>	Total	Cl	TH as	Ca	Mg	Na	K

No.			type		( $\mu\text{s}/\text{cm}$ at 25 <sup>o</sup> C		(mg/l)	(mg/l)	alkalinity	(mg/l)	CaCO <sub>3</sub> (mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
67	Jindore	Jammu	DW	8.24	490	294	0	238	195	20	206	70	8	25	3.6
68	Sidhra	Jammu	DW	7.51	710	426	0	278	228	41	380	57	58	32	5
69	Raghoora	Jammu	DW	7.70	530	318	0	13	11	34	315	78	29	12	3.3
70	Sagoon	Jammu	DW	7.91	500	300	0	609	499	27	217	39	29	55	2.4
71	Surinsar	Jammu	DW	7.96	400	240	0	252	206	20	174	52	11	38	1.5
72	Channi Marsar	Jammu	DW	7.91	410	246	0	291	239	20	217	57	18	30	2
73	Ban	Jammu	DW	8.05	280	168	0	159	130	7	141	43	8	5.8	2.2
74	Sugetar	Jammu	DW	7.99	470	282	0	305	250	41	195	48	18	69	2.9
75	Dhansal	Jammu	DW	7.87	580	348	0	291	239	61	315	57	42	48	2.8
76	Badsoo	Jammu	DW	7.96	400	240	0	225	185	20	206	61	13	23	1
77	Kunihala	Jammu	DW	7.97	400	216	0	278	228	20	195	61	11	16	1.8
78	Jindrah	Jammu	DW	8.45	1950	1170	14	781	664	354	217	22	40	450	8.5
79	Arnia- II	Jammu	DW	7.53	1330	798	0	424	347	129	543	70	90	132	126
80	Alla	Jammu	DW	7.78	1840	1104	0	503	412	191	445	35	87	217	332
81	Agre Chak	Jammu	DW	8.50	920	552	56	305	343	95	217	26	37	169	15
82	Bishnah	Jammu	DW	9.31	1550	930	112	556	643	116	228	13	47	151	462
83	Bassi Kalan	Jammu	DW	8.25	340	204	0	159	130	41	152	22	24	22	6.4
84	Birpur	Jammu	DW	8.06	370	222	0	172	141	27	206	39	26	14	2
85	chatta	Jammu	DW	7.99	370	222	0	238	195	14	217	35	32	8.1	2.2
86	Didyal	Jammu	DW	8.03	380	228	0	185	152	27	163	30	21	37	6.3
87	Gho-Brahamana	Jammu	DW	8.52	1460	876	28	185	199	211	477	35	95	188	14
88	Gudwal	Jammu	DW	8.11	500	300	0	185	152	68	206	35	29	44	17
89	Gho-Rakhwalan	Jammu	DW	8.70	420	252	28	212	220	27	184	26	29	51	3
90	Kainthpur	Jammu	DW	8.06	240	144	0	146	119	14	119	22	16	12	2.7
91	Khairi (Bishna)	Jammu	DW	8.62	600	360	28	252	253	54	239	9	53	75	14
92	Kamila	Jammu	DW	8.10	400	240	0	225	185	20	195	17	37	24	3.5
93	Kothey Saini	Jammu	DW	8.17	380	228	0	225	185	14	206	26	34	25	1.3
94	Kotli Charkan	Jammu	DW	7.95	470	282	0	291	239	34	239	30	40	28	20
95	Lalyal	Jammu	DW	7.80	1100	660	0	185	152	109	445	26	92	120	101
96	Laswara	Jammu	DW	7.51	370	222	0	410	336	27	184	43	18	13	2.3
97	Makwal	Jammu	DW	9.10	920	552	0	490	402	75	217	13	45	108	197
98	Majua Laxmi	Jammu	DW	7.86	530	318	0	305	250	27	260	30	45	37	2.3
99	Mahalshah Kalandrian	Jammu	DW	8.84	740	444	28	410	383	48	163	4	37	185	4.5
100	Maheen Chrkan	Jammu	DW	7.75	430	258	0	238	195	14	195	48	18	8	14
101	Miran Sahib	Jammu	DW	7.81	730	438	0	265	217	68	380	17	82	60	1.2
102	Nikowal	Jammu	DW	7.55	590	354	0	424	347	20	271	35	45	65	1.6
103	patli	Jammu	DW	8.29	800	480	0	503	412	34	152	22	24	207	2.7
104	Palli	Jammu	DW	8.00	730	438	0	397	326	54	282	22	55	91	2.8
105	Poal_II	Jammu	DW	7.85	440	264	0	225	185	7	228	35	34	12	2
106	Rehal	Jammu	DW	7.86	550	330	0	238	195	54	250	30	42	68	2.3
107	Salehar-II	Jammu	DW	9.45	1370	822	98	344	446	157	195	13	40	183	233
108	Satwari	Jammu	DW	8.18	530	318	0	331	271	27	228	43	29	38	15
109	Sei Khurd	Jammu	DW	9.18	860	516	28	159	177	95	228	26	40	94	37
110	Sohanjana	Jammu	DW	9.43	470	282	14	172	164	34	184	26	29	29	47
111	Suchetgarh-II	Jammu	DW	8.67	930	558	42	543	515	54	347	26	69	107	3.3
112	Supwal	Jammu	DW	8.25	390	234	0	185	152	27	184	30	26	26	2.2
113	Swankha	Jammu	DW	9.99	300	180	14	146	143	34	130	26	16	33	8.5
114	Upperla Kanhal	Jammu	DW	8.22	420	252	0	331	271	14	239	22	45	29	3.4
115	Greater Kailash	Jammu	DW	8.67	360	216	7	99	93	34	152	43	11	23	3
116	Karnail Chowk	Jammu	DW	8.44	520	312	0	291	239	34	228	22	42	37	28
117	Jagti	Jammu	DW	7.65	380	228	0	225	185	20	217	70	11	8	2.6
118	Tanda Sheeda	Jammu	DW	7.54	280	168	0	185	152	14	152	48	8	4.1	2.4
119	Chowki Choura	Jammu	DW	7.46	530	318	0	278	228	41	282	87	16	25	2.7
120	Jabah	Jammu	DW	8.21	520	312	0	278	228	54	250	43	34	33	2
121	Ainpur	Jammu	DW	8.17	420	252	0	238	195	54	217	43	26	29	1.8
122	Chan Khatrian	Kathua	DW	8.15	290	174	0	185	152	14	152	35	16	9.8	1.8
123	Dulma Chak	Kathua	DW	7.89	420	252	0	344	282	7	217	48	24	25	2.1
124	Feruchak	Kathua	DW	8.10	320	192	0	238	195	27	174	39	18	21	1.7
125	Gangu Chak	Kathua	DW	8.10	1470	882	0	132	109	252	543	70	90	176	15
126	Hore	Kathua	DW	8.31	410	246	7	185	164	48	174	43	16	16	4.3
127	Jandi (New)	Kathua	DW	8.10	770	462	0	477	391	82	326	48	50	76	48
128	Jasath	Kathua	DW	8.05	540	324	0	358	293	27	293	57	37	33	3.5
129	Karol Krishna	Kathua	DW	7.83	1390	834	0	556	456	184	369	39	66	216	39
130	Konthal	Kathua	DW	7.85	920	552	0	371	304	95	380	96	34	82	4.2
131	Kootah	Kathua	DW	8.08	490	294	0	199	163	61	228	52	24	42	9
132	Lakri	Kathua	DW	8.03	440	264	0	291	239	41	195	52	16	38	6.9
133	Lalachak	Kathua	DW	7.90	470	282	0	278	228	41	260	61	26	40	7.2
134	Lokli	Kathua	DW	8.02	220	132	0	146	119	14	141	43	8	5.2	1.8
135	Londi	Kathua	DW	8.06	340	204	0	278	228	14	184	61	8	17	2.1
136	Madun	Kathua	DW	8.06	510	306	0	358	293	41	282	43	42	54	2.6
137	Mandli	Kathua	DW	7.75	520	312	0	331	271	109	239	48	29	54	9
138	Nagrot-Gujroo	Kathua	DW	7.56	760	456	0	305	250	109	271	78	18	87	6.8
139	Naran	Kathua	DW	7.90	1170	702	0	569	467	54	401	43	71	182	28
<b>Sr.</b>	<b>Location</b>	<b>District</b>	<b>Site</b>	<b>pH</b>	<b>EC</b>	<b>TDS</b>	<b>CO<sub>3</sub></b>	<b>HCO<sub>3</sub></b>	<b>Total</b>	<b>Cl</b>	<b>TH as</b>	<b>Ca</b>	<b>Mg</b>	<b>Na</b>	<b>K</b>



No.			type		( $\mu\text{s}/\text{cm}$ at 25 <sup>o</sup> C		(mg/l)	(mg/l)	alkalinity	(mg/l)	CaCO <sub>3</sub> (mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
140	Nauni	Kathua	DW	7.74	440	264	0	278	228	157	239	52	26	17	2.6
141	Nilcha	Kathua	DW	7.76	220	132	0	172	141	14	130	43	5	7	2.2
142	Pallan	Kathua	DW	8.20	230	138	0	146	119	27	119	26	13	18	1.9
143	Pangdaur	Kathua	DW	7.65	330	198	0	212	174	14	184	43	18	33	3.8
144	Pansar	Kathua	DW	7.70	330	198	0	278	228	20	184	48	16	27	1.6
145	Patyari II (Kootah area)	Kathua	DW	7.54	440	264	0	278	228	41	271	57	32	23	2.5
146	Phinter	Kathua	DW	7.85	290	174	0	132	109	41	163	30	21	18	4.6
147	Plura (Phalora)	Kathua	DW	7.93	730	438	0	463	380	54	141	35	13	179	3.2
148	Raghuchak	Kathua	DW	8.20	240	144	0	159	130	20	119	22	16	20	3.3
149	Ramkot	Kathua	DW	8.25	370	222	0	199	163	34	174	26	26	38	9.6
150	Sadoh	Kathua	DW	8.07	420	252	0	185	152	34	217	30	34	32	6.3
151	Saida	Kathua	DW	7.78	450	270	0	225	185	34	217	74	8	36	3.4
152	Barni	Kathua	DW	8.41	260	156	0	185	152	14	163	39	16	9.7	1.9
153	Kerian Ramnagar	Kathua	DW	7.70	370	222	0	119	98	14	184	39	21	9.7	6.6
154	Kerian Gandyal II	Kathua	DW	8.01	360	216	0	132	109	27	184	35	24	18	6.3
155	Lakhanpur Fort	Kathua	DW	8.22	260	156	0	132	109	20	141	43	8	12	4.6
156	Bhagwal	Kathua	DW	8.25	240	144	0	132	109	14	130	35	11	13	2.5
157	Chapki Kalan	Kathua	DW	8.28	290	174	0	212	174	14	174	48	13	14	3.7
158	Khanpur	Kathua	DW	8.39	220	132	7	132	120	20	119	22	16	14	3.6
159	Chkhariya	Kathua	DW	8.27	200	120	0	132	109	14	87	30	3	13	5.2
160	Mukhandpur	Kathua	DW	8.28	170	102	0	119	98	14	98	22	11	10	3.6
161	Kotepannu	Kathua	DW	8.25	190	114	0	132	109	14	109	35	5	14	4.5
162	Sumwan	Kathua	DW	8.26	190	114	0	119	98	20	98	30	5	11	6
163	Patyari	Kathua	DW	8.20	220	132	0	132	109	14	163	43	13	7.8	4.1
164	Nanke Chak	Kathua	DW	8.26	200	120	0	132	109	14	141	30	16	6.8	4
165	Kathua	Kathua	DW	8.05	450	270	0	225	185	48	163	39	16	78	10
166	Kothian	Kathua	DW	8.10	330	198	0	132	109	20	174	52	11	15	5.5
167	Nagri	Kathua	DW	8.19	250	150	0	146	119	20	141	26	18	23	5.3
168	Gond More	Kathua	DW	8.22	240	144	0	132	109	27	109	22	13	30	3.5
169	Chanranga	Kathua	DW	8.20	390	234	0	212	174	34	217	65	13	24	4.5
170	Sanoora	Kathua	DW	7.46	290	174	0	212	174	14	163	48	11	11	2.3
171	Khanpur	Kathua	DW	7.50	530	318	0	252	206	61	239	61	21	50	1.3
172	Tarich	Kupwara	DW	8.25	190	114	0	79	65	20	98	30	5	22	5.5
173	Radbug	Kupwara	DW	7.66	640	384	0	199	163	123	271	39	42	63	5.5
174	Bramri	Kupwara	DW	7.95	240	144	0	146	119	20	119	26	13	6.9	1.3
175	Jagarpora	Kupwara	DW	8.25	70	42	0	66	54	14	54	4	11	2.1	1.3
176	Hatmulla	Kupwara	DW	8.20	240	144	0	185	152	20	152	43	11	9.3	1.6
177	Kupwara Main Chowk	Kupwara	DW	8.29	210	126	0	132	109	14	119	26	13	12	3.9
178	Drugmulla	Kupwara	DW	7.87	270	162	0	185	152	27	152	30	18	9.9	2.6
179	Mir Mohalla	Kupwara	DW	8.22	110	66	0	79	65	14	76	13	11	6.4	1.3
180	Cherkut	Kupwara	DW	8.24	240	144	0	146	119	27	119	22	16	34	6.3
181	Gulgam	Kupwara	DW	8.01	530	318	0	199	163	82	217	30	34	66	1.8
182	Trehgam	Kupwara	DW	8.25	730	438	0	278	228	41	282	13	61	52	2.2
183	Batpora Bala	Kupwara	DW	8.29	160	96	0	79	65	27	65	17	5	15	1.9
184	Dohama	Kupwara	DW	8.20	710	426	0	172	141	102	369	26	74	35	4.9
185	Khanpora	Kupwara	DW	8.10	370	222	0	146	119	54	163	17	29	17	2.8
186	Magam	Kupwara	DW	7.80	600	360	0	291	239	68	282	13	61	42	2.4
187	Dolipora	Kupwara	DW	7.96	310	186	0	146	119	27	141	43	8	22	12
188	Handwara al Mustafa colony	Kupwara	DW	7.99	390	234	0	119	98	61	163	22	26	40	2.1
189	Chanjmul	Kupwara	DW	8.28	210	126	0	146	119	14	141	17	24	5.5	1.3
190	Waidipora	Kupwara	DW	7.50	450	270	0	252	206	48	271	4	63	31	1.8
191	Hampora	Kupwara	DW	7.70	740	444	0	278	228	116	293	26	55	93	5
192	Chowgal	Kupwara	DW	7.88	350	210	0	199	163	20	217	30	34	9.3	2.3
193	Urwan	Pulwama	DW	8.22	360	216	0	252	206	7	217	9	47	7.1	1.3
194	Sambura Kokapura	Pulwama	DW	8.02	340	204	0	252	206	7	206	39	26	6.5	1.4
195	Zeewan	Pulwama	HP	8.27	380	228	0	252	206	14	260	9	58	8.8	1.4
196	Banpari	Rajauri	DW	7.89	760	456	0	238	195	54	326	35	58	58	3.2
197	Chittiar	Rajauri	DW	8.29	410	246	0	265	217	41	206	35	29	6.7	1.7
198	Narian	Rajauri	DW	8.02	520	312	0	225	185	27	260	52	32	25	2.2
199	Channi Part	Rajauri	DW	8.01	460	276	0	265	217	34	206	26	34	27	2.7
200	Marchola	Rajauri	DW	8.26	490	294	0	252	206	14	228	39	32	61	4.2
201	Thangrot	Rajauri	DW	7.98	440	264	0	331	271	20	239	61	21	24	2
202	Salote	Rajauri	DW	8.23	550	330	0	265	217	34	250	61	24	15	1.8
203	Bakar	Rajauri	DW	8.45	350	210	7	199	174	14	206	43	24	10	1.8
204	Thandapani	Rajauri	DW	8.17	470	282	0	265	217	48	260	39	40	31	1.6
205	Siot	Rajauri	DW	8.49	580	348	7	358	305	41	174	26	26	101	7
206	Bagnoti	Rajauri	DW	8.29	570	342	0	252	206	68	228	22	42	57	2.9
207	Bhatta Morh	Rajauri	DW	8.25	450	270	0	384	315	20	228	22	42	39	3.3
208	Darhal Quilla	Rajauri	DW	8.40	360	216	7	185	164	20	217	17	42	8.3	1.9
209	Pukharni	Rajauri	DW	8.28	380	228	0	305	250	20	239	30	40	21	2.1
210	Lam	Rajauri	DW	8.27	350	210	0	238	195	27	184	22	32	10	1.6
211	Laroka	Rajauri	DW	8.26	420	252	0	252	206	41	239	26	42	20	1.4
212	Jhangar	Rajouri	DW	8.25	580	348	0	318	260	75	304	26	58	58	3.6
213	Kalsian	Rajouri	DW	8.26	420	252	0	278	228	20	217	22	40	20	1.2
Sr.	Location	District	Site	pH	EC	TDS	CO <sub>3</sub>	HCO <sub>3</sub>	Total	Cl	TH as	Ca	Mg	Na	K

No.			type		(µs/cm at 25°C		(mg/l)	(mg/l)	alkalinity	(mg/l)	CaCO3 (mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
214	Chowki Handa	Rajouri	DW	8.37	390	234	7	225	196	14	239	22	45	17	2.2
215	Nounihal	Rajouri	DW	8.29	470	282	0	397	326	34	347	17	74	42	3
216	Potha	Rajouri	DW	8.28	420	252	0	291	239	27	206	26	34	26	4.4
217	Dyala	Rajouri	DW	8.44	300	180	7	225	196	14	174	30	24	9	1.7
218	Lower Kharak	Rajouri	DW	8.28	400	240	0	305	250	20	250	39	37	21	2.6
219	Panja	Rajouri	DW	8.34	450	270	0	238	195	34	239	30	40	16	6
220	Solki	Rajouri	DW	8.27	410	246	0	278	228	14	228	22	42	17	3.8
221	Dharamsal	Rajouri	DW	8.28	610	366	0	397	326	41	326	26	63	59	5.2
222	Bareri	Rajouri	DW	8.41	470	282	14	318	284	20	217	26	37	45	2.6
223	Rumlidara	Rajouri	DW	8.25	420	252	0	278	228	14	239	13	50	17	1.6
224	Kalal	Rajouri	DW	9.67	830	498	70	477	507	34	22	4	3	226	4.4
225	Ding	Rajouri	DW	8.15	460	276	0	265	217	27	228	78	8	27	1.7
226	Garote	Rajouri	DW	8.15	510	306	0	318	260	20	260	26	47	41	2.8
227	Seri	Rajouri	DW	8.24	610	366	0	185	152	75	206	39	26	75	2
228	Kangri	Rajouri	DW	8.14	440	264	0	238	195	27	206	52	18	26	1.5
229	Sial	Rajouri	DW	8.10	630	378	0	291	239	68	217	43	26	83	2.9
230	Bajabain	Rajouri	DW	8.26	480	288	0	291	239	27	250	61	24	13	5.1
231	Bakhar	Rajouri	DW	8.15	450	270	0	238	195	20	206	52	18	27	1.5
232	Nanora	Reasi	DW	8.01	410	246	0	199	163	20	195	43	21	16	16
233	Garan Jagir	Reasi	DW	7.92	450	270	0	305	250	41	239	35	37	25	2.4
234	Penthi (Painthi)	Samba	DW	8.61	160	96	7	93	88	14	76	17	8	9.1	2.9
235	Dhora	Samba	DW	7.85	560	336	0	305	250	34	293	70	29	29	3.6
236	Uttarbani	Samba	DW	8.66	390	234	7	232	202	27	217	22	40	16	8.3
237	Nagrota	Samba	DW	7.75	580	348	0	278	228	48	293	87	18	40	3.3
238	Regal Chowk	Srinagar	DW	8.37	360	216	0	212	174	20	184	26	29	22	3.1
239	Rainawari	Srinagar	DW	7.99	660	396	0	331	271	27	304	52	42	26	34
240	Salabra	Udhampur	DW	7.60	340	204	0	252	206	7	206	48	21	14	1.4
241	Sunal	Udhampur	DW	7.70	330	198	0	238	195	20	195	52	16	8.4	1.6
242	Kah Pahuta	Udhampur	DW	7.99	400	240	0	252	206	20	228	57	21	28	1.1
243	Kot Kaswal	Udhampur	DW	8.10	670	402	0	265	217	34	250	70	18	60	19
244	Manwal	Udhampur	DW	8.01	400	240	0	225	185	27	195	48	18	16	0.1
245	Phangyal	Udhampur	DW	8.15	310	186	0	132	109	34	152	30	18	11	1.4
246	Battal Balian	Udhampur	DW	8.05	670	402	0	212	174	95	336	87	29	63	2.1
247	Seen Tinkran	Udhampur	DW	7.98	460	276	0	225	185	34	228	65	16	26	0.7
248	East Mand	Udhampur	DW	7.40	640	384	0	318	260	54	326	83	29	48	3.6
249	Garhi	Udhampur	DW	7.65	440	264	0	185	152	41	195	43	21	38	1.4
250	Kotli	Udhampur	DW	7.61	390	234	0	265	217	20	250	61	24	10	3.6
251	Birmah	Udhampur	DW	7.56	370	222	0	238	195	27	195	65	8	21	2.5
252	Jhakkar	Udhampur	DW	7.67	380	228	0	252	206	20	195	74	3	21	1.5
253	Rakh Badli	Udhampur	DW	7.70	460	276	0	212	174	48	271	87	13	18	1.5
254	Talpar	Udhampur	DW	7.85	310	186	0	159	130	14	98	30	5	18	4
255	Nagrota Panjgrain	Udhampur	DW	7.76	350	210	0	265	217	20	260	52	32	17	2
256	Dalsar	Udhampur	DW	7.65	540	324	0	358	293	41	206	30	32	80	3
257	Ram Nagar	Udhampur	DW	7.70	430	258	0	265	217	27	228	65	16	24	3.6
258	Dehari	Udhampur	DW	7.83	660	396	0	424	347	54	119	22	16	114	4.4
259	Jallow	Udhampur	DW	7.79	460	276	0	318	260	14	174	39	18	64	2.8
260	Ritti	Udhampur	DW	8.21	720	432	0	543	445	20	65	17	5	184	6.2
261	Kuperlah	Udhampur	DW	7.85	370	222	0	265	217	7	217	65	13	16	1.4
262	Badola	Udhampur	DW	7.60	420	252	0	212	174	41	217	74	8	9.6	2.1
263	Dhannu Kanal	Udhampur	DW	7.53	340	204	0	238	195	7	217	48	24	8.9	5.6
264	Reasi	Udhampur	DW	7.71	840	504	0	675	554	27	293	87	18	18	11
265	Talwara	Udhampur	DW	7.72	500	300	0	331	271	14	575	57	105	7.6	3.1
266	Bhamla	Udhampur	DW	7.80	1250	750	0	318	260	259	521	35	105	110	4
267	Aliyah	Udhampur	DW	8.04	380	228	0	252	206	27	163	48	11	7.6	2.1
268	Nagrota Uttarbani	Udhampur	DW	8.10	530	318	0	106	87	54	206	39	26	42	23
269	Dadua	Udhampur	DW	7.81	490	294	0	278	228	48	250	35	40	24	2.2
270	Muqam Shahwali	Kupwara	SP	7.98	230	138	0	172	141	14	119	35	8	10	1.7
271	chak keegam	Kupwara	SP	7.90	230	138	0	159	130	20	163	35	18	8.2	1.5
272	sher bebi	Ramban	SP	7.98	180	108	0	132	109	14	119	22	16	3.7	1.5
273	Dourusa Bhat Mohalla	Kupwara	SP	7.95	180	108	0	146	119	7	109	26	11	7.4	1.2
274	Tekipora	Kupwara	DW	7.59	760	456	0	278	228	143	369	43	63	59	3.6
275	Lalpora	Kupwara	DW	7.85	180	108	0	106	87	20	98	26	8	7	2.4
276	Sulkoot	Kupwara	DW	7.72	320	192	0	199	163	14	184	26	29	11	3.9
277	Halmathpora	Kupwara	DW	7.80	370	222	0	212	174	34	184	48	16	27	2.4
278	gushi	Kupwara	DW	7.95	380	228	0	159	130	48	174	26	26	28	6.4
279	Balipora	Kupwara	DW	7.75	240	144	0	119	98	20	109	30	8	11	9.8
280	Waser Khoto	Kupwara	DW	8.26	200	120	0	79	65	14	76	17	8	7.9	2.5
281	Panzgam-1	Kupwara	SP	8.21	220	132	0	93	76	34	87	22	8	18	3
282	Panzgam-1	Kupwara	DW	7.90	530	318	0	252	206	68	250	26	45	40	28
283	Tutigund	Kupwara	DW	8.15	770	462	0	93	76	143	250	26	45	86	1.7
284	Lilum	Kupwara	DW	7.68	550	330	0	146	119	95	250	22	47	34	4.3
285	Taratpora	Kupwara	DW	7.84	360	216	0	212	174	34	195	22	34	14	2.5
286	sodal	Kupwara	DW	7.66	560	336	0	318	260	61	304	13	66	50	3.4
287	Darashpora	Kupwara	SP	8.19	260	156	0	185	152	14	130	22	18	18	1.7
288	Sagipora	Kupwara	DW	8.39	250	150	28	159	177	20	130	26	16	9.7	5
289	Zaloor	Kupwara	SP	8.30	260	156	0	119	98	27	141	30	16	21	8.6
Sr.	Location	District	Site	pH	EC	TDS	CO3	HCO3	Total	Cl	TH as	Ca	Mg	Na	K

No.			type		( $\mu\text{s/cm}$ at 25 <sup>o</sup> C		(mg/l)	(mg/l)	alkalinity	(mg/l)	CaCO <sub>3</sub> (mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
290	Harwan	Kupwara	DW	8.28	140	84	0	132	109	14	76	13	11	7	1.6
291	Babagund	Kupwara	DW	8.20	720	432	0	291	239	95	326	26	63	76	2.3
292	Guloora	Kupwara	DW	8.16	200	120	0	132	109	20	119	39	5	5	2
293	Renan	Kupwara	DW	9.75	150	90	56	79	158	14	76	22	5	6.6	2.9
294	Kunel	Kupwara	DW	8.26	320	192	0	238	195	20	195	65	8	19	2.6
295	Yarbug	Baramulla	DW	8.15	250	150	0	146	119	27	130	43	5	9.2	1.8
296	Muminabad	Baramulla	DW	8.28	250	150	0	185	152	20	152	39	13	10	5.5
297	Palpora	Baramulla	DW	8.53	210	126	14	106	110	34	130	26	16	14	2.9
298	Nadihal	Baramulla	DW	8.14	780	468	0	291	239	102	336	26	66	56	70
299	Marazgund	Baramulla	DW	7.82	230	138	0	132	109	20	141	22	21	11	3.3
300	Watergam	Baramulla	DW	7.52	720	432	0	252	206	88	336	9	76	38	2.9
301	Krankshiwani	Baramulla	DW	7.95	940	564	0	424	347	82	163	30	21	78	183
302	parigam Astan mohalla	Pulwama	SP	8.94	550	330	14	199	186	54	271	26	50	39	3.8
303	Nagbal	Pulwama	SP	9.66	180	108	14	119	121	7	109	22	13	9.7	1.3
304	Ladoo	Pulwama	DW	8.70	250	150	14	172	164	14	163	26	24	6.9	1.4
305	Wuyan	Pulwama	SP	8.30	240	144	0	159	130	14	109	17	16	26	1.4
306	Parigam Bala	Pulwama	SP	8.21	240	144	0	79	65	34	87	26	5	16	7.4
307	Matibug	Pulwama	SP	8.04	360	216	0	185	152	27	206	22	37	6.1	1.7
308	Badroo Yaripora	Pulwama	SP	8.08	310	186	0	238	195	14	184	13	37	10	1.7
309	Fresal	Pulwama	SP	8.28	260	156	0	146	119	27	141	30	16	6.3	1.6
310	Moman Dangerpora	Pulwama	HP	8.01	570	342	0	397	326	14	336	22	69	25	4.6
311	Nehalpora Pattan	Baramulla	HP	8.24	360	216	0	119	98	41	174	35	21	13	1.7
312	Banihal	Ramban	SP	7.90	210	126	0	146	119	14	141	30	16	6.1	1.9
313	Ramban	Ramban	SP	7.80	480	288	0	225	185	27	260	61	26	26	5.8
314	Nashri	Ramban	SP	7.90	420	252	0	278	228	14	163	26	24	53	6.5